



TECHNICAL MEMORANDUM No.7 FINAL

**FACILITIES IMPLEMENTATION AND FINANCIAL FEASIBILITY**  
Seattle-Tacoma International Airport

Prepared for  
Port of Seattle  
Seattle, Washington

May 2018



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## CONTENTS

|   | Page |
|---|------|
| Introduction and Summary .....                        | 1-1  |
| 1.1 Background .....                                  | 1-1  |
| 1.2 Purpose .....                                     | 1-1  |
| 1.3 Approach .....                                    | 1-2  |
| 1.4 Summary .....                                     | 1-2  |
| Near-Term Projects .....                              | 2-1  |
| 2.1 Overview .....                                    | 2-1  |
| 2.2 Major Project Linkages and Capacity Drivers ..... | 2-6  |
| 2.2.1 Passenger Gates & Terminal .....                | 2-6  |
| 2.2.2 Cargo Warehouse & Freighter Hardstand .....     | 2-6  |
| 2.3 Project Descriptions & Schedules .....            | 2-7  |
| 2.3.1 Major Airside Projects .....                    | 2-7  |
| 2.3.2 Major Terminal Projects .....                   | 2-10 |
| 2.3.3 Major Cargo Projects .....                      | 2-11 |
| 2.3.4 Major Landside Projects .....                   | 2-12 |
| 2.3.5 Major Airport/Airline Support Projects .....    | 2-14 |
| Airfield Operational Feasibility .....                | 3-1  |
| 3.1 Background .....                                  | 3-1  |
| 3.2 Approach and Assumptions .....                    | 3-1  |
| 3.3 Results and Conclusions .....                     | 3-3  |
| Financial Feasibility .....                           | 4-1  |
| 4.1 Background and Objectives .....                   | 4-1  |
| 4.2 Approach .....                                    | 4-1  |
| 4.3 Results .....                                     | 4-2  |
| 4.4 Conclusions .....                                 | 4-3  |
| Key Actions Following Completion of the SAMP .....    | 5-1  |
| 5.1 Introduction .....                                | 5-1  |
| 5.2 Recommended Actions .....                         | 5-2  |
| Long-Term Vision .....                                | 6-1  |
| 6.1 Long-Term Vision .....                            | 6-1  |

### Appendix A—Implementation Plan Alternatives

## TABLES

|     |   | Page |
|-----|---|------|
| 3-1 | Summary of Operations Included in 2027 Flight Schedule.....       | 3-3  |
| 3-2 | Summary of Estimated 2027 Airfield Delay Associated with NTP..... | 3-3  |
| 4-1 | Financial Impacts of SAMP Near-Term Projects.....                 | 4-2  |

## FIGURES

|      |  |      |
|------|--|------|
| 2-1  | Near-Term Projects.....  | 2-2  |
| 2-2  | Near-Term Projects – Dimensions for Improvements South of the Existing Terminal Complex .....      | 2-3  |
| 2-3  | Near-Term Projects – Dimensions for Improvements in the area of the Existing Terminal Complex..... | 2-4  |
| 2-4  | Near-Term Projects – Dimensions for Improvements North of the Existing Terminal Complex .....      | 2-5  |
| 2-5  | Schedule for Major Projects Associated With New North Gates and Second Terminal .....              | 2-6  |
| 2-6  | Schedule for Major Projects Associated With Cargo Warehouse and Freighter Hardstand .....          | 2-7  |
| 2-7  | Schedule for Major Airside Projects.....   | 2-10 |
| 2-8  | Schedule for Major Terminal Projects.....  | 2-11 |
| 2-9  | Schedule for Major Cargo Projects .....  | 2-12 |
| 2-10 | Schedule for Major Landside Projects.....  | 2-14 |
| 2-11 | Schedule for Major Airport/Airline Support Projects .....  | 2-16 |
| 6-1  | Vision for Comprehensive Long-range Airport Development .....                                      | 6-4  |

# Introduction and Summary

*The key results of the SAMP include a vision for long-term Airport development and a set of Near-Term Projects that is consistent with the Long-Term Vision, is compatible with the existing airfield, and is affordable.*

## 1.1 Background

This *Technical Memorandum No. 7 – Facilities Implementation and Financial Feasibility* (TM-7) is the seventh in a series of memorandums which document the analyses, results, conclusions, and recommendations resulting from the Sustainable Airport Master Plan (SAMP) for Seattle-Tacoma International Airport (Airport). *Technical Memorandum No. 6 – Alternatives* (TM-6) determined an optimal layout of facilities required to satisfy the unconstrained 20-year forecast demand (Long-Term Vision). Airside modeling conducted to test the ability of the Long-Term Vision facilities to accommodate 20-year forecast demand is documented in TM-6. Airside modeling determined that, even with all Long-Term Vision improvements, airfield/airspace constraints resulted in severe congestion and aircraft delays as activity approached 15-year forecast demand (forecast to occur in 2029). Given these existing constraints, all improvements depicted in the Long-Term Vision that are not included in the Near-Term Projects will be subject to further study discussed in section 5 of this TM-7. The Long-Term Vision was refined as part of implementation planning and is illustrated in Figure 6-1 and further described in Section 6 of this TM-7.

## 1.2 Purpose

The purposes of this TM-7 are to:

- Determine a set of Near-Term Projects (NTP) resulting from the SAMP, which fit within the Long-Term Vision for Airport development as broadly defined in *Technical Memorandum No. 6 Alternatives* and illustrated on Figure 6-1.
- Summarize the results of the simulation analyses that confirmed the improvements included in the NTP can meet demand in the year that they would become operational.
- Confirm that the NTP is financially feasible.
- Recommend key follow-on actions, all related to the airfield/airspace system, which should be initiated as soon as practical.
- Document refinements to the Long-Term Vision resulting from implementation plan alternatives analysis.
- Document project phasing alternatives that were considered in determining the NTP.

### 1.3 Approach

The approach to conducting implementation planning and developing the NTP was significantly influenced by the physical constraints unique to the Airport and a recent, sustained increase in activity—among North American large hubs, the Airport experienced the highest growth (21.9%) in aircraft movements and the second highest growth (52.6%) in passenger traffic in the last 10 years. High passenger and cargo demand have strained existing facilities, leaving very few opportunities to relocate functions to underutilized areas and generating a pressing need to provide additional capacity in all key functional areas. The high utilization of the majority of existing facilities coupled with physical constraints results in difficult construction sequencing and long sequences of enabling projects, both of which increase program costs and delay the delivery of needed capacity. These factors drove the need to explore alternative project sequencing that could deliver capacity sooner and/or delay expensive enabling projects.

The implementation planning approach included the following guiding principles:

- Sequence projects to add gate and hardstand (designated aircraft parking) capacity for passenger operations as soon as possible.
- Program construction of a second terminal and landside access to align with construction of gates that can be readily connected to the Second Terminal.
- Sequence projects to add warehouse and hardstand capacity for cargo operations as soon as possible.
- Minimize impacts to existing cargo and aircraft maintenance facilities until additional capacity can be constructed.
- Minimize throwaway costs, by avoiding, where possible, building new facilities that will be impacted by subsequent construction.

### 1.4 Summary

This TM-7 documents the analysis and conclusions of the SAMP implementation planning and financial feasibility assessment. The SAMP Long-Term Vision identifies facility improvements required to satisfy unconstrained demand over the 20-year planning horizon. The implementation plan process began by establishing a baseline implementation plan to deliver needed capacity through a sequence of projects that concludes with the full build-out of the Long-Term Vision. Once the baseline plan was established, development and evaluation of alternative project sequencing then focused on Near-Term Projects to deliver capacity in response to dramatic growth in passenger and cargo activity. These alternatives were developed and evaluated within the context of the physical and financial constraints which were clarified early in implementation planning process. Alternative project sequencing and gate expansion options explored through the implementation planning process are documented in Appendix A.

Recent, sustained increased demand has strained existing facilities. High utilization of the majority of existing facilities and physical constraints limits opportunities for expansion or redevelopment of on-airfield facilities and often triggers the need to relocate existing functions in order to provide additional capacity to accommodate increased demand. The planning team established the guiding principles listed in Section 1.3 *Approach* in response to these constraints and used them to identify a financially feasible package of projects to accommodate near-term demand.

The Near-Term Projects (NTP) detailed in Section 2 *Near-Term Projects* and illustrated in Figure 2-1, include all enabling and capacity improvement projects required to accommodate forecast demand in 2027. The year 2027 corresponds to when substantial gate, hardstand and terminal capacity become operational. In addition to 19 new narrowbody equivalent gates connected to a second terminal, the NTP includes taxiway modifications to increase operational efficiency and the creation of new hardstands to boost capacity for passenger and cargo operations. These improvements were modeled using Total Airspace and Airport Modeler (TAAM) to confirm that they can accommodate forecast 2027 activity. TAAM modeling of the Near-Term Projects is detailed in Section 3 *Airfield Operational Feasibility*.

In addition to modeling the improvements to confirm they can accommodate forecast activity in 2027, the Port also conducted a financial feasibility assessment of the capital program costs to verify that the Port can feasibly finance these Near-Term Projects and other anticipate airport expenses through the year 2027. The analysis projected expenses and considered future airport debt and revenue to assess the Port's financial capabilities and future competitiveness with other airports in terms of Cost Per Enplanement (CPE). The analysis is documented in Section 4 *Financial Feasibility* and concluded that the Near-Term Projects are financially feasible.

As documented in Section 2.5 of *Technical Memorandum No. 6 Alternatives*, airfield modeling determined that, with all improvements included in the Long-Term Vision and no other changes to how the airfield/airspace is operated, the airfield/airspace as currently configured has insufficient capacity to meet the unconstrained 20-year forecast demand at an acceptable level of delay. The improvements included in the NTP fit within the Long-Term Vision and are stand-alone projects that are needed to satisfy near-term demand. While the Long-Term Vision includes airfield projects that improve the effectiveness of the airfield system, a comprehensive airfield/airspace study is needed to develop and assess alternatives to meet the unconstrained 20-year forecast demand. Given the existing airfield/airspace constraints, all improvements depicted in the Long-Term Vision that are not included in the Near-Term Projects will be subject to further study discussed in Section 5 *Key Actions Following Completion of the SAMP*. The Long-Term Vision was refined as part of implementation planning and is illustrated in Figure 6-1 and further described in Section 6 *Long-Term Vision*.

# Near-Term Projects

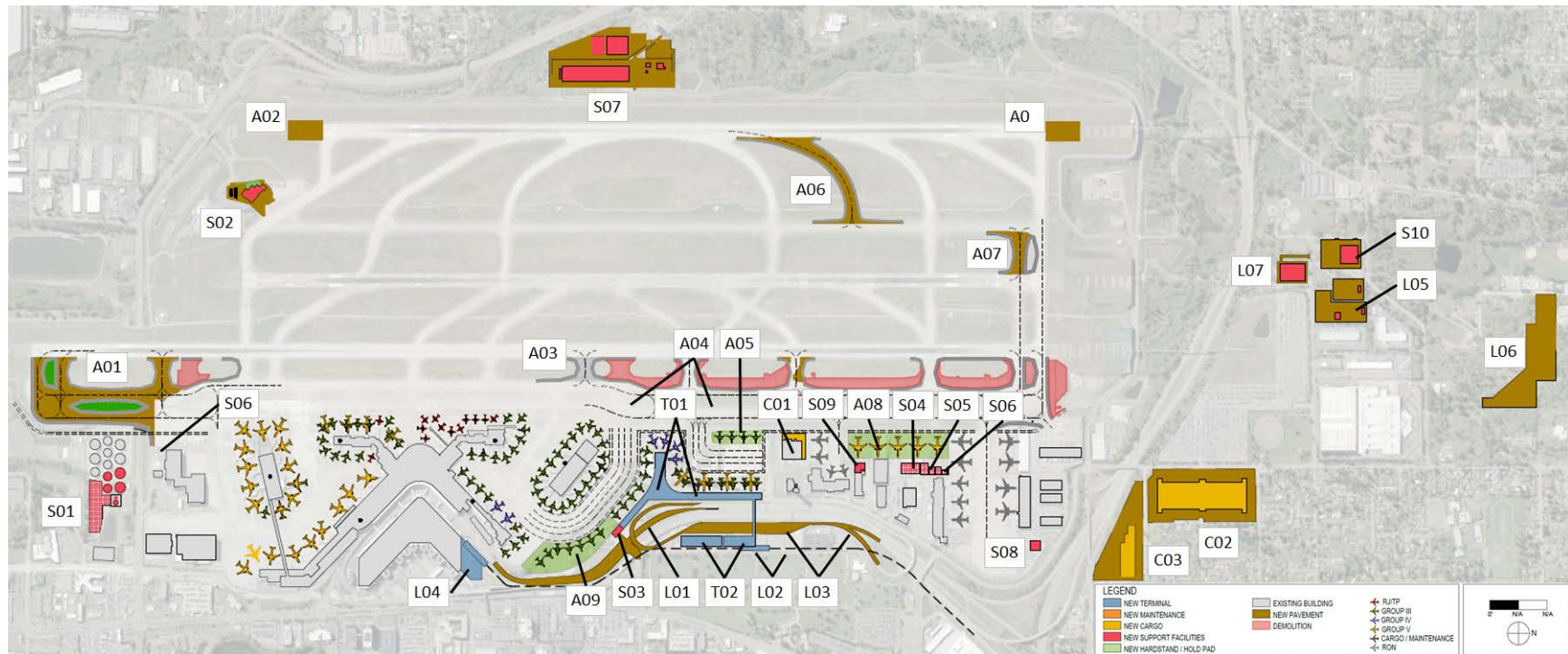
*The Near-Term Projects (NTP) includes enabling and capacity projects, including a new north terminal and 19 new narrow-body gates, which will permit the Airport to accommodate approximately 56 million annual passengers and 480,000 annual aircraft operations.*

## 2.1 Overview

The Near-Term Projects (NTP), illustrated on Figure 2-1, includes enabling and capacity improvement projects to satisfy facility requirements for forecast Airport activity through the year 2027 (approximately 56 million annual passengers and 480,000 annual aircraft operations). The Year 2027 corresponds to when substantial gate, hardstand and terminal capacity estimated to become operational. Airfield projects include taxiway modifications to increase operational efficiency and the creation of new hardstands to boost capacity for passenger and cargo operations. These improvements, along with added gate capacity, were modeled using Total Airspace and Airport Modeler (TAAM) to confirm that they can accommodate forecast 2027 activity. The TAAM modeling effort is documented in Section 3 *Airfield Operational Feasibility*. Figures 2-2, 2-3 and 2-4 illustrate the dimensions used to locate planned improvements and demonstrate compliance with separation requirements per AC 150/5300-13A- Airport Design.

