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HOUSTON AIRPORTS

George Bush Intercontinental Airport - IAH

FIS Renovation & Expansion

Program Definition Manual

99%

DEVELOPED BY:

HNTB | RICONDO & ASSOCIATES

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Executive Summary

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ES.0 Executive Summary

ES.1 INTRODUCTION

The proposed Federal Inspection Services (FIS) Renovation and Expansion Capital Development Program is designed to modernize and expand the existing facility to allow for future international passenger growth. The FIS Program Definition Manual (PDM) is the culmination of this planning study. This document contains background information and detailed project development criteria for use by designers in preparing design and construction documents for the FIS development.

Total passengers for the international markets have more than quadrupled since the FIS facility opened in 2005. George Bush Intercontinental Airport (IAH) is the nation's eighth busiest international gateway and the second fastest growing since the events of September 11, 2001; the FIS facility requires modernization to remain competitive. The current facility was designed prior to the U.S. Customs & Border Protection (CBP) consolidation into one group, which has led to duplication of space and improper adjacencies. This issue has caused inefficiencies in CBP staffing that has created customer service levels that are no longer competitive with terminals at similarly sized airports.

The end result is that the existing FIS facility now requires a major renovation and expansion to meet passenger demand, larger aircraft, current code requirements, new CBP processing technologies and the need to replace and expand the building systems to meet current demands.

The planning team generated an extensive list of guidelines and objectives through several sources, including interviews with HAS staff, workshops, and discussions with airport stakeholders.

ES.2 PLANNING PROCESS

The Houston Airport System (HAS) realized the need to address demand for increased international passenger service. The design day flight schedule described in **Chapter 2** was developed by the LeighFisher Master Plan team and was used to determine program requirements (see **Chapter 4**) developed by Ricondo & Associates, Inc. Extensive collaboration and bi-weekly workshop presentations were used to obtain input from HAS staff, airlines, CBP (Local and National), and other airport stakeholders. The team initially evaluated plans to renovate and expand the FIS facility for new processing trends, increased aircraft size and traffic to accommodate arriving international passengers.

ES.3 FINDINGS

The preferred stakeholder approved plan for the renovation and expansion of the FIS facility can be divided into three main components:

- FIS Projects - Renovations
  - Includes renovations of the existing facility for improvements to the Primary Processing, Secondary Processing, Baggage, CBP Administration, Recheck and Terminal E security checkpoint
- FIS Projects - Expansions
  - Includes the expansion of the passenger baggage claim area, baggage makeup and realignment of the tug ramps from the Airside Service Road to the basement
- FIS Projects - CBP Garage
  - Replacement parking garage for CBP personnel only

Using the Program Requirements in **Chapter 4** as a guiding principal, the preferred plan was developed in tandem with all stakeholders to develop a comprehensive plan.

ES.3.1 FIS PROJECTS

The FIS Projects – Renovations & Expansions component includes the preferred advanced planning-level plan recommended for implementation. Using the Program Requirements outlined in **Chapter 4** and the 2012 CBP Airport Technical Design Standards (or most current version), a detailed space plan was developed. The preferred plan is currently in the review process with CBP. Upon conceptual plan approval, CBP will assign a project manager to coordinate with the future design and contractor team. The plan includes renovations and expansion on four levels of the FIS facility (as shown in **Figures 5.1** – **5.4**):

- Level Two (116) – Primary Processing, CBP Administration, Terminal E Ticketing and Security Checkpoints
- Mezzanine (105) – CBP Administration
- Level One (93) – Baggage Claim expansion, Consolidated Secondary Processing and support, Exit Control, Recheck and Meeter/Greeter
- Baggage Level (78) – Baggage makeup level

Table 3.1 contains a detailed listing of the area and function for each level.

ES.3.2 CBP GARAGE

To accommodate the baggage claim expansion, the existing CBP employee parking garage will be demolished in its entirety. The existing garage contains 250 parking stalls. The new preferred plan includes the replacement of the 250 minimum CBP employee spaces on this site.

ES.3.2.1 Constraints

The project site is extremely constrained both horizontally and vertically. The project site is bounded by roadways on the north and south, the existing FIS facility to the west and the Airside Service Road and Taxiway SF to the east.

Vertical constraints include the line of sight (LOS) from the Air Traffic Control Tower to the surrounding airfield. The preferred concept will not be impacted by the line of sight.

The exterior façade of the parking structure is anticipated to have screening on all sides to match the existing campus at a minimum.

ES.3.2.2 Entry/Exit

The entry to the CBP garage will be maintained in its current configuration with access to and from the south roadways.

ES.3.3 PASSENGER CONNECTIVITY

The existing tunnel from Terminal D to the Subway/FIS will be renovated. At the northern portion of the existing tunnel, new vertical circulation (including escalator and elevators) will be added to access the new arrivals island curb above in the new roadways. This will provide relief to the current congestion of the Terminal E arrival curbfront. Further description of this element is described in **Chapter 5**, **Section 5.3.1**.

ES.3.4 BAGGAGE CIRCULATION SYSTEM CONFIGURATION

The preferred development plan is adding four new claim units in the east expansion area. All units will be equipped with dual baggage feeds to allow for an even passenger distribution around the claim, as well as the possibility for faster baggage delivery. The baggage claim was designed around the planning column grid that was designed for the overall parking structure above. It is anticipated that the design of the structural grid will be further developed in design phases and may allow for better tug and baggage claim separation on both levels.

ES.4 ROUGH ORDER OF MAGNITUDE COST ESTIMATES

A high-level Rough Order of Magnitude (ROM) Cost Estimate was developed during the planning process as indicated on **(Table to be provided in 100%PDM)**. The basis of the ROM is discussed in **Chapter 8** and the full cost estimates are provided in **(Appendix to be provided in 100%PDM)**.

ES.5 RECOMMENDATION

This PDM presents the FIS facility planning criteria, floor plans, phasing approach, and costs based upon stakeholder approval and planning efforts completed to date. The preferred plan herein is intended to serve as a guide to the selected A/E for developing design and construction documents.

Chapter 1 | Introduction

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1.0 Introduction

1.1 Background

In 2005, the new Federal Inspection Services (FIS) opened at George Bush Intercontinental Airport (IAH) to serve the increasing international travelers in the Houston region. At that time there were 11 international carriers serving IAH. The concept for the FIS facility was to accommodate the increased international traffic passing through Terminals D (with 12 gates) and E (with 23 gates). The Central FIS does not have any gates associated with it directly. It is attached to both of these key terminals that receive non-pre-cleared international arrivals via sterile bridges over the landside roadways.

Figure 1.1 illustrates the overview of IAH and the FIS facility.

The development of the Central FIS made a number of strong statements about how the airport was positioning itself to become a world-class international airport. The facility had a number of assets to increase the international market at IAH.

- It was the largest FIS of its kind in the United States
- 784,000 square feet of floor space over three levels
- Four pedestrian bridges connecting Terminals D and E
- 80 FIS booths to process 4,000 arriving passengers per hour, when fully staffed
- 12 baggage claim carousels
- 192 flight information display screens
- One of the first facilities to launch the Global Entry Program in the U.S.

The opening of the FIS facility doubled the airport's prior processing capabilities that had been located in Terminal D, and streamlined the customs, immigration and the baggage processes.

1.2 Project Purpose

The future growth of international travel in Houston is not just imminent, as the growth forecasted in the unified design has been realized. By the close of 2014, IAH hosted more than 9.8 million international passengers. With 17 international carriers now serving IAH, it is time to look at the FIS facility with a different perspective and identify ways that can further leverage its capabilities.

As the Houston Airport System (HAS) increases new international airline service and expands existing airline service, a reconfiguration/reorganization of the FIS facility is needed to maintain and improve the level of service and overall passenger experience. If the FIS facility continues to operate under current conditions, the passenger experience will likely deteriorate to level of service D or lower.

1.3 FIS PDM Objectives

There are four major objectives for the renovation and expansion of the FIS facility:

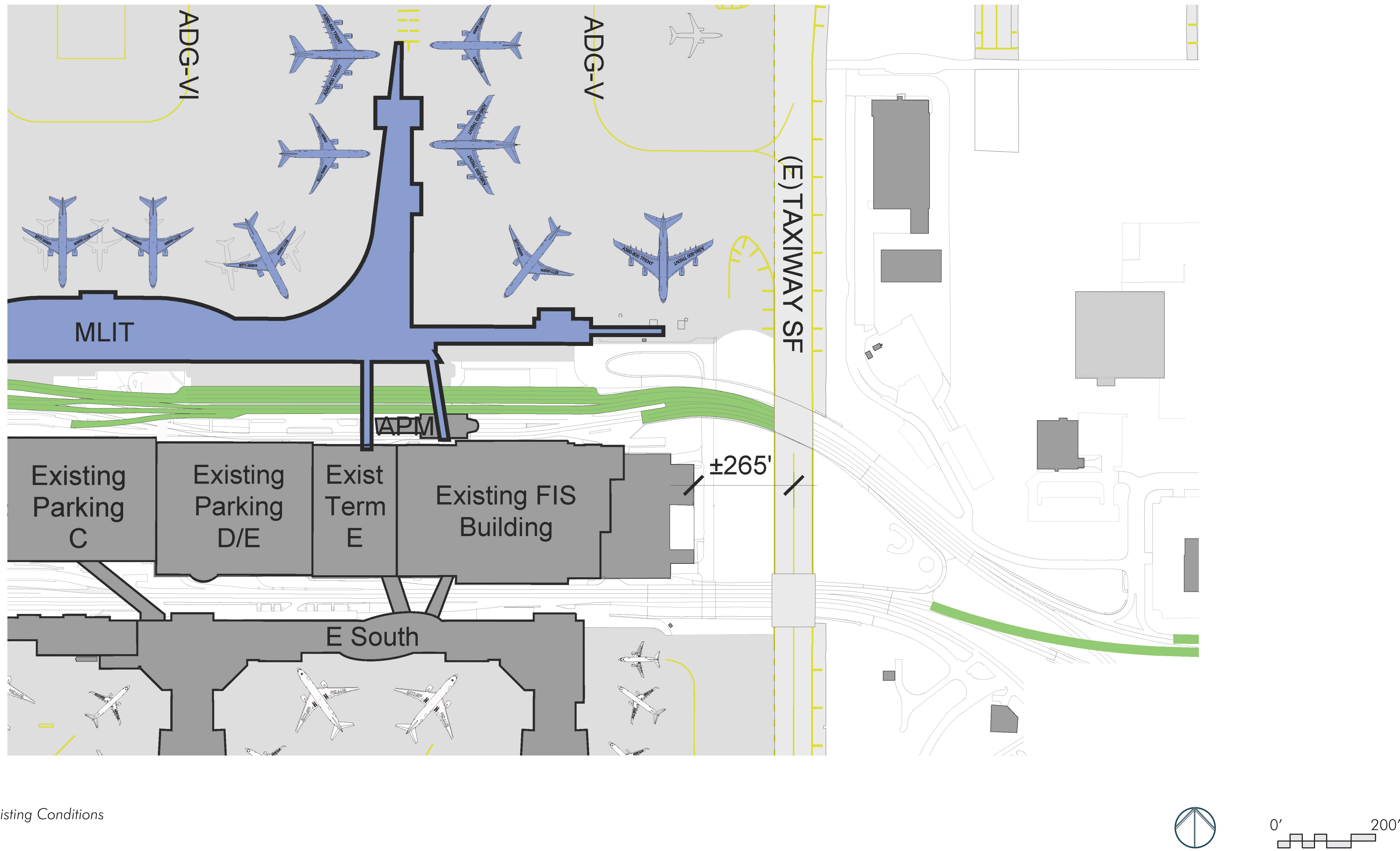
1. Provide a high level of customer service.
2. Program a facility for efficient use of space.
3. Develop a facility that maximizes retail concession revenue.
4. Increase other non-airline revenue sources.
5. Adhering to the strategic priorities of HAS.

This set of guidelines and objectives were developed based on statements obtained from multiple sources including:

- Interviews with HAS staff
- Workshops
- Airport stakeholder discussions
- Reviews of previously written material

These objectives provide a way for the HAS staff and airport stakeholders to evaluate progress, express expectations, guide decision making, and measure success.

FIS Facility



Source: Leigh Fisher; Assessment of Existing Conditions

Chapter 2 | Design Day Schedule

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2.0 Design Day Schedule

There are two primary locations for international flight arrivals at IAH, Terminals D and E. The terminals are jointly served by the CBP Central FIS facility. Terminal E exclusively accommodates the IAH hub-carrier United Airlines. Terminal D accommodates the majority of foreign flag carriers, with the exception of Air Canada, which operates out of Terminal A, and select United Airlines international arrivals. All gates in Terminal D are common use and are governed by the International Facilities Policy (IFP).

As of March 2015, there are 17 airlines and more than 9-million passengers utilizing Terminals D and E.

- Aeromexico
- Air China
- Air France
- Atlas Air
- British Airways
- Emirates
- Korean Air
- KLM
- Lufthansa
- Qatar Airways
- Scandinavian Airlines (SAS)
- Singapore Airlines
- TACA Airlines
- Turkish Airlines
- United Airlines
- VivaAerobus
- Volaris

In Spring 2015, ANA Airlines began service to Tokyo, Japan and in June 2015, EVA Air began service to Taipei, Taiwan, and in December 2015 Air New Zealand began service to Auckland, New Zealand. The design day flight schedule was developed prior to the addition of these routes.

The following sections review the existing Terminals D and E flight schedules and the future MLIT Design Day Flight Schedule (DDFS). The MLIT DDFS is the basis for the future MLIT facility requirements presented in the MLIT PDM, **Chapter 4**.

2.1 Terminal D and Terminal E Gating Analysis Gantt Chart Flag Flight Schedule

- **Figure 2.1** Gantt Chart shows the proposed aircraft activity for the D1 pier west gates (D1A-D6B)
- **Figure 2.2** shows the proposed aircraft activity for the D pier front gates (D7A-D8B)
- **Figure 2.3** shows proposed aircraft activity for the D pier east gates (D9A-D15B)
- **Figure 2.4** shows the existing activity for the E west pier gates (E1-E11)
- **Figure 2.5** shows the existing activity for the E east pier gates (E12A-E24)
- **Figure 2.6** shows the ungated United Airlines flights

Select gates have “A” and “B” designations to indicate two-for-one and three-for-two narrow-body aircraft flexibility.

The Gantt Chart legend:

- Red block flights are operated by foreign flag airlines; blue block flights are operated by United Airlines and their regional affiliates.
- The darker the shade of red or blue, the larger the aircraft.
- A heavy black outline around the flight block indicates the flight arrived from an international origin and requires a gate linked to the FIS.

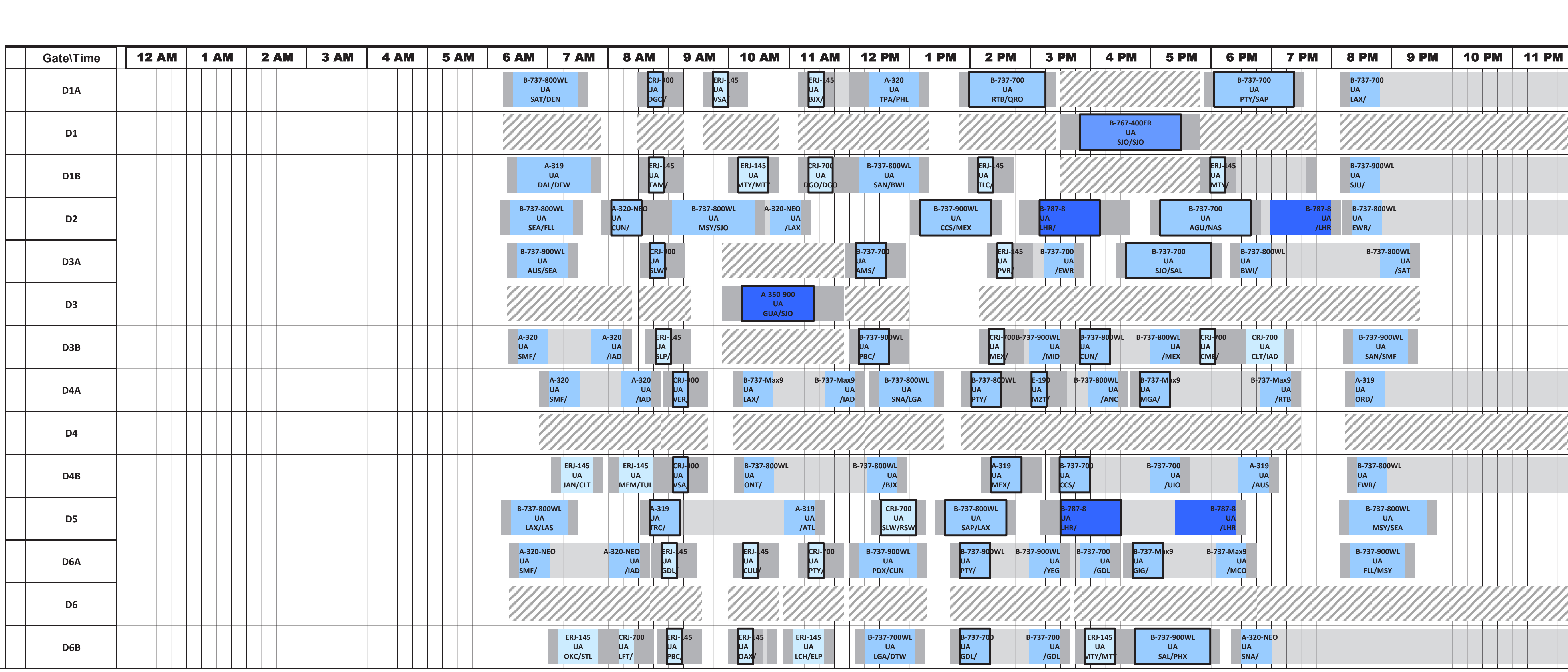
2.2 Summary

The MLIT DDFS was reviewed by the MLIT stakeholder team to ensure that the planned gate count for the MLIT will accommodate the forecasted flight schedule. Under the assumption that there would be at least four Airbus A380-capable gate positions, the MLIT team determined that the planned gate count will accommodate the MLIT DDFS. The MLIT planning team used the MLIT DDFS to estimate peak-hour arriving and departing passenger demand in **Chapter 4**, Program Requirements.

Table 2.1 lists the PAL 33 foreign flag carrier international arrivals. **Table 2.2** lists the PAL 33 United flights operating out of Terminal E, and MLIT D1 pier (west) and D (front). See **Appendix A** for a detailed flight schedule for United flights operating out of Terminal E and MLIT D1 pier (west).

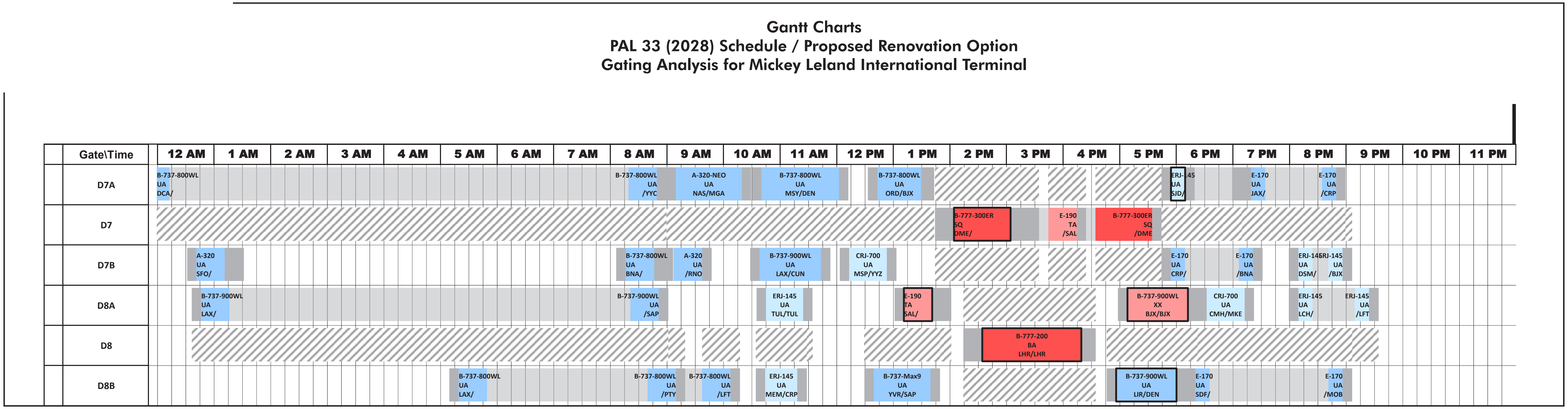
Proposed D1 Pier (West) Gates - Design Day Flight Schedule - PAL 33

Gantt Charts
PAL 33 (2028) Schedule / Proposed Renovation Option
Gating Analysis for Mickey Leland International Terminal



Source:
1: LeighFisher Inc., April 21, 2014

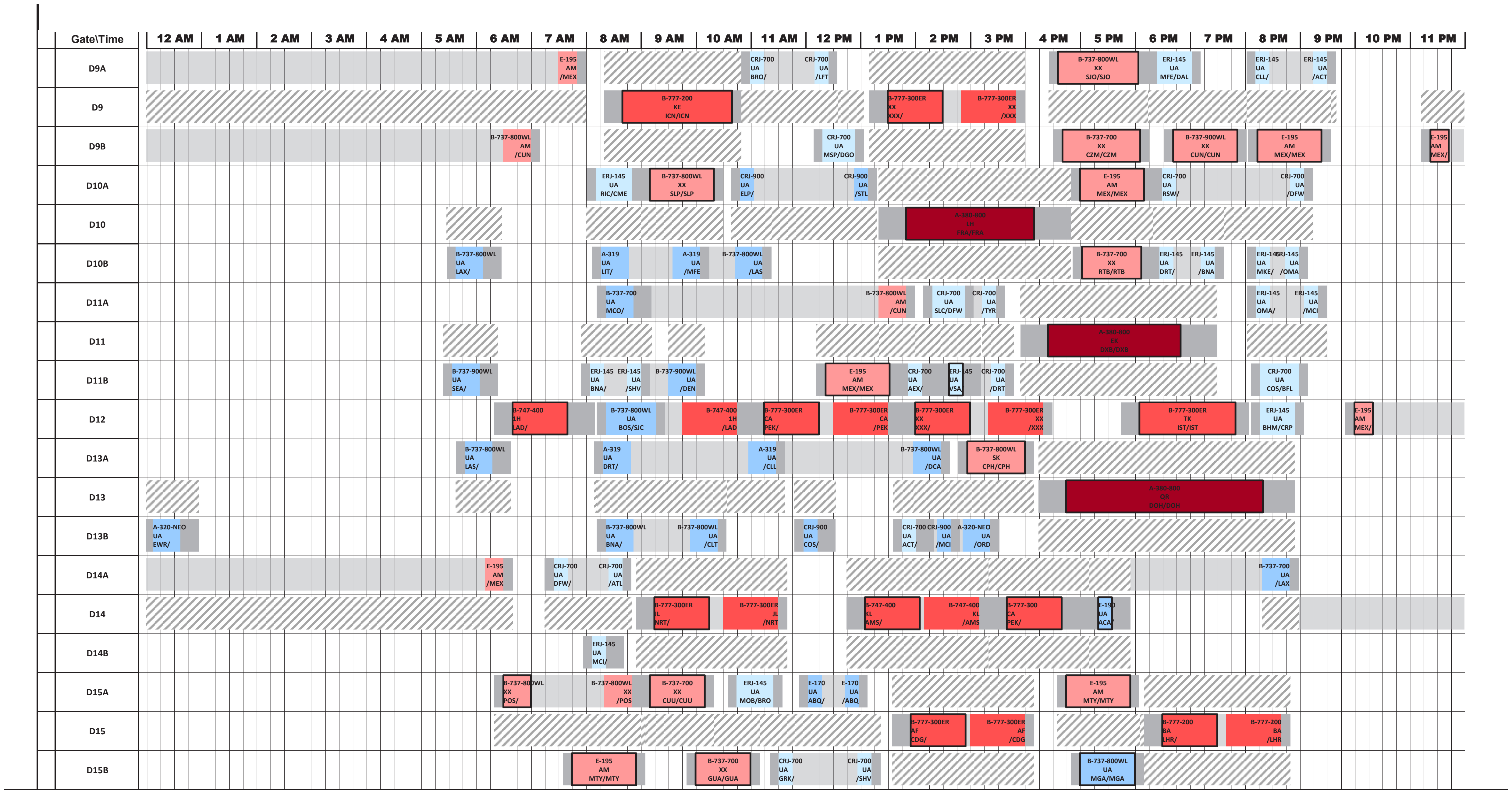
Proposed D Pier (Front) Gates - Design Day Flight Schedule - PAL 33



Source:
1: LeighFisher Inc., April 21, 2014

Proposed D Pier (East) Gates - Design Day Flight Schedule - PAL 33

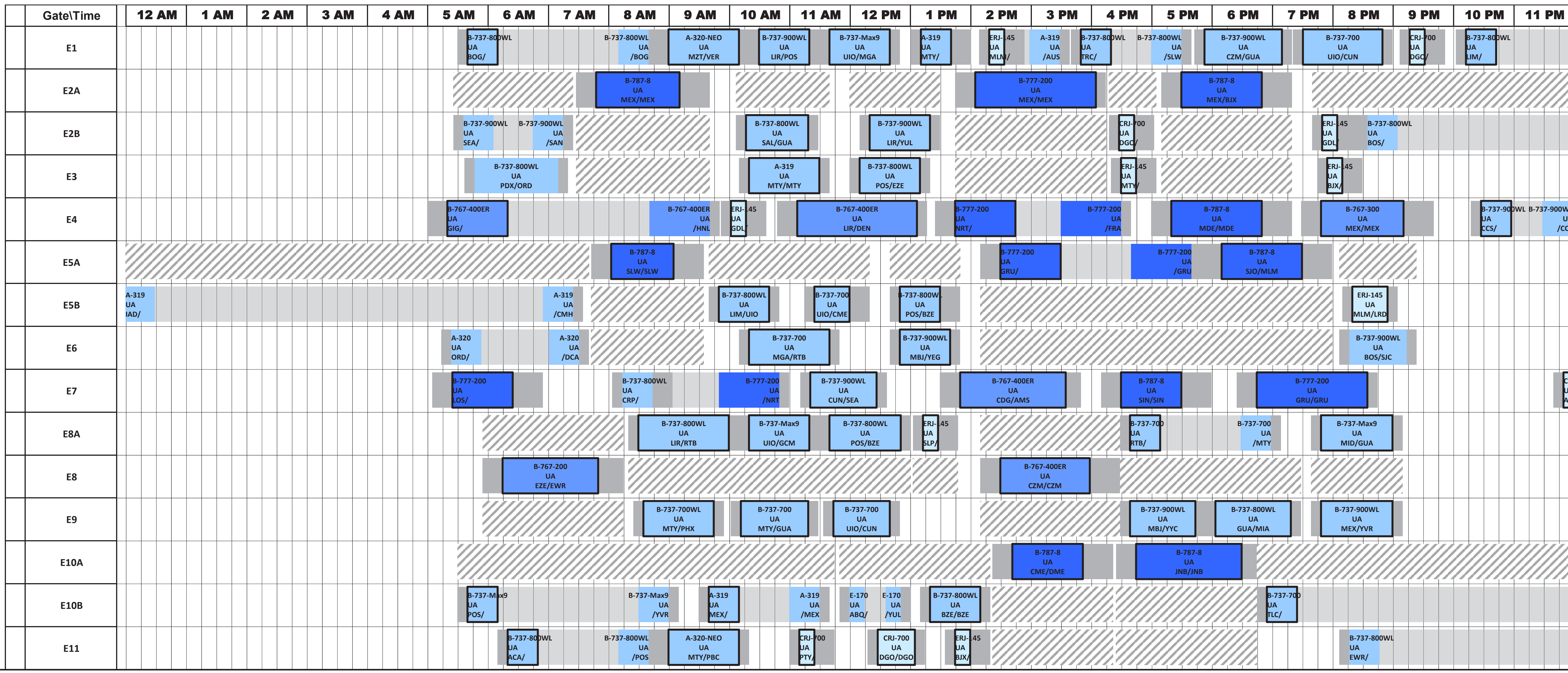
Gantt Charts
PAL 33 (2028) Schedule / Proposed Renovation Option
Gating Analysis for Mickey Leland International Terminal



Source:
1: LeighFisher Inc., April 21, 2014

Existing E (West) Pier Gates - Design Day Flight Schedule - PAL 33

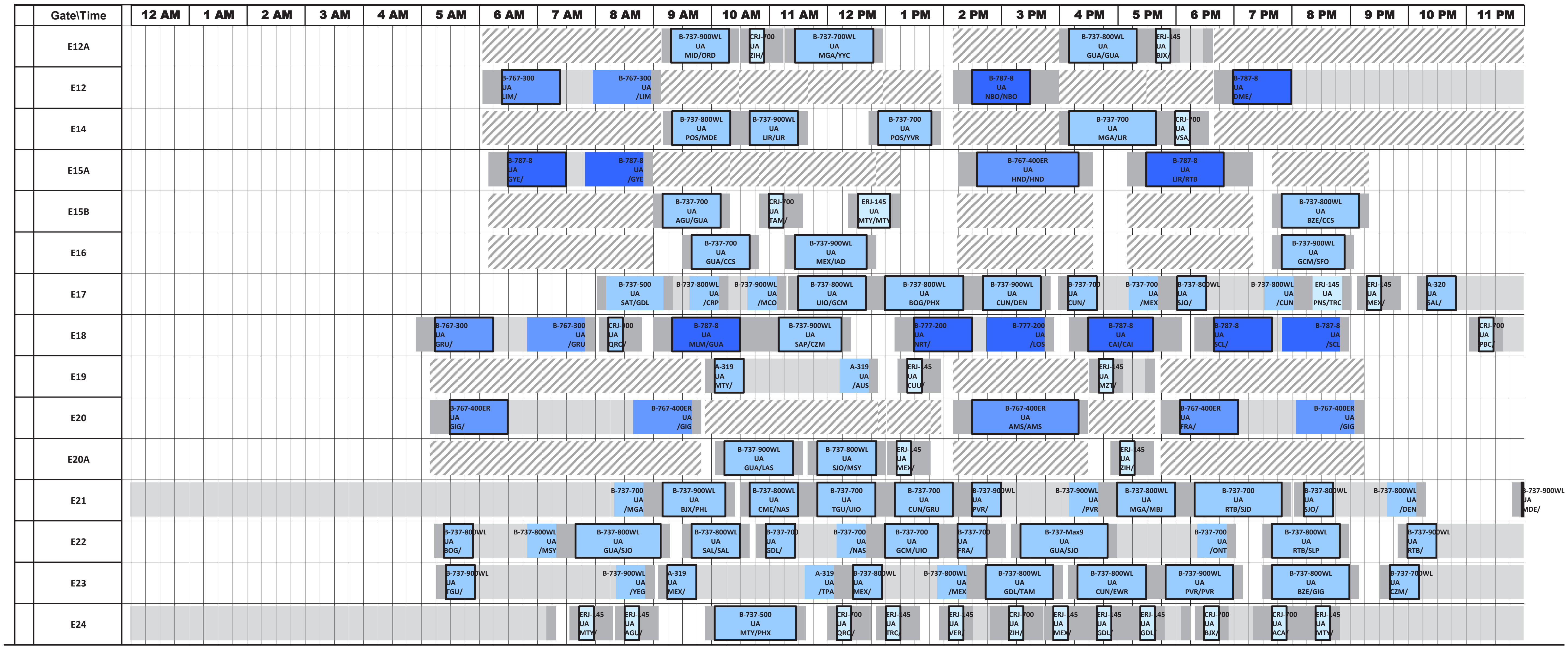
Gantt Charts
PAL 33 (2028) Schedule / Proposed Renovation Option
Gating Analysis for Mickey Leland International Terminal



Source:
1: LeighFisher Inc., April 21, 2014

Existing E (East) Pier Gates - Design Day Flight Schedule - PAL 33

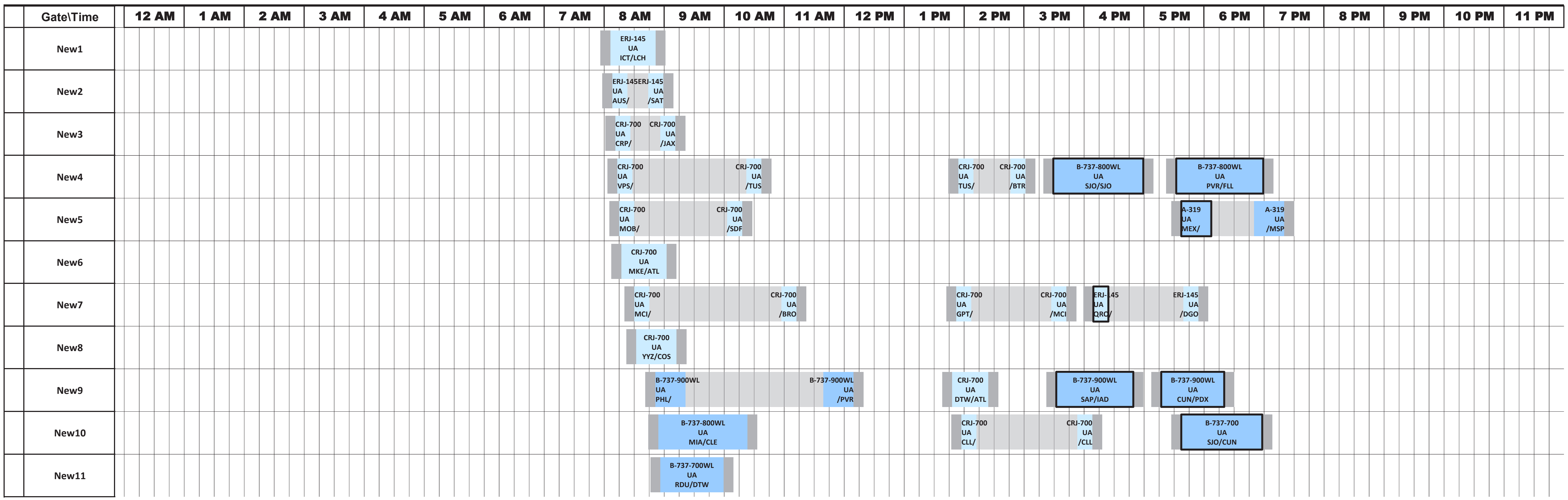
Gantt Charts
PAL 33 (2028) Schedule / Proposed Renovation Option
Gating Analysis for Mickey Leland International Terminal



Source:
1: LeighFisher Inc., April 21, 2014

Ungated United Airlines Flights - Design Day Flight Schedule - PAL 33

Gantt Charts
PAL 33 (2028) Schedule / Proposed Renovation Option
Gating Analysis for Mickey Leland International Terminal



Source:
1: LeighFisher Inc., April 21, 2014

Foreign Flag Carrier - Design Day Flight Schedule - International Arrivals

ARRIVALS		
OP	**DESTINATION**	**STA**
TBD	PORT OF SPAIN	6:30
Atlas Air	LUANDA	6:40
AeroMexico	MONTERREY GENERAL MARIANO ESCOBEDO APT	7:45
Korean Air	SEOUL INCHEON INTERNATIONAL APT	8:40
TBD	CHIHUAHUA	9:10
TBD	SAN LUIS POTOSI	9:10
Japan Airlines	TOKYO NARITA APT	9:15
TBD	GUATEMALA CITY	10:00
Air China	BEIJING CAPITAL APT	11:15
AeroMexico	MEXICO CITY BENITO JUAREZ INT'L APT	12:22
KLM	AMSTERDAM	13:05
TACA Airlines	SAN SALVADOR	13:12
TBD	LONDON HEATHROW APT	13:30
Lufthansa	FRANKFURT INTERNATIONAL APT	13:50
Air France	PARIS CHARLES DE GAULLE APT	13:55
TBD	TOKYO NARITA APT	14:00
Singapore	MOSCOW DOMODEDOVO APT	14:05
British Airways	LONDON HEATHROW APT	14:35
Scandinavian	COPENHAGEN APT	14:57
Air China	BEIJING CAPITAL APT	15:40
Emirates (Pre-Cleared)	DUBAI	16:25
TBD	SAN JOSE	16:36
TBD	COZUMEL	16:41
Qatar Airways (Pre-Cleared)	DOHA	16:45
AeroMexico	MONTERREY GENERAL MARIANO ESCOBEDO APT	16:45
AeroMexico	MEXICO CITY BENITO JUAREZ INT'L APT	17:00
TBD	ROATAN	17:02
TBD	LEON-GUANAJUATO	17:09
Turkish Airways	ISTANBUL	18:05
British Airways	LONDON HEATHROW APT	18:30
TBD	CANCUN	18:42
AeroMexico	MEXICO CITY BENITO JUAREZ INT'L APT	20:14
AeroMexico	MEXICO CITY BENITO JUAREZ INT'L APT	22:00
AeroMexico	MEXICO CITY BENITO JUAREZ INT'L APT	23:23

Source: Leigh Fisher Inc., April, 2014

United Airlines - Design Day Flight Schedule - International Arrivals

OP	DESTINATION	STA
United Airlines	SAO PAULO GUARULHOS INT L APT	5:15
United Airlines	RIO DE JANEIRO INTERNATIONAL APT	5:20
United Airlines	SOUTH AMERICA	5:24
United Airlines	LAGOS	5:25
United Airlines	CENTRAL AMERICA	5:26
United Airlines	RIO DE JANEIRO INTERNATIONAL APT	5:30
United Airlines	SOUTH AMERICA	5:40
United Airlines	CARIBBEAN	5:40
United Airlines	SOUTH AMERICA	6:15
United Airlines	MEXICO	6:20
United Airlines	MEXICO	6:20
United Airlines	SOUTH AMERICA	6:24
United Airlines	SOUTH AMERICA	6:30
United Airlines	SOUTH AMERICA	7:01
United Airlines	CENTRAL AMERICA	7:40

OP	DESTINATION	STA
United Airlines	MEXICO	7:44
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	7:48
United Airlines	CARIBBEAN	7:48
United Airlines	MEXICO	8:03
United Airlines	MEXICO	8:04
United Airlines	MEXICO	8:14
United Airlines	CENTRAL AMERICA	8:30
United Airlines	MEXICO	8:31
United Airlines	MEXICO	8:35
United Airlines	MEXICO	8:40
United Airlines	MEXICO	8:41
United Airlines	MEXICO	8:41
United Airlines	MEXICO	8:42
United Airlines	MEXICO	8:42
United Airlines	MEXICO	8:48

OP	DESTINATION	STA
United Airlines	MEXICO	8:54
United Airlines	MEXICO	8:59
United Airlines	MEXICO	9:00
United Airlines	MEXICO	9:00
United Airlines	MEXICO	9:05
United Airlines	MEXICO	9:05
United Airlines	MEXICO	9:10
United Airlines	MEXICO	9:10
United Airlines	MEXICO	9:19
United Airlines	CARIBBEAN	9:20
United Airlines	CARIBBEAN	9:20
United Airlines	MEXICO	9:20
United Airlines	CENTRAL AMERICA	9:40
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	9:40
United Airlines	MEXICO	9:40

OP	DESTINATION	STA
United Airlines	MEXICO	9:45
United Airlines	SOUTH AMERICA	9:50
United Airlines	MEXICO	10:02
United Airlines	MEXICO	10:04
United Airlines	MEXICO	10:04
United Airlines	MEXICO	10:10
United Airlines	MEXICO	10:10
United Airlines	MEXICO	10:12
United Airlines	MEXICO	10:14
United Airlines	MEXICO	10:14
United Airlines	MEXICO	10:15
United Airlines	CENTRAL AMERICA	10:17
United Airlines	SOUTH AMERICA	10:20
United Airlines	MEXICO	10:20
United Airlines	CENTRAL AMERICA	10:20

OP	DESTINATION	STA
United Airlines	CENTRAL AMERICA	10:30
United Airlines	MEXICO	10:40
United Airlines	MEXICO	10:40
United Airlines	CENTRAL AMERICA	10:40
United Airlines	MEXICO	10:50
United Airlines	MEXICO	10:57
United Airlines	MEXICO	11:00
United Airlines	CENTRAL AMERICA	11:08
United Airlines	CENTRAL AMERICA	11:10
United Airlines	PANAMA CITY TOCUMEN INTERNATIONL	11:10
United Airlines	MEXICO	11:20
United Airlines	MEXICO	11:20
United Airlines	PANAMA CITY TOCUMEN INTERNATIONL	11:20
United Airlines	MEXICO	11:21
United Airlines	SOUTH AMERICA	11:25
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	11:27
United Airlines	CENTRAL AMERICA	11:27

OP	DESTINATION	STA
United Airlines	SOUTH AMERICA	11:30
United Airlines	SOUTH AMERICA	11:40
United Airlines	CARIBBEAN	11:40
United Airlines	SOUTH AMERICA	11:44
United Airlines	CENTRAL AMERICA	11:50
United Airlines	CENTRAL AMERICA	11:50
United Airlines	CENTRAL AMERICA	11:50
United Airlines	SOUTH AMERICA	11:59
United Airlines	SAO PAULO GUARULHOS INT L APT	12:02
United Airlines	AMSTERDAM	12:07
United Airlines	MEXICO	12:10
United Airlines	MEXICO	12:10
United Airlines	CARIBBEAN	12:10
United Airlines	CENTRAL AMERICA	12:20
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	12:27
United Airlines	MEXICO	12:28
United Airlines	MEXICO	12:32

OP	DESTINATION	STA
United Airlines	MEXICO	12:32
United Airlines	CARIBBEAN	12:50
United Airlines	CARIBBEAN	12:50
United Airlines	CARIBBEAN	12:53
United Airlines	SOUTH AMERICA	13:00
United Airlines	CARIBBEAN	13:00
United Airlines	MEXICO	13:01
United Airlines	MEXICO	13:10
United Airlines	MONTERREY GENERAL MARIANO ESCOBEDO APT	13:11
United Airlines	SOUTH AMERICA	13:11
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	13:12
United Airlines	MEXICO	13:13
United Airlines	CENTRAL AMERICA	13:20
United Airlines	MEXICO	13:23
United Airlines	TOKYO NARITA APT	13:30
United Airlines	CENTRAL AMERICA	13:36

OP	DESTINATION	STA
United Airlines	MEXICO	13:45
United Airlines	TOKYO NARITA APT	13:45
United Airlines	PARIS CHARLES DE GAULLE APT	13:50
United Airlines	PANAMA CITY TOCUMEN INTERNATIONL	13:51
United Airlines	MEXICO	13:51
United Airlines	CENTRAL AMERICA	14:00
United Airlines	PANAMA CITY TOCUMEN INTERNATIONL	14:02
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	14:05
United Airlines	MEXICO	14:06
United Airlines	MEXICO	14:09
United Airlines	FRANKFURT INTERNATIONAL APT	14:15
United Airlines	MEXICO	14:19
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	14:20
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	14:22
United Airlines	MEXICO	14:28
United Airlines	MEXICO	14:30

OP	DESTINATION	STA
United Airlines	AMSTERDAM	14:30
United Airlines	MEXICO	14:30
United Airlines	SAO PAULO GUARULHOS INT L APT	14:30
United Airlines	NAIROBI JOMO KENYATTA INTERNATIONAL APT	14:30
United Airlines	TOKYO HANEDA APT	14:35
United Airlines	MEXICO	14:37
United Airlines	MEXICO	14:41
United Airlines	MEXICO	14:41
United Airlines	MEXICO	14:42
United Airlines	MEXICO	14:44
United Airlines	CENTRAL AMERICA	15:02
United Airlines	MEXICO	15:02
United Airlines	MEXICO	15:08
United Airlines	LONDON HEATHROW APT	15:10
United Airlines	CENTRAL AMERICA	15:20
United Airlines	CARIBBEAN	15:27
United Airlines	SOUTH AMERICA	15:30

OP	DESTINATION	STA
United Airlines	CENTRAL AMERICA	15:30
United Airlines	LONDON HEATHROW APT	15:31
United Airlines	CENTRAL AMERICA	15:33
United Airlines	CENTRAL AMERICA	15:50
United Airlines	MEXICO	15:50
United Airlines	MEXICO	15:50
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	15:54
United Airlines	MEXICO	15:55
United Airlines	MEXICO	16:09
United Airlines	CENTRAL AMERICA	16:10
United Airlines	CENTRAL AMERICA	16:10
United Airlines	MEXICO	16:10
United Airlines	MEXICO	16:19
United Airlines	MEXICO	16:28
United Airlines	CAIRO	16:30
United Airlines	MEXICO	16:30
United Airlines	SINGAPORE CHANGI APT	16:30

OP	DESTINATION	STA
United Airlines	CENTRAL AMERICA	16:35
United Airlines	CENTRAL AMERICA	16:36
United Airlines	CENTRAL AMERICA	16:39
United Airlines	CARIBBEAN	16:39
United Airlines	MEXICO	16:39
United Airlines	MEXICO	16:41
United Airlines	RIO DE JANEIRO INTERNATIONAL APT	16:43
United Airlines	CENTRAL AMERICA	16:45
United Airlines	JOHANNESBURG JAN SMUTS APT	16:45
United Airlines	CENTRAL AMERICA	16:50
United Airlines	CENTRAL AMERICA	16:57
United Airlines	CENTRAL AMERICA	17:00
United Airlines	MEXICO	17:00
United Airlines	CENTRAL AMERICA	17:00
United Airlines	MEXICO	17:03
United Airlines	MEXICO	17:10
United Airlines	MEXICO	17:18
United Airlines	MEXICO	17:20

OP	DESTINATION	STA
United Airlines	SOUTH AMERICA	17:20
United Airlines	MEXICO	17:24
United Airlines	CENTRAL AMERICA	17:30
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	17:30
United Airlines	MEXICO	17:33
United Airlines	CENTRAL AMERICA	17:38
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	17:38
United Airlines	MEXICO	17:40
United Airlines	MEXICO	17:50
United Airlines	MEXICO	17:50
United Airlines	MEXICO	17:53
United Airlines	MEXICO	17:55
United Airlines	MEXICO	18:00
United Airlines	MEXICO	18:00
United Airlines	CENTRAL AMERICA	18:02
United Airlines	CENTRAL AMERICA	18:04
United Airlines	PANAMA CITY TOCUMEN INTERNATIONL	18:04
United Airlines	FRANKFURT INTERNATIONAL APT	18:05

OP	DESTINATION	STA
United Airlines	CENTRAL AMERICA	18:10
United Airlines	CENTRAL AMERICA	18:20
United Airlines	MEXICO	18:20
United Airlines	MEXICO	18:30
United Airlines	SANTIAGO COMODORO ARTURO MERINO BENITEZ	18:40
United Airlines	MEXICO	18:42
United Airlines	SAO PAULO GUARULHOS INT L APT	18:45
United Airlines	MEXICO	18:55
United Airlines	MOSCOW DOMODEDOVO APT	19:00
United Airlines	SOUTH AMERICA	19:31
United Airlines	MEXICO	19:40
United Airlines	CENTRAL AMERICA	19:40
United Airlines	CENTRAL AMERICA	19:40
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	19:49
United Airlines	MEXICO	19:49
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	19:49
United Airlines	MEXICO	19:50

OP	DESTINATION	STA
United Airlines	CENTRAL AMERICA	19:50
United Airlines	CARIBBEAN	19:50
United Airlines	MEXICO	19:55
United Airlines	CENTRAL AMERICA	20:13
United Airlines	MEXICO	20:20
United Airlines	MEXICO	20:25
United Airlines	MEXICO	21:17
United Airlines	MEXICO CITY BENITO JUAREZ INTL APT	21:18
United Airlines	MEXICO	21:42
United Airlines	CENTRAL AMERICA	22:00
United Airlines	SOUTH AMERICA	22:13
United Airlines	SOUTH AMERICA	22:20
United Airlines	SOUTH AMERICA	22:28
United Airlines	MEXICO	23:14
United Airlines	MEXICO	23:50
United Airlines	SOUTH AMERICA	23:58

Notes:
1/ STA:Estimated Time of Arrival
2/ OP: Operator
Source: Leigh Fisher Associates, Inc., April, 2014
Prepared by: Ricondo & Associates, Inc., July 2015

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Chapter 3 | Existing Conditions

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3.0 Existing Conditions

This chapter summarizes existing conditions of the FIS facility and different areas by function. Existing conditions and functional usage of the FIS are subdivided into three topical areas: FIS Building/Terminal E Processor, Site Utilities, and Landside.

3.1 Federal Inspections Services Building

The FIS is a 784,000 square foot multi-level facility. Building infrastructure includes: architectural, structural, electrical, mechanical and plumbing assets, as well as utilities internal to the terminal. The FIS building also houses Terminal E's check-in facility. Within the same building footprint of the FIS, the Terminal E central ticketing facility provides United Airlines' ticketing lobby, baggage check and security screening. Deplaning international passengers are directed from Terminals D and E to the FIS facility, whereas deplaning domestic or pre-cleared passengers are directed to the baggage claim devices within Terminal C or the pre-cleared baggage claim in Terminal D. The FIS facility has the following multiple levels:

3.1.1 SPACE UTILIZATION

The levels of the FIS building segregate inbound international baggage processing, inspections and deplaning flows of passengers through the various inspection processes of the FIS.

The existing FIS is a four-level facility and concourse building. Each level name corresponds to the level's height above sea level (e.g., Level Two is 116 feet above mean sea level (MSL)). Following are the names of the four levels:

- Level Two (116) – Primary Processing
- Mezzanine (105) – Office Space
- Level One (93) – Baggage Claim and Recheck
- Baggage Level (78) – Inbound Baggage and Screening

The total building area is approximately 782,550 square feet (sf). Table 3.1 contains a detailed listing of the area and function for each level.

3.1.1.1 Level Two (116)

Level Two, as shown in **Figure 3.1**, is dedicated to the CBP inspection hall. Level Two has 80 FIS agent booths/podiums as well as Global Entry and automated passport control (APC) kiosks, to process 4,000 arriving passengers per hour when fully staffed. The level is connected to Terminal D and flows through sterile passenger bridge connections.

Terminal E's ticket lobby is located on this level. It provides check-in counters, United Airlines (UA) offices, security screening checkpoints, departures curbside, concessions, building systems and access to the parking garage.

3.1.1.2 Mezzanine Level (105)

Located above CBP office space at the east and west ends of the FIS facility are three mezzanine areas that accommodate CBP Administration offices, as shown in **Figure 3.2**.

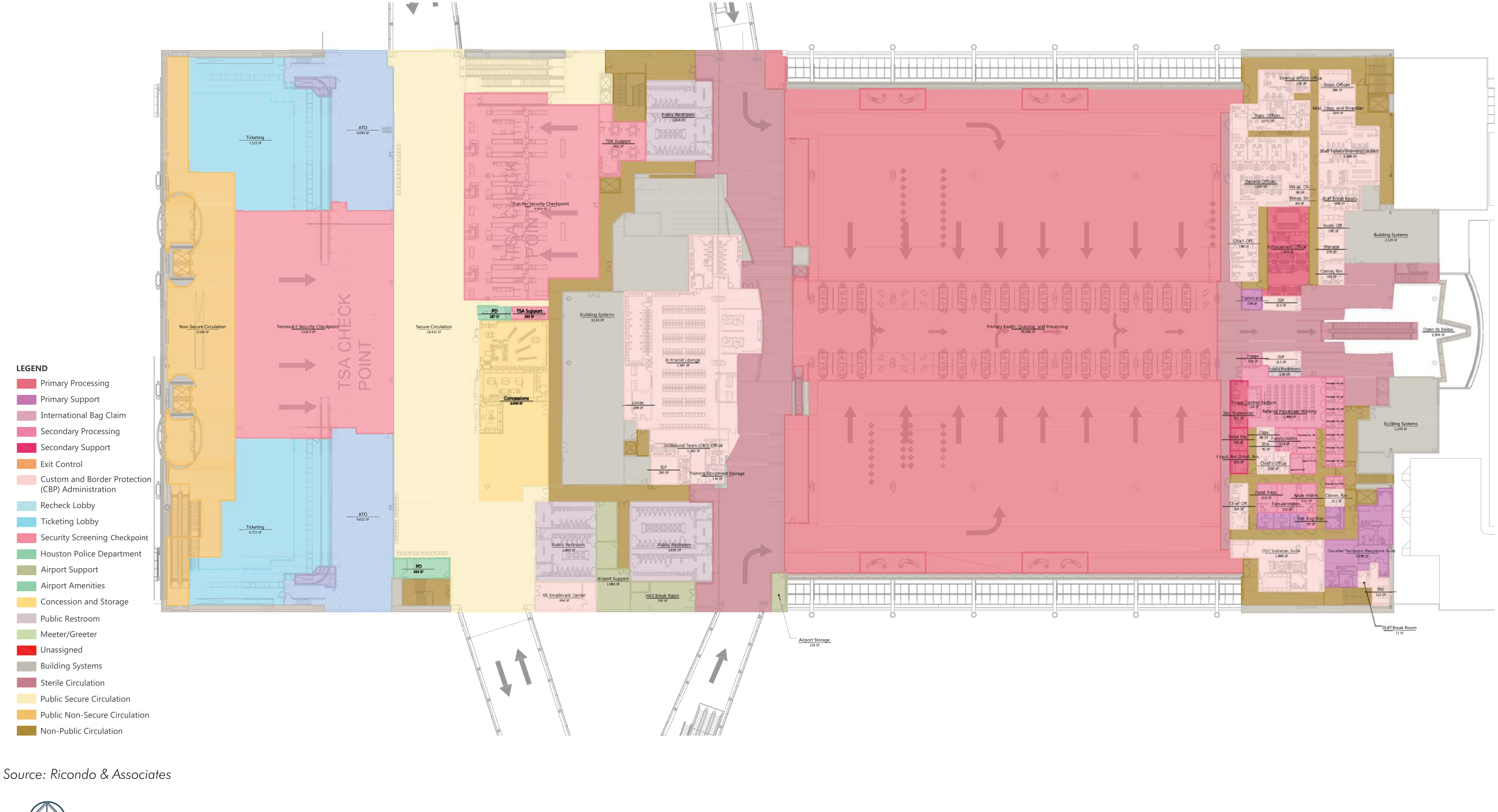
3.1.1.3 Level One (93)

After clearing CBP, passengers proceed to Level One at the east end of the existing facility. Level One, as shown in **Figure 3.3**, consists of 12 baggage claim devices, secondary processing (customs and agricultural inspections), secondary operations and support, and the building's loading dock. Once clear of the FIS, passengers proceed to the Terminal E recheck for connecting passengers or meeter/greeter lobby for Houston destination passengers. Other functions on Level One include: non secure concessions, building systems, airport support offices, arrivals curbside, and access to the parking garage.

3.1.1.4 Baggage Level (78)

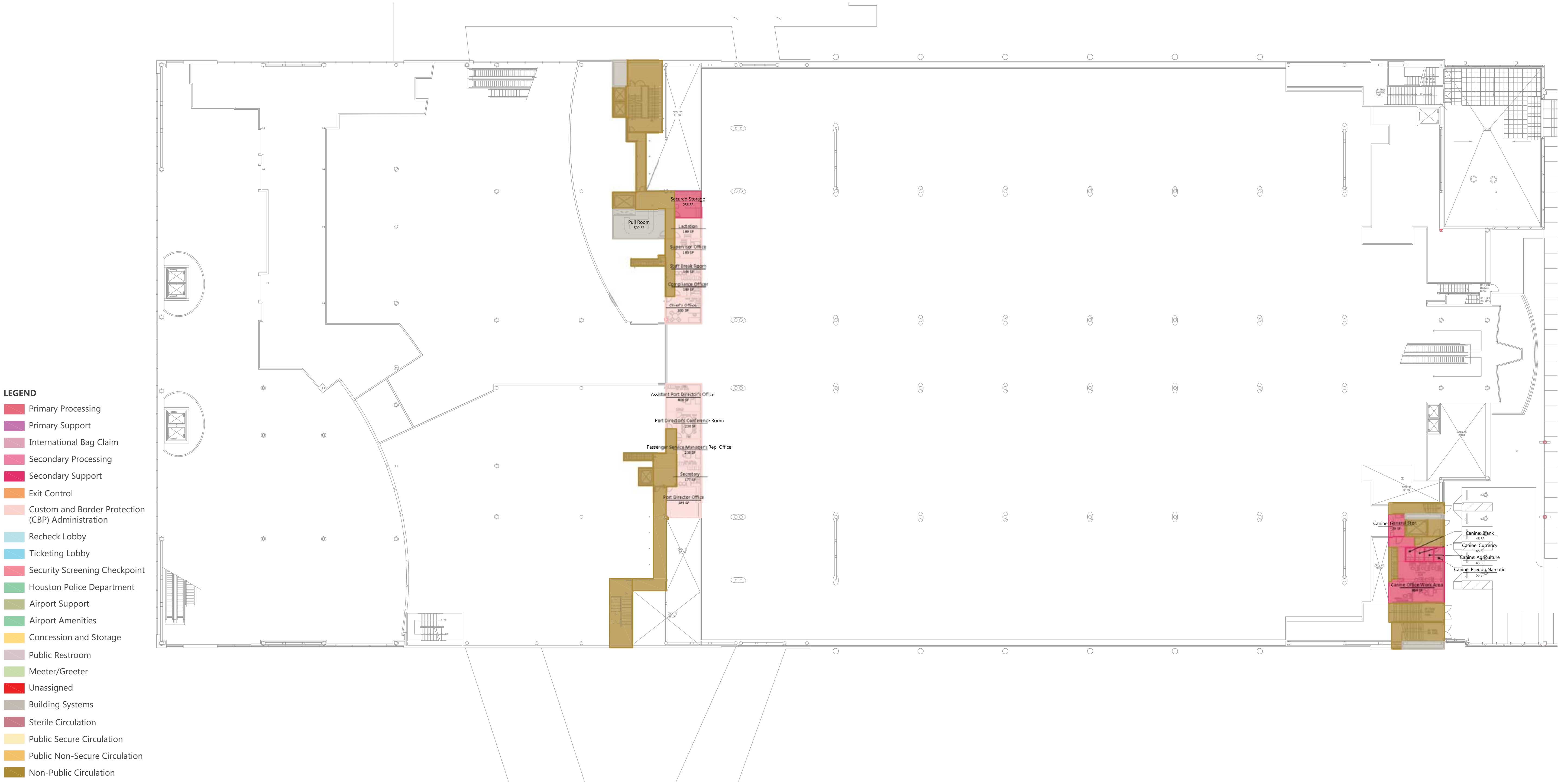
Baggage Level, as shown in **Figure 3.4**, consists of the international inbound baggage handling and conveyors and the right-of-way and boarding platform of the Subway system. The ITT station is actually at a lower level at this location and is accessed via escalators, elevators and stairs from this level. Baggage tugs utilize bridges spanning the terminal roads to access the ramps leading to the baggage handling facility from the east end of the building, adjacent to Taxiway SF.

FIS Facility - Existing Level Two (116)



Source: Ricondo & Associates

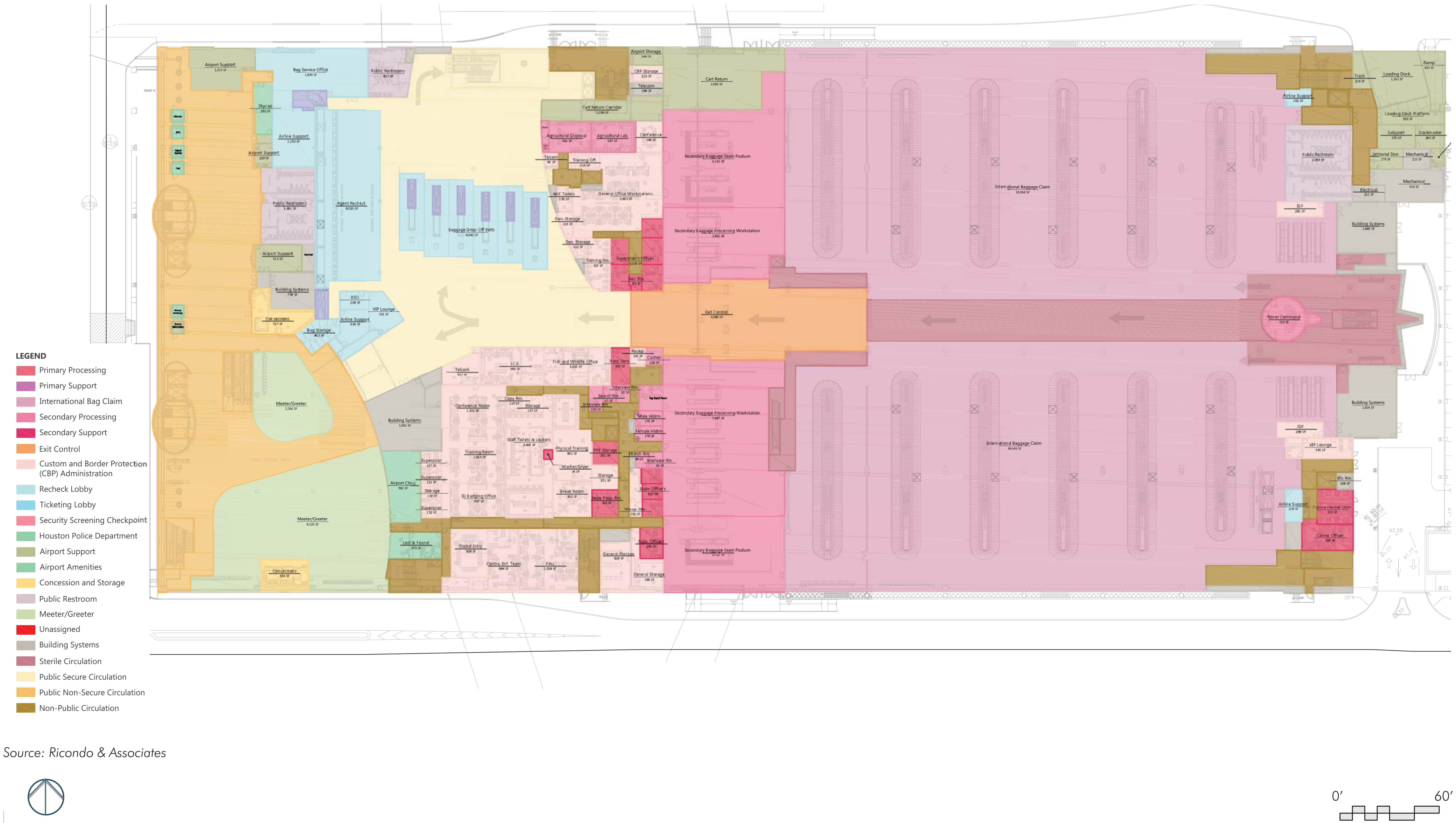
FIS Facility - Existing Mezzanine Level (105)



Source: Ricondo & Associates

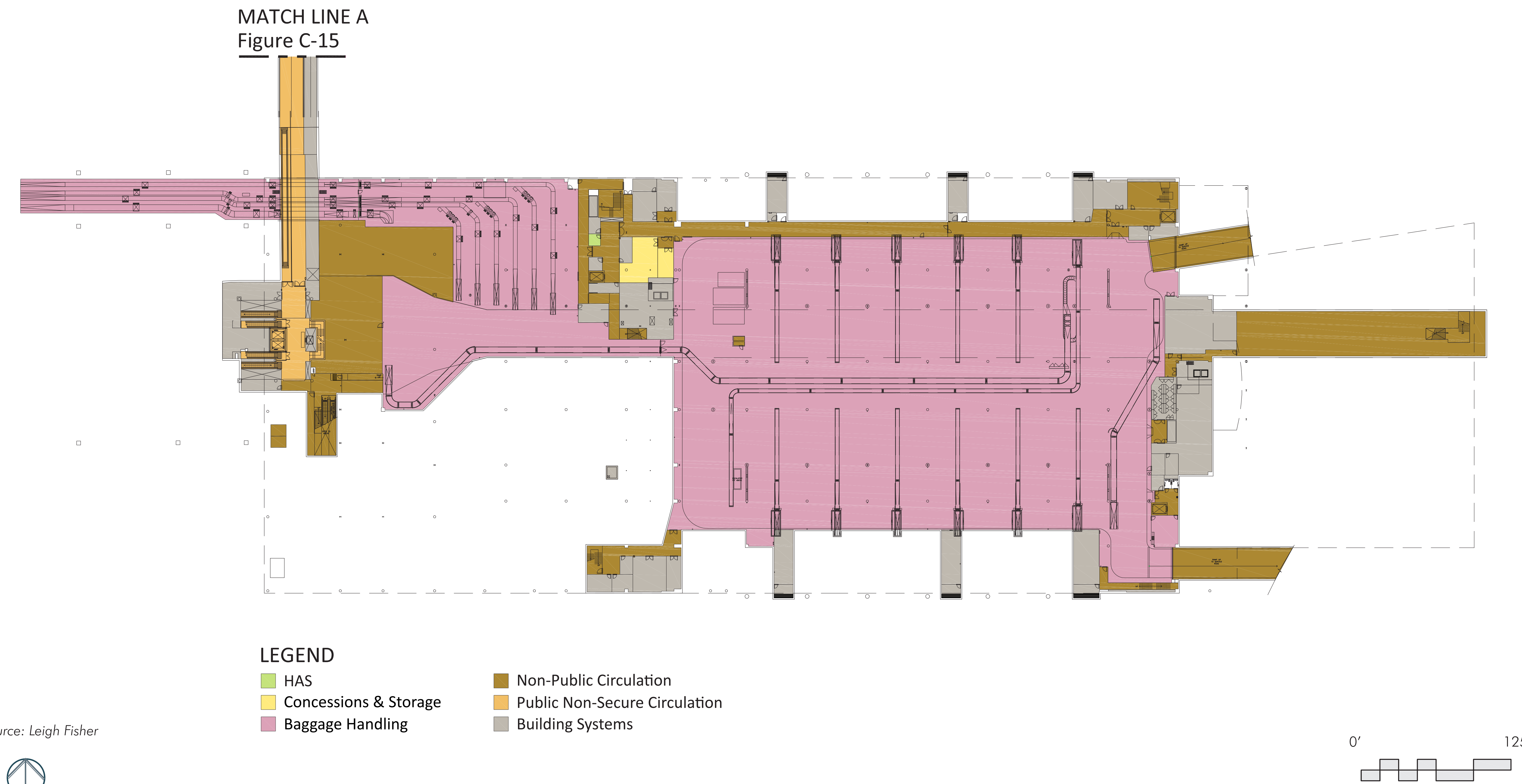
0′ 60′

FIS Facility - Existing Level One (93)



Source: Ricondo & Associates

FIS Facility - Existing Baggage Level (78)



Source: Leigh Fisher

Table 3.1 Summary Inventory of Terminal E Processing Facilities		
		Existing Inventory
Million Annual Enplaned Passengers (MAEP)		
Peak Hour Deplaning Passengers (PHDP)	4,000	
Peak Hour Originating Passengers (PHOP)		
FACILITY	AREA (SF)	POS. (EA)
Federal Inspection Services		
Primary Processing Area		
Primary Booth, Queuing, and Processing	77,920	
Global Entry Program	Incl. in Primary Insp.	
Global Entry Kiosks	Incl. in Primary Insp.	40
Global Entry Kiosks Queue Area	Incl. in Primary Insp.	
Global Entry Verify Agent Podium	Incl. in Primary Insp.	Incl. in APC Verify Agent Podium
Global Entry Verify Agent Podium Queue Area	Incl. in Primary Insp.	
APC Program (US Citizens/US Residents and Visa Waiver)	Incl. in Primary Insp.	
APC Kiosk	Incl. in Primary Insp.	46
APC Kiosk Queue Area	Incl. in Primary Insp.	
APC Verify Agent Podium	Incl. in Primary Insp.	Incl. In Agent Booths
APC Verify Agent Podium Queue Area	Incl. in Primary Insp.	
APC Triage Agent	Incl. in Primary Insp.	Incl. In Agent Booths
APC Triage Queue Area	Incl. in Primary Insp.	
Agent Booth Positions	Incl. in Primary Insp.	66
Non-visa Waiver Agents	Incl. in Primary Insp.	
Non-visa Waiver Agent Queue Area	Incl. in Primary Insp.	
Primary Support Spaces		
CBP Forms Counter	2,030	8
CBP Command and Control Center	150	1

FACILITY	AREA (SF)	POS. (EA)
Counter Terrorism Response Suite	2,000	1
Public Restroom	4,520	2
International Baggage Claim	99,520	12
Secondary Processing Area		
Rover Command and Control Center	730	1
Triage Control Podium	260	2
Referral Passenger Waiting	1,480	1
Public Restroom	2,230	2
Secondary Baggage Exam Podium and Baggage Belts	8,900	3
Secondary Baggage NII Processing Workstation	10,920	6
Cashier's Office	130	1
CBP Agricultural Laboratory (AQI; includes animal processing)	570	1
CBP Agricultural Disposal Room	630	1
CBP/APHIS VS Bird Quarantine and Bird Holding Facilities		
Detainee Baggage Storage	60	1
Interview Room	1,230	13
Search Room	380	4
Male Holdroom	390	2
Female Holdroom	390	2
Juvenile Holdroom		
Family Holdroom	210	1
Food Preparation/Storage	210	-
Expedited/Voluntary Removal Suite		
Secondary Operations and Support		
Immigrant Room		
Fingerprint Room		
Fraudulent Documentation Analysis Room	150	1
Secondary Supervisor's Office	2,060	11
Enforcement Office	1,420	1
Secure Storage	340	2
Canine Kennels	520	10

FACILITY	AREA (SF)	POS. (EA)
Animal Processing Room	Incl. in Ag. Lab	Incl. in Ag. Lab
Washer/Dryer	30	1
Food Preparation Room	Incl. in Secondary Food Prep./ Stor.	Incl. in Secondary Food Prep./ Stor.
Dry Food Storage	Incl. in Secondary Food Prep./ Stor.	Incl. in Secondary Food Prep./ Stor.
Canine Unit Secure Training Aid Storage		
Canine Unit Secure Training Aid Storage (Pseudo Narcotic)	60	1
Canine Unit Secure Training Aid Storage (Agricultural)	50	1
Canine Unit Secure Training Aid Storage (Currency)	50	1
Canine Unit Secure Training Aid Storage (Blank)	50	1
Canine Unit General Storage	130	1
Canine Officer Work Area	1,450	2
Passenger Service Manager's Representative Office	540	2
Agent Office: US Immigration and Customs Enforcement	960	1
Personal Protective Equipment (PPE) Storage	250	1
Exit Control	6,590	
Exit Control Queuing Area	Incl. in processing area	
Global Entry		1
One Stop/ ITI/ ITD		1
Standard		
CBP Administration		
CBP Officer/Staff Areas		
Port Director's Office	380	1
Port Director's Conference Room	240	1
Port Director's Secretary/Reception Area	180	1
Assistant Port Director's Office	410	1
Chief Officer's Office	1,670	8

FACILITY	AREA (SF)	POS. (EA)
Supervisor's Office	3,390	18
Intelligence Office		
General Office Workstations "C"	4,940	4
Anti-Terrorism Contraband Enforcement Team Office "B"	880	1
Passenger Analysis Unit (PAU) Office	1,560	1
Outbound Team (OBT) Office	1,180	1
Fish and Wildlife Services Office	1,010	1
Internal Affairs Office	140	1
CDC Isolation Suite	1,490	1
CBP Support Space		
Airport Reception	110	1
Public Reception/Entrance and Clearance (E&C) Office		
ID Badging, Trusted Traveler Enrollment Center and File room	910	1
Muster/Training Room	2,160	3
Muster/Training Equipment Storage	140	1
Mail, Copy and Shredder	500	3
Weapons Storage Room	340	2
Weapons Cleaning Room	90	1
Communication Equipment Room	310	2
LAN/Telco Room	520	2
Wiring Closet-IDF	1,290	5
General Storage/File Room	2,780	8
Temporary Seize Property Room	310	1
Staff Break Room	1,330	4
Male and Female Staff Toilets/Showers/Lockers	3,970	2
Union Office	300	1
Physical Training Room	800	1
US PASS/NEXUS Enrollment Center and Storage	1,600	2
Lactation Support Room	190	1
VIP Lounge	570	1
In-transit Lounge	7,350	1

FACILITY	AREA (SF)	POS. (EA)
Total FIS Facility Area	**272,550**	
Recheck Lobby		
Baggage Drop-off Belts	4,040	6
Oversize Baggage Assistance		
Agent Assistance	4,520	31
Airline Support/Storage	2,400	5
VIP Lounge	590	1
Baggage Service Office	2,120	2
Baggage Right-of-Way	970	
Total Recheck Facility Area	**14,640**	
Terminal E Ticketing Lobby	13,850	
Bypass Kiosk	Incl. in Lobby Area	
Economy Positions		
Kiosk	Incl. in Lobby Area	
Agent	Incl. in Lobby Area	
Bag-Drop	Incl. in Lobby Area	
Premium Positions		
Kiosk	Incl. in Lobby Area	
Agent	Incl. in Lobby Area	
Bag-Drop	Incl. in Lobby Area	
Ticketing Support Space		
Airline Ticket Office	8,720	
Baggage Right-of-Way	450	
Total Terminal E Ticketing Lobby	**23,020**	
Transportation Security Administration-Existing Configuration		
Terminal E Security Checkpoint	13,620	6
Standard Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP
Pre √ ™ Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP

FACILITY	AREA (SF)	POS. (EA)
Queue Area	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP
TSA Offices/Support and Resolution Rooms		
Transfer Security Checkpoint	9,950	6
Standard Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP
Pre √ ™ Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP
Queue Area	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP
TSA Offices/Support & Resolution Rooms	1,090	2
Total Separate TSA Facility Area	**24,660**	
Transportation Security Administration-Consolidated Configuration		
Consolidated Security Checkpoints		
Standard Lanes	N/A	N/A
Pre √ ™ Lanes	N/A	N/A
Queue Area	N/A	N/A
TSA Offices/Support and Resolution Rooms	N/A	N/A
Total Consolidated TSA Facility Area	**N/A**	
General Spaces		
Houston Police Department	590	2
Airport Support/Storage	8,000	9
Airport Amenities	2,250	4
Concessions	5,980	6
Concession Storage/Support	1,270	
Public Restroom	4,360	3
Cart Return	3,800	2
Meeter/Greeter	10,490	2
Unassigned		
Building Systems	55,300	

FACILITY		AREA (SF)	POS. (EA)
	Open to Below	1,990	
	Baggage Handing	133,750	
Vertical Circulation			
	Sterile Vertical Circulation	2,600	
	Public Secure Vertical Circulation	3,250	
	Public Non-Secure Vertical Circulation	2,760	
	Non-Public Vertical Circulation	10,650	
Circulation			
	Sterile Circulation	31,540	
	Public Secure Circulation	37,730	
	Public Non-Secure Circulation	28,970	
	Non-Public Circulation	102,400	
	Total General Spaces	**447,680**	
	Grand Total Facility Area	**782,550**	

Notes:
1. Square footages are rounded to nearest ten square feet.
2. Excluding Primary Inspection Processing Area
3. Design Standards based on US Customs and Border Protection, Airport Technical Design Standards, June 2012.

3.2 Passenger Circulation

International deplaned passengers enter the Central FIS facility via sterile bridges spanning from Terminals D and E connecting to the western end of Level 2. Passengers flow through the following areas as they are processed:

- **Customs Declaration Form Counters**
  - o Available for arriving passengers with incomplete customs declaration forms prior to entering the primary queue area.
- **Primary Queue Area and Primary Inspection**
  - o Arriving international passengers queue prior to going through primary passport inspection. There are separate primary queue areas on the north (serving Terminal D) and south (serving Terminal E). Restrooms are located within the sterile area prior to the primary queue.
  - o Passengers have various options for primary processing based upon their nationality and situation. The following are the various functions available to passengers:
    - Automated Passport Control (APC)
    - Global Entry
    - One Stop
    - Standard queue/agent booths (non-Visa Waiver passengers)
  - o If passengers are flagged at the primary processing area, they are sent to the secondary referral waiting area on the southeast side of the facility. The Counterterrorism Suite is also located in this area.
- Baggage Claim
  - o Traveling eastward, passengers with checked baggage take the escalator or elevator to reclaim their baggage within one of the 12 baggage claim devices. Once baggage is collected, passengers proceed to exit control at the west end of the building, while restrooms are located on the east.
- Exit Control / Secondary Processing
  - o Passengers will present their customs declaration forms to CBP agents for inspection and exit the facility. Select passengers will be directed to secondary inspection for further screening.
- Baggage Recheck
  - o Connecting passengers recheck their luggage and proceed up an escalator to the rescreening area on Level Two. Once rescreened, passengers enter the secure corridor connecting Terminals D and E and the automated people mover (APM) station for other terminals and departing flights. Restrooms are located within this corridor.
- Meeter/Greeter Area
  - o Houston destination passengers will then proceed to the non-secure meeter/greeter area of the FIS facility. Concessions, access to the arrivals curbside and parking garages are within this area.

3.2.1 PRIMARY QUEUE AREA AND PRIMARY INSPECTION AREA

The primary queue area is where passengers queue prior to going through passport control. The queue area is separated into two general areas: north (serving Terminal D) and south (serving Terminal E). At the back of each queue, passengers are directed via signage and segregated into the appropriate line based on whether they are a U.S. Citizen or permanent resident, foreign visitor, airline crew, diplomat, or a member of the Global Entry or OneStop programs.

Prior to entering the queue, passengers that have not yet completed a customs declaration form can complete one at the form counters located along the north and south curtain wall.

The following options are available to passengers:

- **Automated Passport Control (APC)**
  Passengers who are U.S. citizens/residents or have citizenship from Canada or Visa Waiver countries are eligible to use the APC kiosks. There are two areas of kiosks (one north and one south). Near-term plans will include 50 APC kiosks, which greatly expedite the primary process, thus requiring less queue space and shortening wait times.

- **Global Entry**
  Global Entry enables pre-registered travelers to quickly clear international processing. The kiosks provide travelers with a receipt allowing them access past passport control and onto Level One. Global Entry passengers may use one of the 40 existing kiosks located at the far west end of the primary processing area.

- **OneStop**
  OneStop passengers, who are not collecting any checked baggage, can proceed to secondary inspection and bypass the baggage claim area and secondary inspection queues. OneStop passengers

can then be rescreened for connecting flights or enter the meeter/greeter area.

- **Non-Visa Waiver**
  Non-visa waiver countries' passengers must utilize the standard queue and present their passport to CBP agents at one of the primary inspection booths for immigration processing. Foreign visitors are fingerprinted and photographed.

3.2.2 BAGGAGE CLAIM AREA

Once passengers have cleared primary inspection, they are admitted into the baggage claim area for retrieval of their checked baggage. The baggage claim area features 12 baggage claim carousels that have a total linear frontage of 2,860 linear feet (lf). Eight of the units are 245 lf, two are 230 lf and two are 220 lf. The two west units (adjacent to exit control) have partitions that isolate them from the remaining baggage claim units. Both have direct access to the secondary processing inspection area.

Baggage cart storage is located near the escalators at the east end of the facility and along the north/south walls near the isolation units. The baggage cart restock path comes from the recheck area, through the north secondary inspection area and into the baggage claim hall at the far northwest baggage unit. An oversized baggage belt is located in the southeast corner of the building. CBP rover command and control center (RCCC), 726 sf, is located just west of the escalators and has direct view of the entire baggage claim hall from its raised-platform enclosed room. Restrooms, 2,086 sf, are located at the northeast corner of the baggage claim area.

3.2.3 EXIT CONTROL / SECONDARY INSPECTION

Following baggage retrieval, passengers present their customs declaration forms to CBP officers for inspection at the exit control podiums located at the west end of the central circulation spine of the baggage claim hall. There are eight positions with the outside podiums dedicated to the Global Entry and OneStop programs. The vertical circulation from above that is dedicated to Global Entry and OneStop has corridors on either side that deposit passengers into the exit control queue. Capacity issues at exit control cause low passenger levels of service and undesirable wait times in the exit control queue. At times, the queue can snake all the way through the baggage claim hall causing congestion and wayfinding issues. Passengers are either directed forward to exit the CBP facility or are sent to the adjacent secondary screening area where their baggage is inspected. Within the secondary screening area, CBP has baggage screening x-ray machines and agricultural inspection equipment. The north inspection area includes two agricultural workstations that are located directly in front of the agriculture lab and disposal. It includes four customs baggage inspection lanes that are currently underutilized. The south inspection area includes one agricultural workstation and eight customs baggage inspection lanes. Once cleared of secondary inspection from either side, passengers are directed to exit the facility and into recheck.

3.2.4 CBP OFFICE SPACE

Level Two
The current secondary referral waiting area is located on Level Two, adjacent to the primary processing booths. The facility is undersized and is not located in the ideal location per current 2012 CBP design guidelines. The facility also includes triage, holdrooms, interview rooms and search rooms amongst other support spaces. Ideally, these spaces should be located on Level One, adjacent to the exit control and secondary baggage inspection areas. The Counterterrorism Response Suite and CDC Isolation Suite are located on Level Two in the far southeast corner of the facility. These spaces are appropriately sized and located within the facility.

Located in the northeast corner of Level Two is the enforcement office, supervisor and chief offices and staff support rooms (breakroom and lockers). This area is largely underutilized with most of the area vacant or with spaces that have poor adjacencies. The staff breakroom and locker spaces are appropriately sized and located.

Located off the sterile circulation is the in-transit lounge and outbound team office. These spaces are utilized in the condition that passengers from certain flights need to be isolated and detained away from other arriving passengers. This area is appropriately sized and located within the facility.

Mezzanine Level
Accessed via elevators, CBP administration offices are in three mezzanine spaces located between the primary and baggage claim levels. The mezzanine levels do not include restroom facilities and this should be considered with any reconfiguration of the FIS facility. These spaces contain the following:

- Southeast Mezzanine – Canine Suite (remaining canine support spaces are located directly below on Level One)
- Southwest Mezzanine – Port director office, assistant port director office and conference room
- Northwest Mezzanine – Chief office, supervisor office and other miscellaneous administration spaces

Level One
Located adjacent to the north secondary inspection area are supervisor offices located in an underutilized open workstation area. The agricultural lab and disposal room are located in this area.

Located adjacent to the south secondary inspection area are the remaining secondary support spaces, including the cashier's office, holdrooms, interview rooms, search rooms and other support spaces. Other office spaces include the following and are appropriately sized for the facility:

- Training room
- Conference room
- Badging office
- PAU
- Enforcement offices
- Physical training
- U.S. Fish and Wildlife offices

The lost and found is located adjacent to the meeter/greeter lobby.

Baggage Level
No CBP functions are located on this level.

3.2.5 BAGGAGE RECHECK

After exiting the CBP facility, passengers connecting to another flight with checked baggage can drop their baggage at the recheck area, which is adjacent to the facility exit. There are six baggage takeaway belts that are exclusive to UA and its STAR Alliance partners. Standard linear ticketing is located on the west end of recheck and is dedicated to the foreign flag carriers. The area also includes baggage service offices, baggage storage and other airline support spaces. A public restroom is located near the escalators that transport connecting passengers upstairs to the transfer security checkpoint.

3.3 BAGGAGE

This section reviews the existing baggage circulation systems serving the FIS facility.

3.3.1 RECLAIM

Figure 3.5 shows the existing plan view of the passenger reclaim and circulation flow.

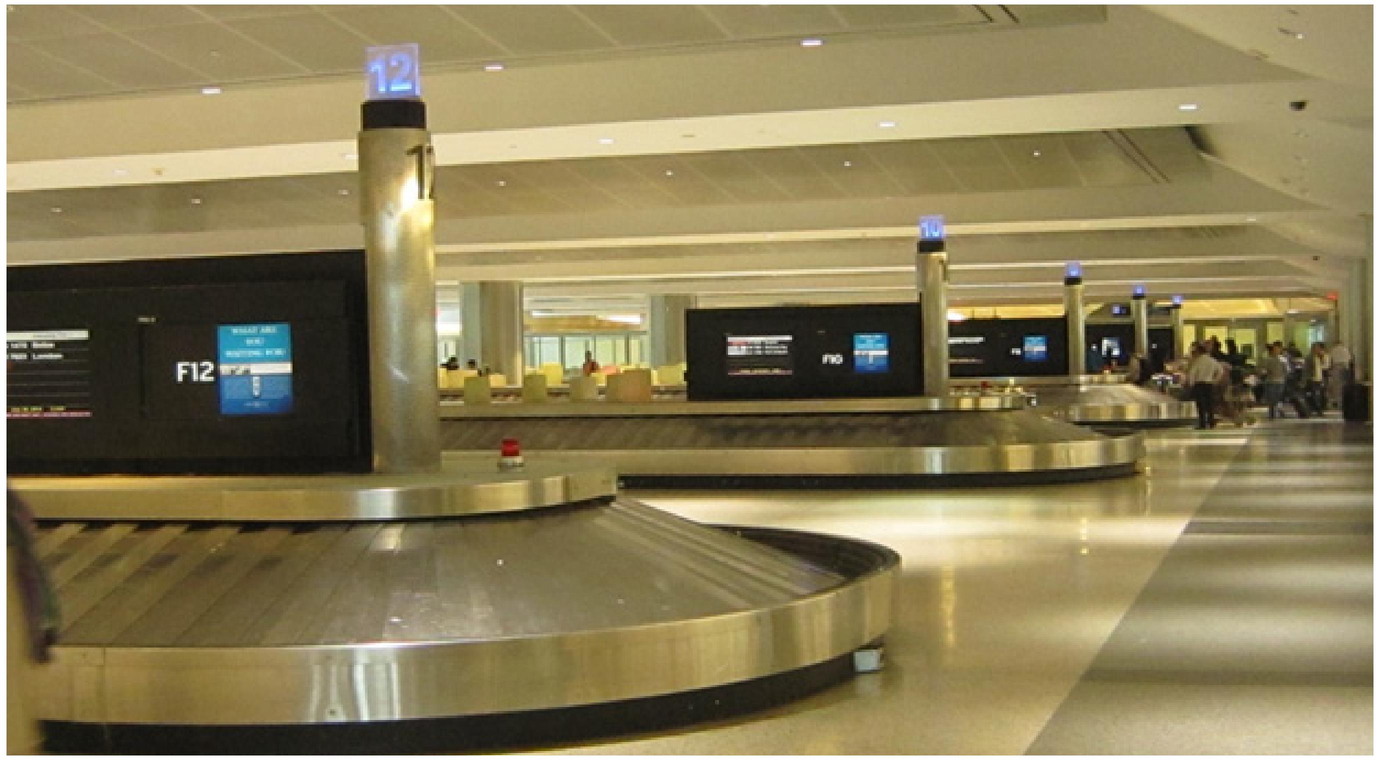
3.3.1.1 Standard Bags

The International Hall has eight inclined reclaim units with a presentation length of 245 feet each, two inclined reclaim units with a presentation length of 230 feet each, and two inclined reclaim units with a presentation length of 220 feet each. The 12 reclaim units represent a total of 2,860 lf of presentation length. All reclaims are oriented in a north/south configuration with the passenger access route along the center line of the reclaim hall.

The reclaim units are all loaded with bags with a single-feed line from below. The loading conveyors on the tug and cart level below can be fed from both sides of the loading conveyor. Each feeding line is secured with a baggage security door to prevent unauthorized access from the reclaim hall to the baggage system and the sterile area of the airport. **Figure 3.6** shows the existing FIS reclaim hall.

Bag claim devices number 1 and number 2 can be used as isolation units for selected flights if required. Therefore they are separated by a wall from the rest of the reclaim hall to allow the separation.

Figure 3.6



3.3.1.2 Oversize Bags

Oversize items are transported via a single oversize conveyor belt from the bag loading level to the bag reclaim hall. The presentation length at the bag loading level for tug and carts is 19.5 lf on the flat loading conveyor and provides space for a single tug train to load bags one at a time. In the bag reclaim hall, the oversize run-out length is 14 lf. This means that oversize bags have to be removed by an agent and presented to the passengers to allow for continued delivery of oversize bags.

3.3.1.3 Non-Conveyable Items

Non-conveyable items are transported via a single cargo elevator from the bag loading level to the bag reclaim hall. It is assumed that non-conveyable items are placed next to the oversize run-out belt for passenger pick-up.

3.3.2 BAGGAGE RECHECK

3.3.2.1 Standard Bags

Standard bags connecting to UA can be inserted into the baggage system at two different locations. Bags can be inserted into the baggage system through six baggage drop conveyors or alternatively at UA recheck counter positions. Bags connecting to airlines other than UA are reinserted into the baggage system through their ticketing counter positions. **Figure 3.7** shows the United Airlines recheck bag drop position.

3.3.2.2 Oversize Bags

Oversize bags are inserted at the recheck counter. Oversize bags connecting to UA are dropped on one conveyor, while bags connecting to other airlines are dropped on a separate conveyor. **Figure 3.8** shows the FIS recheck counters.

Type	United Airlines	Other Airlines	Total
Standard bag positions	16	15	31

Table 3.2: Standard bag recheck counters (Source: Ricondo)

Existing FIS Process Reclaim of Bags

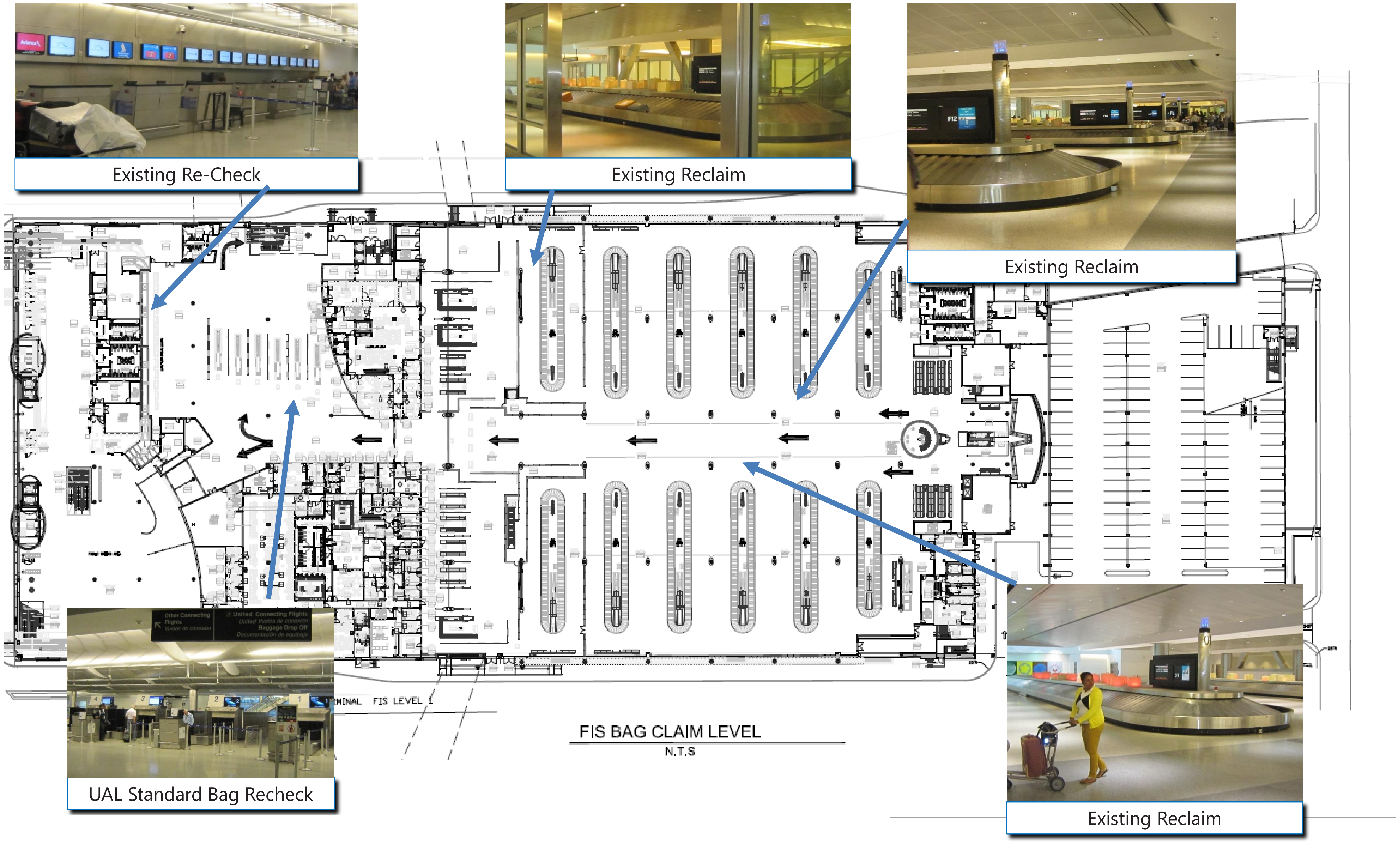


Figure 3.7

Figure 3.8

3.3.2.3 Non-Conveyable Items
Non-conveyable items are transported manually to TSA screening and sortation and bypass the automatic baggage system.

3.3.3 CAPACITY

3.3.3.1 United Airlines Baggage Recheck Drop Positions
When considering passenger interaction, check-of-bag label quality and bag size, it is assumed that the load rate per baggage drop is six bags per minute. Based on this assumption, the six UA bag drops can introduce 36 bags per minute into the baggage system.

3.3.3.2 United Airlines Recheck Ticketing Counter
It is assumed that UA is staffing four of the recheck counters during peak time, and that most passengers are using the bag drop positions and are only using the recheck counters if their bags cannot be processed at the drop-off positions. It is assumed that the recheck counters experience a slower processing time due to reprinting of bag labels, handling of oversized baggage, and reflighting operations, assessed at an average of 30 seconds per bag.

Based on this assumption, the UA recheck counters can insert eight bags per minute into the baggage system from the recheck counters.

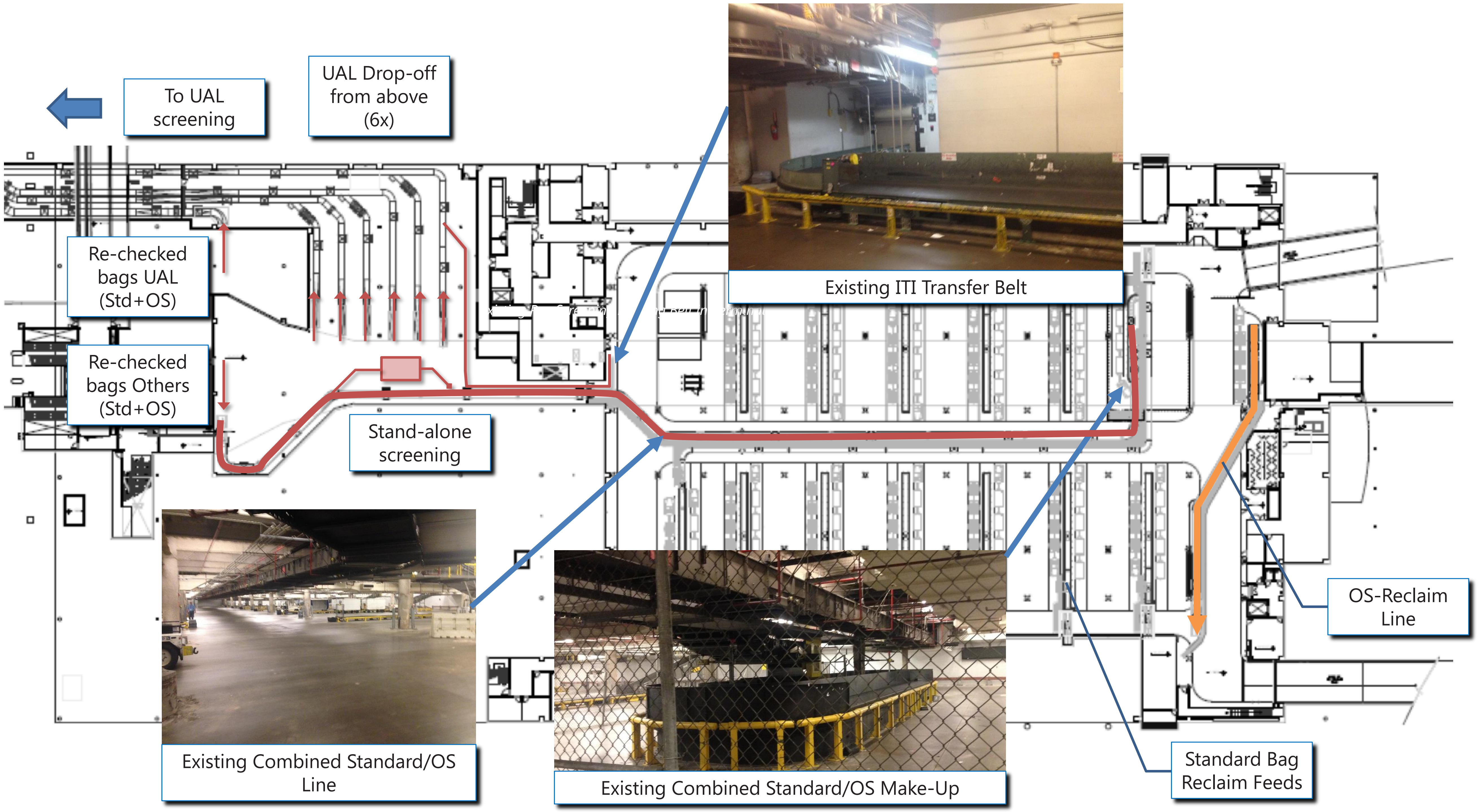
3.3.3.3 Non-United Recheck Ticketing Counters
It is assumed that six of the recheck counters during peak time are staffed. Since all passengers connecting use the recheck counters, an average processing time of 20 seconds per bag is assumed.

Based on this assumption, the recheck counters for non-UA connections can insert 18 bags per minute into the baggage system.

3.3.4 BAGS TRANSFERRING TO UNITED AIRLINES

3.3.4.1 Standard Bags
Figure 3.9 shows the existing baggage system configuration. The six standard bag drop positions are merging into three belt conveyor lines, which transport bags through a tunnel to a baggage screening matrix. Before entering the screening matrix, these three conveyor lines are merged into two lines. Operations has expressed that the merging of the three transport conveyors into two conveyor lines results in frequent start/stops of long transport conveyors in the tunnel, and poses capacity concerns for future growth of UA international operations. **Figure 3.10** shows the current FIS baggage system configuration. **Figure 3.11** shows the tunnel with three bag drop lines and one ticketing counter line.

Existing FIS Baggage System Configuration



Current FIS Baggage System Configuration

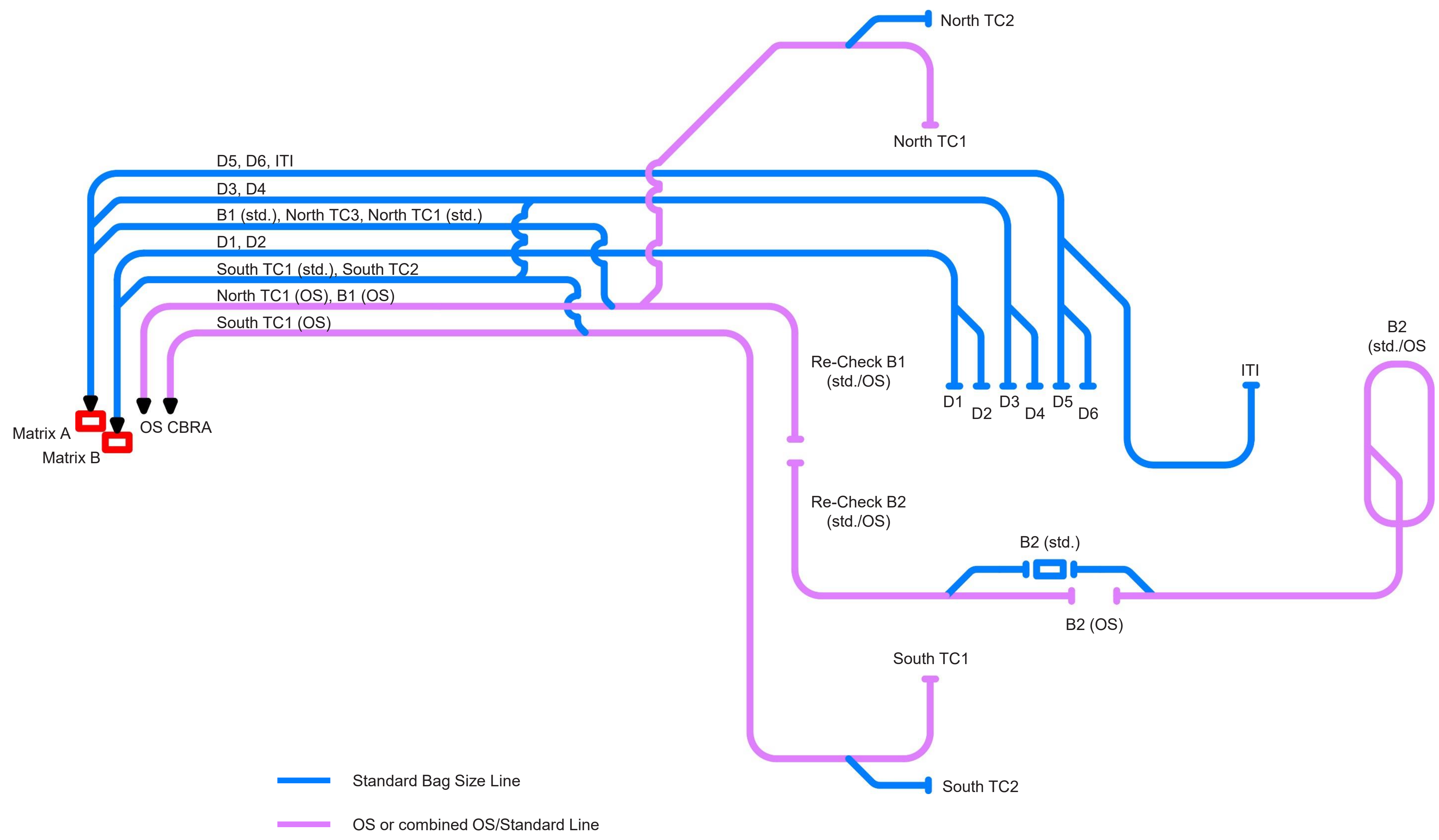
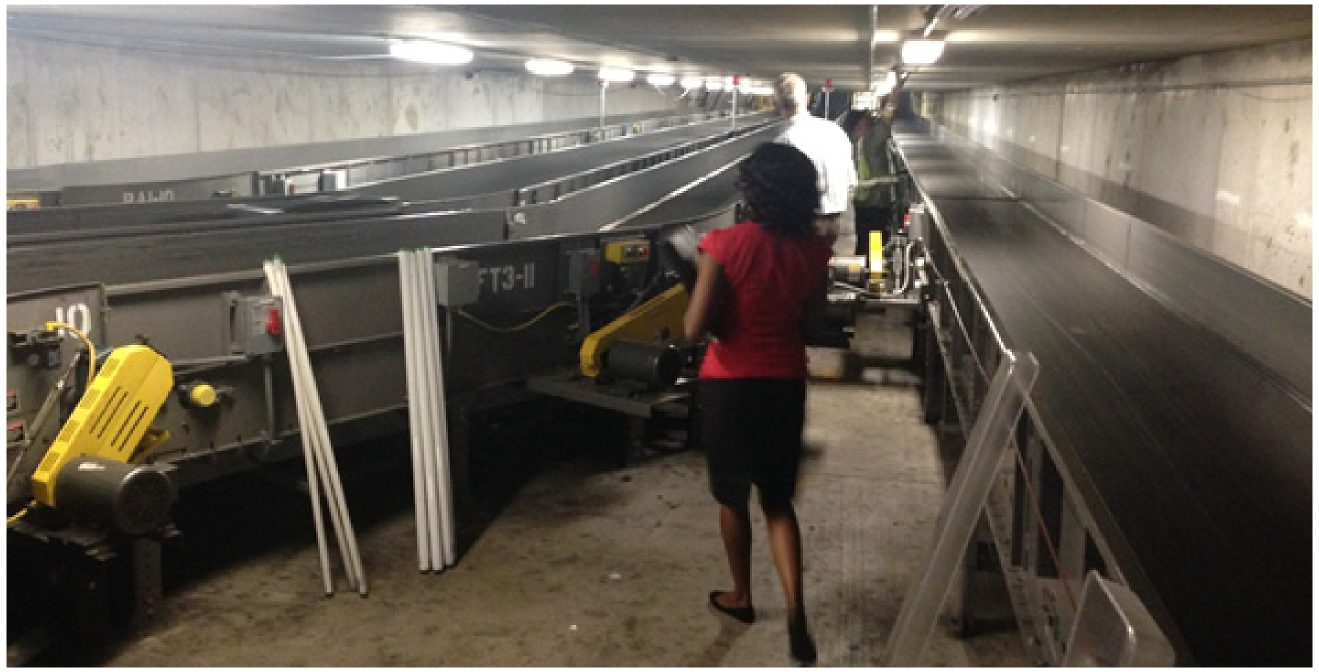


Figure 3.11



The current configuration has two standard bag conveyor lines to transport bags from the bag drop-off location, re-check location, and the international-to-international (ITI) transfer input to the United Airlines' EDS screening matrix.

It has been concluded that the existing United Airlines screening system is operating at its limit and a consolidated screening of all FIS and Terminal E checked bags in the United Airlines bag screening system is not viable for the planned expansion within United Airlines' existing screening system.

3.3.4.2 Oversize Bags

Oversize bags are transported to the checked baggage resolution area (CBRA) via the oversize conveyor located behind the recheck counter. The oversize baggage is conveyed on a wide conveyor which that combines standard baggage with oversize baggage. Downstream from ticketing, oversize baggage is then separated from the baggage flow via vertical sorting units from the standard bags and routed to dedicated manual oversize CBRA screening. After screening, the oversize bags are sorted to the make-up locations in the bag room.

3.3.5 BAGS TRANSFERRING TO AIRLINES OTHER THAN UA

3.3.5.1 Standard Bags/Oversize Bags

All standard and oversize bags are placed on a single conveyor behind the recheck counter and transported on the same conveyor to a screening area below. Before reaching the screening area, a vertical sorter is separating oversize bags from standard size bags. Standard size bags are routed to a stand-alone screening machine while the oversize bags are routed to a manual inspection position.

The stand-alone machine is not fully integrated into the baggage system and bags are inserted into and removed from the machine with a non-driven roller bed conveyor. **Figure 3.12** shows the oversize screening in the background and the standard bag screening on the left of the image.

Figure 3.12

3.3.6 TRANSFER BAGGAGE SORTATION

3.3.6.1 Bags Transferring to United Airlines

After standard bags are cleared by TSA, the bags are sorted via two tilt-tray sorters to their connecting flights, while oversize bags are transported to their connecting flight from the CBRA in the same way domestic checked bags are sorted. This method allows a unified sortation location for the connecting flight for all bags (domestic checked bags and bags transferring from international flights).

3.3.6.2 Bags Transferring to Airlines Other Than UAL

After standard and oversize bags are cleared by TSA, the bags are manually placed onto a single conveyor and transported to a makeup carousel in the northeast corner of the FIS loading level. Airlines with connecting passengers pick up the bags from that location and manually bring them to the makeup position for the connecting flight or directly to the connecting flight. **Figure 3.13** shows the combined makeup carousel for standard and oversize bags.

Figure 3.13

Figure 3.14

3.3.7 INTERNATIONAL-TO-INTERNATIONAL TRANSFER

The facility allows passengers who transfer directly from one international flight to another to bypass Customs, without being required to reclaim their bags. These direct ITI bags are transported from the arriving airplane directly to a feeding conveyor which transports the bags to the TSA screening system. After the bags have been screened, they are sorted to the standard flight sortation location. **Figure 3.14** shows the ITI transfer belt.

3.4 Existing FIS Building Systems (MEP)

This section describes the existing MEP systems serving the FIS building. The majority of mechanical systems were stated to be in good condition according to the FIS Condition Assessment Report, performed by Jacobs, CH2MHill and Burns & McDonnell. The electrical systems are recommended for replacement within the next 15 years. The site water system is in need of replacement and it does not meet the 2012 International Fire Code (IFC) pressure and flow criteria for fire protection.

3.4.1 CHILLED WATER

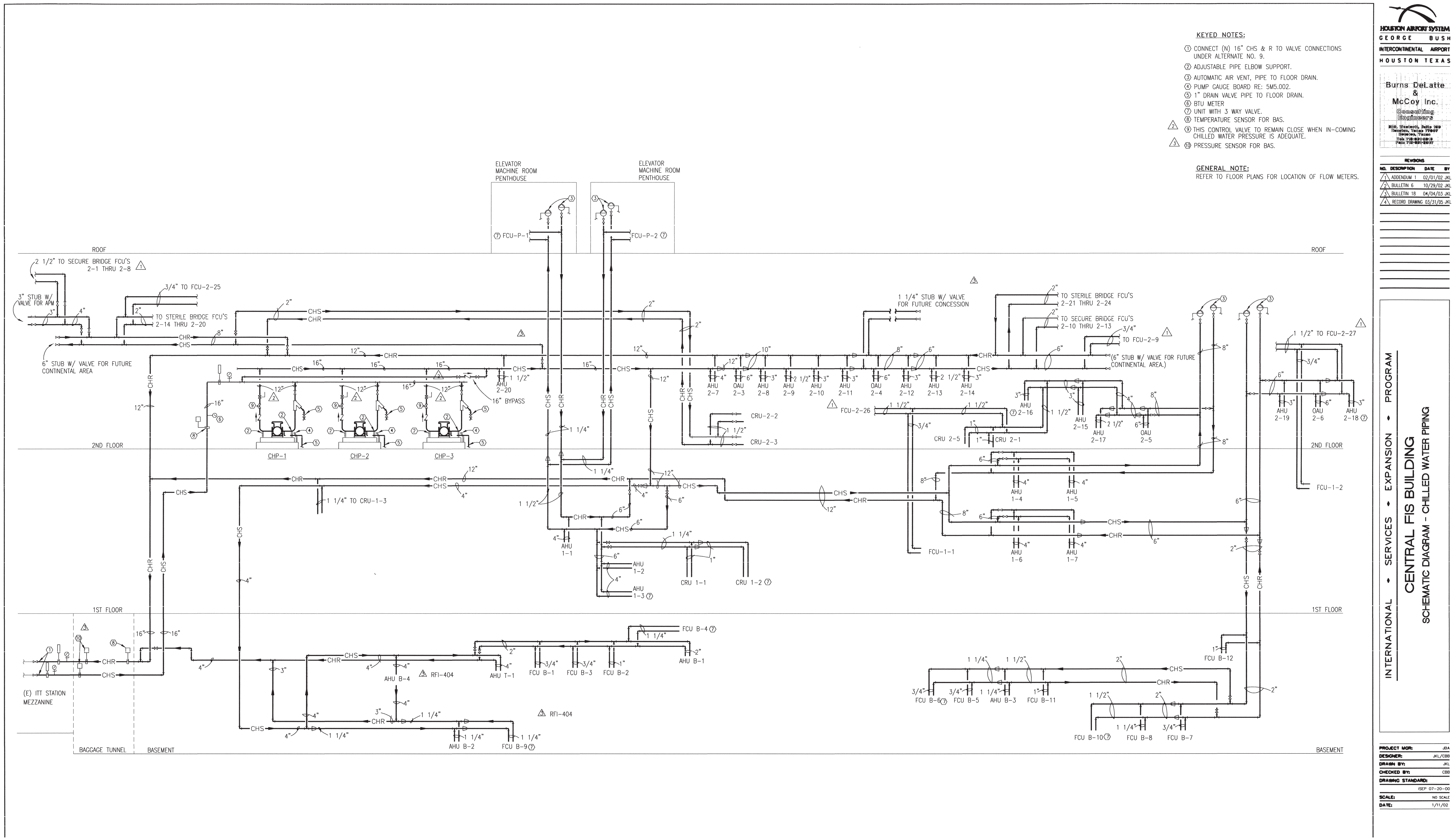
Chilled water is supplied to the FIS building through 16 inch carbon steel water mains. These mains originate from the Central Utility Plant (CUP). They enter the FIS through the ceiling of the ITT station mezzanine, first floor. Three 2,500 gallons per minute (gpm) chilled water pumps are located on the second floor. Four additional pumps are located in the FIS garage and these pumps supply chilled water to the garage east and west. Pump controls use differential pressure set points. The FIS Condition Assessment Report states that the chilled water pumps appear to be in good physical condition. Each pump has a variable frequency drive (VFD), they operate in lead/lag and maintain set point pressure in the system. Refer to **Figure 3.15**, **Figure 3.16** and **Figure 3.17** for existing chilled water pumps. **Figure 3.18** shows a schematic diagram of the Chilled Water Riser piping layout.

