Airport Layout Plan Update

Charles M. Schulz – Sonoma County Airport

2023

Mead&Hunt

STS Airport Layout Plan Update

Narrative Report 2023

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Chapter 1
Introduction

Chapter 1 -

ALP Update Introduction and Inventory

INTRODUCTION

The Airport Layout Plan (ALP) is a planning tool that depicts existing facilities and planned development for an airport. The Federal Aviation Administration (FAA) must approve an ALP for airport sponsors to implement design and construction for facility improvements at federally obligated airports and receive FAA grant funding for eligible capital improvements under the terms of the FAA's Airport Improvement Program. The ALP, by definition, is a plan for an airport that shows existing and proposed airport property boundaries owned or controlled by the sponsor, the location and type of existing and proposed airport facilities and structures, and the location of existing and proposed non-aviation areas. Typically updated every 5 to 10 years, the ALP incorporates recent construction, reflects new documentation requirements, and illustrates future projects anticipated over the next 20 years.

Sonoma County wishes to update the existing ALP at Charles M. Schulz – Sonoma County Airport (STS) to reflect current conditions and proposed future facility requirements. This ALP Update analyzes existing facilities and requirements, updates aviation forecasts, proposes improvements, and develops the ALP for FAA approval. The ALP was updated in accordance with the following documents:

- FAA Advisory Circular (AC) 150/5300-13B, Airport Design (AC-13B)
- FAA AC 150/5000-17, Critical Aircraft and Regular Use Determination
- Federal Regulation Title 14 Part 77, Objects Affecting Navigable Airspace, Section 25, Civil Airport Imaginary Surfaces (Part 77)
- Standard Operating Procedure (SOP) for FAA Review and Approval of Airport Layout Plans (SOP 2.00)

This Narrative Report documents the changes to the STS ALP since the approval of the previous ALP by the FAA in 2012. The STS ALP was updated in conjunction with the 2012 Airport Master Plan (AMP) update. The 2012 ALP incorporated the facilities analyzed during the AMP, which included extensions to both runways, creation of a partial-parallel taxiway for Runway 2/20, expansion of the passenger terminal, and service road loops around all runway ends. Since the 2012 AMP update, the ALP has undergone one pen-and-ink update in 2015, which included the completed construction that extended both runways, relocated the localizer antenna, and installed two stormwater detention basins.

ALP Requirements and Expectations

STS completed a Runway Safety Area (RSA) project in 2015 that included runway and taxiway extensions, navigational aid relocation, and airfield grading. Following extension of Runway 14/32, STS experienced growth in passenger enplanements and the introduction of new scheduled passenger service. This growth has created a strain on the passenger terminal building, automobile parking facilities, and rental car facilities. Previous studies funded by STS have examined options for expanding the passenger terminal, providing additional facilities for rental cars, accommodating general parking demand, and improving traffic circulation as identified in the 2012 AMP. The development of this ALP update includes recommendations from each of these studies to formulate a comprehensive plan for the terminal area.

Since the previous AMP and ALP were completed in 2012, the FAA has updated its airfield design standards, described in AC-13B. The update to AC-13B includes new airfield geometry guidance with a focus on taxiway configuration and reducing the potential for runway incursions. To comply with current FAA guidance, the present configuration of the runways, taxiways, and aircraft parking aprons were evaluated as part of the ALP update. While the changes included in AC-13B are not expected to require immediate modifications to runways, taxiways, and aprons, they do require STS to plan for compliance when updating the ALP. For example, STS will reconstruct non-compliant pavements to meet FAA standards as they near the end of their useful life. The ALP update identifies areas of the airfield that no longer comply with FAA guidance, evaluates alternatives for bringing these areas into compliance, and depicts the preferred ultimate facilities on the ALP for FAA review and approval.

This ALP update establishes a purpose and need for proposed projects at STS. This update should be viewed as a planning tool and does not mandate action by Sonoma County. Major components of this ALP update include:

- Validating the aircraft operations and enplanements forecast,
- Correcting airfield geometry to reduce incursions and meet FAA standards,
- Relocating the airport rescue and firefighting (ARFF) facility,
- Creating a terminal area plan to accommodate near- and long-term building and apron area,
- Analyzing alternative layouts for terminal parking and access roads,
- Analyzing alternative locations for general aviation development or relocation,
- Updating baseline environmental data,
- Creating new noise contours based on new operations forecasts, and
- Updating the ALP set to current FAA standards.

FAA Actions

The FAA requires that airport sponsors keep the ALP up to date for airport development as obligated by FAA grant assurance. FAA approval of the updated ALP is required prior to the issuance of the grant for an airport improvement project. While this document is not a master plan, STS expects the FAA to review and formally approve the forecasts, design aircraft, and the ALP drawing set.

2012 Airport Master Plan

The 2012 AMP was developed concurrently with federal and state environmental documents. Although the AMP was comprehensive in its scope, it focused on:

- Resolution of the nonstandard runway safety area (RSA) for Runway 14,
- Improvement of runway incursion issues associated with Runway 20, and
- Accommodating anticipated increases in scheduled passenger service.

The draft master plan was completed in 2012. The AMP then required an Environmental Impact Report (EIR) to satisfy the California Environmental Quality Act (CEQA) environmental process. After the EIR was completed, the Sonoma County Board approved the AMP and EIR on January 24, 2012. The Federal Environmental Assessment (EA) was not approved until 2013. Construction of the first phase of the major improvements began in 2013 after approval of the EA. Construction was completed in 2015.

Prior to extension of Runway 14/32, STS had been served by only one airline — Horizon. Following completion of the extension, Allegiant Air began service at STS in 2016. American Airlines, United Airlines, and Sun Country Airlines started service at STS in 2017. Prior to the start of the Covid-19 pandemic in early 2020, STS was served by: Alaska Airlines, American Airlines, United Airlines, and Sun Country Airlines. Annual passenger enplanements grew from 132,361 in 2015 to 238,916 (revenue only) and 244,678 (total including non-revenue) in 2019.

The first two AMP elements were addressed through airfield modifications that included extension of Runway 14/32 from 5,121 to 6,000 feet, extension of the main runway's parallel taxiway, and extension of the crosswind Runway 2/20 from 5,021 to 5,202 feet. The 2012 AMP also included a layout for a five-gate passenger terminal, realignment of the terminal circulation road, and additional long-term parking.

New Facilities Since the 2012 AMP

Approval of the 2012 AMP resulted in the construction or modification of the following facilities during the period between 2013 and 2022:

- Extension of Runway 14/32 from 5,121 to 6,000 feet.
- Extension of Runway 2/20 from 5,021 to 5,202 feet.
- Addition of a partial parallel taxiway serving Runway 2/20.
- Relocation of the localizer antenna and associated equipment building outside of the RSA at the approach end of Runway 14.
- Addition of a paved service road that loops around the approach ends of Runways 14 and 20, including two bridges over creeks.
- Addition of a paved service road that loops around the approach of Runway 32.
- Construction of underground and aboveground stormwater detention basins in the northeast quadrant of the Airport.

- Construction on the passenger terminal expansion (to be completed in 2023).
- Construction of new Parking Lot B for long-term parking and solar array canopies.
- Acquisition of property: Parcels 7, 36, 43 as shown on the Airport Property Map.

In 2013, the Airport acquired three parcels, totaling approximately 22 acres, located in the approaches to Runways 14 and 20. Numerous trees in the approaches to Runways 14 and 20 were also removed to eliminate them as obstructions. In 2019, the Airport acquired a 2.5-acre parcel on southern border. The property contains a structure that had been an officers' club during World War II. A preliminary cultural resources evaluation concluded that the property may be eligible for inclusion in the National Register of Historic Places.

To accommodate the increase in scheduled service and passenger enplanements, the passenger terminal and commercial apron has received ongoing modifications. A modular holdroom was added in 2018 and expanded in 2020. Sidewalk improvements and a temporary baggage claim were also completed in 2020. These two improvements enabled a major terminal expansion project to begin. The expansion will involve construction of 30,000 square feet of new terminal space and renovation of 8,000 existing square feet. This expansion is scheduled for completion in 2023.

In 2016, the first phase of the expansion of long-term parking Lot B was constructed. This temporary parking lot had 126 spaces. It was replaced with a permanent 448-space parking lot. The permanent lot included handicap parking spaces, electrical charging stations, and parking canopies with solar arrays.

In 2017, the FBO Vine Jet added a wing to the north side of its large box hangar with commercial uses including a real estate office and a retail bakery. TrueAir constructed a new facility south of Apron D to house its aircraft and flight school operation. This is now occupied by Butterfly Aviation and other aeronautical users. In 2018, Sonoma Jet added a hangar on its leasehold along Flightline Boulevard for corporate aircraft storage.

Runway 20 RIM

The short extension of Runway 2/20 and associated taxiway improvements did not fully resolve the problem of runway incursions. Some pilots, intending to depart on Runway 20, unintentionally turn onto Runway 14. These incursions are commonly made by pilots of piston-powered aircraft who are not familiar with the Airport. The frequency of incursions caused the Airport to be added to the FAA's Runway Incursion Mitigation (RIM) program's Inventory of Airport Locations. If a location has three or more runway incursions in a single calendar year, or an average of one runway incursion per year since the program began, it is considered for inclusion in the RIM inventory. Airport staff worked with the FAA Certification Safety Inspector, Airport Traffic Control, and Airport District Office staff to identify and implement measures to eliminate or at least reduce incursions. Several modifications to pavement marking and striping were tried; none of the modifications have reduced the occurrences of incursions below the threshold for inclusion in the RIM Inventory. Analysis of options to reduce incursions is a key part of this ALP update.

AIRPORT ROLE AND EXISTING CONDITIONS

STS is a public-use facility supporting both commercial service and general aviation operations with limited use by transient military aircraft. STS is owned by the County of Sonoma and operated by the County of Sonoma Department of Transportation and Public Works. STS is located in central Sonoma County, approximately 7 miles northwest of downtown Santa Rosa, 55 miles northwest of San Francisco, and 18 miles inland from the Pacific Ocean.

STS occupies approximately 1,127 acres at an elevation of 128.7 feet above mean sea level (MSL). Land uses east of the airport are a mixture of offices and industrial uses. The Airport's environs also include a mixture of rural residential and agricultural (mainly vineyards) uses. U.S. Highway 101 is 1.6 miles east of STS. The following sections describe STS as it exists in 2022 and the role STS serves in California and the national air transportation system.

National Plan of Integrated Airport Systems and Caltrans

The National Plan of Integrated Airport Systems (NPIAS) is updated every two years to identify airports that are of importance to the national air transportation system. The NPIAS classification system uses predetermined evaluation criteria including proximity to other airports, annual passenger enplanements, and the number of based aircraft. Inclusion into the NPIAS makes airports eligible for FAA Airport Improvement Program (AIP) funding. The 2021-2025 NPIAS report classifies STS as a primary nonhub airport. This classification is assigned because STS receives between 0.05 and 0.25 percent of annual U.S. commercial enplanements.

The California Department of Aviation (Caltrans) Division of Aeronautics classifies STS as Public Use and as a Part 139 Commercial Airport. Airports in the Part 139 category have scheduled passenger service.

Major Facilities

Major airside, terminal, and landside facilities are listed below and summarized in **Table 1-1**. Major facilities include hangars, transient tie-downs, an air traffic control tower (ATCT), ARFF, fixed base operators (FBO), fuel, aircraft maintenance, and a CalFire attack base. Both self-service and full-service from fuel trucks are available with 100 low-lead (100LL) and Jet-A fuel. Fuel service is offered by the two FBOs, Kaiser Air Santa Rosa Jet Center and Sonoma Jet Center.

Airside

STS has two runways, designated as 14/32 and 2/20. Runway 14/32 is aligned northwest to southeast and Runway 2/20 is aligned northeast to southwest. Runway 14/32 is 6,000 feet long and 150 feet wide. Runway 2/20 is 5,202 feet long and 100 feet wide. Runways 14/32 and 2/20 are asphalt and each runway end, except Runway end 2, has blast pads. Runway 14/32 has a full-length parallel taxiway (A) on the east side. Runway 2/20 has a parallel Taxiway B on the east side.

Runway 14/32 is a precision runway equipped with high-intensity runway lights and precision runway markings. The approach to Runway 32 has a Medium Intensity Approach Lighting System (MALSR) and the approach to Runway 14 has a four-light box precision approach path indicator (PAPI). Runway 2/20 is a non-precision runway equipped with medium-intensity runway lights and non-precision runway markings. The approach to Runway 2 has a two-light box PAPI and the approach to Runway 20 has a four-light box PAPI.

Terminal

The terminal area is located on the east side of the Airport. The terminal supports a 13,000-square-foot terminal building, a short-term automobile parking lot, four rental car facilities, restrooms, and a passenger boarding lounge. The terminal building received an expansion and remodel in 2010 and again in 2020. The terminal building is located to the west of the Airport Boulevard loop. Airport parking is positioned to the north and inside of the Airport Boulevard loop. The FAA Air Traffic Control Tower (ATCT) is located in the terminal area, directly south of the terminal building.

Landside

The Airport is accessed via Airport Boulevard from US Highway 101. The Airport is generally encompassed by North Laughlin Road and Skylane Boulevard on the east, Laughlin Road on the south, and Slusser and Windsor Roads on the west. Airport Boulevard loops near the passenger terminal and provides curbside access. Three major parking lots are located in the terminal vicinity that accommodate short-term, long-term, and rental car parking as well as taxicab and ride-share staging. Becker Boulevard and Flightline Drive provide access to general aviation facilities on the east quadrant.

Instrument Approaches

Instrument approach procedures are a series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. STS has four instrument approach procedures for Runways 2, 14, and 32, with details provided in **Figure 1-1** below. The FAA Airport/Facility Directory and FAA Instrument Flight Procedures Information Gateway were accessed on May 1, 2021, to determine the visibility minimums and descent heights for both approaches.

- Runway 14: Area Navigation with Global Positioning System (RNAV (GPS))
- Runway 32: RNAV (GPS) and Instrument Landing System (ILS) or Localizer with Distance Measuring Equipment (LOC DME)
- Runway 2: RNAV (GPS)

Figure 1-1: Airport Profile

General Information

- Airport Ownership: County of Sonoma, California
- Year Opened: 1939
- Airport Property: ~1,127 acres
- NPIAS Airport Classification: Primary, Non-Hub
- CA System Plan Classification: Primary, Non-Hub, Regional
- Airport Elevation: 128.7 ft. MSL

Runway/Taxiway Design

Runway 14/32

- Dimensions: 6,000 ft. long, 150 ft. wide
- Pavement Strength, Surface, and Condition
  - 120,000 lbs. (single wheel)
  - 184,000 lbs. (dual wheel)
  - 300,000 lbs. (dual tandem wheel)
  - Asphalt (grooved), good condition
- Runway Lighting, Marking, and Approach Aids
  - High-intensity edge lights
  - Precision markings
  - Runway 32: ILS
- Average Gradient: 0.17% (rising to southeast)
- Primary Taxiway: Full-length parallel (A) on east

Runway 2/20

- Dimensions: 5,202 ft. long, 100 ft. wide
- Pavement Strength, Surface, and Condition
  - 109,000 lbs. (single wheel)
  - 154,000 lbs. (dual wheel)
  - 254,000 lbs. (dual tandem wheel)
  - Asphalt (grooved), good condition
- Runway Lighting, Marking, and Approach Aids
  - Medium-intensity edge lights
  - Runway 2 Non-precision markings
  - Runway 20: Basic markings
  - Runway 2: PAPI 2 box
  - Runway 20: PAPI 4 box
- Average Gradient: 0.29% (rising to south)
- Primary Taxiway: Partial parallel (B) on northwest

Approach Protection

- Existing Runway Protection Zones (RPZs)
  - Runways 2: 1,700-ft. long; 63% on airport property
  - Runways 20: 1,700-ft. long; 96% on airport property
  - Runway 14: 1,700-ft. long; 21% on airport property
  - Runway 32: 2,500-ft. long; 86% on airport property

Airport Planning Documents

- Airport Master Plan
  - Approved by Sonoma County Board of Supervisors January 2012
  - Approved by FAA August 2013
- Airport Layout Plan Drawing
  - Post-construction Pen & Ink update submitted in June 2015

Traffic Patterns and Approach Procedures

- Airplane Traffic Patterns
  - Runways 2, 11, 29: Left traffic
  - Runway 20: Right traffic; gliders, left traffic; all other aircraft
  - Pattern altitude: 1,000 ft. AGL (1,100 ft. MSL) light aircraft; 1,500 ft. AGL (1,600 ft. MSL) heavy aircraft
- Instrument Approach Procedures (lowest minimums)
  - Runway 14 RNAV (GPS)
    LNAV Straight-in: 1 mile vis., 478 ft. AGL (600 ft. MSL) descent alt.
    Circling: 1 mile vis., 471 ft. AGL (600 ft. MSL) descent alt.
    Final approach course offset 15.08°
  - Runway 32 ILS or LOC/DME
    ILS Straight-in: ½ mile vis., 255 ft. AGL (377 ft. MSL) descent alt.
    Circling: 1 mile vis., 471 ft. AGL (600 ft. MSL) descent alt.
  - Runway 32 RNAV (GPS)
    LPV Straight-in: ½ mile vis., 200 ft. AGL (322 ft. MSL) descent alt.
    Circling: 1 mile vis., 471 ft. AGL (600 ft. MSL) descent alt.
  - Runway 2 RNAV (GPS)
    LP Straight-in: 1 mile vis., 371 ft. AGL (500 ft. MSL) descent alt.
    Circling: 1 mile vis., 531 ft. AGL (660 ft. MSL) descent alt.
- Standard Inst. Departure Procedures (initial course)
  - CHARLIE EIGHT:
  - Runway 2 climb left turn to heading 305°, 300 ft. per NM to 2100
  - Runway 14 climb heading 144°, 285 ft. per NM to 2500
  - Runway 20 climb heading 196°, 265 ft. per NM to 2200
  - Runway 32 climb heading 315°, 375 ft. per NM to 2200
- Visual Approach Aids
  - Airport: Rotating beacon, segmented circle, wind cone
  - Runway 14: PAPI 4-box (3.0°)
  - Runway 32: ILS (MALSR, Glide Slope, Localizer)
  - Runway 2: PAPI 2-box (3.0° glide slope)
  - Runway 20: PAPI 4-box (3.5°)

Terminal Areas

- Location: East side (principal), south and west sides (secondary)
  - Aircraft Parking Capacity (226 hangars)
  - 29 executive hangars (doors between 55 and 65 feet)
  - 261 T-hangars and shade hangars
  - 262 County tie downs
  - 73 transient tiedowns
- Other Major Facilities
  - Passenger terminal
  - Air traffic control tower
  - Aircraft Rescue and Fire Fighting facility
  - CalFire Air Attack Base
  - Sonoma County Sheriff's Helicopter Center
  - Redwood Empire Air Care Helicopter (REACH) facility
  - Pacific Coast Air Museum
- Services
  - Fuel: 100LL (self-serve); Jet-A, Jet A1+ (from truck)
  - Aircraft and helicopter rental and charter
  - Flight instruction
  - Airframe, powerplant, and avionics repair
  - Car rental

Sources: Airport 5010 record, ALP, ADIP, and FAA Instrument Flight Procedures Information Gateway (accessed on May 1, 2021)

Airfield Design Standards

STS is required to maintain facilities consistent with FAA standards as a condition of accepting FAA grants. FAA design standards for runways are determined by the FAA coding system called the Runway Design Code (RDC). The RDC is made up of the Aircraft Approach Category (AAC), the Airplane Design Group (ADG), and the runway approach visibility minimums.

The AAC is broken down into categories A through E and relates to the approach speed (in knots) of the design aircraft. The ADG is broken down into roman numeral categories, I-VI, and relates to the greatest wingspan or tail height of the design aircraft. The most demanding AAC and ADG at an airport sets the Airport Reference Code (ARC). The FAA codes taxiways using a standard called the Taxiway Design Group (TDG).

Some taxiway design standards are based upon the TDG of the design aircraft. The TDG considers the dimensions of the design aircraft's landing gear to determine taxiway widths and pavement fillets to be provided at taxiway intersections. Fillet pavement accommodates the inner wheel of the airplane as it turns. TDG classifications are determined by width of the main gear and wheelbase (the distance from nose gear to main gear).

The design aircraft is the most demanding aircraft that uses an airport on a regular basis, which the FAA defines as more than 500 operations per year. The AAC and ADG of the design aircraft is used to determine the RDC. The RDC of the design aircraft sets the ARC for an airport.

Design Aircraft and RDC on 2012 ALP

The 2012 ALP of record for STS identifies the Embraer ERJ-190 as both the existing and future design aircraft. It serves as the design aircraft for both runways and the main elements of the taxiway system. The ERJ-190 is a 100-seat passenger aircraft, previously used for scheduled service at the Airport. This aircraft is in ARC C-III. The 2012 ALP shows the RDC for Runway 14/32 is C-III-2400.

Existing and Future RDC

Activity forecasts for STS have been prepared as part of this ALP update. The forecasts are presented in Chapter 2 of this Narrative Report. The results of this forecasting effort led to modification of the existing and future design aircraft for STS.

The updated ALP designates the Boeing 737-800 as both the existing and future design aircraft. The 737-800 seats 162 passengers in a two-class layout or 189 passengers in a one-class layout. The 737-800's ARC is D-III. The current and future RDC for Runway 14/32 is D-III-2400. The existing and future design aircraft for Runway 2/20 is the Embraer 175, and the existing and future RDC for Runway 2/20 is C-III-5000.

Summary of Facility Improvements and ALP Changes

The following list summarizes changes to the STS ALP from the previous version. AC-13B was released near the completion of the draft ALP set. Items that required changes (taxiway OFAs, taxiway fillets, and obstacle clearance surfaces) were updated appropriately to match AC-13B standards. A time frame for anticipated implementation is provided after each major project.

- Updated entire ALP set to FAA SOP standards, with addition of detail building area plans, inner-approach airspace sheets, runway profiles with declared distances, and land use map.
- Expanded data tables, including runway, taxiway, and data tables on Data Sheet.
- Expanded and added tables on ALP sheet, including Facility tables, NAVAIDS, and non-standard conditions.
- Updated design aircraft to match the approved forecast fleet mix and updated the runway design codes and runway design surfaces to correspond to the design aircraft specifications.
- Updated baseline environmental data.

Airside

Airside facilities that were evaluated and updated as part of this ALP update are listed below.

Runway 20 RIM

Multiple alternatives to the Runway 20 – Taxiway H – Taxiway A – Runway 14 intersection was analyzed to reduce and eliminate runway incursions. A two-phase solution was proposed and added to the ALP. More information is provided in Chapter 3.

- Added interim sign and markings in this Runway 20 RIM area (See ALP Sheet 18). (1-5 years)
- Incorporated a future permanent geometry design, a 458-foot extension of the Runway 20 end to the northeast. This design extends Runway 2/20 to 5,600 total feet, realigns Taxiway A, provides right-angle entrances to Runway 20, and eliminates Taxiway H (See ALP Sheet 19). (5-10 years)
- Proposed modified future Runway 02/20 declared distances to support operations without effecting the RSA/ROFA. (5-10 years)

Taxiways

Taxiways were evaluated to eliminate non-standard design and intersections. See Chapter 4 for more information.

- Shifted Taxiway A connectors (A3, A4, A5) to eliminate direct apron to runway access and provide 90-degree intersections. (5-10 years)
- Incorporated taxiway fillet design at future Taxiway A connector intersections. (5-10 years)
- Proposed elimination of Taxiway Z. (5-10 years)

- Retained (from previous ALP) the future Taxiway E shift to the approach end of Runway 32. (5-10 years)
- Realigned Taxiway Z to the west 59 feet, closer to Taxiway A, to provide more terminal apron and airline parking position area. (5-10 years)
- Added future run-up apron east of Taxiway A and proposed eliminating the existing Runway 32 run-up apron located in Precision Obstacle Free Zone (POFZ). (5-10 years)

NAVAIDS

- Retained (from previous ALP) the future non-precision [D] approach type (¾ mile) on Runway 14 and incorporated future Part 77 airspace, Threshold Siting Surface (TSS), and Runway Protection Zone (RPZ). (5-10 years)
- Added future touchdown zone and centerline lights to support a future Category II approach (<½ mile) on Runway 32. (1-5 years)
- Added future midpoint runway visual range facility on Runway 14/32. (1-5 years)

Air Traffic Control Tower

- Proposed three future conceptual sites or a replacement ATCT in-place, of which two sites were retained from previous ALP. Next step is coordination with ADO and site selection study with line-of-sight analysis. (5-10 years)

Terminal Area and General Aviation

The passenger terminal expansion was underway (estimated completion in early 2023) during this ALP update. The ALP incorporated changes and proposed facilities, including expansion or relocation of GA facilities, that may be displaced with terminal expansion.

Terminal Expansion

- Added near-term terminal building expansion. (1-5 years)
- Illustrated conceptual long-term terminal building footprint based on the ultimate enplanement forecast. (10-20 years)
- Incorporated passenger terminal apron expansion including airline parking positions. (1-5 years)
- Added a future remain overnight (RON) apron with four parking positions north of Apron A and east of Taxiway Z to accommodate growth in passenger airline operations and RON operations. (1-5 years)

ARFF

Various locations for ARFF facility relocation were evaluated that considered environmental impacts, utility access, airside access, response time, and displacement of existing facilities. See Chapter 5 for more information.

- Added future ARFF facility north of the conceptual ultimate terminal footprint. (1-5 years)
- Reconfigured Apron A to continue to accommodate itinerant aircraft parking and circulation with addition of future ARFF facility. (1-5 years)

General Aviation

Multiple areas for future hangar construction were evaluated for either new or relocated tenants. The ALP shows conceptual hangar development with hangar footprints; other areas are shown as Aviation Reserve for long-term future hangars or redevelopment.

These Aviation Reserve areas may have immediate development obstacles, such as environmental impacts, landside or airside access, or utility constraints. See Chapter 6 for more information.

- Illustrated future general aviation areas with conceptual hangar layouts and other GA facilities in the following areas:
  - **Apron D:** Future box hangars on undeveloped east area. (1-5 years)
  - **Apron E:** Future T-hangars and fuel facility on undeveloped east area. (1-5 years)
  - **Apron F:** Future box hangars south of the existing apron on undeveloped area. (5-10 years)
  - **South hard stands:** Future corporate hangar area. (1-5 years)
- Demarcated three areas for long-term aviation reserve or related development on the west airfield. (10-20 years)
- Delineated future aviation reserve, FBO, or similar corporate development east of Apron B. (5-10 years)

Landside

Changes to landside facilities were analyzed and incorporated that will support terminal area expansion.

- Incorporated future rental car facility and CONRAC expansion. (1-5 years)
- Added future long-term parking on vacant lot east of parking Lot A with future canopies with solar arrays. (1-5 years)
- Added future perimeter fence south of Apron F, west of Runway 32 RPZ, and east of Runway 20 approach. (1-5 years)

Land Use and Property Acquisition

- Created new noise contours based on approved operations forecasts and added to new Land Use Plan sheet.
- Updated parcel data to include acquisition information and funding sources.
- Updated parcels to show existing and future property interests.

NEXT STEPS

- FAA approval for ALP set.
- Add eligible projects to the Airport's capital improvement plan.
- Coordinate with the ADO on project schedules and funding.
- Complete appropriate environmental documentation and engineering design.

Chapter 2
Forecasts

Chapter 2 -

Aviation Forecast Validation

INTRODUCTION

Aviation activity forecasts help determine if existing airport facilities have the capacity to meet future demand or if they will require modifications. Forecasts were produced in the Environmental Impact Report (EIR) and Environmental Assessment (EA) that supported adoption of the 2012 Airport Master Plan. Since this time, Sonoma County Airport (STS) has seen significant growth in enplanements and commercial operations. United and American Airlines now have consistent service to hub airports such as Dallas, Denver and Phoenix, offering more options to travel to eastern U.S. destinations. A recent Market Assessment Analysis shows that more routes and airlines are likely to serve STS in the near term. This will put considerable stress on a terminal facility that is currently undersized. This will also have a ripple effect on terminal area facilities such as the air carrier apron, Aircraft Rescue and Fire Fighting (ARFF), circulation, and passenger automobile parking. This Airport Layout Plan (ALP) update provides a chance to validate the forecasts from the 2012 Master Plan and update them and to review terminal and auxiliary facility expansion needs.

The aviation forecasts were generated in 2019 and submitted to the FAA prior to the COVID-19 pandemic. The pandemic has greatly disrupted aviation in the short term and its long-term effects are yet to be determined. Given the uncertainty related to COVID-19 and its potential sustained impact to aviation activity, there may be a future reevaluation of the forecast data depending on the timeline for facility implementation.

FORECAST VALIDATION OVERVIEW

The forecasts presented here will update and validate the 2012 Master Plan forecasts for aircraft operations and peak hour and annual enplanements associated with scheduled passenger service. Forecasts for general aviation (GA) operations, military operations, and based aircraft will be updated with the 2018 Federal Aviation Administration (FAA) Terminal Area Forecast (TAF) as the source for extended forecasts for these segments. Forecast validation will integrate review of the passenger service analyses prepared by the STS's air service consultant and consider the information in the preparation of forecast updates. The forecast validation follows a linear process that includes the following components:

- **Response to COVID-19:** This was added after draft forecasts were developed and submitted to the FAA. This section discusses the pandemic effect on enplanements at STS and offers scenarios for near-term recovery.

- **Community Profile:** Review of the socioeconomic factors that make up the catchment area and how socioeconomic factors affects passenger demand.
- **Forecast Data Review:** Review of the 2012 Master Plan forecasts, the 2019 Market Assessment Analysis by STS's air service consultant Landrum & Brown (L&B), and the Sonoma County Air Transportation Element of the Sonoma County General Plan.
- **Scheduled Commercial Service Forecasts:** Presentation of the preferred enplanement and operations forecast with the aviation activity profile, methodology, and assumptions.
- **General Aviation Forecasts:** Presentation of the preferred forecasts for GA activity based on established TAF rates.
- **Forecast Summary:** Presentation of standard summary tables the FAA requires.

The forecasts have a base year of 2018 and follow the FAA fiscal year (October to September). The forecast period is 20 years from the base year with reporting intervals of every five years. Data from the past ten years (2008 to 2018) is the basis of analysis of historical trends. The historic data period includes periods of economic expansion and contraction that help forecasts account for various economic conditions and gives a perspective on the effects of economic change on aviation activity.

Common Terms and Abbreviations

Some common terms and abbreviations used in this chapter are presented below. **Table 2-1** shows the abbreviations used through the chapter for airports with existing service, potential new routes, or comparative airports used in forecast methodology.

Table 2-1: Airport Designator Codes

Designator	Airport	Notes
SEA	Seattle-Tacoma International	Existing Service: Alaska
PDX	Portland International	Existing Service: Alaska
SAN	San Diego International	Existing Service: Alaska
SFO	San Francisco International	Existing Service: United
SNA	John Wayne, Orange County	Existing Service: Alaska
LAX	Los Angeles International	Existing Service: Alaska & American, seasonal
PHX	Phoenix Sky Harbor International	Existing Service: American
MSP	Minneapolis−Saint Paul International	Existing Service: Sun Country, seasonal, not daily
DEN	Denver International	Existing Service: United
DFW	Dallas/Fort Worth International	Existing Service: American
LAS	McCarran International, Las Vegas	Existing Service: Sun Country, seasonal, not daily; previously daily
SLC	Salt Lake City International	Potential Route: Near-term[1]
ORD	O'Hare International, Chicago	Potential Route: Near-term[1]
MRY	Monterey Regional	Comparative Airport
SBA	Santa Barbara	Comparative Airport
SMF	Sacramento International	Nearby Airport, within 2-hour drive
OAK	Oakland International	Nearby Airport, within 2-hour drive

Note: Not all markets with potential service are included in this table.

In the 2012 Master Plan Forecasts, aircraft operations were divided into two categories, based on seats:

- **Mainline Airline:** Jet aircraft operations with approximately 100 to 150 seats.
- **Regional Airline:** Operations by turboprops or small jets with fewer than 100 seats.

The FAA also breaks out airline types for forecasting but under different parameters:

- **Air carrier operations:** Represent either takeoffs or landings of commercial aircraft with seating capacity of more than 60 seats.
- **Air taxi / commuter operations:** Represent one category of aircraft with 60 or fewer seats. Commuter operations include takeoffs and landings by aircraft that transport regional passengers on scheduled commercial flights. Air taxi operations include takeoffs and landings of non-scheduled or for-hire flights.

In addition to airline types, the FAA uses two enplanement categories for forecasting purposes:

- **Air carrier enplanements:** Includes domestic enplaned passengers (originations and connections) of U.S. commercial air carriers and international enplanements for both U.S. and foreign flag carriers.
- **Regional enplanements:** Starting in FY 2003, includes enplanements for those airlines whose primary function is to supply passengers to mainline carriers, regardless of aircraft size.

Aircraft that are commonly referred to in this Chapter, with model type and typical seat numbers are shown in **Table 2-2**. These do not represent all aircraft that may operate at STS today or in the future.

Table 2-2: Common Aircraft Specifications

Aircraft Designation	Manufacture	Seats	Notes
CRJ-200	Bombardier	50	phased out by 2023
CRJ-700	Bombardier	66 to 78	
CRJ-900	Bombardier	76 to 90	
E175	Embraer	76 to 88	
Q400	De Havilland	68 to 90	
MRJ 90	Mitsubishi	76	delivery starting 2020
E175-E2	Embraer	80	delivery starting 2021
737-700	Boeing	126 to 140	
737-800	Boeing	160 to 189	

Source: Aircraft planning manuals and SeatGuru.com

RESPONSE TO COVID-19

The forecasts for STS were scoped and developed prior to the onset on the COVID-19 pandemic. The draft forecasts use base year 2018, and they were submitted to the FAA in December 2019 and reviewed while the pandemic surged. The FAA returned comments, which were minimal, in August of 2020.

Ensuing comments indicated these forecasts should address the pandemic. At that point, forecasts were revised to discuss impacts and the potential for near-term recovery specific to STS and to revise the preferred enplanement forecast.

The COVID-19 pandemic has had widespread effects on the global economy with uncertainty for the aviation industry. The aviation industry in the United States has been greatly affected with both domestic and foreign airlines cutting back on flights because of the sudden drop in demand for travel. Uncertainty about when the demand for air travel will return remains, specifically regarding the near-to-mid-term effects of the pandemic, when the industry will return to 2019 activity levels, and long-term growth.

Successful containment and mitigation of COVID-19 is essential for the airline industry recovery. As of December 2020, the spread of COVID-19 continues, with the U.S. topping the world record in number of confirmed COVID-19 cases, according to the U.S. Centers for Disease Control and Prevention. Fortunately, the Food and Drug Administration approved a COVID-19 vaccine in December 2020. However, the timetable for administering and distributing the vaccine to the threshold of population that will provide herd immunity remains uncertain.

2020 STS Operations

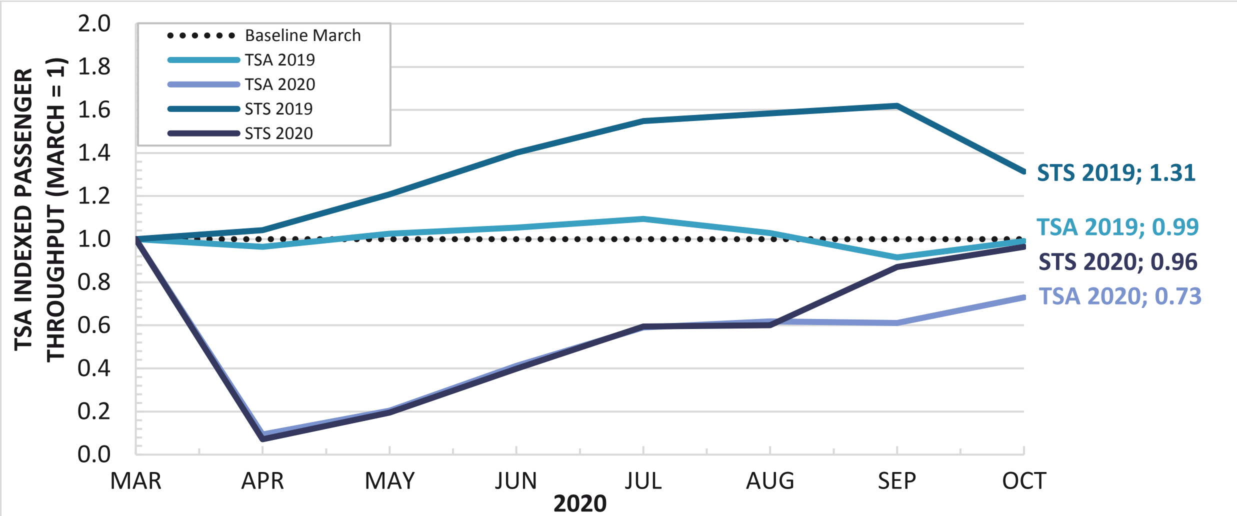
After the start of the COVID-19 pandemic and stay-at-home orders, STS passenger numbers dropped significantly, with 707 total enplanements during April 2020. The Transportation Security Administration (TSA) began reporting daily check point travel numbers in March 2020 and provides data for the same day in 2019 for comparison. **Figure 2-1** compares national indexed passenger throughput with STS passengers as reported by the TSA from March to October in 2019 and 2020. An index charts changes of variables relative to the baseline (March), which is equal to 1.0. An index greater than 1.0 indicates that the passenger number that month is above that of March, while an index below 1.0 shows that month had less passengers than in March.

Figure 2-1 helps illustrate enplanements at STS in 2020 compared to national enplanements, including:

- This drop in passengers at STS from March to April in 2020 was consistent with national trends for reduction in passenger travel.
- During the summer months as local and state travel restrictions were eased, enplanements at STS were at index 0.6 relative to baseline March, a similar rate to national passenger travel.
- In August 2020, enplanements at STS increased at a greater rate than national enplanements, moving closer to the March index, at 0.96 in October.

These trends, although small sample size, show that STS may recover at a rate faster than the national recovery. Of course, this is dependent on vaccine rollout, Sonoma County and California travel restrictions, passenger confidence, and economic health.

Figure 2-1: TSA Passenger Throughput Versus STS Passenger Records



Month	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
TSA 2019	1	0.964839	1.02503	1.054208	1.094	1.028838	0.915399	0.991971
TSA 2020	1	0.093542	0.203925	0.412123	0.590241	0.617768	0.611513	0.729563
STS 2019	1	1.041086	1.208608	1.40077	1.547597	1.584464	1.619039	1.313035
STS 2020	1	0.071295	0.19473	0.397922	0.594071	0.600456	0.870788	0.963821

Sources: Transportation Security Administration (TSA) passenger throughput, STS records

2008 Recession Recovery

A major driver to air travel demand, the economy goes through cycles of expansion and recession. Prior to the outbreak of COVID-19, the United States was experiencing a period of consecutive growth since the recovery from the 2008 Recession. According to the U.S. Bureau of Economic Analysis (BEA), beginning in June of 2009, Gross Domestic Product (GDP) rose every quarter until the first quarter of 2020. The BEA estimates that GDP in the United States decreased at an annual rate of 32.9 percent from the first quarter to the second quarter of 2020. The BEA also estimates a positive third quarter, where GDP increased at an annual rate of 33.4 percent over the second quarter as efforts continued to reopen businesses and activities resumed that were postponed or restricted due to COVID-19.

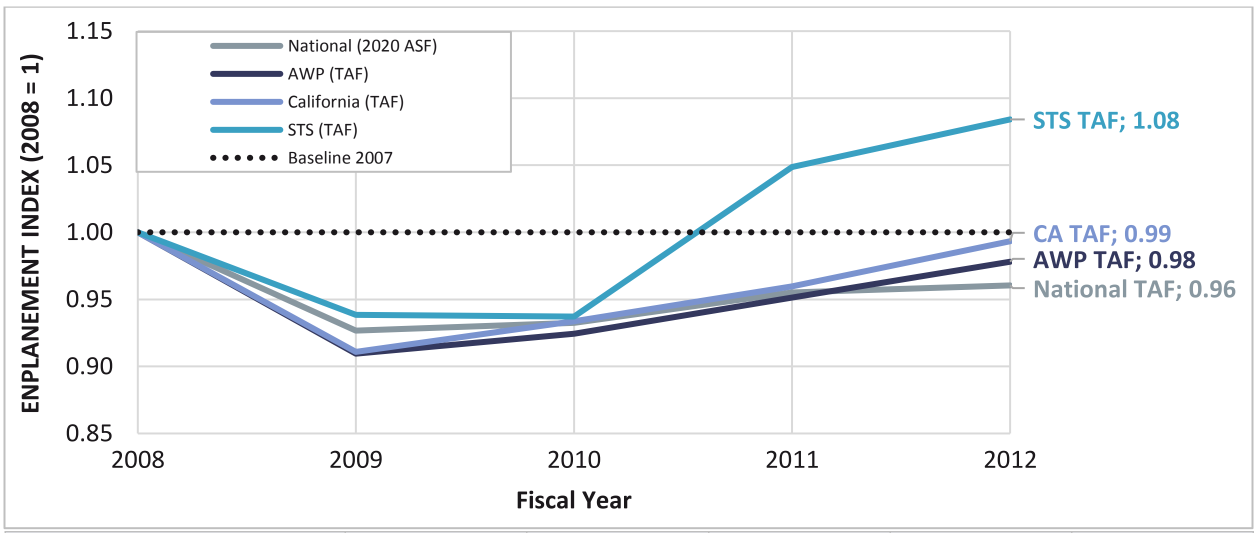
The economic downturn was preceded by widespread stay-at-home orders in early Spring of 2020, limiting travel and forcing non-essential businesses to close or limit production, resulting in economic activity to come to a near standstill. The effects of COVID-19 on the economy stopped a consecutive 11-year expansion of GDP in the U.S., the longest period of economic growth in history. While many regions have since begun reopening in late summer and early fall of 2020, the spread of COVID-19 continues to impact daily life and the economy as a result of social distancing guidelines and containment measures aimed to slow the spread of the virus.

One method of predicting when aviation demand may recover in the near-to-mid-term is to examine a previous period of declining demand and recovery. The most recent historical event that resulted in a significant decrease in aviation demand is the 2008 Recession brought on by the U.S. housing crisis. The Recession resulted in a significant drop in aviation demand, but not as significant as impacts from COVID-19 in 2020.

Relative to the national and state enplanement numbers during and after the 2008 Recession, STS recovered at a higher rate. **Figure 2-2:** shows the indexed enplanement records for STS, California, FAA Airports Western-Pacific Region (AWP), which consists of California, Nevada, and Arizona, and the United States from 2008 to 2012, with 2008 as the baseline year. This period covers the recession and recovery period. Years prior to 2007 have been excluded as STS did not have passenger service from 2004 to 2006. 2007 was the year service returned to STS but would be an outlier as a data point because service was just resuming. Enplanements at STS increased at an average annual rate of 2 percent from 2008 to 2012, while national enplanements decreased at an average of 1 percent annually, and California enplanements decreased at an average of 0.2 percent annually. Observing the historical enplanements at STS during the 2008 Recession and subsequent recovery, STS may be expected to recover at or better than state and national average rates post COVID-19.

STS has shown precedence in recovering from an economic event – the 2008 Recession – that negatively impacts air service demand. Enplanements recovering quickly from 2008 to 2012 followed by sustained growth shows the effects of the inelastic demand for air travel to and from STS as well as the potential for STS to see a relatively quick recovery from the COVID-19 pandemic. Thus, while COVID-19 has had a significant impact on air service in 2020, STS has the potential to recover from its effects quickly and continue growing on the trajectory it was in 2019.

Figure 2-2: Regional Comparison of Enplanement Indices



Fiscal Year	2008	2009	2010	2011	2012
National (2020 ASF)	1	0.926693	0.932586	0.955038	0.960463
AWP (TAF)	1	0.909509	0.924282	0.951419	0.978099
California (TAF)	1	0.910835	0.933556	0.959593	0.993347
STS (TAF)	1	0.938328	0.937162	1.048782	1.084169

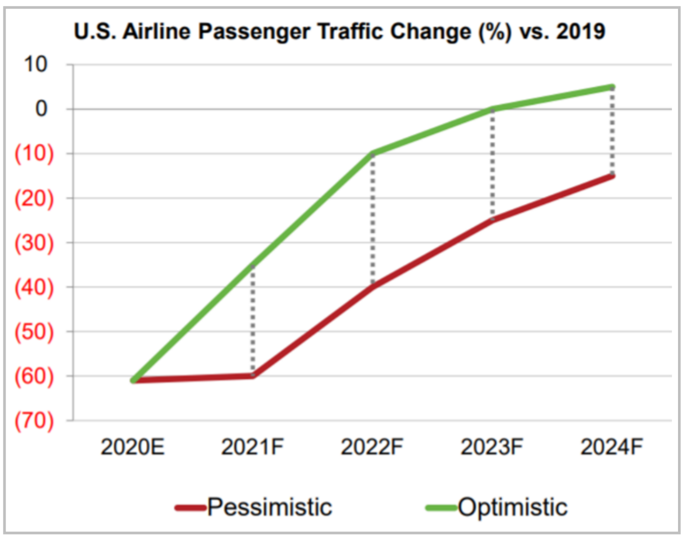
Sources: 2020 FAA Aerospace Forecast, 2020 TAF

Near-Term Recovery Scenarios

Near-term impacts and recovery are now included in the preferred enplanement and passenger aircraft operation forecasts. The preferred near-term recovery is based on local and national factors. It is recommended that STS monitor these forecasts for consistency to actual operations. If operations are significantly different once the pandemic is contained, than STS may need to revisit and revalidate. At that time, the forecast trajectory in the original three-phase forecast for enplanements and commercial operations may be valid again. Consultation with the FAA to update the forecasts to reflect this growth may be warranted at that time.

National analysis predicts various scenarios for returning to pre-pandemic levels of travel. Airlines for America (A4A), a trade group representing major north American airlines, predicts that national passenger volume will not return to 2019 levels prior to 2023-2024. **Figure 2-3** shows two passenger traffic recovery models developed by A4A: an optimistic model that shows passenger traffic returning to 2019 levels in 2023, and a pessimistic model that shows passenger traffic at 15 percent below 2019 numbers in 2024.

Figure 2-3: A4A Near-Term Passenger Traffic Models



Source: Airlines for America, Dec 2020

Similarly, in November 2020 the International Air Transport Association (IATA) forecasted global passenger enplanements to recover to 2019 levels by 2024. This forecast was developed prior to the vaccine being approved, but acknowledges the time it takes to deploy the vaccine and that COVID-19's economic impact will have lingering effects on passenger traffic recovery.

Sonoma County's tourism industry is one factor that can drive strong passenger traffic recovery. Leisure travel will likely surge after a full vaccine rollout and stay-at-home orders are lifted. Travelers have been under quarantine or social distancing measures for most of 2020, and many have been saving for getaway plans as restrictions lift and safety concerns decrease after being vaccinated. Another factor that would help drive strong recovery rates is the diverse market STS serves, with local, business, and leisure travelers. While there is uncertainty how steps made in remote working and technology during the pandemic will affect business travel in the long term, leisure travel has recovered more quickly both during the current pandemic and historically during downturns.

Two recovery scenarios for STS are presented: a conservative recovery, which is in line with the IATA projection of passenger demand returning to pre-COVID levels in 2024, and a strong recovery, which projects recovery in 2023.

Conservative Recovery

The conservative recovery at STS is factored primarily on the IATA's forecast that passenger enplanements will not recover to 2019 levels until 2024. The conservative recovery also assumes that vaccine rollout will be slow and disorganized and may not address new strains of COVID, which will lead to travel restrictions remaining in place and lower confidence to travel. Other factors include an economy that remains stagnant with lingering effects on joblessness and disposable income, business travel that remains below historical levels as companies conserve cash, and the onset of virtual meetings that displace future business travel.

Strong Recovery

A strong recovery at STS is predicated on the optimistic signs that STS has outperformed the national index for TSA throughput in 2020 and its historical tendency to recover from a global economic recession. STS also has a healthy mix of local, business, and leisure travel. This diversity in markets may help STS recover quicker than other markets that rely heavily on business or local travel. These factors would contribute to a strong recovery at STS:

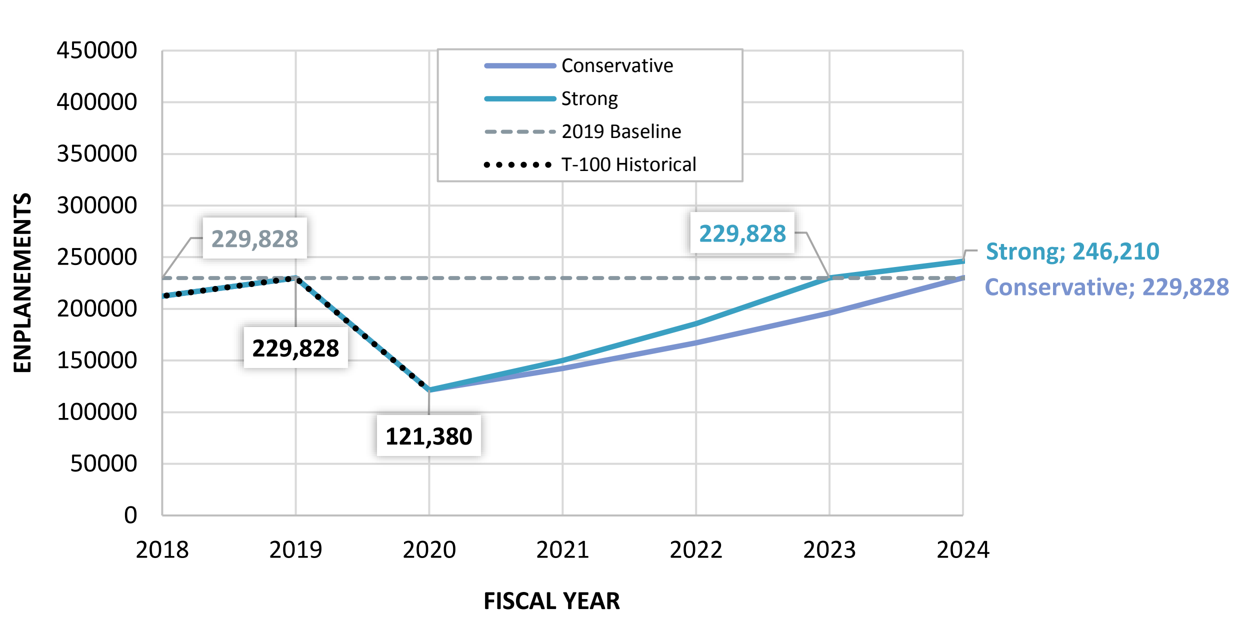
- Market diversity: The leisure market is forecasted to recover faster than business travel.
- Tourism market: Tourism decreased due to COVID-19 but is expected to rebound quickly after vaccine rollout.
- Domestic travel recovery: Domestic travel is expected to recover faster than international travel. While global markets are forecasted to return to pre-COVID levels in 2024 (IATA 2020), large domestic markets in North America are expected to drive recovery.
- Air service: STS continues to develop air service relationships and continues to market the airport to domestic and international carriers.

The approval of a vaccine in December 2020 with nationwide distribution is a promising development. Morgan Stanley Research recognizes the next 6–12 months contain risks from pandemic uncertainty, but historical trends suggest a faster rebound in passenger traffic. While cautious, based on recovery unknowns, Morgan Stanley Research predicts an optimistic timeline for domestic recovery thanks to pent-up demand, fewer competitors than in past global crises, and a more stable fuel-price outlook. Specifically:

- Based on current operational conditions, air travel demand could return to pre-COVID levels by late 2021 or early 2022.
- Airlines with high domestic leisure exposure, medium length of haul (500-2,800 miles), strong customer loyalty, and/or attractive fares will see demand come back first and have the best ability to play offense.
- Jet fuel prices should stay relatively low and steady over the next one to two years if crude oil prices hold steady.

Figure 2-4 shows the conservative and strong scenarios for near-term recovery at STS, with the strong recovery showing a return to 2019 enplanements in 2023, and the conservative recovery in 2024.

Figure 2-4: STS Recovery Scenarios



Fiscal Year	2018	2019	2020	2021	2022	2023	2024
2019 Baseline	229,828	229,828	229,828	229,828	229,828	229,828	229,828
T-100 Historical	212,463	229,828	121,380	-	-	-	-
Strong	-	-	-	150,164	185,774	229,828	246,210
Conservative	-	-	-	142,384	167,023	195,925	229,828

Source: Mead & Hunt, Inc.

COMMUNITY PROFILE

Sonoma County is a popular food and wine destination with multiple outdoor recreation attractions. STS serves as the only airport that has scheduled air service in the North Bay region. STS's primary service area includes Sonoma, Lake, and Mendocino counties, and parts of Humboldt, Marin and Napa counties. This makes STS a major point of access for visitors to Sonoma County and neighboring wine country communities, resorts, and businesses. STS has historically provided the community with connections through major hub airports such as SFO and LAX. The availability of these routes through STS provide the community an alternative to having to drive to the nearby larger airports like SFO, SMF, or OAK, the closest of which are SFO and OAK, each about 75 miles from STS. New service from STS to eastern hub airports in DEN and DFW has only increased airline and destination choices for passengers.

The community profile details the socioeconomic conditions of STS's catchment area, as shown in **Figure 2-5**. The catchment area is defined as the area from which an airport can reasonably expect to draw commercial air service passengers. Key socioeconomic indicators described in this section contribute to understanding the historical trends at STS for the past decade and the socioeconomic data used to help forecast aviation activity.

Figure 2-5: STS Catchment Area

Catchment Area Source: L&B 2019 Market Assessment Analysis

POPULATION

The State of California's Department of Finance provides projections of state, county, and local population. Decennial (10-year) census counts serve as benchmarks and estimates between census years. The Demographic Research Unit realigns ten-year growth patterns with bookend census data every decade. For example, the 2000 and 2010 censuses were used to adjust the population estimates for 2001 to 2009, while the current estimates are only benchmarked by the 2010 census until the 2020 census is completed.

The forecasted population data will be used in calculating enplanements per capita as a factor for the enplanement forecast. **Table 2-3** shows the population projections of the California Department of Finance for the next 20 years.

Table 2-3: Sonoma County Population Projections

Calendar Year	Population	Percent Change
2008	474,819	N/A
2013	493,454	3.9%
2018	502,866	1.9%
2023	518,482	3.1%
2028	536,490	3.5%
2033	553,463	3.2%
2038	567,702	2.6%
2008-2018 CAGR	**0.6%**	**N/A**
2018-2038 CAGR	**0.6%**	**N/A**

Source: California Department of Finance

EMPLOYMENT AND ECONOMIC DEVELOPMENT

Growth in air service demand can be directly tied to a growing local economy as more people travel for business and leisure. This increased demand can lead to possible growth in the number of nonstop routes offered at STS to popular hub airports and travel destinations. For example, when airlines find that many passengers are flying through STS to destinations such as Chicago or Hawaii by connecting through hub airports such as SFO or LAX, it becomes more likely that a nonstop route to the destination will be implemented.

The Sonoma County Economic Development Board uses the North Bay Business Journal Book of Lists to identify the top employers in the county. Top businesses in this list show the range of industries within Sonoma County. The local wine, tech, and health care industries are among the top contributors to the economy. These are the top employers with more than 1,000 employees in 2018:

- Kaiser Permanente – Integrated health care consortium with health plans and hospitals
- St. Joseph Health System – Not-for-profit organization healthcare service provider
- Keysight Technologies – Electronics test and measurement equipment software manufacturer
- Kendall-Jackson Winery – Vineyard and winery
- Sutter Santa Rosa Regional Hospital – Not-for profit hospital
- Amy's Kitchen – A natural and organic food manufacturer

Gross Regional Product (GRP)

GRP is the value of goods and services produced in Sonoma County and serves as an index for the health of the overall economy. GRP grows as more high-value goods are produced. The impact of one unit of a high-value good on the GRP is greater than one unit of a lower-value good, thus as the rate of production of high-value goods increases, GRP increases. The increase in GRP serves as an indicator of more commerce, which leads to an increase in business travel. The GRP per capita indicates that the 2007-2008 Great Recession decreased the GRP for Sonoma County an annual 0.4 percent from 2008 to 2013. The GRP per capita recovered to 2008 levels in 2013. **Table 2-4** shows Sonoma County's GRP for the past decade.

Table 2-4: Sonoma County Gross Regional Product

Calendar Year	GRP[1] ($ Millions)	Percent Change	GRP Per Capita[2]
2008	$24,798	N/A	$52,417
2013	$25,375	2.3%	$51,299
2018	$30,126	18.7%	$58,750
2023	$32,898	9.2%	$61,067
2028	$35,746	8.7%	$63,229
2033	$38,625	8.1%	$65,291
2038	$41,468	7.4%	$67,314
2008-2018 CAGR	**2.0%**	**N/A**	**1.1%**
2018-2038 CAGR	**1.6%**	**N/A**	**0.7%**

1 GRP represents 2018 dollars adjusted for inflation.
2 GRP per capita = GRP / Total Population
GRP Source: Woods & Poole
Population Source: California Department of Finance

At the more individual scale, income per capita is an indicator of the population's wealth. Income per capita in Sonoma County is expected to increase in the next two decades. The income per capita recovered to 2008 levels in 2013 and is projected to grow an average 0.83 percent annually. As citizens have more money to spend, they are more able to afford to travel and, especially by air. The increasing GRP per capita indicates the region's economic growth.

Woods & Poole (W&P) serves as the source data of these economic forecasts. W&P is an independent firm specializing in long-term county economic and demographic data projections. This data helps fill the gaps between official census years. W&P projections expect the county GRP to increase at a higher rate than the county population. This indicates an expected increase in production of high value goods and services such as growth in the tech and healthcare sectors.

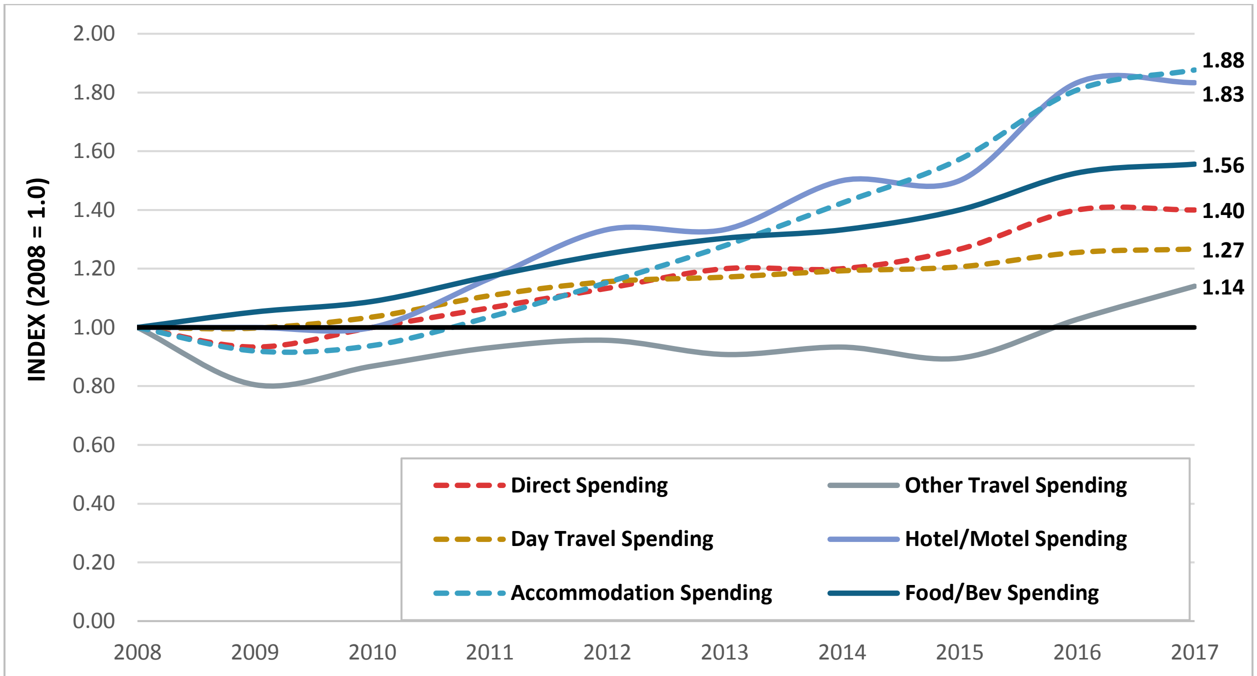
Tourism

Tourism is a mainstay of Sonoma County's economy. The Sonoma County region is known for its concentration of wineries, breweries, and vineyards, which attract both local and international travelers. Growing spending in tourism can lead to an increase in enplanements and demand for additional service or routes to and from STS. Tourism in the region has increased following the economic downturn of 2007-2008.

Total direct travel spending has increased an average 3.8 percent annually between 2008 and 2017 from $1.5 billion to $2.1 billion (Dean Runyan Associates for Visit California 2019). Accommodation spending showed the greatest increase in this period at an average annual rate of 7.2 percent, while food and beverage spending increased an average 5.0 percent annually.

The indexes in **Figure 2-6** show the economic impacts of travel spending in Sonoma County with 2008 as the baseline. Indexes show changes in variables relative to the baseline, so if the index is greater than 1.0, it has grown to a higher value than it was in 2008, while if it is below 1.0, it has decreased in value relative to 2008. **Figure 2-6** shows that travel spending increased between 2008 and 2017 with spending on accommodation (which includes hotels, vacation homes, and campgrounds) and food and beverage having increased the most. This growth in travel spending in Sonoma County helps explain the increase in the number of passengers going through STS and will also help determine if airlines can justify new routes and fill additional seats on larger aircraft.

Figure 2-6: Sonoma County Travel Economic Impacts



FY	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Direct	1.00	0.93	1.00	1.07	1.13	1.20	1.20	1.27	1.40	1.40
Day Travel	1.00	1.00	1.04	1.11	1.16	1.17	1.19	1.21	1.26	1.27
Accommodation	1.00	0.92	0.94	1.04	1.15	1.28	1.42	1.58	1.81	1.88
Other Travel	1.00	0.80	0.87	0.93	0.96	0.91	0.93	0.90	1.03	1.14
Hotel/Motel	1.00	1.00	1.00	1.17	1.33	1.33	1.50	1.50	1.83	1.83
Food/Bev	1.00	1.05	1.09	1.17	1.25	1.30	1.33	1.40	1.53	1.56

Source: Dean Runyan Associates for Visit California

Tourism has a significant impact on government tax revenue in the county due to the Transient Occupancy Tax (TOT), a tax charged to travelers when they rent a room at a hotel, at an inn, or at other lodging for stays fewer than 30 days. Annual total TOT revenue was the highest ever at $43.7 million in 2017. As of the writing of this forecast update, the 2018 TOT records have not yet been updated. The October 2017 wildfires cut the tourism season short but did not affect popular attractions such as wineries, breweries, and outdoor trails.

The main economic impact of the wildfire seemed to come from cancellations to accommodation reservations. However, the *2018 Sonoma County Annual Tourism Report* notes that temporary resettlement of displaced residents and influx of first responders helped offset reduction in visitor spending at restaurants and retail stores in the county.

FORECAST DATA REVIEW

The 2012 Master Plan generated the most recent forecast update. This section reviews the 2012 forecasts. This data will be compared to current operations and enplanements to show the precision of the previous forecasts. This section also reviews the Air Transportation Element (ATE) of the Sonoma County General Plan and the 2019 Market Assessment Analysis.

2012 Master Plan Forecasts

Airline service at STS resumed in 2007 after a period without service that started in 2001. Forecasts for air service enplanements and operations were developed shortly after commercial service resumed at STS in 2007. At that time, the forecasting effort was presented with challenges since most forecasting methods rely on historical data over the past 10 years to establish growth rates.

Table 2-5: 2012 Master Plan Forecast Summary

		2010	2015	2020	2025	2030
Mainline Airlines[1]	Annual Operations	0	3,358	3,925	4,504	5,270
	Average Daily Departures	0	4.6	5.4	6.2	7.2
	Annual Enplanements	0	128,202	150,848	174,005	204,415
	Daily Enplanements	0	351	413	477	560
Regional Airlines[1]	Annual Operations	4,380	2,774	2,920	3,212	3,395
	Average Daily Departures	6	3.8	4	4.4	4.7
	Annual Enplanements	92,659	72,734	78,782	88,368	95,324
	Daily Enplanements	254	199	216	242	261
Total[2]	Annual Operations	4,380	6,132	6,846	7,716	8,665
	Average Daily Departures	6	8.4	9.4	10.6	11.9
	Annual Enplanements	92,659	200,936	229,629	262,373	299,739
	Daily Enplanements	254	551	629	719	821
GA	Local Operations	23,987	53,020	55,833	58,796	61,916
	Itinerant Operations	46,751	84,057	91,728	97,298	103,203
	Based Aircraft	356	371	387	403	418

1 Mainline airlines defined as an aircraft with 100 to 150 seats and regional jests defined as aircraft with fewer than 100 seats.
2 Totals may not be accurate due to rounding.
Source: 2012 Master Plan

Because of these circumstances none of the more traditional approaches to projecting operational and passenger growth were regarded as suitable to the 2012 forecast effort. The traditional approaches included: market share of enplanements, time series analysis, enplanements per capita, and historical growth rate methodologies. The 2012 Master Plan stated that, "To the extent possible, the selected forecast should correlate with the County's General Plan 2020 Air Transportation Element." **Table 2-5 (above)** shows a forecast summary from the 2012 Master Plan.

Sonoma County Air Transportation Element

The ATE of the Sonoma County General Plan 2020 was approved in September 2008 and amended in January 2012. The purpose of the ATE was to "establish policies that will guide future growth and development of aviation activity and airport facilities in the County through the year 2020 in a manner consistent with the goals and policies established in other elements of the General Plan." The ATE looked to guide aviation facilities development and activity by outlining standards for determining consistency of airport plans with the County General Plan. The ATE was amended in 2012 to bring the forecast numbers in line with the 2012 Master Plan forecasts.

ATE Policies

The ATE outlined goals, objectives and policies as related to scheduled air service at STS (Section 5.5 of the ATE). Policy AT-5b specifically set a limit by air carrier service to 21 daily departures, with these allocations distributed between regional carriers and mainline carriers. The ATE defines regional carriers as turboprops and regional jets with 99 or fewer seats and mainline carriers are defined as passenger service jets with approximately 100 to 150 seats. The specific policy includes these stipulations (Sonoma County Permit and Resource Management Department, 2012):

- *All 21 departure allocations may be used by regional carriers.*
- *Mainline carriers may use no more than 7 departure allocations.*
- *Regional carriers shall not be required to give up a departure allocation that is already in use by or allocated to a regional carrier for a mainline carrier.*
- *At no time shall mainline carriers utilize more than 7 of the 21 departure allocations.*

These are other policies from the ATE applicable to passenger service that may be affected by the enplanement and operations forecasts:

- *Policy AT-5e: Any proposed improvement projects to accommodate air carrier passenger services shall be consistent with 15,200 annual operations and 573,000 annual passengers.*
- *Policy AT-5f: A review by the Board of Supervisors shall occur at such a time that the "review threshold" of 650 enplaned air carrier passengers per day averaged over a one-year period (474,500 annual passengers) is reached. The review anticipated by this section is not intended to require an amendment to the Air Transportation Element nor is it intended to require review of this element in its entirety; rather it is intended to trigger Board consideration of the environmental and health impacts and infrastructure needs of the Charles M. Schulz - Sonoma County Airport as it relates to its immediate environs.*

Note that the ATE refers to passengers, defined as the total arriving and departing passengers. Airport planning documents generally forecast enplanements, or departures only (or, one passenger). For STS forecasts, one enplanement equals two passengers (arrival and departure). The enplanement totals for Policy AT-5e are 286,500 and for Policy AT-5f, 237,250 enplanements.

The ATE will guide future growth and development of aviation activity and airport facilities in the County through the year 2020. With the ATE plan set to reach its lifespan, the preferred forecasts in this ALP update may be used to update the goals and policies of the ATE.

2019 Market Assessment Analysis

L&B produced a Market Assessment Analysis in March 2019. The 2019 Market Assessment Analysis is an independent analysis and forecast used to supplement and support the forecasts presented with this ALP update. The Analysis is an important source of data that shows how commercial enplanements and operations at STS are growing at a high rate, with near-term projections for specific routes. These are some of the key findings (Landrum & Brown 2019):

- *Catchment Area bookings increased about 12 percent versus 2015, reflecting strong regional economic growth. This growth was not even, as enplanements to Mexico were not as strong.*
- *Since 2015, STS has been the sixth fastest growing airport in the U.S., increasing enplaned passengers by almost 60 percent.*
- *STS generated traffic growth by mostly increasing share of bookings regionally from five percent to nine percent.*
- *Most of success to-date has been by attracting new service to markets largely reliant on point to point origin and destination traffic.*
- *With recent additions of DEN and DFW service, growth in east-west traffic flows will occur and will be driver of future air service growth.*

The Market Assessment Analysis recommended that STS:

- Work to increase capacity to recently announced new routes, including:
  - PHX: Increase frequency from 2x then 3x daily year-round service
  - DEN: Up-gauge to larger aircraft (CRJ to CR9/E175) and increase frequency from once daily to three times daily.
  - DFW: From seasonal to year-round, and eventually increasing frequency to 3x daily on CR9/E175 aircraft
- Target largest booked origin and destination markets with connecting traffic potential.
  - Chicago O'Hare and Salt Lake City service
  - Longer-term, Houston and Atlanta will be options
  - United, American, Frontier, Delta & Sun Country Airlines are all options
- Additionally, STS should aggressively recruit low cost carrier service to selected Hawaiian and Mexican points.
  - Primary Targets: Guadalajara & Hawaii service
  - Mexico: Focus will be VolarisAirlines, although VivaAerobus is also a target; driven by large Hispanic population base in catchment area
  - Hawaii: Alaska Airlines; strong STS demand to Hawaii

SCHEDULED COMMERCIAL SERVICE FORECASTS

Updated forecasts for passenger service are presented below, including both enplanements and scheduled commercial operations. The airline service profile introduces historical and current service and describes the sources of data used. This is followed by the forecasts for enplanements and operations with methodologies explained.

A pivotal change to the airfield at STS occurred in 2014 that has had a profound effect on air service: Runway 14/32 was extended to 6,000 feet. This made it possible for regional jets and mainline aircraft to operate to and from STS. This also made it feasible for destinations to be served that previously were not physically possible.

In the five years since Runway 14/32 was extended, STS has seen the addition of five airlines and five destinations. The 2019 Market Assessment Analysis anticipates that additional service will be added over the next several years. Over the next five years, additional service is expected as airlines introduce service to test the economic viability of new markets. In the five- to ten-year timeframe, the air service market at STS is expected to reach maturity. After this stage and the introduction of new service, the rate of growth is expected to slow to more closely match trends in California and the United States. Possible forecasting methodologies will be evaluated for their ability to address near-term rapid growth and slower growth as the market reaches maturity.

Airline Service Profile

The aviation activity profile provides context for historical trends in airport activity and attempts to explain the changes that have occurred. The profile serves as a baseline for the forecasts and includes information on passenger airline service and GA activity.

Airline service encompasses scheduled passenger flights and non-scheduled charter flights. The following sections describe the current airline service profile, opportunities for additional air service, passenger enplanements, and commercial operations at STS.

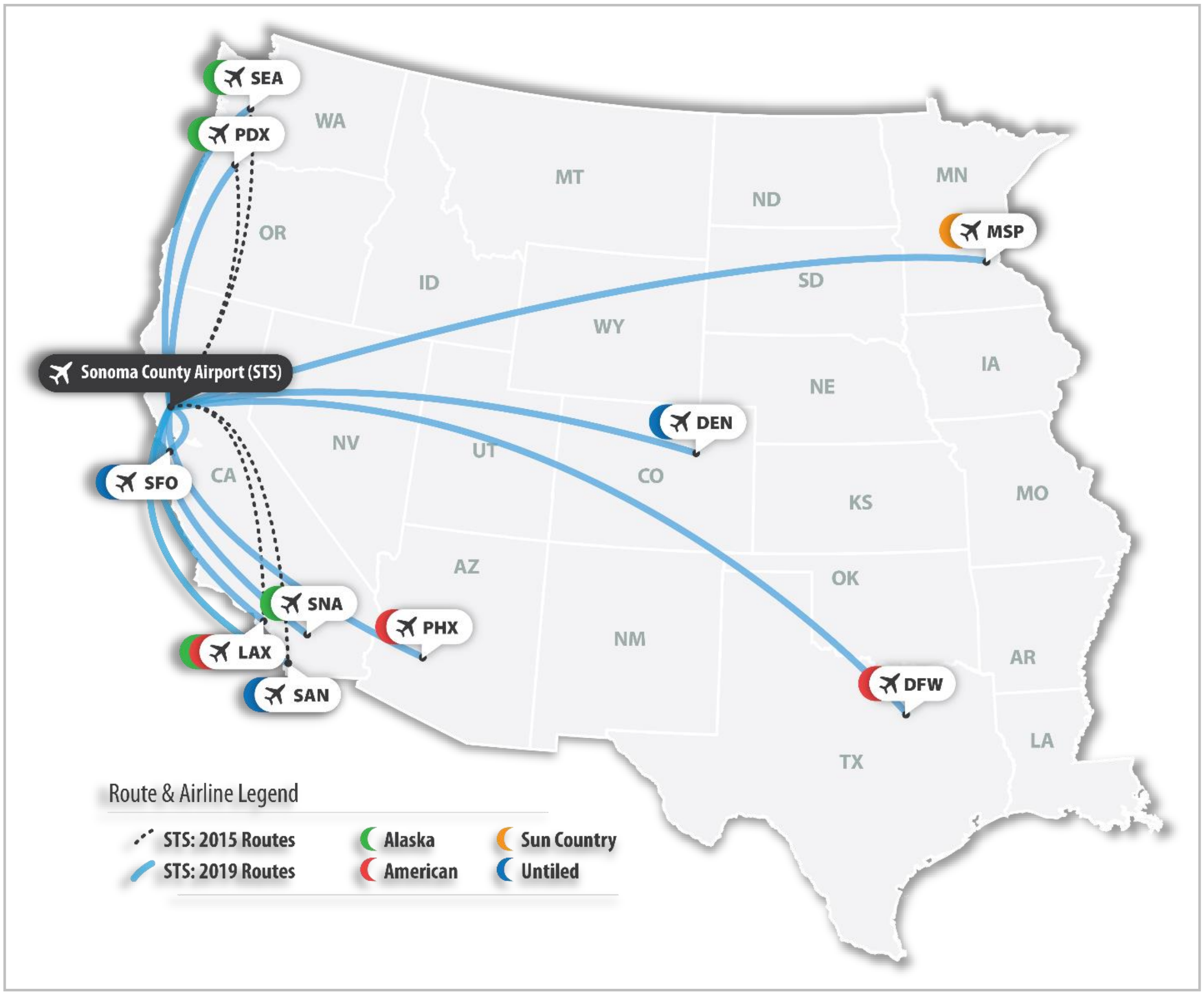
Tables are consolidated at the end of the section.

Airline Profile

After a period without air service starting in 2001, Horizon Air, a subsidiary of Alaska Airlines, began servicing STS as the sole airline from 2007 to 2016. In 2016 Allegiant Air began service at STS. American Airlines, United Airlines and Sun Country Airlines started service at STS in 2017.

Four scheduled passenger airlines served STS in 2018: Alaska Airlines, American Airlines, United Airlines, and Sun Country Airlines. Alaska Airlines' service is operated by regional airline Horizon Air and SkyWest Airlines, American Airlines is operated by SkyWest, Compass, Envoy, and Mesa Airlines, and SkyWest also operates United flights. A daily non-stop service to DFW began on June 6, 2019. Non-stop service at STS, as of July 2019, is shown in **Figure 2-7**. The comparison with the 2015 routes shows the growth in non-stop routes in the past four years.

Figure 2-7: STS 2015 & 2019 Route Map



Source: Mead & Hunt, Inc.

New Air Service Opportunities

Potential new service routes are identified in the 2019 Market Assessment Analysis. New air service opportunities would be accomplished by establishing non-stop service to hub airports and potentially leisure travel destinations. The Market Assessment identified SLC, ORD, and Hawaii as potential destinations, among others. Service to new hub airports may affect existing hub route load factors, for example, when passengers choose to fly to one of the new hub airports such as SLC rather than flying to LAX. Additionally, passengers would no longer have to fly from hubs such as SFO or LAX to destinations such as ORD non-stop. **Table 2-6** shows the market share for origin and final destinations (O&D) for passengers using STS.

Passenger Enplanements

The FAA TAF defines a passenger enplanement as a passenger who boards a scheduled commercial or chartered aircraft with more than nine seats for turboprops, or any number of seats for jet aircraft. Passenger enplanements include revenue and non-revenue passengers who paid taxes and passenger facility charges (PFC) for their carriage. Passenger enplanement counts do not include pilots, flight attendants, and any other members of the airline crew.

Passenger enplanements are categorized as air carrier or regional enplanements, depending on the type of carrier operating the route. For example, passengers on a United A320 flown by United pilots would be categorized as air carrier enplanements, whereas passengers on a United CRJ-900 flown by SkyWest pilots would be categorized as air taxi enplanements.

Enplanements are recorded and categorized by the U.S. Department of Transportation (USDOT), Bureau of Transportation Statistics through T-100 reports. Estimates include both scheduled and non-scheduled enplaned passengers.

- **Air carrier enplanements:** Includes domestic enplaned passengers (originations and connections) of U.S. commercial air carriers and international enplanements for both U.S. and foreign flag carriers.
- **Regional enplanements:** Starting in FY 2003, the FAA included in the regional category enplanements for those airlines whose primary function is to supply passengers to mainline carriers, regardless of aircraft size. As of October 2002, all scheduled and non-scheduled operations using aircraft with 10 or more seats to transport regional passengers must report on T-100.

Historical enplanement data for STS is obtained from the USDOT T-100 database. The source of T-100 data comes from the T-100 forms that scheduled, charter passenger, and air cargo airlines fill out monthly. The T-100 data accounts for any operations that may take place outside of Air Traffic Control Tower (ATCT) operating hours (7 a.m. to 8 p.m.). Enplanements from 2008 to 2018 are shown in **Table 2-7**. Until 2016, all enplanements at STS were categorized as air taxi (regional) operations, since the airlines servicing STS were regional airlines, such as Sky West, Horizon, and Mesa airlines feeding the mainline carrier. In 2016, Allegiant and Sun County airlines – categorized as air carriers, began operating at STS.

T-100 vs TAF Enplanement Records

The FAA TAF is the official forecast that the FAA Headquarters prepares annually for each airport in the National Plan of Integrated Airport Systems (NPIAS). The TAF uses the FAA fiscal year (October to September). The TAF data comes from the USDOT T-100 database, ATCT records, and the FAA Form 5010, which airports submit annually to the FAA.

The TAF is a generally reliable source of information. However, TAF data tends to lag a year behind airport records and the more frequently updated T-100 data. The T-100 is more up to date and as a result, the forecast for scheduled air service is based on the more accurate data from the T-100. **Table 2-8** shows the difference between historical TAF and T-100 enplanement records.

Airline Operations

The seating capacity of the operating aircraft determines the type of commercial operations. Like enplanements, commercial operations are also separated into two categories. Enplanements are separated based on the size of aircraft with the definition provided by the FAA's TAF.

- **Air carrier operations:** Represent either takeoffs or landings of commercial aircraft with seating capacity of more than 60 seats.
- **Air taxi / commuter operations:** Represent one category of aircraft with 60 or fewer seats. Commuter operations include takeoffs and landings by aircraft that transport regional passengers on scheduled commercial flights. Air taxi operations include takeoffs and landings conducted on non-scheduled or for-hire flights.

Historical airline operation data for STS was also obtained from the T-100 database. Airline operations for 2008 to 2018 are shown in **Table 2-9**.

Actual Enplanements and Operations Versus 2012 Master Plan

Table 2-10 shows a comparison between the 2012 Master Plan forecasts and 2018 T-100 numbers for commercial operations and enplanements. This table helps illustrate the accuracy of the 2012 Master Plan forecasts. As shown, the enplanement totals from the 2012 Master Plan and actual (year 2018) are within a few thousand. However, the 2012 Master Plan shows a more even distribution of mainline and regional operations. Actual data shows almost 99 percent of operations at STS are by regional carriers. This results in more total commercial operations, since smaller aircraft are used to accommodate passenger demand.

Scheduled Passenger Airline Load Factor

Load factor is a metric that airlines use to determine performance and is a method for showing the difference between supply and demand. It is calculated by dividing the number of passengers (demand) by the number of available seats (supply). The load factor increases as demand approaches supply and decreases when supply increases faster than demand. Load factors at STS have ranged between 70 and 85 percent in the past 10 years. **Figure 2-8** shows the average load factor for passenger airlines for the past 10 years.

The average load factor for all scheduled flights from STS has declined each year since FY 2014. The average load factor in 2014 was 84.6 percent, in 2018 it had dropped to 73.8 percent. Some of this average decline may be due to low initial load factors associated with the introduction of new airlines and destinations. However, service to DEN and DFW introduced in 2019 saw load factors as high as 90 percent on average for both routes. While these high load factors suggest that there is unmet demand for additional passenger service at STS, they do not support the concept of low initial load factors being typical for newly introduced service. The short tenure of Allegiant and current low load factors for Sun County to Minneapolis-Saint Paul suggest that the market for service from ultra-low-cost carriers is still being defined. As is discussed in the section that follows, airlines balance load factors with fare prices when considering whether to initiate or continue service.

Table 2-6: Market Share for O&D Passengers at STS

Destination	PDEW[1]	Market Size
Los Angeles	238.8	87,162
New York City[2]	213.2	77,818
Chicago[3]	153.2	55,918
Denver	144.5	52,743
Newark	142.0	51,830
Atlanta	138.8	50,662
Boston	134.0	48,910
Dallas-Fort Worth	133.6	48,764
San Diego	124.2	45,333
Las Vegas	113.1	41,282
All Markets	**4,963.9**	**1,811,824**

1 PDEW: Passengers Daily Each Way
2 New York includes LaGuardia (LGA) and John F. Kennedy International (JFK).
3 Chicago includes O'Hare (ORD) and Midway (MDW).
New air service opportunities may also come from changes in aircraft equipment. Airlines are transitioning from smaller, 50-seat aircraft such as the CRJ-200 to larger regional jets like the E175, CRJ700 and 900, and narrow-body jets such as the Boeing 737. This increase in seating capacity makes longer routes possible and more viable, provided the market has demand to fly the routes and fill additional seats. Sun Country has been transitioning from the Boeing 737-700 (126 seats) to the 737-800 (183 seats). Skywest has both the Mitsubishi MRJ 90 and the Embraer 175-E2 (both 76-seat jets) on order with delivery starting 2020 and 2021, respectively.
Source: Landrum & Brown, STS 2019 Market Assessment Analysis

Table 2-7: STS Historical Passenger Enplanements

Fiscal Year	Air Carrier Enplanements	Regional Enplanements	Total Enplanements	Annual Total % Change
2008	0	96,782	96,782	N/A
2009	0	97,849	97,849	1.1%
2010	0	104,869	104,869	7.2%
2011	0	114,013	114,013	8.7%
2012	0	116,321	116,321	2.0%
2013	0	122,912	122,912	5.7%
2014	0	126,016	126,016	2.5%
2015	0	132,361	132,361	5.0%
2016	4,564	151,464	156,028	17.9%
2017	9,495	185,527	195,022	25.0%
2018	3,883	208,580	212,463	8.9%
CAGR[1]	N/A	8.0%	8.2%	N/A

1 CAGR: Compounded Annual Growth Rate
Source: 2018 USDOT T-100

Table 2-8: STS Historical Enplanement T-100 and TAF Comparison

Fiscal Year	T-100	2019 TAF	Total Difference	% Difference
2008	96,782	96,900	-118	-0.1%
2009	97,849	90,924	6,925	7.6%
2010	104,869	90,811	14,058	15.5%
2011	114,013	101,627	12,386	12.2%
2012	116,321	105,056	11,265	10.7%
2013	122,912	110,740	12,172	11.0%
2014	126,016	115,464	10,552	9.1%
2015	132,361	124,040	8,321	6.7%
2016	156,028	158,738	-2,710	-1.7%
2017	195,022	192,316	2,706	1.4%
2018	212,463	210,142	2,321	1.1%
CAGR[1]	**8.2%**	**8.0%**	**N/A**	**N/A**

1 CAGR: Compounded Annual Growth Rate
Source: 2018 USDOT T-100 and FAA TAF

Table 2-9: STS Historical Airline Operations

Fiscal Year	Air Carrier Operations > 60 seats	Air Taxi Operations ≤ 60 seats	Total Operations	% Change
2008	3,650	0	3,650	N/A
2009	3,474	0	3,474	-4.8%
2010	3,478	0	3,478	0.1%
2011	3,558	0	3,558	2.3%
2012	3,632	0	3,632	2.1%
2013	3,856	0	3,856	6.2%
2014	3,920	0	3,920	1.7%
2015	4,158	0	4,158	6.1%
2016	5,032	0	5,032	21.0%
2017	6,072	672	6,744	34.0%
2018	6,246	1,956	8,202	21.6%
CAGR[1]	**5.5%**	**N/A**	**8.4%**	**N/A**

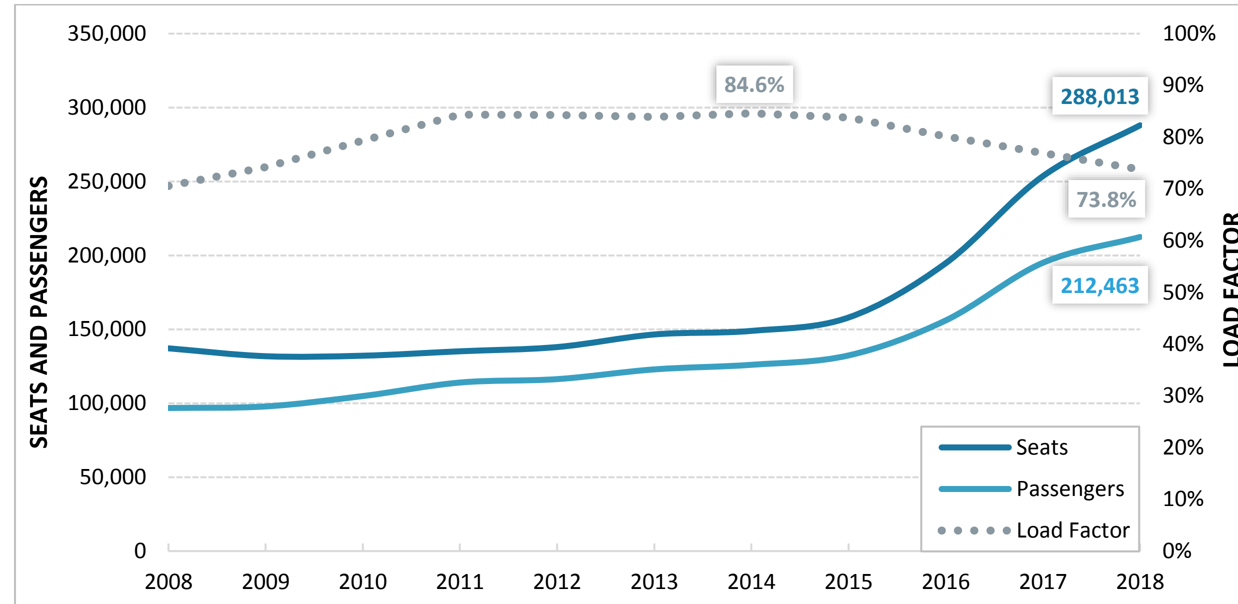
1 CAGR: Compounded Annual Growth Rate
Source: 2018 USDOT T-100

Table 2-10: Actual Enplanements and Operations Versus 2012 Master Plan

Carrier and Operations		2012 Master Plan			Actual
Carrier	Operations	2015	2018[2]	2020	2018
Mainline Airlines[1]	Annual Operations	3,358	3,698	3,925	76
	Average Daily Departures	4.6	5.1	5.4	0.1
	Annual Enplanements	128,202	141,790	150,848	3,883
	Daily Enplanements	351	388	413	11
Regional Airlines[1]	Annual Operations	2,774	2,862	2,920	8,126
	Average Daily Departures	3.8	3.9	4	11.1
	Annual Enplanements	72,734	76,363	78,782	208,580
	Daily Enplanements	199	209	216	571
Total[3]	Annual Operations	6,132	6,560	6,846	8,202
	Average Daily Departures	8.4	9	9.4	11.2
	Annual Enplanements	200,936	218,152	229,629	212,463
	Daily Enplanements	551	597	629	582

1 Mainline airlines defined as an aircraft with 100 to 150 seats and regional jests defined as aircraft with fewer than 100 seats.
2 2012 Master Plan forecast year 2018 extrapolated using linear growth between 2015 and 2020.
3 Totals may not be accurate due to rounding.
Sources: 2012 Master Plan and T-100 data

Figure 2-8: STS Historical Average Load Factor, Available Seats, and Passengers



Category	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Seats	137,156	131,824	132,152	132,158	138,016	148,528	148,960	158,004	194,726	253,602	288,013
Passengers	96,782	97,849	104,869	114,013	116,321	122,912	126,016	132,361	156,028	195,022	212,463
Load Factor	70.6%	74.2%	79.4%	84.4%	84.3%	83.9%	84.6%	83.8%	80.0%	76.9%	73.8%

Data presented includes passengers, seats, and load factors for outbound travel.
Source: USDOT T-100.

Passenger Enplanement Forecast

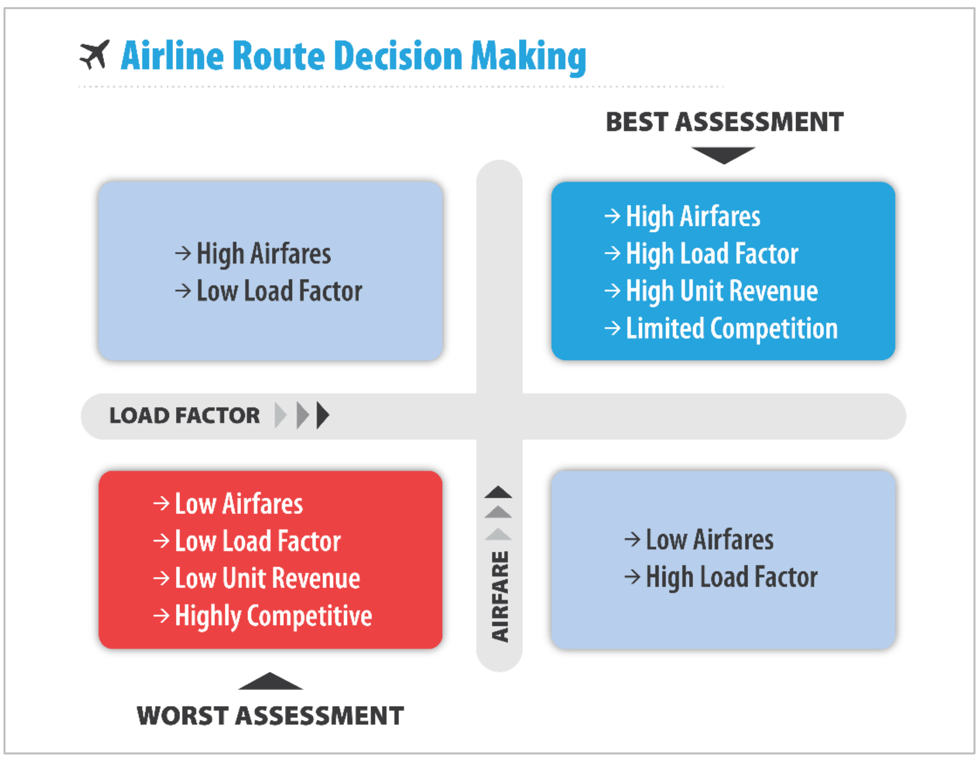
Enplaned passengers are an important forecasting metric, because the majority of airport revenues are generated directly or indirectly from enplaned passengers. At STS, enplanements have risen sharply over the past five years, and forecasting enplanements 20 years out may be uncertain for two reasons:

- STS is considered an emerging air service market that will mature within 20 years, making growth rates variable over this timespan.
- The lack of historical data available makes it a challenge to predict when the air service market at STS will mature.

Because of these uncertainties, various methodologies were considered. These are examined below, and a preferred methodology and enplanement forecast are identified.

When forecasting passenger enplanements in a market experiencing rapid growth, the addition of service to new destinations, and the addition of service by new airlines, it is important to understand how airlines evaluate potential new service. **Figure 2-9** presents a matrix of four classes of markets based upon their load factor and airfare. From an airline perspective the most desirable market is one where flights will be full (high load factors) and higher than average airfares can be charged. In contrast the least desirable market is one with lower load factors where average or below average fares can be charged.