Appendix A details alternative project sequencing and gate expansion options explored through the implementation planning process. The primary driver for the sequence of development included in Alternative 1 - *Baseline* and the exploration of other alternatives through the implementation planning process was the need to increase passenger and cargo facilities capacity as soon as possible. To that end, the planning team used the established guiding principles listed in Section 1.3 *Approach* to determine that Phase 1 of Alternative 2 - *Baseline with SASA deferred and Concourse B reconstruction removed* was the best package and sequence of projects to effectively accomplish this goal. The NTP also includes a number of landside improvements to provide access to the North Terminal; connectivity between the Rental Car Facility, Second Terminal and Main Terminal; expand employee parking; and expand ground transportation holding lots. Airport/airline support facility projects in the NTP primarily replace facilities displaced by passenger and cargo facility development, with the exception of projects S01 Fuel Farm Expansion (a capacity project) and S09 Centralized Receiving and Distribution Center (a security and operational efficiency project). Major project linkages and capacity drivers are discussed in more detail in Section 2.2. All projects included in the NTP are listed and described in Section 2.3 *Project Descriptions & Schedules*.

Figure 2-1  
Near-Term Projects  
Seattle-Tacoma International Airport



#### Airside

- A01 Taxiway A/B Extension
- A02 Runway 16R-34L Blast Pads
- A03 Taxiway L Relocation (*Pre-SAMP project*)
- A04 Taxiway B 500' Separation & RIM Mitigation
- A05 North Hold Pad
- A06 Runway 34L Highspeed Exit
- A07 Taxiway D Extension
- A08 Hardstand (*north*)
- A09 Hardstand (*central*)
- A10 Taxiway Fillets (*not shown*)
- A11 Taxiway Q HS/RIM (*Pre-SAMP project*) (*not shown*)

#### Terminal

- T01 North Gates
- T02 Second Terminal & Parking

#### Cargo

- C01 Cargo 4 South Redevelopment
- C02 Off-site Cargo Ph 1 (*L-Shape*)
- C03 Off-site Cargo Ph 2 (*L-Shape*)

#### Landside

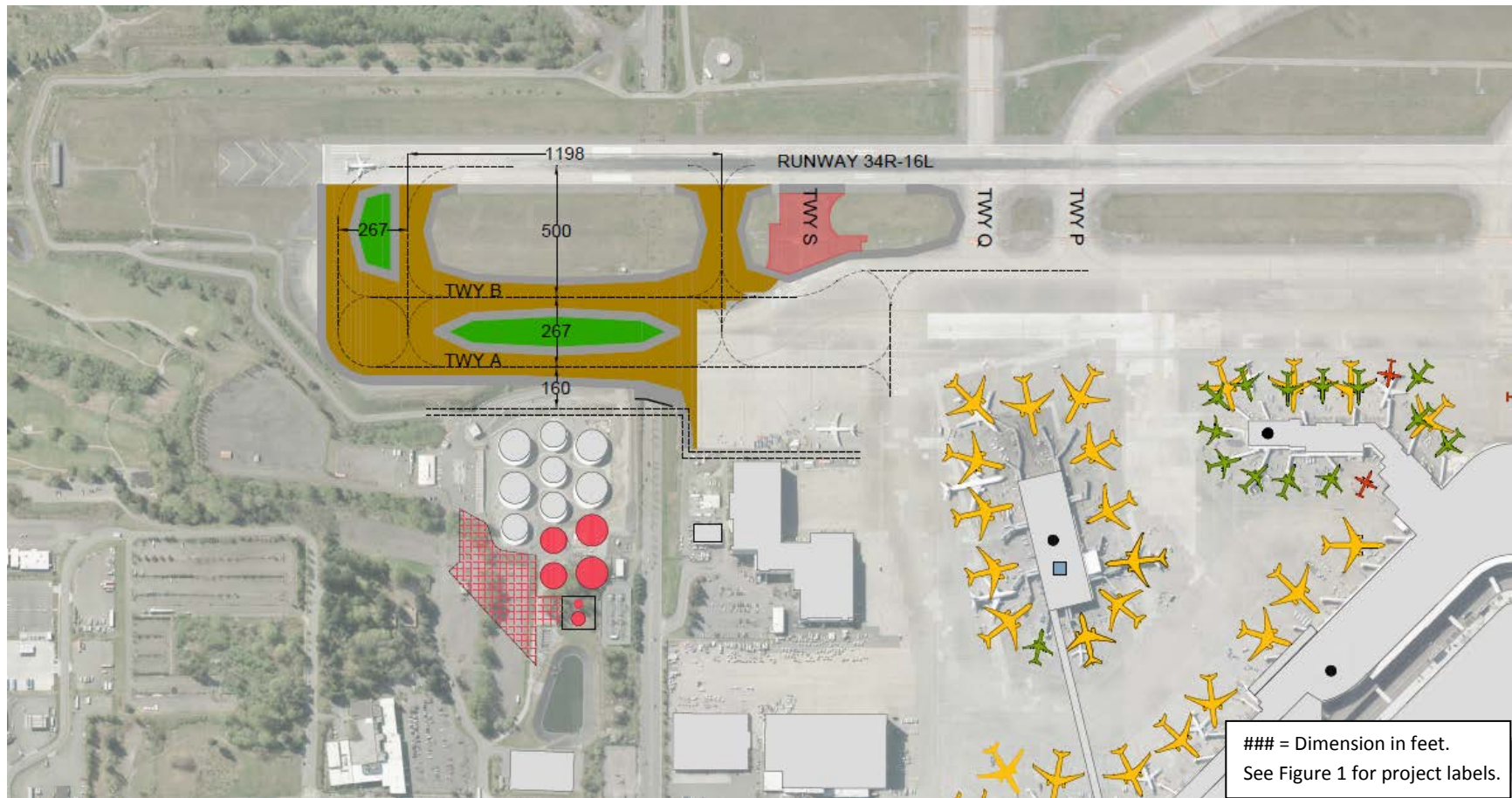
- L01 NAE Relocation (*southbound lanes*)
- L02 Elevated Busway & Stations
- L03 Second Terminal Roads/Curbside
- L04 Main Terminal North GT Lot
- L05 North GT Holding Lot
- L06 Employee Parking Surface Lot
- L07 Employee Parking Structure

#### Airport/Airline Support

- S01 Fuel Farm Expansion
- S02 Primary ARFF
- S03 Secondary ARFF
- S04 Fuel Rack Relocation
- S05 Triculator
- S06 Consolidated De-icing Tanks
- S07 Westside Maintenance Campus
- S08 Airline Support (*north*)
- S09 Airline Support (*west*)
- S10 Centralized Rec. & Dist. Center

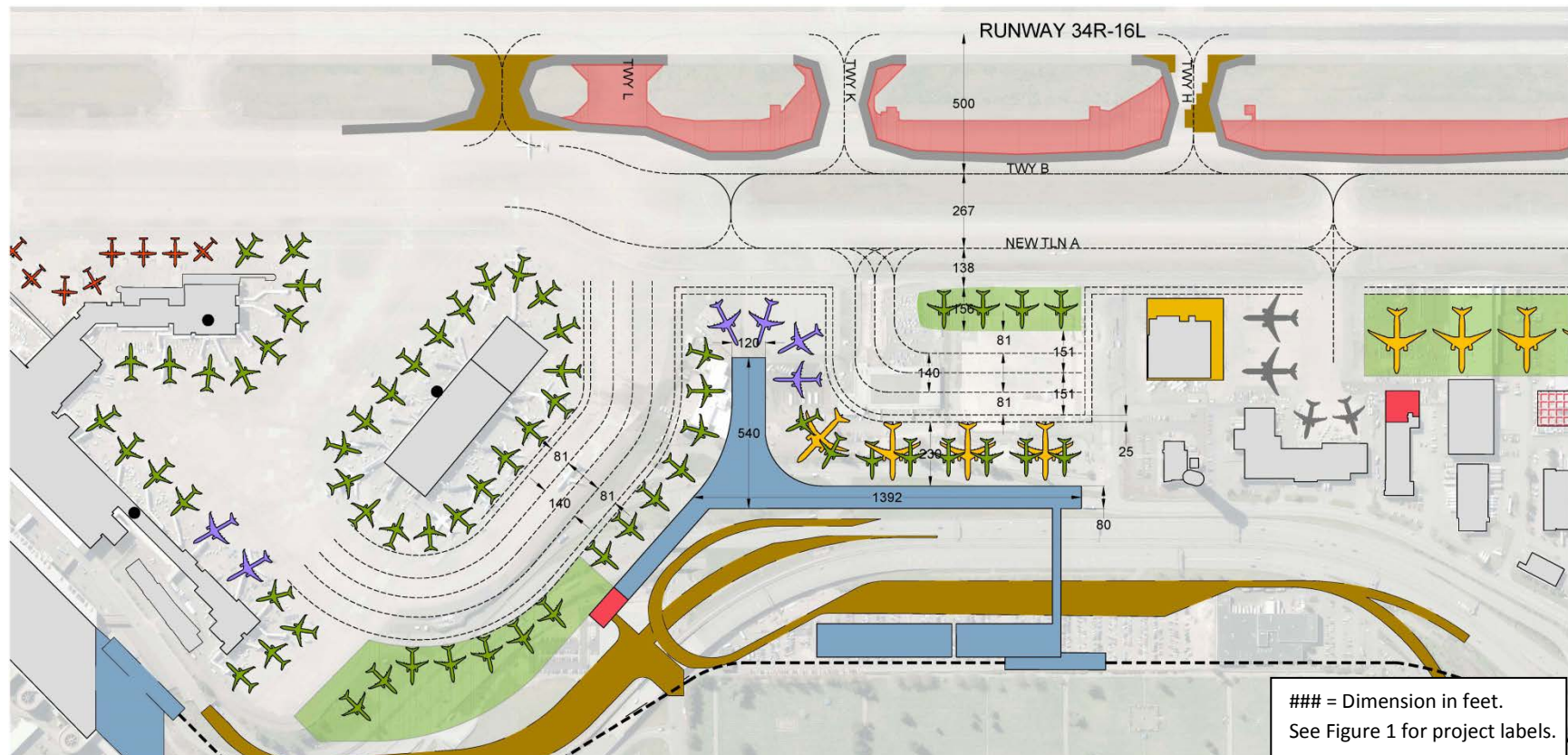
Source: Port of Seattle, 2017.

Figure 2-2  
Near-Term Projects – Dimensions for Improvements South of the Existing Terminal Complex  
Seattle-Tacoma International Airport



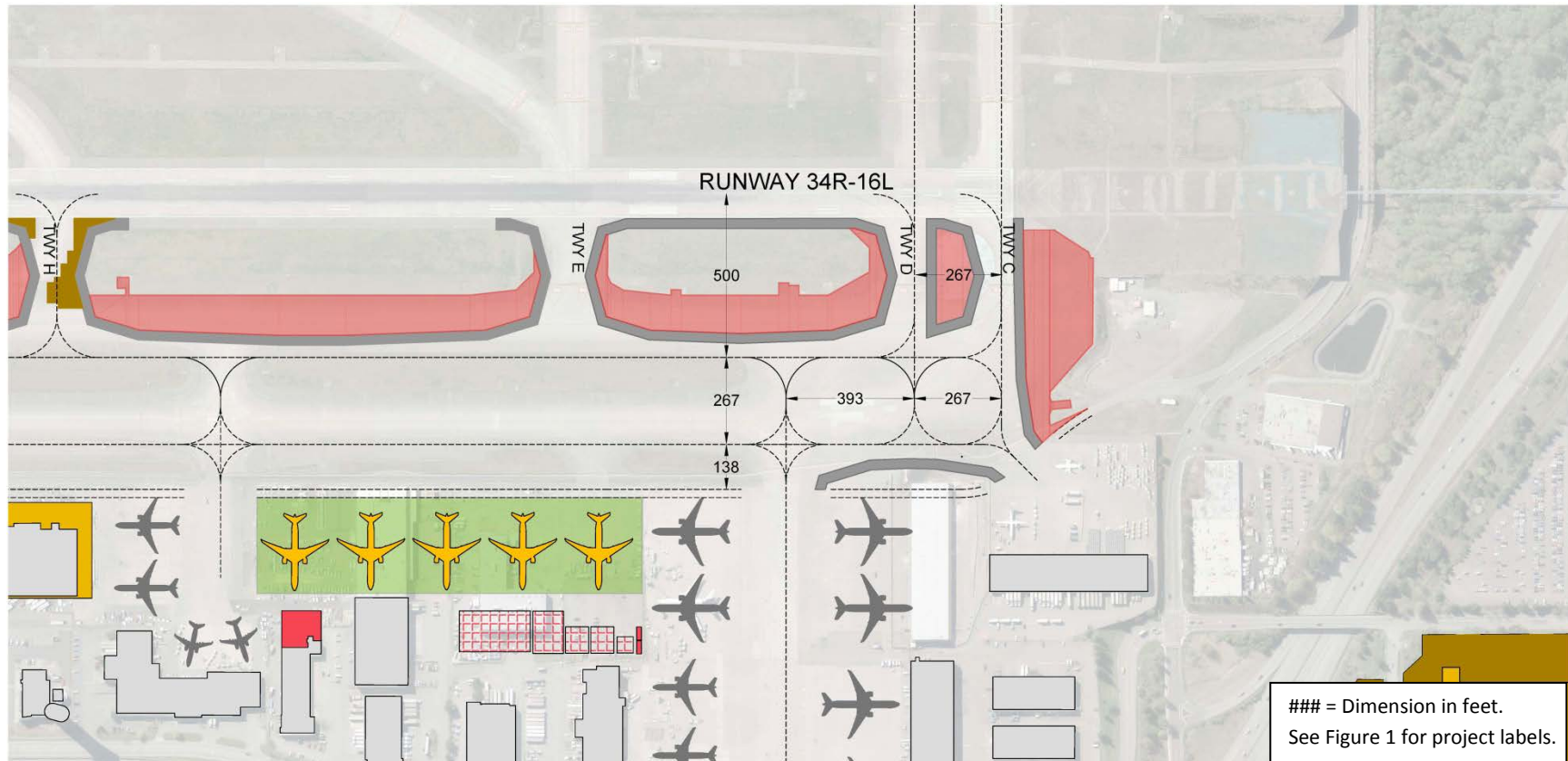
Source: Port of Seattle, 2017.