Figure 3.15

Figure 3.16

Figure 3.17

Chilled Water Riser



Not to Scale

3.4.2 HEATING WATER

Heating water is supplied from the CUP to the FIS building through eight inch mains. The FIS mechanical spaces include three heat exchangers, rated at 189 gpm each. Two of the three heat exchangers meet the building demands and one is in standby. Three 500 gpm heating water pumps are located in the main mechanical room (IA2.0317M), second floor of the FIS building. Two of the three pumps meet the building demand and one is on standby. All three pumps have VFDs, operate in lead/lag and maintain system set point pressure. Two other heating water pumps and two heat exchangers are located in the FIS garage. This system is dedicated to the garage east and west space. Per the FIS Condition Assessment Report, the heating water system is within fair and good physical condition with some exceptions. A few pumps had deferred maintenance and may need to be replaced. Refer to **Figure 3.19**, **Figure 3.20** and **Figure 3.21** for existing heating water pumps. **Figure 3.22** shows a schematic diagram of the Hot Water Riser piping layout.

Figure 3.19

Figure 3.20

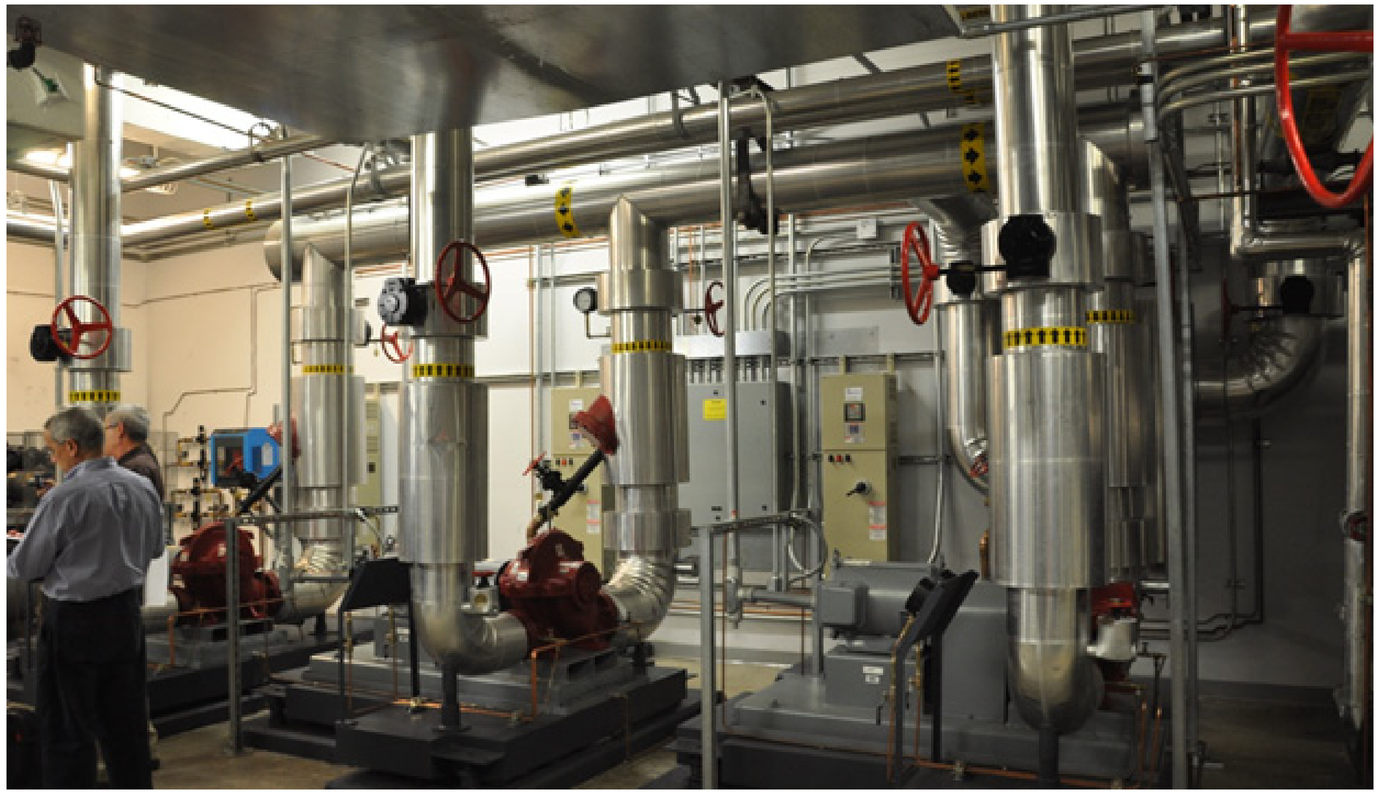
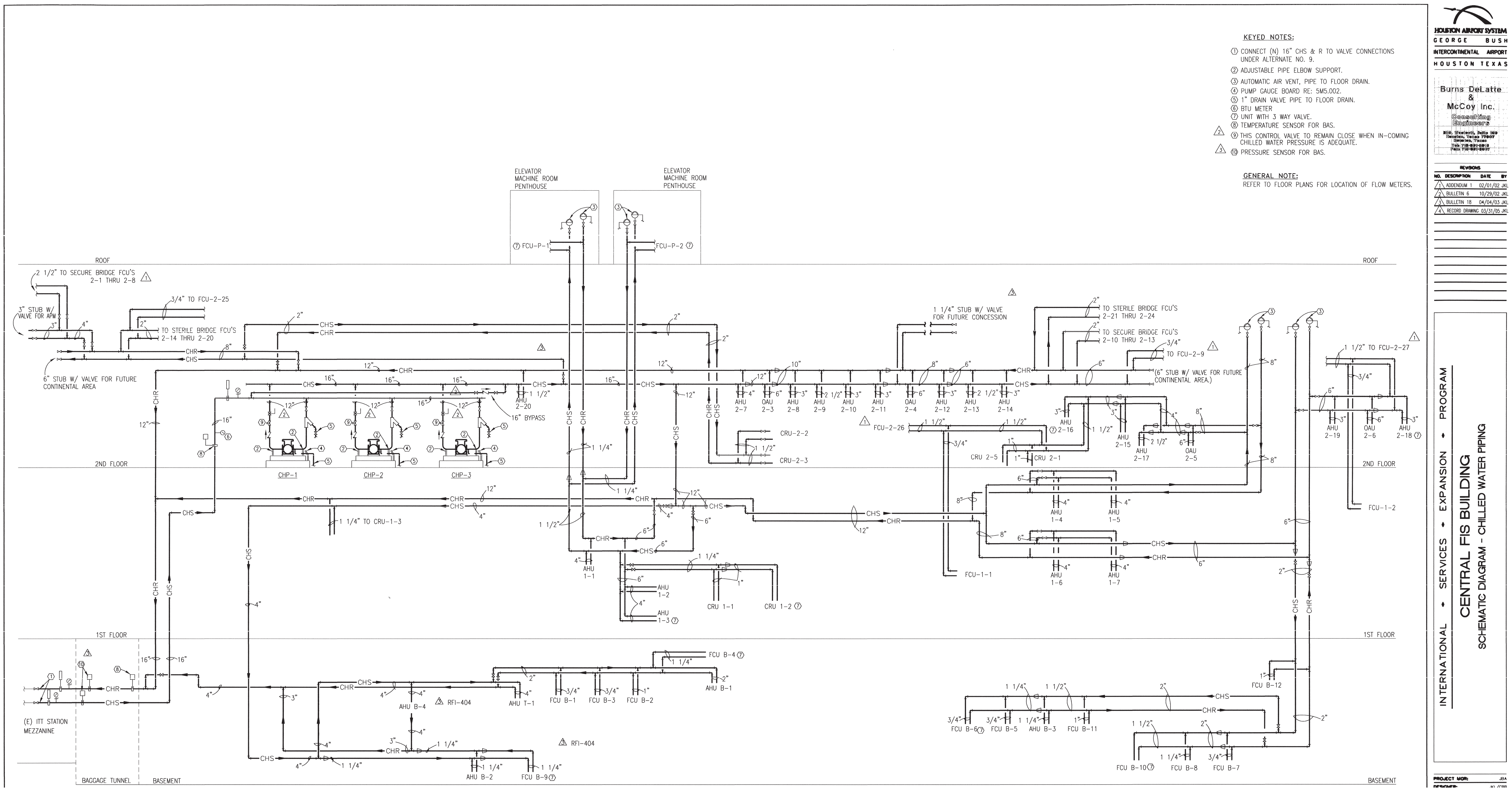


Figure 3.21

Hot Water Riser



Not to Scale

3.4.3 TEMPERATURE CONTROL

Building temperature controls, for the terminals and the CUP, use Alerton field controllers. These controllers are supervised from a common operator interface, maintained by OpenTech Controls. The system is fully BACnet compliant. OpenTech is updating the operator interface software for the CUP controls to URVIEW. This will be supplied by Tridium, who will provide enhanced programming and control features. The controller front-end is intended to be extended to the rest of the airport systems. Installations/retrofits are to occur on new and renovation projects. The temperature control systems have capability for temperature setback and time of day scheduling of equipment operation. This feature has not yet been implemented.

3.4.4 AIR HANDLING UNITS

The FIS has two main mechanical rooms (IA2.0317M and IA2.0316M). These rooms are located on the second floor and they house air handler units, hydronic pumps, heat exchangers and air compressors. This HVAC equipment provides space heating and cooling in the FIS. The HVAC equipment includes a combination of different types of space conditioning equipment, such as single zone, variable air volume, fan coil units, variable air volume (VAV) boxes, fan power boxes, computer room air conditioning units, exhaust fans, air curtains, electric steam humidifiers, electric duct heaters, and electric infrared heaters. Refer to **Figure 3.23**, **Figure 3.24**, and **Figure 3.25** for existing air handling units.

Figure 3.23

Figure 3.24

Figure 3.25

3.4.5 DOMESTIC WATER

The FIS water system consists of domestic cold and hot water piping, water heaters, water re-circulation pumps and a water softener. The supply main comes from North Terminal Road. It includes a double detector check assembly and a water meter. Domestic water is distributed throughout the building. Water piping is original construction. The domestic water system is in good working condition, including the circulation pump; exceptions include some piping that has missing insulation and exposed piping that is prone to condensation damage. Rust is visible on the exposed pipe with missing insulation. New insulation needs to be installed on these exposed piping areas. Refer to **Figure 3.26** for existing domestic water distribution.

Figure 3.26

3.4.6 FIRE PROTECTION

The FIS building is protected with a wet pipe sprinkler system and standpipes per National Fire Protection Agency (NFPA) standards 13 and 14. Several hidden sprinkler heads are installed throughout the building spaces. Heat and smoke sensors are visible. The sprinkler risers are located in mechanical rooms. Standpipes are located in stairwells.

Refer to **Section 3.5.4** for FIS water connection description.

3.4.7 PLUMBING

The FIS sanitary sewer system includes waste and vent piping, and four sanitary sump pumps. Plumbing runs both above and below ground. This system is original construction and, according to the FIS Condition Assessment Report, the sanitary waste and vent piping system is in good working condition. The sump pumps are operational but they are more than ten years old and getting to the end of their useful rated life. The FIS includes a grey water system, which transfers grease waste to a grease interceptor located exterior of the building envelope. The majority of the sanitary waste piping is cast iron. It is a gravity system to the lift stations, where it is pumped to the exterior main waste lines.

3.4.8 NATURAL GAS

The natural gas system is in good condition per the FIS Condition Assessment Report by Burns & McDonnell. This system includes a gas regulator and distribution piping owned and maintained by CenterPoint Energy. The natural gas regulator, at the main service, is in good working condition. The piping is original construction and in good working condition. The natural gas regulator and piping are maintainable and easily accessible. The portion of piping exposed to the outside has started to show signs of rust.

3.4.9 BUILDING AUTOMATION SYSTEM (BAS)

Monitoring and control of the HVAC systems are performed primarily through the BAS. However, the controls system does not have a consistent sequence of operation. The BAS system has multiple sequences and set points for similar types of units. Some units do not have a schedule installed and they are operating 24/7. The building automation system sensors need to be calibrated to obtain more reliable information on actual equipment operation.

3.4.10 ELECTRICAL SYSTEM

The FIS building switchgear is recommended for replacement, per the FIS Condition Assessment Report. The FIS building's CenterPoint auto transfer switches (ATOs) each supply two transformers. Each transformer supplies one main of each of the two main-tie-main lineups. The ATOs are normally configured such that one main, from each of the two switchgear lineups, is supplied from a circuit from one CenterPoint substation. The other main is supplied from a circuit from the other CenterPoint substation. CenterPoint has confirmed this information per their schematic drawing. CenterPoint requested field confirmation of their schematic. See **Figure 3.27**.

Switchgear lineup number one consists of Switchgear MSGR MSA and MSGR MSB. This lineup includes a main-tie-main configuration with kirk-key interlock. The main breakers are rated at 4000A and the tie breaker is rated for 4000A. Switchgear MSGR MSA serves switchboard SWBA, MCC-A and MCC-2NE. Switchgear MSGR MSB serves switchboard SWBB, DPCSA, MCC-B and MCC-2SE.

Switchgear lineup number two consists of switchgear MSGR MSC and MSGR MSD and is a main-tie-main configuration with kirk-key interlock. The main breakers are rated at 4000A and the tie breaker is rated for 4000A. Switchgear MSGR MSC serves switchboard SWBC, DPCD (Continental), MCC-C and MCC-2NW. Switchgear MSGR MSD serves switchboard SWBD, MCC-D and MCC-2SW. Refer to **Figure 3.28**.

The 14 month peak load history, from one electrical utility transformer, included a peak load in August 2013 equal to 679 kVA. This peak load equates to 34 percent of the transformer rating and 20 percent of the switchgear rating. The 14 month peak load history, from the second electrical utility transformer, indicates that the peak load in January 2013 was equal to 539 kVA. This peak load equates to 27 percent of the transformer rating and 16 percent of the switchgear rating. The sum of the two peak loads is 1218 kVA or 61 percent of one transformer rating and 37 percent of the switchgear rating when the switchgear tie breaker is closed and the switchgear is supplied from one of the two redundant transformers.

The 14 month peak load history from the third electrical utility transformer includes a peak load in March 2013 equal to 614 kVA. This peak load equates to 31 percent of the transformer rating and 18 percent of the switchgear rating. The 14 month peak load history from the fourth electrical utility transformer includes a peak load in September 2012 equal to 533 kVA. This peak load equates to 27 percent of the transformer rating and 16 percent of the switchgear rating. The sum of the two peak loads is 1147 kVA or 57 percent of one transformer rating and 34 percent of the switchgear rating when the switchgear tie breaker is closed and the switchgear is supplied from one of the two redundant transformers.

3.4.11 STANDBY POWER DISTRIBUTION

The FIS building switchgear lineups are main-tie-main configurations. While these configurations do allow for manual ties in conditions of transformer failure or ATO failure and allow for continued operation of the loads on redundant transformers, these configurations do not allow for operation of one half of the switchgear lineup during repair of the other half of the switchgear lineup. De-energization of both halves of the switchgear lineup would be recommended for repairs to the switchgear, unless the switchgear section could be electrically and physically isolated from the arc-flash risk of an energized busway during the operation. Future configurations can provide for main-tie-tie-main configurations with full isolation between the two switchgear lineups and isolation and de-energization of any one lineup for maintenance and repair.

The design team should investigate the infrastructure changes required to provide emergency/standby power to feed the entire terminal power load during the schematic phase.

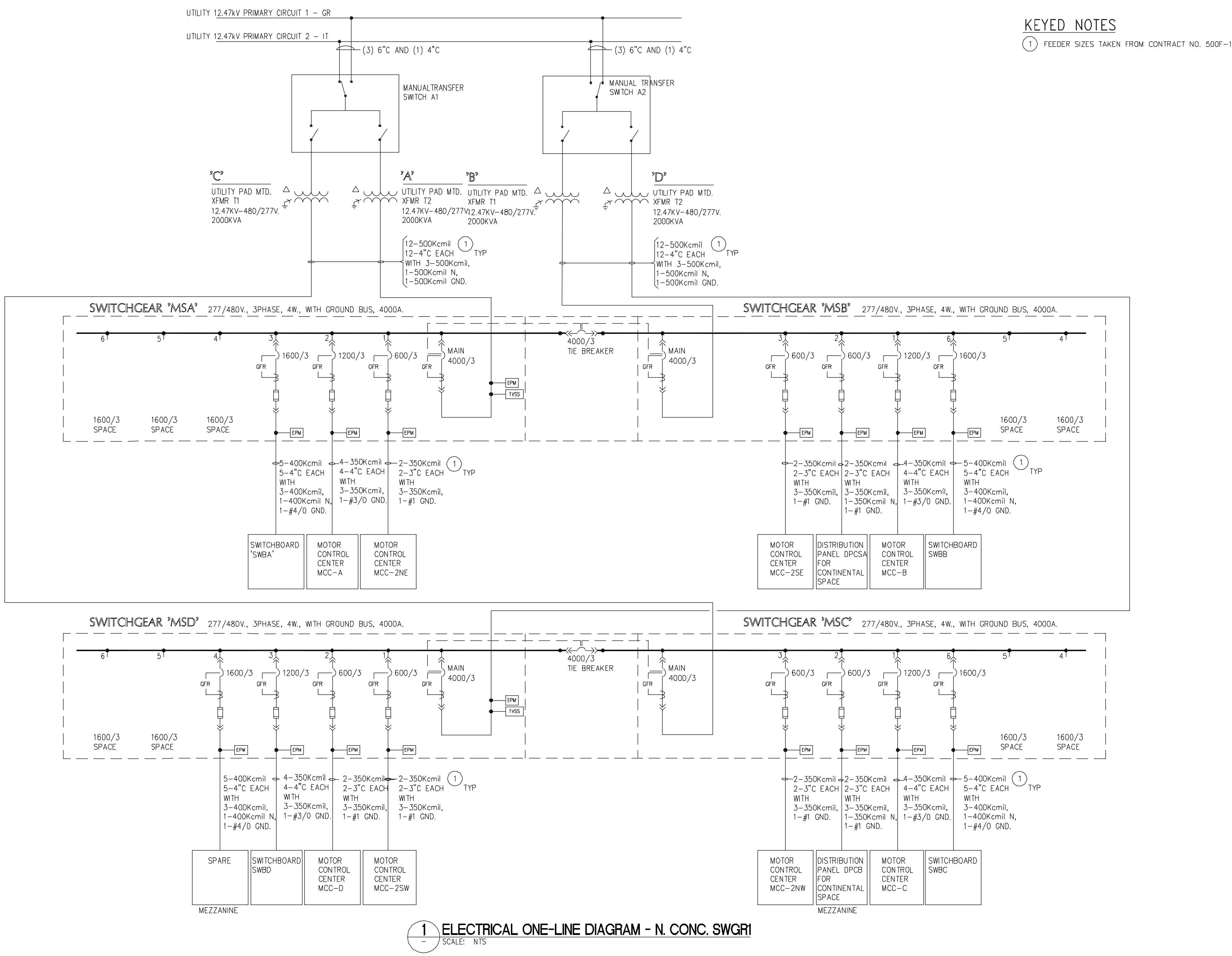
The systems with components that require standby power are as follows:

- Security systems: These systems include access control and surveillance cameras.
- Passenger processing systems: These systems include checkpoint equipment and exit lanes.
- Communication systems: All the data racks within the data rooms, IDF, telephone, and radio equipment.

The size of the standby system will be based on the reliability of the utility supply and identification of the loads that require higher reliability.

The general principal is to provide a functional, reliable, energy efficient and environmentally responsible electrical distribution system. The design should provide for redundant normal power feeds from the utility, like the existing, with automatic transfer to the emergency generator when normal power becomes unavailable.

Electrical One-Line Diagram



FIS Facility Switchgear Lineup

MCC "A"

MCC - B

MCC - C

MCC - D

3.4.12 LIGHTING

The majority of the lighting is functional. Lighting was observed in public spaces on Levels One and Two. The lighting control panels are not programmed, which means that they cannot fully perform the intended function. When properly programmed, the lighting control panels will decrease manual switching requirements by users and possibly improve efficiency. A new lighting control system should be sized and configured for ease of re-programming of lighting controls after acceptance of a lighting control system.

3.4.13 INFORMATION TECHNOLOGY

The existing FIS Information Technology (IT) system is set up in a traditional "hub and spoke" arrangement, with each individual distribution frame (IDF) being fed from a central main distribution frame (MDF) via fiber optic and copper connections. Refer to **Figure 3.29** for a schematic of the FIS "hub and spoke" distribution. The main airport fiber optic loop also utilizes the FIS MDF as a go-between when routed between terminals and other ancillary buildings. This means that almost all airport-wide fiber optic pathways land on FIS MDF patch panels, or are routed through FIS MDF raceways.

The majority of the existing IDF rooms are served off of central air systems, with some rooms having temperature control and some rooms not having control. Most of the IDF rooms do not have dedicated air handling systems meeting current HAS requirements. See **Figure 3.30**, **Figure 3.31**, and **Figure 3.32** for locations of existing FIS IDF and IT rooms.

The existing access control system uses a distributed architecture consisting of redundant head-end servers with automated fall over, intelligent field panels (IFP), and contactless smart card readers and access media. The existing access control software application is ProWatch by Honeywell. The head-end system is currently in place and operates on redundant servers located in the Terminal A MDF.

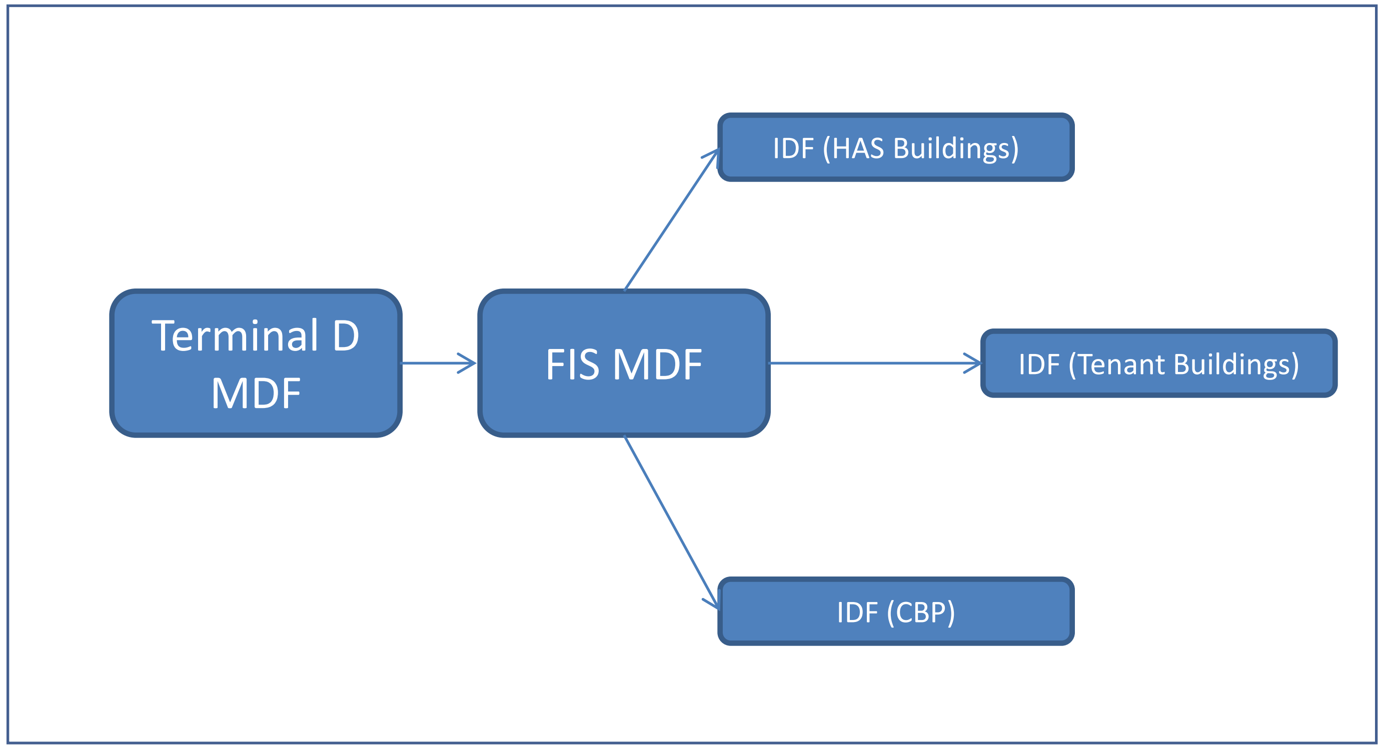
Communication between head-end and IFPs is via network switches on a secure VLAN across the common HAS LAN.

Standard card readers and access media are iCLASS contactless by HID. HAS utilizes a secure iCLASS Elite key managed by HID to ensure a unique security format. Current iCLASS products in use include model R10 for mullions, R40, and RK40 (with keypad) card readers and 16k smart card credentials.

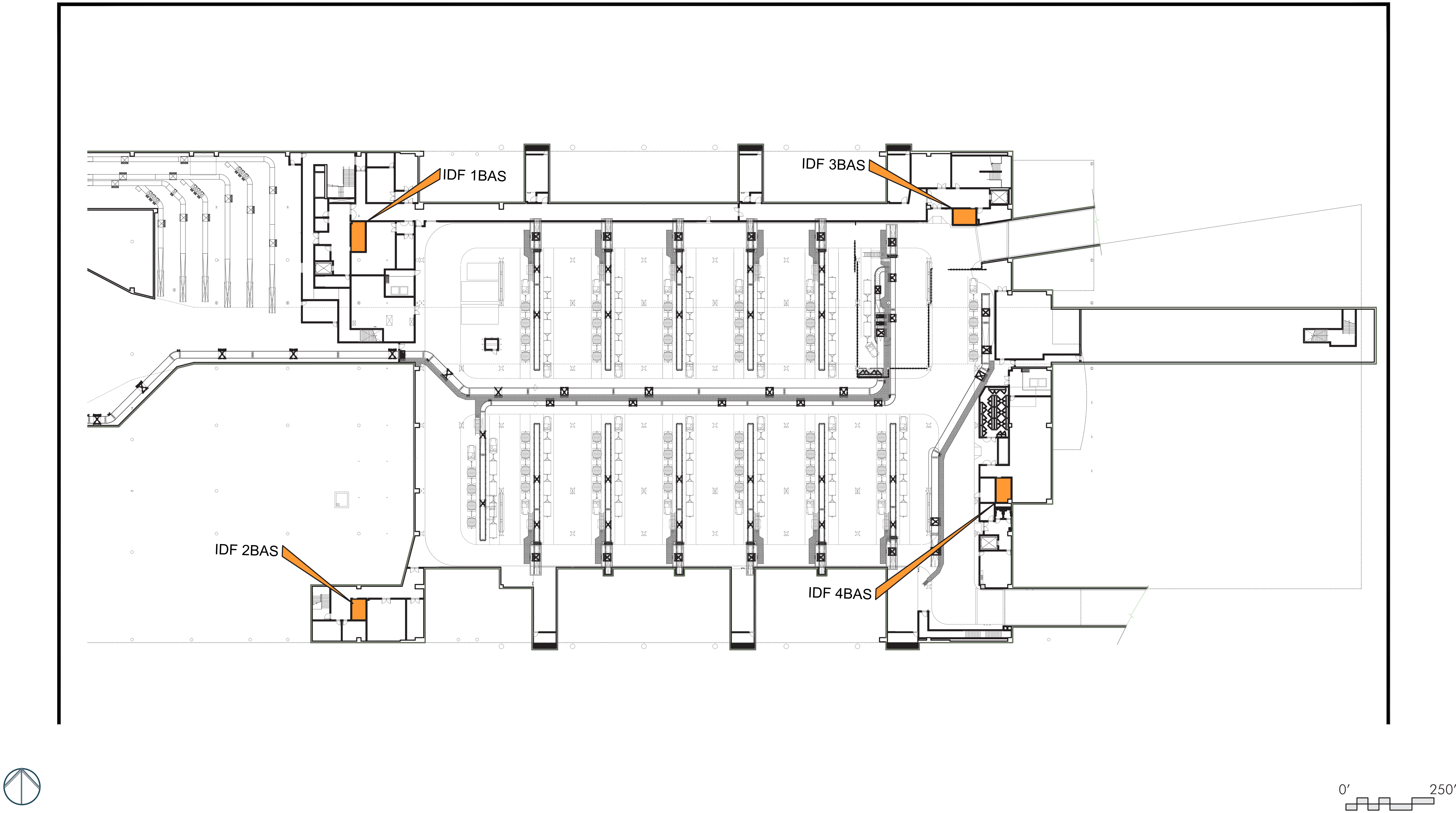
Existing distributed video surveillance system architecture utilizes redundant head-end database servers at the Terminal A MDF and administration building, with camera servers and storage arrays located in the FIS MDF. HAS holds a DVM site license.

The IDF rooms currently in use by the CBP, IA2.0802T.IDF and IDF.FIS.3SF, are currently at maximum capacity and cannot handle any additional expansion. IDF room FIS.3SF has adjacent bathrooms to the south that can be easily removed or relocated. This allows for an expansion of the existing IDF space, and utilizing existing conduit and cable runs without disrupting airport CBP operations.

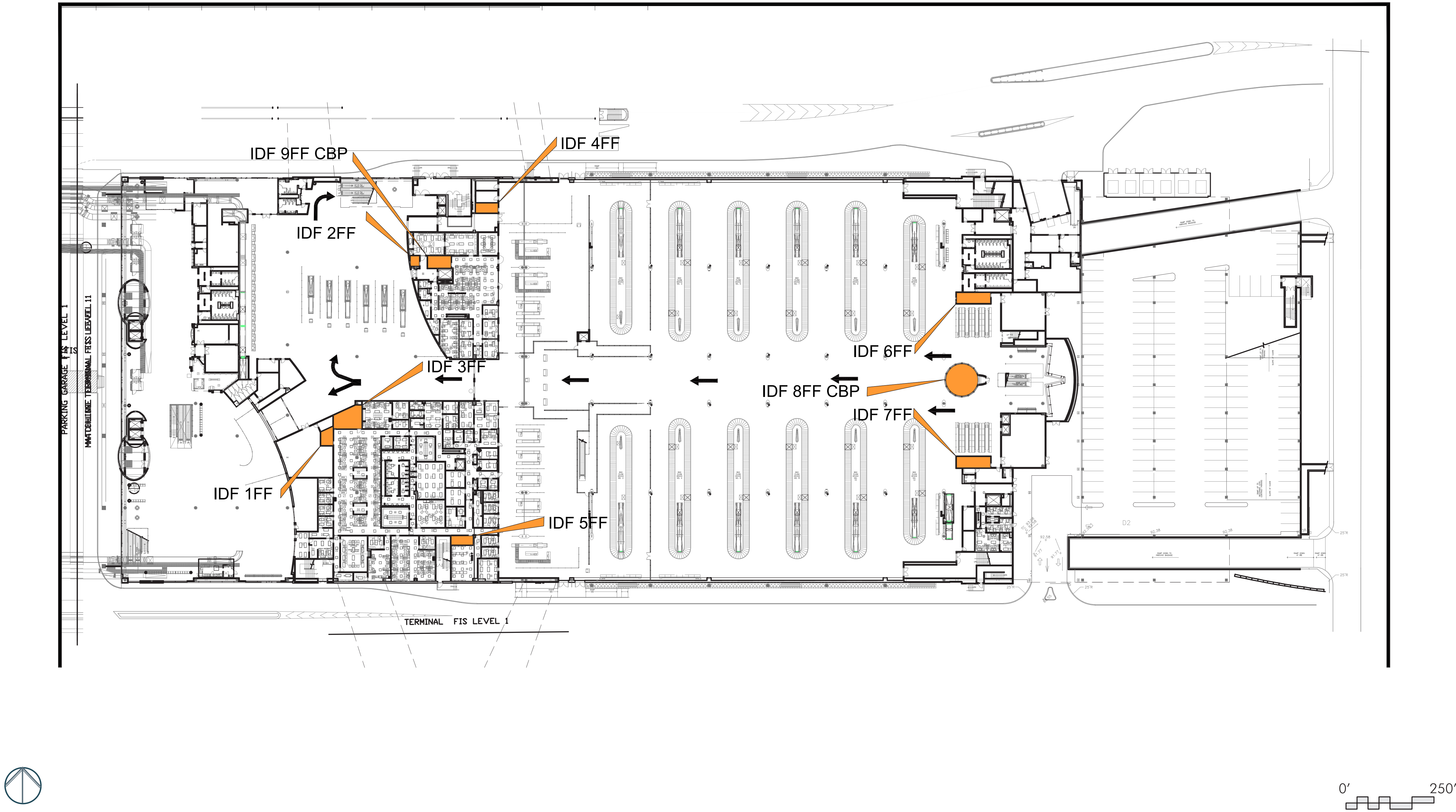
Figure 3.29



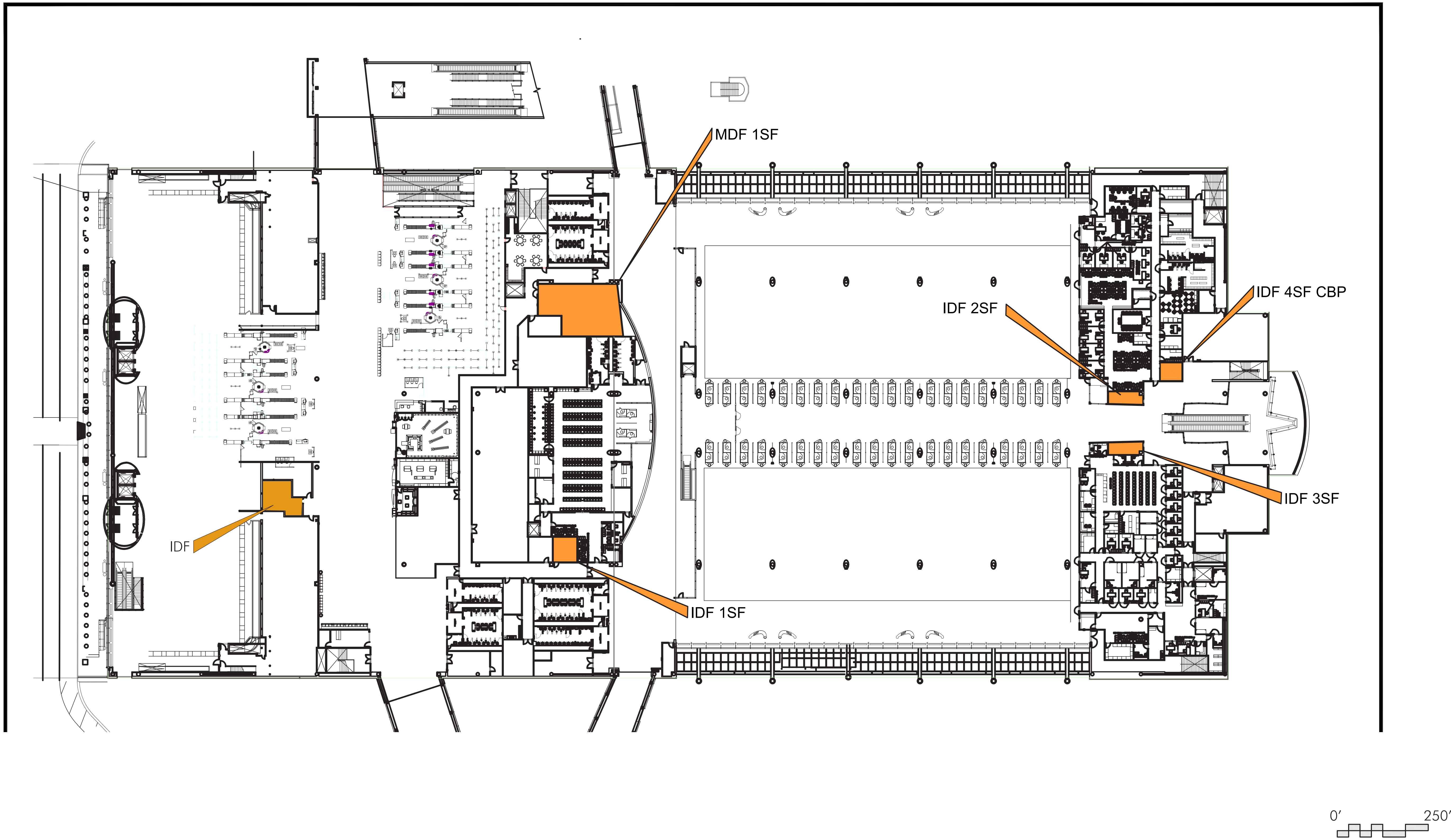
Existing Telecomm Room Locations Floor 1



Existing Telecomm Room Locations Floor 2



Existing Telecomm Room Locations Floor 3



Existing Telecomm Room Locations Floor 3

Fig 3.32

3.5 Site Utilities

This section reviews the existing site utilities serving the FIS complex. Site utilities include 12.3kV power, domestic water, fire protection, sanitary sewer, storm sewer and natural gas.

3.5.1 CHILLED AND HEATING WATER

The current FIS building was renovated during the Terminal E/FIS building upgrade. In 2002, HAS started the renovation phases and expanded to about 800,000 sf. The FIS receives its chilled and heating water directly from the airport CUP. Main lines run from the CUP to the north and split east and west to serve the central terminal area. Capacity exists at the CUP to meet the proposed FIS expansion. **Figure 3.33** shows the chilled and heating water condition assessment and distribution.

3.5.2 WATER SUPPLY SYSTEM

The City of Houston (COH) owns the existing water lines that feed the airport, up to and including the water meters. An eight inch PVC line supplies water to the FIS facility. The eight inch line branches from the existing 16 inch water line loop located in North Terminal Road. The existing 16 inch line has adequate capacity for the FIS expansion. Low COH water pressure is a problem and must be addressed.

Refer to **Section 3.5.4** for FIS water connection description.

3.5.4 FIRE PROTECTION WATER SUPPLY SYSTEM

An eight inch water supply line serves the fire sprinkler risers at the FIS building. COH water pressure is not adequate to meet flow or residual pressure requirements per NFPA 13 & 14. **Figure 3.34** shows the existing fire protection system.

FIS water connection description:

A new 10” branch water line will be provided to serve FIS from the Water Storage System (WSS). The Water Storage System includes a new supply line (12”) and is planned for installation as part of the ITRP Enabling Utilities Landside project in North Terminal Road. This main line is planned to be pressurized to 75 psig. The branch line, serving FIS, is planned to be a 10” PVC underground pipe and will end in an isolation valve vault, with a gate valve, near the FIS for future connection. The 10” line size is based on fire water flow rate equal to 1500 gpm. The FIS project will bring the underground line into the building and provide separate connections for domestic and fire water with backflow preventers, fire pump, booster pumps, isolation valves and ancillary components to make up a complete fire and domestic water system.

3.5.5 SANITARY SEWER

The existing building has a complete sanitary waste and vent system. Sanitary sewer runs south out of the FIS facility and into a collector line which gravity flows to the City Lift Station #3.

The existing FIS sanitary sewer system is composed of three subsystems listed below.

- Service Lines
- Collector Line
- Lift Station (City Lift Station #3)

The service lines are six inches, and carry the building wastewater to a collector line. The collector line is an eight inch gravity line that runs parallel to the FIS building on the south side.

3.5.6 STORM SEWER SYSTEM

The FIS building is served by a storm water collection system consisting of a series of roof leader lines and storm collection drains. Roof leaders from the parking structure divert to an environmental pump station where it is segregated for treatment or allowed to bypass and flow into the drainage system.

3.5.7 NATURAL GAS

CenterPoint Energy owns and maintains the natural gas distribution to the airport. A six inch natural gas line runs in North Terminal Road. System pressure is between 25 psig and 35 psig. A four inch branch line serves the FIS. CenterPoint owns and maintains the gas meter/regulator. HAS has ownership and maintenance downstream of the gas meter. **Figure 3.35** shows the existing natural gas piping system.

3.5.8 12.5 KV SITE POWER

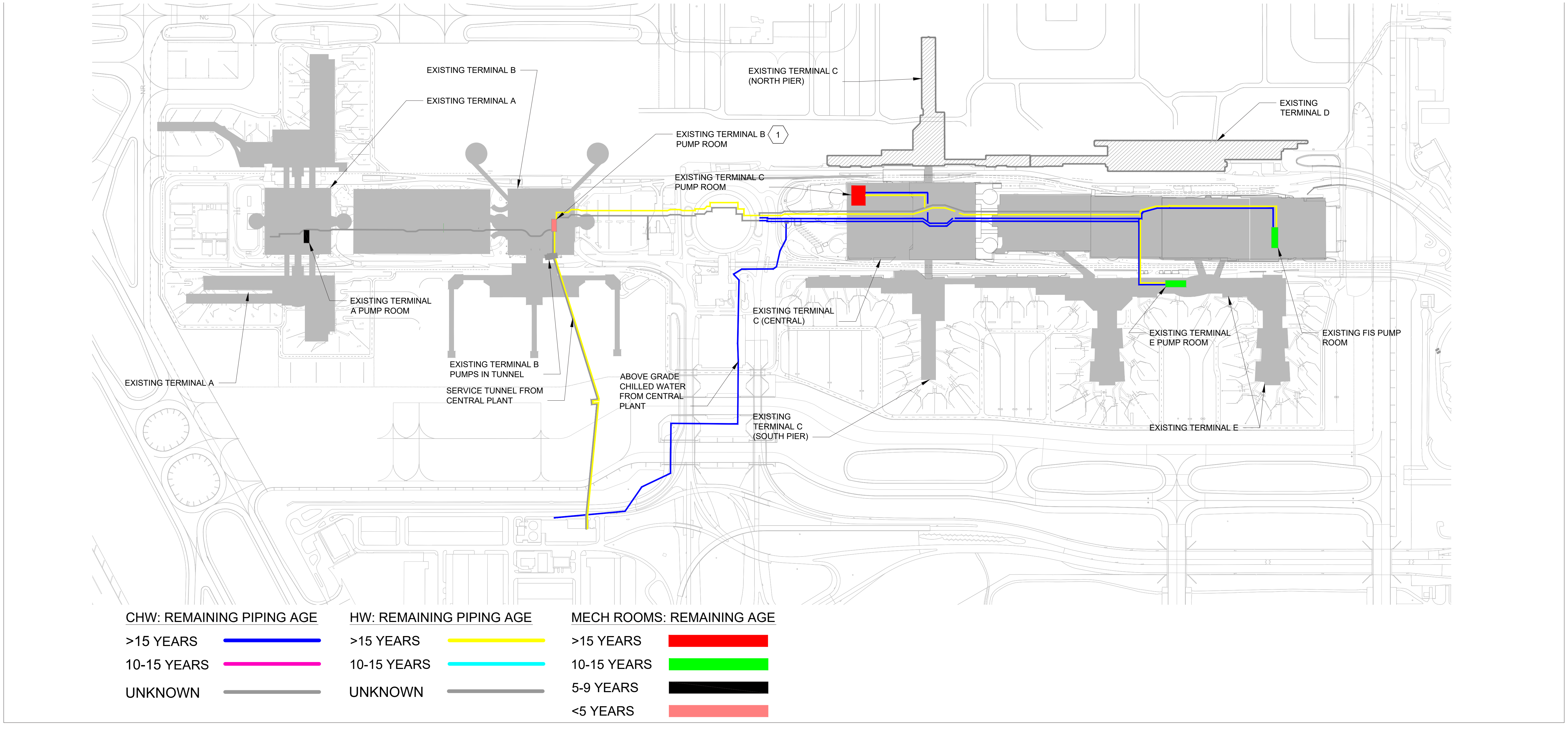
The electrical services to the FIS building originate at two CenterPoint 2000 kVA transformers, located landside, on airport property. These two 12.47 kV-480/277 V transformers serve a switchgear lineup with a main-tie-main configuration. A total of four CenterPoint transformers feed the FIS Building. CenterPoint feeds the transformers from two 12.47 kV distribution lines, each fed from a different off-airport substation. Two transformers are served by an ATO. This allows the service to transfer between the two different 12.47 kV distribution lines. A total of two ATOs serve the building. **Figure 3.36** shows the existing FIS transformer.

CenterPoint Energy owns and maintains the primary electrical power system at IAH and the airport is served by the following four substations:

1. Greens Road, located west of JFK Boulevard on Greens Road;
2. Intercontinental, located north of the fuel farm on Aldine Westfield Road;
3. Treaschwig, located 2.5 miles north of the airport at the intersection of Eagle Crossing and Treaschwig Road; and
4. Westfield, located two miles NW of the airport near the intersection of Bammel Road and Imperial Valley Drive.

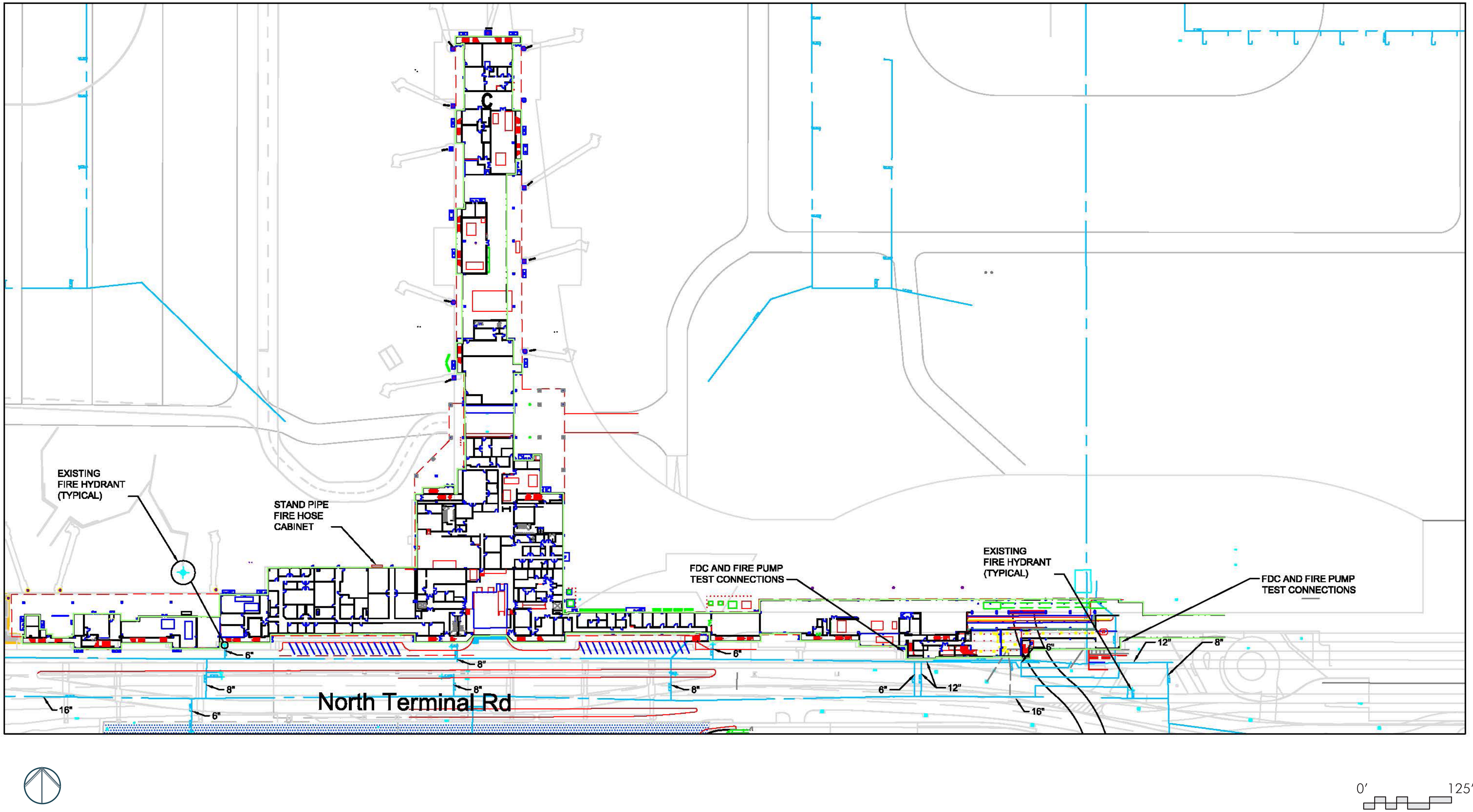
After entering the airport, overhead lines are routed underground in duct banks. These typically consist of 12 six-inch PVC conduits encased in concrete, with manholes at 400 foot intervals.

Distribution Piping Service Life

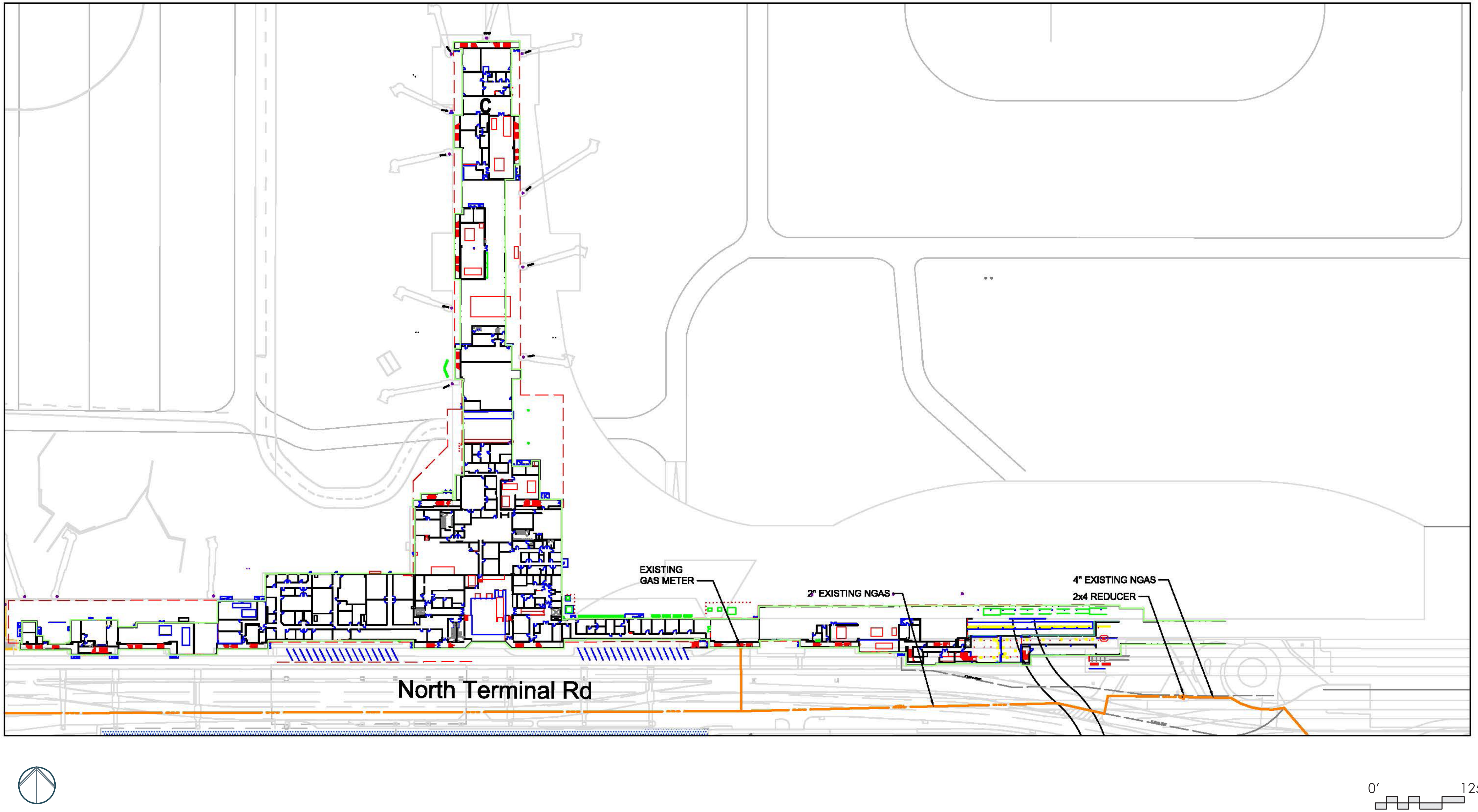


Not to Scale

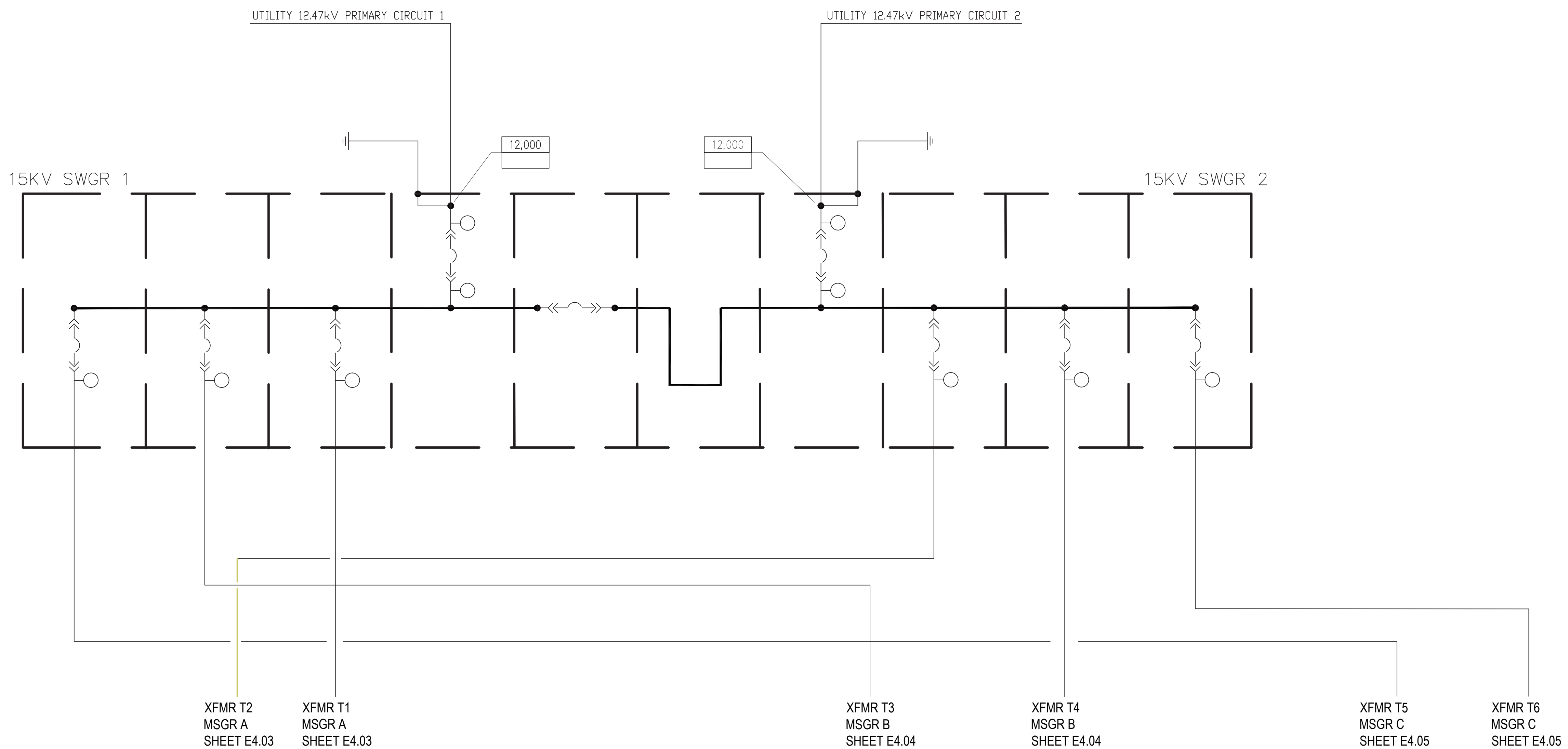
Existing Fire Protection



Existing Natural Gas



FIS Centerpointe - Single Line Diagram



Not to Scale

Greens Road and Intercontinental substations supply the majority of airport loads. Major loads include:

- Terminal hotel complex
- Central Utility Plant
- Control tower
- ARFF Stations
- Airfield lighting vaults

The largest airport demand loads, as of August 6th 2013, are show in **Table 3.3**.

Table 3.3

Central Utility Plant	11.8MW
Federal Inspection Services (FIS)	2.5MW
Hotel	1.5MW
Terminal A Vault and South Concourse	3.0MW
Terminal B Vault and South Concourse	5.2MW
Terminal C South, Vault and Parking Garage	5.3MW
Terminal D Vault	2.0MW
Terminal E	8.0MW
Total:	**39.3MW**

The electrical services to the FIS building originate at CenterPoint's 2000 kVA transformers. Two 12.47 kV-480/277 V transformers serve a switchgear lineup with a main-tie-main configuration. A total of four CenterPoint transformers feed the FIS building. CenterPoint feeds the transformers from two 12.47 kV distribution lines each fed from a different substation, Greens Road and Intercontinental. Two transformers are served by an ATO, allowing the service to transfer between the two different 12.47 kV distribution lines with a total of two ATO's serving the building as shown in **Figure 3.37**.

Figure 3.37

3.6 Landside

The FIS facility is located adjacent to Terminal E and is surrounded by terminal access roads on the north side and the south side of the building. There is no direct passenger access to the facility for passengers. All arriving international passengers exit through Terminal E. Departing international passengers utilize both Terminals D and E, depending on the airline. The only landside access to the building is provided through (1) a loading dock on the north side of the facility that serves the FIS facility and Terminal E and (2) a user-restricted parking facility on the east side reserved for CBP officers. Access to the structure is provided from South Terminal Road. Parking for international passengers is provided in the Terminal D/E garage. A more detailed comprehensive review and analysis of terminal area landside operations is being prepared as part of the *Bush Intercontinental Airport Master Plan Update*, in development by the LeighFisher consultant team. **Figure 3.38** shows the existing terminal roadways.

3.6.1 ROADWAYS

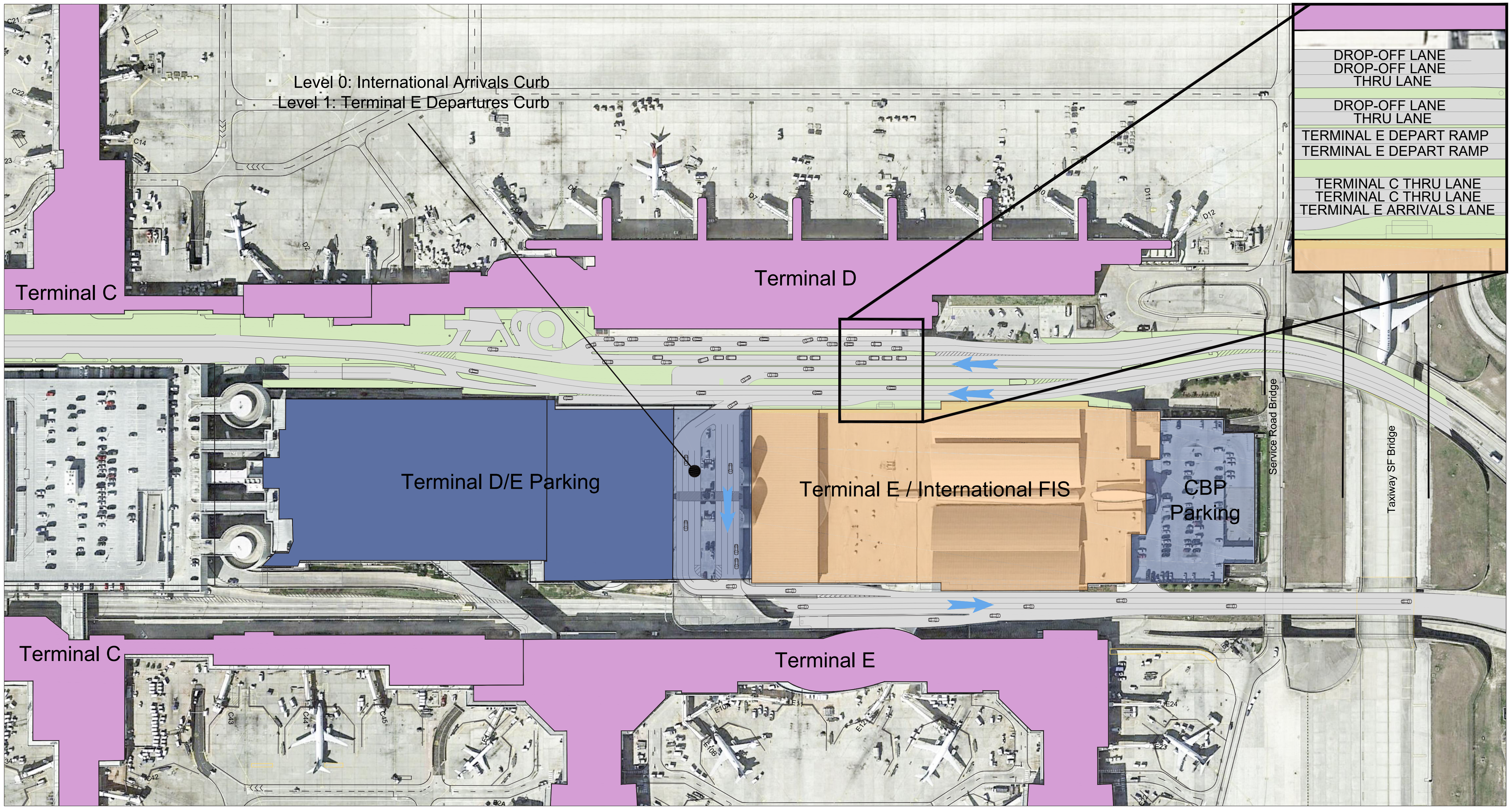
3.6.1.1 North Terminal Inbound Access Road (Westbound)

The FIS facility is bound by North Terminal Road to the north, which provides landside access to the entire terminal area, and is a one-direction roadway running east to west. All landside vehicle traffic can access North Terminal Road via John F. Kennedy Boulevard from the south and via Will Clayton Parkway from the east. Traffic enters the terminal area from the east. When entering the terminal area, the Taxiway SF bridge obstructs driver's views of the terminals and curbsides and limits driver's decision distance. Immediately after Taxiway SF, the roadway diverges to provide access to Terminal D to the right and Terminals E and C to the left. Immediately north of the FIS facility, after the diverge to Terminal D and the Terminal E departures upper level curbside, there are three lanes serving Terminals E and C, which widen to serve the Terminal E lower level roadway. **Figure 3.39** shows the existing north terminal lane allocation.

3.6.1.2 South Terminal Outbound Access Road (Eastbound)

The FIS facility is bound by South Terminal Road to the south. This provides landside egress from the terminal area and is a one-directional roadway running west to east. All traffic from Terminals D, C and E, and some traffic from Terminals A and B use Will Clayton Parkway to exit the airport. South of the FIS facility, there are four lanes with an additional lane merging from the right, from the Terminal E departures upper level curbside. To the east of the FIS facility, there is a parking structure for the exclusive use of CBP and Homeland Security which is accessed from South Terminal Road. **Figure 3.40** shows the existing south terminal lane allocation.

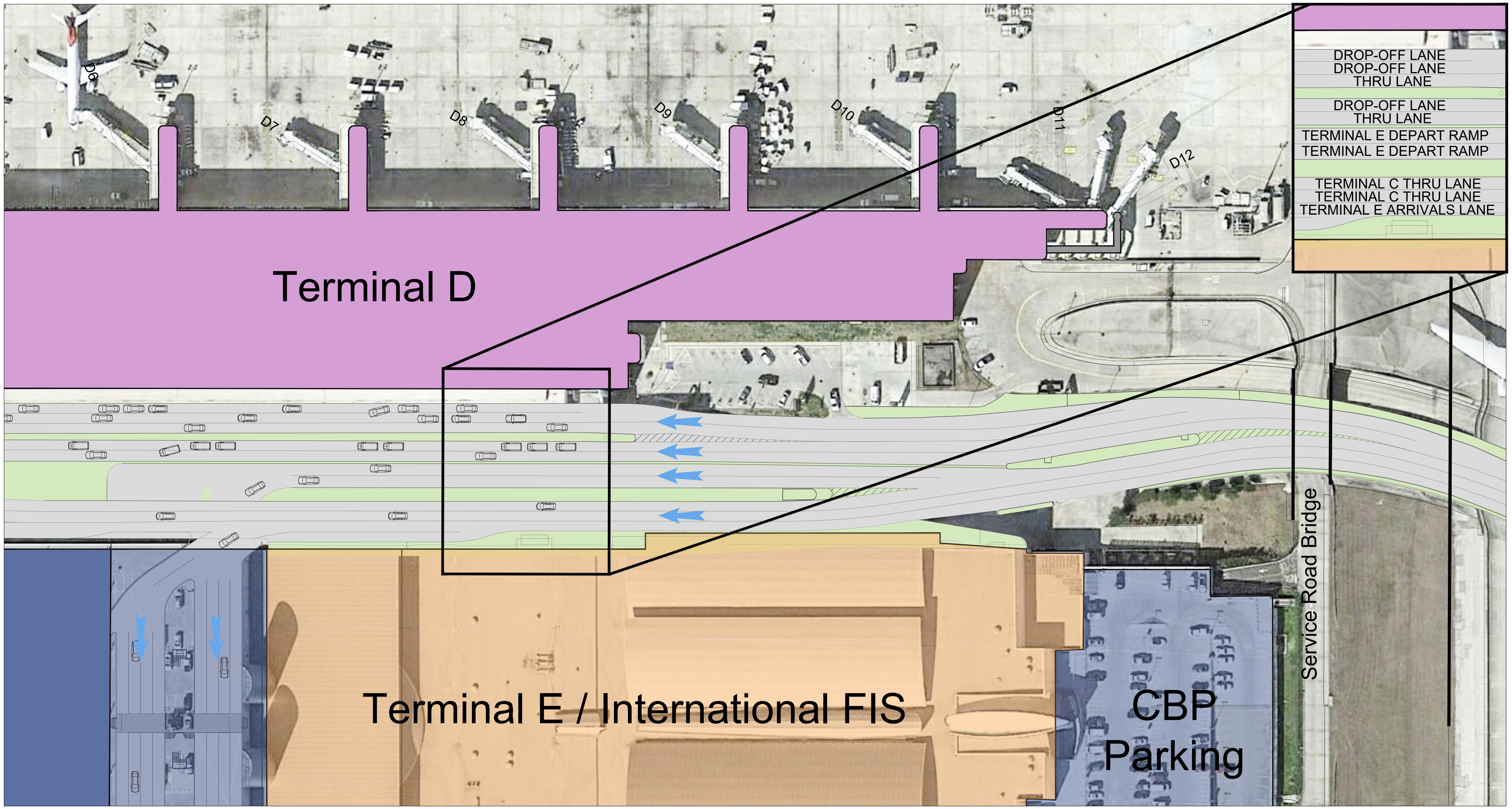
Existing Terminal Roadways



Not to Scale

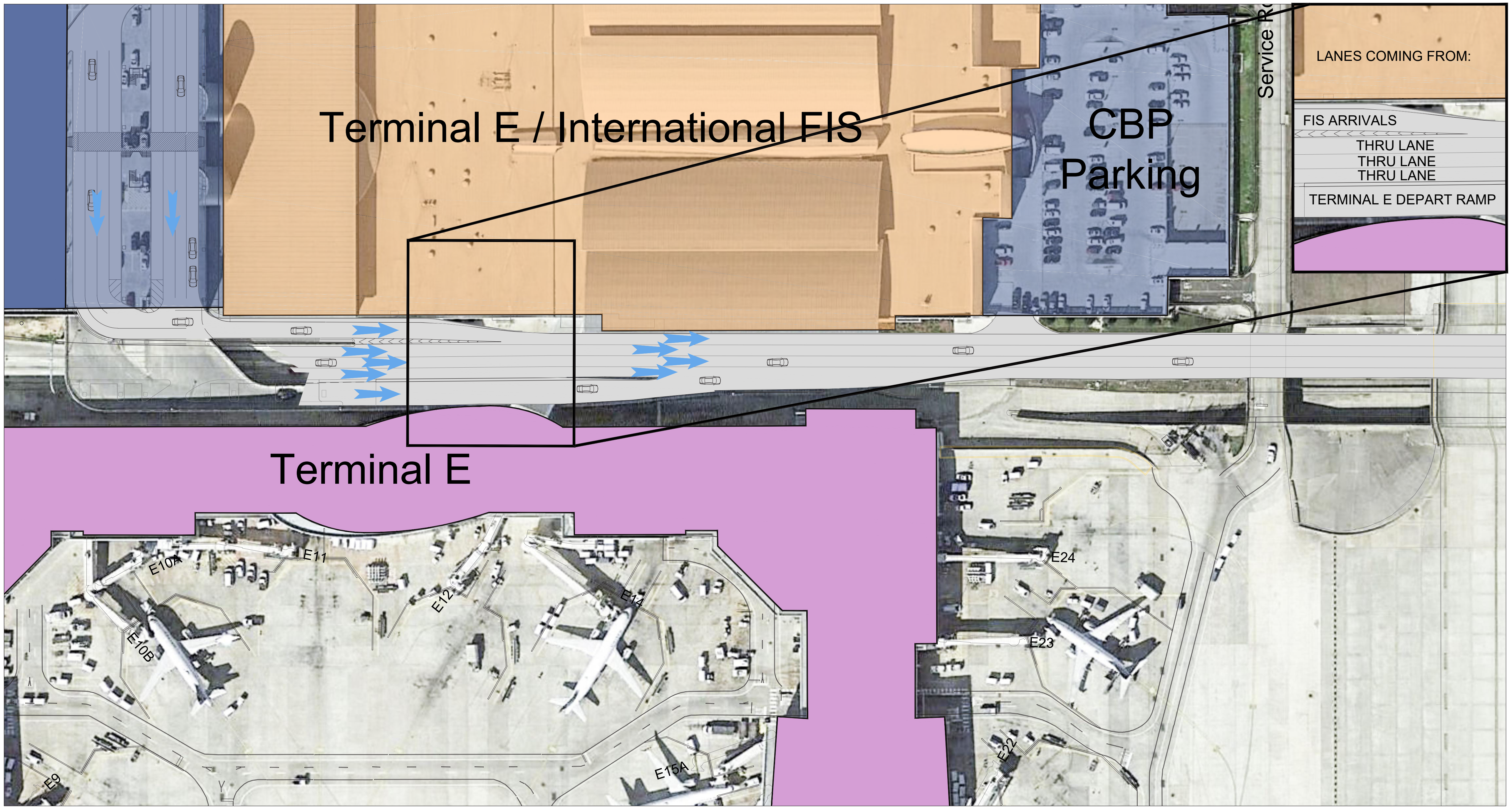
Existing Lane Allocation Fig 3.38

North Terminal Roadway (Westbound)



Not to Scale

South Terminal Roadway (Eastbound)



Not to Scale

3.6.2 ANCILLARY LANDSIDE FACILITIES

3.6.2.1 Authorized Vehicle Parking Facility

Figure 3.41

There is a 250-space, two-level restricted use parking structure adjacent to the east side of the FIS facility. This facility is restricted to only CBP agents' private vehicles, official Homeland Security and other official vehicles. Vehicular access to the structure is via a two-way entry/exit on the southeast side of the structure from South Terminal Road. There is no merge lane for exiting vehicles. Drivers must use caution when entering South Terminal Road as shown in **Figure 3.41**; IAH's authorized vehicle parking facility.

3.6.2.2 FIS Loading Dock

A three bay loading dock is located on the northeast corner of the FIS facility, as shown in **Figure 3.42**. One of the bays is occupied by a waste compaction machine, leaving two bays open for deliveries. Vehicles access the dock from the left lane of North Terminal Road. Once loading/unloading is complete, vehicles exit to the west via North Terminal Road and must traverse the terminal roadway around Terminal C to exit the terminal area.

3.6.2.3 Terminal D Authorized Vehicle Surface Lot, Service Road and AOA Access Point

North of North Terminal Road there is an unrestricted landside service road that leads to the loading dock for Terminal D. This area also contains a surface lot reserved for authorized airport, airline and official consular vehicles. This surface lot, although reserved for restricted vehicles, does not have access control. An Airport Operations Area (AOA) access point is located past the Terminal D loading dock. See **Figure 3.43** for a plan view of this site.

3.6.2.4 Non-Landside Facility Interactions (Airport Service Road and Bag Tug Ramps)

To the east of the CBP parking structure is a two-lane restricted airfield vehicle service road that runs north and south and parallel to the east façade of the parking structure. This road is on the airside and serves baggage tugs delivering inbound baggage from international flights and the underground baggage matrix under the FIS facility via two roads, one to the north and one to the south of the facility. These roads ramp down in order to reach the underground baggage matrix from the airfield level.

Figure 3.42

Figure 3.43

Chapter 4 | FIS Program Requirements

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4.0 FIS Program Requirements

4.1 Overview

Program requirements for Department of Homeland Security (DHS) Federal Inspection Services (FIS) facilities at George Bush Intercontinental Airport/Houston (IAH or the Airport) Terminal E were developed to accommodate peak-hour demand. The facility requirements for processing international arriving passengers and security screening checkpoints for Terminal E international originating and transfer passengers are discussed in this section.

Facility and space requirements described herein relate to passenger processing and support facilities for the planning activity level (PAL) representing demand for 33 million annual passengers (MAP). This milestone is known as PAL 33, representing 2028 activity at IAH.

Table 4.1 presents a comparison of the existing Terminal E processing facility inventory and PAL 33 program requirements.

Table 4.1: Terminal E Processing Facility Requirements

	INVENTORY	PAL 33 REQUIREMENTS
FACILITY	AREA	AREA
Department of Homeland Security Facilities		
Federal Inspection Services	272,550	271,370
Recheck Hall	14,640	16,010
Transportation Security Administration	24,660	31,100
Airline Facilities		
United Airlines International Ticketing Lobby	23,020	23,020
General Spaces	67,170	69,080
Circulation	137,420	137,420
Total Terminal E Processing Facility Area	**539,460**	**548,000**

Note: Square footages are rounded to the nearest 10.
Source: Houston Airport System, FIS Plans, provided on July 2014 (inventory). Ricondo & Associates, Inc., January 2015. Ricondo & Associates, Inc., February 2016 (requirements).
Prepared by: Ricondo & Associates, Inc., February 2016.

The air service characteristics, passenger attributes and operating parameters used to derive the functional and support facility requirements are described in this section.

4.2 Methodology

Facility requirements were developed by correlating demand and assumptions regarding passenger characteristics with level-of-service (LOS) goals. Different methodologies, reflecting the unique mission of each function, were used to develop facility requirements. The requirements analysis was based on 33 MAP, which is representative of forecast 2028 passenger demand. Simulation modeling was used to derive international inbound and outbound processor requirements, such as primary processing and security screening functions, while support area requirements were based on published design standards and industry accepted planning factors.

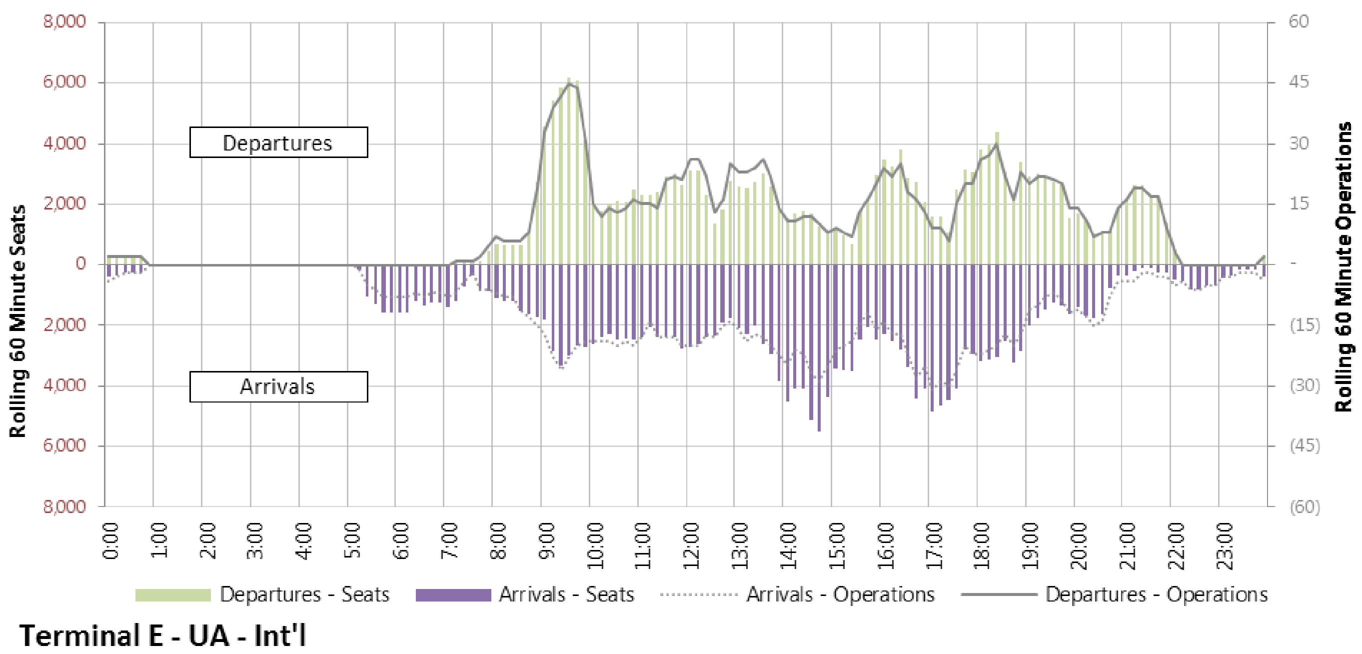
4.3 Aviation Demand

Terminal facilities are planned, sized, and designed to accommodate peak-period passenger demand at a reasonable level of service. A design day flight schedule (DDFS) representing the average day of the peak month was developed by LeighFisher Inc. under its Master Plan contract with the Houston Airport System (HAS) to determine peak-period activity statistics to be used in deriving facility requirements. A DDFS represents the Airport's daily pattern of scheduled airline service; therefore, it provides information on a flight-by-flight basis pertaining to time of aircraft arrival or departure, the operating airline, aircraft type, domestic/international designation, points of origin and destination (airport codes), seat capacity, load factor, and origin and destination (O&D) passenger percentages.

The PAL 33 flight schedule used in the analysis specified load factors that were applied to the number of arriving seats on a flight-by-flight basis to derive numbers of international peak-hour deplaned passengers. These numbers include all international passengers processing through the Airport and represent the principal demand at the FIS facilities. An additional factor was used to derive the number of passengers ending their airline journeys, or terminating, at the Airport (O&D passengers). Passengers who are not terminating their journeys at the Airport are referred to as transfer or connecting passengers, which account for the principal demand at the Recheck Hall and the transfer security screening checkpoint (SSCP). **Figure 4.1** and **Figure 4.2** illustrate daily flight and passenger activity, respectively, represented in the DDFS for PAL 33. **Table 4.2** compares daily and peak-hour activity and the characteristics associated with the 2014 and PAL 33 DDFSs.

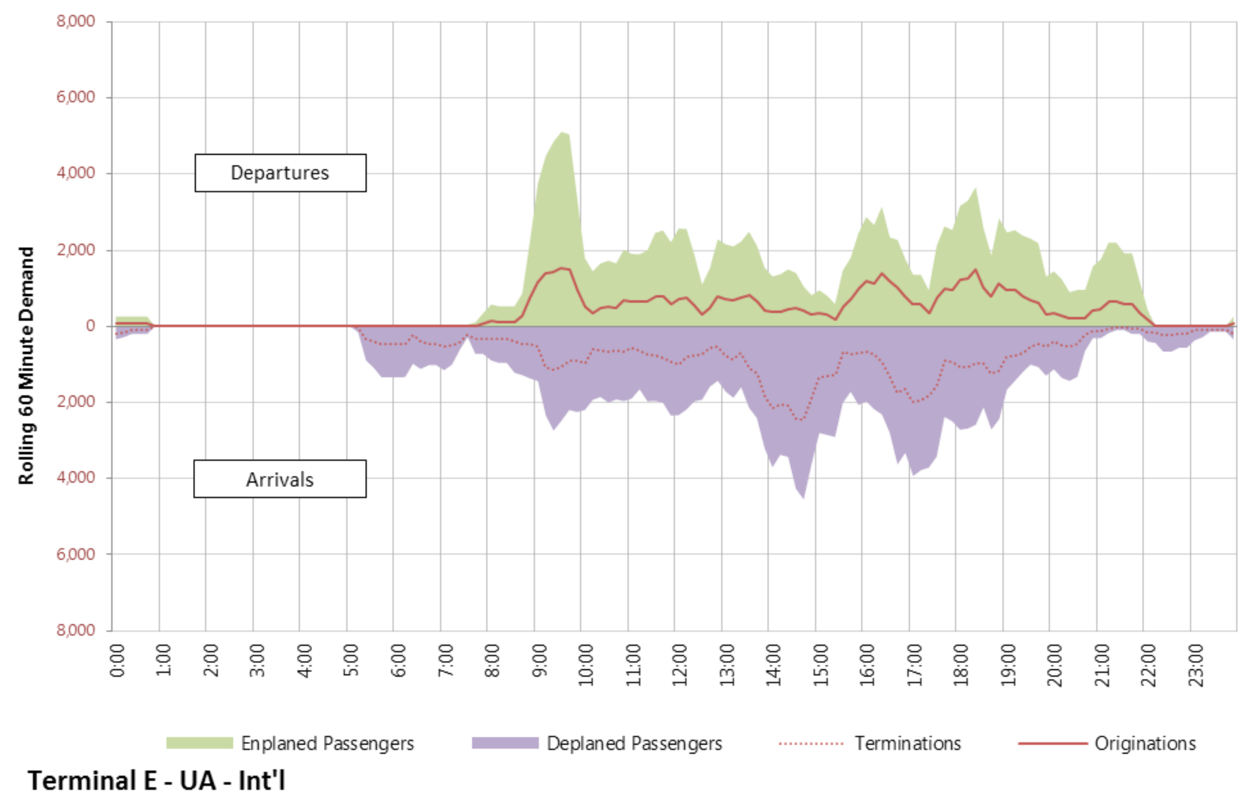
At PAL 33 demand, outbound (departing) peak-hour passenger activity occurs between 9:00 and 10:00, and consists of 45 aircraft operations, with approximately 5,115 enplaned passengers, of which 1,520 would be originating passengers. Departing passenger activity only represents United Airlines' international operations. United Airlines is the only operator in the Terminal E Check-in Lobby.

Figure 4.1: PAL 33 Daily Activity – Seats and Aircraft Operations



Sources: LeighFisher Inc., April 2014 (PAL 33 schedule); LeighFisher Inc., October 2014 (2014 schedule); Ricondo & Associates, Inc., December 2014.
Prepared by: Ricondo & Associates, Inc., January 2015.

Figure 4.2: PAL 33 Daily Passenger Activity



Sources: LeighFisher Inc., April 2014 (PAL 33 schedule); LeighFisher Inc., October 2014 (2014 schedule); Ricondo & Associates, Inc., December 2014.
Prepared by: Ricondo & Associates, Inc., January 2015.

Table 4.2: 2014 and PAL 33 Design Day Flight Schedule Summary

	2014	PAL 33
DAILY		
Departures		
Aircraft Operations	111	253
Seats	13,750	34,573
Enplaned Passengers	11,510	28,785
Originating Passengers	3,345	9,585
Arrivals		
Aircraft Operations	117	264
Seats	16,550	39,060
Deplaned Passengers	13,925	32,275
Terminating Passengers	4,335	14,120
Transfer Passengers	9,555	18,155
Peak Hour		
Departures		
Aircraft Operations	24	45
Seats	3,090	6,165
Enplaned Passengers	2,595	5,115
Originating Passengers	760	1,520
Arrivals		
Aircraft Operations	17	29
Seats	3,185	5,485
Deplaned Passengers	2,635	4,550
Terminating Passengers	690	2,445
Transfer Passengers	1,940	2,105

Notes:

Passenger numbers are rounded to the nearest 5.

Departure numbers reflect all international demand for United Airlines.

Arrival numbers represent all inbound international demand though Federal Inspection Services facilities.

Peak-hour operations reflect the number of flights during the peak passenger demand hour and may not reflect peak numbers of operations throughout the day.

Sources: LeighFisher Inc., April 2014 (PAL 33 schedule); LeighFisher Inc., October 2014 (2014 schedule).
Prepared by: Ricondo & Associates, Inc., January 2015.

International inbound activity has two peak demand periods: a peak passenger demand period and a peak operational demand period. At PAL 33, inbound peak-hour passenger demand would occur between 13:50 and 14:50, and would consist of 29 operations with approximately 5,485 arriving seats, of which 4,550 would be occupied by deplaning passengers and 2,445 would be occupied by terminating passengers. Inbound peak operational demand would occur later in the day, between 16:00 and 17:00, and consist of 31 operations with approximately 4,845 arriving seats, of which 3,935 would be occupied by deplaning passengers and 1,975 would be occupied by terminating passengers. The peak-period operational activity would consist of the following: Air France (1 operation), British Airways (1 operation), Lufthansa German Airlines (1 operation), Singapore Airlines (1 operation), United Airlines (24 operations), and a new entrance carrier (1 operation).

The detailed PAL 33 DDFS is provided in **Appendix A**.

4.4 Assumptions

The assumptions used to inform the simulation models, which were used to establish passenger characteristics (or attributes) and processing rates specific to IAH, are described in this section. Assumptions were developed based on material provided in the 2010 Peak Week Survey,[1] International Arrivals Building Study,[2] International Services Expansion Program,[3] Ricondo & Associates, Inc., airline surveys,[4] or industry accepted guidelines or by airport stakeholders, as applicable.

4.4.1 PROCESS FLOW SUMMARY

Figure 4.3 and **Figure 4.4** depict the process flows and planning assumptions used for each functional facility based on international inbound and outbound processes, respectively.

4.4.2 PASSENGER AND BAGGAGE ATTRIBUTES

In analyzing passenger activity, the time passengers show up at the terminal and the percentage of passengers who check baggage or otherwise use processing units in the airline check-in area were considered. Show-up time is an attribute considered for departing (originating enplaned) passengers, whereas the percentage of passengers with checked bags applies to both departing and arriving (destination or terminating) passengers.

4.4.2.1 Passenger Baggage Attributes

Table 4.3 lists the percentages of passengers checking bags and the numbers of bags checked by origin based on data provided by the airlines. Approximately 87 percent of passengers were determined to check bags at a rate of 1.9 bags per passenger.

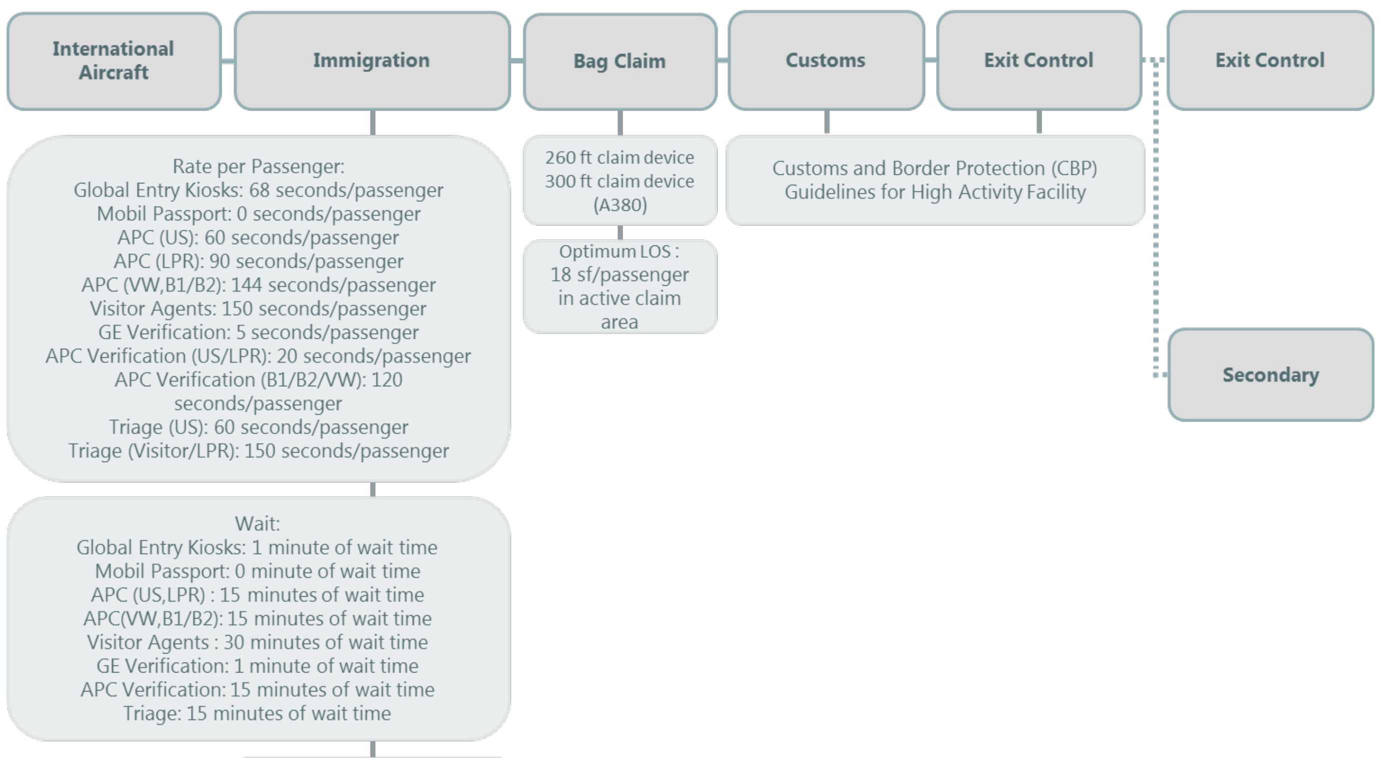
1 *HNTB, 2010 Peak Week Survey, Terminal Observations Draft Section, December 22, 2010.*
2 *HNTB, International Arrivals Building (IAB) Federal Inspection Services (FIS) Staffing Study, July 1, 2013.*
3 *International Service Expansion Program, Criteria and Assumptions for Program Definition, January 11, 2000.*
4 *Airline surveys are provided in Appendix B. Ricondo & Associates, Inc., "Airline Surveys," September 2014.*

Table 4.3: Percentages of Passengers Checking Bags

BAGS	ASIA	EUROPE	MIDDLE EAST	LATIN AMERICA	AFRICA
0	13.0%	13.0%	5.0%	13.0%	13.0%
1	14.0%	65.0%	10.5%	14.0%	14.0%
2	46.0%	15.0%	70.0%	46.0%	46.0%
3	19.0%	5.0%	10.5%	19.0%	19.0%
4	8.0%	1.0%	4.0%	8.0%	8.0%
5	0.0%	1.0%	0.0%	0.0%	0.0%

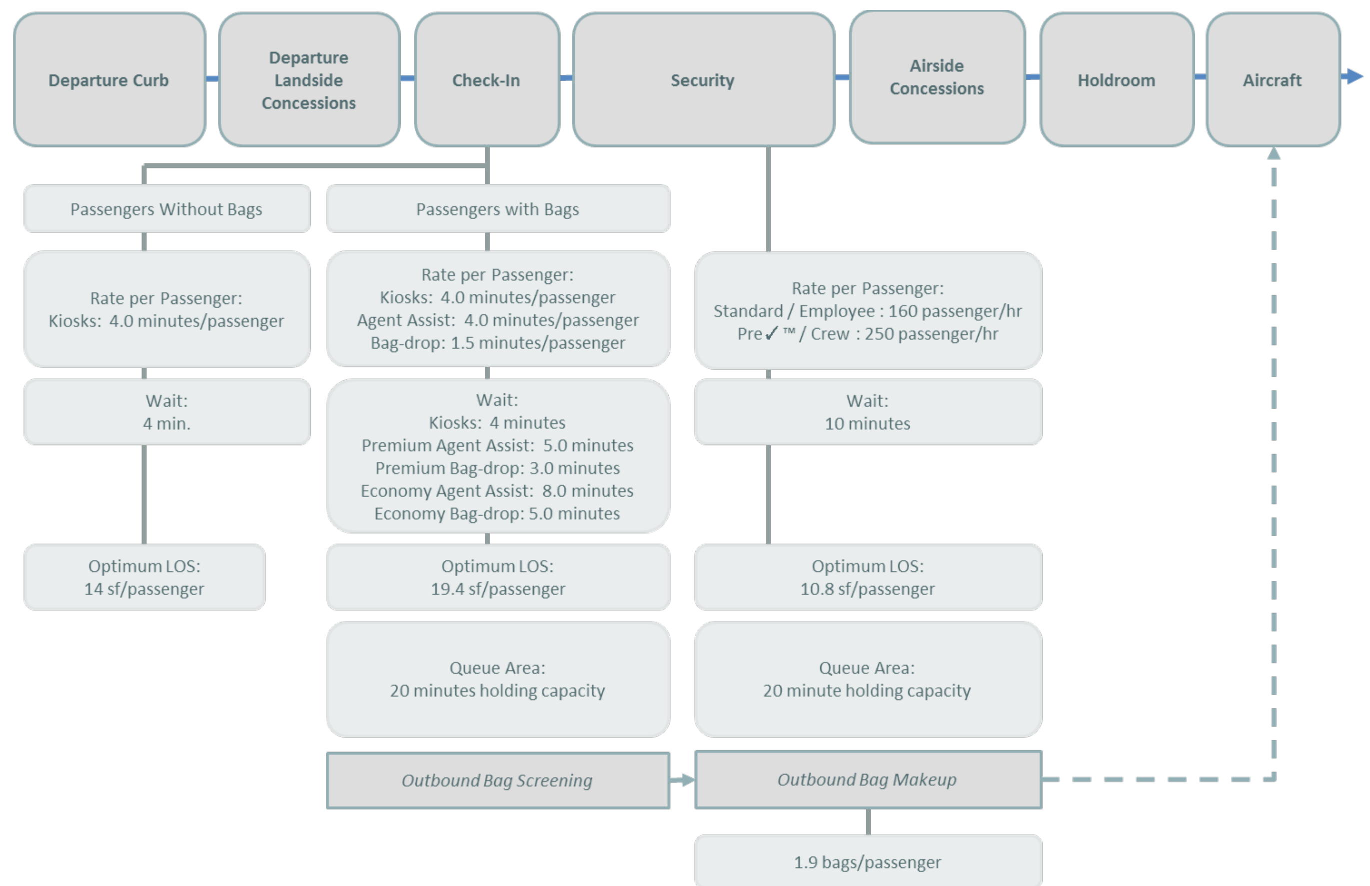
Source: Ricondo & Associates, Inc., Airline Surveys, September 2014.
Prepared by: Ricondo & Associates, Inc., January 2015.

Figure 4.3: Planning Assumptions – Inbound Process



Notes:
sf = Square Feet
APC = Automated Passport Control
US = United States Citizens
LPR = United States Legal Permanent Residents
VW = Visa Waiver
GE = Global Entry
CBP = Customs and Border Protection
LOS = Level of Service
Sources: Specific elements are sourced in subsequent sections.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.4: Planning Assumptions – Outbound Process



Notes:
LOS = Level of Service
sf/pax = Square feet per passenger
CBP = U.S. Customs and Border Protection
Sources: Specific elements are sourced in subsequent sections.
Prepared by: Ricondo & Associates, Inc., January 2015.

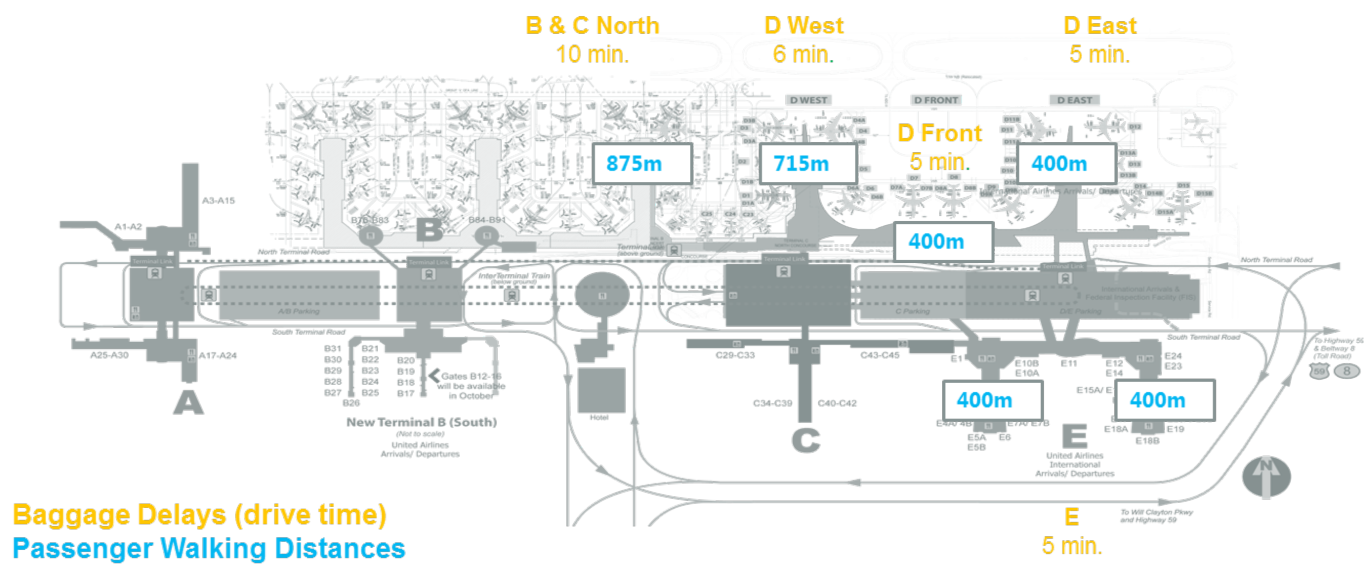
4.4.2.2 Inbound Passenger and Baggage Delays

Prior to entering the FIS facility, international passengers and their baggage are metered based on the distance of travel and progression rates. Inbound passengers deplane at a rate of 25 passengers per minute from Airplane Design Group (ADG) IV/V/VI (dual-aisle) aircraft and at a rate of 19.5 passengers per minute from ADG II/III/IV (single-aisle) aircraft. After deplaning, all arriving passengers walk to the FIS facility for federal inspection. **Figure 4.5** shows the average distance of each pier to the FIS facility; walking rates are based on one meter per second. This distance ranges from an average of 400-875 meters, which equates to approximately seven to 15 minutes of walk time after passengers deplane.

Baggage unload rates differ depending on the type of aircraft. A narrowbody aircraft takes five seconds per bag (12 bags per minute) to unload after five minutes of aircraft block time. A widebody aircraft has a baggage unload rate of one minute per unit load device, with a capacity of 35 bags per unit load device, starting nine minutes after the aircraft is blocked.

Tugs towing baggage carts transport the baggage to the inbound unload piers located at Terminal E. **Figure 4.5** illustrates the average transport time for baggage based on the distance between the aircraft and the inbound piers. Baggage delays can range from five to 10 minutes. Once the baggage carts arrive at the inbound piers, they are unloaded at a rate of 12 bags per minute (five seconds per bag). The average time for the first bag to be placed on the belt is 13 minutes after aircraft block time.

Figure 4.5: Inbound Passenger and Baggage Delays



Notes:

m = Meters

Baggage delays represent the transport time from international capable gates

Source: Ricondo & Associates, Inc., January 2015.

Prepared by: Ricondo & Associates, Inc., January 2015.

4.4.3 FIS FACILITY ASSUMPTIONS

4.4.3.1 Passport Types

Passenger passport types determine the use of initial passport screening channels. These channels are Global Entry (GE), Automated Passport Control (APC), Mobile Passport Control, and typical officer booth positions. Passenger passport types include United States Citizens (USC), Legal Permanent Residents (LPR), Visa Waiver (VW) passengers, B1/B2 Visa holders, and Non-Visa Waiver (NVW) passengers. Approximately 15 percent of all passengers are enrolled in the GE program. All USC, LPR, VW passengers, and B1/B2 Visa holders can use an APC kiosk upon arrival to the primary. NVW passengers use typical piggyback officer booths. **Table 4.4** presents the breakdown of passport types by originating region.

Table 4.4: Passport Types by Region

PASSPORT TYPE	ASIA	EUROPE	MIDDLE EAST	LATIN AMERICA	AFRICA
U.S. Citizens/Legal Permanent Residents	31%	64%	60%	60%	70%
Visa Waiver Passengers/ B1/B2 Visa Holders/ Non-Visa Waiver Passengers	69%	36%	40%	40%	30%

Sources: IAH Stakeholders – United States Customs and Border Protection, Houston Airport System, GCR, Inc., 2014; Ricondo & Associates, Inc., Airline Surveys, September 2014.
Prepared by: Ricondo & Associates, Inc., January 2015

International-to-International Transfer

Portions of all inbound passengers are ITI transfer passengers and are, therefore, not required to retrieve their baggage at the FIS facility. **Table 4.5** shows the percentage of ITI transfer passengers based on airline classification.

Table 4.5: International-to-International Transfer Passenger Percentages

ALLIANCE	TRANSFER PERCENTAGE
United Airlines	22%
Star Alliance	10%
Foreign Flag Airlines	5%

Sources: United States Customs and Border Protection, Houston Airport System, GCR, Inc., United Airlines, 2014
Prepared by: Ricondo & Associates, Inc., January 2015.

4.4.3.2 FIS Attributes

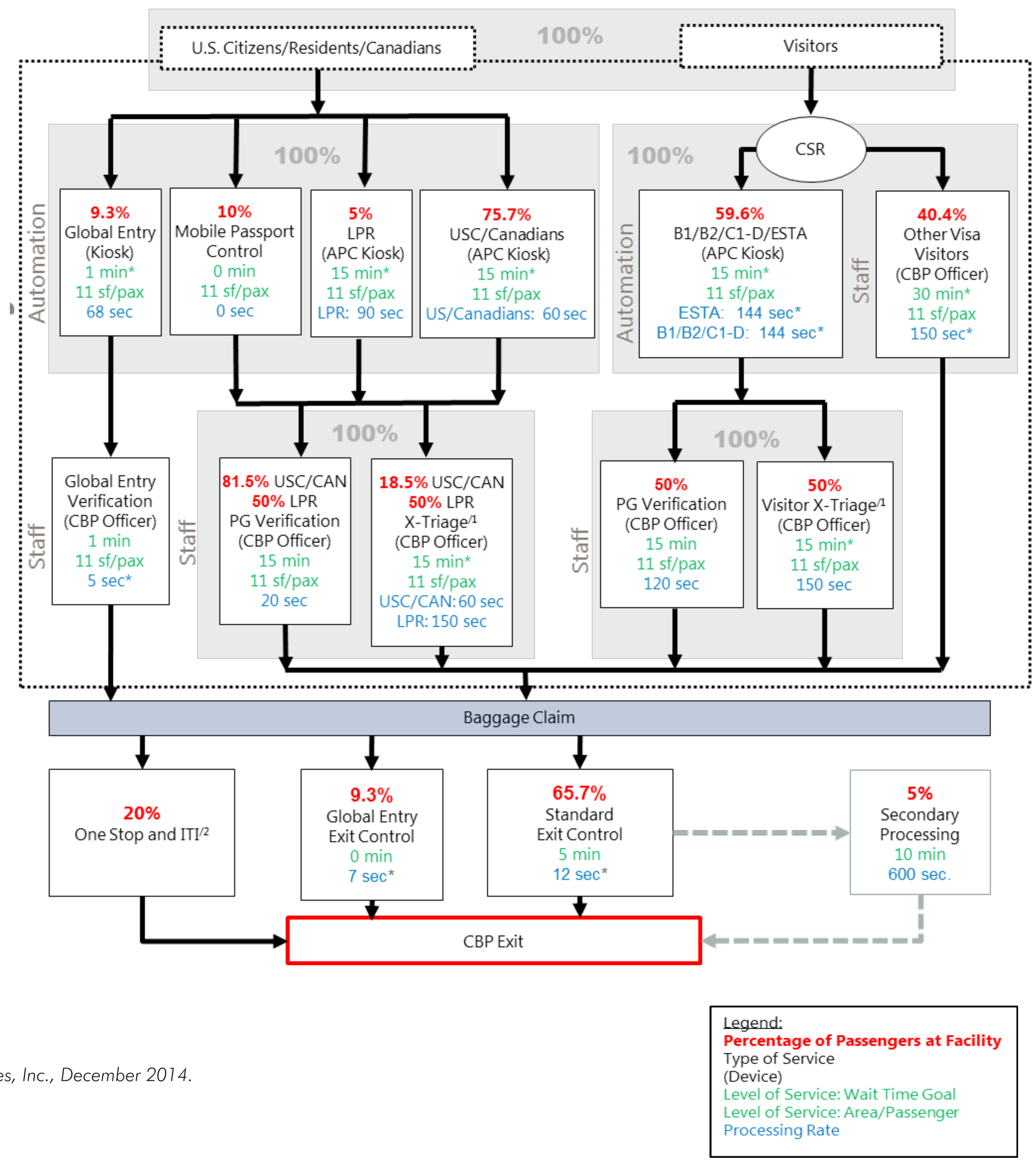
The inspection process begins when the international arriving passenger reaches the FIS facility. U.S. citizens and residents, who are enrolled in the Global Entry program, use the designated Global Entry kiosks, verification podiums, and Exit Control to clear the inspection process. Nearly 10 percent of U.S. citizens and residents passengers are considered travel savvy and are expected to use the government's Mobile Passport Control (MPC) application on their smart phones to submit their personal information, bypassing the APC kiosks. These MPC passengers, along with other APC-eligible passengers, require either a verification officer for a successful transaction or a triage officer to handle unsuccessful transactions. All foreign visitors are briefly interviewed by a Customer Service Representative (CSR) who directs them to either the APC kiosks or an officer based on their eligibility to use the APC kiosks. Non-visa waiver and first time visa waiver, B1, B2 and C1-D visa passengers must see an officer at a typical piggyback booth to complete the inspection process.

After completion of Primary Processing, terminating passengers and non-ITI transfer passengers can reclaim their baggage in the International Baggage Claim Hall. All passengers process through Exit Control for final verification. At Exit Control, some passengers are selected for further inspection by either the U.S. Department of Agriculture or Customs Secondary Processing. **Figure 4.6** illustrates the FIS passenger attributes.

4.4.4 RECHECK HALL ASSUMPTIONS

Transfer passengers who have cleared the FIS processes and are either rechecking their baggage or need agent assistance are served in the Recheck Hall. Transfer passenger processing attributes – processing time, wait time goals and area requirements – at the Recheck Hall are illustrated on **Figure 4.7**. Approximately 67 percent of passengers drop off baggage or need agent assistance and, therefore, use the Recheck Hall. All transfer passengers then proceed to the SSCP for screening. Terminating passengers bypass the Recheck Hall and exit the FIS facility into the International Arrivals Hall, also known as the Meeter/Greeter Lobby.

Figure 4.6: FIS Passenger Attributes

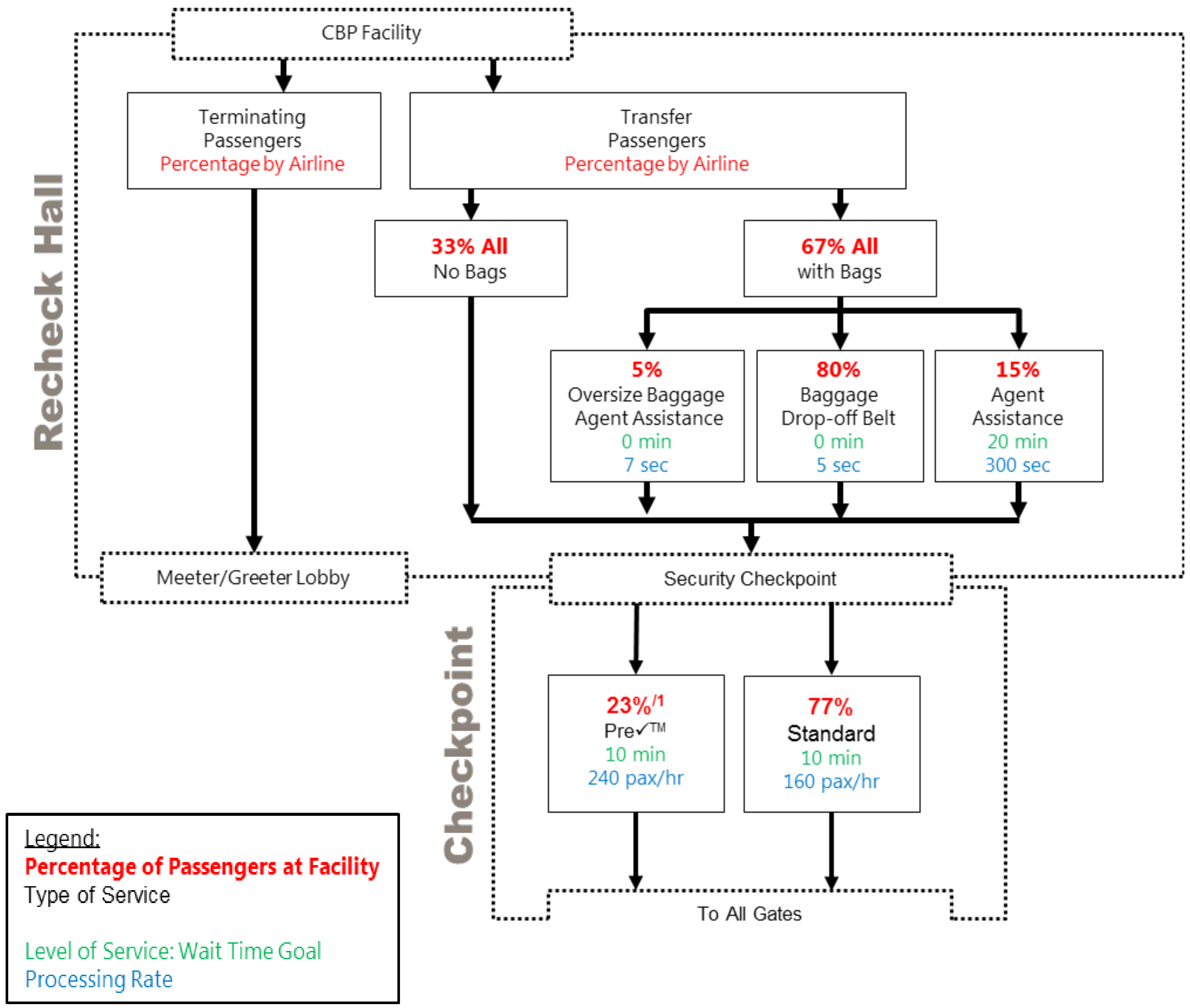


Notes:

min = Minutes | *LPR = Legal Permanent Resident*
sf/pax = Square feet per passenger | *VW = Visa Waiver*
sec = Seconds | *NVW = Non-Visa Waiver*
USC = United States Citizens
United Airlines crew members can utilize the Global Entry access to procss through Primary Inspection, or use the bypass lane with all other airline crew who may have C1-D visas to access the APC kiosks.
/1 IAH Stakeholders - CBP, HAS

Sources: IAH Stakeholders: United States Customs and Border Protection, Houston Airport System, GCR, Inc.; Ricondo & Associates, Inc., December 2014.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.7: International Transfer Passenger Attributes



Notes:

min = Minutes

pax/hr = Passengers per hour

sec = Seconds

/1 United Airlines passengers only

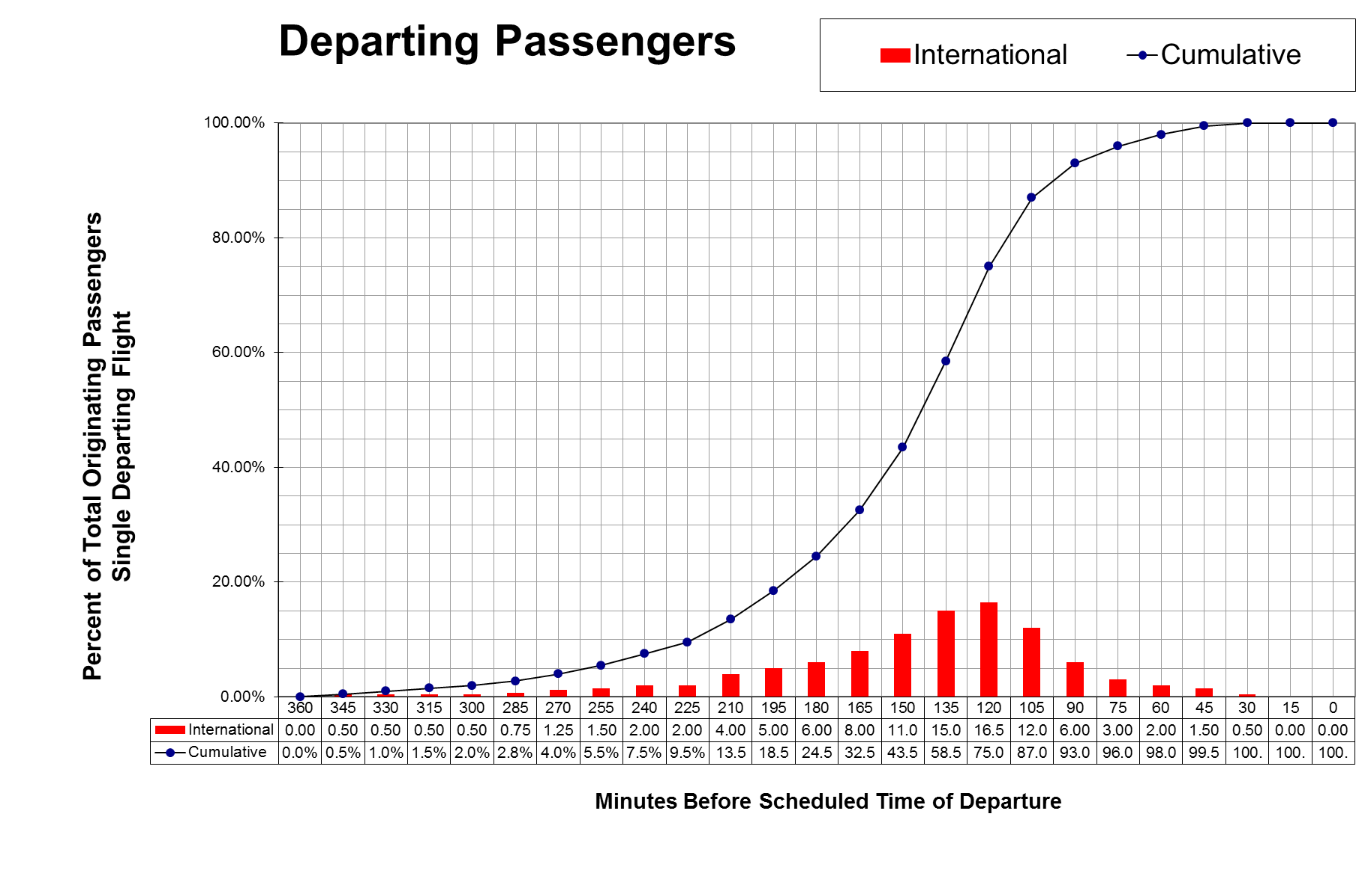
Source: IAH Stakeholders: United States Customs and Border Protection, Houston Airport System, GCR, Inc.; Ricondo & Associates, Inc., December 2014.