Figure 2-9: Airline Route Decision Matrix



Source: Mead & Hunt, Inc.

As noted previously, the trend in load factors at STS is mixed as of June 2019. Average fares at STS are lower than fares at other regional airports, such as SBA and MRY. Competition is currently very strong at STS. These circumstances will change as the market at STS matures and ultimately reaches an equilibrium with other airlines in the region.

Enplanement Forecast Methodologies Considered and Rejected

To be useful in this forecasting effort, methodologies must be able to address rapid growth in the short term with slower growth rates as the market for air service matures at STS. The methodologies in this section were deemed unsuitable for the circumstances at STS.

2019 TAF

The 2019 TAF presents the FAA's current forecast for STS. The rapid growth in enplanements over the last few years has been reflected in significant year-to-year changes in the TAF for STS. The TAF forecasts for STS were updated during production of these forecasts, and now reflect the actual growth in enplanements that has occurred over the past three years. This is a significant change from the 2018 TAF: the 2018 TAF showed minimal change in enplanements in 2018 and 2019, low growth in the near term, and a compounded annual growth rate of 1.9 percent over the next 20 years. The 2019 TAF shows high growth in enplanements over the next 5 years before leveling off to a moderate growth rate over the planning period. The 2019 TAF has a compounded annual growth rate of 3.2 percent over the next 20 years. The 2019 TAF forecast was released prior to the COVID-19 pandemic that has decreased domestic and international airline travel.

Regression Analysis

Regression analysis uses historical data to measure the degree of correlation between two or more variables. Regression takes strongly correlated variables and uses the forecasted values to help predict another. Recent history at STS and the 2019 Market Assessment Analysis indicate a high potential for sharp, near-term growth from additional service. A single, daily flight by a regional airline can add more than 27,000 seats annually. As current enplanements at STS number in the 200,000s, adding one flight would represent sharp growth relative to existing enplanements.

Regression modeling of county population, service area population, GRP, and county employment were considered. However, these factors are very stable and do not reflect the rapid, short-term changes that STS has been experiencing. As a result, regression modeling was not used because of its inability to reflect these short-term changes.

Market Share Analysis

Market share analysis projects enplanements at STS as a percentage of enplanements forecast for a larger geographic area, such as the region, state, or nation. The forecasts for the larger geographic area are typically those made by the FAA, but other sources could be used. This method has the same limitation as the regression method. It is unable to reflect sharp, near-term growth, and as a result, was not used in forecasting.

Enplanement Forecast Methodologies Evaluated

Three forecasting methods based on more STS-specific data and conditions were tested and compared.

TAF Rate

The compounded annual growth rate from the 2019 TAF, 3.2 percent from 2019 to 2038, was applied to the 2018 T-100 enplanement number. This methodology has the advantage that it uses the growth rates forecasted by the FAA specifically for STS. In the five years since the main runway was extended, passenger enplanements have grown about 60 percent. However, a five-year history is too short to establish a long-term trend. Various economic factors may cause year-to-year volatility and could result in loss of service on some routes. Such factors include:

- Shift of passengers from Alaska Airline's flights to connect to a hub airport for a direct flight to the destination airport.
- Discontinuance of service on a new route after a trial period, if an airline believes that greater revenues could be realized on another route.
- Cyclical national economic downturns.

Over the 20-year forecast period, these and other factors can be expected to introduce variability that will reduce the average growth rate from the previous five-year trend. The TAF forecasts a 3.2 percent compound average growth through 2038. Applying this growth rate to the 2018 T-100 enplanement count yields a 2038 forecast of 400,371 enplanements. Initial growth may be delayed due to the COVID-19 pandemic. However long-term projections remain for the TAF rate methodology with the assumption that air travel will return to pre-COVID levels.

2012 Master Plan Rate

The constant growth rate from the 2012 Master Plan forecast was applied to the 2018 T-100 enplanement number. The 2012 Master Plan growth rate was based upon projections made by air service specialists at that time. Air service had only been reestablished for three years at the time that 2012 Master Plan was written. This duration provided limited ability to evaluate the plausibility of the project service increases. As a result, the 2012 Master Plan forecast rate could not have been informed by the growth in air service and enplanements since 2016. As shown in **Table 2-10** above, the 2012 Maser Plan forecast proved to be an effective forecast methodology, even lacking historical data. Applying the 2012 Master Plan rate to the 2018 T-100 enplanements is retained for evaluation.

Three-Phase Methodology

This methodology uses a Three-Phased approach. The first five years include consideration of the flights added in 2018 and 2019, and the routes the Market Assessment Analysis identified as most likely to be added. This period is expected to experience a rapid growth rate similar to the last four years. The second phase, which addresses the subsequent five-year period (2023-2028), uses a per capita enplanement rate based upon a peer airport as a goal for 2028. During this period enplanements increase in a linear manner and reach a benchmark tied to the peer airport in 2028. The growth rate during the second phase will be slower than in the first five years. In the third phase, or last 10 years of the forecast, the 2019 TAF growth rate for 2028-2038 is used to represent growth in a mature market.

The following paragraphs discuss the forecasts for these periods in greater detail. This rapid growth in phase one will likely be delayed due to the COVID-19 pandemic. However, long-term projections remain for the three-phase methodology with the assumption that air travel will return to pre-COVID levels.

The first phase from 2019 to 2023 reflects the potential new routes the airport expects to add in the next five years. Potential service mentioned in the 2019 Market Assessment Analysis includes service to SLC and ORD in the next two to three years, which helps further connect STS to the eastern U.S. Conversely, service to ORD or other cross-country routes may not be feasible for airlines, but these destinations and additional enplanements may be realized with additional daily service to DEN, PHX or DFW.

The second phase of the Three-Phase forecast is a transition from rapid initial growth in enplanements to rates reflecting a maturing market. The growth rate for this phase considered two peer airports identified as having markets like STS: SBA and MRY. These airports were considered as potential peer airports due to:

- **Proximity to larger commercial service airports:** STS is located approximately 75 miles from SFO. SBA to LAX is approximately 105 miles, and MRY to SJC is approximately 75 miles.
- **Similar population profiles:** According to updated census data, Sonoma County's population is 504,000 people. Monterey County has 438,000 people, and Santa Barbara County has 448,000 people. Although this does not include the entire population for each catchment area, these county population numbers represent a significant portion of the catchment area and show that each county has a similar population.
- **Tourist destinations:** Each airport and the surrounding area is attractive to tourists for similar reasons: the California coast, wineries, parks, cosmopolitan towns, historic sites, and outdoor activities such as golf, hiking, camping, or biking.
- **Relatively affluent areas:** Each area also has a strong population base that can support a non-hub airport. The economies of each county where the airports are located were compared to the rest of California. The GRP and income were compared by standardizing both variables on a per capita basis to account for any population and size differences by county. Both GRP per capita and income per capita for Sonoma, Santa Barbara, and Monterey Counties are higher than the state averages in **Table 2-11**.

The goal was to identify a peer airport(s) with a mature market. The rate of enplanements per capita in the peer airport would be used as a benchmark for STS. Once this benchmark is reached, STS's market would be considered mature. Subsequent growth would follow broader regional and national trends.

The 2028 enplanements per capita for Santa Barbara County and Monterey County were calculated and compared to the current ratio of STS. Their respective ratios were:

- STS: 0.42 enplanements per capita
- SBA: 0.83 enplanements per capita
- MRY: 0.41 enplanements per capita

Although MRY shares many characteristics with STS, it has been rejected as a peer airport. Its per capita enplanement ratio is lower than STS's current rate. Because STS is experiencing rapid growth in enplanements, its enplanement per capita ratio is expected to continue to grow.

Table 2-11: Peer Airport GDP and Income Comparison

Year	Sonoma County		Santa Barbara County		Monterey County		California Average by County	
-	GRP[1]/Capita (Millions)	Income/ Capita	GRP[1]/Capita (Millions)	Income/ Capita	GRP[1]/Capita (Millions)	Income/ Capita	GRP[1]/Capita (Millions)	Income/ Capita
2008	$0.052	$52,301	$0.057	$54,986	$0.051	$49,314	$0.049	$44,134
2009	$0.050	$50,086	$0.058	$53,059	$0.052	$48,734	$0.047	$42,224
2010	$0.050	$49,806	$0.056	$52,909	$0.052	$48,485	$0.047	$42,612
2011	$0.050	$51,002	$0.057	$55,342	$0.050	$48,471	$0.048	$44,022
2012	$0.049	$51,958	$0.057	$56,693	$0.051	$49,120	$0.048	$45,579
2013	$0.051	$53,005	$0.058	$55,239	$0.053	$49,596	$0.049	$45,168
2014	$0.054	$55,090	$0.059	$57,215	$0.053	$51,356	$0.051	$47,037
2015	$0.058	$59,139	$0.061	$60,698	$0.056	$55,712	$0.053	$49,979
2016	$0.059	$60,760	$0.060	$60,202	$0.056	$56,335	$0.055	$50,884
2017	$0.058	$60,758	$0.062	$60,905	$0.057	$54,930	$0.055	$51,737
2018	$0.060	$61,656	$0.063	$61,947	$0.057	$55,640	$0.056	$52,550

1 GRP per capita = GRP / Total Population
GRP Source: Woods & Poole
Population Source: California Department of Finance

SBA's enplanement per capita ratio is almost double STS's, which is judged to be unrealistic for STS to achieve. The somewhat greater driving distance to its major hub competitor (LAX) may be the reason that SBA can achieve this high enplanement ratio. For forecasting purposes, the market at STS will be considered mature when it reaches 85 percent of the per capita enplanement ratio for SBA, or 0.71 enplanements per capita. It is assumed that STS will reach this mature market ratio by 2028. A linear projection from the 2023 forecast to 2028 was used.

The third phase of the Three-Phase Methodology assumes that the STS market will have reached maturity in 2028, at which point the third phase would begin. From that point on, enplanements are expected to grow at a rate reflective of the larger regional or national market. The growth rate of 1.9 percent from years 2028-2038 in the 2019 TAF was used for the third phase to represent the growth rate for a mature market at STS.

Figure 2-10 shows the three different forecasting methods compared to the 2019 TAF forecast, with the past 10 years of enplanement data from the T-100 historical records.

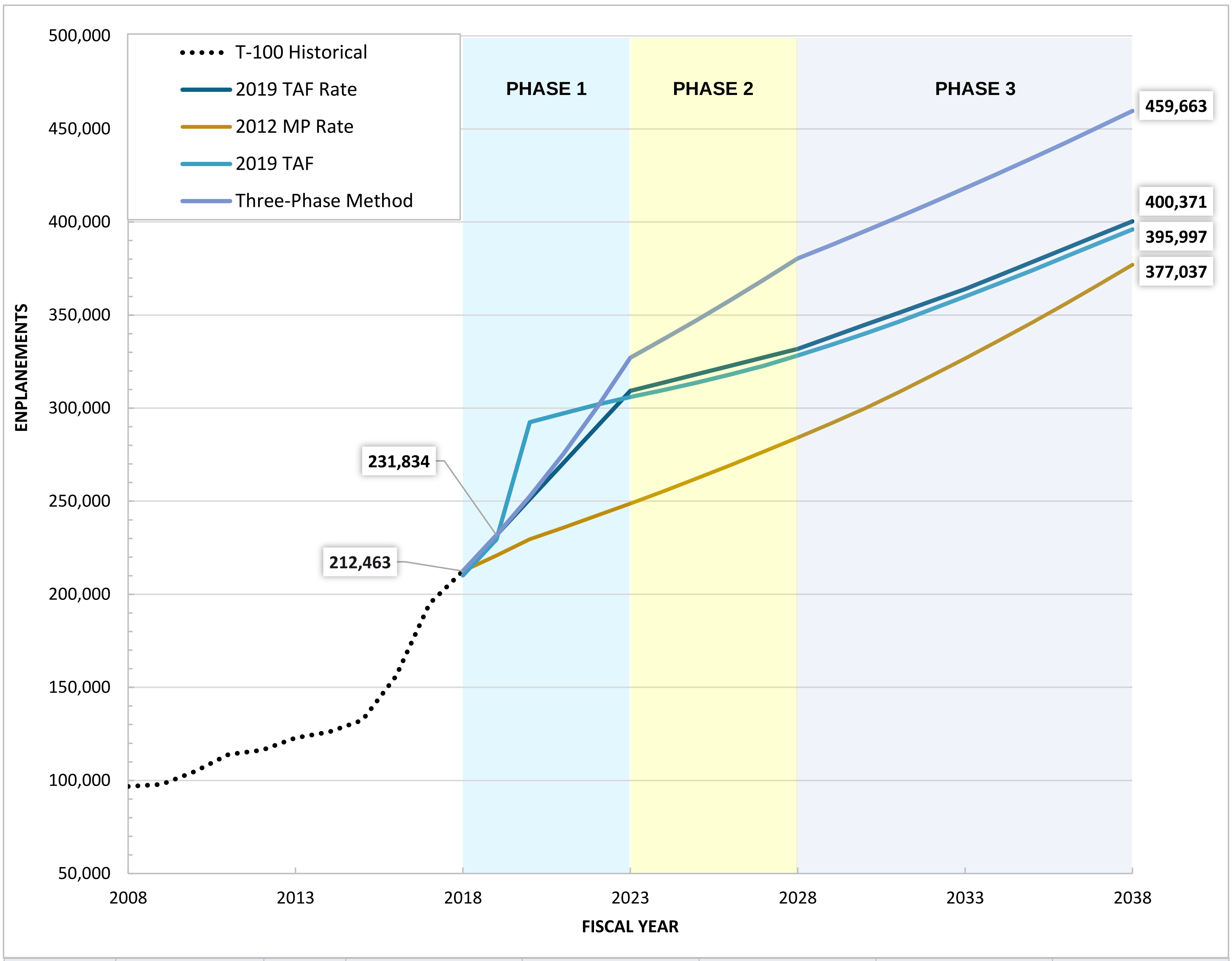
COVID Adjusted Forecast Alternatives

Following the initial draft and analysis of the forecast methodologies presented above, these were updated to consider the effects the COVID-19 pandemic has had on air travel in 2020. A comprehensive Response to COVID section appears at the beginning of this chapter, with near-term recovery scenarios discussed. This section applies these recovery scenarios and presents revised alternative forecasts. **Figure 2-11** shows the 2019 TAF and the 2012 Maser Plan rate with revised enplanement forecast alternatives: the three recovery scenarios account for COVID's influence on the demand.

The new alternative enplanement forecasts show these three different recovery scenarios and then apply the Three-Phase method growth rates after returning to 2019 enplanement levels.

- **Conservative Recovery:** Predicts a return to 2019 enplanements in 2024, with shorter time frames for Phase 1 from 2024 to 2026 and Phase 2 from 2026 to 2029. The Phase 3 growth rate (1.9 percent) is applied from 2029 onward.
- **Strong Recovery:** Return to 2019 enplanements in 2023, with the original five years of growth in both Phase 1 (7.1 percent) from 2023 to 2027 and Phase 2 (3 percent) from 2027 to 2031. The Phase 3 growth rate (1.9 percent) is applied from 2031 onward.
- **Aggressive Recovery:** Return to 2019 enplanements in 2021, with five years of Phase 1 plus-growth (8.8 percent), and six years of Phase 2 growth (3 percent). A lower Phase 3 growth rate of 1.5 percent is applied from 2031 onward, assuming a more mature market.

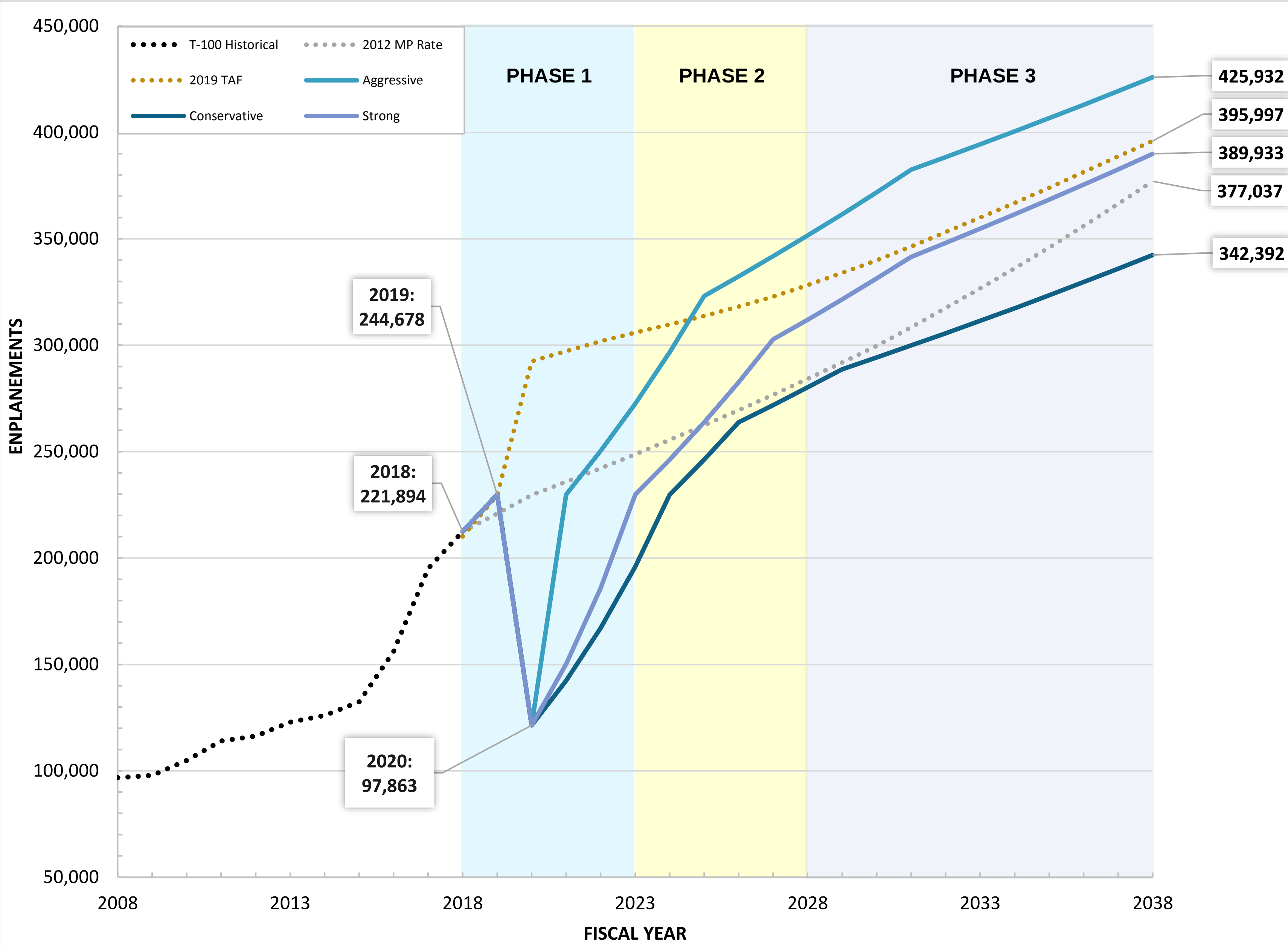
Figure 2-10: Alternative Passenger Enplanement Forecasts



Category	Phase	Year	T-100	2019 TAF Rate	2012 MP Rate	2019 TAF	Three-Phase
Historical	T-100 Historical 2008-2018	2008	96,782	-	-	-	-
		2009	97,849	-	-	-	-
		2010	104,869	-	-	-	-
		2011	114,013	-	-	-	-
		2012	116,321	-	-	-	-
		2013	122,912	-	-	-	-
		2014	126,016	-	-	-	-
		2015	132,361	-	-	-	-
		2016	156,028	-	-	-	-
		2017	195,022	-	-	-	-
Forecast		2018	-	212,463	212,463	210,142	212,463
	Phase 1 2019-2023	2019	-	231,834	220,879	229,413	231,834
		2020	-	251,206	229,629	292,404	252,672
		2021	-	270,577	235,834	297,218	275,383
		2022	-	289,949	242,207	301,805	300,135
	Phase 2 2024-2028	2023	-	309,320	248,751	305,941	327,111
		2024	-	313,827	255,473	309,790	337,132
		2025	-	318,334	262,376	313,760	347,569
		2026	-	322,841	269,456	318,111	358,103
		2027	-	327,347	276,727	322,804	369,072
		2028	-	331,854	28,495	328,229	380,378
	Phase 3 2029-2038	2029	-	338,268	291,864	333,988	387,648
		2030	-	344,682	299,739	339,955	395,057
		2031	-	351,096	308,460	346,355	402,608
		2032	-	358,511	317,434	353,109	410,303
		2033	-	363,925	326,670	359,949	418,145
		2034	-	371,214	336,174	366,905	426,137
		2035	-	378,503	345,954	374,020	434,282
		2036	-	385,792	356,020	381,426	442,583
		2037	-	393,082	366,378	388,728	451,042
		2038	-	400,371	377,037	395,997	459,663

Sources: Mead & Hunt, FAA 2019 TAF, 2012 Master Plan and T-100 data

Figure 2-11: Alternative Passenger Enplanement Forecasts



Category	Phase	Year	T-100	2019 TAF	2012 MP Rate	Conservative	Strong	Aggressive
Historical	T-100 Historical 2008-2018	2008	96,782	-	-	-	-	
		2009	97,849	-	-	-	-	
		2010	104,869	-	-	-	-	
		2011	114,013	-	-	-	-	
		2012	116,321	-	-	-	-	
		2013	122,912	-	-	-	-	
		2014	126,016	-	-	-	-	
		2015	132,361	-	-	-	-	
		2016	156,028	-	-	-	-	
		2017	195,022	-	-	-	-	
Forecast	Phase 1 2019-2023	2018	-	210,142	212,463	221,894	221,894	212,463
		2019	-	229,413	220,879	244,678	244,678	229,828
		2020	-	292,404	229,629	121,380	97,863	121,380
		2021	-	297,218	235,834	142,384	150,164	229,828
		2022	-	301,805	242,207	167,023	185,774	250,260
	Phase 2 2024-2028	2023	-	305,941	248,751	195,925	229,828	272,508
		2024	-	309,790	255,473	229,828	246,210	296,734
		2025	-	313,760	262,376	246,210	263,761	323,113
		2026	-	318,111	269,456	263,761	282,562	332,322
		2027	-	322,804	276,727	271,840	302,703	341,793
		2028	-	328,229	28,495	280,168	311,976	351,534
	Phase 3 2029-2038	2029	-	333,988	291,864	288,750	321,533	361,553
		2030	-	339,955	299,739	294,269	331,382	371,857
		2031	-	346,355	308,460	299,893	341,533	385,455
		2032	-	353,109	317,434	305,625	348,061	388,383
		2033	-	359,949	326,670	311,467	354,713	394,403
		2034	-	366,905	336,174	317,420	361,493	400,517
		2035	-	374,020	345,954	323,487	368,402	406,725
		2036	-	381,426	356,020	329,669	375,444	413,029
		2037	-	388,728	366,378	335,971	382,620	419,431
		2038	-	395,997	377,037	342,392	389,933	425,932

Sources: Mead & Hunt, FAA 2019 TAF, 2012 Master Plan and T-100 data

Preferred Enplanement Forecast Method

Forecasts developed in the initial draft, pre-COVID-19, were eliminated from consideration. However, the Three-Phase method for emerging airport markets was retained for STS enplanement forecasts and applied to the recovery models. This presumes that STS will follow the Three-Phase method for an air service market after recovery from effects of the pandemic, similar to that of peer airports experiencing air service growth.

The preferred forecast method for this ALP update is the **Strong Recovery – Three-Phase method**. The Airport is seeking FAA approval of this forecast. This is represented in blue in **Figure 2-11** above, with 5-year increments and 2019 TAF comparison shown in **Table 2-12** below.

Table 2-12: Preferred Passenger Enplanement Forecast – TAF Comparison

Fiscal Year	Forecast	2019 TAF	TAF Difference	% Difference
2018	212,463	210,142	2,321	1.1%
2019	229,828	229,413	415	0.2%
2020	121,380	292,404	-171,024	-58.5%
2023	229,828	305,941	-76,113	-24.9%
2028	311,976	328,229	-16,253	-5.0%
2033	354,713	359,949	-5,236	-1.5%
2038	389,933	395,997	-6,064	-1.5%
CAGR[1]	**3.1%**	**3.2%**	**N/A**	**N/A**

1 CAGR = Compound Annual Growth Rate
Source: Mead & Hunt and FAA TAF and T-100 data

The difference between the preferred forecast and the TAF in five years (+10 percent) and ten years (+15 percent) are not above the threshold for review. The Strong Recovery – Three-Phase Methodology provides a COVID-19 recovery model with STS returning to 2019 enplanement levels in 2023 and then follows the Three-Phase model for emerging air service markets. The strong recovery is based on:

- **Market diversity:** The leisure market is forecasted to recover faster than business travel.
- **Tourism market:** Tourism decreased due to COVID-19 but is expected to rebound quickly after vaccine rollout.
- **Domestic travel recovery:** Domestic travel is expected to recover faster than international travel. While global markets are forecasted to return to pre-COVID levels in 2024 (IATA), large domestic markets in North America are expected to drive recovery.
- **Air service:** STS continues to develop air service relationships and be aggressive in marketing the airport to domestic and international carriers.

High Forecast for CEQA Reviews

The forecast generated by the preferred Strong Recovery – Three-Phase methodology is moderate and valid for FAA planning purposes. However, this is considered too conservative for the purpose of environmental review under the California Environmental Quality Act (CEQA). Given the rapid growth in flights being offered pre-pandemic and the resultant increases in passenger enplanements during the last five years, it is credible that this growth will continue once STS recovers to 2019 enplanement levels. Therefore, the Aggressive Recovery – Three-Phase method is selected for the high forecast for CEQA review.

- **Aggressive Recovery:** Return to 2019 enplanements in 2021, with five years of Phase 1 plus-growth (8.8 percent), and six years of Phase 2 growth (3 percent). A lower Phase 3 growth rate of 1.5 percent is applied from 2031 onward, assuming a more mature market.

This would result in higher long-term enplanements and airline aircraft operations. This could result in impacts (e.g., noise and traffic) being higher than in the preferred Strong Recovery – Three-Phase forecast. Use of this forecast as a high forecast would fulfill the statutory requirement that the CEQA document inform decision-makers and the public of reasonably foreseeable impacts. The Three-Phase enplanement forecast is shown in **Table 2-13** in five-year increments.

Table 2-13: Passenger Enplanement Forecast – Three-Phase

Fiscal Year	Forecast
2018	212,463
2023	272,508
2028	351,534
2033	394,403
2038	425,932
CAGR[1]	**3.5%**

1 CAGR = Compound Annual Growth Rate
Source: Mead & Hunt and T-100 data

Planning Activity Levels

Most facility improvements being proposed with this ALP Update are not capacity driven. The Runway 20 RIM and taxiway geometry improvements are driven by incursion mitigation. The current ARFF facility constrains terminal expansion, for which near-term terminal expansion is already FAA approved and in design. Long-term terminal expansion, landside improvements, and hangar development will be tied to planning activity levels (PAL) that are outlined below.

PALs focus on the need to plan for aviation activity levels, rather than specific timelines. Proposed development is then linked to activity milestones that are defined in terms of PAL, rather than future calendar years. **Table 2-14** shows PALs for STS that will trigger terminal and landside improvements, based on enplanements.

Table 2-14: Proposed Planning Activity Levels

Planning Activity Level	Enplanements	Associated Milestone
PAL 1	230,000	Return to 2019 activity levels
PAL 2	300,000	21 Daily Departures
PAL 3	350,000	Phase 1 Ultimate Terminal
PAL 4	396,000	FAA 20-year Forecasts
PAL 5	426,000	Ultimate High (CEQA) Forecast, Phase 2 Ultimate Terminal

Source: Mead & Hunt, Inc.

Passenger Airline Operations Forecast

The TAF classifies scheduled operations in two categories: air carrier and air taxi. Air carrier aircraft have 60 or more seats, while aircraft with fewer than 60 seats are considered air taxi aircraft. The forecast for air taxi operations in this section only reflects scheduled passenger airline operations using aircraft with fewer than 60 seats such as the CRJ-200. This section does not include general aviation air taxi operations, for charter or business jet operations, which are included in the GA forecast section that follows.

Operations Forecast Methodologies

Two operations forecasts have been prepared using the Strong Recovery and Aggressive Recovery – Three-Phase methods. Passenger airline operation forecasts were updated to account for the downturn in operations and expected recovery from COVID-19. The assumptions used for each methodology are included in this section.

Airlines are expected to add service to meet demand. Airlines aim to profit by keeping yields high, thus the average load factors for air taxi/commuter operations are expected to increase, and airlines will manipulate their pricing model to sell as many seats at as high a price as possible. The industry-wide shift away from 50-seat aircraft to new 70-seat and larger aircraft is reflected in each operations forecast. Air carrier operations increase over time, reflecting new routes, while air taxi/commuter operations (fewer than 60 seats) will decrease to zero as the 50-seat CRJ-200 is phased out by 2028. Beyond 2028, all future passenger service operations at STS are classified as air carrier operations.

While most airline aircraft will have 76 seats, a percentage of flights by aircraft with more than 90 seats will slightly increase the average number of seats. While the percentage of operations by aircraft with more than 90 seats will remain small (less than 1 percent), these operations will cause the average seats per departure to increase slightly over the 20-year forecast period. The operations forecasts are based on the following assumptions:

- Air taxi aircraft (aircraft with fewer than 60 seats) will be retired by 2028 following the FAA Aerospace Forecast projection of airlines removing 50 seat jets in favor of 70-90 seat jets after 2020. It is expected that regional and narrow-body jets will replace the smaller 50 seat jets. This was projection updated from 2023 to 2028 after revising forecasts for COVID-19.
- The average number of seats per departure will increase over time as smaller jets with fewer than 60 seats are replaced by larger aircraft. Airlines adjust flight frequency to keep load factors high. However, as airlines transition to larger aircraft, load factors are expected to decrease temporarily during the adjustment period.

- Load factors for flight hub routes will decrease with added direct routes. Direct (non-stop) routes to destinations that previously required connections allow for passengers to bypass flights to airports such as LAX or SFO. Additionally, new routes to airports such as DEN or DFW may be preferable for passengers flying east. Lower load factors will lead to airlines adjusting the number of flights to raise load factors. Airlines may also reduce aircraft size if the smaller aircraft can cover the route.

Strong Recovery – Three-Phase Operations Methodology

Since airlines are expected to add service to meet demand, the passenger airline operations forecasts are a function of the preferred enplanement forecast. Future airline operations are calculated by applying the Strong Recovery – Three-Phase method passenger enplanements forecast to assumptions of the average number of seats per aircraft and average load factors. The Strong Recovery – Three-Phase method operations forecast is the preferred forecast for FAA review. **Table 2-15** presents the preferred forecast for scheduled passenger airline operations. Note the reduction in total operations in the short term reflects the phasing out of 50-seat jets in favor of 70- to 90-seat jets after 2020. This is only a temporary loss in operations since the increase in enplanements will result in more operations of larger aircraft in the long term.

Table 2-15: Scheduled Passenger Aircraft Operations – Preferred Forecast for FAA Review

Fiscal Year	Total Enplanements	Air Taxi/Commuter			Air Carrier			Total Operations
		Operations	Avg Load Factor	Avg Seats	Operations	Avg Load Factor	Avg Seats	
2018	212,463	1,948	60.2%	50	6,254	76.3%	77	8,202
2019	229,828	1,200	67.2%	50	6,688	79.0%	78	7,888
2020	121,380	802	53.4%	50	4,578	54.2%	78	5,380
2023	229,828	367	70.0%	50	7,080	80.1%	78	7,447
2028	311,976	100	70.0%	50	9,156	85.0%	81	9,256
2033	354,713	0	0.0%	0	10,240	85.0%	82	10,240
2038	389,933	0	0.0%	0	11,241	85.0%	82	11,241
CAGR[1]	**3.1%**	**N/A**	**N/A**	**N/A**	**3.0%**	**0.5%**	**0.3%**	**1.6%**

1 CAGR: Compound Annual Growth Rate
Note: Operations account for arrivals and departures. Enplanements only account for passengers on departing flights.
Source: Mead & Hunt, USDOT T-100 Database, and Airport Provided Data

Table 2-16: Preferred Passenger Aircraft Operations – TAF Comparison

Fiscal Year	Forecast	2019 TAF[2]	Difference	% Difference
2018	8,202	6,730	1,472	21.9%
2023	7,447	9,067	-1,620	-17.9%
2028	9,256	9,762	-506	-5.2%
2033	10,240	10,704	-464	-4.3%
2038	11,241	11,775	-534	-4.5%
CAGR[1]	**2.0%**	**2.8%**	**N/A**	**N/A**

1 CAGR = Compound Annual Growth Rate
2 Operations for FAA TAF based on air carrier itinerant operations
Source: Mead & Hunt and FAA TAF and T-100 data

The preferred passenger aircraft operations forecast is compared to the 2019 TAF in **Table 2-16**. The difference between the preferred operations forecast and the TAF in five years (10 percent) and ten years (15 percent) are not outside the threshold for review.

Aggressive Recovery – Three-Phase Operations Methodology

The Aggressive Recovery operations forecast is calculated by applying the Aggressive Recovery – Three-Phase passenger enplanements forecast to assumptions about seats per departure and load factors. The approach in the Aggressive Recovery methodology differs slightly from the Strong Recovery methodology in that enplanements were allocated to specific routes based upon the Market Assessment, and that STS will recover to pre-COVID-19 enplanement levels in 2021. The inputs used to project the number of operations were:

- Existing and potential routes are identified using the 2019 Market Assessment Analysis and T-100 data.
- Existing airline fleet information and aircraft manufacturer order books were referenced in identifying the aircraft flying potential routes. The routes are defined by the average number of seats in the types of aircraft that typically fly the route. For example, Horizon Air uses the Q400 and the E175 (both have 76-seat capacity) for the LAX route, so all operations are accounted for in the 60-76 seat aircraft category.

The Aggressive Recovery – Three-Phase passenger airline operations forecast assumes that airlines will add service to meet the level of demand in the Aggressive Recovery enplanement forecast. The Aggressive Recovery – Three-Phase forecast will be used as a high forecast for CEQA review. The forecast by operation type shown in **Table 2-17** satisfies FAA requirements for reporting air taxi and air carrier operations.

Table 2-17: Scheduled Passenger Aircraft Operations – High Forecast for CEQA Review

Fiscal Year	Total Enplanements	Air Taxi/Commuter			Air Carrier			Total Operations
		Operations	Avg Load Factor	Avg Seats	Operations	Avg Load Factor	Avg Seats	
2018	212,463	1,948	60.2%	50	6,254	76.3%	77	8,202
2023	272,508	436	70.0%	50	8,395	80.1%	78	8,830
2028	351,534	113	70.0%	50	10,317	85.0%	78	10,430
2033	394,403	0	0.0%	0	11,457	85.0%	81	11,457
2038	425,932	0	0.0%	0	12,222	85.0%	82	12,222
CAGR[1]	**3.5%**	**N/A**	**N/A**	**N/A**	**3.4%**	**0.5%**	**0.3%**	**2.0%**

1 CAGR: Compound Annual Growth Rate
Note: Operations account for arrivals and departures. Enplanements only account for passengers on departing flights.
Source: Mead & Hunt, USDOT T-100 Database, and Airport Provided Data

The air carrier category includes aircraft that are fewer than 100 seats, which are defined by the ATE as regional jets, and those greater than 100 seats, known as mainline aircraft. To allow comparison with the 2012 Master Plan/ATE forecasts, operations are separated into regional jets and mainline aircraft in **Table 2-18**.

Table 2-18: Scheduled Passenger Aircraft Operations – High Forecast for ATE Review

Fiscal Year	Total Enplanements	Regional Jets (Fewer than 100 seats)			Mainline Jets (100 or more seats)			Total Operations
		Operations	Avg Load Factor	Enplanements	Operations	Avg Load Factor	Enplanements	
2018	212,463	8,101	72.5%	208,580	101	70.3%	3,883	8,202
2023	272,508	8,724	85.0%	265,725	106	85.0%	6,783	8,830
2028	351,534	10,142	85.0%	333,185	288	85.0%	18,350	10,430
2033	394,403	11,058	85.0%	368,967	399	85.0%	25,436	11,457
2038	425,932	11,690	85.0%	392,017	532	85.0%	33,915	12,222
CAGR[1]	**3.5%**	**1.9%**	**0.8%**	**3.2%**	**8.7%**	**1.0%**	**11.4%**	**2.0%**

1 CAGR: Compound Annual Growth Rate
Note: Operations account for arrivals and departures. Enplanements only account for passengers on departing flights.
Source: Mead & Hunt, USDOT T-100 Database, and Airport Provided Data

Peak Passenger Airline Departures

ATE Objective AT-5.2 is to "provide a balance of scheduled air carrier services at the Charles M. Schulz – Sonoma County Airport not to exceed a total of 21 departures per day." As a means of implementing this objective, ATE Policy AT-5f directs that "a review by the Board of Supervisors shall occur at such a time that the "review threshold" of 650 enplaned air carrier passengers per day averaged over a one-year period (474,500 annual passengers) is reached. This threshold for consultation could have been reached in 2020; airlines were inquiring about additional departures for summer 2020 until the pandemic reduced activity.

This section describes the methodology and peak airline departures forecasts to support consultation with the Board of Supervisors. The peak departure forecast utilizes the Three-Phase forecast in combination with peak month enplanements, average seats, and load factors to forecast daily peak departures. It is expected that peak departures will occur in the months with peak enplanements.

Peak Month Enplanements

Based upon Airport records, peak passenger volumes generally occur at STS in summer months. Over the last five years (2016-2020) the percentage of STS enplanements during the peak month has ranged between 10.3 percent to 11.3 percent of annual enplanements. This is an increase from the previous five-year period, where the percentage of enplanements in the peak month ranged from 9.3 percent to 9.9 percent of annual enplanements.

The peak month percentages from the most recent five-year period are used in forecasting peak month enplanements, because these percentages best reflect the emerging trend in seasonal variation. The increase from the previous five-year period likely reflects the increase in the percentage of passengers who are travelling for vacations, which are concentrated during the summer months. Airlines will also test market new flights during peak months to maximize revenue. It is expected that daily departures by airline aircraft will be the highest during these peak months. The low peak departure forecast uses 10.5 percent of annual enplanements, and the high peak departure forecast uses 11.5 percent.

Average Aircraft Capacity

Airline aircraft with as few as 50 seats and as many as 186 seats service STS. However, as a regional airport, most airline aircraft operating at STS have around 76 seats. Given the population of STS's service area, it is expected that aircraft of this size will remain the most common airline aircraft serving STS through the 20-year forecast period. It is possible that seasonal, high-volume routes may see up-gaging by the introduction of 90-passsenger seat aircraft, and up to 186-seat aircraft. However, this is not expected to alter the peak departure forecast since these routes are already accounted for.

Peak Month Load Factor

Average passenger load factors directly affect the number of daily departures for a given volume of passengers. High and low forecasts of peak departures utilized load factors based upon the range that STS has experienced over the last five years. This high load factor was 84.6 percent in 2014; the low was in 2018 at 73.8 percent. This variability reflects the initially low load factors that often occur with the introduction of new service. That is, when new service is introduced, the average number of passengers in each flight is initially low. During a period when many new flights are being added, the average load factor for the Airport will be reduced. The high peak departure forecast assumed a 73 percent load factor, while the low peak departure forecast assumed an 80 percent load factor.

Daily Peak Departure Forecast

The low and high peak departure forecasts are presented in **Table 2-19**. The enplanement forecast for peak departures is based on the Aggressive Recovery – Three-Phase method. This reflects the downturn in enplanements in 2020 and recovery to 2019 enplanements in 2021.

For the peak departure forecast, enplanements from the Aggressive Recovery – Three-Phase method are used as the base for projecting peak departures. The high peak departure forecast assumes a 73 percent load factor, while the low peak departure forecast assumed an 80 percent load factor. Since enplanements are the same for both forecasts, a high load factor means more passengers on fewer flights. Conversely, a lower load factor using the same number of enplanements will result in more flights. Therefore, applying the low load factor results in the 'high' peak departure forecast.

Under the high forecast (low load factor), STS will reach 21 daily airline departures in 2024 and 29 daily departures by 2038. The low forecast (high load factor) predicts 21 daily departures by 2029 with 25 departures by 2038. The peak departure forecast was updated to account for the COVID-19 pandemic. The pandemic likely delays STS reaching the 21-departure threshold for two or three years beyond the original projections developed pre-COVID-19.

The following factors could contribute to STS seeing a return to 2019 activity levels quicker with departures reaching the 21-daily threshold in summer of 2022 or 2023.

- STS was not considered to be a mature market in 2019, as discussed in the Airline Service Profile section above. The rate of growth from 2015-2019 may continue once vaccine rollout is complete and more people feel safe to travel again.
- Enplanements and activity have followed the 2012 Master Plan high forecast since 2012.

- Airlines already established at STS were inquiring about additional spots right up until the COVID-19 pandemic hit.
- STS is in talks with a yet-to-be named airline to add service in spring 2021.
- The leisure market is forecasted to recover faster than business travel, and tourism is expected to rebound quickly after vaccine rollout, as discussed in the Response to COVID-19 section.
- Low-cost carriers are returning to 2019 passenger levels quicker than the legacy carriers and adding additional service in 2021.
  - Allegiant has embarked on the second-largest network expansion in its history while adding over 30 new non-stop routes.
  - Southwest Airlines is expanding its network with new services at over 15 airports including vacation destinations.

Table 2-19: Daily Peak Departure Forecast

Annual1		High Forecast						Low Forecast					
Year	Enplanements	Enplanements			Average		Departures	Enplanements			Average		Departures
		Peak Month %	Peak Month	Daily	Seats	Load Factor	Peak Daily	Peak Month %	Peak Month	Daily	Seats	Load Factor	Peak Daily
2018	212,463		24,433	814			15		22,309	744			12
2019	229,828		26,430	881			16		24,132	804			13
2020	121,380		13,959	465			8		12,745	425			7
2021	229,828		26,430	881			16		24,132	804			13
2022	250,260		28,780	959			17		26,277	876			14
2023	272,508		31,338	1,045			19		28,613	954			16
2024	296,734		34,124	1,137			**21**		31,157	1,039			17
2025	323,113		37,158	1,239			22		33,927	1,131			19
2026	332,322		38,217	1,274			23		34,894	1,163			19
2027	341,793		39,306	1,310			24		35,888	1,196			20
2028	351,534	11.50%	40,426	1,348	76	73%	24	10.50%	36,911	1,230	76	80%	20
2029	361,553		41,579	1,386			25		37,963	1,265			**21**
2030	371,857		42,764	1,425			26		39,045	1,302			21
2031	382,455		43,982	1,466			26		40,158	1,339			22
2032	388,383		44,664	1,489			27		40,780	1,359			22
2033	394,403		45,356	1,512			27		41,412	1,380			23
2034	400,517		46,059	1,535			28		42,054	1,402			23
2035	406,725		46,773	1,559			28		42,706	1,424			23
2036	413,029		47,498	1,583			29		43,368	1,446			24
2037	419,431		48,235	1,608			29		44,040	1,468			24
2038	425,932		48,982	1,633			29		44,723	1,491			25

1 Annual Enplanements: High Forecast for CEQA Review
Source: Mead & Hunt, USDOT T-100 Database, and Airport Provided Data

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GENERAL AVIATION FORECASTS

The GA forecasts for the next 20 years are based upon the 2018 FAA TAF projections. The forecasting method utilizes airport-provided historical records and applies the TAF projections for 5-, 10-, 15-, and 20-year to the relevant forecast periods. This allows accounting for the variances in historical operation counts while keeping TAF expectations for GA operations.

Tables are shown at the end of this section.

General Aviation Operations

GA refers to flight activities that do not include scheduled air services. GA activities do include, but are not limited to, flight training, recreational flying, private and corporate air transportation, and flight testing.

General Aviation Businesses

GA businesses include companies that offer services to the flying public (e.g. fixed-based operators [FBOs]), companies that design and build aircraft, and companies that use aircraft as part of their services (e.g. aerial photography, scenic tours). STS has two FBOs and several Specialized Aviation Service Operations. The following are the businesses located at STS:

- Sonoma Jet Center – FBO with fuel, maintenance, hangars, catering, and concierge service
- KaiserAir Santa Rosa – FBO with aircraft management, charter service, fuel, and line service
- Barron Air Maintenance – Fixed-wing and helicopter maintenance
- Helico Sonoma – Helicopter company with a Part 91 flight school and tour/transport service
- North Coast Air – Flight training, FAA testing center, rentals, and scenic air tours
- Propjet Aviation – Turbine and piston aircraft service
- Ram Aviation – Flight training, rentals, and scenic air tours
- REACH – Air ambulance
- Vine Jet – Aircraft sales, jet charter, and aircraft management service

Airport Versus TAF Operations Records

STS provided historical operations records from the ATCT, and these records are compared to the 2018 TAF in **Table 2-20**. This data includes itinerant operations for air taxi, GA activity, and military operations, plus local activity for GA and military. Like T-100 data, the ATCT records do not match the TAF records for some years. Airport-provided ATCT operation counts are a primary source of operations considered to be more accurate, and therefore, will be used for forecasting purposes.

Air taxi operations shown in **Table 2-20** include takeoff and landings by aircraft with 60 or fewer seats conducted on non-scheduled, or for-hire flights. These do not include operations by scheduled air taxi flights, which are included in the passenger airline operations forecast above.

Itinerant Operations

Itinerant operations are those that originate and terminate at different airports. These operations include business travelers coming to and from the community, recreational pilots, and student pilots performing cross country training flights, Coast Guard training operations with fixed-wing aircraft, and helicopter aircraft flying instrument approaches. In addition to typical itinerant operations, STS experiences seasonal CAL FIRE flight training and fire suppression operations. **Table 2-21** shows the historic itinerant air taxi, GA, and military operations at STS.

STS has historically seen a significant number of itinerant air taxi operations by charter flights and non-scheduled airlines. These operations include on-demand air taxi services by light jet aircraft and do not include operations by scheduled air taxi flights. Air taxi operations have increased an average of 5.7 percent annually in the past decade.

Itinerant GA operations have been decreasing at an average annual rate of 4.1 percent for the past ten years. This is a faster rate of decline than the national rate provided by the 2018 FAA Aerospace Forecast, which has declined an average 2.3 percent annually.

Local Operations

Local GA operations are those that originate and terminate at the same airport and are generally performed by pilots practicing takeoffs and landings. These include touch-and-go operations where the aircraft lands, slows, and then accelerates to take off without leaving the runway. Touch-and-go operations count as two operations: a landing and takeoff. Local operations vary based on the level of flight training at the airport and the activity level of the resident GA community. There are two flight schools located at STS that contribute to the high number of local GA operations.

Table 2-22 shows the historic local operations at STS. STS local GA operations have declined annually in the past decade. This is in line with national local GA trends, which have declined at a slower rate, an average 2.1 percent annually in the same time period. STS experiences a small number of military local operations through Coast Guard training.

Based Aircraft

Based aircraft are aircraft stored at STS, either in hangars or on a tie down apron. This does not include itinerant aircraft temporarily stored at the airport. The FAA categorizes based aircraft by engine type: single-engine piston, multi-engine piston, jet aircraft with turbine engines (including turboprops and turbojets), helicopters, and other, which includes experimental sport, glider, and ultralight aircraft.

Table 2-23 shows the historical based aircraft at STS by aircraft type. Data from 2008 through 2017 shows based aircraft according to the FAA TAF. Data for 2018 was provided by the airport and reflects the increase in jets based at STS in 2018, although this jump in the number of jets did not all happen between 2017 and 2018. It is important to acknowledge the presence of these based jets, and use airport data for forecasting, since jets utilize more space and facilities at STS. The 2018 totals for based aircraft will be used for forecasting.

Itinerant GA Operations Forecast

The GA itinerant operations forecast is based on the FAA TAF forecasts. Itinerant operations for 2023 and beyond match the FAA TAF forecast totals. Overall itinerant operations are expected to increase in the next 20 years by 0.5 percent annually. **Table 2-21** shows the forecasted itinerant operations for the next 20 years by operation type. Total data for 2018 is slightly different than the TAF due to using ATCT data for air taxi totals.

Local Operations Forecast

Table 2-25 shows the forecasted local operations for the forecast period. Local operations for 2023 and beyond match the FAA TAF forecast totals. Local operations are projected by the FAA TAF forecast to increase slowly over the next 20 years. As with itinerant operations, military activity is determined by U.S. Department of Defense and is projected to remain flat.

Based Aircraft Forecast

Pilots choose between airports to base aircraft at by the types of services and facilities offered. STS offers airline service, precision approach capabilities, and the longest runway in Sonoma County. The availability of hangars and proximity of the airport to residences, Santa Rosa's business, and government facilities can also influence pilots' preference for STS.

The based aircraft forecast utilizes the FAA TAF for the total based aircraft count over the forecast period. However, the FAA TAF for aircraft models does not reflect current airport data for based jets, and shows no growth in turboprops, jets, and helicopters. Hangar construction at STS in 2018 and interest from aircraft owners indicate more short-term interest in turboprop, helicopter, and jet storage at STS. The based aircraft forecasts should reflect this interest to properly plan for large hangar development as part of this ALP update.

An alternative method is to use the FAA Aerospace Forecast 2019-2039 rates for turboprop, turbo jet, and helicopters and reduce the growth rate for piston aircraft. As shown in **Table 2-23** above, no single-engine aircraft have been added in nine years at STS. The TAF differs from the 2012 Master Plan forecast, which expected an increase in jets and helicopters while piston aircraft would remain flat. **Table 2-26** summarizes the forecast for based aircraft by aircraft classification with the supplemental rates. The forecast for total based aircraft remains consistent with the TAF, while the composition of based aircraft is determined by the FAA Aerospace Forecast 2019-2039 rates.

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Table 2-20: STS Historical Operations - Airport and TAF Comparison

Year	Itinerant Air Taxi[1], General Aviation & Military Operations				Local General Aviation & Military Operations				Total Air Taxi[1], General Aviation & Military Operations			
-	Airport	TAF	Δ	%Δ	Airport	TAF	Δ	%Δ	Airport	TAF	Δ	%Δ
2008	67,667	67,667	0	0.00%	36,532	36,532	0	0.00%	104,199	104,199	0	0.00%
2009	55,744	56,081	-337	-0.60%	31,406	31,660	-254	-0.80%	87,150	87,741	-591	-0.70%
2010	49,580	49,713	-133	-0.30%	23,709	23,773	-64	-0.30%	73,289	73,486	-197	-0.30%
2011	49,699	49,866	-167	-0.30%	22,504	22,622	-118	-0.50%	72,203	72,488	-285	-0.40%
2012	51,667	51,667	0	0.00%	26,851	26,851	0	0.00%	78,518	78,518	0	0.00%
2013	49,666	49,666	0	0.00%	22,839	22,839	0	0.00%	72,505	72,505	0	0.00%
2014	50,305	50,305	0	0.00%	24,660	24,660	0	0.00%	74,965	74,965	0	0.00%
2015	51,321	52,105	-784	-1.50%	24,914	24,914	0	0.00%	76,235	77,019	-784	-1.00%
2016	49,168	51,494	-2,326	-4.70%	21,996	22,996	-1,000	-4.50%	71,164	74,490	-3,326	-4.50%
2017	49,527	49,863	-336	-0.70%	27,816	27,816	0	0.00%	77,343	77,679	-336	-0.40%
2018	49,707	51,681	-1,974	-4.00%	27,321	27,321	0	0.00%	77,028	79,002	-1,974	-2.50%
CAGR[2]	**-3.00%**	**-2.70%**	**N/A**	**N/A**	**-2.90%**	**-2.90%**	**N/A**	**N/A**	**-3.00%**	**-2.70%**	**N/A**	**N/A**

Source: STS ATCT records and FAA TAF

Table 2-21: STS Historic Itinerant Operations

Year	GA Air Taxi[1]	GA	Military	Total
2008	4,603	62,682	382	67,667
2009	5,118	50,399	227	55,744
2010	5,373	43,895	312	49,580
2011	5,721	43,626	352	49,699
2012	5,230	46,058	379	51,667
2013	5,181	44,225	260	49,666
2014	5,505	44,424	376	50,305
2015	5,790	45,018	513	51,321
2016	7,087	41,335	746	49,168
2017	7,544	41,477	506	49,527
2018	8,046	41,034	627	49,707
CAGR[2]	**5.7%**	**-4.1%**	**5.1%**	**-3.0%**

1 GA Air Taxi operations include takeoff and landings by aircraft with 60 or fewer seats conducted on non-scheduled, or for-hire flights. These do not include operations by scheduled air taxi flights, which are included in the passenger airline operations forecast above.
2 CAGR: Compound Annual Growth Rate
Source: STS ATCT records

Table 2-22: STS Historic Local Operations

Year	GA	Military	Total
2008	36,472	60	36,532
2009	52,712	23	52,735
2010	46,025	48	46,073
2011	47,133	22	47,155
2012	54,375	8	54,383
2013	36,472	60	36,532
2014	31,348	58	31,406
2015	23,709	0	23,709
2016	22,474	30	22,504
2017	26,839	12	26,851
2018	22,821	18	22,839
CAGR[1]	**-4.6%**	**-11.3%**	**-4.6%**

1 CAGR: Compound Annual Growth Rate
Source: STS ATCT records

Table 2-23: STS Historic Based Aircraft Count

Fiscal Year	SEP[1]	Jet	MEP[2]	Helicopter	Other	Total	% Change
2008	300	7	40	1	2	350	N/A
2009	300	7	40	1	2	350	0.0%
2010	267	5	39	1	0	312	-10.9%
2011	267	5	39	1	0	312	0.0%
2012	267	5	39	1	2	314	0.6%
2013	267	5	39	1	2	314	0.0%
2014	267	5	39	4	0	315	0.3%
2015	267	5	39	4	0	315	0.0%
2016	267	5	39	4	0	315	0.0%
2017	267	5	39	4	0	315	0.0%
2018	270	20	40	4	0	334	6.0%
CAGR[3]	**-1.0%**	**-11.1%**	**0.0%**	**14.9%**	**-100.0%**	**-0.5%**	**N/A**

1 SEP: Single Engine Piston
2 MEP: Multi-Engine Piston
3 CAGR: Compound Annual Growth Rate
Source: 2019 FAA TAF and STS ATCT records (2018 data)

Table 2-24: STS Itinerant Operations Forecast

Fiscal Year	GA Air Taxi[1]	GA	Military	Total	TAF Total	Difference
2018	9,020	41,034	627	50,681	50,681	0
2023	7,963	45,160	467	53,590	53,590	0
2028	8,478	46,654	467	55,599	55,599	0
2033	9,079	48,203	467	57,749	57,749	0
2038	9,685	49,800	467	59,952	59,952	0
CAGR[2]	**0.4%**	**1.0%**	**-1.5%**	**0.9%**	**0.8%**	**N/A**

1 GA Air Taxi operations include takeoff and landings by aircraft with 60 or fewer seats conducted on non-scheduled, or for-hire flights. These do not include operations by scheduled air taxi flights, which are included in the passenger airline operations forecast above.
2 CAGR: Compound Annual Growth Rate
Source: STS ATCT records (2018 data), 2019 FAA TAF

Table 2-25: STS Local Operations Forecast

Fiscal Year	GA	Military	Total	TAF Total	Difference
2018	22,821	242	23,063	23,063	0
2023	26,383	220	26,603	26,603	0
2028	26,428	220	26,648	26,648	0
2033	26,473	220	26,693	26,693	0
2038	26,518	220	26,738	26,738	0
CAGR[1]	**0.8%**	**-0.5%**	**0.7%**	**0.7%**	

1 CAGR: Compound Annual Growth Rate
Source: STS ATCT records (2018 data), 2019 FAA TAF

Table 2-26: STS Based Aircraft Forecast

Year	SEP	Jet	MEP	Helicopter	Other	Total	TAF Total	Difference
2018	270	20	40	4	0	334	315	19
2023	270	22	43	4	0	339	331	8
2028	270	25	45	5	0	345	345	0
2033	279	28	48	5	0	360	360	0
2038	287	31	52	6	0	375	375	0
CAGR[1]	**0.4%**	**2.2%**	**1.3%**	**1.7%**	**0.0%**	**0.6%**	**0.9%**	

1 CAGR: Compound Annual Growth Rate
Source: STS ATCT records (2018 data), 2019 FAA TAF and FAA Aerospace Forecast 2019-2039

Table 2-27: Operations by Airport Reference Code – 2018

ADG	AAC				
Category	**A**	**B**	**C**	**D**	**Total**
I	2,757	2,313	451	38	**5,559**
II	779	4,081	3,754	422	**9,036**
III	0	5,003	1,098	276	**6,377**
Total	**3,536**	**11,397**	**5,303**	**736**	**-**

Source: Traffic Flow Management System Count Report, FAA Fiscal Year 2018

Table 2-28: Critical Aircraft Pool – Scheduled Passenger Aircraft

Aircraft Designation	AAC	ADG	Notes
CRJ-200	C	II	Current United service. Phased out by 2028.
CRJ-700	C	II	Current AA service.
CRJ-900	C	III	Current AA service.
E170-200	C	III	Current Alaska Air, AA service.
Q400	C	III	Current Alaska Air service.
MRJ 90	C	N/A[1]	Delivery starting 2020.
E175-E2	C	III	Delivery starting 2021.
737-700	C	III	Current Sun Country (MSP). Potential Hawaii, ORD, ATL routes.
737-800	D	III	Current Sun Country (MSP). Potential Hawaii, ORD, ATL routes.

1 Approach speed for the MDJ 90 not yet published
Sources: FAA AC13A, Appendix 1 and FAA Aircraft Characteristics Database (v2-201810)
The most demanding scheduled passenger aircraft operation at STS in 2018 is the Boeing 737-800. Other non-commercial D-III aircraft operating in 2018 at STS include the Gulfstream V, and Gulfstream VI.

CRITICAL AIRCRAFT

The forecasts detailed above will guide capacity planning as part of this ALP update. Other planning metrics, such as runway design surfaces and taxiway setbacks are determined by the critical aircraft using the airport. The critical aircraft is the most demanding type or group of aircraft with similar characteristics that operate more than 500 operations at an airport annually, excluding touch-and-go operations. At STS, scheduled passenger aircraft and corporate jets are the largest aircraft regularly using the airport and will determine the critical aircraft. Aircraft operated by Cal Fire are not eligible to determine the critical aircraft because the FAA does not consider military or government aircraft for this metric.

The critical aircraft is categorized by the airport reference code (ARC) that is determined by the aircraft approach category (AAC) and the airplane design group (ADG). The critical aircraft is used as a reference to scale and design improvement projects and facility requirements at the airport. This will determine runway and taxiway design surfaces and airfield setbacks.

Operations data by aircraft type is obtained through the Traffic Flow Management System Count (TFMSC). The TFMSC only captures operations with flight plans filed, so most operations by single-engine piston aircraft are not included in the TFMSC. However, the TFMSC can be expected to capture most operations by jet and turboprop aircraft. **Table 2-27**, on the previous page, identifies the operations by AAC and ADG at STS in 2018.

Based on operation numbers, the existing ARC for STS is D-III, based on over 500 operations in the AAC D and ADG III categories. However, no single aircraft type in AAC D has more than 500 operations; rather, the entire AAC D category has more than 500 combined operations. To determine the specific critical aircraft, operations data from commercial operations is analyzed. Aircraft orders and the 2019 Market Assessment Analysis show the aircraft in **Table 2-28**, on the previous page, regularly using STS in 2018 and over the forecast period, with ADG and AAC.

The future critical aircraft may be determined by observing the future operations for specific aircraft models, and the 2019 Market Assessment Analysis that details specific routes and equipment anticipated to be operating at STS. However, predicting specific aircraft models using STS is inexact. Specific routes and equipment will vary seasonally and by demand. The future critical aircraft and ARC is expected to remain the Boeing 737-800. For this ALP update, the critical aircraft for existing and future operations for the airport and both runways is the Boeing 737-800.

Planning for specific areas (terminal, hangars, aprons) may be determined by a specific aircraft. For instance, a corporate jet or multi-engine piston aircraft may be the most demanding aircraft using a specific general aviation area, and this will drive design and setbacks in that area. As areas are evaluated in the ALP Report, other specific aircraft models and design codes may be considered for those specific areas.

FORECAST SUMMARY

- The forecasts were revised to account for impacts from reduction in air travel from the COVID-19 pandemic. Near-term growth will be delayed. Recovery models for STS show a return to 2019 levels between 2021 and 2023.
- Long-term projections are optimistic that air travel will return to pre-COVID levels and growth will continue at pre-2019 rates until STS reaches a mature market.
- Pre-COVID-19 growth in air service demand at STS can be directly tied to a growing local economy as more people travel for business and leisure. This increased demand can lead to possible growth in the number of nonstop routes offered at STS to popular hub airports and travel destinations.
- Commercial enplanements and operations at STS are growing at a high rate, specifically:
    - Catchment area bookings increased about 12 percent between 2015 and 2019.
    - Since 2015, STS has been the sixth fastest growing airport in the U.S., increasing enplaned passengers by almost 60 percent.
    - With recent additions of DEN and DFW service, growth in east-west traffic flows will occur and will be a driver of future air service growth.
    - Passenger enplanements have grown by 8 percent (CAGR) over the past 10 years.
- Given the rapid growth in flights being offered and the resultant increases in passenger enplanements during the last five years, it is credible that this growth will continue in the near term, once STS recovers from the COVID-19 pandemic.
- Enplanements will continue to increase over the 20-year forecast period. Most scheduled service will be provided by regional jets. The 50-seat regional jets will be retired within 10 years. The dominant class of airline aircraft will be those with about 76 seats.
- Enplanements may reach the ATE threshold for review by the Board of Supervisors in 2024, after STS recovers and returns to pre-COVID growth rates for air carrier operations.
    - This will trigger review of maximum daily departures. Under the high forecast, STS will reach 21 daily airline departures in 2024 or 2025 and 30 daily departures by 2038.
- Airline operations will grow during the forecast period, post-COVID. With the retirement of the 50-passenger regional jets, all airline operations will be classified by the FAA as *air carrier* operations.
- Operations by general aviation aircraft are expected to grow at less than 1 percent per year during the forecast period.
- The number of based aircraft is expected to grow from 334 to 360 over the next 20 years. Single-engine piston aircraft will continue to account for over 80 percent of based aircraft. However based jets and turboprops are expected to grow at a faster rate than piston aircraft.
- The existing and future critical aircraft is the Boeing 737-800 and the ARC for STS is D-III.

A summary of the forecasts for FAA approval are presented below. **Table 2-29** details the preferred forecast and TAF comparison. **Table 2-30** and **Table 2-31** show a summary of the preferred forecast for FAA approval.

Table 2-29: Forecast/TAF Comparison – Charles M. Schulz—Sonoma County Airport

Category	Forecast Distance	Year	Airport Forecast	TAF	AF/TAF (% Difference)
Passenger Enplanements	Base yr.	2018	212,463	210,142	1.10%
	Base yr. + 5yrs.	2023	229,828	305,941	-24.90%
	Base yr. + 10yrs.	2028	311,976	328,229	-5.00%
	Base yr. + 15yrs.	2033	354,713	359,949	-1.50%
Commercial Operations	Base yr.	2018	17,222	15,750	9.30%
	Base yr. + 5yrs.	2023	15,410	17,030	-9.50%
	Base yr. + 10yrs.	2028	17,734	18,240	-2.80%
	Base yr. + 15yrs.	2033	19,319	19,783	-2.30%
Total Operations	Base yr.	2018	81,946	85,732	-4.40%
	Base yr. + 5yrs.	2023	87,640	89,260	-1.80%
	Base yr. + 10yrs.	2028	91,503	92,009	-0.50%
	Base yr. + 15yrs.	2033	94,682	95,146	-0.50%

NOTES: TAF data is on a U.S. Government fiscal year basis (October through September).

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Table 2-30: Preferred Forecast Worksheet and Summary A. Forecast Levels and Growth Rates - Base Year 2018: Charles M. Schulz—Sonoma County Airport

Category	Forecast Distance					Average Annual Compound Growth Rates			
Year(s)	**Base Year**	**+ 1yr.**	**+ 5yrs.**	**+ 10yrs.**	**15yrs.**	**Base yr. to +1**	**Base yr. to +5**	**Base yr. to +10**	**Base yr. to +15**
Passenger Enplanements									
• Air Carrier	2,126	5,315	3,948	3,887	3,911	150.00%	13.20%	6.20%	4.10%
• Commuter	210,337	224,513	225,880	308,089	350,803	6.70%	1.40%	3.90%	3.50%
Total enplanements	**212,463**	**229,828**	**229,828**	**311,976**	**354,713**	**8.20%**	**1.60%**	**3.90%**	**3.50%**
Operations									
• Itinerant									
- *Air carrier (Commercial)*	6,254	6,688	7,080	9,156	10,240	6.90%	2.50%	3.90%	3.30%
- *Commuter/air taxi (Commercial)*	10,968	9,163	8,330	8,578	9,079	-16.50%	-5.40%	-2.40%	-1.30%
- *General aviation*	41,034	43,195	45,160	46,654	48,203	5.30%	1.90%	1.30%	1.10%
- *Military*	627	467	467	467	467	-25.50%	-5.70%	-2.90%	-1.90%
• Local									
- *General aviation*	22,821	26,627	26,383	26,428	26,473	16.70%	2.90%	1.50%	1.00%
- *Military*	242	220	220	220	220	-9.10%	-1.90%	-0.90%	-0.60%
Total operations	**81,946**	**86,360**	**87,640**	**91,503**	**94,682**	**5.40%**	**1.40%**	**1.10%**	**1.00%**
Operations Statistics									
• Instrument Operations	25,302	27,243	26,341	29,013	30,958	-3.40%	-0.70%	0.60%	0.90%
• Peak Hour[1] Operations	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
• Cargo/mail (enplaned + deplaned tons)	154	180	180	180	180	16.80%	3.20%	1.60%	1.00%
Based Aircraft by Type									
• Single Engine (Non-jet)	270	270	270	270	279	0.00%	0.00%	0.00%	0.20%
• Multi Engine (Non-jet)	40	41	43	45	48	2.50%	1.30%	1.30%	1.30%
• Jet Engine	20	21	22	25	28	5.00%	2.20%	2.20%	2.20%
• Helicopter	4	4	4	5	5	0.00%	1.70%	1.70%	1.70%
• Other	0	0	0	0	0	0.00%	0.00%	0.00%	0.00%
Total based aircraft	**334**	**336**	**339**	**345**	**360**	**0.60%**	**0.30%**	**0.30%**	**0.50%**

Note 1: Peak Hour forecasts will be presented in the Terminal Area Planning document.

Table 2-31: Preferred Forecast Worksheet and Summary B. Operational Factors - Base Year 2018: Charles M. Schulz—Sonoma County Airport

Category	Forecast Distance				
Year(s)	**Base Year**	**+ 1yr.**	**+ 5yrs.**	**+ 10yrs.**	**15yrs.**
Average aircraft size (seats)					
• Air carrier	77	78	78	81	82
• Commuter	50	50	50	50	0
Average enplaning load factor					
• Air carrier	76%	85%	85%	85%	85%
• Commuter	60%	80%	0%	0%	0%
GA operations per based aircraft	191	208	211	212	207

Note 1: Peak Hour forecasts will be presented in the Terminal Area Planning document.

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Chapter 3
Airfield Geometry

Chapter 3 -

Airfield Geometry

INTRODUCTION

Improving airfield safety is a key goal of the Federal Aviation Administration (FAA) and this ALP update. Four areas on the airfield have been classified as Hot Spots by the FAA and several taxiway segments do meet current FAA design standards. This section will evaluate design alternatives with the potential to eliminate the Hot Spots and bring all taxiways into compliance with design standards. When evaluating alternatives, potential environmental impacts, implementation complexity, and project costs will be considered.

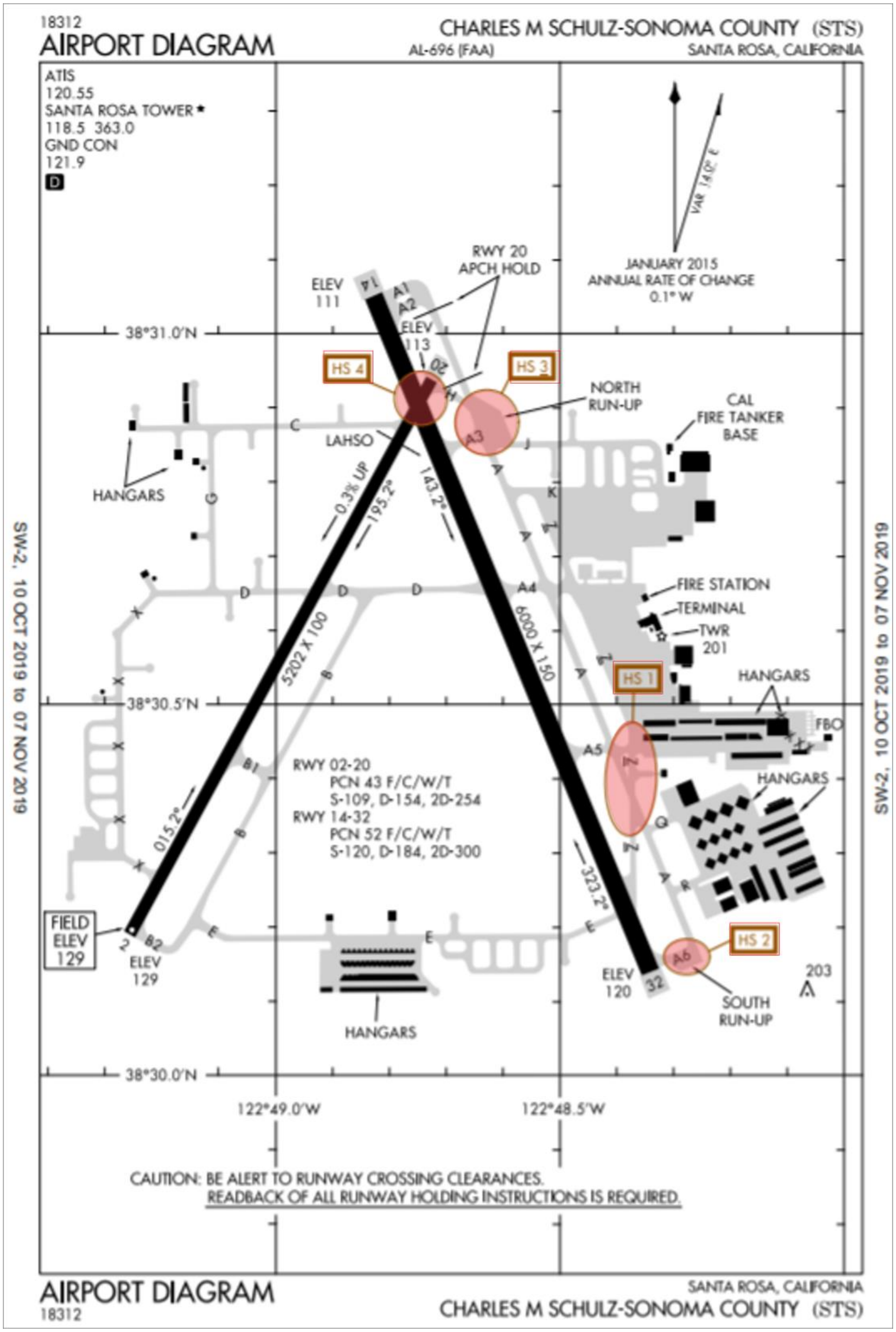
A Hot Spot is a location in an airport movement area with a history of potential risk of collision or runway incursion, and where heightened attention by pilots and drivers is necessary. The FAA designates hot spots, and these are published in the Airports Facility Directory for STS. The four hot spots are illustrated in **Figure 3-1.** The hot spots identified by the FAA are:

- **Hot Spot 1:** Complex intersection in close proximity to Runway 14/32. Aircraft approaching Taxiway A from the Apron C, Apron D, or Taxiway Z sometimes fail to turn onto Taxiway A and instead enter Runway 14/32 without approval.
- **Hot Spot 2:** Run-up apron at Taxiway A6 is not visible from the air traffic control tower (ATCT).
- **Hot Spot 3:** Run-up area east of Taxiway A and Taxiway H intersection in close proximity of Runway 20 approach. The hold area causes pilot confusion.
- **Hot Spot 4:** Wrong runway departure risk. Pilots cleared for takeoff on Runway 20 sometimes turn onto and depart Runway 14. Verify heading and alignment with proper runway prior to departure.

The sections that follow include: Runway 20 incursion mitigation, Taxiway A modification of standard, and taxiway geometry. Goals of this chapter are to:

- Offer solutions to correct and mitigate hot spots.
- Correct taxiway geometry to meet 13A standards.
- Increase situational awareness and operational safety.

Figure 3-1: Airports Facility Directory Hot Spots



Source: Airports Facility Directory, Oct 10 – November 7, 2019

RUNWAY 20 INCURSION MITIGATION

Runway incursions are incidents where people, aircraft, or vehicles end up at risk of collision due to being in a place they do not belong, particularly in the path of aircraft that are landing or taking off. Factors such as unclear signage or markings or the layout of the runways or taxiways can contribute to runway incursions. The FAA has established the Runway Incursion Mitigation (RIM) Program with the intent to address and reduce (or eliminate) risks at airports where particular locations on an airfield have a documented history of incursions.

Background

In 2014 STS extended Runways 14 and 20 as part of the project to provide standard Runway Safety Areas (RSAs). A second goal of the project was to eliminate runway incursions caused by the airport's two runways overlapping at their apex (see **Figure 3-2**). In its March 24, 2010, *Runway Safety Action Plan*, the FAA's Runway Safety Action Team (RSAT) identified "elevated risk for wrong runway departures due to co-located runway thresholds." The RSAT recommended that "STS pursue and implement alternative runway configuration(s)

projects with the FAA Airports District Office (ADO) Program Manager and Engineering to eliminate the present condition of co-located Runway 14/32 and Runway 1/19 [now called Runway 2/20] thresholds."

Alternative runway-taxiway configurations to clarify the runway ends were evaluated as part of an update of STS's 2012 Airport Master Plan. Runway alternatives included extending Runway 14/32 to various lengths and both extending and shortening Runway 2/20. The configuration that is in place today was selected because it:

- Provided distinct runway end markings for both Runway 14 and 19 [20].
- Provided standard RSAs.
- Minimized environmental impacts by not requiring relocation of creeks in the approach to Runway 19 [20].

The Runway 20 threshold was relocated to the northeast of Runway 14/32 along with relocation of Taxiway H. This action decoupled the runway ends with the intention of reducing the possibility that aircraft may depart on the wrong runway. **Figure 3-3** illustrates the existing configuration.

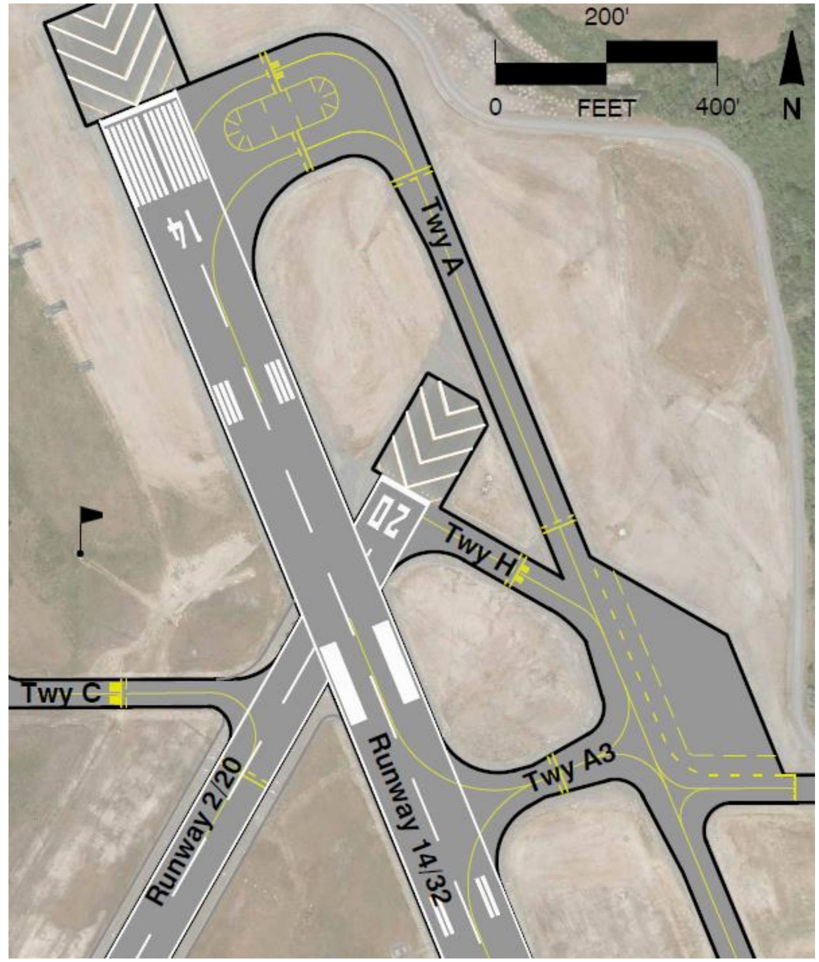
Concerns were expressed at the time by staff from STS, the FAA, and STS's consultant team over the configuration of Taxiways A and H near the end of Runway 20. However, it was believed that signing, marking, and air traffic control procedures would overcome potential problems.

Although the runway-taxiway reconfiguration improved the situation, it did not eliminate all incursions. Documented runway incursions have occurred near the approach end of Runway 20. Some non-local (itinerant) pilots are experiencing confusion related to operational traffic patterns, which has led to incursions. Because of these concerns, STS was included in the Preliminary Inventory of Airport Locations under the FAA's national initiative known as RIM. The RIM program identifies airport risk factors that might contribute to a runway incursion and recommends or develops strategies to help airport sponsors mitigate those risks.

Figure 3-2: Runway 14 & 19 Approach Ends, March 2013

Source: Google Earth, March 2013

Figure 3-3: Runway 20 – Taxiway H Existing Conditions



Source: Mead & Hunt

At STS, the RIM inventory indicates that runway incursions involving the approach end of Runway 20 and Taxiways A, A3, and H have occurred. STS and ATCT staff have been actively evaluating and implementing modifications to airfield markings and signage to reduce the potential for incursions. This Airport Layout Plan (ALP) update evaluates configuration changes to this section of the airfield, along with other measures, with the intention of reducing the potential for runway incursions or departures on an unintended runway.

Runway Incursions

ATCT staff indicated that incursions on Taxiway H – Runway 20 – Runway 14 departures are being made by itinerant pilots unfamiliar with the STS layout. Local pilots familiar with STS and commercial pilots who regularly use the airfield are not committing the incursions.

Although specific incursion incidents during Runway 20 departures vary in detail, they follow a common pattern. Aircraft intending to depart on Runway 20 continue a turn from Taxiway H across Runway 20 onto Runway 14. The prescribed route for departures on Runway 20 for aircraft to follow is: Taxi from the Taxiway H hold bars onto Runway 20, line up on the runway's centerline, and then depart. Incursions are happening when aircraft follow the prescribed route but make a left turn greater than 90 degrees onto Runway 14. **Figure 3-4** illustrates the preferred route in green and the incursion route in red. This area is identified by the FAA as Hot Spot #4.

Pavement geometry and topography may be contributing to the lack of situational awareness:

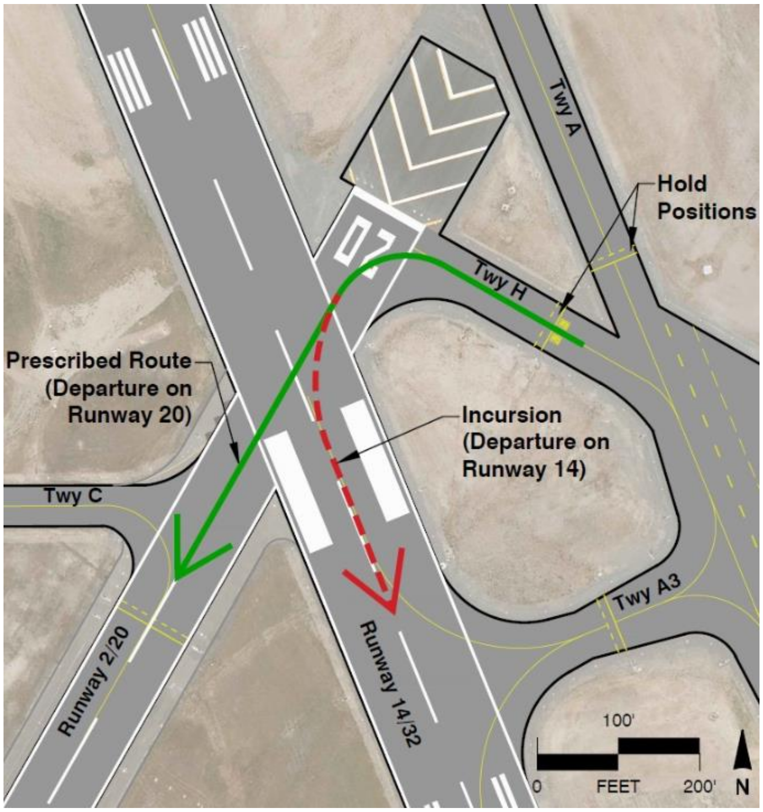
- Expanse of pavement with Taxiway A, A3, H and the runway intersection being interconnected.
- Location of the '20' designation on a short stub of runway pavement.
- The crown of Runway 14/32 making it harder to see Runway 2/20.

STS and the FAA have worked together for the past couple of years to mitigate incursions at Taxiway H – Runway 20 – Runway 14 and have implemented several measures:

- Painting a standard curved lead-in taxiway centerline from the hold bars at Taxiway H to Runway 20.
- Repainting the lead-in taxiway centerline from a curved turn to a straight line. This is a non-standard marking that the FAA Airports District Office (ADO) approved.
- Addition of the intersection to the Aviation Data Integration System (ADIS).
- Creation of an informational bulletin illustrating the wrong-runway departure issue. This bulletin was printed and made available at fixed base operators. It is also posted on the Airport's website in the section dedicated to pilots. Airport staff intend to periodically reprint and distribute copies of this bulletin.

Even with these measures in place, the ATCT documented an incursion in April 2019. Through increased vigilance, ATCT staff have observed and stopped potential incursions before aircraft take-off on the wrong runway.

Figure 3-4: Runway 20 – Taxiway H Incursion Diagram



Source: Mead & Hunt

Objectives and Organization

This study evaluates alternatives that reconfigure the pavement geometry, add or alter marking and signing, and modify operational practices. The goal of this study is to define modifications that reduce the potential for runway incursions, either through improving the pavement geometry, increasing situation awareness, or a combination of the two. The ultimate goal will be for the FAA designated Hot Spots #3 and #4 to be eliminated from the STS Airports Facility Directory.

One possibility may be enhancing pavement geometry by reducing ambiguity in intersections and providing better context for pilots. A possibility to improve pilot situational awareness may be through markings or signage to help identify Runway 20 versus Runway 14/32 and Taxiway H. It is important for STS to maintain Runway 2/20 for operations by commercial aircraft when weather conditions dictate or when Runway 14/32 is non-operational from construction or unforeseen events.

Alternatives will be evaluated based on their likelihood to reduce incursions, the time required for implementation, their possible environmental impacts, and estimated cost. A short-list of potentially useful measures will then be arranged in the order that they should be implemented, with priority given to measures that can be implemented quickly. Should the quickest measures prove effective, there would be no reason to implement more complex and costly measures. Should the quickest measures not prove effective, more complex measures would be implemented. Ultimately, measures that would change airfield geometry, signs, or markings will need to be approved by the FAA and added to the ALP for future design and construction.

The Runway 20 Incursion Mitigation is separated into two sections: permanent geometry design and interim modification of standards (MOS). The permanent geometry looks at solutions that will correct taxiway and runway geometry at the Runway 20 approach through construction and realigning pavement where needed. The interim MOS studies potential sign and marking additions to the Runway 20-Taxiway A-H area that may help limit incursions prior to implementation of the preferred permanent geometry design.

Permanent Geometry Design

- **Alternative 1 Group:** Extend or realign Runway 20 threshold to the northeast of the runway intersection.
- **Alternative 2:** Displace Runway 20 threshold to the southwest of Runway 14/32 intersection.
- **Alternative 3:** Shorten Runway 2/20 to decouple runways.

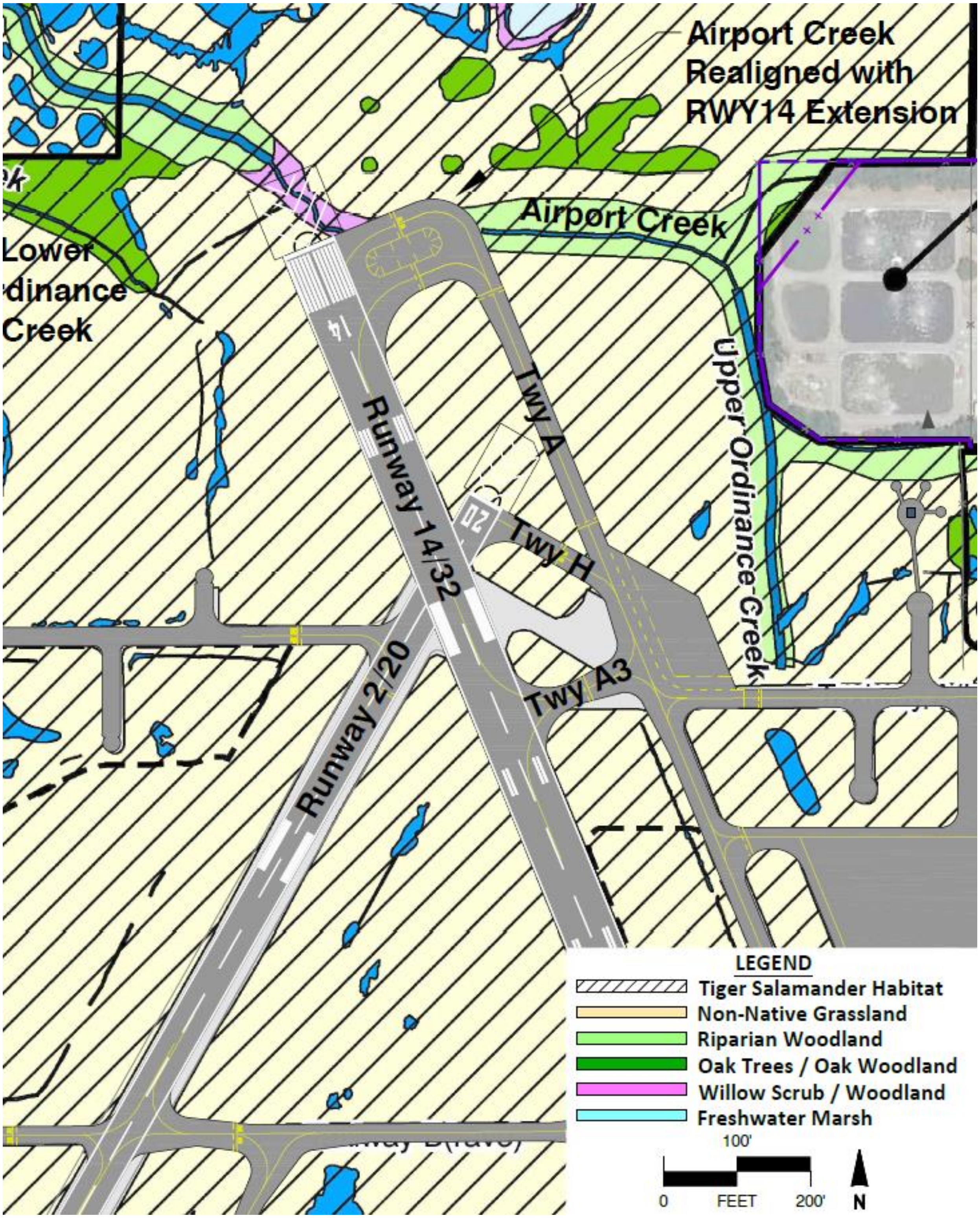
Interim Modification of Standards

- **Alternative 4 Group:** Add non-standard runway or taxiway markings or signs on TW H - RW 20.
- **Alternative 5 Group:** Add non-standard runway or taxiway markings or signs on Taxiway A.

Environmental Constraints

Several environmental factors constrain alternatives that call for construction beyond existing pavement. The unpaved areas in the vicinity of the approach end of Runway 20 are suitable habitat for the California Tiger Salamander. This salamander is designated as Federal *endangered* and State *threatened*. Other protected animal and plant species have been identified on the Airport (e.g., Burke's Goldfields). However, none are known to exist in the area northeast of the approach end of Runway 20. About 500 feet northeast of Taxiway A along the extended centerline of Runway 2/20 is Upper Ordnance Creek. Two tributary creeks, Redwood Creek and Airport Creek, join Upper Ordinance Creek nearby. These creeks have been formally delineated as *waters of the US* under the Clean Water Act. Areas adjacent to the creeks are classified as riparian, which has statutory protections through their contribution to the creeks' biological vitality. **Figure 3-5** shows the location of these biological features relative to the end of Runway 20.

Figure 3-5: California Tiger Salamander Habitat



Source: LSA, STS Biological Resources Report, Figure 13.
Current airport base map with Runway 14/32 extension shown. Environmental map shows previous Airport Creek configuration prior to Runway 14/32 extension.

Cost Considerations

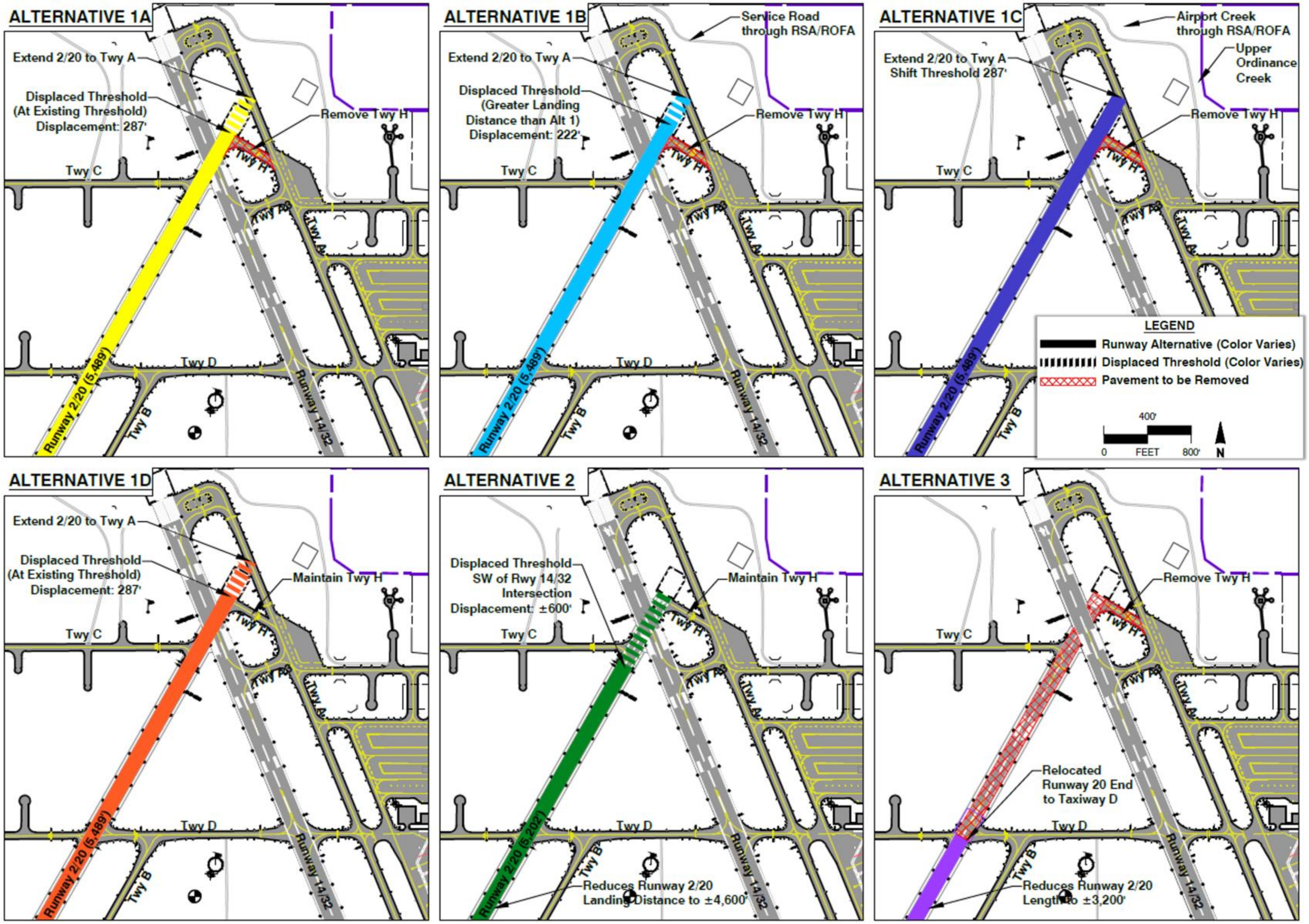
The cost estimates contained in this document enable comparison of alternatives and are order-of-magnitude only. The estimates include the major components of design, construction, environmental processing, and mitigation. The level of precision of these cost estimates make them unsuitable to use for capital improvement planning or grant preparation. More detailed cost estimates will need to be prepared for any alternative being considered for implementation.