Figure 2-3  
Near-Term Projects – Dimensions for Improvements in the area of the Existing Terminal Complex  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

Figure 2-4  
**Near-Term Projects – Dimensions for Improvements North of the Existing Terminal Complex**  
 Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

## 2.2 Major Project Linkages and Capacity Drivers

As described in Section 1.4 *Summary*, a primary purpose of conducting implementation planning is to determine a logical sequence of projects required to increase facility capacity and improve level of service in response to increased demand. Given the physical constraints surrounding the current airfield and high utilization of existing facilities, expansion or redevelopment of on-airfield facilities often triggers the need to relocate existing functions in order to provide additional capacity to accommodate increased demand. The subsections below describe enabling projects required to construct major NTP passenger and cargo capacity improvement projects.

### 2.2.1 Passenger Gates & Terminal

The schedule of projects in Figure 2-5 illustrates construction periods and includes the major capacity projects and enabling projects associated with providing additional passenger gates and terminal facilities. A number of enabling projects are required in order to clear an area for construction of gates hardstand for passenger operations. The critical path linkages between these enabling projects and the T01 North Gates and A09 Hardstand (*central*) projects are shown in red in Figure 2-5.



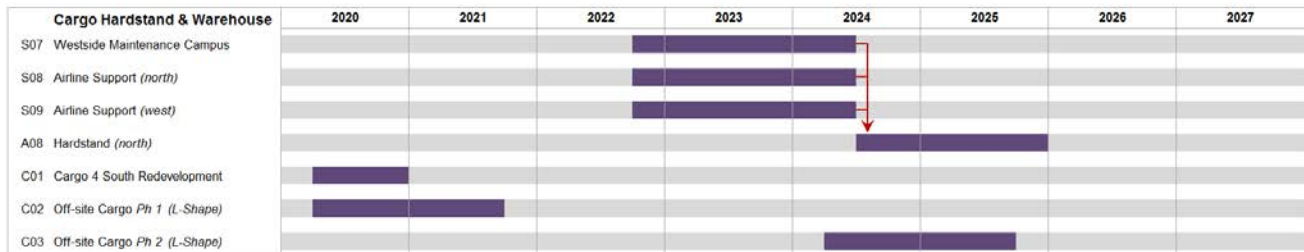
Source: Port of Seattle, 2017.

### 2.2.2 Cargo Warehouse & Freightier Hardstand

The schedule of projects in Figure 2-6 illustrates construction periods and includes the major capacity projects and enabling projects associated with providing cargo warehouse and freighter hardstands. Construction of hardstands for passenger operations, as a first phase of T01 North Gates construction, eliminates the Swissport cargo warehouse and two freighter parking positions in the Cargo 6 area. Reconstruction of the C01 Cargo 4 South building could potentially offset the loss of warehouse capacity at Cargo 6 and construction of new hardstand to the north (A08) would result in a net gain of hardstand capacity in the near-term. While not physically located on the airfield, new cargo warehouses and truck terminals constructed on the L-Shape property (C02 & C03) will be ideally situated to leverage this additional freighter hardstand capacity. Construction of the A08 Hardstand (*north*) requires removal of the Port Aviation Maintenance Facility (AMF) and the United Airlines

maintenance building. Replacement facilities for the AMF will be constructed in the S07 West-side Maintenance Campus. The United Airlines maintenance building includes shops for aircraft and Ground Service Equipment (GSE) maintenance and the Swissport building also includes GSE maintenance facilities. The NTP identifies two areas where these airline support functions can be accommodated (S08 & S09). Figure 2-6 identifies the construction of replacement Port maintenance facilities and the airline support facilities as critical path enabling projects for construction of the A08 Hardstand (*north*).

**Figure 2-6**  
**Schedule for Major Projects Associated With Cargo Warehouse and Freighter Hardstand**  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

## 2.3 Project Descriptions & Schedules

### 2.3.1 Major Airside Projects

Major airside projects are described below and construction schedules are shown on Figure 2-7.

- A01 – Taxiway A/B Extension** – Taxiway B is a full length Taxiway parallel to RWY 16L/34R and serves as a primary link to the runway and all gates. Taxiway A runs parallel to Taxiway B north of the terminal complex. This project would create a similar configuration south of the Cargo 7 hardstand by relocating Taxiway B south of Taxiway S to 500' runway/taxiway separation and provide a new parallel taxiway, Taxiway A. Taxiway A will be located 267' east of Taxiway B. The existing Taxiway B (Runway 16L-34R entry/exit taxiway) will also be split into two entry/exit taxiways, one at the runway threshold and a second 267' (centerline-to-centerline separation) north. All taxiways should be designed to Aircraft Design Group (ADG)-V / Taxiway Design Group (TDG)-6 standards aligning with the airports critical aircrafts. The taxiways should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16L-34R protection, the taxiway shall include hold position markings with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided. To facilitate the taxiway work, the Runway 34R Glide Slope (GS) will need to be relocated to the west side of Runway 16L-34R because it will be displaced by the Taxiway B construction. Relocation of the GS will require fill material to create a pad for the GS antenna and reflective plane that is at the runway elevation. Additional work that may also be required to facilitate the taxiway

construction is a new Vehicle Service Road (VSR) bridge over S 188 Street. The VSR will be placed outside of the proposed Taxiway A Object Free Area (OFA).

- A02 – Runway 16R-34L Blast Pads – A runway blast pad is a surface adjacent to a runway intended to provide erosion protection from aircraft jet blast. The existing blast pads on RWY 16R-34L will be expanded to standard 220'x400' blast pads. This project will require additional asphalt pavement and pavement markings.
- A03 – Taxiway L Relocation (*Pre-SAMP project*) – Taxiway L is a short east-west taxiway adjacent to the North Satellite. Taxiway L will shift approximately 400' to the south to resolve an issue with direct access between Runway 16L-34R and the North Satellite apron. The relocated Taxiway L will be designed to ADG-V / TDG-6 standards and will be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16L-34R protection, the taxiway shall include hold position markings with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided. Relocation of Taxiway L is anticipated to be completed during the 2018 construction season.
- A04 – Taxiway B 500' Separation & RIM Mitigation – To provide the standard 500' runway/taxiway separation, Taxiway B will be moved 100' to the east between Taxiway C (at the north end of the airfield) and the approximate location of the existing Taxiway L. Shifting Taxiway B will also result in Taxiway A being shifted east so that it is 267' (centerline-to-centerline separation) east of Taxiway B. Taxiway A will become a taxilane with 138' Taxiway Object Free Area (OFA) separation. Taxilanes can be either inside or outside of the movement area and the SAMP is not proposing to change the existing operational use of Taxiway A when it becomes the new Taxilane A. Taxiways C, D, E, H, and K between Taxiway B and Runway 16L-34R will need to be adjusted/extended to account for the shift in Taxiway B. Taxiways C and D will also be extended to Taxilane A and the expanse of pavement north of Taxiway C will be removed in an attempt to mitigate the existing RIM location. A phased approach to mitigating the RIM location by connecting Taxiways C and D perpendicularly to the existing Taxiway A and eliminating the expanse of pavement will be evaluated as part of ongoing planning and design activities with the intent to incrementally improve safety at this location. A phased approach appears feasible and may provide an opportunity to mitigate the RIM location earlier than shown in Figure 2-7. All taxiways should be designed to ADG-V/ TDG-6 standards aligning with the airport's critical aircrafts. The taxiways should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16L-34R protection, all taxiway entrances/exits shall include hold position markings with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided.
- A05 – North Hold Pad - In the northwest corner of the apron constructed as part of the T01 North Gates project is a hold pad capable of accommodating four ADG-III

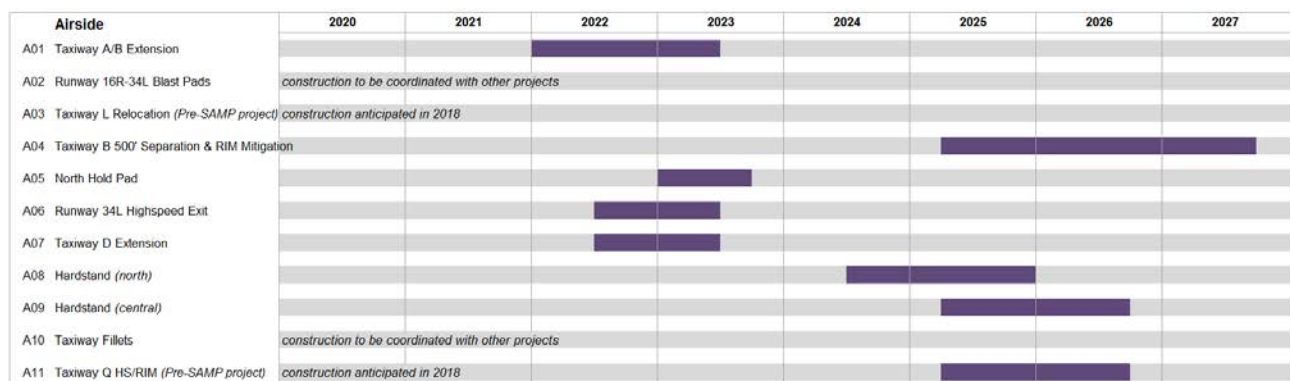
aircraft. The hold pad would be used by aircraft waiting to take off or waiting for a gate, to reduce congestion on the taxiways and at the terminal.

- A06 – Runway 34L High-speed Exit – High-speed exits allow landing aircraft to exit the runway at relatively higher speeds, leading to less time on the runway. A new high-speed exit will be constructed for Runway 34L arrivals. The high-speed exit should be designed to ADG-V / TDG-6 standards aligning with the airport’s critical aircrafts. The high-speed exit should be located between Taxiway J and Taxiway E, approximately 5,000’ from the RWY 34L threshold. The high-speed exit should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16R-34L protection, the taxiway shall include a hold position marking with in-pavement lights. Taxiway signage will be provided. The Airport is currently updating from a Local-Area Augmentation System (LAAS) to a Ground Based Augmentation System (GBAS). As part of the update, a new location for the GBAS is being considered. If the GBAS utilizes the existing LAAS site, the GBAS will need to be relocated to facilitate construction of the high-speed exit.
- A07 – Taxiway D Extension – Taxiway D is currently a short taxiway between Runways 16C-34C and 16L-34R, and is used by aircraft waiting to take off from Runway 16C. This project will extend Taxiway D from Runway 16C-34C west to Taxiway T, which is a full-length taxiway between Runways 16C-34C and 16R-34L. Taxiway D should be designed to ADG-V / TDG-6 standards aligning with the airport’s critical aircrafts. Taxiway D should be parallel to and located 267’ (centerline-to-centerline separation) from Taxiway C. Taxiway D should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16C-34C protection, the taxiway shall include a hold position marking with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided.
- A08 – Hardstand (*north*) – New hardstand (designated aircraft parking) is needed to accommodate increased cargo freighter demand. The hardstand will be constructed in the North Cargo area and located east of Taxiway A with all aircraft entering/exiting the hardstand via Taxiway A. The hardstand will be approximately 1,200’ long with a depth of approximately 300’ on the south and 500’ on the north. The hardstand should be sufficient to accommodate approximately 5 ADG-V aircraft. This project requires the relocation of Airfield Maintenance Building (Project S07) and demolition of the United Airlines maintenance building.
- A09 – Hardstand (*central*) – New hardstand is needed to accommodate increased demand for passenger hardstand operations and Remain Overnight parking of passenger aircraft (RON, used for aircraft parking at night so that they can be used for early-morning departures). Passengers will be bused to/from aircraft on the hardstand, primarily from the Concourse D hardstand holdroom and other holdrooms with bus access on the north side of the terminal complex. This project will create apron space for hardstand/RON operations north of Concourse D and East

of the North Satellite. The apron space should be sufficient to accommodate approximately 7 ADG-III aircraft. The depth and width of the apron varies. This project requires the relocation of the southbound lanes of the North Airport Expressway (Project L01). Following relocation of the roadway, fill will be required to increase the elevation in the area to provide a continuous expansion of the existing apron.

- A10 – Taxiway Fillets *[NOT SHOWN]* – Fillets are essentially rounded corners created with pavement and markings, and are used as part of taxiways to provide adequate distances between aircraft and the pavement edges. Fillets which currently do not meet TDG-6 standards will be improved when the fillet/area is in need of a reconstruction or impacted by a project. Adjustments to fillets will likely require adjustments to full strength pavement panels, shoulders, edge lighting, and signage.
- A11 – Taxiway Q Hot Spot/Runway Incursion Mitigation (HS/RIM) *(Pre-SAMP project) [NOT SHOWN]* – Adjustments will be made to the Taxiway Q centerline paint markings and in-pavement taxiway centerline lights to mitigate hot spots and runway incursions hazards. The Taxiway Q HS/RIM project is anticipated to be completed during the 2018 construction season.