Prepared by: Ricondo & Associates, Inc., February 2016.

4.4.5 PASSENGER SHOW-UP PROFILES

Passenger show-up profiles refer to the amount of time before the scheduled time of flight departure that originating passengers arrive at the terminal. Show-up profiles vary depending on the type of travel (domestic or international), class of service, whether or not the passenger is checking baggage, and time of day. Flights departing early in the morning generally have a condensed show-up profile, which results in a higher surge factor because of the hours of operation for the Transportation Security Administration (TSA) and airline staff. Profiles are also affected by airline flight close-out requirements, which pertain to the time in advance of a flight each airline stops checking in passengers and accepting bags. In general, the airlines' published close-out time for the airport is 60 minutes before scheduled departure for international flights. **Figure 4.8** illustrates the show-up profile used for international passengers checking in at Terminal E.

Figure 4.8: Show-Up Profile for International Passengers at Terminal E



	360	345	330	315	300	285	270	255	240	225	210	195	180	165	150	135	120	105	90	75	60	45	30	15	0
International	0.00	0.50	0.50	0.50	0.50	0.75	1.25	1.50	2.00	2.00	4.00	5.00	6.00	8.00	11.0	15.0	16.5	12.0	6.00	3.00	2.00	1.50	0.50	0.00	0.00
Cumulative	0.0%	0.5%	1.0%	1.5%	2.0%	2.8%	4.0%	5.5%	7.5%	9.5%	13.5	18.5	24.5	32.5	43.5	58.5	75.0	87.0	93.0	96.0	98.0	99.5	100.	100.	100.

Source: Ricondo & Associates, Inc., Airline Surveys, September 2014.

Prepared by: Ricondo & Associates, Inc., January 2015.

4.4.6 INTERNATIONAL PASSENGER CHECK-IN ATTRIBUTES

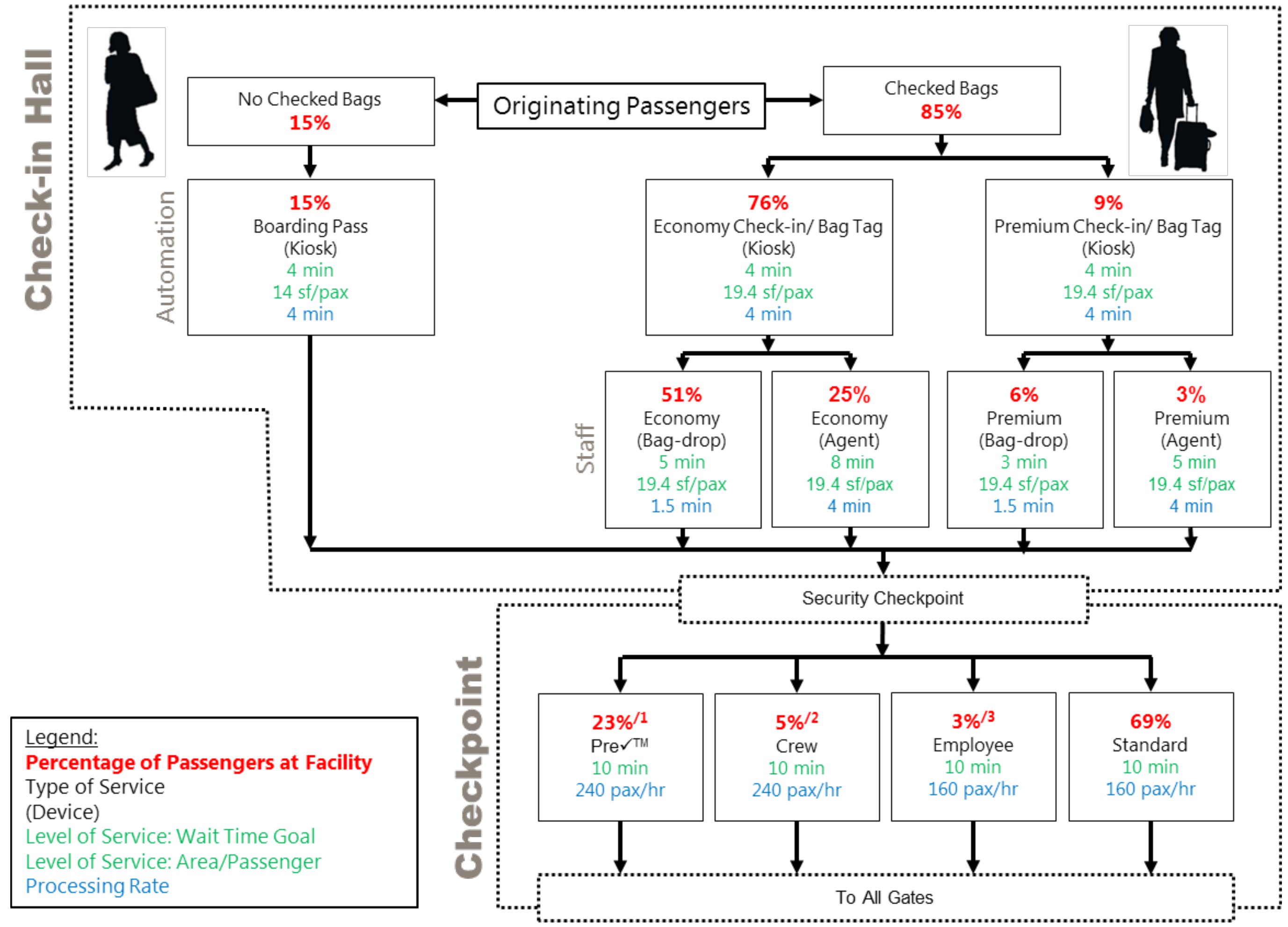
The focus of this analysis is the FIS process and TSA security screening checkpoints at Terminal E. Passenger check-in attributes and show-up profiles were used to meter demand at the TSA checkpoints. **Figure 4.9** illustrates the United Airlines' check-in process at Terminal E.

Common international passenger check-in types in use at IAH include agent counter positions and kiosk positions. Agent counter positions are used for full-service transactions. Kiosk positions may be located in-line with agent positions or they may be stand-alone units in other locations.

Passenger check-in attributes are segmented into three categories: kiosks, baggage drop, or full-service agents. Each category requires various check-in equipment positions to check passengers in for departing flights, such as kiosks, baggage drop positions, and agent counters, as follows:

- **Kiosks:** Stand-alone kiosks, located remotely from the check-in counter or embedded in the front of the check-in counter, are used by passengers acquiring boarding passes and/or printing baggage tags.
- **Baggage Drop Positions:** At these positions, airline staff accepts and tags bags, or accepts bags tagged by passengers who checked in at a kiosk using a two-step check-in process.
- **Full-Service (Agent) Counter Check-in Positions:** At these positions, airline staff may assist passengers with purchasing tickets, obtaining boarding passes, checking in bags, and rebooking flights.

Figure 4.9: International Passenger Check-in Attributes



Notes:

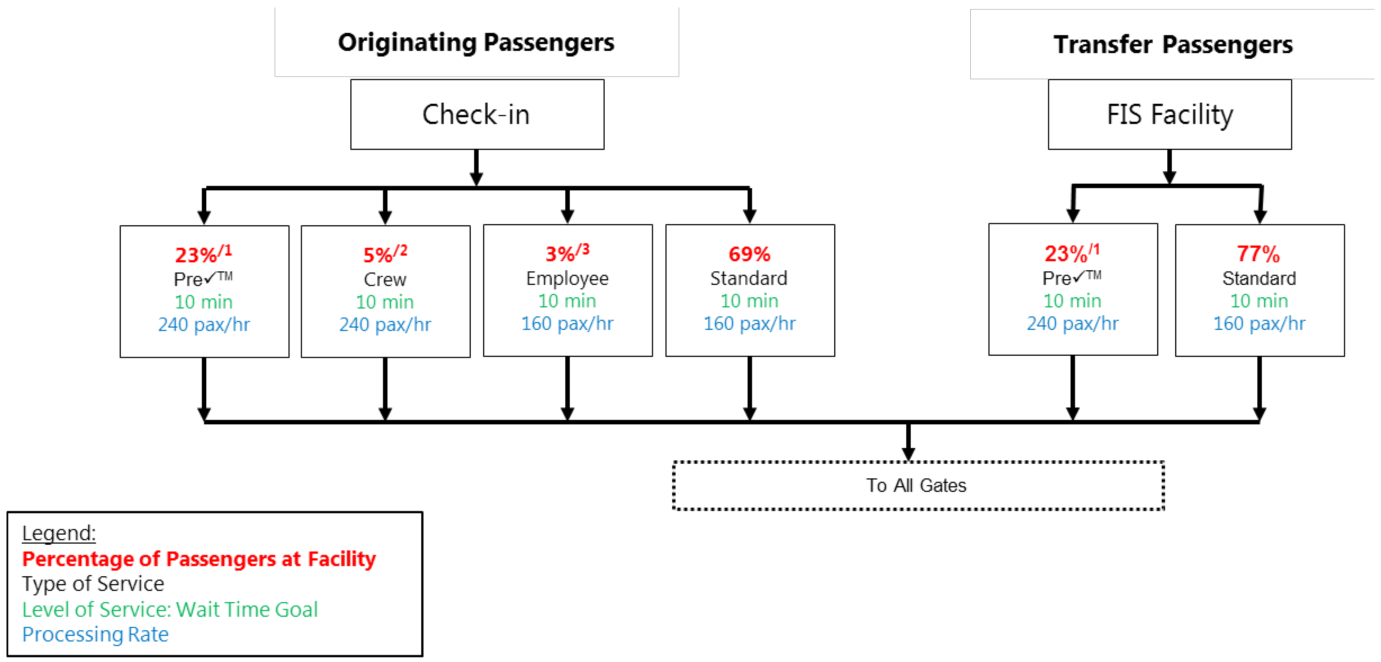
min = Minutes
sf/pax = Square feet per passenger
pax/hr = Passengers per hour
/1 United Airlines passengers only
/2 Using Pre✓™ lanes only
/3 Using standard lanes only

Source: Ricondo & Associates, Inc., Airline Surveys, December 2014
Prepared by: Ricondo & Associates, Inc., February 2016.

4.4.7 PASSENGER SECURITY SCREENING CHECKPOINT ATTRIBUTES

Prior to entering the concourses and gate areas, passengers are required to process through a security screening checkpoint. **Figure 4.10** illustrates the attributes for originating passengers from the Check-in Lobby and for transfer passengers from the FIS facility. Additional demand was assumed at the checkpoint from airport employees and flight crews.

Figure 4.10: Security Screening Checkpoint Passenger Attributes



Notes:

min = Minutes

pax/hr = Passengers per hour

/1 United Airlines passengers only

/2 Using Pre✓TM lanes only

/3 Using standard lanes only

Source: Transportation Security Administration Headquarters Staff

Prepared by: Ricondo & Associates, Inc., February 2016.

4.4.8 LEVEL-OF-SERVICE FRAMEWORK

The methodologies used to calculate terminal facility requirements are consistent with those set forth in the International Air Transport Association (IATA), Airport Development Reference Manual, 10th edition 2014. Facility requirements were developed to accommodate peak-period activity on the average weekday of the peak month at an acceptable LOS. Computer simulation was used to derive demand loads and analyze subsystem performance where appropriate. Simulation-derived performance data pertaining to numbers of passengers waiting for processing and related wait times were correlated with the IATA prescribed LOS framework, defined on **Figure 4.11**. The LOS framework is dependent on variables based on space and time, as diagrammed on **Figure 4.12**. Desirable wait times and space requirements for passengers are simulated to equate to an Optimum LOS, unless otherwise indicated. Under IATA's framework, Optimum LOS represents an acceptable level of service characterized by adequate queuing space and reasonable wait times during periods of peak activity. Optimum LOS equates to good service at reasonable cost.

Figure 4.11: IATA Level of Service Framework

Optimum: Acceptable level of service; conditions of adequate to above-average space and reasonable to very few delays; good level of comfort.

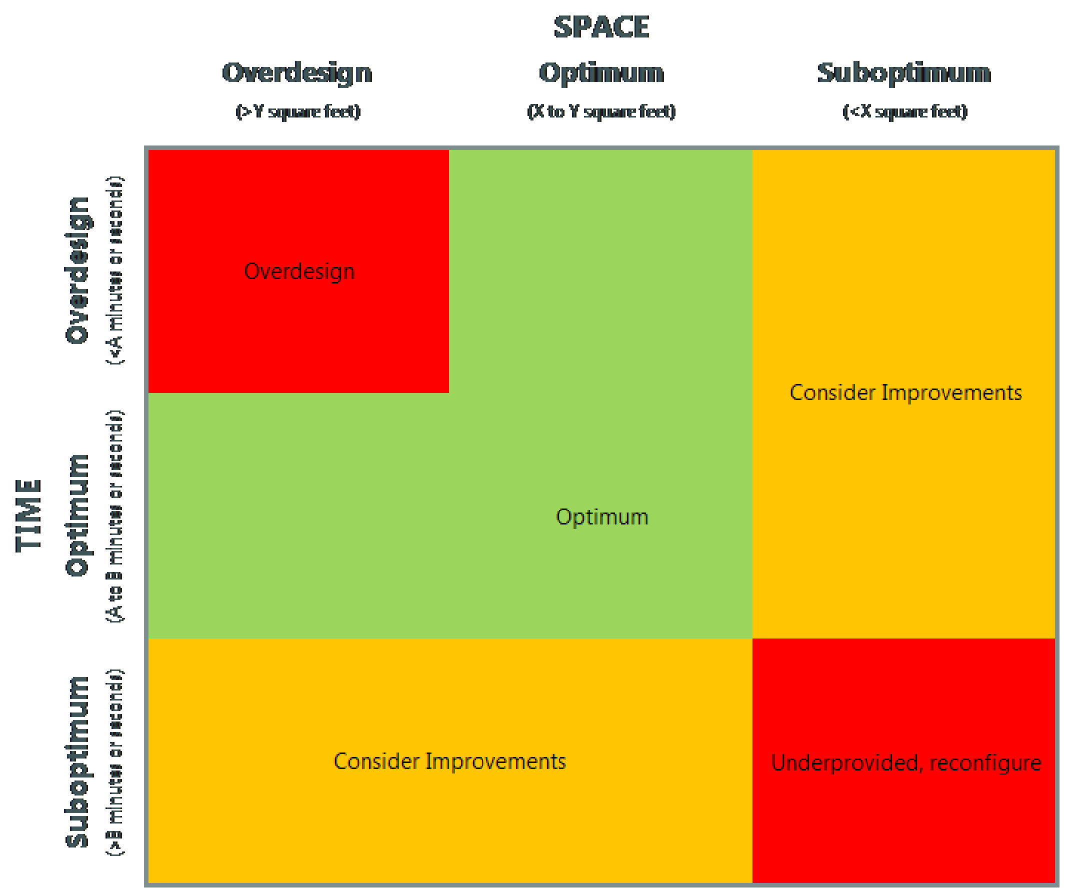
Suboptimum: Unsatisfactory level of service; conditions that provide crowded and uncomfortable spaces and present unacceptable processing and wait times; inadequate level of comfort.

Overdesign: Poor level of service; conditions of either excessive or empty space and over provision of resources; immoderate or unacceptable level of comfort.

Sources: John J. Fruin, Pedestrian Planning and Design, 1971; International Air Transport Association, Airport Development Reference Manual, 10th Edition, effective March 2014.

Prepared by: Ricondo & Associates, Inc., January 2015.

Figure 4.12: IATA Level of Service Space-Time Diagram

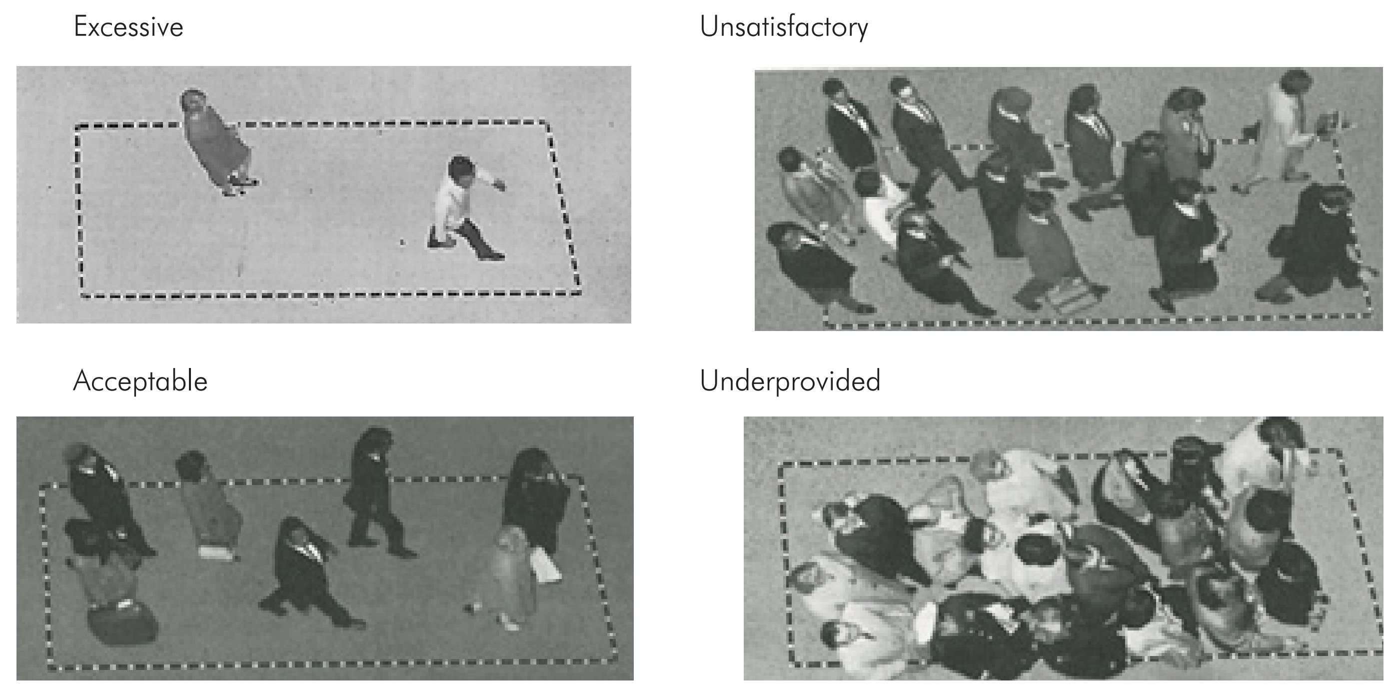


Source: International Air Transport Association, Airport Development Reference Manual, 10th Edition, effective March 2014.
Prepared by: Ricondo & Associates, Inc., January 2015.

The following conditions occur within the LOS framework, as represented on **Figure 4.13**:

- **Excessive Conditions:** The overdesign of facilities results in underutilized spaces with nearly no delays; high maintenance and construction cost relative to facility use.
- **Acceptable Conditions:** Facilities provide adequate space and reasonable delays; cost of maintenance and construction is equitable to facility use.
- **Unsatisfactory Conditions:** Facility meets one but not both space and time LOS variables; improvements should be considered.
- **Underprovided Conditions:** System breakdown results in unacceptable delays; strongly suggest improvements required for an overused facility.

Figure 4.13: Level of Service Framework – Conditions



Source: John J. Fruin, Pedestrian Planning and Design, 1971.
Prepared by: Ricondo & Associates, Inc., January 2015.

4.5 Area Requirements

Multiple tools and processes were used in developing facility requirements, including simulation modeling and static modeling. The process for developing requirements for individual functional areas or groups of areas is described in this section. The DDFS provided the demand basis used to derive facility requirements for FIS facilities and passenger security screening. Area requirements for other airline-related and non-airline-related facilities, including CBP office/staff areas and support spaces, Terminal E ticketing/Check-in Lobby and SSCP, general spaces, and circulation, were derived using published design standards, stakeholder input, or proportional relationships to current inventory ratios, as applicable.

Table 4.6 presents a comparison of DHS-recommended design standards and area requirements for PAL 33. Individual functional area requirements are described in subsequent sections.

Table 4.6: Area Requirements Summary

FACILITY	DESIGN STANDARD AREA (SF)	DESIGN STANDARD POS. (EACH)	PAL 33 REQUIREMENTS AREA (SF)	PAL 33 REQUIREMENTS POS. (EACH)
Primary Processing Area (Primary Booth, Queuing and Processing)	66,000	100		
Global Entry Program				
Global Entry Kiosks			1,100	22
Global Entry Kiosks Queue Area			500	
Global Entry Verify Agent Podiums			570	2
Global Entry Verify Agent Podium Queue Area			120	
APC Program (US Citizens/US Residents and Visa Waiver)			34,310	
APC Kiosks (US Citizens/US Residents)				34
APC Kiosks (Visitor)				40
Passage Granted Verify Officer Podiums				22
X-Triage Officer Positions				25
Officer Booth Positions				
Visitor Officer			4,750	24
Visitor Officer Queue Area			10,940	
Primary Support Spaces				
CBP Forms Counter	120	5	2,030	8
CBP Command and Control Center	230	1	230	1
Counter Terrorism Response Suite	950	2	2,000	1
Public Restroom			7,180	
International Baggage Claim			126,000	16
Secondary Processing Area				
Rover Command and Control Center	230	1	730	1
Triage Control Podium	320	1	320	1
Referral Passenger Waiting	3,130	1	3,130	1
Public Restroom			3,540	
Secondary Baggage Examination Podium and Baggage Belts	1,510	2	3,020	4
Secondary Baggage NII Processing Workstation	2,950	2	5,900	4
Cashier's Office	60	1	130	1
CBP Agricultural Laboratory (AQI; includes animal processing)	450	3	570	1
CBP Agricultural Disposal Room			630	1
CBP/APHIS VS Bird Quarantine and Bird Holding Facilities				
Detainee Baggage Storage	80	2	80	2
Interview Room	240	3	1,230	13
Search Room	240	3	380	4
Male Holdroom	230	1	390	2
Female Holdroom	230	1	390	2
Juvenile Holdroom	180	1	180	1
Family Holdroom			420	2
Food Preparation/Storage	350		350	
Expedited/Voluntary Removal Suite	1,000	1	1,000	1
Secondary Operations and Support				
Immigrant Room	230	1	230	1
Fingerprint Room	180	1	180	1
Fraudulent Documentation Analysis Room	180	1	180	1
Secondary Supervisor's Office	150	1	1,650	11
Enforcement Office	150	1	1,420	1
Secure Storage	160	1	340	2
Canine Kennels			520	10
Animal Processing Room	Incl. in Ag. Lab		Incl. in Ag. Lab	

FACILITY	DESIGN STANDARD AREA (SF)	DESIGN STANDARD POS. (EACH)	PAL 33 REQUIREMENTS AREA (SF)	PAL 33 REQUIREMENTS POS. (EACH)
Washer/Dryer	60	2	60	2
Food Preparation Room	Incl. in Secondary Food Prep./ Storage		Incl. in Secondary Food Prep./ Storage	
Dry Food Storage	Incl. in Secondary Food Prep./ Storage		Incl. in Secondary Food Prep./ Storage	
Canine Unit Secure Training Aid Storage	70	1	70	1
Canine Unit Secure Training Aid Storage (Pseudo Narcotic)	80	1	80	1
Canine Unit Secure Training Aid Storage (Agricultural)	80	1	80	1
Canine Unit Secure Training Aid Storage (Currency)	70	1	70	1
Canine Unit Secure Training Aid Storage (Blank)	70	1	70	1
Canine Unit General Storage	80	1	130	1
Canine Officer Work Area	260	4	1,450	2
Passenger Service Manager's Representative Office	150	1	300	2
Officer Office: U.S. Immigration and Customs Enforcement			960	1
Personal Protective Equipment Storage	200	1	250	1
Exit Control	630	2		
Exit Control Queuing Area	6,250		6,250	
Global Entry			90	1
Standard			1,400	15
CBP Administration				

FACILITY	DESIGN STANDARD AREA (SF)	DESIGN STANDARD POS. (EACH)	PAL 33 REQUIREMENTS AREA (SF)	PAL 33 REQUIREMENTS POS. (EACH)
CBP Officer/Staff Areas				
Port Director's Office	230	1	380	1
Port Director's Conference Room	300	1	300	1
Port Director's Secretary/Reception Area	230	1	230	1
Assistant Port Director's Office	180	1	410	1
Chief Officer's Office			1,670	4
Supervisor's Office	1,350	1	3,390	18
Intelligence Office	150	1	150	1
General Office Workstations "C"	3,200	1	4,940	4
Anti-Terrorism Contraband Enforcement Team Office "B"	1,070	12	1,070	12
Passenger Analysis Unit (PAU) Office	1,070	12	1,560	1
Outbound Team Office	360	4	1,180	1
U.S. Fish and Wildlife Service Office			760	1
Internal Affairs Office			140	1
CDC Isolation Suite			1,490	1
CBP Support Space				
Airport Reception	120	1	120	1
Public Reception/Entrance and Clearance Office				
ID Badging, Trusted Traveler Enrollment Center and File Room	180	1	910	1
Muster/Training Room	750	1	2,160	3
Muster/Training Equipment Storage	50	1	140	1
Mail, Copy and Shredder	120	1	500	3
Weapons Storage Room				
Weapons Cleaning Room				
Communication Equipment Room	100	1	310	2
LAN/Telco Room	230	1	520	2

FACILITY	DESIGN STANDARD AREA (SF)	DESIGN STANDARD POS. (EACH)	PAL 33 REQUIREMENTS AREA (SF)	PAL 33 REQUIREMENTS POS. (EACH)
Wiring Closet-IDF	260	1	1,290	5
General Storage/File Room	530	1	2,780	8
Temporary Seize Property Room	120	1	310	1
Staff Break Room			1,330	4
Male and Female Staff Toilets/Showers/Lockers			3,970	2
Union Office	150	1	300	1
Physical Training Room			800	1
US PASS/NEXUS Enrollment Center and Storage			1,600	2
Lactation Support Room	80	1	190	1
VIP Lounge			570	1
In-transit Lounge			7,350	
Total FIS Facility Area	**98,380**		**271,370**	
Recheck Hall				
Baggage Drop-off Belts			5,010	6
Oversize Baggage Assistance			190	1
Agent Assistance			5,700	30
Airline Support/Storage			2,400	5
VIP Lounge			590	1
Baggage Service Office			2,120	2
Baggage Right-of-Way				
Total Recheck Facility Area			**16,010**	
Terminal E Ticketing Lobby			13,850	
Airline Ticket Office			8,720	
Baggage Right-of-Way			450	
Total Terminal E Ticketing Lobby			**23,020**	
Transportation Security Administration (TSA) Consolidated Passenger Security Screening Checkpoint				

FACILITY	DESIGN STANDARD AREA (SF)	DESIGN STANDARD POS. (EACH)	PAL 33 REQUIREMENTS AREA (SF)	PAL 33 REQUIREMENTS POS. (EACH)
Standard Lanes			16,200	12
Pre✓™ Lanes			4,410	3
Queue Area			8,240	
TSA Offices/Support and Resolution Rooms			2,250	
Total Consolidated TSA Facility Area			**31,100**	
General Spaces				
Houston Police Department			590	
Airport Support/Storage			7,610	
Airport Amenities			2,250	
Concessions			5,980	
Concession Storage/Support				
Public Restroom			6,270	
Cart Return			3,800	
Meeter/Greeter			10,490	
Building Systems			30,100	
Open to Below			1,990	
Vertical Circulation				
Sterile Vertical Circulation			2,600	
Public Secure Vertical Circulation			3,250	
Public Non-Secure Vertical Circulation			2,760	
Non-Public Vertical Circulation			10,650	
Circulation				
Sterile Circulation			31,540	
Public Secure Circulation			37,730	
Public Non-Secure Circulation			28,970	
Non-Public Circulation			19,920	
Total General Spaces			**206,500**	
Grand Total Facility Area (Consolidated SSCP)			548,000	

Notes:

SF = Square Feet rounded to the nearest 10.

Design Standards based on U.S. Customs and Border Protection, Airport Technical Design Standards, June 2012.

Sources: U.S. Customs and Border Protection, Airport Technical Design Standards, June 2012; Ricondo & Associates, Inc., January 2015 (requirements).

Prepared by: Ricondo & Associates, Inc., February 2016.

4.5.1 DEPARTMENT OF HOMELAND SECURITY FACILITIES

As a result of the November 2001 Aviation and Transportation Security Act, the U.S. DHS maintains in-terminal facilities to conduct airline security screening, principally related to the passenger security screening checkpoints, baggage screening areas, and border and Port of Entry (POE) security. DHS terminal facility requirements are based on the following three publications:

- Transportation Security Administration, Recommended Security Guidelines for Airport Planning, Design and Construction, May 2011
- Transportation Security Administration, Checkpoint Design Guide (CDG), Revision 5.1, May 7, 2014
- U.S. Customs and Border Protection, Airport Technical Design Standards, June 2012

Computer modeling was used to determine passenger demand based on the PAL 33 DDFS and to meter passenger demand through appropriately sized FIS facilities and processes. By metering passenger flow through the FIS facilities based on HAS processing goals and transaction times, demand at the transfer passenger SSCP can be more accurately assessed. This approach results in a more accurate calculation of the lane and queue requirements balanced with upstream processor components. Equipment unit requirements were based on TSA goals for expected passenger processing rates. Space requirements to accommodate equipment and passenger queuing and support areas were then developed using DHS published facility templates and guidelines.

4.5.2 FEDERAL INSPECTION SERVICES FACILITIES

All international passengers must be processed at a POE prior to entering the United States, whether they are terminating their journey at the airport or connecting to a domestic or another international flight. Each POE is a fully independent facility within the airport containing CBP administrative offices and facilities capable of processing international arriving passengers, both terminating and connecting. A POE includes the following facilities:

- **Sterile Corridor** - A secure corridor for international passengers to use after deplaning and prior to entering the primary processing area.

- **Primary Processing** - Initial passenger screening to process passports, consisting of APC kiosks, GE kiosks, verification counters, primary screening booths (two officers per booth), primary queue area, supervisor stations, forms counters, restrooms, a counter-terrorism response suite, and CBP coordination center.

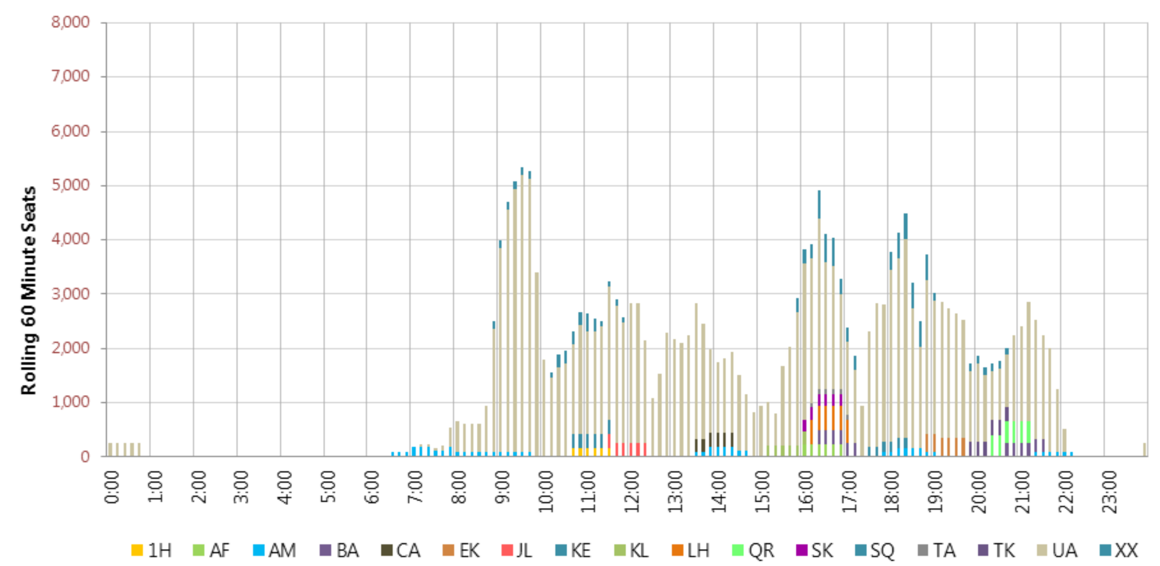
- **International Baggage Claim Hall** - Baggage claim for international passengers; all passengers must reclaim their checked bags prior to exiting the POE. The International Baggage Claim Hall consists of a principal baggage claim area representing the space occupied by the baggage claim carousels, the 12-foot band of space that corresponds to the presentation length of the carousel, and seven feet of circulation space between adjoining claim carousels or other fixtures. Ancillary baggage claim area representing the space occupied by restrooms and general circulation space between upstream and downstream functions.

- **Secondary Processing** - Represents the last stage of the POE process. Typically, passengers are screened with their reclaimed baggage at exit podiums (Exit Control); passengers then exit the POE into U.S. territory. However, if Exit Control staff recommends further search of passenger(s) or baggage, the targeted party must be processed through secondary screening. Secondary screening areas accommodate the screening of passengers and baggage for goods, narcotics or perishables not permissible to bring into the United States. Secondary screening areas typically include holdrooms for each gender, interview rooms, canine areas, an agricultural laboratory and other screening support spaces.

- **Recheck Hall** - Although not part of the CBP process, arriving international passengers connecting to other flights can recheck their bags after POE processing. The recheck lobby usually consists of airline counters and conveyors to send bags to TSA screening and the outbound baggage makeup area.

Figure 4.14 illustrates the daily pattern of passengers that will process through the FIS. Overall FIS facility requirements listed in **Table 4.6** were developed using the latest CBP planning guidelines; however, supplemental calculations were performed to derive international baggage claim requirements and simulation modeling was used to size Primary and Secondary Processing areas. Passenger attributes, LOS goals, and processing times are shown on **Figure 4.6**.

Figure 4.14: PAL 33 Arriving International Enplaned Passengers by Airline



Notes:

Airline abbreviations are according to International Air Transport Association standards.

XX = New entrant carrier

Source: Ricondo & Associates, Inc., April 2014.

Prepared by: Ricondo & Associates, Inc., January 2015.

4.5.2.1 Primary Processing Area

Current Primary Processing facilities consist of Automated Passport Control kiosks, Global Entry kiosks, and officer booth positions to process passengers.

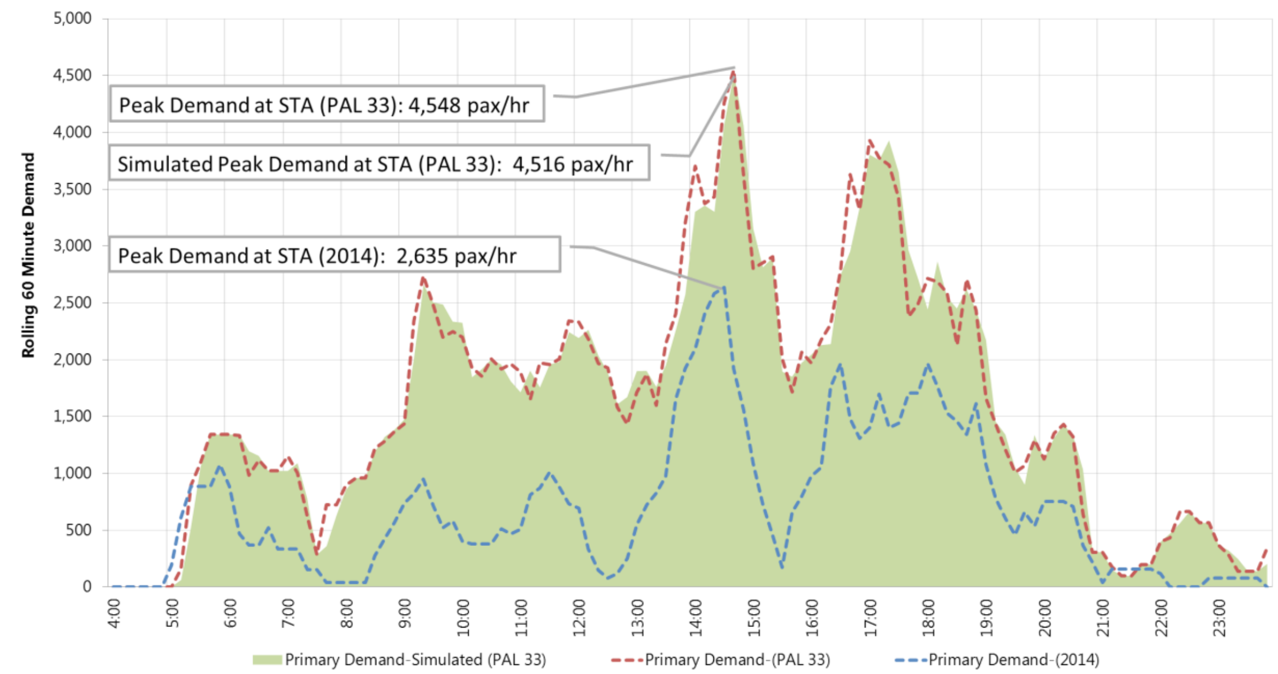
Automated Passport Control is a U.S. CBP program used to expedite the entry process for U.S., Canadian, and eligible Visa Waiver Program international travelers by providing an automated process through CBP's primary inspection area. Travelers are prompted to scan their passports, take a photograph using the kiosk, and answer a series of questions verifying biographic and flight information. Once passengers have completed the series of questions and submitted their Customs declaration form, a receipt is issued. Travelers then bring their passport and receipt to a CBP officer to finalize their inspection for entry into the United States. The increased use of APC kiosks reduces the required number of active primary officer positions. As more types of passengers become eligible to use APC kiosks (e.g., B1 and B2 visa holders, passengers from visa waiver countries, and eventually passengers from non-visa waiver countries), the ratio of APC kiosks to officers will continue to increase, allowing more passengers faster processing through the same facility.

Global Entry is also a U.S. CBP program that allows expedited clearance for pre-approved, low-risk travelers upon arrival in the United States. Program participants proceed to Global Entry kiosks, present their machine-readable passport or permanent U.S. resident card, place their fingertips on the scanner for fingerprint verification, and make a Customs declaration. The kiosk issues the traveler a transaction receipt and directs the traveler to baggage claim and the exit.

Prior to entering the FIS facility, passengers are metered based on aircraft deplaning rates and gate proximity. **Figure 4.15** presents a comparison of simulated PAL 33 passenger demand and PAL 33 passenger demand at scheduled times of arrival with 2014 passenger demand at scheduled time of arrival. PAL 33 peak-hour demand at Primary Processing was calculated at approximately 4,500 passengers per hour and 29 aircraft operations, occurring between 13:50 and 14:50. A secondary PAL 33 peak hour would occur between 16:00 and 17:00, consisting of 31 flights with roughly 3,930 passengers. While the first peak represents the primary passenger demand upon entry into the FIS facilities, the second peak, driven by peak flights, represents the operational demand at baggage claim. The peak-hour demand difference between 2014 and PAL 33 is approximately 1,900 passengers.

Primary Processing consists of three main areas used to process international arriving passengers: officer booths, APC program (kiosks, verification counters, and triage booths), and Global Entry program (kiosks and verification counters). **Figure 4.16**, **Figure 4.17**, and **Figure 4.18** illustrate the space templates for each Primary Processing area, respectively.

Figure 4.15: Primary Processing Facility Demand



Notes:

pax/hr = Passengers per hour

STA = Scheduled Time of Arrival

Source: Ricondo & Associates, Inc., February 2016.

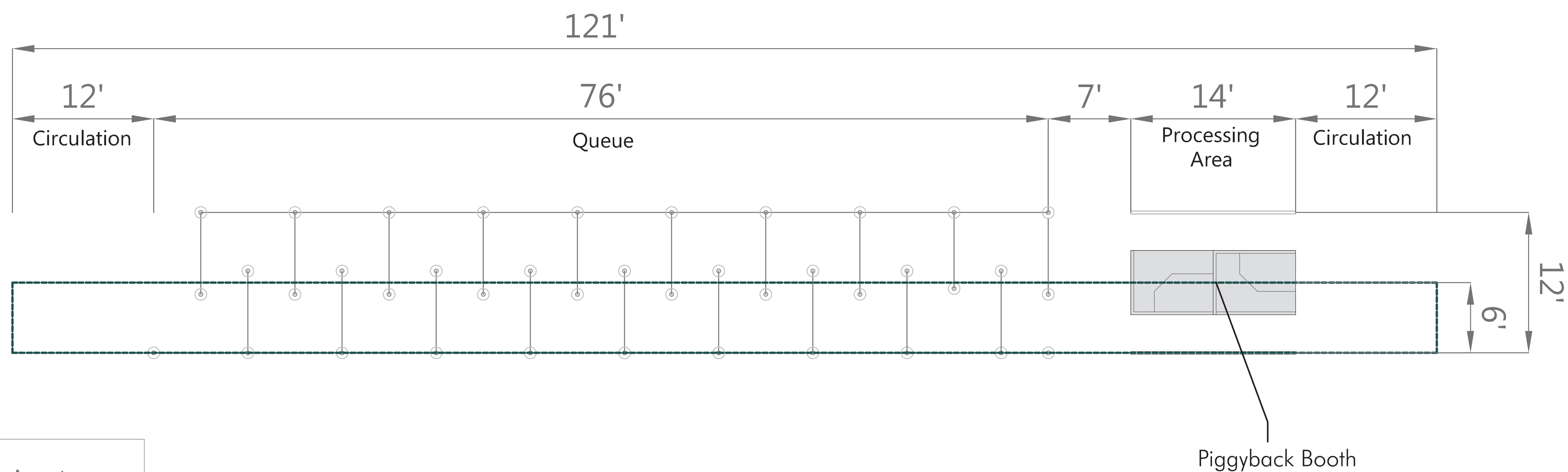
Prepared by: Ricondo & Associates, Inc., February 2016.

The following elements are included in the Primary Processing area:

- **Circulation** - A main circulation corridor for passengers to orient themselves upon entering or exiting Primary Inspection is to be a minimum of 12-feet deep and free of any fixed objects to accommodate passenger movement and wayfinding.
- **Queue Area** - Holding area for passengers waiting to transact with a kiosk or officer ranges in depth depending on LOS goals for area per passenger in queue. Queues are typically defined by queue stanchions with serpentine lanes spaced to allow four feet between each queue stanchion lane.
- **Wait-Behind Line** - Passenger circulation area, located between the queue area and processing area, is typically located seven feet behind the processing area to provide circulation and privacy during transactions.
- **Processing Area** - Standing area for passengers conducting transactions at kiosks or officers varies depending on CBP design standard and LOS goals.

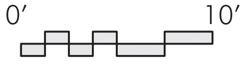
Table 4.7 presents a comparison of CBP design standards and facility requirements for Primary Processing. CBP guidelines are 66,000 square feet of Primary Processing space for a large facility that can process 5,000 passengers during the peak hour. PAL 33 facility requirements consist of approximately 52,290 square feet of Primary Processing space.

Primary Agent

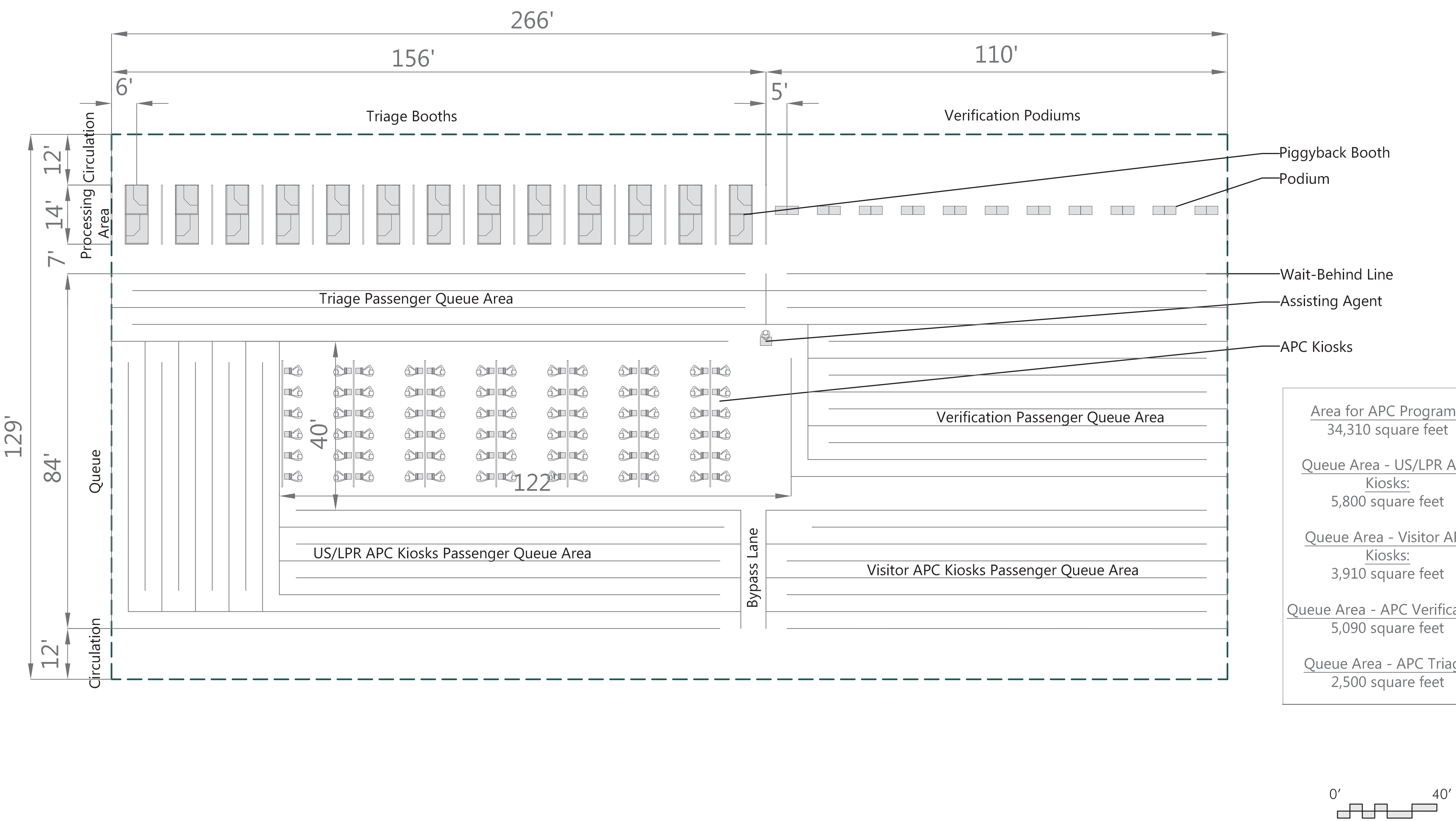


Area per Agent:
726 square feet

Queue Area per Agent:
456 square feet



Primary APC



Area for APC Programs:
34,310 square feet

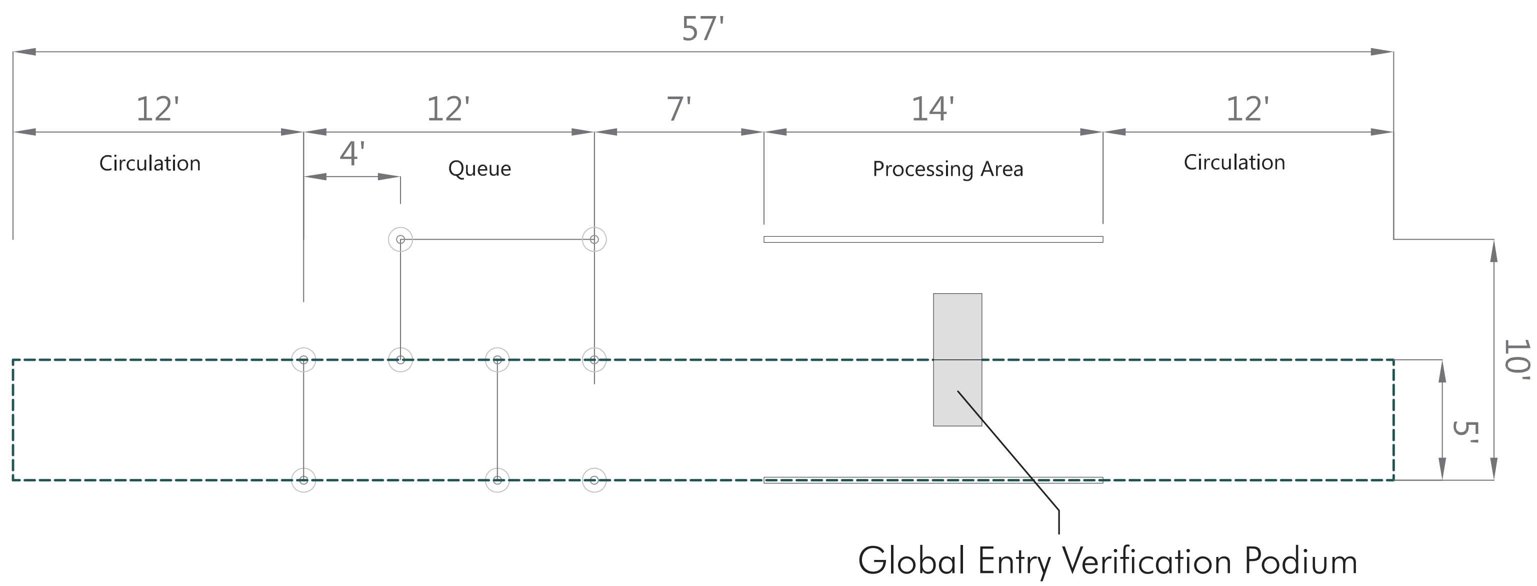
Queue Area - US/LPR APC Kiosks:
5,800 square feet

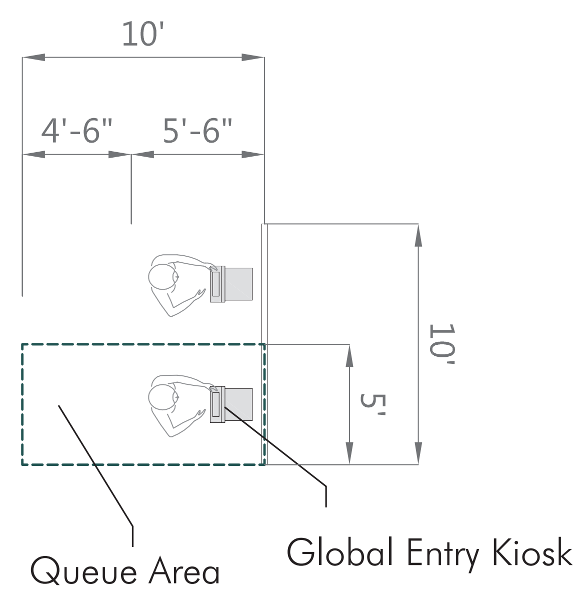
Queue Area - Visitor APC Kiosks:
3,910 square feet

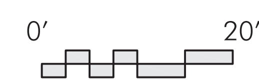
Queue Area - APC Verification:
5,090 square feet

Queue Area - APC Triage:
2,500 square feet

Primary Global Entry







The HAS goal is to process 80 percent of international arriving passengers through Primary Processing within 30 minutes from the point they enter the FIS facility. To process all passengers within the LOS goal during the peak hour, a total of 96 automated kiosks (Global Entry and APC) and 73 officer booth positions will be required. **Table 4.7** summarizes the Primary Processing facility requirements in terms of automated and officer booth positions.

Table 4.7: Primary Processing Facility Requirements at PAL 33

FACILITY	INVENTORY	REQUIREMENTS	PASSENGERS IN QUEUE
Automation			
Global Entry Kiosks	40	22	60
APC Kiosks	50	74	730
TOTAL	90	96	790
Agent Booth Positions			
Global Entry Verification Agents		2	15
APC Verification Agents		22	380
APC Triage Agents		25	190
Visitor Agents		24	310
TOTAL	66	73	

Note: Numbers of passengers in queue are rounded to nearest 5.
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., Febraury 2016.

Officer positions represent the number of officers necessary to process passenger demand based on transaction time and the queue wait time goal. **Figure 4.19** shows the number of officer positions needed throughout the day to maintain the HAS LOS goal for Primary Processing.

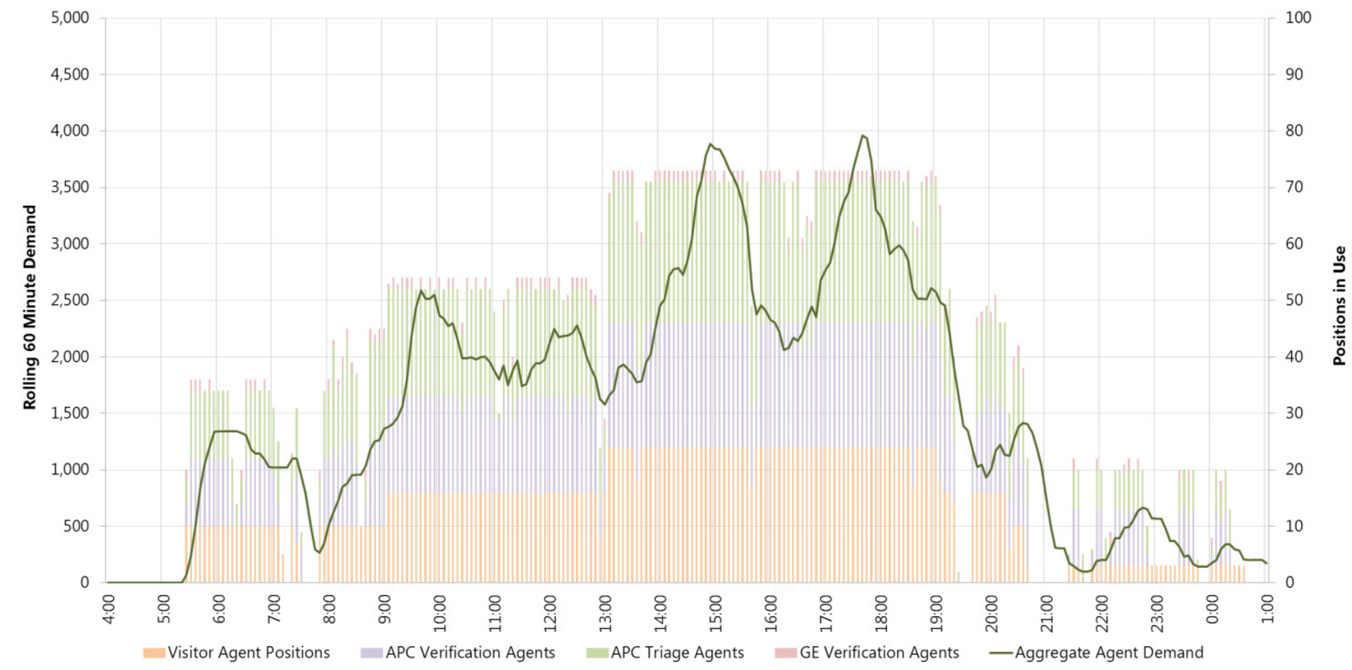
4.5.2.2 Global Entry Performance

Figure 4.20 and **Figure 4.21** illustrate the Global Entry kiosk and verification officer performance (passengers in queue and wait time), respectively, throughout the planning day. During the peak period, 22 Global Entry kiosks would be needed to process passengers within 1 minute. Two Global Entry verification officers are needed during the peak period to process passengers within 1 minute

4.5.2.3 Automated Passport Control Kiosk Performance

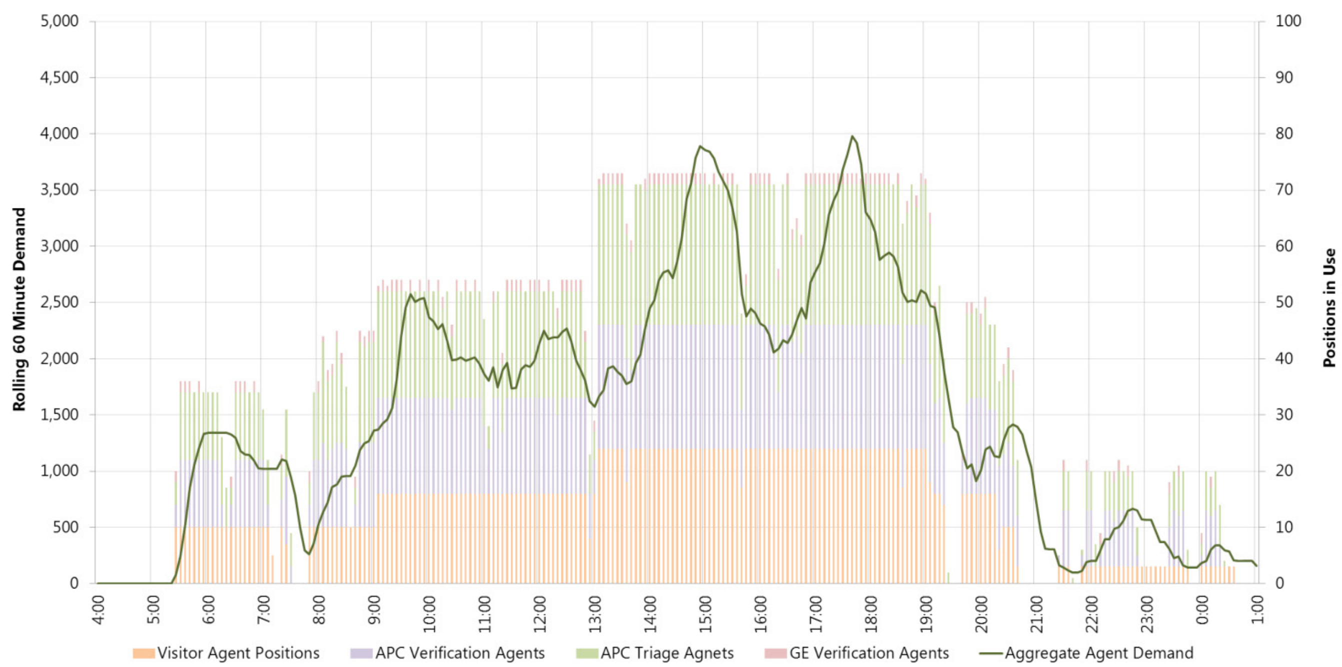
Figures 4.22, **Figure 4.23**, and **Figure 4.24** illustrate the APC kiosk, verification officer, and triage officer performance (passengers in queue and wait time), respectively, throughout the planning day. During the peak period, 74 APC kiosks, 22 APC verification officers, and 25 APC triage officers would be needed to process passengers within 15 minutes.

Figure 4.19: PAL 33 Primary Processing – Agent Positions



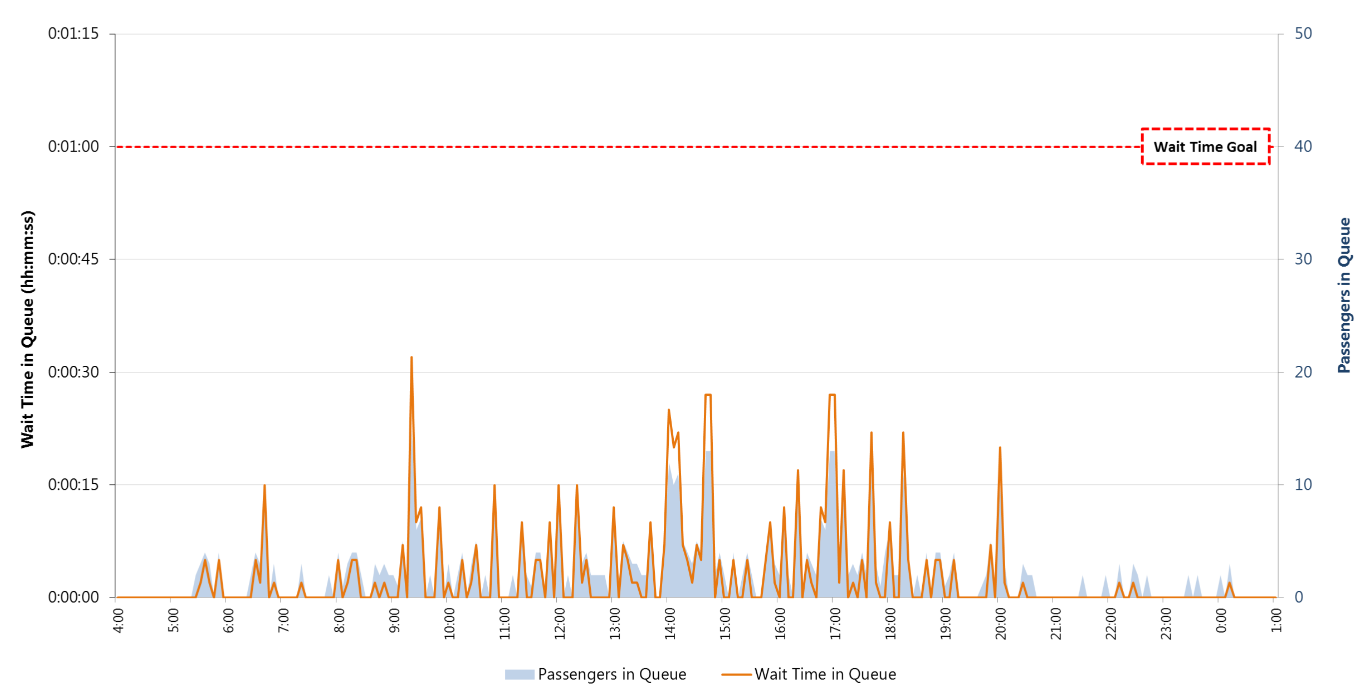
Notes:
APC = Automated Passport Control
GE = Global Entry
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.20 PAL 33 Global Entry Kiosk Performance



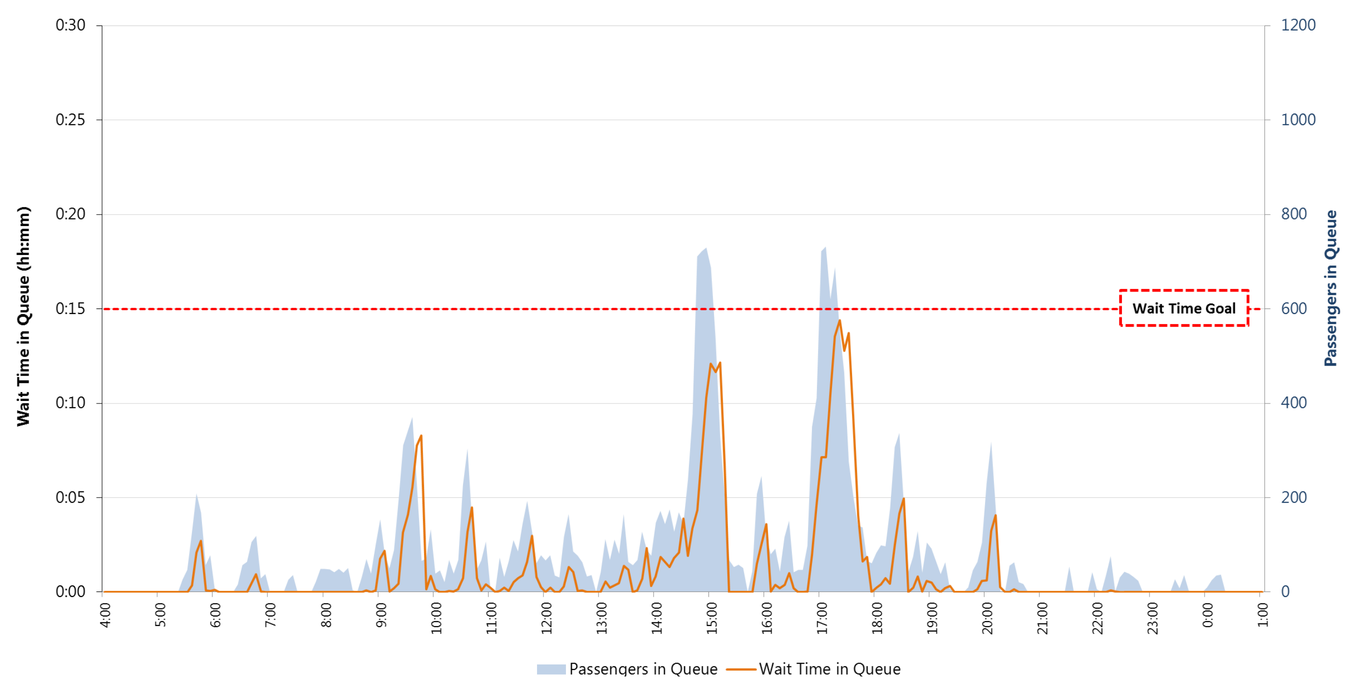
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.21: PAL 33 Global Entry Verification Agent Performance



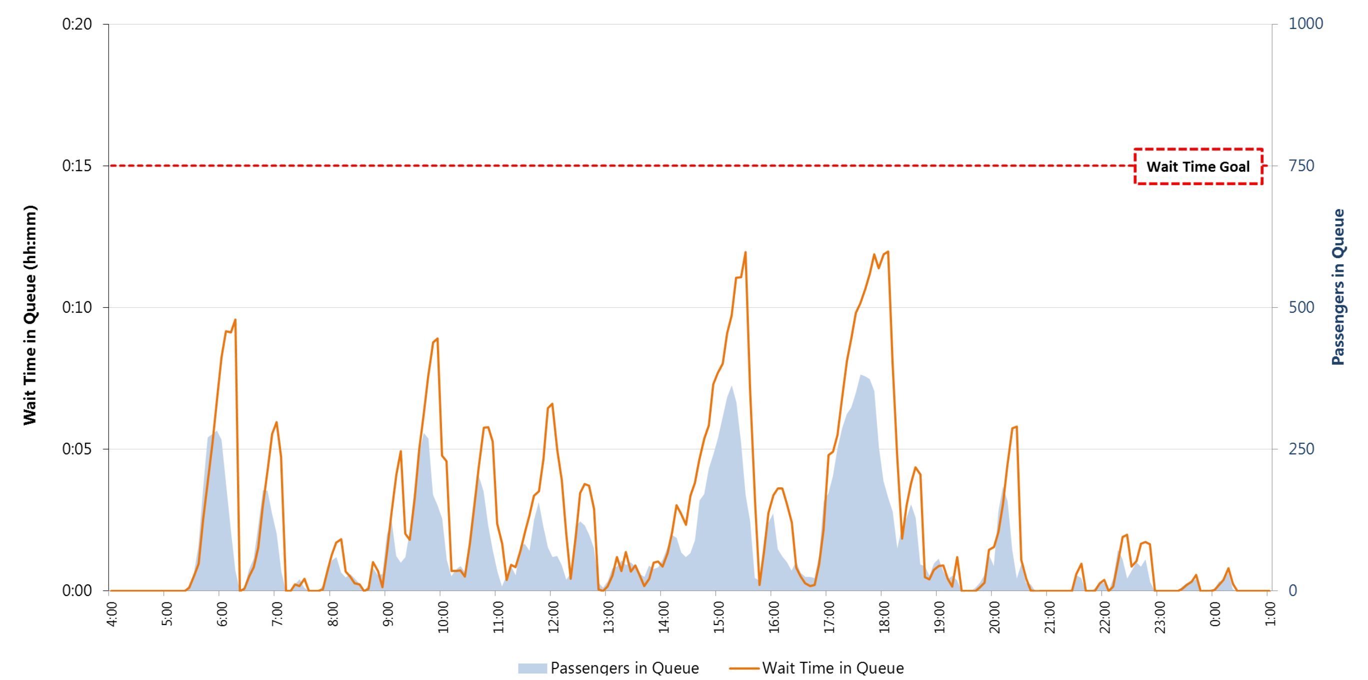
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.22: PAL 33 Automated Passport Control Kiosk Performance



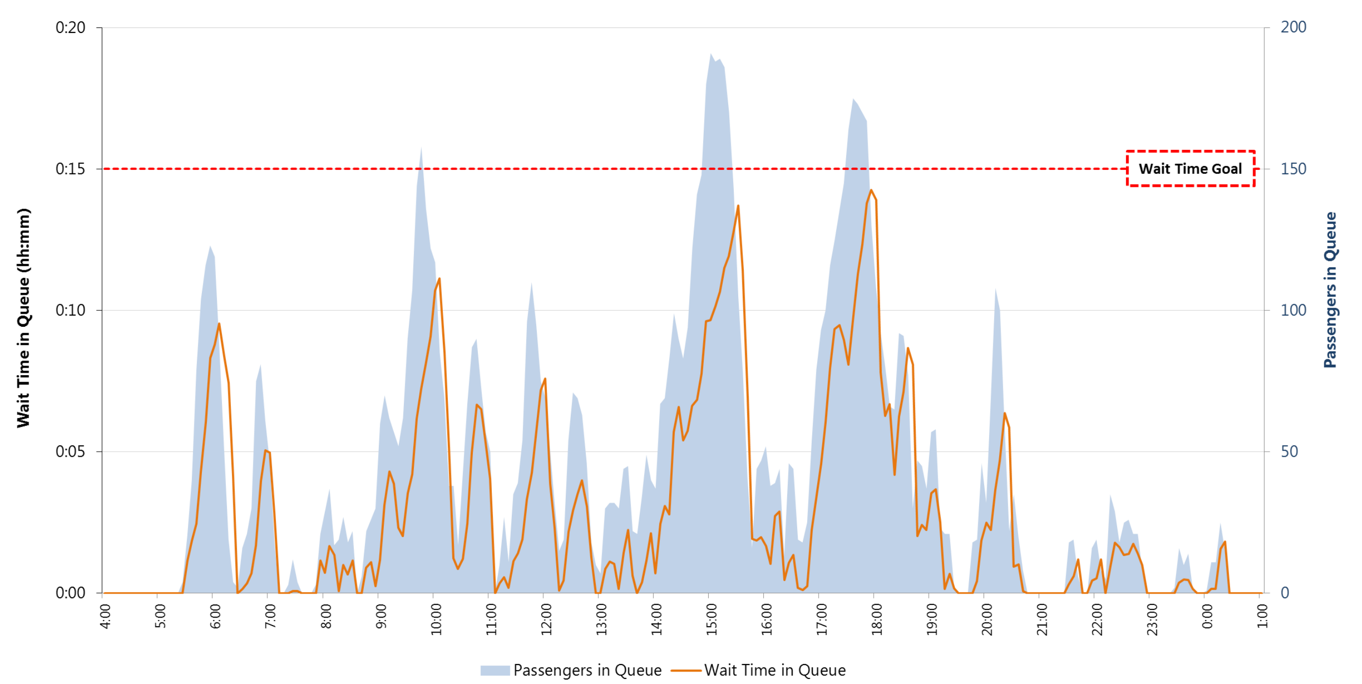
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.23: PAL 33 Automated Passport Control Verification Agent Performance



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.24: PAL 33 Automated Passport Control Triage Agent Performance

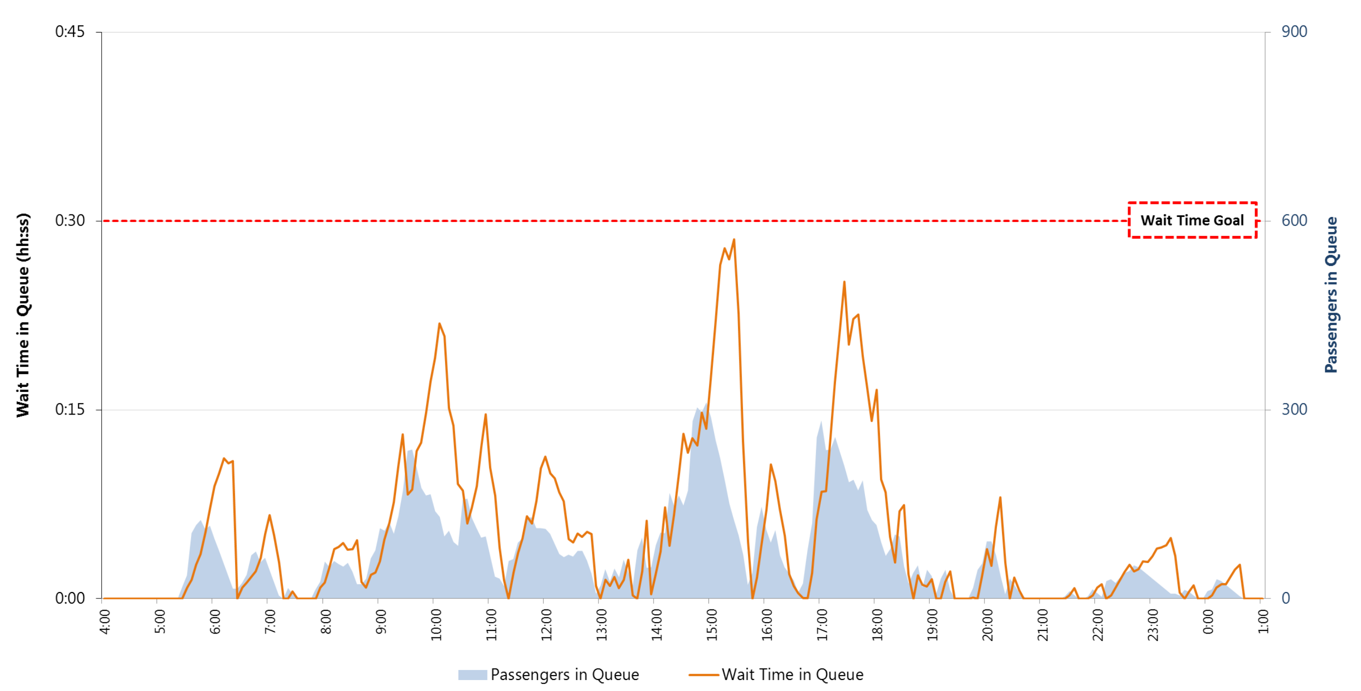


Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

4.5.2.4 Visitor Agent Booth Performance

Figure 4.25 illustrates the visitor officer booth performance (passengers in queue and wait time) throughout the planning day. During the peak period, 22 visitor or non-visa waiver officers would be needed to process passengers within 30 minutes.

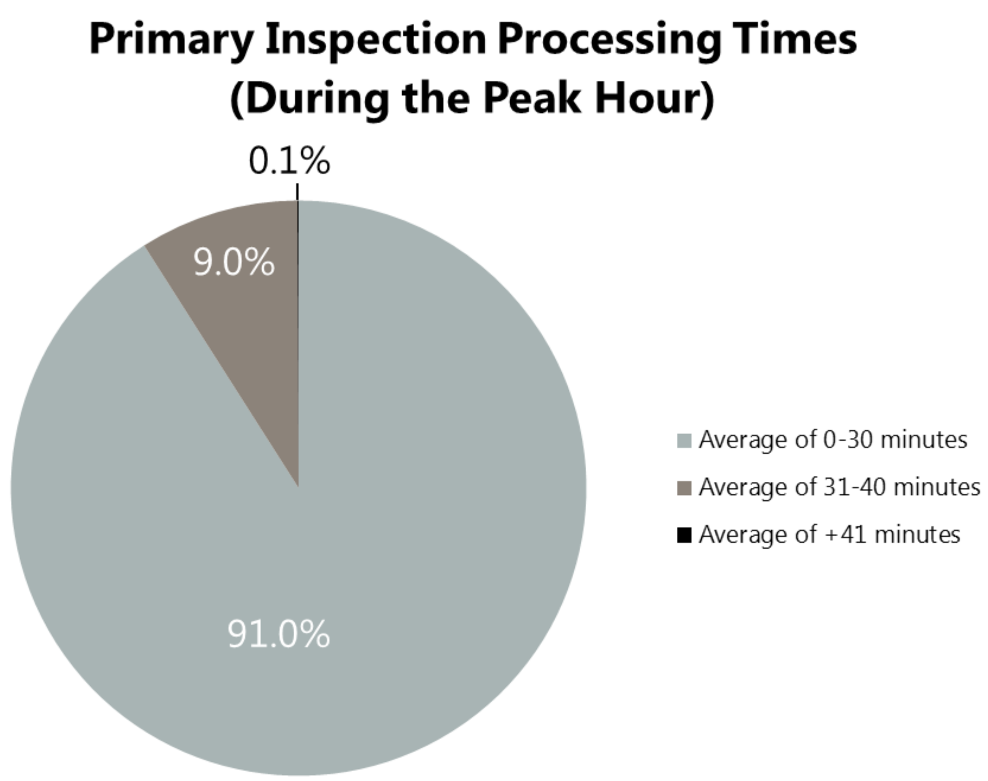
Figure 4.25: PAL 33 Visitor Agent Booth Performance



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.26 illustrates the percentages of passengers traveling through an appropriately sized and staffed Primary Processing facility from the point of entry to their finished transaction. This time does not include the walking distance from the aircraft to the FIS facility. The simulation indicates that, in a properly sized and staffed facility, 91 percent of passengers are processed through Primary Processing in less than 30 minutes during the peak hour. The remaining passengers clear Primary Processing in 31 to 60 minutes, with a maximum wait time of 51 minutes. These times meet the Houston Airport System's stated LOS goal of 80 percent of international arriving passengers completing Primary Processing in 30 minutes or less.

Figure 4.26: PAL 33 Primary Processing - Processing Times



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

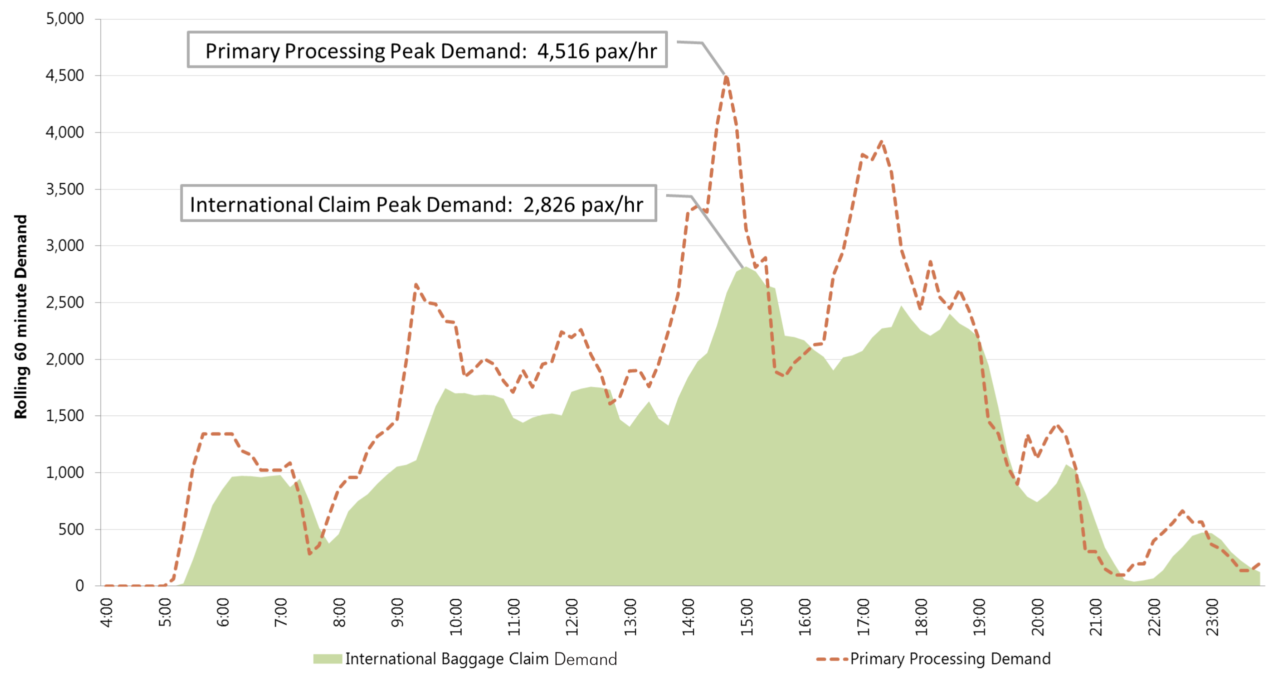
4.5.2.5 International Baggage Claim

Forecast peak hour international aircraft arrivals were extracted from the PAL 33 DDFS and correlated with planning guidelines. Key operating assumptions used in developing international baggage claim requirements are as follows:

- Requirements based on 30-minute peak demand
- Average load factor of 83 percent; average aircraft configuration of 160 seats
- 85 to 87 percent of passengers claiming bags
- Average baggage claim capacity of 173 bags per device
- Average linear presentation frontage (LPF) of 260 feet
- First bag at baggage claim 13 minutes plus drive time after aircraft block time
- One device per narrowbody aircraft, widebody aircraft, or Airbus A380 (300 feet of LPF)
- One device per two regional jets or Embraer 195

Figure 4.27 shows the passenger demand at international baggage claim and the relationship to passenger demand at Primary Processing.

Figure 4.27: PAL 33 International Baggage Claim Demand

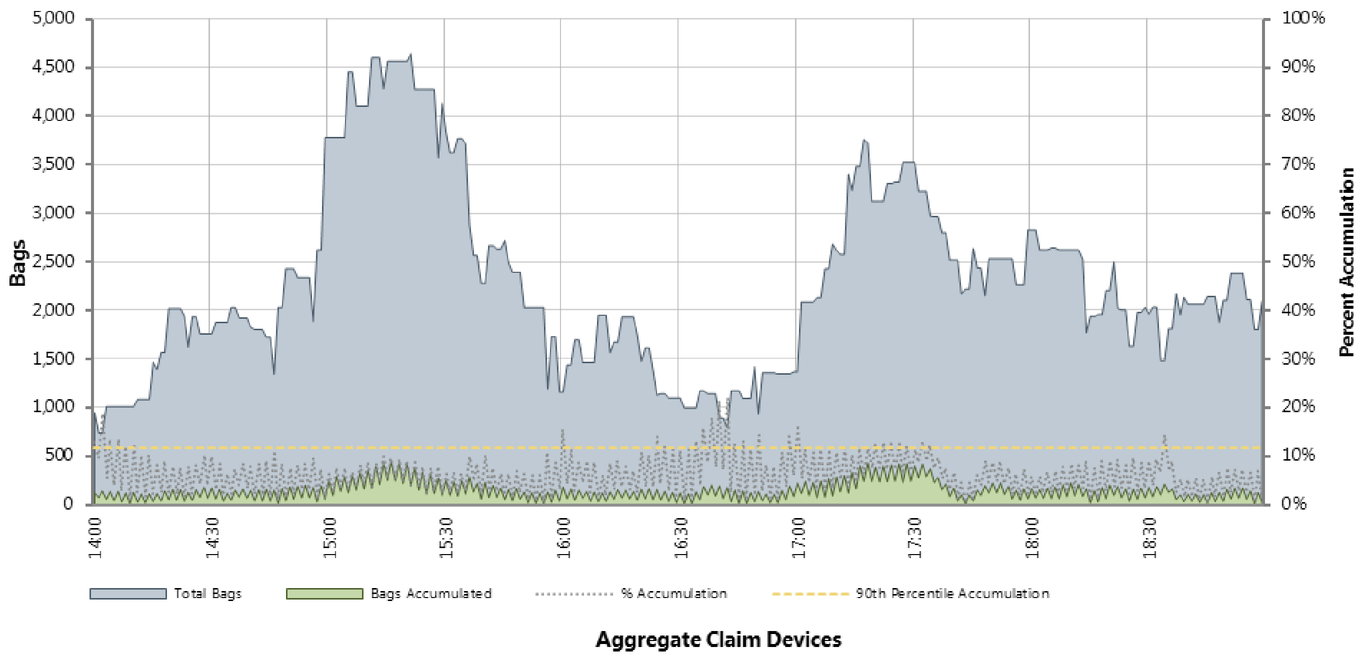


Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Baggage claim facility performance is dependent on inspection processing times upstream of the facility, ITI passengers not claiming baggage, and baggage delivery times. Simulation modeling of the claim devices shows that, as a result of faster processing times at Primary Processing, most passengers meet or are waiting for their baggage. **Figure 4.28** shows that average baggage accumulation is roughly 12 percent of checked baggage if a properly sized and fully staffed CBP Primary Processing area is provided.

Baggage claim requirements are based on peak 30-minute demand occurring between 15:00 and 15:30, with 18 aircraft operations. **Table 4.8** summarizes baggage claim requirements based on the key operating assumptions. Baggage claim requirements are graphically presented on **Figure 4.29**.

Figure 4.28: PAL 33 International Baggage Claim Facility Performance



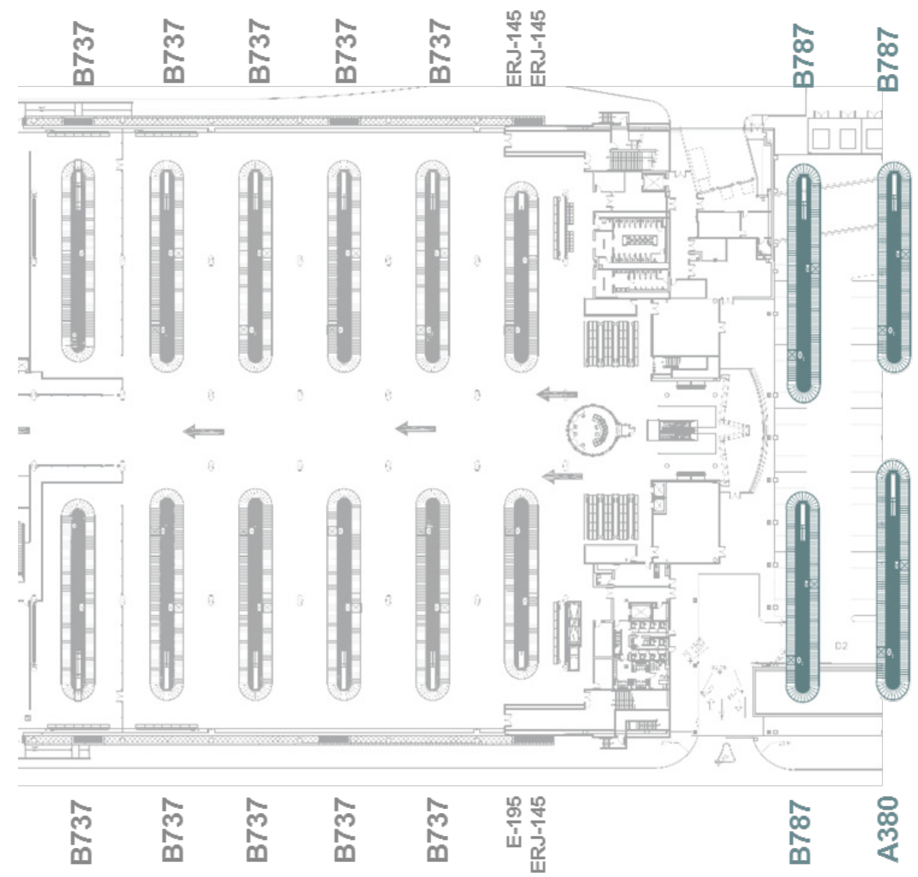
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., Febraury 2016.

Table 4.8: PAL 33 International Baggage Claim Facility Requirements

INTERNATIONAL BAG CLAIM	REQUIREMENTS
Average 260-Foot Claim Devices	14
300-Foot Claim Devices	2
Total Devices	16

Source: Ricondo & Associates, Inc., Febraury 2016.
Prepared by: Ricondo & Associates, Inc., Febraury 2016.

Figure 4.29: International Baggage Claim Units



Source: Houston Airport System, FIS Plans, provided in July 2014.
Prepared by: Ricondo & Associates, Inc., February 2016.

The space requirements for the international baggage claim facility are based on existing claim devices that can accommodate bags from one narrowbody or one widebody aircraft, or from two simultaneous regional jets or an Embraer 195, as depicted on **Figure 4.30**. The space template also provides a layout for a large baggage claim device that can accommodate an Airbus A380. These spatial requirements are based on sloped plate devices with 260 and 300 feet of linear presentation frontage that provides a total device area of 7,750 square feet and 8,750 square feet, respectively. Baggage claim elements illustrated in the figure include:

- **Baggage Claim Device and Retrieval Area.** Spatial area allocated for a single claim device includes the equipment area and clearance between the equipment and adjoining devices, walls, or general circulation corridors. A minimum of 12-feet of clearance from the face of the device for passengers to retrieve their baggage is required.
- **Circulation.** Circulation is provided for passengers moving between baggage claim devices. This area is recommended to include a minimum of seven feet between adjacent claim devices, and to be free of any fixed obstructions to accommodate cross-circulation for passengers.

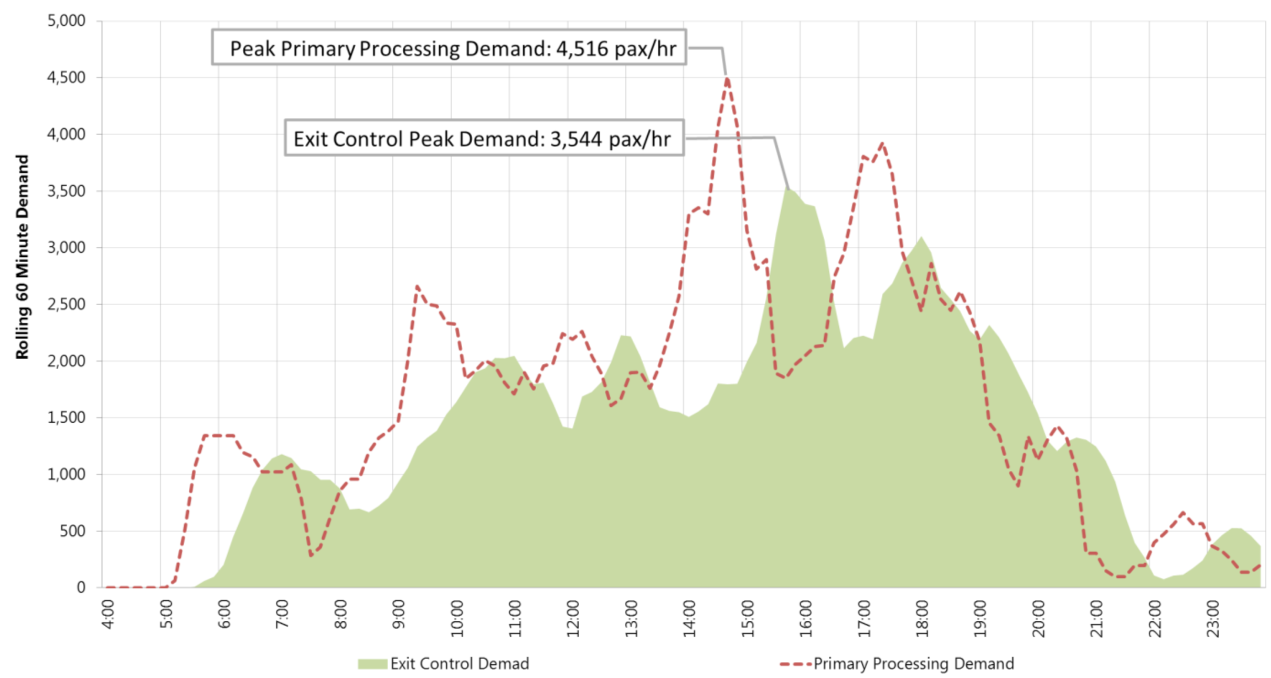
4.5.3 SECONDARY PROCESSING

The Secondary Processing facility integrates Customs, Immigration and Agricultural operations. As part of the final stage of the FIS process, passengers are screened with their checked baggage at Exit Control. If passengers require additional screening, they are escorted to adjacent screening lanes.

Exit Control consists of two passenger queues: Global Entry and standard. Global Entry enrolled passengers account for roughly 9.3 percent of the US passenger population. Global Entry passenger queues provide minimal waiting times and fast processing rates. All other passengers that are not eligible for expedited processing use the standard Exit Control queue. One Stop or ITI passengers, who do not have checked baggage and account for approximately 20 percent of passengers; are processed at Primary Inspection and therefore bypass Exit Control.

Figure 4.31 presents a comparison of passenger demand at Exit Control to passenger demand entering the FIS facility. The PAL 33 peak hour at Exit Control would occur between 15:00 and 16:00, roughly one hour after peak Primary Processing demand.

Figure 4.31: Exit Control Demand



Note: pax/hr = Passengers per hour
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Spatial requirements were developed using the Exit Control space template illustrated on **Figure 4.32**. The space template includes the following components:

- **Queue Area**. Holding area for passengers waiting to transact with an officer ranges in depth depending on level-of-service for area per passenger in queue. Queues are typically defined by queue stanchions with serpentine lanes spaced to allow 4 feet between each queue stanchion lane. Total queue area at Exit Control required by CBP design standards is 6,250 square feet.

- **Wait-Behind Line**. Passenger circulation area between the queue area and the processing area is typically located 7 feet behind the processing area to provide circulation and privacy during transactions.

- **Processing Area**. Standing area for passengers conducting transactions with officers can range depending on CBP design standards and LOS goals.

- **Work Area and Podium**. Consists of a podium and area behind the podium for an officer position. Typical podium dimensions are 3 feet by 4 feet with a work area depth of 5 feet behind the podium.

CBP requirements indicate two Exit Control positions and 6,880 square feet of space. PAL 33 peak-period requirements are 16 Exit Control positions and 7,740 square feet of space to satisfy the desired LOS goal, a difference of 14 positions and 860 square feet. **Table 4.9** summarizes the number of Exit Control positions required for each type of passenger queue at PAL 33.

Table 4.9: PAL 33 Exit Control Requirements

FACILITY	INVENTORY	REQUIREMENTS	PASSENGERS IN QUEUE
Global Entry Officer Positions	1	1	10
Standard Agent Positions	7	15	240
Total Exit Control Officer Positions	8	16	

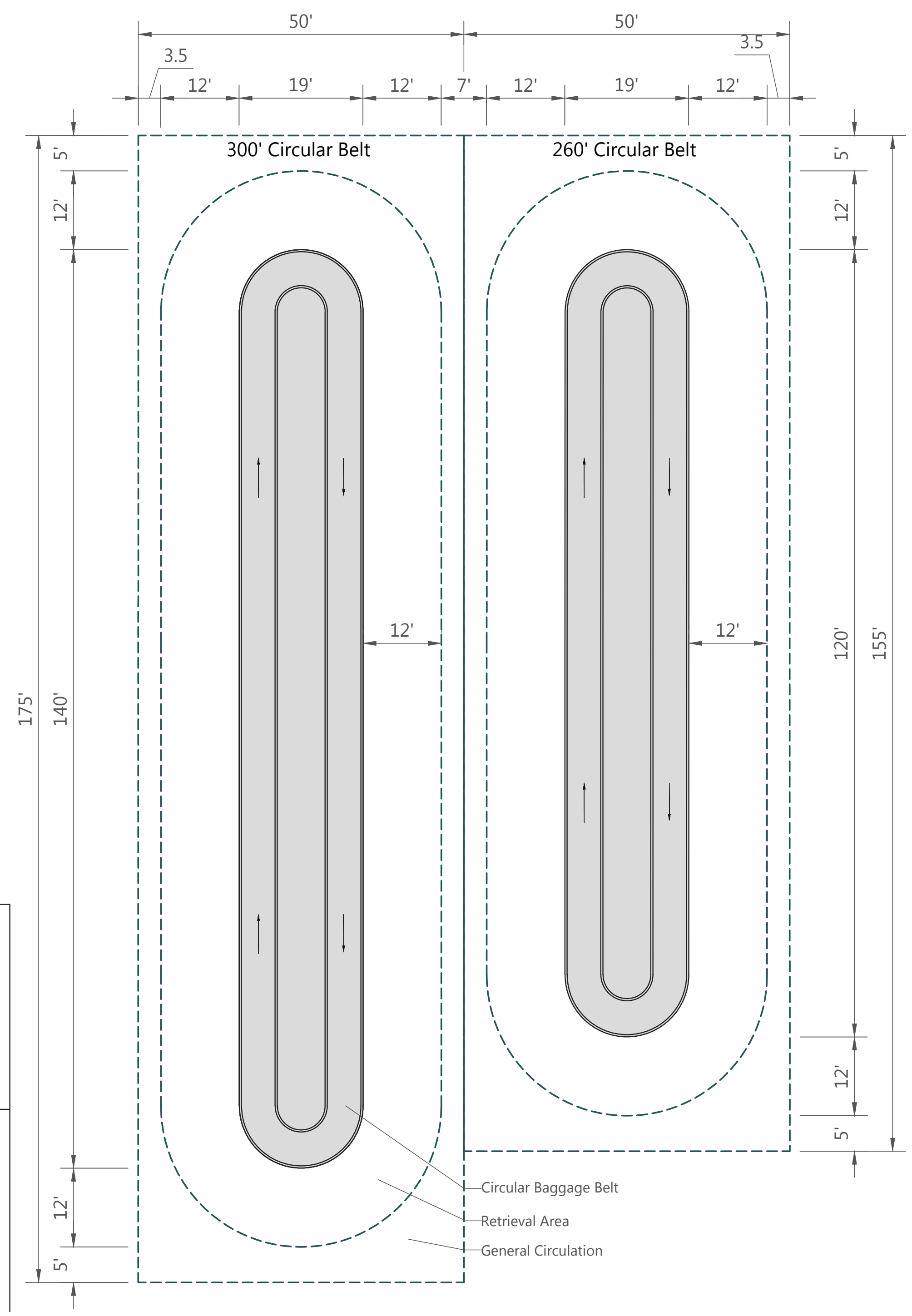
Note: ITI = International-to-International
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

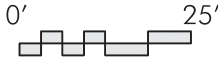
Figure 4.33 illustrates the number of officer positions required throughout the day to process passengers within the LOS goal.

Baggage Claim Facility Space Template

300' Circular Belt
Area per Device:
8,750 square feet
Retrieval Area per Device:
4,073 square feet

260' Circular Belt
Area per Device:
7,750 square feet
Retrieval Area per Device:
3,593 square feet





Exit Control Space Template

Area per Agent Position:
484 square feet

Queue Area per Agent:
391 square feet

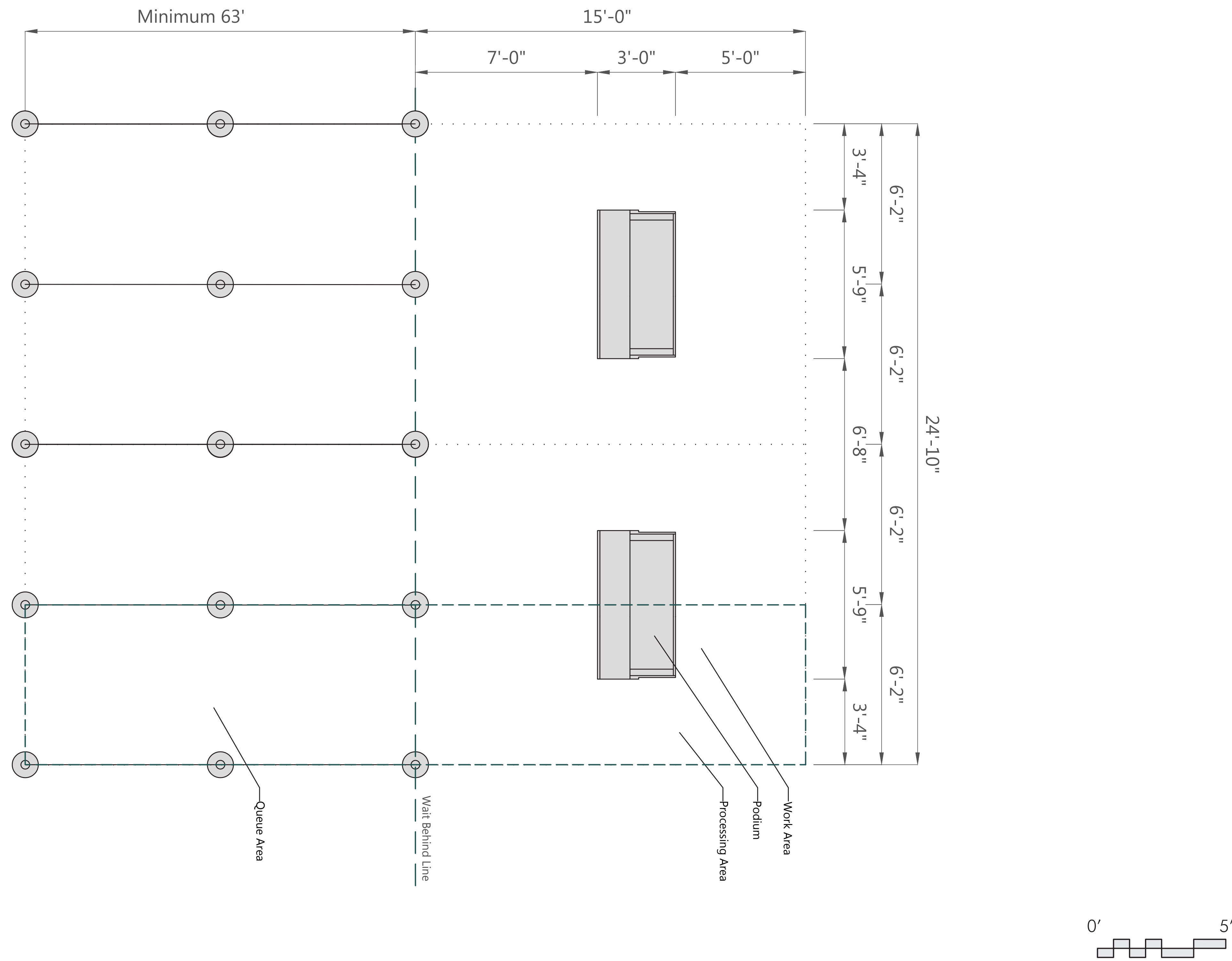
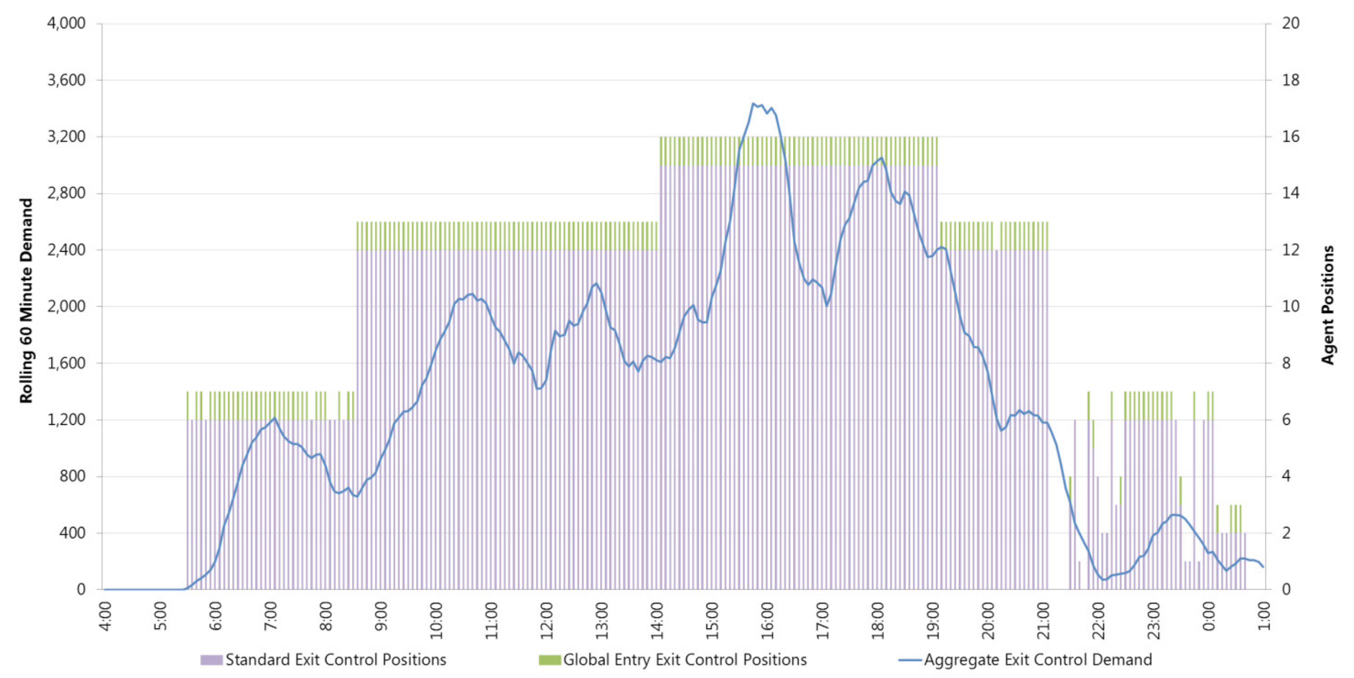
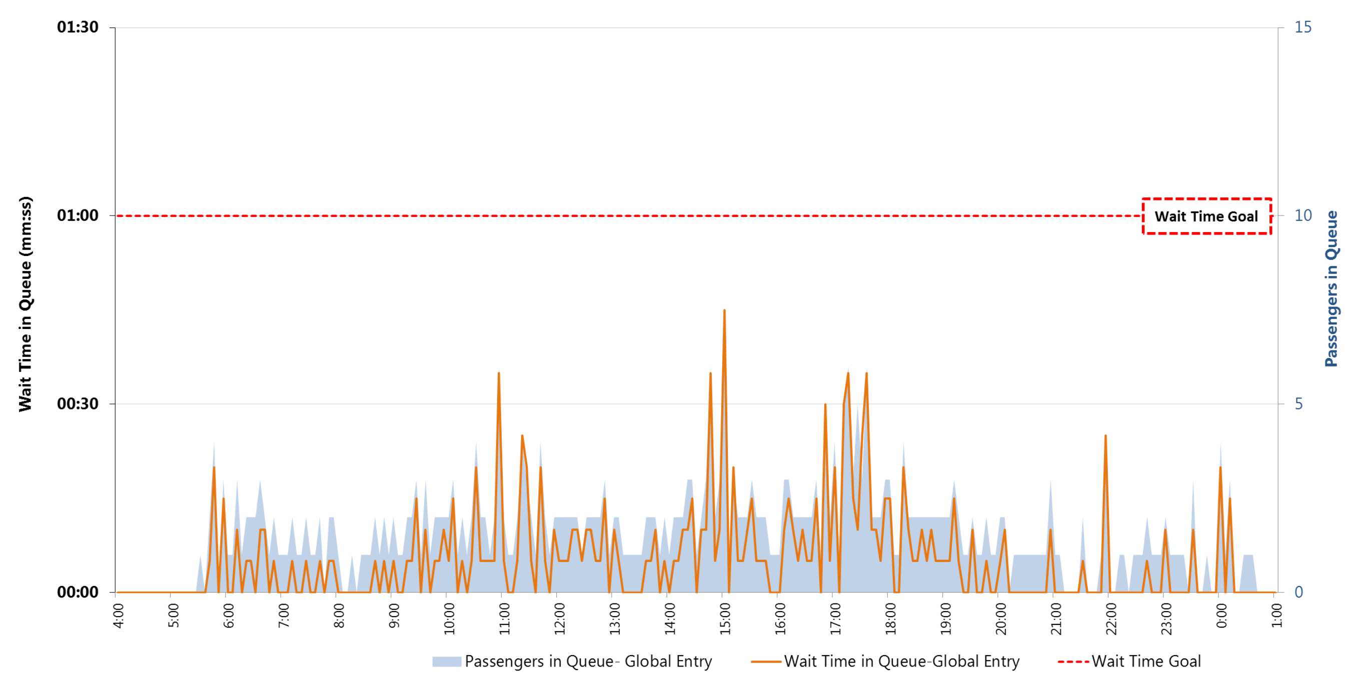


Figure 4.33: Exit Control Officer Positions



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.34: PAL 33 Global Entry Exit Control Performance



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

4.5.3.1 Exit Control Performance

Figure 4.34 and **Figure 4.35** illustrate the Exit Control performance (passengers in queue and wait time) throughout the planning day at PAL 33 for Global Entry and standard processing, respectively. One Global Entry Exit Control officer would be needed during the peak period to process passengers within 1 minute. In addition, 15 standard Exit Control officers would be needed during the peak period to process passengers within 5 minutes.

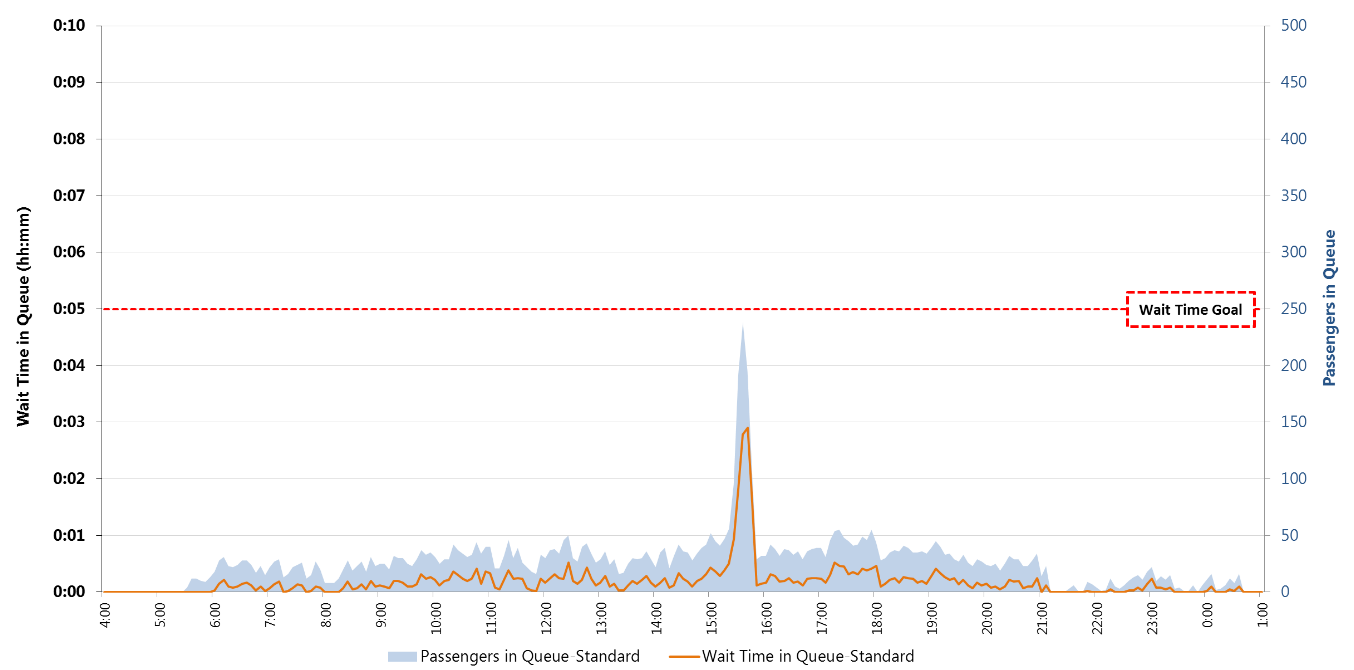
4.5.3.2 Secondary Processing Area

Arriving passengers who CBP has identified as requiring additional examination are directed to the Secondary Processing area for individual screening. Issues may include passport or visa concerns, baggage processing, and/or agricultural products processing. Passengers with these concerns can be screened at either a Customs workstation or a Department of Agriculture workstation.

The majority of passengers are permitted to exit the FIS facility without further inspection. The Secondary Processing area was assumed to screen five percent of passengers with an average waiting time of 10 minutes and a transaction time of five to 15 minutes (average of 10 minutes).