RIM PRELIMINARY ALTERNATIVES – PERMANENT GEOMETRY DESIGN

Six preliminary alternatives for permanent geometry design were presented for initial consideration. A short description of the geometry for each alternative is presented below, with thumbnail sketches in **Figure 3-6**. The primary components for each alternative can be summarized as follows:

- Options that STS and Mead & Hunt developed together
- Ideas that the FAA presented during a preliminary RIM meeting conference call (April 16, 2019)
- Alternatives presented during preparation of the Environmental Assessment (approved 2013) and Environmental Impact Report (approved 2012) for the Airport Master Plan and associated RSA improvements.

Figure 3-6: Runway 20 RIM – Preliminary Alternatives



Alternative 1A: Extend Runway 2/20 to Taxiway A and Retain the Existing Landing Threshold

This alternative proposes extending Runway 2/20 northeast to Taxiway A, increasing the runway's length by 287 feet to a total of 5,489 feet. The landing threshold for Runway 20 would remain in the current location with a displaced landing threshold of 287 feet and the additional runway pavement would be marked as a displaced threshold. This would permit the additional runway length to be used for takeoffs on Runway 20. Declared distances would be used to retain the current runway length for operations on Runway 2.

Taxiway H would be eliminated. Aircraft departing on Runway 20 would enter Runway 2/20 from Taxiway A. Enhanced hold line markings would be placed on Taxiway A to reinforce the need for pilots to stop if they have not received a clearance to cross Runway 20.

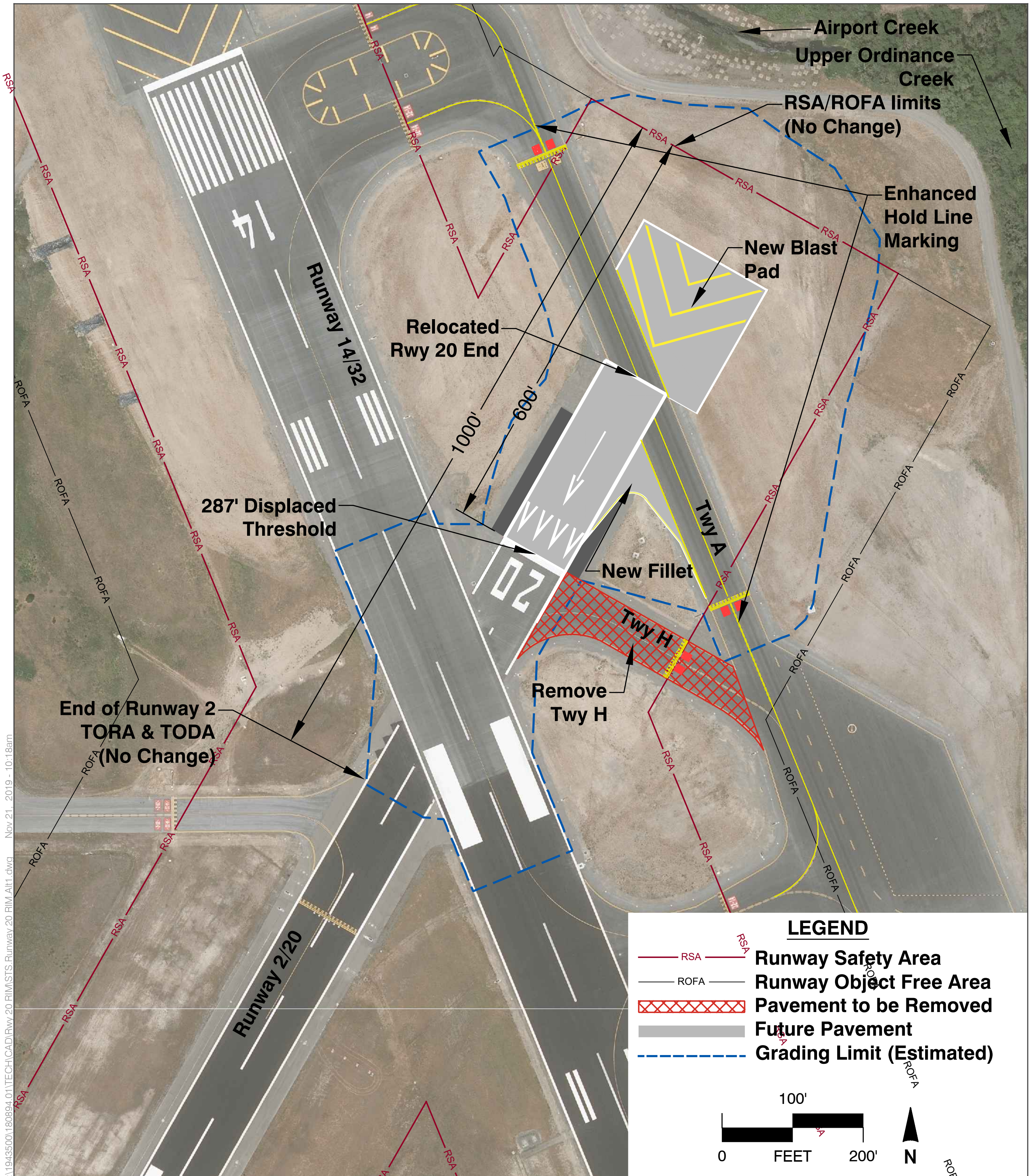
The combination of a displaced threshold for Runway 20 and declared distances on Runway 2 means that the RSA for this runway would not change with this alternative. This eliminates the need to extend the RSA to the northeast into Airport and Upper Ordinance Creeks.

To meet runway centerline gradient requirements, the new end of Runway 20 (and a segment of Taxiway A) would need to be raised about 5 feet. This would require reconstruction of the intersection of the two runways, raising an approximately 850- to 900-foot-long segment of Taxiway A, and regrading to provide the RSA and shoulders with standard gradients.

A preliminary estimate of the cost to design and build this alternative is $5.5 million. Preparation of California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) documents and follow-on permitting would cost an additional $500,000. Total mitigation costs for temporary impacts to California tiger salamander habitat, plus other mitigation measures to address water quality, erosion, emission and air quality would be an additional $115,000. The total estimated cost to implement this alternative is about $6.1 million. This alternative would be expected to take three to five years to implement. A detailed plan of Alternative 1A is shown in **Figure 3-7** with the displaced threshold and connection to Taxiway A.

- **Incursion Mitigation Value:** (1) Elimination of Taxiway H requires aircraft to enter Runway 2/20 from Taxiway A. (2) The displaced threshold centerline arrows would extend about 250 feet along the runway. This would provide greater orientation for pilots than the existing configuration. (3) Departing aircraft would have higher speeds when crossing Runway 14/32; this would make it less likely that they would turn onto that runway.
- **Implementation Cost:** Total costs to implement were estimated to be $6.1 million.
- **Implementation Timetable:** Approval of ALP, design, environmental mitigation and construction would take an estimated three to five years.
- **Environmental Impacts:** Extensive, temporary impacts would occur to California tiger salamander habitat.

Figure 3-7: Runway 20 RIM Alternative 1A



Alternative 1B: Shift Runway 20 Threshold Northeast

Alternative 1B was proposed by the FAA during the call on April 16, 2019. This scenario is similar to Alternative 1A in that it proposes to increase the length of Runway 2/20 287 feet to a total of 5,489 feet. However, this alternative would shift the Runway 20 landing threshold as far northeast as possible – 65 feet – until the point the RSA would reach Airport and Upper Ordinance Creeks. The limiting factors are the runway object free area (ROFA) and RSA, which must remain 600 feet from the landing threshold. The proposed shift would cause the perimeter service road to breach the ROFA and RSA. Vehicles would require ATCT clearance before entering this section of the service road.

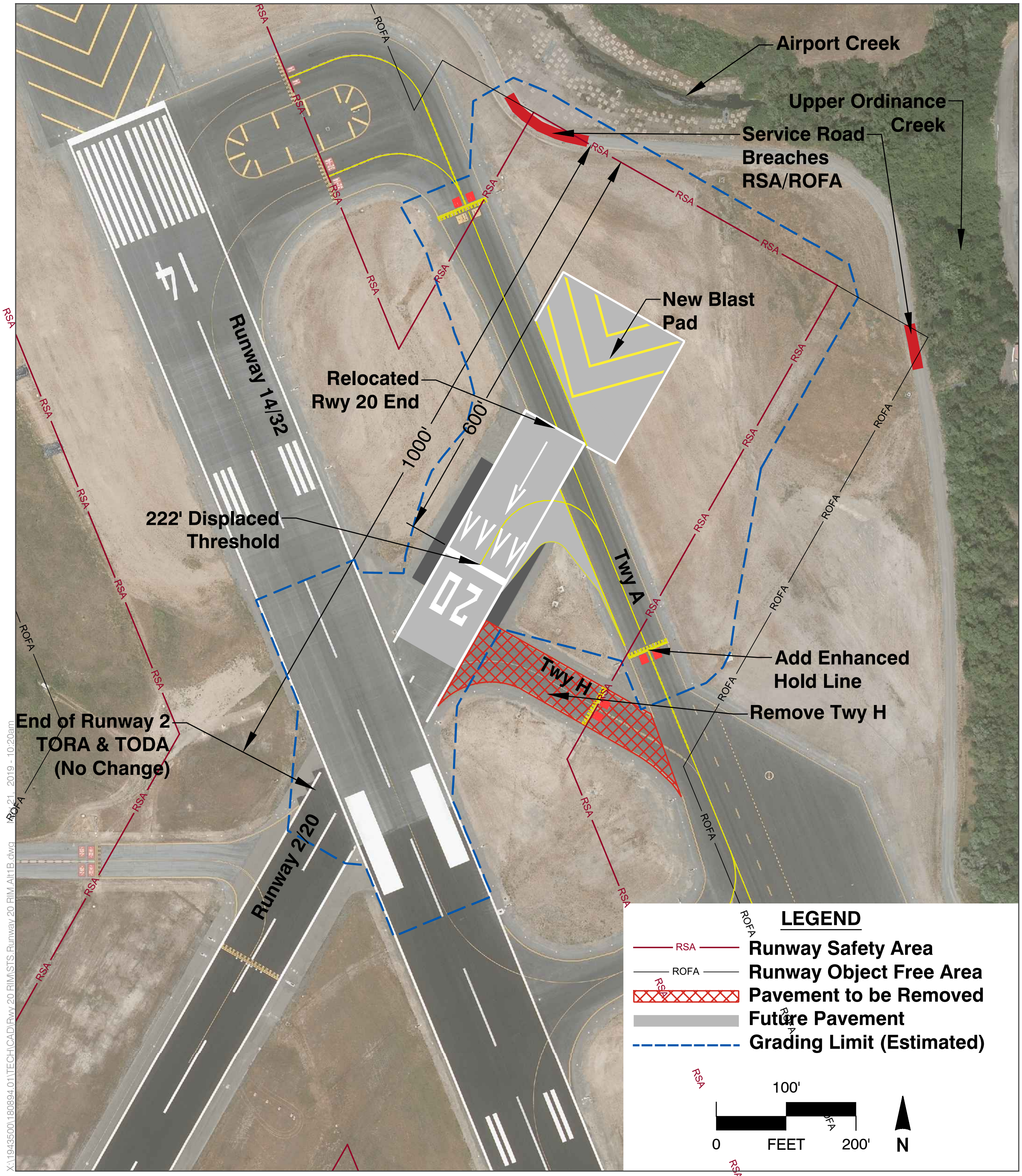
Like Alternate 1A, aircraft departing on Runway 20 would enter Runway 2/20 from Taxiway A and eliminate the need for Taxiway H. Declared distances for operations on Runway 20 would be increased by 65 feet.

This alternative would require all the same modifications to Runway 2/20 and Taxiway A as in Alternative 1A. Additionally, the 65-foot shift in the landing threshold would necessitate extension of the RSA and require both additional surface grading and modification of a segment of the service road to meet RSA gradient requirements.

A preliminary estimate of the cost to design and build this alternative is $5.9 million. Preparation of CEQA and NEPA environmental documents and follow-on permitting would cost an additional $500,000. Mitigation costs for temporary impacts to California tiger salamander habitat, plus other mitigation measures to address water quality, erosion, emission and air quality would be an additional $120,000. The total estimated cost to implement this alternative is about $6.5 million. This alternative would be expected to take three to five years to implement. Alternative 1B is illustrated in **Figure 3-8** with the proposed displaced threshold, impacts to the RSA and ROFA, and the service road.

- **Incursion Mitigation Value:** (1) Elimination of Taxiway H requires aircraft to enter Runway 2/20 from Taxiway A. (2) The additional 65 feet of runway would provide a longer centerline stripe that would make it easier for pilots to orient their aircraft correctly. (3) Departing aircraft would have higher speeds when crossing Runway 14/32; this would make it less likely that they would turn onto that runway.
- **Implementation Cost:** This alternative would cost slightly more than Alternative 1A because of the larger RSA and the need to reconstruct two sections of Taxiway A to meet gradient standards. Costs were estimated to be $6.5 million.
- **Implementation Timetable:** Approval of ALP, design, environmental mitigation and construction would take an estimated three to five years. The largest impact would be temporary impacts to California tiger salamander habitat. Extensive consultations with resource agencies would not be expected.
- **Environmental Impacts:** This alternative has the slightly higher impacts than Alternative 1A.

Figure 3-8: Runway 20 RIM Alternative 1B



Alternative 1C: Shift Runway 20 Threshold Northeast to Taxiway A

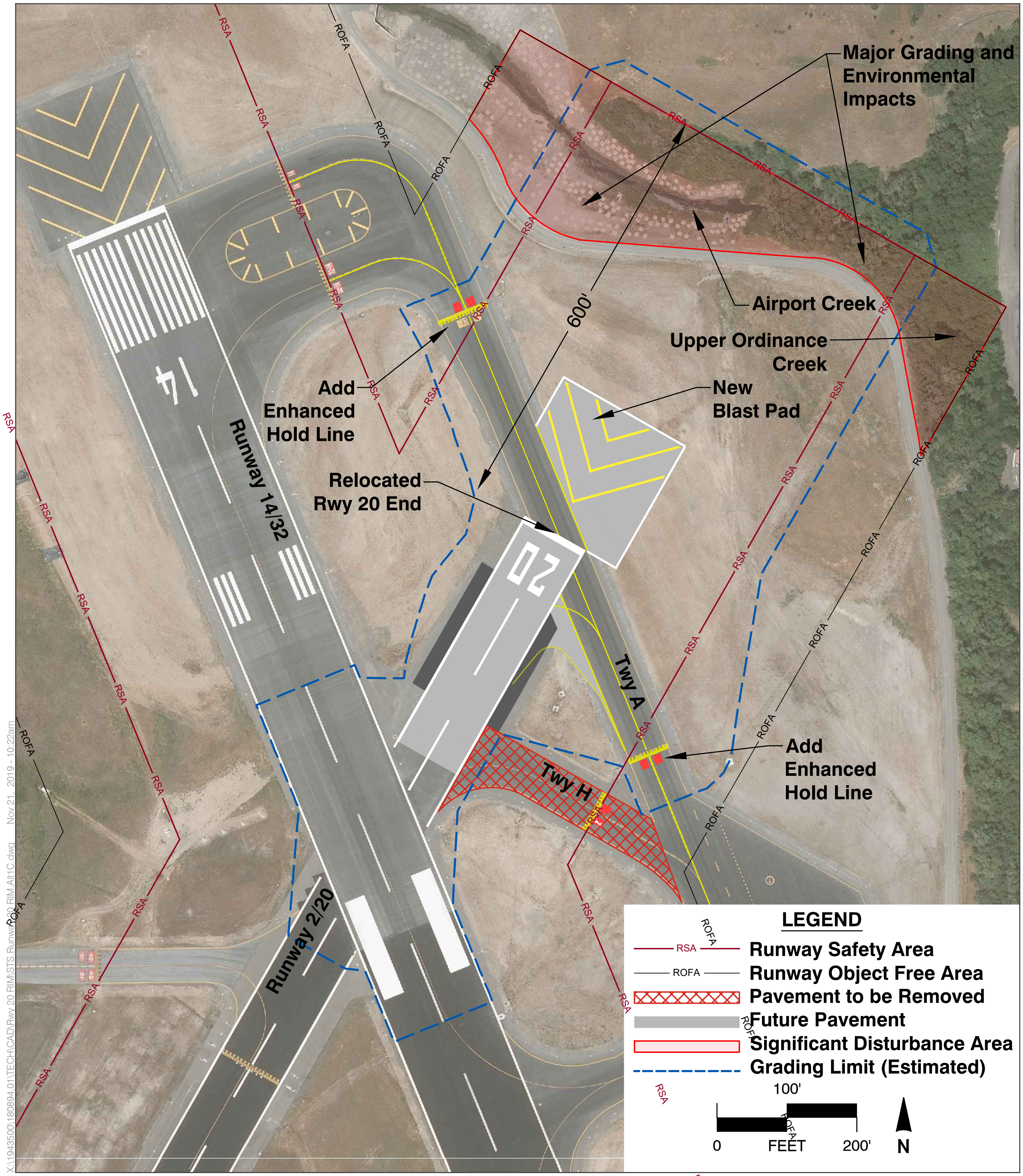
Alternative 1C proposes shifting the Runway 20 landing threshold 287 feet to Taxiway A for a total runway length of 5,489 feet and eliminating the displaced threshold. The RSA and ROFA would extend 600 feet beyond the end of the approach end of the runway, and the shift of the landing threshold would shift the RSA and ROFA into Airport and Upper Ordinance Creeks. The RSA would have to be cleared and graded and the ROFA would need to be clear of non-frangible objects. Extending these design surfaces would require significant fill, creek relocation, and realignment of the service road. This alternative would also potentially require modification of the adjacent sewage treatment ponds.

Aircraft departing on Runway 20 would enter Runway 2/20 from Taxiway A. This alternative would eliminate the need for Taxiway H, like Alternatives 1A and 1B. Declared distances for operations on Runway 20 would be increased by 287 feet.

The estimated order-of-magnitude cost to design and construct this alternative is $9.8 million. Preparation of CEQA and NEPA environmental documents (including an exhaustive analysis of alternatives) and subsequent permitting would cost an additional $750,000. Mitigation costs for impacts to California tiger salamander habitat, wetlands, riparian habitat and related features would be an additional $2 million. With the additional mitigation measures, the total estimated cost to implement this alternative is about $12.6 million. This alternative would be expected to take four to six years to implement. However, to a greater extent than other alternatives, this schedule would be subject to extension due to protracted negotiations over alternatives and environmental mitigations. **Figure 3-9** illustrates Alternative 1C and the likely impacts of runway extension, creek relocation, and RSA grading.

- **Incursion Mitigation Value**: (1) Elimination of Taxiway H requires aircraft to enter Runway 2/20 from Taxiway A. (2) The centerline arrows would extend about 300 feet along the runway. This would provide greater orientation for pilots than the existing configuration. (3) Departing aircraft would have higher speeds when crossing Runway 14/32; this would make it less likely that they would turn onto that runway.
- **Implementation Costs:** This would be the most expensive alternative to implement. Costs associated with Alternative 1C not included in Alternatives 1A and 1B include either placing segments of Airport and Upper Ordinance Creeks in a culvert or relocating adjacent sewage treatment basins. This complication would increase the costs to develop and review alternatives, associated CEQA and NEPA documentation, permitting, and mitigation costs. Total implementation costs would be about $12.6 million.
- **Implementation Timetable:** Airspace review, approval of an ALP update, design, and construction, environmental review and mitigation would take an estimated four to six years.
- **Environmental Impacts:** This alternative would have the greatest impacts. It is the only alternative that would impact wetlands and riparian habitat.
- **Operations:** The amount of runway available for departures on Runway 20 would be increased by 287 feet. This length is just large enough to have the potential to provide some benefit to operations by large jets.

Figure 3-9: Runway 20 RIM Alternative 1C



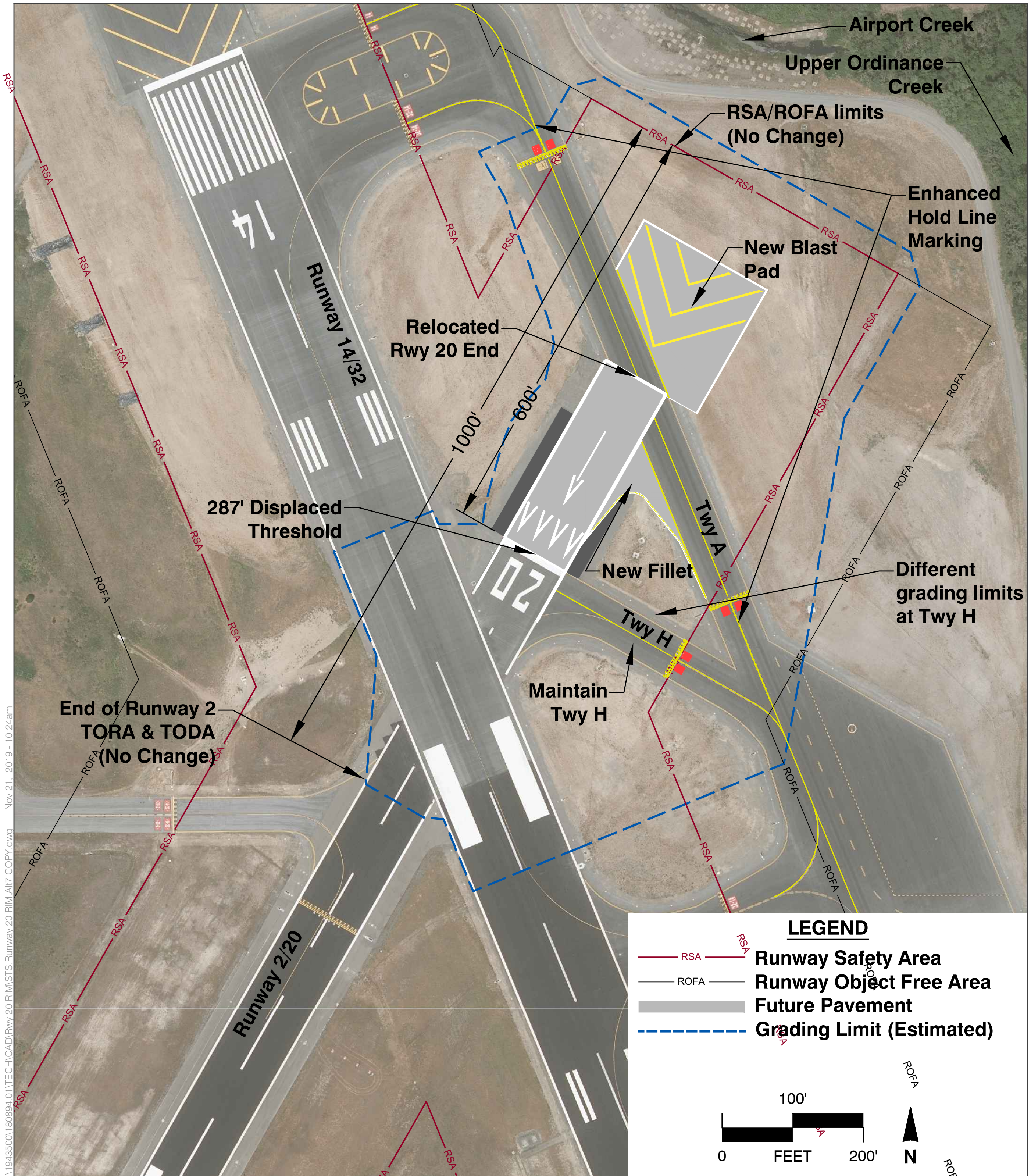
Alternative 1D: Extend Runway 2/20 to Taxiway A and Maintain Taxiway H

Alternative 1D was developed during conversations with ATCT staff after indications that it was important to maintain Taxiway H for operations flow and departures on Runway 20. This alternative is identical to Alternative 1A, except it retains Taxiway H to access Runway 2/20.

The cost to design and construct Alternative 1D would be slightly higher than Alternative 1A, because Taxiway H would have to be reconstructed to match the new elevation of Runway 2/20. A preliminary estimate of the cost to design and build this alternative is $5.9 million. Preparation of CEQA and NEPA environmental documents and follow-on permitting would cost an additional $500,000. Total mitigation costs for temporary impacts to California tiger salamander habitat, plus other mitigation measures to address water quality, erosion, emission and air quality would be an additional $115,000. The total estimated cost to implement this alternative is about $6.5 million. This alternative would be expected to take three to five years to implement. **Figure 3-10** details Alternative 1D and the likely impacts of runway extension and grading impacts with Taxiway H remaining.

- **Incursion Mitigation Value:** By diverting some operations to access Taxiway 20 via Taxiway A, this arrangement could reduce the number of runway incursions. However, it would retain the problematic Taxiway H – Runway 20 intersection. Available information indicates that transient pilots make the incursions. There are limits to the ability of ATCT staff to differentiate between transient and based pilots. Therefore, this alternative is judged to have only limited value in mitigating incursions.
- **Implementation Costs:** This alternative would be more expensive than Alternative 1A because it would add reconstruction of Taxiway H. Total implementation costs would be about $6.5 million.
- **Implementation Timetable:** Airspace review, approval of an ALP update, design, and construction would take an estimated three to five years.
- **Environmental Impacts:** Impacts to the California tiger salamander habitat would be slightly higher than Alternatives 1A and 1B, because of the slightly higher acreage being impacted.
- **Operations:** Retaining Taxiway H while adding a connection to Taxiway A would provide ATCT staff and pilots additional options for queueing for departures. This would provide a modest increase in capacity and flexibility.

Figure 3-10: Runway 20 RIM Alternative 1D



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Alternative 2: Displace Runway 20 Landing Threshold 600 Feet

Alternative 2 proposes relocation of the landing threshold for Runway 20 southwest of the intersection with Runway 14/32 and maintaining Taxiway H. Total runway length would remain at 5,202 feet with a displaced threshold of approximately 600 feet. Displaced threshold chevrons would be added to the segment of Runway 20 prior to the landing threshold. This scenario would maintain the overall length of Runway 2/20 but would shorten the landing distance available on Runway 20 to 4,600 feet. This length would limit its utility as a runway designated for use by commercial airliners.

This alternative would require remarking the runway, changing the color of the lenses in the runway edge lights in the affected section, and the installation of runway threshold lights. The estimated order-of-magnitude cost to design and construct this alternative is $800,000. No costs for mitigation measures would be anticipated. This alternative would be expected to take one to two years to implement. Alternative 2 is shown in the preliminary alternatives graphic above, **Figure 3-6**.

- **Incursion Mitigation Value:** In this alternative, the existing 10-foot centerline stripe would be replaced with a 100-foot long displaced threshold arrow on the centerline. This would provide greater alignment information than the current centerline stripe. However, this alternative also would have the potential to increase incursions. Pilots taxiing from the hold bars at Taxiway H onto Runway 2/20 would have difficulty seeing the "20" marking 600 feet away due to the low viewing angle. The crown in Runway 14/32 will also limit a pilot's ability to observe the relocated designators. ATCT staff at the June 27, 2019, RSAT meeting indicated that they believed that pilots would have difficulty seeing the runway numbers.
- **Implementation Costs:** Due to the need to relocate the PAPI and threshold lights and change edge lights' lenses, this alternative would be more expensive than those that only involve marking changes. However, with an implementation cost of about $800,000, this alternative would be less expensive by orders of magnitude than those involving extension of Runway 2/20.
- **Implementation Timetable:** The one to two years required for implementation means that this alternative would land intermediately between the purely marking alternatives and the runway extension alternatives.
- **Environmental Impacts:** From a preliminary analysis it appears that the only disturbance of unpaved areas would be relocation of the PAPI and its associated electrical cables. The only biological impacts would be to tiger salamander habitat. Mitigation fees would need to be paid for the temporary and permanent impacts to this habitat.
- **Operations:** This alternative would reduce the length available for landing on Runway 20 to 4,600 feet. This would constrain some operations by large corporate jets and some airline aircraft, plus CalFire aircraft that utilize Runway 2/20 more than Runway 14/32. However, the full length would remain available for departures on Runway 20.

Alternative 3: Shorten Runway 2/20 to 3,200 feet

This alternative proposes shortening Runway 2/20 to 3,200 feet and the relocation of the end of Runway 20 to a point abeam Taxiway D. This option would decouple the runways and eliminate Taxiway H. Runway 2/20 would be accessed from Taxiway D. This alternative was considered previously during development of the most recent Airport Master Plan update.

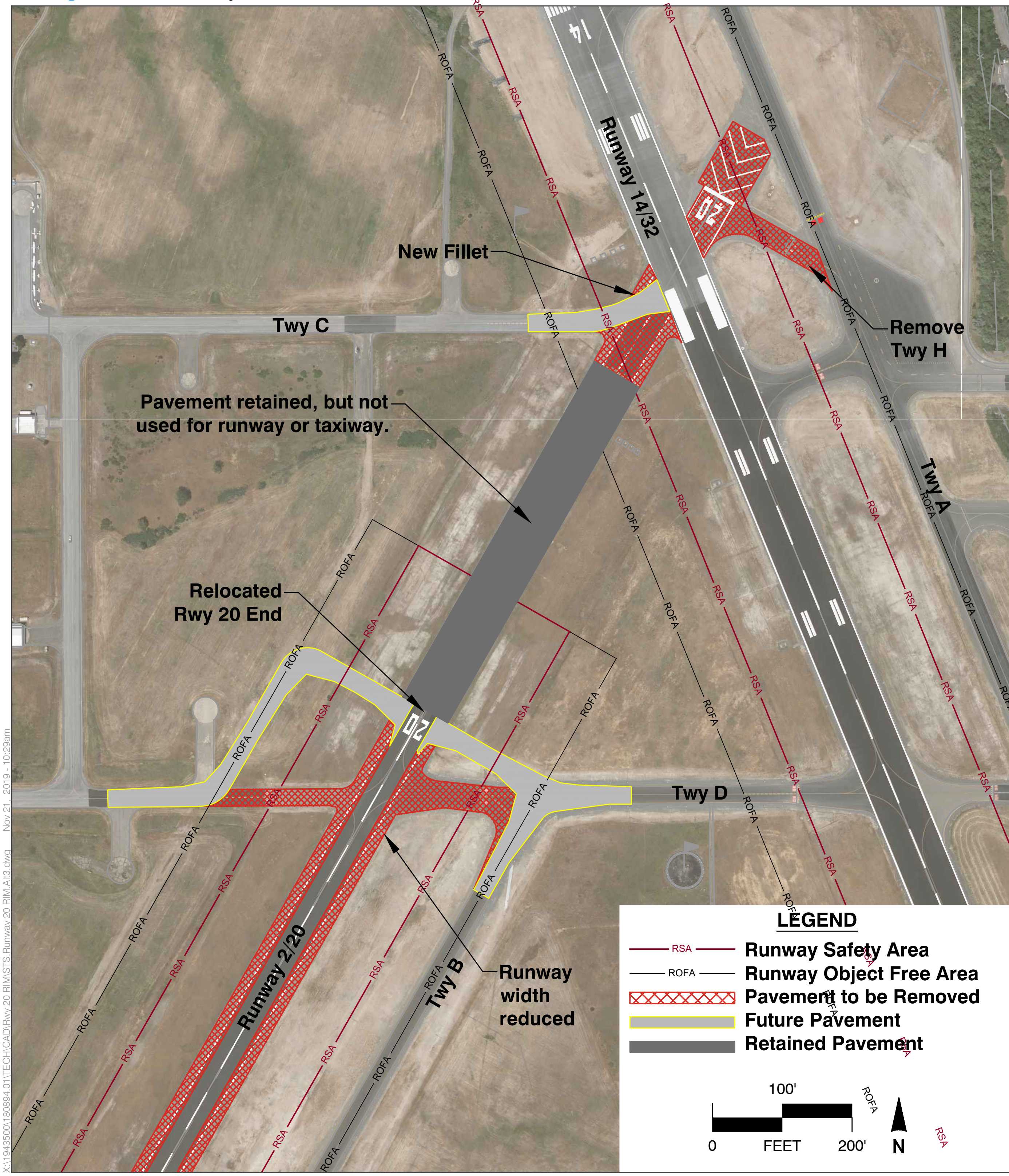
This alternative would require remarking the runway to a width of 75 feet and relocation of the runway edge and threshold lights. It is anticipated that a 100-foot section of runway pavement would be removed immediately south of Taxiway C. The balance of the abandoned section of runway would be retained but marked as unusable. The intersection of Taxiway C and Runway 2/20 would need to be modified to connect to Runway 14/32 at a right angle. Additionally, it is likely that Taxiway D would have to be modified to provide right-angle taxiway connections to the new runway end.

This alternative would change the critical aircraft for this runway, which would then change the Airport Reference Code to B-II, limiting the utility of the runway.

The estimated order-of-magnitude cost to design and construct this alternative is $3.6 million. Preparation of CEQA and NEPA environmental documents and follow-on permitting would cost an additional $500,000. Mitigation costs for temporary impacts to California tiger salamander habitat would be an additional $140,000. It appears possible that construction could avoid the delineated wetlands adjacent to Taxiways B and D. However, it is also possible that changes to drainage patterns could affect these wetlands, and if so, this would require mitigation. The total estimated cost to implement this alternative is about $4.2 million. It is expected that implementation would take three to five years. Alternative 3 is shown in **Figure 3-11**.

- **Incursion Mitigation Value:** Decoupling of Runway 2/20 and 14/32 would separate the runways and eliminate incursion potential from Taxiway H. However, in order to access the departure end of Runway 20 from the east side of the airfield, aircraft would have to cross Runway 14/32 at Taxiway A3. ATCT staff at the June 27, 2019 RSAT meeting felt strongly that this alternative would create a new source for runway incursions and would reduce the capacity of Runway 14/32.
- **Implementation Costs:** This would be one of the most expensive alternatives because of the need to modify Taxiways B, C, and D and reduce the runway's width. Costs would be an estimated $4.3 million.
- **Implementation Timetable:** The three- to five-year implementation period would be equal to the estimated duration of the runway extension alternatives.
- **Environmental Impacts:** There would be extensive impacts to California tiger salamander habitat and potential impacts to jurisdictional wetlands.
- **Operations:** This alternative would restrict the use of Runway 2/20 to aircraft no larger than medium turboprops and small jets.

Figure 3-11: Runway 20 RIM Alternative 3



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RSAT Meeting

The six preliminary permanent RIM alternatives presented at the June 27, 2019, RSAT meeting. None of the runway extension alternatives were favorably received for these reasons, among others:

- Judgement that some extension alternatives would not significantly improvement pilot situational awareness.
- Concern by some ATCT staff that the connection to Taxiway A was similar to the configuration at Lexington Airport where a wrong-runway departure in 2006 killed 49 people.
- The length of time prior to implementation.

RSAT members and ATCT staff expressed concern over shortening Runway 2/20 because a shorter length limits its utility as a runway designated for use by commercial airliners and reduces the flexibility in managing landings by large aircraft. ATCT staff commented that shortening Runway 2/20 would make STS a one-runway airport for commercial and GA jet operations.

RIM – PERMANENT GEOMETRY DESIGN – ELIMINATED ALTERNATIVES

Five of the six preliminary alternatives were eliminated from further consideration based on disadvantages over other alternatives. This was the result of consultation with STS staff, STS ATCT staff, RSAT Team, and the ADO over 2020 and 2021. The alternatives were dismissed for one or more the following reasons.

- Does not provide a clear benefit over another alternative that is less expensive or has less extensive environmental impacts.
- Increases the potential for incursions on other parts of the airfield.
- Would eliminate the use of Runway 2/20 for commercial operations.
- Would likely not improve incursions (indicated by ATCT staff interviews).

Each dismissed alternative is presented below with a description of its incursion mitigation value, its impact on operations, and reasons for dismissal. Analysis of costs, environmental impacts, and impacts to operations are included as an order of magnitude comparison to the preferred alternatives.

Alternative 1B: Reasons for Elimination

- **Cost:** This one of the more costly alternatives.
- **Long implementation period:** There would be at least three years before any potential benefit would occur.
- **Environmental impacts:** This alternative has environmental impacts of a similar scale to Alternative 1A.
- **Operations:** Moving the Runway 20 landing threshold and extending the runway length 65 feet further than Alternative 1A increases the cost but does not provide any significant additional benefit for aircraft operations.

Alternative 1C: Reasons for Elimination

- **Costs:** Costs associated with Creek relocation, design, construction and environmental review would be significantly more than Alternative 1A, which provides similar incursion mitigation.
- **Long implementation period:** There would be at least four years before any potential benefit would occur.
- **Environmental Impacts:** Impacts would be significantly more than Alternative 1A and 1B, which provide similar incursion mitigation.

Alternative 1D: Reasons for Elimination

- **Costs:** Costs would be more than Alternatives 1A and 1B but would provide less mitigation value.
- **Long implementation period:** There would be at least three years before any potential benefit would occur.
- **Environmental Impacts:** Impacts would be greater than Alternative 1A and 1B.

Alternative 2: Reasons for Elimination

- **Incursions Mitigation:** Moving the Runway "20" designators south of Runway 14/32 would not be likely to improve a pilot's situational awareness and could actually decrease awareness and exacerbate the situation.
- **Operations:** This alternative would reduce landing distance available on Runway 20. This would impact some landings by large corporate jets and commercial operations on this runway by limiting load factors and routes serviced. At the June 27, 2019, RSAT meeting ATCT staff expressed concern over the reduction in flexibility for managing landings by large aircraft.

Alternative 3: Reasons for Elimination

- **Operations:** This alternative would reduce the utility of Runway 2/20. Commercial and large business jets would not be able to use Runway 2/20 due to its length. Most jet activity would also be excluded from Runway 2/20, and CalFire will likely not be able to utilize Runway 2/20 pushing more traffic onto Runway 14/32. Runway 2/20 is utilized by ATCT for departures during peak activity times. ATCT estimate that about 15 percent of GA jet departures are on Runway 20. This alternative would be expected to eliminate these operations. At the June 27, 2019, RSAT meeting, one ATCT staff member commented that this alternative would make this a one-runway airport for commercial and GA jet operations.
- **Incursions Mitigation:** This alternative would likely create a subsequent incursion issue. Aircraft taxiing to access Runway 2/20 would need to cross Runway 14/32 at Taxiway A3. ATCT staff stressed that this would increase the potential for incursions.

RIM – PERMANENT GEOMETRY DESIGN – ALTERNATIVES ADVANCED

After consultation with STS staff and the ADO, Alternative 1A was selected as the preferred permanent geometry alternative. This was advanced by the ADO through FAA regional and headquarters review. The FAA rejected Alternative 1A in August 2021.

Alternative 1A: Reasons for Elimination

The FAA review found the intersection of Taxiway A with the extended Runway 20 to be non-standard design. The segment of Taxiway A through Runway 20 would not be aligned at a 90-degree angle to the runway. This would create an intersection with a greater than 90-degree turn, an intersection that may be confusing to pilots. The FAA deemed this unconventional angled intersection of Taxiway A with Runway 20 to be potentially problematic and may continue to represent a Hot Spot with elevated risk for runway incursions (letter from FAA, Fernando Yanez, August 2, 2021).

The FAA recommended further evaluation of alternatives that include an entry taxiway/runway end design alternative that can best achieve a 90-degree geometry and allow for standard installation of REILs while still minimizing the RSA footprint to avoid critical, environmentally sensitive areas. The FAA recognized that further alternatives should leverage the limited available space beyond the current Runway 20 threshold, to the extent practicable. This acknowledgement essentially recognized that further alternatives should be limited to extension on the existing terrain beyond Runway 20. Alternatives should avoid extension into the creeks that are located father to the northeast to limit major environmental impacts.

Alternative 1E: Extend Runway 2/20 beyond Taxiway A and Retain Existing Landing Threshold

Alternative 1E proposes extending Runway 2/20 northeast, increasing the runway's length by 458 feet to a total of 5,660 feet. The landing threshold for Runway 20 would remain in the current location with a displaced landing threshold of 458 feet, and the additional runway pavement would be marked as a displaced threshold. This would permit the additional runway length to be used for takeoffs on Runway 20. Declared distances would be used to retain the current runway length for operations on Runway 2 for standard RSAs.

Taxiway A would be reconfigured to cross the Runway 20 end at a 90-degree angle. Aircraft departing on Runway 20 would enter Runway 2/20 from the realigned Taxiway A, or cross for departures on Runway 14. Taxiway H would be eliminated.

The combination of a displaced threshold for Runway 20 and declared distances on Runway 2 means that the RSA for this runway would not change with this alternative. This eliminates the need to extend the RSA to the northeast into Airport and Upper Ordinance Creeks.

The planning cost estimate for Alternative 1E is higher than Alternative 1A. Since the preliminary alternatives were created, unit costs have increased. Alternatives 1E also impacts drainage and California tiger salamander habitat more than Alternative 1A. However, the need to reconstruct the intersection of the two runways is no longer needed with realignment of Taxiway A.

A preliminary estimate of the cost to design and build this alternative is $17 million. This includes preparation of CEQA and NEPA documents and follow-on permitting. Included in this are mitigation costs for temporary impacts to California tiger salamander habitat, plus other mitigation measures to address water quality, erosion, emission and air quality, which total about $2,500,000. This alternative would be expected to take three to five years to implement. A detailed plan of Alternative 1E is shown in **Figure 3-12** with the displaced threshold and reconfigured Runway 20 – Taxiway A intersection. **Figure 3-13** shows the location of the design aircraft at the new hold positions and clearances under the obstacle clearance surface (threshold siting surface). **Figure 3-14**: illustrates tower line of sight to the proposed runway end and hold positions. Trees north of Taxiway J will need to be trimmed at least 10 feet. The proposed remain overnight aircraft positions will need to be rotated so tails are parallel to the line of sight.

- **Incursion Mitigation Value:** (1) Elimination of Taxiway H with realignment of Taxiway A requires aircraft to enter Runway 2/20 from Taxiway A at 90-degree angles. (2) The displaced threshold centerline arrows would extend about 250 feet along the runway. This would provide greater orientation for pilots than the existing configuration. (3) Aircraft departing on Runway 20 will have 458 more feet of takeoff roll prior to crossing Runway 14/32, making it less likely that they would turn onto that runway.
- **Implementation Cost:** Total costs to implement were estimated to be $17 million.
- **Implementation Timetable:** Approval of ALP, project design, environmental mitigation, and project construction would take an estimated three to five years.
- **Environmental Impacts:** Extensive, temporary impacts would occur to California tiger salamander habitat.

Alternative 1E was submitted to the ADO for FAA review and approval.

Figure 3-12: Runway 20 RIM Alternative 1E

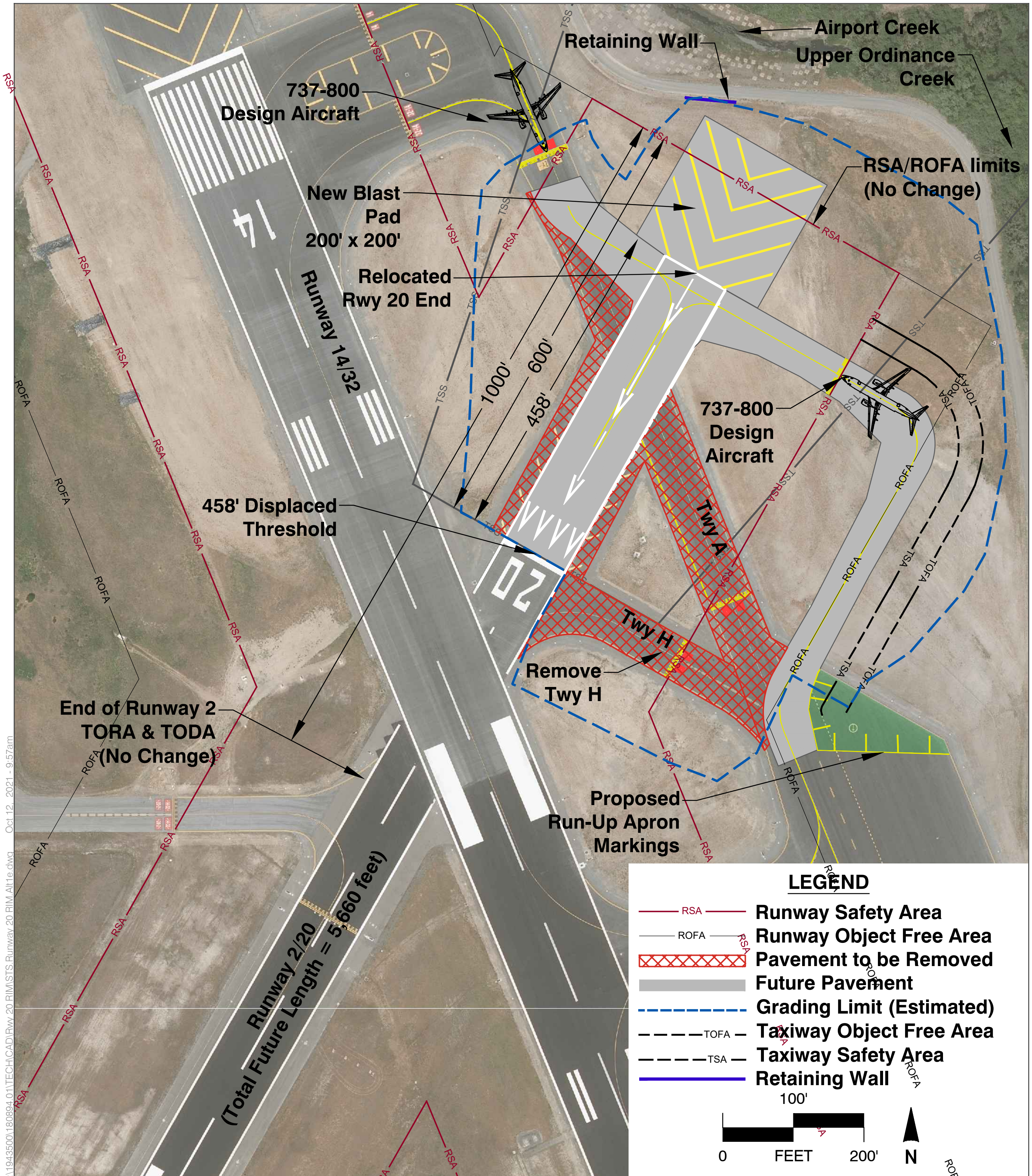


Figure 3-13: Runway 20 RIM Alternative 1E 737-800 Profiles

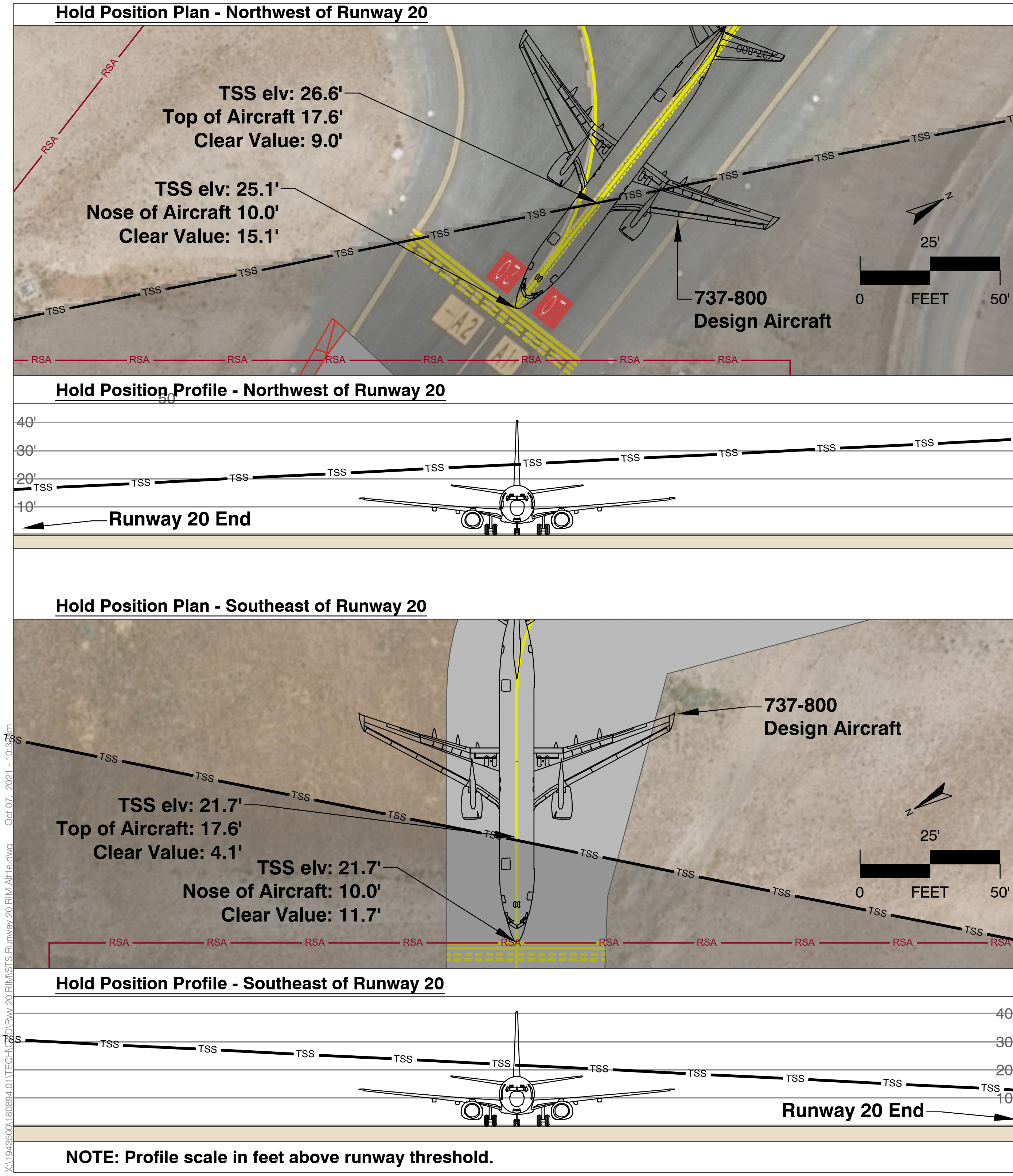
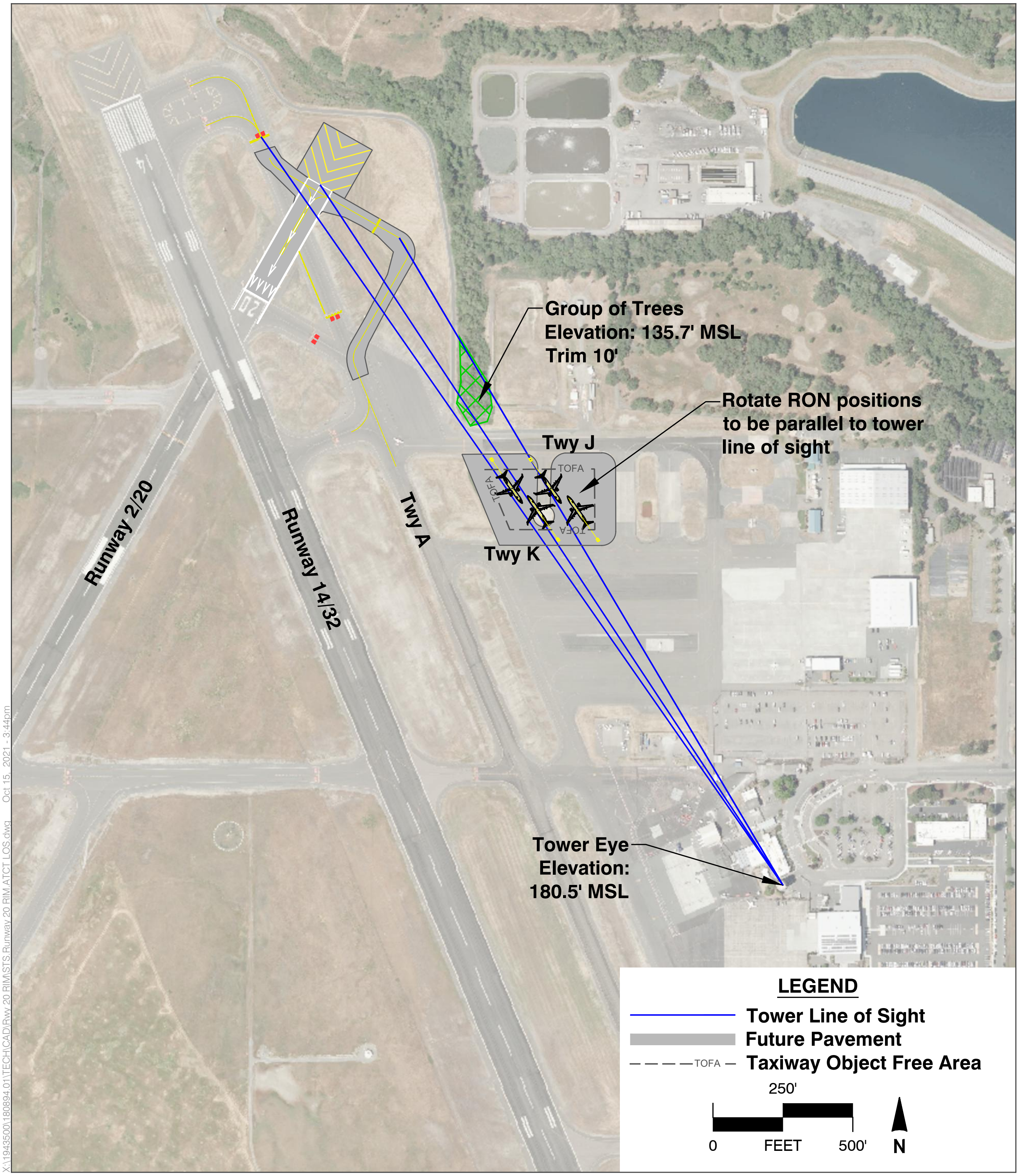


Figure 3-14: Runway 20 RIM ATCT Line of Sight



RIM ALTERNATIVES – INTERIM MODIFICATIONS

Discussions with STS, ATC, RSAT, and the ADO indicated that interim changes and modifications to signs and markings may help reduce or eliminate incursions. The interim modifications have the advantage of being relatively inexpensive, quick to implement, present no environmental impacts, and are easy to remove if they prove to not be effective. These alternatives will be submitted to the San Francisco ADO for formal review. ADO staff indicated that they wished to review each alternative separately. Ultimately, however, there may be value in combining these interim modifications.

A second advantage with interim modifications to signs and markings is these may offer immediate measures that reduce or eliminate incursions prior to implementation of the preferred Permanent Geometry Design, which may take several years.

Another advantage is these interim measures may eliminate incursions and eliminate the need to construct the preferred Permanent Geometry Design. It is recommended to continue coordination with ATC, ADO, and RSAT after these interim mitigation measures are completed to track incursions. During annual RSAT meetings, it is recommended that these interim measures be reevaluated with a report on incursion causes throughout the previous year.

The Interim Modifications propose potential sign and marking additions to the Runway 20-Taxiway A-H area that may help limit incursions prior to implementation of the preferred permanent geometry design.

- **Alternative 4 Group:** Add non-standard runway or taxiway markings or signs on TW H – RW 20.
- **Alternative 5 Group:** Add non-standard runway or taxiway markings or signs on TW A – RW 20.

Interim Modifications Alternatives: Taxiway H – Runway 20

Five preliminary alternatives were recommended for formal consideration for RIM Interim Modification:

- **Alternative 4A:** Extended Taxiway H Centerline Stripe
- **Alternative 4B:** Extend Runway 20 Centerline Across Runway 14/32
- **Alternative 4C:** Shift 20 Designator Marking Closer to Runway 14/32
- **Alternative 4D:** Reduce Taxiway H Width to 50 feet
- **Alternative 4E:** Extend Runway Centerline Northeast and Closer to Runway Designator

Alternative 4A: Extended Taxiway H Centerline Stripe

Alternative 4A, shown in **Figure 3-15**, proposes adding a yellow Taxiway H centerline stripe through the Runway 20 designator and continuing into Runway 14/32 and through the intersection. The intent would be to lead pilots across Runway 14/32 onto Runway 20. This scenario retains Taxiway H. This would be a nonstandard marking; a modification to standards (MOS) would be required before it could be implemented. There would be no changes to the length or threshold for Runway 2/20. The estimated order of magnitude cost to design and paint this stripe is $12,000. No environmental impacts would be anticipated for this alternative. This alternative could be implemented within one year.

RSAT Meeting

Alternative 4A was presented at the June 27, 2019, RSAT meeting. During the meeting ATCT staff proposed two additional marking alternatives, which are the two alternatives presented next. The consensus of the RSAT meeting was that all marking alternatives should be submitted to the ADO for formal consideration. Marking alternatives could be implemented within one year, which was viewed as a major advantage. All the marking alternatives will require modifications to standards. The modifications to standards process will provide a mechanism for additional review of the alternatives.

Alternative 4B: Extend Runway 20 Centerline Across Runway 14/32

This alternative was generated during the June 27, 2019, RSAT meeting. Like Alternative 4A, the intent is to provide a visual guide for pilots to follow across the open pavement at the runway intersection of Runway 2/20. This would be a nonstandard marking and would require approval of a MOS. This scenario retains Taxiway H. The estimated order of magnitude cost to design and paint this stripe is $12,000. No environmental impacts would be anticipated for this alternative. This alternative, illustrated in **Figure 3-16**, would be expected to take less than a year to implement.

Alternative 4C: Shift 20 Designator Marking Closer to Runway 14/32

Alternative 4C, detailed in **Figure 3-17**, was also generated during the June 27, 2019, RSAT meeting. The intent is to make the Runway 20 marking more visible to pilots turning onto the runway. This would increase the potential that pilots would maintain the correct orientation with the centerline of Runway 2/20. The 20 designator marking could be shifted a maximum of about 28 feet without entering Runway 14/32. This would be a nonstandard marking and would require approval of a MOS. This scenario retains Taxiway H. The estimated order of magnitude cost to move these markings is $20,000. No environmental impacts would be anticipated for this alternative. This alternative would take a year or less to implement.

Alternative 4D: Reduce Taxiway H Width to 50 Feet

Alternative 4D, illustrated in **Figure 3-18** proposes to reduce the width of Taxiway H to 50 feet, thereby shifting the taxiway centerline northeast slightly and providing pilots more area to turn and lineup on Runway 20 prior to departure. The perceived benefit is this geometry will allow pilots more pavement and time to recognize the Runway 20 designator. The non-standard condition of reducing Taxiway H is maintaining six existing taxiway lights at a distance greater than standard from the taxiway edge (10 feet). Alternative 4D was proposed by the ADO after review of Alternatives 4A-4C above.

Alternative 4E: Extend Runway Centerline Northeast and Closer to Runway Designator

Alternative 4E, is shown in **Figure 3-19** and proposes to extend the Runway 2/20 centerline northeast, 20 feet closer to the end designator. Alternative 4E was proposed by the ADO after review of Alternatives 4A-4C above. The existing centerline stripe is 11 feet long and it is proposed to extend this to 31 feet which is a non-standard condition due to the proximity of the centerline strip to the runway end designator. It is believed that by extending the centerline stripe, this will allow pilots to better recognize and align on Runway 20 prior to departures opposed to continuing to turn onto Runway 14/32.

Figure 3-15: Runway 20 RIM Alternative 4A

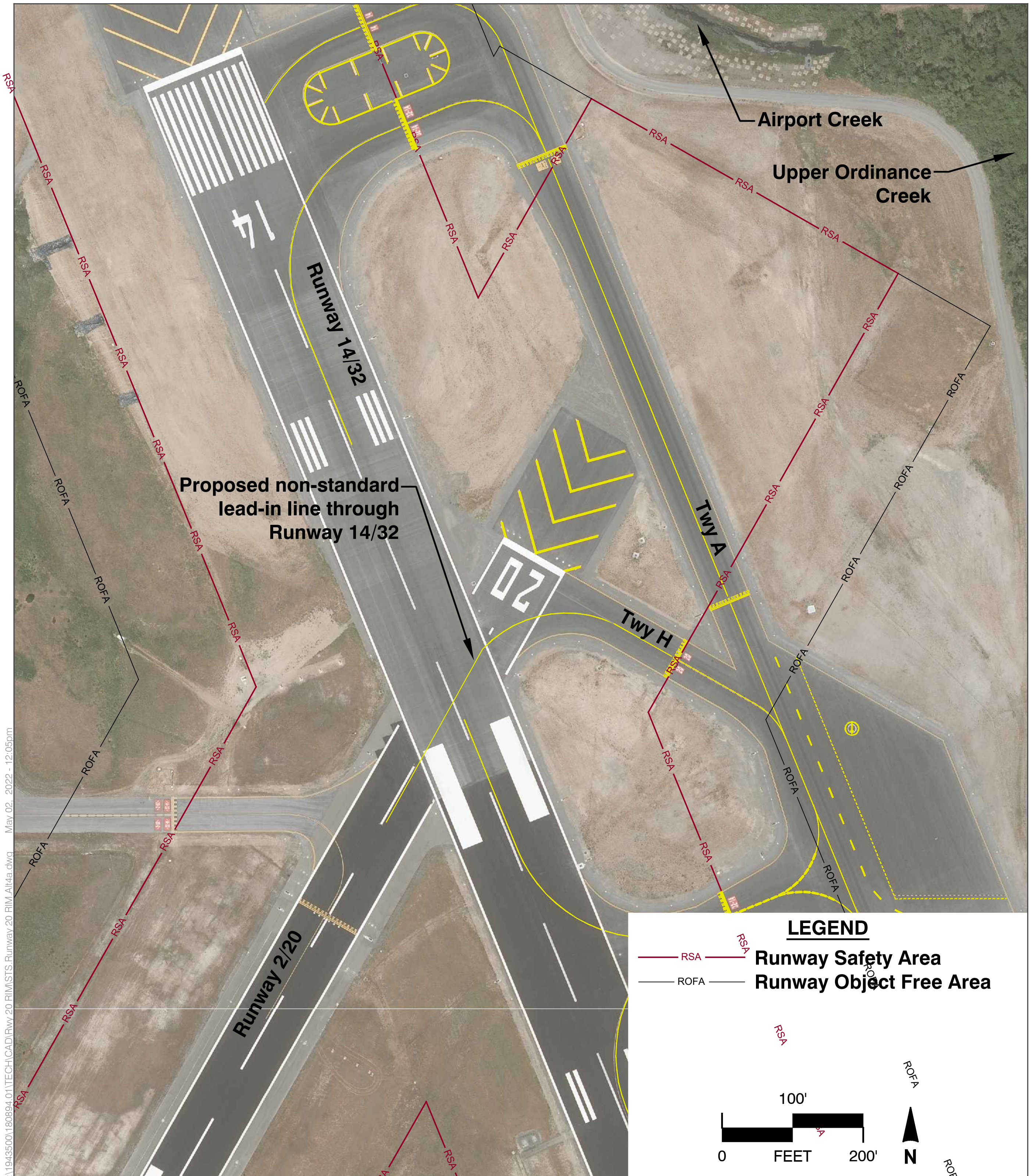


Figure 3-16: Runway 20 RIM Alternative 4B

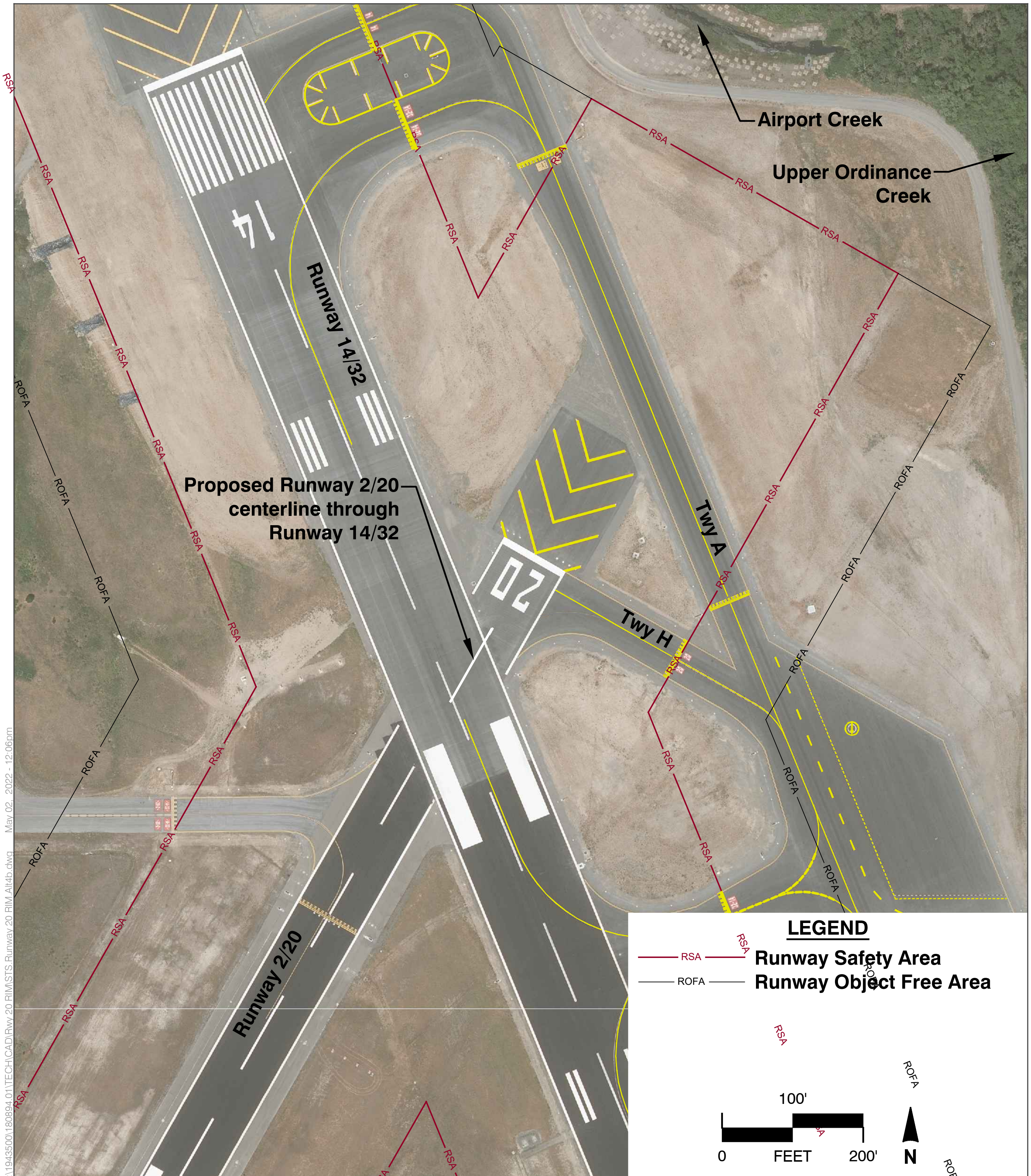


Figure 3-17: Runway 20 RIM Alternative 4C

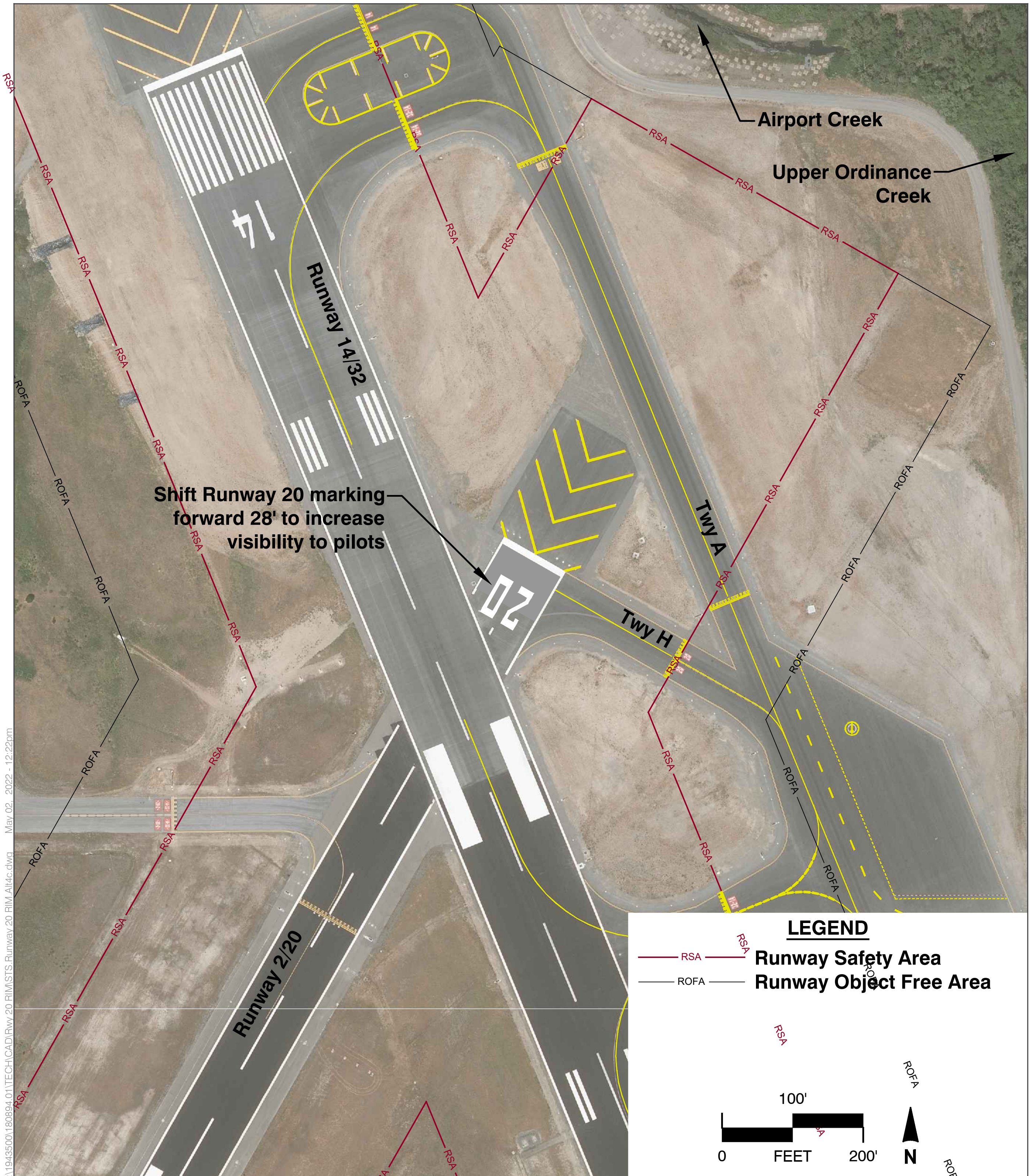


Figure 3-18: Runway 20 RIM Alternative 4D

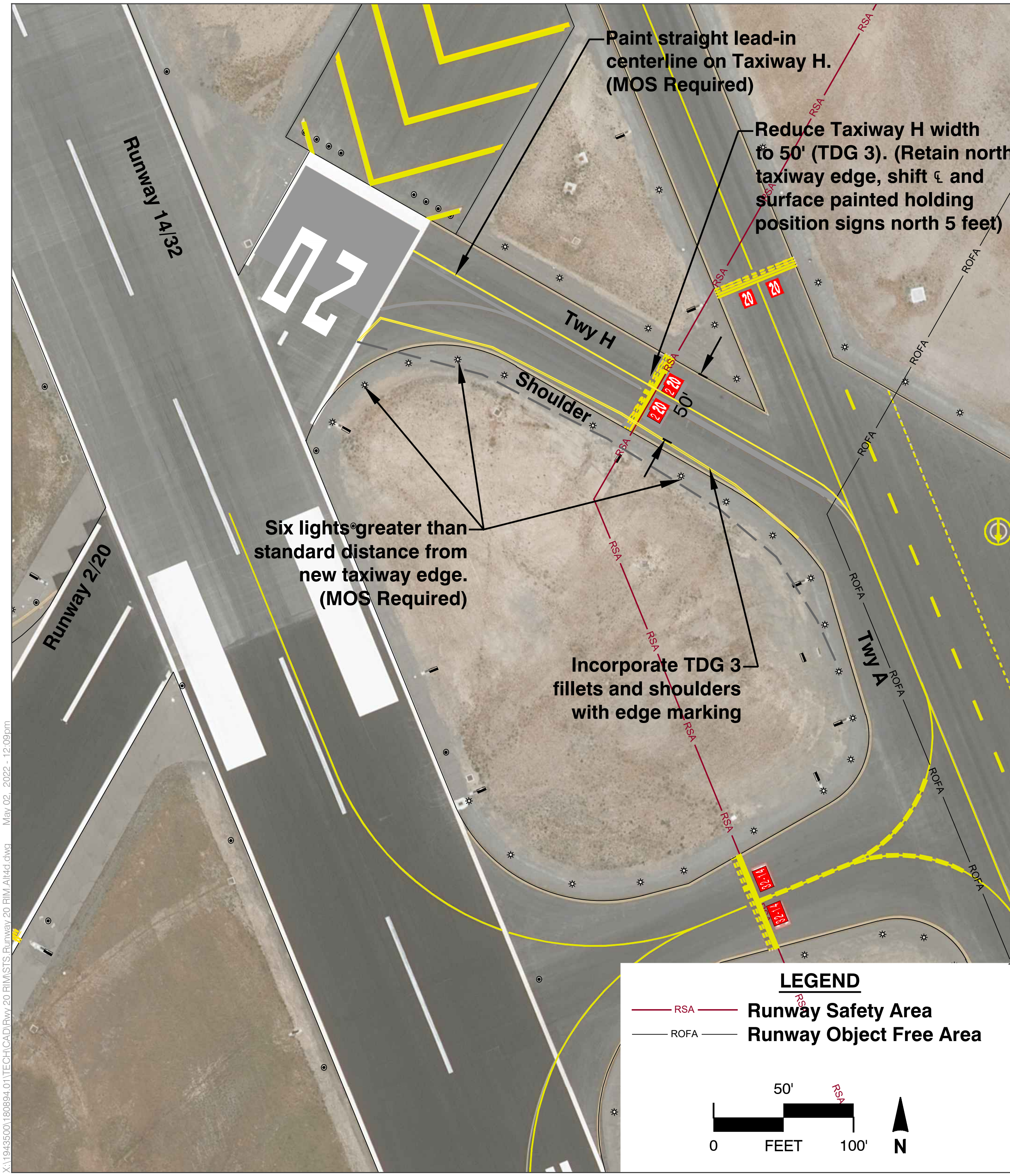
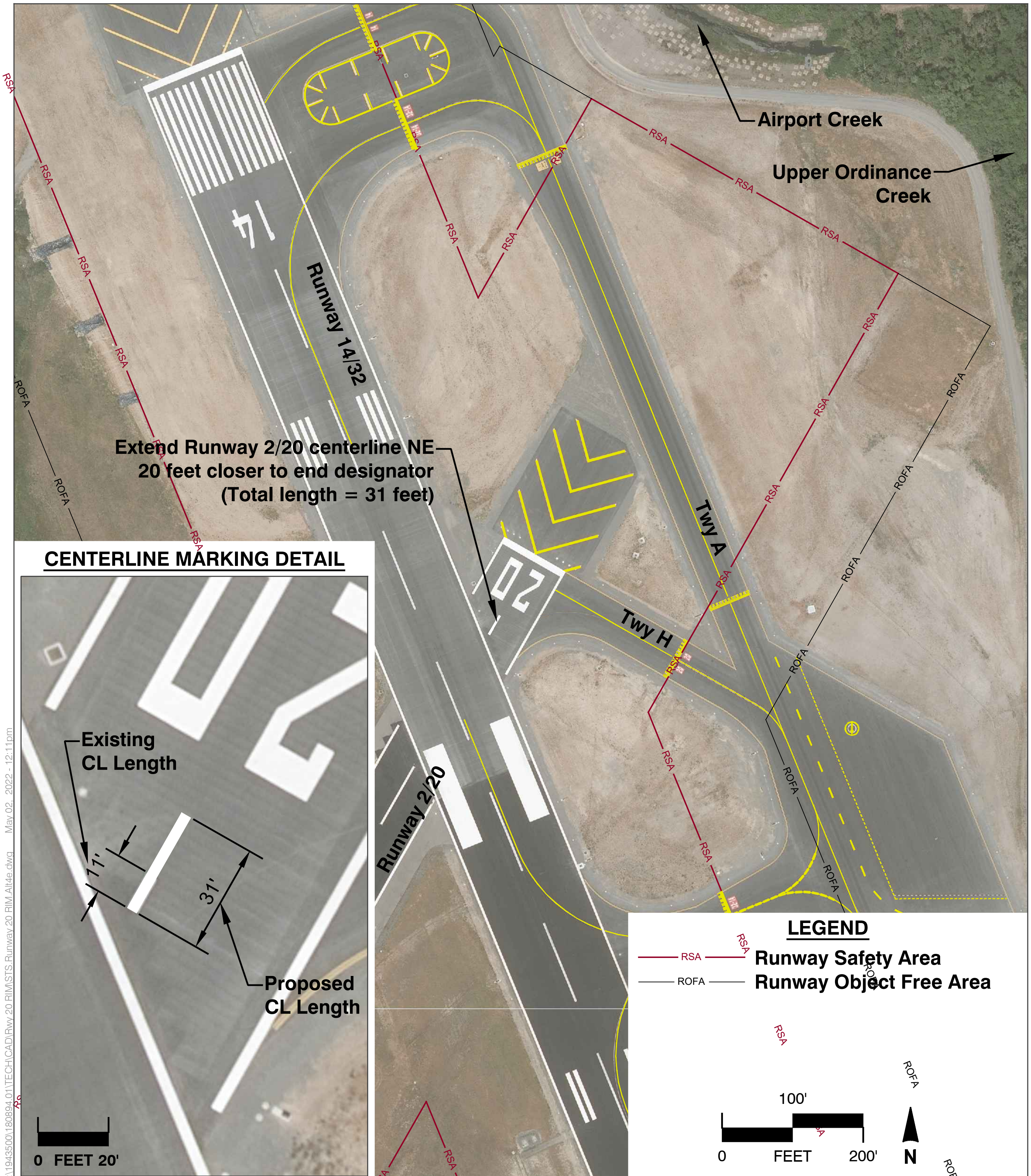


Figure 3-19: Runway 20 RIM Alternative 4E



Interim Modifications Alternatives: Taxiway A – Runway 20

The RSA of Runway 20 extends beyond the runway end, overlapping Taxiway A. An RSA serves the purpose of enhancing the safety of aircraft and is required to be free of objects except for objects that need to be located within the RSA for functionality, such as navigation aids.

Hold position pavement markings and signs are located on and adjacent to Taxiway A, at the outside edge of the Runway 20 RSA. These hold positions prevent the entrance of aircraft and vehicles into the Runway 20 RSA unless instructed otherwise by ATCT. Though these protective measures are in place, transient pilots have been reported to proceed beyond the pavement markings and signage resulting in incursions into Runway 20's approach area. This area is in proximity to the hold area that has been identified as Hot Spot 3, which causes pilot confusion. Additional visual cues on Taxiway A may help alleviate Hot Spot 3.

In this section, alternatives that propose to alter the existing pavement markings are presented with the intent to enhance situational awareness and reduce future runway incursions.

Hold markings on Taxiway A protecting the Runway 20 RSA can be enhanced to visually reinforce that there is a positively controlled RSA and approach area. Three preliminary alternatives are presented for initial consideration. A short description of the proposed changes and reasoning for each alternative is presented below with thumbnail sketches. These are summaries of the primary components for each alternative:

- **Alternative 5A:** Retain Approach Pattern "A" Hold Markings
- **Alternative 5B:** Paint Enhanced Centerline Markings
- **Alternative 5C:** Add Taxiway A Hold Position Signs

FAA Advisory Circular 150/5340-1M *Standards for Airport Markings* (AC 5340-1M) is referenced for signage and marking guidance on an airfield. Each alternative proposed is considered a nonstandard marking per AC 5340-1M. However, the unique circumstance of Taxiway A crossing through the RSA and approach to Runway 20 suggest a need for nonstandard marking to limit potential incursions. The ATCT staff at STS has endorsed the MOS on Taxiway A to enhance pilot awareness and help limit incursions at this location.

Alternative 5A: Retain Approach Pattern "A" Hold Markings

As shown in **Figure 3-20,** Alternative 5A proposes to retain surface painted approach hold position (SPAHP) Pattern "A" markings with associated runway designators to the existing hold lines. SPAHP markings are described in AC 5340-1M, in Section 4.5, "surface painted sign provides supplemental visual cues that alert pilots and vehicle drivers of an upcoming holding position location and the associated runway designator(s) as another method to minimize the potential for a runway incursion…" However, SPAHP markings added to a taxiway that does not lead directly onto the runway, such as a taxiway that crosses through an approach area, are nonstandard markings and would require approval of a MOS.

This combination will provide supplemental visual cues that alert pilots of an upcoming holding position as another method to minimize the potential for a runway incursion. The Pattern "A" approach hold markings and associated runway designators would have a similar presentation to standard runway holding positions and, when paired with the existing hold lines, reinforce pilots to hold when instructed by ATCT.

Alternative 5B: Paint Enhanced Centerline Markings

As detailed in **Figure 3-21**, Alternative 5B proposes to enhance the Taxiway A centerline to visually reinforce a positively controlled Runway 20 RSA and approach surface.

Enhanced centerline markings are described in AC 5340-1M, in Section 4.3.1, "The enhanced taxiway centerline marking provides supplemental visual cues to alert pilots of an upcoming runway holding position marking in order to minimize the potential for runway incursions." Standard holding position lines exist where the Runway 20 RSA and approach surfaces cross Taxiway A. Standard holding position signs are also co-located with the surface painted holding position lines indicating where pilots are to hold prior to crossing the Runway 20 RSA and approach. Nonetheless, the standard holding position lines and sign have not prevented incursions into the Runway 20 RSA and approach area.

However, enhanced centerline markings added to a taxiway that does not lead directly onto the runway, such as a taxiway that crosses through an RSA or approach area but not onto the runway itself, are nonstandard marking and would require approval of a MOS. The enhanced taxiway centerline markings will provide supplemental visual cues to alert pilots of an upcoming runway holding position marking to minimize the potential for runway incursions.

Alternative 5C: Add Taxiway A Hold Position Signs

As illustrated in **Figure 3-22**, Alternative 5C proposes to add two hold position signs on the right side (from a pilot's perspective) of Taxiway A. One sign will be north of the Runway 20 RSA and the other at the hold position south of the Runway 20 RSA. This is proposed to increase pilot situation awareness of the intersection to Runway 20 approach and RSA. Alternative 5C will require approval of a MOS. The signs may be designed and installed with the upcoming Taxiway A rehabilitation project.

Figure 3-20: Runway 20 RIM Alternative 5A

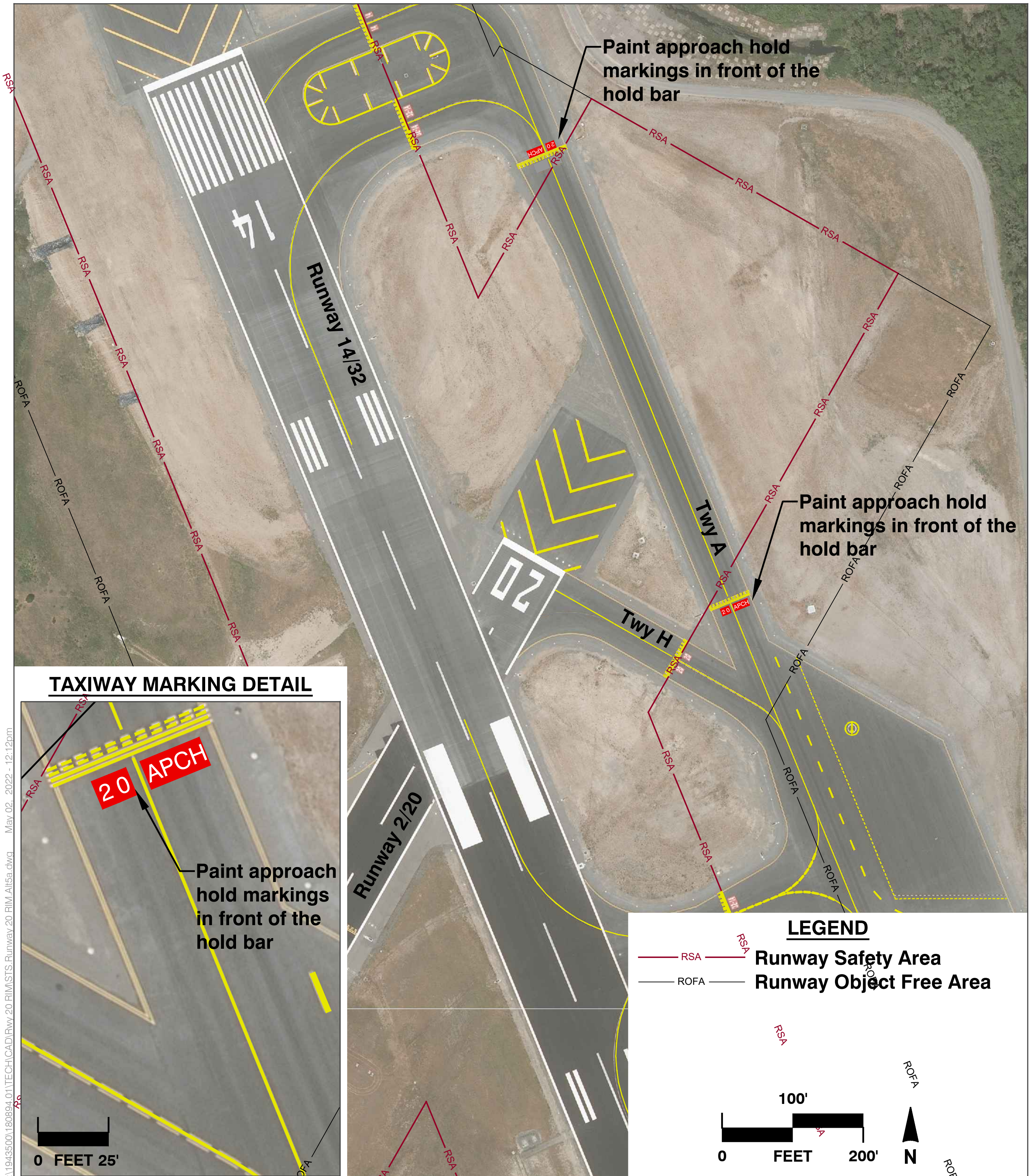


Figure 3-21: Runway 20 RIM Alternative 5B

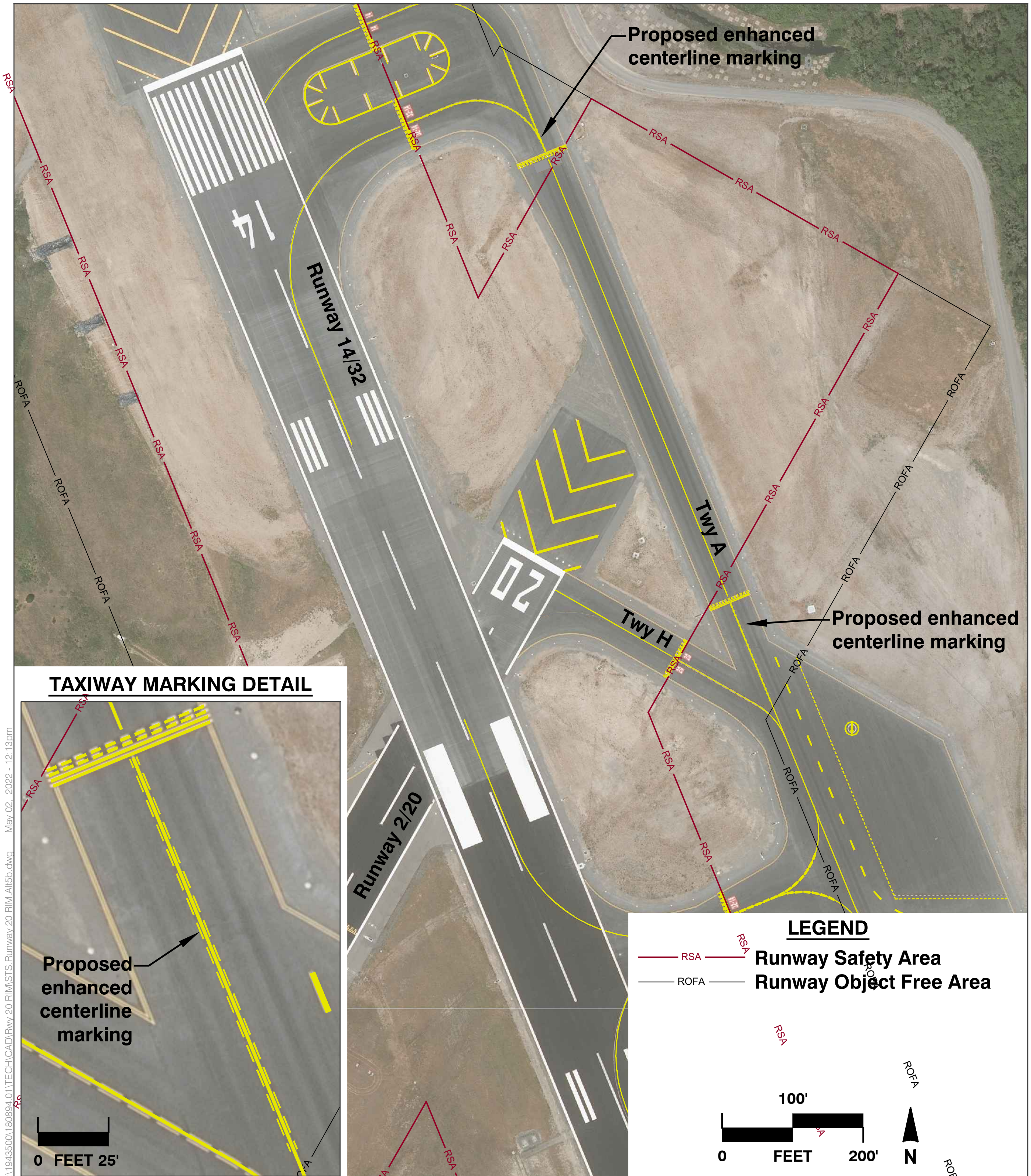


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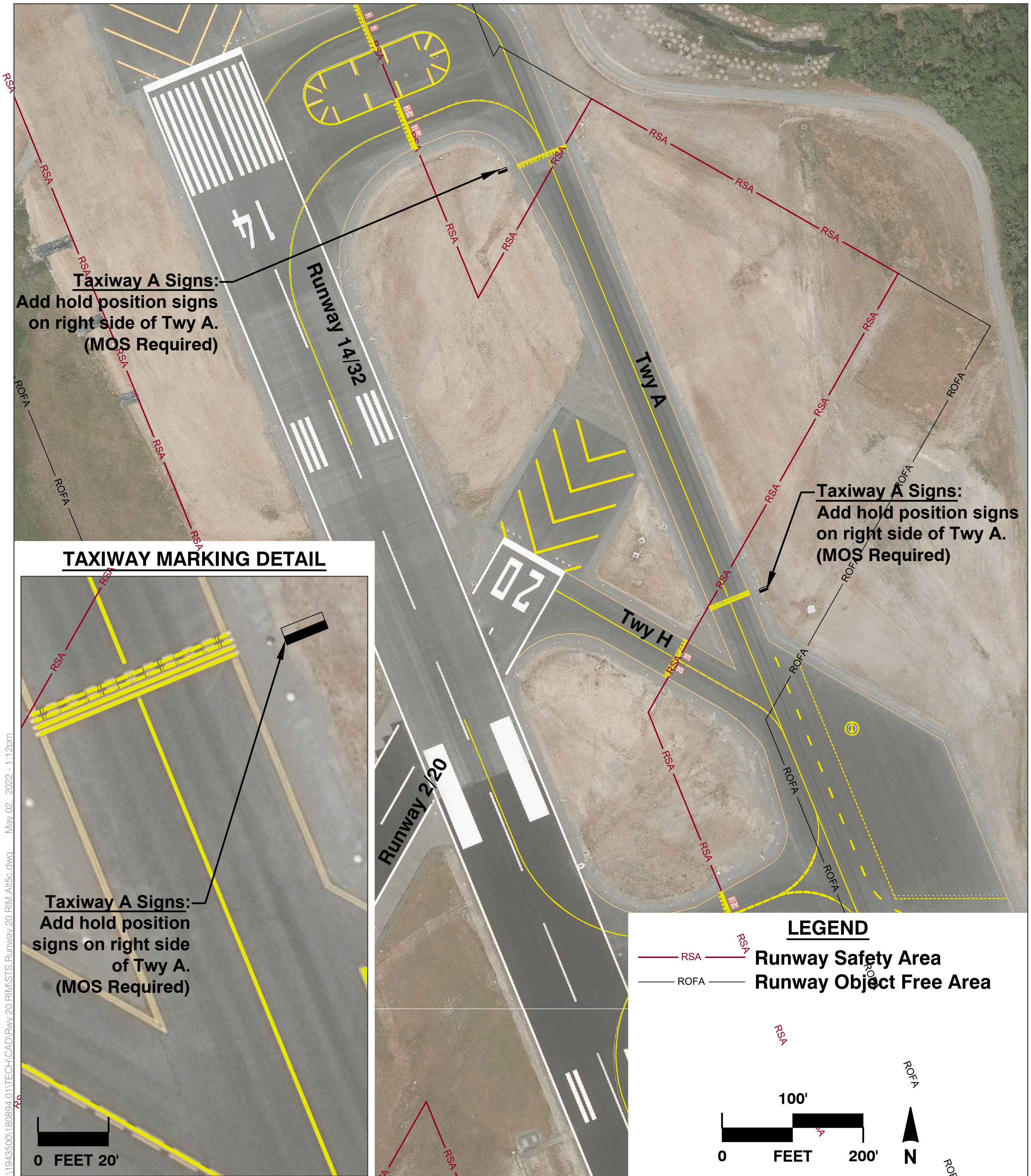
Figure 3-22: Runway 20 RIM Alternative 5C



Interim Modifications Alternatives Selected for Formal Consideration

All interim modification alternatives offer potential value as mitigation measures to the existing Taxiway A–H–Runway 20–Runway 14 incursion issue. All have the important advantages of being relatively inexpensive, quick to implement, presenting no environmental impacts, and easy to remove if they prove to not be productive. It is recommended that these alternatives (4A-4E and 5A-5C) be submitted to the San Francisco ADO for formal review. ADO staff indicated that they wished to review each alternative separately. Ultimately, however, there may be value in combining these alternatives.