Figure 2-7  
**Schedule for Major Airside Projects**  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

### 2.3.2 Major Terminal Projects

Major terminal projects are described below and construction schedules are shown on Figure 2-8.

- T01 – North Gates – The North Gates project is a multi-level concourse connected to the Second Terminal via a pedestrian bridge and tunnel for baggage conveyance. In addition to gates, it includes an apron area for at gate aircraft parking, taxilanes, and a hold pad (A05 North Hold Pad). The multi-level concourse occupies an approximately 215,000 sf footprint and includes a ramp level for baggage/aircraft support functions; passenger concourse level with holdrooms, concessions, restrooms, etc.; and a mezzanine level with

office space and vertical circulation to the north terminal passenger walkway. The apron would accommodate up to 19 Aircraft Design Group (ADG)-III contact gates (sized for narrowbody aircraft such as the Boeing 737, but with the ability to be reconfigured for larger aircraft, and connected to the building) surrounded by dual ADG-III or a single ADG-V taxilane.

Construction of the North Gates and Apron requires the relocation of multiple facilities, including: the primary ARFF, fuel rack, the southbound lanes of the North Airport Expressway (NAE), Cargo 5 hardstand, Cargo 6 hardstand, deicing fluid storage, and the Swissport cargo building. The majority of facilities impacted by the North Gates will be relocated (Projects S02, S04, L01, S06, C02, and C03), with the exception of the Cargo 5 & 6 hardstands. Reconstruction/expansion of the Cargo 5 & 6 hardstands will be one of the initial phases for the North Gates project and will accommodate increased demand for hardstand operations and RON until the North Gates are activated and hardstand operations can be moved to contact gates.

- T02 – Second Terminal & Parking – A second terminal to the north is needed to support the planned North Gates. The Second Terminal will include facilities for passenger check-in; passenger and baggage screening; airline offices, baggage conveyance and claim; concessions; and restrooms. The Second Terminal and associated parking will be sized to support the new North Gates.

Figure 2-8  
**Schedule for Major Terminal Projects**  
Seattle-Tacoma International Airport

| Terminal                      | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|-------------------------------|------|------|------|------|------|------|------|------|
| T01 North Gates               |      |      |      |      |      |      |      |      |
| T02 Second Terminal & Parking |      |      |      |      |      |      |      |      |

Source: Port of Seattle, 2017.

### 2.3.3 Major Cargo Projects

Major cargo projects are described below and construction schedules are shown on Figure 2-9.

- C01 – Cargo 4 South Redevelopment – Additional cargo warehouse capacity is needed to accommodate growth in cargo activity. The Cargo 4 South site will be redeveloped to maximize warehouse capacity. New facilities will include a roughly 80,000 square foot building with warehouse and office space, truck terminals and parking for visitors and employees.
- C02 – Off-site Cargo Phase 1 (*L-Shape*) – Additional cargo warehouse capacity is needed to accommodate growth in cargo activity. New cargo facilities constructed on the Port owned L-Shape property in this first phase of development will include a roughly 330,000 square foot building with warehouse and office space, truck terminals and

parking for visitors and employees. While the L-Shape property is not located on the airfield and has no direct adjacency to freighter hardstands or secure warehouse access for cargo tugs, the close proximity of the L-Shape to the airfield provides the ability to transfer prescreened cargo pallets via trucks to/from the airfield. Cargo warehousing on the L-Shape will be used to build-up and breakdown cargo and will maximize the use of existing and planned freighter hardstand positions.

- C03 – Off-site Cargo Phase 2 (*L-Shape*) – Additional cargo warehouse capacity is needed to accommodate growth in cargo activity. New cargo facilities constructed on the Port owned L-Shape property in this second phase of development will include a roughly 90,000 square foot building with warehouse and office space, truck terminals and parking for visitors and employees. While the L-Shape property is not located on the airfield and has no direct adjacency to freighter hardstands or secure warehouse access for cargo tugs, the close proximity of the L-Shape to the airfield provides the ability to transfer prescreened cargo pallets via trucks to/from the airfield. Cargo warehousing on the L-Shape will be used to build-up and breakdown cargo and will maximize the use of existing and planned freighter hardstand positions.

Figure 2-9  
Schedule for Major Cargo Projects  
Seattle-Tacoma International Airport

| Cargo                                      | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 |
|--|------|------|------|------|------|------|------|------|
| C01 Cargo 4 South Redevelopment            |      |      |      |      |      |      |      |      |
| C02 Off-site Cargo Ph 1 ( <i>L-Shape</i> ) |      |      |      |      |      |      |      |      |
| C03 Off-site Cargo Ph 2 ( <i>L-Shape</i> ) |      |      |      |      |      |      |      |      |

Source: Port of Seattle, 2017.

### 2.3.4 Major Landside Projects

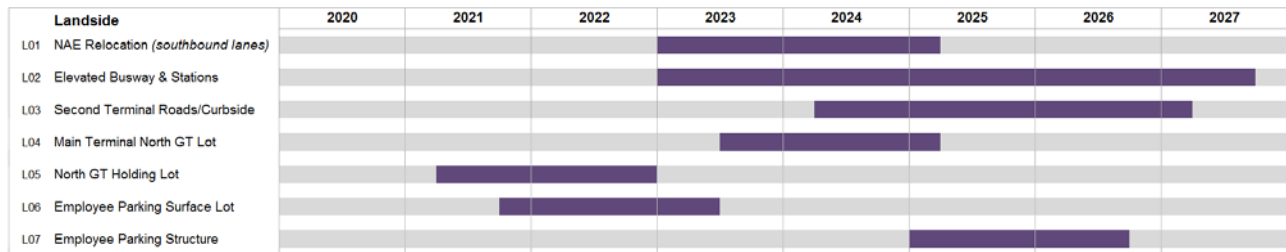
Major landside projects are described below and construction schedules are shown on Figure 2-10.

- L01 – North Airport Expressway (NAE) Relocation (*southbound lanes*) – Relocation of the southbound lanes of the NAE is required to clear the site for construction of A08 Hardstand (*central*) and T01 North Gates. The reconstructed southbound lanes will include the same number of lanes as exist today, and will result in the elimination of the cell phone waiting lot as well as Air Cargo Road and associated on/off ramps currently located south of Gate E125 and air traffic control tower. There are no suitable locations on Port property for relocation of the cell phone waiting lot which requires convenient and intuitive access to the freeway system. In the absence of a cell phone waiting lot, the Port will explore operational alternatives utilizing parking garages at the existing and future terminals.
- L02 – Elevated Busway & Stations – An elevated busway and stations are required to provide a landside connection for non-secure passengers accessing the Main Terminal,

Second Terminal, and Rental Car Facility (RCF). The Main Terminal busway station will be at the north end of the existing Main Parking garage and incorporated into the Main Terminal North Ground Transportation (GT) lot. The busway will extend north over the NAE and Light Rail to a Second Terminal station. The busway will extend north from the Second Terminal Station and ramp down to an at grade intersection at the S. 160<sup>th</sup> GT lot site where the existing RCF bus entrance will provide access to the RCF curb.

- L03 – Second Terminal Roads & Curbside – Landside improvements are required to provide ingress/egress to the Second Terminal and to connect the existing roadways system, providing access to/from the existing Main Terminal. Ingress is provided via a loop ramp from the southbound lanes of the NAE. Curbs for private and commercial vehicles are provided on a single level for arriving and departing passengers. Egress is provided via exit lanes/ramps connecting to the existing S. 160<sup>th</sup> St. Loop, westbound SR 518 on-ramp at S. 160<sup>th</sup> St., and the northbound lanes of the NAE.
- L04 – Main Terminal North Ground Transportation (GT) Lot – Vertical expansion of the existing lot is required to accommodate increased bus demand including charter and cruise passenger buses. The expansion may include levels above for passenger circulation and office space with pedestrian bridge connection to the Main Terminal.
- L05 – North Ground Transportation (GT) Lot – A new GT lot is needed to accommodate increased demand and replace the S 160<sup>th</sup> St. GT lot displaced by the Elevated Busway. A new 180,000 square foot surface lot will be constructed on Port property north of SR 518.
- L06 – Employee Parking Surface Lot – A new surface parking lot is required to accommodate increased demand. A new 1,500 stall employee parking surface lot will be constructed on Port owned property north of SR 518.
- L07 – Employee Parking Structure – A new parking structure would provide additional capacity to accommodate increased demand and/or replace stalls displaced by potential cargo development on the existing North Employee Parking Lot (NEPL). A new parking structure of up to 2,000 stalls would be constructed on Port property adjacent to and west of NEPL.

Figure 2-10  
**Schedule for Major Landside Projects**  
 Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

### 2.3.5 Major Airport/Airline Support Projects

Major airport/airline support projects are described below and construction schedules are shown on Figure 2-11.

- S01 – Fuel Farm Expansion – Expansion of the fuel farm includes additional settling tank capacity and construction of infrastructure to support the Ports biofuel initiative. The addition of four settling tanks adding approximately 10 million gallon storage capacity will require additional piping, expansion of the spill containment dike, and four above ground storage tanks. Infrastructure required to support the Ports Sustainable Aviation Biofuels (SAB) initiative includes a 500,000 gallon blending tank, 100,000 gallon neat SAB receipt tank, spill containment dike, fuel transfer pump, piping to transfer the fuel from the blending station to the existing/proposed settling tanks, and a truck fuel rack to support the delivery of SABs for blending. The infrastructure required for both projects will be located east of the existing fuel farm on the abandoned south end employee parking lot.
- S02 – Primary Air Rescue and Firefighting (ARFF) station – Relocation of the Primary ARFF station from its current location in the Cargo 6 area is required to clear the site for construction of T01 North Gates. The Primary ARFF will be relocated to the site of the existing secondary ARFF in the General Aviation Area. From this location, response times to the furthest runway can be achieved. The ARFF facility will be a multi-bay station that conforms to AC 150/5210-15A – Aircraft Rescue and Firefighting Station Building Design.
- S03 – Secondary ARFF – Relocation of the Primary ARFF station from its current location in the Cargo 6 area is required to clear the site for construction of T01 North Gates. With the relocation of the Primary ARFF station, a Secondary ARFF is needed to provide ambulatory response to the Terminals and Concourses; fuel spill and fire response to the concourse ramp areas, and back-up emergency response to the airfield. The secondary ARFF facility will be integrated with the North Gates at the southeast end of the concourse and will have both airside and landside access.

- S04 – Fuel Rack Relocation – Relocation of the fuel rack from its current location in the Cargo 6 area is required to clear the site for construction of T01 North Gates. The project will include extension of the fuel line to the future location in the North Cargo area east of the new A08 Hardstand (*north*). The project will replace existing, displaced facilities and fuel truck parking.
- S05 – Triculator – The Triculator (or Triturator) is a waste grinding facility that requires water and sewer access to process the contents of ground service provider lavatory trucks. The Triculator is currently located east of the existing ARFF station and is an impediment to the A09 Hardstand (*central*) project. To facilitate the A09 Hardstand (*central*) project, the triculator will be relocated to the North Cargo area east of the new A08 Hardstand (*north*).
- S06 – Consolidated De-icing Fluid Storage Tanks – In an effort to consolidate storage of aircraft deicing fluid and to clear a site for the construction of T01 North Gates, a set of deicing fluid tanks are proposed on both the north and south end of the airfield. The consolidated de-icing fluid storage tanks will be the common de-icing fluid racks from which all ground service providers can fill de-icing equipment with de-icing fluid. The southern set of tanks will replace and occupy the same location as the individual airline tanks that are currently located at Cargo 7. The northern set of tanks is to be located in the North Cargo area, east of the new A08 Hardstand (*north*) and will replace tanks that are displaced from the Cargo 6 area. Each site will have two tanks, one for Type I and the second for Type IV. Each set of tanks will also have a blending station.
- S07 – West-side Maintenance Campus – Relocation of the Port’s Aviation Maintenance Facility (AMF) from its current location in the North Cargo area is required to clear the site for construction of the A08 Hardstand (*north*) project. The AMF will be located on the west side of the airport in the West-side Maintenance Campus and situated on a set of tiered platforms moving down the hill side. The new AMF will accommodate the relocation of current AMF facilities which includes a vehicle fuel rack, airfield deicer storage, and an approximate 135,000 square feet multi-bay building.

The West-side Maintenance Campus will also accommodate relocation of the snow shed from the General Aviation area; relocation of the Port’s Stormwater Lab and Wildlife Management Facility from Port property south of the airfield; and a new Consolidated Resource Recovery Facility (CRRF). The CRRF will be a fully enclosed building for consolidation of Airport waste materials to improve waste handling efficiency; enhance solid waste collection and storage capacity; and provide opportunities to optimize truck traffic. In addition, this facility will provide opportunities for environmental benefits through the sorting and recovery of compostable and non-compostable materials to enhance waste diversion from landfill. Materials will be processed to compact non-compostable waste and reduce the volume and weight of compostable materials through pulping and potentially anaerobic digestion or use of other waste-to-energy conversion technologies.

Due to the sites proximity to the Airport Surveillance Radar (ASR), and based on feedback from FAA Tech-Ops, the project assumes that no structure can be higher than the adjacent elevation of RWY 16R-34L. Today, the top platform closest to the runway sits approximately 20' below the runway elevation.

- S08 – Airline Support (*north*) & S09 – Airline Support (*west*) – To accommodate displaced Ground Service Equipment (GSE) maintenance and aircraft maintenance functions from the United Airlines maintenance building and Swissport cargo facility, and aircraft maintenance functions from the United Airlines maintenance building, two airline support buildings/expansions are planned. The first is a new building that would be located in the far northeast corner of the North Cargo area. The building will have an approximate 15,000 square feet footprint (S08 Airlines Support (*north*)). The second is an expansion of the existing AMB/AFCO III building to the west. The AMB/AFCO III building is currently being used for GSE maintenance functions. The proposed building expansion footprint is approximate 12,500 square feet (S09 Airlines Support (*west*)). Both buildings may be one or two stories depending on need/use.
- S10 – Centralized Receiving & Distribution Center (CRDC) – A new CRDC is needed to improve security and more efficiently screen and move supplies to concessionaires in the current and future passenger terminals. The new CRDC will be constructed on Port owned property north of SR 518 and will include a roughly 50,000 square foot building with warehouse and office space, truck terminals and parking for visitors and employees.