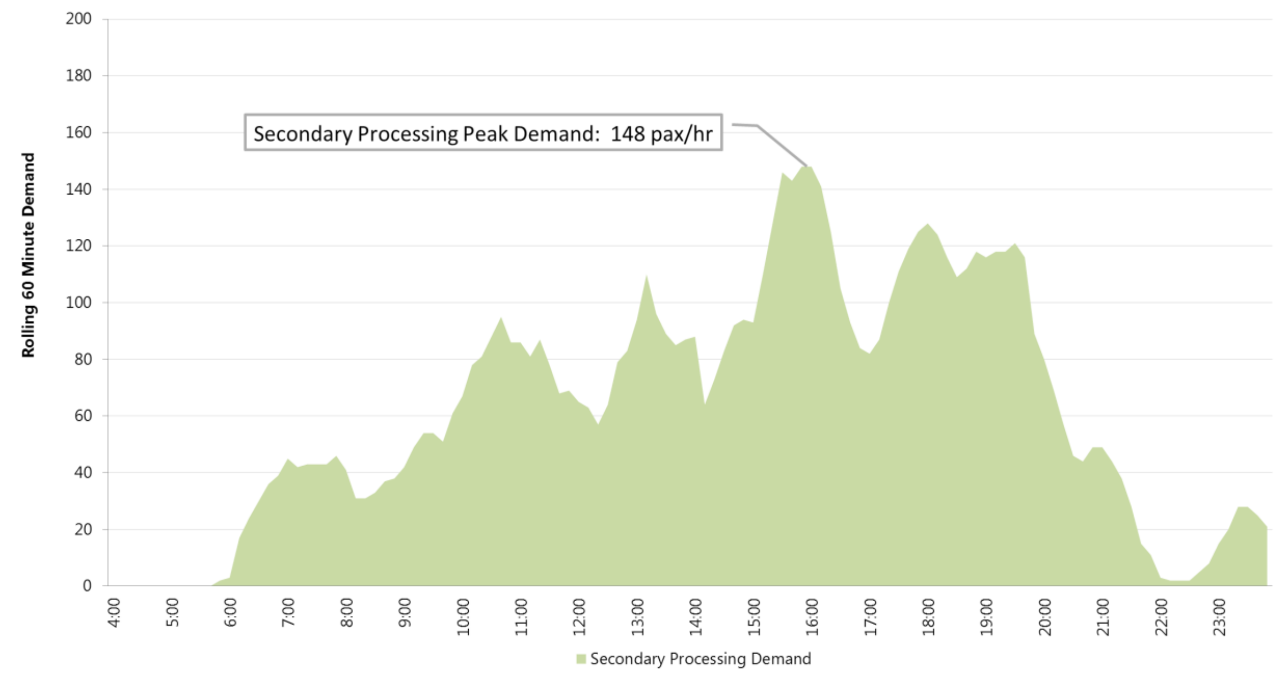
Passenger demand at the Secondary Processing area is shown on **Figure 4.36**. The peak hour at Secondary Processing would be between 16:00 and 17:00. During the peak hour, a total of 12 processing lanes/units would be required to process passengers within the LOS goal.

Figure 4.35: PAL 33 Standard Exit Control Performance



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.36: Secondary Inspection Demand



Note: pax/hr = Passengers per hour
Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

The Secondary Processing area space templates depicted on **Figure 4.37** and **Figure 4.38** are based on CBP design standards. CBP standards require four processing units for a large airport. During the peak period, simulation modeling indicates a requirement for four Department of Agriculture Secondary Processing units and eight Customs Secondary Processing units (pairs of lanes) to process passengers within the LOS goal. **Table 4.10** summarizes the Secondary Processing facility requirements at PAL 33 and **Figure 4.39** shows the wait time and passengers in queue results from the simulation modeling.

Table 4.10: Secondary Processing Requirements

FACILITY	INVENTORY	REQUIREMENTS	PASSENGERS IN QUEUE
Secondary Processing Units (Agriculture)	3	4	
Secondary Processing Units (Customs – Pairs of Lanes)	12 (6 pairs)	8 (4 pairs)	
Total	15	12	45

Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

The international arrivals Recheck Hall is located immediately beyond the exit doors from the CBP facilities. **Figure 4.40** presents a comparison of demand at the Recheck Hall with passenger demand at the beginning and end of the FIS process. Recheck Hall peak period passenger demand is approximately 1,455 passengers and occurs in the late afternoon. The average transfer percentage during the peak hour is 57 percent of passengers.

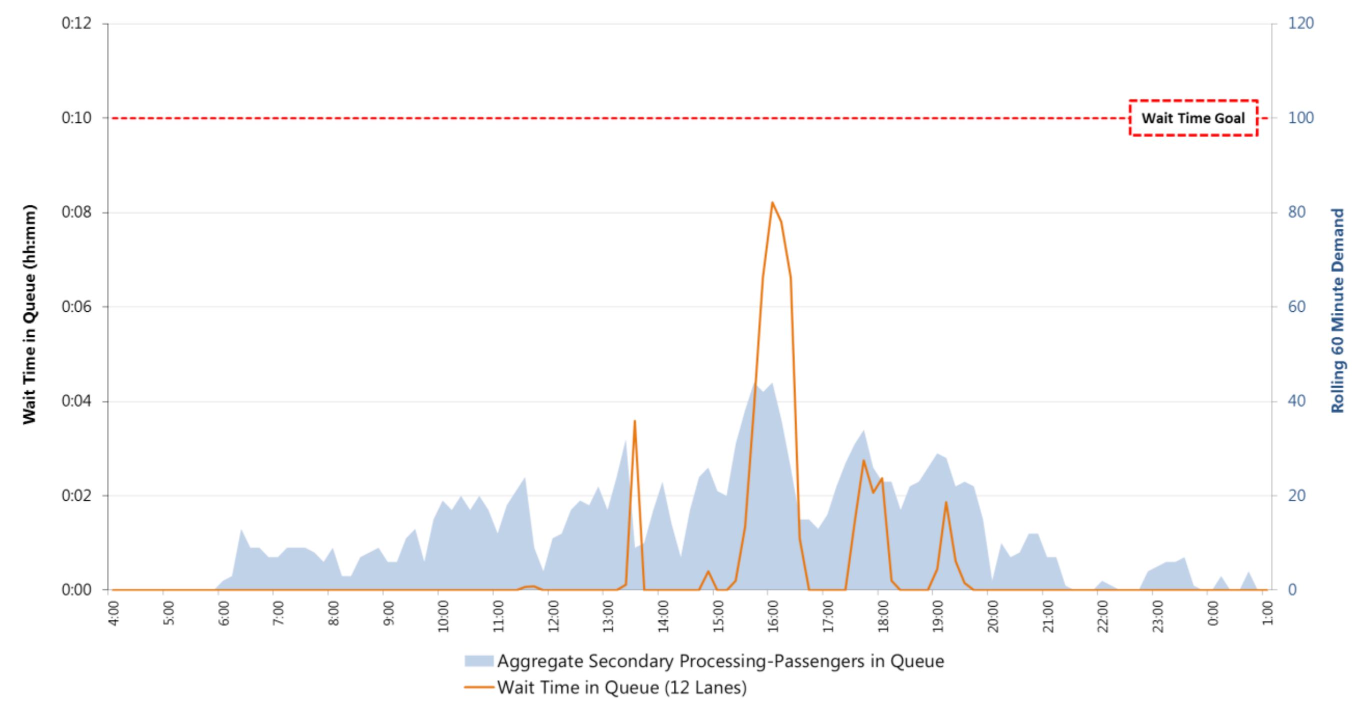
Components of the Recheck Hall include:

- **Airline Rebooking/Assistance Counters**. These counters are principally used to rebook arriving passengers who missed their connecting flight or passengers who need airline assistance. Depending on airline operating preferences, connecting passengers may recheck baggage with the agent or be asked to carry retagged bags to the baggage recheck conveyor.
- **Take-away Conveyor**. Each agent counter has a baggage conveyor to transfer international arriving passenger baggage to the passenger's connecting flight segment.
- **Baggage Drop-off Belts**. Baggage drop-off belts are available for passengers that do not need agent assistance to introduce their checked baggage into the baggage handling system.
- **Other Support**: Includes airline offices and baggage cart return and storage areas, among other support.
- **Circulation**. Corridors and vertical circulation elements are used by passengers to connect to the secure concourse.

Figure 4.41 and **Figure 4.42** illustrate the space templates used to fulfill requirements for the Recheck Hall.

Table 4.11 summarizes the Recheck Hall requirements for PAL 33.

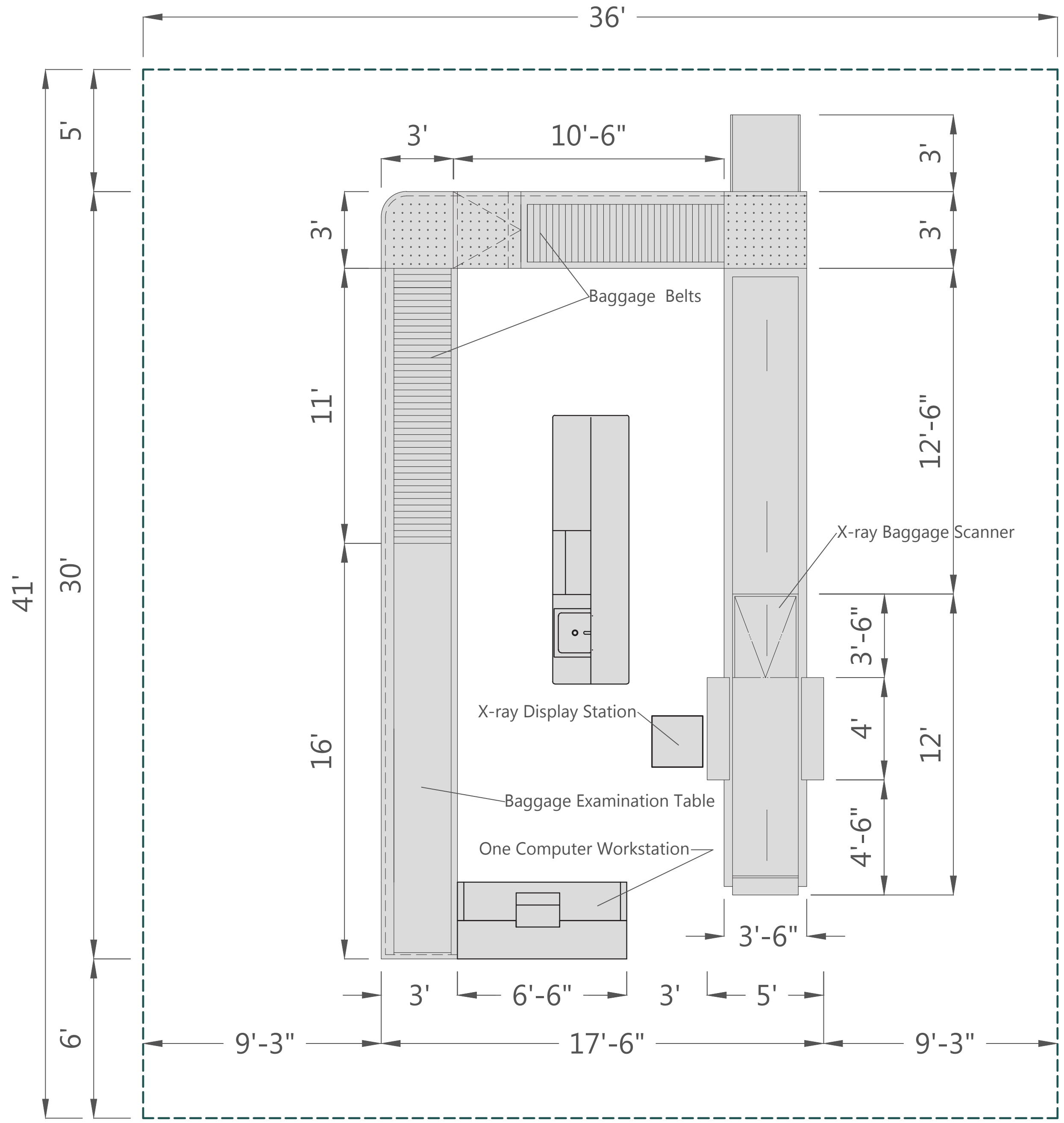
Figure 4.39: PAL 33 Secondary Inspection Performance



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

PAL 33 Department of Agriculture Secondary Baggage Exam Podium and Baggage Belts Space Template

NII Processing Workstation
Area per Station:
1,476 square feet



PAL 33 Customs Secondary Baggage Processing Workstation Space Template

Podium and
Baggage Belts
Area per Station:
756 square feet

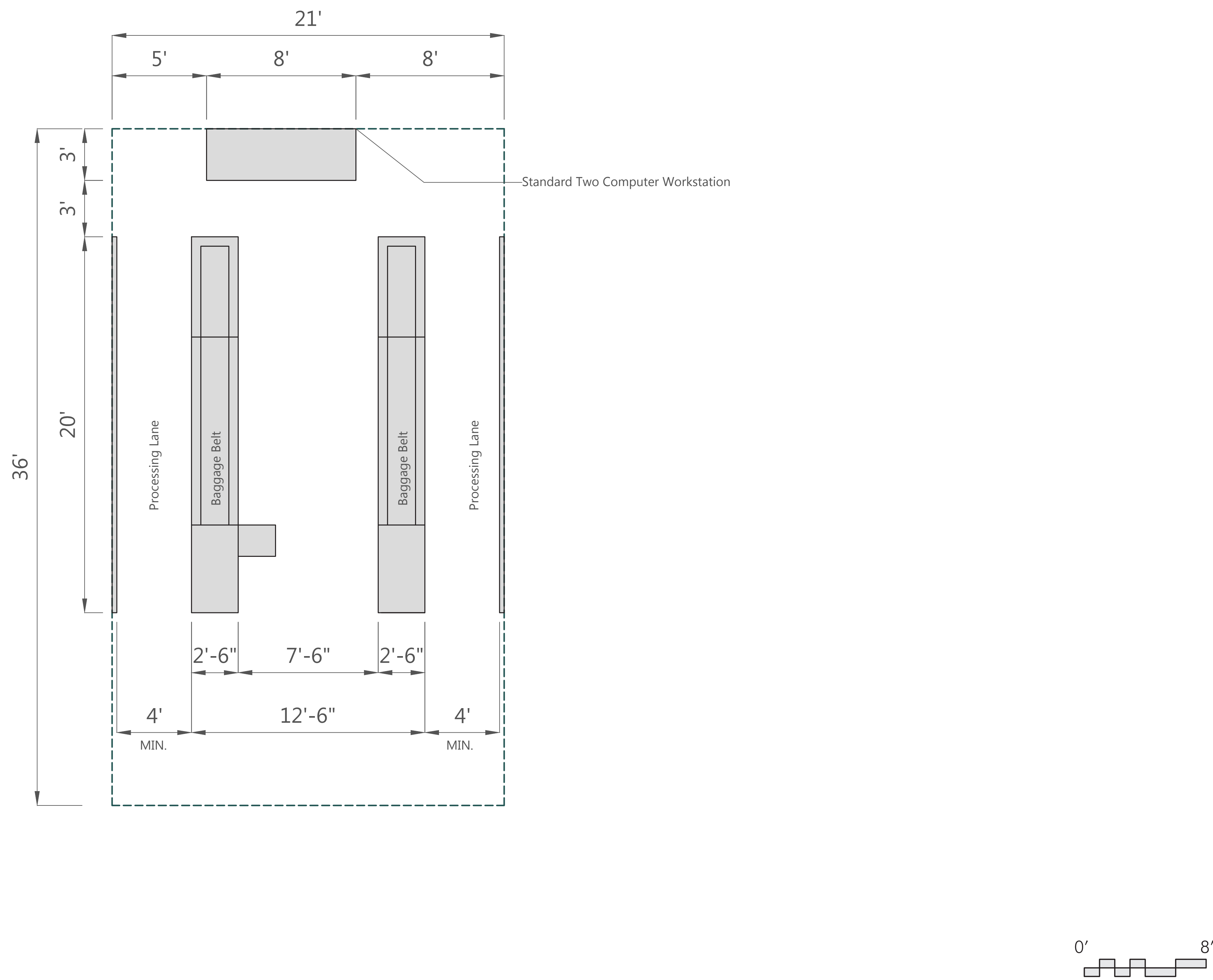
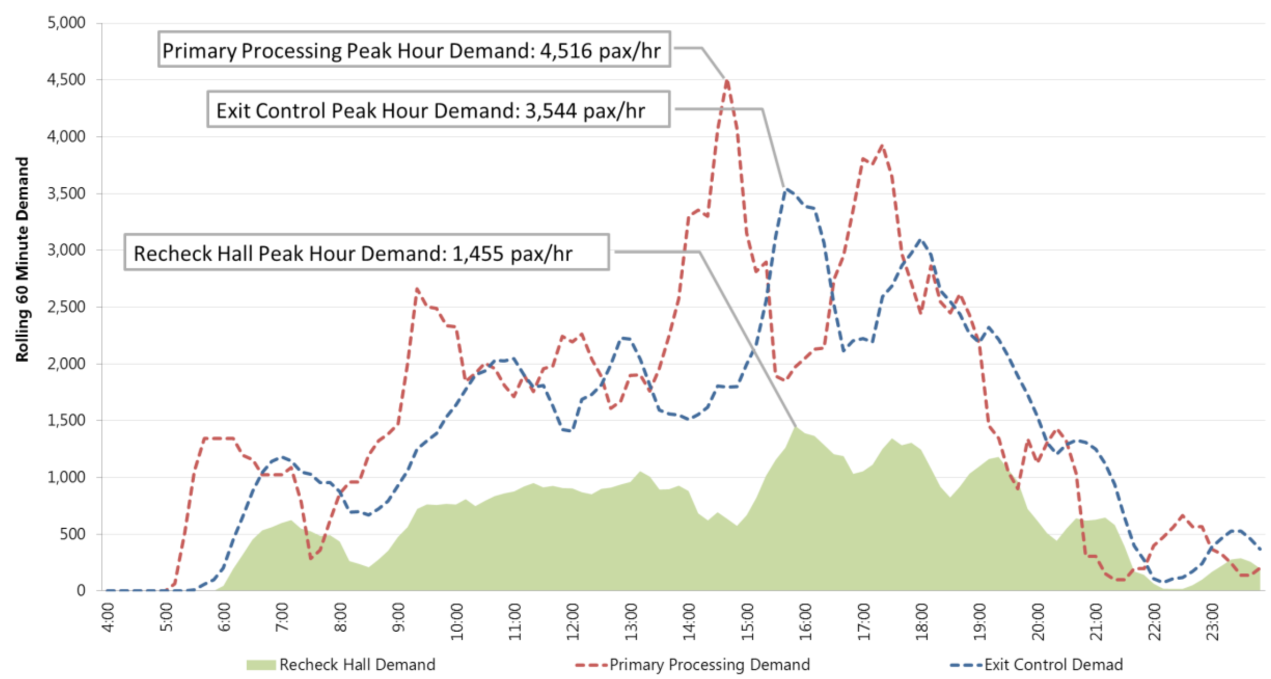


Figure 4.40: PAL 33 Recheck Hall Demand



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Table 4.11: PAL 33 Recheck Hall Requirements

FACILITY	INVENTORY	REQUIREMENTS	PASSENGERS IN QUEUE
Baggage Drop-off Belts			
United Airlines	5	5	10
Foreign Flag Airlines	1	1	10
Oversize Bag Assist Agent	1	1	5
Agent Assist Counters			
United Airlines	16	13	55
Foreign Flag Airlines	15	17	35

Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

4.5.3.3 Support Spaces

Support spaces include Primary and Secondary Processing, operational support areas, and CBP staff and support areas. Existing CBP-operated support areas that exceed design standards should maintain their current space requirements. Areas that do not meet CBP design standards require additional space. Individual areas noted by airport stakeholders to be underutilized or undersized were adjusted appropriately to satisfy PAL 33 requirements. Public restroom requirements are discussed in **Section 4.5.7**.

4.5.4 TRANSPORTATION SECURITY ADMINISTRATION CHECKPOINTS

Although TSA has direct responsibility for determining the size and configuration of the passenger security screening checkpoints and baggage screening facilities at the airport, it typically collaborates with airport management to plan locations and programs.

Equipment unit requirements for SSCPs are based on TSA goals for expected passenger processing rates of approximately 160 passengers per hour per lane, for standard lanes, and 240 passengers per hour per lane for Trusted Traveler Program (Pre√™) lanes. The DHS offers Trusted Traveler programs designed to enhance security and increase system efficiency while providing an improved passenger experience.

Space requirements to accommodate equipment, passenger queuing and TSA support areas were developed using published DHS facility templates and guidelines.

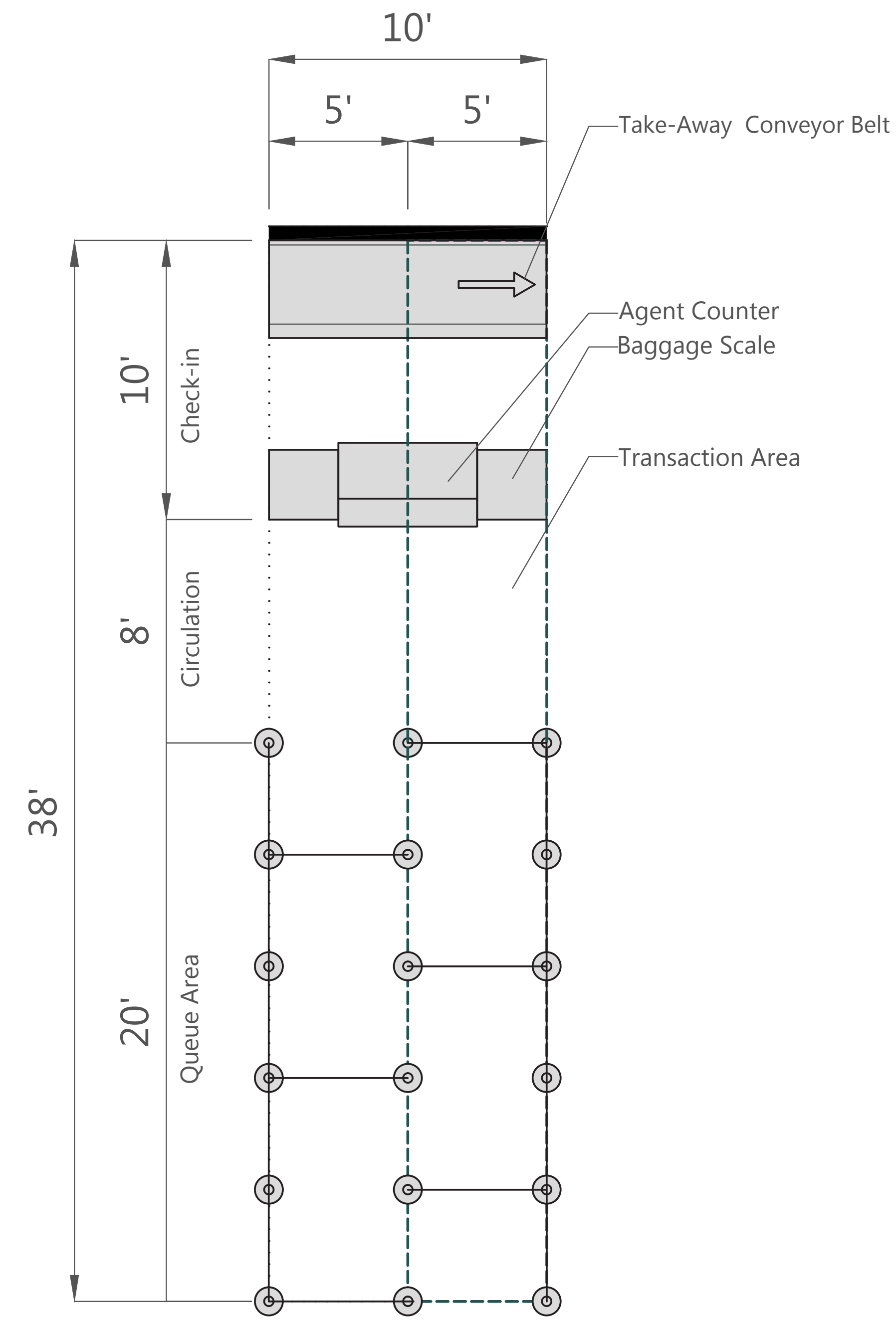
Figure 4.43 illustrates the space template for the SSCPs, including a unit for advanced Demand imaging technology (AIT). The template module includes:

- **Queue and Document Check**
- **Main Screening Area**, consisting of divesting tables, walk-through metal detectors, x-ray equipment, AIT devices, Secondary Processing search/examination space, and recomposure area
- **Supervisor and Law Enforcement Officer Stations**

The template does not include TSA SSCP or corollary areas for AIT workstations, administrative space, technical support space, break areas, or common exit circulation corridors beyond the recomposure area. The TSA SSCP and corollary area requirements are based on the TSA Checkpoint Design Guide (CDG), which recommends 150 square feet per screening lane. Facility requirements for the SSCPs shown in Table 4.6 provide information for a consolidated SSCP for all originating and transfer passengers in Terminal E.

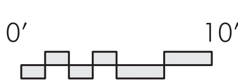
Consolidated SSCP demand would be approximately 2,757 passengers during the peak hour at PAL 33. **Figure 4.44** shows the relationship of demand at the consolidated SSCP to demand at the Terminal E ticketing lobby and transfer passenger demand exiting the Recheck Hall.

PAL 33 Recheck Hall - Airline Assistance Counter Space Template



Area per Agent Position:
190 square feet

Queue Area per Agent:
100 square feet



PAL 33 Recheck Hall - Baggage Drop-Off Belt Space Template

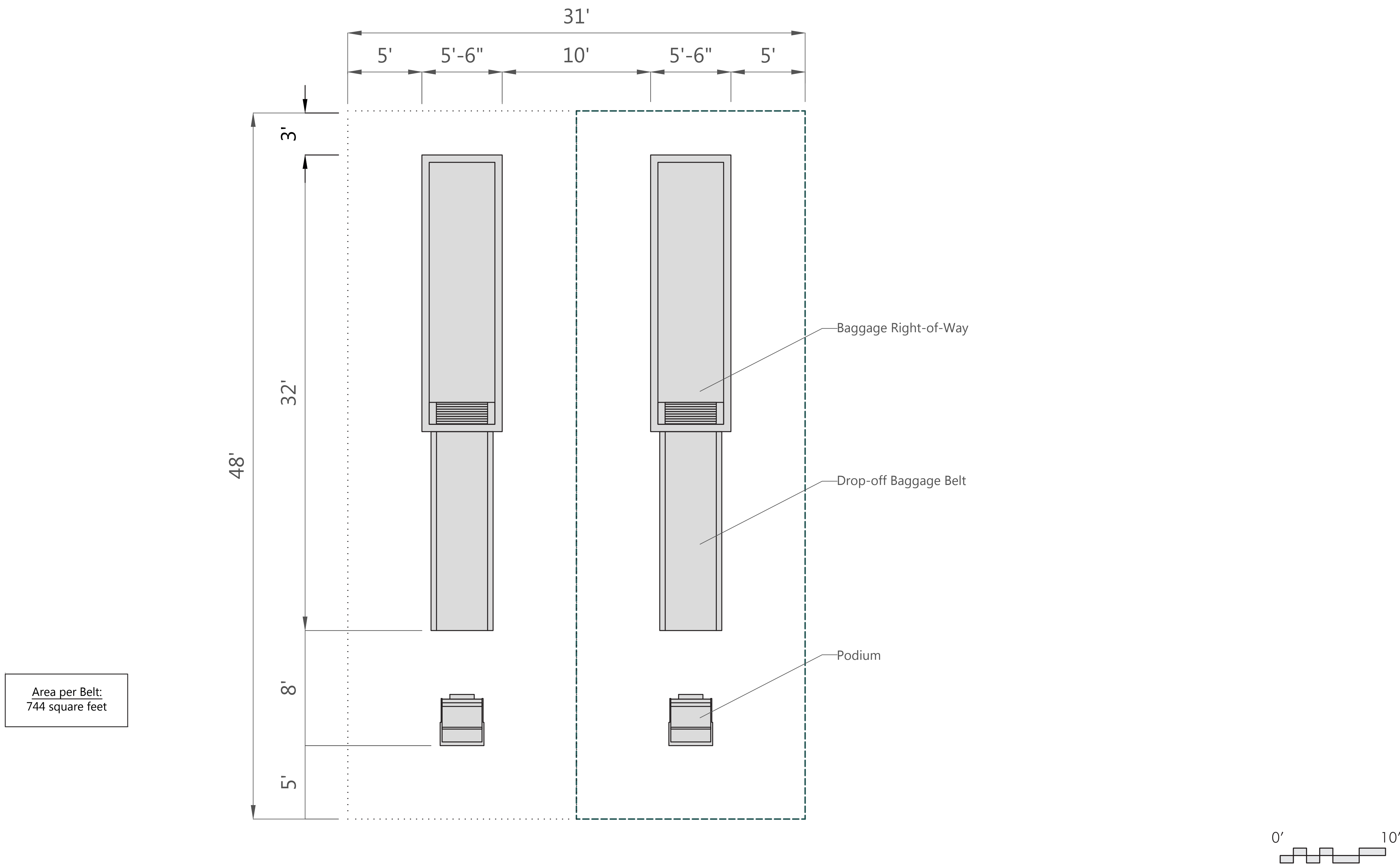
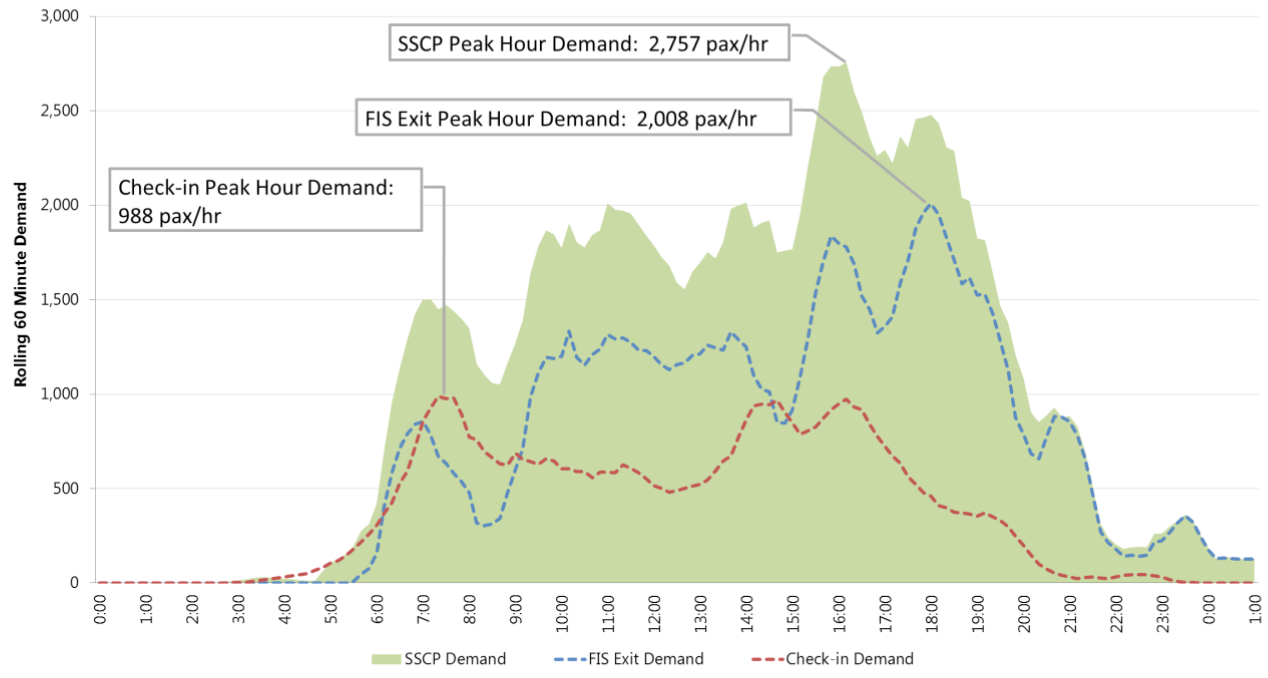


Figure 4.44: PAL 33 Consolidated Security Screening Checkpoint Demand



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

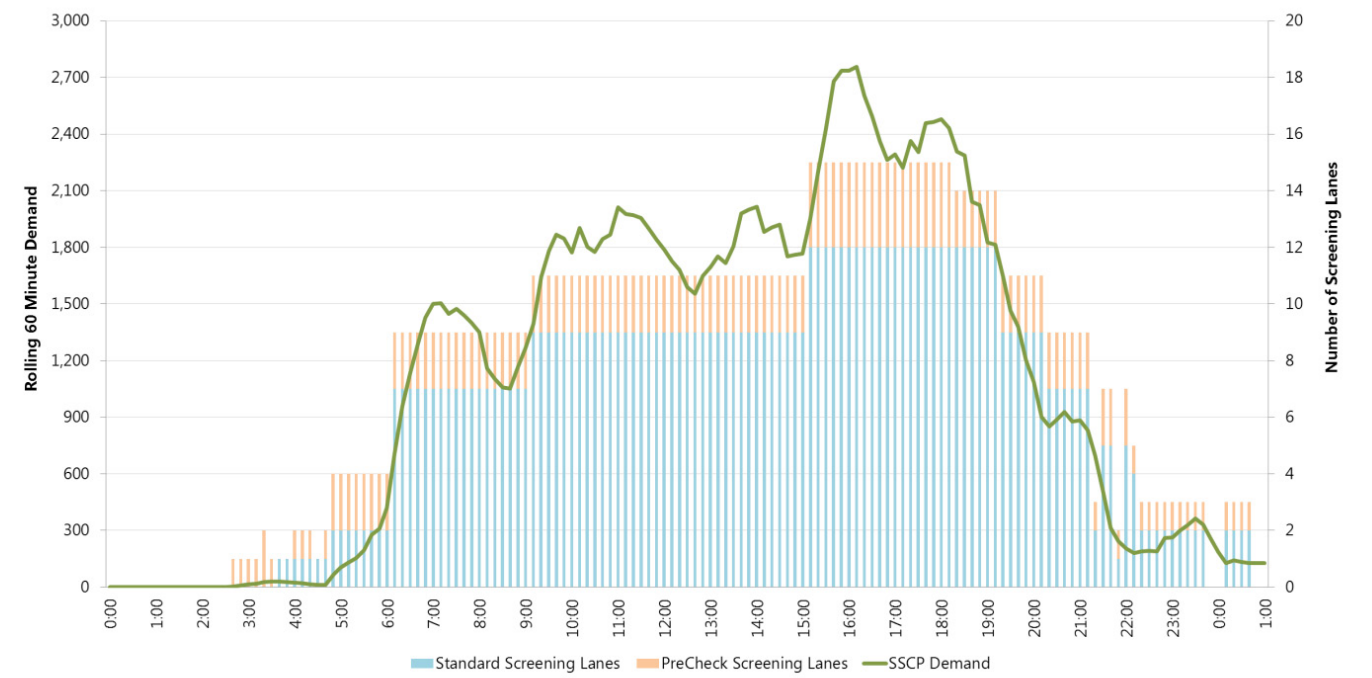
Facility requirements for the consolidated SSCP are summarized in **Table 4.12** and on **Figure 4.48**. During the peak period, the consolidated SSCP requires a total of 15 lanes to process all passengers within the LOS goals.

Table 4.12: PAL 33 Recheck Security Screening Checkpoint Requirements

FACILITY	INVENTORY	REQUIREMENTS	PASSENGERS IN QUEUE
Pre√ ™		3 Lanes	60
Standard		12 Lanes	400
Total	12 Lanes	15 Lanes	

Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

Figure 4.45: PAL 33 Consolidated Security Screening Checkpoint Demand



Source: Ricondo & Associates, Inc., February 2016.
Prepared by: Ricondo & Associates, Inc., February 2016.

4.5.5 GENERAL SPACES

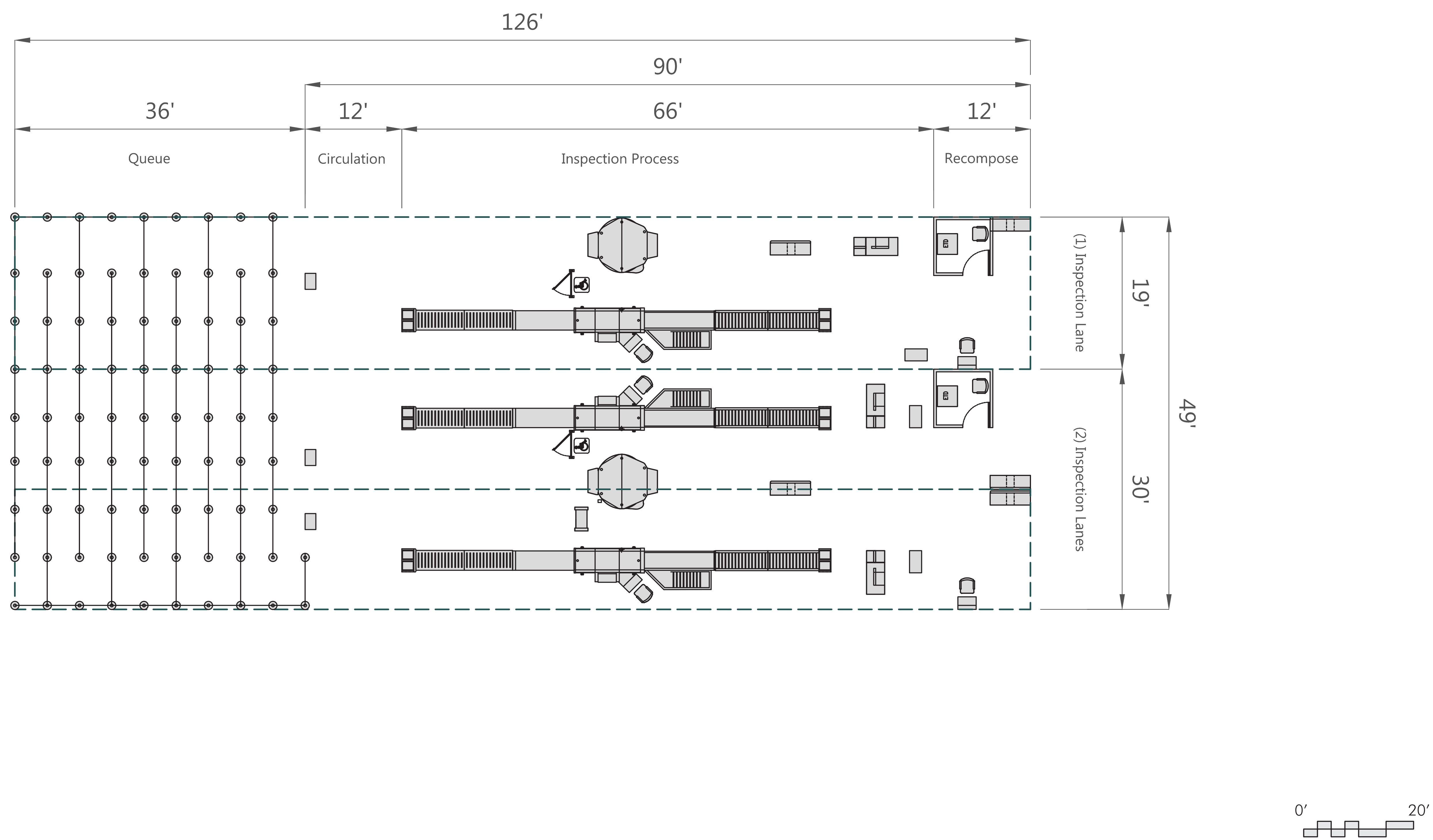
General spaces, such as HAS-operated spaces, concession spaces, buildings systems, and circulation areas were maintained for PAL 33, according to the existing space inventory. Restroom requirements were analyzed to anticipate higher PAL 33 passenger demand compared with present day demand.

4.5.6 RESTROOMS

Public restrooms should be conveniently distributed throughout the public areas of the airport. The number of fixtures to be accommodated in each public restroom will be based on the occupancy or area functions that the restroom will support. A planning rule of thumb for restrooms is to provide three sf of restroom area per peak-hour passenger in the secure areas and two sf of restroom area per peak-hour passenger in the non-secure areas.

Table 4.13 summarizes PAL 33 public restroom space requirements in Terminal E.

Security Screening Checkpoints Space Template



Area per Lane (pair):
1,890 square feet

Area per Lane (single):
2,394 square feet

Queue Area (pair):
540 square feet

Queue Area (single):
684 square feet

Table 4.13: PAL 33 Public Restroom Requirements (in square feet except as noted)

	SECURE AREA	NONSECURE AREA
PUBLIC RESTROOM		
Peak Hour Passengers (PHD or PHE)	5,000	1,000
Planning Factor (SF/PHP)	3	2
Level 2		
Primary Processing Area	7,182	
Secondary Processing Area	222	
Secure Circulation	2,971	
Level 1		
Secondary Processing Area	3,321	
Secure Circulation	1,303	
Non-Secure Circulation		2,000
Total Restroom Area	15,000	2,000
Grand Total	17,000	

Notes:
PHD = Peak hour deplaned passengers
PHE = Peak hour enplaned passengers
SF/PHP = Square feet per peak hour passenger
Source: Ricondo & Associates, Inc., December 2014.
Prepared by: Ricondo & Associates, Inc., January 2015.

Chapter 5 | Preferred Development Plan

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5.0 Preferred Development Plan

This chapter presents the preferred plan for the renovation and expansion of the FIS facility. The project can be divided into three main components:

- FIS Projects - Renovations
  - Includes renovations of the existing facility for improvements to the Primary Processing, Secondary Processing, Baggage, CBP Administration, Recheck and Terminal E security checkpoint.
- FIS Projects - Expansions
  - Includes the expansion of the passenger baggage claim area, baggage makeup and realignment of the tug ramps from the airside service road to the basement.
- FIS Projects - CBP Garage and Arrivals Curb
  - Includes the new parking structure for CBP parking and the new arrivals curb.

Using the program requirements in **Chapter 4** as a guiding principle, the preferred plan was developed in tandem with all stakeholders to develop a comprehensive plan. **Table 5.1** contains a detailed listing of the preferred concept area takeoffs by function and in relation to the **Chapter 4** Program Requirements for each level.

Table 5.1

	EXISTING INVENTORY		DESIGN STANDARDS		REQUIREMENTS PAL 33		AREA DIFFERENCE (EX VS. REQ)	PROPOSED GREEN = EXISTING WITH NO CHANGE		NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
Million Annual Enplaned Passengers (MAEP)					**9,000,000**					
Peak Hour Deplaning Passengers (PHDP)	**4,000**		**5,000**		**4,516**					
Peak Hour Originating Passengers (PHOP)					**977**					
FACILITY	**Area (sf)**	**Pos.(ea)**	**Area (sf)**	**Pos.(ea)**	**Area (sf)**	**Pos.(ea)**	**Area (sf)**	**Area (sf)**	**Pos.(ea)**	
Federal Inspection Services										
Primary Processing Area										
Primary Booth, Queuing, and Processing	77,920		66,000	100			15,610	82,020		
Global Entry Program	Incl. in Primary Insp.		Incl. in Primary Insp.	-				Incl. in Primary Insp.		
Global Entry Kiosks	Incl. in Primary Insp.	40	Incl. in Primary Insp.	-	1,100	22		Incl. in Primary Insp.	42	
Global Entry Kiosks Queue Area	Incl. in Primary Insp.				500			Incl. in Primary Insp.		
Global Entry Verify Agent Podium	Incl. in Primary Insp.	Incl. in APC Verify Agent Podium	Incl. in Primary Insp.	-	570	2		Incl. in Primary Insp.	6	
Global Entry Verify Agent Podium Queue Area	Incl. in Primary Insp.				120			Incl. in Primary Insp.		
APC Program (US Citizens/US Residents & Visa Waiver)	Incl. in Primary Insp.		Incl. in Primary Insp.	-	34,310			Incl. in Primary Insp.		
APC Kiosk	Incl. in Primary Insp.	42	Incl. in Primary Insp.	-		74		Incl. in Primary Insp.	74	
APC Kiosk Queue Area	Incl. in Primary Insp.		Incl. in Primary Insp.	-				Incl. in Primary Insp.		
APC Verify Agent Podium	Incl. in Primary Insp.	Incl. In Agent Booths	Incl. in Primary Insp.	-		22		Incl. in Primary Insp.	22	
APC Verify Agent Podium Queue Area	Incl. in Primary Insp.		Incl. in Primary Insp.	-				Incl. in Primary Insp.		
APC Triage Agent	Incl. in Primary Insp.	Incl. In Agent Booths	Incl. in Primary Insp.	-		25		Incl. in Primary Insp.	26	
APC Triage Queue Area	Incl. in Primary Insp.		Incl. in Primary Insp.	-				Incl. in Primary Insp.		
Agent Booth Positions	Incl. in Primary Insp.	66	Incl. in Primary Insp.	-				Incl. in Primary Insp.		
Foreign Nationals	Incl. in Primary Insp.		Incl. in Primary Insp.	-	4,750	24		Incl. in Primary Insp.	24	
Non-visa Waiver Agent Queue Area	Incl. in Primary Insp.		Incl. in Primary Insp.	-	10,940	-		Incl. in Primary Insp.		
Primary Support Spaces										
CBP Forms Counter	2,030	8	120	5	2,030	8	-	-	-	NOT REQUIRED OR UTILIZED. DELETED FROM PROGRAM
CBP Command and Control Center	150	1	230	1	230	1	(80)	230	1	NEW CENTRALIZED LOCATION IN MAIN PRIMARY CIRCULATION AREA

FACILITY	EXISTING INVENTORY Area (sf)	EXISTING INVENTORY Pos.(ea)	DESIGN STANDARDS Area (sf)	DESIGN STANDARDS Pos.(ea)	REQUIREMENTS PAL 33 Area (sf)	REQUIREMENTS PAL 33 Pos.(ea)	AREA DIFFERENCE (EX VS. REQ) Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Area (sf)	PROPOSED Pos.(ea)	NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
Counter Terrorism Response Suite	2,000	1	950	2	2,000	1	-	6,540	1	RELOCATED TO EXISTING HARD SECONDARY; LEVEL 116-SOUTHEAST
Public Restroom	4,520	2			7,180		(2,660)	4,520	2	(2) EXISTING PRIMARY RR TO REMAIN WITHOUT CHANGE.
International Baggage Claim	99,520	12			126,000	16	(26,480)	133,130	15	Two (2) claim devices require 300' lpf device for simultaneous A380's. NEW EXPANSION AREA = 42250 SF AND INCLUDES (4) NEW UNITS AND (1) NEW UNIT TO REPLACE EXISTING THAT IS REMOVED AT EXIT CONTROL
Secondary Processing Area										
Rover Command and Control Center	730	1	230	1	730	1	-	730	1	EXISTING TO REMAIN
Triage Control Podium	260	2	320	1	320	1	(60)	370	1	RELOCATED TO LEVEL 93 - NORTHWEST
Referral Passenger Waiting	1,480	1	3,130	1	3,130	1	(1,650)	2,580	2	Assumes .025% of 5,000 PHD; Need additional seating RELOCATED TO LEVEL 93 - NORTHWEST
Public Restroom	2,230	2			3,540		(1,310)	4,056	3	Need more restrooms near Referral Passenger Waiting Area EXISTING BAG CLAIM RESTROOM TO REMAIN WITHOUT CHANGE (2086 SF) - NEW RESTROOMS AT REFERRAL PAX WAIT AREA = 570 SF; NEW RESTROOMS AT BAGGAGE EXPANSION = 1400 SF
Secondary Baggage Exam Podium and Baggage Belts	8,900	3	1,510	2	3,020	4	5,880	5,990	3	RECONFIGURED
Secondary Baggage NII Processing Workstation	10,920	6	2,950	2	5,900	4	5,020	5,540	4	RECONFIGURED
Cashier's Office	130	1	60	1	130	1	-	150	1	RELOCATED TO LEVEL 93 - NORTHWEST
CBP Agricultural Laboratory (AQI; includes animal processing)	570	1	450	3	570	1	-	570	1	EXISTING TO REMAIN
CBP Agricultural Disposal Room	630	1			630	1	-	630	1	As required by CBP EXISTING TO REMAIN
CBP/APHIS VS Bird Quarantine and Bird Holding Facilities	-				-		-	-		As required by CBP
Detainee Baggage Storage	60	1	80	2	80	2	(20)	160	1	RELOCATED TO LEVEL 93 - NORTHWEST
Interview Room	1,230	13	240	3	1,230	13	-	960	12	RELOCATED TO LEVEL 93 - NORTHWEST
Search Room	380	4	240	3	380	4	-	160	2	RELOCATED TO LEVEL 93 - NORTHWEST
Male Hold Room	390	2	230	1	390	2	-	180	1	RELOCATED TO LEVEL 93 - NORTHWEST
Female Hold Room	390	2	230	1	390	2	-	180	1	RELOCATED TO LEVEL 93 - NORTHWEST

FACILITY	EXISTING INVENTORY Area (sf)	EXISTING INVENTORY Pos.(ea)	DESIGN STANDARDS Area (sf)	DESIGN STANDARDS Pos.(ea)	REQUIREMENTS PAL 33 Area (sf)	REQUIREMENTS PAL 33 Pos.(ea)	AREA DIFFERENCE (EX VS. REQ) Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Pos.(ea)	NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
Juvenile Hold Room	-	-	180	1	180	1	(180)	180	1	RELOCATED TO LEVEL 93 - NORTHWEST
Family Holdroom	210	1			420	2	(210)	-		As required by CBP; Multiple family holdrooms requested; INCLUDED IN EXPEDITED/VOLUNTARY REMOVAL SUITE
Food Preparation/Storage	210		350		350		(140)	300	1	RELOCATED TO LEVEL 93 - NORTHWEST
Expedited/Voluntary Removal Suite	-		1,000	1	1,000	1	(1,000)	840	1	Space not available in existing facility; RELOCATED TO LEVEL 93 - NORTHWEST
Secondary Operations and Support										
Immigrant Room	-	-	230	1	230	1	(230)	310	1	Space not available in existing facility; RELOCATED TO LEVEL 93 - NORTHWEST (includes Immigrant, Copy/Fax, Fingerprint)
Fingerprint Room	-	-	180	1	180	1	(180)	-	1	RELOCATED TO LEVEL 93 -NORTHWEST; COMBINED WITH IMMIGRATION OFFICE
Fraudulent Documentation Analysis Room	150	1	180	1	180	1	(30)	-		RELOCATED TO LEVEL 93 -NORTHWEST; COMBINED WITH IMMIGRATION OFFICE
Secondary Supervisor's Office	2,060	11	150	1	2,060	11	-	2,300	16	(5) IN EXISTING LOCATION; (9) IN NEW LOCATION; ALL CO-LOCATED AT LEVEL 93 -SOUTHWEST; (2) LEVEL 93 - NW
Enforcement Office	1,420	1	150	1	1,420	1	-	800	2	Underutilized; NEW - LEVEL 93 NW-800 SF
Secure Storage	340	2	160	1	340	2	-	486	2	EXISTING (256 SF) ON MEZZ TO REMAIN, LEVEL 93 NW -230 SF
Canine Kennels	520	10			520	10	-	520	10	As required by CBP; minimum 100 SF; EXISTING TO REMAIN W/O CHANGE
Animal Processing Room	Incl. in Ag. Lab	Incl. in Ag. Lab	Incl. in Ag. Lab	Incl. in Ag. Lab	Incl. in Ag. Lab	Incl. in Ag. Lab		Incl. in Ag. Lab	Incl. in Ag. Lab	
Washer/Dryer	30	1	60	2	60	2	(30)	60	1	Stackable units; EXISTING TO REMAIN W/O CHANGE
Food Preparation Room	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./ Stor.	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./ Stor.		Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./ Stor.	
Dry Food Storage	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./ Stor.	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./ Stor.		Incl. in Secondary Food Prep./Stor.	Incl. in Secondary Food Prep./ Stor.	
Canine Unit Secure Training Aid Storage	-	-	70	1	70	1	(70)	-	-	INCLUDED IN MEZZANINE LEVEL
Canine Unit Secure Training Aid Storage (Pseudo Narcotic)	60	1	80	1	80	1	(20)	60	1	EXISTING TO REMAIN W/O CHANGE
Canine Unit Secure Training Aid Storage (Agricultural)	50	1	80	1	80	1	(30)	50	1	EXISTING TO REMAIN W/O CHANGE

FACILITY	EXISTING INVENTORY Area (sf)	EXISTING INVENTORY Pos.(ea)	DESIGN STANDARDS Area (sf)	DESIGN STANDARDS Pos.(ea)	REQUIREMENTS PAL 33 Area (sf)	REQUIREMENTS PAL 33 Pos.(ea)	AREA DIFFERENCE (EX VS. REQ) Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Area (sf)	PROPOSED Pos.(ea)	NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
Canine Unit Secure Training Aid Storage (Currency)	50	1	70	1	70	1	(20)	50	1	EXISTING TO REMAIN W/O CHANGE
Canine Unit Secure Training Aid Storage (Blank)	50	1	70	1	70	1	(20)	50	1	EXISTING TO REMAIN W/O CHANGE
Canine Unit General Storage	130	1	80	1	130	1	-	130	1	EXISTING TO REMAIN W/O CHANGE
Canine Officer Work Area	1,450	2	260	4	1,450	2	-	1,450	2	EXISTING TO REMAIN W/O CHANGE
Passenger Service Manager's Representative Office	540	2	150	1	540	2	-	300	2	RECONFIGURED OFFICES IN EXISTING LOCATION; LEVEL 93-SOUTHWEST
Agent Office: US Immigration and Customs Enforcement	960	1			960	1	-	780	1	As required by CBP; RELOCATED TO LEVEL 93 - SOUTHWEST
Personal Protective Equipment (PPE) Storage	250	1	200	1	250	1	-	595	2	EXISTING TO REMAIN W/O CHANGE (252 SF); NEW- LEVEL 93 - 345 SF
Exit Control	6,590		630	2			(1,150)			Combined processing and queuing areas
Exit Control Queuing Area	Incl. in processing area		6,250		6,250			13,570		Assumes .05% of 5,000 PHD
Global Entry	-	1	-	-	90	1		SEE ABOVE	2	
Standard	-	10	-	-	1,400	15		SEE ABOVE	11	
CBP Administration										
CBP Officer/Staff Areas										
Port Director's Office	380	1	230	1	380	1	-	380	1	EXISTING TO REMAIN W/O CHANGE
Port Director's Conference Room	**240**	**1**	**300**	**1**	300	1	(60)	300	1	EXISTING TO BE ENLARGED
Port Director's Secretary/Reception Area	180	1	230	1	230	1	(50)	240	1	EXISTING TO BE ENLARGED
Assistant Port Director's Office	410	1	180	1	410	1	-	410	1	EXISTING TO REMAIN W/O CHANGE
Chief Officer's Office	1,670	8			1,670	4	-	2,150	12	(4) EXISTING + (5) NEW AT LEVEL 116 - NORTHEAST; (1) EXISTING ON NW (350 SF) MEZZANINE TO REMAIN; (1) NEW LEVEL 93 NW (180 SF); (1) EXISTING LEVEL 116 - (180 SF)
Supervisor's Office	3,390	18	1,350	1	3,390	18	-	4,503	26 WKSTN 6 OFFICE	Level 2-Underutilized, make open work stations; NEW OPEN WORKSTATION AREA AT LEVEL 116 - NE + (1) OFFICE 150 SF, (2) EXISTING OFFICES - 260 SF + (2) NEW OFFICES - 300 SF LEVEL 116 SE, (1) EXISTING OFFICE - 183 SF MEZZANINE LEVEL
Intelligence Office	-	-	150	1	150	1	(150)	-	-	Included in Fraudulent Documentation Analysis Room - SEE FRAUD DOC ANALYSIS ABOVE
General Office Workstations "C"	4,940	4	3,200	1	4,940	4	-	3,220	25 WKSTN	OPEN WORKSTATIONS AREA - LEVEL 93- SW - 3220 SF W/ 25 WKSTATIONS

FACILITY	EXISTING INVENTORY Area (sf)	EXISTING INVENTORY Pos.(ea)	DESIGN STANDARDS Area (sf)	DESIGN STANDARDS Pos.(ea)	REQUIREMENTS PAL 33 Area (sf)	REQUIREMENTS PAL 33 Pos.(ea)	AREA DIFFERENCE (EX VS. REQ) Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Area (sf)	PROPOSED Pos.(ea)	NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
Anti-Terrorism Contraband Enforcement Team Office "B"	880	1	1,070	12	1,070	12	(190)	880	1	Workstations in groups of 4; 100 sf of aisle per every 4 stations; EXISTING TO REMAIN
Passenger Analysis Unit (PAU) Office	1,560	1	1,070	12	1,560	1	-	1,560	1	Workstations in groups of 4; 100 sf of aisle per every 4 stations' EXISTING TO REMAIN
Outbound Team (OBT) Office	1,180	1	360	4	1,180	1	-	1,180	1	EXISTING TO REMAIN
Fish and Wildlife Services Office	1,010	1			760	1	250	1,010	1	Existing space too large; reduction of 25%; EXISITNG TO REMAIN W/O CHANGE
Internal Affairs Office	140	1			140	1	-	140	1	As required by CBP; RELOCATED TO LEVEL 116 - NORTHEAST
CDC Isolation Suite	1,490	1			1,490	1	-	2,350	1	As required by CBP; EXISTING TO REMAIN - POTENTIAL TO ENLARGE INTO OLD COUNTER TERRORISM SUITE IF DESIRED
CBP Support Space										
Airport Reception	110	1	120	1	120	1	(10)	-	-	NOT REQUIRED PER CBP
Public Reception/Entrance and Clearance (E&C) Office	-	-			-		-	-	-	As required by CBP
ID Badging, Trusted Traveler Enrollment Center, and File room	910	1	180	1	910	1	-	910	1	EXISTING TO REMAIN W/O CHANGE
Muster/Training Room	2,160	3	750	1	2,160	3	-	2,160	3	EXISTING TO REMAIN W/O CHANGE
Muster/Training Equipment Storage	140	1	50	1	140	1	-	140	1	EXISTING TO REMAIN W/O CHANGE
Mail, Copy, and Shredder	500	3	120	1	500	3	-	500	3	EXISTING TO REMAIN W/O CHANGE
Weapons Storage Room	340	2			-		340	170	2	To be located remotely - EXISTING TO REMAIN W/O CHANGE; LEVEL 93 SW + LEVEL 116 NE
Weapons Cleaning Room	90	1			-		90	240	2	To be located remotely - EXISTING TO REMAIN W/O CHANGE; LEVEL 93 SW + LEVEL 116 NE
Communication Equipment Room	310	2	100	1	310	2	-	310	2	Includes telephone and radio; EXISTING TO REMAIN W/O CHANGE
LAN/Telco Room	520	2	230	1	520	2	-	520	2	EXISTING TO REMAIN W/O CHANGE
Wiring Closet-IDF	1,290	5	260	1	1,290	5	-	1,290	5	EXISTING TO REMAIN W/O CHANGE
General Storage/File Room	2,780	8	530	1	2,780	8	-	3,110	10	EXISTING AND NEW LOCATIONS
Temporary Seize Property Room	310	1	120	1	310	1	-	310	1	EXISTING TO REMAIN W/O CHANGE
Staff Break Room	1,330	4			1,330	4	-	1,330	4	As required by CBP; EXISTING TO REMAIN
Male and Female Staff Toilets/Showers/Lockers	3,970	2			3,970	2	-	3,970	2	As required by CBP; Keep Staff Restrooms and Breakrooms; EXISTING TO REMAIN
Union Office	300	1	150	1	300	1	-	300	1	EXISTING TO REMAIN W/O CHANGE - NEAR INTRANSIT LOUNGE LEVEL 116
Physical Training Room	800	1			800	1	-	800	1	As required by CBP; EXISTING TO REMAIN W/O CHANGE

FACILITY	EXISTING INVENTORY Area (sf)	EXISTING INVENTORY Pos.(ea)	DESIGN STANDARDS Area (sf)	DESIGN STANDARDS Pos.(ea)	REQUIREMENTS PAL 33 Area (sf)	REQUIREMENTS PAL 33 Pos.(ea)	AREA DIFFERENCE (EX VS. REQ) Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Area (sf)	PROPOSED Pos.(ea)	NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
US PASS/NEXUS Enrollment Center and Storage	1,600	2			1,600	2	-	1,600	2	As required by CBP; EXISTING TO REMAIN W/O CHANGE
Lactation Support Room	190	1	80	1	190	1	-	210	1	RELOCATED TO LEVEL 116 - NORTHEAST; ADD PLUMBING TO EXISTING ROOM
VIP Lounge	570	1			570	1	-	570	1	As required by CBP; EXISTING TO REMAIN W/O CHANGE
In-transit Lounge	7,350	1			7,350	1	-	7,350	1	EXISTING TO REMAIN W/O CHANGE
Total FIS Facility Area	**272,550**		**98,380**		**271,370**		**(8,840)**	**315,680**		
Recheck Lobby	-									
Baggage Drop-off Belts	4,040	6	-	-	5,010	6	-	5,010	6	Includes baggage right-of-way; EXISTING TO REMAIN
Oversize Baggage Assistance	-		-	-	190	1	(190)	190	1	EXISTING TO REMAIN
Agent Assistance	4,520	31	-	-	5,700	30	(1,180)	5,700	30	EXISTING TO REMAIN
Airline Support/Storage	2,400	5			2,400	5	-	2,615	5	EXISTING & NEW LOCATIONS
VIP Lounge	590	1			590	1	-	590	1	EXISTING TO REMAIN
Baggage Service Office	2,120	2			2,120	2	-	3,360	2	UNITED - 1840 SF; FOREIGN FLAG = 1520 SF
Baggage Right-of-Way	970				Incl. in processing area			Incl. in processing area		
TOTAL RECHECK FACILITY AREA	**14,640**				**16,010**		**(1,370)**	**17,465**		
Terminal E Ticketing Lobby	13,850				13,850		-	13,850		
Bypass Kiosk	Incl. in Lobby Area									
Economy Positions										
Kiosk	Incl. in Lobby Area									
Agent	Incl. in Lobby Area									
Bag-Drop	Incl. in Lobby Area									
Premium Positions										
Kiosk	Incl. in Lobby Area									
Agent	Incl. in Lobby Area									
Bag-Drop	Incl. in Lobby Area									
Ticketing Support Space										
Airline Ticket Office	8,720				8,720		-	9,100	2	UNITED ATO IS RECONFIGURED - ALL NON-SECURE
Baggage Right-of-Way	450				450		-	450		
Total Terminal E Ticketing Lobby	**23,020**				**23,020**		**0**	**23,400**		
Transportation Security Administration-Existing Configuration										
Terminal E Security Checkpoint	13,620	6								N/A

FACILITY	EXISTING INVENTORY Area (sf)	EXISTING INVENTORY Pos.(ea)	DESIGN STANDARDS Area (sf)	DESIGN STANDARDS Pos.(ea)	REQUIREMENTS PAL 33 Area (sf)	REQUIREMENTS PAL 33 Pos.(ea)	AREA DIFFERENCE (EX VS. REQ) Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Area (sf)	PROPOSED GREEN = EXISTING WITH NO CHANGE Pos.(ea)	NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
Standard Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP								N/A
Pre √™ Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP								N/A
Queue Area	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP								N/A
TSA Offices/Support & Resolution Rooms	-									N/A
Transfer Security Checkpoint	9,950	6								N/A
Standard Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP								N/A
Pre √™ Lanes	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP								N/A
Queue Area	Incl. In Terminal E SSCP	Incl. In Terminal E SSCP								N/A
TSA Offices/Support & Resolution Rooms	1,090	2								N/A
Total Separate TSA Facility Area	**24,660**									
Transportation Security Administration-Consolidated Configuration										
Consolidated Security Checkpoints										
Standard Lanes	N/A	N/A			16,200	12		14,280	11	
Pre √™ Lanes	N/A	N/A			4,410	3		3,900	3	
Queue Area	N/A	N/A			8,240			8,290		
TSA Offices/Support & Resolution Rooms	N/A	N/A			2,250			1,350	2	EXISTING BREAKROOM TO REMAIN = 903 SF; NEW OFFICES = 450 SF; UNDER PROGRAM REQUIREMENT SIZE - CONFIRM WITH TSA
Total Consolidated TSA Facility Area	**N/A**				**31,100**		**N/A**	**27,820**		
General Spaces										
Houston Police Department	590	2			590	2	-	460	2	RELOCATED TO EXISTING GE ENROLLMENT CENTER - LEVEL 116
Airport Support/Storage	7,610	9			7,610	9	-	3,080	7	EXISTING AND NEW LOCATIONS
Airport Amenities	2,250	4			2,250	4	-	2,250	4	EXISTING TO REMAIN WITHOUT CHANGE
Concessions	5,980	6			5,980	6	-	5,521	4	LEVEL 116 = 4170 SF (RELOCATED); LEVEL 93 = 1321 SF (EXISTING TO REMAIN)
Concession Storage/Support	-	-			-	-	-	-	-	

	EXISTING INVENTORY		DESIGN STANDARDS		REQUIREMENTS PAL 33		AREA DIFFERENCE (EX VS. REQ)	PROPOSED GREEN = EXISTING WITH NO CHANGE		NOTES PROPOSED PLAN LOCATIONS & COMMENTS SHOWN IN CAPS
FACILITY	**Area (sf)**	**Pos.(ea)**	**Area (sf)**	**Pos.(ea)**	**Area (sf)**	**Pos.(ea)**	**Area (sf)**	**Area (sf)**	**Pos.(ea)**	
Public Restroom	4,360	3	-	-	6,270		(1,910)	4,370	3	EXISTING TO REMAIN; WHERE IS THE ADDITIONAL RR CAPACITY NEEDED?
Cart Return	3,800	2			3,800	2	-	2,930	4	CART RESTOCK CORRIDOR IS MAINTAINED WITH REDUCTION; CART STORAGE IN NEW BAG CLAIM ANNEX
Meeter/Greeter	10,490	2			10,490	2	-	10,490	2	EXISTING TO REMAIN
Unassigned	-	-			-	-	-			
Building Systems	30,100				30,100		-	34,870		Includes MEP and building structure; ADDITIONAL MEP LOCATED IN EXPANSION AREA - LEVEL 93
Open to Below	1,990				1,990		-	1,990		EXISTING TO REMAIN
Vertical Circulation	-	-					-			
Sterile Vertical Circulation							-			
Public Secure Vertical Circulation	3,250				3,250		-	3,972		
Public Non-Secure Vertical Circulation	2,760				2,760		-	2,760		
Non-Public Vertical Circulation	10,650				10,650		-	11,635		
Circulation	-	-					-			
Sterile Vertical Circulation							-			
Public Secure Circulation	37,730				31,540		-	37,170		
Public Non-Secure Circulation	28,970				37,730		-	28,100		
Non-Public Circulation	19,920				28,970		-	19,920		
Total General Spaces	**204,590**				**206,500**		**(1,910)**	**169,518**		
Grand Total Facility Area	**539,460**		**(Existing SSCP)**		**562,100**		**(22,640)**	**553,883**		
			(Consolidated SSCP)		**548,000**					

Notes:

1. Square footages are rounded to nearest ten square feet.

2. Design Standards based on US Customs and Border Protection, Airport Technical Design Standards, June 2012.

3. Transportation Security Administration, Checkpoint Design Guide (CDG), Revision 5.1, May 7, 2014.

5.1 FIS Projects

This section includes the preferred advanced planning-level strategy recommended for implementation that relates to the function of the CBP facility and the Terminal E processor. The planning process included a detailed coordination effort between HAS and all applicable key stakeholders, including United Airlines, foreign flag carriers, the TSA and CBP. Using the program requirements outlined in **Chapter 4** and the CBP Airport Technical Design Standards (2012 version), a detailed space plan was developed. The preferred plan is pending CBP review and approval. Upon conceptual plan approval, CBP will assign a project manager to coordinate with the future design and construction team and provide an official letter of conceptual plan approval that will allow the future design team to move forward. The plan includes renovation and expansion on four levels of the FIS facility (as shown in **Figures 5.1**-**5.4**)

- Level Two (116) – Primary processing, CBP administration, Terminal E ticketing and security checkpoints (**Figure 5.1**)
- Mezzanine (105) – CBP administration (**Figure 5.2**)
- Level One (93) – Baggage claim expansion, consolidated secondary processing and support, exit control, recheck and meeter/greeter lobby (**Figure 5.3**)
- Baggage Level (78/82) – Baggage makeup expansion (**Figure 5.4**)

5.1.1 LEVEL TWO (116)

Level Two, as shown in **Figure 5.1**, is dedicated to the CBP inspection hall. The Terminal E processor ticket lobby is located on this level, including United Airlines check-in counters and ticketing offices, security screening checkpoints, enplaning curbside, secure concessions, building systems and access to the parking garage.

5.1.1.1 Primary Processing

One of the primary goals of the project is to enhance the capacity and throughput of passengers at the Primary Processing Hall. Currently, the facility is divided into two areas: north, serving the Terminal D traffic, and south serving the Terminal E traffic. During peak times, CBP staff assists to direct passengers from opposite sides of the facility to balance the demand and wait times on each side. Upon entrance to the facility from both sides, passengers must locate their respective queue area between the following options as described in **Chapter 3**.

- Foreign National
- Automated Passport Control (APC) for US/LPR and Visitors
- Global Entry
- OneStop
- Crew

Dynamic wayfinding shall be installed at key areas throughout the facility to direct passengers to the correct queue areas. This should help eliminate this currently staffed task. Potential dynamic wayfinding locations in primary processing include the entrance to the FIS Primary Hall prior to queue entry on the north and south, within the queue area to indicate wait times to each queue destination, and above the processing booth or podiums to indicate which are available to the next person in line. The preferred Primary Processing Plan (PPP) is shown on **Figure 5.5**.

Automated Passport Control (APC)
The preferred plan includes 56 total APC kiosks, with 28 units on each side. The existing south APC units will be relocated to the far southeast portion of the facility and expanded. A 10-foot wide circulation corridor should be maintained between the APC area and curtain wall for egress and operational purposes. Likewise, the new north APC program shall be located at the far northeast corner of the facility, leaving a 10-foot circulation corridor between the APC area and curtain wall for egress and operational circulation. The queue to access the APC kiosks is separated by Visitors and US/LPR. A staffed CBP employee will be located at the front of the APC kiosk area to help direct to available kiosks. All APC are located along one spine, with no columns impairing visual sight from entry to all kiosks. After utilizing the APC kiosk, the passenger continues to the end of the spine where they are separated into two queues, APC verification and APC triage. Due to the close proximity of the APC kiosks to the building curtain wall, it is recommended that a frit (or other sun shade component) is applied to the existing curtain wall glazing. The daylight glare upon the APC kiosk screen has provided some issues to the existing APC and this issue should be resolved as part of the renovation project.

APC Verification and APC Triage
The post-APC queue is separated by Triage and Verification. There are twelve APC verification podiums located per side. The APC podiums shall be relocated to their new positions as shown on the preferred plan. The APC triage queue includes 13 double position booths, creating 26 positions per side. The existing booths shall be reused for this purpose. Please note some of the existing booths may require relocation to align with the preferred plan.

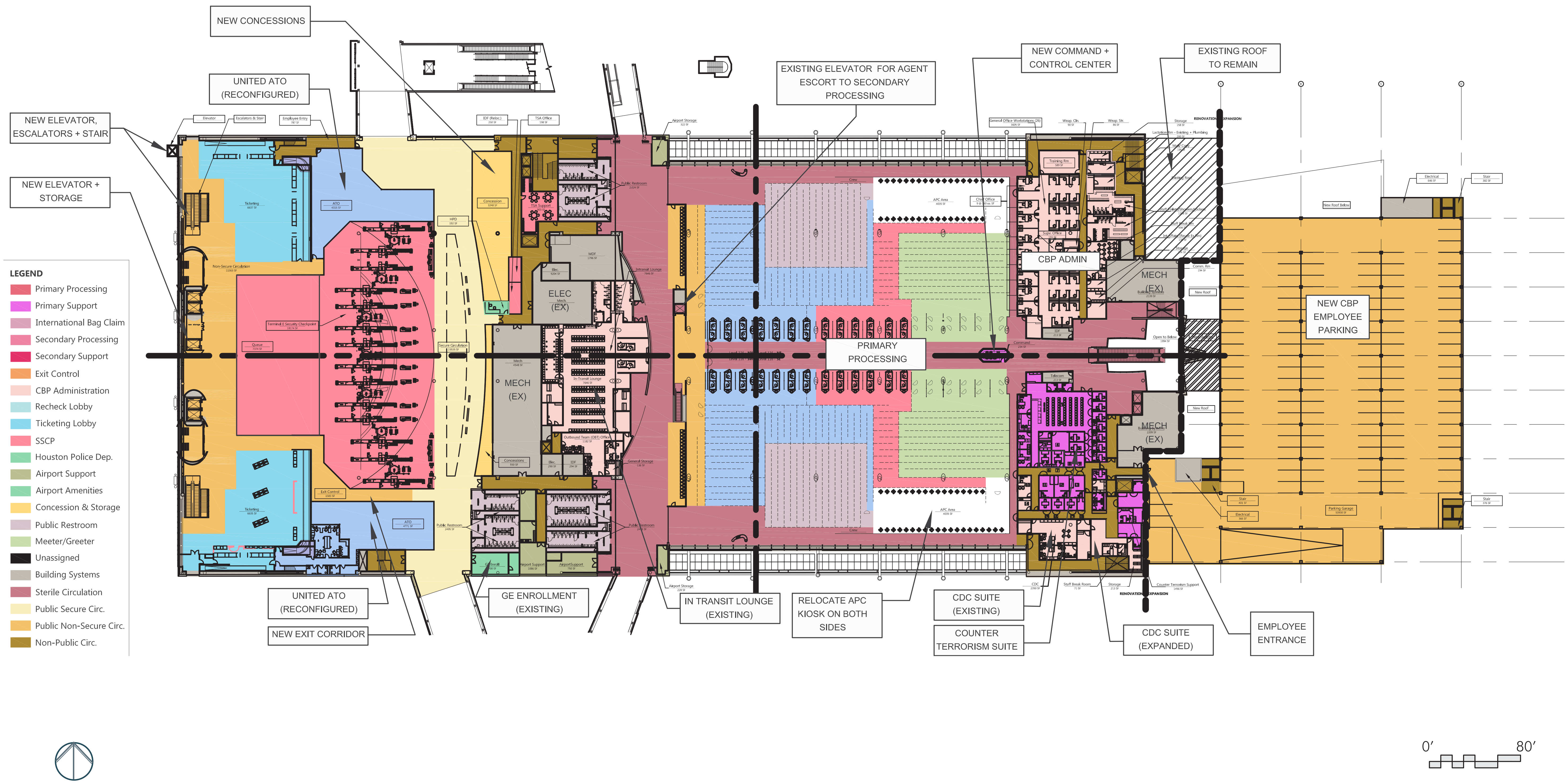
Foreign National
The Foreign National queue includes a total of 12 double-position booths, creating 24 Foreign National agent positions (12 per side). The existing booths are to remain (or be relocated per the preferred plan). No additional millwork or cladding is required.

The APC pre-queue is rotated for future flexibility. As more non-U.S. residents are allowed to utilize the APC, this queue will grow, while the non-Visa waiver queue will diminish. Likewise, if the future demand warrants additional APC kiosks beyond the initial 60 required for this program, there is the ability to grow to the west from the APC area.

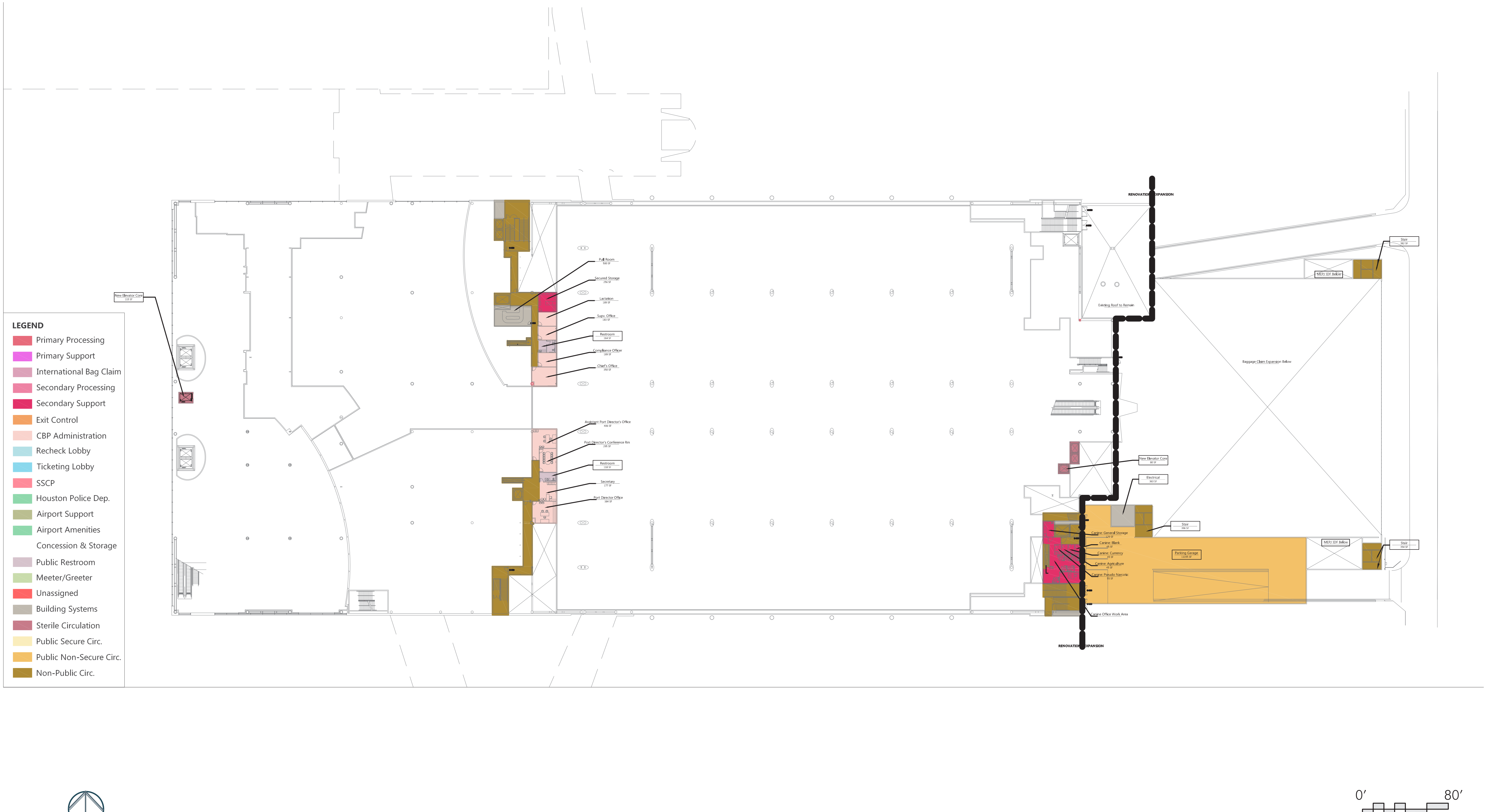
Global Entry / OneStop
The existing Global Entry kiosks are to remain in their current location. Two additional units (one per side) should be added for a total of 42 kiosks per the program requirements, stated in **Chapter 4**. Passenger circulation after the kiosks is to remain in its current state. Passengers without baggage can go directly to the existing escalator or elevator at the west side of the Primary Processing Hall and then bypass exit control below on Level 93.

Crew
Airline crew will have direct access to the APC kiosk via a separate small queue located along the curtain wall. Airline crew will have first priority to the next available APC kiosks utilizing this queue. (see **Figure 5.6**).

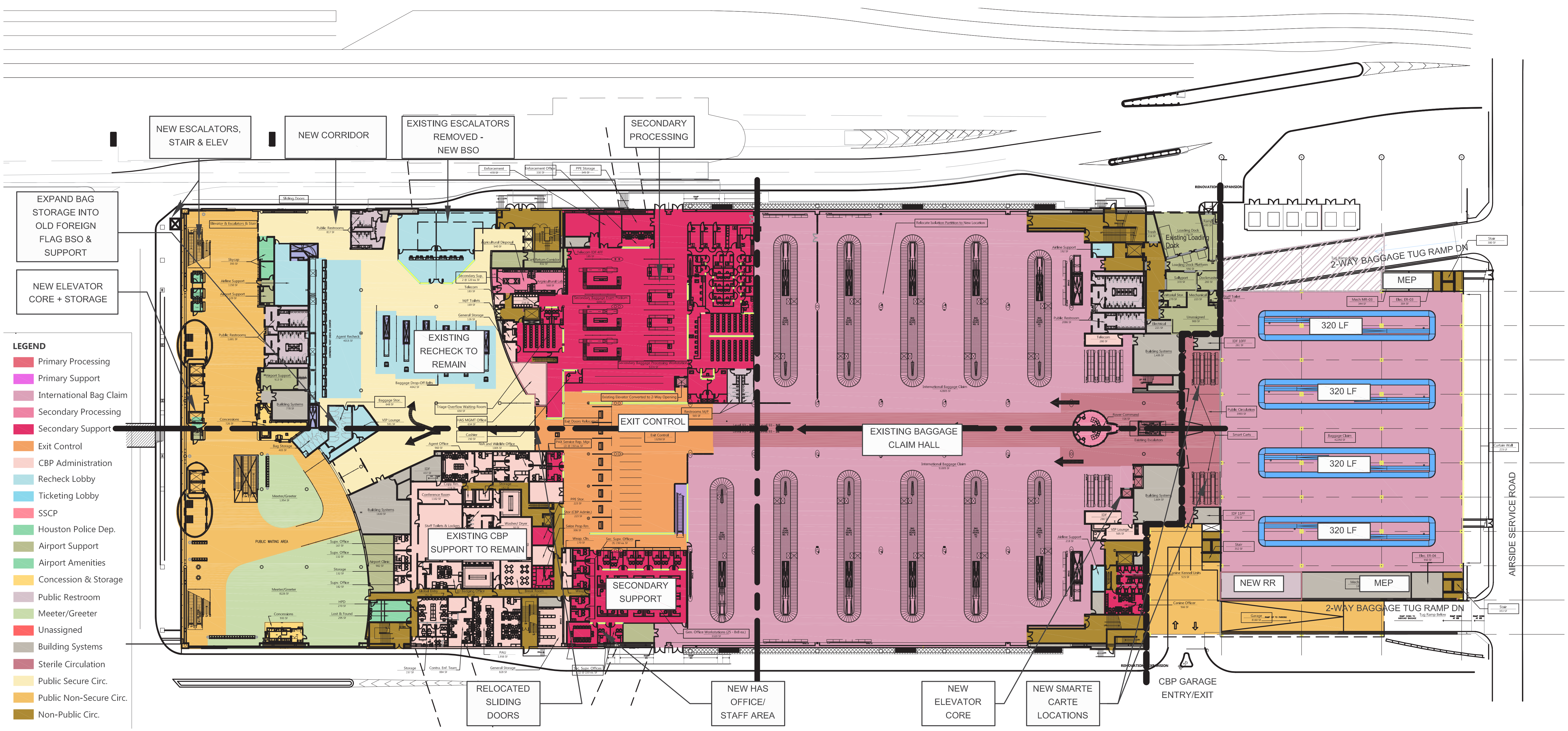
FIS Facility - Proposed Level 2 (116)



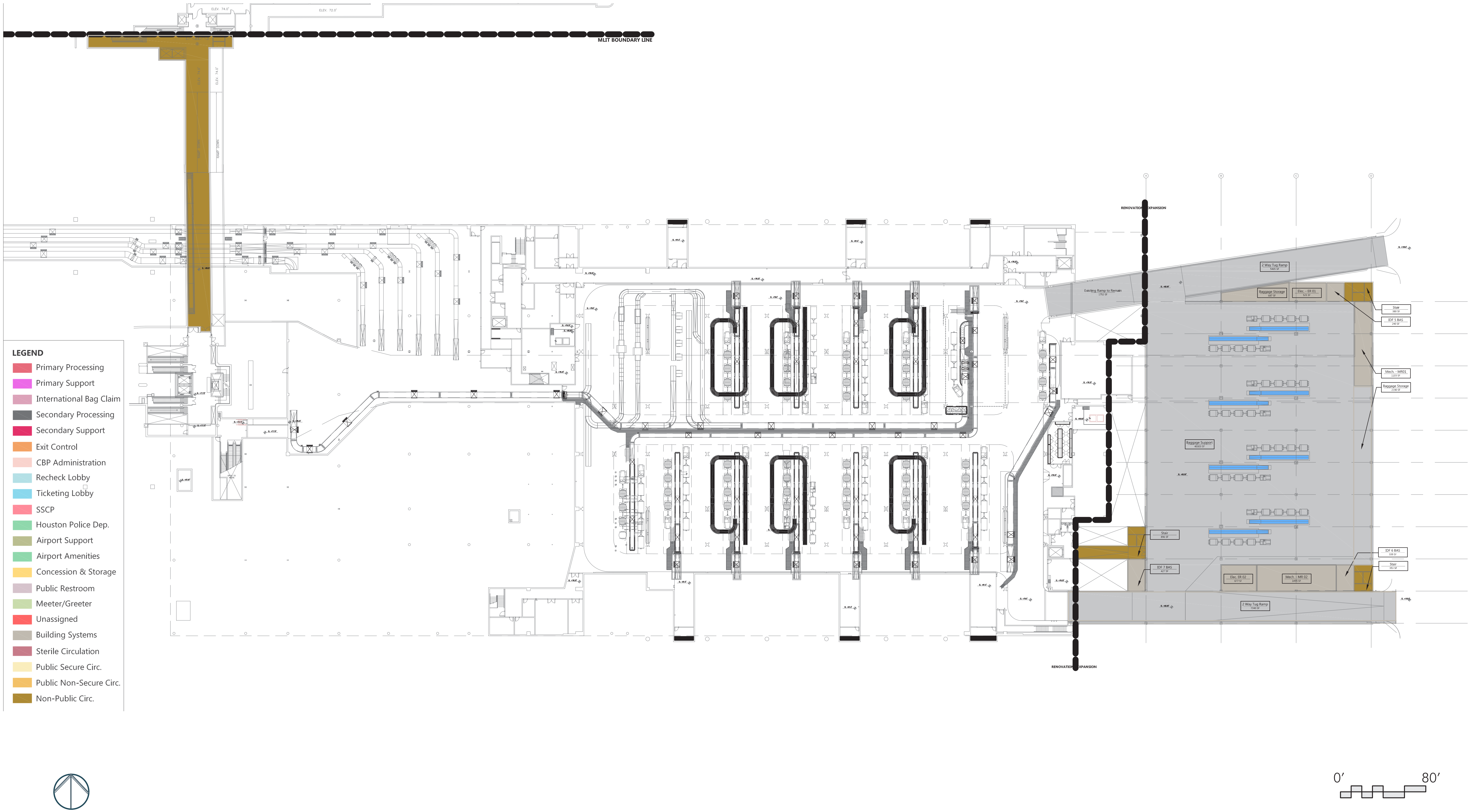
FIS Facility - Proposed Mezzanine Level (105)



FIS Facility - Proposed Level 1 (93)



FIS Facility - Proposed Baggage Level (78)



Primary Processing - Preferred Plan

FOREIGN NATIONALS:

BOOTHS:

- REQ'D: 24 PROPOSED: 24 (12 PER SIDE)

QUEUE: REQ'D: 3,350 SF (140 SF/KIOSK)

PROPOSED: 18,040 SF (752 SF/AGENT)

APC KIOSK:

APC:

- REQ'D: 56 PROPOSED: 74 (37 PER SIDE)

QUEUE: REQ'D: 8,480 SF (152 SF/KIOSK)

PROPOSED: 8,070 SF (110 SF/KIOSK)

APC VERIFICATION:

PODIUMS:

- REQ'D: 22 PROPOSED: 22 (11 PER SIDE)

QUEUE: REQ'D: 4,910 SF (223 SF/KIOSK)

PROPOSED: 14,070 SF (640 SF/KIOSK)

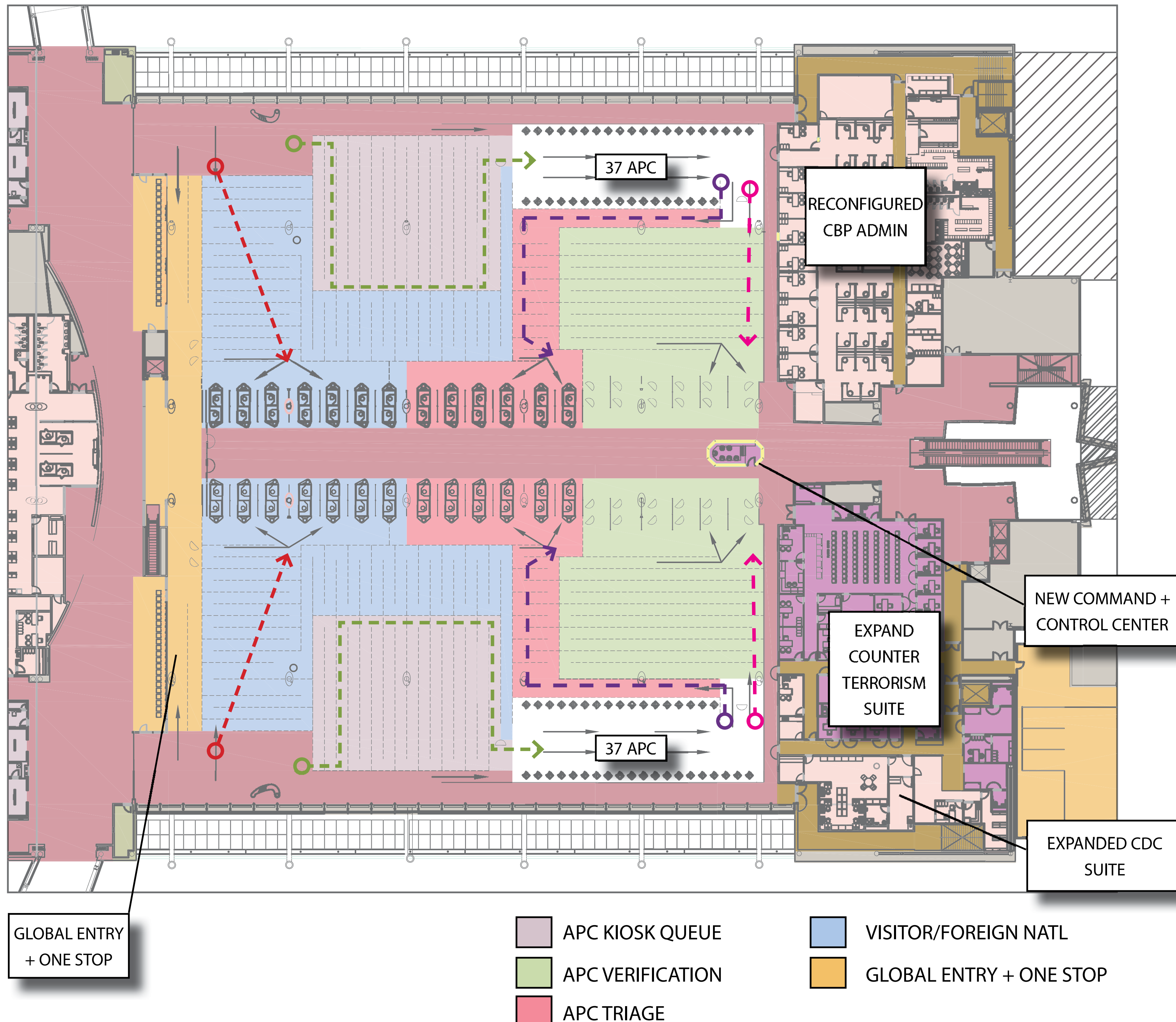
APC TRIAGE:

BOOTHS:

- REQ'D: 25 PROPOSED: 26 (13 PER SIDE)

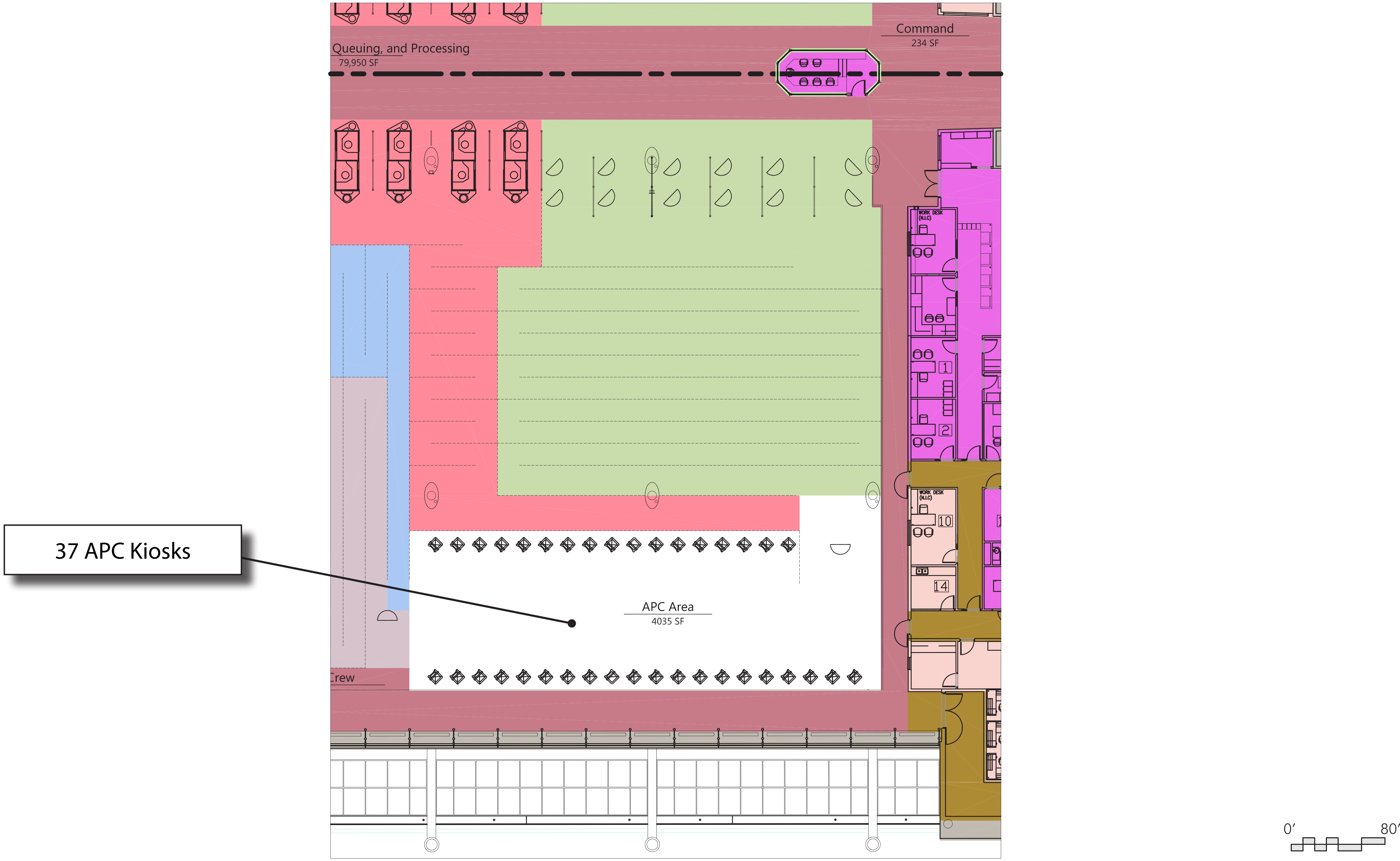
QUEUE: REQ'D: 1,890 SF (73 SF/KIOSK)

PROPOSED: 8,026 SF (309 SF/KIOSK)



Not to Scale

APC Plan - Level 116 Southeast



Command and Control Center

To maximize the viewing angles across the entire primary processing hall, the Command and Control Center will be relocated to a centrally located raised podium within the main circulation spine. The APC verification podiums will be located to align with the columns, thus creating a 40-foot-wide area. The new Command and Control Center is approximately 24 feet long by 10 feet wide and is to be located in the middle of this newly formed 40-foot-wide spine. Passengers will circulate around this room and then to the existing escalators beyond. The central location is critical for CBP staff observation LOS to the entire primary facility. The room includes 360 degree one-way glass, a raised 22-inch platform and millwork for six staff positions. The room shall be designed per the CBP guidelines. It is recommended to include CCTV cameras at any location within the primary processing facility that are not within visual sight of the Command and Control Center.

Hartsfield-Jackson Atlanta International Airport (ATL) uses a similar layout for the Command and Control Center. **Figure 5.7** depicts a comparison for the proposed IAH layout with ATL. The circulation width is similar and slightly wider in the IAH preferred plan layout, compared to ATL.

5.1.1.2 Northeast CBP Administration Reconfiguration

The current offices and soft secondary area located in the northeast quadrant is currently configuired in a sparse and inefficient layout for today's needs by CBP. The area will be reconfigured to include a mix of existing and new chief offices located along the west wall with windows to the Primary Processing Hall. The existing weapons storage/cleaning, staff break rooms, locker rooms, storage, mail/copy and communication rooms will remain without change. The lactation room shall be relocated to this area within the former office in the far northeast portion. The Internal Affairs office shall be relocated to the existing office south of the break room. This relocation does not require any shell/finish change. The existing Training/Computer room at the northern portion of this area will be expanded to the east to allow for larger meetings and training sessions. The remaining space between the new chief offices and the existing staff area shall be converted to an open office environment. This area will allow for 26 workstations (8 feet by 8 feet) and allow staff flexibility and the opportunity for interaction and efficiency. In addition, one additional supervisor office will be constructed directly to the west of the existing weapons rooms. The existing IDF at the southern edge of this sector will remain without change. It was determined through the planning study to maintain all existing IDF locations whenever possible.

Figure 5.8 depicts the CBP northeast administration reconfiguration.

5.1.1.3 Counter-Terrorism Suite

The existing secondary processing referral wait area and support, commonly identified as "hard secondary," will be relocated to Level 93 as part of this program. This existing space will remain with no change, however, will be repurposed as the Counter Terrorism Suite. All existing interview, holdrooms and search rooms will remain without change as part of this new suite. A new "Ink" room that will reuse an existing room, but will require new plumbing and millwork. All offices along the west wall shall have windows that look upon the Primary Processing Hall. The existing IDF room along the passenger circulation spine will remain without change as part of this project.

The existing Counter-terrorism Suite is currently located in the southeast corner of this sector. This space will remain without change as an employee break and storage area. The existing CDC Suite will be reconfigured and expanded to the east to include a new storage room. Further coordination with the CDC is required by the design team to ensure the proper layout is accommodated for their use (see **Figure 5.9**).

5.1.1.4 Consolidated Security Checkpoint

A priority for TSA is to maximize efficiencies whenever possible. The current facility contains two separate security checkpoints that must be staffed. Based upon demand at the various peak times, one checkpoint is often overwhelmed while the other checkpoint and its staff are underutilized. International travelers with connections in Houston traverse from the lower level to the recheck security checkpoint above via escalators/elevators and go directly into the security queue. During peak intervals, the queue will snake down the escalators to the lower floor. Due to physical plan limitations in this area, it is difficult to accommodate additional queue without major rework of the adjacent mechanical and electrical rooms. It was determined that these options may be too costly and challenging to integrate through a phasing process while keeping the building completely operational.

The consolidated checkpoint was preferred by the majority of the stakeholders to address these issues. The current Terminal E and recheck checkpoints include six lanes each. The preferred consolidated checkpoint has a total of 14 lanes, all with access to the same queue. While the program requirements identify 15 lanes for the consolidated checkpoint, the planning study determined that 15 lanes were not physically possible without greatly compromising other functions. All lanes are designed to current TSA standards with ample post-screening recomposure area that will not spill out into the secure concourse as the recheck checkpoint currently does today.

An existing IDF room is located in, what will be, the southern portion of the new consolidated checkpoint. This IDF room will be relocated to the east behind the new Houston Police Department station. This will be the only IDF relocated within this program.

The queue achieves the desired area requirements described in **Chapter 4** with 8,240 sf (see **Figure 5.10**). The queue is designed for flexibility for future TSA technology updates. All passengers enter the queue from the Terminal E ticketing lobby.

5.1.1.5 TSA Support

The existing TSA break room located behind the recheck security lanes shall remain without change for the preferred plan. In addition, a TSA office is included across the hall from the existing TSA break room. All other TSA support spaces are collocated within the consolidated checkpoint area.

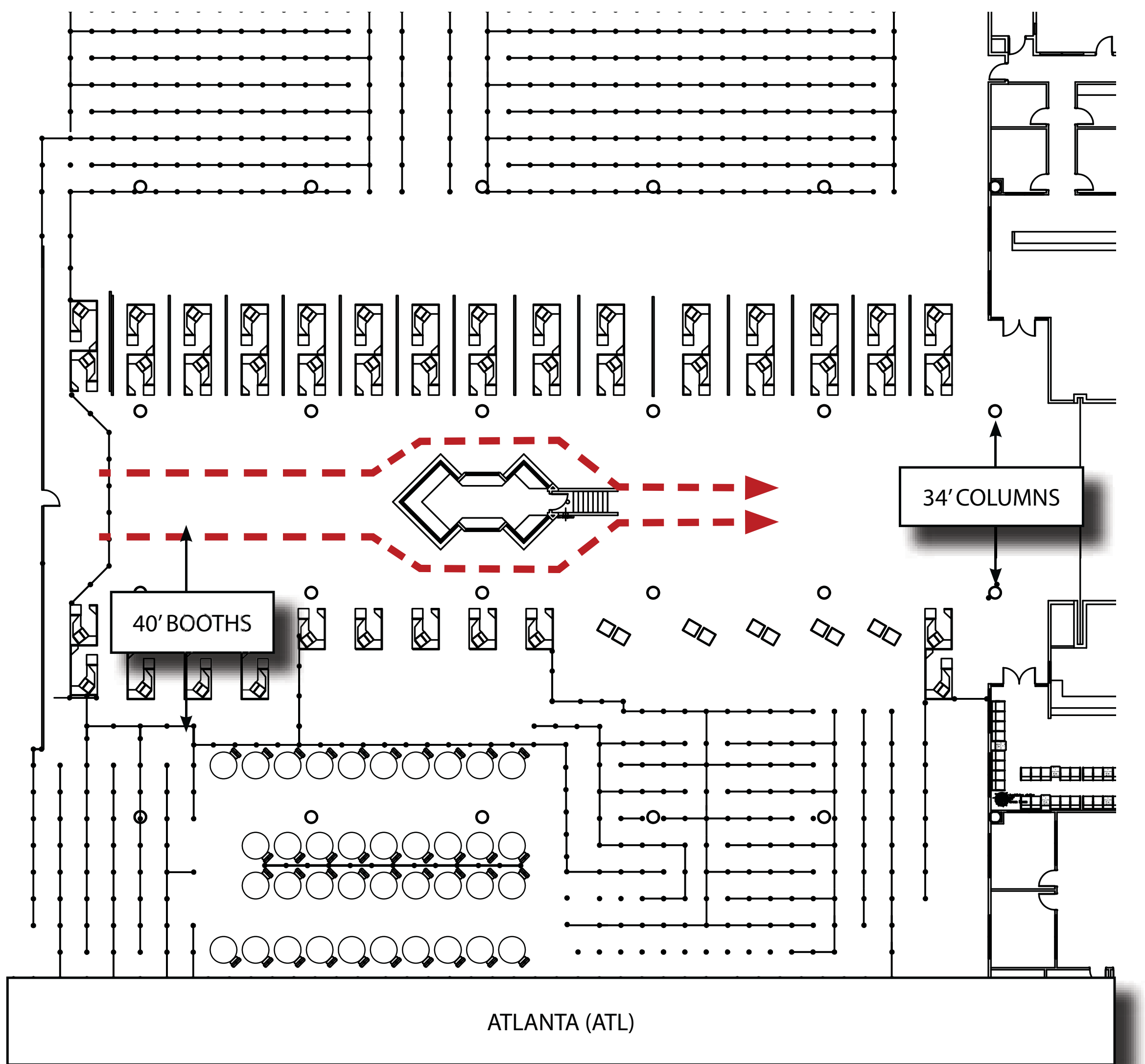
5.1.1.6 Exit Corridor

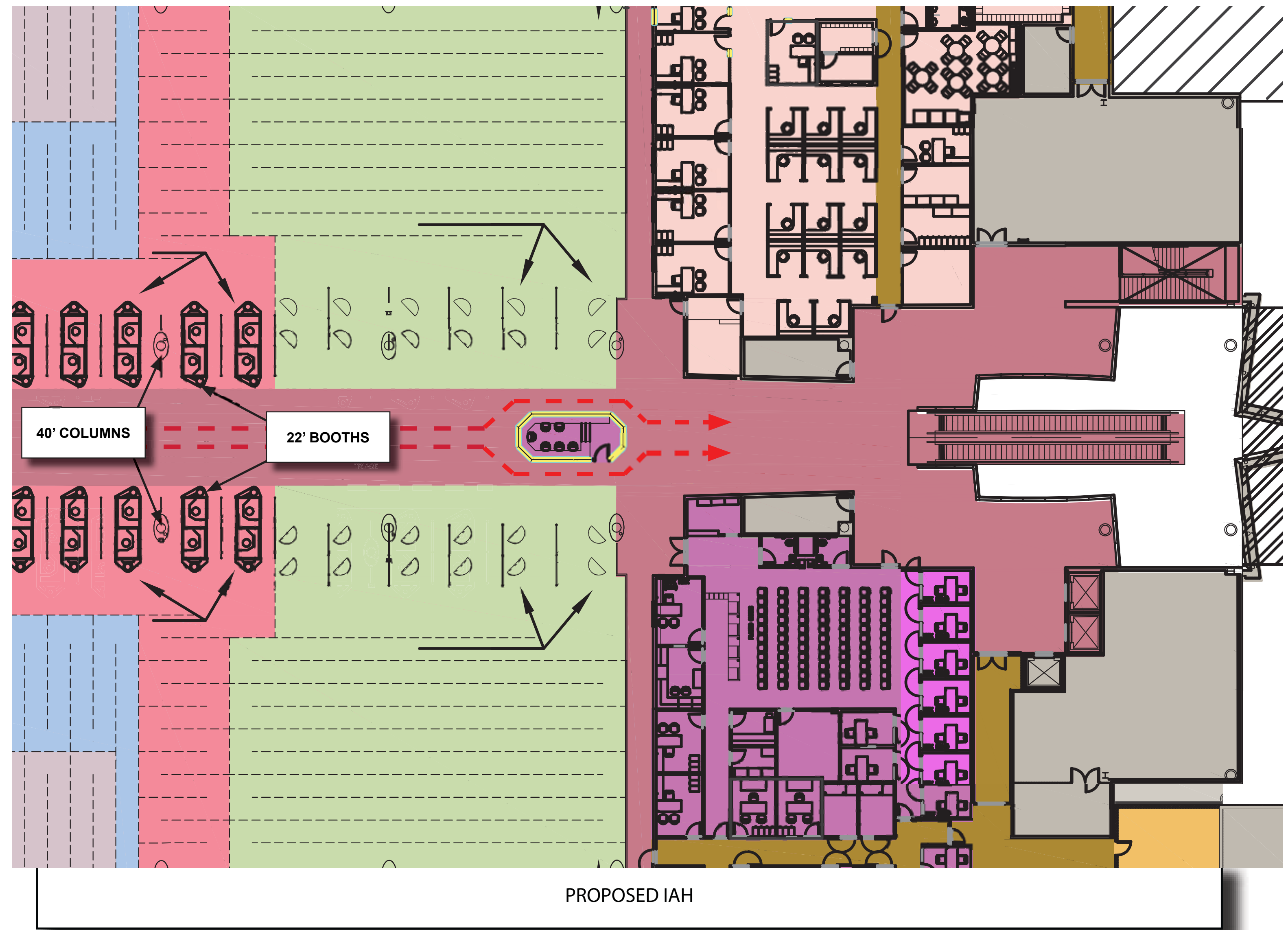
The current exit corridor will be impacted by the new consolidated checkpoint layout. The existing exit corridor is located on the northern side of the checkpoint area. The majority of the passengers utilizing this domestic and pre-clear arrivals exit corridor are coming from Terminal E to the south. The relocation of this corridor to the south of the new consolidated checkpoint will shorten the walking distance for those passengers coming from Terminal E and eliminate cross traffic of departing passengers exiting the security checkpoint. The corridor shall maintain a minimum 10 foot width. **Figure 5.10** depicts the proposed exit corridor in red.

5.1.1.7 Employee Entry

The current employee entrance to the secure concourse is located between the southernmost Terminal E checkpoint lane and the south United Airline Ticketing Office (ATO) space. This entry will be impacted by the consolidated checkpoint. The preferred location would use the existing door at the north United ATO space and then pass through the back of house corridor to the north side of the Terminal E secure area. After evaluating several options involving close coordination with UA, this appeared to be the best solution for the existing building. **Figure 5.10** depicts the proposed employee entrance path in green.