All of these proposals are nonstandard. A MOS will be needed before they could be implemented.

If these alternatives do not reduce incursions to less than one per calendar year, it would be appropriate to convene the RSAT team to reevaluate rejected alternatives and assess whether there might be other alternatives that could be more effective. Following acceptance of this Study by STS staff, next steps include:

- **ADO Submission:** After STS staff review of this Study, it will be revised as needed and submitted to the ADO with MOS for the preferred alternatives.
- **Internal FAA review of MOS:** FAA will provide comments to MOS prior to formal submittal.
- **Implementation:** After approval of MOS, marking or sign alternatives will be designed and applied.
- **Monitoring and one-year check-in:** Consultation with ATCT and RSAT team to determine if marking alternatives are successful at eliminating incursions.

PREFERRED RIM ALTERNATIVES

After multiple revisions and modification of standard submissions of alternatives presented above, consultation with the San Francisco ADO (Phone conference on August 31, 2020, and email follow up on February 24, 2020), the ADO recommended to move ahead with the following for inclusion with the ALP Update.

Interim Modifications

The ADO concurred with the following Interim Modifications:

- **Alternative 4E:** Extend Runway Centerline Northeast and Closer to Runway Designator
- **Alternative 5A:** Retain Approach Pattern “A” Hold Markings
- **Alternative 5B:** Paint Enhanced Centerline Markings
- **Alternative 5C:** Add Taxiway A Hold Position Signs

The ADO indicated that Alternatives 4E, 5A, and 5B may be implemented without submitting an MOS. The ADO stated a MOS is not required if adding the markings are locally funded.

In the case of Alternative 5A, the Pattern "A' markings will be retained while the FAA evaluates policy and standards of updates to applicable Orders/SOP documentation. These updates are on hold pending additional headquarter evaluation. The ADO indicated, in the interim, Pattern "A" markings must be used for the approach/departure holding position.

The ADO concurred with the addition of hold position signs on Taxiway A (Alternative 5C). Since this will require FAA funding, a MOS is required for this condition. The ADO indicated they will support this MOS. The incorporation and design of these hold position signs will be completed with an upcoming Taxiway A project.

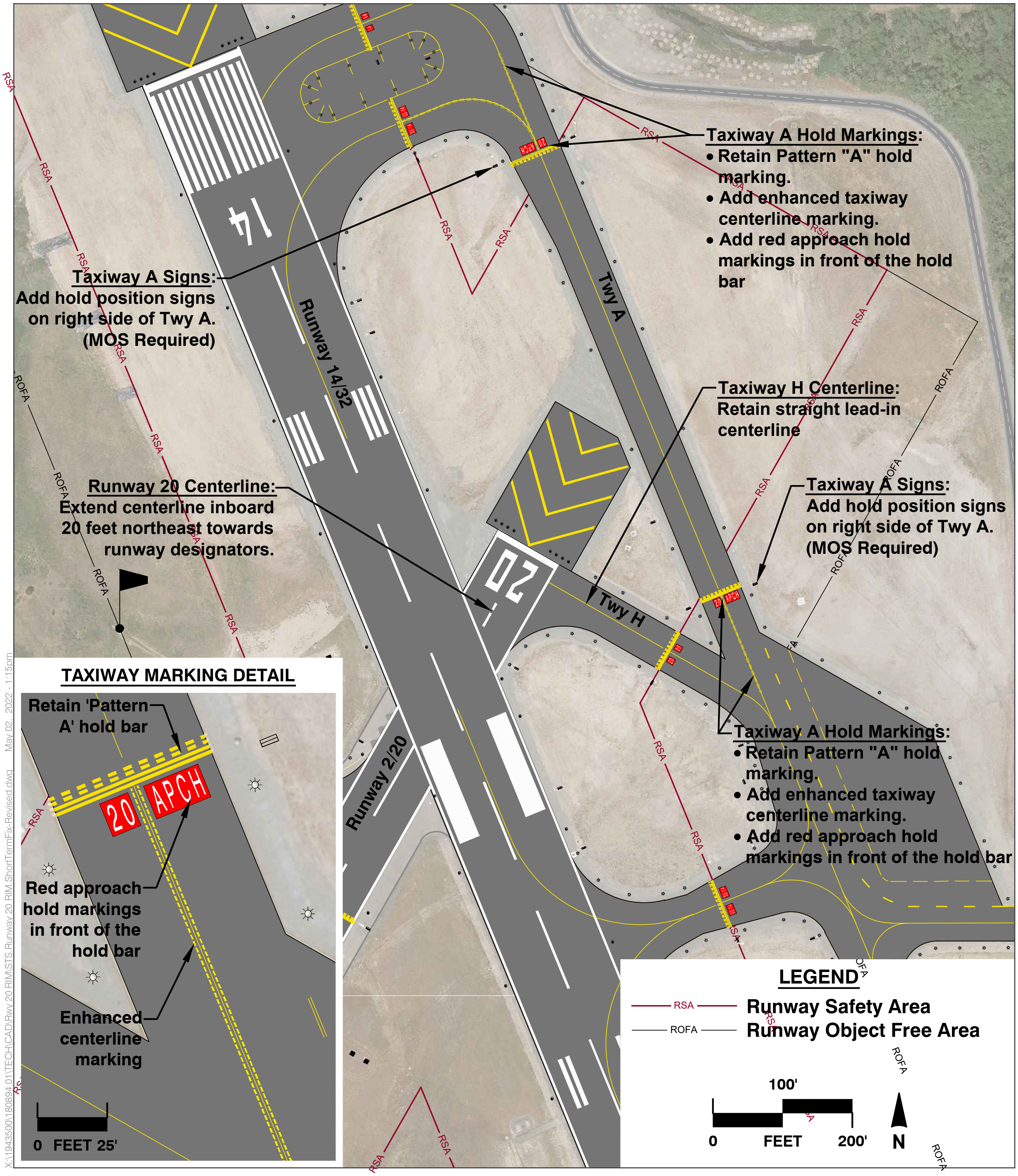
If the Interim Modifications do not reduce incursions to less than one per calendar year, it would be appropriate to convene the RSAT team to reevaluate rejected alternatives and assess whether there might be other alternatives that could be more effective.

Permanent Geometry Design

The ADO concurred with the selection of Alternative 1E (**Figure 3-23**) as the preferred alternative for Permanent Geometry Design. If after one year the Interim Modifications to signs and markings have not eliminated runway incursions, STS may pursue implementation of Alternative 1E. Implementation of Alternative 1E would involve the following steps:

- **Include in ALP:** To preserve this option, it is recommended that it be included in the current ALP Update. A note would be added to indicate that this alternative will not be implemented if the marking alternatives are successful in eliminating incursions.
- **Complete environmental process:** NEPA and CEQA documents will need to be prepared to assess impacts, refine the design to minimize impacts, and define mitigation measures. Resource agency permits and approvals will then need to be obtained.
- **Implementation:** After all environmental approvals are received, the engineering design can be prepared. Construction would then proceed.
- **Monitoring and one-year check-in:** Consultation with ATCT and RSAT team will take place to determine if this build alternative was successful at eliminating incursions.

Figure 3-23: Runway 20 RIM: Preferred Interim Geometry and Marking Modifications



Chapter 4
Taxiway A Analysis

Chapter 4 -

Taxiway A Analysis

INTRODUCTION

Charles M. Schulz–Sonoma County Airport (STS) is seeking to perform needed pavement rehabilitation on Taxiway A addressing signs of pavement deterioration. This working paper evaluates Taxiway A and its connector taxiway geometry, describing potential alternatives with emphasis on near-term engineering design. This paper will be integrated into the final Airport Layout Plan (ALP) Update Narrative Report and may be used in an engineering design justification report.

TAXIWAY SYSTEM (BACKGROUND)

Taxiways enable aircraft to move between the various functional areas on an airfield. The taxiway system at STS has been assessed in terms of design standards and guidelines intended to enhance safety and pilot situational awareness; the efficiency of the system and its effects on airfield capacity; and taxiway design standards that apply to setbacks.

Taxiway Design Standards

Similar to runways, the aircraft design group (ADG) determines separation distance required between taxiways and runways, other taxiways, taxilanes, and objects. Taxiway design also depends on the dimensions of aircraft undercarriage. The taxiway design group (TDG) is based on the landing gear configuration, and considers the gear type, width, length, and relation to the cockpit. The TDG determines the taxiways width, edge safety margin, shoulder width, and fillet dimensions.

Both runways at STS are designed for air carrier use. Therefore, all taxiways in the movement area at STS are also designed for air carrier use. As determined by existing and projected daily flight schedules, the forecast chapter shows regular use (over 500 annual operations) by the Embraer 175, Boeing 737-800, and the Airbus 320. Regional jets such as the Bombardier CRJ 700 and 900 models also use STS regularly. Occasionally,
Alaska Airlines (operated by Horizon Airlines) operates the Bombardier Q400 at STS. The largest aircraft, in terms of wingspan and approach speed, that regularly use STS are shown in **Table 4-1** below. The critical aircraft is the Boeing 737-800 (ADG III), and all taxiways in the movement area at STS are TDG 3.

Table 4-1: Airplane and Taxiway Design Codes

Aircraft Model	Airplane Design Group (ADG)	Taxiway Design Group (TDG)
Embraer 175	III	3
Boeing 737-800	III	3
Airbus 320	III	3
Bombardier CRJ 700	II	2
Bombardier CRJ 900	III	2
Bombardier Q400	III	5

Source: FAA Aircraft Characteristic Database, Version 2, October 2018

Taxiway Width

Taxiway A's current width is 60 feet of pavement with 15-foot gravel shoulders, which exceeds the TDG 3 design standard of 50 feet of pavement with 20-foot shoulders. Alternatives below for Taxiway A consider both 50- and 60-foot-wide taxiway construction.

For many years the critical aircraft had been the Q-400, an aircraft that has unusually wide main gears for its size. The Q-400 is categorized as a TDG 5 aircraft, and the standard width for TDG 5 is 75 feet, which exceeds the current width of Taxiway A. Operations of the Q-400 are down at STS, but it remains in Alaska Airline's fleet. How the disruption caused by COVID-19 will affect Alaska Airline's service to STS when flights resume is uncertain. The potential remains for increased operations by the Q-400 at STS at any time. Retaining the current Taxiway A width, 60 feet, at least for the near term, gives STS the capability to accommodate the aircraft type that has served there the longest.

Taxiway Fillets

Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13A (AC-13A), *Airport Design* provides guidance on taxiway fillets at intersections based on the TDG. Fillets are designed at curves and intersections for cockpit over centerline steering to enable rapid movement of traffic with minimal risk of aircraft excursions from the pavement surface. Some alternatives below incorporate TDG III standard fillets at taxiway connector intersections. In most cases, the fillets encroach on undisturbed land with potential wetlands and may in some cases, increase the amount of environmental review.

Taxiway Shoulders

The required shoulder width for TDG 3 is 20 feet. AC-13A recommends paved shoulders for taxiways and taxilanes accommodating ADG-III aircraft. Soil and turf not suitable for pavement requires a stabilized or low-cost paved surface.

Existing shoulders on Taxiway A are generally 15 feet wide. However, the paved shoulder edge is not well defined the full length of Taxiway A, and in some areas the paved shoulder appears to be less than 10 feet from the edge of Taxiway A. In these areas, the remaining shoulder area may be stabilized with compacted gravel.

Some alternatives below propose standard shoulders on Taxiway A as part of rehabilitation. For the full length of Taxiway A, it may be possible to reduce the taxiway to the standard width of 50 feet, with 20-foot shoulders, while remaining in the existing taxiway/shoulder footprint. Some shoulder areas on Taxiway A may require more pavement or stabilization, and some shoulder areas (near Taxiway A5 intersection) are delineated as a wetland. Field investigation will be needed to resolve this wetland. Once an alternative is selected for Taxiway A rehabilitation, shoulder areas should be considered as part of that project.

TAXIWAY DESIGN METHOD

While taxiway setbacks, widths, and fillet design are based on ADG and TDG, taxiway design geometry is based on practices to reduce incursions and increase visual awareness for pilots. FAA airfield design standards for taxiways are defined in AC-13A. AC-13A was updated in 2014 and revised and expanded upon taxiway geometry standards with the purpose of limiting runway incursions. Existing non-standard taxiway designs are illustrated and described below.

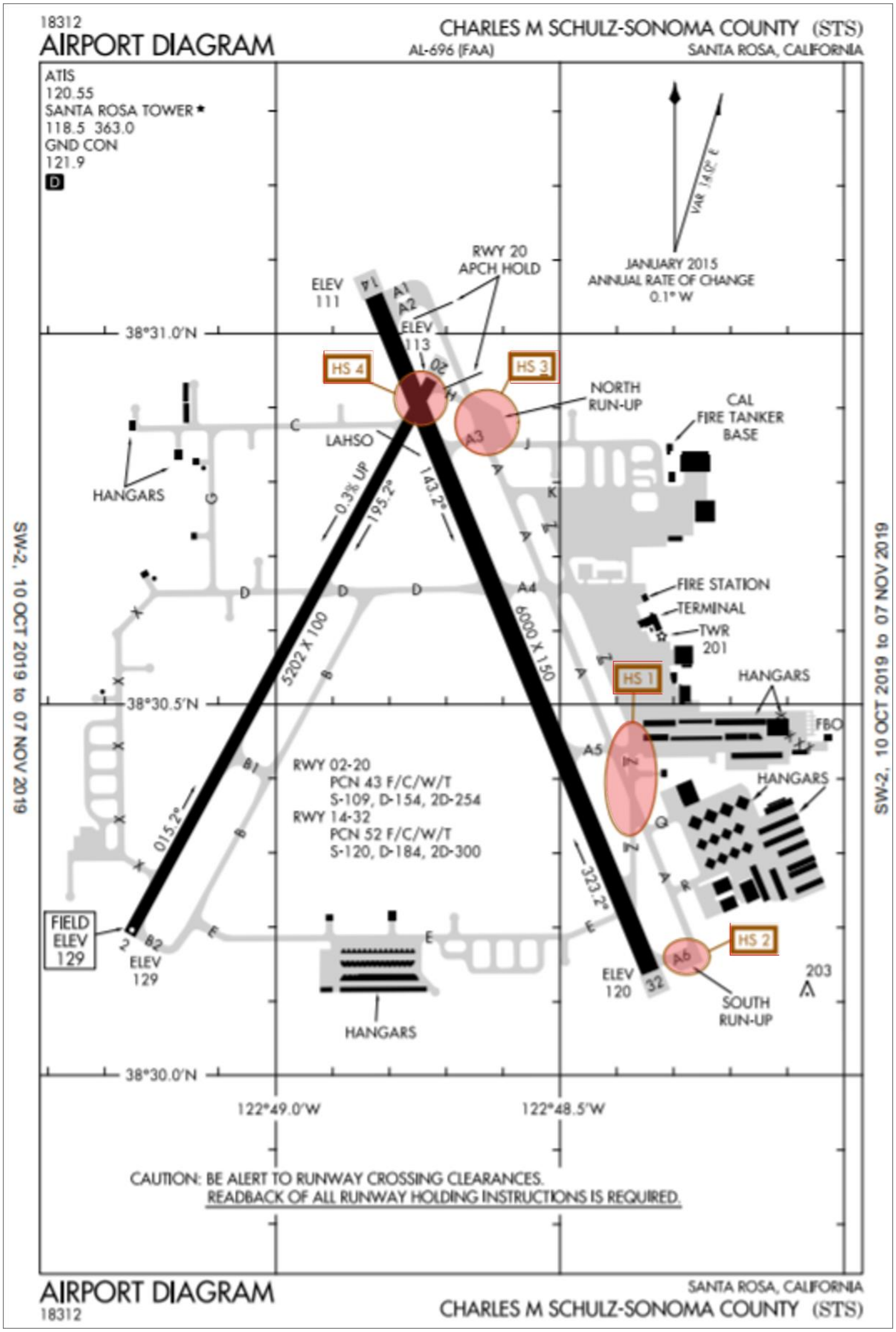
FAA Designated Hot Spots

The FAA has designated four hot spots at STS, which are published in its Airports Facility Directory. A hot spot is a location in an airport movement area with a history of potential risk of collision or runway incursion, and where heightened attention by pilots and drivers is necessary. The following four hot spots (**Figure 4-1**) were identified:

- **Hot Spot 1:** Complex intersection in close proximity to Runway 14/32. Aircraft approaching Taxiway A from the Apron C, Apron D, or Taxiway Z sometimes fail to turn onto Taxiway A and instead enter Runway 14/32 without approval.
- **Hot Spot 2:** Run-up apron at Taxiway A6 is not visible from the air traffic control tower (ATCT). Conversations with the ATCT staff revealed that only the southeast corner of the run-up apron is blind to the ATCT.
- **Hot Spot 3:** Run-up area east of Taxiway A and Taxiway H intersection in close proximity of Runway 20 approach. The hold area causes pilot confusion.
- **Hot Spot 4:** Wrong runway departure risk. Pilots cleared for takeoff on Runway 20 sometimes turn onto and depart Runway 14. Failing to verify heading and alignment with proper runway prior to departure.

Hot spot 4 was previously addressed in the Runway 20 Runway Incursion Mitigation (RIM) analysis. Hot spots 1, 2, and 3 are addressed below in Taxiway A Alternative Evaluation.

Figure 4-1: Airports Facility Directory Hot Spots



Source: Airports Facility Directory, Oct 10 – November 7, 2019

Non-Standard Design

Design guidelines in AC-13A recommend taxiway layouts that enhance safety by discouraging runway incursions. Taxiways at STS were found to not conform with the following design recommendations. These are highlighted on **Figure 4-2**.

Taxiways A4, A5, C, and Z – Acute Angle Exit and Increasing Visibility: Right-angle intersections between taxiways and runways provide the best visibility to the left and right for a pilot. At airports with large jet activity, acute angle, or high speed, runway exits enhance airport capacity and increase efficiency in runway use but should not be used as runway entrance or as crossing points. A right-angle turn at the end of a parallel taxiway is a clear indication of approaching a runway. When the design peak hour is less than 30 operations, a right-angled exit taxiway in the proper location will achieve an efficient flow of traffic.

Taxiway A-A5-Z Intersection and Taxiway C-Runway 2/20 Intersection – Complex Intersection: Taxiways should not coincide with the intersection of two runways. Taxiways configured with multiple taxiway and runway intersections in a single area create large expanses of pavement. These expanses make it difficult to provide proper signs, marking, and lighting. This is also identified as hot spot 1 in **Figure 4-1** above.

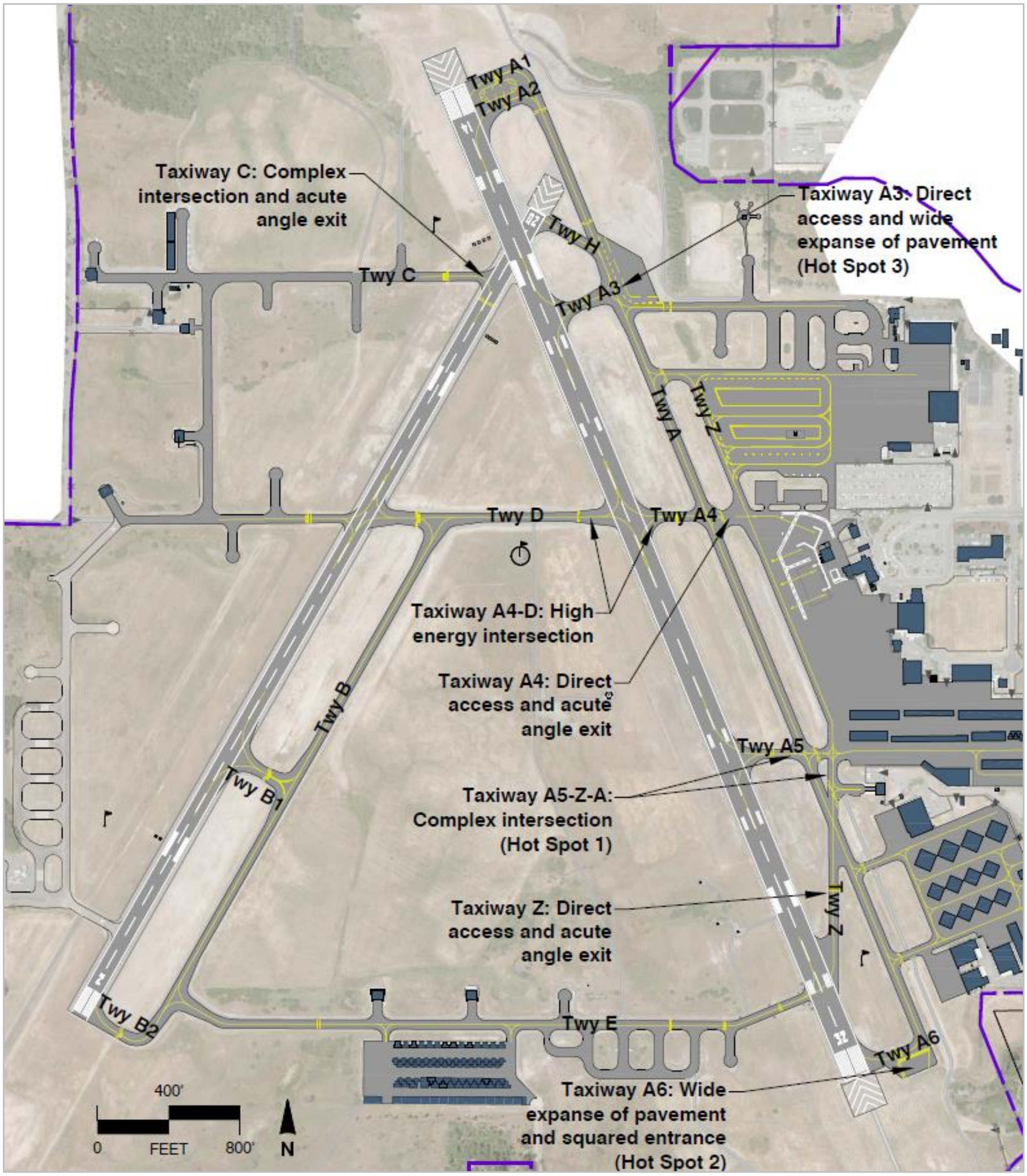
Taxiway A6 – Squared Entrance Taxiway: It is recommended that the outer edge of an entrance taxiway be curved. A squared corner may be confused for a runway end. Above, this is also identified as hot spot 2, because the line of sight from the ATCT is blocked to the southeast corner of the runup apron.

Taxiways A3 and A6 – Wide Expanses of Pavement: Taxiway to runway interface encompassing wide expanses of pavement is not recommended. Above, this is also identified as hot spot 3 (Taxiway A3).

Taxiways A3, A4, and Z – Direct Access: Taxiway design that leads directly from an apron to a runway without requiring a turn is discouraged.

Taxiway A4-D intersection – High Energy Intersections: Intersections in the middle third of the runways are discouraged. By limiting runway crossings to the outer thirds of the runway, the portion of the runway where a pilot can least maneuver to avoid a collision is kept clear.

Figure 4-2: Non-Standard Taxiway Geometry



TAXIWAY A ALTERNATIVE EVALUATION

The goals for ultimate Taxiway A design as part of the Airport Layout Plan (ALP) Update are to correct the non-standard design issues presented above to also meet the taxiway design standards for the critical aircraft using STS. Concurrent with this ALP Update, STS is seeking to perform needed pavement rehabilitation on Taxiway A south of Taxiway A3. Taxiway A, north of Taxiway A3 is generally in good condition and any rehabilitation with this section is under consideration with changes associated with Runway 20 RIM analysis.

Rehabilitation of Taxiway A is a high priority for STS because it is the busiest taxiway, and the signs of deterioration observed will continue while STS awaits approvals and possible environmental processes. STS intended to start engineering design for the rehabilitation in 2015 as recommended in STS's Airport Pavement Management Program. To address these signs of deterioration, initial engineering indicates a combination of slurry seal, mill and overlay as well as sections of pavement removal and replacement. If rehabilitation is delayed by ALP approval and environmental review, the condition of Taxiway A may continue to degrade and create safety hazards or ultimately impact safe operations.

FAA guidance directs that a taxiway be designed and constructed to meet FAA design standards during any reconstruction. This includes meeting TDG requirements for width and fillets and meeting geometry standards to limit incursions.

Complicating the matter is the ALP of record does not show geometry corrections to Taxiway A. Ideally reconstruction of Taxiway A would be used as an opportunity to correct nonstandard designs associated with Taxiway A and its connector taxiways. However, the 2013 approved ALP was completed prior to new taxiway design standards released in changes to AC-13A. The 2013 ALP does not include design changes on Taxiway A needed to:

- Eliminate oblique-angle taxiways
- Provide fillets meeting current standards
- Relocate taxiways that directly connect aprons to the runway
- Provide standard taxiway widths

The ALP update currently underway will address all of these issues, but it is likely that the updated ALP will not receive FAA approval before late 2020. Awaiting approval would further delay the needed rehabilitation.

The alternatives presented in this section provide an ultimate taxiway design that meets standards and is proposed to be included on the ALP. This section also describes alternative design options for near-term solutions for Taxiway A rehabilitation. These different options are driven by environmental impacts and implementation. The proposed alternatives show various impacts to existing pavements, lighting, signage, and sensitive environmental areas at STS. Depending on impacts to areas currently unpaved, the proposed taxiway geometry design changes may require environmental analysis such as a National Environmental Policy Act (NEPA) environmental assessment (EA).

Environmental Interests

Typically, a pavement rehabilitation project will qualify for a Categorical Exclusion (CATEX). If the taxiway rehabilitation project was limited to the existing footprint of Taxiway A, with a slurry seal and reconstruction of the failing section near Taxiway A4, it would likely qualify for a CATEX. However, realigning the connector taxiways will impact formally delineated wetlands in the infield areas between Taxiway A and Runway 14/32 as well as habitat for protected species. The formal wetland delineation approved by the U.S Army Corps of Engineers (USACE) is 10 years old. The field investigations upon which the delineations are based were completed as part of preparation of an EA for the Runway Safety Area. This will need to be updated prior to review of any project that might impact wetlands. Optimally this would be undertaken prior to beginning preparation of the EA. Wetlands shown in alternative designs are from a 2019 wetland mapping update.

Projects with impacts to wetlands require permits from the USACE. Nationwide permits are issued by USACE when impacts are under a specific threshold. These permits can be processed more quickly than Individual Permits. The Individual Permit process must be used when projects have more than minimal impacts.

Realignment of each connector taxiway, individually, would likely qualify for a Nationwide Permit. However, if all of the nonstandard conditions were constructed in one project, it appears that an Individual Permit would be required. Correcting the nonstandard conditions in several projects could be considered segmentation.

Essentially all of the unpaved portions of the Airport are considered habitat for the California tiger salamander, a designated endangered species. Additionally, the US Fish and Wildlife Service (USFWS) considers all wetlands on STS to be habitat for Burke’s goldfields, a protected plant species. This judgement was accepted without challenge during the Runway 14 safety area project because of schedule requirements. Any impacts to a protected species would make modifications to the connector taxiways ineligible for a CATEX. An Environmental Assessment (EA) would need to be prepared.

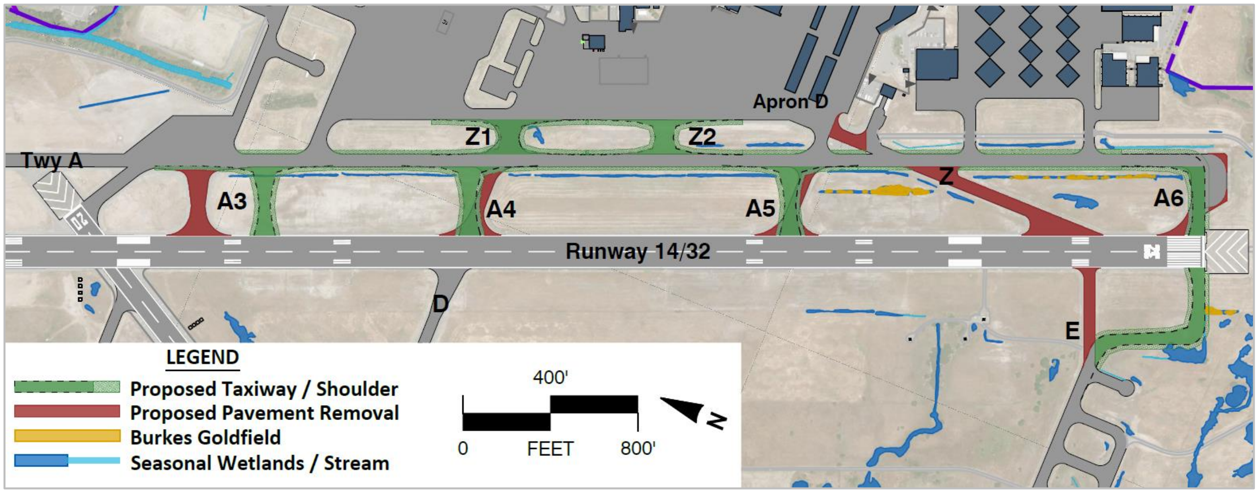
Preparation of an EA commonly requires at least 18 months and could not start until the updated ALP was approved. Therefore, scheduling the modification of the connector taxiways to be completed at the same time as the proposed slurry seal and isolated pavement removal and replacement would delay engineering design three to four years. This would mean that the needed repairs would not occur for four to five years.

Currently mitigation credits for impacts to Burke’s goldfields cost $1.1 million per acre. The mitigation ratio is currently 3:1. This effectively triples the per acre cost. These mitigation costs, along with permitting costs, would need to be included in project budgets for the connector taxiways. Further, the California Department of Fish and Wildlife (CDFW) considers any impacts to wetlands in an area where Burke’s goldfields have been found to be a “take” of the species. A 2081 permit is required for this take, and requires a $20,000 fee in addition to mitigation. Negotiations associated with the take permit commonly take about one year and may run concurrently to the EA, however this process is open to delays with CDFW.

ALTERNATIVE 1: STANDARD DESIGN

Alternative 1 (**Figure 4-3**) shows taxiway design that conforms to AC-13A standards with: incorporates standard geometry design and fillets for TDG 3 taxiways, reconfigured connectors, reduces the width of Taxiway A to 50 feet and adds shoulders the length of Taxiway A. The figure includes the 2019 wetland mapping update and Burke's goldfield location data.

Figure 4-3: Taxiway A Alternative 1



The proposed design for individual segments described below includes the impacts that will likely determine the level of environmental analysis. After evaluation of the proposed designs, the individual taxiway segments may be selected individually for another hybrid design not shown below.

Taxiway A3

The proposed design for Taxiway A3 is to relocate it approximately 300 feet to the south to disconnect from the hold apron area. A new Taxiway A3 is proposed to be constructed with TDG 3 fillets and 20-foot shoulders. Taxiway A3 would present wetland impacts, but no direct impacts to known locations of Burke's goldfields. The project would be subject to preparation of an EA and would require a permit from USACE.

Taxiway A4

The proposed design reconfigures Taxiway A4 to form a 90-degree angle to Runway 14/32 and Taxiway A, with TDG 3 fillets and 20-foot shoulders. The proposed Taxiway A4 incorporates the existing taxiway footprint as much as possible, with the purpose of limiting new pavement on the infield area. Taxiway A4 remains connected to Runway 14/32 at a location that provides access from Taxiway D across Runway 14/32 to Taxiway A. Reconfiguring Taxiway A4 to a right angle also disconnects this from the connector between A and Z, with two full 90-degree turns. This construction would have a small impact to wetlands, which means it would require an EA and a permit from USACE.

Taxiway A5

The proposed design for Taxiway A5 reconfigures it to a 90-degree angle to Runway 14/32 and Taxiway A, with TDG 3 fillets and 20-foot shoulders. The proposed Taxiway A5 incorporates the existing taxiway footprint as much as possible, with the purpose of limiting new pavement on unpaved areas. This construction would have a small impact to wetlands. It may be possible to slide the realigned Taxiway A5 slightly to the north to avoid impacts to the infield area known to have Burke's goldfields. However, USFS's presumption of impacts to Burke's goldfields habitat means that an EA would be required, as well as a permit from USACE.

North Apron Connector Taxiway

The proposed design for the Taxiway A4 connector between A and Z reconfigures the connector to a 90-degree angle to Taxiway A, and expands the connector with TDG 3 fillets and 20-foot shoulders. Since this design disconnects the connector from Taxiway A4, the connector is proposed to be named Taxiway Z1. A section of the fillet for Taxiway Z1 appears to clip a section of wetland. Therefore, an EA would be required as well as a permit from USACE.

South Apron Connector Taxiway

A second connector between Taxiways A and Z is proposed south of Taxiway Z1, with the purpose of replacing access lost by removal of the Taxiway Z connector stub to the south. This second taxiway connector is designed to TDG 3 standards and is proposed to be named Z2. Taxiway Z2 by design appears that it may be constructed without impacting wetlands or known Burke's goldfields sites. However, because the unpaved areas are considered habitat for the California tiger salamander, and EA would be required.

Taxiway Z

Taxiway Z is proposed to be removed between Taxiway A and Runway 14/32, with the intention of eliminating hot spot 1. The proposed design reconfigures taxiway access to the Sheriff's facility to eliminate the connection between Taxiway A and Apron D. Removal of pavement may not be immediately necessary, as markings could signify closure. Closure of Taxiway Z between Taxiway A and Runway 14/32 is dependent on the reconfiguration of Taxiway E, as described below. This taxiway closure and removal could be done without impacting wetlands or known locations of Burke's goldfields. However, because the unpaved areas are considered habitat for the California tiger salamander would be affected by pavement removal, an EA would be required.

Taxiway A6

The proposed design for Taxiway A6 redesigns it with TDG 3 fillets and 20-foot shoulders. The run-up apron is reconfigured to correct the square corner on the run-up apron. The square corner may be marked as unusable with green paint rather than removing pavement. With the introduction of TDG 3 fillets and 20-foot shoulders, this project would impact wetlands and might impact known Burke's goldfields locations, which would trigger the State 2081 permit process. The project would impact habitat of the California tiger salamander. Preparation of an EA would be required as well as a permit from USACE.

Taxiway E

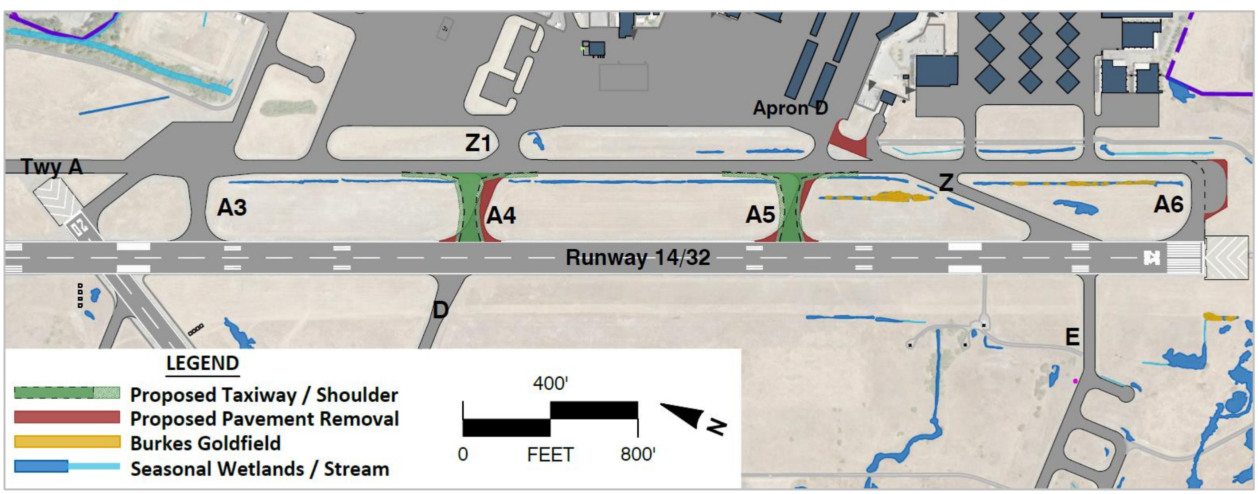
The proposed design for Taxiway E reconfigures it to connect at the threshold of Runway 32, with TDG 3 fillets and 20-foot shoulders. The project would impact habitat of the California tiger salamander and Burke's goldfields. This project would appear to have the most severe complications and likely trigger the State 2081 permit process. It is likely to have the highest mitigation costs of all individual taxiway segments associated with Taxiway A. Preparation of an EA would be required as well as a permit from USACE.

Alternative 1 would require a NEPA EA. It would require a supplement to the California Environmental Quality Act (CEQA) Environmental Impact Report (EIR). Permits would be required from the USACE, USFWS, and CDFW. Completion of the EA/EIR process would take at least 18 months, and the FAA must approve the EA prior to a grant for engineering design being issued. Once the EA is approved, permitting would take another 6 months to a year. Permits are not needed to start design, but must be in hand prior to construction. Alternative 1 has a significant potential to be delayed due to prolonged negotiations related to the take permit process with CDFW of Burke's goldfields areas.

ALTERNATIVE 2A: HYBRID DESIGN

Alternative 2A (**Figure 4-4**) is a hybrid design that implements several elements of Alternative 1 while limiting environmental impacts with the goal of expediting design and rehabilitation of Taxiway A. This alternative proposes that Taxiway A be maintained at 60 feet wide, and that Taxiway A4 and A5 be converted to 90-degree connectors with 50-foot widths, TDG 3 fillets, and 20-foot shoulders. Modifications to eliminate hot spots would be made: eliminating the Taxiway Z connection between Taxiway A and Apron D, and correcting the square corner on Taxiway A6. These pavement areas may be marked as unusable with an "X" and green paint as opposed to removing pavement.

Figure 4-4: Taxiway A Alternative 2A



The hybrid design of Alternative 2A proposes modifications to hot spots and design on Taxiways A4 and A5 for the purpose of:

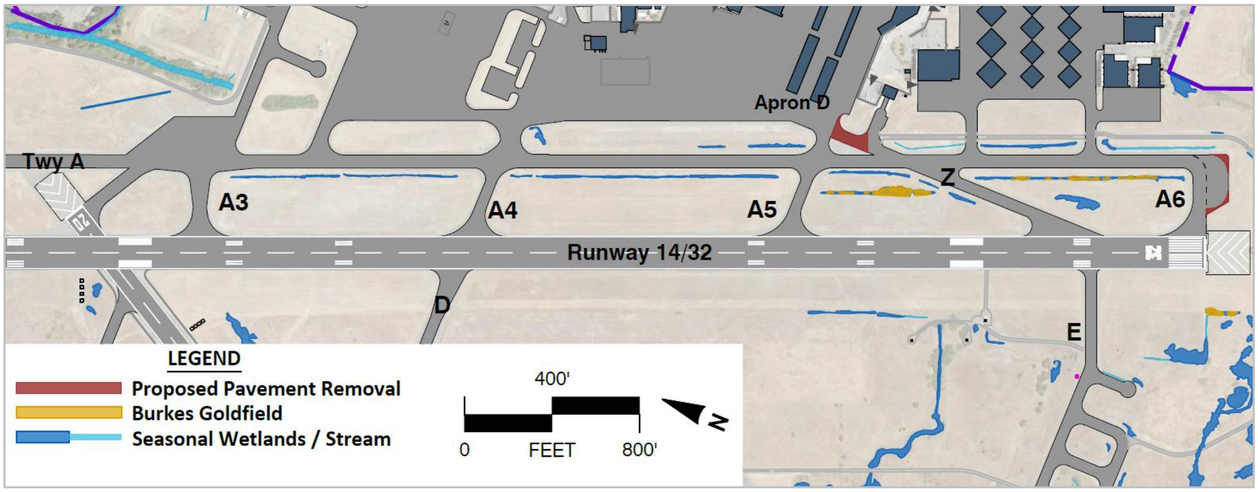
- Initiating the process of standardizing the Taxiway A system by converting Taxiways A4 and A5 to TDG 3 standards with right-angle intersections.

Alternative 2A would require a NEPA EA. It would also require a supplement to the CEQA EIR. Permits would be required from USACE, USFWS, and CDFW. Completion of the EA/EIR process would take at least 18 months, and the FAA must approve the EA prior to a grant for engineering design being issued. Permitting would take another 6 months to a year. Permits are not needed to start design, but most be in hand prior to construction.

ALTERNATIVE 2B: COMPROMISED DESIGN

Alternative 2B (**Figure 4-5**) implements several components from Alternative 1, but fewer than Alternative 2A. Alternative 2B proposes that a 60-foot width is maintained on Taxiway A. The components include the hot spot corrections that do not require new pavement, thus not likely triggering environmental review beyond a CATEX: eliminating Taxiway Z between Taxiway A and Apron D, and eliminating a portion of the run-up apron on Taxiway A6 to correct the square corner. These pavement areas may be marked as unusable with “X” and green paint rather than removing pavement.

Figure 4-5: Taxiway A Alternative 2B



The compromise design of Alternative 2B proposes modifications to hot spots for the purpose of:

- Limiting environmental impacts, with Alternative 2B likely requiring a CATEX, which facilitates near-term design and rehabilitation of Taxiway A with the intention of reducing the cost for Taxiway A rehabilitation.

Alternative 2B would need an ALP update to show the areas to be removed, however this may be accomplished with a pen-and-ink approval to expedite the project.

ALTERNATIVE 3A: IN-PLACE DESIGN AND MAINTAIN WIDTH

Alternative 3A proposes an in-place rehabilitation for Taxiway A with no new or permanently removed pavement on Taxiway A or the connectors. Alternative 3A would maintain the 60-foot width of Taxiway A and not introduce taxiway fillets at intersections, or a full-length shoulder. Alternative 3A would likely require a CATEX. This would be the least complicated alternative from the standpoint of environmental impact and design and would expedite the construction schedule. With this action, the Standard Design (Alternative 1) will still be added to the ALP for the next Taxiway A or Runway 14-32 pavement reconstruction project. Alternative 3A could begin prior to the ALP Update being approved.

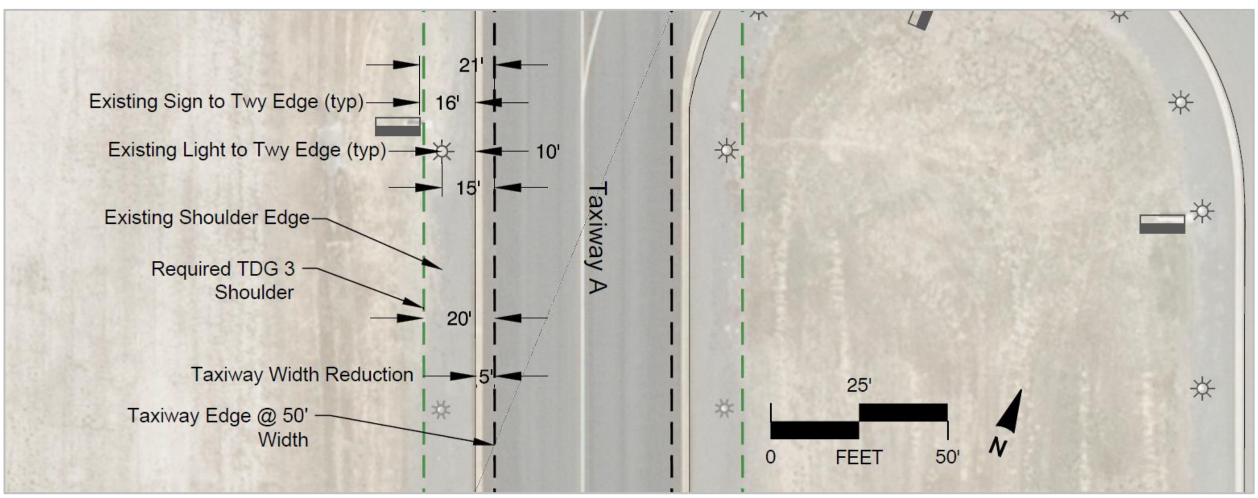
ALTERNATIVE 3B: IN-PLACE DESIGN AND REDUCTION TO 50-FEET

Alternative 3B proposes reducing the width of Taxiway A to 50 feet with no other geometry changes, to meet TDG 3 standards. Reduction to 50 feet wide requires changes to the location of the lights and signs relative to the taxiway edge. **Figure 4-6** details a section of Taxiway A with existing light and sign locations. Taxiway edge lights are currently located 10 feet from the edge of Taxiway A.

FAA standards permit edge lights to be located between 2 and 10 feet from the edge of a taxiway, and narrowing Taxiway A to 50 feet would render the existing lighting non-standard due to their distance from the edge. Instead the edge lights would need to be relocated at least 5 feet closer to the new taxiway edge along the entire length of Taxiway A.

Signs along Taxiway A would also need to be realigned closer to the edge of the taxiway if it is narrowed. The standard for taxiway guidance signs is for the distance of the taxiway edge to the near side of the sign to be between 10 and 20 feet.

Figure 4-6: Taxiway A Alternative 3B



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The existing shoulders of Taxiway A are stabilized with rolled base material. It appears possible to reduce the taxiway width, shift the edge lights provide a standard should without impacting wetlands or California tiger salamander or Burke's goldfield habitat. However, it appears that some of existing sign footings extend beyond the edge of the stabilized shoulder. Relocating these signs and removing the footings may result in impacts to California tiger salamander habitat. Therefore, it is expected that an EA would be required for this alternative.

Individual taxiway connector segments are shown below in **Table 4-3** and **Table 4-4** with a thumbnail figure and data on new pavement, removed pavement, signs and lights to be displaced, and likely NEPA document for that individual taxiway.

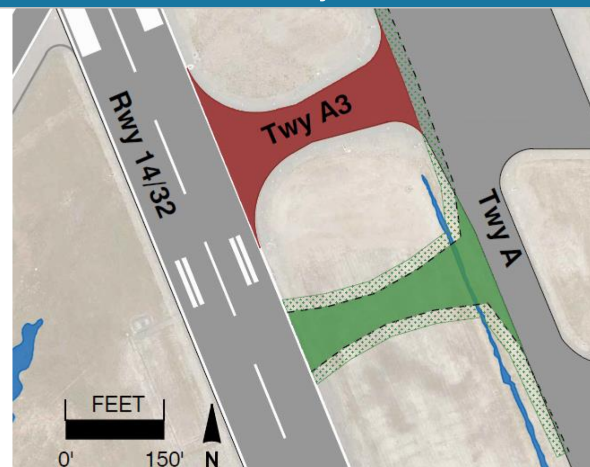
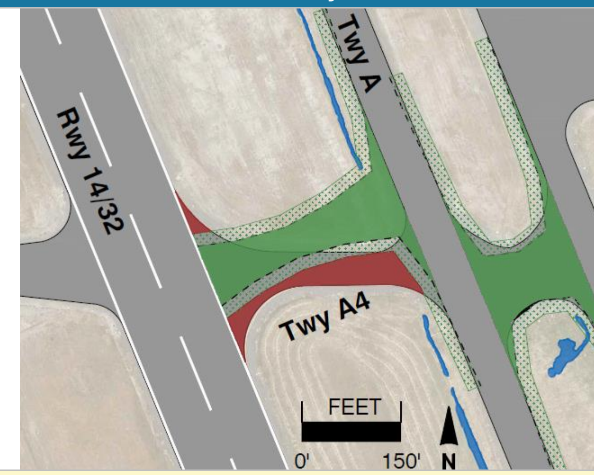
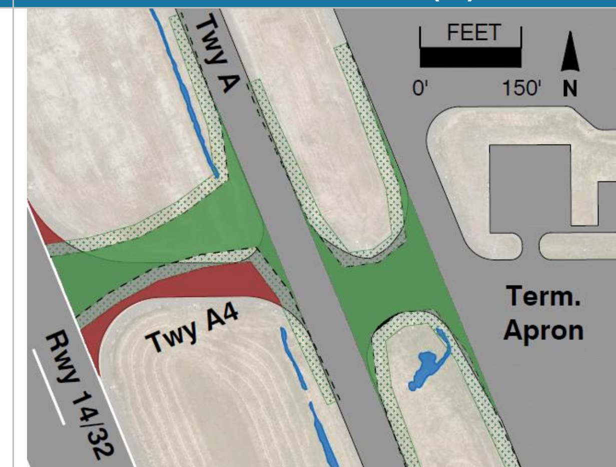
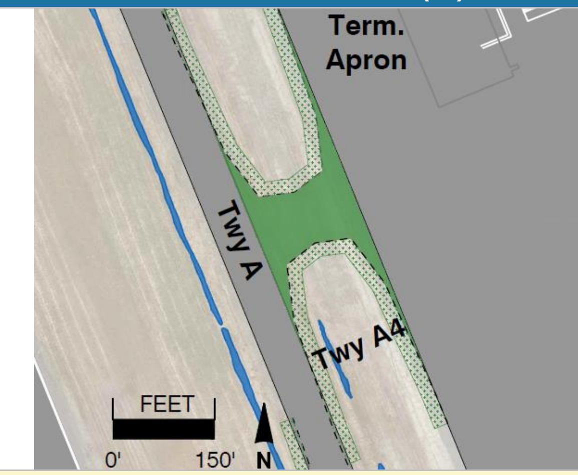
Table 4-2: Taxiway A Alternatives Matrix

Alternative Number	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B
Alternative Name	**Standard Design**	**Hybrid Design**	**Compromised Design**	**In-Place Design & Maintain Width**	**In-Place Design & Reduce to 50-feet**
Alternative Features	• Complies with 13A • 50-foot taxiways • Hot Spot Correction: – *Twy A3 relocation* – *Eliminate Z (full)* – *Round corner on A6* • TDG compliance on A3, A4, A5 and A6 (width and fillets) • Connector taxiway corrections	• 60-foot Taxiway A • 50-foot connectors • TDG compliance on A4 and A5 (width and fillets) • Hot Spot Correction – *Eliminate Z (east of A)* – *Round corner on A6* • No Change to A3 design or location	• 60-foot Taxiway A • 50-foot connectors • Hot Spot Correction – *Eliminate Z (east of A)* – *Round corner on A6* • Maximize existing pavement • Minimize environmental impacts	• In place rehab • 60-foot Taxiway A • No new or permanently removed pavement	• Reduce Twy A to 50 feet full length • Lights and signs to be realigned to new edge • Option: Include 20-foot standard shoulder
Full AC-13A Compliance	Full	Partial	Partial	No	No
Hot Spot Correction	Full	Partial	Partial	No	No
New Pavement (SF)	126,600	28,750	None	None	None
Perm. Removed Pavement (SF)	133,330	28,330	13,100	None	None
New Shoulder (SF)	143,000[1]	25,820	None	None	10,000[1]
Lights Displaced (No.)	125	46	None	None	92
Signs Displaced (No.)	26	8	None	None	14
NEPA Document[2]	EA	EA	CATEX	CATEX	EA
Planning to Design Timeline	3-4 Years	3-4 Years	2 Years[3]	6 Months	3-4 Years
Limits of Disturbance	Edge of 20-foot shoulders	Edge of 20-foot shoulders	Edge of 20-foot shoulders	Existing edge of Taxiway A	Edge of 20-foot shoulders[1]

1. Does not include stabilization or pavement outside of existing Taxiway A shoulder edge where needed.
2. NEPA document based on assumption that any impact to a wetland is also an impact to habitat for Burke's goldfields, and all unpaved portions of the Airport are considered habitat for the California tiger salamander.
3. Potential for Alt 2B to be implemented with pen-and-ink ALP update which may shorten the timeline.

Notes: Add Standard Design (Alternative 1) to ALP for next Taxiway A rehabilitation.
Pavement square footages (SF), lights, and sign totals are approximate.

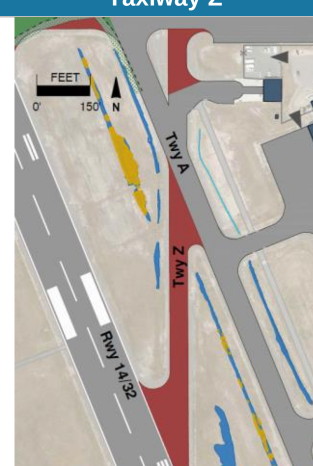
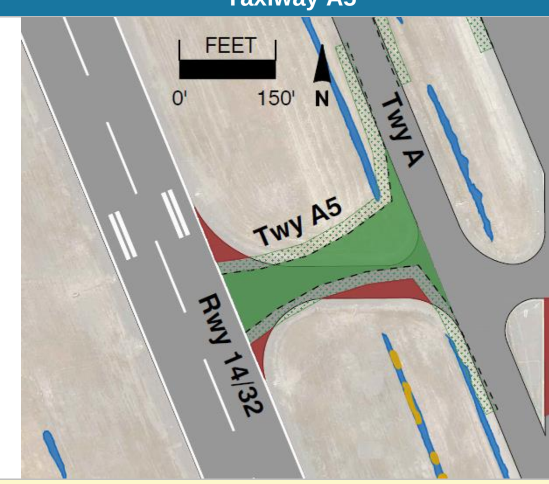
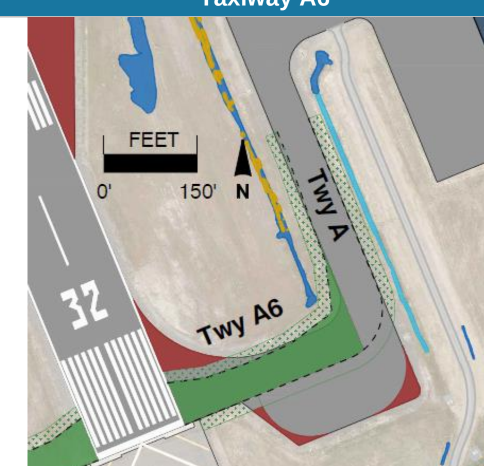
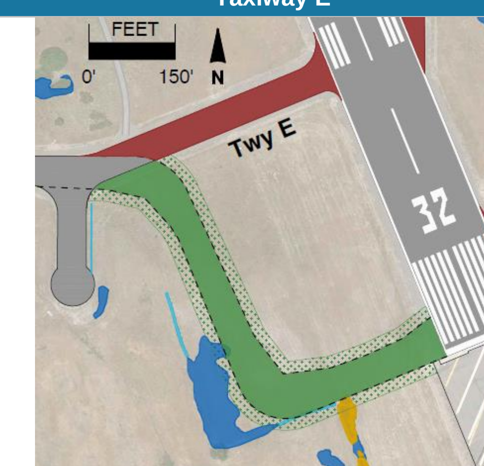
Table 4-3: Individual Taxiway Connector Segments (A3, A4, Z1, Z2)

Taxiway Connector	Taxiway A3		Taxiway A4	North A-Z Connector (Z1)	South A-Z Connector (Z2)
Detail					
	Removed Section	**Proposed Design**	**Proposed Design**	**Proposed Design**	**Proposed Design**
New Pavement (SF)	None	24,800	1,700	21,800	16,600
Removed Pavement (SF)	29,000	None	None	None	10,050
New Shoulder (SF)	None	18,000	24,800	26,850	13,600
Lights Displaced (No.)	19	10	10	4	23
Signs Displaced (No.)	6	None	1	None	3
NEPA Document[1]	EA	EA	EA	EA	EA

Pavement square footages (SF), lights, and sign totals are approximate.

1 NEPA document based on assumption that any impact to a wetland is also an impact to habitat for Burke's goldfields, and all unpaved portions of the Airport are considered habitat for the California tiger salamander.

Table 4-4: Individual Taxiway Connector Segments (Z, A5, A6, E)

Taxiway Connector	Taxiway Z		Taxiway A5	Taxiway A6		Taxiway E	
Detail							
	Removed Section	**Proposed Design**	**Proposed Design**	**Run-Up Apron**	**Proposed Design**	**Removed Section**	**Proposed Design**
New Pavement (SF)	None	10,600	12,150	None	1,600	None	47,950
Removed Pavement (SF)	52,450	None	5,180	2,500	3,800	19,750	None
New Shoulder (SF)	None	None	12,220	None	16,300	None	30,700
Lights Displaced (No.)	3	None	23	None	22	10	1
Signs Displaced (No.)	4	None	5	None	5	2	None
NEPA Document[1]	EA	EA	EA	CATEX	EA	EA	EA

Pavement square footages (SF), lights, and sign totals are approximate.

1 NEPA document based on assumption that any impact to a wetland is also an impact to habitat for Burke's goldfields, and all unpaved portions of the Airport are considered habitat for the California tiger salamander.

Chapter 5
ARFF Relocation Analysis

Chapter 5 -

ARFF Relocation Analysis

EXECUTIVE SUMMARY

Sonoma County Airport's (STS) Aircraft Rescue and Firefighting (ARFF) facility is located immediately north of the passenger terminal building. Planned expansion of the terminal and associated facilities cannot occur until the ARFF building is relocated. Additionally, the ARFF facility has reached the end of its useful life, is undersized, and needs to be expanded to accommodate additional vehicle bays and associated parking areas. As a part of the update of the STS's Airport Layout Plan (ALP) alternative sites for a replacement ARFF building were evaluated. This Executive Summary summarizes the factors used to identify and evaluate possible sites for a replacement ARFF facility.

STS is currently classified as ARFF Index B, which means the Airport meets the standards to accommodate regular use (i.e., five daily departures) by aircraft as large as the Boeing 737-700 and less frequent use by larger aircraft. The updated forecasts prepared as part of this ALP update anticipate that this ARFF Index will accommodate the airline aircraft expected to use STS during the 20-year planning period.

Requirements and Siting Criteria

FAA advisory circulars and federal regulations provide standards and guidance for planning, designing, and constructing an ARFF facility. The new facility will be designed to be consistent with these standards and regulations to facilitate the duties of personnel, expedite the movement of equipment, and provide ready access to materials and supplies. The following factors were considered when siting the new ARFF Facility:

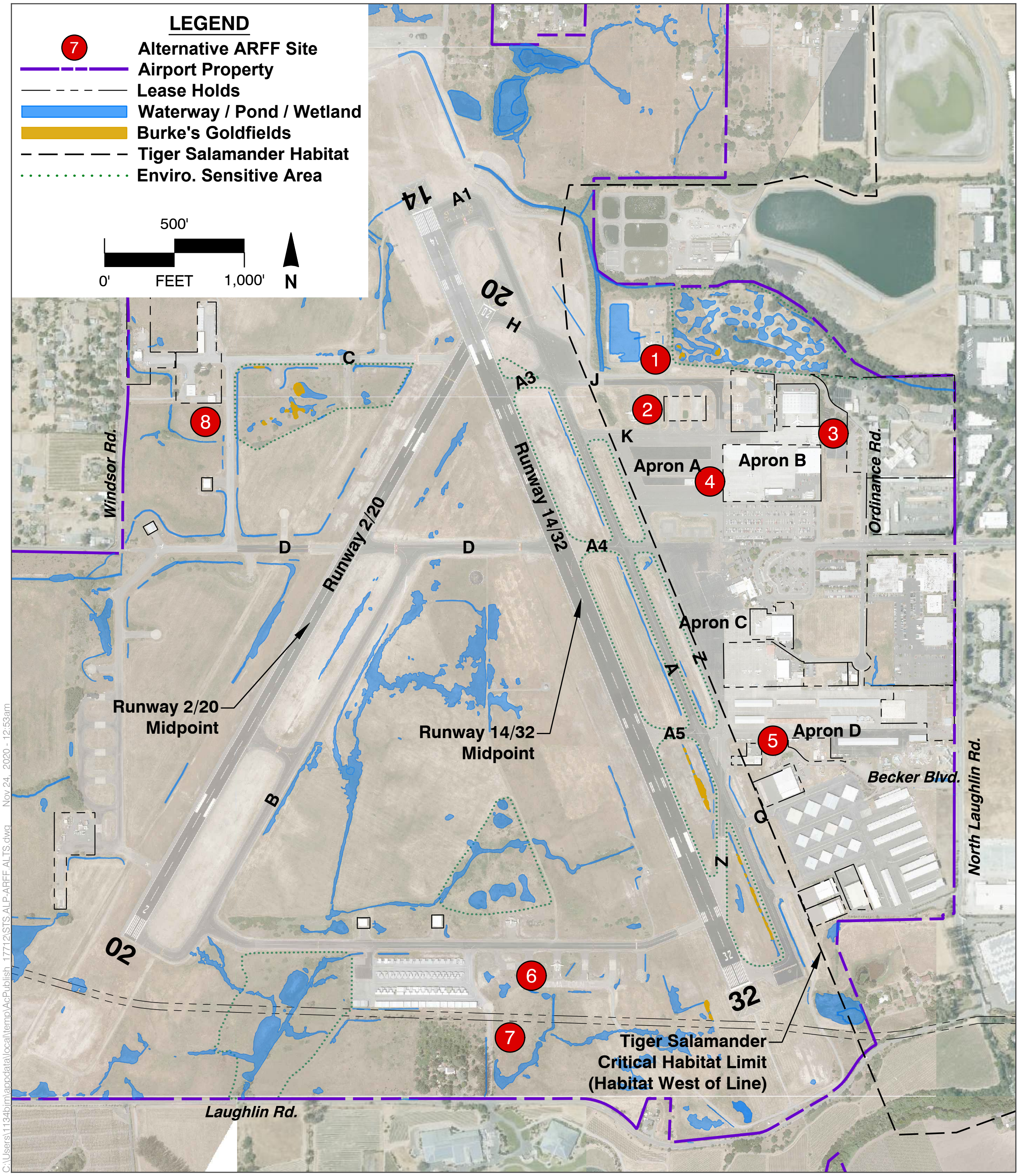
- **Airside Access and Response Time:** The preferred site should allow adequate response time to various airfield locations, as determined by federal regulations.
- **Impact on Facilities and Operations:** The preferred site should not significantly impact airport operations as well as existing and future facilities. A primary goal of this relocation is to enable terminal expansion.
- **Environmental Impacts:** The preferred site will have limited impacts to airfield areas that contain habitat for several special-status species and classes of wetlands.
- **Airport Observation:** The preferred site should provide ARFF staff a view of the airfield from the facility.
- **ATCT Line of Sight:** The preferred site should not interfere with Air Traffic Control Tower (ATCT) line of sight to aircraft movement areas.

- **Proximity to Operations Staff Primary Work Area:** The preferred site should ideally be located near to where the Airport's operations staff spend most of their time. STS does not have dedicated ARFF crews; ARFF services are provided by the Airport's operations staff. Proximity improves efficiency in staff utilization.
- **Landside Access:** The preferred site should ideally be located near a security fence line so visitors (e.g., delivery trucks) may access when needed. Because visitors are infrequent, this is a useful, but not essential, factor.
- **Ability to Serve as a Joint-Use Facility:** Selection of the preferred site should consider the operational and financial benefits to the Airport to jointly operate an ARFF / fire station with the Sonoma County Fire District.

Eight preliminary sites for ARFF relocation were identified. Each site has limits or constraints due to either airside access, landside access, available land, utilities, or environmental impacts. **Figure 5-1** shows the preliminary sites, location of water/wetlands, and environmentally sensitive areas.

- **Alternative 1** is west of the Cal Fire base, north of Taxiway J, and south of the Remote Transmitter/Receiver (RTR) site.
- **Alternative 2** is near the site designated on the 2013 ALP between Taxiways J and K. Alternative 2 shifts the ARFF facility east to a location that will not block line of sight between the ATCT and aircraft on Taxiway J holding at Taxiway A.
- **Alternative 3** is on the east end of Apron B adjacent to existing Fixed Base Operator (FBO) hangars.
- **Alternative 4** is north of the footprint for the proposed ultimate passenger terminal and northwest of long-term public Parking Lot B.
- **Alternative 5** is on the south side of Apron D east of the Sonoma County Sheriff's helicopter facility.
- **Alternative 6** is in the south quadrant on the old hard stand positions east of Apron F.
- **Alternative 7** is in the south quadrant south of Apron F.
- **Alternative 8** is in the west quadrant with Taxiways C and D providing airside access.

Figure 5-1: ARFF Preliminary Alternative Sites



Preliminary Analysis

The eight ARFF site alternatives were evaluated based on the site requirements described above. For site evaluation purposes, costs associated with the actual ARFF facility design and construction are expected to be relatively equal for all proposed sites. Significant cost variables for specific sites are utility access and interference with FAA facilities. Other variable cost drivers are landside access, environmental mitigation, and grading and drainage.

Alternative Site 1

Initial analysis was favorable for Site 1, as it appeared to offer advantages over other locations: an undeveloped pocket of land that will likely not accommodate other uses, lack of conflicting facilities nearby, limited impacts to airport operations and terminal expansion, a clear view of the airfield and appropriate access times, and easily accessible for operations staff. However, the proximity to the RTR tower array required further analysis and represented unanticipated costs. The FAA requested a draft Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) study be submitted. One significant component of that effort was a shadow study report with preliminary analysis of impacts to RTR transmission. The shadow study determined the proximity Alternative 1 to the RTR will interfere with transmission signals. This study also showed that moving the ARFF slightly in this general location does not prevent interference with the RTR. The ARFF facility height is fixed by function, so lowering the building and vehicle bay is not an option.

Following receipt of the shadow study, the FAA's Operations and Engineering Support Group (OESG) responded with a meeting to discuss a feasibility study proposal for RTR modification. The FAA provided order of magnitude costs for addressing ARFF impacts to the RTR facility that addressed two scenarios: raising of the RTR antennas and relocating the facility to a new site. The most likely cost for raising the antennas was estimated to be about $1.7 million with a low estimate of $1.3 million and high estimate of $2.6 million. A new RTR site had a most likely cost of $3.6 million, with low and high costs estimated to be $2.7 and $5.4 million, respectively. The FAA cost estimates were based upon several assumptions:

- STS would be responsible for managing all design and construction activities. These costs are not included in the estimates presented above.
- The costs do not include FAA's overhead costs for labor and expenses.
- The costs do include the costs of providing RTR signal coverage during construction.
- There is a high degree of uncertainty over the technical requirements and constraints on the new facility until a formal feasibility study is conducted by the FAA.

Costs associated with RTR modification, coordination with FAA, and an uncertain timeline and construction date make Alternative 1 a less attractive option than Sites 4 and 8.

Alternative Site 8

Site 8 was retained for consideration because it is the best of the sites not on the east side. Costs beyond the general costs for site design and construction of Site 8 include water and sewer access and California Tiger Salamander mitigation costs. There were two west quadrant wastewater service options: extension of a sewer line from the east side of the Airport or installation of a septic system. There were two west quadrant domestic water service options: extension of a water main and use of a well and onsite water storage tanks.

Even if well and septic systems can be used, providing sewer and water service is estimated to cost over $1 million at Site 8. Any Airport project not limited to existing pavement will be considered to have impacted the California tiger salamander's habitat. Therefore, development of this site will require mitigation. Mitigation will consist of payment of a per acre mitigation fee of $32,000 per acre.

For this analysis, the onsite septic system paired with the onsite well and storage tanks is selected for planning cost estimates. The significant increase in costs associated with water main and sewer line connections, combined with the inconvenience for operations staff to access from the east side building area, likely make Site 8 unfeasible.

Alternative Site 4

Site 4 likely has the lowest development costs and least potential for delay. Environmental processing will be relatively simple compared to Sites 1 and 8 since this site is located on existing pavement. This makes it both less expensive to build and less subject to delay. The primary drawbacks are impacts to Apron A and potential constraints to ground service equipment. The impacts to Apron A are judged to be the most significant impact. As air service expands, Apron A will need to be modified to accommodate increased spaces designated for overnight and unscheduled maintenance parking for airline aircraft. Adjacent FBOs are seeking additional apron area for their use. There are no adjacent alternative sites for these uses.

As the ARFF analysis occurred, analyses for the near-term terminal footprint, aircraft parking positions, and the ultimate terminal footprint were refined. The analysis indicated requirements for Apron A to accommodate additional airline parking positions for remain overnight (RON) or maintenance positions away from the terminal in the near term. The proposed concept is to add pavement to the former helicopter parking positions, immediately north of the current airline parking positions, and the area between Taxiways J and K. This additional pavement allows for some flexibility on Apron A and reopens the potential to develop the ARFF facility on Apron A without severely impacting existing general aviation, the FBO, or the ultimate terminal facilities.

Three variations on Site 4 permit evaluation of different configurations of Apron A and associated taxilanes. Each Apron A alternative utilized the anticipated 2040 footprint of the passenger terminal. The terminal design accommodates six gate positions in one row. This configuration eliminates 5 push-back tiedown positions for single-engine aircraft and 10 taxi-through positions sized for piston and smaller turboprop twin-engine aircraft. These reductions occur independent of the location of the ARFF facility. Small shifts in the location and configuration of the ARFF facility optimize the space available for aircraft parking in each apron alternative.

Recommended Site

After refined analysis of the ultimate terminal footprint, gate positions, and impacts on general aviation parking, it was determined Apron A will accommodate an ARFF facility. After consideration of the strengths and weaknesses of each alternative, Site 4 on Apron A has been selected as the preferred site. The principal weakness of Site 4 is its impact to the ultimate terminal and general aviation parking on Apron A. This is judged to be less significant than its attributes:

- Site 4 is located in the east-side core area with access to existing facilities, which makes it efficient for operations staff, who serve as the ARFF staff.
- Site 4 offers minimal environmental impacts.
- Site 4 can be used for a joint-use ARFF / fire station.
- Site 4 does not constrain future passenger terminal development.
- Site 4 has a low impact on airport and aircraft operations.

Site 4 will be added to the ALP and the layout and orientation will continue to be refined so the proposed ARFF facility is compatible with future terminal and parking expansion.

INTRODUCTION

The ARFF facility is located immediately north of the passenger terminal building. Planned expansion of the terminal and associated facilities cannot occur until the ARFF building is relocated. Additionally, the ARFF facility has reached the end of its useful life, is undersized, and needs to be expanded to accommodate additional vehicle bays and associated parking areas. This study evaluates alternative sites for a replacement ARFF building as a part of the update of the ALP and concludes with a future preferred site.

A previous ARFF relocation study was completed in 2010. The study analyzed a site west of Cal Fire between Taxiways J and K. The 2010 ARFF Study results led to a site plan that assumed that local fire district response vehicles and staff would be collocated with the ARFF facility. Preliminary siting analysis in this study considers ARFF requirements such as location, response, and impact on operations for airport functions; its ability to serve as a site for collocated fire services was not initially considered. However, a collocated facility may be revisited once a preferred site is found that satisfies airport requirements.

The 2013 ALP designates a site for the future ARFF facility west of Cal Fire between Taxiways J and K. FAA OE/AAA from 2018 (ASN 2018-AWP-1500 through 1503-NRA) and input from ATCT staff concluded that to place an ARFF building at this location interferes with line of sight between the ATCT and aircraft taxiing on Taxiway J and holding at Taxiway A. To evaluate alternative locations and other potential sites, an ARFF siting study was made a part of this ALP update.

ARFF FACILITY REQUIREMENTS AND SITING STANDARDS

FAA Advisory Circular 150/5210-15A (AC 5210-15A) and the Code of Federal Regulations Title 14, Part 139 (Part 139), provide standards and guidance for planning, designing, and constructing an ARFF facility. The new facility will be designed to be consistent with standards in AC 5210-15A and Part 139 to “facilitate the duties of personnel, expedite the movement of equipment, and provide ready access to materials and supplies.”

Classification Index

The design requirements for an ARFF facility depend on the ARFF Index rating, as outlined in AC 5210-15A. The ARFF Index rating is based on the length of the longest air carrier aircraft averaging at least five daily departures. The implication is that the longer the aircraft, the more passenger seats on board, and the more firefighting resources that are needed to respond to an incident.

- Index B: This index Includes aircraft at least 90 feet but less than 126 feet long. Index B requires one or two response vehicles, depending on the amount of water or foam production carried by all vehicles is at least 1,500 gallons.
- Index C: This index includes aircraft at least 126 feet but less than 159 feet long. Index C requires two or three response vehicles, depending on the amount of water or foam production carried by all vehicles is at least 3,000 gallons.

The FAA's Airports Facility Directory currently classifies STS as ARFF Index B. STS currently has the appropriate ARFF equipment to accommodate Index B operations. The following analysis looks to confirm the current and future ARFF classification at STS.

The most common air carrier aircraft using STS today and throughout the planning period are shown in **Table 5-1** with their respective lengths. This table shows the same aircraft fleet mix from Table 2-28 in the Forecast Chapter. Schedules from STS during the peak month of 2019 show more than five daily departures by the CRJ-900 and E175. Operations by these aircraft confirm the existing ARFF classification as Index B.

Table 5-1: Aircraft Lengths for ARFF Index

Aircraft	Length	ARFF Index
CRJ-200	87.8'	A
CRJ-550	76.3'	A
CRJ-700	76.3'	A
CRJ-900	118.8'	B
E170-200	98.1'	B
Q400	107.8'	B
MRJ 90	117.5'	B
E175-E2	106.2'	B
B737-700	110.3'	B
B737-800	129.5'	C

Source: Lengths from FAA-Aircraft-Char-Database-v2-201810

Forecasts show growth in operations by the Boeing 737-700 and 737-800 at STS. The 737-800 is classified as ARFF Index C. Operations by this aircraft may reach five daily departures over the planning period. Forecasts approved by the FAA (August 2021) show 13 operations by air carrier aircraft daily at STS in 2028. As of December 2021, the fleet mix at STS is fluid with operations by regional jets and narrow-body aircraft, including the 737-800. STS should be prepared to reclassify to ARFF Index C should the 737-800 or larger aircraft reach an average of 5 daily departures.

Airside Access and Response Time

For a Part 139 commercially certificated airport the standard firefighting response time is three minutes from the time of the alarm for at least one ARFF vehicle to reach the midpoint of the farthest runway serving commercial aircraft to begin application of the extinguishing agent. All other ARFF vehicles must reach this same point within four minutes. This response time should include an allotment for ARFF personal to dress into firefighting gear and enter vehicles. Both runways serve commercial aircraft at STS. Therefore, for each alternative, the response time was calculated to the midpoint of the most distant runway. Other points on the airfield are also included for reference.

Impact on Facilities and Operations

Siting to relocate an ARFF should consider how the facility will interact with airport operations as well as existing and future facilities. A primary goal of this relocation is to enable terminal expansion. Therefore, the new location must not be in a place where the ARFF will limit near-term and ultimate terminal expansion. ARFF siting should also consider airport operations in its vicinity. The optimal location will be where aircraft operations will not interfere with ARFF response. Likewise, locating the new facility where ARFF operations do not limit airport operations, aircraft movement, and facilities such as FBOs and aprons is important.

Facility Requirements

AC 5210-15A provides the standards for an ARFF station and square footage recommendations. Requirements for four functional areas are described below: vehicle bays, an ARFF building, the ARFF vehicle apron, and parking lot.

Vehicle Bays

The length, width and height of vehicle bays is established by using the dimensions of the largest existing or anticipated new truck with the minimum parking clearances. Proper sizing of the ARFF vehicle bays will provide operational flexibility, a clear margin of safety, and space to undertake minor maintenance tasks for each truck. These ARFF vehicle standard clearances are guidance minimums:

- At least 6 feet between the vehicle and walls
- 8 feet between vehicles parked side by side
- 5 feet between vehicles parked end to end
- 5 feet between vehicle and stall bay doors.

These separation distances are minimums, so clearances will be at least this much and can be expanded by up to 20 percent for local considerations. The recommendation is for each equipment bay to be 50 feet long and 19 feet wide. The standard ceiling clearance above the ARFF vehicle work platform is at least 7 feet. The dimensions used for this planning study for the vehicle bays is 50 feet long by 60 feet wide. This provides space for three bays which would allow the Airport to move up to Index C in the future. The actual design will be refined prior preparation of the environmental review documents and architectural design. It is also possible that the ARFF facility will become a joint-use facility with the Sonoma County Fire Protection District.

Building

AC 5210-15A includes standards for office space, crew quarters, training rooms, and other spaces. Variables that determine the size of the facility include the number of firefighters expected to be on shift at any one time and the size and type of vehicles occupying the equipment bays. To reduce the footprint of the facility, rooms or offices may be on a second floor. Facility dimensions and layout will be refined during the design phase. Based on FAA Guidance, an ARFF facility staffed with three firefighters requires approximately 3,600 square feet of office, dormitory, and common use space.

Based on guidance listed above, the height of the facility is to be, at a minimum, 24 feet above finished grade. This is based on the vehicle height plus requirements for work platform clearance above the ARFF vehicle. For planning and airspace analysis purposes, the total height above ground of the ARFF facility is 28 feet. This will provide a margin to account for unforeseen design issues, roof equipment, or changes in ground elevation for grading or drainage requirements.

Vehicle Apron

The vehicle apron where ARFF vehicles stage is ideally large enough to allow the longest vehicle to turn around to back into any bay of the station. To allow this mobility, guidance indicates an extension of the apron from the doors to the taxiway object free area (TOFA) at least equal to one length of the longest vehicle if sited next to a taxiway. Apron width must be at least equal to the distance between the outermost left and right vehicle bay door openings plus 3 feet on each side.

The visibility limitations to the rear of a typical ARFF vehicle can make backing into an equipment bay difficult. Typically, backing requires additional personnel to guide the driver. Drive-through bays with additional vehicle apron space allow ARFF vehicles to pull straight through the bays, which eliminates the need to back into the bay. This design requires more area for pavement but provides more efficient operations and increases the operational safety and flexibility of the station.

Alternatives in this evaluation include maneuvering room to support drive-through bays. The evaluated designs accommodate staging areas and circulation paths to remain clear of any adjacent TOFAs.

ARFF Employee Parking

The space allocated for employee parking includes the parking stalls, circulation, walkways, and buffering areas. The design recommended for employee parking area accommodates two duty shifts plus spaces for visitors. The 2010 ARFF Study shows 11 parking spaces for staff and visitors.

ARFF Facility Recommendations

This study recommends a new ARFF site footprint includes:

- **Vehicle Bays:** Three bays for ARFF vehicles (3,000 square feet)
- **ARFF Building:** Administrative offices, meeting rooms, bathrooms, kitchen, day room, and equipment storage (3,600 square feet)

- **ARFF Vehicle Aprons:** Staging apron (3,150 square feet) and drive-through bay apron (6,800 square feet)
- **Employee Parking:** Lot for ARFF staff with 8 parking spaces and space for vehicle circulation (2,100 square feet).

This Analysis identifies layouts for the ARFF describing general building orientation, vehicle access, and how this may affect neighboring facilities and airport operations. Specific facility designs will be completed after alternatives are evaluated and a site is selected.

Utility Access

All proposed sites have access to electrical and telecommunications. Access to water and sewer utilities may prove to be prohibitive to south and west quadrant alternative development. The south and west quadrants currently lack access to water and sewer. The General Aviation Development Chapter provides an overview of estimated costs associated with bringing water and sewer to each general location. Generally, well and septic installation is quicker and less expensive for alternatives in the south and west quadrants, as opposed to extending the water or sewer mains from North Laughlin Road.

South quadrant wastewater service options:

- Extension to the main sewer line on North Laughlin Road. This is the most expensive method, with an estimated cost of $2.0 to $2.3 million and does not include environmental review, mitigation, and connection fees.
- Construction of an onsite septic system, which is estimated to cost $350,000 to $450,000. The lower cost for a septic system significantly improves the feasibility of developing an ARFF facility in the southern quadrant.

West quadrant wastewater service options:

- Extension of a sewer line to the sewage treatment facility. This is the most expensive method, with an estimated cost of $1.7 to $2.0 million, and does not include environmental review, mitigation and connection fees. This cost estimate represents greater uncertainty than for the similar connection to the southern quadrant due to the need for directional boring under airfield pavement.
- Construction of an onsite septic system, which is estimated to cost $350,000 to $450,000.

South quadrant domestic water service options:

- Extension of a water main from North Laughlin Road. This is the most expensive method, with an estimated cost of $1.5 to $1.8 million. This does not include environmental review, mitigation, and connection fees.
- Use of an onsite well with storage tanks to provide both water for both domestic use and fire protection. Well installation and drilling are estimated to cost $400,000 to $500,000. This does not include costs for filtration, storage tanks, and environmental review.
- Use of an onsite well for domestic water and connection to the Sonoma County Water Agency (SCWA) aqueduct for fire protection. This is the least expensive option since it does not require storage for fire suppression tanks. However, a Finding of Necessity and subsequent agreement with SCWA would be required by the developer.

West quadrant domestic water service options:

- Extension of a water main from North Laughlin Road. This option is the most expensive, estimated to be $1.5 to $1.8 million plus environmental review, mitigation, and connection fees.
- Use of an onsite well with storage tanks to provide both water for both domestic use and fire protection. Well installation and drilling are estimated to cost $400,000 to $500,000, plus costs for filtration, storage tanks, and environmental review.

Environmental Impacts

The airfield contains habitat for several special-status species (California Tiger Salamander and the Burke's Goldfield) and classes of wetlands (i.e., waters of the U.S.). These areas are illustrated in **Figure 5-2** below. Potential impacts to these species and wetlands are evaluated for each of the alternative ARFF sites. Relocation of ARFF facilities is not explicitly listed in Order 1050.1F as qualifying for a Categorical Exclusion (CATEX) for compliance with the National Environmental Policy Act (NEPA). Sites with significant impacts to wetlands or special-status species will require an Environmental Assessment (EA). Consultation with the ADO will be required to determine if the selected site requires preparation of a CATEX or EA.

Other Site Selection Considerations

These factors are also considered for ARFF relocation, as outlined in Section 2-3 of AC 5210-15A:

- Airport Observation: Provide ARFF staff the widest possible view of the airfield from the facility.
- ATCT Line of Sight: Avoid placing the facility where it will interfere with ATCT line of sight to aircraft movement areas.
- Proximity to Operations Staff Primary Work Area: Locate the site near to where the Airport's operations staff spend most of their time. STS does not have dedicated ARFF crews; ARFF services are provided by the Airport's operations staff. Proximity improves efficiency in staff utilization.
- Landside Access: Locate facilities where they are typically located, at the security fence line so visitors (e.g., delivery trucks) may access when needed. Because visitors are infrequent, this is a useful, but not essential, factor.
- Ability to Serve as a Joint-Use Facility: Consider the operational and financial benefits to the Airport to jointly operate an ARFF / fire station with the Sonoma County Fire District.

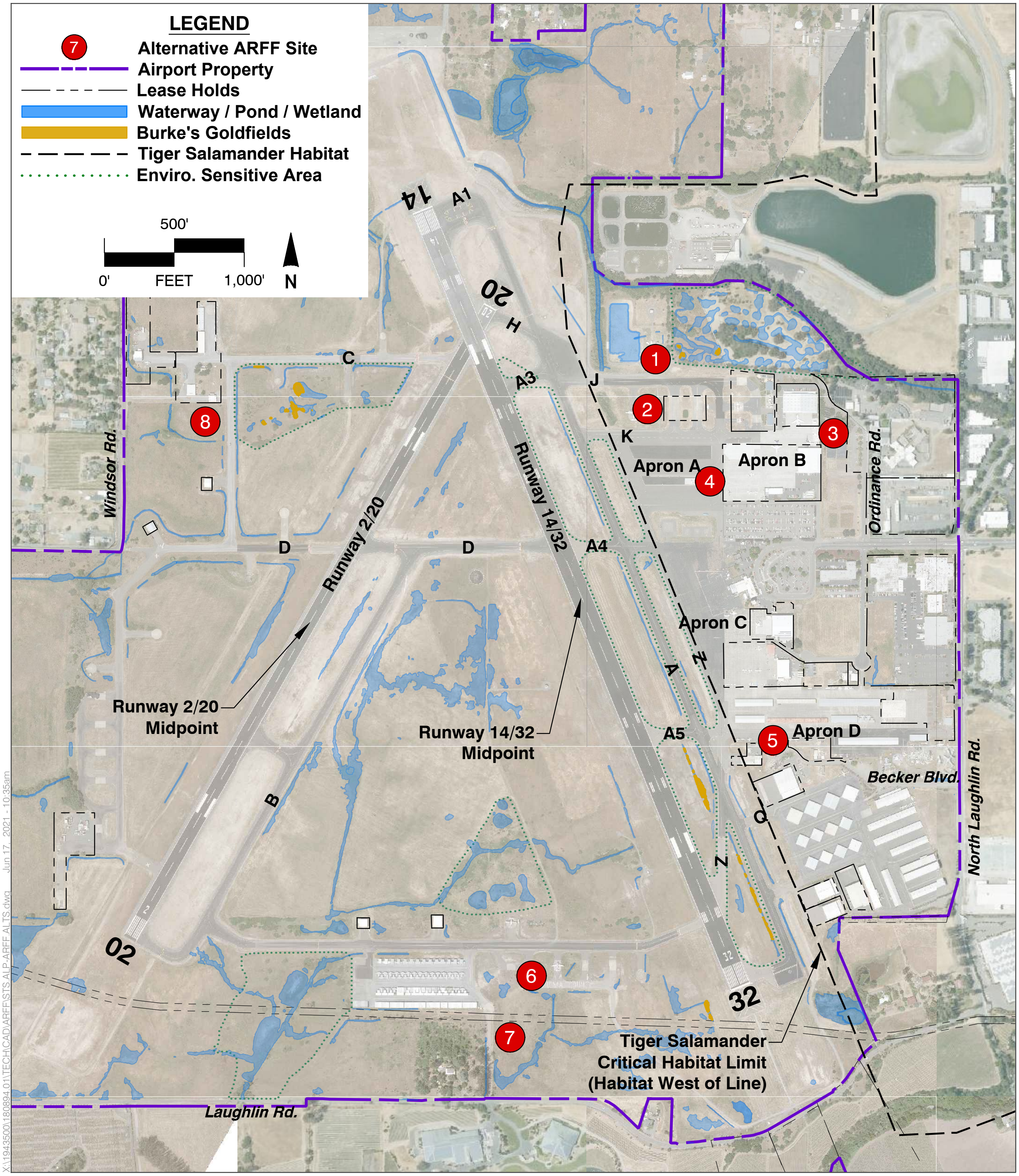
ARFF ALTERNATIVE SITES

Eight preliminary sites for ARFF relocation were identified. Each site has limits or constraints due to either airside access, landside access, available land, utilities, or environmental impacts. **Figure 5-2** shows the preliminary sites, location of water/wetlands, and environmentally sensitive areas.

- **Alternative 1** is west of the Cal Fire base, north of Taxiway J, and south of the Remote Transmitter/Receiver (RTR) site. This site may block RTR transmission and interfere with communication between the ATCT and aircraft on Taxiway A.

- **Alternative 2** is near the site designated on the 2013 ALP between Taxiways J and K. Alternative 2 shifts the ARFF facility east to a location that will not block line of sight between the ATCT and aircraft on Taxiway J holding at Taxiway A. An OE/AAA analysis in 2019 concluded that this location would interfere with communication between the ATCT and aircraft on Taxiway A.
- **Alternative 3** is on the east end of Apron B adjacent to existing Fixed Base Operator (FBO) hangars. An ARFF facility in this location would conflict with aircraft operations at the FBOs, which may affect ARFF response times.
- **Alternative 4** is north of the footprint for the proposed ultimate passenger terminal and northwest of long-term public Parking Lot B. Alternative 4 would reduce parking capacity for aircraft on Apron A and potentially constrain the ultimate terminal and area for storage of ground service equipment.
- **Alternative 5** is on the south side of Apron D east of the Sonoma County Sheriff's helicopter facility. The Alternative 5 site is constrained by existing facilities and Becker Boulevard. The site has the potential to interfere with aircraft operations on Apron D.
- **Alternative site 6** is in the south quadrant on the old hard stand positions east of Apron F. Site 6 provides immediate airside access to Taxiway E but is limited by the lack of utilities such as water and sewer service.
- **Alternative site 7** is in the south quadrant south of Apron F and has the benefit of limited environmental impact compared to Site 6. Site 7 is limited by the lack of utilities such as water and sewer service.
- **Alternative 8** is in the west quadrant with Taxiways C and D providing airside access. This site is also limited by lack of existing utilities. Road improvements to Windsor Road may also be required to provide adequate landside access.

Figure 5-2: ARFF Preliminary Alternative Sites

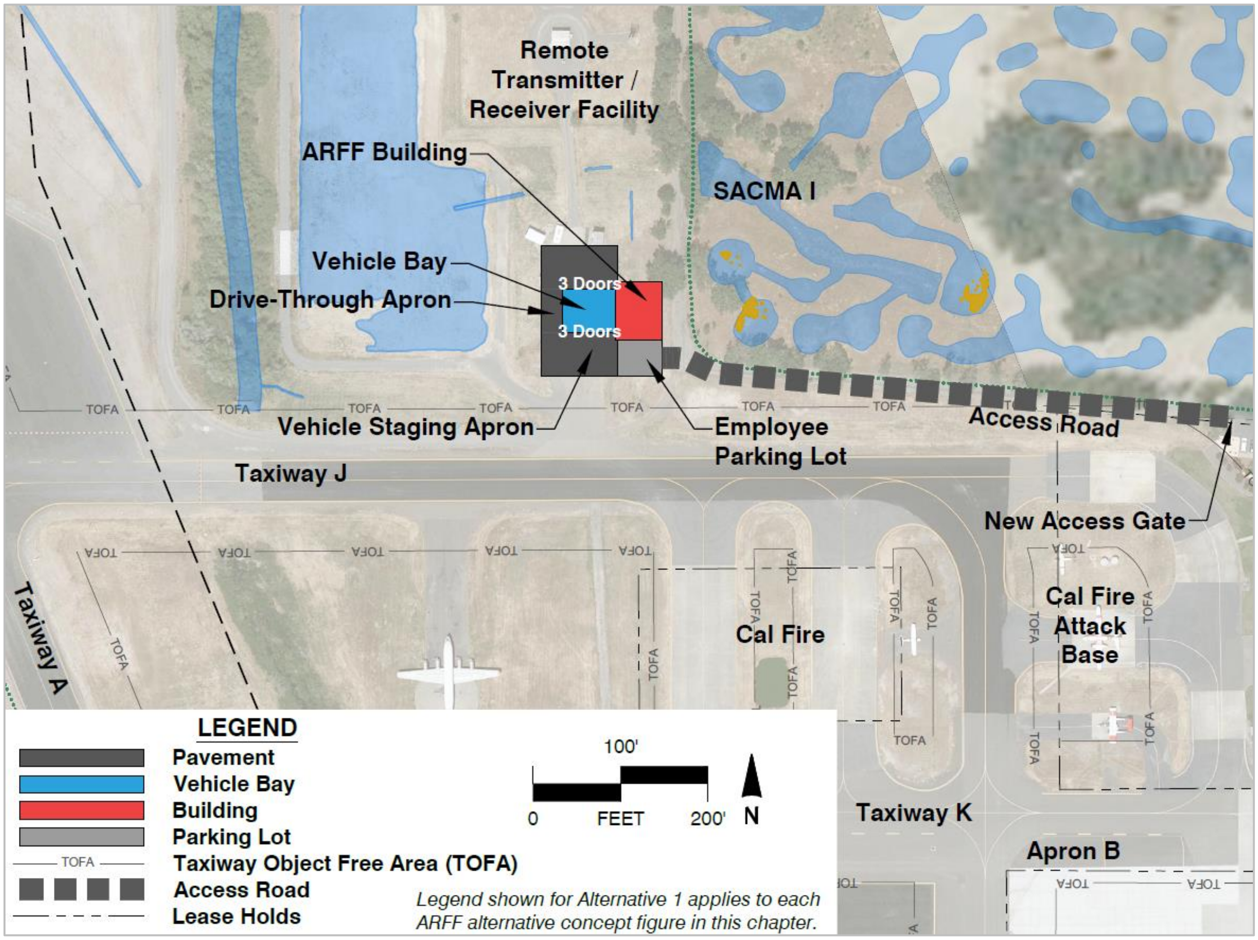


ARFF Alternative 1: Remote Transmitter/Receiver Site

Alternative 1 is located north of Taxiway J and south of the RTR facility site. The RTR antenna array relays air traffic control radio communications to aircraft using STS. **Figure 5-3** illustrates Alternative 1 for a conceptual ARFF facility with building orientation, parking, and road access.