Figure 2-11  
Schedule for Major Airport/Airline Support Projects  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

# Airfield Operational Feasibility

*The airfield can support the Near-Term Projects at sustainable levels of annualized delay.*

## 3.1 Background

Simulation modeling was performed to assess and confirm the ability of the airfield to support the proposed first phase of Airport development (i.e. the NTP).

## 3.2 Approach and Assumptions

As with all prior SAMP airfield simulation modeling, airfield simulation modeling related to the NTP was conducted using the Total Airspace and Airport Modeler (TAAM). With the exception of the facilities layout and flight schedule, the remaining modeling parameters were identical to the parameters used in prior simulations.

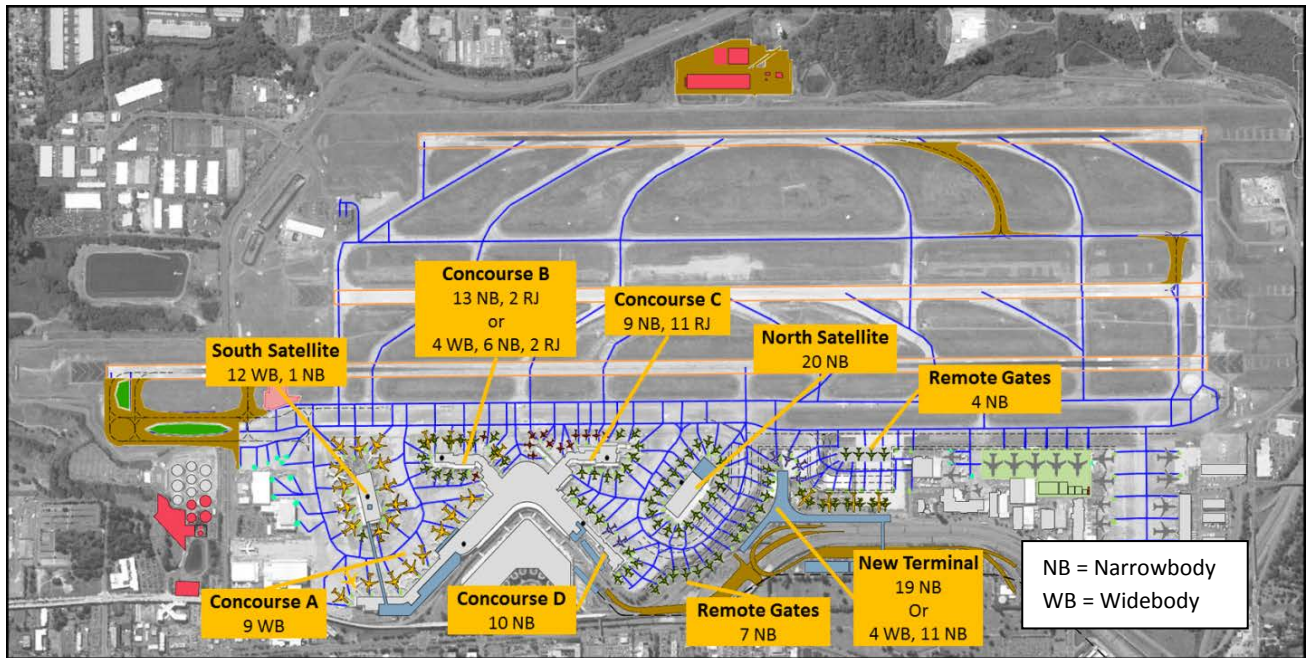
The facilities modeled are illustrated on Figure 3-1 and included NTP improvements to both the airfield and passenger terminal (please refer to Section 2.3 for descriptions of the improvements). Physical airfield improvements modeled included:

- A high-speed exit off Runway 34L between Taxiways E and J (A06 Runway 34L Highspeed Exit)
- An additional runway crossing at Taxiway D between Taxiway T and Runway 16C-34C (A07 Taxiway D Extension)
- Parallel Taxiways A and B located adjacent to the threshold of Runway 34R (A01 Taxiway A/B Extension)

Terminal improvements modeled included:

- A new International Arrivals Facility adjacent to Concourse A (IAF, *pre-SAMP project*)
- A newly renovated North Satellite (NorthSTAR, *pre-SAMP project*)
- 19 narrow-body aircraft gates (T01 North Gates)
- 7 hardstand positions located immediately north of Concourse D (A09 Hardstand (*central*)) and 4 hardstand positions located north and west of the new North Gates (A05 North Hold Pad)

Figure 3-1  
**Facilities Layout Modeled**  
 Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

For the purposes of conducting modeling to test the ability of the airfield to support the NTP, a design day flight schedule (DDFS) representative of the year in which the NTP will be completed (2027) was developed. This flight schedule was (1) consistent with the other flight schedules used during the SAMP to assess facility requirements and for other TAAM modeling, and (2) contained activity estimated for 2027 (i.e., activity between PAL 2 (2024) and PAL 3 (2029)). Table 3-1 summarizes the activity contained in this 2027 flight schedule.

As with other SAMP simulations, simulations related to the NTP were conducted for five different weather and flow configurations and for two different airfield efficiency scenarios. The airfield efficiency scenarios simulate delays assuming that the future runway throughput would remain the same as today or with a moderate increase of 3-4 operations per hour (operations increase based on consultation with FAA staff). For more discussion on the simulated conditions and efficiency scenarios, please refer to Chapter 2 and Appendix G of *Technical Memorandum No. 6 – Alternatives*.

**Table 3-1**  
**Summary of Operations Included in 2027 Flight Schedule**  
 Seattle-Tacoma International Airport

| 2027 Design Day<br>Flight Schedule | Operation Type |           |         |
|------------------------------------|----------------|-----------|---------|
|                                    | Arrival        | Departure | Total   |
| Operations                         |                |           |         |
| DDFS Operations                    | 726            | 733       | 1459    |
| Peak Hour Ops                      | 68             | 63        | 108     |
| Peak Hour Start                    | 8:40 PM        | 10:36 AM  | 9:31 AM |
| Aircraft Type                      |                |           |         |
| Wide Body                          | 25             | 25        | 50      |
| Narrow Body                        | 448            | 456       | 904     |
| Regional Jet                       | 114            | 113       | 227     |
| Turboprop                          | 139            | 139       | 278     |
| O/D Market Type                    |                |           |         |
| Domestic                           | 654            | 660       | 1314    |
| International                      | 27             | 28        | 55      |
| Precleared                         | 45             | 45        | 90      |

Source: LeighFisher, 2017.

### 3.3 Results and Conclusions

Table 3-2 summarizes the estimated average delays resulting from simulating the operation of the NTP assuming the 2027 flight schedule. Annualized weighting values were identified in consultation with FAA staff. When delay numbers for each model are weighted and totaled using the annualized weighting values shown, the average delay per operation is 22.0 minutes if there is no improvement in airfield efficiency and 16.6 minutes with medium improvement.

**Table 3-2**  
**Summary of Estimated 2027 Airfield Delay Associated with NTP**  
 Seattle-Tacoma International Airport

| Model      | 2027 No Improvement |           |       |        | 2027 Medium Improvement |           |       |        |
|------------|---------------------|-----------|-------|--------|-------------------------|-----------|-------|--------|
|            | Arrival             | Departure | Total | Weight | Arrival                 | Departure | Total | Weight |
| South VMC  | 11.7                | 12.3      | 12.0  | 0.3345 | 8.2                     | 7.1       | 7.7   | 0.3345 |
| South MMC  | 20.2                | 33.6      | 26.9  | 0.1099 | 19.4                    | 17.5      | 18.5  | 0.1099 |
| South IMC  | 21.2                | 54.8      | 37.8  | 0.2028 | 21.1                    | 30.9      | 26.0  | 0.2028 |
| North VMC  | 7.0                 | 40.1      | 23.5  | 0.2496 | 7.7                     | 35.6      | 21.7  | 0.2496 |
| North IMC  | 110.9               | 107.7     | 109.4 | 0.0132 | 108.0                   | 99.7      | 104.0 | 0.0132 |
| Annualized |                     |           |       | 22.0   |                         |           |       | 16.6   |

Source: LeighFisher, 2017.

# Financial Feasibility

*The Near-Term Projects are financially feasible.*

## 4.1 Background and Objectives

This section summarizes the objectives, approach, results, and conclusions of an assessment conducted to determine the financial impacts and demonstrate the feasibility of the Near-Term Projects identified and described in Chapter 2 of this *Technical Memorandum No. 7*. The assessment was completed by Port of Seattle financial staff and incorporated existing forecasts of revenues, expenses, and planned capital improvements.

In order for the Near-Term Projects to be considered financially feasible, the financial forecast included in the assessment must demonstrate the Airport's ability to:

- Maintain debt service coverage consistent with bond covenants.
- Maintain debt levels within practical levels.
- Maintain cash reserves at levels consistent with current funding policy.
- Maintain a passenger airline cost per enplaned passenger (CPE) within a reasonable range of those projected at other large hub airports undergoing major capital programs.
- Maintain the capital capacity necessary for renewal and replacement of existing assets as well as ongoing maintenance costs.

## 4.2 Approach

The starting point for the assessment was the Port's financial forecast and funding plan for Sea-Tac Airport. This forecast includes assumptions relating to future revenues and operating and maintenance costs as well as future capital expenditures (excluding SAMP-related projects) and future operating and maintenance costs associated with new facilities. The funding plan for the existing capital program includes cash generated from airport operations, committed Airport Improvement Program and Transportation Security Administration grants and reasonable assumptions for future grants based on reviews with the FAA, Passenger Facility Charge (PFC) revenues continuing at the \$4.50 level, Customer Facility Charge revenues to fund the debt service and operations of the consolidated rental car facility (in operation since 2012), and revenue bonds. Since most grants and PFCs in the coming years are committed to existing projects, the primary funding sources for SAMP projects will be cash from operations (net income) and new revenue bonds to be repaid from airport revenues.

Airline rates and charges were calculated consistent with the terms of the Signatory Lease and Operating Agreement (SLOA) that will go into effect June 1, 2018 (SLOA IV). The terms of SLOA IV are very similar to the prior agreement (SLOA III), with one notable change being the reduction of revenue sharing for 2018 and 2019 and the elimination of revenue sharing for 2020 and beyond. While the term of SLOA IV is for 2018 – 2022, the Port has assumed the terms of this agreement will continue throughout the forecast period. A continuing provision allows the Port to charge debt service coverage in the airline rate bases if needed to achieve total debt service coverage of 1.25x.

### 4.3 Results

The financial impacts of implementing the SAMP projects are reflected in Table 4-1 below.

| <b>Table 4-1</b><br><b>Financial Impacts of SAMP Near-Term Projects</b><br><b>Seattle-Tacoma International Airport</b> |       |          |           |            |            |            |            |              |            |            |                  |
|--|-------|----------|-----------|------------|------------|------------|------------|--------------|------------|------------|------------------|
|  | 2018  | 2019     | 2020      | 2021       | 2022       | 2023       | 2024       | 2025         | 2026       | 2027       | 2018-27<br>Total |
| <b>Capital program (\$M)</b>   |       |          |           |            |            |            |            |              |            |            |                  |
| Baseline   | 808   | 756      | 614       | 373        | 268        | 177        | 108        | 89           | 28         | 28         | 3,249            |
| SAMP   | --    | <u>1</u> | <u>56</u> | <u>158</u> | <u>487</u> | <u>720</u> | <u>810</u> | <u>1,017</u> | <u>855</u> | <u>361</u> | <u>4,465</u>     |
| Total  | 808   | 757      | 670       | 531        | 755        | 897        | 918        | 1,106        | 883        | 389        | 7,714            |
| <b>Key Measures</b>  |       |          |           |            |            |            |            |              |            |            |                  |
| CPE (\$)   | 11.62 | 13.92    | 16.28     | 17.80      | 18.71      | 21.07      | 21.34      | 22.24        | 23.28      | 29.99      |                  |
| D/S coverage   | 1.56  | 1.50     | 1.42      | 1.31       | 1.28       | 1.27       | 1.31       | 1.33         | 1.25       | 1.25       |                  |
| Total Debt (\$M)   | 2,703 | 3,229    | 3,747     | 4,121      | 4,731      | 5,381      | 6,215      | 7,108        | 7,811      | 7,827      |                  |
| Debt/Enplanement (\$)  | 110   | 130      | 149       | 163        | 186        | 209        | 236        | 267          | 286        | 280        |                  |
| Cash (\$M)   | 279   | 294      | 309       | 325        | 338        | 350        | 363        | 376          | 390        | 409        |                  |

Source: LeighFisher, 2017.

The baseline capital program includes all current projects and also includes an allowance for as yet undefined projects or budget changes to existing projects within the \$3.25 billion. Based on a consultant's report on publicly available information on future CPE levels at the 30 large hub airports, it is the Port's judgment that by 2027 a number of large hub international gateway airports will have CPE in the \$25 - \$30 range, and some will likely be higher. Consequently, a projected CPE in this range will likely be competitive. Maintaining annual debt service coverage of at least 1.25x ensures the Port will meet its bond covenants. While less information is available about future debt levels at large hub airports, based on information obtained from the Port's bankers, it appears there will be multiple large hub airports with debt per enplaned passenger in the \$250 - \$300 range, and some above \$300. Throughout the projection period, the Port is able to maintain a minimum cash balance equivalent to ten months of operating and maintenance costs (consistent with current target).

The financial projections include assumptions relating to future growth in non-aeronautical revenues as well as future operating and maintenance costs. Many factors can impact the actual costs the Port will incur and the actual revenues that the Port will generate. The costs of executing the capital program could also vary from current estimates. Clearly there are risks. Over a ten-year period, the Port will have opportunities to adjust course (change spending, alter fees) as conditions change in order to manage financial performance.