Primary Processing - Command + Control Center





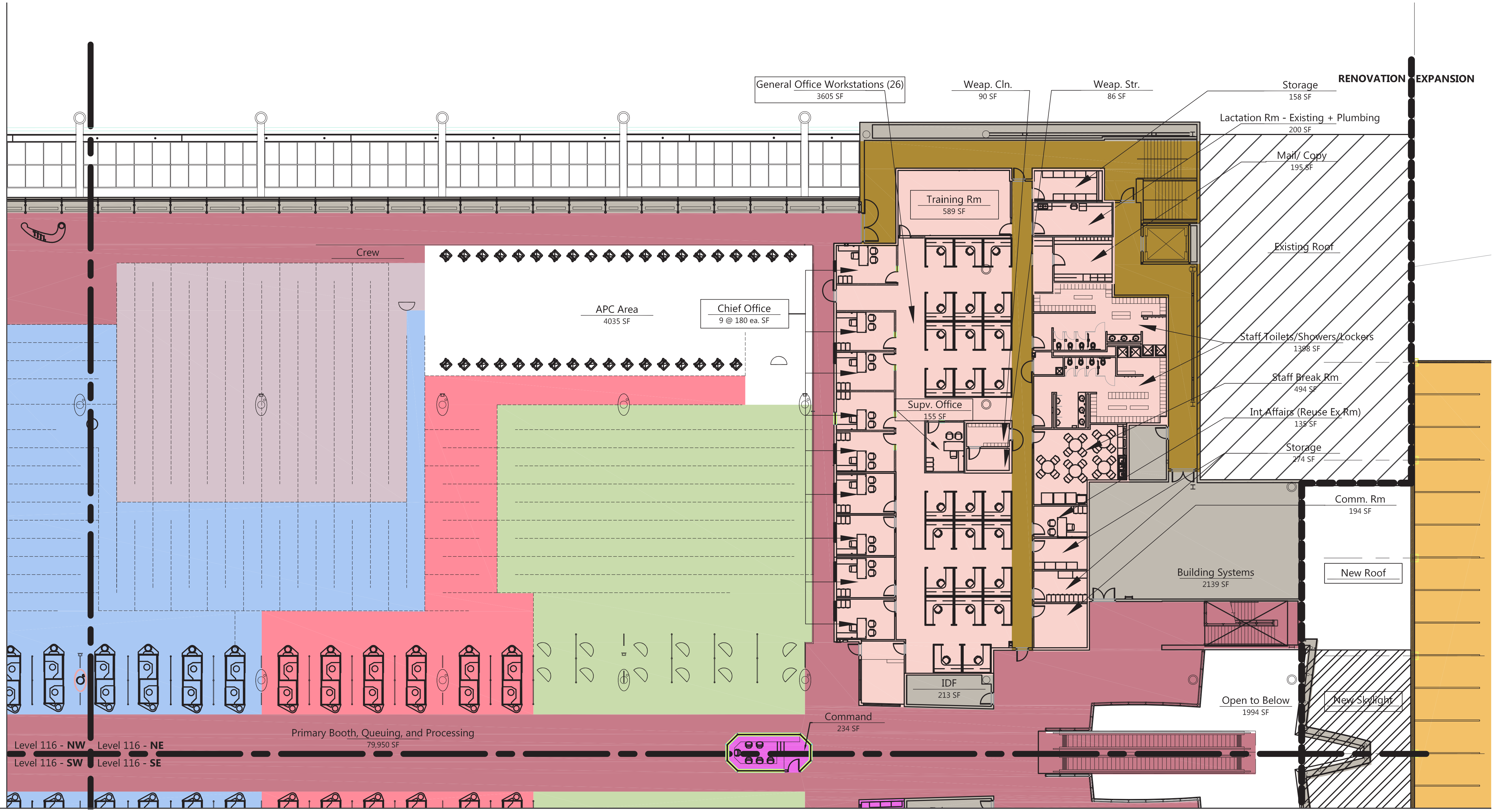
FIS COMPARISON

	ATL	IAH
DISTANCE BETWEEN COLUMNS	34'	40'
DISTANCE AROUND C+CC	10'	12'

- APC KIOSK QUEUE
- APC VERIFICATION
- APC TRIAGE
- VISITOR (NON-VISA WAIVER)
- GLOBAL ENTRY + ONE STOP
- CREW

Not to Scale

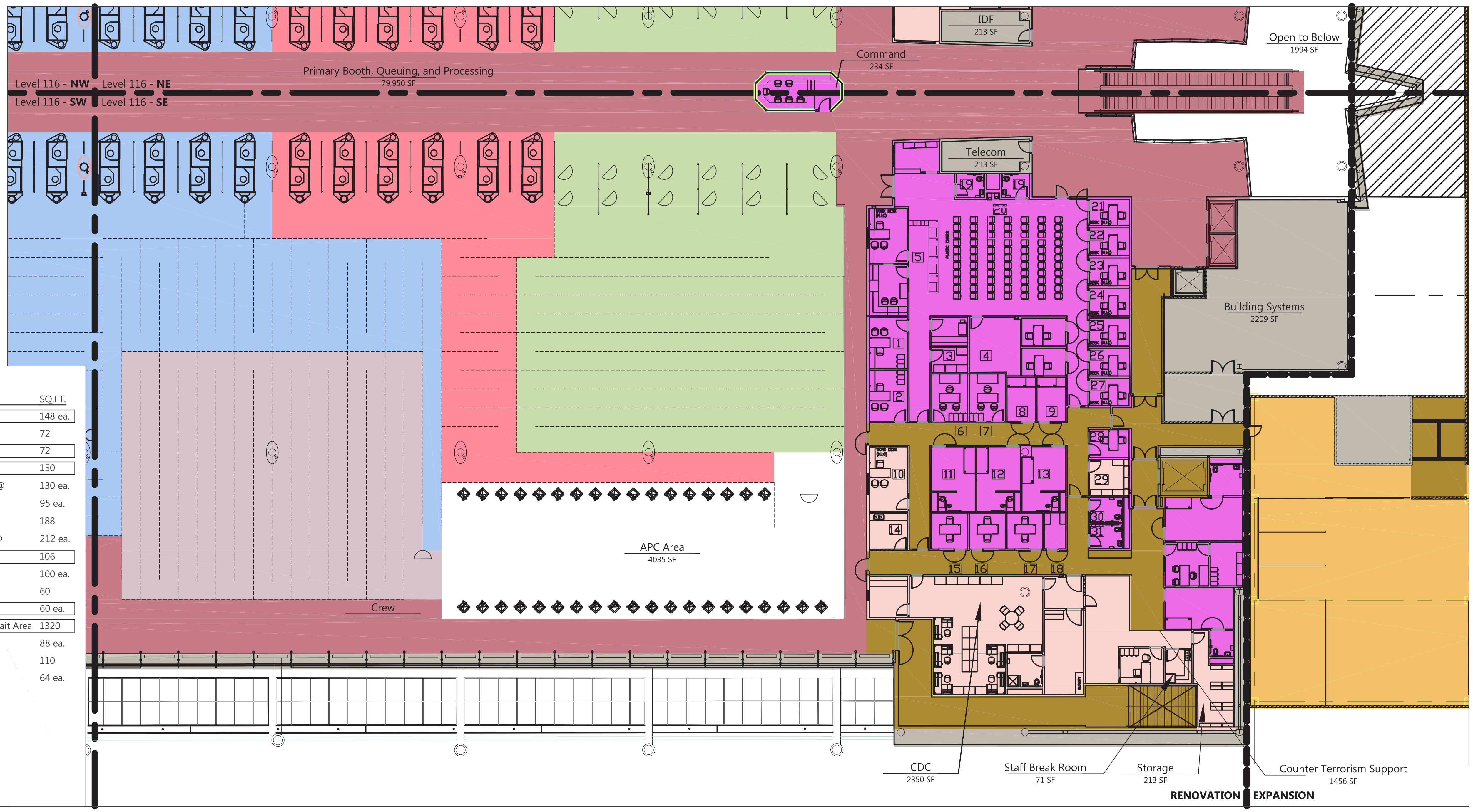
Level 116 Northeast - CBP Administration



LEGEND

- Primary Processing
- Primary Support
- International Bag Claim
- Secondary Processing
- Secondary Support
- Exit Control
- CBP Administration
- Recheck Lobby
- Ticketing Lobby
- SSCP
- Houston Police Dep.
- Airport Support
- Airport Amenities
- Concession & Storage
- Public Restroom
- Meeter/Greeter
- Unassigned
- Building Systems
- Sterile Circulation
- Public Secure Circ.
- Public Non-Secure Circ.
- Non-Public Circ.

Level 116 Southeast - Preferred Plan



LEGEND

- Primary Processing
- Primary Support
- International Bag Claim
- Secondary Processing
- Secondary Support
- Exit Control
- CBP Administration
- Recheck Lobby
- Ticketing Lobby
- SSCP
- Houston Police Dep.
- Airport Support
- Airport Amenities
- Concession & Storage
- Public Restroom
- Meeter/Greeter
- Unassigned
- Building Systems
- Sterile Circulation
- Public Secure Circ.
- Public Non-Secure Circ.
- Non-Public Circ.

LEGEND

#	Room Name	SQ.FT.
1-2	Sec. Supv. (2) @	148 ea.
3	Storage (Ex)	72
4	Copy	72
5	Triage	150
6-7	Supv. Office (2 - Ex) @	130 ea.
8-9	Search (2 - Ex) @	95 ea.
10	Chief Office (Ex)	188
11-13	Hold Room (3 - Ex) @	212 ea.
14	Ink (Add Plumbing)	106
15-17	Interview (3 - Ex) @	100 ea.
18	Det. Bag Stor. (Ex)	60
19	RR (2) @	60 ea.
20	Counter Terrorism Wait Area	1320
21-28	Interview (8 - Ex) @	88 ea.
29	Comm Room (Ex)	110
30-31	RR (2 - Ex) @	64 ea.

NEW

TSA has indicated that in the near future, all employees accessing the secure area must be screened. In this event, a security checkpoint must be developed in each terminal that is dedicated solely to employees. This may not be feasible or cost effective based upon the layout of each terminal. An alternative discussed during this planning study was an off-site employee screening building that takes airside employees to their terminals/concourses via bus. Denver International Airport currently uses this model of airside employee screening and this option could be used as a precedent for the future IAH operation. Further study of this concept is not within the scope of this project.

5.1.1.8 United Airlines – Airline Ticketing Offices

Currently, United Airlines has ATOs in two areas: north and south. The north ATO consists of 4,094 sf and the south ATO includes 4,622 sf. The consolidated checkpoint impacts the configuration of their office space. The preferred plan maintains the same square footage as the existing area, but in a new layout that works with the adjacent consolidated checkpoint. The preferred plan includes 4,195 sf for the north and 4,770 sf for the south ATO area, and is completely nonsecure. During the design phase, further coordination with United Airlines is critical to insure airline requirements are satisfied.

The United Airlines ticketing lobby area is not within the scope of this project (refer to **Figure 5.10**). Further coordination with United Airlines, HAS and the design team will need to occur during the design phases.

5.1.1.9 Secure Circulation Corridor

The new consolidated checkpoint will require the secure circulation corridor, connecting Terminal D to E, to relocate to the east. The existing concessions are located approximately in the same location as the new secure corridor. The new corridor width shall be 40 feet at its widest point, at the exit of the security checkpoint. New Flight Information Display Systems (FIDS) shall be mounted on the ceiling in direct line of sight from the security checkpoint exit. It is recommended to include two sets of FIDS to avoid congestion within the circulation path. Daylight will enter the corridor from the north and south via the bridges. The existing daylight provided by the current skylight will now be located above the security checkpoint area. An additional opportunity for daylight lighting above the secure corridor, near the curved atrium space, is recommended as shown in **Figure 5.10** as a dashed line. This area provides a design opportunity to enhance the passenger experience and sense of place at this critical congregation/decision node. The existing restrooms and Global Entry Office, located off the secure concourse, are not affected by this program and are not part of the scope of this project.

5.1.1.10 Concessions

All Terminal E secure concessions are directly impacted by the preferred plan update. All existing Terminal E concessions will be demolished in their entirety. A new concession core (4,178 sf) will be located on the northern end of the corridor area. Opportunities for kiosks, or other shallow concessions, will be located along the curved area directly in front of the security checkpoint exit. All concession areas are connected to existing back-of-house corridors for access to the existing freight elevator, for freight and operational movement (see **Figure 5.10**).

5.1.2 MEZZANINE LEVEL (105)

At the east and west ends of the FIS facility, above the CBP office space, three mezzanine levels accommodate CBP administration offices and the CBP Canine Suite, as shown in **Figure 5.11** and **Figure 5.12** – Mezzanine Enlarged Plans.

5.1.2.1 Southeast Mezzanine (Canine Suite)

The existing Canine Suite in the southeast mezzanine shall remain in place with no change. The existing door on Level 93, located below, is utilized for animal relief for the on-site canines and must be maintained.

5.1.2.2 Southwest Mezzanine (CBP Administration – Port Director Suite)

This mezzanine includes the CBP Port Director Suite. The majority of this space shall remain with minor reconfiguration. A unisex restroom is to be added off the expanded reception/secretary room. Currently, no restroom facilities are located on the mezzanines. CBP staff identified travel to the facilities located on Level 93 as an inconvenience. The Port Director conference room shall be expanded per program requirements. The existing Port Director and Assistant Port Director rooms shall remain without change.

5.1.2.3 Northwest Mezzanine (CBP Administration)

Like the southwest mezzanine, a unisex restroom shall be added to the northwest mezzanine to eliminate the need for staff to use the facility downstairs. The only other change to this level is a small pantry with a sink adjacent to the new restroom. All other rooms on this floor are to remain without impact. The former lactation room will be repurposed as a supervisor office. This change does not require shell/finish modification.

5.1.3 LEVEL ONE (93)

After clearing primary processing on Level 116, passengers will then proceed to Level One located at the east end of the existing facility. Upon arriving at the bottom of the escalators, passengers will have a decision point to either continue straight to the new baggage claim units or turn to the west, towards the existing baggage claim units. Dynamic signage will be critical to prevent congestion in this node. The Baggage Information Display System (BIDS) is recommended in eye sight of the passengers on the escalators before arriving at Level One. This will allow passengers to identify their baggage claim unit prior to exiting the escalator. To prevent congestion, the existing BIDS located on the side of this atrium should be removed to maximize circulation area. It is recommended to create a one-way path (by segregating with stanchions or partitions) for passengers that have claimed their baggage in the new expansion and are headed west to the exit control area. This would segregate passengers with baggage from the passengers coming down the escalators. During planning, various studies were completed to widen this node to avoid any potential congestion. Due to the existing mechanical rooms, elevators and stairs directly north and south of the node, it was determined too costly to make major changes in this area. The preferred plan also includes an additional skylight at this node and will, also, include retrofit of the existing curtain wall structure to allow for the Level 93 opening. Detailed design is required to properly modify this existing glazing wall.

Future demand may warrant the need for additional passenger elevators due to the high volume of wheelchair traffic. **Appendix C** describes the existing conditions and future needs for vertical circulation within the entire facility.

A new elevator shaft with (1) cab will be added near the existing elevators in the southeast quadrant of the CBP area. This new set of elevators will allow for additional capacity to avoid dwell times for wheelchair access. Due to Houston's thriving medical community, passengers requiring wheelchairs will continue to grow faster than most airports.

A new down only escalator from primary to the baggage claim hall was also discussed during the planning phase. It was not needed per the program requirements but was discussed as redundancy for when one of the existing escalators is down for maintenance. The existing stair located north of the escalator area can also be used as a backup circulation flow if needed. While the cost estimate does include a placeholder for one additional escalator, it is not currently shown on the preferred plan and shall be determined in design if it is needed.

Live Animal Handling is intended to be accommodated via the current operation. Following stakeholder review, it was decided not to include an additional dedicated elevator for this process based on cost concerns. However, the future design team will need to explore this component in greater detail in order to confirm the validity of this planning decision.

Level One, as shown in **Figure 5.3**, includes the baggage claim, secondary processing and support office within the CBP facility. The existing loading dock and receiving area in the northeast quadrant will remain without change. After exiting the FIS, the recheck and meeter/greeter halls are located along the western portion of the building.

5.1.3.1 Baggage Claim Annex

As described in **Chapter 3**, the current facility contains 12 baggage claim units. Four additional claim units are installed in the baggage claim annex with all four units sized appropriately for A380 use. The new baggage claim expansion on Level 93, that includes the additional units, is approximately 42,500 sf of enclosed, conditioned space (see **Figure 5.13**). The majority of this space is to be high level finishes that complement the existing facility. The new annex includes a new restroom facility, mechanical/electrical rooms and baggage cart storage. Description of the baggage handling system is included in **Section 5.4**.

5.1.3.2 Baggage Claim Existing

The majority of the existing Baggage Claim Hall is to remain without change. The existing claim unit at the far northwest corner of the facility (Unit #1) will be removed in its entirety to allow for the consolidated secondary processing area. Once the baggage claim unit has been removed, the opening in the floor slab should be infilled and floor finish should be installed to match the existing adjacent surfaces. See **Section 5.1.3.4** for further information regarding secondary processing.

Six of the existing claim units will be equipped with a second loading belt to allow for a faster loading of bags onto the claim unit. The claims which have been identified as the most viable options for the secondary feed lines are carousel numbers 3, 4, 5, 6, 9 and 10.

5.1.3.3 Exit Control

Another primary goal of this project is to provide additional queue area at exit control from the FIS facility. During peak periods, passengers often queue all the way through the baggage claim area causing circulation and wayfinding issues for passengers searching for the correct baggage claim unit. To allow for additional square footage in the immediate exit control area, the preferred plan recommends demolishing portions of the existing office space immediately west of exit control. The existing podiums can then move to the new location and expand to the full 16 positions indicated per program requirements. Recently, HAS updated the area to include 12 positions. The podiums from this project should be reused in the preferred plan reconfiguration. An additional four positions will be added in the final plan bringing the total to 16 positions as required in **Chapter 4**.

The exit control area dramatically increases in size from 6,250 sf to 12,900 sf, which will eliminate the issue of passengers backing up through the Baggage Claim Hall. The location of the podiums is centrally located in the facility to eliminate sharp turns for passengers with large baggage carts. The queue shall be in straight line queues and not snake north or south.

Global Entry and OneStop allows passengers without baggage to bypass the exit control podiums and proceed to exit. The existing escalator and elevator allow for a circulation path from the Level 116 primary processing area to Level 93. Corridors flanking the exit control area shall have glass partitions that allow these passengers to bypass the podiums and not interact with passengers in the exit control queue (see **Figure 5.14**).

With the relocation of the exit control podiums to the west, the existing sliding doors that lead to recheck will need relocation to the west to provide ample circulation space from all exit podiums.

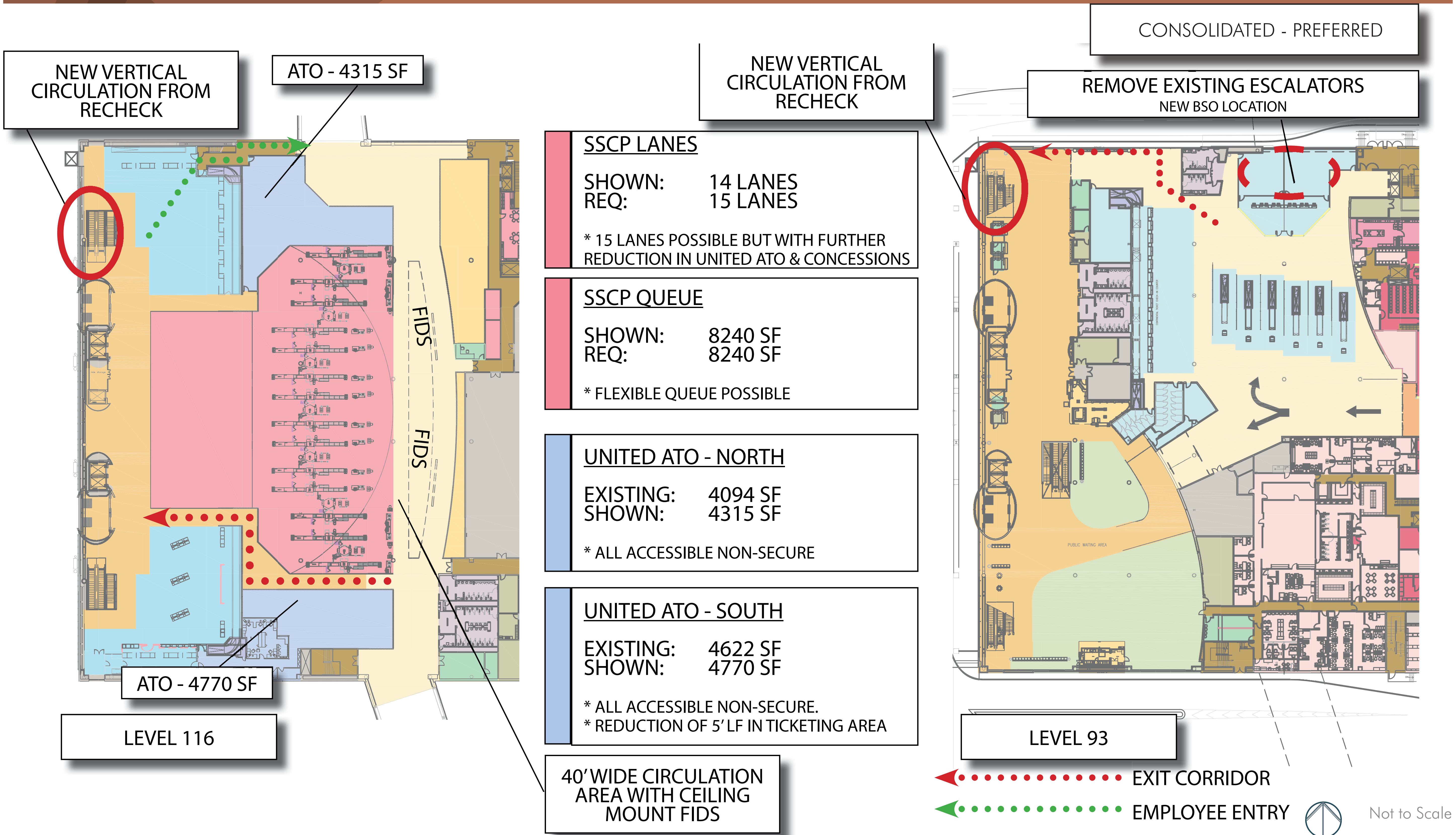
Passengers who are flagged at exit control may need additional screening. These passengers are directed to the secondary processing area located to the right (north) of the exit control area. See **Section 5.1.3.4** for further details on the secondary processing area.

5.1.3.4 Secondary Processing

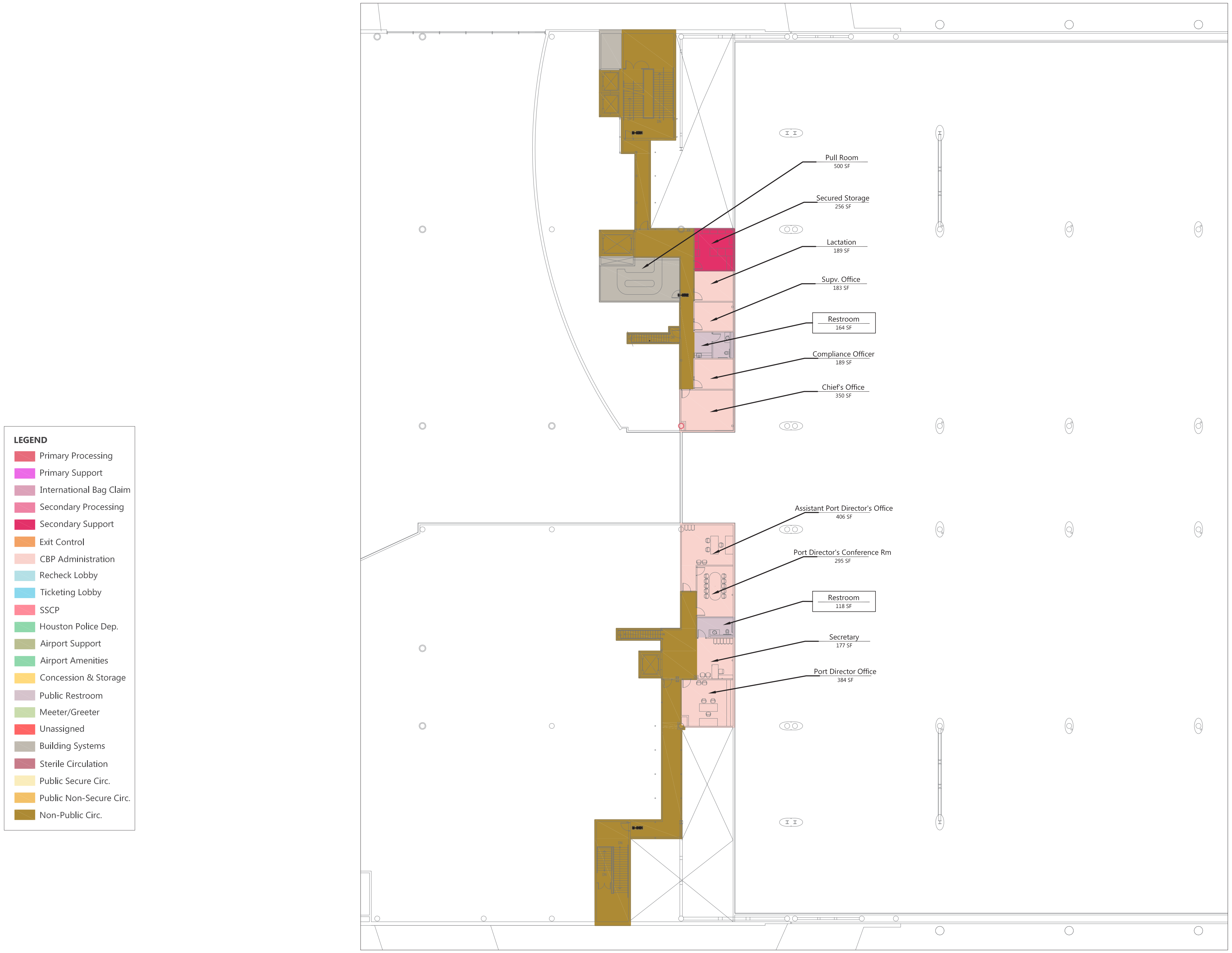
The current facility contains components of secondary processing across three areas of the facility. This separation has created inefficiencies of CBP staffing, thus impacting the LOS to passengers. The preferred concept consolidates all components of secondary processing to one area that is located with the proper adjacencies required in the CBP guidelines.

Located directly north of the exit control area, the entrance to the consolidated secondary processing allows for easy wayfinding that does not require additional and unnecessary escorts. The new location is located directly below the Primary Processing Hall. The existing elevator at the west end of primary processing now arrives in the lower level, directly into the secondary processing area. The existing elevator opens to the south, which allows

SSCP Checkpoint - Consolidated Option



Mezzanine Level 105 - Enlarged Plan



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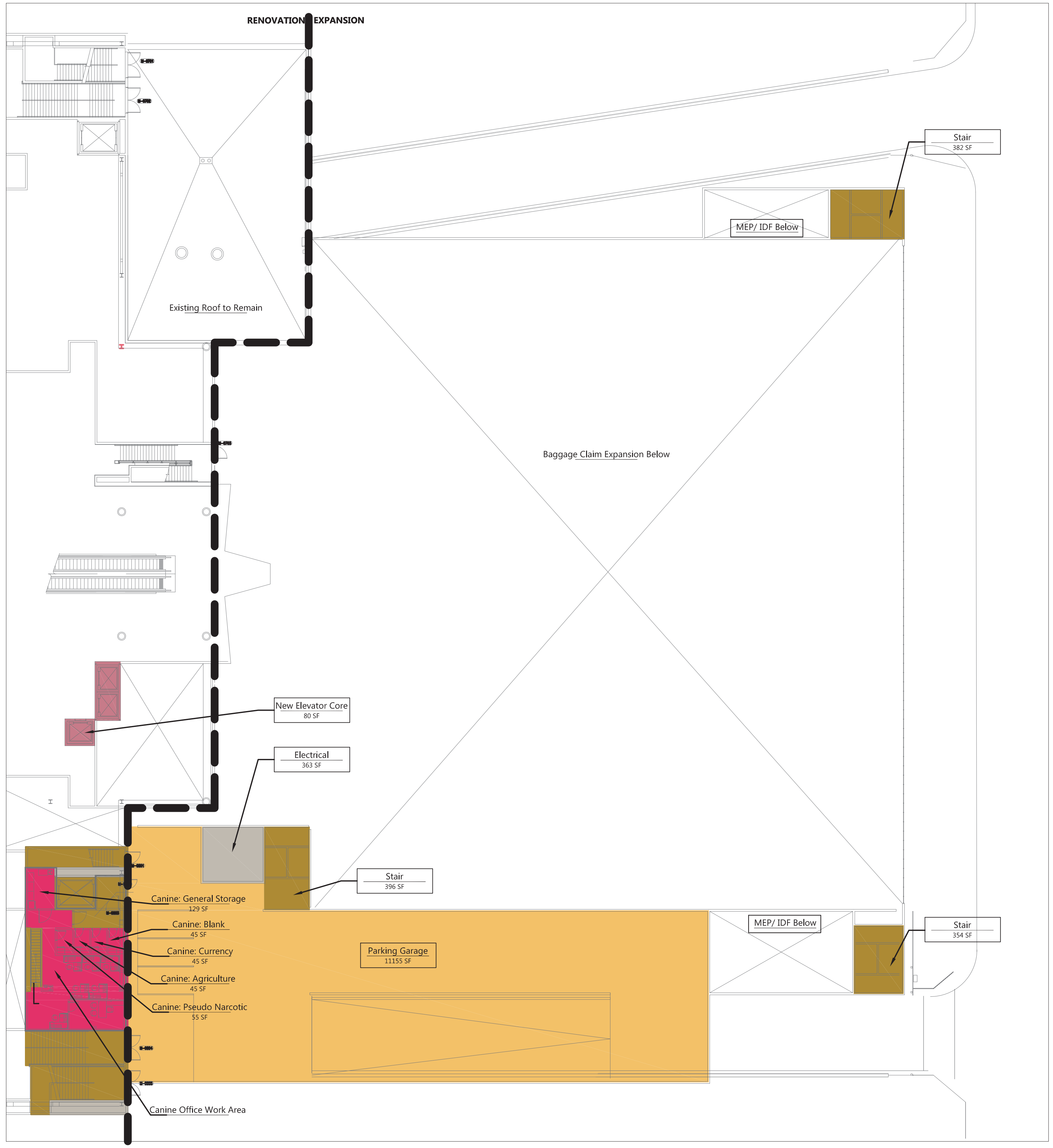
Mezzanine Level 105 - Enlarged Plan



LEGEND

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- Primary Support
- International Bag Claim
- Secondary Processing
- Secondary Support
- Exit Control
- CBP Administration
- Recheck Lobby
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- SSCP
- Houston Police Dep.
- Airport Support
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- Concession & Storage
- Public Restroom
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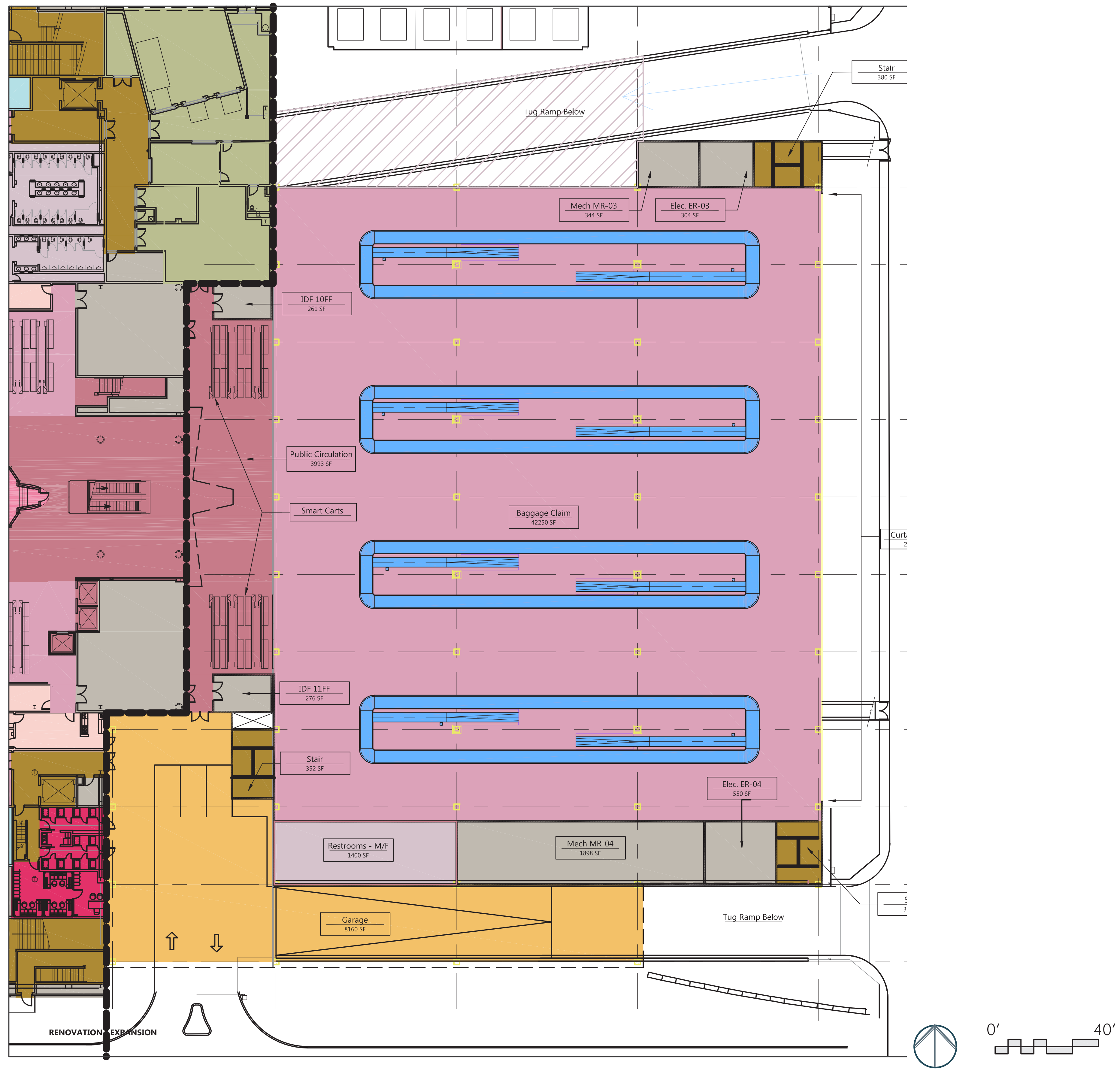
- Unassigned
- Building Systems
- Sterile Circulation
- Public Secure Circ.
- Public Non-Secure Circ.
- Non-Public Circ.

Not to Scale

Level 93 - Expansion



LEGEND

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- Public Secure Circ.
- Public Non-Secure Circ.
- Non-Public Circ.

Level 93 - Exit Control/Secondary Processing

EXIT CONTROL:

- INTUITIVE & GENEROUS PASSENGER FLOW FROM BAGGAGE CLAIM TO EXIT CONTROL WITH MINIMAL SHARP TURNS
- PASSENGERS WITHOUT BAGGAGE PROCEED DIRECTLY FROM ESCALATOR/ELEVATOR TO EXIT; BYPASSING PODIUMS

SECONDARY PROCESSING:

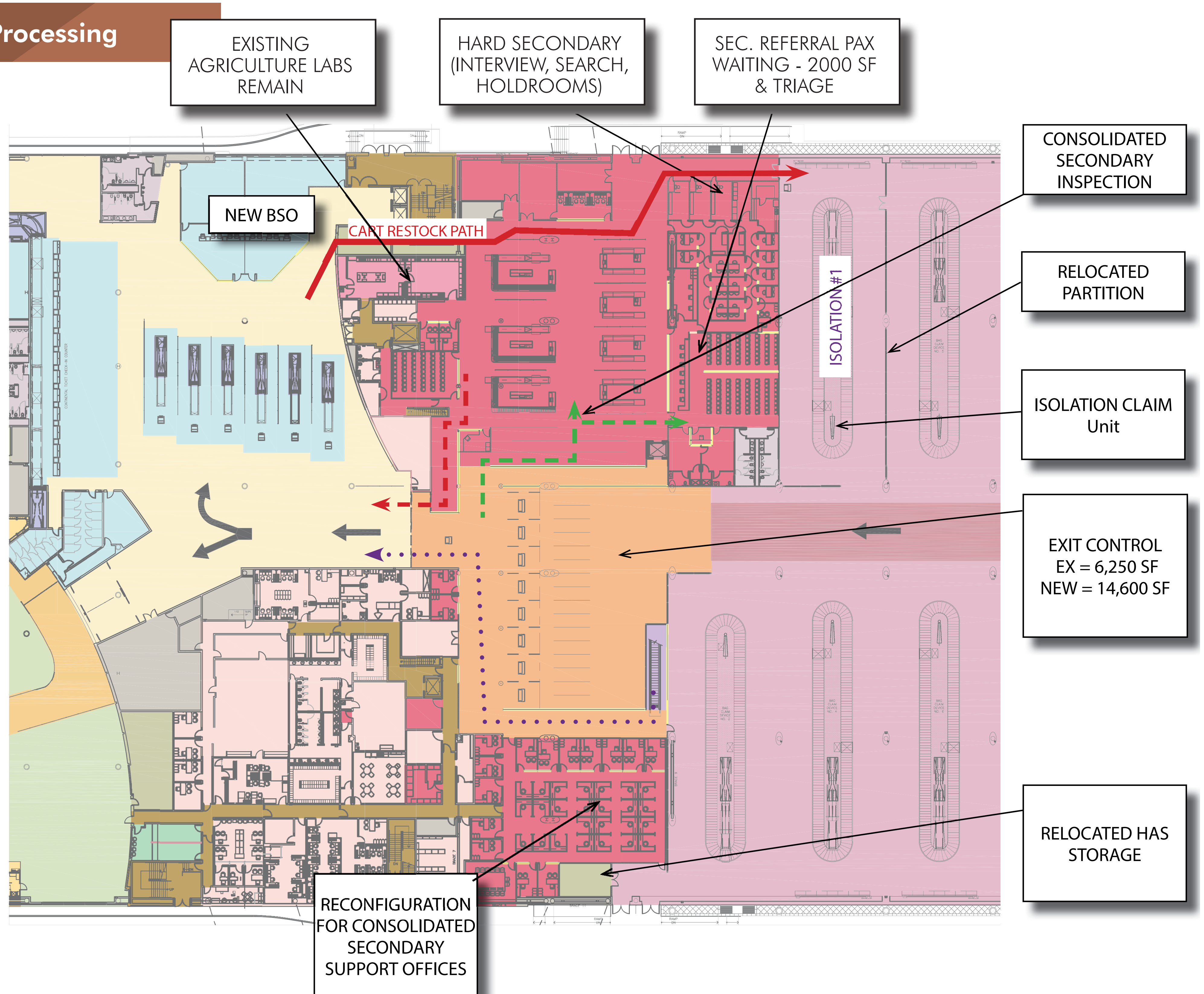
- ALL INSPECTION IS COLOCATED
- ISOLATION BAGGAGE CLAIM UNIT NORTH AND COMBINED CORRAL WITH ACCESS TO SECONDARY INSPECTION
- ALL HARD SECONDARY COLOCATED AND ADJACENT TO SECONDARY INSPECTION (INCL. HOLDROOMS, INTERVIEW, SEARCH, ETC..)

BAGGAGE

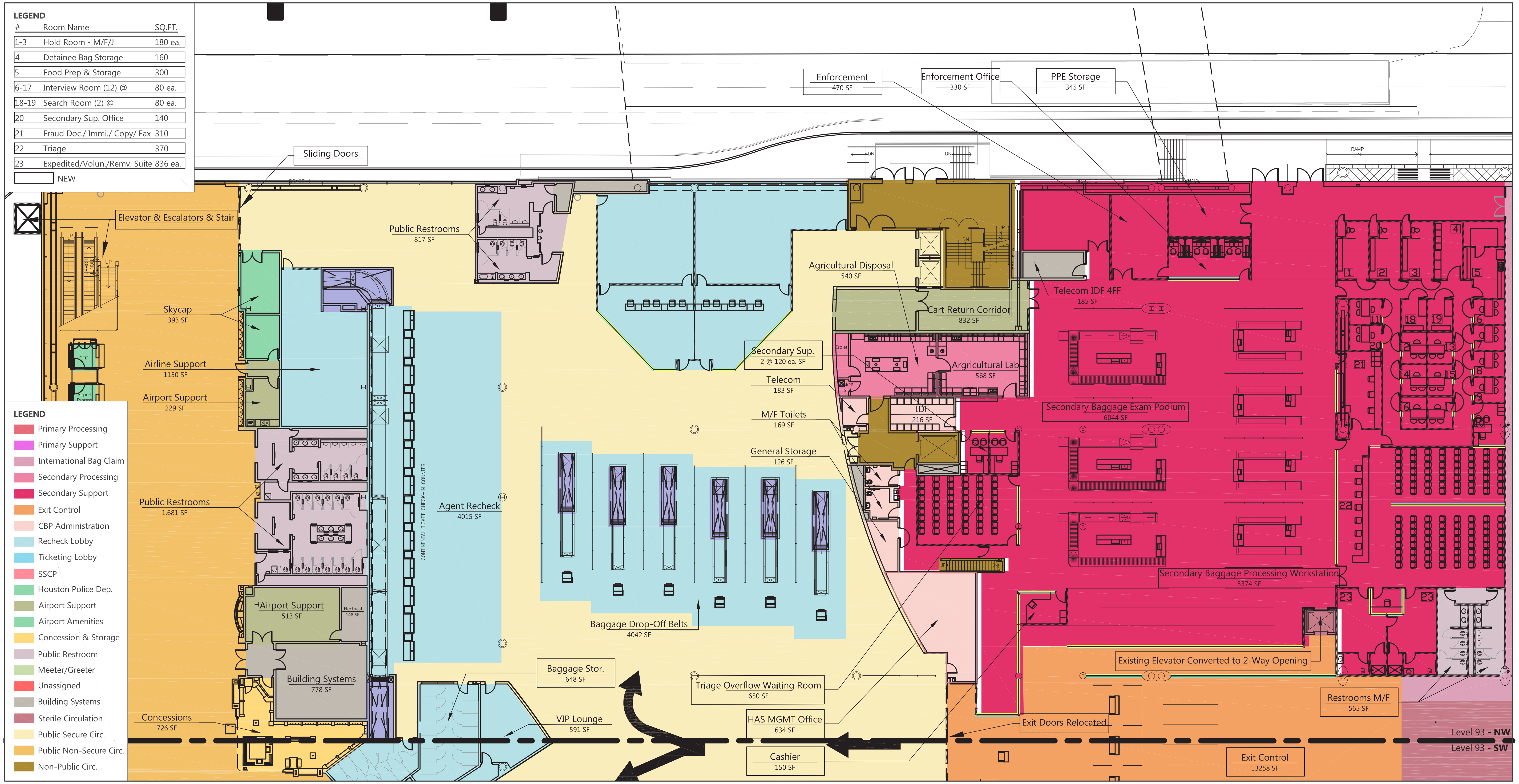
- REMOVE NW BAGGAGE UNIT
- CART RESTOCK PATH REMAINS

SECONDARY OFFICE

- REWORK EXISTING NORTH OFFICE TO NEW SECONDARY REFERRAL WAITING AND RESTROOMS
- NEW COMBINED SECONDARY SUPPORT



Level 93 Northwest - Consolidated Secondary Processing



Not to Scale

for Global Entry and OneStop passengers that cannot use the escalators to traverse between levels. The facility improvements include modifications to this elevator to allow for opening to the north to allow CBP escorted passengers to arrive in secondary processing without mingling with other passengers.

The secondary processing queue leads directly to the customs and agricultural inspection stations. There are eight customs inspection and three agricultural inspection positions. The program requirements indicate a need for four agricultural positions. During the CBP approval process, it was determined by CBP, at the national level, and the Port Director that three units would suffice for the future. The agricultural units are located directly adjacent to the existing agricultural lab and office. The lab and office will remain without change as part of this program.

Located to the east of the inspection area is what is commonly known as “hard secondary.” This area is relocated from its current location on Level 116 southeast. The referral wait area increases the seating area to 1,965 sf with larger restrooms. The wait area can accommodate approximately 120 seats. Additionally, a 650 sf overflow wait area is provided to the west of the inspection area that can accommodate approximately 54 seats.

Triage is centrally located between the inspection area and the passenger wait area. Windows shall separate the inspection from triage for visual connection and observation from CBP triage agents. The preferred plan allows for seven triage agents located at custom millwork. Adjacent to triage, an expedited/voluntary removal suite allows space for families with long-duration stays at the FIS facility. This room includes a watch/observation room with one-way glass looking into the two family suites. A door is located between the two suites allowing for one large suite if necessary. Each family suite contains a restroom and shower facility. This room must have direct line of sight from triage.

Interview, search and holdrooms are located to the north of the referral wait area per the program requirements. Changes from the program requirements include a reduction of search rooms from the required four to two, and a reduction of six holdrooms to three. This was determined adequate through the CBP approval process. Other spaces within this area include the food prep/storage, detainee bag storage, fingerprint, fraud document/ immigration (with copy/fax capability), and a secondary supervisor office.

Located at the north portion of the consolidated secondary processing area are the enforcement office, PPE and storage, and the existing IDF 4FF that must remain intact.

The baggage cart return path from recheck to the west through the facility to the baggage claim area must be maintained. This path is noted in red on **Figure 5.14** (Exit Control/Secondary Processing).

Located at the west end of the facility is the existing agricultural lab/office, two secondary supervisor offices and one chief office. The existing storage, IDF and restrooms will remain without change.

The cashier’s office is located with direct line of sight to the exit path of travel. The exit corridor leads directly to the FIS exit sliding doors to recheck.

The two existing baggage units farthest west are used as isolation units. When designated flights are predetermined for additional screening, the passengers pick up their bags at the isolation units. These are immediately accessible to the secondary processing area. This adjacency is included in the preferred plan with a corridor directly to secondary processing along the northern wall. This path also allows for egress to the exit doors in the event of an emergency.

See **Figure 5.15** for the enlarged plan at consolidated Secondary Processing.

5.1.3.5 Secondary Support Offices

The majority of the CBP secondary office work area is located at the southwest sector of Level 93. Five secondary supervisor offices are to remain with the addition of nine more offices. This area includes a CBP team conference room and an open office work environment that can contain 25 modular workstations (8 feet by 8 feet). Other new functions include two Passenger Service Manager offices (150 sf each) and adjacent general storage (450 sf). The remainder of the CBP area shall remain without change. Areas to remain are indicated with dot hatch on **Figure 5.16** Secondary Processing Support.

5.1.3.6 Recheck and New Recheck Corridor

The recheck area remains mostly unchanged with the exception of the new corridor to the consolidated security checkpoint. The existing United Airlines baggage service office (BSO) will be removed in its entirety to allow for a 20-foot-wide corridor with access to the non-secure area. A new stairwell, pair of escalators, and an elevator will be installed in the northwest corner of the facility that will traverse to Level 116. This will provide access for connecting passengers to the consolidated security checkpoint above. This change will require structural modifications including a new opening in the floor slab. The existing escalators will be removed in their entirety and the ceiling/floor slab, above, infilled.

5.1.3.7 Baggage Service Offices

The new recheck corridor will require relocation of the existing United BSO office. A new BSO area is to be located where the existing escalators are currently located. This allows for a new United BSO (1,800 sf) and relocated/expanded foreign flag carrier BSO (1,500 sf). The wall between the two lobby areas of the BSO shall be an operable partition to allow for the entire lobby to be one space for future common use capability. The current foreign flag BSO will then be converted to additional baggage storage. The final plan shall allow for storage cage space for 20 or more airlines. The current facility only contains 10 cages. Each cage shall be roughly 6 feet by 10 feet.

5.1.3.8 Meeter/Greeter

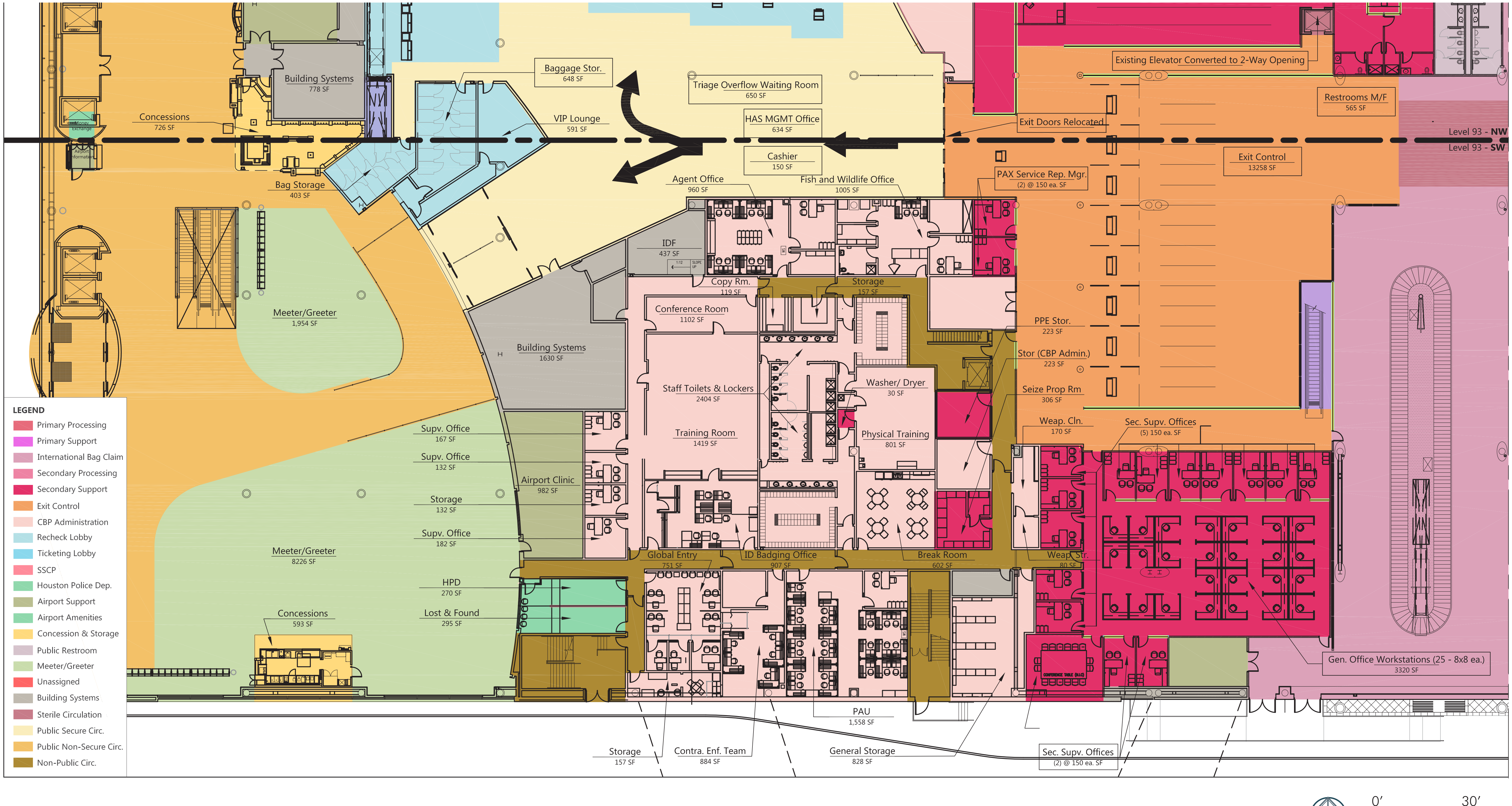
Current concerns with the meeter/greeter area involve congestion from waiting parties congregating near the FIS/recheck exit doors. It is recommended to extend the existing handrail that separates exiting passengers from greeters farther out to provide greater separation. It is also recommended to remove the existing art/historical gallery to allow for more congregation area and seating. As part of a separate HAS project, the existing FIDS to the east of the Starbucks concession will be removed and ceiling mounted monitors installed above the exit doors. Another potential separate HAS project includes converting the existing medical clinic behind the art/historical gallery to a space for other uses. This room is not within the scope of this project. The Houston Police office will be relocated adjacent to the existing Lost and Found and will require minor modification.

5.1.3.9 HAS Staff Support

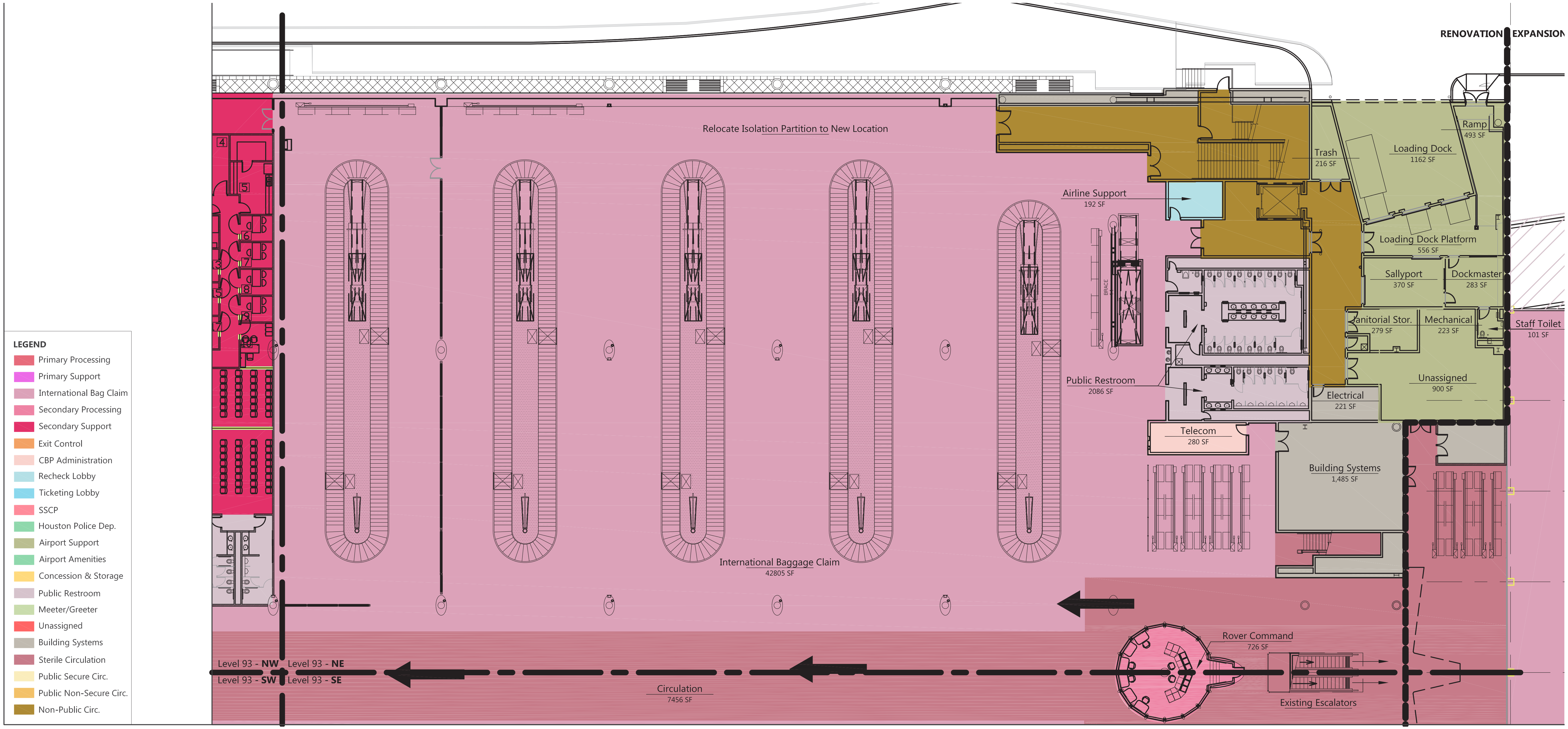
The new recheck corridor will require relocation of the HAS international operations staff. A new location has been identified within the existing CBP Training Room located adjacent to the CBP sterile exit sliding doors. A new door will be required to have access directly from the recheck area. This room shall not have access directly into the sterile CBP facility. Further coordination with HAS on-site staff will be required to ensure all requirements are met. During planning, the following components were identified within this space:

- Office area including six modular workstations
- Locker area capable of storage for 15-20 staff members per shift
- Conference space for briefings/training
- Break room

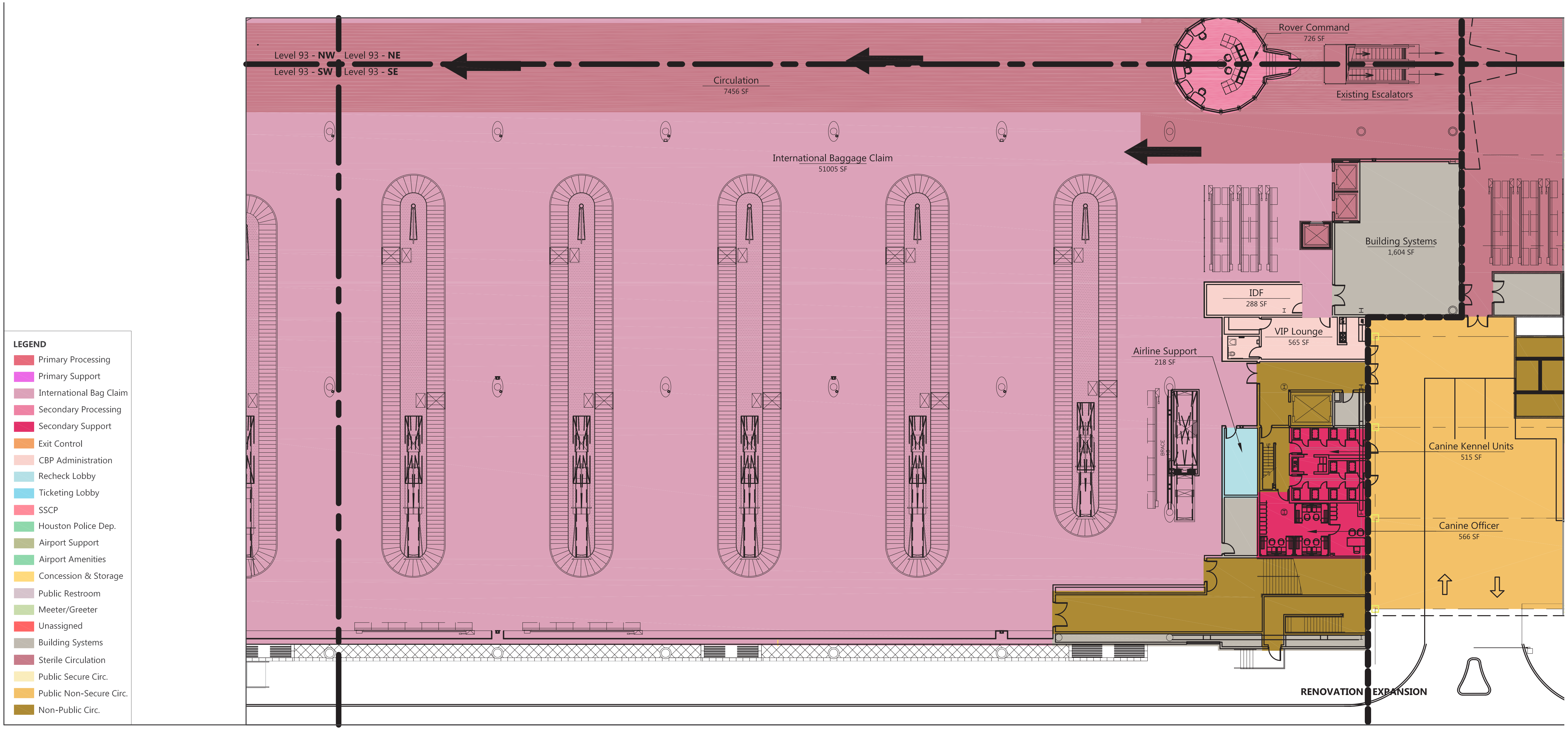
Level 93 Southwest - Secondary Processing Support



Level 93 Northeast



Level 93 Southeast



(See **Figure 5.17** Level 93 NE and **Figure 5.18** Level 93 SE)

HAS storage on Level 116 will remain in its current condition. Level 93 will gain additional storage in the new baggage claim annex and near the secondary support offices in the southwest corner of the baggage claim hall.

5.1.4 BAGGAGE LEVEL (78)

The Baggage Level, as shown in **Figure 5.19**, consists of the international inbound baggage handling, conveyors and the baggage right-of-way. Baggage tugs utilize bridges spanning the terminal roads to access the ramps leading to the baggage handling facility from the eastern end of the building, adjacent to Taxiway SF. The baggage claim annex includes the inbound conveyors for the four new units above. See **Section 5.4** for additional information on the preferred baggage handling system plan. Building systems, including mechanical and electrical, are located within the new expansion building.

5.2 Garage Projects

The existing CBP employee parking garage will be demolished in its entirety to accommodate the baggage claim expansion. The existing garage contains 250 parking stalls. During design, many studies were completed that included public and the required CBP employee spaces. The final determination was to only include the required 250 spaces for CBP employee use only.

5.2.1 CONSTRAINTS

The project site is extremely constrained both horizontally and vertically. The site is bounded by roadways on the north and south, the existing FIS facility to the west and the airside service road and Taxiway SF to the east.

Vertical constraints include the line of sight from the Air Traffic Control Tower to the surrounding airfield. A Line of Sight Study was performed and determined that the highest point on a potential garage could be 140 feet above the ground level (Level 93). The project does not impact this line of sight constraint. The following is a summary of the CBP employee garage:

The parking summary (**Figure 5.20**, **Figure 5.21** and **Figure 5.22**) includes Americans with Disabilities Act (ADA) required spaces per level. All stalls are assumed to be 9 feet wide by 18 feet deep. This system should be coordinated with the HAS Parking Department and consistent with other IAH parking garages. Other required parking structure guidelines and certifications are described in **Chapter 6**.

The exterior façade of the parking structure is anticipated to have screening on all sides to match the existing campus at a minimum. The Design team shall consider the east facade of the garage for further development as it will be the gateway facade to the east.

5.2.2 ENTRY/EXIT

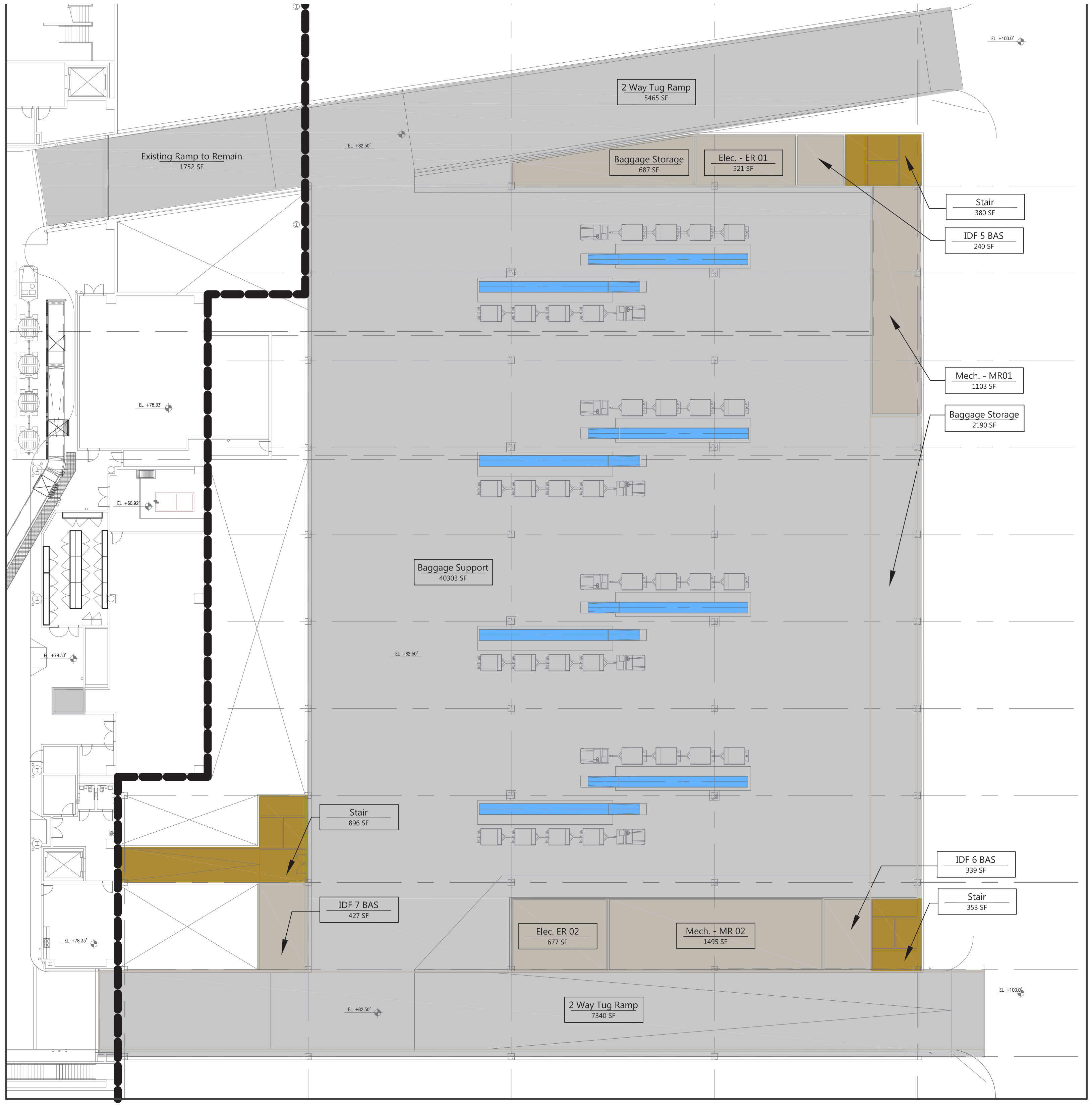
The entry to the garage is located along the south roadway system via the existing CBP employee entry/exit. No landside roadway changes are anticipated for this project.

5.2.3 PARKING LEVELS

The entry level of the parking garage is Level 93, along the south roadways. There will be limited service and emergency vehicle parking located directly adjacent to the existing FIS exit door near the canine area. All other vehicles will immediately go up the new internal ramp to the mezzanine level. The vehicle ramp will be stacked above the airside baggage tug ramp to the basement.
Upon entering the mezzanine level, all cars will circulate to the next internal ramp to access Level 116, which is the first parking level. The mezzanine level will also include CBP service and emergency access parking stalls.
Level 116 is the first parking level and provides employees direct access from the garage to the existing FIS facility in the southwest quadrant of the garage. This will provide covered CBP employee parking. Electrical rooms and stair towers for proper egress are also located on this level.

Level 127 is the final level of the facility. It includes the remaining CBP parking with employee entry to the facility via the stair tower in the southwest corner of the garage to Level 116. This level will be open air without covered parking. The entire parking structure provides 268 spaces, which meets and exceeds the requirement of 250 spaces. **Figures 5.23** and **Figure 5.24** below depicts the plans for each level and section view showing the vehicular circulation.

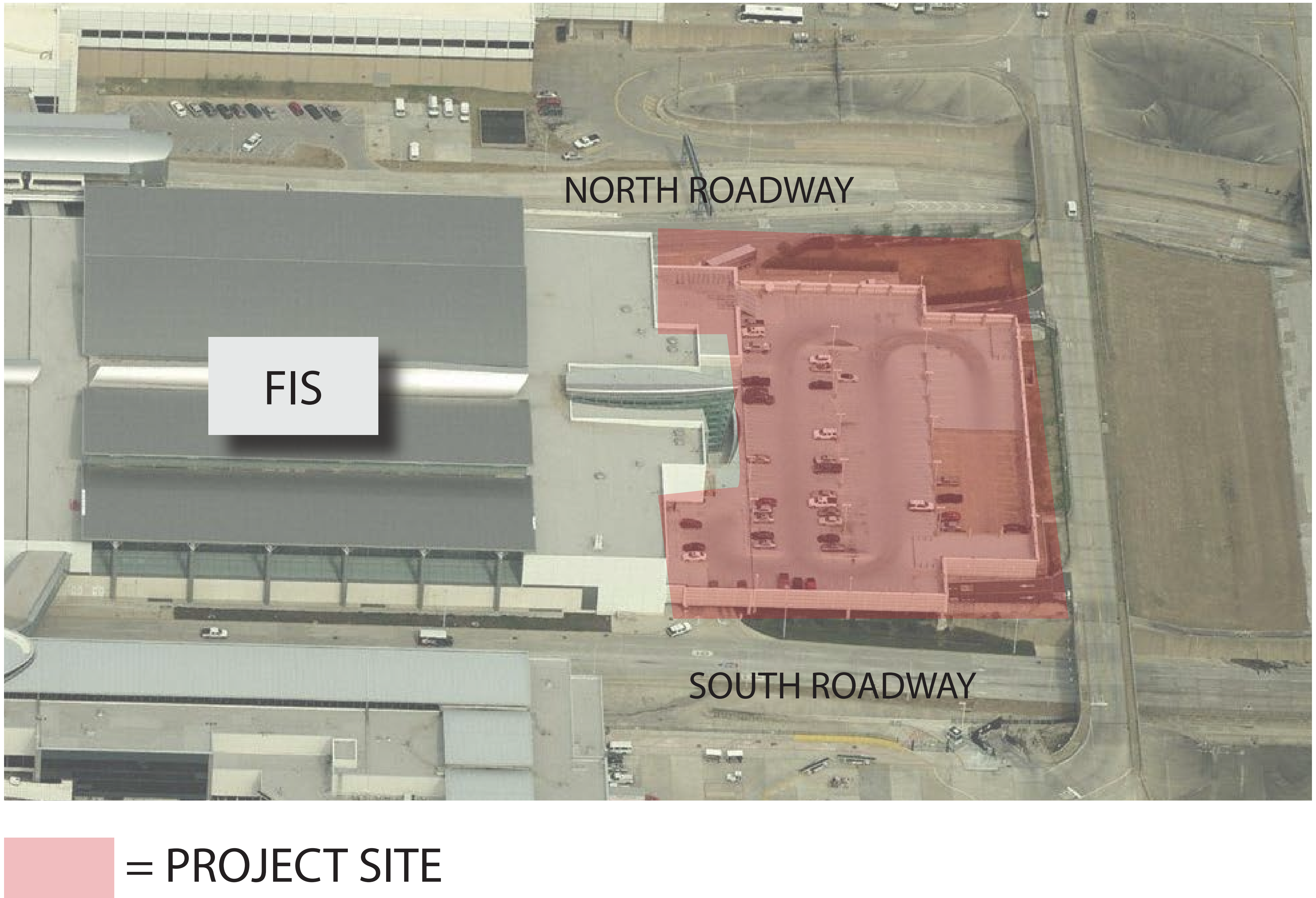
Level 78 - Expansion Baggage Makeup



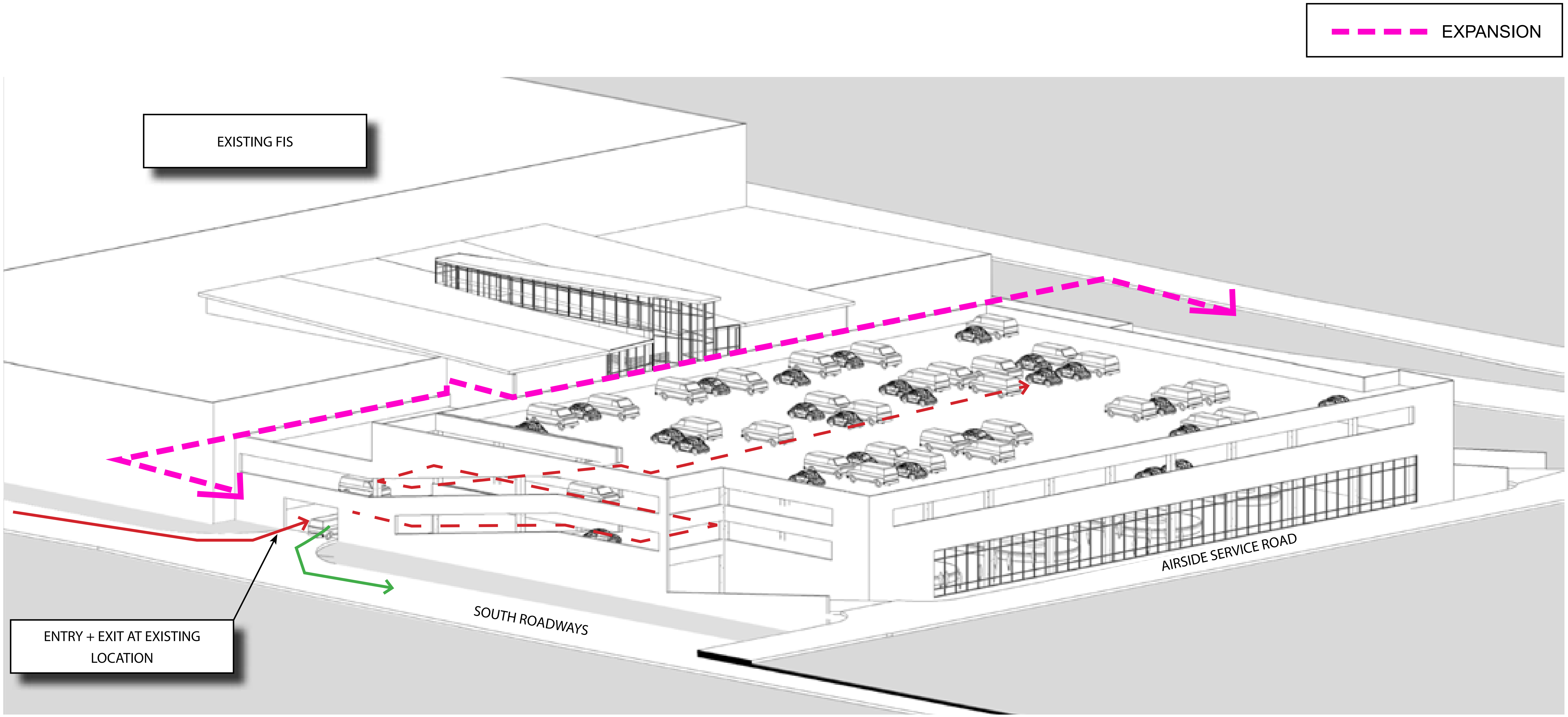
LEGEND
- Primary Processing
- Primary Support
- International Bag Claim
- Secondary Processing
- Secondary Support
- Exit Control
- CBP Administration
- Recheck Lobby
- Ticketing Lobby
- SSCP
- Houston Police Dep.
- Airport Support
- Airport Amenities
- Concession & Storage
- Public Restroom
- Meeter/Greeter
- Unassigned
- Building Systems
- Sterile Circulation
- Public Secure Circ.
- Public Non-Secure Circ.
- Non-Public Circ.

0' 30'

Parking Garage Summary



Garage - Entry and Exit Diagrams



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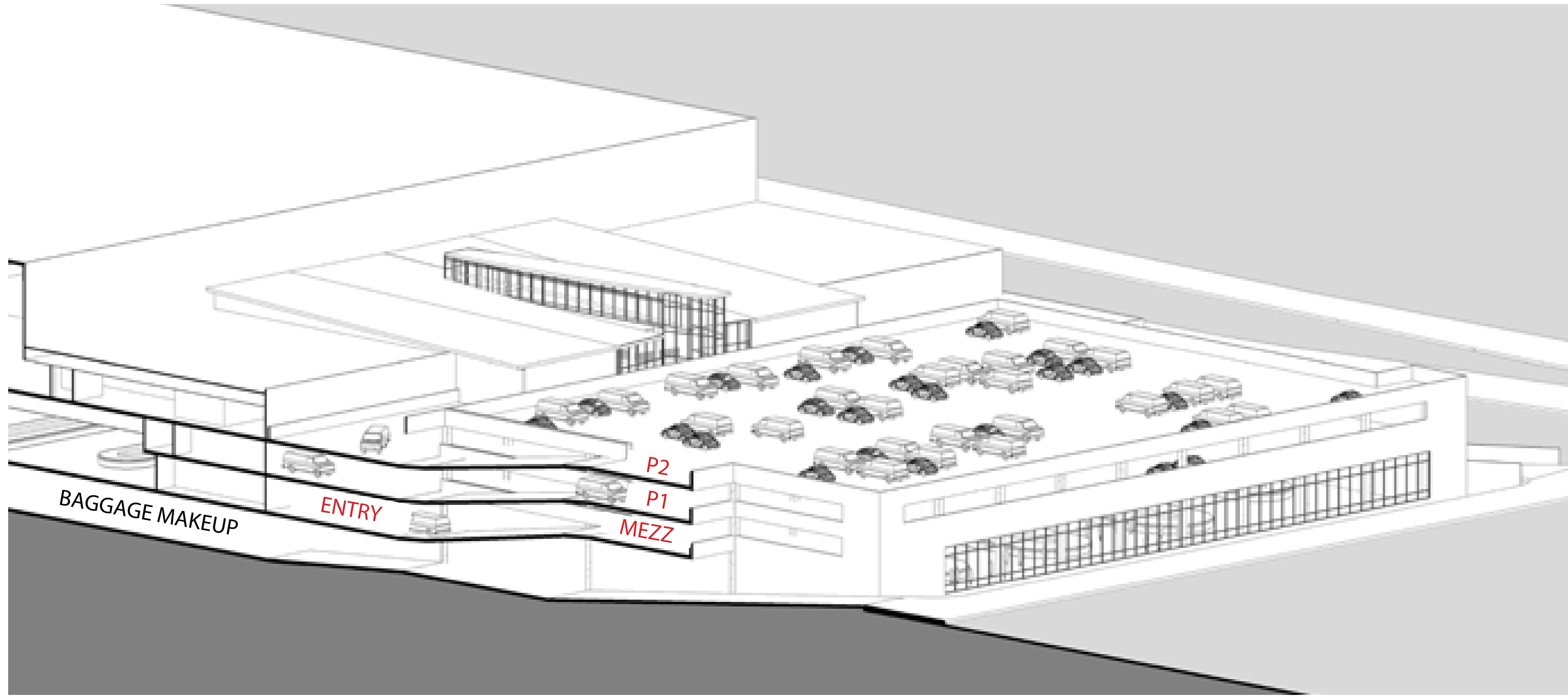
Parking Garage Summary

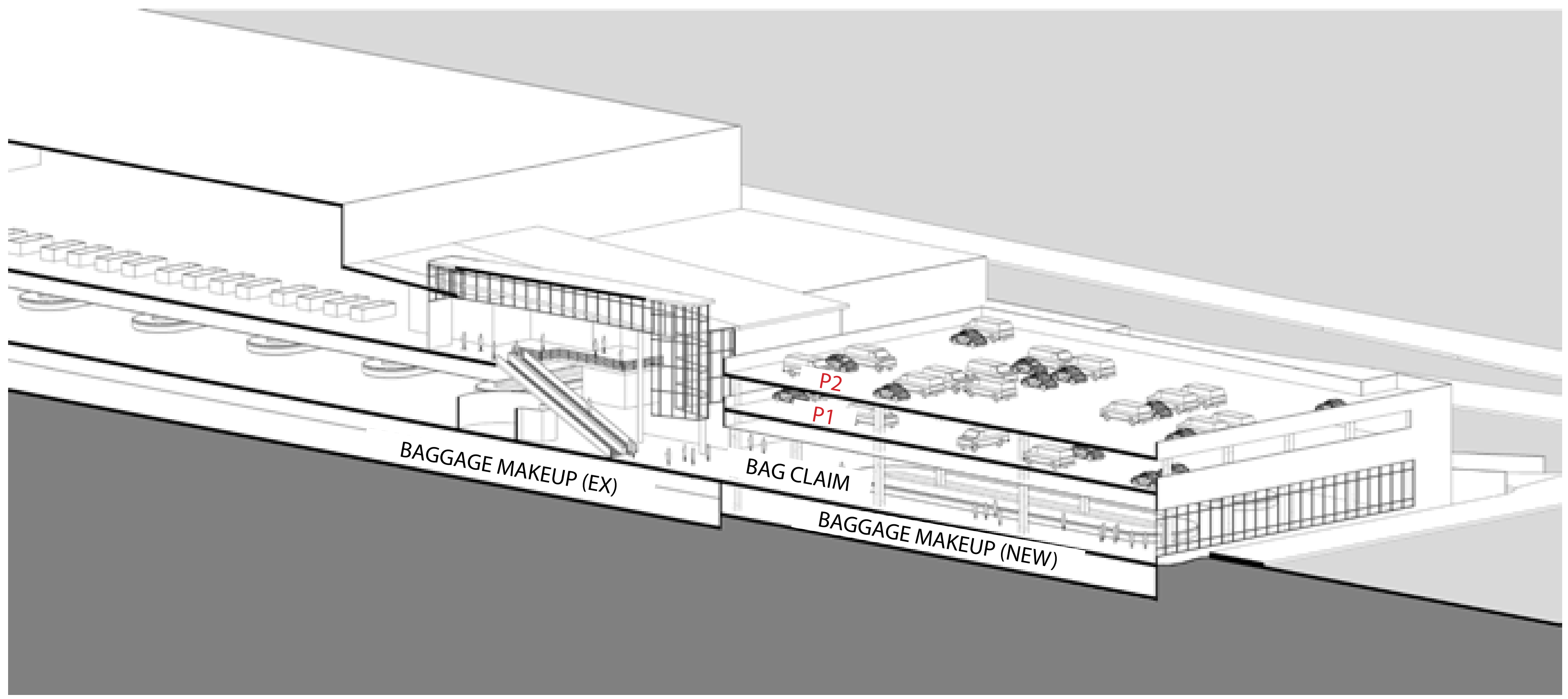
CBP GARAGE

(SECTION THRU GARAGE VERTICAL CIRCULATION)



CBP GARAGE

(SECTION THRU NEW BAGGAGE EXPANSION BUILDING)



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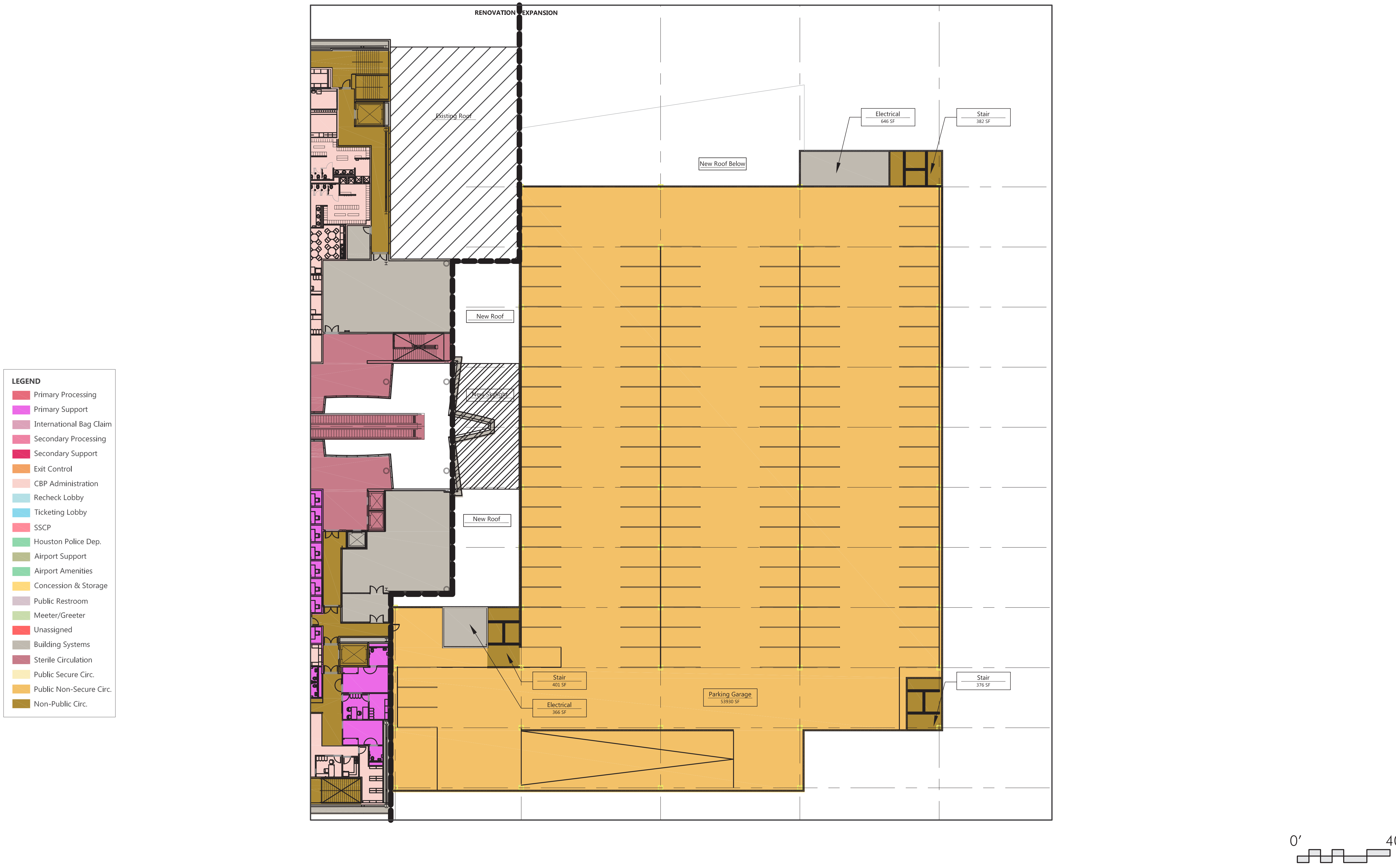
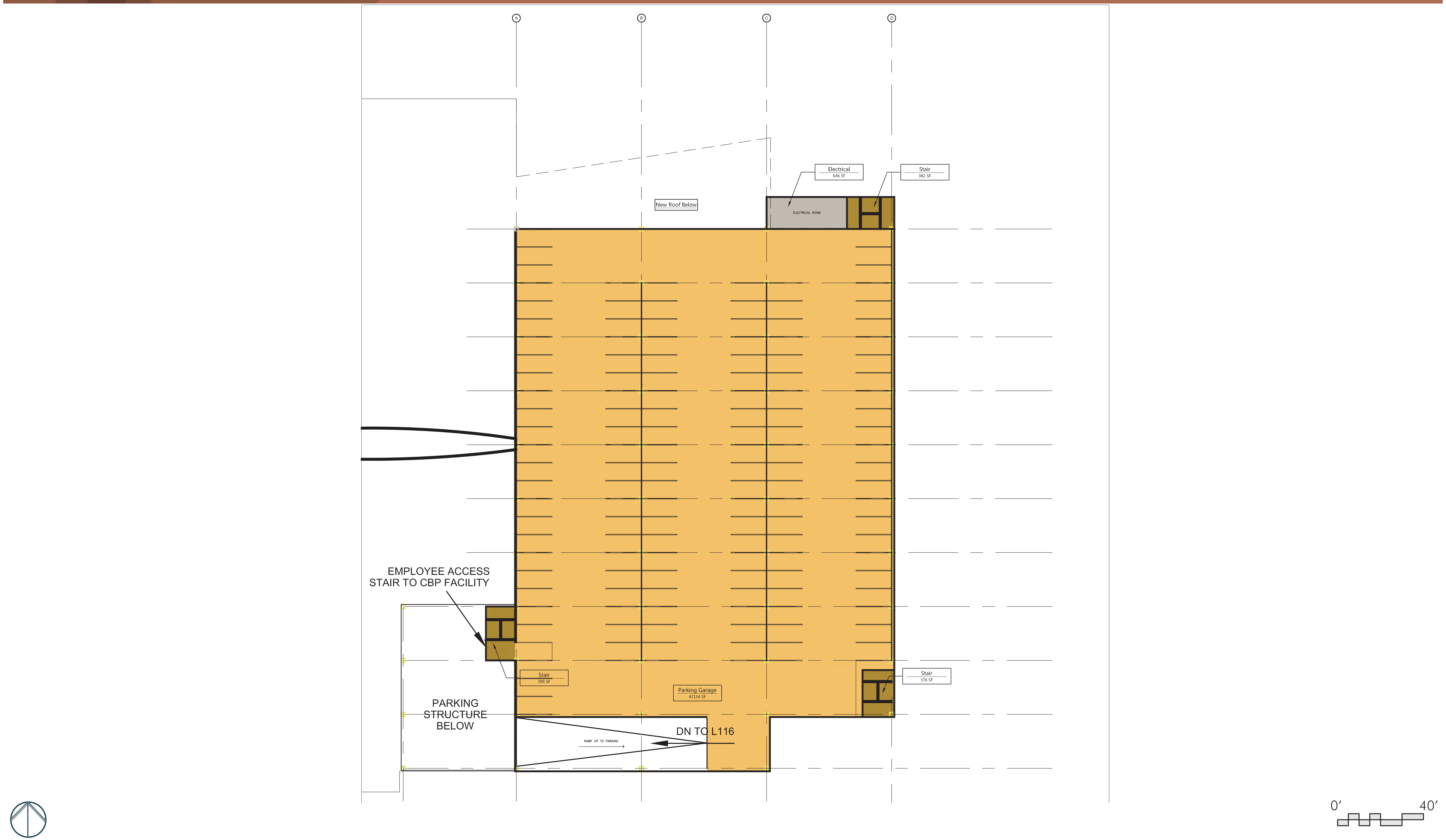
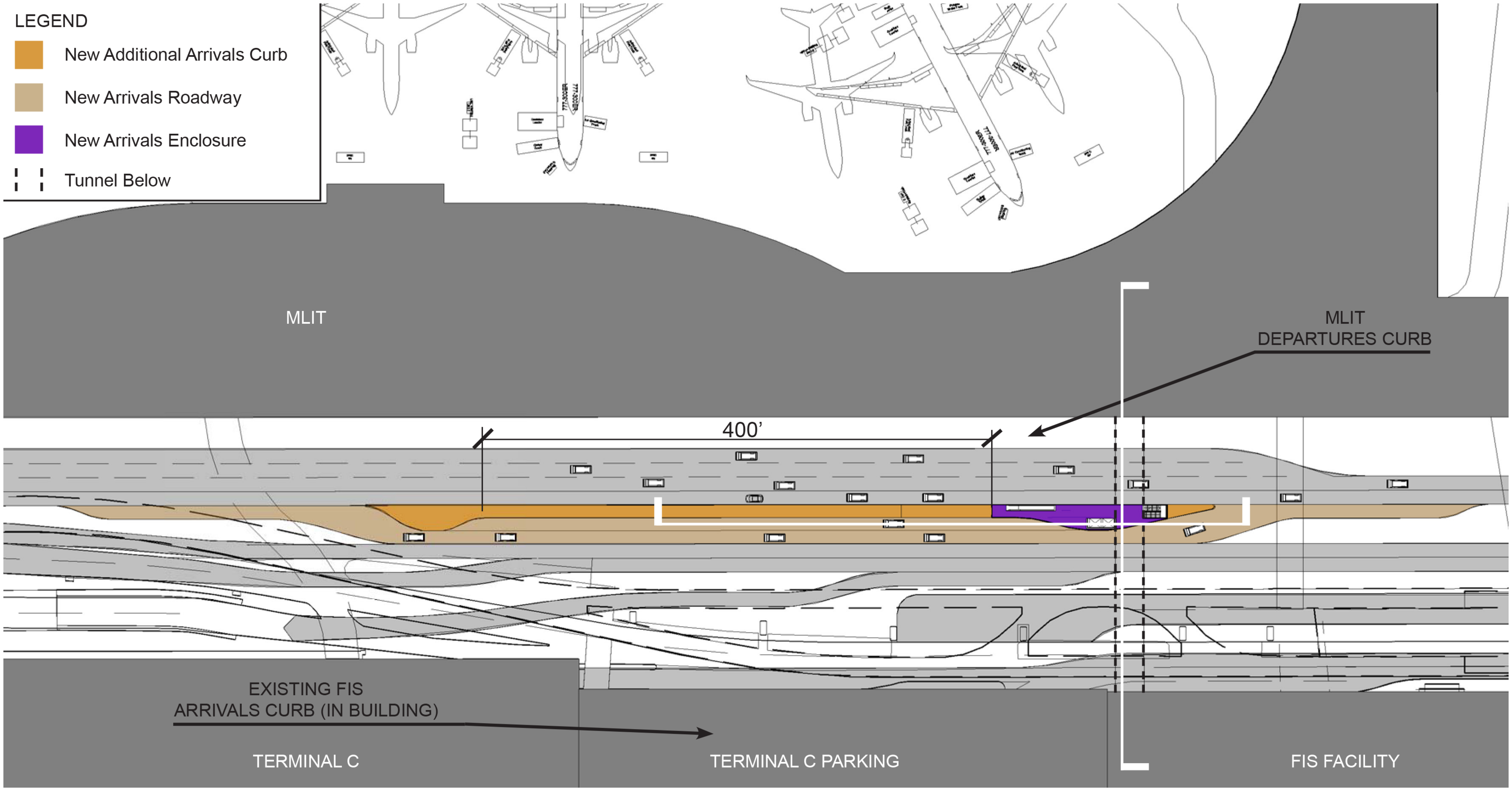
Garage - CBP Employee Parking (Level 116)



Garage - CBP Employee Parking (Level 127)

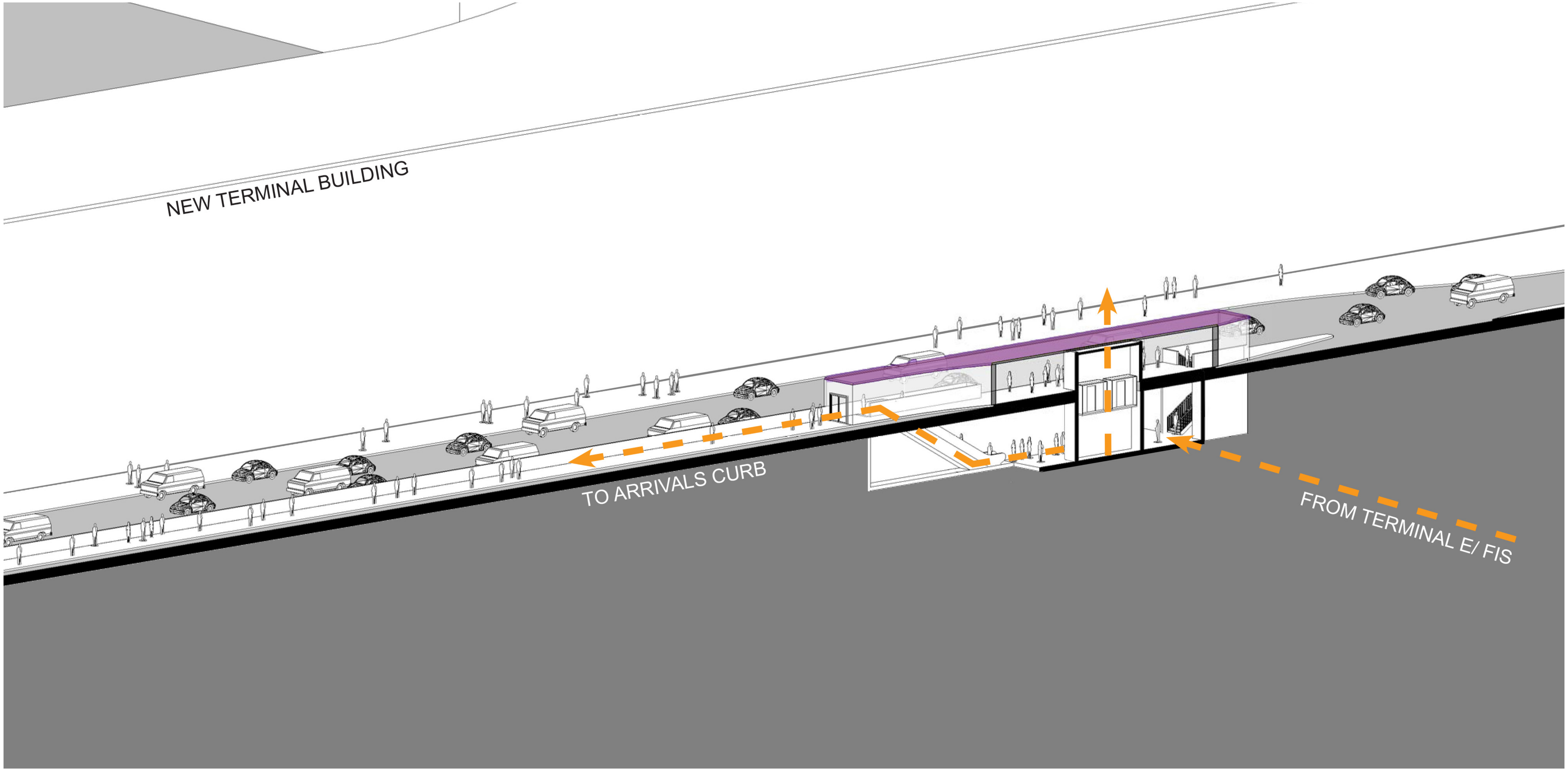


Planned Arrivals Curb



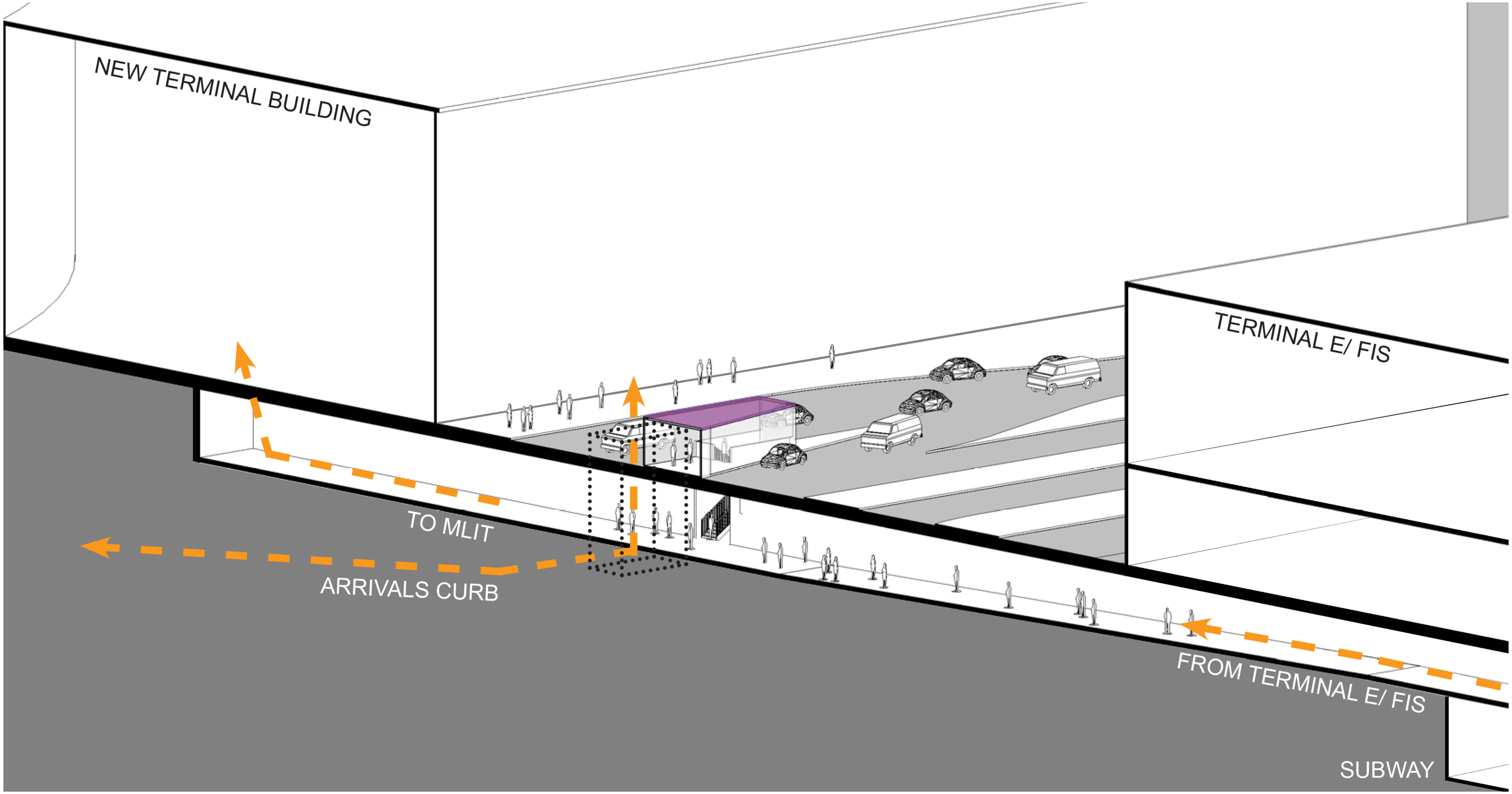
Not to Scale

New Arrivals Island Curb - East/West Section



Not to Scale

New Arrivals Island Curb - North/South Section



Not to Scale

5.3 Landside / Existing Tunnel

5.3.1 INTERNATIONAL ARRIVALS CURB

The existing international arrivals curb for arriving passengers is congested, especially at peak arrival times. With an ongoing and projected increase in international traffic, the need for more arrival curb length becomes a high priority. With the planned reconfiguration of North Terminal Road, between Taxiway SF and the Marriott Hotel, there is an opportunity to build an additional arrivals curb to serve either commercial or private vehicles.

This curb which would be included within the FIS budget would be located in front of the newly rebuilt MLIT , south of the planned departures curb and north of the Terminal D bypass road (**Figure 5.25**). The width of this area allows for the construction of a 10-foot-wide by 400-foot-long sidewalk/curb, one vehicle standing lane and one vehicle travel lane. A 200 ft long canopy is included above the sidewalk curb to shield passengers. The sidewalk/curb is accessed by passengers from the east by an escalator and set of elevators leading from the underground pedestrian tunnel that links the Terminal E/FIS facility to Terminal D. Vehicles access the arrivals pickup area via Terminal Road East. Following the signage for Terminal D/MLIT, there will be a lane that diverges where vehicles can go left for arrivals, straight to exit and right to departures. The available space will accommodate two lanes that will still preserve space for a Terminal C bypass roadway, and would most easily accommodate limited commercial traffic. This would allow private vehicles to follow the signs to the existing FIS arrivals curb at Terminal E. When deciding what traffic would use this curb wayfinding, one should consider limiting and simplifying the choices for vehicles and passengers alike.

5.3.2 EXISTING TUNNEL FROM TERMINAL D/MLIT TO TERMINAL E/FIS

The existing tunnel from Terminal D to the ITT/FIS will be renovated. New finishes should be coordinated and complementary to the new MLIT facility to the north, and the existing Subway and Terminal E facility to the south. As indicated on **Figure 5.26** & **Figure 5.27**, a new set of oversized elevators and escalators will be added to access the new arrivals island curb above in the new roadways. The elevators should be sized for multiple smartcart use. This will provide relief to the current congestion of the Terminal E arrivals curb front. Due to its proximity to the MLIT/FIS boundary line, this scope of work will have to be closely coordinated and timed within the phasing process.

There are no other landside modifications required as part of this project.

5.4 Baggage Circulation System Configuration

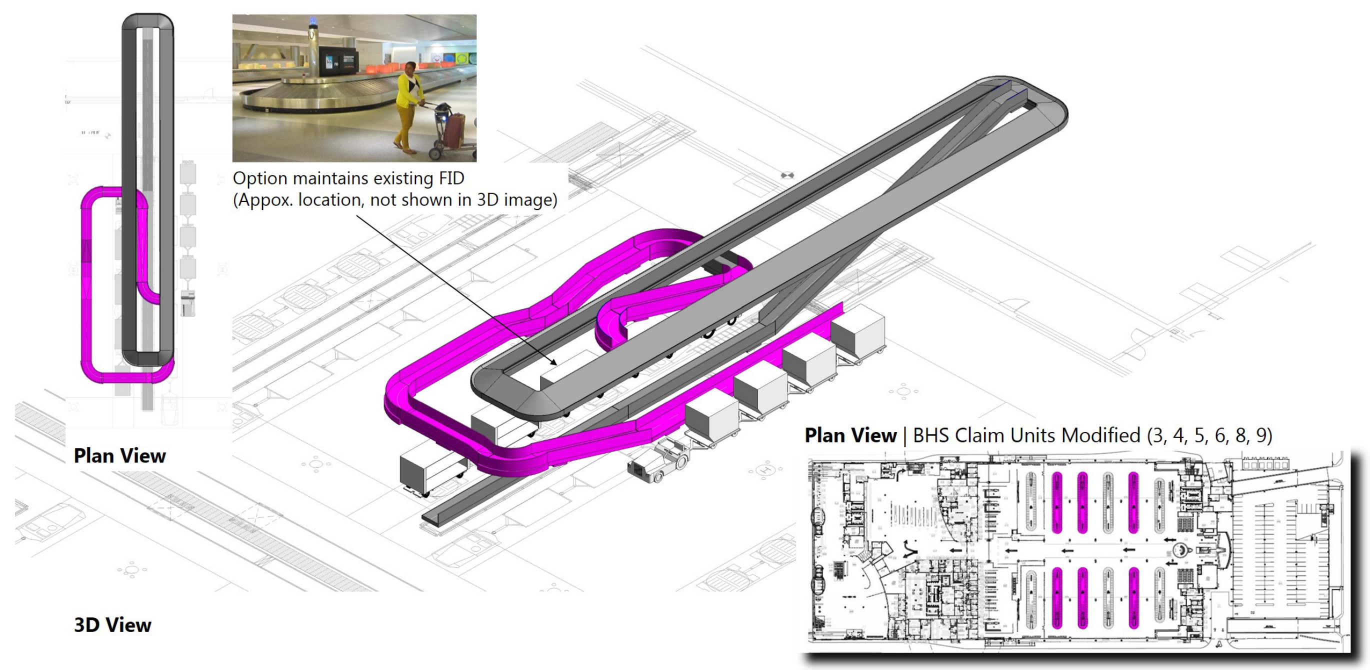
This section describes the preferred baggage configuration serving the redeveloped FIS facility.

5.4.1 RECLAIM

5.4.1.1 Standard Bags

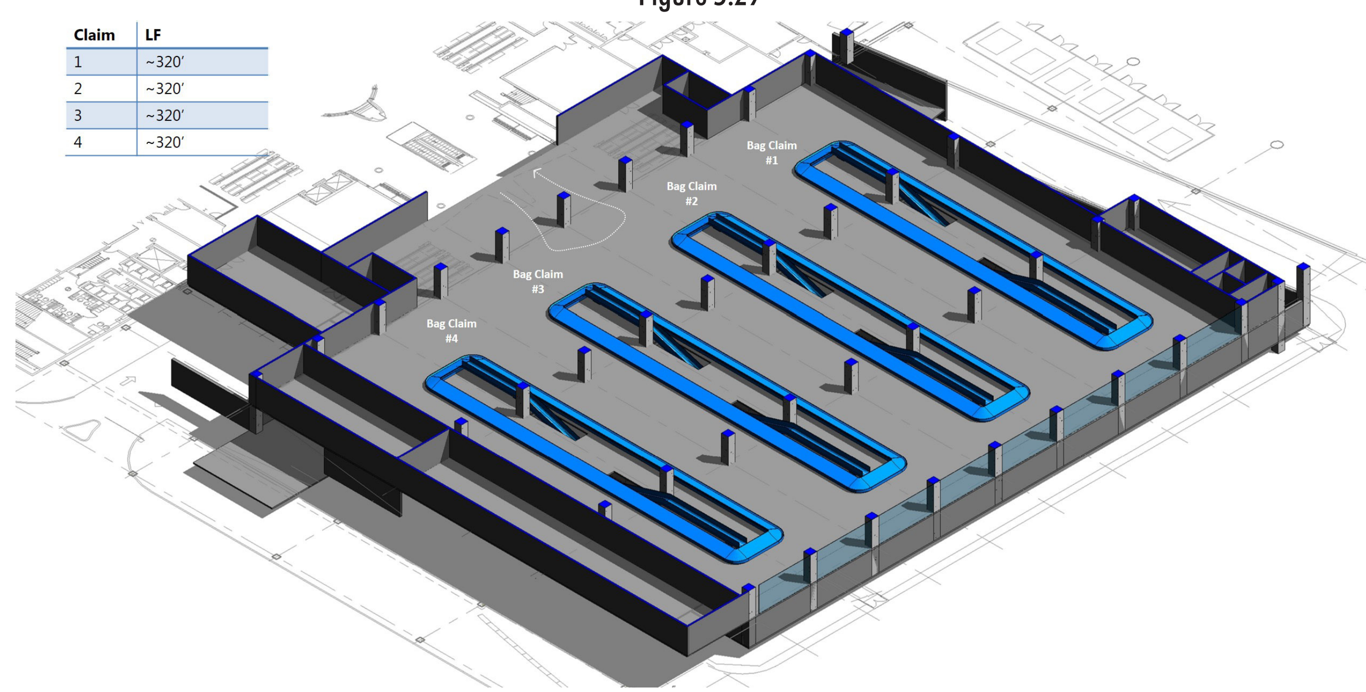
The existing reclaim units are oriented in a north/south configuration with the passenger access route along the center spine of the reclaim hall. Six of the existing reclaim units will be modified with a second feed line from below to allow for faster baggage transfer time to these claim units. The remaining unmodified loading conveyors on the tug and cart level below can be fed from both sides of the loading conveyor. Each feeding line is secured with a baggage security door to prevent unauthorized access from the reclaim hall to the baggage system and the sterile area of the airport. **Figure 5.28** depicts a dual feed configuration for existing bag claim units.

Figure 5.28



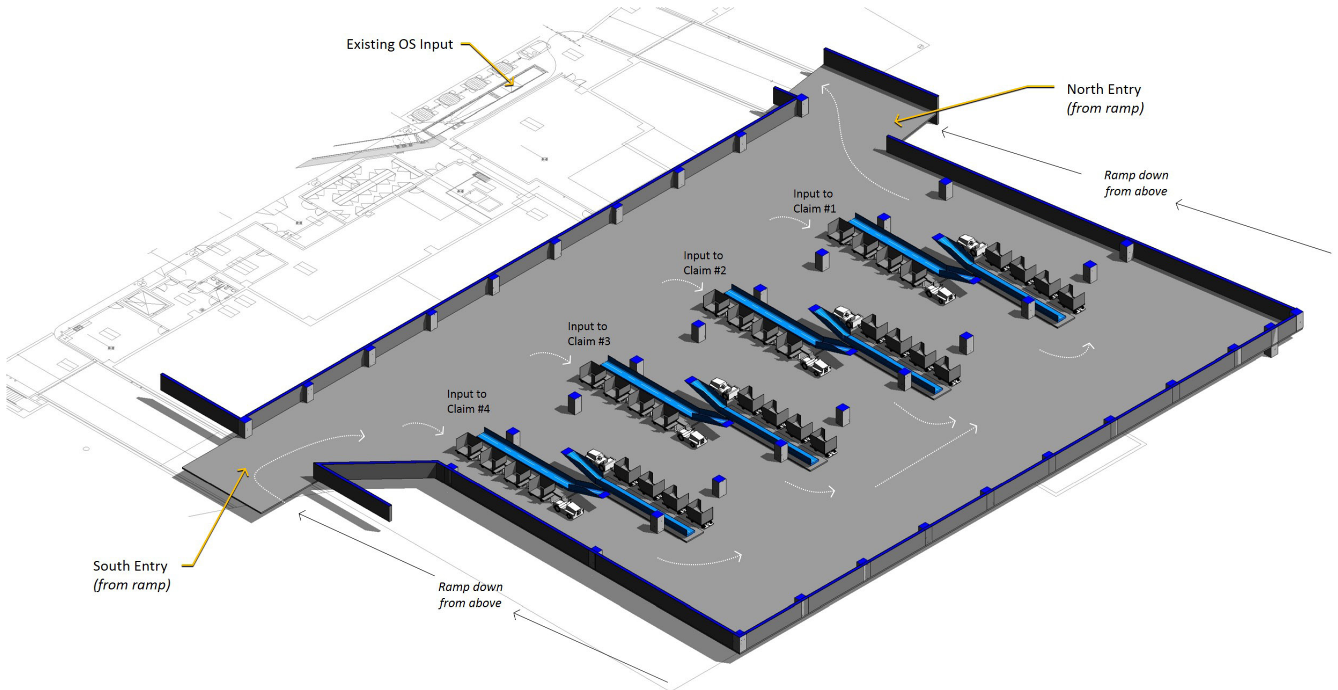
The preferred development plan adds four new claim units in the east expansion area. All units are equipped with dual baggage feeds to allow for even passenger distribution around the claim, as well as the possibility for faster baggage delivery. The baggage claim was designed around the planning column grid that was created for the overall parking structure above. It is anticipated that the design of the structural grid will be further developed in design phases and may allow for better tug and baggage claim separation on both levels. **Figure 5.29** and **Figure 5.30** depict the preferred reclaim plans for Level 93 and Level 74.

Figure 5.29



Claim	LF
1	~320'
2	~320'
3	~320'
4	~320'

Figure 5.30



The ramps into Baggage Level 74 will be located on the north and south sides of the baggage claim expansion. It is recommended to arrange tug and cart flow uni-directional as much as possible to prevent cross traffic.

5.4.1.2 Oversize Bags

It has been determined that an expansion or modification of the existing oversize belt is not required.

5.4.1.3 Non-Conveyable Items

It has been determined that an expansion or modification of the existing non-conveyable delivery configuration is not required.

5.4.2 BAGGAGE RECHECK

It has been determined that an expansion or modification to existing baggage recheck configuration is not required.

5.4.3 BAGS TRANSFERRING TO UNITED AIRLINES (UAL)

5.4.3.1 Standard Bags

The general configuration of the baggage routing remains as is. The six standard bag drop positions are merging with the FIS recheck ticketing line and the Terminal E ticketing lines to transport bags through a tunnel to United Airlines baggage screening and sortation matrix.

5.4.3.2 Oversize Bags

Oversize routing remains as is. Oversize bags are transported to the Checked Baggage Reconciliation Area (CBRA) for screening via the oversize conveyor located behind the ticketing counter. The oversize baggage is conveyed on a wide conveyor, which combines standard baggage with oversize baggage. Downstream from ticketing, oversize baggage is then separated from the baggage flow via vertical sorting units from the standard bags. They are then routed to dedicated manual oversize CBRA screening area. After screening, the oversize bags are sorted to the makeup locations in the bag room.

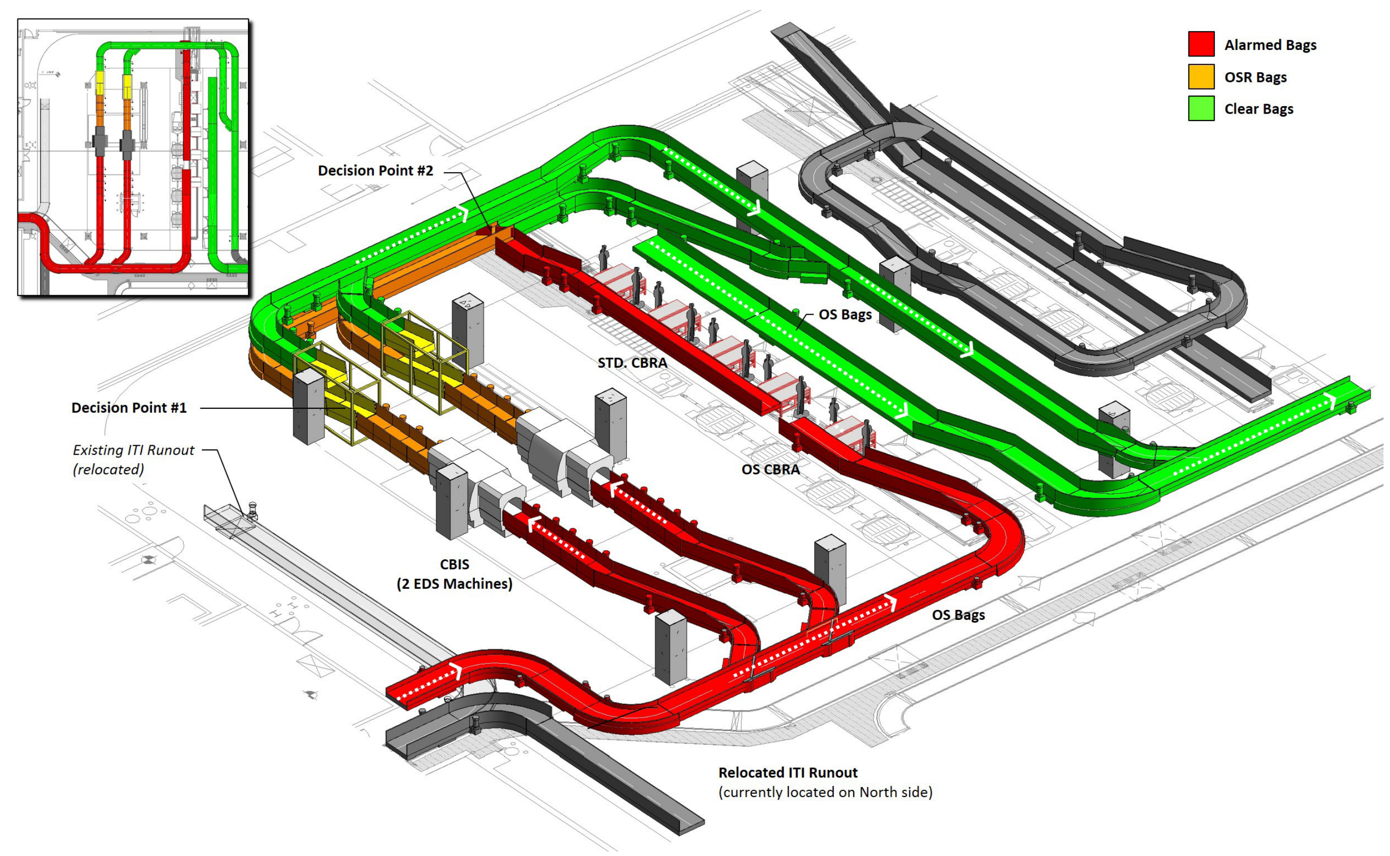
5.4.4 BAGS TRANSFERRING TO AIRLINES OTHER THAN UAL

5.4.4.1 Standard Bags/Oversize Bags

All standard and oversize bags are placed on a single conveyor behind the recheck ticketing counter and transported on the same conveyor to a new screening area below. Before reaching the Checked Baggage Inspection System (CBIS), oversize bags are separated from standard size bags. Standard bags are routed through EDS screening machines while the oversize bags are routed directly to the CBRA for manual inspection position.