Alternative Site 1 was initially selected because the site appeared to offer advantages over other locations: an undeveloped pocket of land that will likely not accommodate other uses, lack of conflicting facilities nearby, and low impact on airport and aircraft operations. However, the proximity to the RTR tower array required further analysis and unanticipated costs, which are included in this section.

Figure 5-3: ARFF Alternative 1 Concept – RTR Site



Airfield Access, Response Times and Joint Use

The Alternative 1 site has unrestricted views of the terminal area and the central portion of the airfield, but trees are likely to obscure views of the approach ends of Runway 14 and Runway 20. Access to the airfield is via Taxiway J, then Taxiway A to reach the runways.

The distance from Alternative 1 to the center of Runway 2/20 is 4,700 feet. Using a typical response time of 45 seconds for fire crews to dress in protective clothing, mount vehicles, and exit the facility, an ARFF truck needs to maintain an average of 24 miles per hour to reach the midpoint of this site within three minutes. It would be difficult to operate a joint-use facility at this site. Structural fire trucks would need to pass through a secure gate. It would take time for the gate to open, and the driver of the truck would be required to wait until it closed before proceeding. This would be a significant delay in responding to emergencies outside of the Air Operations Area (AOA).

Impact on Terminal and Operations

Alternative 1 is not located on or near the near-term or ultimate terminal footprint. This location will not impede terminal expansion over the next 20 years.

Alternative 1 relocates the ARFF facility away from the existing terminal apron and FBO facilities, reducing the likelihood of interference with aircraft operations. Interference is possible when Cal Fire aircraft use Taxiway J. However, this is restricted to times with aircraft firefighting activity.

Modifying RTR Antennas

The Alternative 1 site was initially favored due to location on the airfield and the low impact on operations, but the proximity to the RTR facility was a concern. When the proposed site was presented to the FAA with questions on impacts to the RTR transmission and communications, the FAA requested a draft OE/AAA study be submitted. One significant component of that effort is a shadow study report with preliminary analysis of impacts to RTR transmission. An additional site (Alternative 1B) was identified closer to the RTR towers with the intention of possibly being located under the radio transmission signals.

The shadow study determined the proximity of both Alternative 1A and 1B to the RTR will interfere with transmission signals. This study also showed that moving the ARFF slightly in this general location does not avoid interference with the RTR. The ARFF facility height is fixed by function, so lowering the building and vehicle bay is not an option.

Following receipt of the shadow study, a call with the FAA's OESG was proposed to discuss feasibility to raise or relocate the RTR towers to accommodate either site 1A or 1B. During this call, the OESG stated:

- There are three frequencies at the RTR: ground, clearance, and local. All of these are transmitters, and the receivers are on the ATCT cab. At least two antennas would need to be raised: ground main and ground standby.
- Any feasibility studies related to RTR modification would be done under a reimbursable agreement. OESG was not confident whether the existing structures could be altered or if new structures would be required.
- Relocating the towers on the new ARFF building is a possibility. This scenario requires continuous access to equipment and antennas by operations staff. The OESG recommended to have an ARFF building designed with a communication room with separate access and new ducts to connect to ATCT for this scenario.
- OESG indicated they were planning to upgrade the RTR antennas soon, but no specific date was provided.

If Alternative 1 is a viable site, the next step will be for OESG to perform a feasibility study to determine the costs, and initial design for RTR modification. OESG staff indicated they will likely be able to develop a reimbursable agreement within 90 days. FAA staff prefers to schedule design and construction projects three years out and would not be able to schedule this design any earlier than two years. FAA staff also indicated that it would be possible to utilize an accredited consulting firm to perform the design and construction under FAA supervision.

Facility Requirements

The site provides sufficient area for the building, parking, drive lanes, vehicle staging, and room to maneuver beside and behind the station for pull-through access to the vehicle bays.

Access to this site would be via Ordnance Road, which terminates east of the Cal Fire facility. A new access road is proposed to extend from the Cal Fire parking lot to the ARFF site, using the same alignment as an abandoned service road. This will require shifting the fence that currently runs along the center of this abandoned road to the north about 10 feet. The fence would remain on the paved section of the old road. This would avoid impacting the adjacent SACMA wetlands mitigation area.

For this access road to be a public-use road, it will need to be fenced on both sides. The northern side would prevent entry to the SACMA wetlands area. The southern fence would prevent entry to the airfield operations area. To be acceptable, the southern fence must remain outside of the TOFA for Taxiway J. However, using the current alignment, the location of the southern fence would penetrate Taxiway J's TOFA on the eastern half of this taxiway. Therefore, it would not be possible to create a publicly accessible road to this site. Access would need to be provided via a service road inside the airfield operations area.

The service road represents a potential penetration to the Taxiway J TOFA. Along Taxiway J, the TOFA is set at 93 feet from the taxiway centerline to meet standards for Airplane Design Group III. The eastern third of the service road would fall within the TOFA. However, this taxiway is almost exclusively used by Cal Fire's fire attack aircraft. The dominant fire attack aircraft is the S-2T, but Cal Fire now also uses the Lockheed C-130. Both aircraft can be accommodated operationally despite the TOFA penetration.

The proposed access road is a secure road with an electronically operated gate in the existing fence on the west side of Cal Fire's parking lot. The secure service road would follow the same alignment as the previously evaluated public road, without a southern fence penetrating the TOFA. Signs would be placed to alert operations staff using this road that vehicles need to maintain separation from aircraft taxiing on Taxiway J. New operations staff would also receive this instruction prior to being permitted to drive in the airfield operations area, and Cal Fire would also receive these instructions to include them in their site-specific operating instructions for pilots.

Alternative 1 is located near existing utilities and water and sewer mains. The only utility costs associated with this concept are for local connections. There is no significant cost impact for utility extensions.

Environmental Impacts

This site includes portions of a paved hard stand used to park military aircraft during World War II and an abandoned service road. The balance is non-native grassland. It appears that the facility could be constructed without impacting areas where protected species are known to exist. However, even though the site is not within the designated critical habitat for the California tiger salamander, it is within the animal's range. Payment of mitigation fees is expected to be required. Because of impacts to the California tiger salamander, Alternative 1 sites would likely require an EA. No impacts to wetlands are expected.

ARFF Alternative 1 Overview

Alternative 1 provides these advantages:

- The site takes advantage of an undeveloped parcel of land that is unlikely to accommodate other uses.
- The site does not constrain future airport facility development.
- The site has low impact on airport and aircraft operations.

Alternative 1 provides these disadvantages:

- The site creates interference with RTR facility and radio transmission relay from the ATCT to aircraft on Taxiway A, requiring relocation or the raising of existing tower antennas.
- High potential for delay from coordination with FAA on moving or raising RTR facility.
- Landside access will have modest biological impacts. It is expected that it will be possible to obtain needed permits.
- The access road will not be completely independent of aircraft operations on Taxiway J.

ARFF Alternative 2: Taxiway J / Apron A

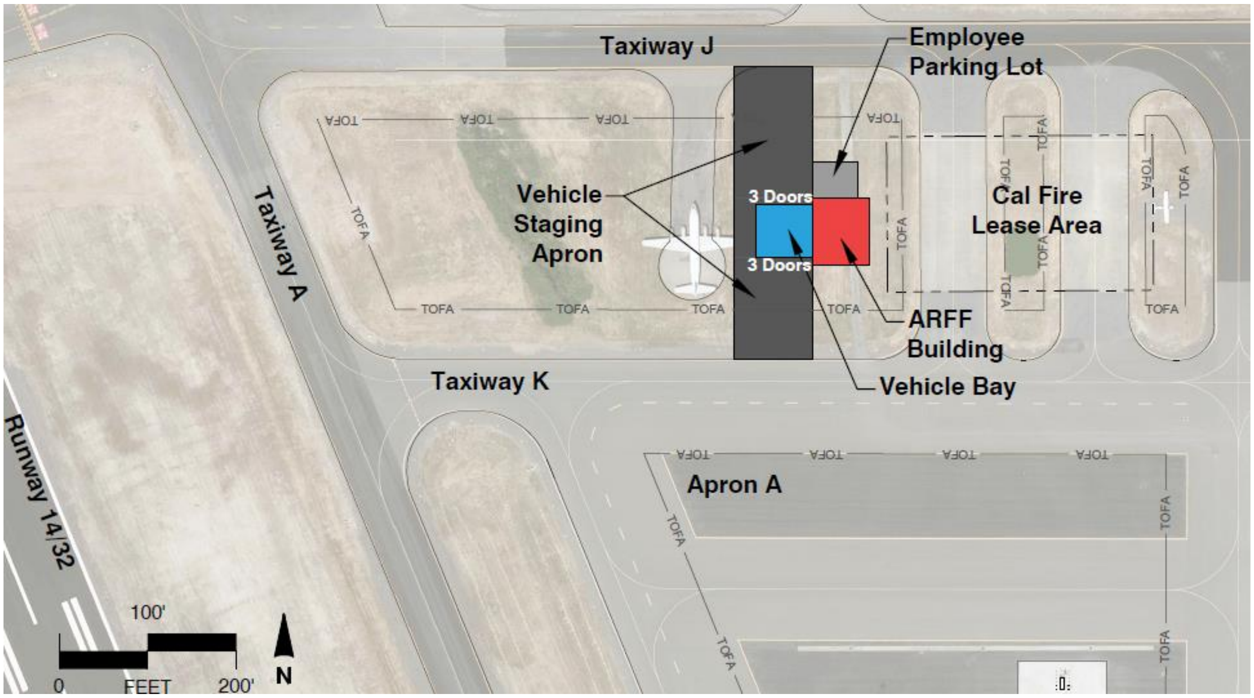
The 2013 ALP designates a site between Taxiways J and K and east of Cal Fire for the replacement ARFF building. The FAA OE/AAA from 2018 (ASN 2018-AWP-1500 through 1503-NRA) and input from the ATCT staff concluded that an ARFF building at this location interferes with the line of sight between air traffic control and aircraft taxiing on Taxiway J and holding at Taxiway A. Tech ops staff also indicated the original site blocks RTR transmissions to aircraft operating on Apron A.

For this analysis, Alternative 2 is proposed in the same general location but shifted approximately 200 feet to the east. This places the ARFF facility as far east as possible while avoiding the Cal Fire leasehold and the TOFA area for adjacent taxiways. This location also provides line of sight from the ATCT to the Taxiway J hold position at Taxiway A. **Figure 5-4** illustrates Alternative 2 with a proposed building orientation, vehicle bays, and parking areas. This location does not provide direct landside access and will require ARFF staff to cross active airfield pavement to access.

Airfield Access, Response Times, and Joint Use

This site has unrestricted views of the northern terminal area and the central portion of the airfield. Trees are likely to obscure views of Runways 14 and 20 approach areas. Access to the airfield is via Taxiway J or Taxiway K and then Taxiway A to reach the runways. The distance from Alternative 2 to the midpoint of Runway 2/20 is 4,000 feet. Using a typical response time of 45 seconds for fire crews to dress in protective clothing, mount vehicles, and exit the facility, an ARFF truck needs to maintain an average of 20 miles per hour to reach the midpoint within three minutes. It would be difficult to establish this as a joint-use facility. Structural fire trucks would need to exit the AOA via taxiways and pass through a gate. This would be significant source of delay in responding to emergencies.

Figure 5-4: ARFF Alternative 2 Concept – Taxiway J / Apron A



Impact on Terminal and Operations

Alternative 2 is not located on or near the near-term or ultimate terminal footprint. This location will not impede terminal expansion over the next 20 years.

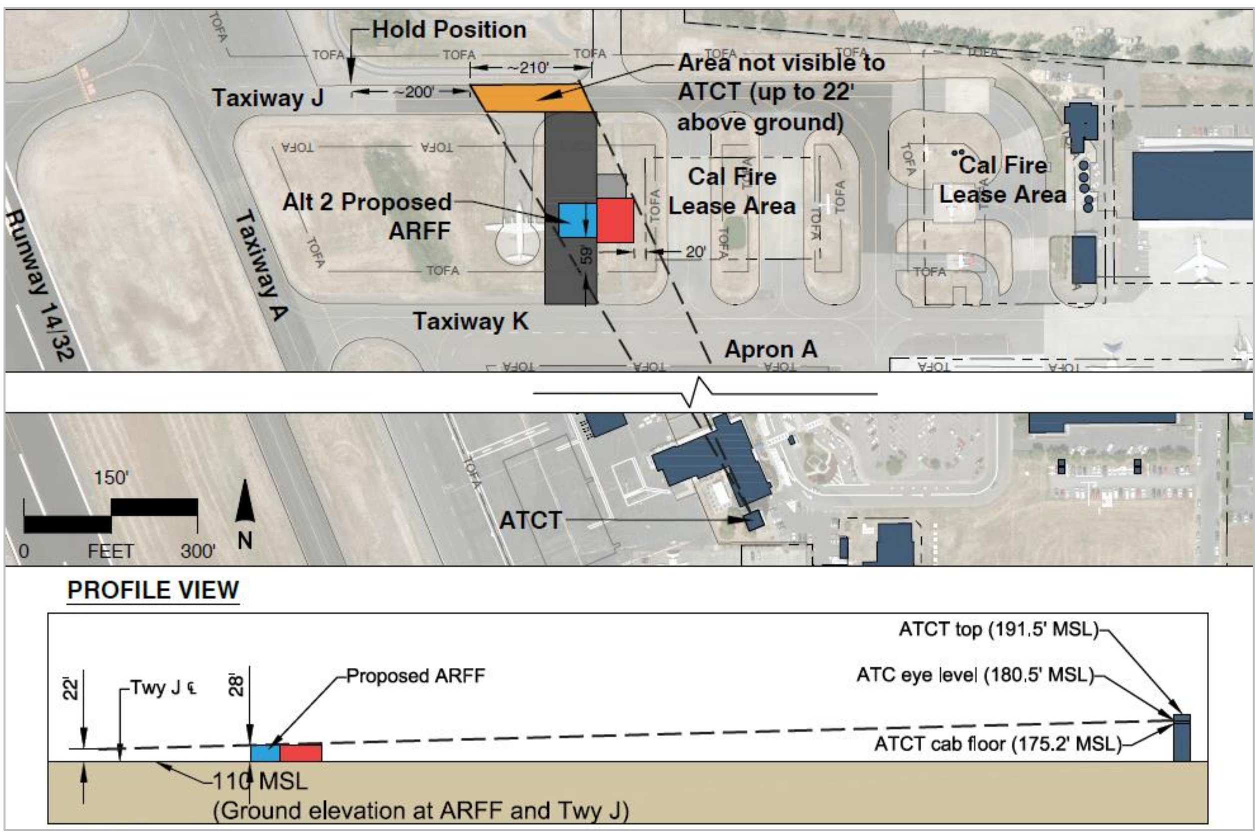
Alternative 2 relocates the ARFF facility away from the existing terminal apron. There is potential for interference with GA and FBO activity on Taxiway K and when Cal Fire aircraft use Taxiway J. Alternative 2 is not impacted by existing facilities but siting the facility outside the TOFA of the Cal Fire taxilane to the east of the proposed site is necessary.

Tower Shadow Study

Preliminary conversations with ATCT staff indicated the Alternative 2 site may be acceptable if the ARFF location from the ALP is shifted to the east as proposed. ATCT staff indicated that clear line of sight between the ATCT and the Taxiway J hold position to Taxiway A must be clear. Moving the facility to the east accomplishes this. However, line of sight between the ATCT and Taxiway J remains blocked for a portion of Taxiway J. This section details this analysis and the ATCT staff response and opinion on the Alternative 2 ARFF site.

The Alternative 2 ARFF facility is offset 20 feet from Cal Fire's leasehold. The top of the ARFF building is 28 feet above ground. The ATCT controller eye level was determined from the Brelje & Race 2018 survey of the cab floor and adding 5 feet (the finished floor of ATCT cab is at 175.2 feet mean sea level, and eye level equals 180.2 feet mean sea level). **Figure 5-5** shows the line-of-sight shadow on Taxiway J from the ATCT and the plan and profile views of the viewshed from the ATCT to Taxiway J. The Alternative 2 ARFF facility would block an area over 200 feet long on Taxiway J and obscure any object up to 22 feet on the Taxiway J centerline.

Figure 5-5: ARFF Alternative 2 – ATCT Line of Site



Discussions with ATCT management staff indicated they do not object to the location of Alternative 2. The ATCT will have clear line of sight to the hold position on Taxiway J, plus about 200 feet before this hold position. The ATCT staff indicated Taxiway J is almost exclusively used by Cal Fire aircraft and small aircraft rarely use this. However, FAA's Operations and Engineering Support Group staff indicated that the revised location will still likely block RTR transmissions to aircraft operating on Apron A.

This site would require the same type of RTR antenna modifications described in Alternative 1. Therefore, it would also suffer the same schedule uncertainties and high costs.

Facility Requirements

The Alternative 2 site provides sufficient area for the ARFF facility and room to maneuver beside and behind the station for pull-through access to the vehicle bays. The building, parking area and staging areas are outside the TOFAs for Taxiways J and K. They are also outside the aircraft-specific TOFA for C-130s. This location does not provide direct landside access. This will require ARFF staff to cross active airfield pavement to access.

Alternative 2 is near existing utilities on the east quadrant. The only utility costs will be for local connections.

Environmental Impacts

This site includes portions of a paved hard stand used to park military aircraft during World War II, and the balance is non-native grassland. It appears that the facility could be constructed without impacting wetlands or areas of protected species' habitat. The Alternative 2 site would likely require a CATEX or focused EA for NEPA compliance, because of limited biological impacts.

ARFF Alternative 2 Overview

Alternative 2 provides these advantages:

- The site offers direct access to Taxiways J and K.
- The site provides adequate response times and surveillance of the terminal area and majority of the airfield.
- The probability of interference with aircraft operations is low.

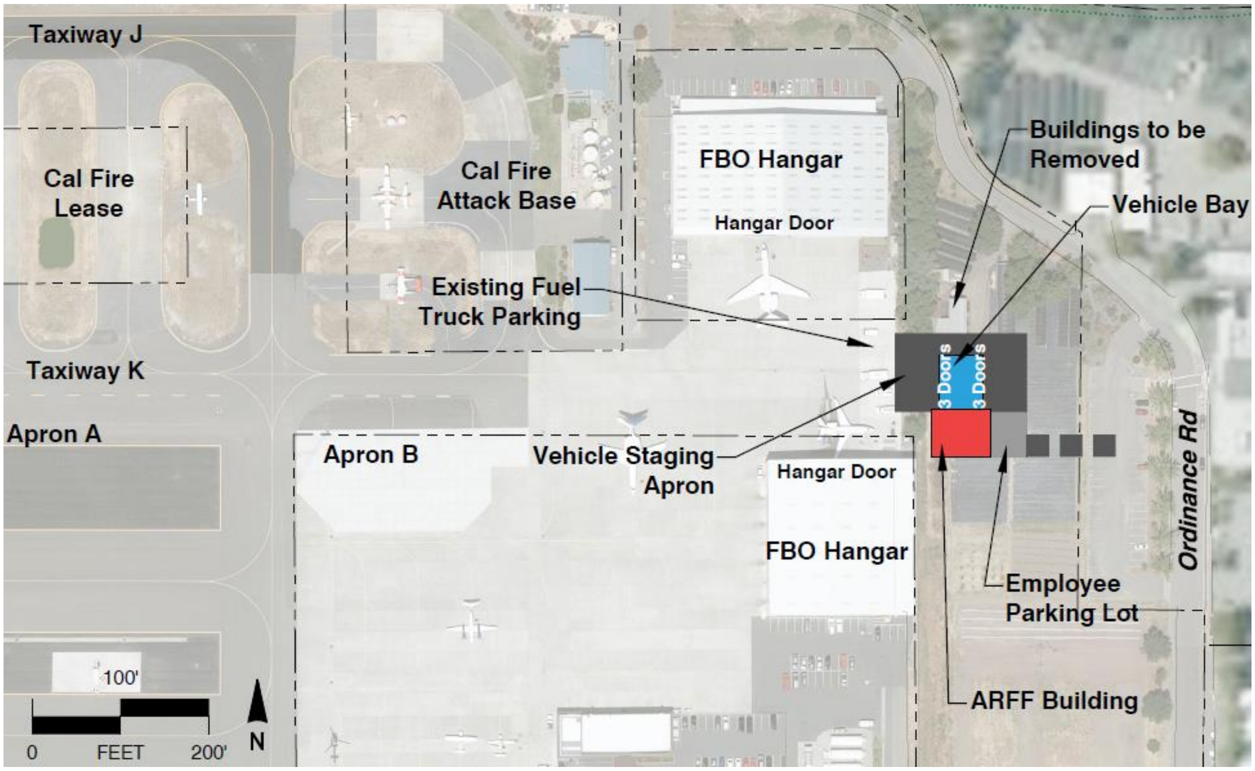
Alternative 2 provides these disadvantages:

- The lack of direct landside access will require staff to cross active airfield.
- High potential for delay from coordination with FAA on moving or raising RTR facility.
- The site represents a partial line of sight obstruction of Taxiway J from the ATCT.

ARFF Alternative 3: FBO North / Apron B

Alternative 3 is on the east side of Apron B, between Kaiser Air hangars at the east end of the FBO apron. **Figure 5-6** illustrates a conceptual ARFF facility in this location with proximity to existing lease areas and hangars. An access road connects the ARFF parking lot to Ordnance Road via the North County Detention Center's parking lot. Six spaces are eliminated by this connection.

Figure 5-6: ARFF Alternative 3 Concept – FBO North / Apron B



Airfield Access, Response Times, and Joint Use

The Alternative 3 site has restricted views of the airfield and terminal area. Access to the airfield is via Taxiway K and then Taxiway A to access the runways. Located on the eastern edge of the apron, the site's distance to the midpoint of Runway 2/20 via Taxiway K, Taxilane Z, and Taxiway A4 to Taxiway D is approximately 5,100 feet. Assuming 45 seconds of response time for firefighters suiting up and mounting vehicles, the ARFF vehicle needs to average 26 miles per hour. This would be one of the better sites for a joint-use facility. Structure fire trucks could exit directly to a public street.

Aircraft on Taxiway K and activity on Apron A and Apron B are likely to interfere with ARFF vehicles and limit response times. It is unlikely an ARFF vehicle could make the Runway Safety Area (RSA) at the approach end of Runway 2 in under three minutes without undue risks associated with maneuvering around aircraft on the FBO aprons.

Impact on Terminal and Operations

The Alternative 3 site is not located near the near-term or ultimate terminal footprint. This location will not limit terminal expansion over the next 20 years. However, ARFF vehicles traveling form the facility to the airfield may be constrained by commercial aircraft maneuvering on Taxiway K or Apron A.

Alternative 3 will impact the FBO and aircraft operations. Kaiser Air hangar doors open onto the apron that fronts on the paved area for staging of the ARFF vehicles. Aircraft being towed in and out of these hangars are likely to block the ARFF station access to the airfield.

The proposed ARFF vehicle apron also displaces the fuel truck parking space. ARFF vehicle routing between the facility and the airfield may interfere with Cal Fire operations when aircraft are in active firefighting operations.

Facility Requirements

The Alternative 3 site is constrained by existing facilities, located between FBO hangars and Apron B. The proposed ARFF facility will need to be setback from the apron to avoid FBO facilities and lease areas. In this concept, the vehicle apron is shifted back from the existing apron edge to prevent ARFF vehicles from blocking aircraft using the FBO hangars. Alternative 3 requires more detailed site design to potentially fit into the allotted area. Ample space appears to be available to allow for the building, parking, drive lanes, vehicle staging, and room to maneuver beside and behind the station for pull-through access to the vehicle bays. Landside access for Alternative 3 is from Ordnance Road east of the site.

Alternative 3 is located near existing utilities and water and sewer mains. The only utility costs associated with this concept are for local connections.

Environmental Impacts

The proposed site includes buildings, pavement, and formerly farmed areas. Constructing the facility without impacting wetlands or areas where protected species are known to exist appears possible. The Alternative 3 site would likely require a CATEX or focused EA for NEPA compliance, because of limited biological impacts.

ARFF Alternative 3 Overview

Alternative 3 provides these advantages:

- Landside access via Ordnance Road
- Access to water and sewer utilities

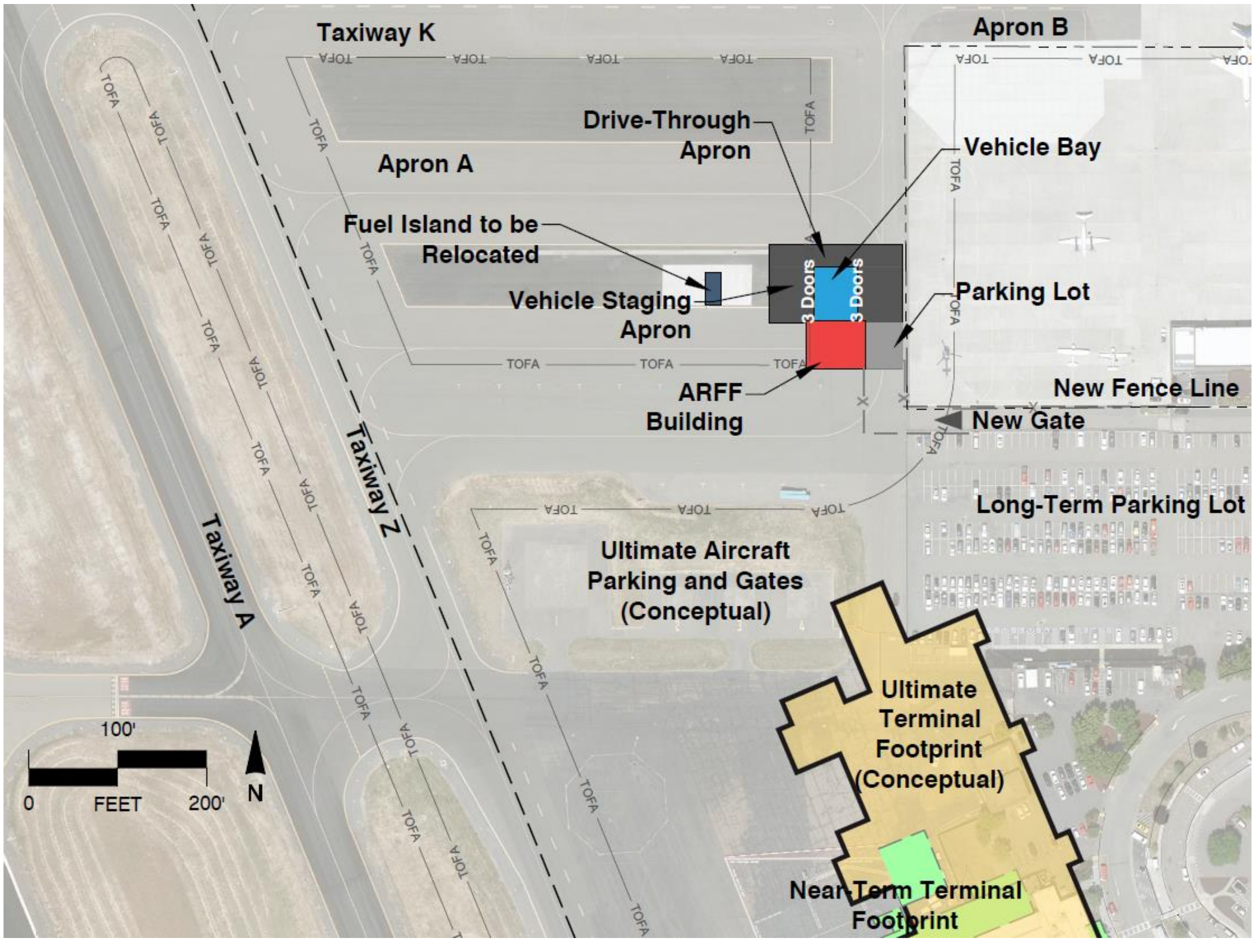
Alternative 3 provides these disadvantages:

- Negative impact on FBO aircraft operations and facilities.
- Slowest response time to Runway 2/20 midpoint and end of runways.
- Potential for interference with response route and time by aircraft operations between ARFF site and airfield
- Limited surveillance of airfield.

ARFF Alternative 4: North Terminal

ARFF Alternative 4 is north of the proposed ultimate passenger terminal footprint and northwest of the long-term public parking lot. **Figure 5-7** illustrates a conceptual facility layout and relationship to existing aprons and vehicle parking. The footprint of the conceptual ultimate terminal facility and its associated parking apron is included to show its relationship to Alternative 4.

Figure 5-7: ARFF Alternative 4 Concept – North Terminal



Airfield Access, Response Times, and Joint Use

Similar to other alternative sites near Apron A, this site has unrestricted views of the terminal area and the central portion of the airfield. Trees obscure views of the Runway 20 approach area. Access to the airfield requires crossing the Apron A tie down area. The distance to the center of Runway 2/20 is 3,650 feet. Assuming 45 seconds of response time for firefighters to suit up and mount vehicles, to reach the center of Runway 2/20 in under three minutes the ARFF vehicle needs to average 18 miles per hour. The potential exists for conflicts with ground service equipment when initially leaving the ARFF facility. If a joint use facility was constructed, the proposed design would allow fire trucks to exit via a public road without passing through a gate.

Impact on Terminal and Operations

This alternative has several negative impacts on airfield operations. Alternative 4 eliminates space available for transient aircraft, remain overnight (RON) positions, or mechanical airline positions on Apron A. This also impacts Apron B and FBO operations. Some apron impacts could be reduced if Apron A was expanded to include the area proposed for Alternative Site 2 between Taxiways J and K.

Near-Term Terminal Impacts

Alternative 4 ARFF has the greatest potential to impact terminal facilities. The near-term terminal footprint has been established for construction and is shown on **Figure 5-8**. A row of five conceptual parking position envelopes is also shown. The nearest aircraft parking position to Alternative 4 is 275 feet south. At this location, the ARFF will not impact aircraft parking positions, aircraft movement, and ground service equipment. The ARFF site may limit RON or mechanical positions north of the terminal, but these may be positioned elsewhere on Apron A.

Ultimate Terminal Impacts

Alternative 4 may have an impact on the ultimate terminal facility. An ultimate conceptual terminal footprint based on forecasts for year 2040 enplanements and operations is included in **Figure 5-9**. This footprint is based on long-term enplanement projections. In this concept, parking positions may wrap around the terminal and be located south of the ARFF facility. The terminal wing located closest to the ARFF would likely contain baggage sorting, and this area will need to be accessed by ground service equipment. The modest impact on areas accessed by ground service equipment can be mitigated by refinements to the terminal footprint. The terminal design used in these alternatives is conceptual, not a hard design. RON positions required beyond the seven gate positions will need to be located elsewhere on Apron A and not adjacent to the terminal. If Alternative 4 is considered a viable site, how this relates to the terminal area and redesign of Apron A will be evaluated further.

Figure 5-8: ARFF Alternative 4 – Near-Term Terminal

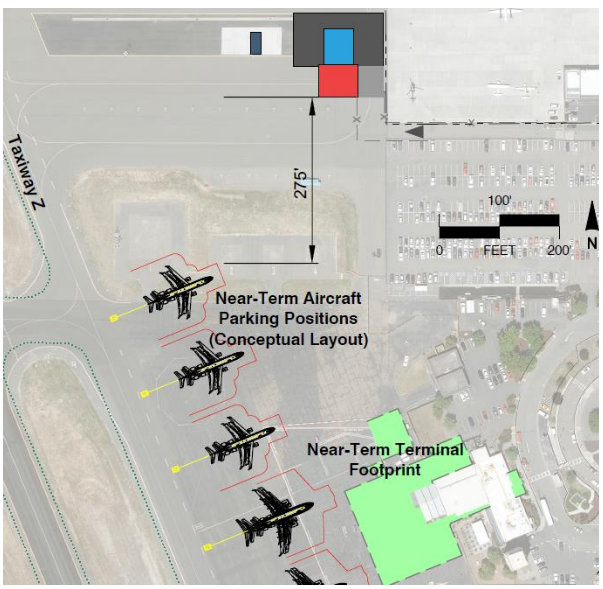
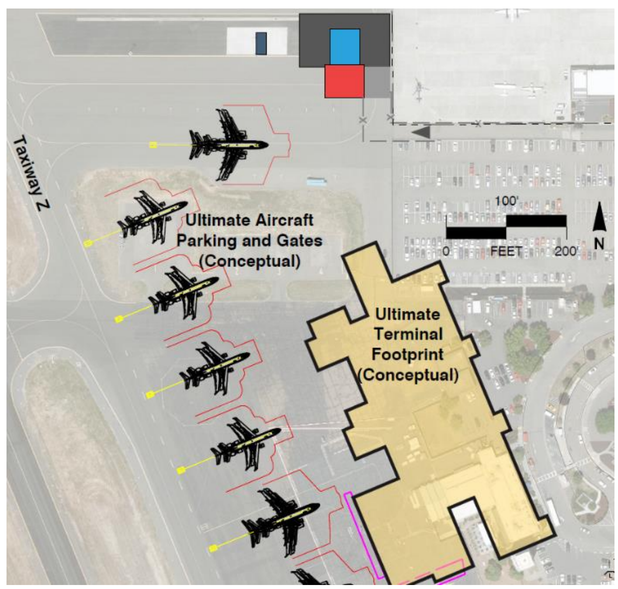


Figure 5-9: ARFF Alternative 4 – Ultimate Terminal



Facility Requirements

Alternative 4 provides space for the ARFF building, auto parking, drive lanes, vehicle staging, and room to maneuver around the station to provide access to the vehicle bays. This location is accessible via the unnamed road that provides access to Kaiser Air's offices. The publicly accessible portion of this road is extended about 300 feet to the west. The existing security gate relocates to a point just past the ARFF facility's parking lot. The perimeter fence is extended along the north side of this road.

Like other sites on the east quadrant, Alternative 4 is near existing development with established utility access. The only utility costs will be for local connections with no significant cost impact for utility extensions.

Environmental Impacts

The proposed footprint is located on a paved site, which means no significant environmental impacts are anticipated. The Alternative 4 site would likely require a CATEX or focused EA for NEPA compliance, because of limited impacts. Expansion of Apron A is not considered to be a connected action. Relocation of the ARFF facility is expected to occur within the next five years (by 2026).

ARFF Alternative 4 Overview

Alternative 4 provides these advantages:

- Best response time to Runway 2/20 midpoint
- Centrally located site with direct access to the terminal
- Access to water and sewer utilities
- Low environmental impacts.

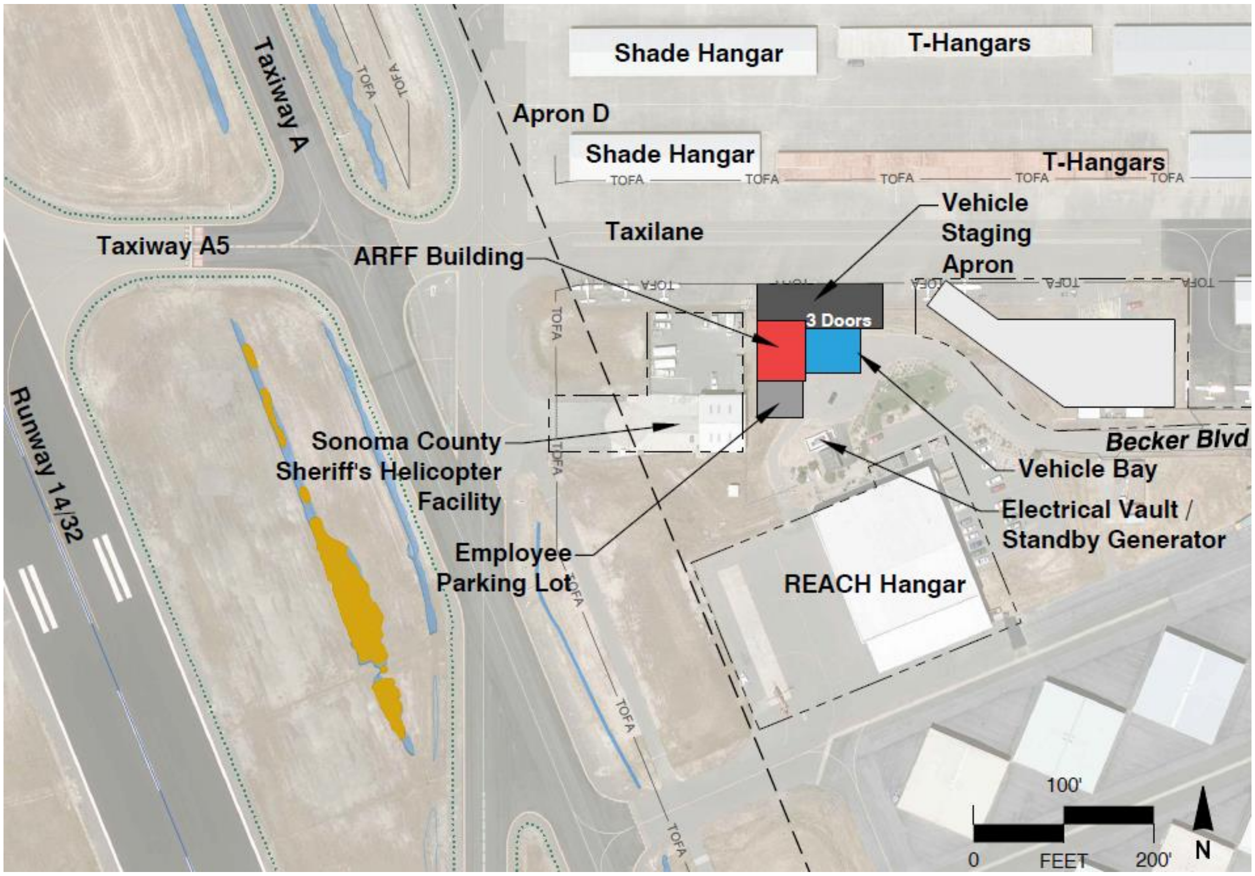
Alternative 4 provides these disadvantages:

- Impacts to general aviation parking capacity on Apron A
- Potential to limit terminal expansion and constrain auxiliary terminal functions.
- Impacts to FBO operations

ARFF Alternative 5: Apron D

ARFF Alternative 5 is located on the south side of Apron D, east of the Sonoma County Sheriff Helicopter Unit's facility. **Figure 5-10** shows a conceptual layout for this site. This alternative is constrained and has a 5-foot elevation drop across the site, which would be a design issue. Additionally, use of the site blocks access to the Sheriff's parking lot.

Figure 5-10: ARFF Alternative 5 Concept – Apron D



Airfield Access, Response Times, and Joint Use

Alternative 5 site has restricted views of the airfield and terminal area, blocked by shade hangars to the north and the Sheriff's facility and FBOs to the south. Redevelopment of Apron D may eliminate the shade hangars and provide line of sight to the north airfield. Access to the airfield is direct from Apron D to the Taxiway A5 intersection with just one turn needed to access Taxiway A.

Distance to the midpoint of Runway 2/20 is 4,550 feet. Assuming 45 seconds of response time for firefighters to suit up and mount vehicles, to reach the center of Runway 2/20 in under three minutes, the ARFF vehicle needs to average 23 miles per hour. There is probability that aircraft on Apron D plus FBO activity may interfere with ARFF vehicles and reduce response times. A joint-use facility at this site would be severely constrained. Depending on the design, structure fire trucks would need to depart down one of Apron D's taxilanes and then pass through a gate, or on Becker Boulevard if terrain issues are resolved. This would represent a significant delay in response time.

Impact on Terminal and Operations

Alternative 5 is not located near the ultimate terminal footprint and will not limit terminal expansion over the next 20 years.

The Alternative 5 site is constrained by existing facilities and Becker Drive and has the potential to interfere with operations on Apron D. Several aircraft tie-down positions along the south edge of Apron D become displaced to create the vehicle apron staging areas in front of the station. The Apron D taxilane passes in front of the Alternative 5 site, and ARFF vehicles will use this taxilane to access the airfield. Aircraft on this taxilane during an ARFF call may cause congestion and limit response time. Redevelopment of Apron D, as proposed in General Aviation Development, may alleviate these concerns.

Leasehold areas adjacent to the site may be impacted during construction and revision of parking areas. In this concept, the Becker Boulevard cul-de-sac needs to be redesigned since a portion of this is allocated to the new ARFF facility. The Alternative 5 site blocks entry to the Sheriff's parking lot and impacts access to the REACH facility.

Facility Requirements

The site does not allow for pull-through access to the vehicle equipment bays. The need for the ARFF vehicles to back into the vehicle bays may increase congestion on Apron D. The site is also constrained by existing facilities. Reconfiguration of the ARFF employee parking and the building layout beyond the conceptual layout may be needed to accommodate Sheriff's and REACH facility access and Becker Drive turnaround.

Alternative 5 is located near development with access to existing utilities on the east quadrant. The only utility costs associated with this concept are for local connections with no significant cost impact for utility extensions.

Environmental Impacts

Alternative 5 is located on previously disturbed land and most of the site is currently paved. Anticipated environmental impacts are low. The Alternative 5 site would likely require a CATEX or focused EA for NEPA compliance, because of limited biological impacts.

ARFF Alternative 5 Overview

Alternative 5 provides these advantages:

- Landside access via Becker Drive
- Access to water and sewer utilities
- Proximity to other emergency response facilities.

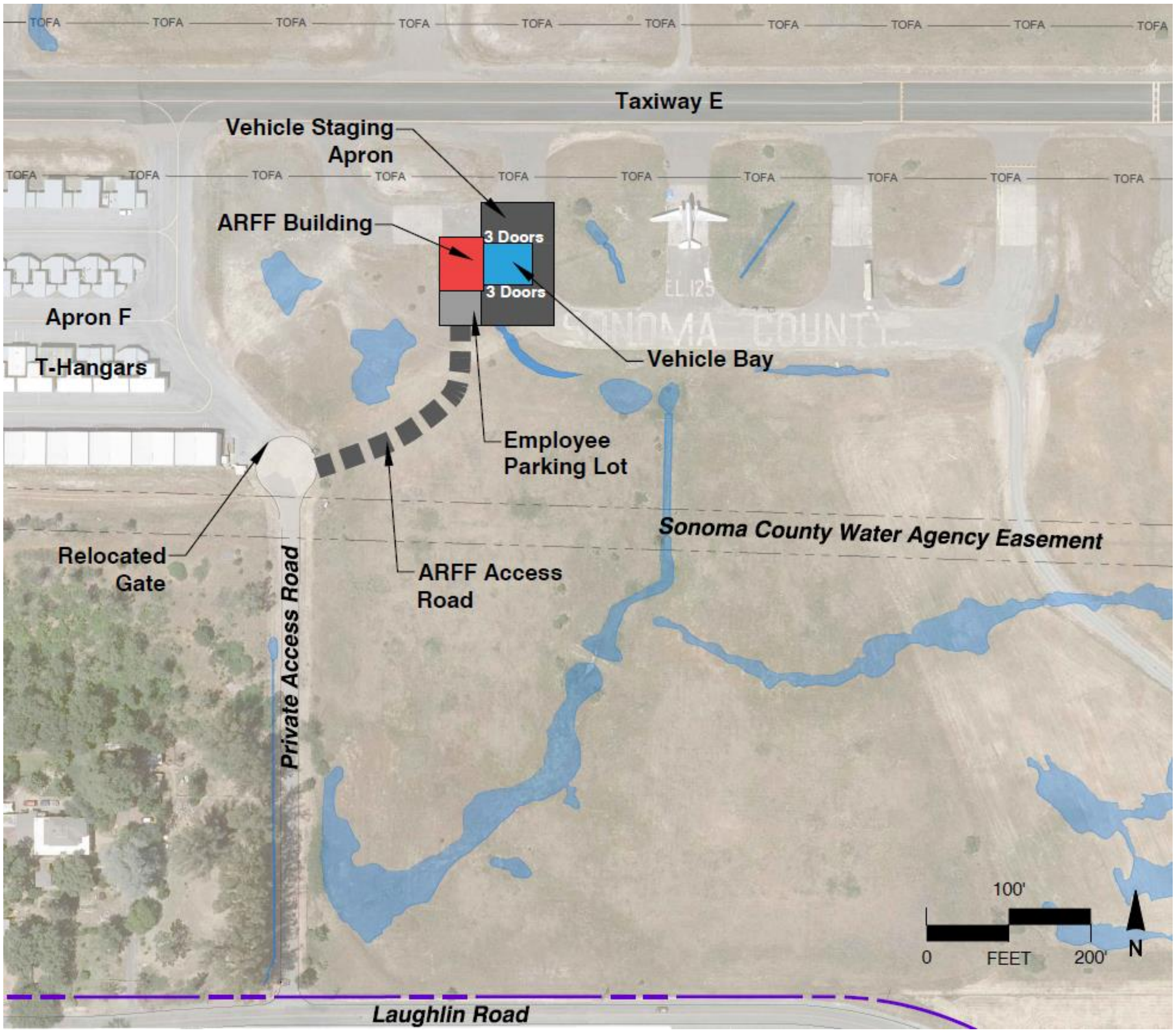
Alternative 5 provides these disadvantages:

- The site is constrained by existing facilities and significant grade change.
- The site requires redesign of Sheriff's facility parking lot and Becker Drive cul-de-sac.
- The site has limited surveillance of the airfield.
- Aircraft operating on Apron D may interfere with the ARFF response.
- The site does not allow for pull-through access to the equipment bays.

ARFF Alternative 6: South Hard Stands

ARFF Alternative 6 is in the southern quadrant of STS on the old military hard stand sites east of Apron F. The balance of the site is in undeveloped and includes jurisdictional wetlands. **Figure 5-11** shows a conceptual layout for this site with proximity to existing facilities, access, and vehicle parking.

Figure 5-11: ARFF Alternative 6 Concept – South Hard Stands



Airfield Access, Response Times, and Joint Use

The Alternative 6 site has unrestricted views of the airfield, except for the approach end of Runway 2, which is obstructed by Apron F hangars. Access to the airfield is via Taxiway E to either Runway 14/32 or 2/20.

The distance from Alternative 6 to the center of Runway 2/20 is 5,450 feet. Using a typical response time of 45 seconds for fire crews to dress in protective clothing, mount vehicles, and exit the facility, an ARFF truck needs to maintain an average of 28 miles per hour to reach the midpoint of Runway 2/20 within 3 minutes. A joint-use facility at this site would have the benefit of direct access to a public street. However, the location is more distant from non-aviation industrial development east of the Airport.

Impact on Terminal and Operations

Alternative 6 is on the south quadrant and not near the terminal area, which means this location will not impede terminal expansion over the next 20 years. Alternative 6 is east of the hangar banks on Apron F and south of Taxiway E. This location does not interfere with or limit aircraft movement. However, an ARFF facility on this site will reduce the efficiency of airport operations staff who provide the ARFF services. The longer drive time from the east side core area to Site 6 will reduce the hours available for operations and maintenance activities.

Facility Requirements

The Alternative 6 site is unrestricted by other STS facilities. The facility will need to be set back from the Taxiway E TOFA to provide wingtip clearance from taxiing aircraft to the ARFF vehicle staging area. Sufficient area is available for the required ARFF facility functions including room to maneuver beside and behind the station for pull-through access to the vehicle bays. Access to the site occurs via the exiting access road that connects to Laughlin Road. The security gate is currently located midway along this access road and needs to be shifted to the cul-de-sac to allow public access to the ARFF facility.

Sewer and water service are unavailable leading to a substantial cost to extend sewer and water to this site, as discussed in the Utility Access section above. There is an option for well drilling to supply domestic water and an onsite septic system, which reduces costs for these utilities.

Environmental Impacts

The site includes paved areas associated with the hardstands and the balance vegetated. The unpaved portion includes a jurisdictional wetland, considered to be habitat for the endangered Burke's Goldfields, and Tiger Salamander critical habitat. Because of these habitat areas, Alternative 6 will require the preparation of an EA for NEPA compliance. Obtaining necessary permits from the Army Corps of Engineers and Regional Water Quality would require documentation that there were no feasible alternative sites with lower impacts on wetlands.

ARFF Alternative 6 Overview

Alternative 6 provides these advantages:

- This site has no constraints from existing facilities.
- The site does not impact airport operations or existing facilities.
- Landside access is via Laughlin Road.

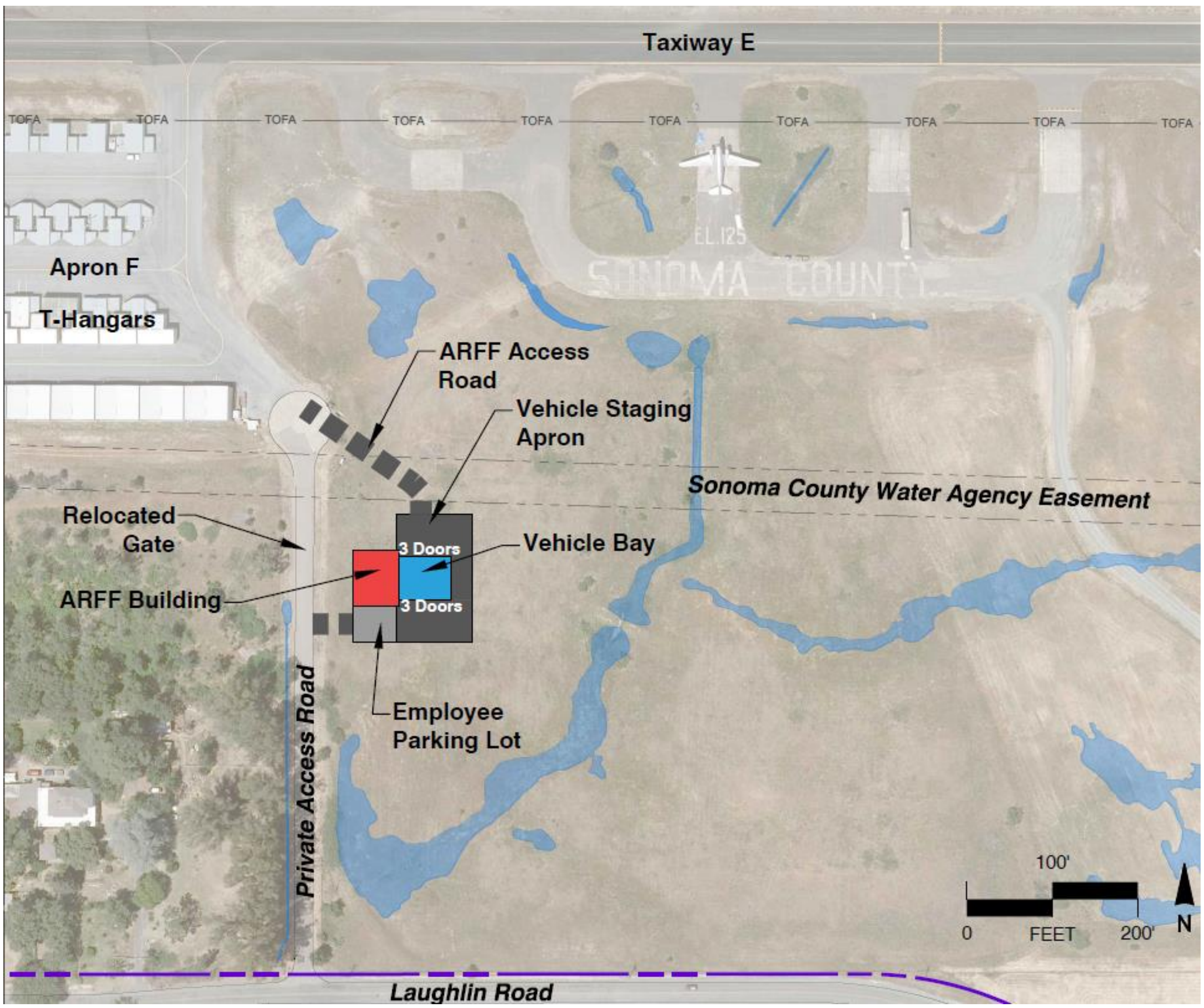
Alternative 6 provides these disadvantages:

- Lack of direct access to water and sewer utilities.
- Potential significant biological impacts and it may be difficult to obtain needed permits.
- Site is not as convenient as east quadrant sites for operations staff to access.

ARFF Alternative 7: Apron F

ARFF Alternative 7 is south of Apron F. Site 7 offers a benefit of reduced environmental impact compared to Site 6. **Figure 5-12** shows a conceptual layout for this site with proximity to existing facilities, access, and vehicle parking. Like Site 6, this location is not developed. The only utility available at this site is electricity, and the cost to extend sewer and water to this site is substantial.

Figure 5-12: ARFF Alternative 7 Concept – Apron F



Airfield Access, Response Times, and Joint Use

The Alternative 7 site is obstructed by Apron F hangars that lead to semi-restricted views of the airfield. Access to the airfield is via either Apron F taxilane or a new service road, to Taxiway E, to either Runway 14/32 or 2/20. The distance from Alternative 7 to the center of Runway 2/20 is 5,150 feet. Using a typical response time of 45 seconds for fire crews to dress in protective clothing, mount vehicles, and exit the facility, an ARFF truck needs to maintain an average of 26 miles per hour to reach the midpoint of Runway 2/20 within three minutes. As with Alternative Site 6, this site has the advantage of direct access to a public street and the disadvantage of a somewhat remote location.

Impact on Terminal and Operations

Alternative 7 is on the south quadrant and not near the terminal area. This location will not impede terminal expansion. Alternative 7 is southeast of the hangar banks on Apron F. The ARFF facility would not itself impact aircraft movement. However, ARFF vehicles accessing the airfield via Apron F taxilane may interfere with general aviation operations there. Additionally, as noted in Alternative 6, an ARFF site in the southern quadrant will increase the amount of time operations staff spend driving from the east-side core area. This will reduce the hours that they are available to perform their operations and maintenance activities.

Facility Requirements

The Alternative 7 site provides sufficient area for the building, parking, drive lanes, vehicle staging, and room to maneuver beside and behind the station for pull-through access to the vehicle bays. Access to the site is via Laughlin Road and the exiting access road. The security gate is currently located midway along this access road and needs to be shifted to the cul-de-sac to allow public access to the ARFF facility.

Sewer and water service are not available at this site. As discussed in the Utility Access section above, an option to extend sewer and water to this site comes with substantial costs. A less expensive option for water and sewer is to incorporate an onsite septic system and a well to supply domestic water.

Environmental Impacts

This site is currently undeveloped and falls within designated tiger salamander critical habitat. The site is near jurisdictional wetlands considered to be habitat for the endangered Burke’s Goldfields. Without data on how drainage patterns would be affected, it is not possible to know whether use of this site would impact the hydrology of the nearby wetlands. Because of its impacts to tiger salamander critical habitat, Alternative 7 will require the preparation of an EA for NEPA compliance. Obtaining necessary permits will require demonstration that no feasible alternative with lower biological impacts exists.

ARFF Alternative 7 Overview

Alternative 7 provides these advantages:

- Greenfield site with no constraints from existing facilities
- Does not impact aircraft operations or existing facilities
- Landside access via Laughlin Road.

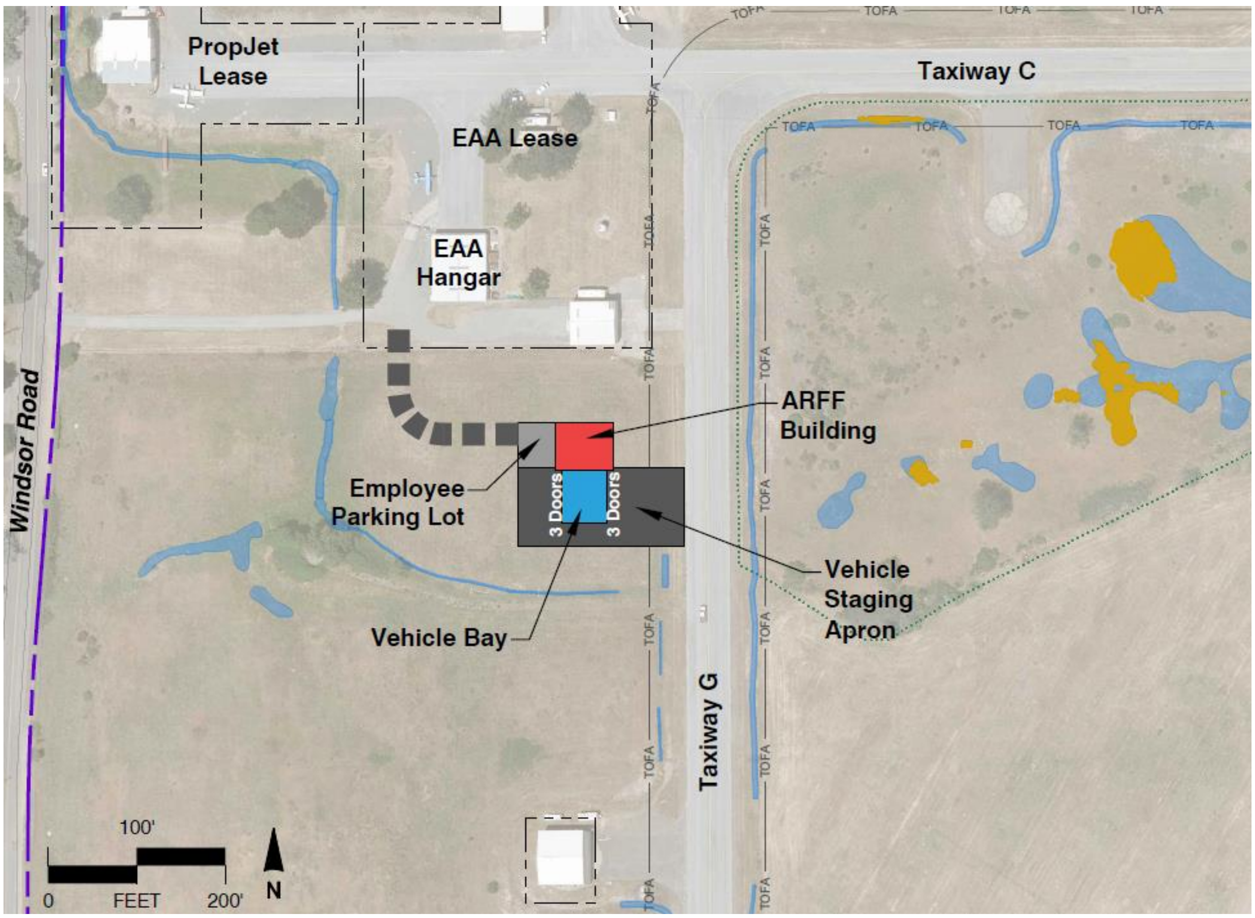
Alternative 7 provides these disadvantages:

- Lack of direct access to water and sewer utilities
- Site is not as efficient as east quadrant sites for operations staff to access.
- Site has significant biological impacts and may be hard to obtain permits.

ARFF Alternative 8: West Quad

The Alternative 8 site is on the west quadrant of STS near the EAA building and the old gun club and between scattered GA hangars. **Figure 5-13** shows a conceptual layout with Taxiways C and G providing airside access. Like Sites 6 and 7, sewer and water service is not readily available. Landside access is from Windsor Road to the west; however, road improvements may be required to provide adequate access.

Figure 5-13: ARFF Alternative 8 Concept – West Quad



Airfield Access, Response Times, and Joint Use

The Alternative 8 site has unrestricted views of the airfield and terminal area. Access to the airfield is via either Taxiway C or G to Runway 14/32 and 2/20. For Site 8 only, response time analysis is calculated to the midpoint of Runway 14/32, since this is farther from Alternative 8 than the midpoint of Runway 2/20. The distance from Alternative 8 to the center of Runway 14/32 is 3,750 feet. Using a typical response time of 45 seconds for fire crews to dress in protective clothing, mount vehicles, and exit the facility, an ARFF truck needs to maintain an average of 19 mph to reach the Runway 14/32 midpoint within 3 minutes. A joint-use facility at this site would have the advantage of direct access to a public street. However, the location is more distant from non-aviation industrial development east of the airport.

Impact on Terminal and Operations

Alternative 8 is on the west quadrant and not near the terminal area. This location will not impede terminal expansion over the next 20 years. Alternative 8 is south of isolated hangars on undeveloped land. This location does not interfere or limit aircraft movement. As with Alternatives 6 and 7, this site is distant from the east-side core area where operations staff spend most of their workdays. An ARFF facility on this site will increase the driving time for operations staff and reduce their availability for their other duties.

Facility Requirements

The Alternative 8 site is a greenfield site unrestricted by other STS facilities. Sufficient area is available for the required ARFF facility functions including room to maneuver beside and behind the station for pull-through access to the vehicle bays. Access to the site occurs via Laughlin Road and the exiting access road. The security gate is currently located midway along this access road and needs to be shifted to the cul-de-sac to allow public access to the ARFF facility.

Sewer and water service are not available leading to substantial cost to extend sewer and water to this site, as discussed in the Utility Access section above. There is an option for well drilling to supply domestic water and an onsite septic system, which reduces costs for these utilities.

Environmental Impacts

The site is currently undeveloped. The site lies within designated tiger salamander critical habitat. No wetlands would be directly impacted by development on this site. However, delineated wetlands are located adjacent to this site. Development of this site is not anticipated to affect the Burke's Goldfields' site across Taxiway G because of the barrier that the taxiway provides. Because of tiger salamander habitat area, Alternative 8 will require the preparation of an EA for NEPA compliance.

ARFF Alternative 8 Overview

Alternative 8 provides these advantages:

- Greenfield site with no constraints from existing facilities
- Does not impact airport operations or existing facilities
- Landside access via Windsor Road.

Alternative 8 provides these disadvantages:

- Lack of direct access to water and sewer utilities
- Potentially significant environmental impacts.
- Site is not as efficient as east quadrant sites for operations staff to access.

ARFF ALTERNATIVE EVALUATION

For the preferred ARFF site, alternative evaluation is based on the site meeting requirements listed in the ARFF Facility Requirements and Siting Standards section above. After initial evaluation, the categories of indirect costs and delays to implementation were added to the matrix. These summarize the significant barriers to approval of the site, design, and construction. For site evaluation purposes, costs associated with the actual ARFF facility design and construction are expected to be relatively equal for all proposed sites. Significant cost variables for specific sites are utility access and interference with FAA facilities. Other variable cost drivers are landside access, environmental mitigation, and grading and drainage.

Along with variable cost impacts, delays to implementation should be considered when selecting a site. Delays associated with FAA coordination for RTR redesign, Army Corps of Engineers permitting of wetland impacts, EA and approval time, relocating Airport facilities, and providing utility access are considered variables that influence the ARFF design and construction timeline.

Some factors are more critical to site selection than others. For a site to be considered viable it must avoid or mitigate impacts to these factors:

- Interference with NAVAIDS/Equipment: A site that interferes with a NAVAID or other equipment necessary for the safety of aircraft operations would be unacceptable.
- Wetlands: The key state and federal resource agencies are expected to consider any impacts to wetlands to be an impact on the endangered Burke's goldfields. These agencies are unlikely to issue necessary approvals/permits for projects that impact Burke's goldfields, if other viable alternatives exist.
- Staffing Efficiency: Because of major inefficiencies in staff utilization, sites outside of the eastside terminal area would pose an unacceptable burden on Airport staff resources.
- Impacts to Apron A: Apron A is used by general aviation aircraft for transient parking, fueling and access to a major FBO, and for airline aircraft RON and unscheduled maintenance purposes. Demand will increase as airline flights and passenger gates expand. There are no alternative sites to accommodate these GA and airline needs. A further constraint to Apron A could limit airline service and transient general aviation use. An alternative that constrains Apron A should only be considered if there are no other viable alternatives.

Table 5-2 presents an alternative matrix with the siting requirements. Each alternative has either an impact on existing facilities, impact on operations, major design hurdles, or a combination of these.

Table 5-2: ARFF Comparison Matrix

Location									
Airfield Access and Response Times	Distance to Rwy 2/20 Midpoint								
	Avg MPH to Reach 2/20 Mid in 3 min[1]								
	Direct Access to Taxiway								
	Surveillance of the Airfield								
	Joint-Use Facility								
Impact on Terminal Area Facilities	Interference with ATCT Line of Sight								
	Interference with NAVAIDs/Eqpmt								
	Impacts to Other Facilities								
	Impacts to Terminal Expansion								
	Impacts to Operations								
ARFF Facility Requirements	Adequate Space for Facility Layout								
	ARFF Vehicle Staging Area								
	Pull Through ARFF Bays								
	Landside Access - Staff/Visitor Access								
	Operations Staff Efficiency Impact								
Environmental Impacts	Wetland Impacts								
	Tiger Salamander Impacts								
	Burke's Impacts								
	NEPA Document								
Utility Access	Water								
	Sewer								
Other Impacts	Indirect Costs (Order of Magnitude)								
	Delays to Implementation (From Indirect Impacts)								

Meets Requirements Impact Major Impact

Notes:
1 Response time includes 45 seconds for ARFF personnel to dress in emergency suits and enter vehicle.
2 Midpoint of Runway 14/32 is farthest midpoint of air carrier runway for Site 8.
CE: Categorical Exclusion
EA: Environmental Assessment
ACOE: Army Corps of Engineers
RTR: Remote Transmitter/Receiver

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Sites Eliminated from Consideration

Based on the preceding evaluation, the ARFF alternatives listed in **Table 5-3** were eliminated from further consideration. The most significant factors were impacts to communication facilities, inefficiencies in operations staff utilization, potential for conflicts with taxiing aircraft, and major environmental impacts.

Table 5-3: ARFF Alternatives Eliminated from Consideration

Alt	Major Issues
Site 2	• Presents constraints and congestion on Apron A while requiring modification or relocation of RTR facilities, and the associated schedule and cost uncertainties make this alternative nonviable.
Site 3	• Creates complications with existing operations and facilities. • Poses a high potential for conflicts with airfield access.
Site 5	• Requires significant grade change and is constrained by existing facilities • Requires redesign of Sonoma County Sheriff's facility parking lot and Becker Drive cul-de-sac.
Site 6	• Impacts Burke's goldfields habitat. • Produces inefficiencies by requiring long driving time from east-side core area by operations staff.
Site 7	• Is located in hangar area, with potential conflicts to taxiing aircraft. • Produces inefficiencies by requiring long driving time from east-side core area by operations staff. • Is setback from airfield with constrained visibility of Runway 2/20.

ARFF Alternatives for Further Consideration

Initial evaluation reveals the best locations for the replacement ARFF facility are Sites 1, 4, and 8. While all have undesirable features and impacts, they are the best of a limited range of choices. Although cost is always an important consideration, the best sites are operationally robust, have limited or no impacts on other aviation facilities or uses, and have limited environmental impacts. These desired characteristics make Sites 1, 4, and 8 superior to the others initially considered.

The general costs to construct an ARFF facility are assumed to be relatively equal for the three finalist sites. The basic costs include design and construction of the building, staging aprons, auto parking and extension of utilities from adjacent sites. Alternatives 1 and 8 have costs beyond these general estimates for California Tiger Salamander mitigation, plus RTR modification, and utility access. Planning-level cost estimates were prepared for California Tiger Salamander mitigation, modification of the RTR antennas for Site 1, and provision of water and sewer service to Site 8 are provided below.

Alternative Site 1

Alternative 1 has the major advantages of being close to the east-side core area and utilizing an area not allocated to another aviation use. Its principal complication is the uncertainty of the time and cost it will take to design and modify the RTR facility. Its environmental impacts are minor, and it will represent small mitigation costs.

The FAA OESG provided guidance and planning level cost estimates for RTR modification using available data from similar FAA projects and the proposed budget for a feasibility study. It is stressed these are estimates, estimated conservatively for this study to provide a worst-case cost estimate.

The FAA provided order of magnitude costs for addressing ARFF impacts to the RTR facility in an April 20, 2021, email to Jon Stout, STS Airport Manager. These cost estimates addressed two scenarios: raising of the RTR antennas and relocating the facility to a new site. The most likely cost for raising the antennas was estimated to be about $1.7 million with a low estimate of $1.3 million and high estimate of $2.6 million. A new RTR site had a most likely cost of $3.6 million, with low and high costs estimated to be $2.7 and $5.4 million, respectively. The FAA cost estimates were based upon several assumptions:

- STS is responsible for managing all design and construction activities. These costs are not included in the estimates presented above.
- The costs do not include FAA's overhead costs for labor and expenses.
- The costs do include the costs of providing RTR signal coverage during construction of the facilities.
- There is a high degree of uncertainty over the technical requirements and constraints on the new facility until a formal feasibility study is conducted by the FAA.

Costs associated with RTR modification, coordination with FAA, and an uncertain timeline and construction date make Alternative 1 a less attractive option. Initially Alternative 1 was favored based on location and lack of impact on airfield operations. However, the high estimated costs, the lack of clarity on timing and schedule, and coordination with the FAA make this site unfeasible. The Sites described below may offer similar benefits without modifying a major communication facility.

Alternative Site 8

Site 8 was retained for consideration because it is the best of the sites not on the east side. Site 8 requires capital improvements for water and sewer utilities. It has the side benefit that utility development may help fund infrastructure to support general aviation development on the west quadrant. Even if well and septic systems can be used, providing sewer and water service would cost over $1 million at Site 8. Unlike Sites 6 and 7, Site 8 will not be able to access the aqueduct for fire protection water and will require additional water storage for fire protection. Any Airport project not limited to existing pavement will be considered to have impacted the California tiger salamander's habitat. Therefore, development of this site requires mitigation. Mitigation will consist of payment of a per acre mitigation fee of $32,000 per acre.

Costs beyond the general costs for site design and construction of Site 8 include water and sewer access and California Tiger Salamander mitigation costs. There were two west quadrant wastewater service options: extension of a sewer line from the east side of the Airport or installation of a septic system.

- Extension of a sewer line to the sewage treatment facility is the most expensive method, with an estimated cost of $1.7 to $2.0 million. The estimate does not include environmental review, mitigation, and connection fees. This cost estimate represents greater uncertainty than for the similar connection to the southern quadrant due to the need for directional boring under airfield pavement.
- Construction of an onsite septic system is estimated to cost $350,000 to $450,000.

Two west quadrant domestic water service options consist of extension of a water main and use of a well and onsite water storage tanks.

- Extension of a water main from North Laughlin Road is the most expensive, estimated to be $1.5 to $1.8 million plus environmental review, mitigation, and connection fees.
- To use an onsite well with storage tanks to provide water for both domestic use and fire protection, well installation and drilling are estimated to cost $400,000 to $500,000, plus costs for filtration, storage tanks, and environmental review.

For this analysis, the onsite septic system paired with the onsite well and storage tanks is selected for planning cost estimates. Site 8 also requires California Tiger Salamander mitigation costs based on the facility footprint in the habitat area. Payment of mitigation fees is expected to be required. The significant increase in costs associated with water main and sewer line connections, combined with the inconvenience for operations staff to access from the east side building area, likely make Site 8 unfeasible.

Alternative Site 4

Site 4 likely has the lowest development costs and least potential for delay. Environmental processing will be relatively simple compared to Sites 1 and 8 since this site is located on existing pavement. This makes it both less expensive to build and less subject to delay. The primary drawbacks are impacts to Apron A and potential constraints to ground service equipment. The impacts to Apron A are judged to be the most significant impact. As air service expands, Apron A will need to be modified to accommodate increased spaces designated for overnight and unscheduled maintenance parking for airline aircraft. Adjacent FBOs are seeking additional apron area for their use. There are no adjacent alternative sites for these uses.

As the ARFF analysis occurred, analyses for the near-term terminal footprint, aircraft parking positions, and the ultimate terminal footprint were refined. The analysis indicated requirements for Apron A to accommodate additional airline parking positions for remain overnight (RON) or maintenance positions away from the terminal in the near-term. The proposed concept is to add pavement to the former helicopter parking positions, immediately north of the current airline parking positions, and the area between Taxiways J and K. This additional pavement allows for some flexibility on Apron A and reopens the potential to develop the ARFF facility on Apron A without severely impacting existing general aviation, the FBO, or the ultimate terminal facilities.

Three variations on Site 4 permit evaluation of different configurations of Apron A and associated taxilanes. Each alternative below impacts Apron B and FBO operations, specifically Kaiser Air ramp utilization. Each Apron A alternative utilized the anticipated 2040 footprint of the passenger terminal. The terminal design accommodates six gate positions in one row. This configuration eliminates 5 push-back tiedown positions for single-engine aircraft and 10 taxi-through positions sized for piston and smaller turboprop twin-engine aircraft. These reductions occur independent of the location of the ARFF facility. Small shifts in the location and configuration of the ARFF facility were made to optimize the space available for aircraft parking in each apron alternative.

Apron A Alternative 1

In this alternative (**Figure 5-14**) the ARFF facility has pull-through bays for the ARFF vehicles. Access to the facility is via the public road that passes in front of Kaiser Air's general aviation terminal. The ARFF's offices and auto parking lot are located north of the vehicle bays. The fuel island remains in its present location but is modified to permit fueling only on one side. The size of the southernmost aircraft parking box is reduced. This eliminates three to four parking positions for midsized general aviation aircraft. The parking box for larger general aviation aircraft remains in its present configuration.

The undeveloped area between Taxiways J and K is paved to provide four spaces for airline RON or unplanned maintenance. Placing these four airline parking positions away from the terminal is undesirable but judged to be acceptable. Paving of this area requires conversion of an open ditch to a culvert. This ditch segment is classified as a jurisdictional wetland.

Apron A Alternative 2

In this alternative (**Figure 5-15**) the RON and unscheduled maintenance positions for airline aircraft are arrayed as an extension of the six gate positions expected to exist in the next 5-7 years. This is optimum for airline aircraft but reduces space on the existing Apron A for parking general aviation aircraft. The existing large aircraft parking box decreases substantially from 61,500 square feet to 27,000 square feet. This reduces the parking capacity for larger corporate jets by about three aircraft. The existing fueling island remains in its present location with fueling on both sides of the island. Parking for smaller aircraft in the row associated with the fueling island is reduced to about two aircraft. This alternative creates two rows of parking for general aviation aircraft between Taxiways J and K. These rows accommodate aircraft as large as medium corporate jets. Depending upon the size of the aircraft, these two rows can serve from 9 to 15 aircraft. Paving of this area requires conversion of an open ditch to a culvert. This ditch segment is classified as a jurisdictional wetland.

In this alternative the ARFF facility shifts further south than in Apron A Alternative 1. ARFF vehicles have to back into the parking bays; the facility is not designed with pull-through bays. This site reduces the amount of space north of the terminal available for ground service equipment. The exit route for ARFF vehicles also is used by ground service equipment. The ARFF facility's offices and auto parking lot are located east of the vehicle bays. Road access is via the public road that serves Kaiser Air. The gate and fencing on the access road are moved to the east to allow vehicle access to the ARFF parking lot.

Apron A Alternative 3

Apron A Alternative 3 (**Figure 5-16**) includes elements of the first two alternatives. The northern and mid-apron parking boxes remain in the current configuration. The undeveloped area between Taxiways J and K are configured to accommodate four airline RON or unscheduled maintenance positions. The location of the ARFF facility is similar to Apron A Alternative 1. ARFF vehicles need to back into their bays. In this version, the ARFF vehicle bays are shifted about 20 feet north of the associated office. This allows the bays to be aligned with the apron service road while keeping the present alignment of the public road that provides access to Apron A. The auto parking lot utilizes a portion of the long-term parking lot.

This alternative also illustrates a possible joint-use layout. Two bays are added at the east end of the building for use by fire trucks or general maintenance on other airport vehicles. The fencing and gate associated with the public access road need to be extended to the west. The new configuration permits the fire trucks to exit via this road without passing through a gate.

Figure 5-14: ARFF Site 4 - Apron A Alternative 1

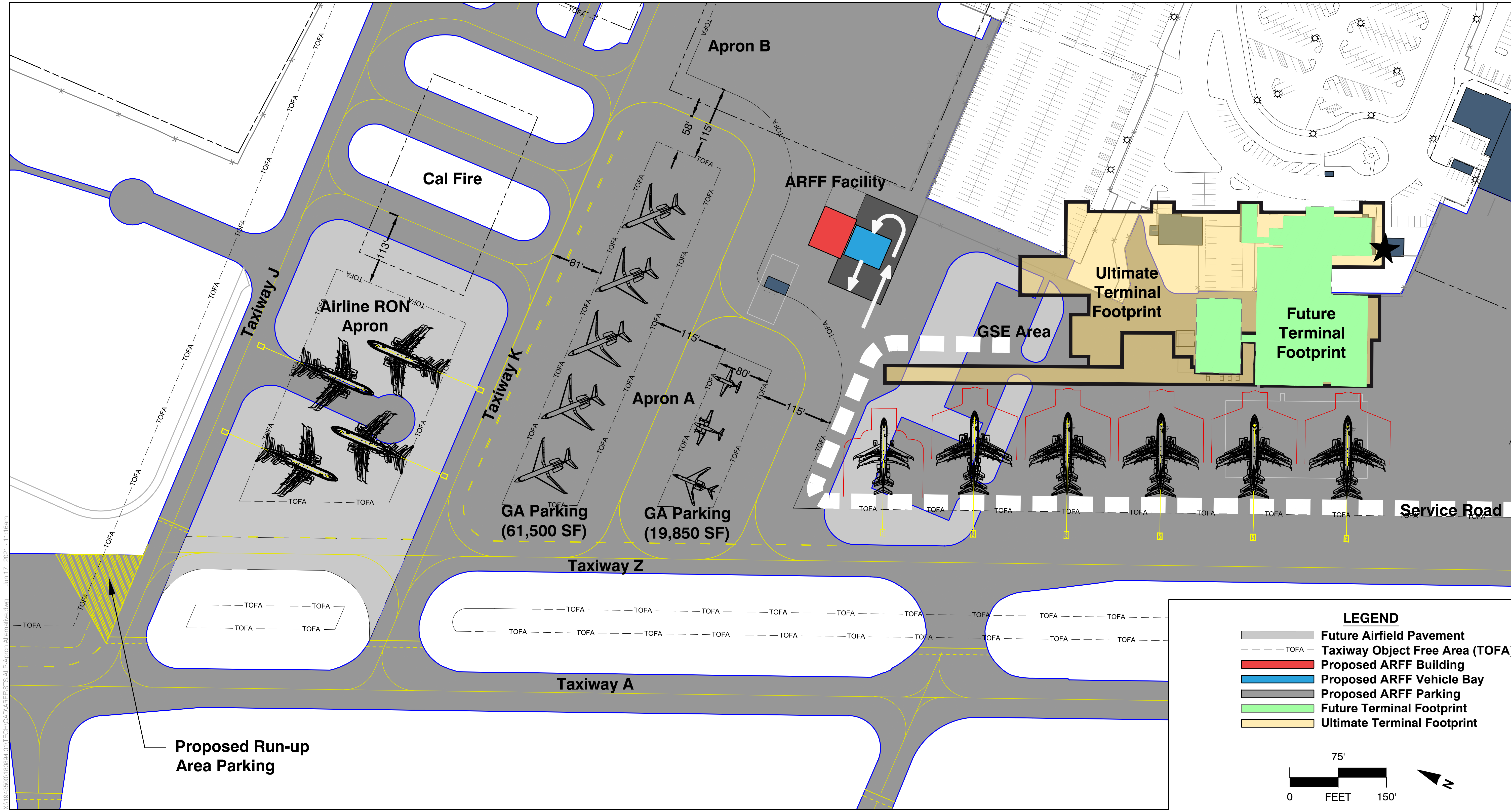


Figure 5-15: ARFF Site 4 - Apron A Alternative 2

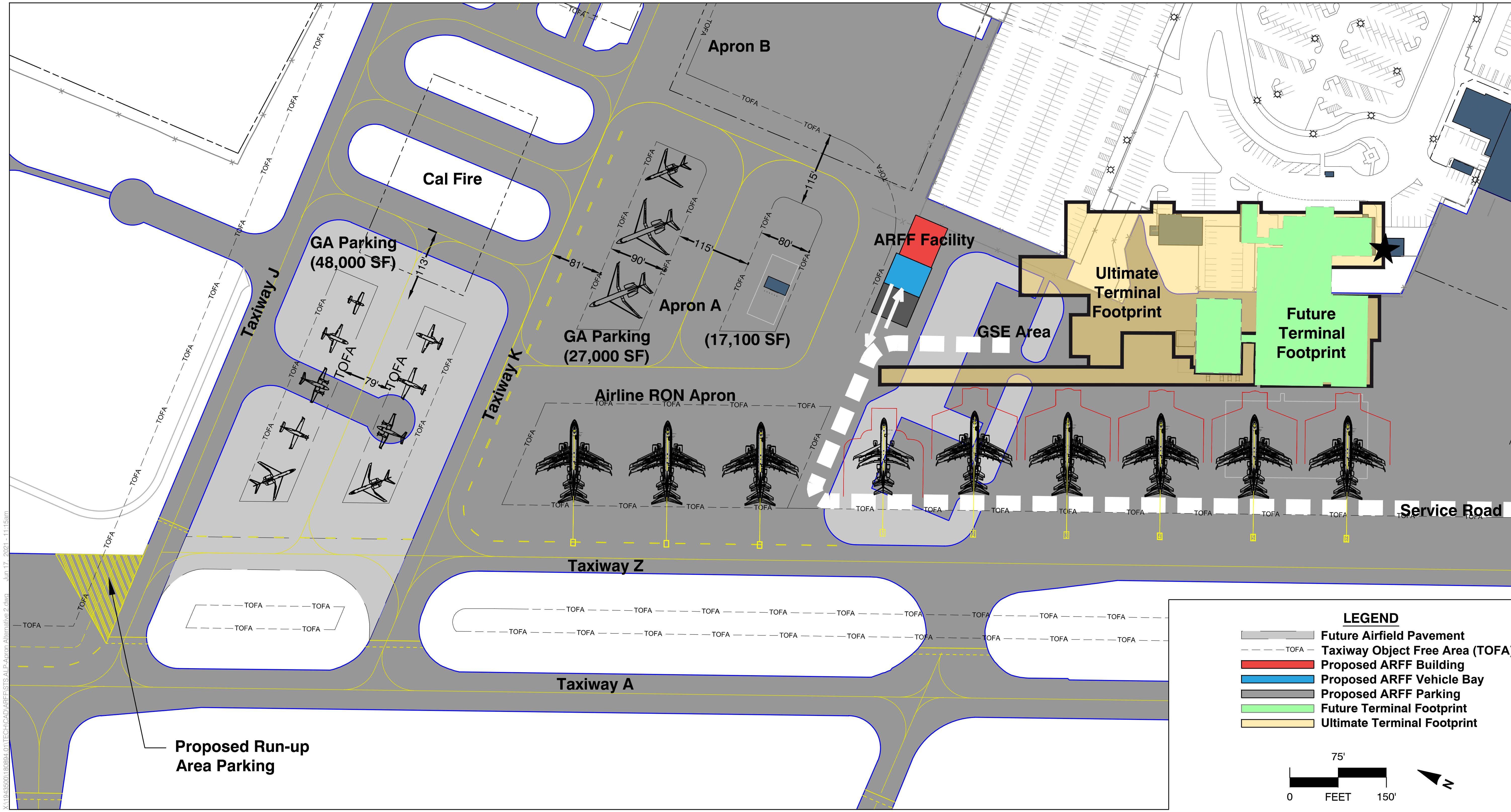
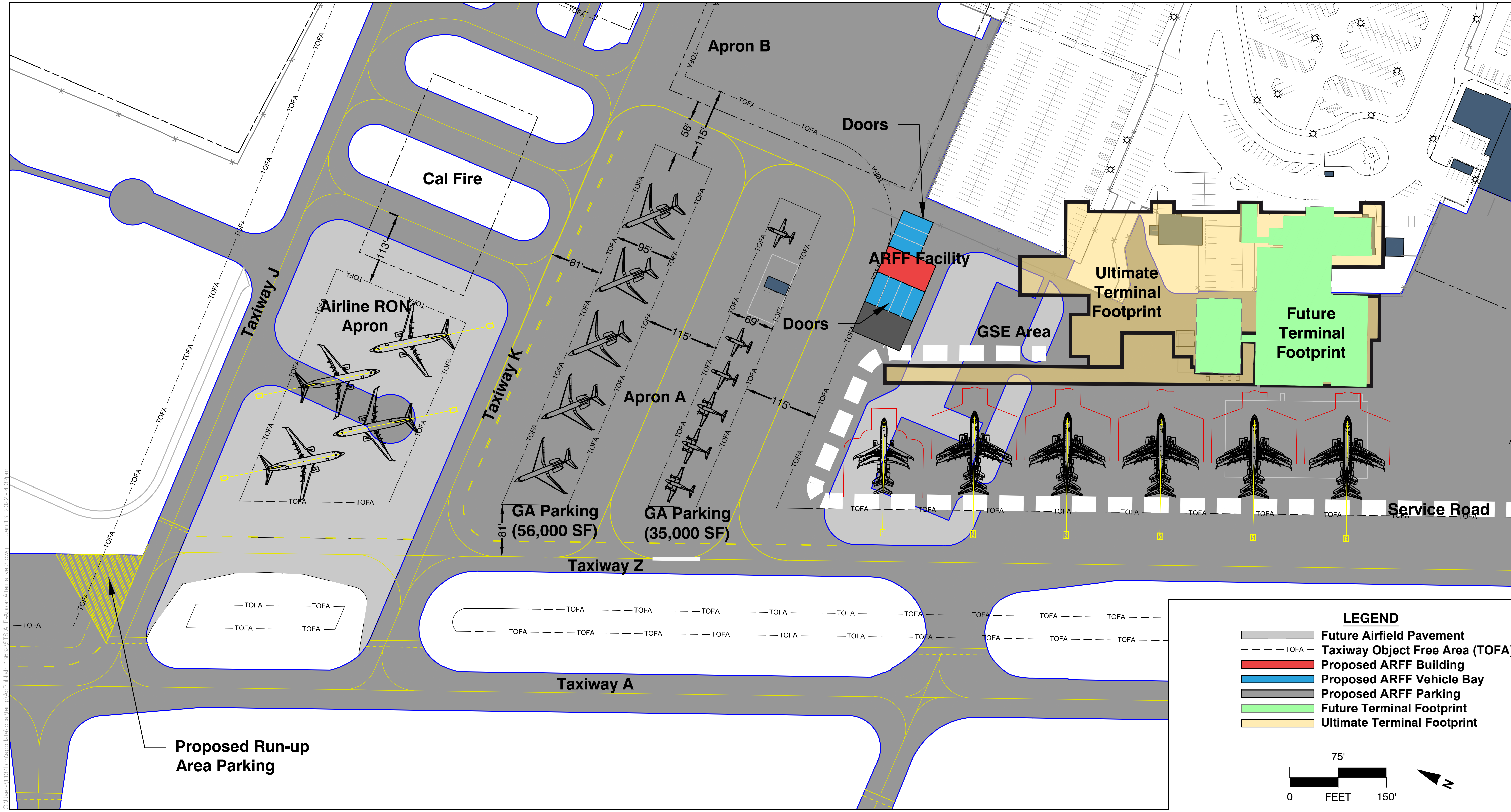


Figure 5-16: ARFF Site 4 - Apron A Alternative 3



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Recommended Site

After refined analysis of the ultimate terminal footprint, gate positions, and impacts on general aviation parking, it was determined Apron A will accommodate an ARFF facility. After consideration of the strengths and weaknesses of each alternative, Site 4 on Apron A has been selected as the preferred site. The principal weakness of Site 4 is its impact to the ultimate terminal and general aviation parking on Apron A. This is judged to be less significant than its attributes:

- Site 4 is located in the east-side core area with access to existing facilities, which makes it efficient for operations staff, who serve as the ARFF staff.
- Site 4 offers minimal environmental impacts.
- Site 4 can be used for a joint-use ARFF / fire station.
- Site 4 does not constrain future passenger terminal development.
- Site 4 has a low impact on airport and aircraft operations.

Apron A Alternative 3 is selected as the preferred design for ARFF Alternative 4 due to the following advantages:

- It has the least impact on general aviation parking capacity.
- It provides 4 RON and unplanned maintenance spaces in reasonable proximity to the terminal.
- It retains the ability to serve as a joint-use ARFF / fire station.
- Its environmental impacts are identical with the other two.

Figure 5-17 shows a more detailed site layout for the preferred location. The future ARFF facility will be added to the ALP at this location. The Site 4 - Apron A Alternative 3 layout and orientation will continue to be refined so the proposed ARFF facility is compatible with future terminal and parking expansion.

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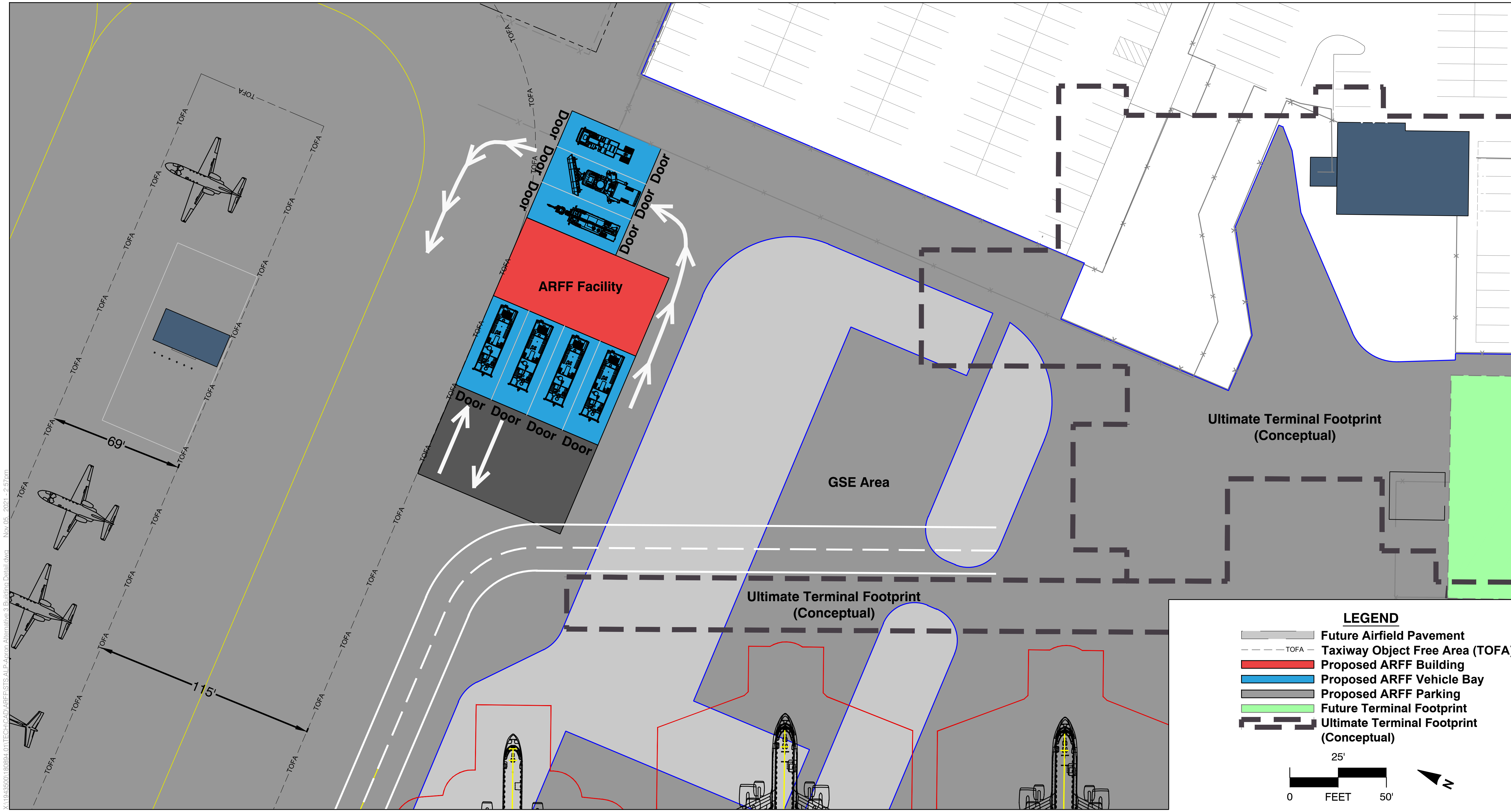
Figure 5-17: ARFF Site 4 - Apron A Alternative 3



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Chapter 6
GA Development

Chapter 6 -

General Aviation Development

A key purpose of this update of the Airport Layout Plan (ALP) for Charles M. Schulz–Sonoma County Airport (STS) is to identify means to accommodate forecast growth in based aircraft. Most aircraft are currently based on the east side of the Airport, with limited numbers also based on the western and southern quadrants. The limited acreage available for development is in the eastern quadrant but is subject to competition for various uses, including passenger terminal expansion, fixed base operators (FBO), rental car facilities, a replacement aircraft rescue and firefighting (ARFF) facility, and auto parking. Additionally, some banks of hangars for small aircraft have reached the end of their useful life and need to be replaced. This working paper examines alternative means of providing storage space for new aircraft and replacing existing hangars. The goal of this is analysis is to identify areas available for realistic hangar development and present concepts for each site.