## **4.4 Conclusions**

Based on the estimated costs of the Near-Term Projects, and the estimated timing of the expenditures, the assessment indicates that the Port's objectives can be met and that the plan is financially feasible.

The Port recognizes that undertaking this capital program will significantly increase airline costs at Sea-Tac, and significantly increase debt levels for the Port of Seattle. Information from peer airports suggest large hubs undertaking major expansions are increasing projected CPEs to levels that would have been considered "too high" a few years ago. Major expansions are very expensive, but the alternatives to expanding these large hubs are even more expensive to the cities and communities: foregoing airport expansion and suffering the economic consequences, or building or expanding another local airport.

In order to deliver the required capital improvements, and to potentially reduce the cost of construction, the Port will consider whether a public, private partnership (P3) of some kind could be advantageous to achieving the Port's objectives.

Another factor that could mitigate the cost impact of implementing the SAMP projects is if the project schedules are delayed, or if certain project elements are not deemed to be needed in the time frames currently planned. With each additional year that the project schedule is extended, Sea-Tac earns income from operations and PFCs that can be used to pay capital costs and therefore reduce the amount of revenue bonds needed to fund the program. Offsetting this, project delays can result in increased project costs due to cost escalation and increased project overhead, but on a net basis, there can still be savings.

# Key Actions Following Completion of the SAMP

*Increasing airfield/airspace operating efficiency is the most pressing long-range facility issue facing the Airport. Effective solutions will require a comprehensive process that should begin as soon as practical.*

## 5.1 Introduction

In addition to actions directly related to environmental approvals, design, and construction of the NTP, the most significant actions following completion of the SAMP relate to the airfield/airspace system. As documented in Section 2.5 of *Technical Memorandum No. 6 Alternatives*, airfield modeling of the Long-Term Vision determined that with these improvements, and no other changes to how the airfield/airspace is operated, the airfield/airspace has insufficient capacity to meet the unconstrained 20-year forecast demand at a sustainable level of annualized delay. Airfield modeling of the NTP determined that with moderate efficiency gains over how the airfield/airspace is operated today (identified in consultation with FAA staff, see Section 3 – *Airfield Operational Feasibility*), the NTP improvements provide sufficient capacity to meet forecast demand in the year 2027 at a sustainable level of annualized delay. The improvements included in the NTP fit within the Long-Term Vision identified in the SAMP and are stand-alone projects that are needed to satisfy near-term demand. While the Long-Term Vision includes airfield projects that improve the effectiveness of the airfield system, a comprehensive airfield/airspace study is needed to develop and assess alternatives to meet the unconstrained 20-year forecast demand. Key findings and recommended actions are described in more detail below.

1. The airfield/airspace system, as it is currently configured and operated, has insufficient capacity to meet the unconstrained 20-year forecast demand at a sustainable level of annualized delay with all improvements in the SAMP Long-Term Vision. The primary constraint on the close-in airspace is the departure rate. The SAMP Long-Term Vision identifies several alternatives with the potential to improve the effectiveness of the airfield system. Such alternatives include, but are not limited to, end-around taxiways and modified runway use strategies. These requirements, constraints and alternatives for their resolution are discussed in *Technical Memorandum No. 5 Facility Requirements* and *Technical Memorandum No. 6 Alternatives*.
2. Design criteria issues are not unusual at U.S. airports; they occur for reasons such as the introduction of new aircraft, and are remedied either by physical changes or modifications to standards. Given the constraints to the airfield/airspace system, there are numerous airfield design criteria compliance issues that should be studied further in a comprehensive study of the airfield/airspace following the SAMP.

The significant design criteria compliance issues include those related to:

- Separation between Runway 16L-34R and Taxiway B (400 feet)
- Airfield intersection geometry
- Runway incursion and hot spot mitigation
- High-energy intersections
- Right-angle intersections
- Direct access to runway from apron
- Three-node concept

Design criteria compliance issues and alternatives for their resolution are discussed in *Technical Memorandum No. 5 Facility Requirements* and *Technical Memorandum No. 6 Alternatives*.

3. The most significant design criteria compliance issue is the non-standard centerline-to-centerline separation between Runway 16L-34R and Taxiway B of 400 feet. The standard separation based on current operations is 500 feet. The basis for this separation standard is low-visibility approaches to Runway 16L.\*

In a letter to the Airport Managing Director dated May 26, 2017 the FAA stated that the Port should initiate a study specifically designed to develop a plan to fully meet this separation standard in the long term. The facilities included in the Port's Long-Term Vision and NTP meet this standard by relocating both Taxiway A and Taxiway B in the areas of potential new construction north and south of the existing terminal complex. However, achieving 500 feet separation standard between Runway 16L-34R and Taxiway B in the area of the existing terminal complex would result in the loss of gates on the west side of both Concourse B and Concourse C.

## 5.2 Recommended Actions

The issues and potential solutions involving airfield/airspace system capacity and design criteria compliance are complex and involve benefit-cost tradeoffs. Therefore, additional study is required and should include a comprehensive systems and modeling approach and an inclusive stakeholder engagement process. The FAA and the Port should engage in this comprehensive study as soon as practical to assess the full range of issues and opportunities associated with reasonably improving airfield/airspace capacity and resolving design criteria compliance issues. The approach should be rigorous, analytical and involve airspace/airfield simulation modeling. The scope of the study should be limited to Sea-Tac airport and the close-in airspace and involve key stakeholders, including but not limited to: the Port, FAA, airlines, and the public. The Port and the FAA have committed to scoping the study in 2018.

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\*FAA advisory Circular 150/5300-13A *Airport Design* specifies that the separation required for an airplane design group V Taxiway B is 500 feet when airplanes in approach categories C, D, and E are conducting approaches with visibility minimums lower than ½ mile. The existing separation is 400 feet.

# Long-Term Vision

*Given existing airfield/airspace constraints, all improvements depicted in the Long-Term Vision that are not included in the NTP will be subject to further study.*

## 6.1 Long-Term Vision

The vision for long-range development at the Airport is to provide facilities in all key functional areas (airfield, terminal, cargo, and airport/airline support facilities) to meet requirements for the unconstrained 20-year forecast of airport activity. The Long-Term Vision is the result of screening and analysis of a broad range of alternatives as documented in *Technical Memorandum No. 6 Alternatives (TM-6)*. The alternatives analysis determined that the resulting Long-Term Vision is the most cost effective and operationally efficient layout of facilities to deliver balanced capacity to satisfy 20-year unconstrained demand within the conditions unique to Sea-Tac which constrain future Airport development.

Airside modeling conducted to test the ability of the Long-Term Vision facilities to accommodate 20-year forecast demand is documented in TM-6. Airside modeling determined that, even with all Long-Term Vision improvements, airfield/airspace constraints resulted in severe congestion and aircraft delays as activity approached 15-year forecast demand (forecast to occur in 2029). Given these existing constraints, all improvements included in the Long-Term Vision that are not included in the Near-Term Projects will be subject to further study discussed in section 5 of this TM-7. The Long-Term Vision is illustrated in Figure 6-1 and depicts all Near-Term Projects (shown in color) that would remain if development shown in grey were constructed. All Near-Term Projects included in the Long-Term Vision and described below are indicated by a project code and name. (e.g. A08 Hardstand (north))

Given the physical constraints surrounding the current airfield and high utilization of existing facilities, expansion or redevelopment of on-airfield facilities often triggers the need to relocate existing functions in order to provide additional capacity to accommodate increased demand. The Long-Term Vision includes on-airfield facility expansion and redevelopment in the following areas:

- Modification of the airfield to improve safety and efficiency, including extension of Taxiway A/B in the southeast corner of the airfield (A01 Taxiway A/B Extension) and new end-around taxiways south and north of the airfield.
- Construction of aircraft hardstands to the south of the existing terminal in an area currently occupied by Alaska Airlines aircraft maintenance facilities to provide additional hold positions for passenger aircraft operations and remain overnight parking for passenger aircraft.

- Extension of Concourse D and gate expansion to the north of the existing terminal into an area currently occupied by cargo and airport/airline support facilities.
- Construction of new hardstands north of the future gate expansion, in an area currently occupied by the Port's Aviation Maintenance Facility (AMF) and United Airlines maintenance building (A08 Hardstand (*north*)). In the near-term, this hardstand provides additional cargo freighter parking positions and potential Remain Overnight parking for passenger aircraft (RON). With the development of additional cargo capacity in SASA, and reconfiguration/expansion of facilities in this area, this hardstand will eventually provide additional, flow-through hold positions for passenger aircraft operations.
- Construction of a new development "platform" in SASA by selectively excavating and filling the terrain. With the new platform, SASA would be capable of accommodating aircraft via a taxiway bridge to the existing airfield.
- Construction of new airline support facilities (e.g., ground support equipment and aircraft maintenance facilities) in SASA and the far north cargo area (S08 Airline Support (*north*) & S09 Airline Support (*west*)).
- Redevelopment of cargo facilities in the far north cargo area to maximize the efficiency of cargo operations in a limited footprint.

Facilities displaced by expansion and redevelopment of on-airfield facilities would be accommodated in three areas:

- SASA would accommodate relocated aircraft maintenance hangars and cargo facilities, as well as airline support facilities.
- The existing General Aviation (GA) area would accommodate relocated Primary Airport Rescue and Firefighting facility (S02 Primary ARFF).
- The future West-side Maintenance Campus would accommodate relocated airport support facilities, including the Port's Aviation Maintenance Facility (various shops/equipment storage), the Transportation Operations Center (bus maintenance), Distribution Center (parts warehouse), and the snow shed.

The plan also envisions improvements on Port property not contiguous to the airfield, including:

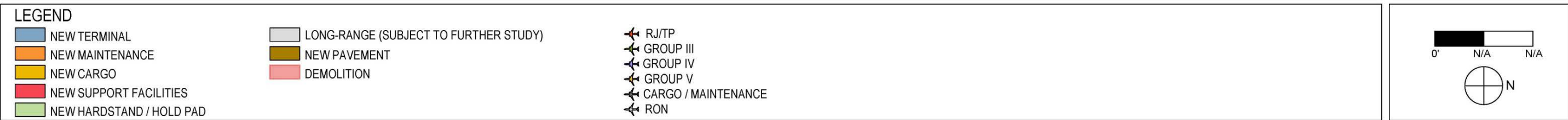
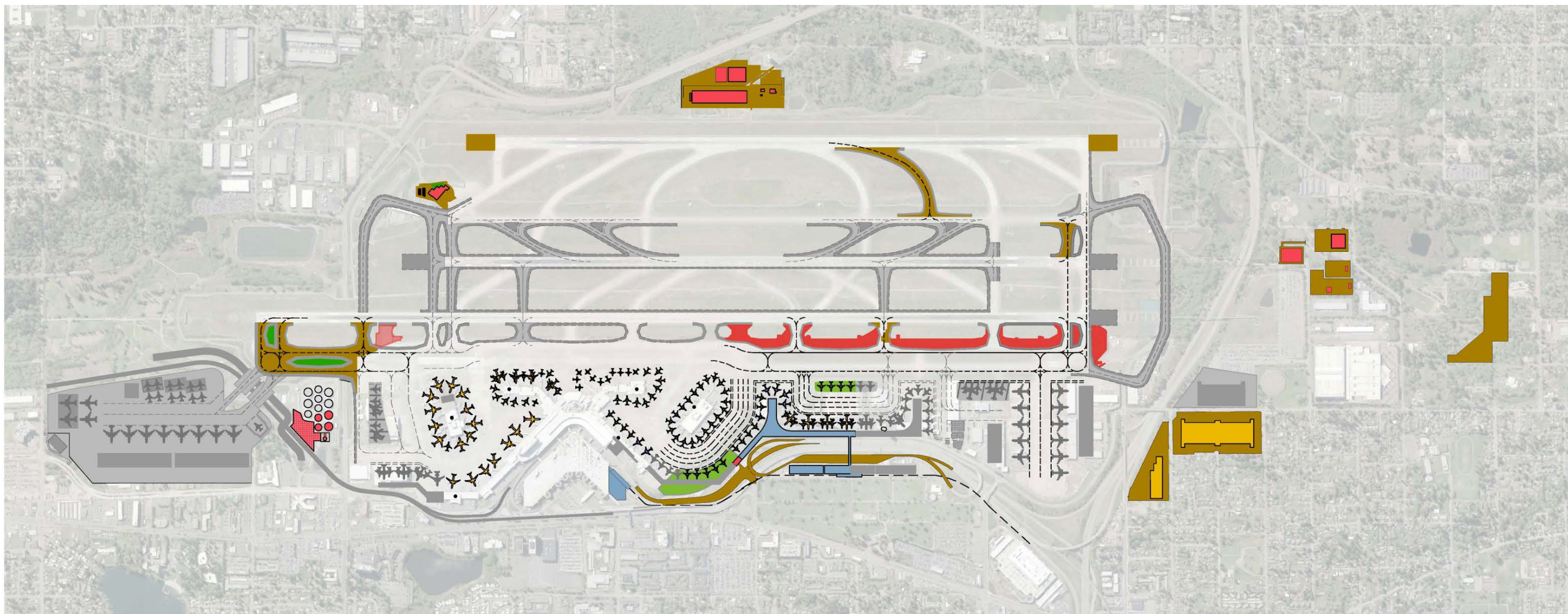
- Relocation of construction logistics facilities to vacant property south of S. 200th St.
- Expansion the existing Fuel Farm to the east (S01 Fuel Farm Expansion).
- Construction of a second terminal processor and associated passenger parking in an area currently occupied by the Doug Fox parking lot. In the near-term, the Second

Terminal and associated parking (T02 Second Terminal & Parking) would be sized to support gates constructed under the T01 North Gates project.