The new CBIS and CBRA, as shown in **Figure 5.31** are located in the northwest corner of Baggage Level 74. The current feed line to the most northwestern claim unit can be removed, as this claim unit will be decommissioned. As part of this work, the existing ITI Transfer line will be modified to maintain tug and cart access. Oversize and standard bags cleared in this new CBIS/CBRA will be routed to the existing makeup carousel in the northeast corner of Baggage Level 74.

Figure 5.31



5.4.5 TRANSFER BAGGAGE SORTATION

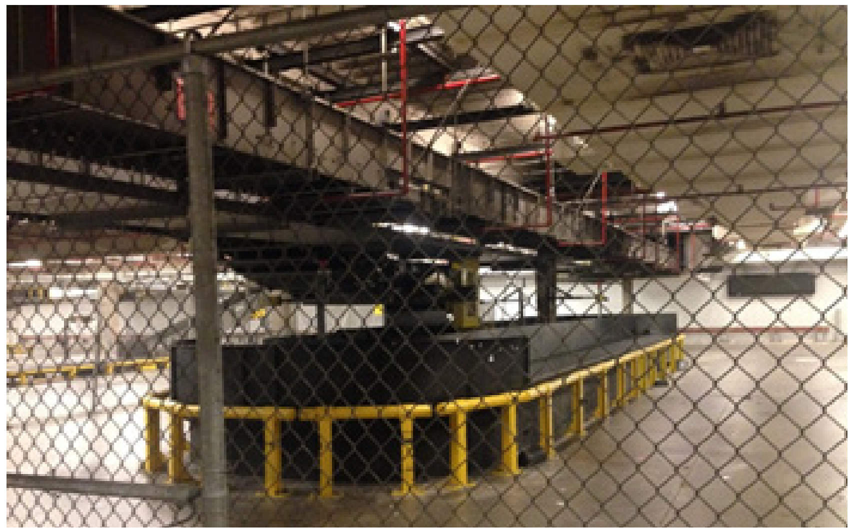
5.4.5.1 Bags Transferring to United Airlines

Bags transferring to United Airlines will be sorted within the United Airlines baggage system.

5.4.5.2 Bags Transferring to Airlines Other Than UAL

After standard and oversize bags are cleared by TSA, the bags are routed via a single conveyor to the existing makeup carousel in the northeast corner of the FIS loading, Level 74. Airlines with connecting passengers pick up the bags from that location and manually bring them to the makeup position for the connecting flight or directly to the connecting flight. **Figure 5.32** shows the combined makeup carousel for standard and oversize bags.

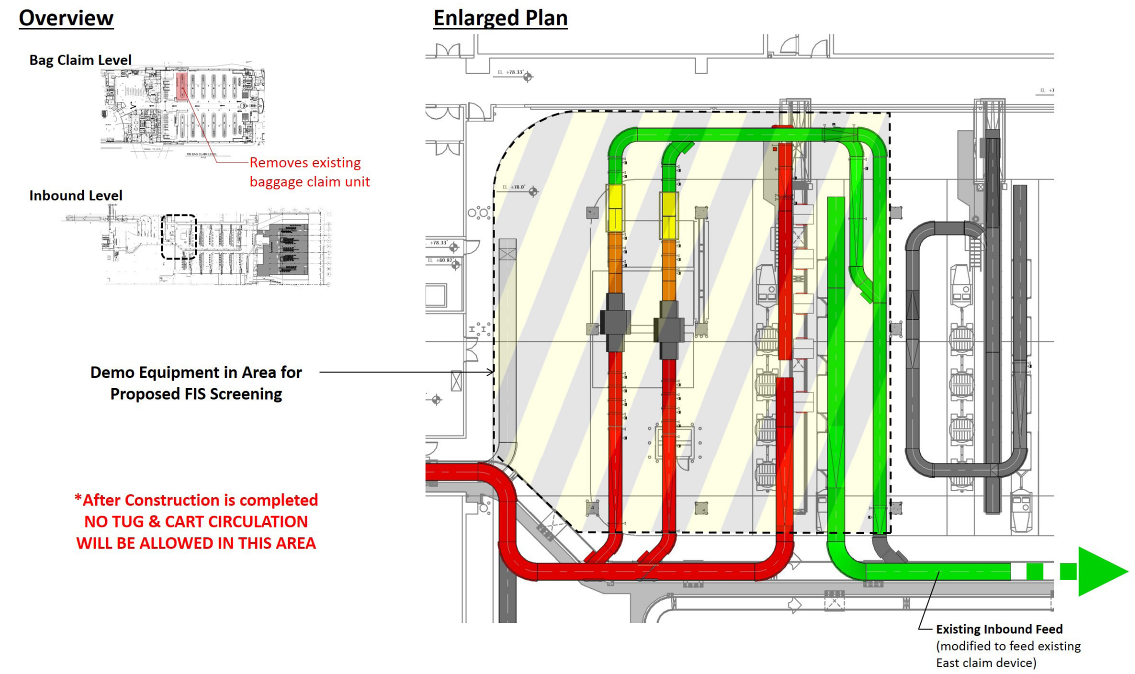
Figure 5.32



5.4.6 INTERNATIONAL-TO-INTERNATIONAL TRANSFER

The new configuration will maintain the capability to allow passengers transferring directly from one international flight to another. These passengers do not require reclaiming their bags, but they still have to pass through customs for immigration and passport control purposes. These direct ITI bags are transported from the arriving airplane directly to a feeding conveyor, which transports the bags to the TSA screening system. After the bags have been screened, they are sorted to the standard flight sortation location. **Figure 5.33** shows the ITI transfer belt.

Figure 5.33



The ITI loading belt may be reconfigured to the south side of the FIS loading, Level 74, to allow for additional tug and cart circulation space. If a reconfiguration is required, it will depend on the design of the new CBIS/CBRA and if sufficient circulation space can be maintained at the north end of the CBIS.

5.5 EXISTING FIS BUILDING (MEP) SYSTEMS

This section recommends proposed changes to the existing utility systems that serve the FIS Building. The systems will need to support both the renovated and expanded areas of the FIS. The estimated FIS facility renovation area is 120,445 sf. The FIS expanded area (heated and cooled space) is equal to 76,600 sf. An additional 79,400 sf of ramp level space will need to include heating. The following descriptions include building utilities. Refer to **Section 5.3** for the proposed needs of site utilities.

Descriptions take into consideration previous condition assessment studies performed for HAS. For example, the average Asset Condition Index (ACI) of the assessed FIS facility electrical equipment is 7.58 on the scale from zero to 10. This rating indicates that the electrical distribution equipment is fully operational, fully meets minimum mission requirements, has more than 10 years remaining service life, and is generally in good condition for its age. For the most part, few deficiencies were noted and they included the following:

- One panel board is recommended for replacement because of severe corrosion.
- Seven motor control centers are recommended for replacement because of bad breakers.
- Five panel boards are recommended for replacement due to varying issues ranging from an exposed bottom to missing space covers and plates.

The average ACI rating for mechanical equipment was five. In general, the existing air handling units are in good condition but pumps, variable air volume boxes, and fan coils are due for replacement given they were installed in 2002.

Building utilities consist of:

1. Chilled Water
2. Heating Water
3. Temperature Control
4. Air Handling Units
5. Domestic Cold and Hot Water
6. Fire Protection and Life Safety
7. Plumbing (Waste and Vent)
8. Natural Gas
9. Building Automation System
10. Electrical System
11. Emergency and Standby Distribution System
12. Lighting System
13. Information Technology

5.5.1 CHILLED WATER

The renovated areas will require replacement piping and other mechanical and electrical components within the immediate area of concern. The new expansion will demand an estimated 300 tons or approximately 670 gpm of chilled water to meet the cooling load. New 6-inch chilled water lines will need to be run from the existing mechanical room mains over to the new expansion area (see **Figure 5.34**).

A set of 12-inch chilled water distribution lines, currently on Level 93, deliver water from the booster pumps rooms (on Level 116) (See **Figure 5.36**) in the FIS facility. The new 6-inch chilled water lines will be connected to these existing lines and distributed to the new mechanical rooms that will be installed on Level 93 (see **Figure 5.34**) and MEP Room on Level 78 (See **Figure 5.35**)

Upon completion, the FIS facility will have a total estimated demand equal to 5,040 gpm (see **Table 5.2** for Cooling Loads). The existing pumps are in good physical condition; however, their variable speed drives (Coyote brand) have operational problems. Replacement of the existing pumps with three new pumps, equal to 2,550 gpm each, (see **Table 5.2** for Cooling Loads) with Ultralow Harmonic VFD Drives is recommended (see **Figure 5.36**).

5.5.2 HEATING WATER

The new, expanded FIS area, equal to 156,600 sf, will require an estimated 3,915 MBH of heating load. Total heating demand of the building will be 16,100 MBH, or approximately 1,600 gpm of heating water. The existing heat exchangers are sufficient to provide the new demand but have deteriorating insulation. Replacement of the insulation and providing regular maintenance to these units is recommended. Replacing the existing pumps with three new VFD units, equal to 800 gpm each, is also recommended (see **Table 5.2** for Heating Loads).

New 4-inch hot water lines will be required to supply the demand of the new expansion area of the FIS Building. A set of 6-inch hot water lines are located in the existing mechanical room on the east side of Level 93. The new 4-inch hot water lines will extend to the new mechanical rooms on Level 93 and Level 78. See **Figure 5.34** and **Figure 5.35**.

5.5.3 TEMPERATURE CONTROL

The new FIS temperature controls are planned to be Allerton field controllers to match the existing system in the FIS. These controllers are to be supervised from a common operator interface maintained by OpenTech Controls Inc. The temperature control systems include the function for temperature setback and time of day scheduling of equipment operation.

5.5.4 AIR HANDLING UNITS

The FIS facility will maintain the mechanical rooms currently in service, including renovated areas. Most of the existing air handler units have 50 percent or more of remaining service life; however, some of them need to be repaired and all of them require maintenance (see **Table 5.3**).

The expansion of the FIS facility will be conditioned by air handler units located in mechanical rooms at different levels of the new expanded area. This expansion will accommodate four mechanical rooms, two on Level 78 (MR-01 & MR-02) (see **Figure 5.39**), which will house ventilation units to supply the baggage makeup expansion and two on Level 93 (MR-03 & MR 04) (see **Figure 5.40**), which will house air handler units to provide service for the baggage claim expansion and the new sterile corridor and parking offices on Level 116.

Air plenum return will be used wherever the design of the building allows. Ventilation units shall be installed throughout the building to provide the respective air changes needed to meet the new expansion requirements. The design firm will determine the final quantities, sizes and distribution of the HVAC system.

5.5.5 DOMESTIC WATER

The new FIS expansion will not require any additional restrooms at this point. According to past condition assessment studies, the domestic hot water recirculation pump is past its rated service life and needs to be replaced.

5.5.6 FIRE PROTECTION

The FIS facility is protected with a wet pipe sprinkler system and standpipes per NFPA 13 & 14. New 6-inch sprinkler system risers will be needed to serve the new FIS space. Heat and smoke sensors will be needed. The sprinkler risers are to be located in the new mechanical rooms. Standpipes are located in the new stairwells.

The FIS will be served from the new combined fire water/water distribution system located near the C garage. A combined water distribution line will run in a new utilidor over to the east end of the MLIT.

The life safety systems are operational in the FIS facility and are currently code compliant; however Halon 1301 should be replaced with FM 200. There are no known deficiencies with the life safety systems. The current life safety system code requirements are grandfathered in for the FIS area. The renovation and expansion of the FIS facility will require the system to be brought up to full code compliance.

5.5.7 PLUMBING (WASTE AND VENT)

The FIS expansion will not require any additional plumbing fixtures. Per previous condition assessment studies, the sanitary sewer sumps have three years of remaining service life and need to be replaced. Alteration of existing Agriculture lines may be necessary and should be reviewed during the design process.

5.5.8 NATURAL GAS

According to the FIS Condition Assessment by Burns & McDonnell, the natural gas system is in good condition. This system includes a gas regulator and distribution piping owned and maintained by CenterPoint Energy. The natural gas regulator, at the main service, is in good working condition. The piping is original construction and is in good working condition. The natural gas regulator and piping are maintainable and easily accessible. The portion of piping exposed to the outside has started to show signs of rust.

5.5.9 BUILDING AUTOMATION SYSTEM (BAS)

The existing FIS BAS master controller is located in the Central Utility Plant (CUP). It monitors and controls HVAC systems in the FIS building. Fiber communication cable runs between the CUP and FIS. There is a need to replace pneumatic controllers in the renovated areas and install primarily direct digital controllers (DDC) for the new areas. The new expansion will be served from the JCI system. The new expansion needs to be integrated into the JCI system via remote controllers.

Detailed points for monitoring and control will be determined by the design engineer. The following are typical points which should be included and connected to the BAS:

- Space temperature and humidity sensors
- Building pressurization at selected locations throughout each terminal
- CO2 sensors in return air ducts
- Discharge air temperature on any air terminal boxes using reheat
- Supply and return temperature for chilled water and hot water at each mechanical room or separate air handling unit
- Supply and return pressure (or differential pressure) at each mechanical room
- Return and supply air temperature at each air handling unit
- Run status for all air handling units, fan coil units and compressors
- Tank high/low level alarms for domestic water tank

Table 5.2 FIS HVAC Loads

FIS BUILDING

DIMENSIONAL INFORMATION	SQUARE FEET	Existing	647,474				
		Expansion Level 116	10,750				
		Expansion Level 93	65,850				
		Expansion Level 78	80,000	BUILDING HEIGHT (FEET):	15	VOLUME OF THE BUILDING (CUBIC FEET):	1,200,000.00
SYSTEM INFORMATION		CHILLED WATER - ΔT:	12 °F	CHANGES PER HOUR:	5	HOT WATER - ΔT:	20 °F

COOLING INFORMATION:	EXPANSION ON LEVEL 93 & 116		EXISTING DEMAND	TOTAL LOAD	LOAD INSTALLED	RECOMMENDATION
COOLING RESULTS	TONS REQUIRED:	333	2,815	3,148	3,750	Assuming an 80% of the Total demand, the actual capacity of the existing chilled water pumps will be able to provide what it is required for the new expansion since the pumps are provided with VFD.
	GPM DEMANDED:	666.09	5,630.21	6,296.30	7,500.00	
	SIZE OF THE PIPE	6"			16	

Cooling Factor: 230 sq ft/Tons

VENTILATION INFORMATION:	EXPANSION ON LEVEL 78
VENTILATION RESULTS	CFM Required: 100,000.00

HEATING INFORMATION:	EXPANSION ON LEVELS 93 + 78		EXISTING DEMAND	TOTAL LOAD	LOAD INSTALLED	RECOMMENDATION
HEATING RESULTS	MBH REQUIRED:	3,915.00	16,186.85	20,102	15,000.00	- According to Burns & McDonnell report the existing hot water pumps present operational issues. This would be a good opportunity to replace the existing pumps for three (3) new pumps of 800 gpm each which will supply the demand required for the new expansion + existing building. The heat exchangers will required to be replace as well for three (3) heat exchangers of 800 gpm each.
	GPM DEMANDED:	391.50	1,618.69	2,010.19	1,500.00	
	SIZE OF THE PIPE:	5"			10"	

Heating factor: 25 MBH/sqft

Table 5.3

ROOM NUMBER	EQUIPMENT TYPE/NAME	ACI	DEFICIENCIES	RECOMMENDATION
LEVEL 78				
REPLACEMENT PRIORITY - PRIORITY				
0M0502	HEATING VENTILATION UNIT HVU-B-1	0	This unit has been turned off through the BAS and it has multiple operational issues. The unit has a useful service life remaining and is recommended to be place back into normal operation	The area that this unit serves will be remodeled, it is recommended to repair this unit since it has 50% of remaining life and the reparation of its issues vs replacement will have a cost impact. Reparation $2,500, replacement $42,000.
0M0604	CIRCULATING PUMP HWCP-B-2	0	This pump has served beyond their useful life and should be replace	It is recommended to replace this unit since it has 55% of its remaining life.
0C0704	EXHAUST FAN EF-B-6	0	This unit has experienced common issues of mechanical failure and a lack of BAS communication issues	It is recommended to replace this unit since it has 55% of its remaining life.
REPLACEMENT PRIORITY - NEAR TERM				
TUG RAMP 0A0810	AIR CURTAIN ACF-B-4	0	This unit has been turned off at the HOA. It is recommended to be placed back into operation.	It is recommended to repair this unit since it has 55% of its remaining life.
2P1102	FAN COIL UNIT FCU-2	5	This unit has a common issue that includes: fan status reported to BAS not functioning, installation issues, and BAS graphics not matching existing installation.	It is recommended to repair this unit since it has 40% of its remaining life.
0A0809	FAN COIL UNIT FCU-B-10	5	This unit has a common issue that includes: fan status reported to BAS not functioning, installation issues, and BAS graphics not matching existing installation.	It is recommended to repair this unit since it has 50% of its remaining life and the reparation of its issues vs replacement will be the same cost
0M0803	FAN COIL UNIT FCU-B-11	5	This unit has a common issue that includes: fan status reported to BAS not functioning, installation issues, and BAS graphics not matching existing installation.	It is recommended to repair this unit since it has 40% of its remaining life.
0M0803	FAN COIL UNIT FCU-B-7	5	This unit has a common issue that includes: fan status reported to BAS not functioning, installation issues, and BAS graphics not matching existing installation.	It is recommended to repair this unit since it has 50% of its remaining life and the reparation of its issues vs replacement will be the same cost
0M0805	FAN COIL UNIT FCU-B-8	5	This unit has a common issue that includes: fan status reported to BAS not functioning, installation issues, and BAS graphics not matching existing installation.	It is recommended to replace this unit since it has just 28% of its remaining life. This unit will have to be relocated south to the existing location to allow for a new elevator.
Existing Corridor to the West	FAN COIL UNIT FCU-T1	5	This unit has a common issue that includes: fan status reported to BAS not functioning, installation issues, and BAS graphics not matching existing installation.	It is recommended to repair this unit since it has 55% of its remaining life.
REPLACEMENT PRIORITY - LONG TERM				
0A0709	AIR CURTAIN ACF-B-1	7	This unit is running in Hand and when placed into mode the fans continue to run with the doors closed. Recommend verify wiring to the door limit switches and turn units off when the door is closed.	It is recommended to repair this unit since it has 55% of its remaining life.
0A0709	AIR CURTAIN ACF-B-3	7	This unit is running in Hand and when placed into mode the fans continue to run with the doors closed. Recommend verify wiring to the door limit switches and turn units off when the door is closed.	It is recommended to repair this unit since it has 55% of its remaining life.
0A0304	FAN COIL UNIT FCU-B-1	7	This unit has installation issues and controls/operation issues.	It is recommended to replace this unit since it has just 28% of its remaining life.
0A0703	FAN COIL UNIT FCU-B-5	5	This unit has installation issues and controls/operation issues.	It is recommended to replace this unit since it has just 28% of its remaining life.
0T0407	FAN COIL UNIT FCU-B-9	7	This unit has installation issues and controls/operation issues.	It is recommended to repair this unit since it has 55% of its remaining life.
0M0803	EXHAUST FAN EF-B-1	7	This unit has installation issues and controls/operation issues.	It is recommended to do the required maintenance to this unit since it has minor issues and 50% of its remaining life.

Table 5.3

ROOM NUMBER	EQUIPMENT TYPE/NAME	ACI	DEFICIENCIES	RECOMMENDATION
			LEVEL 93 - 50,625 SQ FT	
			REPLACEMENT PRIORITY - NEAR TERM	
1M0217	AIR HANDLER UNIT AHU-1-3	7	This unit presents little or no BAS communication to assess, invalid sequence of operations, hardware failures, excessive filter loading, control hardware failure, and casing deterioration.	The AHU-1-3 is conditioning the area that will be renovated. It is recommended to repair this unit since it has 55% remaining life.
1M0707	AIR HANDLER UNIT AHU-1-4	5	This unit presents little or no BAS communication to assess, invalid sequence of operations, hardware failures, excessive filter loading, control hardware failure, and casing deterioration.	The AHU-1-4 is conditioning part of the area that will be renovated. It is recommended to repair this unit since it has 50% remaining life.
1M0707	AIR HANDLER UNIT AHU-1-5	5	This unit presents little or no BAS communication to assess, invalid sequence of operations, hardware failures, excessive filter loading, control hardware failure, and casing deterioration.	The AHU-1-5 is conditioning part of the area that will be renovated. It is recommended to repair this unit since it has 55% remaining life.
1M0806	AIR HANDLER UNIT AHU-1-6	7	This unit presents little or no BAS communication to assess, invalid sequence of operations, hardware failures, excessive filter loading, control hardware failure, and casing deterioration.	The AHU-1-6 is close to the area that will be renovated. It is recommended to repair this unit since it has 55% remaining life.
13075	FAN COIL UNIT FCU-1	5	This unit has installation issues and controls/operation issues	It is recommended to replace this unit since it has 28% remaining life.
			LEVEL 116 - 69,000 SQ FT	
			REPLACEMENT PRIORITY - PRIORITY	
2M0415	AIR HANDLER UNIT AHU-2-7	3	This unit has multiple operational issues with flow and temperature control. The unit has a remaining service life and should be repaired to full operation condition.	This unit has 50% remaining life. The reparation of this unit will cost $4,800 vs replacement $31,200. It is recommended to be repaired since most of the issues have to do with the controls and instrumentation.
			REPLACEMENT PRIORITY - NEAR TERM	
2M0415	AIR HANDLER UNIT AHU-2-8	5	This unit presents little or no BAS communication to assess, invalid sequence of operations, and hardware	This unit is serving part of the area that will be renovated during the FIS Expansion. It has 55% remaining life, and recommended for repair.
2M0415	AIR HANDLER UNIT AHU-2-9	5	This unit presents little or no BAS communication to assess, invalid sequence of operations, and hardware	This unit is serving part of the area that will be renovated during the FIS Expansion. It has 65% remaining life, and recommended for repair.
2M0415	AIR HANDLER UNIT AHU-2-10	5	This unit presents little or no BAS communication to assess, invalid sequence of operations, and hardware	This unit is serving part of the area that will be renovated during the FIS Expansion. It has 55% remaining life, and recommended for repair.
2M0415	AIR HANDLER UNIT AHU-2-13	7	This unit presents little or no BAS communication to assess, invalid sequence of operations, and hardware	This unit is serving part of the area that will be renovated during the FIS Expansion. It has 55% remaining life, and recommended for repair.
2M0415	AIR HANDLER UNIT AHU-2-14	7	This unit presents little or no BAS communication to assess, invalid sequence of operations, and hardware	This unit is serving part of the area that will be renovated during the FIS Expansion. It has 70% remaining life, and recommended for repair.
2M0327	HOT WATER PUMP HWP-2	7	This unit is operating different than the sequence of operations with energy efficiency changes that may be incorporated to the sequence. HWP-2 also was noted with a mechanical issue of excessive noise.	This unit has approximately 50% remaining life, and is recommended to replace due to operational issues and increasing demand of the expansion of the FIS facility. It is also recommended to install (3) three hot water pumps of 800 gpm.
2M0327	HOT WATER PUMP HWP-3	7	This unit is operating different than the sequence of operations with energy efficiency changes that may be incorporated to the sequence.	This unit has approximately 50% remaining life, and is recommended to replace due to operational issues and increasing demand of the expansion of the FIS facility. It is also recommended to install (3) three hot water pumps of 800 gpm.

Table 5.3

ROOM NUMBER	EQUIPMENT TYPE/NAME	ACI	DEFICIENCIES	RECOMMENDATION
			LEVEL 116 - 69,000 SQ FT	
2M0327	CHILLED WATER PUMP CHP-1	7	This unit has operational sequence issues.	It is recommended to replace the chilled water pumps. The pumps are driven with Problematic Coyote Speed Drives and causing operational issues. The new pumps will be Ultralow Harmonic VFD Drives at 2,500 gpm.
2M0327	CHILLED WATER PUMP CHP-2	7	This unit has operational sequence issues.	It is recommended to replace the chilled water pumps. The pumps are driven with Problematic Coyote Speed Drives and causing operational issues. The new pumps will be Ultralow Harmonic VFD Drives at 2,500 gpm.
2M0327	CHILLED WATER PUMP CHP-3	7	This unit has operational sequence issues.	It is recommended to replace the chilled water pumps. The pumps are driven with Problematic Coyote Speed Drives and causing operational issues. The new pumps will be Ultralow Harmonic VFD Drives at 2,500 gpm.
			REPLACEMENT PRIORITY - LONG TERM	
2M0327	HEAT EXCHANGER HEX-2	7	Missing insulation on this unit.	It is recommended to replace the existing with (3) three new heat exchangers at 800 gpm, due to the increasing demand of the new FIS expansion.

Note:

820 sq ft will be renovated on Level 105

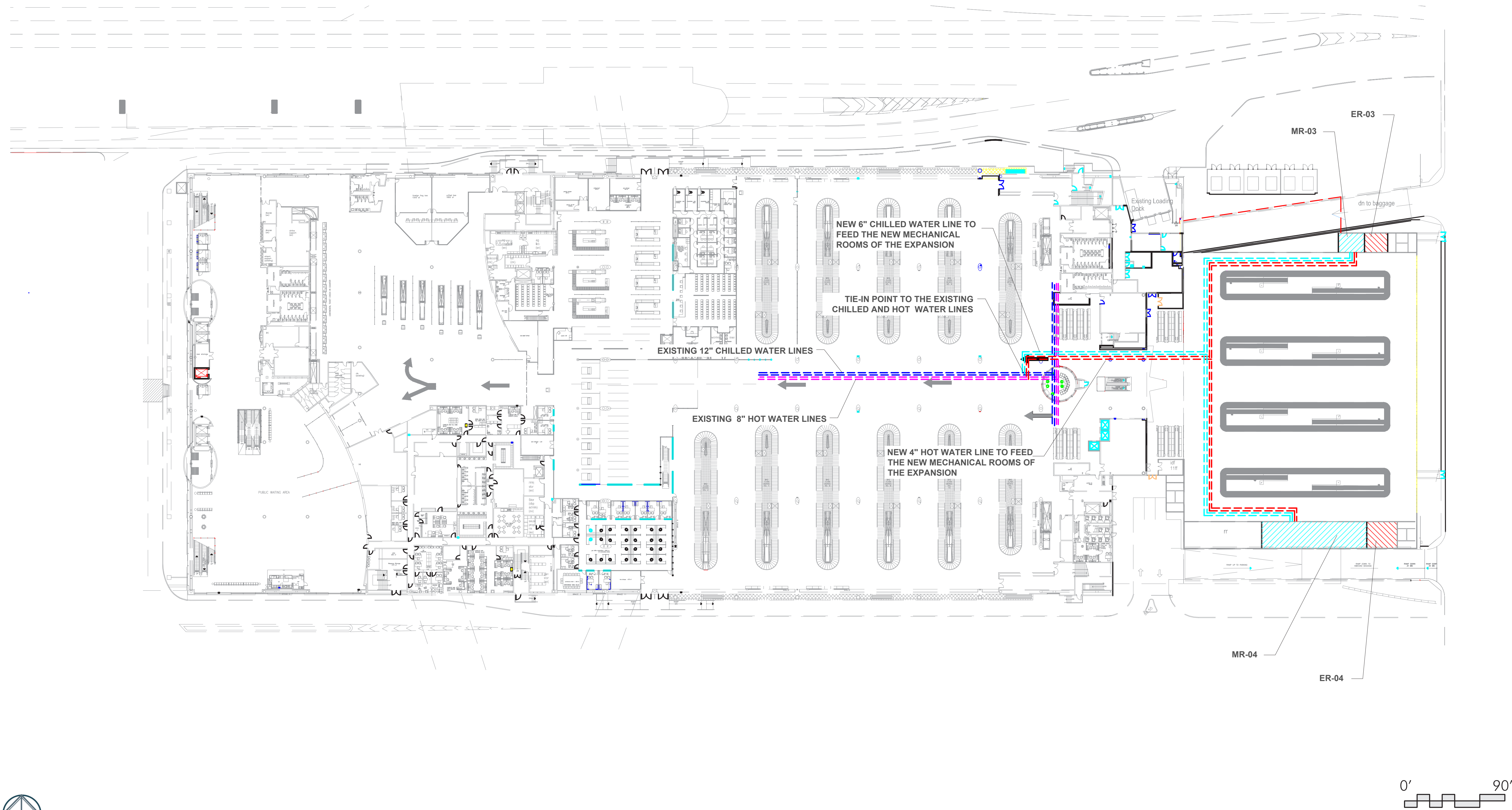
Meet or exceed the recommended control measures of the SMACNA IAQ Guidelines for Occupied Buildings Under Construction

It is requested that all hydronic pipes are tested, flushed, drained, filled and vented prior to tie in existing system to prevent debris from entering the central plant and loss of pressure.

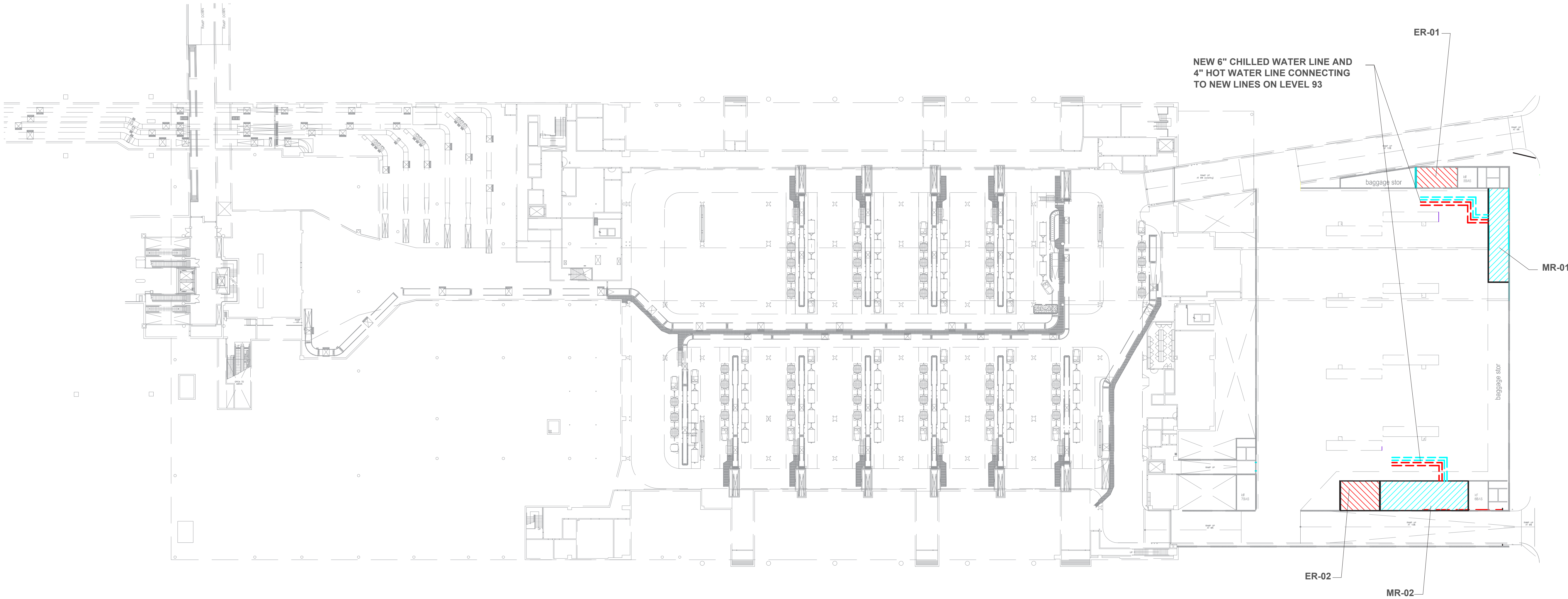
These systems shall also be chemically treated to the same amount to match the chemical amount in the existing system.

It is recommended that the new Building is kept under positive pressure at all times via a measurable Central Building Pressurization System to prevent air displacement.

Distribution Plan - Chilled & Hot Water Layout (Level 93)



Distribution Plan - Chilled & Hot Water Layout (Level 78)



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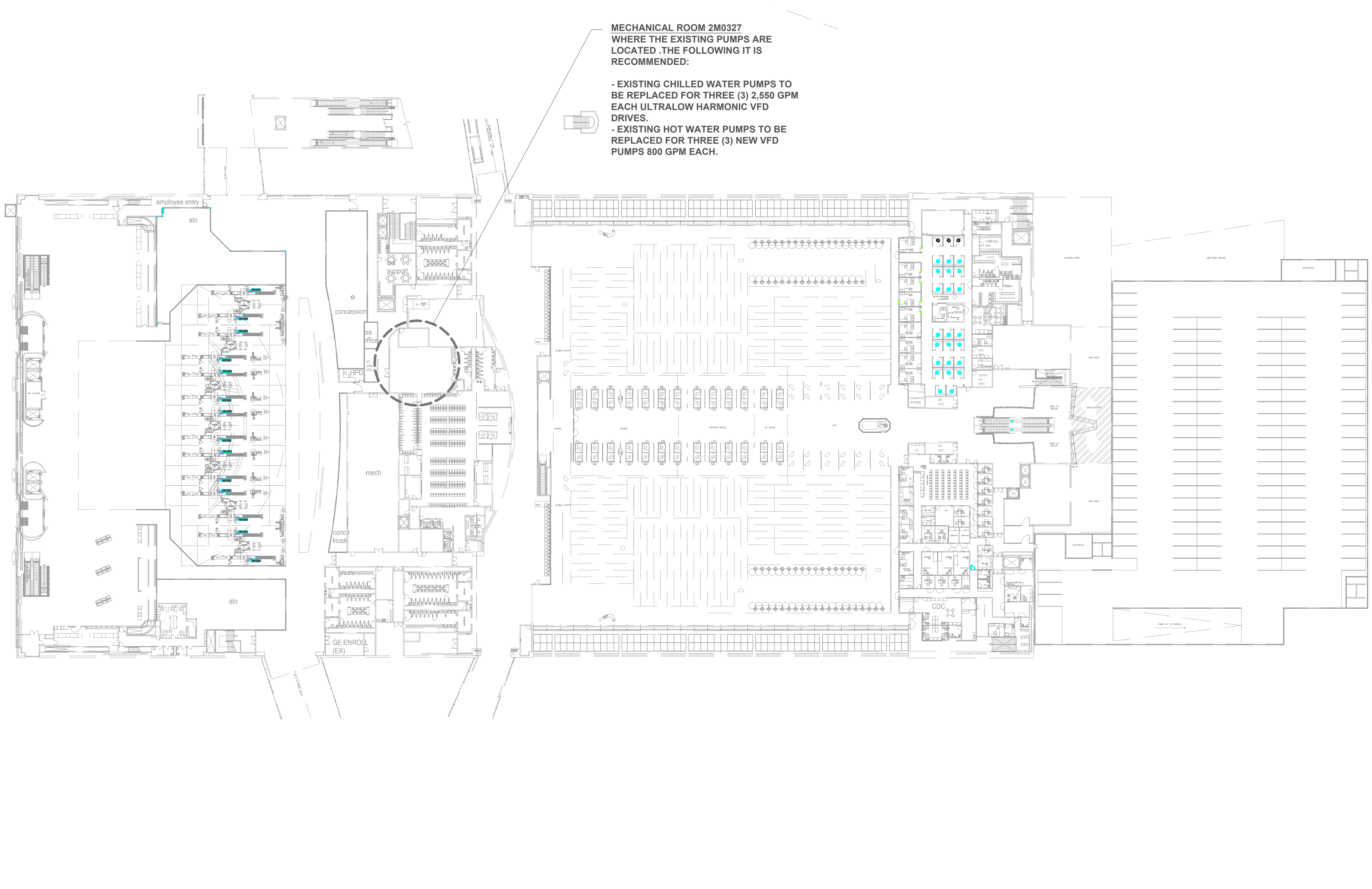
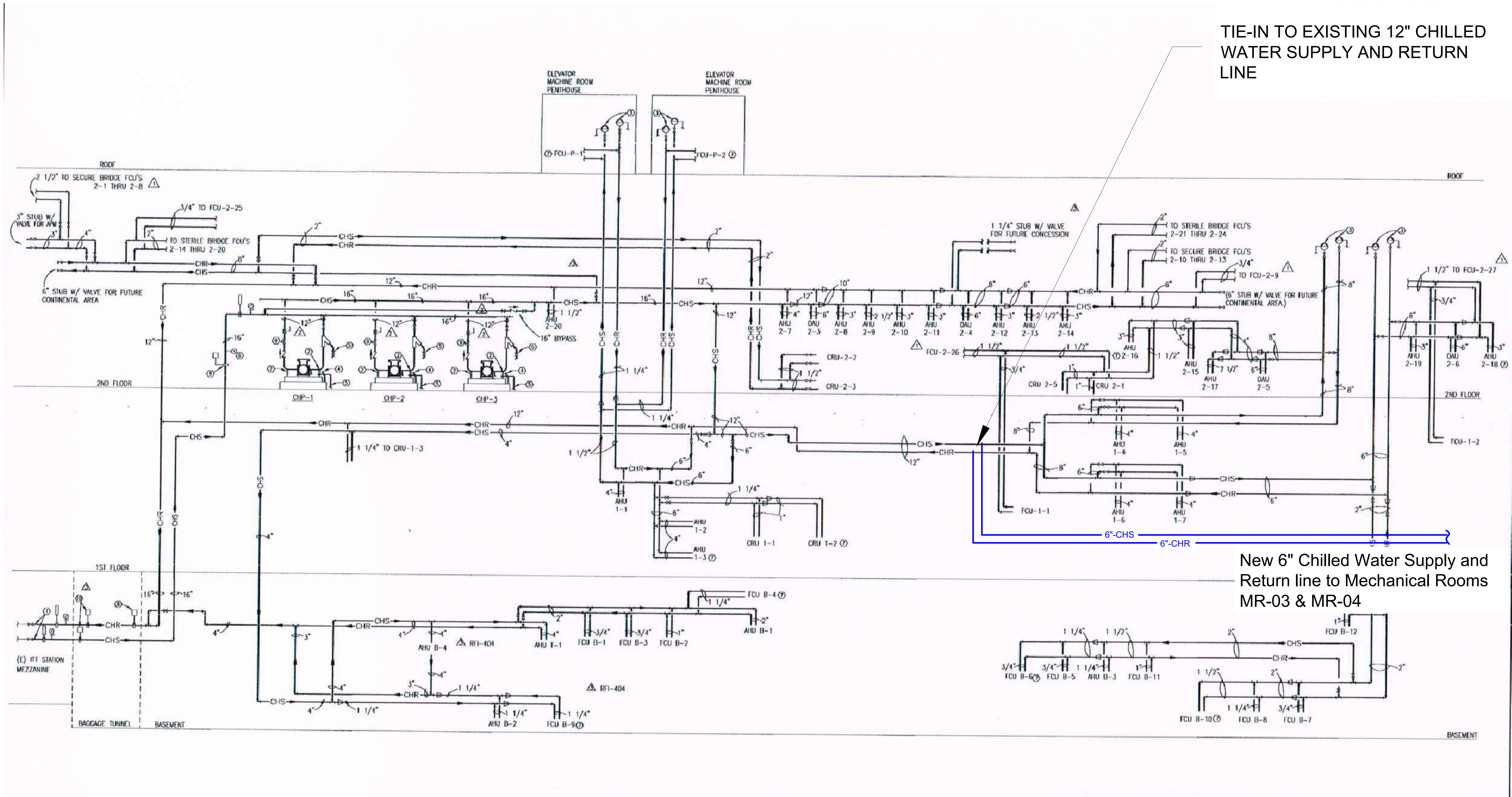
Chilled & Hot Water Pump Room (Level 116)



Chilled Water Riser



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5.5.10 ELECTRICAL SYSTEM

Over a 14-month peak load history, the following information was determined:

- One electrical utility transformer indicated a peak load in August 2013 of 679 kVA, or 34 percent of the transformer rating and 20 percent of the switchgear rating.
- The second electrical utility transformer indicated a peak load in January 2013 of 539 kVA, or 27 percent of the transformer rating and 16 percent of the switchgear rating.
- The sum of the two peak loads is 1,218 kVA, or 61 percent of one transformer rating and 37 percent of the switchgear rating when the switchgear tie breaker is closed and the switchgear is supplied from one of the two redundant transformers.
- The third electrical utility transformer indicated a peak load in March 2013 of 614 kVA, or 31 percent of the transformer rating and 18 percent of the switchgear rating.
- The fourth electrical utility transformer indicated a peak load in September 2012 of 533 kVA, or 27 percent of the transformer rating and 16 percent of the switchgear rating.
- The sum of the two peak loads is 1,147 kVA, or 57 percent of one transformer rating and 34 percent of the switchgear rating when the switchgear tie breaker is closed and the switchgear is supplied from one of the two redundant transformers.

A preliminary load calculation was performed based on the method calculation of square footage and information about the equipment that will be installed in the new FIS facility. A second feeding that will be added to the existing carousels 3, 4, 5, 6, 9 and 10 is among the new equipment to be installed. This addition estimates 14 motors per secondary feed, approximately 84 new motors total will be added. Installation of MCCs that will supply power to the new secondary feeds is proposed (preliminary analysis of available space) in the existing electrical room IHO-0708.M. This will be distributed to the various sectors that control the different conveyors.

The FIS expansion includes 80,000 sf (FIS TUG BAGGAGE MAKEUP ROOM) (see **Figure 5.39**) + 80,000 sf (FIS BAGGAGE CLAIM) (see **Figure 5.40**) + 8,000 sf (FIS CONDITIONED WALKWAY) + 120,000 sf (PARKING GARAGE) = 288,000 sf (see **Figure 5.41**). The estimated new power requirement is equal to 5,184 kVA (4,147 kVA demand). Adding these new areas to the existing FIS facility totals 6,512 kVA.

The existing switchgear is not sufficient to handle the existing or the future power load.

New switchgear is recommended to feed the new FIS facility load. Locate the switchgear in a new electrical room dedicated for this service. The electrical power to feed this switchgear will come from the HAS receiving station (12.5 kV) (See **Figure 5.42**).

5.5.11 EMERGENCY AND STANDBY POWER DISTRIBUTION

It is estimated that Emergency and standby power will be provided from a 2 MW generator, which location will be defined during the ITRP Enabling Utilities Landside Project. The intended plan is to route 12.5 kV distribution circuits with the purpose of distributing the respective terminal buildings, except for Terminal E. The generator estimated will be a diesel unit for outdoor use. It will have a day tank and an above ground storage tank. Natural gas or jet fuel will not be used. The generator will feed a switchboard ESWB and the switchboard will feed multiple automatic transfer switches that lead to the respective terminal building distribution panels, including the FIS. The distribution panels will serve elevators, lift stations, exit/egress lights, card readers, security doors, CCTV, radio equipment and fire alarm systems. Given the limited capacity of the generator (2 MW), off-loading software will be required to allow proper operation of the system so it does not exceed its capacity.

5.5.12 LIGHTING SYSTEM

Lighting for the renovated and new areas will consist of fluorescent troffers in public areas and strip fluorescent fixtures in mechanical spaces. Fixtures will have energy saving ballasts and T-4 warm white lamps. High bay interior areas will include metal halide HID fixtures. Egress lighting will be connected to generator power. HID egress fixtures will contain quartz restrike.

Exit lighting will be connected to generator power and consist of cast aluminum exit signs with fluorescent lamps. Exterior lighting should be high-pressure sodium HID. Lighting control for back-of-house, toilets, offices and other small spaces should be locally switched. Lighting control for large spaces and public areas is to be controlled by Lutron relay or dimming panels.

5.5.13 INFORMATION TECHNOLOGY

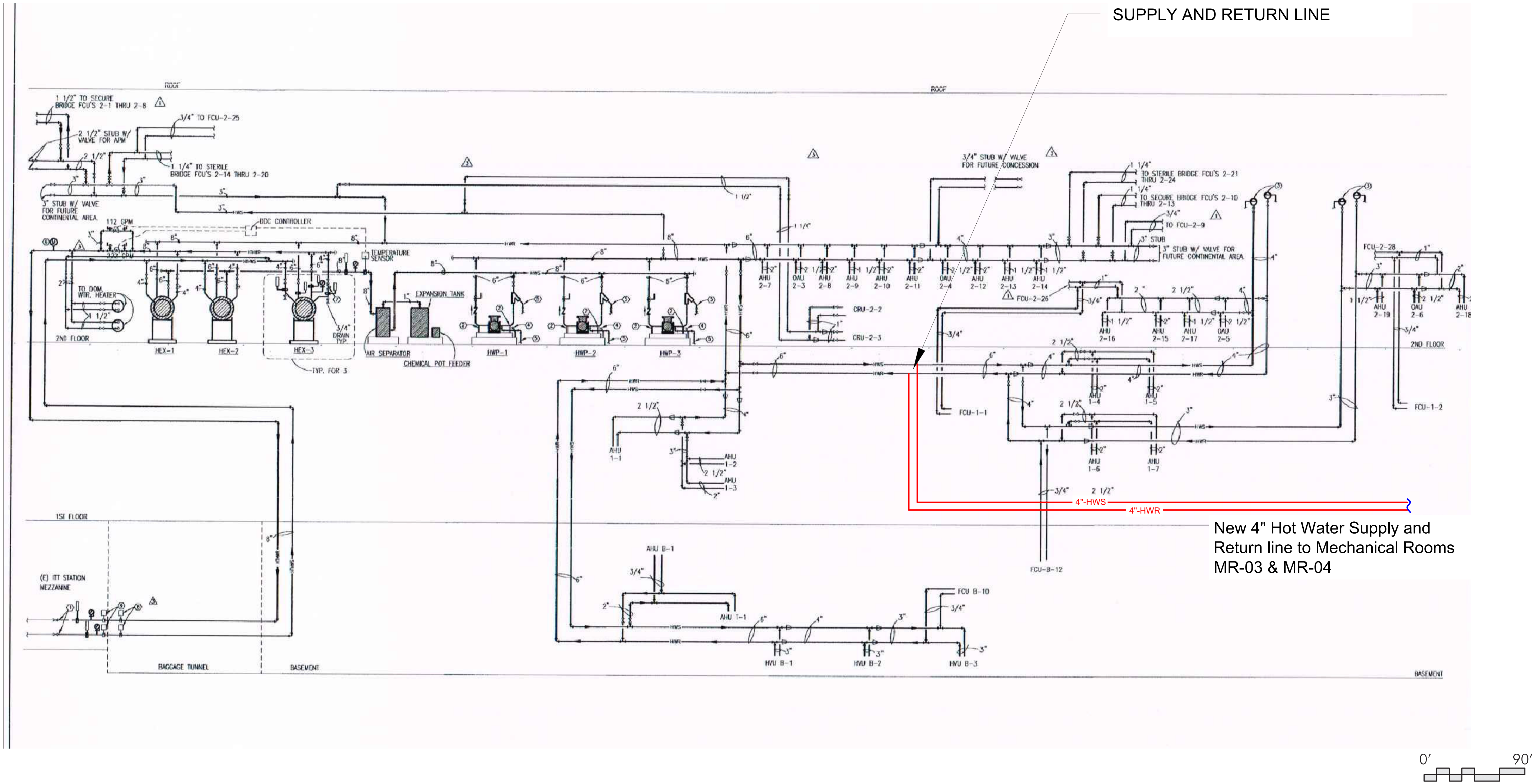
The existing FIS IT system is set up in a traditional “hub and spoke” arrangement. This arrangement shall be maintained and built upon, with each new IDF being fed from the existing central MDF, via fiber optic (FO) and copper connections. The main airport FO loop also utilizes the FIS MDF as a go-between when routed between terminals and other ancillary buildings. This means that almost all airport-wide FO pathways land on FIS, MDF, patch panels, or are routed through FIS MDF raceways. All these existing pathways shall be maintained and protected in place during construction.

The existing MDF has enough room to house any additional core layer networking equipment for all telephone and cable TV connections, including FO converters, Cisco-type routers and switches, centralized telephone and fire alarm interface for the PA system, central building management control center, energy management system, wireless network, radio communications, data communications, head units for eVIDS, as well as ACS and CCTV for the new FIS addition. Extra care shall be taken to ensure that all existing systems remain protected in place and functional during the duration of construction. Any shut-downs shall be coordinated with HAS personnel, and planned for off-peak hours.

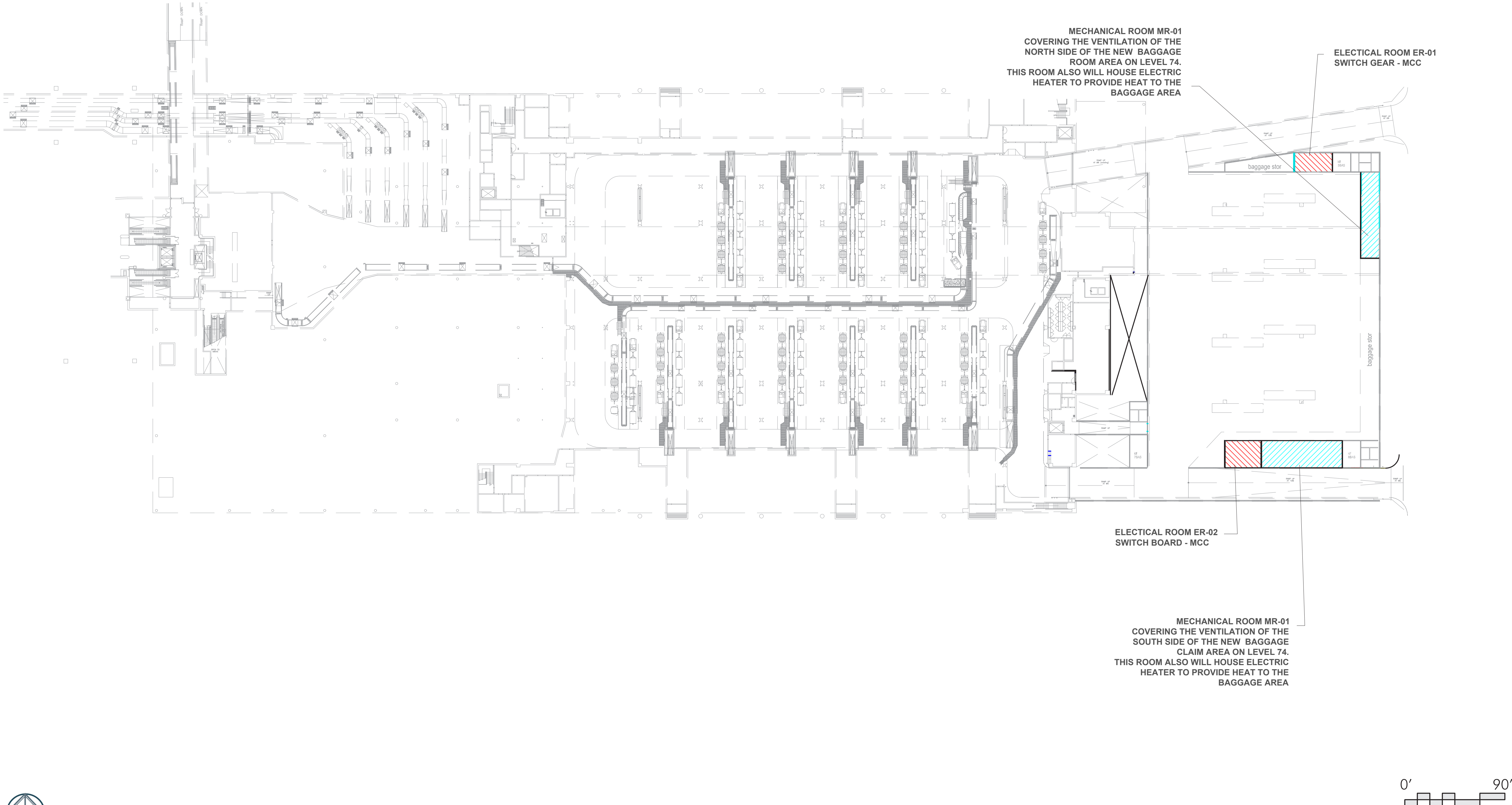
The existing MDF room will provide a central hub for communication distribution to seven smaller telecommunication rooms or IDFs located throughout the new FIS expansion. Six of the seven IDFs will be HAS dedicated, with two located on Level 78, two located on Level 93, and two located on Level 116. The east IDF on Level 116 is for the new garage camera, radio, & cellular systems. The west IDF located on Level 116 will replace existing IDFs 1FF & 3FF. It shall be used to support the exit booth security and automated revenue collection systems, plus the security and ACAMS for the sterile corridor, escalators, moving walkways, and elevators. The IDFs located on Levels 78 and 93 will be used to support the BIDs/eVIDS located on their respective floors. The seventh and final IDF will be for the CBP, located on Level 78, and used to support existing IDF room IA2.0802T.IDF/IDF.FIS.3SF. It’s currently at maximum capacity and cannot handle any additional expansion. However if additional IDF rooms are required by the CBP, the existing room has adjacent bathrooms to the south that can be easily removed or relocated. This allows for an expansion of the existing IDF space, and utilizing existing conduit and cable runs without disrupting airport CBP operations. The expansion would cause for additional electrical infrastructure since the current power panels & UPS system supplying the IDF equipment is already near max capacity.

The new CBP IDF will be used to support the additional rooms installed on Level 93. Additional renovations located at the west end of the existing FIS are to be supported by existing IDFs. All IDF rooms shall be equipped with a single-room-wide Uninterruptible Power Supply (UPS) that supports all active electronics for a minimum of 30 minutes. It is recommended that two centralized north and south UPS systems be provided to support the new IDFs on the north and south sides of the FIS. These UPS systems can be located in a central electrical room or

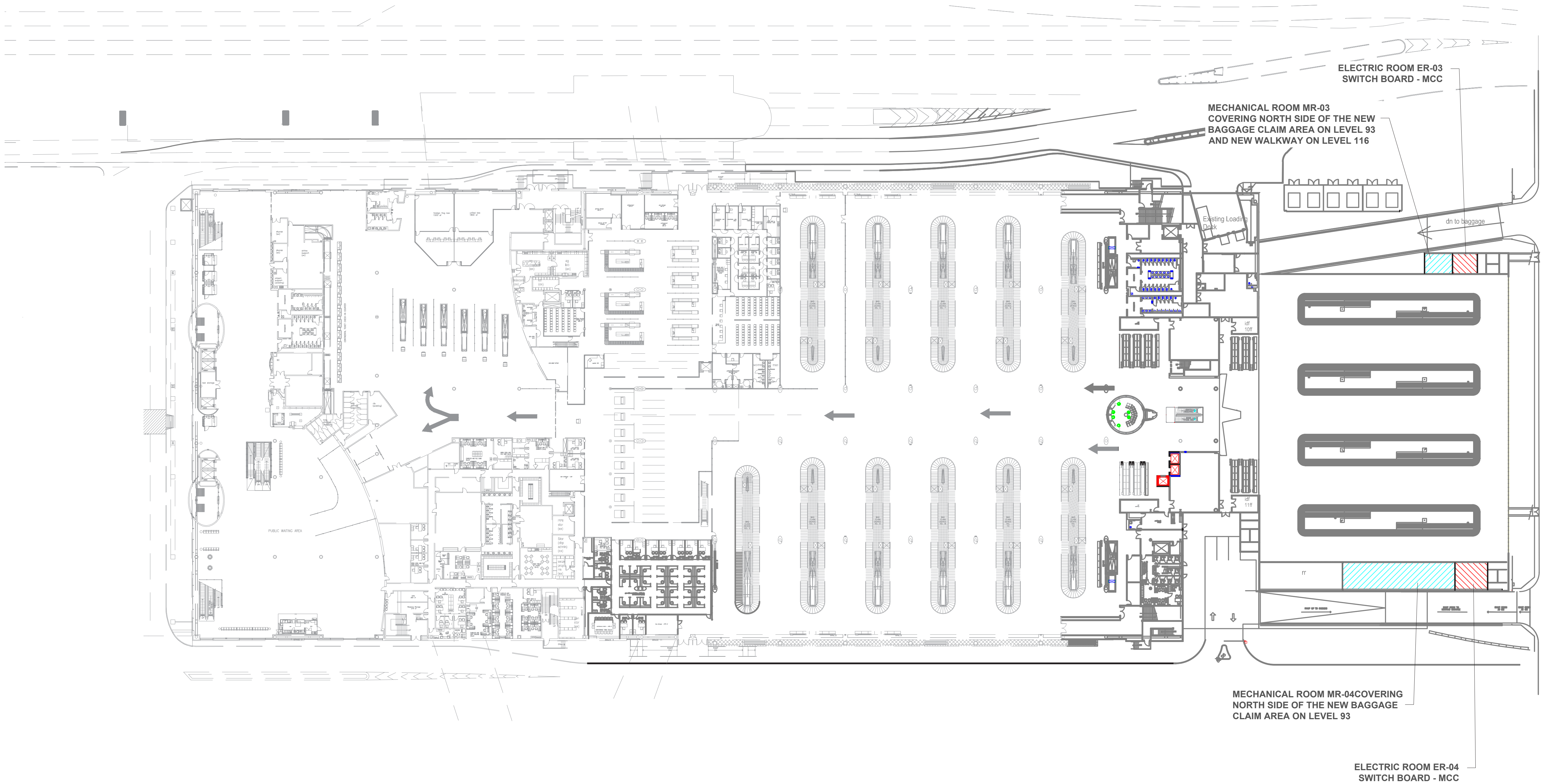
Hot Water Riser



Preferred Plan - MEP Rooms (Level 78)

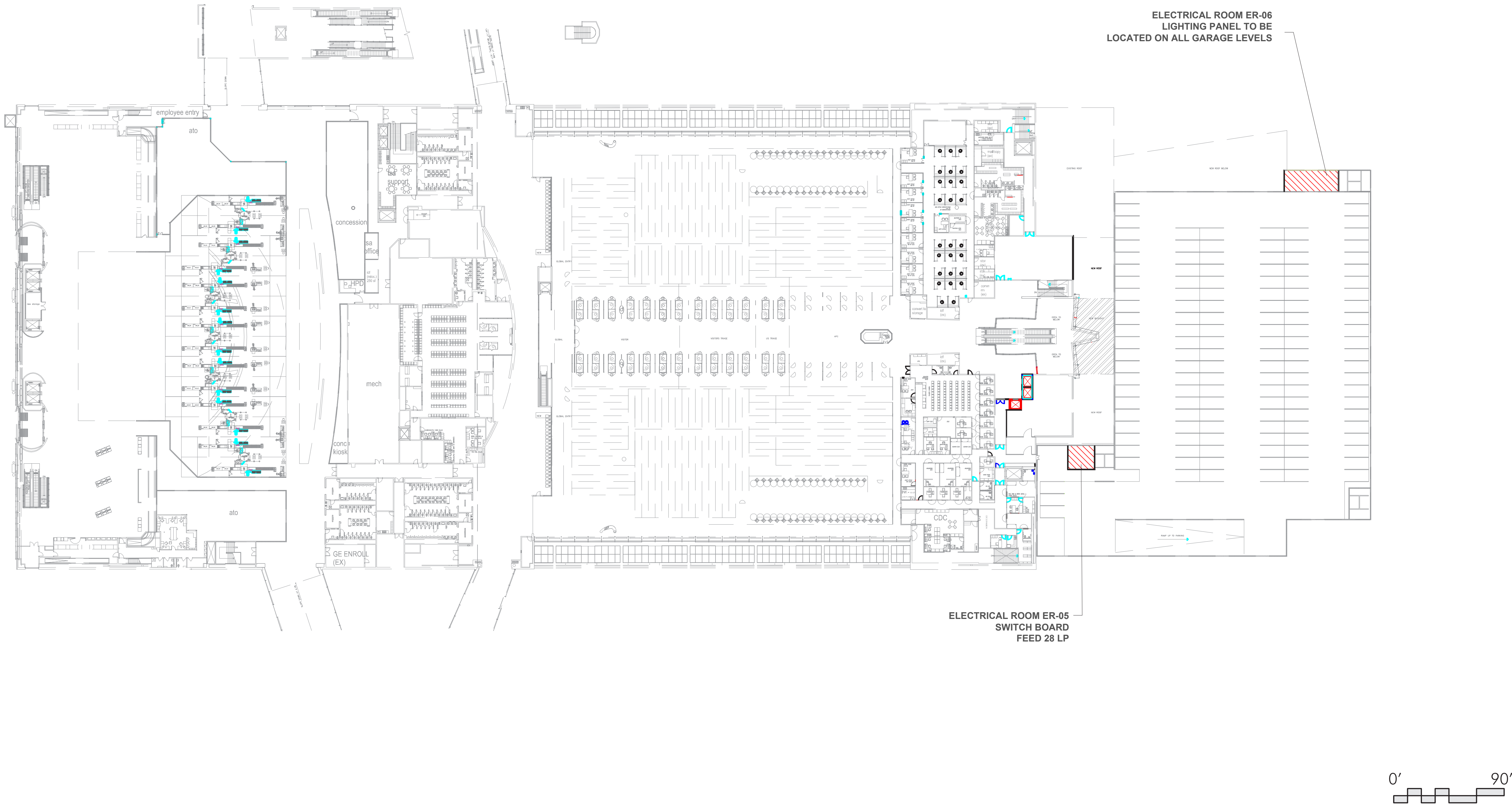


Preferred Plan - MEP Rooms (Level 93)

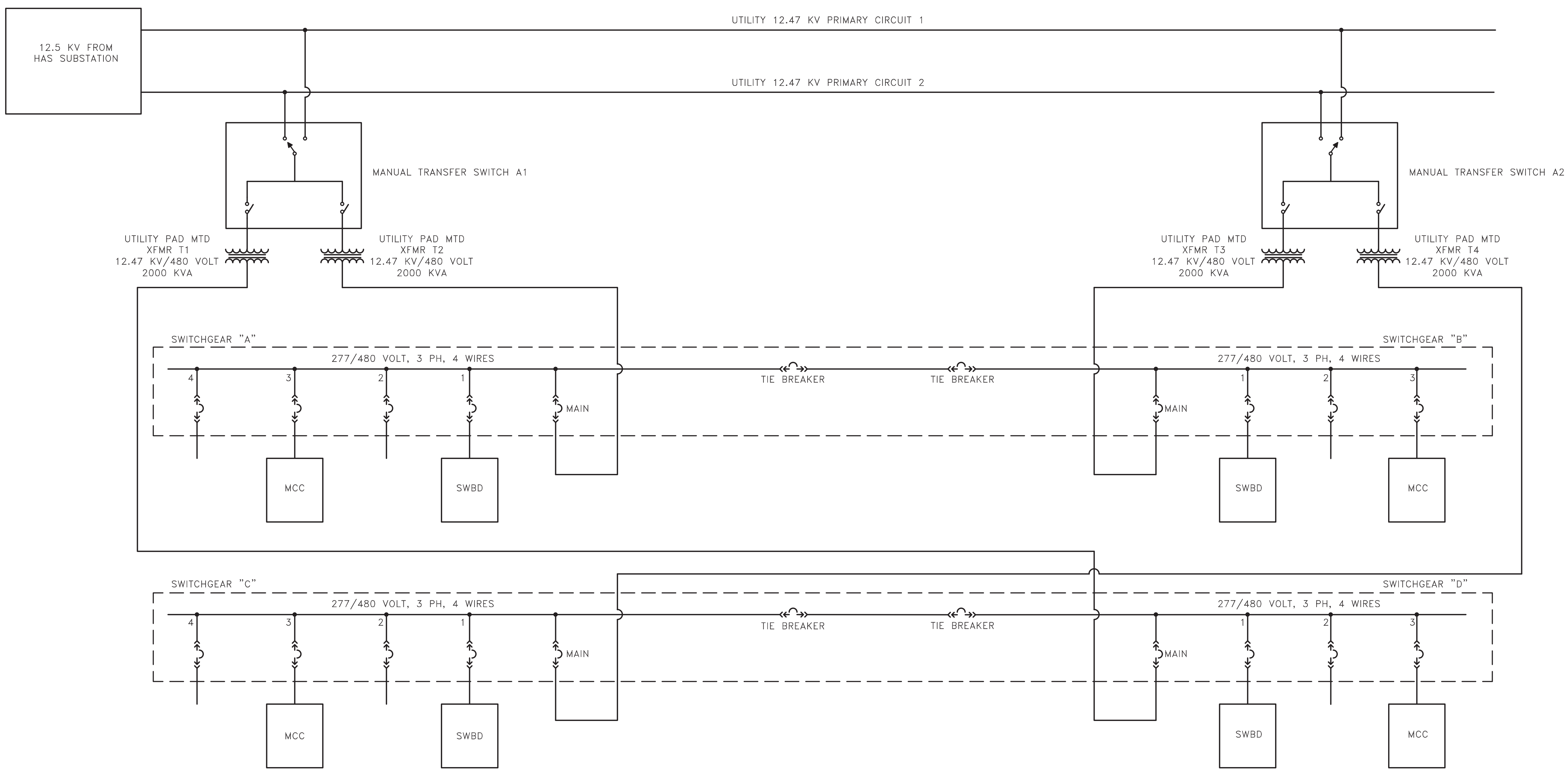


0′ 90′

Preferred Plan - MEP Rooms (Level 116)



Preferred Plan - Electrical One Line Diagram



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IDF location. The UPS systems shall be clearly labeled to identify which IT rooms and electrical panels they serve. Additional square footage shall be allotted for the UPS IDF. UPS systems shall be Powerware to match existing HAS IDF UPS systems.

The six 250 sf IDFs will house routers for connections to:

- Local airline GIDS
- Connections to airline and passenger Wi-Fi routers
- Local eVIDS systems
- Amplifiers, noise sensors and network switches for local PA systems
- ACAMS security panels for local doors
- CCTV network hubs for signal consolidation and local viewing, if required by individual airlines or CBP
- Local Fire Alarm sub-panels provisions for connectivity to TSAs Hi-SOC WAN
- BAS

Each IDF shall be connected to the centralized UPS system for emergency power. All FO and copper backbones shall be installed in cable trays on the basement levels from the MDF to all IDFs.

Each IDF will have a dedicated UPS backed-up air-conditioning unit, capable of operating independently of the terminal cooling system. This will allow for whole room cooling during extended blackouts, or CUP failures.

The existing public announcement (PA) system consists of an IED system. The new PA system shall match the existing system, and consist of all necessary components for a complete and operational system including:

- Amplifiers
- IP microphones
- CBP and TSA stations
- Noise detectors
- Zone specific directional tower speakers

The existing eVIDS system is InFax. The new eVIDs system shall be similar to the existing, and meet all architectural design requirements. All SSCP and primary CBP kiosks shall have reconfigured data systems for queue flexibility. See architectural design requirements for additional information regarding location and system infrastructure.

All LAN equipment, unless otherwise specified, shall be manufactured by Cisco Systems. Substitutions for specified Cisco Systems components are not permitted. The LAN configuration shall be a hierarchical star utilizing centralized core switches that star out to individual edge level devices located throughout the premises in designated areas. Single-mode FO cable shall provide the connectivity between all devices. Each edge level device services the HAS communications equipment (administrative LAN workstations, building management stations, etc.) via UTP copper cabling.

All LAN equipment shall provide Internet Protocol (IP) switching across all types of network technologies and topologies, including ethernet, fast ethernet and gigabit ethernet. The LAN architecture shall be based on 10 Gbps between the two core networking switches located in the MDF and the edge level networking equipment located in the TR. Where applicable, the edge level equipment shall be dual homed to the separate core devices. Each active device shall be accessible from a network, console or auxiliary RS-232 port. A configuration specialist shall be able to enter supervisory mode and change default configurations as appropriate for required operation of special system components. Each active device shall be capable of generating Simple Network Management Protocol (SNMP) or SNMP3 alarms. The device shall be respondent to Remote Network Monitoring (RMON) inquiries from an expert level network management inquirer.

All network equipment shall be compliant to physical and operational parameters. The equipment shall be capable of responding to SNMP, SNMP3 and/or RMON network management program calls from the Network Management System. Network equipment shall provide multimedia and multicast support through use of Protocol Independent Multicast (PIM) and/or Internet Group Management Protocol (IGMP). Network equipment shall support full-duplex connectivity on links (10Base-TX, 100Base-TX, 1000Base-TX, 100Base-F/TX, and 1000Base-FX). All network equipment shall be Virtual Local Area Network (VLAN) compatible based on both port and MAC addresses. VLAN assignments shall be configurable from a centralized administrative console. Network equipment shall not require reconfiguration of end-station network interface cards or network interface card drivers to accommodate intra-VLAN and inter-VLAN traffic.

Network equipment shall support automated VLAN creation and administration capabilities. Network equipment shall support port mirroring. This shall be done by sending frames directly from a specified port to another switch port or from an external network analyzer. Network equipment for use in the main MDF and TRs shall belong to one family of product. The equipment must allow for common sparing of all Interface Processor Modules and all Supervisor Modules. Network equipment shall support Terminal Access Controller Access Control System (TACACS), in order to provide secure port filtering. The equipment must enable individual ports to allow access only to certain workstations.

All active LAN devices shall include all software as required for interconnectivity. All active devices shall have fully functional network management options installed. The wired system shall perform as designed, providing a minimum of 10/100/1000 Mbps to each end user device and one Gbps from edge switch to core switch on the backbone. The 802.11n wireless access devices shall be provided in order to allow full terminal access to the wireless network. The designer shall coordinate with airport security, IT and CBP in order to determine where to limit coverage.

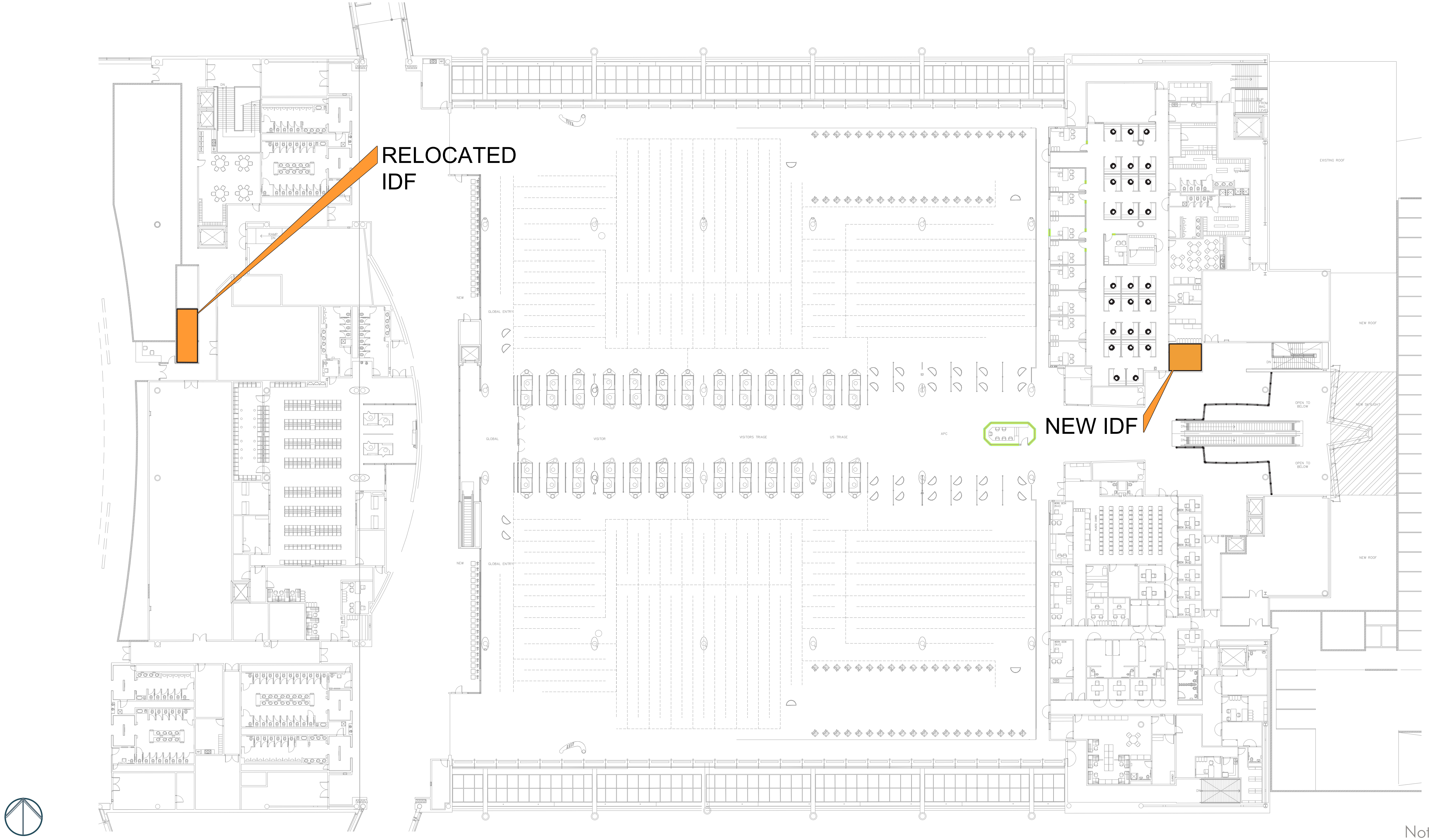
A complete ACS should be provided, including iCLASS Elite Contactless Smart Card readers, or an equivalent, with keypad where required. Card readers shall be "single-package" type, combining controller, electronics and antenna in one package. Connect card readers to intelligent field panels (IFPs). The IFPs shall be connected to the security host, by means of a TCP/IP network. It shall respond to commands from the host. Each IFP shall connect into the TCP/IP network through an ethernet HUB. The IFP shall forward the host information regarding access, status and alarms that the IFP has gathered from the readers and sensor devices, which the IFP controls. The IFP shall meet, or exceed, the following functional requirements. Each IFP shall be identifiable from the central host by means of a unique IP address.

See **Figure 5.43**, **Figure 5.44** and **Figure 5.45** for Terminal Telecommunications Rooms at Level 116, Level 93 and Level 78.

All IT and communications installations shall be in accordance with the latest version of:

- Distributed Antenna System; Section 270420
- Television Distribution System; Section 270450
- Telecommunications Grounding and Bonding; Section 270526
- Interior Communication Pathways; Section 270528
- HAS/PDC/Design Division Specifications; Section 270553
- Exterior Communication Pathways; Section 270543
- Identification and Labeling of Communication Infrastructure; Section 270553
- Communications Cabinets and Equipment Rooms; Section 271100
- Backbone and Riser Media Infrastructure; Section 271300

Proposed IT Space - Level 116



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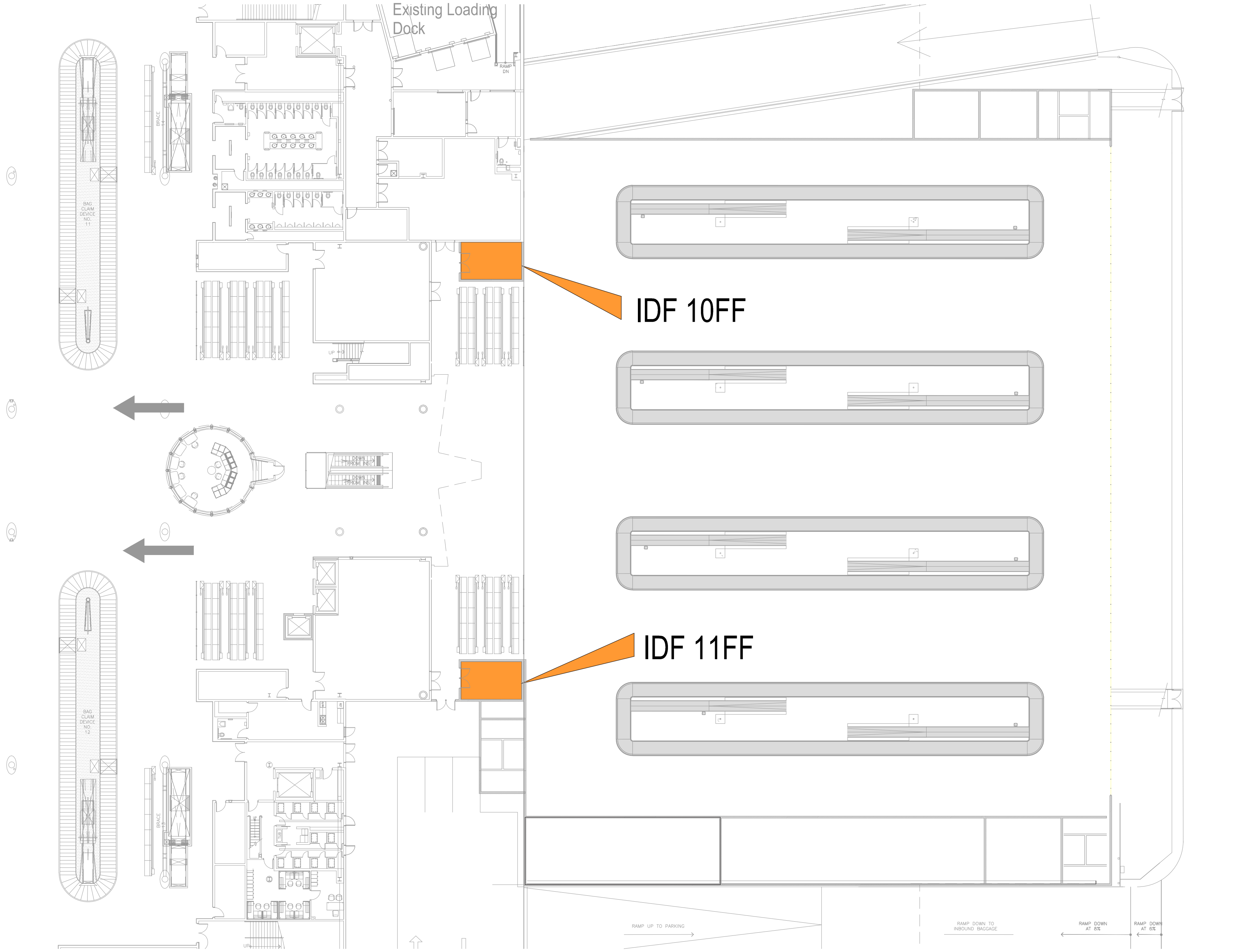
Proposed IT Space - Level 93



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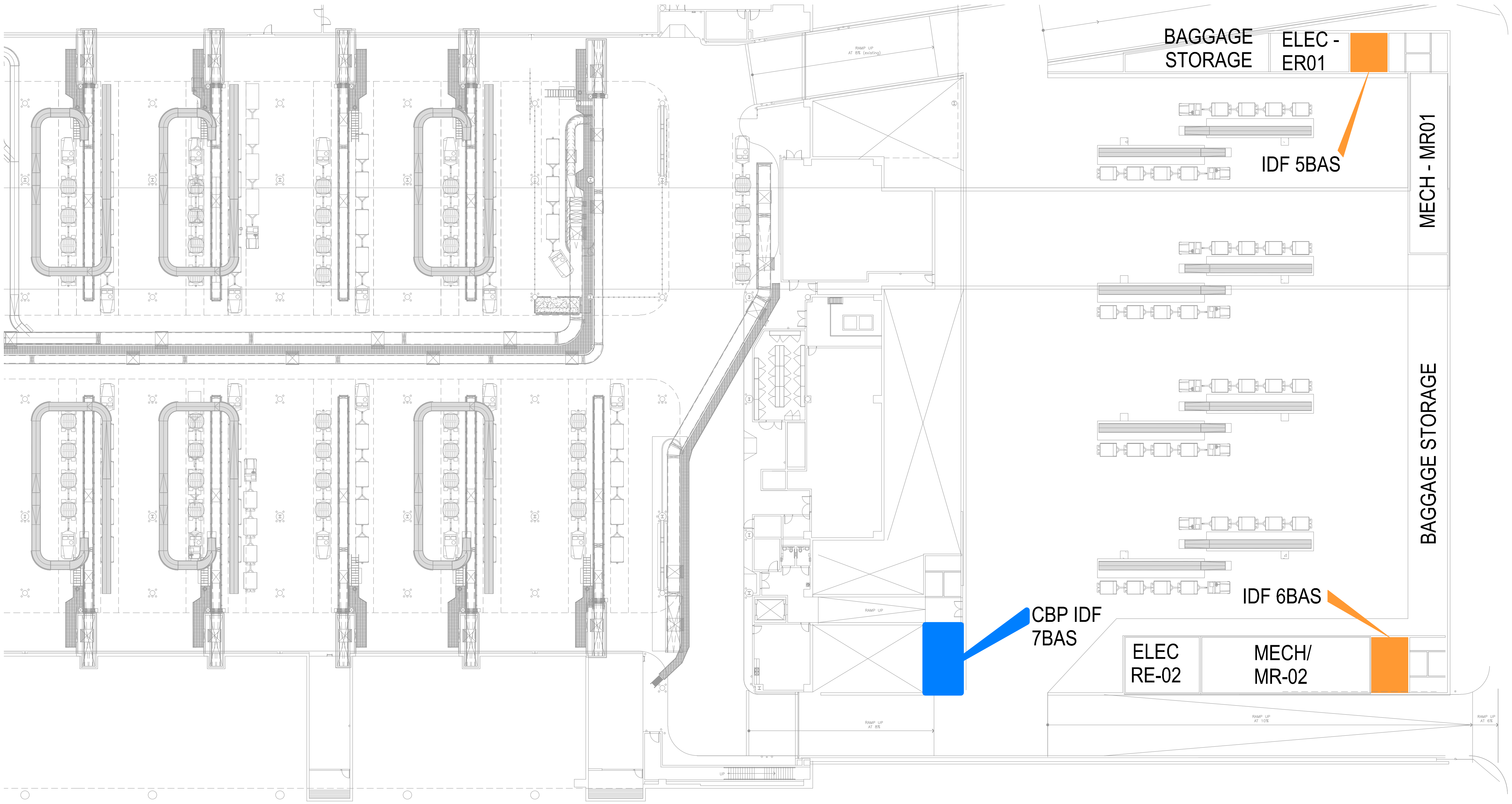
Proposed IT Space - Level 78



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- Horizontal Media Infrastructure; Section 271500
- Data Communication Network Equipment; Section 272100
- PC, Laptop, and Servers Equipment; Section 272200
- Audio Communication System; Section 275113
- Access Control; Section 281300
- Video Surveillance Control and Management System; Section 282300

5.6 PROPOSED SITE UTILITIES EXPANSION

This section describes the proposed site utilities serving the FIS facility. The systems will need to support both the renovated and expanded areas of the FIS. The estimated FIS renovation area is 120,445 sf. The FIS expanded area (conditioned space) is equal to 76,600 sf. Refer to **Section 5.2** for building utilities proposed needs. Descriptions take into consideration previous condition assessment studies performed for HAS. Site utilities consist of:

1. Chilled and Heating Water
2. Combined Fire Water and Water Supply
3. Sanitary Sewer
4. Storm Sewer
5. Natural Gas
6. 12.5 kV Site Power
7. Emergency and Standby Distribution System
8. Information Technology

5.6.1 CHILLED AND HEATING WATER

Per **Section 5.2.1**, a set of existing 12-inch lines serve the FIS. Chilled water supply originates from the CUP. Chilled water lines run north, to the Central Terminal Area (CTA), and split east and west in the core buildings. The FIS facility connects to the existing chilled water headers located in the ITT. The chilled water headers at this connection are 20 inches.

In the future ITRP Enabling Utilities Landside Project or related project, it is planned to install a new branch line for chilled water-distribution. It is intended that that the new chilled water line will serve the north terminals and core terminals. It is also estimated that additional piping is to be installed during this project to increase redundancy by providing a backfeed path, including the FIS.

5.6.2 COMBINED FIRE WATER AND WATER SUPPLY

The City of Houston owns the existing water lines that feed the airport, up to and including the water meters. An 8-inch PVC line supplies water to the FIS facility. The 8-inch line branches from the existing 16-inch water line loop located in North Terminal Road. The existing 16-inch line has adequate capacity for the FIS expansion. However, low City of Houston water pressure is a problem and must be addressed. An 8-inch water supply line serves the fire sprinkler risers at the FIS building. City of Houston water pressure is not adequate to meet flow or residual pressure requirements per NFPA 13 and 14.

A new water storage and pump station is planned for the C garage site. This system will include water and fire water storage, pumping and distribution. A water loop will be routed into the new utilidor to serve all terminals, except Terminal E. This system will provide an estimated 75 psi to each terminal for fire sprinkler systems in the buildings. It is not intended to connect into the fire hydrant system. In addition, it is not intended to meet the 110 psi pressure required at the terminal building roof standpipe. The City of Houston Fire Department will use the fire hydrants and their pumper trucks to meet the NFPA requirements for the standpipe systems.

5.6.3 SANITARY SEWER

The existing building has a complete sanitary waste and vent system. Sanitary sewer runs south out of FIS, and into a collector line, which gravity flows to the City Lift Station #3.

The existing FIS sanitary sewer system is composed of three subsystems listed below.

- Service Lines
- Collector Line
- Lift Station (City Lift Station #3)

The service lines are six inches, and carry the building wastewater to a collector line. The collector line is an 8-inch gravity line that runs parallel to the FIS building on the south side and is adequate to accept the additional waste water from the FIS expansion.

It is worth noting that a new lift station is planned for installation to the east of MLIT. This system waste piping will be sized with 10 percent to 15 percent extra capacity at peak flow conditions. A sewer connection could be tied into this new lift station, if needed.

No grease vaults are planned for the FIS facility.

5.6.4 STORM SEWER

The FIS facility is served by a stormwater collection system consisting of a series of roof leader lines and storm collection drains. Roof leaders from the parking structure divert to an environmental pump station where it is segregated for treatment or allowed to bypass and flow into the drainage system.

The FIS roof drains are collected by a network of RCP storm lines ranging from 12 inches to 30 inches. The system discharges into the 10-foot-high by 8-foot-wide storm box culverts located in North Terminal Road.

5.6.5 NATURAL GAS

Plenty of gas is available to serve the new FIS expansion. CenterPoint Energy owns and maintains the natural gas distribution to the airport. A 6-inch natural gas line runs in North Terminal Road. System pressure is between 25 psig and 35 psig. The gas main reduces to four inches in North Terminal Road. A branch line runs to a meter and pressure regulator outside of FIS. CenterPoint owns and maintains the gas meter/regulator. HAS has ownership and maintenance downstream of the gas meter.

5.6.6 THE 12.5 KV SITE POWER

In order to support the estimated 7,224 kVA of additional connected load located in the new FIS expansion, a minimum of four new 2 MVA Pad Mount Transformers will be added. To support the new transformers, a minimum of four new 15 kV, 4 MVA feeders will need to be provided from the proposed HAS-owned network station. The new 15 kV, 8 MVA feeders will be run in separate 8-inch by 5-inch ductbank, with tandem manholes from HAS-owned switchgear fed from the existing CenterPoint GR and IT substations. Each pair of feeders will be capable of handling the full load of the proposed FIS connected load. Each pair of feeders will be a redundant feeder from separate substations, with one set of feeders per each of the tandem manholes. These 8-feet by 16-feet tandem manholes are used to reduce the risk of failure by keeping the feeders isolated in the chance of fault. It is recommended that each of the proposed feeders be three #250KCMIL. The final size of the feeders, manholes and ductbanks will be determined by the designer.

5.6.7 EMERGENCY AND STANDBY POWER DISTRIBUTION

Per **Section 5.2.11**, the emergency and standby power will be provided from the 2 MW generator, the location will be determined on the ITRP Enabling Utilities Lanside Project or related project. It is estimated that the 12.5 kV distribution circuits will be routed into the new utilidor for distribution to the respective terminal buildings, except for Terminal E. The generator estimated will be a diesel unit for outdoor use. It will have a day tank and an aboveground storage tank. Natural gas or jet fuel will not be used. The generator will feed a switchboard ESWB and the switchboard will feed multiple automatic transfer switches that lead to the respective terminal building distribution panels, including FIS. The distribution panels will serve elevators, lift stations, exit/egress lights, card readers, security doors, CCTV, radio equipment and fire alarm systems. Given the limited capacity of the generator (2 MW), off-loading software will be required to allow proper operation of the system so it does not exceed its capacity.

5.6.8 INFORMATION TECHNOLOGY

The new IT systems will need to match the existing systems and extend into the FIS expansion area. Existing systems to be matched shall include but is not limited to the following: Public Address (PA), Master Antenna Television (MATV), Flight Information Display (FID), Distributed Antenna (DA), Passenger Tracking, Security & Access Control, and Restroom Counting.

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Chapter 6

Program Concept Design Criteria

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6.0 Program Concept Design Criteria

This chapter summarizes the design criteria that the selected design firm should take into consideration as the program moves forward through design and construction of the FIS facility. Sections of this chapter address the governing codes and standards that need to be met during design, incorporation of the City of Houston's Art Program, and suggestions regarding Best Practices and Sustainability. All of the criteria identified within this chapter is in alignment with the overall International Terminal Redevelopment Program (ITRP), for which the FIS will be a part of.

HAS identified six areas that the design firm needs to focus on while completing the final design of the reconstructed FIS:

- Function
- Aesthetics
- Intuitiveness
- Affordability
- Future Expansion Capability
- Competitive Class Facility

6.1 Architectural - Level of Finish

Chapter 5 identified the different functional areas that should be incorporated into the final design of the FIS. HAS has developed standard tenant finishes for the purpose of being applied airport-wide in order to maintain continuity. Because this is a renovation project, there are areas of the current FIS that will be maintained as-is and in close proximity to reconfigured space. New finishes within reconfigured areas should either match or complement existing finishes to achieve a cohesive end product. Coordination between the design firm and HAS will take place in order to establish final specifications and selection of all other furnishings and equipment.

6.2 Governing Codes and Standards

The reconstruction of the FIS will require that the new structure adhere to all current codes and standards applicable to this type of building. The sources of the applicable codes and standards are spread among several national, state, and local jurisdictions, each having some involvement in the design and construction of the FIS. This holds true even if the structure is being reconstructed and reconditioned in some areas. All applicable codes, guidelines, standards and governing authorities may not be listed in the subsection below. It is the responsibility of the design architect/engineer to identify and address all applicable codes, standards and guidelines set forth by governing authorities with jurisdiction over the project. Industry standards are not listed individually, but information can be accessed through the following industry websites:

- Airports Council International-North America: www.aci-na.org
- American Association of Airport Executives: www.aaae.org
- Airport Consultants Council: www.acconline.org
- Transportation Research Board - Airport Cooperative Research Program: www.trb.org/ACRP

The following is a list of governing authorities, and applicable codes and standards:

Permitting or Governing Authorities
- Federal Aviation Administration
- The City of Houston
- Harris County Flood Control District
- Texas Commission on Environmental Quality
- Texas Department of Licensing and Regulations, Architectural Barriers
- U.S. Environmental Protection Agency
- U.S. Green Building Council

Governing Codes, City of Houston
- Building Code, International Building Code with City of Houston Amendments
- Fire Code, International Fire Code with City of Houston Amendments
- Mechanical Code, Uniform Mechanical Code with City of Houston Amendments
- Plumbing Code, Uniform Plumbing Code with City of Houston Amendments
- Electrical Code, National Electrical Code with City of Houston Amendments
- Energy Code, International Energy Conservation Code with City of Houston Amendments

Governing Codes, State of Texas
- Architectural Barriers Act, Article 9102, Texas Civil Statutes, effective 4/1/94
- 2010 Standards of Accessible Design, effective 3/15/12

Standards and Guidelines, Federal Aviation Administration
- Advisory Circular 150/5300-13A, Airport Design, dated 9/28/12
- Advisory Circular 150/5220-21C, Aircraft Boarding Equipment, dated 6/29/12
- Advisory Circular 150/5340-1K, Standards for Airport Markings, dated 11/17/10
- Advisory Circular 150/5320-15A, Management of Airport Industrial Waste, dated 9/8/08
- Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminals, dated 4/22/88
- Advisory Circular 150/5230-4B, Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports, dated 9/28/12
- Title 14, Code of Federal Regulations, Part 139, Airport Certification, dated 6/9/04
- Title 14, Code of Federal Regulations, Part 77, Objects Affecting Navigable Airspace, dated 8/15/07
- FAA Order 1050.1E, Environmental Impacts: Policies and Procedures, as amended
- FAA Order 5050.4, National Environmental Policy Act (NEPA) Implementing Instructions for Airport Projects, as amended
- OSHA
- Electrical (NEMA) Standards

- IATA Standards
  - IATA Passenger Services Conference Resolutions Manual
  - IATA Airport Development Reference Manual, 9th Edition, January 2004)
- PGDS Guidelines v. 4.2

Standards and Guidelines, Department of Homeland Security
- Recommended Security Guidelines for Airport Planning, Design and Construction, revised May 2011
- Airport Technical Design Standards Passenger Processing Facilities, August 2006

Standards and Guidelines, Houston Airport System
- CAD/Geospatial Data Standards (www.fly2houston.com/TIP)
- IT Standards (www.fly2houston.com/TIP)
- IAH Surveyors Handbook (www.fly2houston.com/TIP)
- General Design Standards
- Signage Standards (under development)

Standards and Guidelines, American Association of State Highway and Transportation Officials
- A Policy on Geometric Design of Highways and Streets
- Texas Manual on Uniform Traffic Control Devices
- Standard Specifications for Highway Bridges
- A Policy on Geometric Design of Highways and Streets
- LEED for Multiple Buildings and On-Campus Building Applications Guide

U.S. Green Building Council
- LEED for Multiple Buildings and On-Campus Building Applications Guide

National Fire Protection Association
- NFPA 10, Standard for Portable Fire Extinguishers, 2007 Edition
- NFPA 13, Standard for the Installation of Sprinkler Systems, 2007 Edition
- NFPA 14, Standard for the Installation of Standpipes and Hose Systems, 2007 Edition
- NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection, 2007 Edition
- NFPA 30, Flammable and Combustible Liquids Code, 2008 Edition
- NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2006 Edition
- NFPA 70, National Electrical Code, 2008 Edition
- NFPA 72, National Fire Alarm and Signaling Code, 2007 Edition
- NFPA 80, Standard for Fire Doors and Other Opening Protectives, 2007 Edition
- NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems, 2002 Edition
- NFPA 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems, 2006 Edition
- NFPA 92A, Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences, 2006 Edition
- NFPA 101, Life Safety Code, 2006 Edition
- NFPA 110, Standard for Emergency and Standby Power Systems, 2005 Edition
- NFPA 407, Standard for Aircraft Fuel Servicing, 2007 Edition
- NFPA 415, Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways, 2008 Edition
- NFPA 780, Standard for the Installation of Lightning Protection Systems, 2008 Edition
- NFPA 900, Building Energy Code, 2007 Edition

U.S. Department of Homeland Security, U.S. Customs and Border Protection 2012 Edition (or most current), Federal Inspection Services
- Air/Ports-of-Entry Technical Requirements (ATR), published by the Immigration and Naturalization Service (INS), February 2002
- Holdroom Design Standards, September 20, 2000
- Airport Technical Design Standards, Passenger Processing Facilities, dated August 2006 or the latest approved version
- Things to Look for in the Design of Inspection Facilities at Airports, Seaports, and Ferryports, published by the INS in February 1999
- Federal Inspection Services' Airport Facility Guidelines, 2000 Edition
- Airport Border Integrity Antiterrorism Program Overview, published by the INS in 1999

Other Applicable Guidelines and Standards
- Americans with Disabilities Act, 28 CFR Part 35, Final Rule, published July 26, 1991
- Title VI of the Civil Rights Act of 1964 (42 USC 2000(d) et seq.)
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA) Standard 90.1, Energy Standard for Low Rise Residential Buildings, 2007 Edition with Change 1 in 2010
- American Society of Heating, Refrigerating, and Air-Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE) Standard 62.1 and 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Commercial/Residential Buildings
- U.S. Green Building Council, Leadership in Energy and Environmental Design for New Construction and Major Renovations (LEED-NC) v2.2
- Texas Health and Safety Code, Chapter 382, (Texas Clean Air Act)
- Resource Conservation and Recovery Act of 1976 (Solid Waste Disposal Act) and amendments
- Federal Emergency Management Agency, National Flood Insurance Act of 1968/The Flood Disaster Protection Act 1973
- Texas Administrative Code, Title 30, Part 1 Texas Commission on Environmental Quality, Chapter 334, "Underground and Aboveground Storage Tanks" American Institute of Steel Construction, Specifications for the Design, Fabrication, and Erection of Structural Steel
- Health & Safety Code, "Elevators and Escalators"
- Airports Council International, ACI 318-02, Requirements for Reinforced Concrete
- Texas Department of Insurance, First Tier Coastal Counties Wind Load Criteria
- Houston Airport Standards
- All applicable FAA regulations
- HAS Tenant Improvement Manual, Latest Edition
- Bush Intercontinental Airport/Houston, Surveyors Handbook, dated June 2007

American Society of Mechanical Engineers
- ASME A17.1, Safety Code for Elevators and Escalators
- ASME A17.2, Inspector's Manual for Elevator and Escalators

American Society of Heating, Refrigerating, and Air-Conditioning Engineers
- ASHRAE Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, 2010
- ASHRAE Standard 62.1, 2007
- ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, 2007
- ASHRAE Standard 52.1, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

National Electrical Manufacturers Association
- All applicable standards

Underwriters Laboratories
- UL Labeling Requirements
- UL 1008, Transfer Switch Equipment
- UL 1449, Surge Protective Devices, 3rd Edition
- UL 1558, Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

American Association of State Highway and Transportation Officials
- Standard Specifications for Highway Bridges
- A Policy on Geometric Design of Highways and Streets
- LEED for Multiple Buildings and On-Campus Building Applications Guide

Current Minimum HAS IT Requirements

The Communication design drawings shall be prepared by, and drawings shall be stamped by, a registered RCDD, following the guidelines set forth in the most recent HAS IT specifications that are applicable. The list below is a list of current minimum requirements for the IT infrastructure/equipment installation:

- Spec 270526 Telecommunications Grounding and Bonding
- Spec 270528 Interior Communication Pathways
- Spec 270543 Exterior Communication pathways
- Spec 270553 Identification and Labeling of Communication Infrastructure
- Spec 271100 Communications Cabinets and Equipment Rooms
- Spec 271300 Backbone and Riser Media Infrastructure
- Spec 271500 Horizontal Media Infrastructure
- Spec 272100 Data Communication Network Equipment
- Spec 272200 PC, Laptop, and Servers Equipment
- Spec 275113 Audio Communication System
- Spec 281300 Access Control
- Spec 282300 Video Surveillance Systems

In general, considerations should be given for a 25 percent growth when designing IDFs and all associated hardware. All equipment and systems shall conform with and meet HAS IT specifications and requirements.

All new and reworked cable installations will follow the latest HAS IT specification installation methods unless local, state and federal codes supersedes. Routing and coordination of all cable trunks and cable systems shall be approved by the HAS Technology Division. Horizontal link will not exceed 295 feet (90 meters), per the HAS IT specifications. Total channel length from a network switch to station equipment will not exceed 328 feet (100 meters), including patch and drop cables. Routing, approval and coordination of all cable trunks and cable support systems shall be approved and directed by HAS Technology Division. Reference the specification section listed above.

Fiber optic cable specifications (type and quantity) are dependent on specific project needs. Close coordination needs to be made with the HAS IT Division when designing fiber optic infrastructure.

Facilities designed or modified to be data communications areas shall comply with regard to electrical noise and availability of an adequate signal reference ground/grid. Appropriate distances and/or shields should be maintained in accordance with HAS IT specifications. Reference specification listed above.

Extension and/or expansion of existing HAS security systems must be consistent with the current Airport Security Plan approved by the Transportation Security Administration (TSA).

The network infrastructure shall be designed so that each end system (computer, printer, etc.) or host will be connected to a switched 1000BaseT Ethernet port (Edge switch) at a minimum. It is the System Integrator's responsibility to insure adequate and correct port types for all hosts, servers, special equipment, etc., connecting to the edge access layer switches.

The HAS Data Network is designed as a large multi-layer hierarchical campus TCP/IP based Ethernet network consisting of Cisco Core, Distribution, and Access layer electronics. Gigabit Ether Channel fiber links are currently utilized between Core and Distribution layer switches to provide added reliability and a 4-Gigabit backbone. This provides 'redundant paths' to the rest of the data network, yielding reliability and fail-over capabilities for that particular switch or stack of switches. The HAS Technology Division network design standard is to design and configure all fiber link connections between backbone switches utilizing routed point-to-point links, not VLAN trunks across the network.

The HAS IT Division network design standard is to limit or restrict the propagation of any failure or electrical problem associated with a host workstation or server, to a single Layer 2 switch or stack of Layer 2 switches in a wiring closet. In order to do this, the deployment of VLANs and VLAN trunking is restricted to one wiring-closet switch or stack of switches. Determinism is an important design goal of the HAS Technology Division network design criteria. For the network to be deterministic, the design must be as simple and highly structured. Recovery mechanisms must be considered as part of the design process. Quality of service (QOS) for voice over IP (VoIP) consists of providing low-enough packet loss and low-enough delay so that voice quality is not affected by conditions in the network.

HAS provides a wireless network for the traveling public and secure internal business needs. The wireless APs must be POE and adhere to HAS standards.

HAS uses a passenger tracking system based on identifying Bluetooth capable devices. This system must be deployed at all security checkpoints. The system must be integrated into the existing passenger tracking software developed by Infax.

Any network electronics such as switches, routers, firewalls, VPN concentrators, wireless access points, etc. that are installed on the HAS network must be able to be managed by the currently installed network management software.

6.3 Art Program

Standards in public art planning, design and construction are essential in the mission of identifying HAS facilities and the City of Houston as a diverse international center for energy, innovation and culture. HAS facilities should be understood as a platform for the creation of a unique airport terminal environment and a distinct Houston experience. This concept transforms the site into a collaboration stretching beyond the design team by engaging with Houston's heritage of innovation, contemporary aspirations and as an energetic international city.

Houston's two commercial airports, George Bush Intercontinental and William P. Hobby (HOU), have varying art works on display or integrated within the architecture or landscape. As a part of HAS, a City of Houston agency, IAH is subject to the 1999 Civic Art Ordinance stating that 1.75 percent of construction monies in city-run projects should be allocated to art beautification (this does not apply to runways, taxiways and ramps). As designated in the Civic Art Ordinance, HAS and all other city departments must partner in project management with the non-profit organization Houston Arts Alliance.

The artworks commissioned by HAS have been created by emerging, mid-career and established artists from the regional, national and international arenas. As part of the HAS mission, it is very important to foster the art community within Houston and exhibit works throughout the airport system taking advantage of the global exposure each offers. A majority of the commissioned art for HAS has largely been the works of artists based in the Houston area.

6.3.1 INTEGRATED/PERMANENT ART

Integrated/permanent artworks are often large in scale and can establish a strong physical connection between a building and/or landscape.

The HAS public art staff will work with the design architect to determine appropriate locations for permanent installations and establish design requirements for each identified location. Typically, locations chosen for permanent art installations are within centrally-located gathering spaces and high traffic areas. The nature of these types of locations is often large in scale, allowing permanent art installations to be easily incorporated effectively. However, the art installation should not adversely detract the passenger from its destination. Large, centrally-located gathering points are often decision points. The art shall complement and not deter from wayfinding, which is critical to the function of the facility.

Provisions should be made in order to ensure that permanent art installations can be easily accessed for maintenance purposes and cleaned efficiently. The means and methods to conduct these types of tasks should be known and evaluated to determine the feasibility before a commissioned art piece is approved. Critical topics of discussion, such as specific maintenance procedures, maintenance of frequency and disruption of operations during maintenance periods will need to be investigated. Equal consideration should also be given to the actual materiality of a permanent art installation. The inherent durability of a material and environmental factors that would be acting upon it can primarily dictate maintenance requirements and procedures. Examples of integrated/permanent art are shown in **Figure 6.1** and **Figure 6.2**.

Figure 6.1 - Example of Permanent

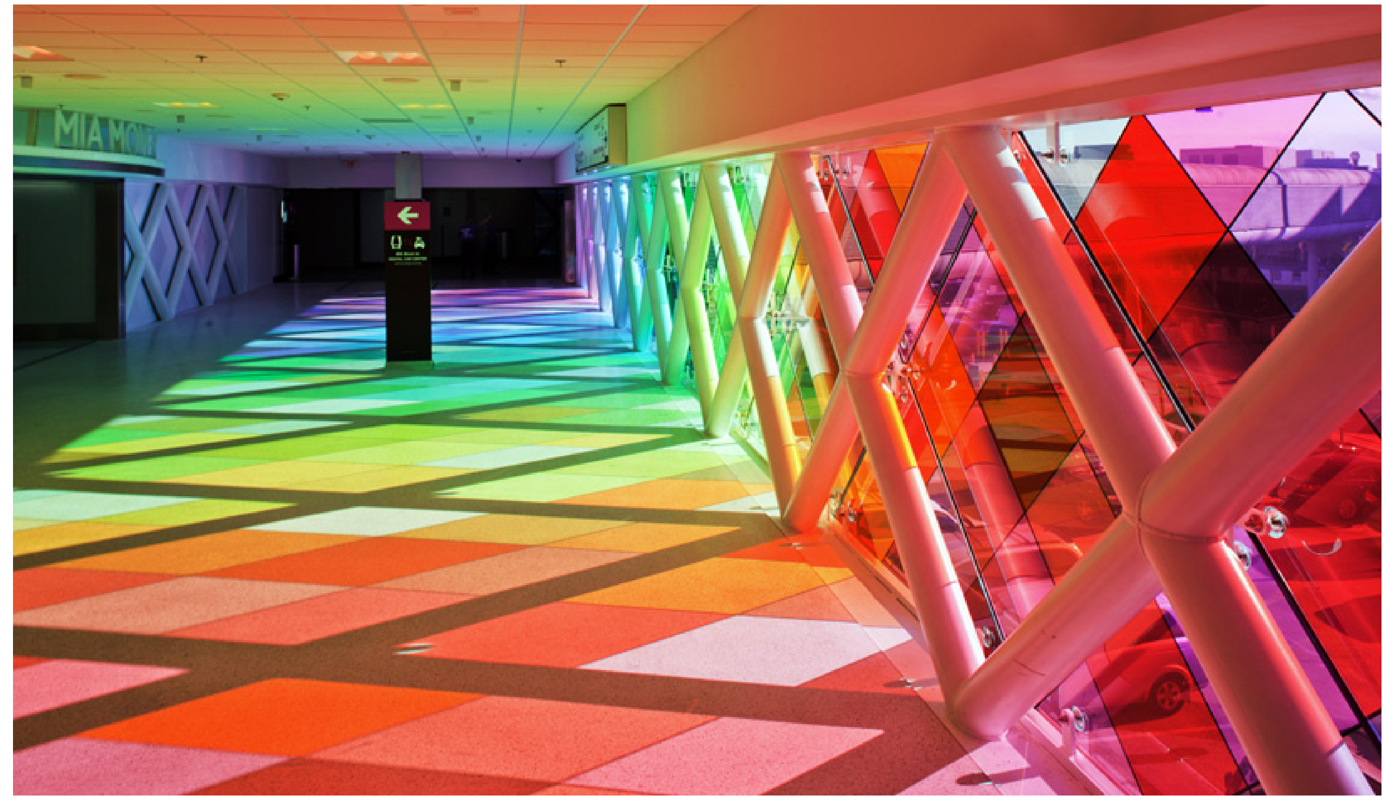


Figure 6.2 - Example of Permanent

6.3.2 ARTIST SELECTION

1. Making the artist call through

- Request for Qualifications
- Request for Proposals

The Request for Qualifications (RFQ) is the most common artist selection process currently in use by public agencies in America. RFQs are sent out like a "call for artists," broadcast to specific regions or nationally. The RFQ outlines the project location, budget, scope, theme, timeline, and other specifics relevant to the project, and offers applicants instructions for submitting. Artists are usually asked to submit a letter of interest, a resume, and work samples of past work (with descriptions of each work sample). A selection committee is usually established (made up of key stakeholders) to review submissions and narrow the pool of applicants to a smaller number of finalists who are, then, contracted to produce proposals. It is standard practice to compensate artists for proposal development, although the amount varies from project to project; there are very few standards in the public art field. Finalists are given adequate time to develop proposals and then submit them for final review, often in an interview setting allowing for first-hand interaction with the committee.

RFQs are popular with commissioning agencies and artists because they are simple, don't require much time at the outset, and offer the committee a spectrum of possible candidates. Successful applications provide committee members with a good idea of what they might expect from the artist, based on their qualifications and past work. The cover letter provides some insight as to how the artist might approach the opportunity, but they are not proposals. An RFQ can be widely distributed or sent to only a select number of artists, depending on restrictions that may be imposed by the funding source, the budget and the administrative time available for the project. "Invitational RFQs" are RFQs that are sent to a pre-selected, qualified pool of artists, and not broadcast to all artists.

The Request for Proposal (RFP) asks applicants to submit ideas, sketches and even budgets for a proposed project, often without compensation. Current best practices dictate that artists should be compensated for proposal development. If you ask an artist to create a design proposal, you should compensate them. This approach can work out well if you have a specific project in mind and access to a small number of competent artists that you believe are qualified for the job.

2. The Selection Panel

The panel should consist of three to five individuals to avoid a tie vote. Panel members should include a client-appointed person and two art professionals (independent public art curator and an artist). If the panel is a five member group, a community representative and a non-contracted architect could be added. Art consultants, commercial gallery representatives or persons with an invested interest in individual artists should not be considered.

6.3.3 PORTABLE/ROTATING ART

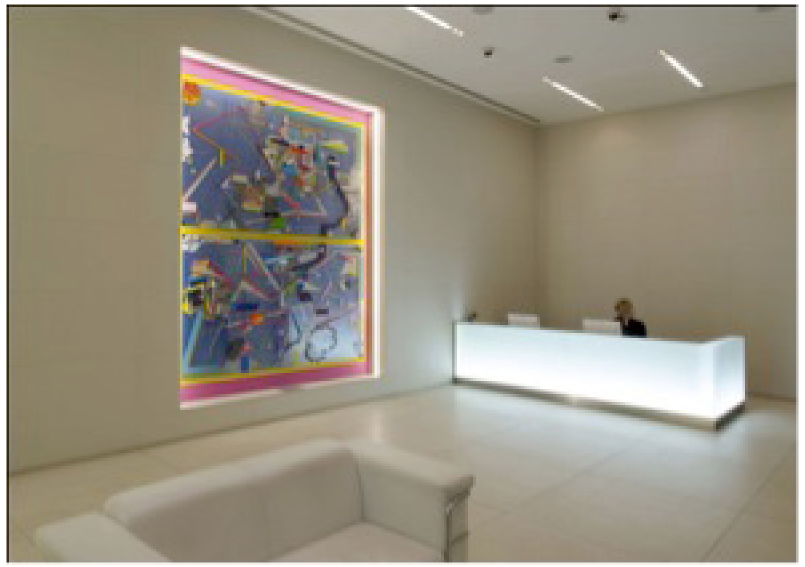
HAS is actively building a collection of artworks that is considered portable. This means the pieces are movable and can be displayed in a gallery-type setting or displayed in protective casing in public areas. These pieces consist generally of flatwork (photography, paintings, etc.) or crafts (sculptures or worked pieces of a moderate size). Distinct methods to present these types of works to the public are being explored. These options include galleries or integrated display cases in public areas with high passenger traffic flow.