FORECAST DEMAND

An update of aviation activity forecasts was necessary as part of this ALP update to accurately conceptualize development. **Table 6-1** presents the ultimate (2038) forecast demand for additional based aircraft storage by aircraft type, which determines what type of hangar is needed. The number based on FBO leaseholds is an estimate based upon the current pattern of use.

Table 6-1: Additional Based Aircraft Forecast (2038)

Aircraft Type	Total Forecast	Number on FBO Leaseholds	Individual Hangar Demand
Single-Engine Piston	21	0	21
Multi-Engine Piston	12	2	10
Jet / Turboprop	11	5	6
Helicopter	2	2	0

Source: Mead & Hunt and FAA Approved Forecasts (Aug 2, 2021)

This analysis assumes that all aircraft will be stored in hangars. Piston aircraft will be in T-hangars or small conventional (box) hangars, and jets and turboprops in conventional hangars. These assumptions guide the design analysis, but actual hangar types and sizes correlate to actual demand.

ASSESSMENT OF DEVELOPMENT POTENTIAL

The evaluation of possible GA development sites began by identifying areas on or planned to become part of STS that could plausibly be developed. Broadly this included all areas outside of critical runway and taxiway design surfaces (object free areas and runway protection zones), building restriction lines, and existing leaseholds. This area was then divided into development sites whose boundaries encompass an area with similar physical and operational characteristics. Existing taxiways, including abandoned ones, roads, and existing aviation uses (e.g., hangars areas) were used to define area boundaries. Areas were also defined by similar physical characteristics. Characteristics included: plant community, existing use (e.g., sprinkler fields), and prior use (i.e., former landfill). As a result, 25 potential GA development areas were defined.

Initial Review

This section presents a summary of the key characteristics that shaped the evaluation of each of the 26 potential GA development sites (**Figure 6-1**). Sites with severe limitations were removed from further consideration. The key reasons for eliminating a site are noted following its description.

Site 1

In the northwest corner of STS in an area defined north of a sprinkler field with woods and two creeks. Development impacts the largest stand of oaks on STS. Taxiway access requires crossing two creeks and their tributaries, and road access is from Windsor Road. Sewer and water service are not currently available. This area falls within designated critical habitat for the California tiger salamander. The creeks and adjacent wetlands are formally designated as jurisdictional waters of the U.S.

This site was eliminated from further consideration because its development would impact numerous biological features including creeks, wetlands, and oak woodlands. Development would be disproportionately expensive because it would require provision of sewer and water, and bridging two creeks to provide taxiway and road access. This area could be used for nonaeronautical or low impact uses.

Site 2

North of the Experimental Aircraft Association (EAA) area and south of a creek and wooded area. The site is currently an open field that is relatively level. Four small wetlands have the potential to be impacted. Airfield access is via Taxiway C, and road access is from Windsor Road. Sewer and water service are not currently available. This area falls within designated critical habitat for the California tiger salamander. This site is classified for potential long-ream development as GA Development Area Reserve.

Site 3

North of Taxiway C and south of Ordinance Creek. Most of the site is currently used as a sprinkler field for disposal of treated effluent by the SCWA and two large wetlands are in the middle of the site. However, significant development is achievable without directly impacting the wetlands. Access to Windsor Road requires a road across Site 2. Sewer and water service are not currently available. This site falls within designated critical habitat for the California tiger salamander.

All sites on the west side would be burdened with the expense of providing sewer service and water service for domestic use and fire protection. This site was eliminated from further review because it would also have the expense of providing vehicle access from Windsor Road. This access road would be about 750 feet long.

Site 4

South of EAA and west of Taxiway G. The site is mostly an open field with a vegetated mound in its center and two box hangars in the northeast corner. Wetlands exist in the form of three ditches and one isolated wetland. Significant development is possible with limited or no impact to these wetlands. Taxiways G or D offer airfield access, and road access is either via the existing entrance to EAA or a separate entrance from Windsor Road. Sewer and water service are not currently available. This area falls within designated critical habitat for the California tiger salamander. This site was retained for secondary evaluation and classified for GA Development Area Reserve.

Site 5

East of Taxiway G and south of Taxiway C. The site is designated as an environmentally sensitive area with a Burke’s goldfields preserve. This area falls within designated critical habitat for the California tiger salamander. Taxiways C and G offer airfield access, and road access is possible across Site 4 but requires severing the connection of Taxiway G to either Taxiway C or B. No sewer or water connections exist.

This site was eliminated from secondary review because of the presence of the Burke’s goldfields preserve.

Site 6

East of Taxiway G and north of Taxiway B. The parcel is currently used as a sprinkler field for disposal of treated effluent by the Town of Windsor. The site is generally level. Drainage ditches classified as wetlands exist on the western, southern, and eastern boundaries. This area falls within designated critical habitat for the California tiger salamander. Significant development is possible with limited or no impact to these wetlands. Access to Windsor Road is possible across Site 4, but requires severing the connection of Taxiway G to either Taxiway C or B. No sewer or water connections exist.

This site was eliminated from further review because its development would require severing of taxiways serving the west side. This would impede circulation and eliminate areas from potential aviation use.

Site 7

Along STS's southwestern border. This is the site of a closed landfill. Although the site is generally level, the types of uses allowed atop the fill are limited by its former use. A ditch classified as a wetland passes through the middle of the site. The southern third has a wetland that is one of the largest on the Airport. This area falls within designated critical habitat for the California tiger salamander. Airfield access is possible using the abandoned Taxiway W to Taxiway D, and road access from Windsor Road exists in the southern half of the site. No sewer or water connections exist.

This site was eliminated from secondary review because it is the site of closed landfill.

Site 8

West of abandoned Taxiway W. Law enforcement currently uses the site for driver training. The site is level. Drainage ditches classified as wetlands and isolated wetlands exist in the northern and central portions. Significant development is possible with limited or no impact to these wetlands. This area falls within designated critical habitat for the California tiger salamander. Use of the abandoned Taxiway W to Taxiway D provides airfield access, and road access exists from Slusser Road. No sewer or water connections exist.

All sites on the west side would be burdened with the expense of providing sewer service and water service for domestic use and fire protection. This site would also have the expense of reconstructing Taxiway W and demolition of the adjacent hardstands. However, development might be possible on the existing hard stands. This site is classified for potential long-ream development as GA Development Area Reserve.

Site 9

South of Taxiway B and east of abandoned Taxiway W. This generally level site is currently used as a sprinkler field for disposal of treated effluent by the SCWA. Drainage ditches classified as wetlands exist on the western, southern, and eastern boundaries. This area falls within designated critical habitat for the California tiger salamander. Significant development is possible with limited or no impact to these wetlands. Taxiway D provides airfield access, and road access exists at the intersection of Windsor Road and Mark West Station Road. No sewer or water connections exist.

All sites on the west side would be burdened with the expense of providing sewer service and water service for domestic use and fire protection. This site would also have the expense of extending a new taxiway from Taxiway D to serve this area. This site is classified for potential long-ream development as GA Development Area Reserve.

Site 10

In the center of the airfield north of Taxiway E and south of Taxiway D. Much of this generally level site is currently used as a sprinkler field for disposal of treated effluent by the SCWA. The site has an extensive network of wetlands. This area falls within designated critical habitat for the California tiger salamander. An occurrence of Lobb's aquatic buttercup, a California species of concern, exists on this site. Taxiway access is possible from Taxiways D or E, but vehicle access to this parcel could only occur if Taxiway E is severed or made a nonmovement area. No sewer or water connections exist.

This site was eliminated because its use would require severing of Taxiway E or its designation as a nonmovement area. This would complicate the ability of air traffic control to move aircraft from the west to east sides of the airfield.

Site 11

Midfield north of Taxiway E. The site is classified as an environmentally sensitive area with a wetland preserve. This area falls within designated critical habitat for the California tiger salamander. Taxiway access is possible from Taxiway E, and vehicle access is only possible if Taxiway E is severed or made a nonmovement area. Sewer and water service are not currently available.

This site was eliminated because its use would require severing of Taxiway E or its designation as a nonmovement area. This would complicate the ability of air traffic control to move aircraft from the west to east sides of the airfield.

Site 12

Southwest of the approach end of Runway 2 and south of Taxiway E. The site has three groups of wetlands. This area falls within designated critical habitat for the California tiger salamander. An easement with SCWA runs east-west through the middle of the parcel. Significant development is possible with little or no impact to the wetlands. Airfield access is from Taxiway E, and vehicle access is from Laughlin Road. The site has significant topographic variation. Extensive grading would be required to provide the shallow slopes that taxilanes and hangars require. Sewer and water service are not currently available.

All sites on the west side would be burdened with the expense of providing sewer service and water service for domestic use and fire protection. This site was eliminated from further review because it would also have the expense of extensive grading to meet slope requirements for taxilanes and hangars.

Site 13

South of Taxiway E and west of Apron F. The site is designated as an environmentally sensitive area with a wetland preserve. This area falls within designated critical habitat for the California tiger salamander. A seasonal creek runs north-south through the center of the site. An easement with SCWA runs east-west through the middle of the parcel. Taxiway access is from Taxiway E, and road access is from Laughlin Road. Sewer and water service are not currently available.

This site was eliminated because it is a wetland preserve.

Site 14

Between Apron F and Laughlin Road. The terrain rises from north to south but appears developable for aviation uses. The site is largely open grasslands, but a group of oak trees are on the eastern section of the site. A drainage ditch classified as a wetland exists in the northwestern corner of the site, and an isolated wetland exists on the southwest side.

This area falls within designated critical habitat for the California tiger salamander. An occurrence of Lobb's aquatic buttercup, a California species of concern, exists on this site. An easement with SCWA runs east-west at the north side of the parcel. Significant development is possible with limited or no impact to these wetlands. Airfield access is from Taxiway E across Apron F, and road access exists from Laughlin Road via the road that provides access to Apron F. No sewer or water connections exist. This site was retained for secondary review.

Site 15

In the southern quadrant along Laughlin Road. This site became part of the Airport in 2019, and it contains a residence that may be eligible for inclusion in the National Register of Historic Places. The existing structure, a former officers' club, may be able to be restored and repurposed for an Airport-compatible use. Taxiway E access to the site would be through Apron F. No sewer or water connections exist.

This site was eliminated from GA development possibilities; however, this parcel may be redeveloped for non-aeronautical uses that incorporate the historic residence.

Site 16

East of Apron F and south of Taxiway E. The terrain is gently rolling. Interconnected wetlands exist through the center of the site along with other isolated wetlands. A colony of Burke's goldfields exists in the northeast corner of the site. An easement with SCWA runs east-west through the middle of the parcel. Airfield access is from Taxiway E, and road access is either via the existing road providing access to Apron F or directly from Laughlin Road. No significant development is possible without impacting wetlands. However, the northern third of the site in the area encompassing the ex-military hard stands could be developed with limited wetland impacts and no direct impact on the known locations of the Burke's goldfields. No sewer or water connections exist. This site was retained for secondar review because the northern third of the site around the hardstands appears developable.

Site 17

In the southeast corner of the Airport south of Apron F. A pond extends through the center of the site. A second wetland exists in the northeast corner of the site. The western half of this site lies within designated critical habitat for the California tiger salamander. The southern part of the site is possibly accessible from Laughlin Road, but the northern part is landlocked. Taxiway access is from Taxiway A. No sewer or water connections exist.

This site was eliminated from secondary review because development of structures would be limited to a confined area and additional development will require wetland mitigation.

Site 18

West of Apron E and between Taxiways Q and R, and east of the service road. The site is level grassland, and no wetlands exist on the site. The western half of this site lies within designated critical habitat for the California tiger salamander. Airfield access is from Taxiway A and road access is from either Becker Boulevard or North Laughlin Road. This site is carried forward for secondary review.

Site 19

East of Apron E and south of Becker Boulevard. Two parcels, a larger parcel adjacent to North Laughlin Road and one small parcel south of Becker Drive. The site is level grassland, and no wetlands exist on the site. The site is not within designated critical habitat for the California tiger salamander. Airfield access is from Apron E, and road access is from either Becker Boulevard or North Laughlin Road. No sewer or water connections exist on this site. However, sewer and water connections are available adjacent to the site. This site is carried forward for secondary review.

Site 20

South of Apron D and west of North Laughlin Road. The undeveloped portions of the site are level grassland, and no wetlands exist on the site. Three buildings and abandoned pavement exist on the large parcel. The site is not within the designated critical habitat for the California tiger salamander. Airfield access is from Apron D, and road access is from North Laughlin Road. No sewer or water connections exist on the site. However, sewer and water connections exist in the vicinity of the site. This site is retained for further review.

Site 21

East of Flightline Drive and north of Apron D. The site is level grassland. One wetland exists on the site. Burrowing owls have been found on this site. This site is not within the designated critical habitat for the California tiger salamander. The site is part of a leasehold developed with industrial uses that expires in 2036. To date, the leaseholder has not been willing to release the undeveloped parcel. Airfield access is from Apron E, and road access is from Flightline Drive. Sewer and water connections are available adjacent to the site.

This site is eliminated from further review because it is currently subject to a lease that will not expire for 15 years.

Site 22

North of Airport Boulevard and east of Ordinance Road. This site is currently used as a corporation yard and leased by Sonoma County Transportation and Public Works. Providing airfield access requires relocation of Ordinance Road and provision of a new access route to KaiserAir's terminal. The taxiing route is through the parcel that contains the former Sheriff's garden. Existing road access is from Airport Boulevard. All utilities are available onsite. The site is not within the designated critical habitat for the California tiger salamander. No biological data is readily available for this site. However, the site has several buildings, and the balance is mostly paved. This site may be considered for non-aeronautical development which may require relocating the corporation yard.

The site is rejected from further review because of the circuitous taxiway route and need to relocate Ordinance Road.

Site 23

West of Ordinance Road and east of KaiserAir's leasehold. The level site is currently occupied by the former Sheriff's garden and a parking lot serving the North County Detention Facility. The southern end of the parcel is the proposed location for long-term automobile parking. The narrowness of the parcel constrains development. Airfield access is through the KaiserAir leasehold, and road access is possible from either Airport Boulevard or Ordinance Road. All utilities are available adjacent to site. This site has previously been considered for FBO facilities. The site is not within the designated critical habitat for the California tiger salamander. No protected biological features are known to exist on this site. This site is selected for secondary review.

Site 24

North of Taxiway J and east of the Remote Transmitter Receiver (RTR) facility. The site is a preserve where wetlands and Burke's Goldfields habitat were created to mitigate Airport project impacts. The site is not within the designated critical habitat for the California tiger salamander. Aircraft access the site from Taxiway J, and vehicles access the site from Ordinance Road near the Cal Fire Air Attack Base. Utilities connects may be available near the Cal Fire facility. However, if larger water lines are needed, a new connection is likely to need to be extended from further away.

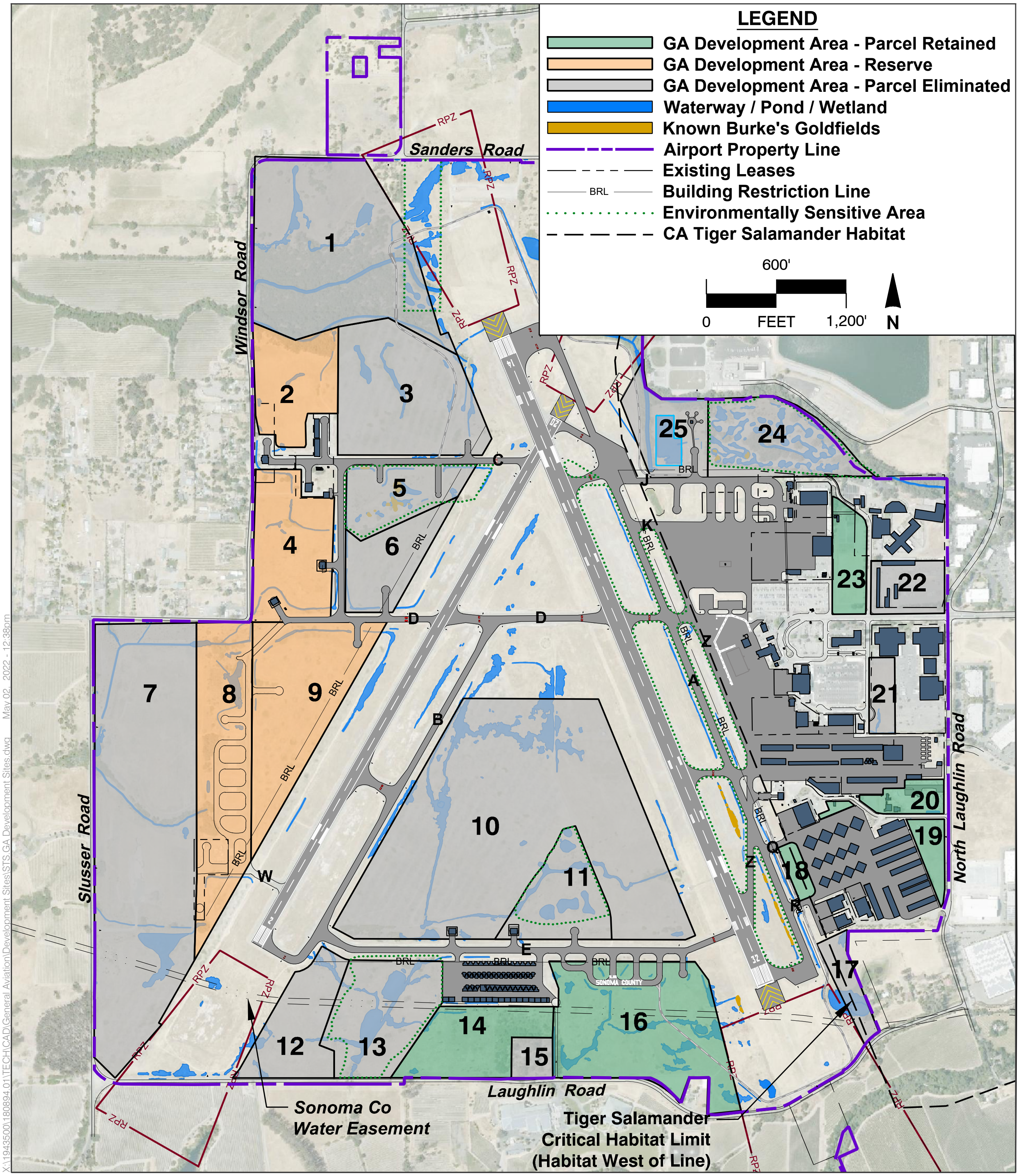
This site is eliminated from secondary review because is a wetlands and Burke's Goldfields habitat preserve.

Site 25

North of Taxiway J on the current RTR facility. The site is constricted by the RTR, detention pond, and creek. Airfield access is from Taxiway J, and public access is possible from Ordinance Road, but this may be difficult due to environmental impact on adjacent wetlands. Placing structures on this site impacts the RTR facility's functionality and likely requires the facility to be relocated. Utilities are nearby. The site within designated California tiger salamander habitat.

This site is removed from secondary review because it would require relocation of the RTR equipment. The cost to relocate the RTR equipment could exceed $5 million.

Figure 6-1: Potential GA Development Sites



Infrastructure Development

A key difference between development options in the eastern quadrant and those in the southern and western quadrant is the existence of supporting infrastructure. Hangar development in the southern and western quadrants will require investment in supporting infrastructure such as utilities and taxiway access. The cost of providing this needed infrastructure affects the timing and viability of development options in these two quadrants. This section presents the three categories into which the principal infrastructure requirements fall: sewer service, water service, and taxiways.

Sewer Service

Primarily aircraft storage is anticipated for hangar development in the southern and western quadrants. While some of the larger box hangars may be occupied by corporate flight offices or SASOs, they are not expected to have large staffs or large customer volumes. The remoteness of the sites and circuitous road access make more intensive development unlikely. This assumption guides the evaluation of sewer service needs.

The nature of the hangar use likely indicates low sewer demand. One public restroom constructed in each quadrant, with separate facilities for men and women, will serve users of the majority of hangars, which do not have restrooms. Some larger box hangars may have their own restrooms.

Two ways to provide sewer service are available to the west and south quadrants:

- Connect to the SCWA sewer main on North Laughlin Road or the sewage treatment facility northeast of STS
- Develop an onsite septic system.

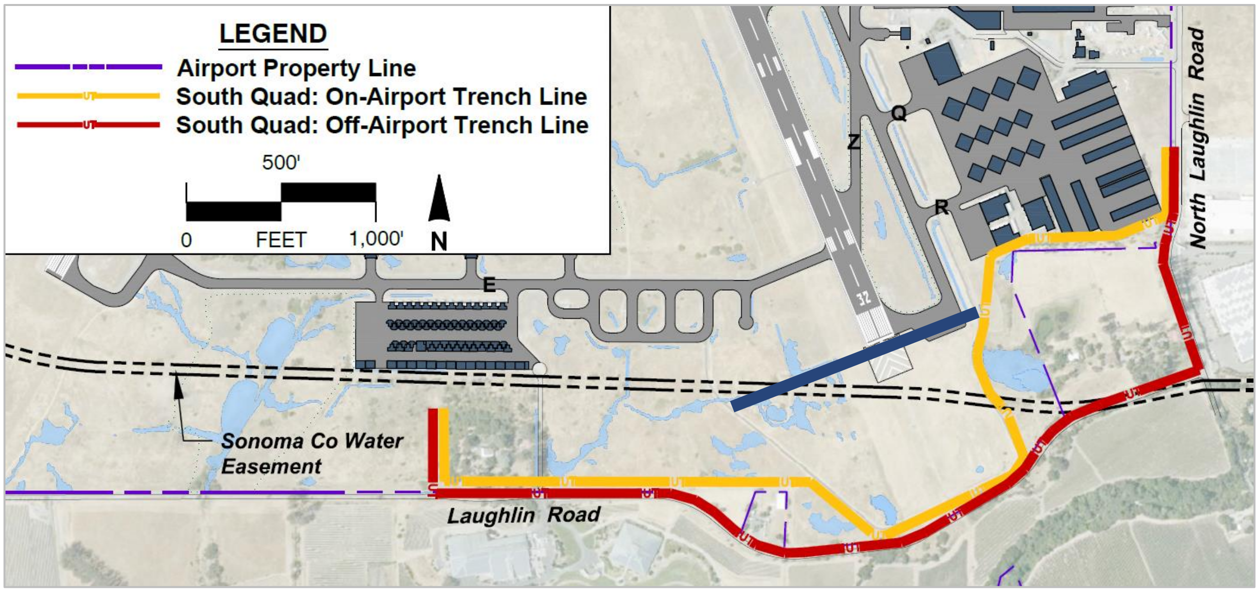
Southern Quadrant

Connect to sewer main: Two routes for the sewer line underwent preliminary evaluation. These routes extend from the nearest point of connection to the center of the southern quadrant. This central location allows calculation of order-of-magnitude costs. The chosen routes minimize impacts to wetlands. Both on- and off-airport routes require about 6,100 feet of sewer line.

The off-airport route (red line, **Figure 6-2**) places the pipe within the right-of-way of Laughlin Road to its junction with North Laughlin Road. The line then continues north to a connection in North Laughlin Road.

The second route (gold in **Figure 6-2**) runs on the Airport, parallel to Laughlin Road and inside STS's fence, and loops around the service road and runway safety area for the approach to Runway 32. The sewer line then passes along the Airport property line south of Apron E. From there it connects to the main in North Laughlin Road. A third option (blue in **Figure 6-2**) that keeps the sewer on-Airport is a directional bore under Runway 14/32 to the hard stand areas.

Figure 6-2: South Quadrant Conceptual Trench Lines



The planning-level estimated cost to design and construct this length is about $2.0 to $2.3 million. There may be cost savings if the sewer and water lines (explained below) are extended concurrently. However, cost analysis to that degree of detail is beyond a planning level of analysis. The cost estimate does not include environmental review, mitigation, and connection fees.

Both proposed routes have potential biological impacts. The off-Airport route potentially requires use of the shoulder in areas with wetland features that may be jurisdictional. The on-Airport route avoids direct impacts to delineated wetlands but passes through California tiger salamander habitat.

Both routes have potential construction challenges as well. The proposed off-Airport route requires construction in sections that contain significant differences in elevation between the road and shoulder that are likely to require retaining walls. The on-Airport route passes near an FAA electrical building and through a narrow corridor where only a few feet separate the perimeter fence and the access road. None of these factors make either route infeasible.

Septic system: Given the low volume that hangars generate, a septic system could be developed to treat the wastewater. Wineries in the vicinity of the Airport already use this method of treating effluent. Installation of a septic system has the potential to address sewage treatment needs at substantially less cost than connection to the SCWA sewage treatment system. An engineered septic system, such as a mound system, is expected to be required. The cost to construct a mound system is estimated to be $350,000 to $450,000, based on recently constructed systems nearby. A mound system constructed at this price would accommodate 10 bathrooms. After analysis of the options, there are two feasible ways for providing wastewater utilities to the south quadrant, with substantial cost differential between the two options:

- Extension to the main sewer line on North Laughlin Road. This is the most expensive method, with an estimated cost of $2.0 to $2.3 million. The cost estimate does not include environmental review, mitigation, and connection fees.

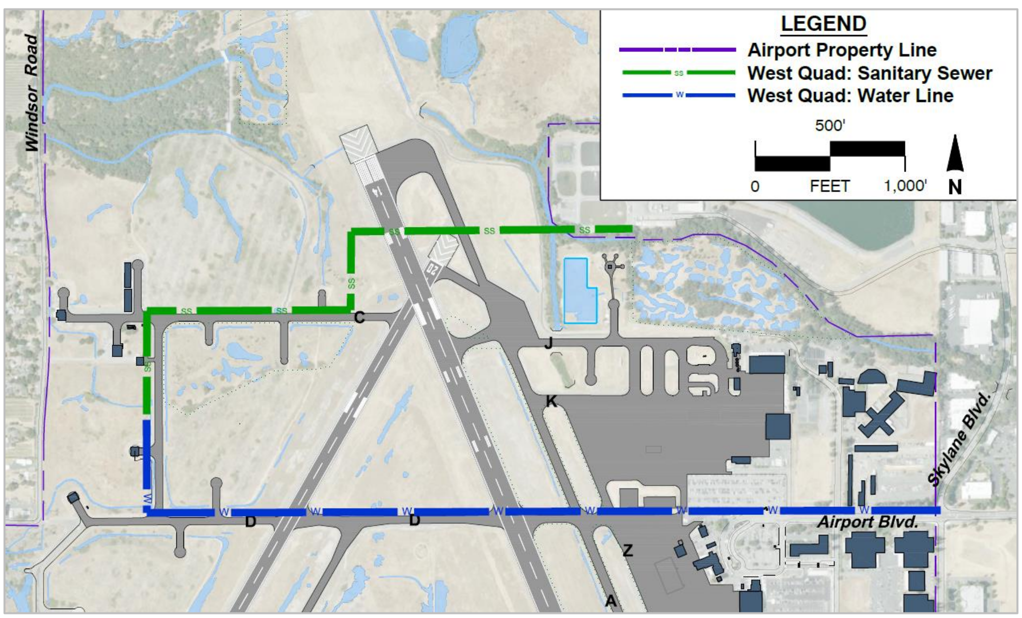
- Excavation for an onsite septic system, which is estimated to cost $350,000 to $450,000. The lower cost for a septic system significantly improves the feasibility of developing hangars in the southern quadrant.

Western Quadrant

Connect to sewer main: One route consists of a line to connect to the sewage treatment facility adjacent to the east side of the Airport. This proposed route from the western quadrant is approximately 4,300 feet (green in **Figure 6-3**). The chosen route is intended to minimize wetland and other biological impacts as well as disruption to airfield operations. If this option is implemented, the use of adjustments to the route and directional boring are expected to reduce biological and operational impacts to the absolute minimum.

This was developed to establish order-of-magnitude costs for this connection. The planning-level estimate to design and construct this line is in the range of $1.7 to $2.0 million. The uncertainty over this estimate is greater than the estimate for the southern quadrant. Resolving uncertainties relating to the design of sewage transmission lines, the length of directional bores under runways and taxiways, and design changes needed to avoid existing underground utilities requires completion of a preliminary engineering design. The cost estimate does not include environmental review, mitigation, and connection fees.

Figure 6-3: West Quadrant Conceptual Water and Sewer Lines



Septic System: As with the southern quadrant, the use of a septic system to treat wastewaters generated by hangars in the western quadrant appears feasible. Based upon the experience with other uses in the vicinity, some form of engineered septic system, such as a mound system, is expected to be required. An order of magnitude cost to serve this hangar area is $350,000 to $450,000, based on recently constructed systems nearby. A mound system constructed at this price would accommodate 10 bathrooms. This does not include the cost of the associated collection system. Those costs are assumed to be borne by the hangar developer.

After analysis of the options, there are two feasible ways for wastewater utilities to the west quadrant, with substantial cost differential between the two options:

- Extension to the main sewer line to the sewage treatment facility. This is the most expensive method, with an estimated cost of $1.7 to $2.0 million. The cost estimate does not include environmental review, mitigation and connection fees. There is also greater uncertainty in this cost estimate.
- Excavation for an onsite septic system, which is estimated to cost $350,000 to $450,000.

Water Service

Minimal daily water use is expected. The proposed banks of small hangars have neither restrooms nor landscaping. The larger hangars are likely to have modest landscaping around their associated parking lots, and most large hangars are expected to contain a single restroom. Fire sprinklers for the large hangars and a hydrant system for the hangar area represent the biggest water demand.

Southern Quadrant

Three ways to provide water service to the southern quadrant have potential:

- Connection to the SCWA water main on North Laughlin Road
- Connection to the Sonoma County Water Agency's (SCWA) transmission line
- Development of an onsite well and water storage system.

Connection to water main: The two connection routes described for water service (on- and off-Airport, shown in **Figure 6-2** above) are viable means to route connection to a water main. However, if the same general route for sewer and water is used, the two parallel lines must be in separate trenches to meet building code requirements. Like the sewer service, the connection point for water is in North Laughlin Road, and the length of the water line is about 6,100 feet.

Planning-level design and construction costs are estimated at $1.5 to $1.8 million, but extending the sewer and water lines concurrently may yield cost savings. However, analysis to that degree is beyond what is possible at this planning level of analysis. The cost estimate does not include environmental review, mitigation, and connection fees.

Connection to SCWA transmission line: A major water transmission line operated by the SCWA runs through the southern quadrant and serves communities in the western part of Sonoma County. There is currently a connection to the aqueduct that serves a fire hydrant on Apron F. Discussions with SCWA agency staff indicated that obtaining water service from this water line for additional fire protection may be possible. Because of the line's location, extension of service lines to hangars in the southern quadrant would be relatively short. SCWA staff indicated that providing domestic water from the aqueduct would be against agency policy. The proximity of the existing water line serving the hydrant on Apron F means that no extension would be required to serve hangars in this area. The additional connections would be associated with new development of hangars. The connections to the existing system are assumed to be funded by the hangar developers.

Onsite water system: Wineries in the vicinity of the Airport rely upon onsite wells for water. The creation of a similar system for hangars in the southern quadrant appears feasible. The cost to drill and install a well is estimated to be $400,000 to $500,000, based on recently constructed systems nearby. The well is expected to need to be drilled to a depth of 500 feet. The water will need to be filtered or treated to remove arsenic. If filter media is used, the media will need to be treated as hazardous material when it reaches the end of its useful life. Wells will also require water storage tanks. The cost for water storage is relative to development and domestic service demand. Storage requirements for fire protection will be greater than for domestic water.

The cost of extending service to individual hangars is assumed to be borne by the hangar developer. If fire flows cannot be met by connection to the SCWA transmission line (discussed above), then onsite storage is expected to be required. The costs for this have not been estimated.

After analysis of the options, there are three feasible ways to provide water for domestic use and fire protection to the south quadrant:

- Extension of a water main from North Laughlin Road. This is the most expensive method, with an estimated cost of $1.5 to $1.8 million plus environmental review, mitigation, and connection fees.
- Use of an onsite well with storage tanks to provide both water for both domestic use and fire protection. Well installation and drilling are estimated to cost $400,000 to $500,000, plus costs for filtrations, storage tanks, and environmental review.
- Use of an onsite well for domestic water and connection to the SCWA aqueduct for fire protection. This is the least expensive option since storage for fire suppression tanks would not be required. However, a Finding of Necessity with SCWA and subsequent agreement would be required by the developer.

Western Quadrant

Two means for providing water service to the southern quadrant are potentially available for the western quadrant:

- Connection to the City of Windsor's water main on North Laughlin Road
- Development of an onsite well and water storage system.

Connection to water main: Like the southern quadrant alternative, connecting to an existing water main in North Laughlin Road appears feasible. However, the point of connection is further north near the intersection with Airport Boulevard (blue in **Figure 6-3** above). The length of the transmission line is shorter than the southern quadrant alternative at 5,900 feet. Directional bores will need to pass under Runway 14/32 and its parallel taxiway. The planning level estimate cost to design and construct this water line would be about $1.5 to $1.8 million. The cost estimate does not include environmental review, mitigation, and connection fees.

Onsite water system: As with the southern quadrant, providing water service with a well and storage system appears feasible. The cost is expected to be the same as discussed for the southern quadrant: $400,000 to $500,000. As with the southern quadrant, this does not include costs for storage tanks and distribution.

After analysis of each system, there are two feasible ways to provide water for domestic use and fire protection to the west quadrant:

- Extension of a water main from North Laughlin Road. This option is the most expensive, estimated to be $1.5 to $1.8 million. The cost estimate does not include environmental review, mitigation and connection fees. There is also greater uncertainty in this cost estimate.
- Use of an onsite well with storage tanks to provide both water for domestic use and fire protection. Well installation and drilling are estimated to cost $400,000 to $500,000. This does not include costs for filtrations, storage tanks, and environmental review.

Realignment of Taxiway E

The FAA may require that the nonstandard taxiway configuration where Taxiway E connects to Runway 14/32 be realigned concurrently with the development of new hangars in Sites 12, 14, and 16. In the interest of safety, FAA standards direct that aircraft cross runways at their ends. Eliminating the current nonstandard condition before introducing additional based aircraft into the southern quadrant avoids increasing the potential for runway incursions.

The cost to design and construct the new alignment of Taxiway E is estimated (at the planning level) to be in the range of $4 to $5 million. This amount includes engineering design, construction, and construction administration. The cost does not include preparation of environmental documents and mitigation costs. This development impacts California tiger salamander habitat, jurisdictional wetlands, and known colonies of Burke's goldfield. The California tiger salamander and Burke's goldfield are both classified as endangered under both the Federal and California Endangered Species Acts. The environmental review process for this project is anticipated to be complicated and protracted.

West Side Parallel Taxiway

Taxiway access to the western quadrant is currently available via Taxiways C and D. Neither taxiway meets current FAA standards as points to access Runway 2/20 or other parts of the airfield. Taxiway C intersects Runway 20 near the approach end, but not at its apex. Taxiway D crosses Runway 2/20 at a *high energy* point in the middle third of the runway. Pilots using the runway have limited opportunities to maneuver to avoid aircraft crossing. It is possible that the FAA will require development of a full-length parallel taxiway west of Runway 2/20 as a condition of hangar development in the western quadrant. For similar reasons, the FAA may also require construction of a partial parallel taxiway to connect Taxiway C to the approach end of Runway 20. This west side parallel taxiway and partial parallel taxiway connector to Runway 14 would be built to the same standards as Taxiway B, the partial parallel on the east side of Runway 2/20. The planning-level estimate to design and construct these taxiways is at least $19 million. This does not include environmental documentation and mitigation costs.

Site Evaluation

The possible GA development sites were evaluated based upon seven potential constraints:

- Impacts on existing facilities – Development on parcel will require relocation or elimination of existing uses
- Biological features – Known wetland, critical habitat, or protected species on parcel
- Adjacent taxiway access – Parcel proximity to existing taxiways or taxilanes
- Offsite taxiway required – Parcel development will require construction of major taxiway segment to access airfield
- Availability of utilities
- Street access
- Availability – Parcel part of airport and not part of existing leasehold

Evaluation Methodology

The goal of this evaluation is to separate sites into one of four categories based upon their development potential. All characteristics may not apply to an individual site, and the most constraining characteristic will determine the site ranking:

1: Best Development Potential

- Little to no impact to existing facilities
- Little to no environmental impact
- Area available for immediate development
- Immediate access to utilities

2: Good Development Potential

- Little impact to existing facilities, with some relocation
- Minor environmental impact with possible mitigation
- Immediate development with some infrastructure improvements
- Utilities infrastructure improvements/ extensions needed

3: Fair Development Potential

- Impact to existing facilities, with potential for relocation
- Major environmental impact with straightforward mitigation
- Near-term development dependent on infrastructure improvements
- Fair to poor access to utilities

4: Poor Development Potential

- Major impact to existing facilities
- Major environmental impact with complicated mitigation
- Major infrastructure requirements
- Poor access to utilities

The results of the evaluation of the eight sites selected for secondary review are presented in **Table 6-2**. The site ranking distinguishes between each site's suitability for near-term development and its long-term development potential. Sites with lower rankings should be preserved for eventual aviation use.

Table 6-2: Secondary Site Review Summary

Parcel #	2	4	14	16	18	19	20	23
Impact on Existing Facilities	0	0	L[1]	L[2]	L[3]	0	0	0
Sensitive Biological Features	M	M	L	H	M	L	0	0
Adjacent Taxiway Access	L	L	L	L	0	L	L	L
Offsite Taxiway Required	H	H	M	0	0	0	0	0
Availability of Utilities	H	H	H	H	0	0	0	0
Street Access	L	L	L	L	0	0	0	0
Availability	0	0	0	0	0	0	L	L
Near-Term Site Ranking	4	4	3	3	1	1	2	2
Long-Term Site Ranking	3	3	2	2	1	1	1	1

Key:

1 – Best Development Potential
2 – Good Development Potential
3 – Fair Development Potential
4 – Poor Development Potential

0 – No impact or constraint;
L – Limited impact or constraint;
M – Moderate impact or constraint;
H – High impact or constraint

Notes:
1. Two existing hangars would be relocated
2. Eliminates hardstands used for aircraft parking
3. Requires minor utility changes to fire hydrants and drop inlets

Source: Mead & Hunt

Of the eight sites, the four sites located on the east side are ranked as having best or good development potential. These sites will be easier and less expensive to develop because of the availability of utilities and simpler environmental approval process. Next easiest to develop are the two sites in the southern quadrant. The two sites in the southern quadrant have significantly higher development costs and site 16 has potentially environmental constraints to overcome. Sites 2 and 4 would rank the same as Site 14, except for the potential that a west-side parallel taxiway for Runway 2/20 might be required before significant development can occur. Therefore, Sites 2 and 4 should be considered as long-term development reserve for storage hangars or SASOs.

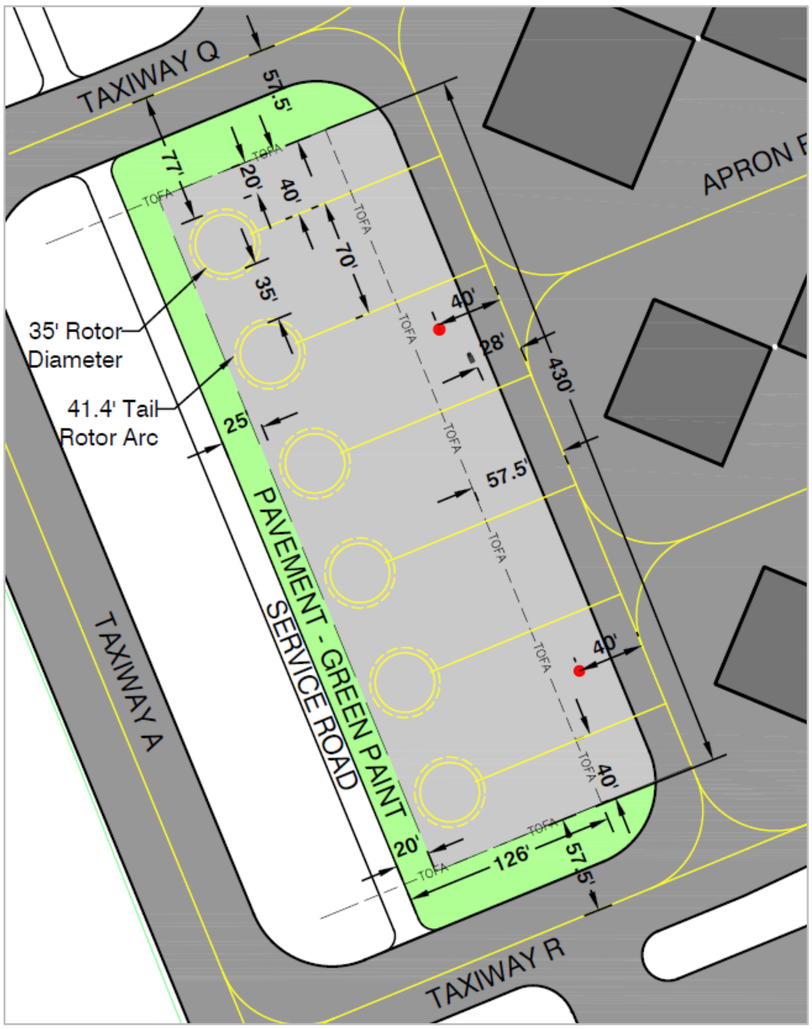
GA DEVELOPMENT CONCEPTS

Hangar and apron layouts were conceptualized for the six sites identified has having fair to best near-term development potential. A matrix at the end of this section summarizes the number of hangars in each concept, the amount of total new pavement, and wetland area affected.

Site 18 Concepts

Site 18 is limited to apron development due to the location. The building restriction limit and Part 77 airspace clearances do not allow for structures on this site. A concept for Site 18 is shown in **Figure 6-4**. This concept accommodates three helicopter parking positions plus transient parking relocated from the terminal apron and Apron A, to be relocated for future terminal expansion.

Figure 6-4: Site 18 Concept



The helicopter parking positions are designed to accommodate Robinson R22 and R44 helicopters, with 55-feet between centerline, which provides standard separation for turn-round and taxi-through operations. The 20-foot square pads are larger than the minimum 14.4 feet required. Pad size may be reduced, but this will not affect required offsets. The setbacks between the helicopter parking pads and Taxiway Q and the new fixed-wing apron are larger than FAA standards. FAA standards focus on wingtip and rotor clearances. The design incorporates larger separations to minimize the potential for impacts from rotor wash or flying debris.

An additional fixed-wing parking apron of 23,500 square feet is shown with Taxilane Object Free Area for Airplane Design Group II. There are two fire hydrants, a drop inlet, and a drainage swale that pass through the site. Based upon an initial site inspection it appears that relocation of the utilities and modification of the drainage can be accomplished without major design challenges.

Site 19 Concepts

Site 19 is limited to Airplane Design Group (ADG) I aircraft with wingspans of 49 feet or less because of the narrow taxilane access from Apron E. Two possible development concepts are identified here.

Alternative 1 shows 29 nested T-hangars in rows and 3 box hangars extending to the east (**Figure 6-5**). The nested T-hangars have 40-foot doors, and the box hangars are 50 feet wide. Alternative 2 shows a row of 10 box hangars perpendicular to the existing rows west of Site 19 (**Figure 6-6**). The box hangars are 50 feet wide and fit on the parcel with taxilane access.

Figure 6-5: Site 19 Alternative 1

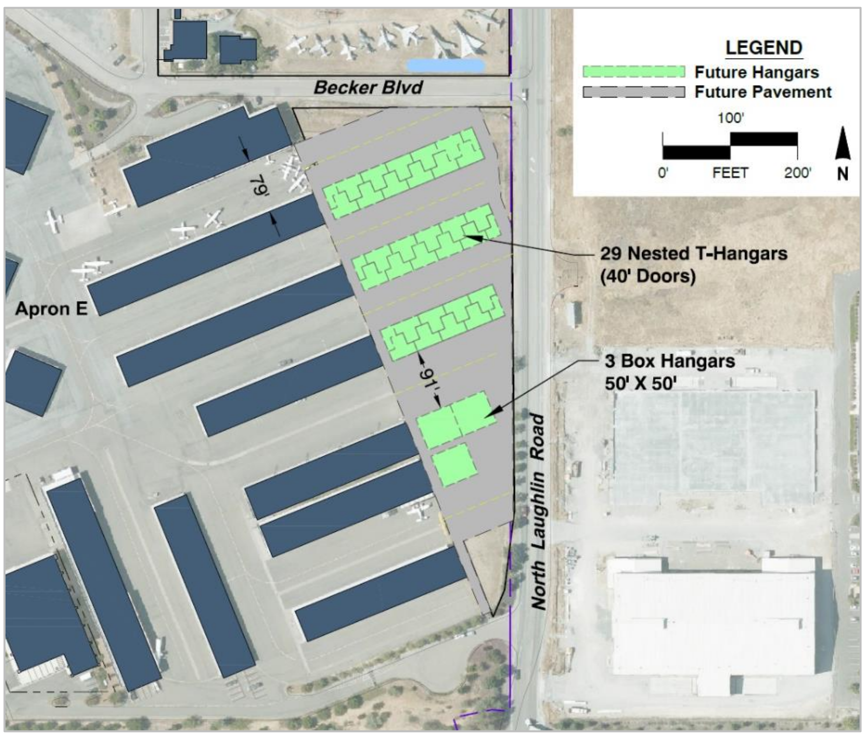
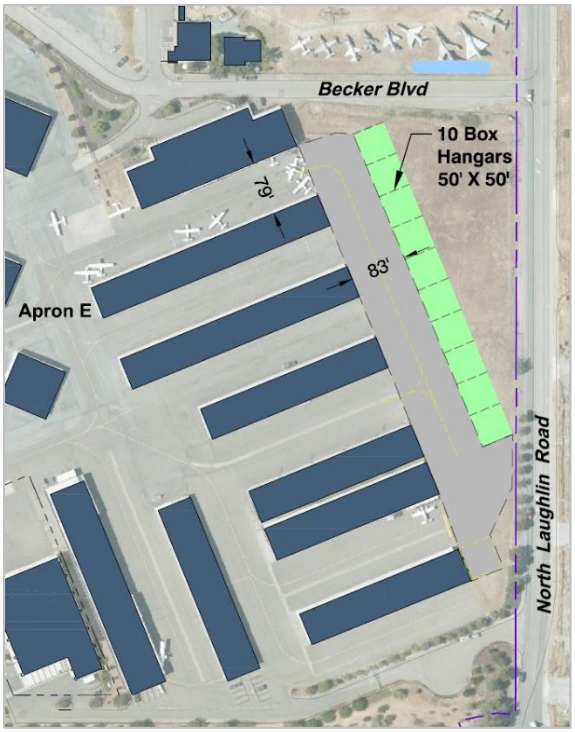


Figure 6-6: Site 19 Alternative 2



Site 20 Concepts

Site 20 is limited to ADG II aircraft with wingspans of 75 feet or less because of the taxilane access from Apron D. The two alternative concepts show varying hangar sizes to accommodate different tenants.

Alternative 1 is a concept developed as part of a 2015 preliminary hangar analysis that shows five corporate hangars with doors facing north (**Figure 6-7**). This allows for a taxilane plus some area in front of the hangar reserved for staging. The corporate hangars back up to Becker Boulevard with public parking at the street front. Site 20 Alternative 2 shows 17 box hangars that are 50-feet wide with a central taxilane and apron area between the hangar and taxilane for staging (**Figure 6-8**).

Figure 6-7: Site 20 Alternative 1

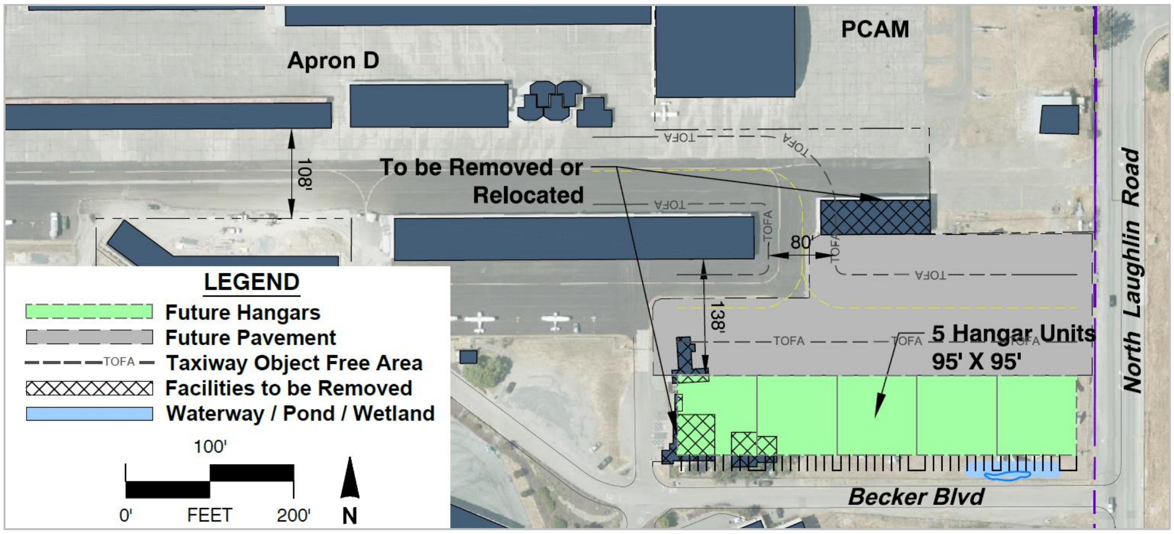
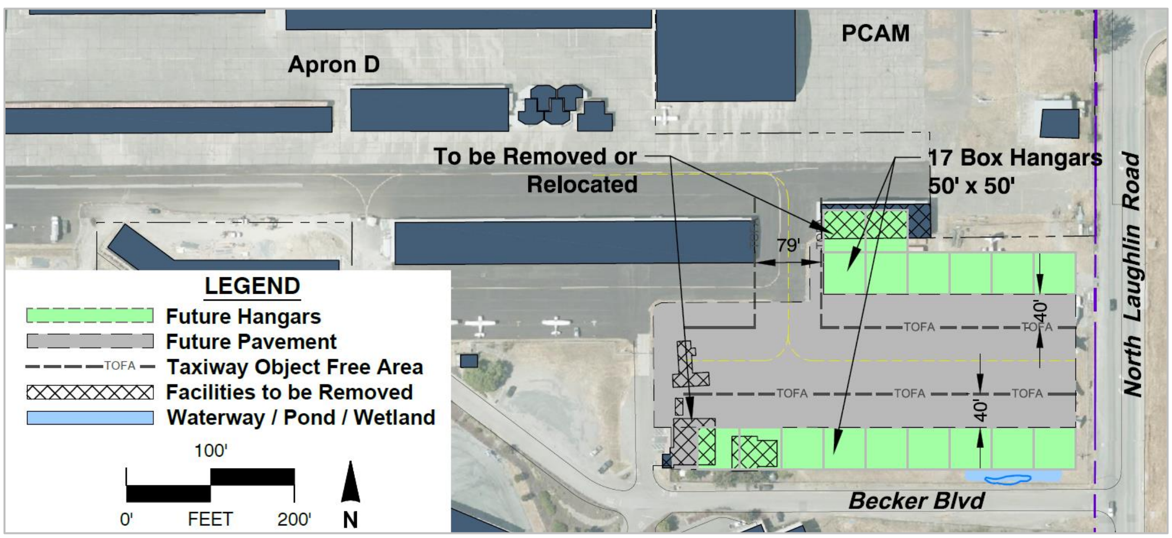


Figure 6-8: Site 20 Alternative 2



Site 23 Concepts

Site 23 is constrained by existing FBO facilities on Apron B, Ordinance Road to the east, and a utility easement 20 feet wide running in a north-south direction along the west side of the parcel. Any development will require relocating the Sheriff's vehicle parking lot. Site 23 is limited to ADG II aircraft with wingspans of 79 feet or less.

Two development concepts for Site 23 are presented here. Both alternatives are refinements of concepts developed as part of a 2015 preliminary hangars analysis. Alternative 1 presents a corporate hangar with a north facing door and new apron area north of the conceptual hangar and east of Apron B (**Figure 6-9**).

Additionally, a 10,500-square-foot office facility is attached to the new hangar, which provides space for FBO services. The shape and size of parcel limits the size of the new hangar and facility layout.

Alternative 2 shows a corporate hangar with a west facing door to provide direct access from Apron B (**Figure 6-10**). The hangar is flanked with office space on the north and south sides of the facility.

Figure 6-9: Site 23 Alternative 1

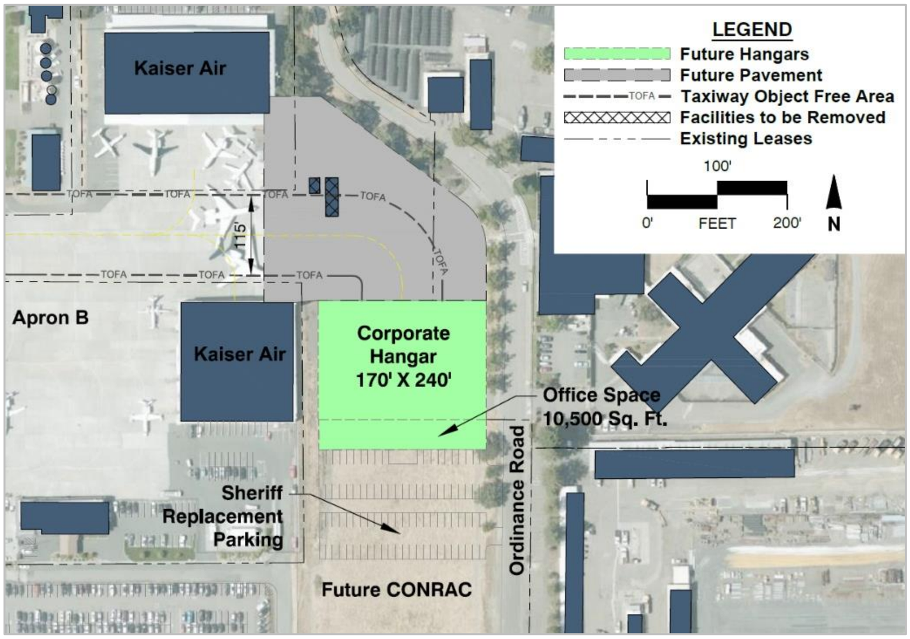
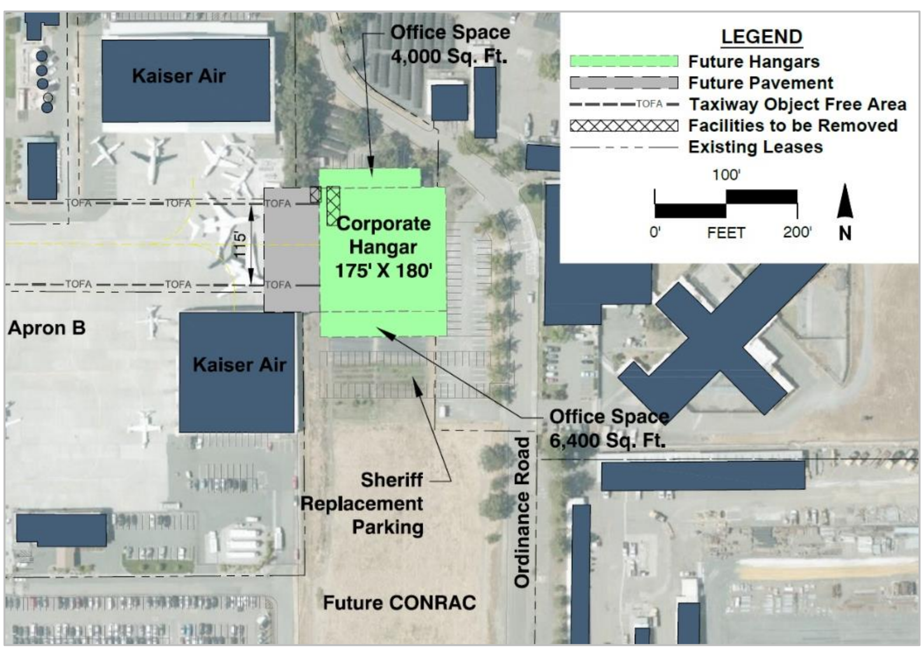


Figure 6-10: Site 23 Alternative 2

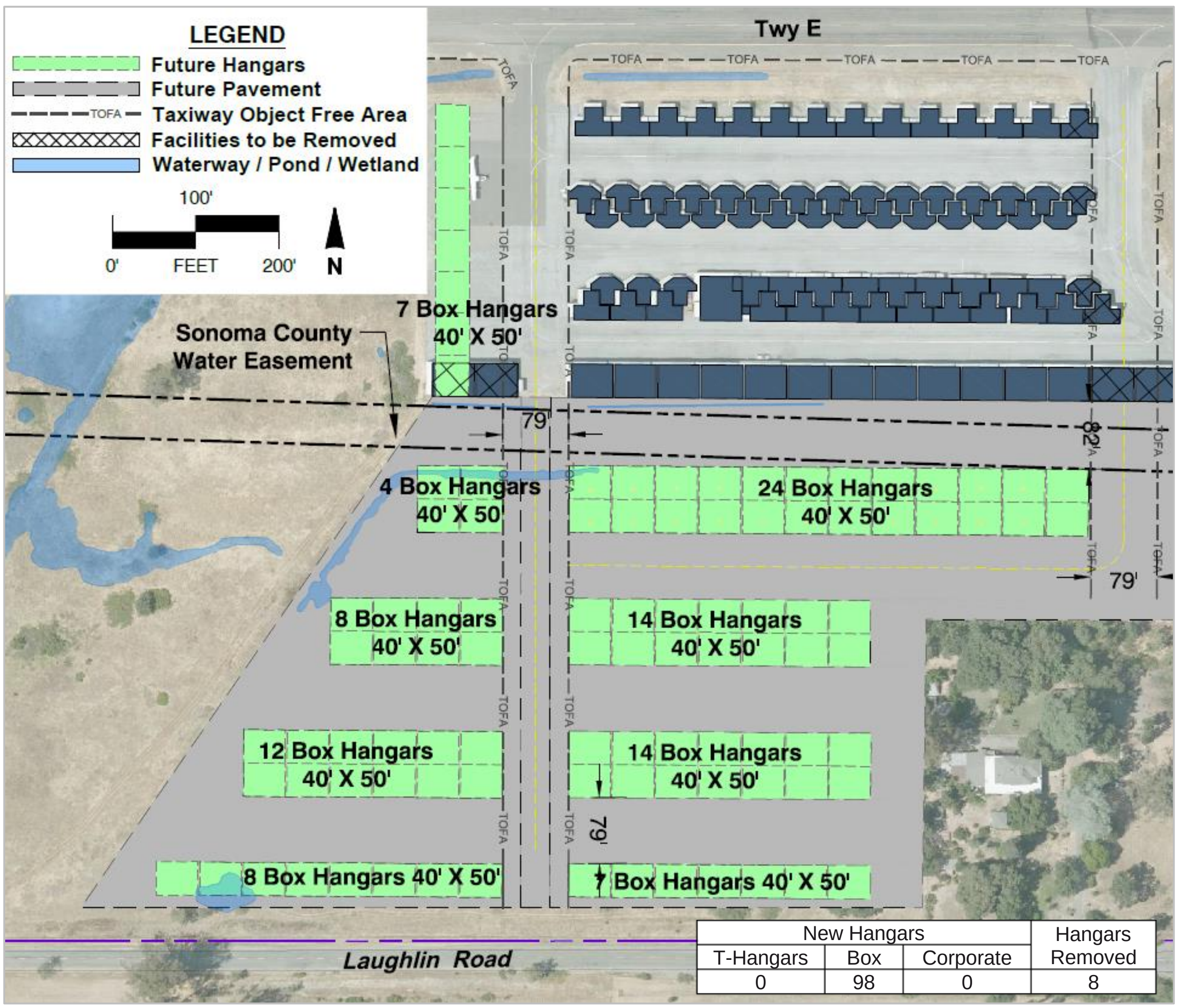


Site 14 Concepts

Site 14 is the largest site identified with development potential. Two development concepts are presented here. The Sonoma County water easement runs east-west through the site, so buildings are not proposed over this. In each alternative, hangars are removed to provide standard wingtip clearance through Apron F and replaced in the developed area. Landside access is from Laughlin Road.

Alternative 1 consists of rows of box hangars laid out parallel to the existing hangars on Apron F with seven more box hangars on the west side of the existing apron (**Figure 6-11**). Taxilanes on the east and west sides of Apron F extend south for airside access. These taxilanes provide clearance for ADG I aircraft. The taxilane extensions displace eight hangars.

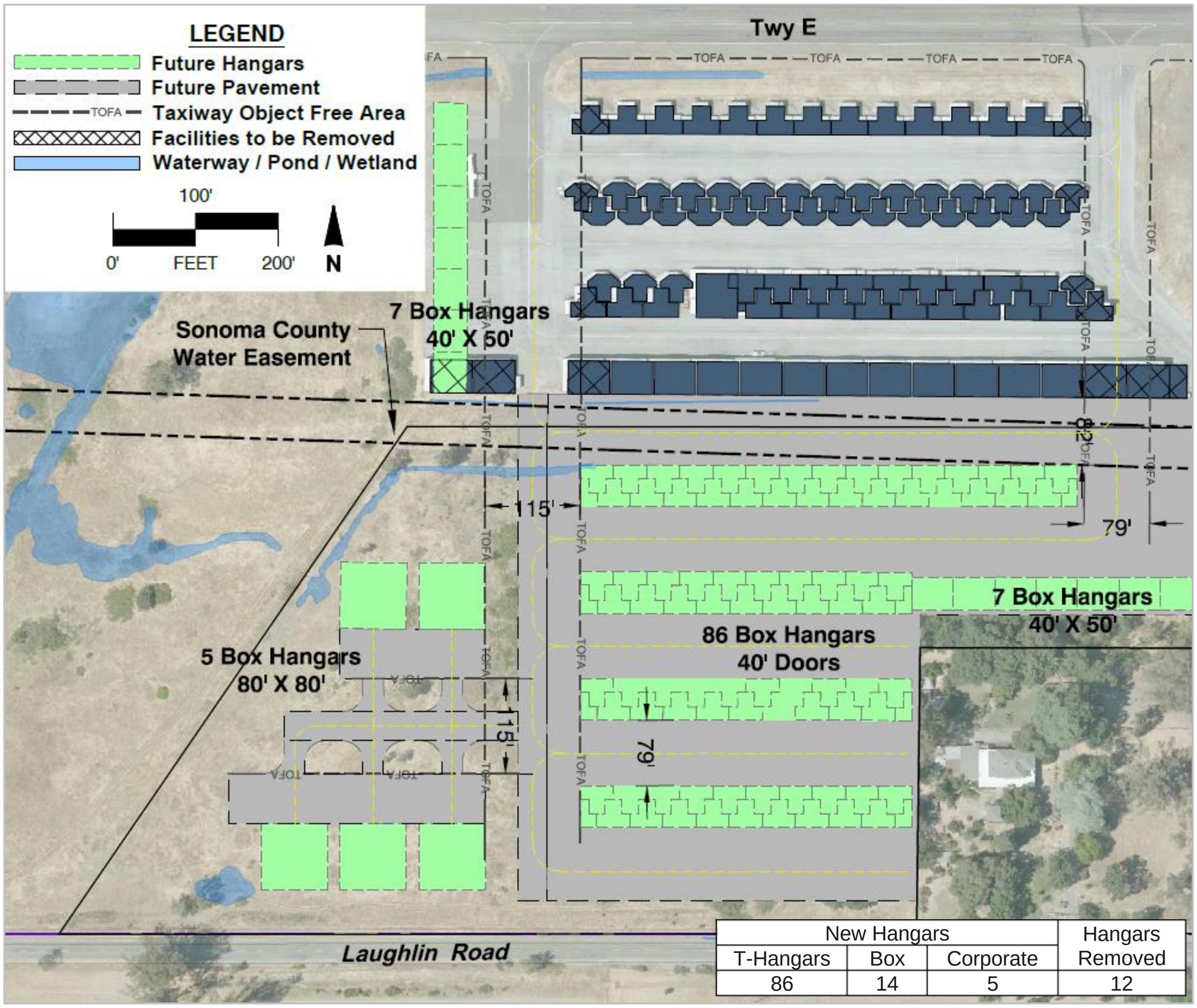
Figure 6-11: Site 14 Alternative 1



New Hangars			Hangars Removed
T-Hangars	Box	Corporate	
0	98	0	8

The Alternative 2 concept shows four rows of nested T-hangars (with 40-foot doors) south of Apron F and five corporate hangars with the potential to be used as FBOs or SASOs west of the extended taxilane (**Figure 6-12**). This west taxilane is designed to provide clearance for ADG II aircraft to correspond with the corporate hangar size and facility use. The lack of utilities limits the type of facility in this area. The design for Alternative 2 intends to limit wetland impacts compared to Site 14 Alternative 1.

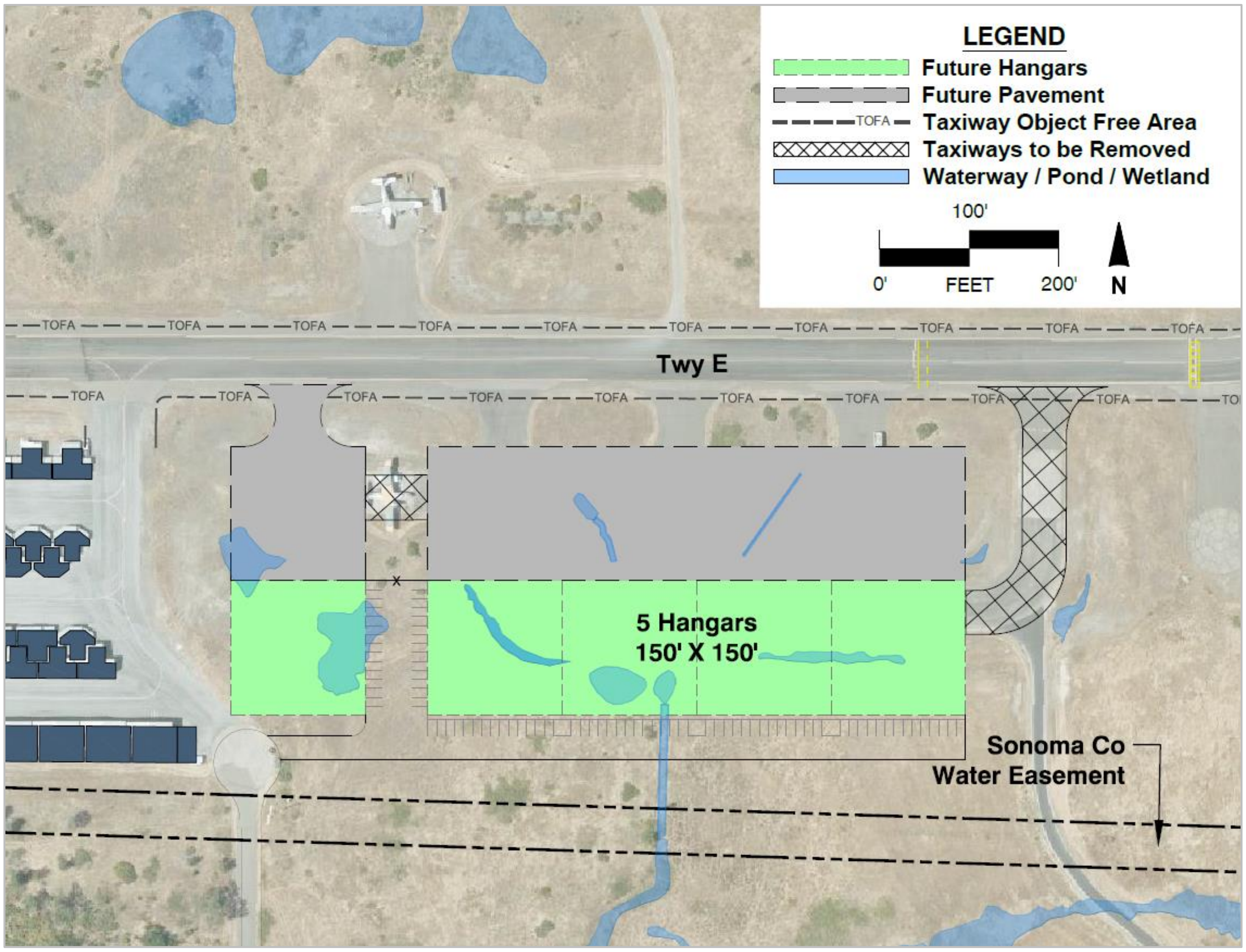
Figure 6-12: Site 14 Alternative 2



Site 16 Concept

One development concept for Site 16 is illustrated in **Figure 6-13**. This concept replicates a similar layout that was developed as part of a 2015 preliminary hangar analysis. The concept shows five 150-foot-by-150-foot corporate hangars that may be utilized by an SASO or FBO. These sites take advantage of the existing hardstand positions and do not interfere with the water line easement or significant wetlands south of this area.

Figure 6-13: Site 16 Concept



Development Concept Recommendations

The goal of this analysis is to narrow the areas that are realistically available for development and present concepts for what type of development is possible in each site. The concepts are intended to illustrate that varying aircraft, layouts, uses, and hangar facilities may be accommodated in each site. Because of limitations (utilities, access, funding), specific demand for development on a specific parcel is the trigger for exploring further refinement and options. Additional items to be considered are grading and drainage, detention basins, and funding for capital expenditures.

The construction of hangars and their associated taxilanes, apron and access roads will create impervious surfaces. The stormwater runoff from these surfaces will need to be managed to meet water quality and runoff standards. The Natural Resources Conservation Service's Web Soil Survey indicates that Airport soils are characterized by hydrologic soil group D soils, which have minimal ability to infiltrate. Therefore, it is anticipated that the stormwater from the new impervious surfaces will need to be treated, detained, and then metered out at the same rate as the existing conditions peak flows.

The treatment would be with bioretention swales. Detention basins would be used to slow the runoff. The runoff would then be channeled to existing streams. For planning purposes, each acre of impervious surfaces will require 1,750 square feet of bioretention swale and 910 square feet of detention basin.

Table 6-3 shows a summary of the concepts with new hangars provided, total new pavement, and wetland area affected. The forecast summary of ultimate based aircraft is also included for reference. This table helps show how each concept may satisfy ultimate based aircraft or FBO and SASO demand. For example:

- Developing Site 18 would accommodate displaced helipads and transient parking from terminal building expansion and apron reconfiguration.
- Developing Site 19 Alternative 1 would satisfy the ultimate demand for piston aircraft, with surplus hangars.
- Developing Site 20 Alternative 2 would satisfy 55 percent of demand for piston aircraft.
- Developing Site 14 would satisfy the ultimate demand for piston aircraft, with surplus hangars.

Table 6-3: Site Concept Development Summary

Parcel #	Concept Alt #	New Hangars			Hangars Removed	Total New Hangar Area (sq ft)	Total New Pavement Area (sq ft)	Total Affected Wetland Area (sq ft)
		T-Hangars (~40' Doors)	Box (50'-80' Doors)	Corporate (>80' Doors)				
18		0	0	0	0	N/A	75,000	N/A
19	1	29	3	0	0	41,500	89,300	N/A
	2	0	10	0	0	25,000	58,000	N/A
20	1	0	0	5	0	45,125	73,500	2,000
	2	0	17	0	0	42,500	80,200	2,000
23	1	0	0	1	0	51,300	72,000	N/A
	2	0	0	1	0	41,900	13,600	N/A
14	1	0	98	0	8	196,000	390,000	6,000
	2	86	14	5	12	140,500	336,000	3,800
16		0	0	5	0	112,500	125,800	28,000

Aircraft Type	Total Forecast	Number on FBO Leaseholds	Net Demand
Single-Engine Piston	21	0	21
Multi-Engine Piston	12	2	10
Jet / Turboprop	11	5	6
Helicopter	2	2	0

Source: Mead & Hunt

This exercise shows that these parcels accommodate ultimate demand. Also, if multiple sites are developed, there is potential for surplus hangar space, which may be utilized to capture shade hangar tenants on Apron D and open this area up for FBO or SASO development. The next section looks at relocating these tenants and redevelopment of Apron D.

APRON D REDEVELOPMENT

The western half of Apron D has two shade hangars with a total of 21 units, four banks of T-hangars with 54 units and 5 portable hangars. Three interrelated issues affect the requirements for new storage hangars:

- Four banks of hangars on Apron D are requiring high levels of maintenance and warrant replacement.
- Additional space is needed for FBO/SASO leaseholds. Apron D, with available utilities and prominent airside access, is a prime location for these facilities.
- Both shade hangars extend past the building restriction line.

An engineering evaluation of Apron D hangars identified an extensive list of repairs that were needed to allow their continued use. It is appropriate to consider whether these hangars have reached the end of their useful life and need to be replaced. Maintenance activities are an increasing burden on STS's budget and operations staff. One alternative is to replace the hangars with similar units in the same location, but this alternative temporarily displaces the aircraft based in them. Another alternative constructs replacement hangars on the sites identified. This option prevents the temporary displacement of the based aircraft.

Additional FBOs/SASOs need space, but STS has limited sites for them. Only three parcels in the east quadrant are available to accommodate them. As described in the Development Potential Section above, two of these sites (19 and 20) have limited airside access or are constrained by existing development. Site 23 is a viable option for one FBO/SASO facility, but this location is constrained by existing development and displaces Sheriff's facilities. Any FBO or SASO facility in the south quadrant (Sites 12, 14, or 16) requires utility extensions and likely improvements to Taxiway E.

If redevelopment is selected, the new hangars must meet requirements related to the building restriction line. For Runway 14/32, that line is set 750 feet from the runway's centerline. Both existing shade hangars on Apron D extend past the building restriction line for Runway 14/32. If not being replaced, these are permitted to remain. If they are relocated, no new structures can extend past that line. This slightly reduces the area available for structures.

Apron D Alternatives

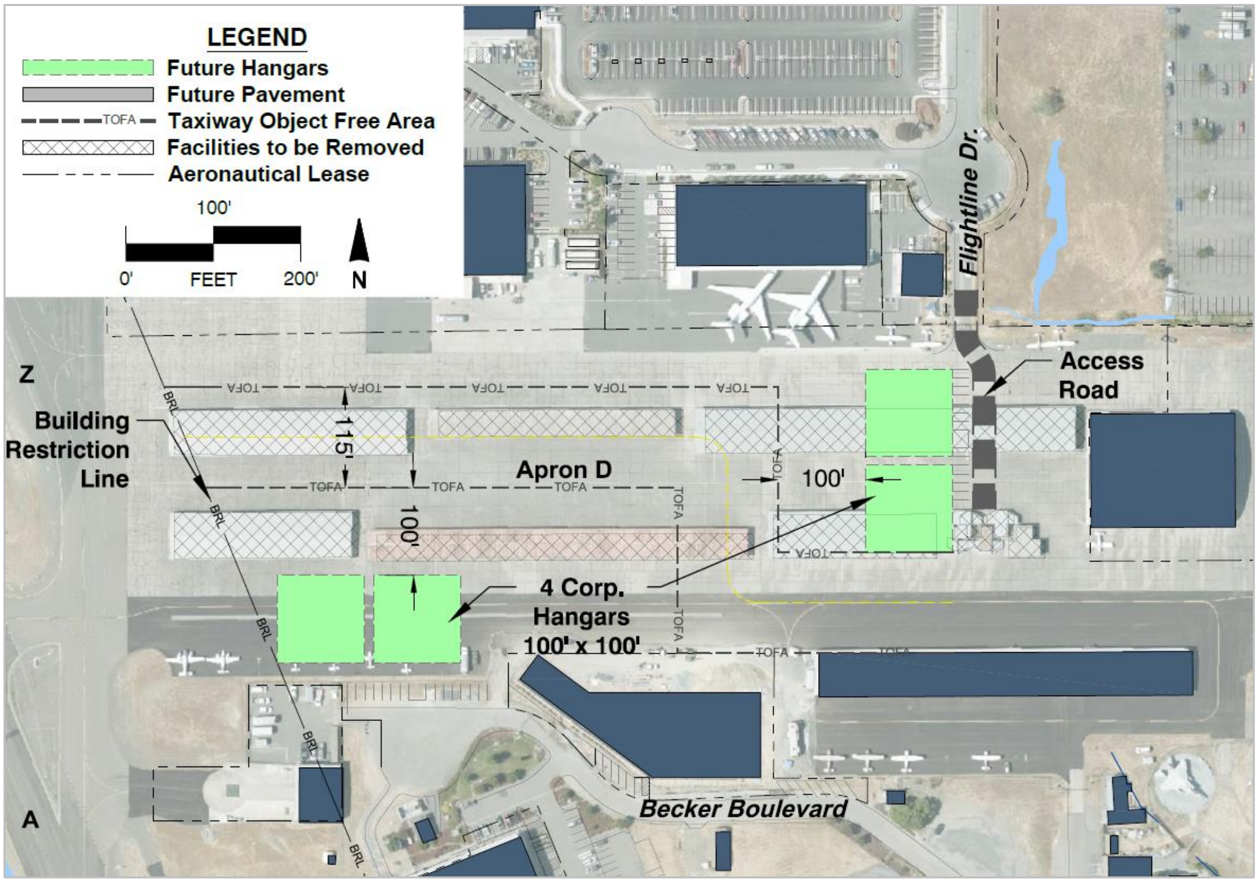
Assuming the south quadrant, specifically Site 14, is developed to accommodate the shade and T-hangar tenants, then the western half of Apron D is a viable option for development to accommodate corporate hangars, FBOs, or SASOs. Apron D is prime real estate with airside access, available utilities, and integration with other Airport facilities such as maintenance and fuel farms.

Redevelopment Concepts Alternatives

Two concepts for Apron D redevelopment show corporate hangar development on Apron D with landside access. Apron D Alternative 1 (**Figure 6-14**) shows a concept similar to one developed as part of a 2015 preliminary hangar analysis. Two corporate hangars are on the southwest corner of Apron D north of the Sherriff's facility and directly west of a new FBO hangar. The new concept depicts hangars measuring 100 feet by 100 feet, shifted slightly west, and adds two corporate size hangars on Apron D.

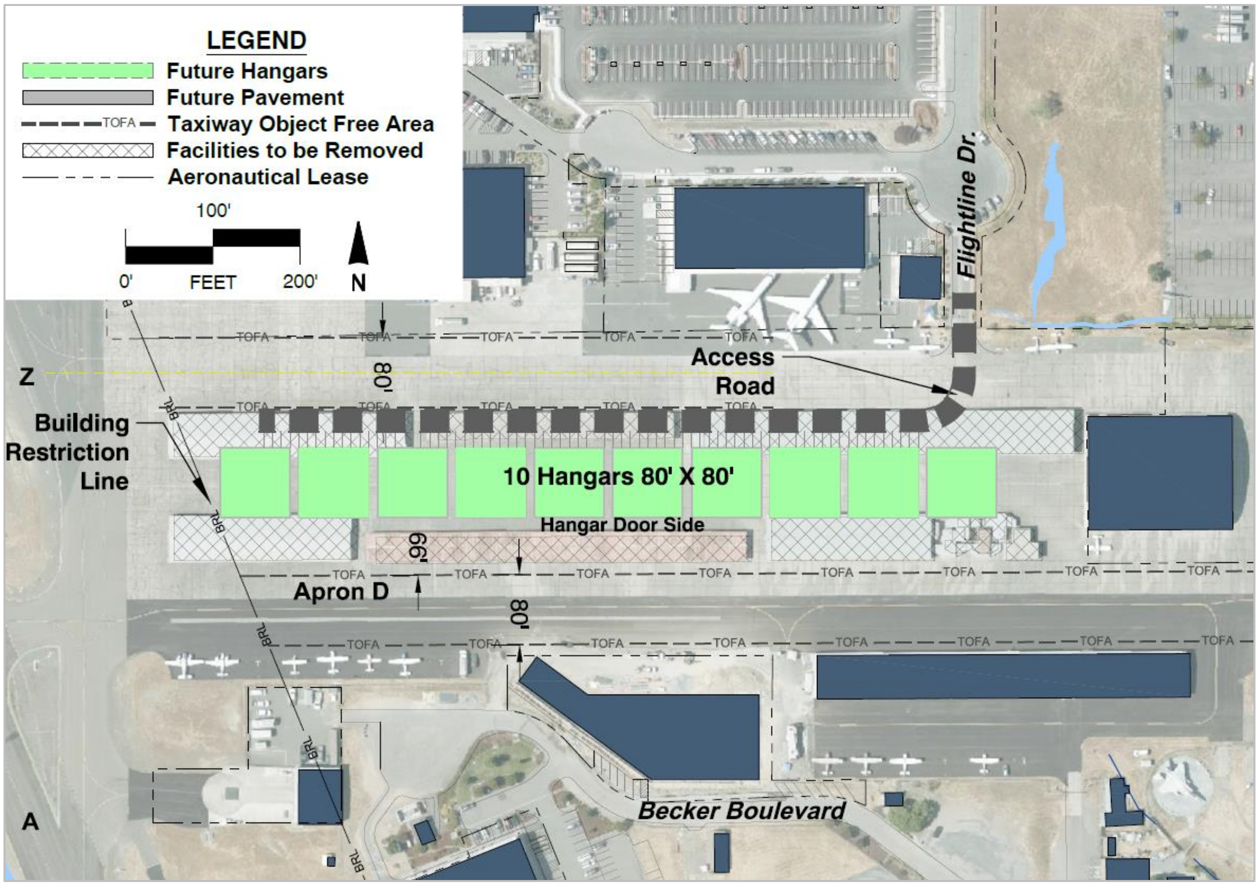
A new taxilane accesses all facilities on Apron D including the FBOs on the north edge. The taxilane is designed for ADG II aircraft with wingspans up to 79 feet. The design of each new facility places apron area in front of the hangar for aircraft staging. Becker Boulevard provides landside access for the southwest facilities, and Flightline Drive provides access for the other hangars.

Figure 6-14: Apron D Alternative 1



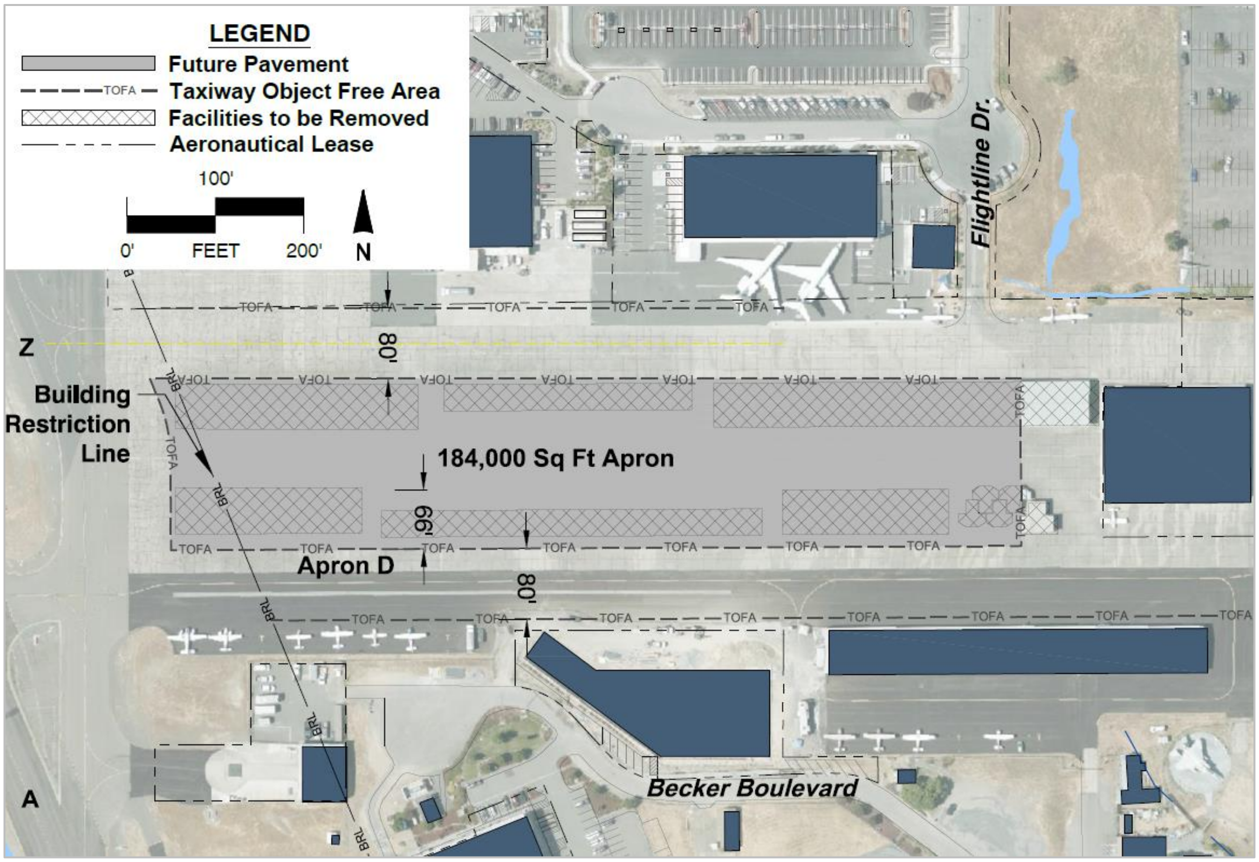
Apron D Alternative 2 (**Figure 6-15**) is a concept that shows corporate hangars in the center of Apron D with south facing doors. Landside access runs east and west from Flightline Drive. One taxilane north of the access road allows aircraft to access the FBOs north of Apron D. This design for this taxilane accommodates ADG I aircraft. A second taxilane designed for ADG I aircraft on the south side of Apron D accesses the proposed and remaining facilities. Alternative 2 proposes more hangars, but smaller ones (80 feet by 80 feet) with less staging area between the hangar door and taxilane.

Figure 6-15: Apron D Alternative 2



Apron D Alternative 3 (**Figure 6-16**) is a concept that proposes a tie-down and transient apron for Apron D. This alternative may supplement apron and tie-down areas lost with terminal expansion to the north onto Apron A. This concept shows Apron D as a 184,000 square foot apron without any hangar development. The apron area is flanked on the north and south by taxilanes that allow access to existing hangars and Apron D.

Figure 6-16: Apron D Alternative 3



Reconstruction in Current location

Reconstruction of the 53 small hangar units in their present location preserves the status quo. Two of the three taxilanes serving these hangars do not provide the standard clearance of 39.5 feet between the taxilane centerline and fixed or movable objects. However, it appears possible to reconstruct hangars to meet the alternative clearance requirements contained in FAA Engineering Brief No. 78.

Appendix A
SOP 200 ALP Checklist

APPENDIX A. ALP REVIEW CHECKLIST

The following checklist shall be used in lieu of FAA AC 150/5070-6B, Appendix F, Airport Layout Plan Drawing set. This checklist is intended for use when submitting a new or updated ALP to the FAA for review and approval. Consultants and/or sponsors should indicate "Yes," "No" or "N/A" (not applicable) for every item on the checklist. The same checklist shall be provided to FAA for review and verification. For all reviewers: It is important that each item listed be shown on the respective plan.

Airport Identification (to be completed by Sponsor or Consultant)			
Airport	Charles M. Schulz - Sonoma County Airport		
City and State	Santa Rosa, California	Location Identifier	STS
Airport Owner	County of Sonoma		

ALP Submission Information (to be completed by Sponsor or Consultant)		
ALP Prepared by	Mead & Hunt	
	Name of Consulting Firm	
	Bradley Musinski, Project Manager	5/15/2022
	Name of Individual	Date
	707-284-8685	
	Telephone	
	brad.musinski@meadhunt.com	
	Email address	
Consulting QA/QC Review	Bob Casagrande, Engineering Department Manager	April 2022
	Name and Title of Individual	Date
Sponsor Review	Jon Stout, STS Airport Manager	April 2022
	Name and Title of Individual	Date

FAA Review (to be completed by FAA)		
	Name and Title of Individual	Date

Critical Design Aircraft or Family of Aircraft:

	Make	Model	Annual Itinerant Operations
Existing	Boeing	737-800	More than 500 C/D-III Operations Annually
Future	No Change	No Change	No Chnage

Forecasted Year: 2038

Airport Reference Code (ARC): D-III

Runway Design Code (RDC) & Runway Reference (RRC):

Runway	RDC	RRC
14/32	D-III	D-III-2400
02/20	C-III	C-III-5000

Approach Minimums:

Rwy End	Minimum	Rwy End	Minimum
14	1 Mile		
32	½ Mile		
02	1 mile		
20	Visual		

Runways (Existing and Future):

14/32	6,000’	150’	No Change	No Change	Y
02/20	5,202’	100’	5,660’	No Change	Y

For the balance of the checklist, enter a mark (✔ or X) to confirm inclusion.