- Extensive roadway improvements to provide access to the Second Terminal and improve access to the Main Terminal (L01 North Airport Expressway Relocation & T03 Second Terminal Roads/Curbside).
- Construction of an elevated bus guideway to provide a landside connection between the Main Terminal, Second Terminal, and the Rental Car Facility (RCF) (L02 Elevated Busway & Stations).
- Expansion of the existing Main Terminal North Ground Transportation Lot (L04 Main Terminal North GT Lot).
- Relocation and expansion of employee parking to areas north of SR 518 (L06 Employee Parking Surface Lot & L07 Employee Parking Structure).
- Relocation and expansion of the existing S. 160<sup>th</sup> Street ground transportation holding lot to an area north of SR 518 (L05 North GT Holding Lot).
- Construction of a Centralized Receiving and Distribution Center (CRDC) in an area north of SR 518 (S10 Centralized Receiving and Distribution Center).
- Construction of cargo warehousing in an area north of SR 518 and adjacent to 24th Ave S (C02 & C03 Off-site Cargo *Ph1* & *Ph2*).

The Long-Term Vision is illustrated in Figure 6-1 and depicts all Near-Term Projects (shown in color) that would remain if development shown in grey were constructed.

Figure 6-1  
Vision for Comprehensive Long-range Airport Development  
Seattle-Tacoma International Airport



Source: Port of Seattle and LeighFisher, 2016.

# Appendix A

## Implementation Plan Alternatives

The planning team used the established guiding principles listed in Section 1.3 *Approach* to first create a baseline Implementation Plan alternative for the long-range vision and then develop order of magnitude costs for the majority of projects. The project costs and insights into constructability were then used to develop alternatives that strove to achieve one or more of the following:

- Deliver needed capacity more quickly;
- Reduce or defer costs;
- Further minimize impacts to existing facilities.

Discussion of each alternative documents a progression of the implementation planning process, and as such, the alternatives are listed in the sequence they were devised and evaluated. Discussion of each alternative focuses on projects required to deliver capacity for passenger and cargo operations to meet the unconstrained 20-year forecast of airport activity. Subsection 2.3 *Project Descriptions & Schedules* includes a full listing and description of projects in all key functional areas required to accommodate near-term activity, along with construction schedules and project linkages.

### ***Alternative 1 - Baseline***

Alternative 1 constructs enabling projects and subsequent capacity enhancement projects as quickly as possible in areas the planning team determined were the most beneficial and reasonable given the established guiding principles. It envisions construction that can be roughly divided into two phases described and illustrated below.

#### **Phase 1**

- Area 1 – SASA - Construction of SASA platform and bridge allows aircraft access to new aircraft maintenance and cargo facilities. Relocation of aircraft maintenance facilities to SASA enables development of the South Hardstand in Phase 2. Construction of new cargo facilities in SASA enables gate expansion and cargo redevelopment in Phase 2.
- Area 2 – Westside Maintenance Campus – Relocation of the Port's Aviation Maintenance Facility (AMF) enables construction of the North Hardstand. Relocation of the Transit Operations Center and Distribution Center to the Westside Maintenance Campus enables construction of the SASA platform.
- Area 3 – North Gates & North Terminal – Relocation of the southbound lanes of the North Airport Expressway (NER), the fuel rack, and the ARFF station along with demolition of the Swissport cargo warehouse and Cargo 6 hardstand, enables

construction of gates immediately north of the existing terminal complex (North Gates). The location/extent of the gate expansion to the north allows these gates to be connected to a new, second terminal (North Terminal) as soon as possible. In Phase 1, hardstand is constructed in the area between the existing Concourse D and the new North Gates (Concourse D Hardstand). In Phase 2, gates are constructed in this area as a single loaded concourse connecting the north end of the existing Concourse D and the North Gates (Concourse D Extension). Demolition of the Doug Fox parking lot and Gate Gourmet flight kitchen enables construction of the North Terminal.

- Area 4 – North Hardstand & Cargo Warehouses Redevelopment/Expansion – Relocation of the Port’s AMF to the Westside Maintenance Campus and demolition of the United Airlines maintenance building enables expansion of hardstand in the north cargo area (North Hardstand). Redevelopment of the Cargo 4 South building and new construction of cargo warehouse facilities on the L-Shape property provides additional warehouse capacity to replace capacity lost with the demolition of the Swissport warehouse and to accommodate increased demand.

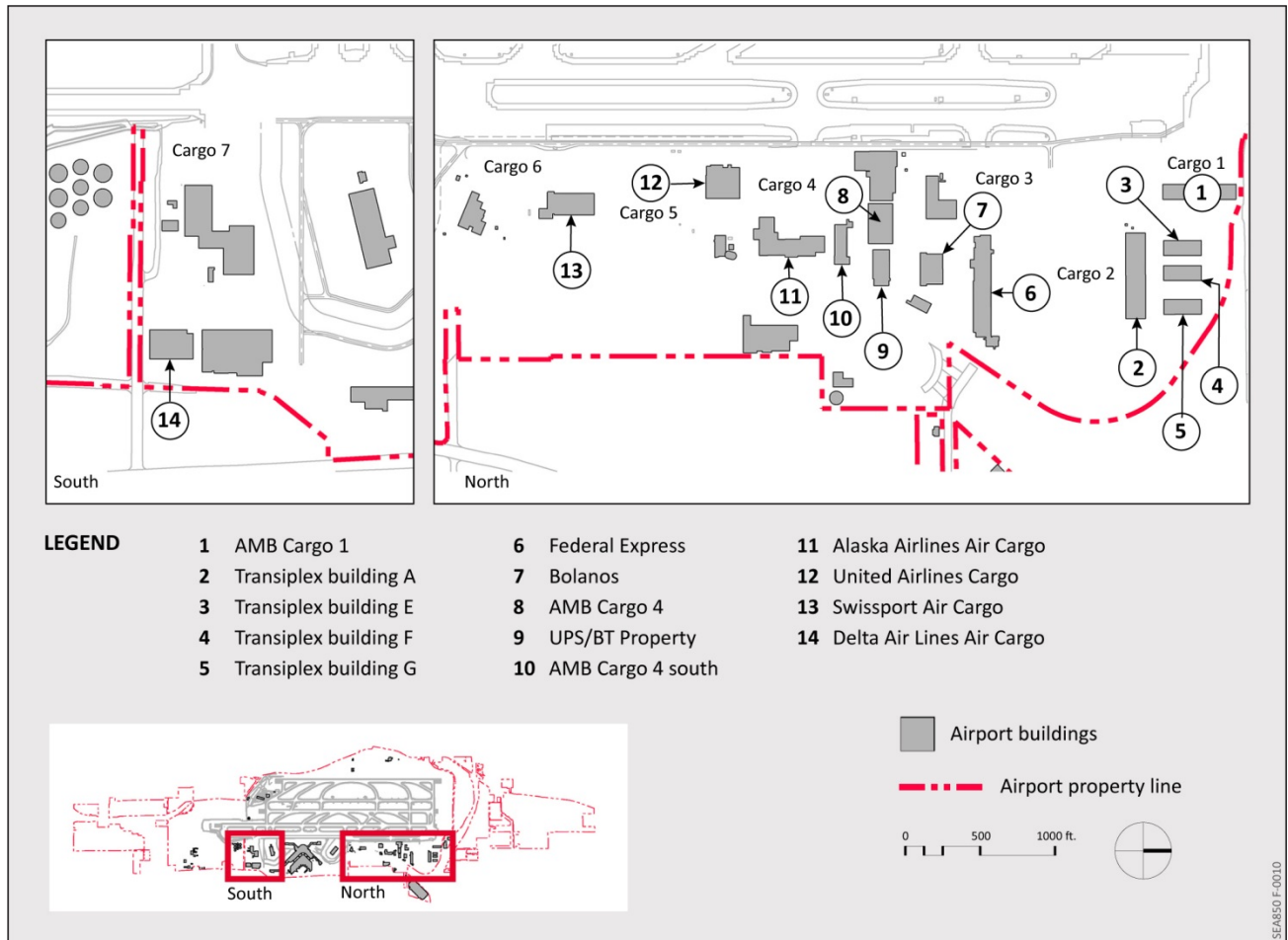
Figure A-1 shows the locations of many key facilities that must be relocated to accommodate the necessary new facilities for the Alternative 1 – Baseline concept. Phase 1 of construction related to Alternative 1 is illustrated on Figure A-2.

## **Phase 2**

- Area 1 – South Hardstand - Construction the South Hardstand is enabled by the relocation of aircraft maintenance facilities to SASA in Phase 1.
- Area 2 – Concourse B Reconstruction – Construction of additional gate capacity in Phase 1 enables gates to be taken out of service as Concourse B is reconstructed to accommodate widebody aircraft connected to the International Arrivals Facility (IAF). [Note – Reconstruction of Concourse B was subsequently eliminated from consideration as described in Alternative 2 below]
- Area 3 – North Gates & Terminal Expansion – Expansion of gates further into the north cargo area is enabled by construction of new cargo facilities in SASA. Additional gates are also constructed in the Concourse D Hardstand area as a single loaded concourse connecting the north end of the existing Concourse D and the North Gates (Concourse D Extension). Expansion of the North Terminal is required to support additional north end gates.
- Area 4 – North Cargo Redevelopment – Construction of additional cargo facilities in SASA enables redevelopment of cargo facilities in the far North Cargo area.

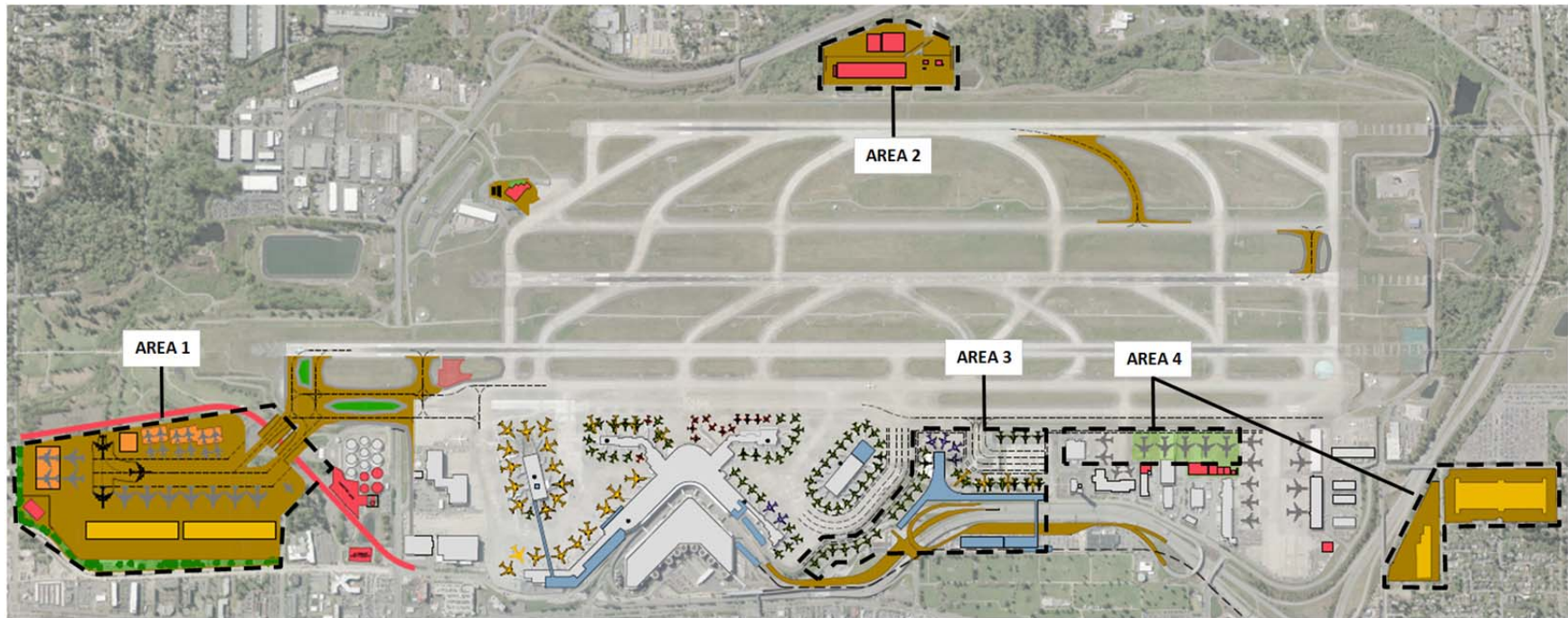
Phase 2 of construction related to Alternative 1 is illustrated on Figure A-3.