Vertical surfaces inside the FIS facility are ideal locations for the integration of permanent built-in display cases where flat artwork can be displayed (see **Figure 6.3** and **Figure 6.4**). Collaboration between HAS and the architect would need to occur to identify optimal locations for built-in display cases. These need to be feasible in terms of constructability and to maximize visual impact, in order to enhance the customer experience.

A typical built-in display case would have a secure glass enclosure that can be removed for maintenance purposes, ideally three feet off the floor and four feet wide, with the display section between one and two feet deep. Larger versions can be constructed to accommodate larger flat artworks. These built-in cases should provide adequate lighting that protects the integrity of all displayed art pieces. Display lighting methods should limit the use of large fixtures. LEDs with a CRI accuracy of a true 3,000 K are ideal and the use of halogen lamps should be avoided. Alternatively, T8 light strips can be considered. Typically a lighting lamp can be dimmed to around five percent of their light output without creating a difference in color temperature. If natural light will be present within a display case area, light-filtering glass should be used to protect art pieces that would be adversely affected by ultraviolet light.

Figure 6.3 – Preferred flatwork display casing

Figure 6.4 – Larger integrated flatwork display



6.3.4 INNOVATIVE ART INSTALLATIONS

The mission of the HAS Temporary Art Program is to present memorable art and cultural experiences that enhance and humanize the travel experience at Houston airports. These exhibitions feature local and regional temporary exhibitions by providing access to an array of contemporary artworks and cultural exhibits that reflect and celebrate Houston.

The HAS envisions the temporary art possibilities at IAH and HOU as a strong and unique way to propel its international identity. The HAS Public Art staff is conceptualizing various proposals that include a world-class installation art space that does not exist in any other airport in the United States. The HAS has a built-in audience, and to truly utilize the spaces within the airports, a serene environment should be incorporated that would be a fresh and pristine space without the visual distractions that one is accustomed to seeing in airports. Proposed modifications should include, but are not limited to: no concessions, limited signage, strategically placed seating, lighting and high windows.

The plan would be to have an environment with a program, awarding temporary installations to regional, national and international artists. These fresh, unique installations would exist for limited periods of time keeping the reoccurring passenger continuously rediscovering the great city of Houston.

6.3.5 MULTIMEDIA DISPLAYS

The evolution of contemporary art in the late 20th century, and into the 21st century, is highlighted by artists who have begun using new mediums to create and express art afforded by unprecedented advances in the technological industry. Often, mediums such as sound, artificial light and moving images are used in conjunction with one another, thus creating by definition, multimedia art. The emergence of multimedia art brings new challenges and opportunities that traditional art pieces typically do not have.

The installation requirements for multimedia art can have multiple variables that should be considered and must be evaluated on a case by case basis. For instance, large media walls would require computer interfaces to handle the audio and visual aspects of digital works of art. High-speed internet connectivity, electrical power, and location specific ventilation would likely be needed to facilitate multiple digital displays, audio and lighting systems. Given this complexity, a multimedia specialist along with the assistance of HAS would need to research the requirements for a large media wall. Any space identified as a suitable location to support a multimedia art installation should be adaptable for future technological systems to be installed. An example of a multimedia station is seen in **Figure 6.5**.

Figure 6.5 – Example of a multimedia station

6.3.6 GALLERY

There may be opportunities to incorporate fixed gallery spaces within the FIS facility where the works of regional artists can be exhibited. This type of dedicated display space can be a very impactful approach to introducing outside visitors to Houston's local culture and provide lounge areas for passenger relaxation while enhancing the passenger experience. A gallery space would be an open space where medium-to-large installations could be exhibited along with smaller works of art located in display cases as previously mentioned.

6.3.7 CIVIC ART

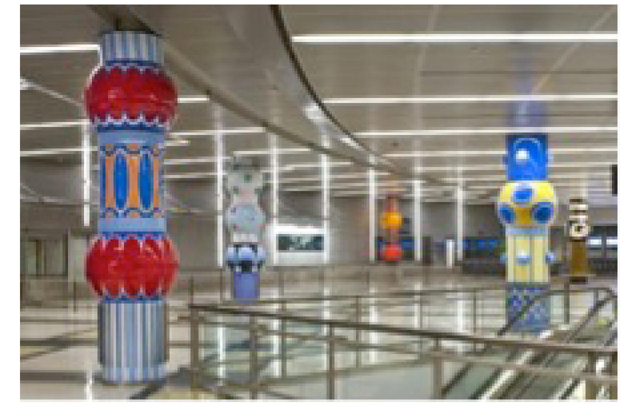
The following section provides examples of art pieces and artists currently on display at the FIS facility.

Location : U.S. Customs and Border Protection Building,
partition between Sterile Corridor and the Customs Area at George Bush Intercontinental Airport

Airdrops, by Kate Petley, is a large scale wall piece captures the small details of the movement of water, both real and imagined. Light and fluid-action are exaggerated through the hypnotic reflections created by the special effects inherent in the materials, with plexi-glass art panels inserted between two sheets of glazing.

One Bounce, Two Bounce has 48 circular designs in two long murals that were inspired by the aviation industry, the City of Houston, and many other artistic sources. Their size, simplicity, and color are meant to work with the immense scale of the baggage hall, engage the passerby, and reflect the vibrancy and diversity of the City of Houston.

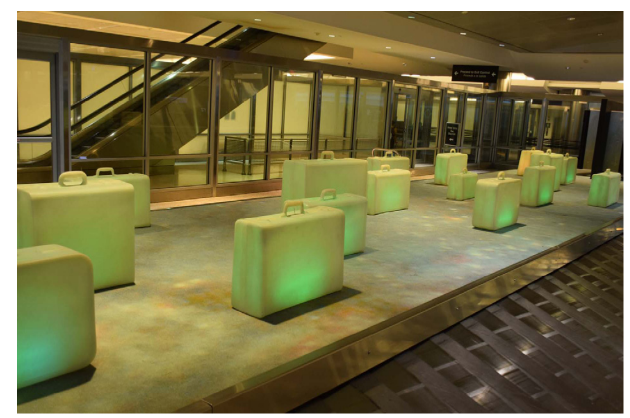
Bounce Location: The north and south walls of the U.S. Customs and
Border Protection building's baggage hall at George Bush Intercontinental Airport



Beads Location: International Arrival Hall
at George Bush Intercontinental Airport

Beads are the focal points in the International Arrival Hall. Each architectural column in the area has been transformed into colorful beads within the radial design of the space, providing color within the softer palate of the space. While most generally consider beads as adornment, they have been used throughout the world to express social circumstance, political history, economic structure and religious beliefs. They have also been enlisted as symbolic repositories of sacred knowledge; thought to have curative powers; used in barter or as standard monetary units; traded from culture to culture, and have traveled across continents and oceans. Because they are used by so many contemporary and ancient cultures, beads often mirror the sociological, psychological, economic and religious aspects of a society's technical skill. There are certain universal features of beads and the handling of them that cut across cultural differences. Houston, Texas is a community built around diversity. This is reflected by the Beads in the International Arrival Hall.

Travel Light Location: Baggage Hall in the U.S. Customs and Border Protection Building
at George Bush Intercontinental Airport



Travel Light, by The Art Guys, Michael Gailbreth and Jack Massing, consists of approximately 400 cast-resin, LED-illuminated suitcases dancing across the galactic images atop the 12 baggage claim units of this enormous baggage hall. The Hubble Telescope provides the patterns and elaborately programmed LEDs bring beautiful and colorful dances of light throughout this inscrutable project.

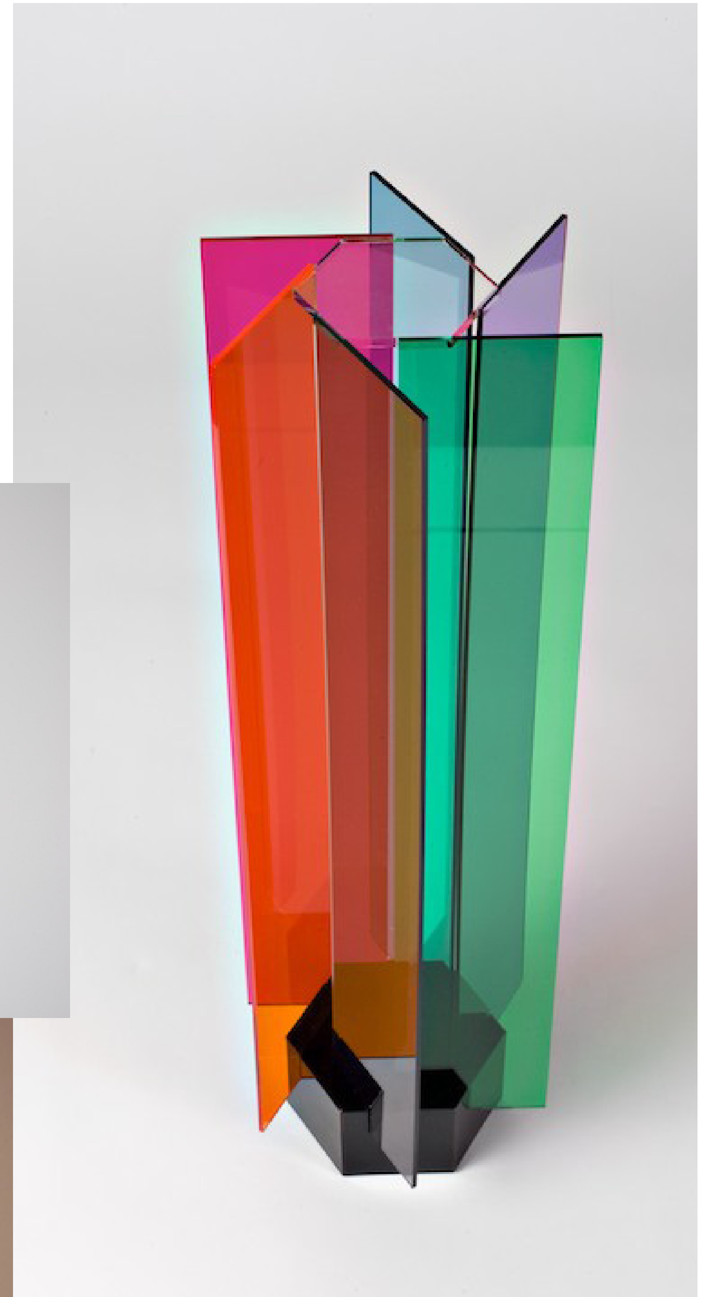
Passages 1, 2, 3, 4 Location: Over Roadway Bridges between Terminals D and E at George Bush Intercontinental Airport

Passages 1, 2, 3, 4 has a concept of etched glass design that is meant to convey a pleasant sense of transition for the travelers who are the viewers of this installation. Travelers should feel a gradual sense of flight before or after their travels. Each bridge, titled Passages I, II, III, IV, has a different presence of space, conveying its own intimate statement of motion. Passages 1, 2, 3, 4 is by Bertram Samples and Leslie K. Elkins. The glass medium demonstrates the elements of air and flight. The glass' luminosity places the traveler in a transitional space while journeying from one terminal to another.

6.3.8 PORTABLE WORKS

The following works are a non-exhaustive sample of the portable works the airport has acquired and commissioned. Works include pieces from:

- Jonathan Leach
- Megan Harrison
- Karin Broker
- Jeff Forster
- Luis Jimenex
- Katrina Moorhead
- Howard Sherman
- Robert Pruitt
- Randy Twaddle



6.3.9 POTENTIAL ART LOCATIONS

Through the planning process, many potential locations were identified. The goal is to provide impactful locations to the largest passenger volumes while not detracting from the functional use of the facility. The following locations were identified and should be developed by HAS Public Art Curator.

West Façade – New Baggage Claim and Parking Structure

The expansion of the FIS facility with the new baggage claim and CBP parking structure will partially eliminate views from the east end of the existing facility. Currently, the FIS has an art installation, SkyWall, that is installed directly to the existing CBP employee parking garage facade. With the demolition of this garage, SkyWall will need to be relocated elsewhere on the airport campus.

The new west façade will have the most impact for passengers in the FIS as they go down the escalators from Primary to Baggage Claim. The current curtain wall provides daylight; however, the existing garage does block full view outward. The new view will be through the curtain wall glazing and directly at the new CBP parking levels. Art integration would greatly enhance the environment and "sense of place" of this key interior transition point. Any art installation shall not detract from the wayfinding within this atrium space. This critical decision point for passengers will include dynamic signage in the form of Baggage Information Display Screens (BIDS). See **Figures 6.6 – 6.8**.

Interior Expansion Area

The integration of art shall be where the passengers will get the most impact, while not detracting from the operations and clear wayfinding of the facility. Currently, the FIS boasts an excellent variety of art installations. In addition to the major circulation node noted above, the new baggage claim expansion building will provide the most impactful new location for art. Another potential location would be within the new exit control queue area. It should be noted that any art installation in the queue area shall not obstruct wayfinding and regulatory signage within the space.

Garage - East + Interior

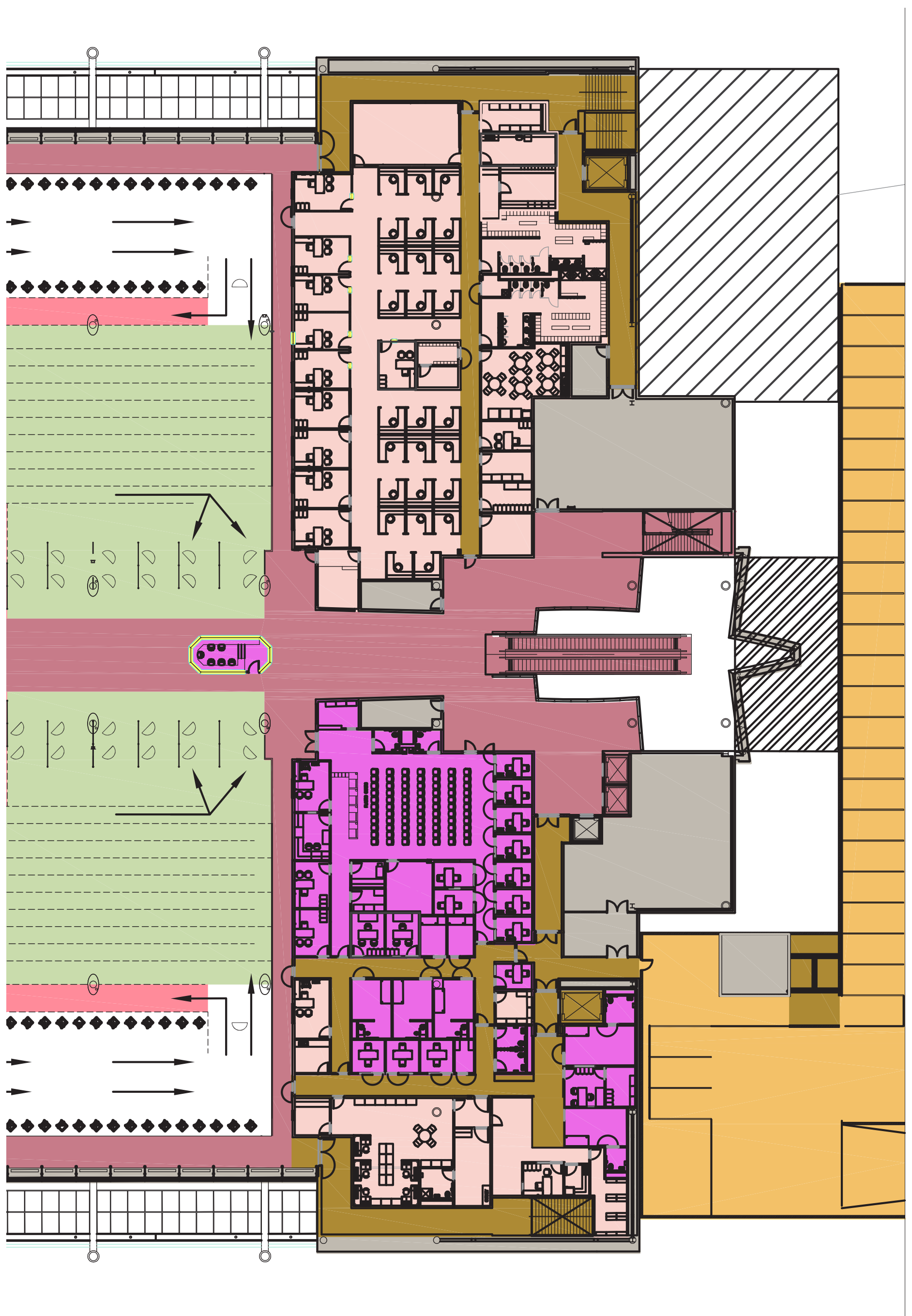
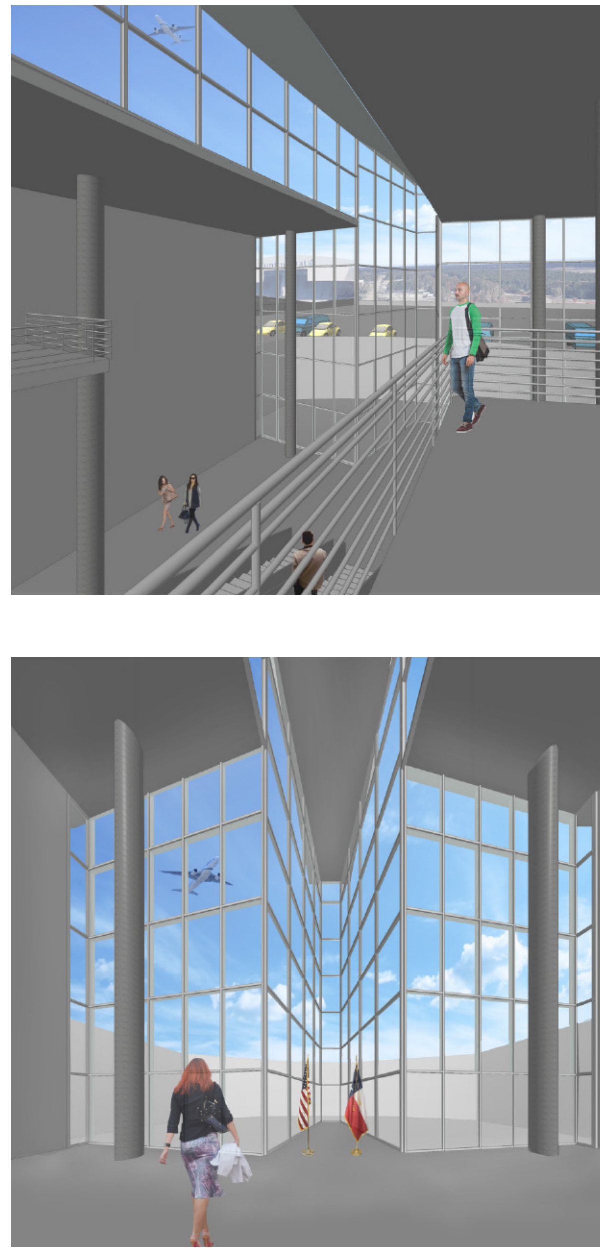
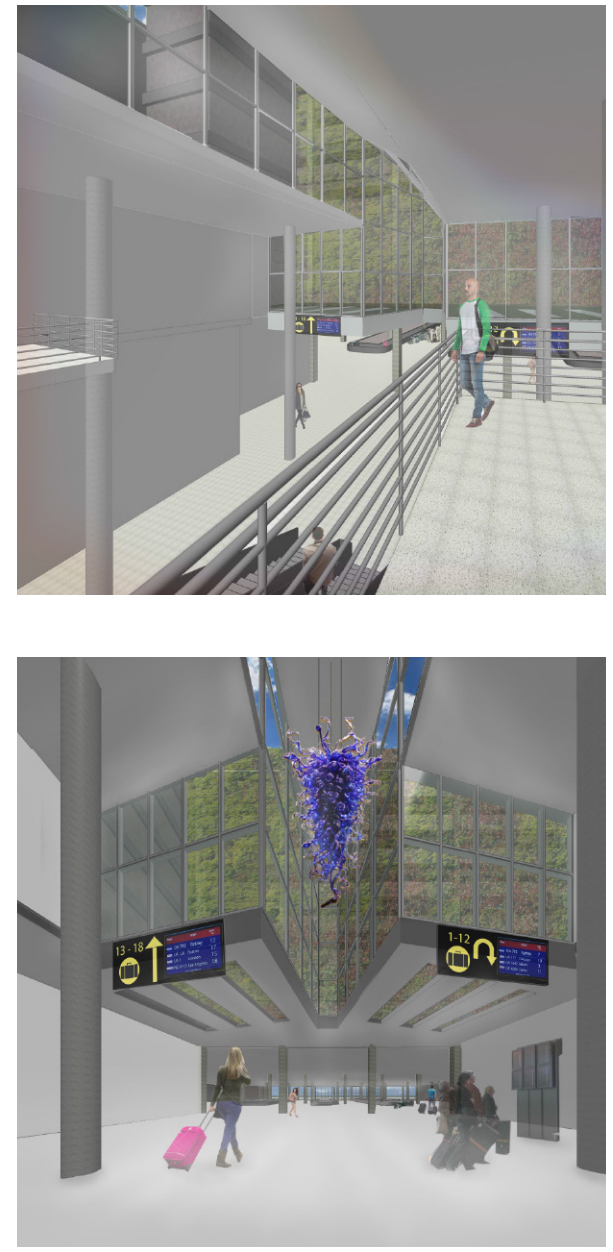


Figure 6.6



EXISTING

Figure 6.7



LEVEL 116

LEVEL 93

PROPOSED

Figure 6.8

6.4 Wayfinding

Airports can be complex and difficult spaces to navigate. Numerous factors affect public perception and levels of customer service within airports. This is particularly true when airport modifications or upgrade programs are undertaken. Many older terminals and roadways have outdated and inconsistent wayfinding and signage systems not reflective of current world principals and standards. Improvement projects create even more challenges for individuals functioning within the airport's wayfinding processes.

As an airport continues to evolve, it is important that its wayfinding and signage systems be designed to accommodate changes in a holistic manner. It must be understood that regardless of an individual facility's demarcation, the wayfinding pathways extend to and from the surrounding roadways, parking, curbsides, terminals and concourse areas. Facility architecture, services, functions and amenities, as well as vertical and horizontal routes must always be carefully considered and viewed as part of the airport's interconnected and overall wayfinding system. A solid understanding of graphic/visual cues and human behavioral responses to wayfinding processes is paramount. The established wayfinding system must function seamlessly, within the built environment, without user hesitation or confusion, regardless of which area of the airport is being navigated.

6.4.1 PURPOSE

This section presents information regarding the general development and planned implementation of HAS' new wayfinding signage system within the International Terminal Renovation Program (ITRP). It will briefly discuss design criteria, how the new wayfinding signage system is to be used, and how it holistically relates to the overall wayfinding program at IAH. For additional details, references and information regarding the updated HAS Wayfinding System, see the latest edition of the document "HAS Wayfinding System: Signage Design Guidelines, Standards and Typical Applications."

6.4.2 SCOPE

This section's scope includes the general description and design for the new HAS Wayfinding System as it pertains to its implementation within the FIS facility. The following is a list of general topics included within this chapter:

- Wayfinding Analysis
    - Evaluation Criteria
    - Signage Philosophy
    - Standard Terminology
    - Bilingual/Multilingual Signage
    - Message and Sign Type Hierarchy
    - Color Coding
    - Symbols
    - Scale of Copy
    - Sign Placement

- Wayfinding Plan – FIS program
    - Sign Types – General Overview
    - HAS Wayfinding Sign Family
    - Sign Type Identification System
    - Design Description – Wayfinding Signage
    - Graphic Standards and Guidelines
    - Conceptual Wayfinding Plans
    - Transitional Wayfinding
    - Final Wayfinding Plans and Signage Design Intent

Mickey Leland International Terminal and FIS program signs regulated by this chapter:

- All landside exterior and interior directional, identification and informational wayfinding signs within public areas (static and dynamic)
- Associated roadway/curbside wayfinding signs
- Associated parking wayfinding signs

Mickey Leland International Terminal and FIS program signs not regulated by this chapter:

- Tenant/concession/retail signs and standards
- Directory artwork
- Vehicular and pedestrian regulatory or life safety/egress signs
- Non-public, airside or back-of-the-house areas
- TSA and CBP standard, federal and required signage

6.4.3 WAYFINDING ANALYSIS

It is important for wayfinding signs to adhere to a basic guideline of copy styles/sizes, maintain consistent terminology, use recognizable and universally accepted symbols, incorporate uniform color systems, and utilize consistent recognizable sign types. This section covers key elements that impact the effectiveness of a wayfinding signage system, as well as overall wayfinding processes at airports in general. Note that industry standard wayfinding and signage factors are also covered in additional detail within the following documents:

- Guidelines for Airport Signing and Graphics, Terminal and Landside, Third Edition 2001
- ACRP Report 52, Wayfinding and Signing Guidelines for Airport Terminals and Landside, 2011
- Americans with Disabilities Act, 2010 ADA Standards for Accessible Design, Latest Revisions
- Manual on Uniform Traffic Devices (MUTCD), Latest Edition/Revision

The following are general descriptions of the evaluation criteria used for analyzing the IAH wayfinding program:

Signage Philosophy
Establish an integrated framework that would produce one comprehensive, holistic and aesthetically attractive signage system that can be easily identified, understood and followed.

Standard Terminology
Experience the same terms and sign types from one terminal/facility/area to the next, which will assist in rapid public comprehension of various airport functions/destinations. Message content must be in layman's terms, equally understandable by first-time and frequent travelers.

Bilingual/Multilingual Signage
Signage should exhibit sensitivity to the high degree of expected bilingualism of passengers that will use the FIS by recognizing the needs of ethnic and linguistic minorities.

Message and Sign Type Hierarchy
Clear and concise information presented by "primary, secondary and tertiary" sets of messages greatly improves efficient passenger flow. Utilizing a system of consistent sign types organized by and placed within the environment based on message priority also contributes to increased wayfinding efficiency.

Color Coding
Colors have great effect on human behavior and deciphering of wayfinding information. Thoughtful consideration and consistent, disciplined implementation should always be utilized when using a color within a wayfinding sign system.

Symbols
The use of short verbal messages in combination with symbols is typically more effective than the use of messages or symbols alone. The use of consistent graphic representations and sizing of symbols and arrows maintains system cohesion and rapid information deciphering. Limiting the number of arrows at a given decision point greatly improves information processing and passenger flow.

Scale of Copy
In a fast paced, often congested environment such as an airport, a conservative pedestrian viewing distance of 25 feet of viewing distance to each inch of capital letter height should be used.

Sign Placement
Placement of signs at key decision points and in the direct line of sight of the traveling public reduces decision times. A reasonable range of 75 to 125 feet between major directional overhead signs is acceptable and meets the general intent of ADA guidelines using three inch to four inch high capital letters. Placing signs at regular intervals within longer contained corridors reinforces wayfinding information and also improves traffic flow.

6.4.4 WAYFINDING PLAN – FIS FACILITY

This section will focus on the general Wayfinding Plan as it pertains to the new Wayfinding Signage System to be developed for the FIS program. It highlights several ideas, but the primary goal of this section is to provide a condensed set of general guidelines that are to be used when developing and implementing all wayfinding signage within the modernization program.

6.4.4.1 Design Description – New HAS Wayfinding Signage System

The new HAS Wayfinding Signage System has been developed to make all airport wayfinding signage an extension of the HAS's world-class branding and wayfinding philosophies. It was developed to be universally adopted at all three HAS-owned Houston metropolitan area airports (IAH, HOU and EFD), as well as to meet the established principles of the "HAS Mission and Vision for Wayfinding," listed below:

- Provides safe, efficient and appealing wayfinding at all HAS airport facilities (IAH, HOU and EFD).
- Reinforces HAS as the "Airport Standard of Excellence in the Americas."
- Unifies signage as one holistic wayfinding system, both interior and exterior.
- Shares a consistent, positive "tone-of-voice" at all HAS airports.
- Creates a consistent and shared "sense of arrival" and a "sense of place" at each airport facility and property.

These same principles will be used for all wayfinding signage implemented within the FIS program.

6.4.4.2 Sign Types – General Overview

There are several elements that make up a clear and recognizable sign. The message and its copy size/clarity are of great importance, so too is the actual sign entity that it is placed on. Having consistent and distinct sign types enhances a wayfinding system by making them more recognizable as virtual "breadcrumbs" to users within unfamiliar environments. Many travelers can decipher the type of information that will be given based on the size, shape, mounting location or color of a sign. This shortens the decision-making process, creating smoother traffic flow and increased trust in the overall wayfinding system. Signage for the FIS Primary Processing, Vertical Circulation Atrium and Exit control should be part of the project in order to maintain consistency and an "opening day fresh" look.

Sign types will typically be used based on their message priority and basic wayfinding function:

- **Primary Sign Types:** Signs used for priority destinations/functions of the airport are considered "primary" signage and should be the most visible and visually dominant to other wayfinding signage.
- **Secondary Sign Types:** Secondary messaging (such as phones, ATMs, etc.) should typically be reserved for sign types pre-determined as "secondary" in nature, and should appear visually subordinate to the primary signage.
- **Tertiary Sign Types:** Tertiary messaging (such as regulatory, safety related information, etc.) should also be placed on sign types pre-determined for "tertiary" use, and should typically appear visually subordinate to both primary and secondary signage.

6.4.4.3 Wayfinding Sign Family

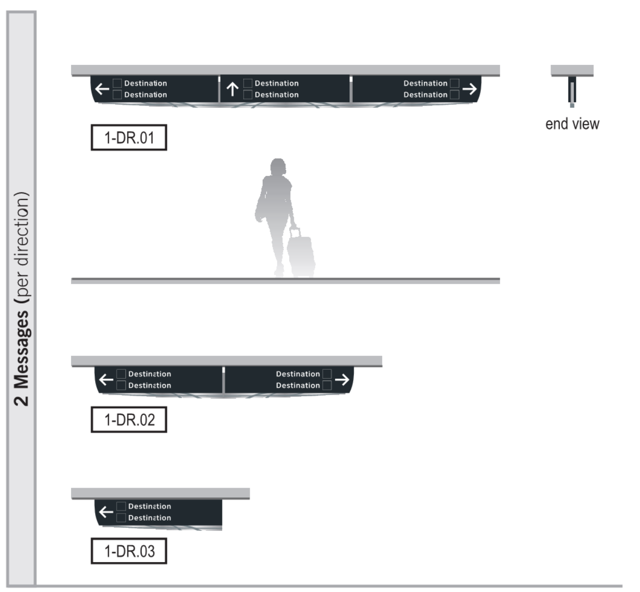
The HAS's new wayfinding system uses a comprehensive sign typing system that is based on categories of a sign's function. It has been developed into a holistic family of signs with each member having its own specific use and purpose, while utilizing a "kit-of-parts" design philosophy. It is designed to be manageable, seamlessly integrated with all of IAH's facilities, and can be updated on a continuing basis as needs arise.

Wayfinding sign types at HAS properties will be categorized as directional, identification, informational, regulatory, life safety/egress and temporary. Major sign type classifications (as categorized by function) and general descriptions of each include:

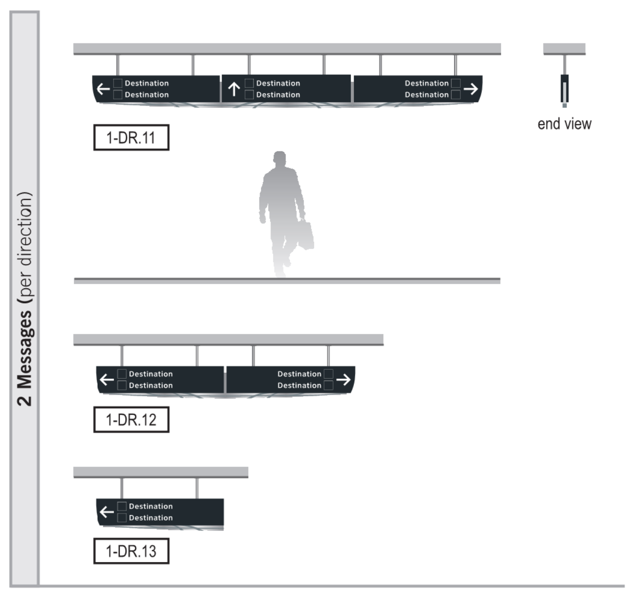
- **Directional:** signs that display standardized directional messaging to assist in finding one's way through a defined area or environment (i.e., an overhead sign at a decision point with arrow/symbol/destination messages listed)
- **Identification:** signs used as unique markers to identify specific locations within a defined area or environment (i.e., a gate identification sign)
- **Informational:** signs or graphic systems that display specific and very detailed information to assist in orientation within a complex or unfamiliar environment (i.e., a directory map or FIDS)
- **Regulatory:** signs that display regulatory information (i.e., "No Parking" or "Loading Zone Only" signs)
- **Life Safety/Egress:** signs that display life safety and vertical circulation/egress-related information as required by local and national codes (i.e., fire escape stairway core level identification signs)

Planned Sign Family 1 of 2

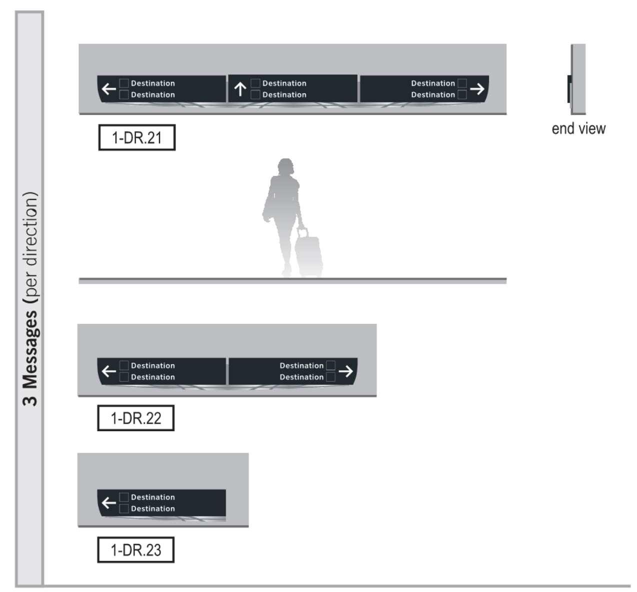
1-DR.00 to **1-DR.09** = Directionals: **CEILING** Mount - **Flush Top**



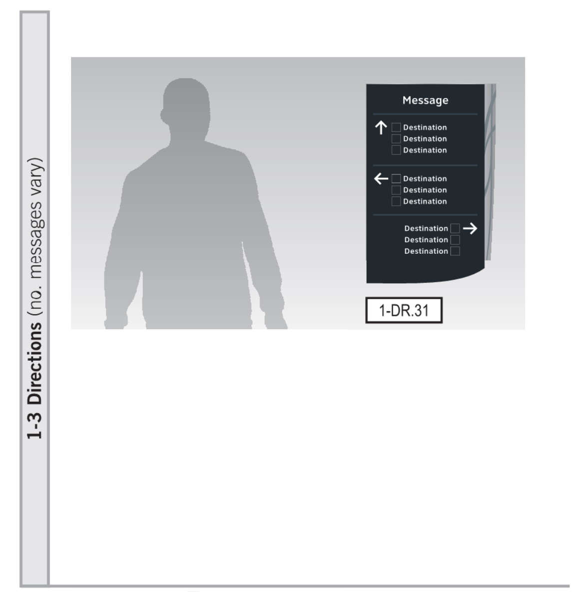
1-DR.10 to **1-DR.19** = Directionals: **CEILING** Mount - **Suspended**



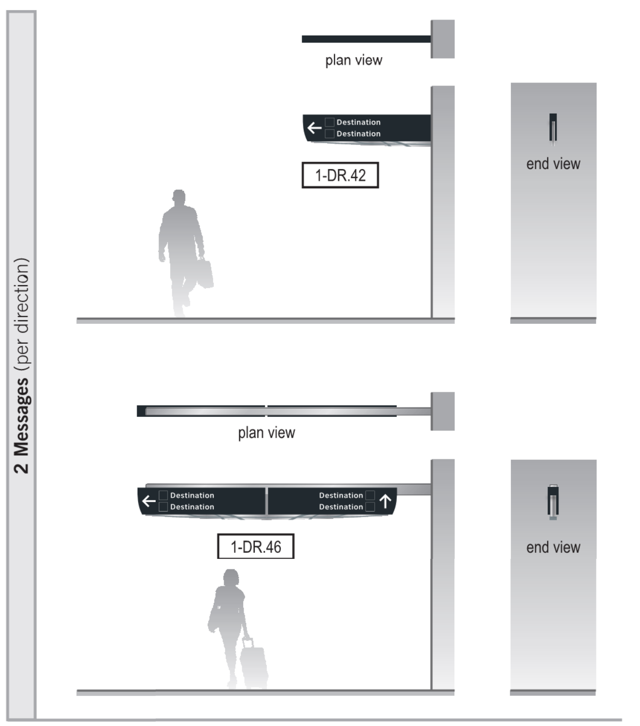
1-DR.20 to **1-DR.29** = Directionals: **WALL / SOFFIT** Mount



1-DR.30 to **1-DR.39** = Directionals: **WALL** Mount - **Sma**



1-DR.40 to **1-DR.49** = Directionals: **FLAG / CANTILEVER** Mount

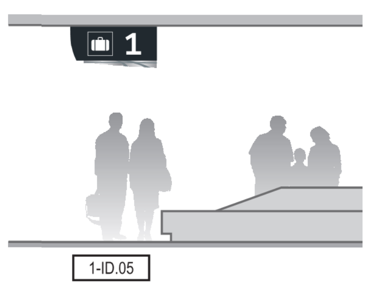


1-DR.50 to **1-DR.59** = Directionals: **FLOOR** Mount

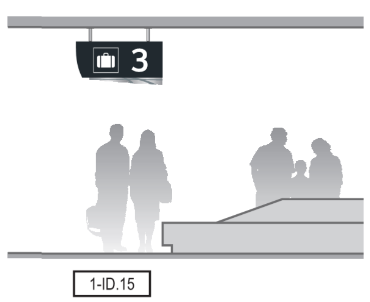
SOURCE: HAS Wayfinding System: Signage Design Guidelines, Standards and Typical Applications (Latest Ed.)
PREPARED BY: Labozan Associates, Inc., December 2015

Planned Sign Family 2 of 2

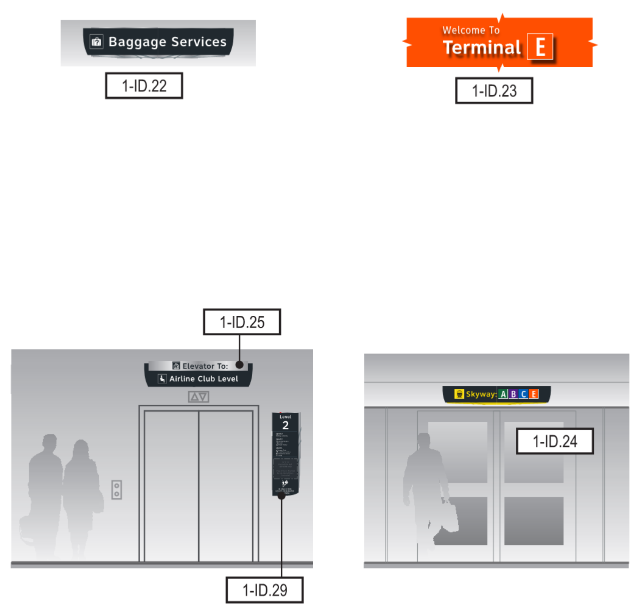
1-ID.00 to **1-ID.09** = Identification: **CEILING** Mount - **Flush Top**

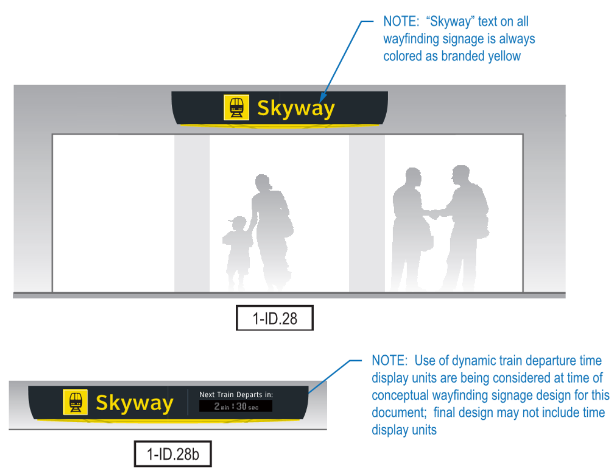


1-ID.10 to **1-ID.19** = Identification: **CEILING** Mount - **Suspended**

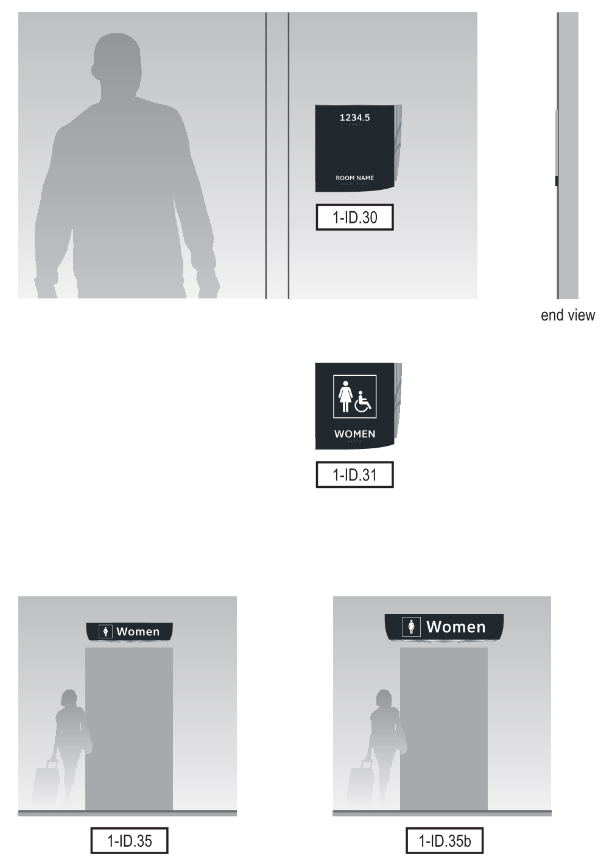


1-ID.20 to **1-ID.29** = Identification: **WALL / SOFFIT** Mount





1-ID.30 to **1-ID.39** = Identification: **WALL** Mount - **ADA and Restrooms**

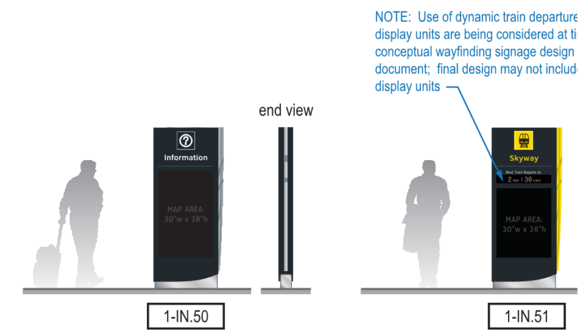


1-IN.10 to **1-IN.19** = Informational: **CUTE**

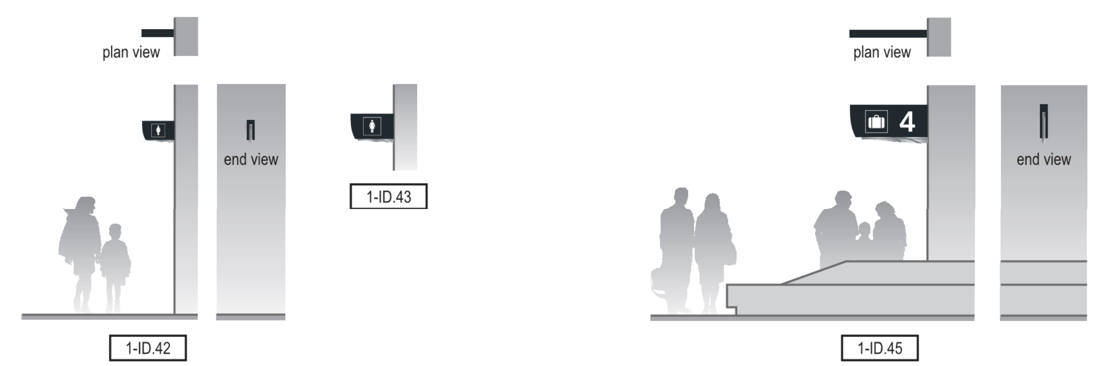
TO BE DEVELOPED

1-IN.20 to **1-IN.29** = Informational: **WALL** Mount

1-IN.50 to **1-IN.59** = Informational: **FLOOR** Mount



1-ID.40 to **1-ID.49** = Identification: **FLAG** Mount



Graphics 1 of 2

COLORS

TERMINAL IDENTIFICATION

Terminal A	Terminal B	Terminal C	Terminal D	Terminal E	Skyway & Subway Trains
PMS 349C	**PMS 2597C**	**PMS 300C**	**PMS 187C**	**PMS 1655C**	**PMS 3965C**
Terminal A Watermark Accent	Terminal B Watermark Accent	Terminal C Watermark Accent	Terminal D Watermark Accent	Terminal E Watermark Accent	Skyway & Subway Trains Watermark Accent
PMS 3435C	**PMS 2695C**	**PMS 294C**	**PMS 188C**	**PMS 180C**	**PMS 3975C**

SIGN GRAPHICS / STRUCTURES / MISC. OTHER

Sign Face Background	Divider Rule-Line Graphic	ID Header Background	White Text/Graphics	Suspension Hardware	Safety Red	Warning Yellow	Black Text/Graphics
PMS 433C	**PMS 432C**	**PMS 427C**	**White**	**Bright Silver:** to match MAP paint # 41342SP	**PMS 186C or 3M 4092 DG3 Red**	**PMS 116C or 3M 4091 DG3 Yellow**	**PMS Black C or C:50 M:40 Y:40 K:100**

ARROWS

0 degrees (3 o'clock):	45 degrees:	90 degrees (12 o'clock):	135 degrees:	180 degrees (9 o'clock) :	225 degrees:	270 degree (6 o'clock):	315 degrees:
- Right	- Ahead on the Right - Up to the Right	- Ahead Forward - Up	- Ahead on the Left - Up to the Left	- Left	- Here on the Left - Down to the Left	- Ahead Here - Down	- Here on the Right - Down to the Right

SOURCE: HAS Wayfinding System: Signage Design Guidelines, Standards and Typical Applications (Latest Ed.)
PREPARED BY: Labozan Associates, Inc., December 2015

TYPEFACES

PEDESTRIAN WAYFINDING TEXT

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789@#$%^&*():;

Font = ClearviewText Medium
Use = Primary typeface for all standard pedestrian wayfinding word messages

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789@#$%^&*():;

Font = ClearviewOne Book Condensed
Use = Supplemental pedestrian wayfinding word messages (i.e. "via," "to:" and CBP notification text)

VEHICULAR WAYFINDING TEXT

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789@#$%^&*():;

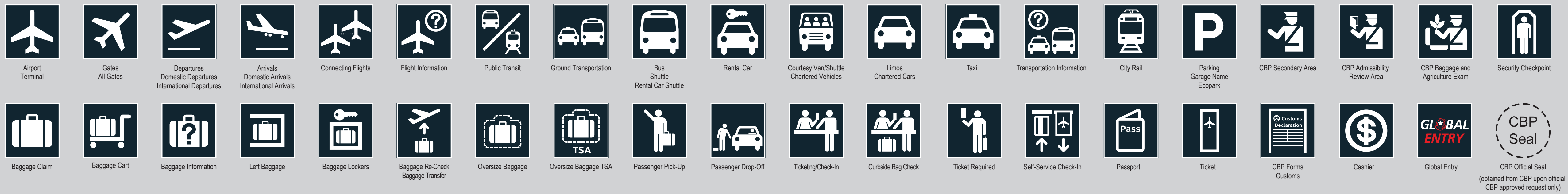
Font = Clearview Highway 2-B
Use = Primary typeface for all standard vehicular wayfinding word messages

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
0123456789@#$%^&*():;

Font = Clearview Highway 1-B
Use = Supplemental vehicular wayfinding word messages

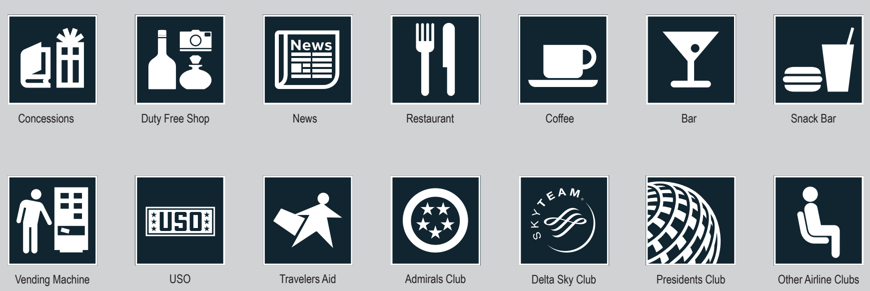
Graphics 2 of 2

TRAVEL SYMBOLS

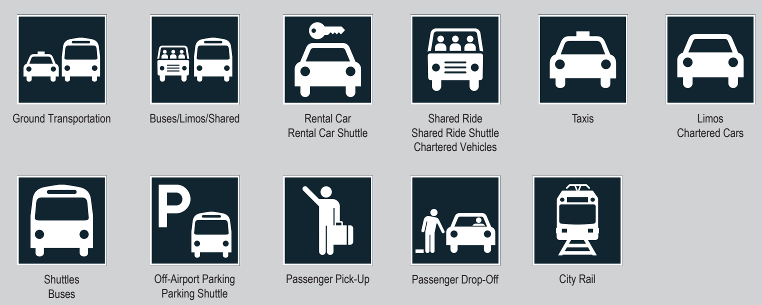


PUBLIC SERVICE SYMBOLS

AMENITIES & CONCESSIONS

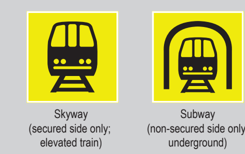


GROUND TRANSPORTATION



TERMINAL IDENTIFICATION: IAH Only

INTER-TERMINAL TRAINS: IAH Only



TXDOT HIGHWAY SHIELDS: IAH Only

REGULATORY

NOTE: Use only this HAS wayfinding universal symbol artwork as shown; re-proportioning and/or manipulating is not allowed

Messages

MESSAGE HIERARCHY - HAS Terminals / Concourses / CBP Areas

PRIMARY	SECONDARY	TERTIARY	REGULATORY/STATUTORY
Directional - Terminal X *(used only at IAH: "X" = terminal letter)* - Terminal X via Walkway *(used only at IAH: "X" = terminal letter)* - Skyway XXXXX *("X" = ABCDE per terminal area)* - Subway XXXXX *("X" = ABCDE per terminal area)* - Ticketing/Check-In - Baggage Claim - Ground Transportation - Gates X#-X# *(IAH: "X" = terminal ltr.; "#" = gate no.)* - Gate X# *(IAH: "X" = terminal ltr.; "#" = gate no.)* - All Gates *(used at HOU and EFD only)* - X Gates *(IAH: "X" = terminal letter)* CBP Areas (Special Required Directional Messages): - U.S. Customs and Border Protection *(NOTE: must always be accompanied by the official CBP seal on left side of text; "and" must always be spelled out, no ampersands allowed)* - Global Entry - CBP Secondary Area - CBP Exit - Baggage Re-Check	**Directional** - Connector - International Departures - International Arrivals - Domestic Flights - Parking - Parking Garages - Bridge to Parking - Connecting Flights - Airline Clubs *(i.e. Presidents Club, etc)* General: - Restrooms - Elevator	**Directional** - Telephones - ATM	All required CBP, TSA & FAA related regulatory/statutory information, including (but may not be limited to): - U.S. CUSTOMS AND BORDER PROTECTION SECURITY AREA... - ILLEGAL DRUGS... - ASSAULTING AN OFFICER OR EMPLOYEE OF THE UNITED STATES... - SEARCH AND DETENTION OF PERSONS, BAGGAGE, VEHICLES AND CONVEYANCES... - CURRENCY AND MONETARY INSTRUMENTS... - SMUGGLING... - AGRICULTURAL DECLARATION... - EXPLOSIVES, FIREARMS, AND WEAPONS ARE PROHIBITED... - CURRENCY AND MONETARY INSTRUMENTS... - Etc... Notifications: - AUTHORIZED PERSONNEL ONLY - DO NOT ENTER - Warning: Restricted Area, Do Not Enter - Warning: Emergency Exit Only, Door Monitored by Alarm - Etc... Other / General: - No Smoking - All life safety/egress - Elevator escape route maps/notifications *(with ADA code compliance)*
Identification - Terminal X *("X" = terminal letter)* - Airline Names - All Gates - Gates X#-X# *(IAH: "X" = terminal ltr.; "#" = gate no.)* - Gates #-# *(HOU: "#" = gate no.)* - Gate numbers *(i.e. IAH = A1, A2 ...; HOU = 1, 2, ...; etc)* - Baggage Claim - Ticketing/Check-In - Curbside Bag Check - Bag carousel numbers *(i.e. 1, 2, 3, etc)* - Self-Service Check-In CBP Areas (Special Required ID Messages): - U.S. Customs and Border Protection *(NOTE: must always be accompanied by the official CBP seal on left side of text)* - WELCOME TO THE UNITED STATES - Global Entry - CBP Secondary Area - CBP Exit - Baggage Re-Check	**Identification** - Skyway XXXXX *("X" = ABCDE per terminal area)* - Subway XXXXX *("X" = ABCDE per terminal area)* - Connector - Restrooms - Men - Women - Assisted - Information - Level # at elevators *(i.e. 1, 2, 3, etc)* - Elevator - Stair # *("#" = stair no. per individual bldg numbering system)*	**Identification** - Oversize Baggage - Baggage Re-Check - Telephones - Emergency Phone - Paging Phone - Fire Extinguisher - AED - ATM - Concessions - General room name/number IDs *(with ADA code compliance)*	
Informational - FIDS - BIDS - GIDS - Self-service check-in kiosks information CBP Areas (Special Required Notification Messages): - Please Have Your Documents Completed and Ready to Present to an Officer - Thank You for Your Cooperation	**Informational** - Terminal X Directory *("X" = terminal letter)* - Airport Directory - General bag carousel information - Clocks - Visual Paging	**Informational** General: - All general safety related information	

SOURCE: HAS Wayfinding System: Signage Design Guidelines, Standards and Typical Applications (Latest Ed.)
PREPARED BY: Labozan Associates, Inc., December 2015

- **Temporary (aka "Transitional"):** signs that can be directional, identification, informational and regulatory, but are made of temporary materials and mounting methods

6.4.4.4 Sign Type Identification System

Sign type identification for all IAH wayfinding signage program implementation is to be grouped into the following categories:

- **Pedestrian Signs** (Note: Certain vehicular signs also fall within these series numbers)
  - Series 1: Terminals/Concourses – includes all public-accessible Terminal and Concourse related areas
  - Series 2: CBP Required Signage – includes areas as controlled by CBP
  - Series 3: Curbside/Ground Transportation – includes all Curbside and Ground Transportation related areas
- **Vehicular Signs**
  - Series 4: Roadways – includes all on-property public-accessible roads
  - Series 5: Parking – includes all on-property public-accessible garages and surface lots Vehicular Sign (Note: Certain vehicular signs also fall within these series numbers)
- **Other Areas**
  - Series 6: Support facility areas
  - Series 7 (and above): Are to be assigned as needed and based on unique requirements of individual projects. (Note: All expanded series numbering and categorization must be coordinated with HAS for final approval.)

6.4.4.5 Graphic Standards and Guidelines

Consistency and Standards Based

- Consistent visual/graphic presentation across entire wayfinding system to include:
  - Graphics/Colors/Fonts/Symbols
  - Shapes/Proportions/Sign Types
  - Placement/Orientation and Rotation Philosophy/Decision Points

- Subscribe to established industry design standards and requirements
  - Accessibility (ADA)
  - Sustainability (USGBC/LEED)
  - TxDOT/MUTCD (vehicular signage)

Sign Types (see **Figure 6.9** and **Figure 6.10**)

- Configuration, sizing and placement relative to message priority/function
  - Primary destinations = priority overhead
  - Secondary destinations = secondary overhead or wall mount
  - Tertiary destinations = tertiary wall mount
  - Simplicity = declutter, less is better

Color Coding and Application (see **Figure 6.11**)

- Sign Background = Neutral "Graphite" or "Charcoal" Gray (PMS 433C)
  - Minimizes confusion with branded terminal ID colors
  - Creates neutral backdrop for messaging/symbols/arrows and branded ID colors
  - Least visual impact to other existing airport signage during phases of updating

- Multi-Color Discipline = IAH-branded colors used as terminal and train-system related identification "accents" only
  - Helps to highlight and differentiate terminals and associated parking facilities, as well as inter-terminal train/people-mover systems
  - Limited to a small number of priority areas/functions
    - Terminal A = "Green" (PMS 349C)
    - Terminal B = "Purple" (PMS 2597C)
    - Terminal C = "Blue" (PMS 300C)
    - Terminal D = "Red" (PMS 187C)
    - Terminal E = "Orange" (PMS 1655C)
    - Skyway (secured side) and Subway trains = "Yellow" (PMS 3965C
  - For additional color standards, see the latest edition of the document "HAS Wayfinding System: Signage Design Guidelines, Standards and Typical Applications"; no other colors may be used for IAH wayfinding signage unless otherwise noted and approved by HAS.

Typefaces, Arrows and Symbols (see **Figure 6.11** and **Figure 6.12**)

- Clearview font family
  - Established as effective for pedestrian and vehicular use
  - Variety of styles that apply specifically to vehicular and pedestrian traffic
  - Sized/kerned appropriately for predicted viewing distances and speeds

- Using modern industry standard AIGA/DOT Universal Symbol System
  - Reinforces destination text
  - Assists international travelers
  - Graphic presentation/format reduces possible halation (if illuminated)

Message Hierarchy (see **Figure 6.13**)

- Primary – priority destinations (largest, most visible)
- Secondary – secondary destinations (supplemental)
- Tertiary – auxiliary/support destinations

Message Functions

- Directional – direct to destination point(s)
- Identification – identify destination point(s)
- Informational – convey detailed information
- Regulatory – describe regulations, warnings and requirements
- Temporary – may be any of the above, but used in interim conditions only

Illumination

- HAS wayfinding signage will always utilize consistent and standardized illumination methods. This will enhance and provide holistic visibility and legibility across the overall wayfinding system, while also meeting applicable ADA and MUTCD/TxDOT requirements for wayfinding signage.

- The following are examples of typical wayfinding signage illumination types:
  - Non-Illuminated
  - External Illumination (aka "Front-lit")
  - Reflective Illumination
  - Internal Illumination (aka "Back-lit")
  - At the time of this document's publication, final universal illumination implementation standards for the HAS wayfinding system are still in discussion and development. In the interim and for the purposes of general design intent, the following recommended guidelines and standards, for illumination implementation, shall be used whenever designing and/or specifying HAS wayfinding signage. (Note: These recommendations are based on wayfinding industry typical best practices at time of this document's publication, and may change in the future as advancement of illumination technologies occur):
    - Interior Pedestrian Signage:
      - Primary/preferred method = use internal illumination whenever possible.
    - Exterior Pedestrian Signage:
      - Primary/preferred method = use internal illumination whenever possible, or where it's most beneficial and/or required (i.e. within parking garages and/or under architectural covers where ambient lighting conditions vary radically the closer/further signage is located in proximity to the projection of daylight).
      - Secondary method = use external illumination via nearby or dedicated lighting sources when internal illumination is not viable or possible. (Note: Use reflective graphics when nearby or when dedicated lighting sources are not available.)
    - Vehicular Signage - Roadways and Parking Garages/Lots:
      - Primary required method = on all overhead and roadside wayfinding signage, always use highly reflective sign face graphics by utilizing products such as 3M's DG3 line of reflective roadway sign films
      - Specialized applications = use internal and/or external illumination on specialized signage, such as airport property entrance gateways and architectural/building identification as applicable
    - Vehicular Signage - Curbsides:
      - Primary/preferred method = use highly reflective sign face graphics by utilizing products such as 3M's DG3 line of reflective roadway sign films
      - Secondary method = use internal illumination for other specialized signage at terminal curbsides (i.e., curbside airline/meeting place ID)

6.4.4.6 General Sign Placement

A general rule for placing wayfinding signage is that a designer visualizes themselves as an average departing or arriving passenger within a given airport environment, while thinking about decision points and required messaging expected at a given location. This guideline is, of course, very general in context. Other disorienting conditions may occur, which in turn may require placement of additional signage. These typically include:

- Complex architecture/interior environments
- Competing pedestrian wayfinding traffic
- Visual/environmental distractions
- Congested/contained corridors

Conversely, more favorable conditions which typically reduce need for repetitive signage are:

- Efficient architecture/interior environments
- Single-direction wayfinding traffic flow
- Ceiling, wall or floor treatments reinforcing single-direction traffic flow
- Lighting treatments emphasizing travel corridors or other destinations

Directional sign placement will be perpendicular to wayfinding traffic. This will occur at all decision points and areas where people become disoriented by architectural or environmental conditions. Directional signs will be placed at reassuring intervals within a captive corridor to reinforce directional messaging to wayfinding traffic. Note that architectural/interior conditions or competing pedestrian traffic flow may inadvertently imply a change of direction. In these situations, additional directional signs will be used to reinforce the intended direction as needed.

Identification sign placement will typically occur at or near all priority destinations and entrances. Identification signs, such as gate ID signs or corridor/building entrances, will typically be placed perpendicular to wayfinding traffic.

Informational sign placement will typically be located nearest to major decision points. Directories will typically be located to the side of a major decision point and will be parallel/in-line with wayfinding traffic. FIDS and other dynamic informational systems should be located parallel/in-line with wayfinding traffic unless otherwise deemed beneficial to be perpendicular in a given situation.

6.4.4.7 Critical Dynamic Wayfinding locations

The FIS facility includes many decision points which must convey direction in multiple languages and various messages depending on the situation. Dynamic signage that is consistent with overall wayfinding is suggested in the following locations to deter from circulation bottlenecks in key transition areas:

- **Primary Processing** – multiple locations
  - At north and south entries to the facility on Level 116, within the sterile circulation, directing passengers to either the north or south queue areas depending on CBP staffing levels.
  - Within the queue area to direct passengers to the correct queue for their designation (e.g., Non-visa waiver, APC, Global Entry). This will help to properly queue passengers in the proper areas and should take precedent and be the primary focus. If additional space is available, secondary signing could also include BIDS information pertaining to the baggage claim carousel for each flight, anticipated wait times and other useful information during the passenger dwell time in queue. If the passenger can be well informed of the next steps, it will help to eliminate any delay or dwell time in the baggage claim hall below.
  - Additional requirements as necessary to be developed and coordinated between CBP, HAS, and airlines

- **Vertical Circulation Atrium**
  - Located in eyesight of the existing escalators that traverse from Level 116 (primary processing) to Level 93 (baggage claim). While on the escalators, passengers can evaluate which claim unit their bags are located on prior to getting off the escalator. This will help to deter congregation issues at the bottom of the escalator area.

- **Baggage Claim**
  - o BIDS should be appropriately located in highly visible areas to direct passengers to their baggage carousels. Mounting BIDS parallel to pedestrian traffic flow is preferred so as to not obstruct or bottleneck circulation.

- **Exit Control**
  - o Dynamic signage can be used for queue management in the exit control area to direct passengers to open podiums and thus speeding up the process.

- **Baggage Re-check Area**
  - o Dynamic signage can be used to identify ticket counters and baggage re-check queuing areas if necessary. Further coordination with airlines to determine need will be required.

- **Meeter Greeter Area**
  - o Display dynamic FIDS information in the Meeter Greeter area to provide flight arrival status. FIDS should be highly visible and appropriately located so as to not obstruct or bottleneck circulation.

- **Exit Control**
  - o Dynamic signage can be used for queue management in the exit control area to direct passengers to open podiums and thus speeding up the process.

6.5 Best Practices/Sustainability

HAS is proud of having achieved significant sustainability goals and intends to continue its efforts of implementing sustainable procedures and practices for HAS development and operations. The incorporation of these procedures and practices in planning, design, construction, operation and maintenance phases for the reconstructed FIS will build upon the successful sustainability initiatives HAS has actualized. The decision-making process of identifying and implementing these practices should occur early in each phase of the FIS reconstruction in order to maximize opportunities and results. Current sustainability certification programs and practices that are applicable to each phase of the program include:

- Leadership in Energy and Environmental Design (LEED)
- Envision rating systems expertise
- CenterPoint Energy rebate programs
- Economical renewable energy strategies
- Building commissioning services
- Monitoring and Verification (M&V)

HAS understands the value of life cycle costs and the trade-offs between construction budget reductions at the expense of operations and maintenance.

Design criteria for “Sustainability Best Practices (SBP)” include the following:

(1) Implementation to the maximum cost effective extent possible during design, construction and post-construction phases.

(2) The SBP short list will be measured in a balanced scorecard approach, utilizing ACI-NA recognized criteria, which includes the economic impact, operational impact, natural resources impact, and societal impact (EONS).

(3) The FIS will be designed and constructed in consideration of the guidelines provided by Airport Cooperative Research Program (ACRP) Report 42 (Sustainable Construction Practices) and ACRP Synthesis 10, in addition to other recognized industry guidelines.

(4) Third party, independent commissioning of select systems will be performed prior to receiving a Certificate of Occupancy.

Best practices in sustainability include:

- **Renewable Energy:** Increase generation of electricity from renewable resources.
  Texas established its Renewable Portfolio Standards (RPS) as part of the legislature’s restructuring of the state’s electricity market in 1999. In August 2005, Senate Bill 20 (S.B. 20) increased the renewable-energy mandate to 5,880 MW by 2015 (about 5 percent of the state’s electricity demand), including a target of 500 MW of renewable-energy capacity from resources other than wind. Wind accounts for nearly all of the current renewable-energy generation in Texas. S.B. 20 set a target of reaching 10,000 MW of renewable-energy capacity by 2025. Other than wind, renewable energy opportunities to consider for IAH include solar, biomass, landfill gas and municipal solid waste.

- **Energy Conservation:** Improve energy conservation. The Public Utility Commission is heading down a path to increase electricity costs for most of Texas. In February 2011, a combination of bitterly cold weather and generator shutdowns led to a sudden shortage of electricity in the power grid supervised by the Energy Reliability Council of Texas, which covers most of the state. The shortage led to “load shedding” (rolling blackouts) across the grid. Texas Building Energy Performance Standards follow ASHRAE 90.1, which require major facility projects in the state to be constructed to “high energy efficiency standards” in order to reduce energy use. CenterPoint Energy Company has Energy Rebate Programs that need to be reviewed for application to the terminal project. For terminal buildings, energy savings may be realized through efficient lighting, lighting controls, single duct variable air volume systems in customer lobbies and office space, low emissivity glass, energy efficient equipment and sustainable operating strategies.

- **Self-Generation Opportunities:** Review self-generation opportunities.
  Utility companies in Texas are required to disclose their fuel sources and adopt net metering to credit customers’ utility bills for electricity they provide to the grid from renewable sources. Review self-generation opportunities including cogeneration systems that use digester gas from wastewater treatment plants or landfills and solar PV arrays to determine if these options are attractive, including third party investment strategies.

- **Demand-Shifting Strategies:** Plan for demand-shifting strategies.
  Electricity generation costs in Texas are going up. Thermal energy storage is a demand shift strategy that benefits from “time-of-day” strategies covered in ASHRAE 90.1. Strategies like thermal energy storage systems, power shedding controls and optimum chiller operations are strategies to shift on-peak demand charges to save costs.

- **Greenhouse Gas Reduction:** Reduce GHGs.
  Senate Bill 184 established a report to determine, “No Regrets” Greenhouse Gas Emissions Reduction Strategies for the State of Texas. Several GHG emissions reduction strategies were developed for both stationary and mobile sources. Identify ways to increase energy efficiency and reduce emissions during construction and operation of the terminal project.

- **Waste to Energy Strategies:** Look for waste to energy opportunities.
  Waste to energy strategies in Texas include municipal solid waste, anaerobic digestion and biogas (landfill gas). Generation from those sources contributes minimally to the electricity grid. Consider opportunities regarding a wastewater treatment plant or landfill to clean up digester gas or landfill gas to pipeline quality to receive carbon offset credits at the airport.

- **Recycling:** Improve recycling. Research ways to enhance the recycling program at HAS including composting carbon waste and recycling paper, glass and metals for revenue based recycled scrap.

- **Grant Funding:** Obtain available grant funding.
  Identify available grant funding to support sustainable projects for the terminal.

6.5.1 SUSTAINABILITY REGULATIONS

The understanding of the interconnections between economic, social and environmental aspects of sustainability drives successful projects, so too does the application of sustainability regulations. Several sustainability requirements have been incorporated into the relevant Houston codes for renovation or construction of non-residential buildings. A listing of codes is summarized at the end of this section for buildings similar to the FIS facility.

LEED requirements for new construction and major renovation projects address design and construction activities for both new buildings and major renovations of existing buildings. This includes major HVAC improvements, significant building envelope modifications and major interior rehabilitation. There are several LEED-certified airport terminal buildings to review as case studies. Two of the most recent U.S. examples are Terminal 2 West (SAN) and Bradley-West (LAX). LEED criteria are best suited for projects involving buildings.

Infrastructure projects, including roads, bridges, airports, etc. do not fit easily into the LEED program. To better evaluate these infrastructure projects, the Envision™ rating system was created.

Harvard, the International Sustainability Institute (ISI), and Sustainable Infrastructure Advisory Board (SIAB) members built upon Zofnass research to develop the Envision™ rating system. The intent of the rating system is to be able to assess the sustainability of a project over its entire life-cycle, from the “evaluate need” phase, where project alternatives are examined, through design, construction, commissioning, operations and, finally, to rehabilitation and decommissioning. At each phase, the impact on sustainability is quantified, compared with national standards, local context, and benchmark projects, supporting more efficient decision making.

Harvard researched more than 120 different sustainable rating systems in practice worldwide as part of the Zofnass research program. A select few of the more familiar and widely used rating systems include:

- LEED (U.S. based – Leadership in Energy & Environmental Design)
- CASBEE (Japan based - Comprehensive Assessment for Building Environmental Efficiency)
- Cascadia (Pacific Northwest based - the Living Building Challenge/Net Zero Energy Goal)
- Green Globes (non-profit worldwide organization - Green Building Initiative)
- BREEAM (U.K. based - Building Research Establishment’s Environmental Assessment Method)
- CEEQUAL (U.K. based - Civil Engineering Environmental Quality & Award).

This analysis provided a rich source of research material and a great perspective and context in thought leadership, regarding sustainability, across the planet.

The structure of Envision™ includes multiple credits under the umbrellas of five primary areas of analysis, including the impact of an infrastructure project. The five categories are listed and described below.

Effective Leadership – Helps drive successful sustainable projects using a new way of thinking about how projects are developed and delivered. Project teams are most successful if they communicate and collaborate with other team members early in the project, involve a wide variety of people in creating ideas for the project, and understand the long-term holistic view of the project and its life cycle. This category encourages and rewards these actions under the view that together, with traditional sustainability actions, such as reducing energy and water use, effective and collaborative leadership produces a sustainable project that contributes positively to the world around it.

Climate Change – The top issue facing the world today. Today’s decision-making methodology does not adequately address it. Decisions are driven by economic and social considerations without adequate consideration of their impacts on greenhouse gas emissions. Addressing climate change includes mitigation and adaptation. Adaptation may prove too expensive. Metrics for measuring mitigation and adaptation are total greenhouse gas emissions in CO_2e, generated over the full lifecycle of each project, and the ability of a project to cope with stresses beyond a normal design basis (e.g., flooding, structural loading, temperature fluctuations).

Resource Allocation – Deals with the optimal allocation of resources that has the least impact on the current environment and resource availability, and maximizes the potential of future generations to have access to the resources they will need. The subcategories within Resource Allocation are materials, energy and water. Life-cycle assessment is an accounting tool used to track, quantify and summarize environmental and social impacts of resource-use by products over their entire supply chain.

Natural World – This is the impact of people on nature. Landscape ecology, with its emphasis on how spatial patterns impact the movement of materials, energy, water and animals across the landscape, is the ideal foundation for this category. Negative impacts of people on nature include polluting and degrading the landscape. The orthogonal, planned patterns of design are very different from the irregular, finely textured, fractal and meandering patterns of nature that are the result of non-random natural processes. Road ecology is an example of applying a landscape ecology perspective to infrastructure.

Quality of Life – These principles include doing no harm, being nurturing, and being enduring. Existing guidelines (such as the Endangered Species Act) include aspects of quality of life, but are inadequate to address its complete scope. New quantitative techniques are emerging to measure the impact of infrastructure on the quality of life of residents, but these tools still fall short in addressing the full scope of quality of life. Health impacts can be quantified, but fully accounting for the intrinsic value of nature is beyond the ability of tools today. Development patterns, roads, airports and power plants impact quality of life. Congestion, noise and pollution create negative health impacts. Over-consumption works against this category. Using less has economic and environmental benefits.

A partial listing of applicable codes, rating systems and standards include:

- LEED for new construction and major renovations
- Envision™ Rating System
- Sustainability Plan for the City of San Francisco
- City of Houston and County of Houston Building Codes International Building Codes (IBC, IFPC, IPC, IMC, IEEC)
- NEC
- NFPA
- ASHRAE 90.1

6.5.2 COMPREHENSIVE LIST OF INTERNATIONAL RATING SYSTEMS

Common Systems
Envision™ BREEAM CASBEE CEEQUAL GB Tool
Green Globes
LEED
RMI

U.S. Government Initiatives and Guidelines
California Integrated Waste Management Board - Green Building Program
Collaborative for High Performance Schools (CHPS) Database of State Incentives for Renewables & Efficiency
Federal Energy Management Program - Greening Initiatives/Tools
Federal Greening Toolkit
Field Guide to Sustainable Construction
Green Buildings BC Greening Federal Facilities
Maryland Environmental Design Program
Minnesota Sustainable Design Guide
National Renewable Energy Laboratory
New Jersey Clean Energy Program
New York State Energy Research & Development Authority (NYSERDA)
New York State Green Building Tax Incentive Initiative
OECD Project on Sustainable Buildings
Oregon Department of Energy
Pennsylvania Buildings - Governor's Green Government Council
Performance Contracting Legislation by State
U.S. Air Force Environmentally Responsible Facilities Guide
U.S. DOE and U.S. EPA Energy Star Program
U.S. DOE Building Technologies Program
U.S. DOE Energy Efficiency and Renewable Energy (EERE)
U.S. DOE High Performance Commercial Buildings: A Technology Roadmap
U.S. EPA's Environmentally Preferable Purchasing (EPP) U.S. GSA - Great Lakes Region - Build Green
U.S. GSA Sustainable Design and LEED
U.S. National Park Service - Guiding Principles of Sustainable Design
U.S. Naval Facilities Engineering Command - Design Policy
Whole Building Design Guide

Life Cycle Analysis and Costing Products
ATHENA Sustainable Materials Institute
BEES (Building for Environmental and Economic Sustainability) [NIST] BuildingGreen.com - Life Cycle Assessment
California Life Cycle Cost Assessment Model
Cradle to Cradle
ENVEST (Environmental Impact Estimating Design Software) [UK BRE] GREENGUARD Environmental Institute
ACLCA Center
Life Cycle Analysis of Wood Products LISA (LCA in Sustainable Architecture) MBDC
UNEP SBCI (Sustainable Buildings & Construction Initiative)

Sustainability Principles
Biomimicry Principles
Charter of Rights and Responsibilities for the Environment
Deep Ecology Principles
ICC Charter and ISO 14000
International Council of Local Environmental Initiatives
Ontario Round Table on Environment and Ecology (ORTEE) Permaculture Principles
The CERES Principles
The Earth Charter
The Five Principles of Ecological Design
The Hannover Principles
The Houston Principles
The Natural Step
The Netherlands National Environmental Policy Plan (NEPP)
The Precautionary Principle
The Sanborn Principles

6.5.3 TECHNICAL SUSTAINABILITY TOOLS

Life cycle costing (LCC) analysis is key to sustainable design. The approach that follows is suggested for the FIS facility project.

Performing Life Cycle Assessments
LCC is a decision making tool used to evaluate building or improvement alternatives that incorporates initial capital outlay and future costs. Alternative results are compared to a baseline design or a current condition. LCC can be as simple as a capital cost estimate compared to future cost savings, often referred to as simple payback. The simple payback method is commonly used for small investments, clearly economical that more detailed LCC is not worth analyzing. More commonly, sophisticated clients prefer to review all capital and future recurring costs and will make their decisions based on the sensitivities of the many assumptions needed to perform the analysis.

The LCC summary for each alternative is often presented as a reflection of net present value (NPV) of future cash flows. NPV reflects the value of proceeds (benefits) less the present value of capital outlays (costs). Using a common LCC approach, a variety of alternatives can be considered and costs can be prioritized and benefits optimized using regression tools.

Every member of a project team has a different bias. LCC changes these biases with emphasis by working for the lowest long term cost of ownership.

Consider these perspectives on many projects

- Project managers and estimators want to reduce capital costs as the only criteria.
- Facilities engineers want to minimize repair as the only criteria.
- Users want to maximize uptime hours and avoid failures.
- CFOs want to maximize project net present value as the only criteria.
- Shareholders want to increase wealth as the only criteria.

The best sustainable approach looks to harmonize these biases by looking for the lowest long-term cost of ownership. LCC focuses on facts, money and time. There is no single method for conducting LCC. Organizations have the flexibility to implement LCC as established in International Standard ISO15686, in accordance with the intended application and the requirements of the organization. LCC is different from many other techniques, such as environmental performance evaluation, environmental impact assessment life cycle analysis (LCA) and risk assessment. Why is LCC different from LCA? These techniques seek to evaluate the triple bottom line measure of cradle-to-grave cost in terms of environmental measures.

Approach: Evaluating short-term and long-term costs requires steps that can be broken down into more detail as the complexity and size of investment grows.

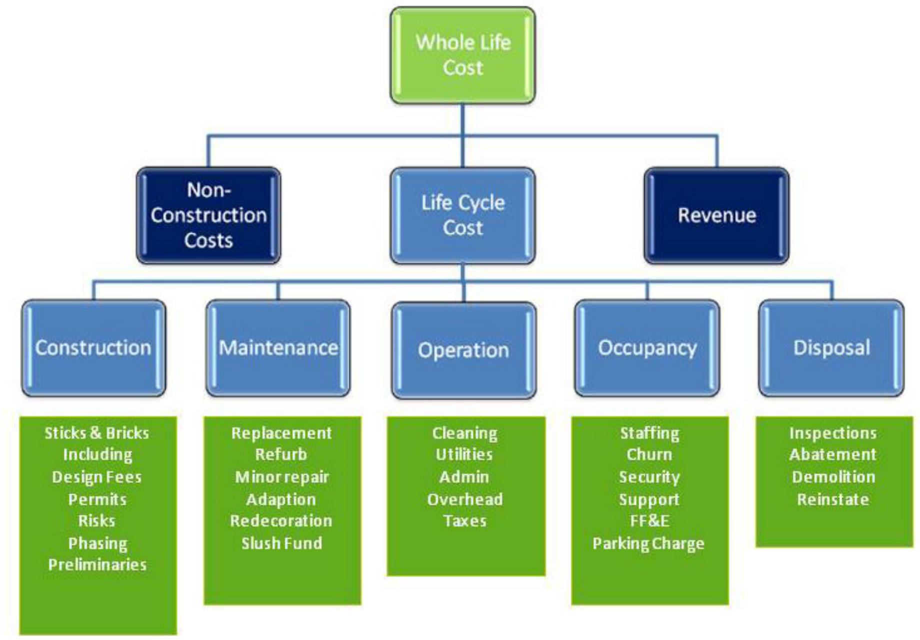
Definition: Work with the team to identify the recommended analysis approach. Agree on the appropriate financial criteria, the numbers of alternatives and the study life period prior to starting the analysis.

Analysis: Coordinate and assess the initial capital costs, recurring capital costs and ongoing maintenance or energy costs through the life of the study. This stage is often called "brainstorming" because of alternatives generated and the need to avoid making recommendations. Often, synergies are developed where one alternative affects others.

In the simplest sense, the LCC can be conducted on building elements, energy saving alternatives, or entire building systems. Most studies conducted are for two to three alternatives for four to five major building systems. LEED studies consider all initiatives required to achieve a level of certification, but there are many overlaps in building systems that make this task less intuitive to analyze.

Scope, Risk and Uncertainty: Figure 6.14 identifies the possible elements of LCC. Any or all can be incorporated, depending upon the level of complexity and detail needed.

Figure 6.14 – Elements of Life Cycle Costing



Risks of cost variation are most certain because of the numerous assumptions that need to be made during the course of a study. One of the most critical risks, linked to each listed below, results from the human nature of modifying the plan data to suit a predicted outcome.

- CapEx – design incomplete
- OpEx – variable
- Inflation - percent
- Obsolescence
- Plan ≠ Actual
- Quality of data
- Lifetime – how long?
- Discount Rate - percent

Reporting: Produce the results and recommendations in a simple graphic, summarizing cost and benefits for all alternatives. Impact assessment statements should include the implications to incorporating the recommendations. Sensitivities can be run on the many assumptions that need to be made in order to calculate the LCC.

6.5.4 ENERGY

Energy conservation and renewable energy are keys to sustainable design. Consider the following steps when designing the FIS facility:

1) **Expand Energy Efficiency**
   Meet the requirements of ASHRAE 90.1-2013 Energy Standard for Buildings. New requirements in 2013 include:

- Revised, stricter opaque element and fenestration requirements at a reasonable level of cost-effectiveness.
- Improvements to daylighting controls, space-by-space lighting power density limits, and thresholds for top lighting.
- Revised equipment efficiencies for heat pumps, packaged terminal air conditioners (PTACs), single package vertical heat pumps and air conditioners (SPVHP and SPVAC), and evaporative condensers.
- Improved equipment efficiencies and controls for chillers.
- Improved controls for heat rejection and boiler equipment.
- Improved requirements for expanded use of energy recovery, small-motor efficiencies, and fan power control and credits.
- Clarifications for the use of prescriptive provisions when performing building energy use modeling, and revisions to enhance capturing daylighting when performing modeling calculations.

2) **Optimizing the Design of the HVAC Systems**
Design HVAC systems that are appropriately sized for the loads. Include control schemes to set back temperatures during unoccupied time periods along with optimizing the use of the most energy efficient equipment.

3) **Maximizing the Generation of Renewable Energy**
Look for opportunities for the utility company to incentivize renewable energy systems on the project. Consider third party Buy-Own-Operate-Maintain strategies for installing large Solar PV arrays.

4) **Designing Highly Energy Efficient or Zero Net Energy Buildings**
Review ASHRAE standards for High Performance Building Design.

5) **Specifying Future-Looking Building Automation Technology**
The key to long lasting energy conservation is to maintain the building operations at the "commissioned" level. Many buildings let the HVAC systems drift out of tolerance over time, which can waste up to three percent of the system energy per year. Building Automation Systems (BAS) need to include metering and verification technology to help operators recognize when key parameters run outside of commissioned setpoints. Sub-meters can track real time energy and demand usage on HVAC equipment. The BAS needs energy trending dashboards to show energy consumption in real time and contrast the data with the commissioned benchmarked data. This information will help establish "demand-shift" strategies to reduce electric bills. HAS can contract the monitoring service remotely or do it in-house. The key is to define the project M&V plan early in the design, in order to include key meters and software in the project so energy consumption can be tracked when needed. Meters and instrumentation will need to be maintained within accepted tolerances in order to provide accurate feedback on energy usage.

6.5.5 PROJECT SPECIFIC DESIGN STRATEGIES FOR FIS

The following specific items will be evaluated during the project design to further the project's sustainability goals:

1. Energy metering at CenterPoint Energy's 34.5 kV/12.5 kV substation for comparison with electrical bills from Reliant Energy.
2. Sub-metering at terminal buildings and tenants.
3. Supervisory Control and Data Acquisition (SCADA) system.
4. Efficient light fixtures, including LEDs.
5. Lighting controls (e.g., timers, photo sensors, motion and occupancy sensors).
6. BAS to control and monitor HVAC systems for:
    a. More precise DDC control of pumps and fans to match demands.
    b. Improved outside air quantity control.
    c. Improved lighting controls and use of daylighting to reduce power consumption.
7. M&V program to maintain HVAC systems as commissioned in the future years.
8. Variable Frequency Drives (VFDs) on pump and fan systems.
9. Increased differential temperatures for chilled water in AHUs.
10. Run CUP chillers in parallel during normal operating hours and in series during peak demand. Running in series will increase differentials between chilled water supply and return temperatures and improve overall system efficiency by:
    a. Older chiller efficiency increases because they get warmer chilled water return (56°F to 59°F) and cool it down 10°F.
    b. New chiller efficiency is realized because they take older chiller supply temperature (46°F to 49°F) and cool it down to 39°F for distribution.
    c. More cooling effect can be distributed in existing pipe network because differential temperature is now 17°F to 20°F (versus 12°F). The higher delta T allows for the increased cooling with the same chilled water flow rate.
    d. AHU coils will be upsized in Terminal D to account for the higher delta T.
11. Indoor chemical and pollutant source control.
12. Indoor air quality management plan.
13. Electrical charging stations for aircraft ground service equipment.
14. Highly efficient baggage systems.
15. Powered and preconditioned air at jet gates.
16. Low-flow water fixtures.
17. Use of alternative fuel vehicles during construction.

18. Program to maximize recycling of on-site construction waste.

19. Chilled Beam: Does not work in a positive pressure ventilation system. Airport terminals must maintain a positive pressure to prevent undesirable outdoor aircraft emissions from migrating into the space. Atmospheric water vapor often condenses on chilled beams causing dripping when they operate in humid climates.

20. Displacement Ventilation: involves supplying conditioned air into a space near the floor and exhausting from the ceiling. The supply airflows can be reduced as they only need to cool the occupied zone. Air temperatures rise as they move to the ceiling. Displacement ventilation does not work well for airport terminals due to the varied mix of occupancies. Supply and exhaust needs should occur in passenger ticketing, security, baggage handling, concessions and boarding.

DEMAND RESPONSE CONSIDERATIONS
IAH is served by CenterPoint Energy Company. They currently supply power to IAH at a flat rate ($0.074/kWh). No demand or time-of-day charge is provided in the rate.

1. Cogeneration:

   a. Flat electrical rate does not help self-generation economics.

   b. IAH is in a non-attainment pollutant zone, which does not help self-generation using fossil fuels.

c. All the power must be consumed at IAH in order to optimize economics. This requires additional electrical distribution costs.

2. Thermal Energy Storage (TES): No demand charge in the current electric rate which renders TES solutions not economical.

3. Battery Storage: Consider battery storage if self-generation systems are realized; helps to consume all self-generated power at the airport and provide demand response to shave peak demand time periods.

4. Network Station: Consider feeder switching station (receiving/distribution station) to receive power from CenterPoint and self-generated systems (cogeneration/renewables) to improve reliability through multiple feeder switching capability and to consume all self-generated power at the airport.

DISTRIBUTED FORMS OF GENERATION CONSIDERATIONS (Including on-site solar and geothermal heat)

1. Geothermal (ground source heat pumps): Heat pump technology is inadequate to meet peak cooling and heating demands at IAH. Supplemental systems must be added, including electric resistive heating, remote boilers and chillers. Large horizontal closed loop underground piping or injection wells are needed. Lack of space to install the piping/injection wells are a problem.

2. Solar PV: The PUC is currently considering a rulemaking that would finally implement a provision of the RPS that would require that 500 MWs be generated by renewable resources other than wind, such as solar and geothermal power. Without a RPS provision for solar PV or geothermal, these technologies will be difficult to economically justify.

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Chapter 7 | Phasing

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7.0 PHASING

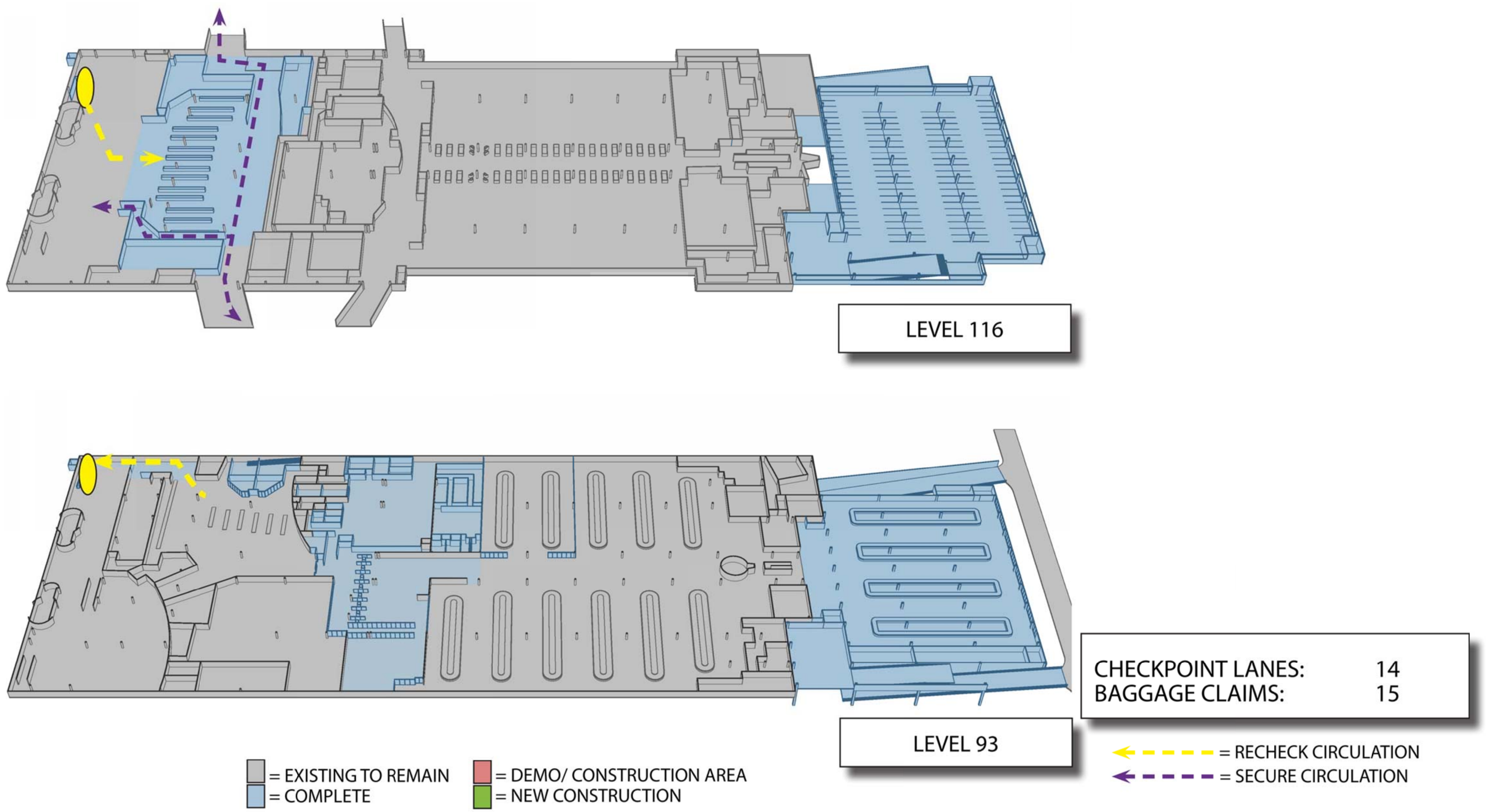
The following chapter outlines the process for the renovation and expansion of the FIS facility. The phasing shall maintain working operations of the facility during all stages of construction while keeping any disruption to the CBP work ability and passenger experience to a minimum. Working hours shall be during non-peak demand times to avoid disruption to daily operations whenever possible. Due to physical site constraints, layoff areas will not be available immediately adjacent to the project site. The site is constrained by Taxiway SF on the east, the terminal roadways on the north and south and the existing FIS facility on the west. The project will include five phases, as well as enabling projects to allow for demolition of the existing CBP employee parking garage.

Phase 0 – Enabling projects or standalone projects
Phase 1 – Demolition of existing garage
Phase 2 – Construction of new baggage expansion / CBP parking structure, recheck corridor and concession demolition
Phase 3 – Secondary processing reconfigurations and consolidated checkpoint
Phase 4 – Secondary processing support offices, exit control and consolidated checkpoint
Phase 5 – Reconfiguration of CBP office and Counter Terrorism Suite, consolidated checkpoint and recheck components

All phases are broken into sub-phases to allow for quick availability of key areas or for easy transitions during the construction process. A safe and efficient passenger path of travel must be maintained throughout the entire construction duration.

Figure 7.1 depicts an overview of the entire completed facility with areas of impact shown in blue.

Phasing Complete



7.1 Phase 0: Enabling Projects or Standalone Projects

Prior to initiation of the project, enabling projects are required to facilitate a smooth transition into the construction phases. There are also projects that could be completed at any time prior, during or after the construction process as they are independent of the overall construction sequence. **Figure 7.2 indicates the potential enabling or standalone projects as described in the following sections.**

7.1.1 RELOCATION OF CBP STAFF PARKING

Prior to demolition of the existing parking garage, CBP employee parking must be temporarily relocated. The existing garage contains 250 parking spaces. It is anticipated that this function is to be relocated to one level of the existing Terminal C/E garage. A floor of the existing garage will need to be blocked off to public use and access. Gate access should be provided only to CBP employees. Infrastructure costs are expected to be minimal for this enabling project since the existing garage currently has this capability. The largest impact to the airport will be the loss of revenue generating public spaces in the interim. The Design Team shall confirm with HAS of the preferred location for this enabling project prior to commencement as operations may have changed at that time.

7.1.2 SITE UTILITIES

Access is necessary for underground utilities to the project site from the anticipated ITRP Enabling Utilities Landside Project or related project. It is estimated that portions of the north roadway will need phased rework to allow for this utility pathway. Portions of this work could occur as part of other ITRP projects, prior to the FIS expansion project.

7.1.3 APC RELOCATION AND EXPANSION

Portions of the APC expansion and relocation are independent of the phasing sequence required for the remaining FIS work. Currently, HAS is completing a project to relocate the north APC kiosks to the preferred concept location at the northeast section of the primary processing hall. The current project will allow for 22 APC kiosks on the north. As a separate enabling project, the final 8 will be installed, including the necessary electrical and data infrastructure. The future location of the APC area is within the existing queue area and no other construction is required for its installation. The entire build-out of triage and APC verification podiums will not occur until later phases due to rework needed near the existing command and control center and secondary referral wait/triage area. The associated queue can be reworked for the full build-out when the APCs are installed.

The south primary area currently includes APCs near the west end of the facility. The ultimate plan relocates these units and expands quantity at the east end of the facility in the same layout as the north. Once the kiosks are moved to their final location, the existing infrastructure (in-floor electrical and data) is expected to remain and the queue stanchions relocated to the final layout. This south relocation can be initiated at any time, thus expediting the overall primary processing wait times prior to construction.

7.1.4 DUAL FEED BAGGAGE CONVERSION

While the above APC modifications will help with passenger wait times in the primary hall, a new potential issue will be the timeliness of baggage arriving in the baggage claim hall for passenger pickup. Passenger dwell times around baggage carousels could cause congestion. With the baggage claim expansion not complete until the new expansion building is built, one solution to mitigate this issue is the conversion of existing baggage claims to include dual feed conveyors. Currently, all existing units have one feed from the below inbound room to the unit above. Consideration to incrementally convert the existing units to dual feed will allow for current level of service to be maintained and enhanced, even before construction of the new baggage claim units. Six units have been identified within the existing building that can be converted to dual feed. This project should be done incrementally so only one unit is unused at any time.

7.1.5 CDC SUITE MODIFICATIONS

The existing CDC suite is located on Level 116 in the southeast quadrant. The preferred plan includes minor modifications to this suite including a small expansion into the current Counter Terrorism Suite. This modification can be completed at any point prior or during construction. Coordination with the CDC will be required to maintain daily operations and confirm final requirements prior to design/construction.

7.1.6 ELEVATOR MODIFICATIONS

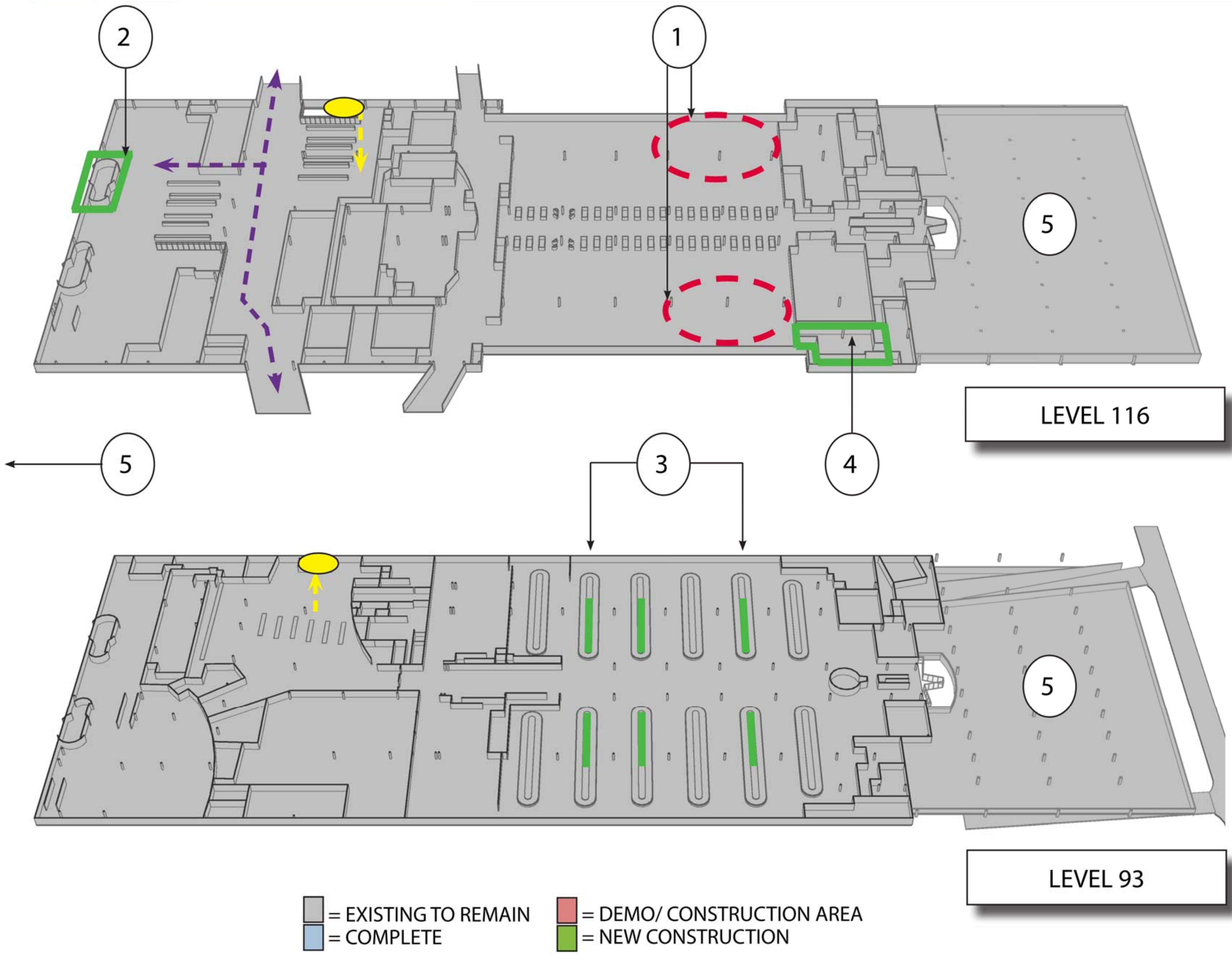
The existing elevator core that services the ITT, Terminal E and Terminal E Garage levels provides an inadequate level of service due to extended wait times on each level. The proposed plan includes a new elevator located just south of the existing north elevator bank to assist with capacity issues. Architectural cladding should be used to help visually tie the existing elevators to the new elevator. Ricondo has completed a study regarding existing conditions and potential modifications for improvement. This can be reviewed in **Appendix C**. This rework can be completed independent to the overall FIS construction sequence.

7.2 Phase 1

7.2.1 DEMOLITION OF EXISTING CBP PARKING STRUCTURE

Prior to any new construction on the site, the existing CBP parking structure will be demolished in its entirety. During demolition, full access to the airside service road and north/south roadways shall be maintained for airport/airline operations. At least one of the two existing baggage tunnels from the airside service road to the Level 78 inbound baggage makeup room must be maintained. CBP employee parking will be located at the temporary parking floor on the existing D/E garage (as identified in the Enabling Projects). Access must be maintained from the east side of the facility for CBP security purposes, as well as egress from the facility that will be in full operation during this demolition and subsequent parking structure reconstruction. During this phase (**Figure 7.3**), there is no anticipated impact to passengers within the facility. Phase duration is anticipated to be three months.

Phase - 0



PHASE 0-

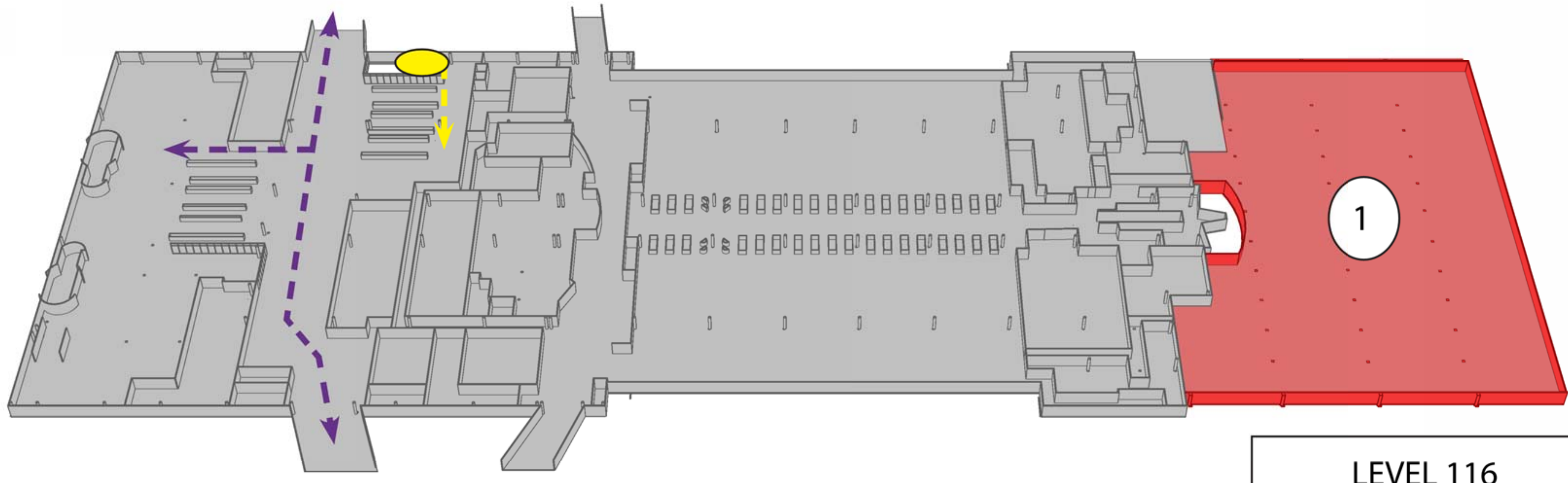
ENABLING PROJECTS:

1. COMPLETE PRIMARY PROCESSING UPDATES INCLUDING APC, CCC AND QUEUE CHANGES
2. ELEVATOR MODIFICATIONS
3. EXISTING BAG CLAIM DUAL FEED CONVERSION
4. CDC SUITE MODIFICATIONS
5. RELOCATE CBP PARKING TO EXISTING E GARAGE

CHECKPOINT LANES:	12
BAGGAGE CLAIMS:	12

= RECHECK CIRCULATION
= SECURE CIRCULATION

Phase - 1



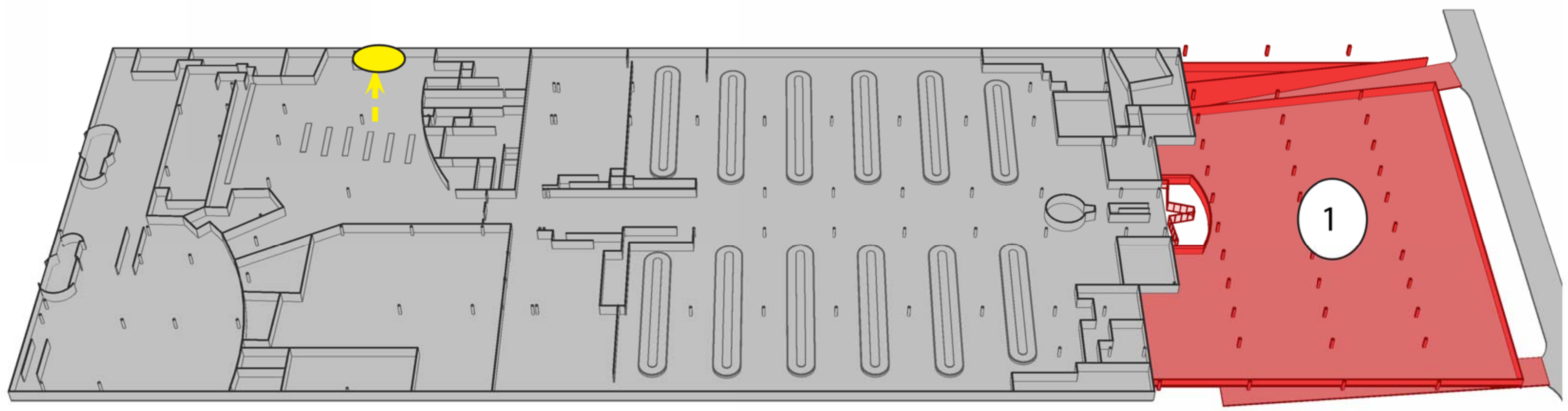
LEVEL 116

PHASE 1-

EXPANSION:

1. DEMOLISH EXISTING GARAGE

RENOVATION:



LEVEL 93

CHECKPOINT LANES: 12
BAGGAGE CLAIMS: 12

= EXISTING TO REMAIN
= COMPLETE
= DEMO/ CONSTRUCTION AREA
= NEW CONSTRUCTION

= RECHECK CIRCULATION
= SECURE CIRCULATION

7.3 Phase 2

7.3.1 BAGGAGE CLAIM EXPANSION & CBP GARAGE CONSTRUCTION

Upon demolition of the existing parking structure, the new baggage claim annex (including the Level 74 inbound makeup facility and FIS baggage claim expansion of four units) shall be built.

Construction of the new CBP garage will have direct impact on the operation of the airside service road and baggage ramps to the existing inbound makeup facility. Consideration for a clear and safe path for both of these functions must be allowed by the contractor. It is recommended to build one airside baggage tug ramp from the airside service road to the Level 74 basement at a time. This will ensure uninterrupted operations of the facility.

7.3.2 NEW RECHECK CORRIDOR AND VERTICAL CIRCULATION

A new vertical circulation core is to be built in the far northwest corner of the facility to transport passengers from the recheck area up to the Terminal E ticket lobby and, ultimately, to the new consolidated checkpoint. This includes two new escalators (up only), public stairs and elevator. A new non-secure corridor is to be built from recheck to this new vertical circulation core. The current United BSO and HAS front line staff is impacted by this project and will require temporary relocation. It is possible that the HAS front line staff could be relocated to their permanent location at this time. This location is on Level 93 NW quadrant in the existing CBP computer training room. This work would need to be completed with approval by CBP and without disruption to CBP operations. The installation of the new elevators and escalators will require structural openings in the Level 116 and 93 structural slabs, and other systems-related relocations in this location.

7.3.3 DEMOLITION OF EXISTING SECURE CONCESSIONS

On Level 116, the first step of the new consolidated security checkpoint requires demolition of the existing secure concessions, including Ruby's Diner and other smaller retail outlets. Once demolished, it will be repurposed as the final secure corridor, and will be replaced with concession kiosks, daylighting by way of skylights or clearstory, and the new ceiling mounted FIDS. This phase does not impact passenger circulation path or either security checkpoints, and could be accomplished with a temporary construction partition between the scope of work and the existing secure concourse pathway.

It is anticipated that the duration for Phase 1 in its entirety will be 12 months. The majority of this time encompasses the construction of the new baggage expansion facility and CBP garage. The interior renovations can be phased anytime within this 12 month period, which may allow the security checkpoint renovations to occur on a fast-track schedule.

Figure 7.4 depicts the expansion and renovation in Phase 2.

7.4 Phase 3

Prior to the start of this phase, the following enabling projects are expected to be complete and operational:

- New CBP parking
- New baggage claim expansion (Level 93) and makeup area (Level 78)
- New non-secure recheck corridor and vertical circulation core at the northwest corner of the facility

7.4.1 CONSOLIDATED CHECKPOINT PHASE 1 AND UNITED ATO (SOUTH)

Starting from the south, the new consolidated checkpoint begins its transformation. The existing Terminal E checkpoint is not impacted by this phase. Six new security lanes are installed with associated infrastructure and shell work. Work on the new domestic exit corridor occurs in this phase. The existing United south ATO area will be reconfigured to its final layout. A 40' secure concourse is maintained throughout this phase and has no impact to either checkpoint. There will be no deterioration to passenger level of service. The existing IDF located between the existing checkpoint and the United south ATO will be relocated at this phase. This is the only IDF impacted throughout the entire construction process. The existing employee entrance will also be relocated to the north ticketing lobby, as it is impacted by this phase of construction.

7.4.2 EXISTING BAGGAGE CLAIM DEMOLITION

The completion of the new baggage claim expansion, including four new units, allows the existing northwest baggage claim unit (#1) to be demolished in its entirety. The structural floor slab will be infilled at the opening and will allow construction to begin on the new consolidated CBP secondary processing area. On Level 74, the removal of this baggage unit will allow for the new baggage screening area within the FIS inbound makeup room.

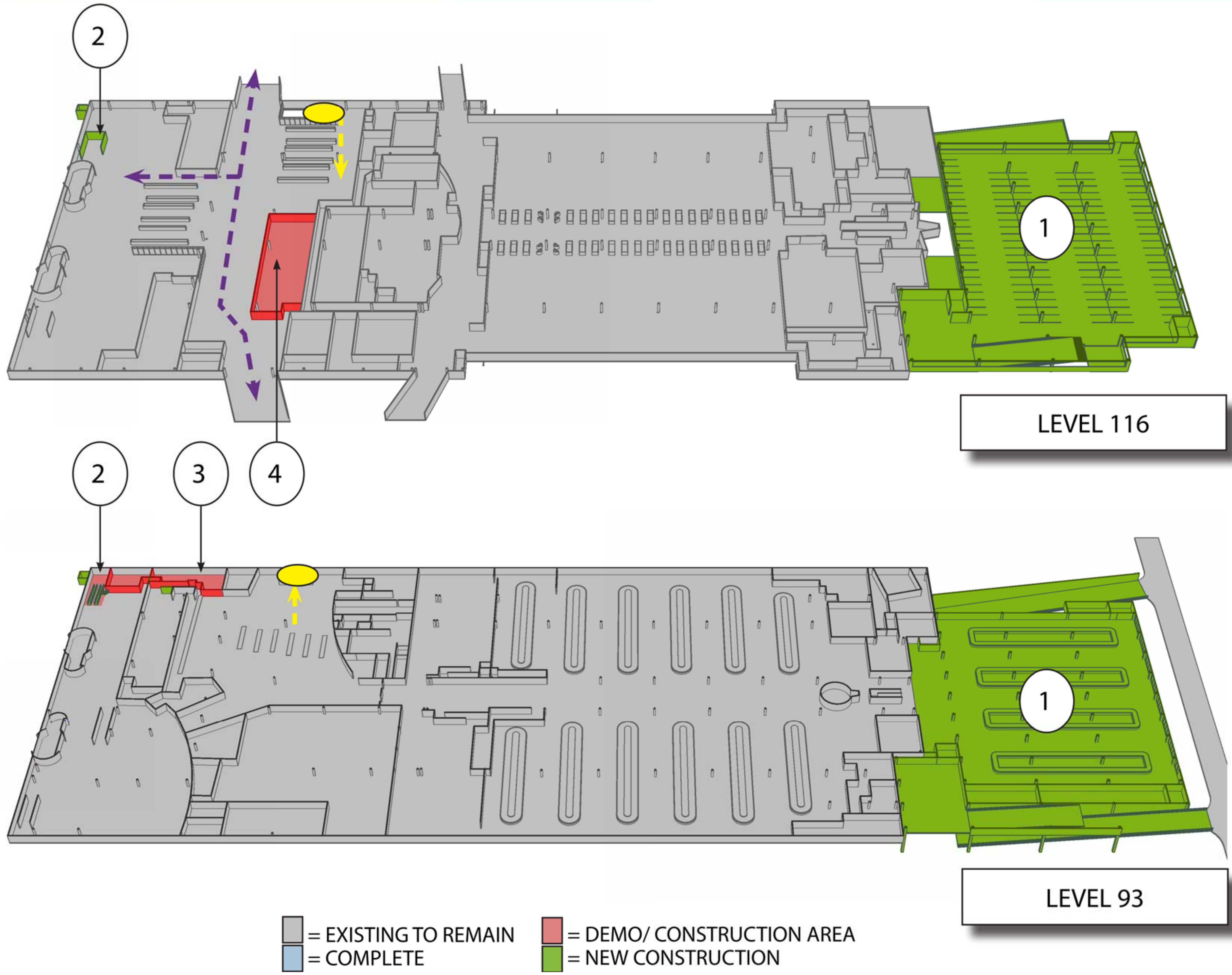
7.4.3 NEW SECONDARY PROCESSING

The removal of the northwest baggage claim carousel will allow for construction of the new consolidated secondary processing area. During this phase, all secondary processing will be consolidated in the existing south processing area. Existing north millwork shall be moved to the south temporarily to avoid disruption in CBP operations or passenger queue wait times. The existing agricultural lab and offices will remain operational and will not be impacted as part of this project. Exit control will remain in its current state during this phase. This phase includes conversion of the existing elevator, located in primary, to operate and open to both directions on Level 93. This will allow for CBP escorts directly from primary above and into the new secondary area. All IDF rooms and other MEP spaces in this area will be maintained to avoid disruption in service.