A.1. Narrative Report

Narrative Report					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
A. Executive Summary – A concise summary of the findings/ recommendations of the master planning effort or changes to the ALP. This should include a description of planned projects, an implementation plan/timeline, and identification of benchmarks or actions that will be conducted to either verify the original planning assumptions or proceed with project implementation.	From AC 150/5070-6, Section 202: An accompanying ALP Narrative Report should explain and document those changes and contain at least the following elements: – Basic aeronautical forecasts. – Basis for the proposed items of development. – Rationale for unusual design features and/or modifications to FAA Airport Design Standards. – Summary of the various stages of airport development and layout sketches of the major items of development in each stage. – An environmental overview to document environmental conditions that should be considered in the identification and analysis of airport development alternatives and proposed projects.	×			
1. Identify Projects along with description		×			
2. Create a Timeline for each Project		×			
3. Identify and List:		×			
a. Proposed Projects (e.g., Hangar development)		×			
b. Milestones/ Triggering Events (e.g., 1. All hangars are full, 2. There is a waiting list long enough to fill a new development, 3. Hangars have reached their useful life, etc.)		×			
c. Action items/Next Steps (e.g., 1. Maintain log and gather data, 2. Discuss plan with ADO, 3. Coordinate with ADO regarding potential for inclusion in FAA ACIP (Airports Capital Improvement Program), 4. Identify funding sources.)		×			
d. Funding Plan	Capital Improvement Plan for the forecast horizons. See AC 150/5070-6, Chapter 11. Only a rough, order-of-magnitude report is needed in the executive summary.			×	

Narrative Report					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
B. Basic aeronautical forecasts (0-5, 6-10, 11-20 years): Basic aeronautical forecasts (0-5, 6-10, 11-20 years):	Forecasts of future levels of aviation activity as approved by the FAA. These projections are used to determine the need for new or expanded facilities. See AC 150/5070-6, Chapter 7.	×			
1. Total annual operations	Total local and itinerant aircraft operations at the airport.	×			
2. Annual itinerant operations by all aircraft	Itinerant operations by aircraft that leaves the local airspace, generally 25 miles or more from the airport. See AC 150/5070-6, Chapter 7, Section 702.a. and Figure 7-2.	×			
3. Annual itinerant operations by current critical aircraft		×			
4. Annual itinerant operations by future critical aircraft		×			
5. Number of based aircraft	Aircraft that use the subject airport as a home base, i.e., have hangar or tie-down space agreements. See AC 150/5070-6, Chapter 7, Section 702.a. and Figure 7-2.	×			
6. Annual instrument approaches	Number of instrument approaches expected to be executed during a 12-month period. See AC 150/5070-6, Chapter 7, Section 702.a. and Figure 7-2.	×			
7. Number of enplanements	See AC 150/5070-6, Chapter 7, Section 702.a. and Figure 7-2.	×			

Narrative Report					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
8. Critical Aircraft (also referred as "design aircraft" or "critical design aircraft)	The critical aircraft is the most demanding aircraft identified in the forecast that will use the airport. Federally funded projects require that the critical aircraft will make substantial use of the airport in the planning period. Substantial use means either 500 or more annual itinerant operations or scheduled service. The critical aircraft may be a single aircraft or a composite of the most demanding characteristics of several aircraft. Provide the aircraft, AAC, and ADG. (e.g. Boeing 737-400, C-III) See AC 150/5300-13A, Paragraph 105(b) and FAA Order 5090.3C, 3-4.	×			
9. Runway Design Code (RDC)	Describe the RDC for each runway. For the purpose of airport geometric design, each runway will contain a RDC which signifies the design standards to which the runway is to be built. The RDC consists of three parameters: Aircraft Approach Category (AAC), Airplane Design Group (ADG) and the approach visibility minimums. These parameters represent the aircraft that are intended to be accommodated by the airport, regardless of substantial use. See AC 150/5300-13A, Paragraph 105(c).	×			
10. Runway Reference Code (RRC)	Describe the RRC for each runway. The RRC describes the current operational capabilities of a runway where no special operating procedures are necessary. The RRC consists of the same three components as the RDC, but is based on planned development and has no operational application. See AC 150/5300-13A, Paragraph 318.	×			
C. Alternatives/Proposed Development		×			

Narrative Report					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
11. Explanation of proposed development items	Specific projects can be described as project listings on a master table, on individual project data sheets, or in projects booklets.	×			
12. Discuss near-term and future Approach Procedure Requirements or effects (e.g., LPV, Circling, etc.)	Based on existing or forecast usage. See FAA Order 7400.2, Figures 6-6-3 and 6-3-9.			×	
13. Navigational Aids or Other Equipment Needs (e.g., Approach Lights, Wind Cones, AWOS, etc.)	The need for new or additional navigational aids is a function of the fleet mix, the percentage of time that poor weather conditions are present, and the cost to the users of not being able to use the airport while it is not accessible.	×			
14. Wind coverage. Is it adequate for existing and future runway layouts? Has wind data been updated?	This analysis determines if additional runways are needed to provide the necessary wind coverage. Reference AC 150/5300-13A, Appendix 2 for guidance on wind coverage analysis techniques.	×			
D. Modification to Standards.	Any approved nonconformance to FAA standards, other than dimensional standards for RSAs and OFZs, require FAA approval. A description of all approved modification to standards shall be provided. See AC 150/5300-13A, Paragraph 106(b) and FAA Order 5300.1.	×			
E. Obstruction Surfaces (14 CFR Part 77 and Threshold Siting Surface)	Reference 14 CFR Part 77 and AC 150/5300-13A, Paragraph 303.		×		
F. Runway Protection Zone	A description of any incompatible land uses inside the RPZ shall be provided. Prior to including new or modified land use in the RPZ, the Regional and ADO staff must consult with the National Airport Planning and Environmental Division, APP-400. This policy is exempt from existing land uses in the RPZ. See AC 150/5300-13A, Paragraph 310 and FAA memorandum dated September 27, 2012.		×		

Narrative Report					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
G. Development summary (including sketches, schedules, and cost estimates) for stages of construction for: Development summary (including sketches, schedules, and cost estimates) for stages of construction for:	Documentation provided should include any electronic spreadsheets and files to facilitate in modifying the financial plan on an as-needed basis.	×			
15. Development Projects Completed Since Last ALP					
16. 0-5 years					
17. 6-10 years					
18. 11-20 years					
H. Shadow or line-of-sight study for towered airports (negative or positive statements are required).	Reference FAA Order 6480.4. This can be from the Airway Facilities Tower Integration Laboratory (AFTIL) or simpler GIS-generated studies.	×			
I. Letters of coordination with all levels of government, as needed.	Affected private and/or governmental groups, agencies, commissions, etc., that may have input on the plans. See AC 150/5070-6, Chapter 3.	×			
J. Wildlife Hazard Management Issues Review (in narrative).	Reference AC 150/5200-33.			×	
K. Preliminary Identification of Environmental Features	Potential or known features only. Further environmental analysis will be necessary. Reference FAA Order 5050.4B. Begin framework for NEPA analysis.	×			
19. Major airport drainage ditches		×			
20. Wetlands		×			
21. Flood Zones		×			
22. Historic or Cultural features		×			
23. Section 4(f) features		×			
24. Flora/Fauna		×			

Narrative Report					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
25. Natural Resources		×			
26. Etc. (other features identified in Order 5050.4B)				×	
L. Note Action Items from Runway Safety Program Office	List and note status of items from Runway Safety Program Office or Runway Safety Action Plan.			×	
M. Declared Distance (DD)	The narrative on declared distances is used to aid in understanding the maximum distances available and suitable for meeting takeoff, rejected takeoff, and landing distances performance requirements for turbine powered aircraft. The narrative shall also provide clarification on why declared distances have been implemented. Declared distances data must be listed for all runway ends. The TORA, TODA, ASDA, and LDA will be equal to the runway length in cases where a runway does not have displaced thresholds, stopways, or clearway, and have standard RSAs, ROFAs, RPZs, and TSS. Reference AC 150/5300-13A, Paragraph 323.	×			
Remarks					
Items included in Narrative Report for project as scoped.					

A.2. Title Sheet

- The scale of the Title Sheet should be developed to include the items listed below.
- The minimum size for the final drawing set is 22" X 34" (ANSI D) and 24" X 36" (ARCH D). Coordinate use of 34" x 44" (ANSI E) and 26" X 48" (ARCH E) with FAA. Color drawings may be acceptable if they are still usable if reproduced in grey scale.

Title Sheet					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
A. Title and revision blocks	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Airport sponsor approval block	Provide an approval block for the sponsoring authority's representative to sign. Include space for name, title, and date.	×			
C. Date of ALP (date the airport sponsor signs the ALP)	The month and year of signature prominently shown near the title.	×			
D. Index of sheets (including revision date column)	Airport Layout Drawing, Airport Airspace Drawing, Inner Portion of the Approach Surface Drawing, Terminal Area Drawing, Land Use Drawing, Airport Property Map, Airport Departure Surface, etc.	×			
E. State Aeronautics Agency Approval Block (as needed)	Provide an approval block for the sponsoring authority's representative to sign. Include space for name, title, and date.	×			
F. State outline with county boundaries. County in which airport is located should be highlighted.	Provide as needed.	×			
G. Location map (general area)		×			
H. Vicinity map (specific airport area)		×			
Remarks					

A.3. Airport Data Sheet

- For smaller airports, some of the ALP sheets may be combined if practical and approved FAA.

Airport Data Sheet					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
A. Title and Revision Blocks	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Wind Rose (all weather and IFR) with appropriate airport reference code and runway orientation depicted, crosswind coverage, and combined coverage, source of wind information and time period covered (for IFR runways applicable minimums should be included):	Assembly and analysis of wind data to determine ultimate runway orientation and also provides the operational impact of winds on existing runways. If instrument procedures are present or will be requested then both all-weather and instrument meteorological condition wind roses are required. See AC 150/5300-13A, Appendix 2.	×			
1. 10.5, 13, 16, 20 knots wind rose (based on appropriate airport reference code)	When a runway orientation provides less than 95 percent wind coverage for any aircraft forecasted to use the airport on a regular basis, a crosswind runway is recommended. The 95 percent wind coverage is computed on the basis of the crosswind not exceeding 10.5 knots for Airport Reference Codes A-I and B-I, 13 knots for Airport Reference Codes A-II and B-II, 16 knots for Airport Reference Codes A-III, B-III, and C-I through D-III, and 20 knots for Airport Reference Codes A-IV through D-VI. See also AC 150/5300-13A, Paragraph 302(c)(3) and AC 150/5300-13A, Appendix 2.	×			
2. Percentage of wind coverage/crosswind		×			
3. Source of data	Wind data may be obtained from NOAA at http://www.ncdc.noaa.gov/ Reference AC 150/5300-13A, Appendix 2, Paragraph A2-5 and A2-6.	×			

Airport Data Sheet					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
4. Age of data (last 10 consecutive years of data with most current data no older than 10 years)	Data must be from the latest 10-year period from the reporting station closest to the airport. Reference AC 150/5300-13A, Appendix 2, Paragraph A2-5.	×			
C. Airport Data Table		×			
1. ARC for Airport	List the Airport Reference Code (ARC) for airport. 5300-13AARC is an airport designation that signifies the airport’s highest Runway Design Code (RDC), minus the third (visibility) component of the RDC. Reference AC 150/5300-13A.	×			
2. Mean maximum temperature of hottest month	List the mean maximum temperature and the hottest month for the airport location as listed in “Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree-Days” (Climatography of the United States No. 81). See AC 150/5325-4, 506.b.	×			
3. Airport elevation (highest point of the landing areas, nearest 0.1 foot) – using North American Vertical Datum of 1988 (NAVD88)	List the Airport Elevation, the highest point on an airport's usable runway expressed in feet above mean sea level (MSL). Use NAVD88. Reference AC 150/5300-13A, Paragraph 102(g) All elevations shall be in NAVD88. A note shall be put on the Airport Layout Drawing that denotes that the NAVD88 vertical control datum was used.	×			
4. Airport Navigational Aids, including ownership (NDB, TVOR, ASR, Beacon, etc.)	List the electronic aids available at the airport.	×			

Airport Data Sheet					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
5. Airport reference point coordinates, nearest second (existing, future if appropriate, and ultimate) - NAD83	List the Airport Reference Point, the latitude and longitude of the approximate center of the airport. Use the North American Datum of 1983 (NAD83) coordinate system. See AC 150/5300-13A, Paragraph 207. All latitude/longitude coordinates shall be in NAD83. A note shall be put on the Airport Layout Drawing that denotes that the NAD83 coordinate system was used.	×			
6. Miscellaneous facilities (taxiway lighting, lighted wind cone(s), AWOS, etc.) [Including type/model and any facility critical areas]	List any other facilities available at the airport.	×			
7. Airport Reference Code and Critical Aircraft (existing & future)	List the existing and ultimate Airport Reference Code and Critical Aircraft, the most demanding aircraft identified in the forecast that will use the airport. Federally funded projects require that critical design airplanes have at least 500 or more annual itinerant operations at the airport (landings and takeoffs are considered as separate operations) for an individual airplane or a family grouping of airplanes. See AC 150/5325-4, 102.a.(8) and AC 150/5070-6, 702.a. Indicated dimensions for wingspan and undercarriage, along with approach speed.	×			
8. Airport magnetic variation, date and source	Magnetic declination may be calculated at http://www.ngdc.noaa.gov/geomag-web/#declination. This model is using the latest World Magnetic Model which has an Epoch Year of 2010. See FAA Order 8260.19, "Flight Procedures and Airspace." Chapter 2, Section 5, for further information.	×			
9. NPIAS service level (GA, RL, P, CS, etc.)	See FAA Order 5090.3C.	×			

Airport Data Sheet					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
10. State equivalent service role	As applicable pursuant to State Aviation Department System Plan.	×			
D. Runway Data Table	The Runway Data Table should show information for both existing and ultimate runways.	×			
1. Runway identification (Include identifying runways that are "utility")	A column for each runway end should be present. List the runway end number and if pavement strength is less than 12,500 pounds (single-wheel), then note as utility.	×			
2. Runway Design Code (RDC)	5300-13AThe first component, depicted by a letter, is the AAC and relates to aircraft approach speed (operational characteristics). The second component, depicted by a Roman numeral, is the ADG and relates to either the aircraft wingspan or tail height (physical characteristics); whichever is more restrictive. The third component relates to the visibility minimums expressed by RVR values in feet of 1200, 1600, 2400, and 4000. List the RDC for each runway. See AC 150/5300-13A, Paragraph 105(c).	×			
3. Runway Reference Code (RRC)	The RRC describes the current operational capabilities of a runway where no special operating procedures are necessary. Like the RDC, it is composed of three components: AAC, ADG, and visibility minimums. List the RRC for each Runway. See AC 150/5300-13A, Paragraph 318.	×			
4. Pavement Strength & Material Type	Indicate the runway surface material type, e.g., turf, asphalt, concrete, water, etc.	×			
a. Strength by wheel loading	List the existing and ultimate design strength of the landing surface. See AC 150/5320-6, Chapter 3.	×			
b. Strength by PCN	See AC 150/5335-5.	×			

Airport Data Sheet					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
c. Surface treatment	Note any surface treatment: grooved, PFC, etc.	×			
5. Effective Runway Gradient (%) Author to note maximum grade within runway length. Note to included statement that the runway meets line of sight requirements	List the maximum longitudinal grade of each runway centerline. See AC 150/5300-13A, Paragraph 313.	×			
6. Percent (%) Wind Coverage (each runway)	List the percent wind coverage for each runway for each Aircraft Approach Category. See AC 150/5300-13A, Appendix 2.	×			
7. Runway dimensions (length and width)	Dimensions determined for the Critical Design Aircraft by using graphical information in AC 150/5325-4.	×			
8. Displaced Threshold	Provide the pavement elevation of the runway pavement at any displaced threshold. See AC 150/5300-13A, Paragraph 303(2).	×			
9. Runway safety area dimensions (actual existing and design standard)	List the existing and ultimate dimensions of the Runway Safety Area (RSA). See AC 150/5300-13A, Paragraph 307.	×			
10. Runway end coordinates (NAD83) (include displaced threshold coordinates, if applicable) to the nearest 0.01 second and 0.1 foot of elevation.	Show the latitude and longitude of the threshold center and end of pavement (if different) to the nearest .01 of a second and 0.1 foot of elevation.	×			
11. Runway lighting type (LIRL, MIRL, HIRL)	List the existing and ultimate type of runway lighting system for each runway, e.g., Reflectors, Low Intensity Runway Lighting (LIRL), Medium Intensity Runway Lighting (MIRL), or High Intensity Runway Lighting (HIRL). LIRLs will typically not be shown for new systems. See AC 150/5340-30, Ch. 2.	×			

Airport Data Sheet					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
12. Runway Protection Zone (RPZ) Dimensions	List the existing and ultimate Runway Protection Zone (RPZ) dimensions. See AC 150/5300-13A, Paragraph 310. Prior to including new or modified land use in the RPZ, the Regional and ADO staff must consult with the National Airport Planning and Environmental Division, APP-400. This policy is exempt from existing land uses in the RPZ. See AC 150/5300-13A, Paragraph 310 and FAA memorandum dated September 27, 2012.	×			
13. Runway marking type (visual or basic, non-precision, precision)	Indicate the existing and ultimate pavement markings for each runway. See AC 150/5340-1, Section 2.	×			
14. 14 CFR Part 77 approach category (50:1; 34:1; 20:1) Existing and Future	List the existing and ultimate approach surface slope. See FAA Order 7400.2, Figures 6-6-3 and 6-3-9.	×			
15. Approach Type (precision, non-precision, visual)	List the existing and ultimate Part 77 Approach Use Types. See FAA Order 7400.2, Figures 6-6-3 and 6-3-9.	×			
16. Visibility minimums (existing and future)	List the existing and ultimate visibility minimums for each runway. See AC 150/5300-13A, Table 1-3.	×			
17. Type of Aeronautical Survey Required for Approach (Vertically Guided, not Vert. Guided)	List the type of aeronautical survey required for the visibility minimums given. See AC 150/5300-18, Section 2.7 and AC 150/5300-13A, Table 3-4 and Table 3-5.	×			
18. Runway Departure Surface (Yes or N/A)"	Determine applicability of 40:1 Departure Obstacle Clearance Surface (OCS) as defined in Paragraph 303(c) of AC 150/5300-13A.	×			

Airport Data Sheet					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
19. Runway Object Free Area	List the existing and ultimate dimensions of the Runway Object Free Area (OFA). See AC 150/5300-13A, Paragraph 309. Objects non-essential for air navigation or aircraft ground maneuvering purposes must not be placed in the ROFA, unless a modification to standard has been approved.	×			
20. Obstacle Free Zone	The OFZ clearing standard precludes aircraft and other object penetrations, except for frangible NAVAIDs that need to be located in the OFZ because of their function. Modification to standards does not apply to the OFZ. List the Runway OFZ, Inner-approach OFZ, Inner-transitional OFZ, and Precision OFZ if applicable.	×			
21. Threshold siting surface (TSS)	List the existing and ultimate threshold siting surface (i.e. approach and departure surfaces). Identify any objects penetrating the surface. If none, state “No TSS Penetrations”. Reference AC 150/5300-13A, Paragraph 303.	×			
22. Visual and instrument NAVAIDs (Localizer, GS, PAPI, etc.)	List the existing and ultimate visual navigational aids serving each runway.	×			
23. Touchdown Zone Elevation	List the highest runway centerline elevation in the existing and ultimate first 3000 feet from landing threshold. See FAA Order 8260.3, Appendix 1.	×			
23. Taxiway and Taxilane width	List the existing and ultimate width of the taxiways and taxilane. Reference AC 150/5300-13A, Paragraph 403 and Table 4-2.	×			
24. Taxiway and Taxilane Safety Area dimensions	List the existing and ultimate taxiway and taxilane safety area dimensions. Reference AC 150/5300-13A, Paragraph 404(c) and Table 4-1.	×			

Airport Data Sheet					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
25. Taxiway and Taxilane Object Free Area	List the existing and ultimate taxiway and taxilane object free area dimensions. Reference AC 150/5300-13A, Paragraph 404(b) and Table 4-1.	×			
26. Taxiway and Taxilane Separation	List any objects located inside the Taxiway/Taxilane Safety Area and Taxiway/Taxilane Object Free Area. Also provide the distance from the taxiway/taxilane centerline to the fixed or movable object. Reference Paragraph 404(a) and Table 4-1.	×			
27. Taxiway/Taxilane lighting	List the existing and ultimate type of taxiway lighting system, e.g., Reflectors, Low Intensity Taxiway Lighting (LITL), Medium Intensity Taxiway Lighting (MITL), or High Intensity Taxiway Lighting (HITL). LITLs will typically not be shown for new systems. See AC 150/5340-30, Chapter 4.	×			
28. Identify the vertical and horizontal datum	All latitude/longitude coordinates shall be in North American Datum of 1983 (NAD 83). A note shall be put on the Airport Layout Drawing that denotes that the NAD 83 coordinate system was used. All elevations shall be NAVD88. A note shall be put on the Airport Layout Drawing that denotes that the NAVD88 vertical control datum was used.	×			
E. Modification to Standards Approval Table (if applicable, a separate written request, including justification, should accompany the modification to standards). Show: Approval Date/ Airspace Case No. / Standard to be Modified / Description	Provide a table to list all FAA approved Modifications to Standards. See AC 150/5300-13A, Paragraph 106(b), and FAA Order 5300.1. List "None Required" on the table if no Modifications have yet been proposed or approved.	×			

Airport Data Sheet					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
F. Declared Distances Table	Required even if Declared Distances are not in effect. Declared distances are only to be used for runways with turbine-powered aircraft. The TORA, TODA, ASDA, and LDA will be equal to the runway length in cases where a runway does not have displaced thresholds, stopways, or clearways, and have standard RSAs, ROFAs, RPZs, and TSS. Reference AC 150/5300-13A, Paragraph 323.	×			
1. Take Off Run Available (TORA)	List the runway length declared available and suitable for the ground run of an airplane taking off, i.e., Take Off Run Available (TORA). The TORA may be reduced such that it ends prior to the runway to resolve incompatible land uses in the departure RPZ, and/or to mitigate environmental effects. Reference AC 150/5300-13A, Paragraph 323(d)(1).	×			
2. Take Off Distance Available (TODA)	List the length of remaining runway or clearway (CWY) beyond the far end of the TORA ADDED TO the TORA. The resulting sum is the Take Off Distance Available (TODA) for the runway. The TODA may be reduced to mitigate penetrations to the 40:1 instrument departure surface, if applicable. The TODA may also extend beyond the runway end through the use of a clearway Reference AC 150/5300-13A, Paragraph 323(d)(2).	×			
3. Accelerate Stop Distance Available (ASDA)	5300-13A List the length the length of runway plus stopway (if any) declared available and suitable for satisfying accelerate-stop distance requirements for a rejected takeoff. Additional RSA and ROFA can be obtained by reducing the ASDA. Reference AC 150/5300-13A, Paragraph 323(d)(3).	×			

Airport Data Sheet					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
4. Landing Distance Available (LDA)	5300-13A List the length of runway declared available and suitable for satisfying landing distance requirements. The LDA may be reduced to satisfy the approach RPZ, RSA, and ROFA requirements. Reference AC 150/5300-13A, Paragraph 323(e).	×			
G. Legend	Provide a Legend that identifies all symbols and line types used on the drawing. Lines must be clear and readable with sufficient scale and quality to discern details.			×	
Remarks					

A.4. Airport Layout Plan Drawing

- For smaller airports, some of the ALP sheets may be combined if practical and approved by FAA.
- Two, or more, sheets may be necessary for clarity, existing and proposed. The reviewer should be able to differentiate between existing, future, and ultimate development. If clarity is an issue, some features of this drawing may be placed in tabular format. North should be pointed towards the top of the page or to the left. (scale 1"=200' to 1"=600')

Airport Layout Plan Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
A. Title and Revision Blocks	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Space for the FAA approval stamp	Leave a blank four-inch by four-inch area for the FAA approval stamp.	×			
C. Layout of existing and proposed facilities and features:	To assure full consideration of future airport development in 14 CFR Part 77 studies, airport owners must have their plans on file with the FAA. The necessary plan data includes, as a minimum, planned runway end coordinates, elevation, and type of approach for any new runway or runway extension. See AC 150/5300-13A, Paragraph 106.	×			
1. True and magnetic North arrow with year of magnetic declination	Magnetic declination may be calculated at http://www.ngdc.noaa.gov/geomag-web/#declination. This model is using the latest World Magnetic Model which has an Epoch Year of 2010. See FAA Order 8260.19, "Flight Procedures and Airspace." Chapter 2, Section 5, for further information.	×			
2. Airport reference point – locate by symbol a Lat./Long. To nearest second (existing, future, and ultimate) NAD 83	List the Airport Reference Point, the latitude and longitude of the approximate center of the airport. Use the NAD 83 coordinate system. See AC 150/5300-13A, Paragraph 207.	×			
3. Wind cones, segmented circle, beacon, AWOS, etc.	Show as applicable pursuant to AC 150/5300-13A, Chapter 6.	×			

Airport Layout Plan Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
4. Contours (showing only significant terrain differences)	Topography, budget, and future uses of the base mapping, will dictate what intervals of topographical contours to use on the maps. Topographic issues may be important in the alternatives analysis, which may require that reduced contour intervals be used. See AC 150/5070-6, 1005.	×			
5. Elevations: All NAVD88	All latitude/longitude coordinates shall be in NAD83/NAVD88.	×			
a. Runway – existing, future, and ultimate ends (nearest 0.1 ft.)	Show the latitude and longitude of the threshold center and end of pavement.	×			
b. Touchdown Zone Elevation (highest point in first 3,000 ft. of runway)	List the highest runway centerline elevation in the existing and ultimate first 3000 feet from landing threshold. See FAA Order 8260.3, Appendix 1.	×			
c. Runway high/low points (existing and future)	For all runways identify high and low points (centerline) and provide elevation information.	×			
d. Label runway/runway intersection elevations	Label the pavement elevation of runway intersections where the centerlines cross.	×			
e. Displaced Thresholds (if any)	Label the pavement elevation and coordinates of the runway pavement at any displaced threshold. See AC 150/5300-13A, Paragraph 303(a)(2).	×			
f. Roadways & Railroads (where they intersect Approach surfaces, the extended runway centerline, and at the most critical points)	Provide elevation information for the traverse ways' centerline elevation where they intersect the Part 77 Approach surfaces (existing and ultimate). Note whether this elevation is the actual elevation or the traverseway elevation plus the traverseway adjustment (23' for railways, 17' for interstate highways, 15' for other public roads, or 10' for private roads). See also 14 CFR Part 77.	×			

Airport Layout Plan Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
g. Structures, Buildings, and Facilities	All buildings on the Airport Layout Drawing should be identified by an alphanumeric character. List these identifiers in a table and give a description of the building. If no Terminal Area drawing is done, also include the top of structure elevation in MSL. If any of the structures violate any airport or approach surfaces give an ultimate disposition to remedy the violation. Don't forget navigation aid shelters, AWOS/ASOS, RVRs, PAPIs, Fueling systems, REILs, etc. Also identify the structure use (hangar, FBO, crew quarters, etc.), as needed. Some lesser objects may be identified by symbols in the legend.	×			
h. Define features to include: trees streams, water bodies, etc.	Provide information and delineate trees, streams, water bodies, etc., on or near airport property and approach surfaces.	×			
6. Runway Details		×			
a. Runway Design – runway length, runway width, shoulder width, blast pad width, blast pad length, and cross wind component. (existing, future, and ultimate)	AC 150/5325-4 describes procedures for establishing the appropriate runway length. AC 150/5300-13A, Table 3-4 and Table 3-5 provides the minimum runway length. AC 150/5300-13A, Table 3-8 provides the standard dimensions of the runway width, shoulder width, blast pad width, blast pad length, and crosswind component based on RDC. Clearly denote the runway numbers at the thresholds. Show location of existing and future threshold lights.	×			
b. Orientation – true bearing to nearest 0.01 second (and runway numbers)	Show the true bearing to the nearest .01 of a degree of the runway centerline.	×			

Airport Layout Plan Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
c. End Coordinates – existing, future, and ultimate degrees, minutes, seconds (to the nearest 0.01 second)	Show the latitude and longitude of the threshold center and end of pavement (if different) to the nearest .01 of a second.	×			
d. Runway Safety Areas (RSA) – actual, existing, future, and ultimate (including dimensions)	Show the extents of the existing and ultimate RSA 5300-13A. Reference AC 150/5300-13A, Paragraph 307.	×			
e. Runway Object Free Areas (ROFA)	Show the extents of the existing and ultimate ROFA. Reference AC 150/5300-13A, Paragraph 309.	×			
f. Precision Obstacle Free Zone (POFZ)	Show the extents of the existing and ultimate POFZ. Reference AC 150/5300-13A, Paragraph 308(d).	×			
g. Obstacle Free Zone (OFZ)	Show the extents of the existing and ultimate OFZ. Reference AC 150/5300-13A, Paragraph 308.	×			
h. Clearways and Stopways	Show any/all clearways and stopways/overruns and the markings used to denote these areas. See AC 150/5300-13A, Paragraph 311 and 312; and AC 150/5340-1, Section 2, Paragraph 14.			×	
i. Runway Protection Zone (RPZ) - Dimensions (existing, future, and ultimate)	Show existing and ultimate RPZ. See AC 150/5300-13A, Paragraph 310. Show the existing and ultimate protective area/zone type of ownership. Identify any incompatible objects and activities inside the RPZ. Prior to including new or modified land use in the RPZ, the Regional and ADO staff must consult with the National Airport Planning and Environmental Division, APP-400. This policy is exempt from existing land uses in the RPZ. See AC 150/5300-13A, Paragraph 310 and FAA memorandum dated September 27, 2012.	×			

Airport Layout Plan Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
j. 14 CFR Part 77 Approach Surfaces	Show the portion of the existing and ultimate approach surfaces that are over airport and adjacent property and identify the approach surface dimensions and slope. See FAA Order 7400.2, Figure 6-3-9.	×			
k. Threshold Siting Criteria: Approach/Departure Surface (existing, future, and ultimate) 5300-13A	Determine and identify pursuant to AC 150/5300-13A, Paragraph 303(b) and 303(c).	×			
l. Terminal Instrument Procedures (TERPS)surface and TERPS GQS, if applicable.	Determine and identify pursuant to AC 150/5300-13A, Paragraph 303(a)(4)(a), Table 3-4, and Table 3-5. Reference FAA Order 8260.3.		×		
m. Navigation Aids (NAVAIDS) – PAPI, ILS, GS, LOC, ALS, MALSR, REIL, etc., (plus facility critical area's)	Show all NAVAIDS and provide clearance distances from runways, taxiways, etc. Reference AC 150/5300-13A, Chapter 6.	×			
n. Marking – thresholds, hold lines, etc.	Show on the runway the type and location of markings, existing and ultimate. See AC 150/5340-1, Section 2.	×			
o. Displaced threshold coordinates and elevation	Show the latitude, longitude, and the pavement elevation of the runway pavement at any displaced threshold. See AC 150/5300-13A, Paragraph 303(a)(2).5300-13A.	×			
p. Runway centerline separation distances	Show the runway centerline separation distances to parallel runway centerline, holding position, parallel taxiway/taxilane centerline, aircraft parking area, and helicopter touchdown pad, if applicable. Reference AC 150/5300-13A, Paragraph 321 and Table 3-8.	×			
7. Taxiway Details	Show the taxiway centerline separation distances to parallel taxiway/taxilane centerlines, fixed or movable objects.	×			

Airport Layout Plan Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
a. Dimensions – width (existing & ultimate)	Taxiway width based on Taxiway Design Group (TDG). See AC 150/5300-13A, Table 4-2.	×			
b. Taxiway Edge Safety Margin (TESM)	TESM dimension based on TDG. See AC 150/5300-13A, Table 4-2.		×		
c. Taxiway Shoulder Width	Taxiway shoulder width based on TDG. See AC 150/5300-13A, Table 4-2.	×			
b. Taxiway/Taxilane Object Free Area (TOFA)	TOFA width based on Taxiway Design Group (TDG). TOFA extend the entire length of taxiway. See AC 150/5300-13A, Table 4-1.	×			
c. Taxiway/Taxilane Safety Area (TSA)	TSA width based on TDG. TSA extend the entire length of taxiway. See AC 150/5300-13A, Table 4-1.		×		
d. Taxiway/Taxilane Centerline Separation from:		×			
i. Runway centerline	Show the distance from centerline of runway to centerline of taxiway. See AC 150/5300-13A, Table 4-1.	×			
ii. Parallel taxiway	Show the distance from centerline of taxiway to centerline of parallel taxiway. See AC 150/5300-13A, Table 4-1.	×			
iii. Aircraft parking	Show the distance from centerline of taxiway to marked aircraft parking/tie downs. See AC 150/5300-13A, Table 4-1.	×			
iv. Fixed or Movable Objects	Show the distance from centerline of taxiway to airport objects such as buildings, facilities, poles, etc. See AC 150/5300-13A, Table 4-1.	×			
8. Fences (identify height)	Show the location of existing and ultimate fences and identify height.	×			

Airport Layout Plan Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
9. Aprons		×			
a. Dimensions (square footage, dimension, or length and width)	Include dimensions of apron and distance from runway and taxiway centerlines. Apron should be sized using activity forecast and the apron design spreadsheet. See AC 150/5300-13A, Chapter 5 and FAA Engineering Brief No. 75.	×			
b. Identify aircraft tie-down layout	Show proposed tie-down layout on the apron area. See AC 150/5300-13A, Figure A5-1, AC 20-35, and AC 150/5340-1.	×			
c. Identify Special Use Areas (e.g., deicing or aerial application areas on or near apron)	Show as applicable and pursuant to representative ACs.			×	
10. Roads	Label all roads.	×			
11. Legend	Provide a Legend that identifies all symbols and line types used on the drawing. Lines must be clear and readable with sufficient scale and quality to discern details.	×			
12. Items to be identified with distinct line types	Use distinct line types to identify different items and differentiate between existing and ultimate.	×			
a. NAVAID Critical Areas (Glide Slope, Localizer, AWOS, ASOS, VOR, RVR, etc.)	Show the critical area outline for all Instrument Landing System and other electronic Navigational Aids located on the airport. See AC 150/5300-13A, Chapter 6 for general guidance and FAA Order 5750.16 for critical area dimensions.	×			
b. Building Restriction Lines 5300-13A(BRL)	The BRL is the line indicating where airport buildings must not be located, limiting building proximity to aircraft movement areas. See AC 150/5300-13A, Paragraph 213(a).	×			
c. Runway Visibility Zone (RVZ)	Show the RVZ for the existing and ultimate airport configurations. See AC 150/5300-13A, 305(c).	×			

Airport Layout Plan Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
d. Airport Property Lines and Easements (existing, future, and ultimate)	Show the airport property boundaries, including easements, for the existing and ultimate airport configurations.	×			
13. Survey Documentation		×			
a. Survey Monuments (PACS/SACS, see AC 150/5300-16)	Show the location of all established survey monuments located on or near the airport property. Identify Primary and Secondary Airport Control Stations (PACS/SACS) if they exist. See AC 150/5300-16. Show the location of all section corners on or near the airport property.	×			
b. Offsets, stations, etc.	Show as applicable.			×	
14. Any Air Traffic Control Tower (ATCT) line of sight/shadow study areas (use separate sheet if necessary)	Reference FAA Order 6480.4.	×			
15. General Aviation development area (e.g., fuel facilities, FBO, hangars, etc.) – greater detail can be shown on the terminal area drawing	Show as applicable.	×			
16. Facilities and movement areas that are to be phased out, if any, are described	Show as applicable.			×	

Remarks

TSA and TESM shown on Data Sheet (Taxiway Data Table) and illustrated on Terminal Area Plan sheets.

TERPS/GQS shown on RW 32 Airspace sheets.

A.5. Airport Airspace Drawing

- A required drawing.
- Scale 1" = 2000' plan view, 1" = 1000' approach profiles, 1"=100' (vertical) for approach profiles.
- 14 CFR Part 77, Objects Affecting Navigable Airspace, defines this as a drawing depicting obstacle identification surfaces for the full extent of all airport development. It should also depict airspace obstructions for the portions of the surfaces excluded from the Inner Portion of the Approach Surface Drawing.

Airport Airspace Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
A. Title and Revision Block	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Plan view (based on ultimate runway lengths) Include location of water or sewage facilities if inside horizontal surface.		×			
1. U.S. Geological Survey (USGS) Quad Sheet for base map	Use the most current USGS Quadrangle(s) as a base map for the airspace drawing.	×			
2. Runway end numbers	Show the ultimate runways and runway numbers. Contact the FAA before renumbering existing runways.	×			
3. Part 77 Surfaces (Horizontal, Conical, Transition, based on ultimate). Including elevations at the point where surfaces change.	Show the extents of the Part 77 imaginary surfaces. For airports that have precision approach runways show balance of the 40,000' approach on a second sheet, if necessary. See 14 CFR Part 77.19.	×			
4. 50' elevation contours on sloping surfaces (NAVD88)	Show contour lines on all sloping Part 77 imaginary surfaces. See 14 CFR Part 77.19.	×			
5. Top elevations of penetrating objects for the inner portion of the approach surface drawing	Identify by unique alphanumeric symbol all objects beyond the Runway Protection Zones that penetrate any of the Part 77 surfaces. See 14 CFR Part 77.	×			
6. Note specifying height restriction (ordinances/statutes)	List any local zoning restrictions that are in place to protect the airport and surrounding airspace. See AC 150/5190-4.			×	
7. North Arrow with magnetic declination and	Magnetic declination may be calculated at	×			

Airport Airspace Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
year	http://www.ngdc.noaa.gov/geomag-web/#declination. This model is using the latest World Magnetic Model which has an Epoch Year of 2010. See FAA Order 8260.19, "Flight Procedures and Airspace." Chapter 2, Section 5, for further information.				
C. Profile view		×			
1. Airport Elevation	List the Airport Elevation, the highest point on an airport's usable runway expressed in feet above mean sea level (MSL). Use NAVD88 datum. See AC 150/5300-13A, Chapter 1, Paragraph 102(g).	×			
2. Composite Ground Profile along extended Runway Centerline (Representing the composite profile, based on the highest terrain across the width and along the length of the approach surface)	Depict the ground profile along the extended runway centerline representing the composite profile, based on the highest terrain across the width and along the length of the approach surface.	×			
3. Significant objects (bluffs, rivers, roads, schools, towers, etc.) and elevations	Identify all significant objects (roads, rivers, railroads, towers, poles, etc.) within the approach surfaces, regardless of whether or not they are obstructions. Use the objects' same alphanumeric identifier that was used on the plan view. Identify the top elevations of all significant objects (roads, rivers, railroads, towers, poles, etc.) within the approach surfaces, regardless of whether or not they are obstructions.	×			
4. Existing, future, and ultimate runway ends and approach slopes	Show existing and ultimate runway ends and FAR Part 77 approach surface slopes. See 14 CFR Part 77.19.	×			
D. Obstruction Data Tables (identify obstacles not depicted on the Inner Portion of the Approach Surface Drawing)		×			
1. Object identification number	Identify all significant objects (roads, rivers, railroads, towers, poles, etc.) within the approach surfaces, regardless of whether	×			

Airport Airspace Drawing

Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
	or not they are obstructions. Use the objects alphanumeric identifier that was used on the plan view.				
	Identify the top elevations of all significant objects (roads, rivers, railroads, towers, poles, etc.) within the approach surfaces, regardless of whether or not they are obstructions.				
2. Description	Provide a brief description of the object, e.g., Power Pole, Cell Tower, Natural Gas Flare, etc.	×			
3. Date of Obstruction Survey	Provide the date of latest obstruction survey.	×			
4. Ground Surface Elevation	Provide the ground surface elevation (MSL) at the base of each object.	×			
5. Object Elevation	List the above ground level (AGL) height and the top of object elevation (above mean sea level / AMSL / MSL) for each object.	×			
6. Amount of surface penetration	List the surface that is penetrated and the amount the object protrudes above the surface. See 14 CFR Part 77.	×			
7. Proposed or existing disposition of the obstruction	Provide a proposed or existing disposition of the object to remedy the penetration. See AC 70/7460-1.	×			
a. Proposed Disposition (existing)		×			
b. Proposed Disposition (future)				×	
Remarks					

A.6. Inner Portion of the Approach Surface Drawing

- A required drawing.
- Scale 1”=200’ Horizontal, 1”=20’ Vertical, two sheets may be necessary for clarity. Typically, the plan view is on the top half of the drawing and the profile view is on the bottom half. Views should be drawn from the runway threshold to a point on the approach slope 100 feet above the runway threshold elevation, at a minimum, or the limits of the RPZ, whichever is further.
- Drawings containing the plan and profile view of the inner portion of the approach surface to the runway and a tabular listing of all surface penetrations. The drawing will depict the obstacle identification approach surfaces contained in 14 CFR Part 77, Objects Affecting Navigable Airspace. The drawing may also depict other surfaces, including the threshold-siting surface, Glideslope Qualification Surface (GQS), those surfaces associated with United States Standards for Instrument Procedures (TERPS), or those required by the local FAA office or state agency. The extent of the approach surface and the number of airspace obstructions shown may restrict each sheet to only one runway end or approach.

Inner Portion of the Approach Surface Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
A. Title and Revision Block	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Plan View (existing, future, and ultimate)		×			
1. Inner portion of approach surface	Show the area from the runway threshold out to where the ultimate approach surface slope is 100 feet above the threshold elevation.	×			
2. Aerial photo for base map	Use an aerial photograph for the base map.	×			
3. Objects (identified by numbers)	Identify all significant objects (roads, rivers, railroads, towers, poles, etc.) within the approach surfaces, regardless of whether or not they are obstructions using an alphanumeric character.	×			
4. Property line within approaches	Show the property lines that are within the area/portion of airport shown.	×			

Inner Portion of the Approach Surface Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
5. Road & railroad elevations, plus movable object heights	Provide elevation information for the traverse ways' centerline elevation where they intersect the Part 77 Approach surfaces (existing and ultimate). Note whether this elevation is the actual elevation or the traverse way elevation plus the traverse way adjustment (23' for railways, 17' for interstate highways, 15' for other public roads, or 10' for private roads). See also 14 CFR Part 77.	×			
6. Part 77 Approach Surface clearance over Roads and Railroads at the most critical points, the Centerline and Edge of the surface.	Provide elevation information for the traverse ways where they intersect the edges and centerline of the Part 77 Approach surfaces (existing and ultimate). Note whether this elevation is the actual elevation or the traverseway elevation plus the traverseway adjustment (23' for railways, 17' for interstate highways, 15' for other public roads, or 10' for private roads). See also 14 CFR Part 77.	×			
7. Physical end of runway, end number, elevation (NAVD88) Nearest 0.1 foot	Show the existing and ultimate runway end, runway number, and the elevation of the threshold center.	×			
8. Airport Design Surfaces		×			
a. Runway Safety Area	Show the extents of the existing and ultimate Runway Safety Area (RSA). See AC 150/5300-13A, Paragraph 307 and Table 3-8.	×			
b. Runway Object Free Area	Show the extents of the existing and ultimate Object Free Area (OFA). See AC 150/5300-13A, Paragraph 309 and Table 3-8.	×			
c. Runway Obstacle Free Zone (OFZ)	Show the extents of the existing and ultimate OFZ which includes the inner-approach OFZ, inner-transitional OFZ, and the Precision OFZ (POFZ), if applicable. See AC 150/5300-13A, Paragraph 308.	×			

Inner Portion of the Approach Surface Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
d. Runway Protection Zone (RPZ)	Show the extents of the existing and ultimate RPZ. Prior to including new or modified land use in the RPZ, the Regional and ADO staff must consult with the National Airport Planning and Environmental Division, APP-400. This policy is exempt from existing land uses in the RPZ. See AC 150/5300-13A, Paragraph 310, Table 3-5 and FAA memorandum dated September 27, 2012.	×			
e. NAVAID critical area	Show the critical area outline for all Instrument Landing System and other electronic Navigational Aids located on the airport. See AC 150/5300-13A, Chapter 6 for general guidance and FAA Order 5750.16 for critical area dimensions.	×			
9. Ground contours	Show ground contour lines in 2', 5', or 10' intervals. Topographic issues may be important in the alternatives analysis, which may require that reduced contour intervals be used. See AC 150/5070-6, Paragraph 1005.	×			
10. North arrow with magnetic declination and year	Magnetic declination may be calculated at http://www.ngdc.noaa.gov/geomag-web/#declination. This model is using the latest World Magnetic Model which has an Epoch Year of 2010. See FAA Order 8260.19, Chapter 2, Section 5, for further information.	×			
C. Profile view		×			
1. Existing and proposed runway centerline ground profile (list elevations at runway ends & at all points of grade changes) (representing the composite profile based on the highest terrain across the width and along the length of the approach surface)	Depict the ground profile along the extended runway centerline representing the composite profile, based on the highest terrain across the width and along the length of the approach surface to where the ultimate approach surface slope is 100 feet above the threshold elevation. A more effective presentation may be a rendering of a composite critical profile.	×			

Inner Portion of the Approach Surface Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
2. Future development from plan view	Identify future development using same alphanumeric identifier that was used on the plan view.	×			
3. Part 77 Approach/transition surface; existing and future VASI/PAPI siting surface	Show the boundaries of the existing and ultimate Part 77 Approach Surface. See FAA Order 7400.2, Figure 6-3-9, See also 14 CFR Part 77.	×			
4. Threshold Siting Surface	Depict any applicable siting requirements pursuant to Table 3-2 of FAA AC 150/5300-13A.	×			
5. Terrain in approach area (fences, streams, etc.)	Show all significant terrain(fences, streams, mountains, etc.) within the approach surfaces, regardless of whether or not they are obstructions	×			
6. Objects – identify the controlling object (same numbers as plan view)	Show all significant objects (roads, rivers, railroads, towers, sign and power poles, etc.) within the approach surfaces, regardless of whether or not they are obstructions. Identify the objects using same alphanumeric identifier that was used on the plan view.	×			
7. Cross section of road & railroad	Show the cross-section of any roads and/or railroads that cross the area shown. Indicate cross section elevations of roads and railroads at edges and extended centerlines that cross the area shown.	×			
8. Existing and proposed property and easement lines	Show the airport property boundaries, including easements, for the existing and ultimate airport configurations. AC 5300-13A Note easements for pipelines and residential through the fence gateways.	×			
D. Obstruction tables for each approach surface (surface should be identified)	A separate table for each runway end must be used to enhance information clarity.	×			
1. Object identification number	List each object by the same alphanumeric symbol used in the plan view.	×			

Inner Portion of the Approach Surface Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
2. Description	Provide a brief description of the object, e.g., Power Pole, Cell Tower, Natural Gas Flare, etc.	×			
3. Date of Obstruction Survey and Survey Accuracy	Provide the date of latest obstruction survey.	×			
4. Surface Penetrations	5300-13A For any object that penetrates the Part 77 surface, the approach surface, or the obstacle free zone, describe the vertical length the object protrudes.	×			
5. Proposed disposition of surface penetrations	Provide a proposed disposition of the object to remedy the penetration as described in item 4 above. See AC 70/7460-1 for Part 77 violations. “Removal” and/or “Lower” should be listed for any Airports safety area/zone violations. See AC 150/5300-13A, Paragraph 303 and 308.	×			
6. Object elevation	List the Above Ground Level (AGL) height and the top of object elevation in MSL for each object.	×			
7. Triggering Event (e.g., a runway extension) – Timeframe/expected date for removal	List the surface that is penetrated and the amount the object protrudes above the surface. See 14 CFR Part 77 and AC 150/5300-13A, Paragraphs 303 and 308.			×	
8. Allowable approach surface elevation (if applicable)		×			
9. Amount of approach surface penetration (if applicable)		×			
10. Proposed disposition of approach surface obstruction (if applicable)	Provide a proposed disposition of the object to remedy the penetration. See AC 70/7460-1 for Part 77 violations. “Removal” and/or “Lower” should be listed for any Airports safety area/zone violations. See AC 150/5300-13A, Paragraph 303.			×	

Inner Portion of the Approach Surface Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
11. Obstacle Free Zone (OFZ)	Determine and depict the applicable OFZ surfaces, see AC 150/5300-13A, Paragraph 308. Provide a proposed disposition of the object to remedy the penetration. Note: Modification to the OFZ standard is not permitted.	×			
E. Runway Centerline Profile	This may be shown on the Inner Portion of the Approach Surface drawing if there is space to show the runway and Runway Safety Area in sufficient detail otherwise a separate sheet may be necessary. At a minimum this drawing is to show the full length of the runway and Runway Safety Area including: runway elevations, runway and Runway Safety Area gradients, all vertical curves, and a line representing the 5' line-of-sight. See AC 150/5300-13A, Paragraph 305.	×			
1. Scale	The vertical scale of this drawing must be able to show the separation of the runway surface and the 5' Line-of-Sight line. See AC 150/5300-13A, Paragraph 305.	×			
2. Elevation	Show runway elevations, runway and Runway Safety Area gradients, and all vertical curve data. See AC 150/5300-13A, Paragraph 318.	×			
3. Line of Sight	The vertical scale of this drawing must be able to show the separation of the runway surface and the 5' Line-of-Sight line. See AC 150/5300-13A, Section 305.	×			
Remarks					

A.7. Runway Departure Surface Drawing

- Required where applicable. For each runway that is designated for instrument departures.
- This drawing depicts the applicable departure surfaces as defined in Paragraph 303 of FAA AC 150/5300-13A. The surfaces are shown for runway end(s) designated for instrument departures.
- 40:1 for Instrument Procedure Runways (Scale, 1" = 1000' Horizontal, 1" = 100' Vertical, Out to 10,200' beyond Runway threshold) 62.5:1 for Commercial Service Runways (Scale, 1" = 2000' Horizontal, 1" = 100' Vertical, Out to 50,000' beyond Runway threshold).
- Contact the FAA if the scale does not allow the entire area to fit on a single sheet. The depiction of the One Engine Inoperative (OEI) surface is optional; it is not currently required.

Runway Departure Surface Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
A. Title and Revision Blocks	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Plan view (existing & future)	See AC 150/5300-13A, Paragraph 303(c).	×			
1. Aerial Photo for base map	Use an aerial photograph for the base map. A USGS 7.5 minute series map is also acceptable.	×			
2. Runway end numbers and elevations (nearest 1/10 of a foot)	Show the existing and ultimate runway end, runway number, and the elevation of the threshold center. For runways that have a clearway, depict this surface and the relocated departure surface. Reference AC 150/5300-13A, Paragraph 303(c)(1).	×			
3. 50' elevation contours on sloping surfaces (NAVD88)	Show contour lines on the Part 77 imaginary surfaces. See 14 CFR Part 77.19.	×			
4. Depict property line, including easements	Show the property line(s) that are within the area/portion of airport shown.	×			
5. Identify, by numbers, all traverse ways with elevations and computed vertical clearance in the departure surface	Identify all significant objects (roads, rivers, railroads, towers, poles, etc.) within the departure surfaces, regardless of whether or not they are obstructions using unique alphanumeric characters.	×			

Runway Departure Surface Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
6. Ground contours	Show ground contour lines in 2', 5', or 10' intervals. Topographic issues may be important in the alternatives analysis, which may require that reduced contour intervals be used.	×			
C. Profile view (existing & future)		×			
1. Ground profile	Depict the ground profile along the extended runway centerline representing the composite profile, based on the highest terrain across the width and along the length of the departure surface to extents of the surface dimensions.	×			
2. Significant objects (bluffs, rivers, roads, buildings, fences, structures, etc.)	Show all significant objects (roads, rivers, railroads, towers, poles, etc.) within the approach surfaces, regardless of whether or not they are obstructions using an alphanumeric character.	×			
3. Identify obstructions with numbers on the plan view	Identify the objects using same alphanumeric identifier that was used on the plan view.	×			
4. Show roads and railroads with dashed lines at edge of the departure surface	Show the cross-section of any roads and/or railroads that cross the area shown.	×			
D. Obstruction Data Tables		×			
1. Object identification number	Identify all significant objects (roads, rivers, railroads, towers, poles, etc.) within the departure surfaces, regardless of whether or not they are obstructions using unique alphanumeric characters. List each object by the same alphanumeric symbol used in the plan view.	×			
2. Description	Provide a brief description of the object, e.g., Power Pole, Cell Tower, Tree, Natural Gas Flare, etc.	×			
3. Object Elevation	List the Above Ground Level (AGL) height and the top of object elevation in MSL for each object.	×			

Runway Departure Surface Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
4. Amount of surface penetration	List the object protrudes above the departure surface. See AC 150/5300-13A, Paragraph 303(c).	×			
5. Proposed or existing disposition of the obstruction	Provide a proposed disposition of the object to remedy the penetration. See AC 150/5300-13A, Paragraph 303(c).	×			
6. Separate table for each departure surface	A separate table for each runway end must be used to enhance information clarity.	×			
Remarks					

A.8. Terminal Area Drawing

- Scale 1”=50’ or 1”=100’. Plan view of aprons, buildings, hangars, parking lots, roads.
- This plan consists of one or more drawings that present a large-scale depiction of areas with significant terminal facility development. Such a drawing is typically an enlargement of a portion of the ALP. At a commercial service airport, the drawing would include the passenger terminal area, but might also include general aviation facilities and cargo facilities. See AC 150/5300-13A, Appendix 5.
- Use scale that allows the extent of the terminal/FBO apron area to best fit the chosen sheet size, e.g., typical GA airports may be able to use 1”=50’ scale on a 22” X 34” sheet, but a complex hub airport with multiple terminal areas may require a 1”=100’ scale on a 36” X 48” sheet. Contact FAA if an airport layout requires scaling or sheet sizing other than what is listed.
- This drawing is not needed at every airport type and is therefore optional.

Terminal Area Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
A. Title and Revision Blocks	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Building data table 1. Structure identification number 2. Top elevation of structures (AMSL) 3. Obstruction marking/lighting (existing/future)	All buildings on the Airport Layout Drawing should be identified by an alphanumeric character. List these identifiers in a table and give a description of the building. If no Terminal Area drawing is done, also include the top of structure elevation in MSL. Show the location of existing and ultimate hangars. Include dimensions of apron and distance from runway and taxiway centerlines. See AC 150/5300-13A, Appendix 5. Show the elevation of the highest point of each structure.		×		
C. Buildings to be removed or relocated noted	If any of the structures violate any airport or approach surfaces give an ultimate disposition to remedy the violation.	×			
D. Fueling facilities, existing and future	Show the location of existing and ultimate fueling facilities. Include dimensions of apron and distance from runway and taxiway centerlines.	×			

Terminal Area Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
E. Air carrier gates positions shown (existing/future)	Show the existing and ultimate air carrier gate positions. See AC 150/5300-13A, Chapter 5.	×			
F. Existing and future security fencing with gates	Show the existing and ultimate security fencing and gates. See AC 150/5300-13A, Paragraph 606.	×			
G. Building restriction line (BRL)	Show the Building Restriction Line (BRL) that is within the area/portion of airport shown. The BRL identifies suitable building area locations on airports. This should be located where the Part 77 surfaces are at 35' above the airport elevation unless a different height is coordinated with the FAA. See AC 150/5300-13A, Paragraph 213(a).	×			
H. Taxiway or Taxilane centerlines designated	Show centerlines of all taxiway and taxilanes within the area/portion of airport shown.	×			
I. Dimensions		×			
1. Clearance Dimensions between runway, taxiway, and taxilane centerlines and hangars, buildings, aircraft parking, and other objects. 2. Dimensions of aprons, taxiways, etc.	Show the location of existing and ultimate apron. Include dimensions of apron and distance from runway and taxiway centerlines. Apron should be sized using activity forecast and the apron design spreadsheet. See AC 150/5300-13A, Chapter 5 and FAA Engineering Brief No. 75.	×			
Apron/Hangar areas that do not meet dimensional standards of the critical aircraft should be identified and the wingspan/design group of the aircraft that can use that area depicted. Include tie down location with clearances	Show the dimensions between existing and ultimate runway, taxiway, and taxilane centerlines and existing and ultimate hangars, buildings, aircraft parking, and other fixed or movable objects. See AC 150/5300-13A, Chapter 3 and Chapter 4. Show proposed tie-down layout on the apron area as well as taxilane marking plan. See AC 150/5300-13A, Appendix 5, AC 20-35, and AC 150/5340-1.	×			

Terminal Area Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
J. Property Line	Show the property line(s) that are within the area/portion of airport shown.	×			
K. Auto parking (existing & ultimate)	Show the existing and ultimate auto parking areas. See AC 150/5300-13A, Appendix 5.	×			
L. Major airport drainage ditches or storm sewers	Show any significant airport drainage ditches or storm sewers within the area/portion of airport shown.	×			
M. Special Use Area (e.g., Agricultural spraying support, Deicing, or Containment)	Show any special use areas within the area/portion of airport shown.			×	
N. North Arrow with magnetic declination and year	Magnetic declination may be calculated at http://www.ngdc.noaa.gov/geomag-web/#declination. This model is using the latest World Magnetic Model which has an Epoch Year of 2010. See FAA Order 8260.19, "Flight Procedures and Airspace." Chapter 2, Section 5, for further information.	×			
O. Fence	Show the existing and ultimate perimeter fencing or general area fencing.	×			
P. Entrance Road	Show the existing and ultimate entrance road. See 5300-13AFAA Order 5100.38, Chapter 6, Section 2.	×			
Remarks					

A.9. Land Use Drawing

- Scale 1”=200’ to 1”=600’.
- A drawing depicting on- and off-airport land uses and zoning in the area around the airport. At a minimum, the drawing must contain land within the 65 DNL noise contour. For medium or high activity commercial service airports, on-airport land use and off-airport land use may be on separate drawings. The Airport Layout Drawing should be used as a base map.
- Drawing optional. Need based on scope of work.

Land Use Drawing					
Item	Instructions	Sponsor/Consultant			FAA
		Yes	No	N/A	
A. Title and Revision Blocks	Each drawing in the Airport Layout Plan drawing set shall have a Title and Revision Block. For drawings that have been updated, e.g., as-builts, the revision block should show the current revision number and date of revision.	×			
B. Airport boundaries/property, existing & future (fee and easement)	Show the existing and ultimate property lines. If known, show property lines for parcels surrounding the airport.	×			
C. Plan view of land uses by category (Agricultural, Aeronautical, Commercial, Residential, etc.). Use local land use categories.		×			
1. On-Airport (existing & future)	Label existing and ultimate on-airport property by usage, e.g., Terminal Area, Air Cargo, Public Ramp, Airfield - Movement, Airfield - Non-movement, etc. Include existing and future airport features (e.g., runways, taxiways, aprons, safety areas/zones, terminal buildings and navigational aids).	×			
2. Off-Airport (existing & future) [to the 65 DNL Contour at a minimum, if contour known]	Label existing and ultimate off-airport property by usage and zoning, e.g., Agricultural, Industrial, Residential, Commercial, etc.	×			
D. Boundaries of local government	List any local zoning restrictions that are in place to protect the airport and surrounding airspace. See AC 150/5190-4.	×			
E. Land use legend	Provide a legend that identifies all symbols and line types used on the drawing. Lines must be clear and readable with sufficient scale and quality to discern details.	×			
F. Public facilities (schools,	Identify public facilities, e.g.,	×			

Land Use Drawing					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
hospitals, parks, churches etc.)	schools, parks, etc.				
G. Runway visibility zone for intersecting runways	Show the Runway Visibility Zone(s) for the existing and ultimate airport configurations. See AC 150/5300-13A, Section 305.	×			
H. Show off-airport property out to 65 DNL if available	Label existing and ultimate off-airport property by usage and zoning, e.g., Agricultural, Industrial, Residential, Commercial, etc.	×			
I. Airport Overlay Zoning or Zoning Restrictions	List any local zoning restrictions that are in place to protect the airport and surrounding airspace. See AC 150/5190-4.			×	
J. North arrow with magnetic declination and year	Magnetic declination may be calculated at http://www.ngdc.noaa.gov/geomag-web/#declination. This model is using the latest World Magnetic Model which has an Epoch Year of 2010. See FAA Order 8260.19, "Flight Procedures and Airspace." Chapter 2, Section 5, for further information.	×			
K. Drawing details to include runways, taxiways, aprons, RPZ, terminal buildings and NAVAIDS	Show existing and future airport features (e.g., runways, taxiways, aprons, safety areas/zones, terminal buildings and navigational aids, etc.). See AC 150/5300-13A.	×			
L. Crop Restrictions	Show the Crop Restriction Line (CRL). See AC 150/5300-13A, Paragraph 322 and AC 150/5200-33.			×	
Remarks					

A.10. Airport Property Map / Exhibit A

- Scale 1”=200’ to 1”=600’.

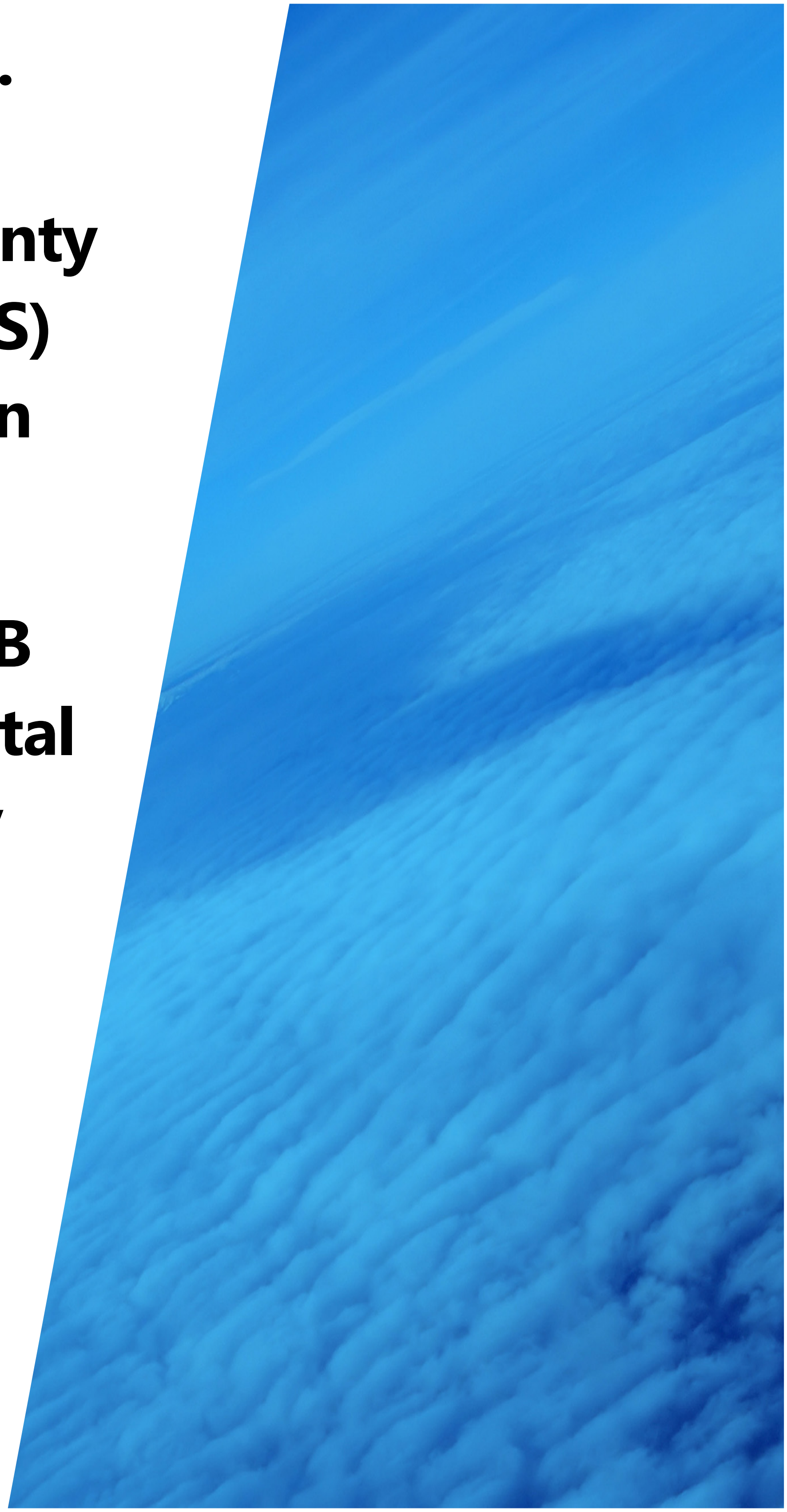
Airport Property Map / Exhibit A					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
A. Will Property Map serve as Exhibit A? – **If YES,** follow the directions to the right. – **If NO,** go to item B below.	If prepared in accordance with AC 150/5100-17, Land Acquisition and Relocation Assistance for Airport Improvement Program Assisted Projects, use ARP SOP no. 3.00 Exhibit A guidance instead of below checklist.		×		
If Property Map *will not* serve as Exhibit A: B. Title and Revision Blocks		×			
C. Plan view showing parcels of land (existing, future, and ultimate)		×			
1. Fee land interests (existing and future)		×			
2. Easement interests (existing and future)		×			
a. Part 77 protection		×			
b. Compatible Land Use				×	
c. RPZ protection		×			
3. Airport Property Line		×			
D. Legend – shading/cross hatching, survey monuments, etc.		×			
E. Data Table		×			
1. Depiction of various tracts of land acquired to develop airport	If any obligations were incurred as a result of obtaining property, or an interest therein, they should be noted. Obligations that stem from Federal grant or an FAA-administered land transfer program, such as surplus property programs, should also be noted. The drawing should also depict easements beyond the airport boundary.	×			

Airport Property Map / Exhibit A					
Item	**Instructions**	**Sponsor/Consultant**			**FAA**
		Yes	**No**	**N/A**	
2. Method of acquisition or property status (fee simple, easement, etc.)		×			
3. Type of Acquisition Indicated	(e.g., AIP-noise, AIP-entitlement, PFC, surplus property, local purchase, local donation, condemnation, other)	×			
4. Acreage		×			
F. Access point(s) for through-the-fence arrangements including residential				×	
Remarks					

Appendix B
Environmental Inventory

Charles M. Schulz – Sonoma County Airport (STS) Layout Plan Update

Appendix B Environmental Inventory



April 2021

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TABLES

FIGURES

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B. ENVIRONMENTAL INVENTORY AT SONOMA COUNTY AIRPORT

As discussed in the Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B Change 2, *Airport Master Plans*, the purpose of considering environmental factors in airport master planning is to help Sonoma County (the Airport Sponsor) thoroughly evaluate airport development alternatives and to provide information that will help expedite subsequent environmental processing. Although this specific project is an Airport Layout Plan (ALP) Update and not a Master Plan, the same factors are evaluated. For a summary description of the existing environmental conditions at Charles M. Schulz – Sonoma County Airport (Airport), environmental resource categories outlined in FAA Order 1050.1F (*Environmental Impacts: Policies and Procedures*) and the 1050.1F Desk Reference were used as a guide that help identify potential environmental effects during the ALP Update. Specifically, this Inventory assesses whether any changes have occurred to special-status species and wetland habitats since environmental reviews were conducted for the Runway Safety Enhancement Project in 2012, shortly after the 2012 Master Plan Update. This Inventory used aerial photographs, existing habitat and wetland delineation maps, and a field reconnaissance for resource evaluations. The Inventory also includes observations and mapped biological information collected during the past several years under the Wildlife Exclusion Perimeter Fence Project (currently ongoing).

The following environmental resource categories are not present within the vicinity of the Airport and therefore do not warrant further discussion:

- Coastal Resources. The Airport is located about 20 miles east of the Pacific Ocean well outside the designated California Coastal Zone. The Coastal Barriers Resources Act only applies to undeveloped coastal barriers along the Atlantic and Gulf Coasts and the Great Lakes.
- Wild and Scenic Rivers. The closest Wild and Scenic River is the American (Lower) River near Sacramento, about 70 miles east of the Airport. Therefore, no impacts to that river segment would occur.

B.1 Air Quality

The U.S. Environmental Protection Agency (USEPA) sets National Ambient Air Quality Standards (NAAQS) for certain air pollutants to protect public health and welfare through Section 109 of the Clean Air Act (CAA). The USEPA has identified the following six criteria air pollutants and has set NAAQS for them: Carbon Monoxide (CO), Lead (Pb), Nitrogen Dioxide (NO_2), 8-Hour Ozone (O_3), Particulate Matter (PM_{10} or $PM_{2.5}$), and Sulfur Dioxide (SO_2).

Geographic areas that meet all the NAAQS are considered "in attainment" for the NAAQS. Geographic areas that exceed one or more NAAQS are designated as "nonattainment" areas, which can be marginal, moderate, serious, severe, and extreme depending on the degree to which they exceed the NAAQS. For purposes of air quality, Sonoma County is the geographic area in which the Airport is located.

States having nonattainment areas must develop a State Implementation Plan (SIP) that demonstrates how the geographic area will be brought back into attainment within designated timeframes. Geographic areas with prior nonattainment status that have since attained the applicable NAAQS are designated "maintenance areas." The California Air Resources Board (CARB) develops the SIP for nonattainment areas in the State. The County does not currently meet the Federal 8-hour standard for healthy levels of ozone and has been designated by the USEPA as a marginal nonattainment area for ozone.[1] Further, the USEPA has determined the County exceeds the 24-hour standard for emissions of fine particulate matter ($PM_{2.5}$) and is recognized as a moderate nonattainment area. In the past, the County was designated as nonattainment for CO but in April 1998 the Bay Area was re-designated to attainment and now operates under a maintenance plan in order to prevent emissions from reaching an unhealthy level.

California maintains more stringent standards than the NAAQS to which the County must adhere. Sonoma County has been designated by the Bay Area Air Quality Management District (BAAQMD) as nonattainment for the 1-hour and 8-hour standards for O_3, the annual arithmetic mean and the 24-hour standards for coarse particulate matter (PM_{10}), and the annual arithmetic mean standard for $PM_{2.5}$. The County is in attainment for all other criteria pollutants.

B.2 Biological Resources

Biological resources include terrestrial and aquatic plant and animal species; game and non-game species; special status species; and environmentally sensitive or critical habitats. Vegetation types identified and mapped on the Airport consist of non-native grassland/ruderal, seasonal wetland, stream, pond, freshwater marsh, willow scrub/woodland, riparian woodland, oak woodland, and oak trees (see **Figure 1**).[2]

Non-developed areas of the Airport consist primarily of non-native grasslands and ruderal vegetation types and include many areas that are regularly or occasionally irrigated with treated wastewater and mowed or harvested for hay. The Airport contains several biological preserves, established by Sonoma County, that support vernal pools and other seasonal wetland habitats as well as stands of riparian and oak woodlands. Riparian corridors along Redwood Creek, Airport Creek, and Ordinance Creek are located in the northern portion of the Airport. Trees in the riparian corridors and adjacent oak woodlands east and west of the runway ends are regularly trimmed (typically once every two to three years, as needed) by the Airport Sponsor for runway safety purposes under FAA AC 150/5300-13.

There are currently five ponds within the Airport and one pond adjacent to the Airport that is hydrologically connected to one of the ponds within the Airport (see **Figure 1**). A series of three

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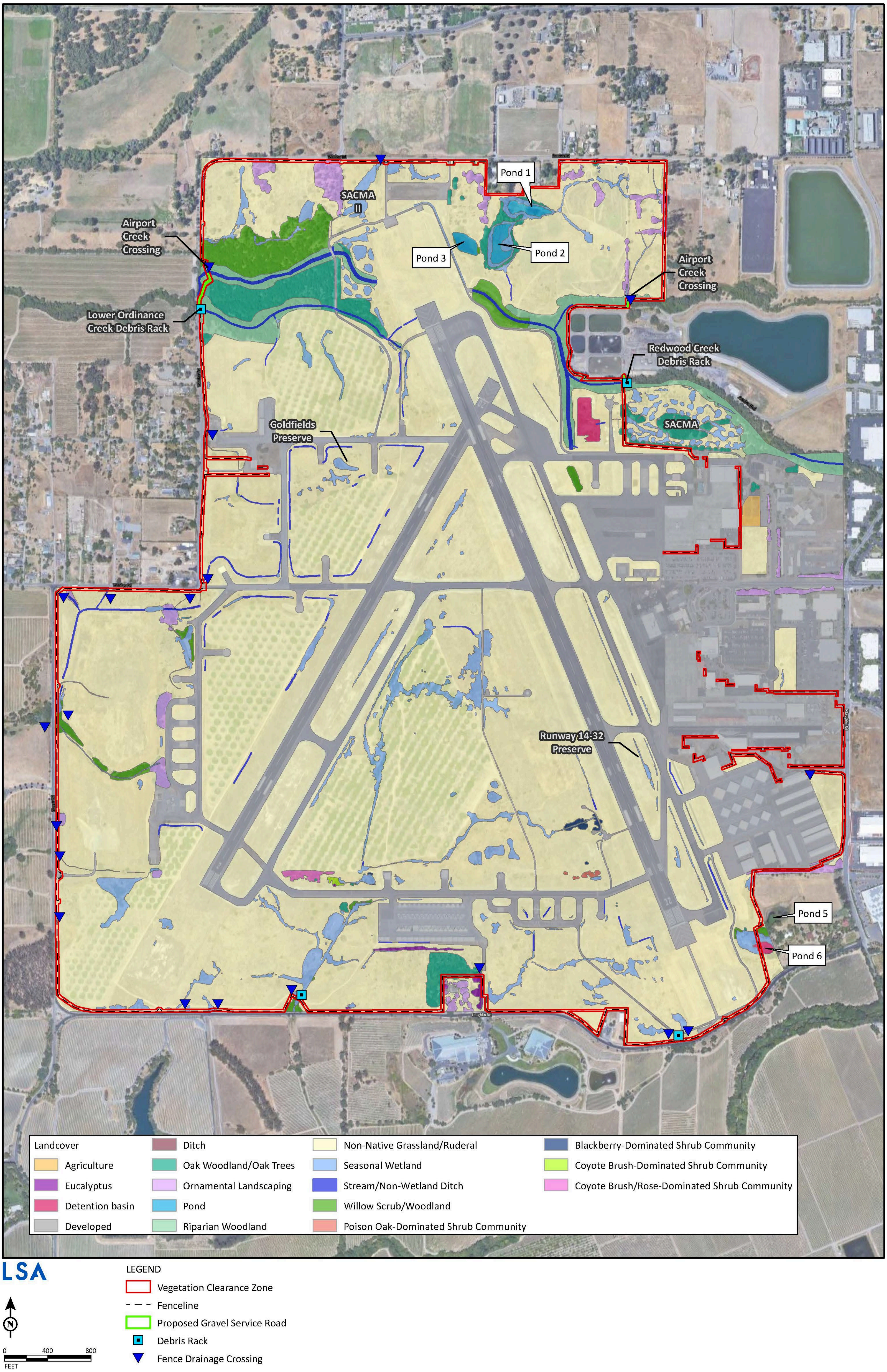
1 U.S. Environmental Protection Agency. Criteria Air Pollutants, January 18, 2017. Available: https://www.epa.gov/criteria-air-pollutants. Accessed: February 2021.

2 **Figure 1** is taken from the Airport's Wildlife Exclusion Perimeter Fence Project Biological Assessment (2021). Biological surveys were conducted of the Airport property and reports are available through the County.

FIGURE 1
VEGETATION TYPES WITHIN AIRPORT



Note: The identified fenceline does not necessarily follow the Airport property boundary at all locations.
Source: LSA, 2020; Mead & Hunt, 2020 Google Maps Hybrid, 2019

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constructed ponds occurs in a natural swale/drainage at the northern end of the Airport property, just south of Sanders Road. The ponds are fed by seasonal runoff from the local watershed which includes two upstream swales to the east. These ponds have edges of willow scrub/woodland habitat and contain deep water through most of the year. The two easternmost ponds appear connected and may have the same water surface elevation. Overflow from these two ponds may drain partially southward across a dam via a swale to Airport Creek, and partially westward across a dam to the westernmost pond. Overflow from the westernmost pond drains south through an outlet pipe to Airport Creek. Pond 4 was filled as part of the Runway Safety Area Improvement Project.

Two inter-connected ponds (one within the airport and one adjacent to the Airport) are located in the southeast corner of the Airport north of Laughlin Road (Ponds 5 and 6). The upstream northeastern pond (Pond 5) is located on private property and appears to be a dammed natural swale that receives local runoff, is relatively shallow, and may dry during the summer. The lower, southwestern pond (Pond 6) was modified during the Airport's Runway Safety Area Improvement Project and now functions as a detention basin. Pond 6 receives overflow from Pond 5 and runoff (through a culvert) from the taxiway and service road to the northwest. Most of the water drains out of Pond 6 within approximately 48 hours of a rain event or other input. The water drains southward toward Mark West Creek. Both ponds have willow scrub/woodland habitat along their edges. Pond 6 has seasonal wetland around the perimeter in an area that was previously inundated much of the year. An area of freshwater marsh along the northern edge of Pond 6 appears to be converting to seasonal wetland as a result of the modified hydrology. Refer to **Section B.1.13.1** for further discussion on Water Resources.

The U.S. Fish and Wildlife Service (USFWS) identifies a variety or plant and animal species, listed as Threatened or Endangered under the federal ESA, as having potential range (current or historic) within the Airport vicinity. Of the USFWS identified species, the following plant species have potential to be present or have suitable habitat at the Airport: Burke's goldfields (*Lasthenia burkei*), Many-flowered Navarretia (*Navarretia leucocephalas sp. Plieantha*), Sebastopol meadowfoam (*Limnanthes vinculans*), Showy Indian clover (*Trifolium amoenum*), Showy Indian clover (*Trifolium amoenum*), Sonoma Alopecurus (*Alopecurus aequalis* var. *sonomensis*), Sonoma sunshine (*Blennosperma bakeri*), and White sedge (*Carex albida*).

Of the USFWS identified species, the following animal species have potential to be present or have suitable habitat at the Airport: California tiger salamander, Sonoma County Distinct Population Segment (DPS) (*Ambystoma californiense*), California freshwater shrimp (*Syncaris pacifica*), and California red-legged frog (*Rana draytonii*).

The Airport vicinity also has the potential to contain a number of National Marine Fisheries Service (NMFS) listed species, which include California coastal chinook salmon evolutionary significant unit (ESU) (*Oncorhynchus tshawytscha*), Central California Coast coho salmon ESU (*Oncorhynchus kisutch*), and Central California Coast steelhead ESU (*Oncorhynchus mykiss*).

Although the Endangered Species Act (ESA) does not protect state-protected species or habitats, the National Environmental Policy Act of 1969 (NEPA) documentation ensures that environmental analysis prepared for airport actions addresses the potential effects to state-protected resources. The California Natural Diversity Database (CNDDB) identifies a variety of state protected species and/or habitat that may be present on or near the Airport. Of the CNDDB identified species, the following plant species have potential to be present or have suitable habitat at the Airport: Baker's goldfields (*Lasthenia californica* ssp. *bakeri*), Baker's Navarretia (*Navarretia leucocephala* ssp. *bakeri*), Bent-flowered Fiddleneck (*Amsinckia lunaris*), Boggs Lake Hedge-hyssop (*Gratiola heterosepala*), Brownish Beaked-rush (*Rhynchospora capitellata*), California Beaked-rush (*Rhynchospora californica*), Congested-headed Hayfield Tarplant (*Hemizonia congesta* ssp. *congesta*), Dwarf Downingia (*Downingia pusilla*), Fragrant fritillary (*Fritillaria liliacea*), Gairdner's yampah (*Perideridia gairdneri* ssp. *gairdneri*), Pappose tarplant (*Centromadia parryi* ssp. *parryi*), Peruvian Dodder (*Cuscuta obtusiflora* var. *glandulosa*), Pitkin Marsh Paintbrush (*Castilleja uliginosa*), Round-headed Beaked-rush (*Rhynchospora globularis*), Saline Clover (*Trifolium hydrophilum*), Swamp Harebell (*Campanula californica*), Thurber's Reed Grass (Calamagrostis crassiglumis), and White Beaked-rush (*Rhynchospora alba*).

Of the CNDDB identified species, the following animal species have potential to be present or have suitable habitat at the Airport: Western pond turtle (*Emys marmorata*), Burrowing owl (*Athene cunicularia*), Loggerhead shrike (*Lanius ludovicianus*), Northern harrier (*Circus cyaneus*), White-tailed kite (*Elanus leucurus*), Yellow warbler (*Dendroica petechia brewsteri*), Yellow-breasted chat (*Icteria virens*), Grasshopper sparrow (*Ammodramus savannarum*), American badger (*Taxidea taxus*), Pallid bat (*Antrozous pallidus*), and Townsend's big-eared bat (*Corynorhinus townsendii*).

The Migratory Bird Treaty Act (MBTA) prohibits the taking of any migratory birds, their parts, nests, or eggs except as permitted by regulations, and does not require intent to be proven. Trees are located on or adjacent to the Airport that have the potential to hold nests for migratory bird species.

B.3 Climate

Greenhouse gases (GHG) are gases that trap heat in the earth's atmosphere. Both naturally occurring and man-made GHGs primarily include water vapor, carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Activities that require fuel or power are the primary stationary sources of GHGs at airports. Aircraft and ground access vehicles that are not under the control of an airport sponsor, typically generate more GHG emissions than airport-controlled sources. Research has shown there is a direct correlation between fuel combustion and GHG emissions. In terms of U.S. contributions, the Government Accountability Office (GAO) reports that "domestic aviation contributes about three percent of total carbon dioxide emissions, according to USEPA data," compared with other industrial sources, including the remainder of the transportation sector (20 percent) and power generation

(41 percent).[3] The International Civil Aviation Organization (ICAO) estimates that GHG emissions from aircraft account for roughly 1.3 percent of all anthropogenic GHG emissions globally.[4]

For disclosure purposes, GHG emissions related to any increase in Airport activity should be calculated at the project level, as well as GHG emissions related to construction activities.

B.4 Department of Transportation Act, Section 4(f) and Land and Water Conservation Fund Act Section 6(f)

The U.S. Department of Transportation (USDOT) Act, Section 4(f) provides that no project that requires the use of any land from a public park or recreational area, wildlife and waterfowl refuge, or historic site be approved by the Secretary of the Interior unless there is no viable alternative and provisions to minimize any possible harm are included in the planning. Similarly, the Land and Water Conservation Fund (LWCF) Act prevents the conversion of lands purchased or developed with Land and Water Conservation funds to non-recreation uses, unless the Secretary of the Interior, through the National Park Service, approves the conversion. Conversion may only be approved if it is consistent with the comprehensive statewide outdoor recreation plan when the approval occurs. Additionally, the converted property must be replaced with other recreation property of reasonably equivalent usefulness and location, and at least equal fair market value.

Section 6(f) of the LWCF Act, 16 United States Code § 4601 et. seq. provides funds for buying or developing public use recreational lands through grants to local and state governments. LCWF Act Section 6(f)(3) prevents conversion of lands purchased or developed with LWCF to non-recreation uses unless the conversion is approved by the Secretary of Interior acting through the National Park Service (NPS). Actions that would use Section 4(f) lands must also comply with Section 6(f) of the LWCF Act, 16 USC § 4601-8(f), if the property was acquired or developed with financial assistance under the LWCF State Assistance Program. Section 6(f) is administered by the NPS and requires that areas funded through the program remain for public outdoor recreation use or be replaced by lands of equal value, location, and recreation usefulness.

There are two known historic resources in the Airport vicinity that are eligible for the National Register of Historic Places (NRHP). The James H. and Frances E. Laughlin House is approximately 0.7 miles east of the Airport property.[5] Additionally, there is a collection of single-family residences referred to as the Talmadge Estate which are eligible for listing under Criterion C of the NRHP as a distinctive example of late 19th-century Neoclassical architecture. See the section on Historical, Architectural, Archeological, and Cultural Resources for additional analysis of

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3 U.S. Government Accountability Office, Report to Congressional Committees, Aviation and Climate Change, June 2009. Available: http://www.gao.gov/new.items/d09554.pdf.

4 International Civil Aviation Organization (ICAO) Environmental Report 2019, *Destination Green: The Next Chapter*, 2019. Available: https://www.icao.int/environmental-protection/Documents/ICAO-ENV-Report2019-F1-WEB%20(1).pdf.

5 National Park Service, *National Register of Historic Places – NPS Digital Library*. Available: National Register of Historic Places (U.S. National Park Service) (nps.gov).

NRHP and archaeological resources of historic significance on and in proximity of Airport property.

The closest recreational facility is R.T. Mitchell Park, which is approximately 0.7 miles northeast of the Airport property and is not a Section 6(f) property. There are no wildlife and waterfowl refuges within vicinity of the Airport.

B.5 Farmlands

The FAA requires consideration of "important farmlands," which it defines to include "all pasturelands, croplands, and forests considered to be prime, unique, or statewide or local important lands."

No prime farmland or soil of statewide significance is present at the Airport. Further, soils suitable for agriculture at the Airport were dedicated to urban development prior to the passage of the Farmland Protection Policy Act of 1981. However, farmland is located within proximity of the Airport, specifically to the west and south. As shown in **Figure 2**, parcels directly to the south of the Airport and one to the west include land protected under Williamson Act Contract.

While no farmlands are located at the Airport, if any project extends outside of the existing Airport boundaries, there is potential to affect farmlands. Farmland impacts would then need to be evaluated using the Natural Resources Conservation Service Conversion Impact Rating Form AD-1006.

B.6 Hazardous Materials, Solid Waste, and Pollution Prevention

Solid waste from Sonoma County is landfilled outside of Petaluma on Mecham Road. The Sonoma County Department of Transportation and Public Works owns and operates four transfer stations throughout Sonoma County, located in Annapolis, Guerneville, Healdsburg, and Sonoma. A closed landfill is located on the southwest side of the Airport property and visible from Slusser Road. The County uses practices to prevent unnecessary exposure of people and property to risks of damage or injury from hazardous materials according to the *Public Safety Element* of the Sonoma County General Plan 2020.[6]

The Airport was formerly the site of the Santa Rosa Army Airfield (SRAAF), which was established as a sub-base to the Hamilton Army Airfield and was used to conduct training operations for fighter squadrons from 1942 to 1946. The primary mission of the SRAAF was to complete pre-combat training for fighter crews, including gunnery, bombing, and chemical warfare training. In 1982, and again in 1985, construction projects near Ordinance Road uncovered broken glass ampules containing chemical agents. After both incidents, the Army sent a clean-up crew to perform additional evaluation of the sites. The Army concluded that numerous unbroken glass

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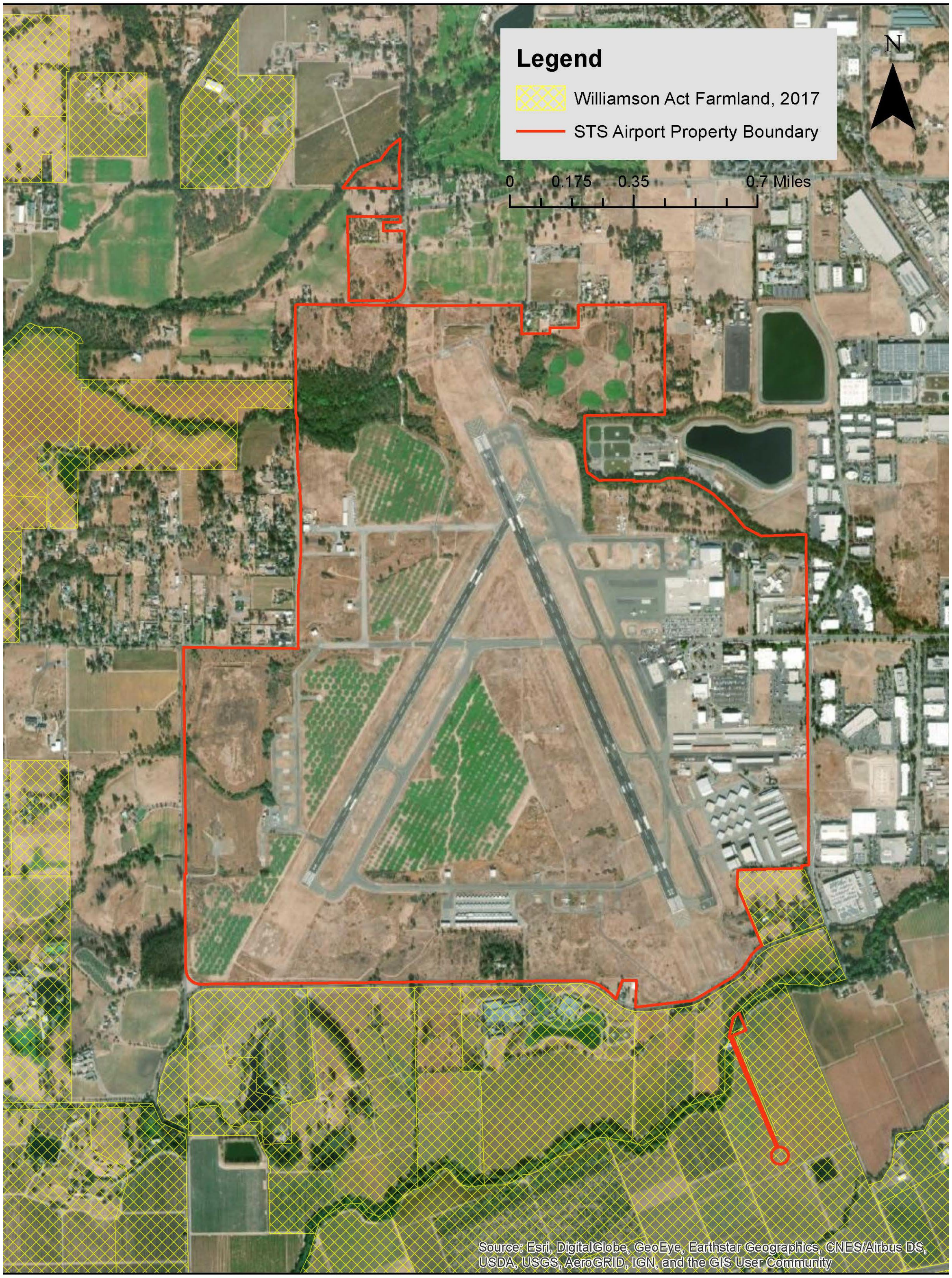
6 County of Sonoma. *General Plan 2020*. Amended August 2, 2016. Available: https://sonomacounty.ca.gov/PRMD/Long-Range-Plans/General-Plan/

Figure 2
WILLIAMSON ACT FARMLAND



Source: Sonoma County, 2019; Town of Windsor, 2019; RS&H 2021; Mead & Hunt, 2021 ampules were deposited in the vicinity of Ordinance Road during World War II training sessions as a result of equipment malfunctions. No evidence indicates that bulk chemical agents were purposely disposed of on this site. However, additional unbroken ampules could still exist in this location (see **Figure 3**).[7]

An investigation conducted by the California Regional Water Quality Control Board identified twelve separate areas of concern within the former SRAAF boundary. Aside from the underground storage tanks (USTs) that were cleaned and closed in 2006, the remaining eleven areas of concern showed no evidence of hazardous or toxic waste, explosive ordinance, or hazardous building debris.[8]

A variety of petrochemicals and chemicals products such as avgas, Jet A, solvents, cleaning products, various other lubricants, aqueous film forming foam (AFFF), and per- and polyfluoroalkyl substances (PFAS) are used and have been used at the Airport. Since the Airport is a licensed hazardous waste generator, it must comply with all federal, state, and county regulations relating to the handling of hazardous materials. The Airport has a General Industrial Storm Water Permit with the Regional Water Quality Control Board that requires monitoring and inspection of Airport facilities to prevent future hazardous material impacts to the local environment.

The Airport Sponsor and on-site tenants currently have a number of permitted and regulated fueling facilities within the Airport boundaries. Each of these facilities is operated under federal, state, and county regulations. Other hazardous materials used to support operations at the Airport are regularly transported to and from the facility in accordance with all local, state, and federal regulations.

B.7 Historical, Architectural, Archeological, and Cultural Resources

According to the NRHP, the nearest historic structure listed is James H. and Frances Laughlin House, which is about 0.7 miles east of the Airport.

The Airport Sponsor recently acquired the 2.88-acre parcel (assessor's parcel number [APN] 059-200-002) at 3725 Laughlin Road and will use Passenger Facility Charges (PFCs) for reimbursement of acquisitions costs. The Airport's 2011 Master Plan[9] identifies the property's acquisition to eliminate the potential for incompatible development adjacent to the Airport. Due to the use of PFCs for reimbursement, the property acquisition is an "undertaking" as defined at 36 CFR Section 800.16(y) with the potential to affect historic properties (36 CFR Section 800.3(a)). The FAA, therefore, must address the requirements of Section 106 of the National Historic

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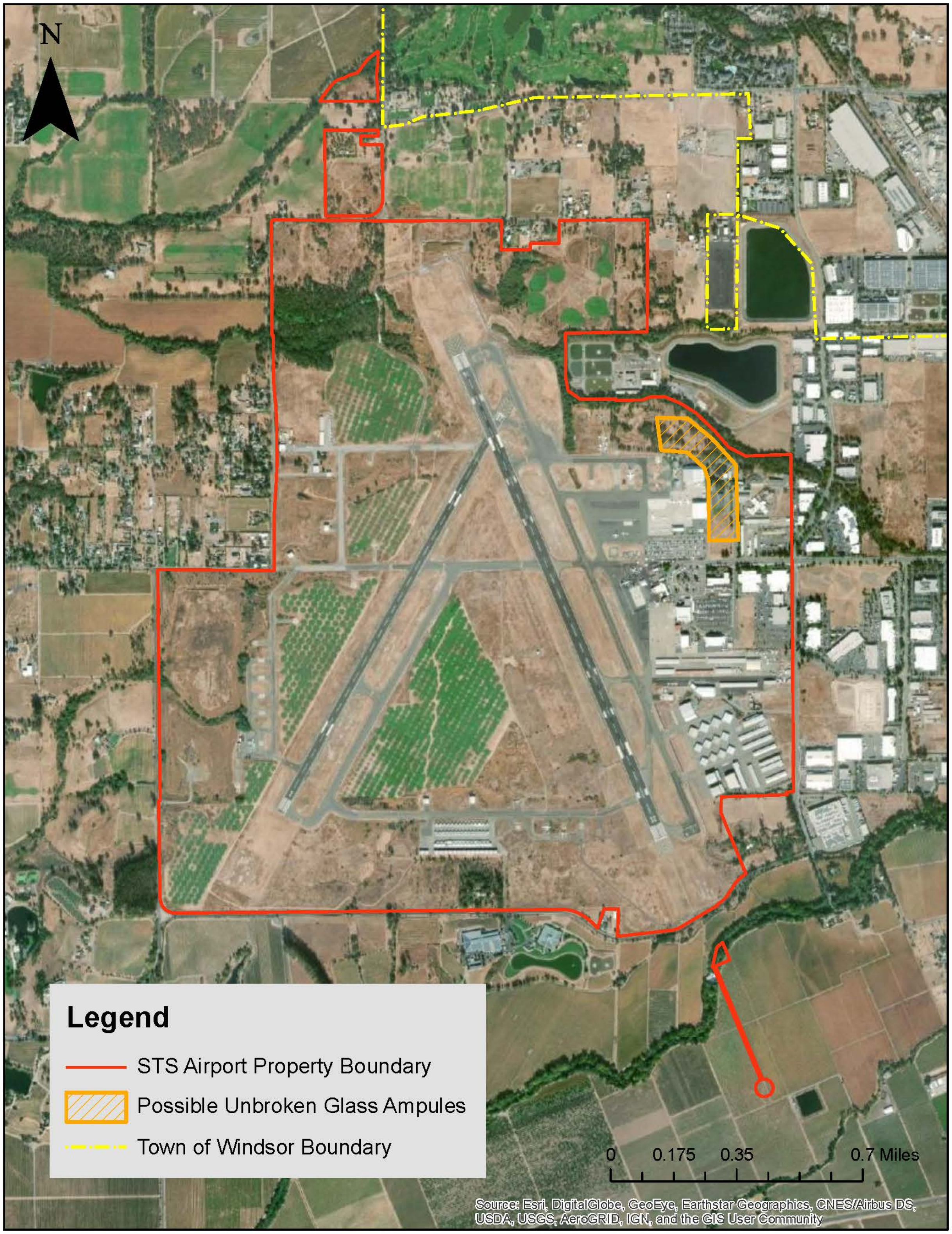
7 County of Sonoma, Permit and Resource Management Department, *Mitigated Negative Declaration- Apex Aviation Hangar Project*, May 2, 2005.