Figure A-1  
Existing Airport Facilities  
Seattle-Tacoma International Airport



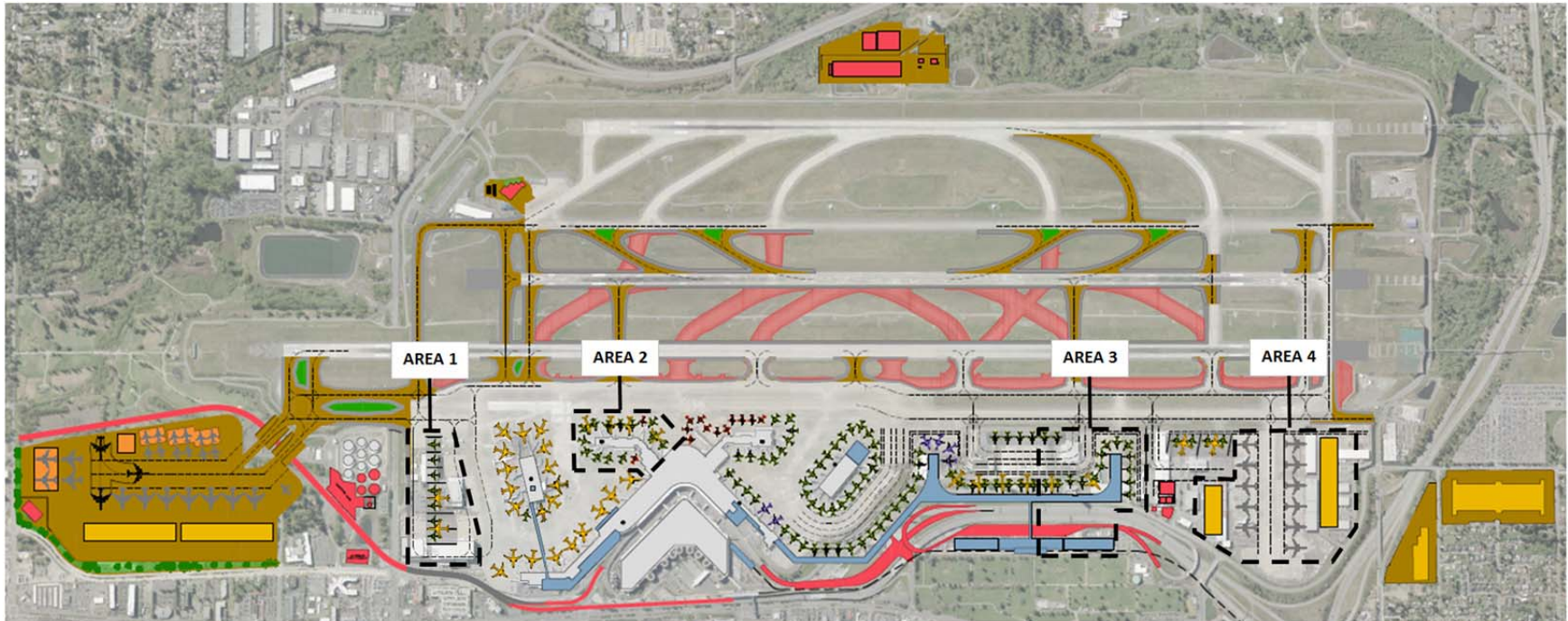
Source: LeighFisher, 2015.

Figure A-2  
**Alternative 1 – Baseline, Phase 1**  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

Figure A-3  
**Alternative 1 – Baseline, Phase 2**  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

### ***Alternative 2 – Baseline with SASA deferred and Concourse B reconstruction removed (Adjusted Baseline)***

Alternative 2 pushes SASA and required enabling projects to the outer years due to the high cost. SASA enables redevelopment/expansion of facilities in phase 2 of the baseline implementation plan and so delay of SASA has the potential to delay some capacity projects and will most definitely delay others. Construction of replacement aircraft maintenance facilities and additional cargo facilities in SASA enables phase 2 gate expansion, hardstand expansion south of the South Satellite, and cargo facility redevelopment in the far north cargo area. Since SASA provides additional cargo capacity, the delay of SASA may cause the delay of phase 2 gate expansion further into the north cargo area if future cargo demand is high and existing cargo facilities in the north cargo area are highly utilized. For the same reason, the delay of SASA may also delay the redevelopment of cargo facilities the far north cargo area as existing capacity would be taken out while facilities are redeveloped to make more efficient use of space. Extension of gates on Concourse A and expansion of the south hardstand would presumably have to wait for replacement aircraft maintenance facilities in SASA.

Alternative 2 eliminates the reconstruction of Concourse B from further consideration due to the 500' runway/taxiway separation design standard.

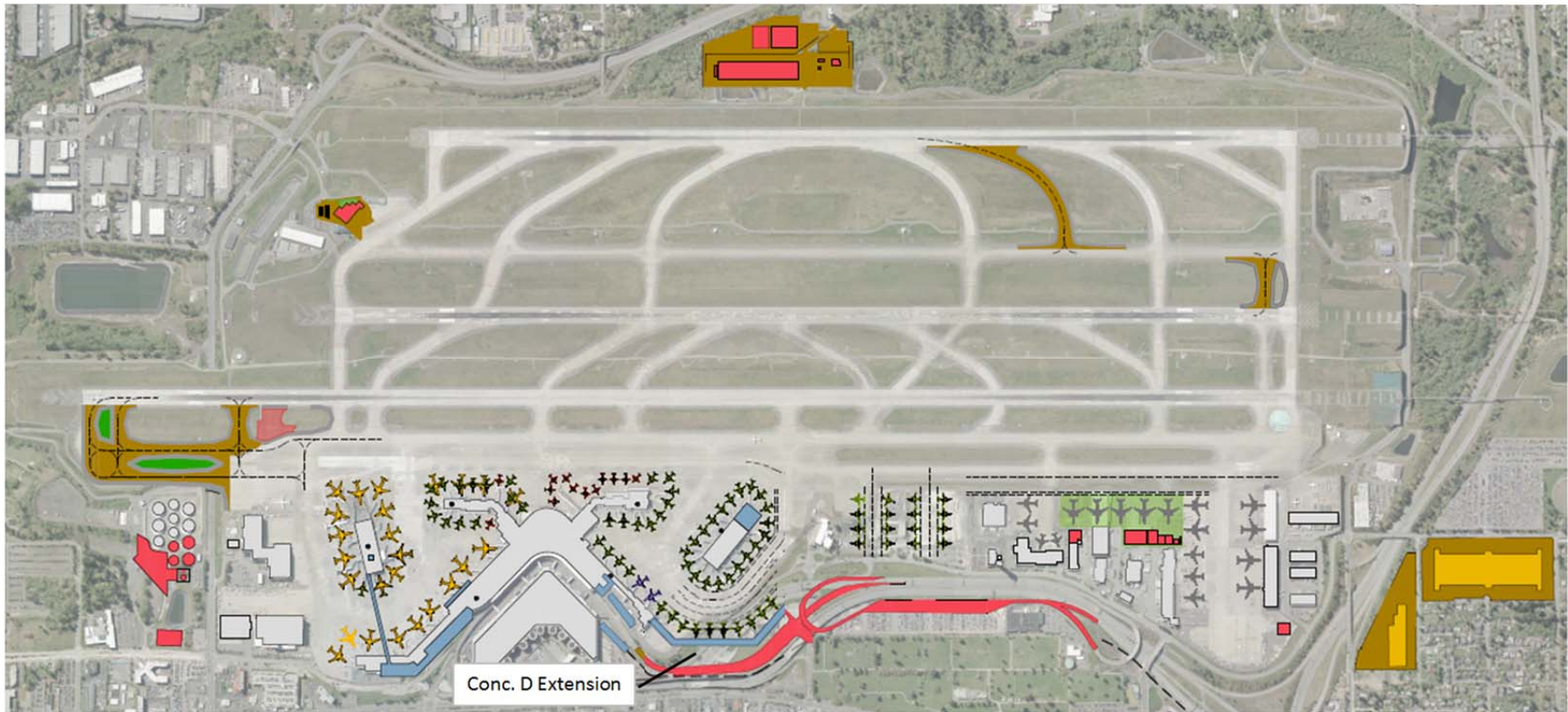
These adjustments to the Baseline under Alternative 2 were carried forward in Alternatives 3 & 4 and the Recommended Development Plan.

### ***Alternative 3 – Adjusted Baseline with Concourse D Extension in Phase 1***

Alternative 3 assumes the adjusted baseline and considers an alternative sequence of phase 1 North Gates construction where Concourse D is extended prior to construction of the gates in the Cargo 6 area. In addition to relocation of the southbound lanes of the NER, Extension of Concourse D requires a widening of the existing Concourse D and associated enabling projects prior to the gates becoming operational. The existing Concourse D is 40' wide at its most constricted point in the area of gates D1 & D2 (20' holdroom width and 20' wide circulation area). Passengers queueing to board aircraft at these gates often spill out into the circulation area impeding flow to/from gates further north on Concourse D. With the extension of Concourse D, this pinch point will become more congested and level of service will degrade. Alternative 3, phase 1, is illustrated on Figure A-4.

The SAMP assumes construction of the Concourse D hardstand holdroom as an existing condition (assumed operational in 2018). In order to provide space for the widening of Concourse D, this facility would need to be demolished and replacement hardstand holdroom capacity constructed. In addition to providing replacement of hardstand holdroom facilities, additional holdroom capacity will be needed to enable gate holdroom capacity to be taken out as Concourse D is widened. A first phase of Alternative 3 is a limited extension of Concourse D which will provide the replacement hardstand holdroom space at the ramp level and the gate holdroom space at the concourse level.

Figure A-4  
**Alternative 3 – Adjusted Baseline with Concourse D Extension in Phase 1**  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

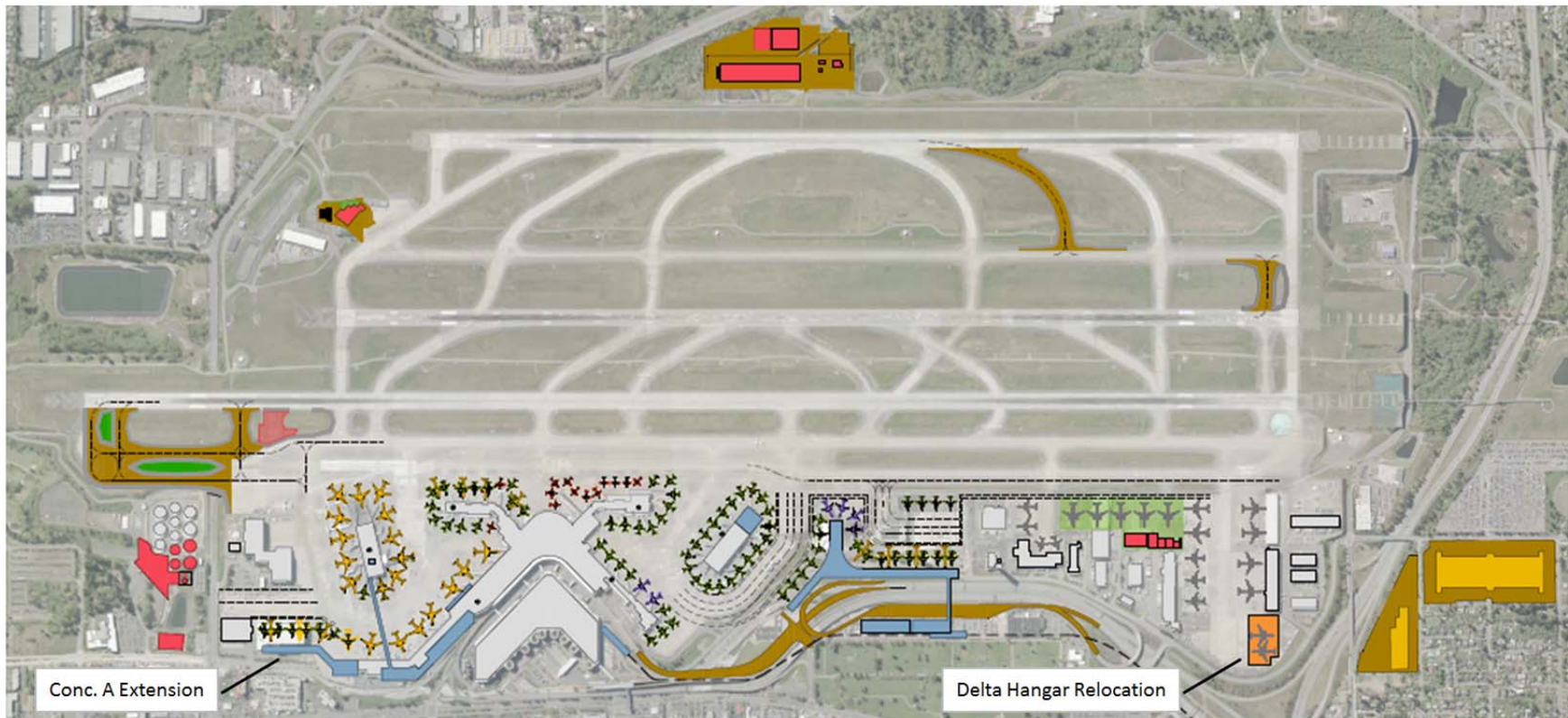
While gates and prerequisite enabling projects in both areas can be constructed in roughly the same timeframe, the planning team determined that construction of gates in the Cargo 6 area as a first phase of North Gates, as planned in the adjusted baseline, is preferred to construction of gates on an extended Concourse D as a first phase of North Gates. A primary reason is that gates in the Cargo 6 area are positioned to be readily connected to the planned North Terminal. Connecting gates to the North Terminal as soon as possible is one of the established guiding principles because it provides relief to the existing Main Terminal, increasing level of service and decreasing the potential of over investing in the Main Terminal. Another primary reason for building gates at Cargo 6 first is that it delivers a greater number of gates and gates that have the flexibility to accommodate a wider range of aircraft gauge.

#### ***Alternative 4 – Adjusted Baseline with Concourse A Extension in Phase 1***

Alternative 4 assumes the adjusted baseline and adds a new project that constructs gates on an extension of Concourse A as soon as possible in addition to constructing the North Gates. The planning team decided to explore this alternative in hopes that it could deliver gates relatively quickly and increase level of service by reducing the need for hardstand operations. In developing this alternative, the planning team determined that extending Concourse A to the south to the extent shown, fits with the long-range vision as it provides flexible gates that can accommodate a wide range of aircraft gauge that can be connected to the IAF and would also not impact the Delta Cargo building.

The planning team worked closely with stakeholders to evaluate the benefits and impacts of constructing these gates as soon as possible. One of the impacts was that Delta Air Lines' aircraft maintenance hangar would need to be relocated to another location on the airfield because SASA would not be available in the same time frame. The best location for the hangar was determined to be the far northeast corner of the north cargo area, which would eliminate a large area used for GSE storage and a significant amount of cargo hardstand leased to FedEx. In addition to the impacts to cargo facilities, the hangar would be located at the opposite end of the airfield to where Delta currently operates and the gates on the extension of Concourse A would only be constructed one year sooner than the North Gates. While it was eventually decided to include the Concourse A Extension in the long-range vision, it was decided that the Concourse A Extension would not be included in the RDP. Alternative 4 is illustrated on Figure A-5.

Figure A-5  
**Alternative 4 – Adjusted Baseline with Concourse A Extension in Phase 1**  
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.