8 Letter from California Regional Water Quality Control Board, *Notice of Proposed No Further Action*, February 24, 2006.

9 County of Sonoma. *Charles M. Schulz – Sonoma County Airport Master Plan*. July 2011. Available: https://sonomacountyairport.org/about-sts/master-plan/.

Figure 3
HAZARD SITES IN THE AIRPORT BOUNDARY



Source: RS&H, 2021; Mead & Hunt, 2021.

Preservation Act of 1966, as amended, by taking into account the effects of the undertaking on any district, site, building, structure, or object included in or eligible for inclusion in the NRHP within the area of potential ground disturbance.

A cultural resources investigation of the 3725 Laughlin Road property acquisition, conducted in November 2019, identified no archaeological historic properties in the Area of Potential Effects (APE). However, the investigation did identify a NRHP-eligible single-family residence and associated buildings dated from 1891 (i.e., the "Talmadge Estate"). The Talmadge Estate appears eligible for listing under Criterion C of the NRHP as a distinctive example of late 19th-century Neoclassical architecture.

The Airport property has been heavily disturbed as part of previous Airport-related development. Past environmental documentation has identified a Native American site of interest on Airport property. Tribes with interests in Sonoma County include:

- Absentee-Shawnee Tribe of Indians of Oklahoma;
- Cloverdale Rancheria of Pomo Indians of California;
- Dry Creek Rancheria Band of Pomo Indians, California;
- Federated Indians of Graton Rancheria, California;
- Kashia Band of Pomo Indians of the Stewarts Point Rancheria, California;
- Koi Nation of Northern California;
- Lytton Rancheria of California;
- Middletown Rancheria of Pomo Indians of California;
- Scotts Valley Band of Pomo Indians (Scotts Valley Band of Pomo Indians of California); and
- Sherwood Valley Rancheria of Pomo Indians of California.

B.8 Land Use

The Sonoma County General Plan 2020 identifies planned land uses for the unincorporated areas immediately surrounding the Airport (see **Figure 4**).[10] Planned land uses north of the Airport include Diverse Agriculture (one dwelling unit per 10 to 60 acres) and Rural Residential uses (one dwelling unit per 2.5 to five acres). South of the Airport planned land uses include Land Intensive Agriculture (one dwelling unit per 20 to 100 acres) and Rural Residential (one dwelling unit per four acres).

The Town of Windsor's General Plan identifies a mix of planned land uses for the areas north of the Airport.[11] The nearest point within the Town limits is 0.7 miles to the northeast of the existing end of Runway 14. The incorporated areas of Windsor located within the Airport vicinity

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10 County of Sonoma. *General Plan 2020*. Amended August 2, 2016. Available: https://sonomacounty.ca.gov/PRMD/Long-Range-Plans/General-Plan/.

11 Town of Windsor, *Town of Windsor General Plan 2015*, July 20, 2005.

are extensively developed. Therefore, planned land uses reflect the uses that currently exist and include Low-Medium Density Residential (three to six dwelling units per acre), and Medium Density Residential (five to eight dwelling units per acre). The Town's "Sphere of Influence," which represents the ultimate physical boundaries of the Town, encompasses unincorporated County lands outside the limits of the Town's boundary. These areas are slated for Estate Residential/Low Density Residential (0.2 to three dwelling units per acre) and are located approximately two miles northwest of the existing end of Runway 14 (see **Figure 4**).

B.9 Natural Resources and Energy Supply

Natural resources (e.g., water, asphalt, aggregate, etc.) and energy use (e.g., fuel, electricity, etc.) at an airport is a function of the needs of aircraft, support vehicles, airport facilities, support structures, and terminal facilities.

Water is the primary natural resource used at the Airport on a daily basis. Asphalt, aggregate, and other natural resources have also been used in various construction projects at the Airport. None of the natural resources that the Airport uses, or has used, are in rare or short supply. Energy use at the Airport is primarily in the form of electricity required for the operation of Airport-related facilities (e.g., terminal building, hangars, airfield lighting) and fuel for aircraft, aircraft support vehicles/equipment, and Airport maintenance vehicles/equipment.

There are currently no mining activities for oil, natural gas, sand, gravel, or crushed stone that occur at the Airport. The Airport Sponsor receives water through the Town of Windsor. Water resources are used for Airport-related activities, including aircraft/vehicle washing, irrigation, and potable drinking water. Pacific Gas and Electric (PG&E) supplies electricity to the Airport while AT&T provides telecommunication to the Airport via a Minimum Point of Entry (MPOE). All sources of energy are provided via underground conduits.

B.10 Noise and Compatible Land Use

Day-Night Sound Level (DNL) is based on sound levels measures in relative intensity of sound, (decibels or dB) on the "A-weighted scale" or dBA over a time-weighted average normalized to a 24-hour period. DNL has been widely accepted as the best available method to describe aircraft noise exposure.[12] Appendix B, paragraph B-1 of FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures,* recognizes the use of the Community Noise Equivalent Level (CNEL) as an alternative metric to the Day/Night Average Sound Level (DNL) in California. FAA Order 1050.1F, Exhibit 4-1 defines a significant noise impact as an action that would increase noise by 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the CNEL 65 dB

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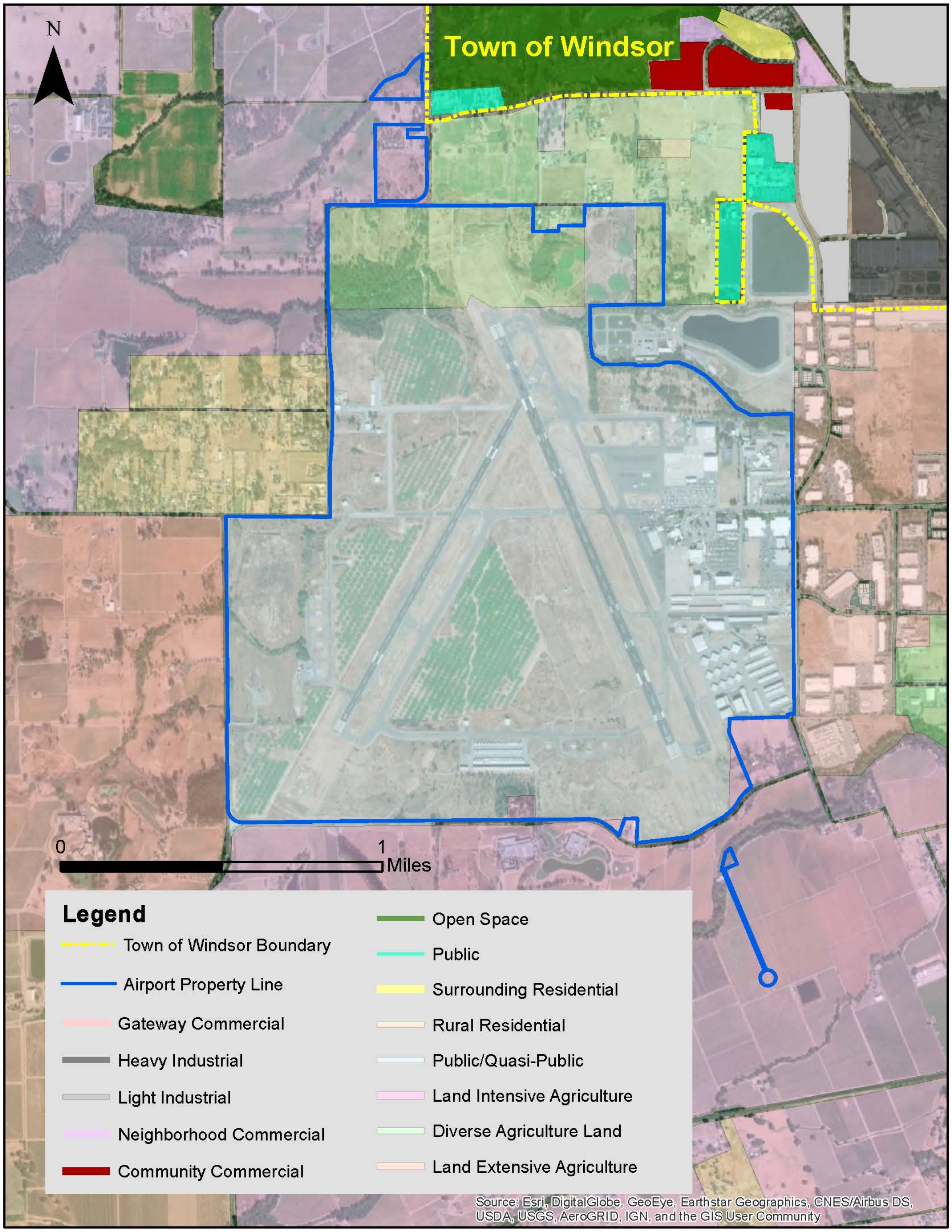
[12] Federal Aviation Administration, *Technical Support for Day/Night Average Sound Level (DNL) Replacement Metric Research*, Final Report, June 14, 2011. Available: https://www.faa.gov/about/office_org/headquarters_offices/apl/research/science_integrated_modeling/noise_impacts/media/6-14-2011_finalreport_metricsmestre_etal_061411_part1.pdf Accessed: October 19, 2020.

FIGURE 4
EXISTING LAND USE IN AIRPORT VICINITY



Source: Sonoma County, 2019; Town of Windsor, 2019; RS&H 2021; Mead & Hunt, 2021 noise exposure level, or that will be exposed at or above the CNEL 65 dB level due to a CNEL 1.5 dB or greater increase, when compared to the No Action Alternative for the same timeframe.

As determined in the Airport's Comprehensive Airport Land Use Plan (CALUP),[13] all residential areas are considered compatible with cumulative noise level below DNL 55 dBA. As shown in **Figure 4**, there are residential land uses near the Airport. These areas may be sensitive to aircraft noise associated with the Airport.

B.11 Socioeconomics Environmental Justice, and Children's Health and Safety Risks

The primary considerations of a socioeconomics analysis are the economic activity, employment, income, population, housing, public services, and social conditions of the area. The Airport is within two census tracts: Census Tract 1538.01 and Census Tract 1527.02.

The per capita income for the two census tracts at the Airport are less than that for Sonoma County and the Town of Windsor, but about the same as that for the City of Santa Rosa (see **Table 1**).

TABLE 1
PER CAPITA INCOME LEVELS

Area	Dollars
Census Tract 1538.01	$38,109
Census Tract 1527.02	$36,365
Sonoma County	$42,178
City of Santa Rosa	$36,935
Town of Windsor	$40,960

Source: U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates

The U.S. Census Bureau uses a set of money income thresholds that vary by size to determine who is in poverty. A family's total income must be less than the family's threshold, and then every individual in the family is considered in poverty. Currently, the national poverty level for a family of four is $26,695[14] with a rate of 12.3 percent. The poverty rate for the applicable jurisdictions in the Airport vicinity is shown in **Table 2**. The poverty rate within the Airport vicinity is below the national poverty rate as well as that of Sonoma County and the City of Santa Rosa, and about the same as the poverty rate of the Town of Windsor.

13 County of Sonoma. *Comprehensive Airport Land Use Plan*. Available: https://sonomacounty.ca.gov/PRMD/Long-Range-Plans/Airport-Land-Use-Plan/.

14 U.S. Census Bureau, *Poverty Thresholds by Size of Family and Number of Children*, available at: https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html. Accessed March 2021.

TABLE 2
POVERTY RATES (ALL FAMILIES)

Area	Percent
Census Tract 1538.01	4.0
Census Tract 1527.02	3.7
Sonoma County	7.2
City of Santa Rosa	10.3
Town of Windsor	4.0

Source: U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates

According to the U.S. Census Bureau, approximately 75 percent of the total population in Sonoma County is comprised of people of white ethnic decent. The largest minority race groups for the County include people that identify as Hispanic / Latino and people of Asian descent.[15]

According to the U.S. Census Bureau, the percent of minority populations in the study area ranges from 25 percent to 31.2 percent on average from the latest data available. See **Table 3** for the racial composition of the two census tracts at the Airport, Town of Windsor, Santa Rosa, and Sonoma County.

TABLE 3
MINORITY POPULATIONS

	Census Tract 1538.01	Census Tract 1527.02	Sonoma County	City of Santa Rosa	Town of Windsor
Percent by Ethnicity Group/a/					
White	75.0%	68.8%	74.8%	66.8%	74.3%
Black or African American	1.1%	1.7%	1.7%	2.6%	0.9%
American Indian and Alaska Native	1.8%	0.3%	0.9%	0.1%	1.7%
Asian	3.5%	3.0%	4.1%	5.5%	2.6%
Native Hawaiian and Other Pacific Islander	0.0%	0.0%	0.3%	0.6%	0.5%
Some Other Race	11.6%	14.2%	12.9%	17.1%	12.8%
Two or More Races	6.9%	12.0%	5.4%	6.0%	7.1%
Total Residents	*10,263*	*5,342*	*499,772*	*179,701*	*27,447*

/a/: Percentages may not equal 100 percent due to rounding.
Source: U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates

15 U.S. Census Bureau, *American Fact Finder*, available at: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml. Accessed March 2021.

B.12 Visual Effects

FAA Order 1050.1F describe factors to consider within light emissions and visual resources/visual character. Potential impacts of light emissions include the annoyance or interference with normal activities, as well as effects to the visual character of the area due to light emissions, including the importance, uniqueness, and aesthetic value of the affected visual resources.

B.12.1 Light Emissions

Current Airport facilities are illuminated for safety and security reasons by various types of landside lighting for buildings, access roads, apron areas, and automobile parking areas, as well as airside lighting for the runway, taxiways, and apron areas. Runway, taxiway, and apron areas are lighted for nighttime operations as well. The closest light sensitive land use to the Airport is a rural residential property located just southeast of Runway 14-32 and south of the Airport hangar facilities.

B.12.2 Visual Resources and Visual Character

Structures at the Airport include, but are not limited to, the terminal building, fixed base operators, hangars, and maintenance buildings. The Airport is zoned as Public Facilities and is developed in a manner that is consistent with this zoning.

Vegetation (e.g., trees and shrubs) helps to reduce both the light emissions and visual effects to the Airport for residential areas. Direct views of the Airport from rural residential property located just southeast of Runway 14-32 and south of the Airport hangar facilities are blocked by tall trees and landscaping. Additional residential land uses are located on the west side of the Airport across Windsor Road and on the north side of the Airport along Sanders Road. The view to the Airport from these properties is partially blocked by existing landscaping.

Consideration of aesthetics in the future at the Airport should attempt to adhere to existing design, art, and architecture at the Airport and in the vicinity in order to minimize any potential viewshed effects.

B.13 Water Resources

Water resources are considered wetlands, floodplains, surface waters, groundwater and wild and scenic rivers. These resources typically function as a single, integrated natural system that are important in providing drinking water and in supporting recreation, transportation and commerce, industry, agriculture, and aquatic ecosystems.

B.13.1 Wetlands

The Clean Water Act (CWA) defines wetlands as ". . . those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."[16] Wetlands have three necessary characteristics:

- Water: presence of water at or near the ground surface for a part of the year;
- Hydrophytic Plants: a preponderance of plants adapted to wet conditions; and
- Hydric Soils: soil developed under wet conditions.

As shown in **Figure 5**, the National Wetlands Inventory has identified wetlands within and in close proximity to the Airport.[17] According to the Biological Assessment (BA) prepared for the Airport's Wildlife Exclusion Perimeter Fence Project (2021),[18] the Airport property contains the following seasonal wetlands: vernal pools, swales. Ditches, drainages, and depressions with wetland vegetation. The seasonal wetlands are generally consistent with the following two vegetation alliances:

- Smooth Goldfield's vernal pools (*Lasthenia glaberrima* Herbaceous Alliance), consisting of smooth goldfields (*Lasthenia glaberrima*), slender popcorn-flower (*Plagiobothrys stipitatus*), Douglas meadowfoam (*Limnanthes douglasii*), maroon-spot downingia (*Downingia concolor* var. *concolor*), winged water starwort (*Callitriche marginata*), blennosperma (*Blennosperma nanum* var. *nanum*), semaphore grass (*Pleuropogon californicus*), annual hairgrass (*Deschampsia danthonioides*), and coyote thistle (*Eryngium armatum*).
- Other Seasonal Wetlands, which is characterized by disturbed pools and swales and other seasonal wetland areas, as well as some drainage ditches, tend to be dominated by non-native species such as Italian ryegrass, Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), curly dock (*Rumex crispus*), pennyroyal (*Mentha pulegium*), rabbit's-foot grass (*Polypogon monspeliensis*), spinyfruit buttercup (*Ranunculus muricatus*), and Bermuda grass (*Cynodon dactylon*).

Refer to **Section B.1.2** for a description of ponds located on Airport property.

B.13.2 Floodplains

Floodplains are "…lowland areas adjoining inland and coastal water which are periodically inundated by flood waters, including flood-prone area of offshore islands."[19] Floodplains are often referred to in terms of the 100-year floodplain, which is intended to indicate the one percent chance of a flood occurring in any given year. EO 11988 directs federal agencies to take action to reduce the risk of flood loss; minimize the impact of floods on human safety, health,

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16 U.S. Environmental Protection Agency, Section 404 of the Clean Water Act. Available: https://www.epa.gov/cwa-404/how-wetlands-are-defined-and-identified-under-cwa-section-404.

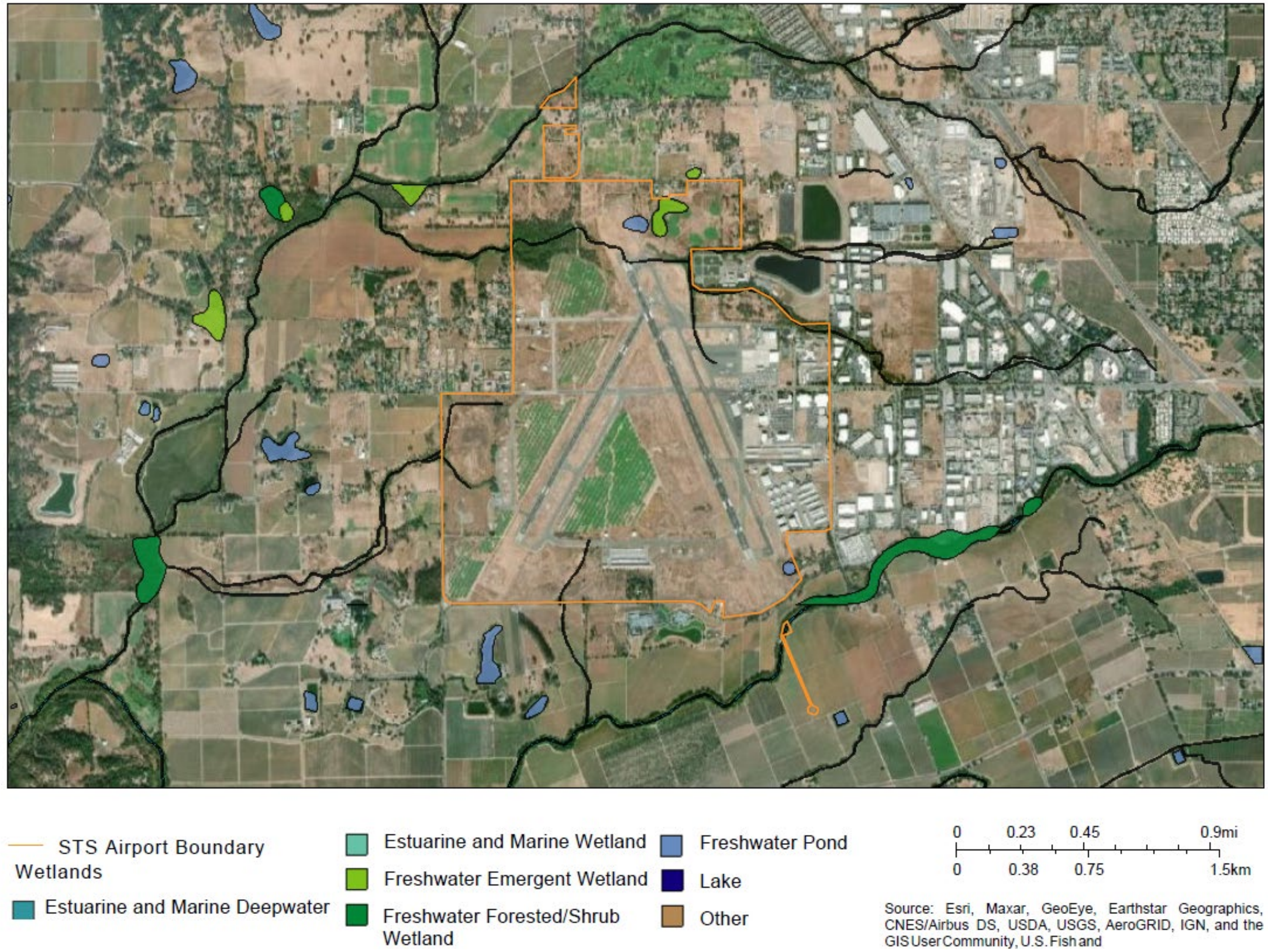
17 U.S. Fish and Wildlife Service, National Wetlands Inventory Mapper, Sonoma County Airport. Available: https://www.fws.gov/wetlands/data/mapper.html. Accessed: February 22, 2021.

18 LSA Associates, Inc. Biological Assessment: Charles M. Schulz – Sonoma County Airport Proposed Wildlife Exclusion Perimeter Fence Project. Sonoma County. February 2021.

19 Executive Order 11988, *Floodplain Management*, May 1, 1977.

Figure 5

WETLANDS WITHIN AIRPORT VICINITY



Source: USFWS National Wetlands Inventory Mapper 2021; RS&H, 2021; Mead & Hunt, 2021 and welfare; and restore and preserve the natural and beneficial floodplains. EO 11988 does not allow activities in a floodplain unless there is no practicable alternative and measures to minimize unavoidable short-term and long-term impacts are included. USDOT Order 5650.2 outlines the policies and procedures for ensuring that proper consideration is given to the avoidance and mitigation of adverse floodplain impacts in agency actions, planning programs, and budget requests. Therefore, the objective is to avoid, to the extent practicable, any impacts within the 100-year floodplain.

Three creeks flow across the Airport, generally from east to west. The creeks are tributaries to Mark West Creek via Windsor Creek to the west of the Airport. Runoff from the northern and northeastern portions of the Airport drains to Redwood Creek and Airport Creek. Both creeks support riparian or wetland habitat within the Airport. Ordinance Creek has been largely channelized or put into culvert and provides drainage to the developed area with hangars and aircraft storage on the eastern portion of the Airport. An approximately 890-foot segment of Airport Creek has been put into a culvert beneath the Runway Safety Area associated with the approach end of Runway 14. Runoff from the southern portion of the Airport drains to depressions along the north side of Laughlin Road and then flows via culverts and unnamed seasonal streams to Mark West Creek to the south. The western portion of the Airport drains to Airport Creek, which flows via an existing culvert under Windsor Road. Airport Creek and Redwood Creek both experience flooding under current conditions. Flood insurance rate map (FIRM) designations for the Airport vicinity, which are shown on **Figure 6**, indicate that floodplains exist within the Airport boundary. The floodway at the Airport, along Mark West Creek, includes both Zone AE and Zone AO Federal Emergency Management Agency (FEMA) designation. Floodways are used to discharge base flood waters without increasing the water elevation beyond a specified height. Zone AE flood insurance rate zones are used to designate areas where there is a 1-percent-annual-chance for flooding to occur. These areas are determined by detailed methods of analysis.[20] While both Zones AE and AO have a 1-percent-annual-chance of flooding in a 100-year period, Zone AE has detailed base flood elevations on the FIRM. The base flood elevation ranges from 88 feet to 110 feet in the flood zones.

B.13.3 Surface Waters

Surface waters include areas where water collects on the surface of the ground, such as streams, rivers, lakes, ponds, estuaries, and oceans. The Airport, which is in the jurisdiction of the North Coast Regional Water Quality Control Board, is located within the Mark West Creek subbasin of the Russian River Watershed. The subbasin is comprised of approximately 83 square miles that includes Windsor and the northern portion of Santa Rosa. Elevations in the subbasin range from 50 feet above sea level at the confluence of Mark West Creek and the Russian River to nearly

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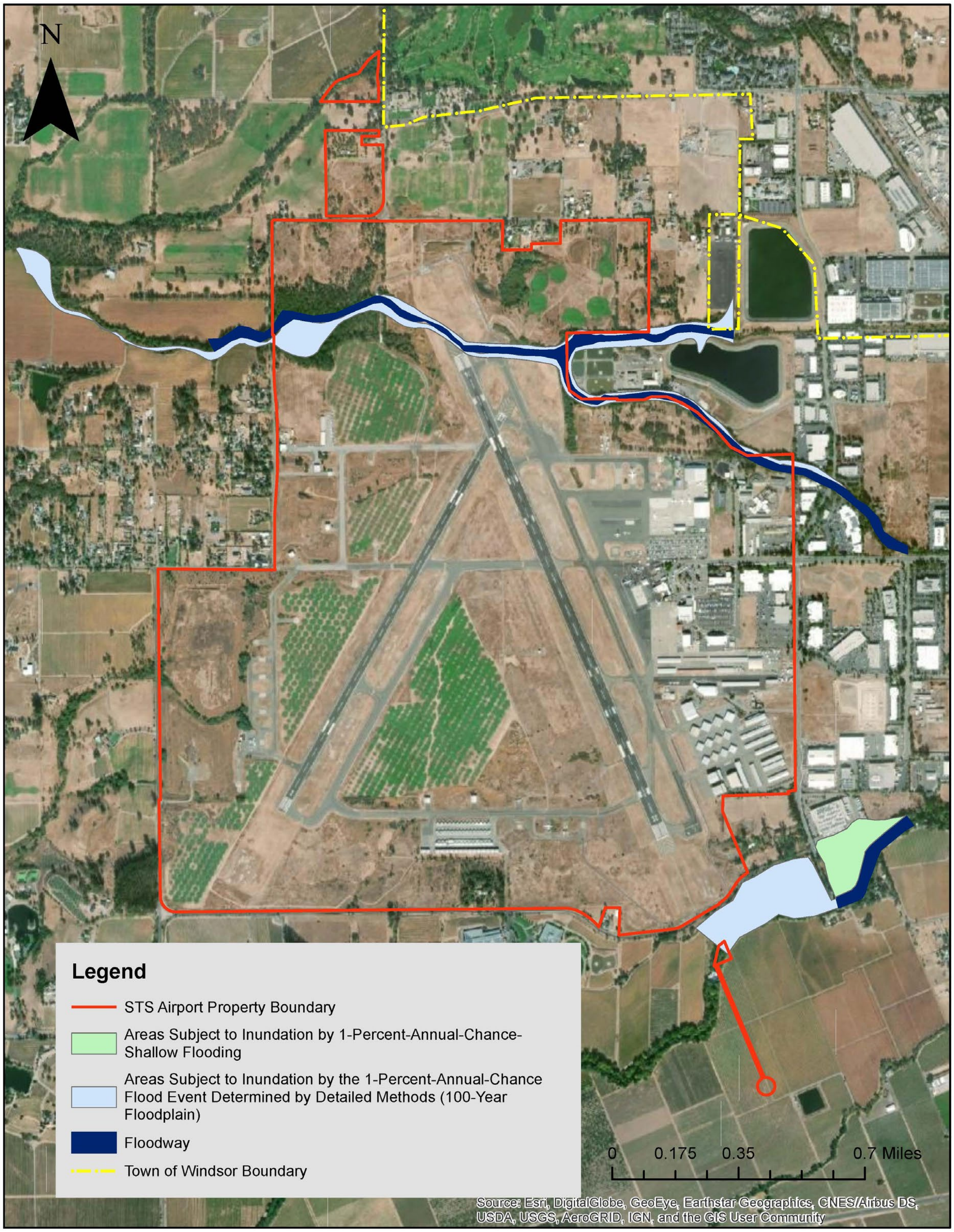
[20] FEMA, Frequently Asked Questions, available at: http://www.fema.gov/plan/prevent/fhm/fq_genin.shtm. Accessed July 2019.

Figure 6
FLOODPLAIN MAP



Source: FEMA, 2021; RS&H, 2021; Mead & Hunt, 2021

2,000 feet above sea level at its eastern boundary. The eastern portion of the subbasin is considerably more topographically diverse with mountains and valleys while the western portion, where the Airport is located, is generally flat. The site receives an average annual rainfall of approximately 31 inches.

The Airport is set within the Santa Rosa Plain. Primary water quality impairments in the Santa Rosa Plain as described in the County of Sonoma General Plan and Basin Plan are sedimentation and siltation, nutrients and pathogens. Agricultural practices and the conversion of rangeland and forestland to vineyard have increased sedimentation and siltation in the Mark West Creek subbasin. Nutrients have been introduced to the subbasin through the use of fertilizers, grazing livestock, leaking septic systems and other nonpoint sources. Pathogens, primarily fecal coliform bacteria, have been introduced into the watershed by wastewater discharges, leaking septic systems, and from animal waste.

B.13.4 Groundwater

Groundwater is described as the "subsurface water that occupies the space between sand, clay, and rock formations."[21] The nearest sole source aquifer to the Airport is the Santa Margarita Aquifer in Scotts Valley, which is located about 100 miles south of the Airport.

Approximately 42 percent of Sonoma County uses groundwater for potable and irrigation uses. The Sonoma County General Plan establishes four classifications to indicate general areas of groundwater availability:

- Class I are the major groundwater basins;
- Class II are major natural recharge areas;
- Class III are marginal groundwater availability areas; and
- Class IV are areas with low or highly variable water yield.

The General Plan designates the Airport to be over a major groundwater basin (Class I).

The Airport is located entirely within the Santa Rosa Valley Groundwater Basin and the Santa Rosa Plain Subbasin, which is distinct from the surface water subbasin. The Santa Rosa Plain Subbasin is the largest of the subbasins with a total surface area of approximately 125 square miles, extending from Rohnert Park in the south to between Healdsburg and Windsor in the north. In accordance with the Water Quality Control Plan for the North Coast Region, groundwater has been impaired at various locations region-wide particularly as a result of agricultural, industrial, and commercial chemical handling, storage, and disposal practices. Particular problems are known to exist in several groundwater basins within the Region, including the Santa Rosa Plain. The depth of the groundwater for the Santa Rosa Valley Basin and the Santa Rosa Plain Subbasin varies between two to five feet within grade during the winter season for areas within the Airport property. Sonoma County does not currently have a

21 Federal Aviation Administration, 1050.1F Desk Reference, Section 14.4 Groundwater. July 2015.

groundwater management plan. Groundwater is managed indirectly by Permit and Resource Management Department (PRMD) through well permits and by groundwater availability zones established in the General Plan.

B.13.5 Application of Treated Wastewater

Under an agreement between the Airport Sponsor and the Sonoma County Water Agency, treated wastewater from the wastewater treatment plant operated by the Sonoma County Water Agency is applied as irrigation water to the western and central portions of the Airport. The treated wastewater meets all State of California standards and contributes to the replenishment of groundwater in the Airport vicinity.

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Appendix C
Noise & Emissions Report

APPENDIX C

AIRCRAFT NOISE AND EMISSIONS TECHNICAL REPORT

MAY 2, 2022

APPENDIX C

AIRCRAFT NOISE AND EMISSIONS TECHNICAL REPORT

This technical report describes the aircraft noise exposure and emissions for the Charles M Schultz-Sonoma County Airport (STS) Focused Airport Layout Plan Update.

1.1 NOISE MODEL

The methodology for assessing noise exposure included preparing Community Noise Equivalent Leve (CNEL) contours using the Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT) Version 3d. The AEDT works by defining a network of grid points at ground level around an airport. It then selects the shortest distance from each grid point to each flight track and computes the noise exposure generated by each aircraft operation, along each flight track. Corrections are applied for atmospheric acoustical attenuation, acoustical shielding of the aircraft engines by the aircraft itself, and aircraft speed variations. The noise exposure levels for each aircraft are then summed at each grid location. The cumulative noise exposure levels at all grid points are then used to develop noise exposure contours for selected values (e.g. CNEL 65, 70 and 75).

1.2 AEDT INPUT DATA

In the development of CNEL contours, the AEDT uses both default and airport-specific factors. The default factors include engine noise levels, thrust settings, aircraft arrival and departure flight profiles, and aircraft speed. The airport-specific factors include the number of aircraft operations, the type of aircraft, runway use, the assignment of aircraft operations to flight tracks, local meteorological conditions, and operational time (day/evening/night) data. The following describe these airport-specific data.

1.2.1 Meteorological Data

The AEDT accounts for the influences of meteorological conditions on aircraft performance and atmospheric sound absorption. Meteorological conditions affect the transmission of aircraft noise through the air. The AEDT uses temperature and relative humidity to calculate atmospheric absorption coefficients, which in turn are used to adjust aircraft performance and noise propagation. The 10-year average meteorological conditions included in the AEDT for STS are:

» Temperature: 54.8° Fahrenheit
» Barometric pressure: 1010.8 millibars
» Relative humidity: 73.5%

1.2.2 Aircraft Operations

The Base and Ultimate scenarios annual operations by category are provided in **Table C1.** As shown, annual operations for the Base scenario total 95,523 (an average of 262 operations per day). The Ultimate scenario operations total 107,860 (an average of 296 per day). For the purposes of preparing CNEL contours, operational data need to be segregated by aircraft type. The Base and Ultimate aircraft fleet of itinerant and local operations are provided in **Tables C2** and **C3**, respectively.

TABLE C1 - ANNUAL AIRCRAFT OPERATIONS

Scenario	Air Carrier	Air Taxi / Commuter	GA Itinerant	GA Local	Military	Total Operations
Base	15,330	7,963	45,160	26,383	687	95,523
Ultimate	21,170	9,685	49,800	26,518	687	107,860

Source: Mead & Hunt, 2021

TABLE C0 - ANNUAL AIRCRAFT OPERATIONS - ITINERANT

Representative Aircraft Type (s)	AEDT Equip ID	AEDT ANP	Base Operations	Ultimate Operations
Embraer 175	3815	EMB175	5,840	9,490
Boeing 737-800	203	737800	5,110	8,030
Canadair RJ 700/900	2426	CRJ9-ER	4,380	2,920
Airbus A320	2587	A320-232	-	730
Bombardier Challenger 300/350/600	1239	CL600	1,894	2,185
Cessna Citation CJ1/CJ2/CJ3	1288	CNA500	1,415	1,632
Cessna 525 Citation Jet	6060	CNA525C	1,109	1,278
Learjet 35/45/60, Hawker 800	2028	LEAR35	1,094	1,262
Cessna 560 Citation XLS	6065	CNA560XL	1,033	1,192
Cessna 750 Citation X, Falcon 2000	1307	CNA750	975	1,124
Gulfstream G400, Falcon 7X	1920	GIV	970	1,119
Citation II/Bravo	1292	CNA55B	903	1,042
Cessna Citation Sovereign/ Latitude	3047	CNA680	749	864
Cessna Citation Mustang, Phenom 100	6062	CNA510	680	784
Raytheon Premier I, Beechjet400	6159	MU3001	639	737
Dassault Falcon 50/900	1320	FAL900EX	634	732
Cessna 560 Citation V/Ultra	1298	CNA560U	473	546
Gulfstream GV / 500	1923	GV	422	487
Bombardier Global Express	1773	BD-700-1A10	383	442
Israel IAI-1125 Astra/1126 Galaxy	1977	IA1125	302	349
Cessna Citation III	1234	CIT3	199	230
Gulfstream G280	4198	CL601	195	224
Bombardier Global 5000	2573	BD-700-1A11	123	142
Eclipse 500	3159	ECLIPSE500	112	130
King Air 90, Super King Air 300/350	1503	DHC6	5,259	5,873
Pilatus PC12, Cessna 208, Socata TBM7	1489	CNA208	5,192	5,798
Cessna 441, Piper Cheyenne, TBM-850	2580	CNA441	2,342	2,616
Cessna 172/177/206	1261	CNA172	5,043	5,706
Beech 35/36, Cessna 210, DA-40	1276	GASEPV	4,809	5,440

Cirrus SR20/22	1325	COMSEP	3,347	3,787
Cessna 206	3172	CNA206	306	346
Baron 55/58, Cessna 340/414/421P	1196	BEC58P	6,712	7,402
King Air 90, Super King Air 300/350	1546	DHC6	989	994
Rockwell OV-10 Bronco	1457	OV10A	264	265
Lockheed C-130 Hercules	3170	C130E	66	66
Airbus Helicopters H135	4097	EC130	3,140	3,283
Robinson R-44	3161	R44	449	469
Agusta A-109	28	A109	449	469
Bell 429	4125	B429	449	469
Eurocopter MH-65 Dolphin	4120	SA365N	344	344
UH-60 Black Hawk	21	S70	114	115
Lockheed C-130 Hercules	3170	C130E	229	229
		Total	69,140	81,342

Source: Mead & Hunt; RS&H, 2021

TABLE C3 - ANNUAL AIRCRAFT OPERATIONS – LOCAL

Representative Aircraft Type (s)	AEDT Equip ID	AEDT ANP	Base Operations	Ultimate Operations
Cessna 172/177/206	1261	CNA172	7,882	7,922
Beech 35/36, Cessna 210, DA-40	1276	GASEPV	7,515	7,554
Cirrus SR20/22	1325	COMSEP	5,231	5,258
Cessna 206	3172	CNA206	479	481
Baron 55/58, Cessna 340/414/421P	1196	BEC58P	5,277	5,304
		Total	26,383	26,518

Source: Mead & Hunt; RS&H, 2021

1.2.3 Time of Day

Aircraft operations modeled in the AEDT are assigned as occurring during daytime (7:00 a.m. to 6:59 p.m.), evening (7:00 p.m. to 9:59 p.m.) or nighttime (10:00 p.m. to 6:59a.m.). The calculation of CNEL includes an additional weight of 4.77 dBA added to those aircraft events that occur during the evening and 10.0 dBA for those occurring at night. The time-of-day percentages of operations modeled are summarized in **Table C4**.

TABLE C4 - TIME OF DAY

Aircraft	Day (7:00am – 6:59pm)	Evening (7:00pm-9:59pm)	Night (10:00pm-6:59am)	Total
		Departures		
Embraer 175	89%	11%	-	100%
Boeing 737-800	33%	17%	50%	100%
Canadair RJ 700/900	50%	33%	17%	100%
		Arrivals		
Embraer 175	100%	-	-	100%
Boeing 737-800	57%	29%	14%	100%
Canadair RJ 700/900	50%	33%	17%	100%

		Departures and Arrivals		
GA Jets and Turboprops	91%	7%	2%	100%
GA Piston / Helicopter	83%	12%	5%	100%
Cal Fire	90%	5%	5%	100%
Military	91%	7%	2%	100%

Source: Mead & Hunt; RS&H, 2021

1.2.4 Departure Stage Length

Stage length data is used in the AEDT to represent the various weights of a departing aircraft. For example, a fully loaded aircraft departing on a long-haul flight weighs more on departure than the same aircraft departing on a short-haul flight, due to the weight of the additional fuel needed to travel a longer distance. A heavier aircraft uses more runway length and climbs at a slower rate than lighter aircraft. To account for this, the AEDT contains 10 departure climb profiles (corresponding to different departure weights), depending on the type of aircraft. These profiles represent aircraft origin to destination trip lengths from less than 500 nautical miles (nm) to over 8,500 nautical miles. At STS, the maximum distance traveled on a regular basis is up to 2,500nm. The distances of each stage length in the AEDT are shown in **Table C5**. The commercial aircraft departure stage lengths modeled for the Base and Ultimate scenarios are included in **Table C6**. All general aviation and military operations were modeled Stage Length 1.

TABLE C5 - AEDT STAGE LENGTH DESCRIPTIONS

Stage Length	Distance (Nautical Miles)
1	0-500
2	501-1,000
3	1,001-1,500
4	1,501-2,500

Source: FAA AEDT Tech Manual 3d, March 2021

TABLE C6 - DEPARTURE STAGE LENGTH BY AIRCRAFT TYPE

Aircraft	Stage Length 1	Stage Length 2	Stage Length 3	Stage Length 4	Total
		Base			
Embraer 175	89%		11%		100%
Boeing 737-800	50%	33%		17%	100%
Canadair RJ 700/900	33%	67%			100%
		Ultimate			
Embraer 175	61%	31%	8%		100%
Boeing 737-800	40%	20%	10%	30%	100%
Canadair RJ 700/900	50%	50%			100%
Airbus A320			100%		100%

Source: Mead & Hunt; RS&H, 2021

1.2.5 Runway Use

Runway use refers to the frequency with which aircraft utilize each runway end for departures and arrivals. The more often a runway is used, the more noise is generated in areas located off each end of that runway. Wind direction and speed dictate the runway directional use (or flow) of airports. From a safety and operational standpoint, it is preferable for aircraft to arrive and depart into the wind. Wind direction changes may also necessitate the need to switch an airport's flow. Overall modeled runway use is included in **Table C7**.

TABLE C7 - MODELED RUNWAY USE

Category	02	20	14	32	Total
		Departures			
Commercial	-	2%	58%	40%	100%
GA Jets and Turboprops	-	10%	55%	35%	100%
GA Piston	3%	14%	55%	28%	100%
Cal Fire	3%	33%	36%	28%	100%
Military			60%	40%	100%
		Arrivals			
Commercial	-	-	55%	45%	100%
GA Jets and Turboprops	-	1%	42%	57%	100%
GA Piston	1%	4%	50%	45%	100%
Cal Fire	1%	4%	65%	30%	100%
Military			60%	40%	100%
		Touch-and-Go			
GA Piston	3%	12%	57%	28%	100%

Source: Mead & Hunt; RS&H, 2021

1.2.6 Modeled Aircraft Flight Tracks

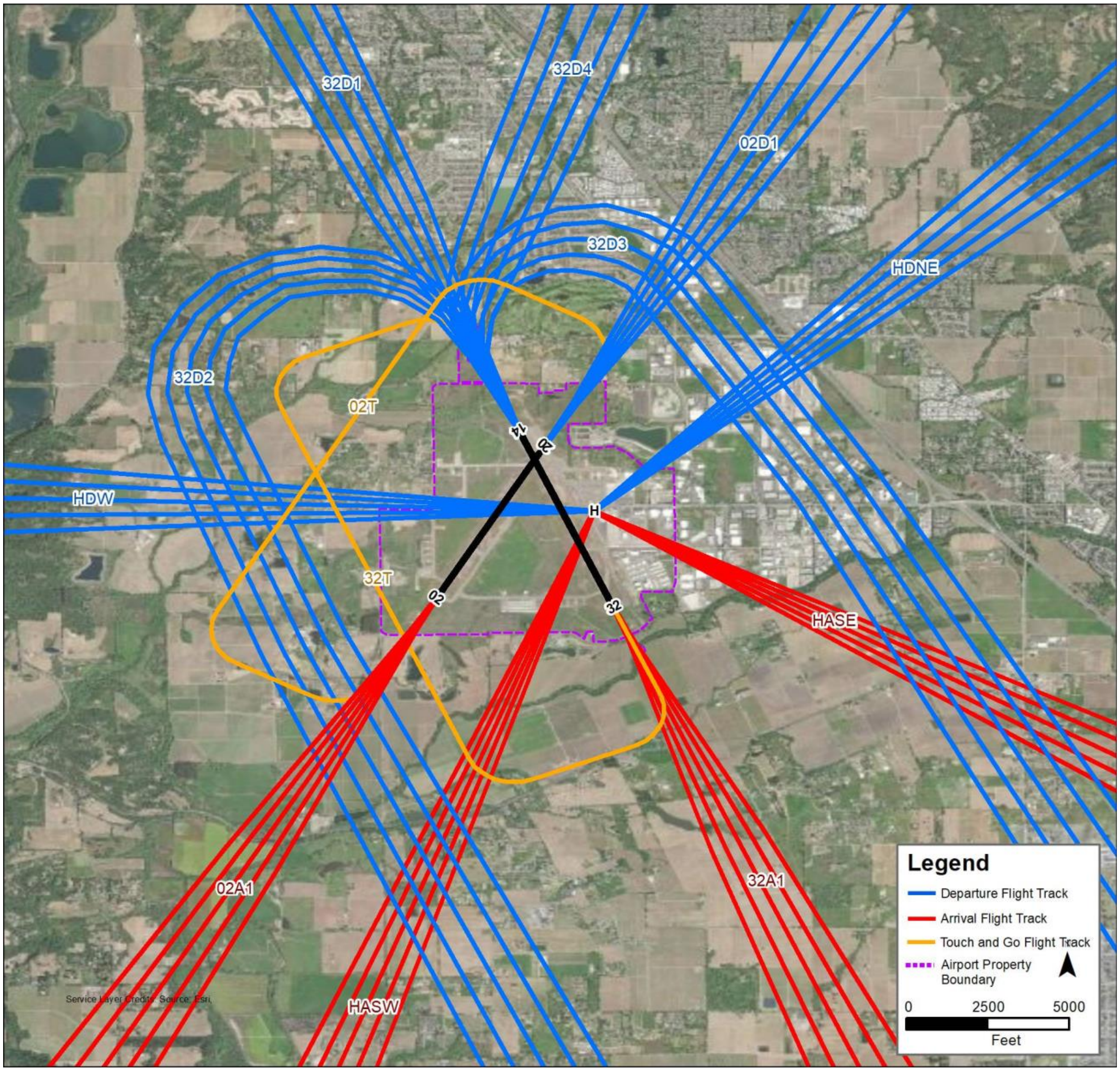
The location of flight tracks is an important factor in determining the geographic distribution of noise on the ground. The AEDT uses airport-specific ground tracks and vertical flight profiles to compute three-dimensional flight paths for each modeled aircraft operation. The "default" AEDT vertical profiles, which consist of altitude, speed, and thrust settings, are compiled from data provided by aircraft manufacturers. The flight tracks and track use estimates were developed from input by STS air traffic control tower personnel. The modeled Base scenario AEDT flight tracks for north flow and south flow are depicted on **Figures C1** and **C2** respectively. The modeled flight track use percentages are shown in **Table C8**. For modeling purposes, Cal Fire and military operations were modeled consistent with the commercial aircraft. The flight tracks for the Ultimate scenario were only slightly modified to have aircraft departures match the new Runway 20 end. Arrival flight tracks to Runway 20 remained consistent with the Base scenario with aircraft arriving to the displaced threshold. Helicopters were modeled operating from a helipad on the east side of the airfield.

TABLE C8 - MODELED FLIGHT TRACK USE

			Track ID			
			North Flow Departures			
Runway 2	02D1					Sum
Commercial	100%					100%
GA Jet / Turboprop	100%					100%
GA Piston	100%					100%
Runway 32	32D1	32D2	32D3	32D4		
Commercial	40%	60%				100%
GA Jet / Turboprop	40%	50%	5%	5%		100%
GA Piston	30%	20%	30%	20%		100%
			North Flow Arrivals			
Runway 2	02A1					
Commercial	100%					100%
GA Jet / Turboprop	100%					100%
GA Piston	100%					100%
Runway 32	32A1					
Commercial	100%					100%
GA Jet / Turboprop	100%					100%
GA Piston	100%					100%
			South Flow Departures			
Runway 20	20D1	20D2	20D3			
Commercial	50%	25%	25%			100%
GA Jet / Turboprop	50%	25%	25%			100%
GA Piston	40%	20%	40%			100%
Runway 14	14D1	14D2	14D3	14D4	14D5	
Commercial	35%	10%	25%	-	30%	100%
GA Jet / Turboprop	30%	15%	25%	5%	25%	100%
GA Piston	20%	20%	20%	20%	20%	100%
			South Flow Arrivals			
Runway 20	20A1					
Commercial	100%					100%
GA Jet / Turboprop	100%					100%
GA Piston	100%					100%
Runway 14	14A1	14A2	14A3	14A4	14A5	
Commercial	40%		50%	10%		100%
GA Jet / Turboprop	40%		50%	10%		100%
GA Piston	20%	30%	5%	5%	40%	100%

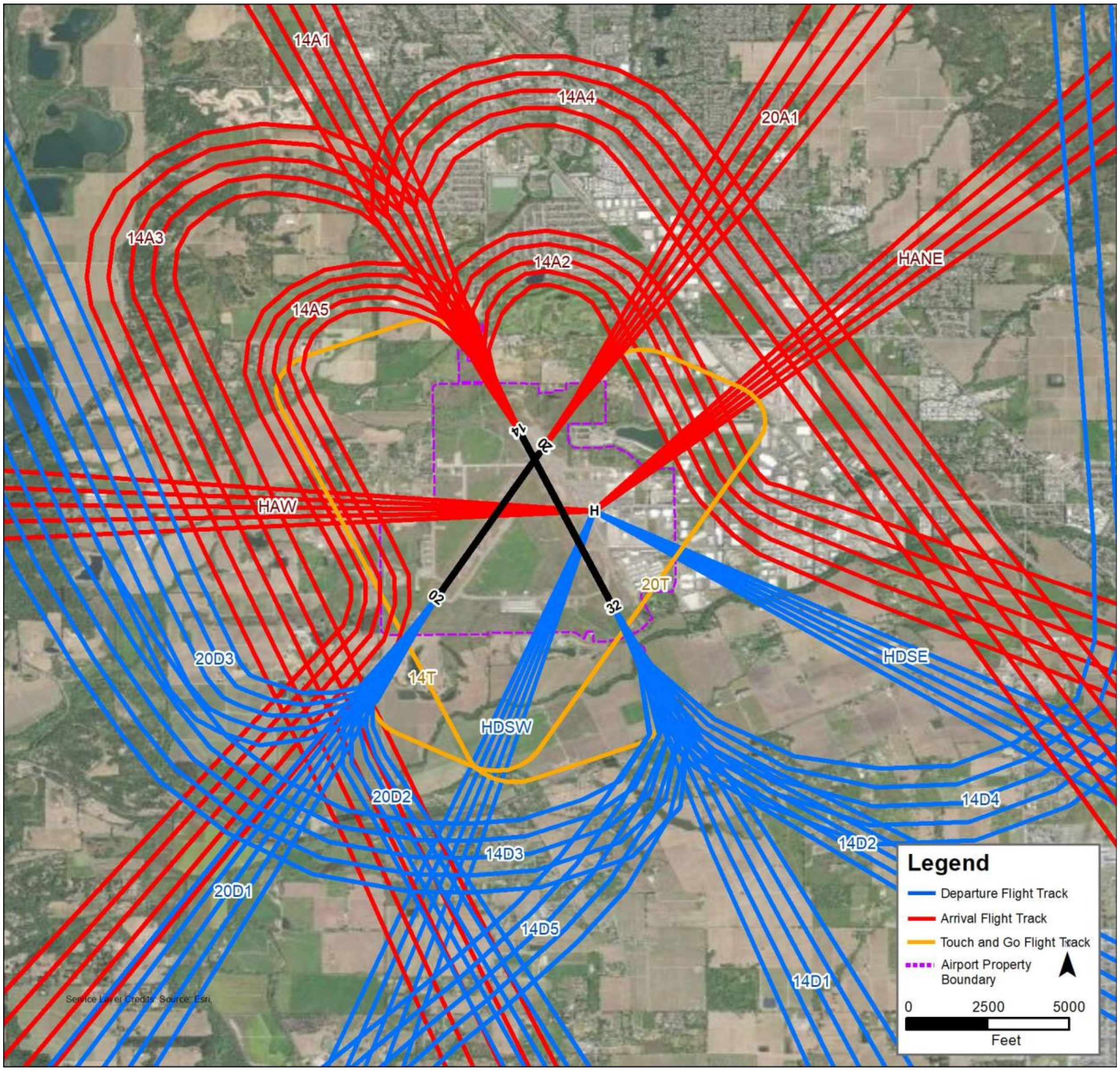
Source: STS ATCT Personnel; RS&H, 2021

FIGURE C1 - MODELED AIRCRAFT FLIGHT TRACKS – NORTH FLOW



Source: STS ATCT Personnel; RS&H, 2021

FIGURE C2 - MODELED AIRCRAFT FLIGHT TRACKS – SOUTH FLOW



Source: STS ATCT Personnel; RS&H, 2021

1.3 BASE SCENARIO CNEL CONTOURS

The Base scenario 60-75 CNEL contours are provided on **Figure C3**. **Table C9** identifies the areas within the CNEL contour ranges. As shown in the table, the total area within the 60 and greater CNEL contour is approximately 1,394 acres. The size of the contours are largest off the ends of Runway 14-32, which is the highest used runway at STS.

TABLE C9 - CNEL CONTOUR AREAS - BASE

CNEL Range	Area (acres)
60 - 65	887
65 - 70	304
70 - 75	114
75+	89
Total	1,394

Source: RS&H, 2021

1.4 ULTIMATE SCENARIO CNEL CONTOURS

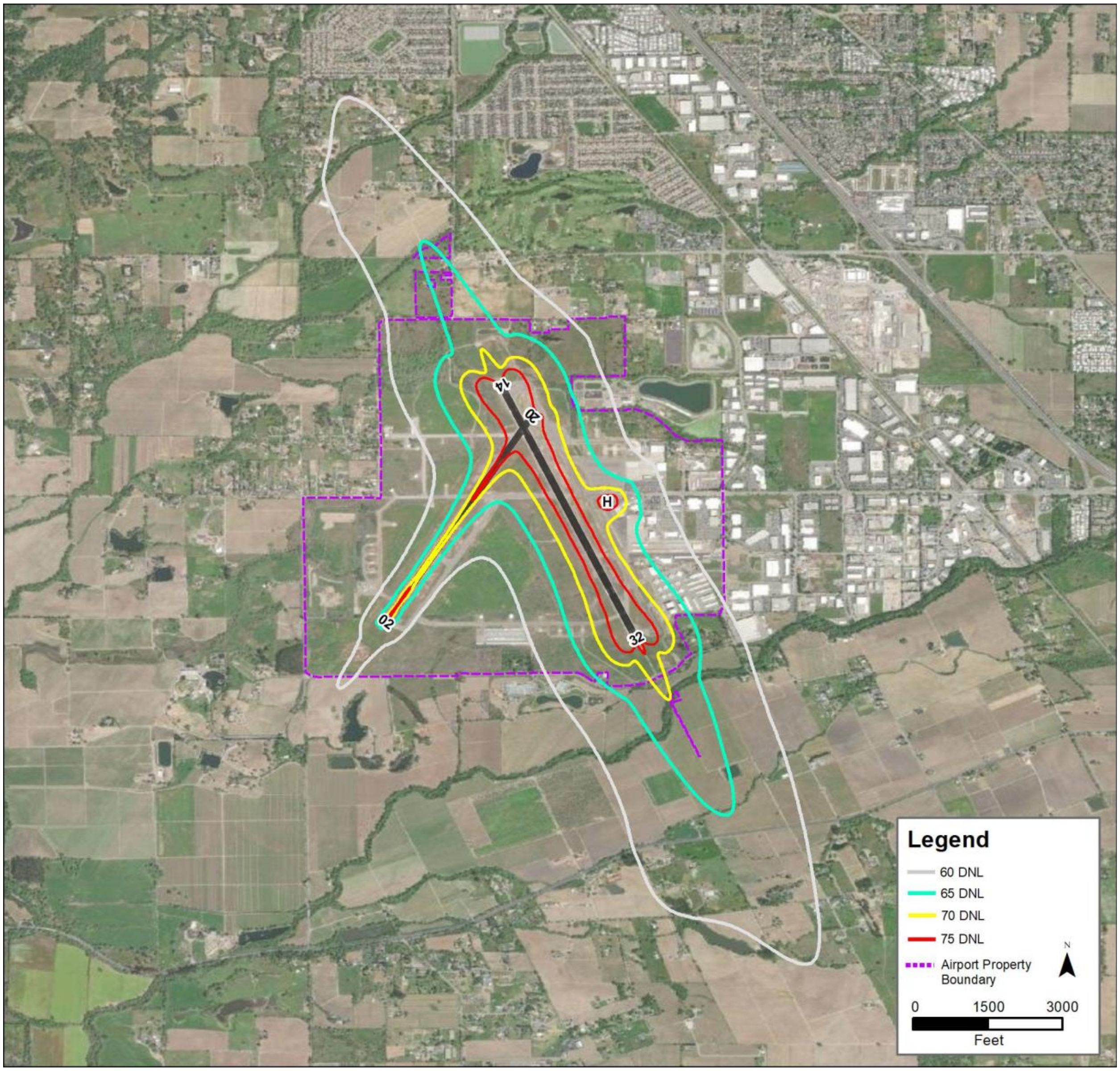
The Ultimate scenario 60-75 CNEL contours are provided on **Figure C4**. **Table C10** identifies the areas within the CNEL contour ranges. As shown in the table, the total area within the 60 and greater CNEL contour is approximately 1,852 acres. The contours are slightly larger than the Base scenario due to the greater number of operations forecast at the airport with the Ultimate scenario.

TABLE C10 - CNEL CONTOUR AREAS – ULTIMATE

CNEL Range	Area (acres)
60 - 65	1,185
65 - 70	415
70 - 75	140
75+	112
Total	1,852

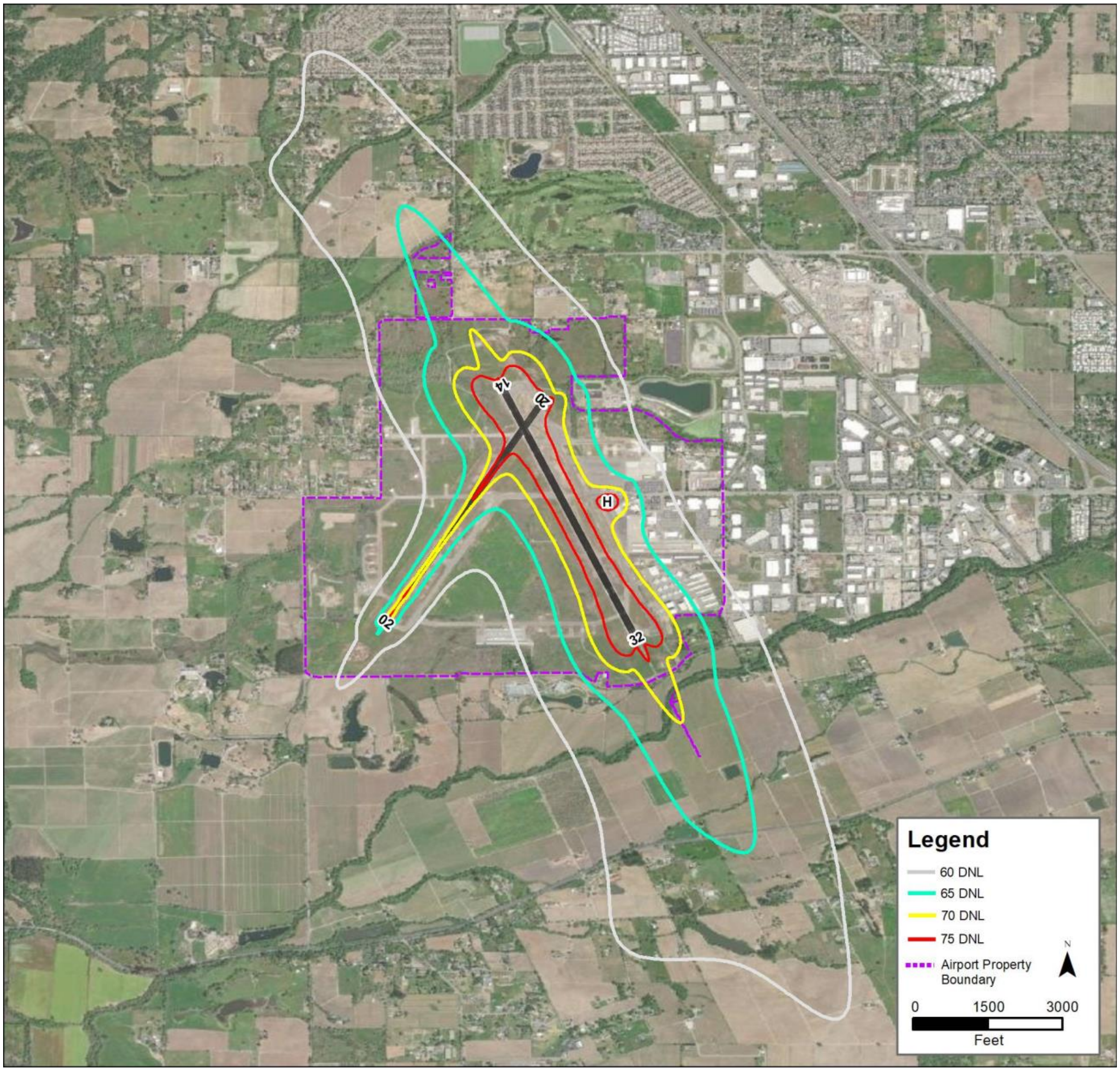
Source: RS&H, 2021

FIGURE C3 - BASE SCENARIO 60-75 CNEL CONTOURS



Source: RS&H, 2021

FIGURE C4 - ULTIMATE SCENARIO 60-75 CNEL CONTOURS



Source: RS&H, 2021

1.5 AIRCRAFT EMISSIONS

The operational emissions inventory was prepared for the aircraft operations, which are by far the largest contributor to emissions at an airport, for the Base and Ultimate Scenarios. Other sources that contribute to emissions at an airport include aircraft auxiliary power units, ground support equipment, motor vehicles and stationary sources. The aircraft emissions were computed using the AEDT version 3d. The inventories were prepared for emissions of CO, NO_x, SO_x, PM_{10}/$PM_{2.5}$ and VOC. The aircraft annual operations and fleet are shown in **Table C11**. The runway use, flight tracks and stage lengths used to model the emissions were the same as the data used in the noise modeling effort. **Table C12** presents the aircraft operational emission inventories for the Base and Ultimate scenarios.

TABLE C11 - BASE AND ULTIMATE SCENARIOS ANNUAL AIRCRAFT OPERATIONS

Representative Aircraft Type (s)	AEDT Equip ID	AEDT ANP	Base Operations	Ultimate Operations
Embraer 175	3815	EMB175	5,840	9,490
Boeing 737-800	203	737800	5,110	8,030
Canadair RJ 700/900	2426	CRJ9-ER	4,380	2,920
Airbus A320	2587	A320-232	-	730
Bombardier Challenger 300/350/600	1239	CL600	1,894	2,185
Cessna Citation CJ1/CJ2/CJ3	1288	CNA500	1,415	1,632
Cessna 525 Citation Jet	6060	CNA525C	1,109	1,278
Learjet 35/45/60, Hawker 800	2028	LEAR35	1,094	1,262
Cessna 560 Citation XLS	6065	CNA560XL	1,033	1,192
Cessna 750 Citation X, Falcon 2000	1307	CNA750	975	1,124
Gulfstream G400, Falcon 7X	1920	GIV	970	1,119
Citation II/Bravo	1292	CNA55B	903	1,042
Cessna Citation Sovereign/ Latitude	3047	CNA680	749	864
Cessna Citation Mustang, Phenom 100	6062	CNA510	680	784
Raytheon Premier I, Beechjet400	6159	MU3001	639	737
Dassault Falcon 50/900	1320	FAL900EX	634	732
Cessna 560 Citation V/Ultra	1298	CNA560U	473	546
Gulfstream GV / 500	1923	GV	422	487
Bombardier Global Express	1773	BD-700-1A10	383	442
Israel IAI-1125 Astra/1126 Galaxy	1977	IA1125	302	349
Cessna Citation III	1234	CIT3	199	230
Gulfstream G280	4198	CL601	195	224
Bombardier Global 5000	2573	BD-700-1A11	123	142
Eclipse 500	3159	ECLIPSE500	112	130
King Air 90, Super King Air 300/350	1503	DHC6	5,259	5,873
Pilatus PC12, Cessna 208, Socata TBM7	1489	CNA208	5,192	5,798
Cessna 441, Piper Cheyenne, TBM-850	2580	CNA441	2,342	2,616
Cessna 172/177/206	1261	CNA172	12,926	13,627
Beech 35/36, Cessna 210, DA-40	1276	GASEPV	12,325	12,994
Cirrus SR20/22	1325	COMSEP	8,578	9,045
Cessna 206	3172	CNA206	785	827
Baron 55/58, Cessna 340/414/421P	1196	BEC58P	11,989	12,706

King Air 90, Super King Air 300/350	1546	DHC6	989	994
Rockwell OV-10 Bronco	1457	OV10A	264	265
Lockheed C-130 Hercules	3170	C130E	66	66
Airbus Helicopters H135	4097	EC130	3,140	3,283
Robinson R-44	3161	R44	449	469
Agusta A-109	28	A109	449	469
Bell 429	4125	B429	449	469
Eurocopter MH-65 Dolphin	4120	SA365N	344	344
UH-60 Black Hawk	21	S70	114	115
Lockheed C-130 Hercules	3170	C130E	229	229
			95,523	107,860

Source: Mead & Hunt; RS&H, 2021

TABLE C12 - AIRCRAFT EMISSIONS (TONS PER YEAR)

Scenario	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	VOC
BASE	463.4	65.2	8.7	1.0	1.0	47.6
ULTIMATE	522.9	92.4	11.6	1.3	1.3	55.4

Source: RS&H, 2021

Appendix D
Transportation Facilities

Appendix D -

Transportation Facilities

INTRODUCTION

Ease of vehicular accessibility is vital for all who use an airport and its many facilities. The surrounding ground transportation system should accommodate a combination of daily local and airport traffic as congestion can cause missed flights and other unforeseen circumstances. Parking availability is not only crucial for passengers, but for airport employees, rental car services, and revenue generation. The existing system of ground transportation and ground facilities supporting the Charles M. Schulz Sonoma County Airport (STS) terminal area are described below with demand analysis and alternative recommendations.

TERMINAL AREA VEHICLE ACCESS AND INVENTORY

STS is accessed via Airport Boulevard (Exit 495B) from Redwood Highway (U.S Route 101). As illustrated in **Figure D-1**, Airport Boulevard is a four-lane undivided arterial roadway that travels east to west approximately 1.5 miles to the terminal road from Redwood Highway. Once reaching the terminal road Airport Boulevard transitions into a two-lane one-way traffic loop past the terminal and surface parking facilities. Over this 1.5 miles Airport Boulevard intersects with North/Southbound traffic at two signalized and five additional stop-controlled roadways. There is also a gated railroad crossing approximately 1-mile west of STS. These roadways primarily provide connection to the general aviation, business, institutional, and light industrial land uses in the airport vicinity and do not serve as alternative routes to the terminal.

KaiserAir Santa Rosa and Sonoma Jet Center provides FBO services at STS. KaiserAir can be accessed via a private drive off of Airport Boulevard just east of the Long-Term A. This private drive also serves as Level 1 Staging area for Fire/ EMS access. Sonoma Jet Center is located south of the passenger terminal alongside other general aviation services providing aeronautical instruction, maintenance, storage, charter services and sales (Helico Sonoma, North Cost Air, Barron Air Maintenance, PropJet Aviation, Ram Aviation, Vine Jet).

In addition to personal passenger vehicle access, bus and transit services are offered to and from STS providing passengers connection to regional destinations. This includes San Francisco International Airport (SFO), downtown Santa Rosa, and Petaluma. Current bus and transit providers serving STS are Airport Express, Sonoma County Transit, and Mendocino Transit Authority. Sonoma-Marin Area Rail Transit (SMART) provides passenger rail service within one-mile of the airport and offers a limited no cost express bus service from the Cloverdale, Healdsburg, and Windsor stations to STS. SMART operations seven days a week, from 8:00 AM to 7:00 PM and offers some relief of parking demand (Updated 2023).

Figure D-1: Local Area Road Network

Automobile Parking

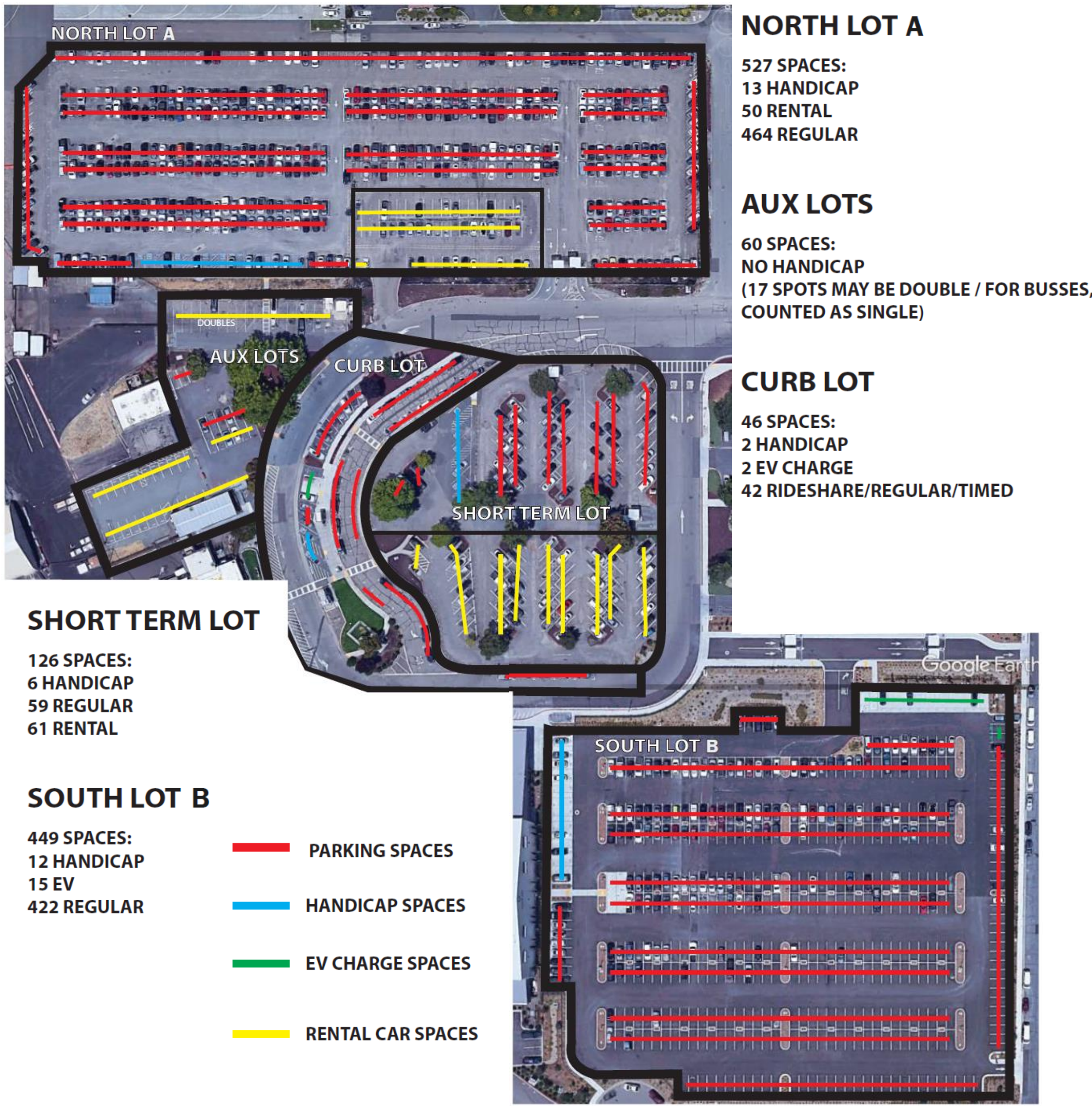
Airport automobile parking is located in three primary parking lots and two additional areas in the immediate vicinity of the passenger terminal. The Short-Term, Long-Term A and B, Temporary Curb Lot, and Auxiliary Lot are owned by the Airport and managed by a third-party operator. The parking inventory with stall counts and use are shown in **Table D-1** and illustrated in **Figure D-2**.

Table D-1: Landside Parking Supply

Parking Lot	Total Stall Count	General Use Count[1]	ADA Stall Count	EV Stall Count	Temporary Stall Count[3]	Rental Car Stall Count
Short-Term Lot	126	59	6	0	0	61
Long Term A	527	464	13	0	0	50
Long Term B	449	422	12	15	0	0
Curb Lot (Temporary)	46	0	2	2	42	0
Aux Lot[2]	60	0	0	0	0	60
Total	**1,208**	**945**	**33**	**17**	**42**	**171**

Source: STS Airport and Mead & Hunt, Inc
1: General use stalls are those that are available for passenger parking and employee parking.
2: Aux Lot includes general use parking previously reserved for use by fire station and use by employees.
3: Temporary stalls include those utilized by rideshare services and "Cell Phone Lot" users.

Figure D-2: Airport Parking Facilities



The majority of stalls are reserved for passenger and employee parking. Passengers are charged for parking based on the lot and duration of stay. Employees are not charged for parking and provided a pass that allows them access to the public lots. The following fees structure is used for public parking (updated July 2023):

<u>Short Term Lot</u>
$2.00 per 30 min.
First 2-Hours Free, $20 daily max

<u>Long-Term Lot A & B</u>
$15.00 per Day.

AUTOMOBILE PARKING FACILITY NEEDS AND DEMAND ANALYSIS

This section looks at the relationship of passenger enplanement and parking data over the past five years. This is done to evaluate the adequacy of existing parking inventory to meet future parking demand. This analysis will focus on four primary automobile parking components found within the immediate passenger terminal vicinity.

- Passenger Parking – Publicly available parking that serves passengers and visitors to the airport for the commercial landside facilities.
- Employee Parking – Parking provided for airport administrative, TSA, airline operator, and other airport staff.
- Rental Car Parking – Parking contracted for rental car parking for use by concessionaires, including ready, return, and maintenance facilities.
- Temporary Parking – Parking provided for pick-ups and drop-offs where vehicles remain attended. Used by the general public, TNCs and rideshare services.

The basis for projecting parking facilities needs and demand in this section is forecasted enplanements versus the most recently available parking data in 2019. Forecasted enplanements are used because it is presumed that enplanements and parking demand are linearly related. For this analysis, the Preferred Enplanement Forecast (PEF) was used. The PEF is also called the 'High Forecast for CEQA Review' in the Aviation Forecast Validation chapter.

Table D-2 shows forecasted enplanements and the resulting ratios that will be used for projecting increase in parking demand. Ratios are presented for planning horizons that correlate with the Planning Activity Levels (PALs) for forecasted enplanements. These should serve as the benchmarks interventions proposed later in this study. The planning year provided serves as an estimate to support long-range planning efforts.

Table D-2: PAL Enplanement Projections and Ratios

Planning Activity Level	Projected Future Year	Forecast Enplanements[1]	Projection Ratio
PAL 1	Current	230,000	**1.00**
PAL 2	5-Year	300,000	**1.30**
PAL 3	10-Year	350,000	**1.52**
PAL 4	15-Year	396,000	**1.72**
PAL 5	20-Year	426,000	**1.85**

Source: Mead and Hunt, Inc
1: Preferred Enplanement Forecast (High Forecast for CEQA Review) from Chapter 2: Aviation Forecasts Validation

Existing Passenger Parking Demand

To evaluate passenger parking demand a baseline is needed that will be used to determine demand at its peak. Historical enplanements by month provide the best measure of which months STS is busiest for parking and will identify which month's data is used for the demand analysis.

Table D-3 shows enplanements data from 2015 through 2019 by month. The data indicates that the busiest months for enplanement are historically July, however this shifted to September in 2019. This is likely due to a recent shift in passenger characteristics, with more locals and business travelers using STS instead of primarily leisure travelers. However, the summer months are still anticipated to be the busiest for enplanements at STS. It is important to note that while September is the peak month for 2019, the enplanements in September do not deviate drastically from the historical month of July. This indicates that if enplanements shift back to a peak month of July in the future projections based on September 2019 will be sufficient to forecast that demand.

Table D-3: Historical Enplanements (2015 – 2019)

Month	2015	2016	2017	2018	2019
January	8,009	10,035	11,410	13,345	13,916
February	8,012	10,322	11,984	14,114	12,919
March	8,947	11,731	15,563	16,017	16,292
April	9,139	12,772	15,087	17,475	16,994
May	10,906	15,082	16,579	18,965	19,777
June	12,811	17,566	20,371	21,291	23,171
July	**13,629**	**17,711**	**22,635**	**22,825**	25,389
August	12,883	16,384	19,744	22,546	25,816
September	11,913	14,518	19,015	21,596	**26,427**
October	13,017	15,564	13,695	19,854	21,740
November	10,920	14,687	17,881	17,598	19,582
December	11,528	13,595	15,839	16,268	22,655

Source: STS Airport

Seasonal and traveler parking characteristics influence parking demand because the type of trips taken fluctuate in length and purpose throughout the year. For example, a business traveler is likely to use the Public Parking Lot for a shorter duration than someone parking the entirety of their family vacation. This fluctuation means that the month with highest enplanements does not always correlate to the month for peak parking demand. To ensure this analysis provides a nuanced look at parking data based on seasonal observations, recorded parking data for January through December 2019 was used.

To account for this variation, the analysis evaluates two (2) data sets that together amount to Peak Daytime Occupancy, or the moment where parking demand is highest throughout the year.

- **Average Overnight Occupancy –** This is a measure of the average quantity of parking stalls occupied by vehicles overnight. This is determined using 2019 nightly vehicle counts provided by the Airport parking operator.
- **Average Duration of Stay –** This is a measure of the overall average duration that a vehicle occupies a parking stall. This was determined using 2019 transaction data provided by the Airport parking operator.

Using the formula below, Peak Daytime Occupancy can be determined for each lot. This helps to establish an understanding of user behavior at the airport and each lot's independent parking demand.

Peak Daytime Occupancy = **Average Overnight Occupancy + (Average Overnight Occupancy / Average Duration of Stay)**

The findings from this analysis illustrate the seasonal variation in parking demand. For example, the peak month for daytime occupancy in the Short-Term lot is April, while the peak month for combined long-term parking was September. This resulted in September being the overall peak month, which was largely driven by the higher overnight occupancy in Long-Term lot A & B. On average approximately 561 parking stalls were occupied overnight between the lots. This represents approximately 63% of parking supply. The results of this analysis support the use of September as the peak month for parking.

Forecasted Passenger Parking Demand

As was noted previously, it is assumed that parking demand and enplanements have a strong correlation. Using this correlation, the analysis forecasts future parking demand by projecting the ratio of existing parking demand and the PEF ratio from **Table D-2**.

Table D-4 shows the projected peak parking demand for each passenger parking lot. Parking supply operates at peak efficiency when parking occupancy is at approximately 85 percent. When occupancy is greater the lot operates at a lower level of service (LOS) with operational delays. The remaining 15 percent is the needed flow factor accommodating peak period overlap of arrival and departure passengers. This limits a patron's time cycling the parking field in search of the last remaining parking space.

Table D-5 shows the parking supply, demand, and corresponding surplus/deficit for each parking lot considering the effective parking supply for the Preferred Forecasted Growth rate (PEF Rate).

Based on the analysis of parking demand for the passenger parking lots there is a marginal overall deficit of parking in the current condition, increasing to a sever deficit by the short-term planning horizon. This severity increases to a total of 1,070 stalls by the 20-year horizon at the Preferred Forecasted Growth rate. This indicates that during peak events the Airport Passenger Parking Lots are full and even overflow to the street parking available in the terminal vicinity. This is also confirmed by anecdotal observations provided by airport staff.

Table D-4: Peak Passenger Parking Demand

Parking Lot	PAL: Enplanements:	2019 / PAL 1 230,000	PAL 2 300,000	PAL 3 350,000	PAL 4 396,000	PAL 5 426,000
Short-Term Lot		143	187	218	247	265
Long Term A		426	556	649	734	790
Long Term B		296	386	451	510	549

Source: Mead & Hunt, Inc, STS Airport Parking Data

Table D-5: Peak Passenger Parking Demand Forecast

Parking Lot	PAL: Enplanements:	2019 / PAL 1 230,000	PAL 2 300,000	PAL 3 350,000	PAL 4 396,000	PAL 5 426,000
Short-Term Lot						
Supply[1]		59	59	59	59	59
Effective Supply		50	50	50	50	50
Demand		143	187	218	247	265
Surplus / Deficit[2]		**-93**	**-137**	**-168**	**-197**	**-215**
North Lot (Daily/ Long Term A)						
Supply[1]		464	464	464	464	464
Effective Supply		394	394	394	394	394
Demand		426	556	649	734	790
Surplus / Deficit[2]		**-32**	**-162**	**-254**	**-340**	**-395**
South Lot (Daily/ Long Term B)						
Supply[1]		422	422	422	422	422
Effective Supply		359	359	359	359	359
Demand		296	456	530	583	641
Surplus / Deficit[2]		62	-97	-172	-224	-282
	Total	**-63**	**-326**	**-514**	**-688**	**-800**

Source: Mead & Hunt, Inc, STS Airport Parking Data
1: Parking supply was determined by a count of all General Use Stalls from Table 1-1. ADA, EV, and Rideshare stalls are dedicated to specialized users and are not necessarily available to passengers based on availability but rather earmarked based on statutory or policy requirements.
2: Deficits do not include the demand employees place on parking facilities.

Rental Car Parking Demand

The automobile rental concession agreements with four rental car concessionaires—Avis/Budget, Enterprise, Hertz and Sixt—specifies assigned rental parking spaces for each company, illustrated in **Figure D-3** below. This agreement established the location and allocation of parking spaces for each operator in 2019 based on the market share percentage of each agency with gross revenues over the preceding 12 months. STS charges a Customer Facility Charge (CFC) to maintain and operate rental car facilities and plan for future expansion and improvements. Rental car parking demand is primarily influenced by enplanements. Demand is also influenced by terms of the rental concession agreements, which dictate the fees and costs incurred by rental car companies for parking spaces in the Ready/Return Lots. Low fees will result in a high desire by the companies for additional parking stalls in the Ready/Return Lot as there will be less shuttling of vehicles by company employees. Conversely, high fees will result in low desire for additional stalls.

Discussions between STS and rental car agencies have culminated in preliminary planning for a Consolidated Rental Car (CONRAC) facility that will further impact demand for rental parking stalls at STS. For this reason, identifying demand based on historic enplanement and transaction ratios will not accurately capture future demand and faculty need. For this reason, the recommendation of this Study is not to project a surplus or deficit of available parking in the Ready/Return Lot. Rather, the recommendation is to hold the number of parking stalls available to concessionaires constant for the life of the current rental concession agreements.

The available number of rental car ready/return spaces is currently sufficient for the four rental car operators if used properly to provide limited short-term vehicle parking for customers picking up and dropping off rental vehicles. Dependent on the demand for the other automobile parking types, existing rental car parking facilities may be moved or redistributed to better account for transition to the future rental car CONRAC facility. The objective of these spaces remains solely to provide rental car operators a place to temporarily park vehicles they have shuttled from their service facilities to meet immediate customer's pickup/drop-off demand. **Table D-6** shows the overall availability of Rental Parking at the Airport.

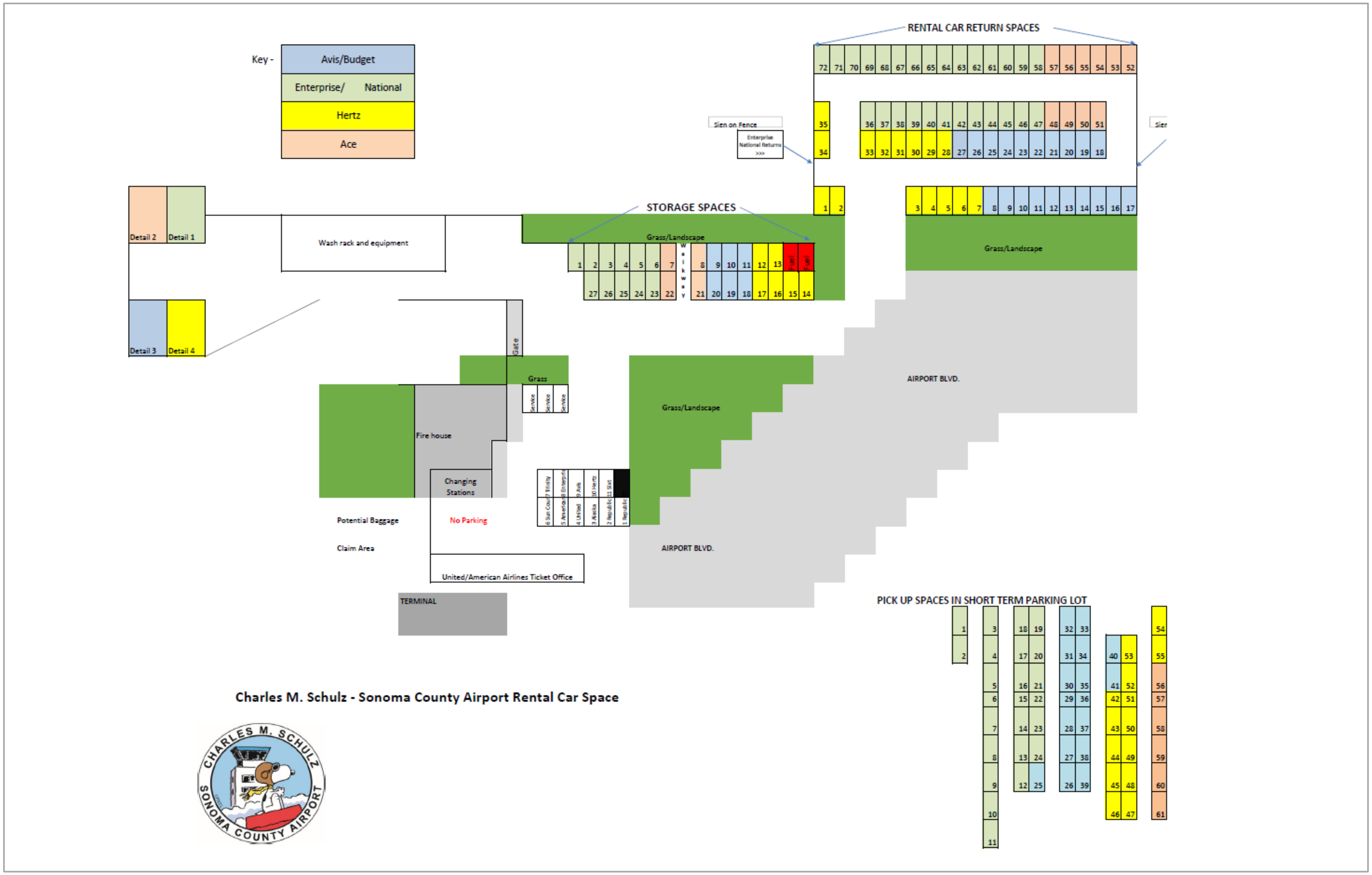
Table D-6: Overall Ready / Return Lot Parking Availability

Short-Term Lot	North Lot (Daily/ Long Term A)	South Lot (Daily/ Long Term B)	Curb Lot (Temporary Parking)	Aux Lot[1]	Total
61	50	-	-	60	**172**

Source: STS Airport and Mead & Hunt, Inc

1: Aux Lot includes general use parking previously reserved for use by fire station and use by employees. Double stalls allow for maximized capacity near the QTA fueling and washing facilities.

Figure D-3: Rental Car Facilities



Source: STS Airport and Mead & Hunt, Inc

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Temporary Parking Demand

Temporary parking lots include cell phone lots or rideshare staging areas, where vehicle may not be left unattended. Temporary parking lots or areas help limit demand and congestion at the arrival curb, and reduces volumes attributed to recirculating traffic. Cell phone lots are typically located with easy access to the main airport access road but are not within walking distance to the terminal to discourage their use as a no-cost, short-term lot.

Temporary parking areas do not require the same number of spaces as other parking lots. *The National Academies of Sciences Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies*, 2010, recommend temporary parking lots provide between 30 and 60 parking stalls.[1] The increased utilization of Transportation Network Companies (TNCs) for passengers traveling to and from an airport requires additional consideration for vehicle staging. While this demand does not necessarily require stripped stalls, the colocation of TNCs with the cell phone lot remains industry practice. Some airports have also required traditional taxi service to stage in the cell phone lot.

Temporary parking is currently allocated to stalls in the Curb Lot. These consist of angled stalls on the Terminal Drive side and parallel stalls located on a separate dedicated rideshare/TNC drive. Based on the size of STS it is estimated that temporary parking demand is 30 stalls, which will increase to 60 stalls along with enplanements over time. **Table D-7** shows the projected surplus or deficit of temporary parking at STS for each PAL.

Table D-7: Temporary Parking Demand

Parking Lot	PAL: Enplanements:	2019 / PAL 1 230,000	PAL 2 300,000	PAL 3 350,000	PAL 4 396,000	PAL 5 426,000
Curb Lot[1]						
Supply		42	42	42	42	42
Effective Supply		36	36	36	36	36
Demand		30	30	60	60	60
Deficit/ Surplus		**6**	**6**	**-24**	**-24**	**-24**

Source: Mead & Hunt, Inc

1: Temporary stalls include those utilized by rideshare services and "Cell Phone Lot" users.

Based on the analysis of parking demand for the temporary parking lot there is a small overall surplus of parking in the current condition. It is anticipated that this becomes a deficit in the 10-year planning horizon. Disruption and redistribution of temporary parking may be needed to facilitate the expansion of surplus for other surface parking types. In the event this occurs, planning for a 30-stall facility with the opportunity for expansion to 60-stalls over time will be needed. As mentioned above, ideally this would be located further from the terminal than the existing facilities in order to prevent premium stalls being used by non-paying users.

1 National Academies of Sciences. "Guidebook for Evaluating Airport Parking Strategies and Supporting Technologies." National Academies Press: OpenBook, 21 Jan. 2010

Parking Facility Needs and Demand Summary

The following are automobile parking facility issues that will need to be addressed through various interventions. With each listed issue, supplemental information is provided to lend context to the urgency and scale of the problem.

Passenger Parking

The analysis of Passenger Parking found small deficits in the short-term increasing over the planning horizon. Based on the analysis of each lot, a substantial portion of this deficit occurs in the short-term parking. This is due to the prevalence of overnight parkers in this lot. In the peak month of September, on average approximately 28% of stalls are occupied overnight. This accounts for nearly half of this lots deficit. Immediate intervention will be needed to remedy this trend in order to stave off a reduction in level of service during peak events.

As enplanements increase, the demand for additional passenger parking facilities will increase across the board. This requires planning for additional passenger parking stalls. Due to a lack of availability of vacant lands in the terminal vicinity, intervention may necessitate the construction of a parking structure rather than surface lots. Whether to build surface or proceed to the development of a structure will be dependent on an evaluation of actual enplanements compared to projections.

Rental Parking

As noted above, rental demand and supply are not necessarily directly correlated to an increase in enplanements, however, and increase in demand is expected. Interventions should focus on identifying potential sits for growth that have characteristics desirable to rental operators such as proximity to the terminal and counters, covered walkways and parking, and efficient access to the QTA facilities. The development of a CONRAC facility will need to be an Airport priority, not only for Rental Parking demand, but also as a result of the dispersed condition of existing Rental Parking stalls and how this impacts the availability and efficiency of passenger, employee, and temporary parking facilities.

Temporary Parking

The Curb Lot does not adequately serve the roll of a Temporary Parking facility due to its proximity to the terminal. Currently the most premium stalls at the Airport are occupied by Rideshare/TNC providers looking for an ideal fair. Anecdotal observation by Airport staff indicated that providers wait for a longer fair in order to maximize their fee and frequently turn down passengers looking for shorter rides.

Temporary parkers should be relocated to a newly developed approximately 30 stall temporary parking facility. This relocation will allow for the realignment/ reorganization of the terminal roadway and curbside for more efficient use and maximize parking supply. Locating it along the presumed travel path of Airport visitors, within convenient distance is preferred. Supply should increase over time and is estimated to need 60 stalls by the 15-year planning horizon.