On the north mezzanine, the addition of plumbing for the new restroom will be finished as part of this phase. No other work is anticipated on the north mezzanine as part of this project.

All employees with workstations or offices within this impacted area will be relocated to the Level 116 northeast office area temporarily. This will allow all employees impacted to maintain offices or workstations thru this construction phase.

Phase - 2



PHASE 2-

EXPANSION:

1. CBP GARAGE UNDER CONSTRUCTION (TUG RAMPS TO BASEMENT TO BE SUBPHASED TO MAINTAIN ACCESS)

RENOVATION:

2. BUILD NEW RECHECK VERTICAL CIRCULATION, INCLUDING CUT SLAB FOR NEW OPENING
3. RECONFIGURE EXISTING BSO FOR NEW RECHECK CORRIDOR
4. DEMO EXISTING SECURE CONCESSIONS

CHECKPOINT LANES:	12
BAGGAGE CLAIMS:	12

= RECHECK CIRCULATION
= SECURE CIRCULATION

7.4.4 ISOLATION PARTITION RELOCATION

With the relocation of secondary processing to a consolidated location on the north side, the south baggage claim used for isolation purposes will be now handled on the north side. To allow for isolation of passengers on these flights, the existing glass partition shall be relocated from the south to the final location on the north as shown on the preferred plans.

In **Figure 7.5**, it is anticipated that Phase 3 will have a total duration of six months, and parts of this phase can start prior to the completion of the new baggage claim expansion.

7.5 Phase 4

Prior to the start of this phase, the following projects are expected to be complete and operational:

- Six new security checkpoint lanes open in the consolidated checkpoint
- New domestic exit corridor at Terminal E
- United south ATO
- Level 93 Secondary processing and referral wait area

7.5.1 RECONFIGURATION OF EXISTING TERMINAL E CHECKPOINT

With the opening of the first six new checkpoint lanes in the consolidated configuration, the existing Terminal E security checkpoint can be reconfigured in its entirety and five new lanes can be installed. The remaining queue area not completed in Phase 3 will be completed in Phase 4.

7.5.2 REMOVE PARTIAL RECHECK SECURITY CHECKPOINT AND RENOVATE SECURE CONCOURSE

In order to maintain a clear secure concourse circulation path, the two furthest south checkpoint lanes from the existing recheck security checkpoint are to be removed and finishes upgraded. This will leave four existing lanes at recheck. When included with the six new consolidated lanes, this will leave 10 available lanes at completion of Phase 4. To mitigate overcrowding of the Recheck checkpoint with only 4 lanes available, passengers can be redirected on Level 93, thru the new recheck corridor and vertical circulation prior to accessing the escalators to the recheck checkpoint during peak times.

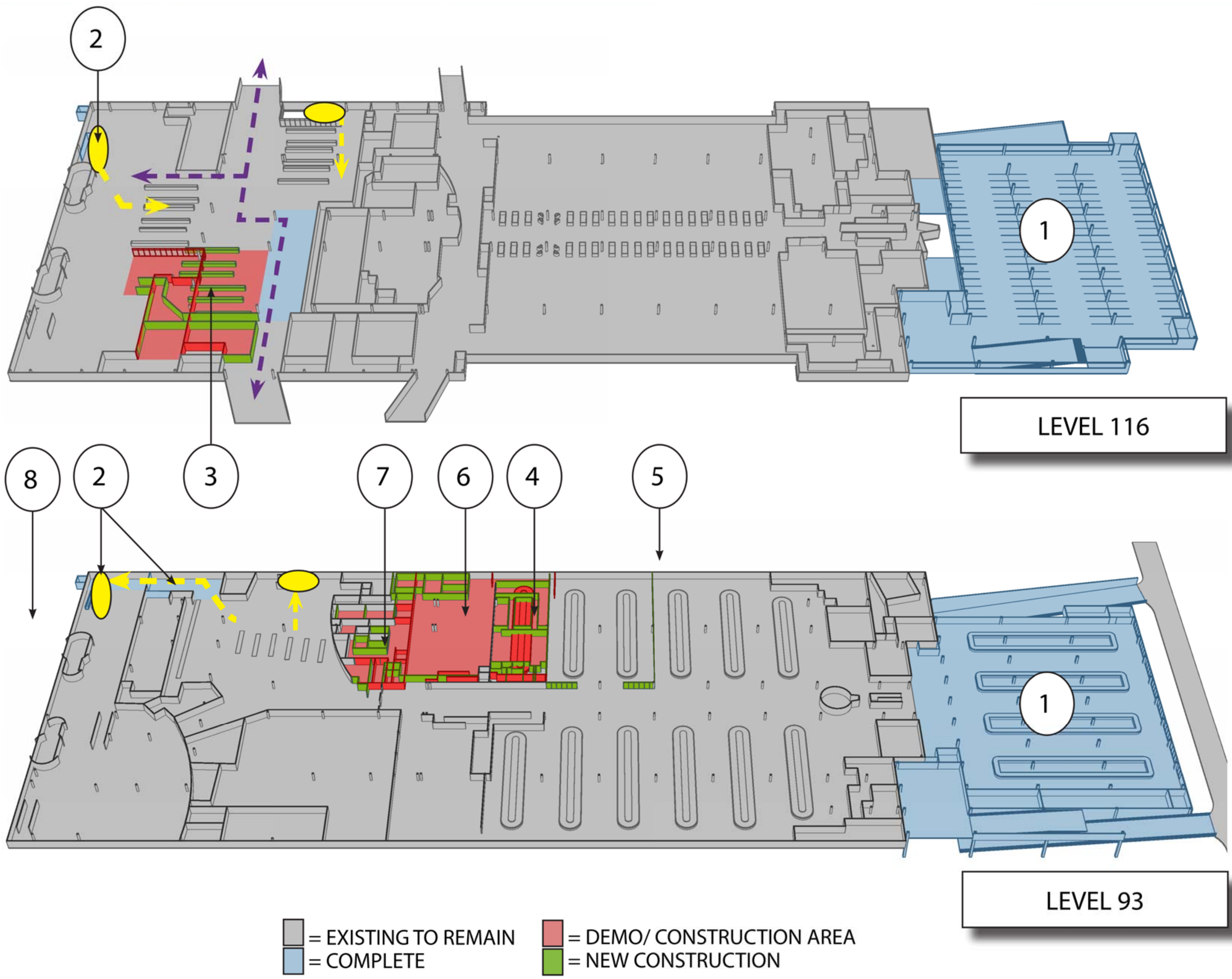
7.5.3 SECONDARY SUPPORT OFFICES AND SOUTH MEZZANINE

With the completion of the new consolidated secondary processing area in Phase 3, the existing south processing area is no longer needed. This area will close in order to start the reconfiguration for the new secondary support area. This area includes the majority of the secondary supervisor offices and CBP staff open workstations. This phase shall encompass the minor renovations to the south mezzanine and the addition of plumbing for the new restroom. This work will have no impact to passengers.

7.5.4 EXIT CONTROL RENOVATION

Currently, HAS is undergoing a small project for additional four exit control positions. This will allow for 12 exit control positions prior to this project's commencement. The preferred plan reconfigures the exit control to include nearly double the amount of queue area to eliminate the issue of passengers backing up thru the baggage claim corridor. It includes 16 exit control positions. In order to maintain existing levels of service, the renovation of the exit control shall occur in mini-phases. This should be easily accomplished since the majority of this work is simply millwork and stanchion relocation.

Phase - 3



PHASE 3-

EXPANSION:

1. NEW BAGGAGE CLAIM & CBP PARKING OPEN

RENOVATION:

2. NEW RECHECK CORRIDOR & VERTICAL CIRCULATION OPEN
3. RECONFIGURE SOUTH UNITED ATO, BUILD NEW CONCOURSE EXIT CORRIDOR & 6 NEW SSCP LANES
4. REMOVE EXISTING NW BAGGAGE CLAIM
5. RELOCATE ISOLATION PARTITION
6. RELOCATE AG & INSPECTION MILLWORK
7. BUILD NEW SECONDARY PROCESSING & REFERRAL WAIT AREA & RECONFIGURE NORTH MEZZANINE
8. NEW EDS SCREENING TO BE BUILT ON LEVEL 78 (AFTER REMOVAL OF NW BAGGAGE UNIT)

CHECKPOINT LANES:	12
BAGGAGE CLAIMS:	15

= RECHECK CIRCULATION
= SECURE CIRCULATION

7.5.5 EXIT DOOR RELOCATION

In order to provide proper separation between cleared passengers and secondary processing, the current sliding doors used to exit the FIS facility will be rebuilt to the west. This relocation shall occur during non-peak hours to minimize disruption to the operation of the facility since there is no other possible exit from the facility, other than thru the existing and new set of sliding doors.

Figure 7.6 depicts the renovations in Phase 4.

7.6 Phase 5

Prior to the beginning of this phase, the following projects are complete and operational:

- Five new checkpoint lanes within the consolidated checkpoint to make a total of 11 lanes
- Final exit control
- Level 93 south secondary processing support offices and south mezzanine

7.6.1 REMOVE EXISTING RECHECK SECURITY CHECKPOINT AND VERTICAL CIRCULATION

This sub-phase removes the remaining recheck security checkpoint and reconfigures to the final secure concourse and concession area. This phase shall be completed prior to removing the escalators to open the secure concourse to its maximum potential sooner. Once this is complete the existing escalators can be removed in their entirety. Structural work will be needed to infill the existing Level 116 floor slab.

7.6.2 COMPLETE CONSOLIDATED CHECKPOINT AND UNITED NORTH ATO

The completion of the consolidated checkpoint's final three lanes will require reconfiguration of the United north ATO area.

7.6.3 NEW BAGGAGE SERVICE OFFICE AND BAG STORAGE

Once the existing escalators are removed, the final baggage service offices can be built on Level 93. This area will be the final location for both the foreign flag carriers and United Airlines. The existing baggage storage will remain, but the existing foreign flag office will be converted to additional bag storage capacity.

7.6.4 RECONFIGURATION OF EXISTING NE CBP OFFICES, COMMAND AND CONTROL

With completion of the Level 93 CBP spaces, the reconfiguration of the existing Level 116 CBP offices and "soft" secondary area can be completed. Other current uses within this space include Chief offices and other support staff. The work of this area shall be completed in sub-phases to allow for movement of staff temporarily during reconstruction. The existing CBP locker rooms, breakrooms, communications room and storage will remain in place and a path shall be maintained for their use during this phase.

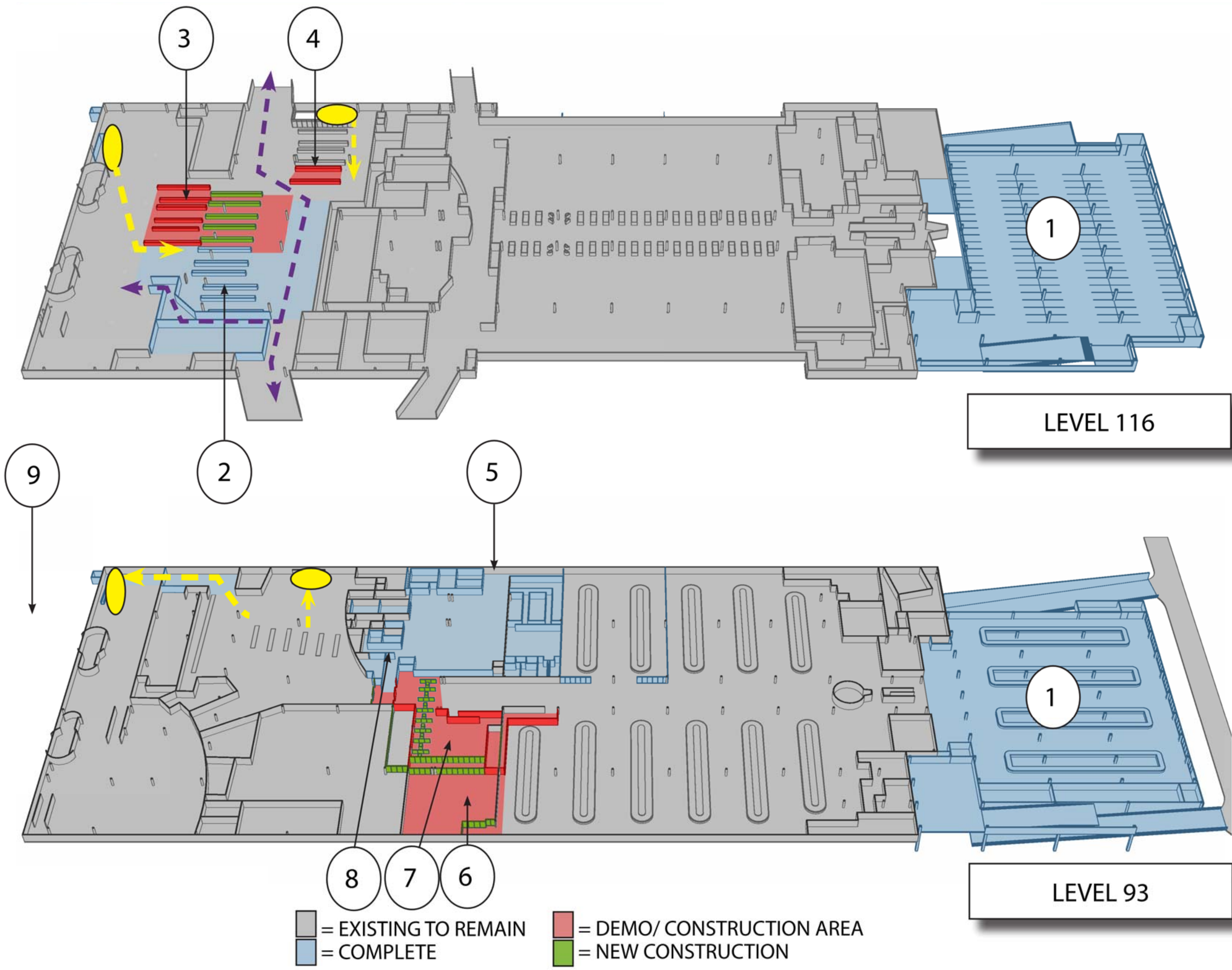
Prior to demolition of the existing command and control center, the new centrally located facility must be built. This new raised platform is constructed within the circulation area between the existing booths. At this location, the new APC verification podiums will be built slightly farther north per the preferred plan. Careful phasing must be considered for this rework to maintain full operation of the facility. The construction of the new command and control center is recommended to be built during off-peak hours to mitigate this issue.

7.6.5 NEW COUNTER TERRORISM SUITE

With the relocation of the secondary referral wait area and secondary processing to Level 93 in Phase 3, the existing secondary referral wait area can be repurposed and renovated as the new counterterrorism suite. This will require minor plumbing work to relocate waiting area restrooms. This sub-phase will allow for the final completion of the south primary processing queue and final location of the APC verification podiums and airline crew processing area. This phase does not require change to the existing IDF room. It is anticipated that the duration for this phase will be approximately three months.

Figure 7.7 depicts the final phase, which is anticipated to have a total duration of three months.

Phase - 4



PHASE 4-

EXPANSION:

1. NONE (COMPLETE)

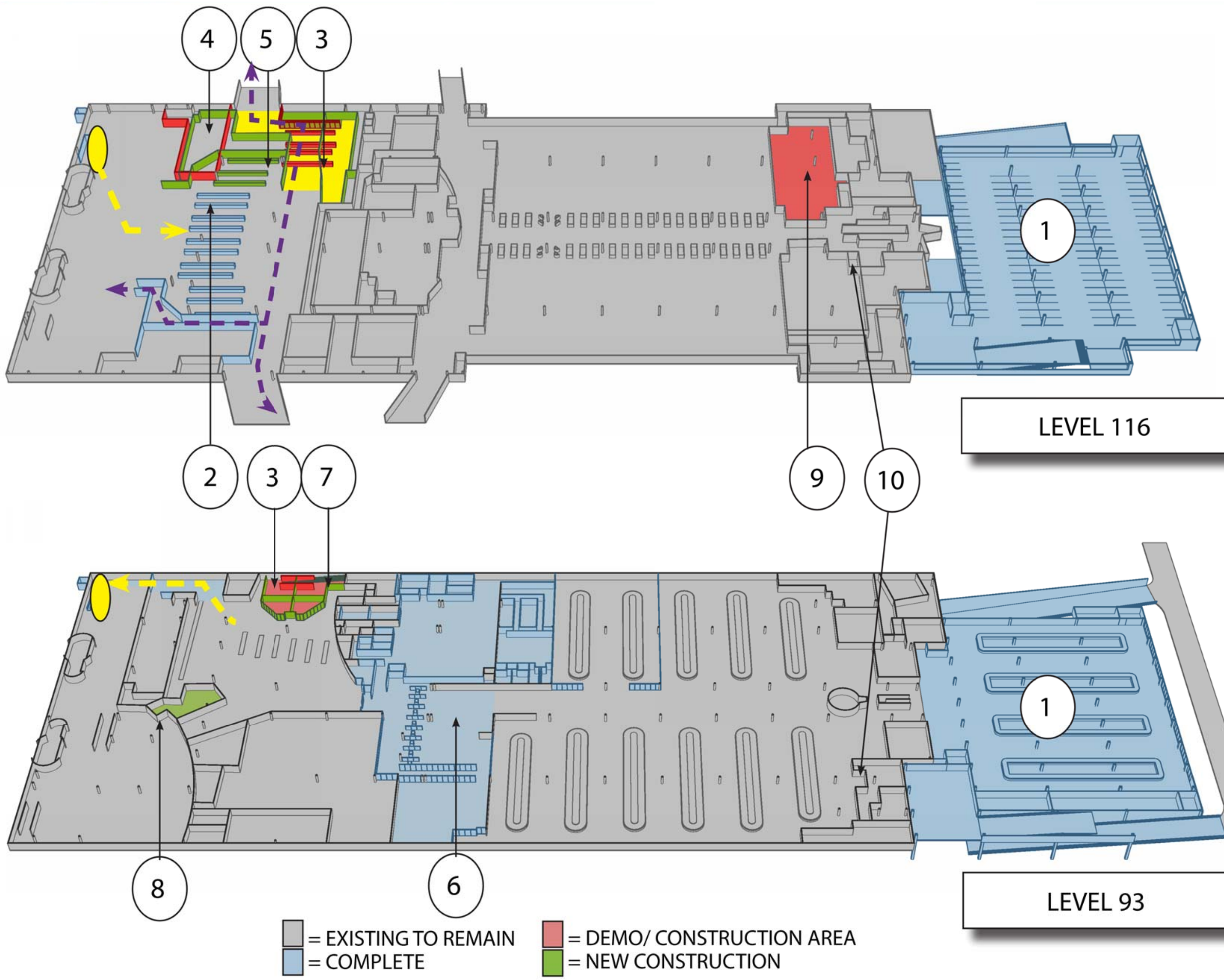
RENOVATION:

2. SOUTH UNITED ATO, NEW CONCOURSE EXIT CORRIDOR & 6 NEW SSCP LANES OPEN
3. DEMO EXISTING TERMINAL E CHECKPOINT & REBUILD 5 NEW LANES
4. DEMO (2) LANES FROM TRANSFER CHECKPOINT AND RENOVATE FOR NEW SECURE CORRIDOR
5. NEW SECONDARY PROCESSING & REFERRAL WAIT AREA OPEN
6. RECONFIGURE NEW SECONDARY SUPPORT OFFICES , HAS OFFICE & SOUTH MEZZANINE
7. REWORK EXIT CONTROL (IN PHASES TO ELIMINATE DEGRADE IN LEVEL OF SERVICE)
8. MOVE EXIT SLIDING DOORS TO WEST
9. NEW EDS BAGGAGE SCREENING OPEN - LEVEL 78

CHECKPOINT LANES:	10
BAGGAGE CLAIMS:	15

= RECHECK CIRCULATION
= SECURE CIRCULATION

Phase - 5



PHASE 5-

EXPANSION:

1. NONE (COMPLETE)

RENOVATION:

2. 5 NEW CHECKPOINT LANES OPEN (TOTAL=11)
3. DEMO EXISTING TRANSFER 71 CHECKPOINT; EXISTING ESCALATORS & INFILL SLAB (INTERIM PHASE TO REMOVE EXISTING LANES + RECONFIGURE CORRIDOR TO ACCOMODATE SECURE CIRCULATION PATH)
4. RECONFIGURE NORTH UNITED ATO
5. BUILD REMAINING CONSOLIDATED CHECKPOINT LANES
6. NEW EXIT CONTROL, SECONDARY SUPPORT OFFICES, HAS OFFICE & S. MEZZANINE OPEN
7. BUILD NEW BSO
8. RECONFIGURE EXISTING BAG STORAGE
9. RECONFIGURE L116 OFFICES (NE)
10. BUILD NEW ELEVATOR CORE

CHECKPOINT LANES:	11
BAGGAGE CLAIMS:	15

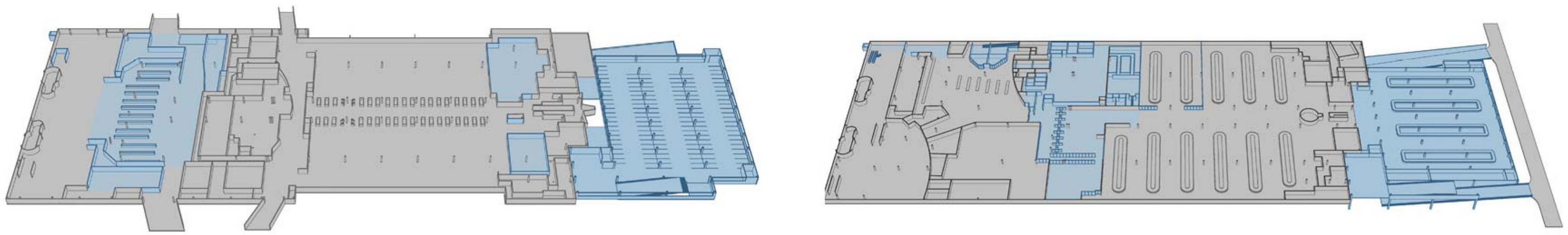
= RECHECK CIRCULATION
= SECURE CIRCULATION

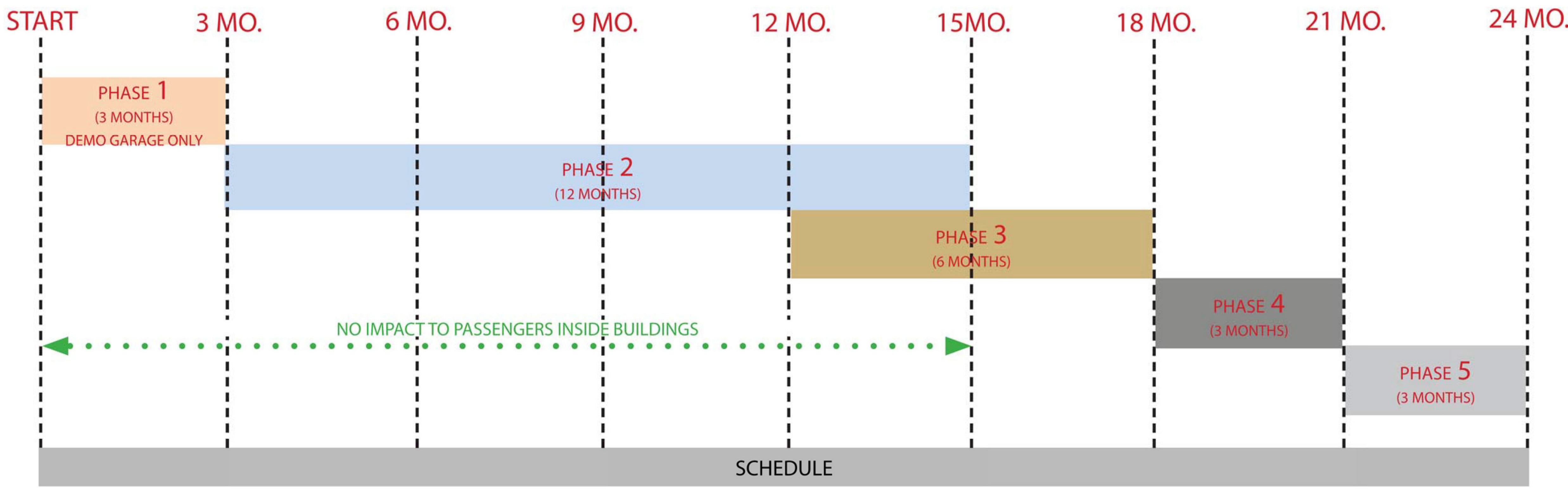
7.7 Phasing Schedule

The total duration of the FIS expansion and renovation project, including the CBP parking, is anticipated to be approximately 24 months. The first 15 months are primarily for the demolition and rebuild of the baggage expansion and CBP parking levels, which will have no impact to passengers within the facility. The remaining nine months include interior renovation of the FIS facility only.

The following tentative schedule is outlined in **Figure 7.8** for the FIS project.

Anticipated Phasing Schedule





Note:
HAS EPM team should validate costs and schedule prior to AE and CMAR solicitation.

FINAL:	
CHECKPOINT LANES:	14
BAGGAGE CLAIMS:	15

Chapter 8 | Program Cost Estimates

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8.0 Program Cost Estimates

This chapter summarizes the Rough Order of Magnitude (ROM) costs for the FIS Facility Renovation and Expansion Program. The scope of work includes the two-story CBP employee garage located above the baggage claim expansion.

8.1 Basis of Estimate & Scope Boundary Plans

This estimate is based upon the scope boundary plan drawings (**Figures 8.1-8.5**) for the FIS Renovation and Expansion Program, dated May 4, 2016. Measurements of quantities were taken from these documents, where possible, and parametric measurements were used in conjunction with references from other airport terminal projects at HAS and comparable terminals in the United States previously estimated by HNTB and Connico.

8.2 Basis of Pricing

The ROM estimates reflect the fair market value for the construction of this project and should not be construed as a prediction of low bid. The unit costs include labor, material and equipment costs plus subcontractors' overhead and profit costs. Costs are based upon 2016 U.S. dollars with escalation to Quarter 1, 2019.

8.2.1 PROCUREMENT METHOD

Pricing assumes a procurement process with competitive bidding for every portion of the construction work. This means that the Construction Manager at Risk (CMAR) will receive a minimum of three competitive bids from all subcontractors and materials/equipment suppliers. If fewer bids are solicited or received, it is anticipated that prices will be higher.

8.2.2 WAGE RATES

This estimate is priced on the basis of union prevailing wage rates.

8.2.3 PHASING

It is assumed that phased construction will not be overly constrained by airport operational constraints; the construction team will have reasonable access to the work area.

8.2.4 ACCESS AND SECURITY

The estimate anticipates that site access will be primarily from the landside and that security requirements will be typical for this scale of project at an active airport facility.

8.3 Escalation

Escalation costs have been included in this study, assuming the mid-point of construction as Quarter 1, 2019. The Program Management team will determine the actual date of construction of the FIS program as it is developed as part of the larger ITRP project. Construction durations and overall program schedule are based on the preliminary schedule found in the detailed estimate included in **(Appendix to be provided in 100%PDM)**.

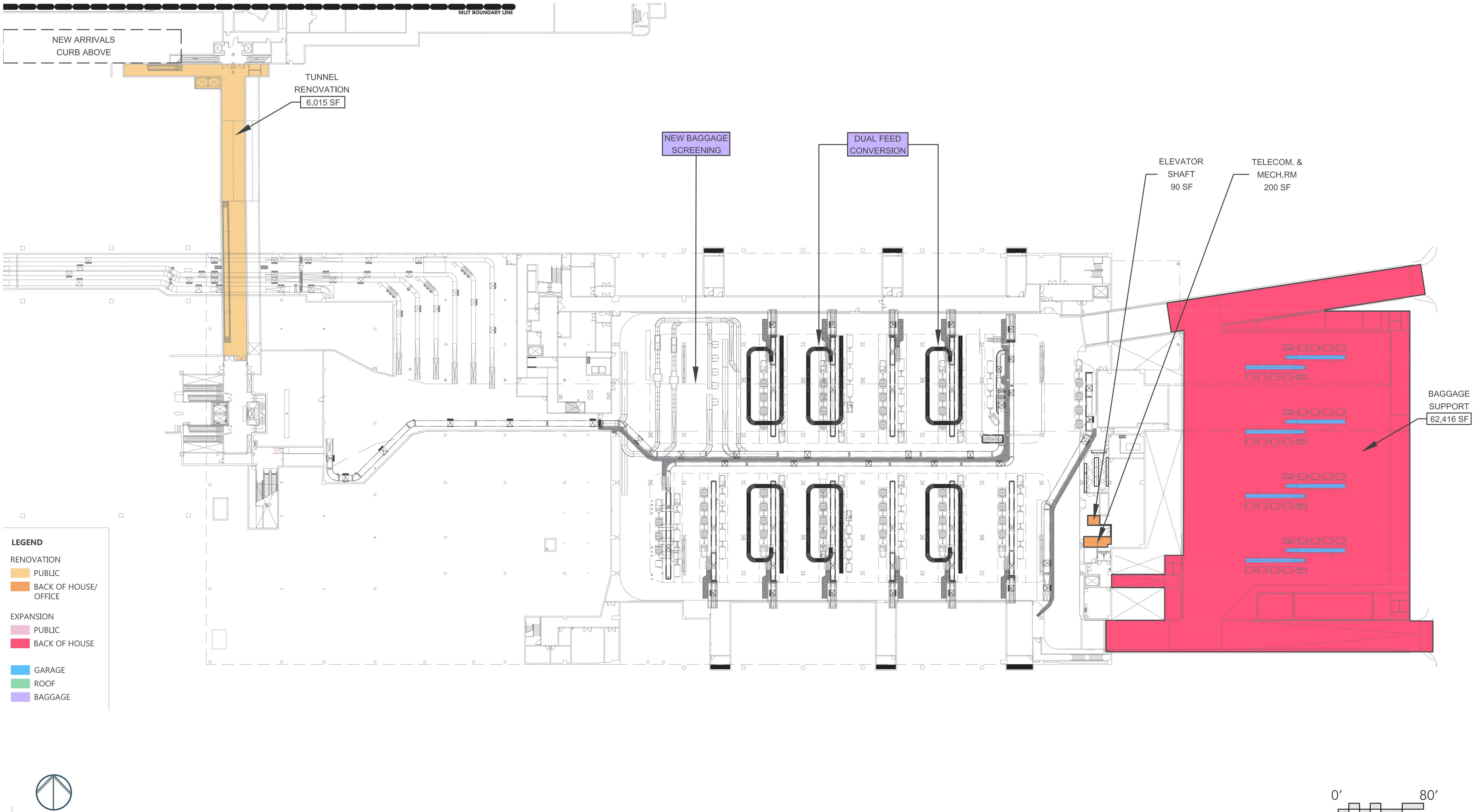
8.4 Mark-Up and Contingency Assumptions

Table 8.1 summarizes the soft costs and contingencies ROM estimate.

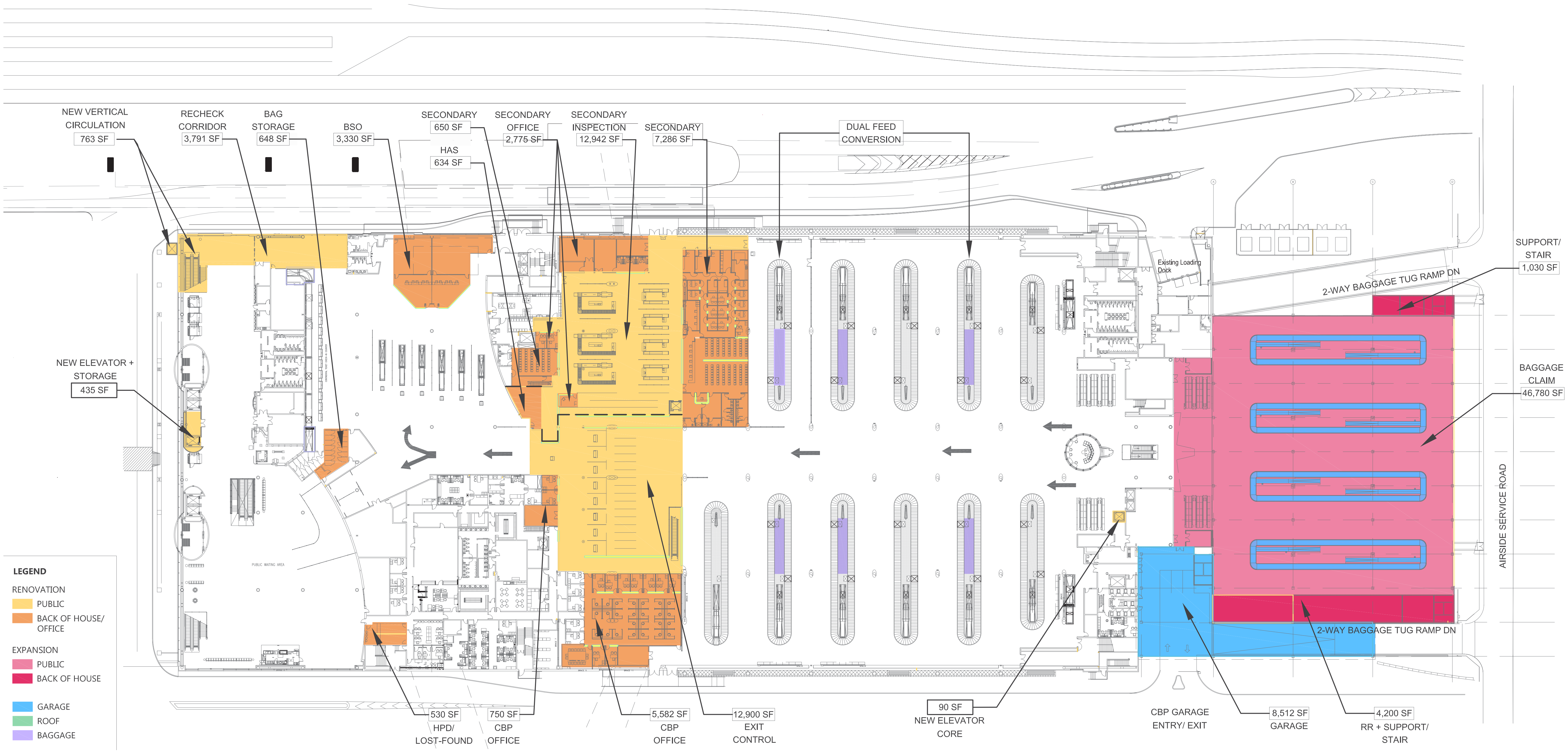
Table 8.1 – Soft Costs and Contingencies

CATEGORY	PERCENTAGE
Architecture / Engineering Fees	10.00%
CMAR General Requirements/ CMAR Fees	10.00%
Insurance	2.25%
Testing	2.00%
Commissioning	2.00%
Public Art	1.75%
Program Management	7.75%
Planning	1.00%
Administrative Fees	1.00%
TOTAL SOFT COSTS	37.75%
PROGRAM CONTINGENCY	30.00%

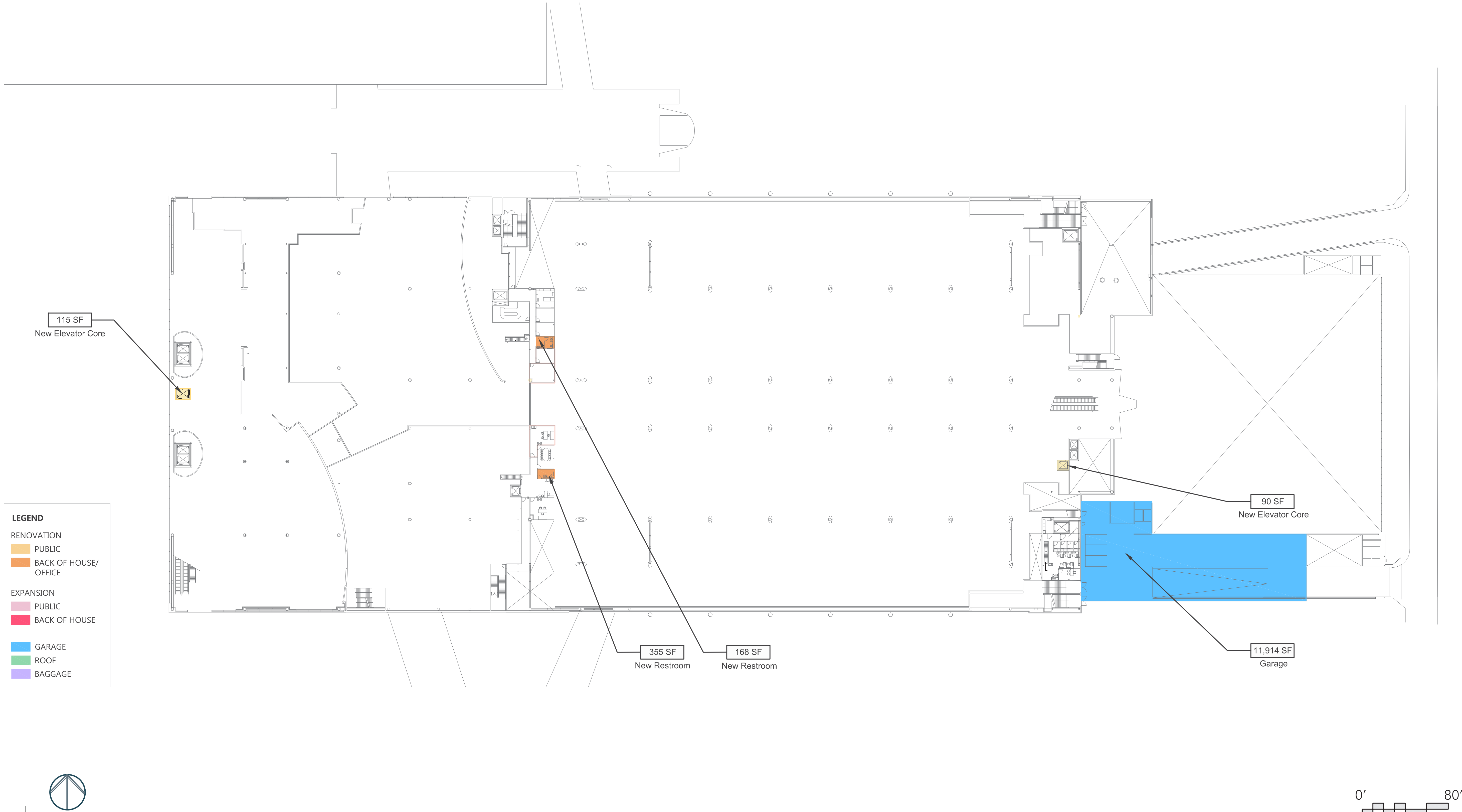
Scope Boundary Plan - Level 78



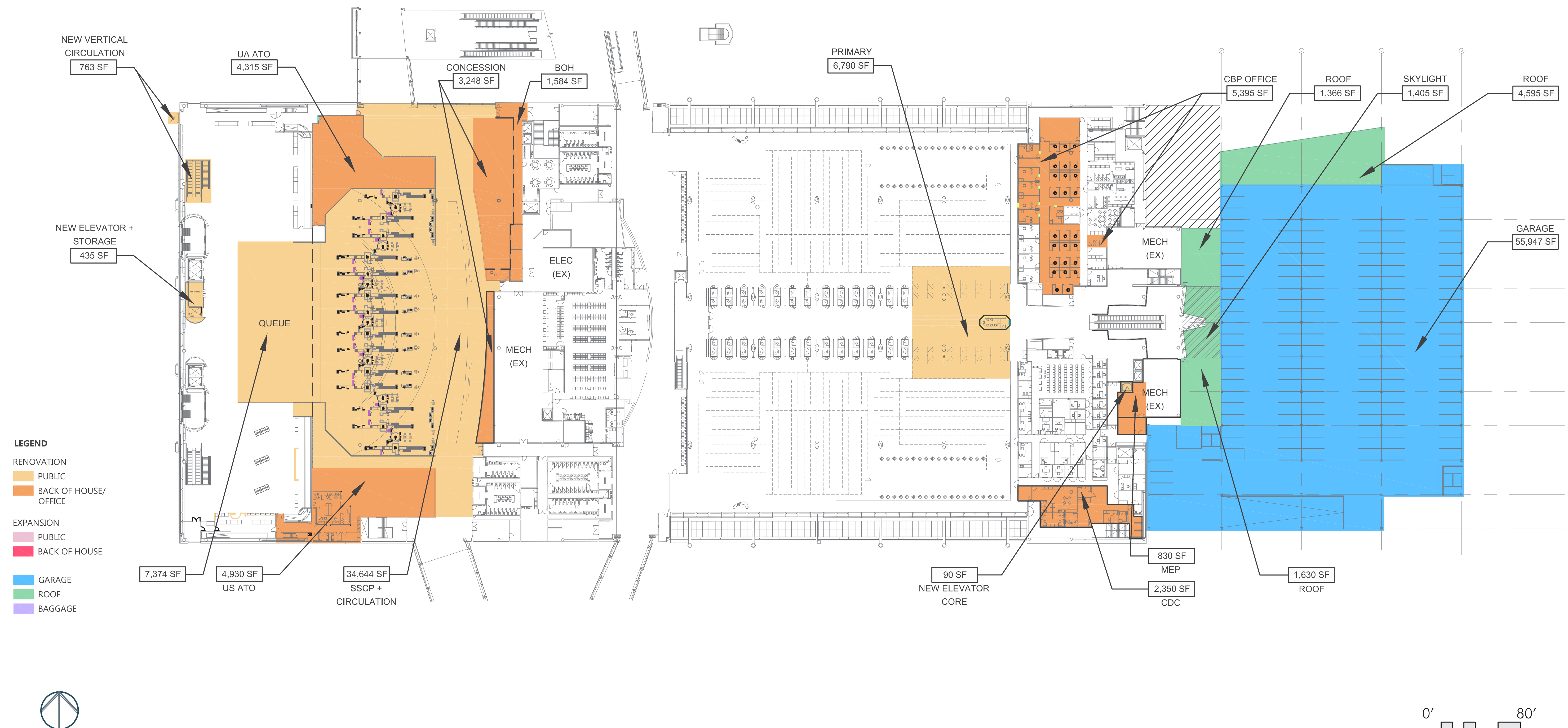
Scope Boundary Plan - Level 93



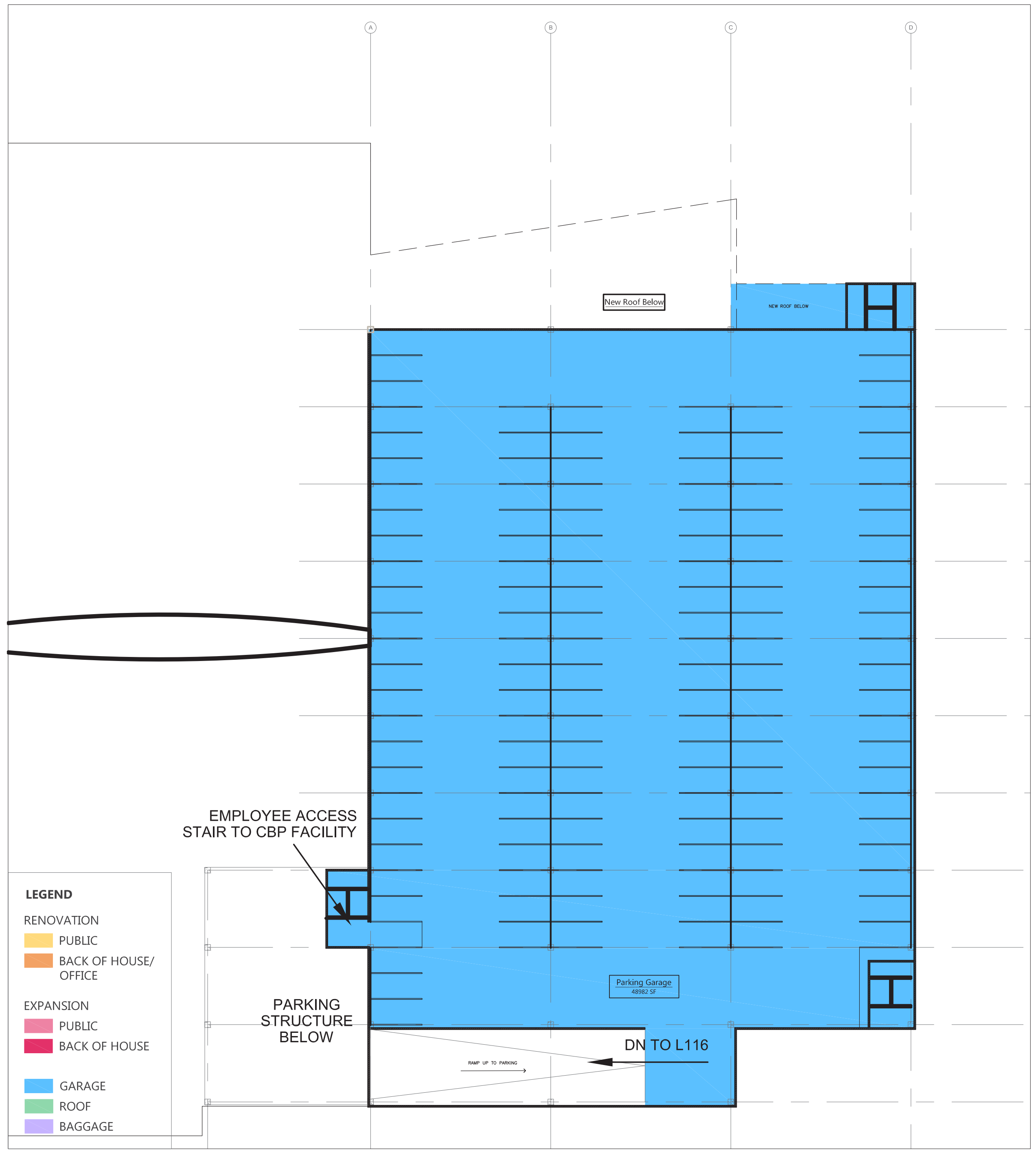
Scope Boundary Plan - Level 105



Scope Boundary Plan - Level 116



Scope Boundary Plan - Level 127



0′ 50′

8.5 Statement of Probable Cost of Construction

The ROM estimates are based upon 2016 U.S. Dollars. The consultant team has many years of experience providing cost consulting services in the aviation construction industry. Historically, the deviation between construction estimates and the corresponding bid amounts is minimal. The consultant team has no control over the method of determining prices adopted by any individual general contractor, subcontractor or supplier. The consultant team cannot control the cost of labor and materials, the bidding environment or other market conditions, and it is not possible to provide any guarantee that proposals, bids or actual construction costs will not deviate from this or subsequent cost estimates.

The consultant team has prepared this estimate in accordance with widely accepted principles and practices to reflect the fair market value of the project. This estimate is made on the basis of the experience, qualifications and the best judgment of professional consultants who have gained an expertise in the aviation construction industry.

8.6 Project Scope Clarifications

The following assumptions have been made in regard to this project:

8.6.1 FOUNDATIONS

Foundations will be drilled piers with pier caps and grade beams.

8.6.2 BASEMENT CONSTRUCTION

The project includes a basement that houses the baggage makeup area. For purposes of pricing, this is assumed to be a cast-in-place structure.

8.6.3 SUPERSTRUCTURE

For purposes of pricing, the superstructure will be structural steel with cast-in-place concrete floor slabs metal deck. The parking levels and vertical ramps shall be cast-in-place concrete.

8.6.4 EXTERIOR ENCLOSURE

Exterior enclosure is assumed to be a combination of curtain wall, metal panels and concrete masonry (CMU). There will be no public entrances to the facility on the exterior. Exterior materials will complement the existing FIS structure.

8.6.5 INTERIOR CONSTRUCTION

Interior partitions are considered metal framing with drywall, with large areas of interior glass walls.

8.6.6 STAIRS

Stairs are considered metal pan with concrete infill at non-public areas.

8.6.7 INTERIOR FINISHES

Passenger areas are assumed to have terrazzo flooring (or similar material), glass partitions and guardrails, and other wall finishes of durable materials, and high end ceilings. All public area finishes are to meet or exceed current HAS finish standards. Back-of-house areas are assumed to include areas with carpet tile (or similar) flooring, painted gypsum board walls and acoustical ceilings, and other areas with sealed concrete floors, painted CMU walls and painted exposed-structure ceilings.

Concessions and clubs spaces have been estimated as shell construction. Future tenants will provide interior design and construction of these spaces under separate leases, agreements and permits. Cost for reconfiguration of airline spaces and their fit-out are included in the cost estimate.

8.6.8 CONVEYING SYSTEMS

Conveying systems include elevators and escalators. The costs for these systems are represented parametrically based on similar programs (dollars per square foot). There are no moving walkways anticipated in this project.

8.6.9 PLUMBING

Plumbing costs are represented parametrically based on similar programs (dollars per square foot).

8.6.10 HVAC

HVAC costs are represented parametrically based on similar programs (dollars per square foot).

8.6.11 FIRE PROTECTION

Fire protection costs are represented parametrically based on similar programs (dollars per square foot).

8.6.12 ELECTRICAL

Electrical costs are represented parametrically based on similar programs (dollars per square foot).

8.6.13 SERVICES

Services include fire alarms, telephone/data networks and systems and equipment, access control, CCTV, EVIDS, and paging, public address, and master clock systems. The costs for these systems are represented parametrically based on similar programs (dollars per square foot).

8.6.14 EQUIPMENT

Equipment includes baggage handling systems. The costs for these systems are represented parametrically based on similar programs (dollars per square foot).

8.6.15 FURNISHINGS

Furnishings include transaction millwork counters and other fixed furnishings, public seating, and other moveable furnishings. The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.6.16 DEMOLITION

Demolition costs are for the phased demolition of the existing CBP garage. One airside vehicular ramp from the airside service road to the existing basement must be maintained throughout construction. Site demolition is covered in the sitework costs. The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.6.17 AIRSIDE SITEWORK

There is only minimal airside work that pertains to the connection of the basement tug ramps to the airside service road. No aircraft apron is impacted as part of this project.

8.6.18 UTILITY ENABLING PROJECTS

Utility enabling projects include electrical, fire and domestic water, chilled/heating water, aviation fuel, environmental lift stations and sanitary sewers.

8.6.19 OTHER ENABLING PROJECTS

Other enabling projects include:

- Temporary relocations during construction (multiple phases)
- Temporary relocation of CBP parking to existing C/E garage.
- Hoteling space for staff during construction (multiple phases including airline ATO and baggage offices. This program includes fit-out of these spaces on temporary and permanent basis.)
- Additional enabling projects, which are not yet defined

8.7 Exclusions

This estimate specifically excludes the following items:

- Any non-competitive bid or restrictive contract conditions
- Feasibility and financing costs
- Land acquisition and real estate fees
- Owner-furnished items and owner move-in costs
- TSA and CBP provided equipment and furnishings
- Items marked on plans as N.I.C. (Not in Contract)
- Furniture and equipment beyond that listed in the narrative
- Hazardous waste remediation

Appendix A

International Flight Schedules

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Appendix A - International Flight Schedules

International Arrivals Schedule – PAL 33

TABLE 1 OF 7

STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	5:15	183	85%	18%	E18
I	UA	GIG	RIO DE JANEIRO INTERNATIONAL APT	5:20	235	83%	27%	E4
I	UA	BOG	CENTRAL AMERICA	5:24	160	94%	31%	E22
I	UA	LOS	LAGOS	5:25	276	82%	78%	E7
I	UA	TGU	CENTRAL AMERICA	5:26	185	90%	24%	E23
I	UA	GIG	RIO DE JANEIRO INTERNATIONAL APT	5:30	235	83%	27%	E20
I	UA	BOG	CENTRAL AMERICA	5:40	157	94%	31%	E1
I	UA	POS	CARIBBEAN	5:40	149	69%	33%	E10B
I	UA	EZE	BUENOS AIRES MINISTRO PISTARINI	6:15	174	84%	13%	E8
I	UA	ACA	MEXICO	6:20	157	89%	18%	E11
I	UA	SJD	MEXICO	6:20	124	73%	29%	C26
I	UA	LIM	SOUTH AMERICA	6:24	183	88%	8%	E12
I	XX	POS	CARIBBEAN	6:30	157	85%	85%	D15A
I	UA	GYE	SOUTH AMERICA	6:30	242	81%	57%	E15A
I	1H	LAD	AFRICA	6:40	189	82%	95%	D12
I	UA	SCL	SOUTH AMERICA	7:01	160	81%	57%	C25
I	UA	GUA	CENTRAL AMERICA	7:40	157	80%	22%	E22
I	UA	MTY	MEXICO	7:44	50	74%	33%	E24
I	AM	MTY	MEXICO	7:45	99	85%	99%	D15B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	7:48	242	84%	52%	E2A
I	UA	MBJ	CARIBBEAN	7:48	154	93%	31%	C24
I	UA	SLW	MEXICO	8:03	242	63%	3%	E5A
I	UA	CUN	MEXICO	8:04	160	91%	27%	D2
I	UA	QRO	MEXICO	8:14	82	80%	21%	E18
I	UA	LIR	CENTRAL AMERICA	8:30	157	81%	24%	E8A
I	UA	AGU	MEXICO	8:31	50	91%	22%	E24
I	UA	MTY	MEXICO	8:35	118	74%	35%	E9
I	KE	ICN	SEOUL INCHEON INTERNATIONAL APT	8:40	301	85%	85%	D9

International Arrivals Schedule – PAL 33

STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	UA	DGO	MEXICO	8:40	82	83%	14%	D1A
I	UA	TAM	MEXICO	8:41	120	82%	33%	C26
I	UA	TAM	MEXICO	8:41	50	82%	27%	D1B
I	UA	SLW	MEXICO	8:42	82	63%	27%	D3A
I	UA	TRC	MEXICO	8:42	120	84%	42%	D5
I	UA	SLP	MEXICO	8:48	50	86%	18%	D3B
I	UA	GDL	MEXICO	8:54	50	88%	22%	D6A
I	UA	PBC	MEXICO	8:59	50	83%	15%	D6B
I	UA	MZT	MEXICO	9:00	160	72%	14%	E1
I	UA	MTY	MEXICO	9:00	160	74%	35%	E11
I	UA	VER	MEXICO	9:05	82	85%	27%	D4A
I	UA	VSA	MEXICO	9:05	82	78%	30%	D4B
I	UA	BJX	MEXICO	9:10	154	89%	22%	E21
I	XX	CUU	MEXICO	9:10	124	85%	85%	D15A
I	XX	SLP	MEXICO	9:10	157	85%	85%	D10A
I	UA	AGU	MEXICO	9:10	124	91%	22%	E15B
I	JL	NRT	TOKYO NARITA APT	9:15	313	85%	85%	D14
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	9:15	120	84%	52%	E23
I	UA	MID	MEXICO	9:19	154	74%	14%	E12A
I	UA	GCM	CARIBBEAN	9:20	76	85%	30%	C24
I	UA	POS	CARIBBEAN	9:20	157	69%	33%	E14
I	UA	MLM	MEXICO	9:20	242	92%	13%	E18
I	UA	SAL	CENTRAL AMERICA	9:40	157	88%	45%	E22
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	9:40	120	84%	52%	E10B
I	UA	GUA	CENTRAL AMERICA	9:40	124	80%	22%	E16
I	UA	VSA	MEXICO	9:45	50	78%	30%	D1A
I	UA	LIM	SOUTH AMERICA	9:50	157	88%	8%	E5B
I	XX	GUA	CENTRAL AMERICA	10:00	124	85%	85%	D15B
I	UA	GDL	MEXICO	10:02	50	88%	22%	E4
I	UA	MTY	MEXICO	10:04	108	74%	35%	E24

International Arrivals Schedule – PAL 33

STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	UA	MTY	MEXICO	10:04	120	74%	35%	E19
I	UA	MTY	MEXICO	10:10	50	74%	33%	D1B
I	UA	OAX	MEXICO	10:10	50	88%	27%	D6B
I	UA	MTY	MEXICO	10:12	124	74%	35%	E9
I	UA	GUA	CENTRAL AMERICA	10:14	154	80%	22%	E20A
I	UA	GUA	CENTRAL AMERICA	10:14	300	80%	22%	D3
I	UA	CUU	MEXICO	10:15	50	64%	22%	D6A
I	UA	SAL	CENTRAL AMERICA	10:17	152	88%	45%	E2B
I	UA	UIO	SOUTH AMERICA	10:20	149	86%	57%	E8A
I	UA	MTY	MEXICO	10:20	120	74%	35%	E3
I	UA	MGA	CENTRAL AMERICA	10:20	124	82%	17%	E6
I	UA	LIR	CENTRAL AMERICA	10:30	185	81%	24%	E1
I	UA	CME	MEXICO	10:40	157	60%	47%	E21
I	UA	ZIH	MEXICO	10:40	68	74%	18%	E12A
I	UA	LIR	CENTRAL AMERICA	10:40	185	81%	24%	E14
I	UA	MZT	MEXICO	10:50	99	73%	27%	C24
I	UA	GDL	MEXICO	10:57	124	89%	25%	E22
I	UA	TAM	MEXICO	11:00	68	82%	27%	E15B
I	UA	LIR	CENTRAL AMERICA	11:08	235	81%	24%	E4
I	UA	SAP	CENTRAL AMERICA	11:10	154	93%	27%	E18
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	11:10	68	93%	27%	E11
I	CA	PEK	BEIJING CAPITAL APT	11:15	313	82%	85%	D12
I	UA	BJX	MEXICO	11:20	50	88%	23%	D1A
I	UA	DGO	MEXICO	11:20	68	83%	14%	D1B
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	11:20	68	93%	27%	D6A
I	UA	CUN	MEXICO	11:21	154	91%	27%	E7
I	UA	UIO	SOUTH AMERICA	11:25	124	86%	57%	E5B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	11:27	154	84%	52%	E16
I	UA	MGA	CENTRAL AMERICA	11:27	118	82%	17%	E12A
I	UA	UIO	SOUTH AMERICA	11:30	157	86%	57%	E17

International Arrivals Schedule – PAL 33								
STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	UA	UIO	SOUTH AMERICA	11:40	149	86%	57%	E1
I	UA	POS	CARIBBEAN	11:40	157	69%	33%	E8A
I	UA	UIO	SOUTH AMERICA	11:44	124	86%	57%	E9
I	UA	TGU	CENTRAL AMERICA	11:50	124	90%	24%	E21
I	UA	SJO	CENTRAL AMERICA	11:50	160	92%	19%	E20A
I	UA	TGU	CENTRAL AMERICA	11:50	157	90%	24%	C26
I	UA	GYE	SOUTH AMERICA	11:59	144	81%	57%	C25
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	12:02	157	85%	18%	C24
I	UA	AMS	AMSTERDAM	12:07	124	80%	71%	D3A
I	UA	PBC	MEXICO	12:10	185	83%	27%	D3B
I	UA	QRO	MEXICO	12:10	68	80%	21%	E24
I	UA	POS	CARIBBEAN	12:10	157	69%	33%	E3
I	UA	LIR	CENTRAL AMERICA	12:20	185	81%	24%	E2B
I	AM	MEX	MEXICO CITY BENITO JUAREZ INTL APT	12:22	99	84%	99%	D11B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	12:27	157	84%	52%	E23
I	UA	DGO	MEXICO	12:28	68	83%	14%	E11
I	UA	MTY	MEXICO	12:32	50	74%	33%	E15B
I	UA	SLW	MEXICO	12:32	66	85%	30%	D5
I	UA	POS	CARIBBEAN	12:50	157	69%	33%	E5B
I	UA	MBJ	CARIBBEAN	12:50	185	93%	31%	E6
I	UA	POS	CARIBBEAN	12:53	124	69%	33%	E14
I	UA	BOG	CENTRAL AMERICA	13:00	160	94%	31%	E17
I	UA	GCM	CARIBBEAN	13:00	124	86%	44%	E22
I	UA	TRC	MEXICO	13:01	50	84%	57%	E24
I	KL	AMS	AMSTERDAM	13:05	270	81%	99%	D14
I	UA	CUN	MEXICO	13:10	124	91%	27%	E21
I	UA	MTY	MEXICO	13:11	120	74%	35%	E1
I	UA	CCS	SOUTH AMERICA	13:11	154	70%	27%	D2
I	TA	SAL	CENTRAL AMERICA	13:12	96	88%	98%	D8A

International Arrivals Schedule – PAL 33

STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	13:12	50	84%	49%	E20A
I	UA	SLP	MEXICO	13:13	50	86%	18%	E8A
I	UA	BZE	SOUTH AMERICA	13:20	157	73%	23%	E10B
I	UA	CUU	MEXICO	13:23	50	64%	22%	E19
I	UA	NRT	TOKYO NARITA APT	13:30	276	82%	65%	E18
I	XX	LHR	LONDON HEATHROW APT	13:30	313	85%	85%	D9
I	UA	SAP	CENTRAL AMERICA	13:36	152	93%	27%	D5
I	UA	BJX	MEXICO	13:45	50	88%	23%	E11
I	UA	NRT	TOKYO NARITA APT	13:45	276	82%	65%	E4
I	UA	CDG	PARIS CHARLES DE GAULLE APT	13:50	235	80%	69%	E7
I	LH	FRA	FRANKFURT INTERNATIONAL APT	13:50	526	85%	65%	D10
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	13:51	185	93%	27%	D6A
I	UA	GDL	MEXICO	13:51	124	89%	25%	D6B
I	AF	CDG	PARIS CHARLES DE GAULLE APT	13:55	303	80%	97%	D15
I	XX	NRT	TOKYO NARITA APT	14:00	313	85%	85%	D12
I	UA	RTB	CENTRAL AMERICA	14:00	124	74%	28%	D1A
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	14:02	157	93%	27%	D4A
I	SQ	DME	MOSCOW DOMODEDOVO APT	14:05	278	70%	92%	D7
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	14:05	276	84%	52%	E2A
I	UA	VER	MEXICO	14:06	50	85%	27%	E24
I	UA	TLC	MEXICO	14:09	50	86%	27%	D1B
I	UA	FRA	FRANKFURT INTERNATIONAL APT	14:15	124	85%	81%	E22
I	UA	MLM	MEXICO	14:19	50	92%	27%	E1
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	14:20	68	84%	49%	D3B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	14:22	120	84%	52%	D4B
I	UA	PVR	MEXICO	14:28	50	90%	27%	D3A
I	UA	PVR	MEXICO	14:30	185	90%	19%	E21
I	UA	AMS	AMSTERDAM	14:30	235	80%	71%	E20
I	UA	CZM	MEXICO	14:30	235	86%	31%	E8
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	14:30	276	85%	18%	E5A

International Arrivals Schedule – PAL 33

STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	UA	NBO	NAIROBI JOMO KENYATTA INTERNATIONAL APT	14:30	242	81%	57%	E12
I	BA	LHR	LONDON HEATHROW APT	14:35	299	83%	97%	D8
I	UA	HND	TOKYO HANEDA APT	14:35	235	82%	57%	E15A
I	UA	VSA	MEXICO	14:37	50	78%	30%	D11B
I	UA	CUN	MEXICO	14:41	173	91%	27%	E17
I	UA	GDL	MEXICO	14:41	124	89%	25%	C26
I	UA	CME	MEXICO	14:42	242	60%	47%	E10A
I	UA	GDL	MEXICO	14:44	157	89%	25%	E23
I	SK	CPH	COPENHAGEN APT	14:57	260	85%	85%	D13A
I	UA	BZE	SOUTH AMERICA	15:02	118	73%	23%	C24
I	UA	MZT	MEXICO	15:02	99	73%	27%	D4A
I	UA	ZIH	MEXICO	15:08	68	74%	18%	E24
I	UA	LHR	LONDON HEATHROW APT	15:10	242	83%	27%	D2
I	UA	GUA	CENTRAL AMERICA	15:20	149	80%	22%	E22
I	UA	MBJ	CARIBBEAN	15:27	149	93%	31%	C25
I	UA	CCS	SOUTH AMERICA	15:30	124	70%	27%	D4B
I	UA	SJO	CENTRAL AMERICA	15:30	157	92%	19%	New4
I	UA	LHR	LONDON HEATHROW APT	15:31	242	83%	27%	D5
I	UA	SAP	CENTRAL AMERICA	15:33	154	93%	27%	New9
I	CA	PEK	BEIJING CAPITAL APT	15:40	311	82%	85%	D14
I	UA	SJO	CENTRAL AMERICA	15:50	235	92%	19%	D1
I	UA	TRC	MEXICO	15:50	157	84%	42%	E1
I	UA	CUN	MEXICO	15:50	157	91%	27%	D3B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	15:54	50	84%	49%	E24
I	UA	MTY	MEXICO	15:55	50	74%	33%	D6B
I	UA	CUN	MEXICO	16:09	124	91%	27%	E17
I	UA	GUA	CENTRAL AMERICA	16:10	157	80%	22%	E12A
I	UA	MGA	CENTRAL AMERICA	16:10	124	82%	17%	E14
I	UA	QRO	MEXICO	16:10	50	80%	21%	New7
I	UA	CUN	MEXICO	16:19	152	91%	27%	E23

International Arrivals Schedule – PAL 33								
STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	EK	DXB	DUBAI	16:25	497	68%	81%	D11
I	UA	DGO	MEXICO	16:28	68	83%	14%	E2B
I	UA	CAI	CAIRO	16:30	242	81%	57%	E18
I	UA	MTY	MEXICO	16:30	50	74%	33%	E3
I	UA	SIN	SINGAPORE CHANGI APT	16:30	242	81%	91%	E7
I	UA	MGA	CENTRAL AMERICA	16:35	118	82%	17%	C24
I	UA	SJO	CENTRAL AMERICA	16:36	124	92%	19%	D3A
I	XX	SJO	CENTRAL AMERICA	16:36	160	85%	85%	D9A
I	UA	RTB	CENTRAL AMERICA	16:39	124	74%	28%	E8A
I	UA	MBJ	CARIBBEAN	16:39	154	93%	31%	E9
I	UA	GDL	MEXICO	16:39	50	88%	22%	E24
I	UA	MZT	MEXICO	16:41	50	72%	14%	E19
I	XX	CZM	MEXICO	16:41	124	85%	85%	D9B
I	UA	GIG	RIO DE JANEIRO INTERNATIONAL APT	16:43	149	83%	27%	D6A
I	UA	SAL	CENTRAL AMERICA	16:45	154	88%	45%	D6B
I	QR	DOH	DOHA	16:45	500	81%	65%	D13
I	AM	MTY	MEXICO	16:45	99	85%	99%	D15A
I	UA	JNB	JOHANNESBURG JAN SMUTS APT	16:45	242	81%	57%	E10A
I	UA	MGA	CENTRAL AMERICA	16:50	149	82%	17%	D4A
I	UA	LIR	CENTRAL AMERICA	16:57	173	81%	24%	D8B
I	UA	MGA	CENTRAL AMERICA	17:00	157	82%	17%	E21
I	UA	SJD	MEXICO	17:00	154	73%	29%	C26
I	AM	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:00	99	84%	99%	D10A
I	UA	MGA	CENTRAL AMERICA	17:00	157	82%	17%	D15B
I	XX	RTB	CENTRAL AMERICA	17:02	124	85%	85%	D10B
I	UA	ZIH	MEXICO	17:03	50	74%	18%	E20A
I	XX	BJX	MEXICO	17:09	154	85%	85%	D8A
I	UA	AGU	MEXICO	17:10	124	91%	22%	D2
I	UA	CUN	MEXICO	17:18	154	91%	27%	New9
I	UA	ACA	MEXICO	17:20	99	89%	27%	D14

International Arrivals Schedule – PAL 33

STATUS	OP	AP3L	ORIGIN	STA	SEATS	LF%	O/D %	GATE
I	UA	MDE	SOUTH AMERICA	17:20	242	82%	57%	E4
I	UA	GDL	MEXICO	17:24	50	88%	22%	E24
I	UA	LIR	CENTRAL AMERICA	17:30	242	81%	24%	E15A
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:30	242	84%	52%	E2A
I	UA	PVR	MEXICO	17:33	167	90%	19%	New4
I	UA	SJO	CENTRAL AMERICA	17:38	124	92%	19%	New10
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:38	120	84%	52%	New5
I	UA	BJX	MEXICO	17:40	50	88%	23%	E12A
I	UA	CME	MEXICO	17:50	68	60%	27%	D3B
I	UA	PVR	MEXICO	17:50	185	90%	19%	E23
I	UA	CZM	MEXICO	17:53	154	86%	31%	E1
I	UA	SJD	MEXICO	17:55	50	73%	27%	D7A
I	UA	VSA	MEXICO	18:00	68	78%	30%	E14
I	UA	MTY	MEXICO	18:00	50	74%	33%	D1B
I	UA	SJO	CENTRAL AMERICA	18:02	157	92%	19%	E17
I	UA	GUA	CENTRAL AMERICA	18:04	152	80%	22%	E9
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	18:04	124	93%	27%	D1A
I	UA	FRA	FRANKFURT INTERNATIONAL APT	18:05	235	85%	81%	E20
I	TK	IST	ISTANBUL	18:05	337	82%	85%	D12
I	UA	SJO	CENTRAL AMERICA	18:10	242	92%	19%	E5A
I	UA	RTB	CENTRAL AMERICA	18:20	124	74%	28%	E21
I	UA	GDL	MEXICO	18:20	157	89%	25%	C24
I	BA	LHR	LONDON HEATHROW APT	18:30	299	83%	97%	D15
I	UA	BJX	MEXICO	18:30	68	88%	23%	E24
I	UA	SCL	SOUTH AMERICA	18:40	242	81%	57%	E18
I	UA	AGU	MEXICO	18:42	68	91%	22%	C26
I	XX	CUN	MEXICO	18:42	154	85%	85%	D9B
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	18:45	276	85%	18%	E7
I	UA	TLC	MEXICO	18:55	124	85%	30%	E10B
I	UA	DME	MOSCOW DOMODEDOVO APT	19:00	242	70%	85%	E12

International Arrivals Schedule – PAL 33								
STATUS	**OP**	**AP3L**	**ORIGIN**	**STA**	**SEATS**	**LF%**	**O/D %**	**GATE**
I	UA	UIO	SOUTH AMERICA	19:31	124	86%	57%	E1
I	UA	ACA	MEXICO	19:40	68	88%	18%	E24
I	UA	BZE	SOUTH AMERICA	19:40	157	73%	23%	E23
I	UA	RTB	CENTRAL AMERICA	19:40	157	74%	28%	E22
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	19:49	154	84%	52%	E9
I	UA	MID	MEXICO	19:49	149	74%	14%	E8A
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	19:49	183	84%	52%	E4
I	UA	GDL	MEXICO	19:50	50	88%	22%	E2B
I	UA	BZE	SOUTH AMERICA	19:50	157	73%	23%	E15B
I	UA	GCM	CARIBBEAN	19:50	154	86%	44%	E16
I	UA	BJX	MEXICO	19:55	50	88%	23%	E3
I	UA	SJO	CENTRAL AMERICA	20:13	157	92%	19%	E21
I	AM	MEX	MEXICO CITY BENITO JUAREZ INTL APT	20:14	99	84%	99%	D9B
I	UA	MLM	MEXICO	20:20	50	85%	30%	E5B
I	UA	MTY	MEXICO	20:25	50	74%	33%	E24
I	UA	DGO	MEXICO	21:17	68	83%	14%	E1
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	21:18	50	84%	49%	E17
I	UA	CZM	MEXICO	21:42	118	86%	31%	E23
I	AM	MEX	MEXICO CITY BENITO JUAREZ INTL APT	22:00	99	84%	99%	D12
I	UA	RTB	CENTRAL AMERICA	22:00	154	74%	28%	E22
I	UA	LIM	SOUTH AMERICA	22:13	157	88%	8%	E1
I	UA	SAL	CENTRAL AMERICA	22:20	138	88%	45%	E17
I	UA	CCS	SOUTH AMERICA	22:28	154	70%	27%	E4
I	UA	PBC	MEXICO	23:14	68	83%	15%	E18
I	AM	MEX	MEXICO CITY BENITO JUAREZ INTL APT	23:23	99	84%	99%	D9B
I	UA	ACA	MEXICO	23:50	68	88%	18%	E7
I	UA	MDE	SOUTH AMERICA	23:58	173	82%	57%	E21

Notes:
1/ STA: Estimated Time of Arrival
2/ OP: Operator
3/ AP3LC: IATA standard airport three letter code
5/ Domestic Status: I-International
6/ LF%: Load Factor Percentage
7/ O/D%: Origin/Destination Percentage
Source: Leigh Fisher Associates, Inc., April, 2014
Prepared by: Ricondo & Associates, Inc., July 2015.

International Departures Schedule - PAL 33

TABLE 1 OF 8

STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	MTY	MEXICO	7:10	68	74%	35%	B7-S
I	UA	DGO	MEXICO	7:40	68	82%	12%	B7-S
I	UA	CUU	MEXICO	7:50	68	64%	16%	B26-S
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	7:50	183	85%	18%	E18
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	7:52	50	84%	41%	B4-S
I	UA	MGA	CENTRAL AMERICA	8:00	149	82%	16%	C29
I	UA	UIO	SOUTH AMERICA	8:00	124	86%	44%	C26
I	UA	BOG	CENTRAL AMERICA	8:40	157	94%	31%	E1
I	UA	POS	CARIBBEAN	8:40	157	69%	34%	E11
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	8:45	154	94%	41%	B10
I	UA	MGA	CENTRAL AMERICA	8:50	124	82%	16%	E21
P	UA	YYC	CALGARY	8:50	157	73%	47%	D7A
I	UA	GYE	SOUTH AMERICA	8:50	242	81%	57%	E15A
I	UA	VSA	MEXICO	8:50	50	78%	34%	B9-S
I	UA	SAL	CENTRAL AMERICA	8:50	185	88%	49%	B7
I	UA	CME	MEXICO	8:50	50	60%	47%	D10A
I	UA	CZM	MEXICO	8:51	157	86%	31%	B17
I	UA	CZM	MEXICO	8:51	118	86%	31%	C30
I	UA	SAP	CENTRAL AMERICA	8:52	154	93%	27%	D8A
P	UA	YEG	EDMONTON INTERNATIONAL APT	8:52	185	83%	20%	E23
I	UA	LIR	CENTRAL AMERICA	8:56	173	81%	23%	B34
I	UA	CUU	MEXICO	8:56	50	64%	16%	B20-S
I	UA	LIM	SOUTH AMERICA	8:58	183	88%	8%	E12
I	UA	MBJ	CARIBBEAN	8:58	154	93%	32%	C24
P	UA	YVR	VANCOUVER INTERNATIONAL APT	9:00	149	90%	14%	E10B
P	UA	YYC	CALGARY	9:00	138	73%	47%	B19
I	UA	BJX	MEXICO	9:00	50	88%	23%	B11-S
I	UA	OAX	MEXICO	9:00	124	88%	57%	B20

International Departures Schedule - PAL 33

STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	CUN	MEXICO	9:00	173	91%	27%	B24
I	UA	BZE	SOUTH AMERICA	9:01	157	73%	22%	C36
I	UA	SLW	MEXICO	9:05	242	63%	3%	E5A
I	UA	SJO	CENTRAL AMERICA	9:05	160	92%	20%	C42
I	UA	GUA	CENTRAL AMERICA	9:06	152	80%	18%	B11
I	UA	TRC	MEXICO	9:06	50	84%	57%	B18-S
I	UA	TRC	MEXICO	9:07	124	84%	57%	C34
I	UA	SJO	CENTRAL AMERICA	9:08	157	92%	20%	E22
I	UA	SLP	MEXICO	9:08	50	86%	9%	B12
I	UA	MTY	MEXICO	9:09	68	74%	35%	B5-S
I	UA	CME	MEXICO	9:09	185	60%	47%	C33
I	UA	GDL	MEXICO	9:09	157	89%	21%	B9
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	9:10	157	94%	41%	D8B
I	UA	VER	MEXICO	9:10	82	86%	22%	B1-S
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	9:11	242	84%	51%	E2A
I	UA	GDL	MEXICO	9:11	108	89%	21%	E17
I	UA	TLC	MEXICO	9:14	50	86%	27%	B10-S
P	UA	YVR	VANCOUVER INTERNATIONAL APT	9:18	173	90%	14%	B23
I	UA	MGA	CENTRAL AMERICA	9:20	149	82%	16%	C32
I	UA	LIM	SOUTH AMERICA	9:20	235	88%	8%	B16
I	UA	MLM	MEXICO	9:27	50	92%	13%	B24-S
I	UA	MTY	MEXICO	9:30	124	74%	34%	C29
I	UA	QRO	MEXICO	9:32	50	80%	24%	B8-S
I	UA	SCL	SOUTH AMERICA	9:38	157	82%	42%	B30A
I	UA	GIG	RIO DE JANEIRO INTERNATIONAL APT	9:40	235	83%	27%	E20
I	UA	SAL	CENTRAL AMERICA	9:48	154	88%	49%	B29
I	UA	RTB	CENTRAL AMERICA	10:00	157	74%	28%	E8A
I	UA	VER	MEXICO	10:10	160	85%	22%	E1
I	UA	PBC	MEXICO	10:10	160	83%	15%	E11
I	UA	GUA	CENTRAL AMERICA	10:10	124	80%	18%	E15B

International Departures Schedule - PAL 33								
STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	MGA	CENTRAL AMERICA	10:20	160	82%	16%	D7A
I	UA	MDE	SOUTH AMERICA	10:20	157	82%	57%	E14
I	UA	RTB	CENTRAL AMERICA	10:22	157	74%	28%	B31
P	UA	YYZ	TORONTO LESTER B PEARSON INTL APT	10:25	82	66%	47%	B11
I	UA	SJO	CENTRAL AMERICA	10:27	160	92%	20%	D2
I	UA	GUA	CENTRAL AMERICA	10:30	242	80%	18%	E18
I	UA	SAL	CENTRAL AMERICA	10:30	157	88%	49%	E22
I	UA	CCS	SOUTH AMERICA	10:40	124	70%	32%	E16
I	UA	UIO	SOUTH AMERICA	10:40	157	86%	44%	E5B
I	UA	MTY	MEXICO	10:40	50	74%	35%	D1B
I	UA	NRT	TOKYO NARITA APT	10:50	276	82%	65%	E7
I	UA	CUN	MEXICO	10:51	152	91%	27%	B6A
I	UA	TGU	CENTRAL AMERICA	11:10	157	90%	24%	C29
I	UA	GUA	CENTRAL AMERICA	11:19	124	80%	18%	E9
I	UA	GUA	CENTRAL AMERICA	11:19	152	80%	18%	E2B
I	UA	GCM	CARIBBEAN	11:20	149	86%	44%	E8A
I	UA	POS	CARIBBEAN	11:20	185	69%	34%	E1
I	UA	SJO	CENTRAL AMERICA	11:25	160	92%	20%	B30A
I	UA	SJO	CENTRAL AMERICA	11:25	300	92%	20%	D3
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	11:30	120	84%	51%	E10B
I	UA	MTY	MEXICO	11:30	120	74%	34%	E3
P	UA	NAS	NASSAU INTERNATIONAL APT	11:30	157	93%	50%	E21
I	UA	LIR	CENTRAL AMERICA	11:30	185	81%	23%	E14
I	UA	MZT	MEXICO	11:35	50	72%	14%	B2-S
I	UA	QRO	MEXICO	11:35	50	80%	24%	B11
I	UA	PVR	MEXICO	11:36	167	90%	19%	B34
I	UA	ACA	MEXICO	11:39	50	88%	20%	B14-S
I	UA	ZIH	MEXICO	11:39	50	74%	18%	B18-S
I	UA	SJD	MEXICO	11:40	50	74%	31%	B3-S
I	UA	RTB	CENTRAL AMERICA	11:40	124	74%	28%	E6

International Departures Schedule - PAL 33

STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	CUN	MEXICO	11:44	154	91%	27%	D7B
I	UA	DGO	MEXICO	11:44	68	82%	12%	D1B
I	UA	ZIH	MEXICO	11:50	68	74%	18%	B5-S
I	UA	PBC	MEXICO	12:00	99	83%	27%	B5
I	UA	TAM	MEXICO	12:00	68	82%	31%	B26-S
I	UA	CME	MEXICO	12:00	124	60%	47%	E5B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	12:02	124	84%	51%	C40
I	UA	GDL	MEXICO	12:07	50	88%	18%	B15-S
I	UA	PVR	MEXICO	12:10	185	90%	19%	New9
I	UA	LIM	SOUTH AMERICA	12:10	68	88%	27%	B7-S
I	UA	CZM	MEXICO	12:15	154	86%	31%	E18
P	UA	NAS	NASSAU INTERNATIONAL APT	12:40	124	93%	50%	E22
I	UA	LIR	CENTRAL AMERICA	12:40	68	81%	27%	B11
I	UA	GCM	CARIBBEAN	12:40	157	86%	44%	E17
I	UA	MGA	CENTRAL AMERICA	12:40	149	82%	16%	E1
I	UA	CUN	MEXICO	12:40	124	91%	27%	E9
I	UA	BJX	MEXICO	12:48	157	89%	24%	D4B
P	UA	YYC	CALGARY	12:48	118	73%	47%	E12A
I	UA	BJX	MEXICO	12:50	50	88%	23%	B5
P	UA	NAS	NASSAU INTERNATIONAL APT	12:50	160	93%	50%	B8
I	UA	UIO	SOUTH AMERICA	12:50	124	86%	44%	E21
I	UA	MTY	MEXICO	12:50	50	74%	35%	B14-S
I	UA	MZT	MEXICO	12:51	99	73%	27%	B2
I	UA	BZE	SOUTH AMERICA	12:51	157	73%	22%	E8A
P	UA	YUL	MONTREAL DORVAL INTERNATIONAL APT	12:51	70	71%	47%	E10B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	12:54	157	84%	51%	B30A
P	UA	YYZ	TORONTO LESTER B PEARSON INTL APT	12:54	66	67%	27%	D7B
I	UA	DGO	MEXICO	12:54	66	83%	27%	D9B
I	UA	DGO	MEXICO	13:05	68	82%	12%	E11
I	UA	MTY	MEXICO	13:05	50	74%	35%	E15B

International Departures Schedule - PAL 33								
STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	CUN	MEXICO	13:08	154	91%	27%	D6A
I	UA	AGU	MEXICO	13:10	68	91%	24%	B7-S
I	UA	EZE	BUENOS AIRES MINISTRO PISTARINI	13:10	157	84%	13%	E3
I	UA	GCM	CARIBBEAN	13:17	124	86%	44%	B31
P	UA	YUL	MONTREAL DORVAL INTERNATIONAL APT	13:20	185	71%	37%	E2B
I	UA	BJX	MEXICO	13:30	157	89%	24%	D7A
I	UA	BZE	SOUTH AMERICA	13:30	157	73%	22%	E5B
I	UA	SAP	CENTRAL AMERICA	13:40	149	93%	27%	D8B
P	UA	YEG	EDMONTON INTERNATIONAL APT	13:40	185	83%	20%	E6
P	UA	YVR	VANCOUVER INTERNATIONAL APT	13:48	124	90%	14%	E14
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	13:51	124	94%	41%	B13
I	UA	UIO	SOUTH AMERICA	13:55	124	86%	44%	E22
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	14:10	124	85%	18%	E21
I	UA	BZE	SOUTH AMERICA	14:10	157	73%	22%	E10B
I	UA	RTB	CENTRAL AMERICA	14:10	185	74%	28%	B2
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	14:22	154	84%	51%	D2
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	14:24	157	84%	51%	E23
I	UA	GYE	SOUTH AMERICA	14:30	149	81%	57%	B23
I	UA	MTY	MEXICO	14:31	50	74%	35%	B12-S
I	UA	GDL	MEXICO	14:48	50	88%	18%	B6-S
I	UA	LIR	CENTRAL AMERICA	15:00	157	81%	23%	B28
I	UA	SAP	CENTRAL AMERICA	15:12	124	93%	27%	B11
I	UA	QRO	MEXICO	15:16	124	80%	27%	D1A
I	UA	BJX	MEXICO	15:21	50	88%	23%	B22-S
I	UA	MID	MEXICO	15:30	185	74%	21%	D3B
P	UA	YEG	EDMONTON INTERNATIONAL APT	15:30	185	83%	20%	D6A
I	UA	GDL	MEXICO	15:30	124	89%	21%	D6B
I	UA	ACA	MEXICO	15:30	68	88%	20%	B28
I	UA	NBO	NAIROBI JOMO KENYATTA INTERNATIONAL APT	15:30	242	81%	57%	E12
I	UA	BJX	MEXICO	15:34	50	88%	23%	B9-S

International Departures Schedule - PAL 33

STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	AMS	AMSTERDAM	15:35	235	80%	71%	E7
I	UA	BOG	CENTRAL AMERICA	15:39	160	94%	31%	C36
I	UA	MZT	MEXICO	15:40	99	73%	27%	B1
I	UA	MTY	MEXICO	15:40	50	74%	35%	B12-S
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	15:44	50	84%	41%	B24-S
I	UA	LOS	LAGOS	15:45	276	82%	78%	E18
I	UA	MLM	MEXICO	15:51	157	92%	13%	C31
I	UA	MLM	MEXICO	15:51	157	92%	13%	C31
I	UA	DME	MOSCOW DOMODEDOVO APT	15:52	242	70%	85%	E10A
I	UA	TAM	MEXICO	15:54	157	82%	27%	E23
I	UA	CZM	MEXICO	15:59	235	86%	31%	E8
I	UA	CUN	MEXICO	16:01	154	91%	27%	B9
P	UA	YYZ	TORONTO LESTER B PEARSON INTL APT	16:01	50	66%	47%	B19-S
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	16:05	276	84%	51%	E2A
I	UA	UIO	SOUTH AMERICA	16:05	118	86%	44%	C24
I	UA	ZIH	MEXICO	16:08	68	74%	18%	B7-S
I	UA	AMS	AMSTERDAM	16:20	235	80%	71%	E20
I	UA	HND	TOKYO HANEDA APT	16:20	235	82%	57%	E15A
I	UA	GDL	MEXICO	16:20	124	89%	21%	D6A
I	UA	MTY	MEXICO	16:25	50	74%	35%	D6B
I	UA	FRA	FRANKFURT INTERNATIONAL APT	16:30	276	85%	81%	E4
I	UA	TGU	CENTRAL AMERICA	16:40	157	90%	24%	C26
I	UA	PVR	MEXICO	16:40	185	90%	19%	E21
I	UA	SJO	CENTRAL AMERICA	16:50	149	92%	20%	E22
I	UA	SJO	CENTRAL AMERICA	17:00	157	92%	20%	New4
I	UA	GUA	CENTRAL AMERICA	17:20	157	80%	18%	E12A
I	UA	SAL	CENTRAL AMERICA	17:30	157	88%	49%	B6A
I	UA	UIO	SOUTH AMERICA	17:30	124	86%	44%	D4B
I	UA	SLW	MEXICO	17:30	157	63%	3%	E1
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:30	157	84%	51%	D3B

International Departures Schedule - PAL 33

STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
P	UA	YEG	EDMONTON INTERNATIONAL APT	17:30	173	83%	20%	B24
I	UA	SIN	SINGAPORE CHANGI APT	17:30	242	81%	91%	E7
I	UA	SJO	CENTRAL AMERICA	17:31	235	92%	20%	D1
P	UA	YYC	CALGARY	17:37	157	73%	47%	B25
I	UA	CAI	CAIRO	17:37	242	81%	57%	E18
I	UA	MLM	MEXICO	17:37	50	92%	13%	B9-S
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	17:40	276	85%	18%	E5A
I	UA	LIR	CENTRAL AMERICA	17:40	124	81%	23%	E14
P	UA	NAS	NASSAU INTERNATIONAL APT	17:40	120	93%	50%	B31
I	UA	SLW	MEXICO	17:41	50	64%	3%	B6-S
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:42	124	84%	51%	E17
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:42	160	84%	51%	B9
P	UA	YYC	CALGARY	17:44	154	73%	47%	E9
I	UA	DGO	MEXICO	17:55	50	82%	12%	New7
I	UA	MBJ	CARIBBEAN	18:00	157	93%	32%	E21
I	UA	MGA	CENTRAL AMERICA	18:00	157	82%	16%	D15B
I	UA	MLM	MEXICO	15:51	157	92%	13%	C31
I	UA	DME	MOSCOW DOMODEDOVO APT	15:52	242	70%	85%	E10A
I	UA	TAM	MEXICO	15:54	157	82%	27%	E23
I	UA	CZM	MEXICO	15:59	235	86%	31%	E8
I	UA	CUN	MEXICO	16:01	154	91%	27%	B9
P	UA	YYZ	TORONTO LESTER B PEARSON INTL APT	16:01	50	66%	47%	B19-S
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	16:05	276	84%	51%	E2A
I	UA	UIO	SOUTH AMERICA	16:05	118	86%	44%	C24
I	UA	ZIH	MEXICO	16:08	68	74%	18%	B7-S
I	UA	AMS	AMSTERDAM	16:20	235	80%	71%	E20
I	UA	HND	TOKYO HANEDA APT	16:20	235	82%	57%	E15A
I	UA	GDL	MEXICO	16:20	124	89%	21%	D6A
I	UA	MTY	MEXICO	16:25	50	74%	35%	D6B
I	UA	FRA	FRANKFURT INTERNATIONAL APT	16:30	276	85%	81%	E4

International Departures Schedule - PAL 33

STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	TGU	CENTRAL AMERICA	16:40	157	90%	24%	C26
I	UA	PVR	MEXICO	16:40	185	90%	19%	E21
I	UA	SJO	CENTRAL AMERICA	16:50	149	92%	20%	E22
I	UA	SJO	CENTRAL AMERICA	17:00	157	92%	20%	New4
I	UA	GUA	CENTRAL AMERICA	17:20	157	80%	18%	E12A
I	UA	SAL	CENTRAL AMERICA	17:30	157	88%	49%	B6A
I	UA	UIO	SOUTH AMERICA	17:30	124	86%	44%	D4B
I	UA	SLW	MEXICO	17:30	157	63%	3%	E1
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:30	157	84%	51%	D3B
P	UA	YEG	EDMONTON INTERNATIONAL APT	17:30	173	83%	20%	B24
I	UA	SIN	SINGAPORE CHANGI APT	17:30	242	81%	91%	E7
I	UA	SJO	CENTRAL AMERICA	17:31	235	92%	20%	D1
P	UA	YYC	CALGARY	17:37	157	73%	47%	B25
I	UA	CAI	CAIRO	17:37	242	81%	57%	E18
I	UA	MLM	MEXICO	17:37	50	92%	13%	B9-S
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	17:40	276	85%	18%	E5A
I	UA	LIR	CENTRAL AMERICA	17:40	124	81%	23%	E14
P	UA	NAS	NASSAU INTERNATIONAL APT	17:40	120	93%	50%	B31
I	UA	SLW	MEXICO	17:41	50	64%	3%	B6-S
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:42	124	84%	51%	E17
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	17:42	160	84%	51%	B9
P	UA	YYC	CALGARY	17:44	154	73%	47%	E9
I	UA	DGO	MEXICO	17:55	50	82%	12%	New7
I	UA	MBJ	CARIBBEAN	18:00	157	93%	32%	E21
I	UA	MGA	CENTRAL AMERICA	18:00	157	82%	16%	D15B
I	UA	SAL	CENTRAL AMERICA	18:01	124	88%	49%	D3A
I	UA	SAL	CENTRAL AMERICA	18:01	152	88%	49%	B30A
I	UA	TAM	MEXICO	18:06	50	82%	31%	B13
I	UA	UIO	SOUTH AMERICA	18:07	149	86%	44%	C25
I	UA	MTY	MEXICO	18:07	118	74%	34%	B29

International Departures Schedule - PAL 33								
STATUS	**OP**	**AP3L**	**DESTINATION**	**STA**	**SEATS**	**LF%**	**O/D %**	**GATE**
I	UA	CUN	MEXICO	18:13	157	91%	27%	C32
I	UA	FRA	FRANKFURT INTERNATIONAL APT	18:25	235	85%	81%	B4
I	UA	LHR	LONDON HEATHROW APT	18:25	242	83%	27%	D5
I	UA	VSA	MEXICO	18:25	50	78%	34%	B21-S
I	UA	OAX	MEXICO	18:29	50	88%	57%	B4-S
I	UA	JNB	JOHANNESBURG JAN SMUTS APT	18:30	242	81%	57%	E10A
I	UA	AGU	MEXICO	18:36	120	91%	17%	B35
P	UA	NAS	NASSAU INTERNATIONAL APT	18:40	124	93%	50%	D2
I	UA	QRO	MEXICO	18:50	50	80%	24%	B8-S
I	UA	MDE	SOUTH AMERICA	18:50	242	82%	57%	E4
I	UA	RTB	CENTRAL AMERICA	18:50	242	74%	28%	E15A
I	UA	BJX	MEXICO	18:50	242	89%	24%	E2A
I	UA	QRO	MEXICO	18:53	99	80%	27%	B34
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	18:54	124	84%	51%	B13
I	UA	MTY	MEXICO	18:59	124	74%	34%	E8A
I	UA	CUN	MEXICO	18:59	124	91%	27%	New10
I	UA	AGU	MEXICO	19:00	68	91%	24%	B1
I	UA	PVR	MEXICO	19:00	185	90%	19%	E23
P	UA	YYZ	TORONTO LESTER B PEARSON INTL APT	19:05	50	66%	47%	B19-S
I	UA	CUN	MEXICO	19:07	154	91%	27%	B9
I	UA	GUA	CENTRAL AMERICA	19:10	154	80%	18%	E1
I	UA	TLC	MEXICO	19:15	50	86%	27%	B20-S
I	UA	MTY	MEXICO	19:15	50	74%	35%	B23
I	UA	RTB	CENTRAL AMERICA	19:20	149	74%	28%	D4A
I	UA	TAM	MEXICO	19:20	68	82%	31%	B7-S
I	UA	AGU	MEXICO	19:20	68	91%	24%	C26
I	UA	SAP	CENTRAL AMERICA	19:23	124	93%	27%	D1A
I	UA	MLM	MEXICO	19:30	242	92%	13%	E5A

International Departures Schedule - PAL 33

STATUS	OP	AP3L	DESTINATION	STA	SEATS	LF%	O/D %	GATE
I	UA	SJD	MEXICO	19:50	124	73%	31%	E21
I	UA	GDL	MEXICO	19:59	50	88%	18%	B4-S
I	UA	LHR	LONDON HEATHROW APT	20:00	242	83%	27%	D2
I	UA	GDL	MEXICO	20:00	157	89%	21%	C24
I	UA	ACA	MEXICO	20:00	68	88%	20%	B7-S
I	UA	CUN	MEXICO	20:02	157	91%	27%	E17
I	UA	VER	MEXICO	20:31	50	86%	22%	B16-S
I	UA	GRU	SAO PAULO GUARULHOS INT L APT	20:35	276	85%	18%	E7
I	UA	SCL	SOUTH AMERICA	20:50	242	82%	42%	E18
I	UA	CUN	MEXICO	20:50	124	91%	27%	E1
I	UA	ACA	MEXICO	20:50	68	88%	20%	B7-S
I	UA	SLP	MEXICO	20:50	157	85%	9%	E22
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	20:50	154	84%	51%	B23
I	UA	TRC	MEXICO	20:52	50	84%	57%	E17
I	UA	SLP	MEXICO	20:53	50	86%	9%	B8-S
I	UA	BJX	MEXICO	20:57	50	88%	23%	D7B
I	UA	GIG	RIO DE JANEIRO INTERNATIONAL APT	21:00	157	83%	27%	E23
P	UA	YVR	VANCOUVER INTERNATIONAL APT	21:00	154	90%	14%	E9
I	UA	GUA	CENTRAL AMERICA	21:00	149	80%	18%	E8A
I	UA	MTY	MEXICO	21:04	124	74%	34%	B6A
I	UA	GDL	MEXICO	21:04	50	88%	18%	B28-S
I	UA	GIG	RIO DE JANEIRO INTERNATIONAL APT	21:05	235	83%	27%	E20
I	UA	PTY	PANAMA CITY TOCUMEN INTERNATIONL	21:10	185	94%	41%	C36
I	UA	CCS	SOUTH AMERICA	21:10	157	70%	32%	E15B
I	UA	MEX	MEXICO CITY BENITO JUAREZ INTL APT	21:11	183	84%	51%	E4
I	UA	BOG	CENTRAL AMERICA	23:59	160	94%	31%	B22
I	UA	CCS	SOUTH AMERICA	23:59	154	70%	32%	E4

Notes:
1/ STA: Estimated Time of Arrival
2/ OP: Operator
3/ AP3LC: IATA standard airport three letter code
5/ Domestic Status: I-International, P-Pre-Cleared
6/ LF%: Load Factor Percentage
7/ O/D%: Origin/Destination Percentage
Source: Leigh Fisher Associates, Inc., April, 2014
Prepared by: Ricondo & Associates, Inc., January 2015.

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Appendix B

Proof of Concept

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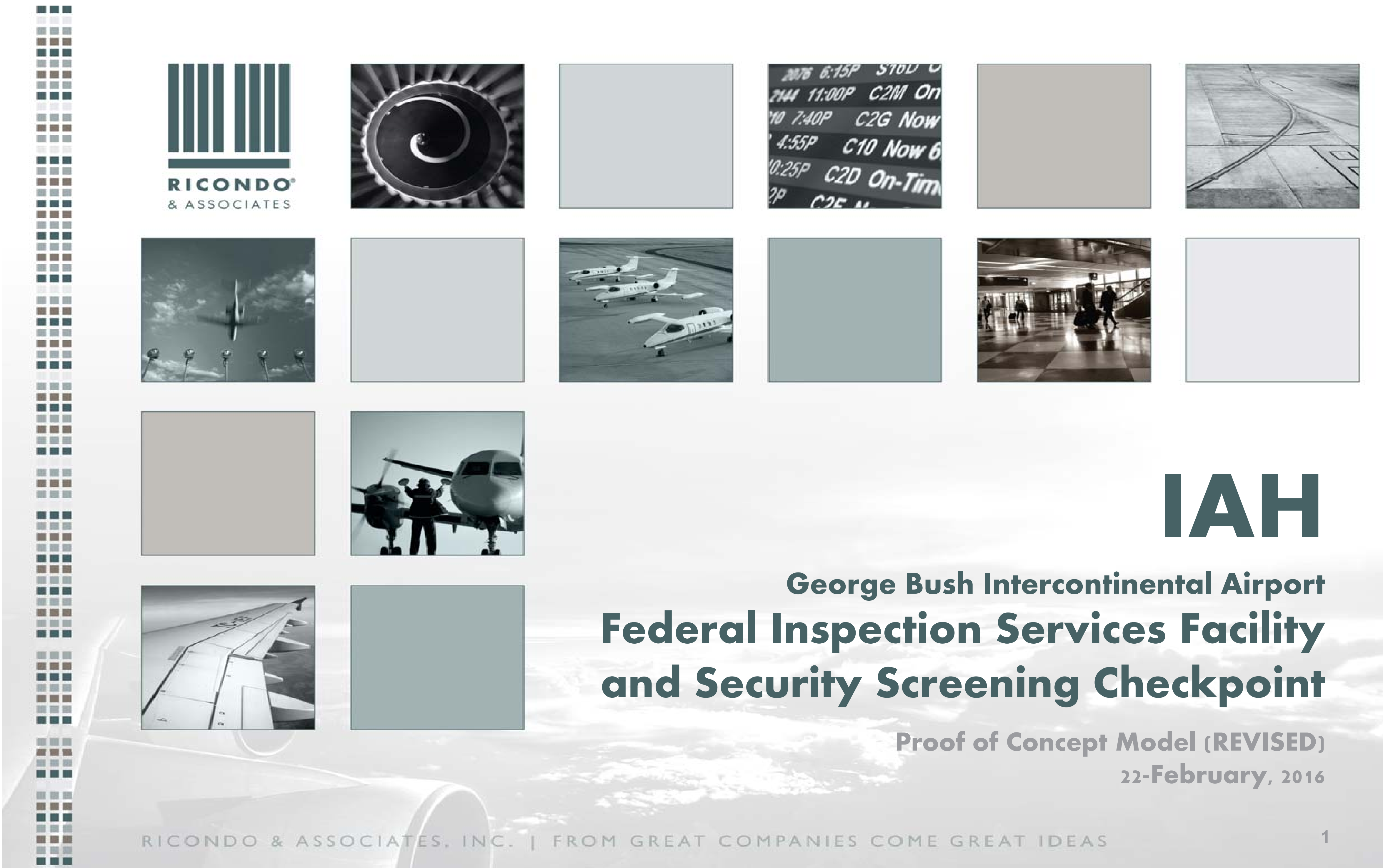
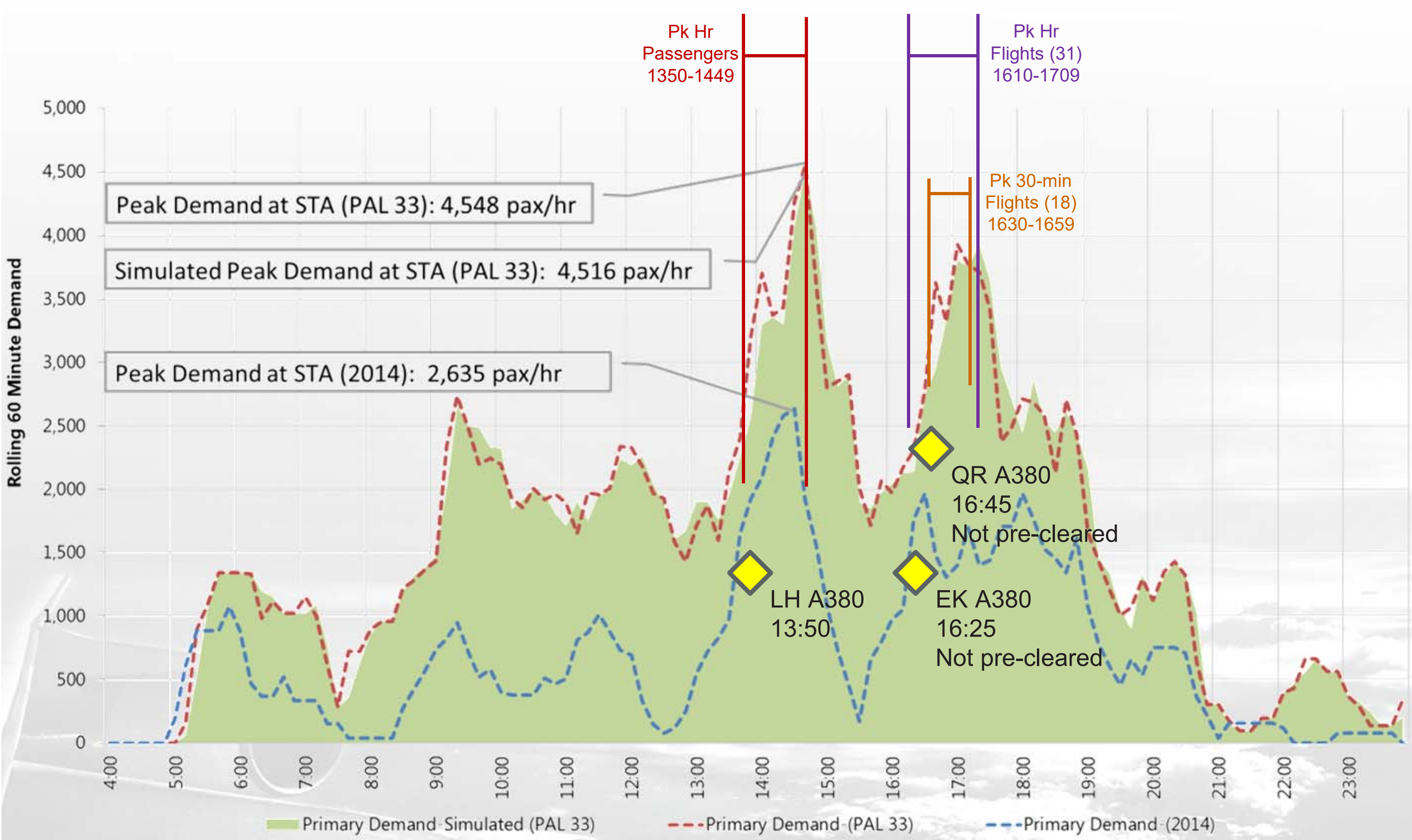

RICONDO
& ASSOCIATES
IAH
George Bush Intercontinental Airport
Federal Inspection Services Facility
and Security Screening Checkpoint
Proof of Concept Model (REVISED)
22-February, 2016
RICONDO & ASSOCIATES, INC. | FROM GREAT COMPANIES COME GREAT IDEAS
1

FIS Demand Summary

- Peak passenger demand occurs between 13:50-14:49, and consists of about 29 flights and about 4,550 passengers.
- Peak operational demand occurs between 16:10-17:09 and consists of 31 flights and about 3,930 passengers.
- The peak hour demand difference between 2014 and PAL 33 is roughly **1,900** passengers.



Air Service Activity Summary		
Aggregate International Activity	**2014**	**PAL 33**
Daily Activity		
Operations (flights)	117	264
Seats (seats)	16,551	39,062
Deplanements (pax)	13,923	32,275
Terminations (pax)	4,335	14,119
Transfers (pax)	9,555	18,156
Peak Hour Activity		
Operations (flights)	17	31
Seats (seats)	3,184	5,486
Deplanements (pax)	2,635	4,548
Terminations (pax)	691	2,444
Transfers (pax)	1,938	2,103

Source: LeighFisher Inc., April 2014 (PAL 33 schedule); LeighFisher Inc., October 2014 (2014 schedule); Ricondo & Associates, Inc., December 2015.
Prepared by: Ricondo & Associates, Inc., February 2016

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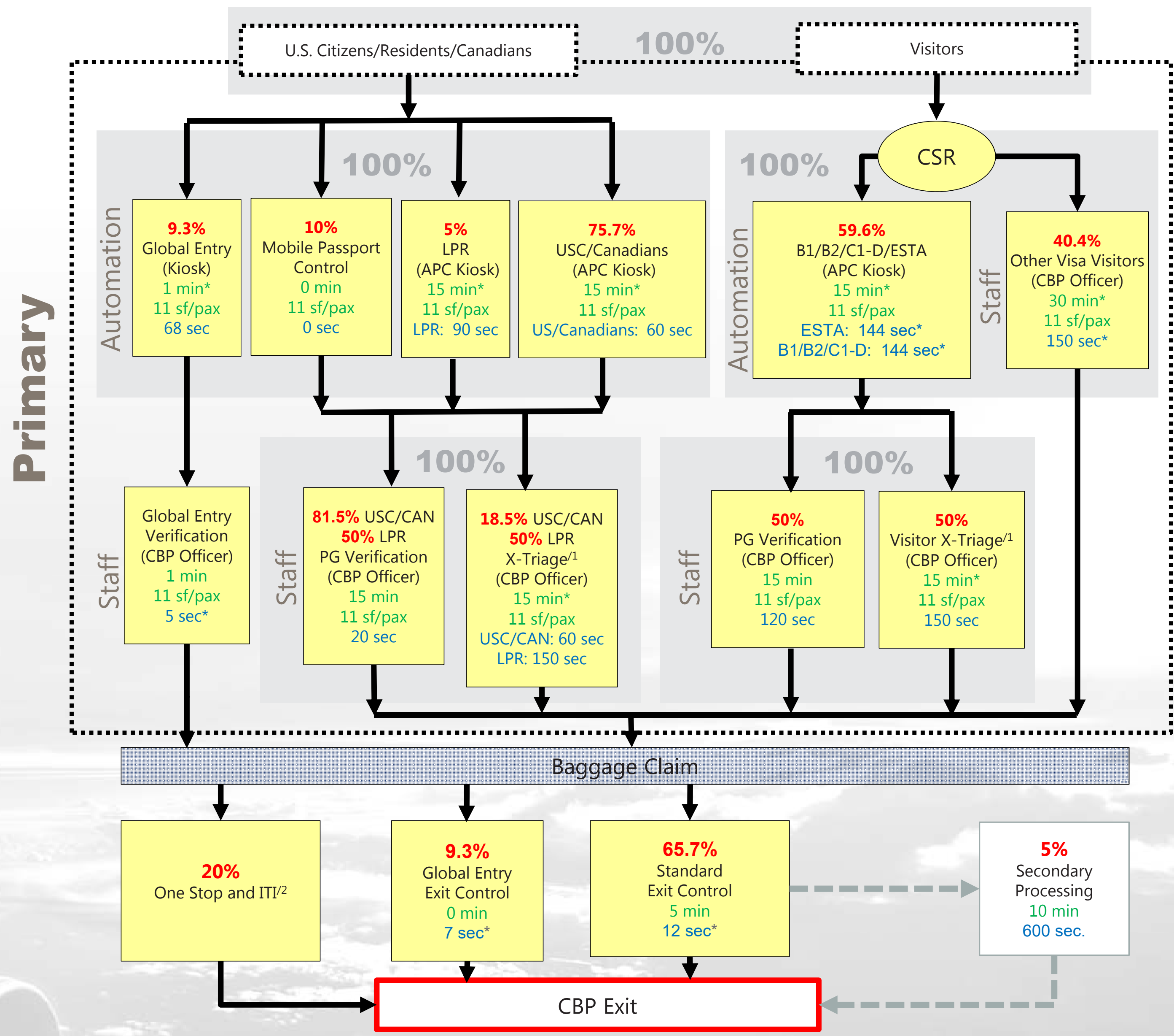
FIS Analysis Assumptions (Revised)

HAS Goal:
80% of passengers processed through Primary within 30 minutes from the point they enter the FIS (approximately 10 minutes walk-time from aircraft).

Legend:
Percentage of Passengers at Facility
Type of Service
(Device)
Level of Service: Wait Time Goal
Level of Service: Area/Passenger
Process Cycle Time – start of passenger process to start of next passenger process (see Sources below)



Assumptions Notes:
- USC: United States Citizen
- LPR: Legal Permanent Resident
- CAN: Canadian Citizen
- CSR: Customer Service Representative
- PG: Passage Granted
- X: Passenger receives "X" on receipt at APC Kiosk
- ITI: International to international transfer
- Yellow boxes indicate revisions to previous analysis (January 2015).

1/ Percentage at Triage includes kiosk error reads, passengers refusing to use kiosks, and declarations.
2/ One Stop and ITI passengers are fully processed at Primary Inspection and therefore bypass Exit Control.

*Passport Types by Origin (All Carriers)

Origin	USC/USR/LPR	VW/B1/B2/NVW
Europe	64%	36%
Middle East	60%	40%
Asia	31%	69%
Latin Am.	60%	40%
Africa	70%	30%

Sources:
* IAH Customs and Border Protection

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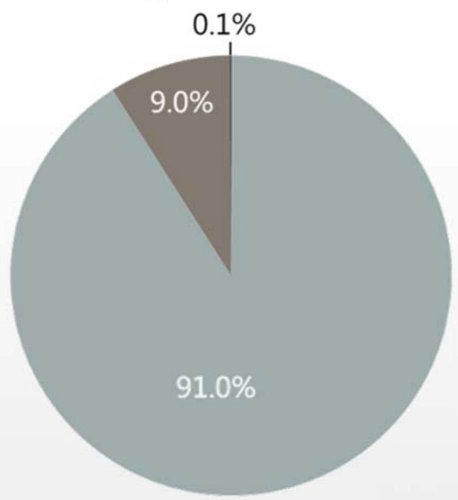
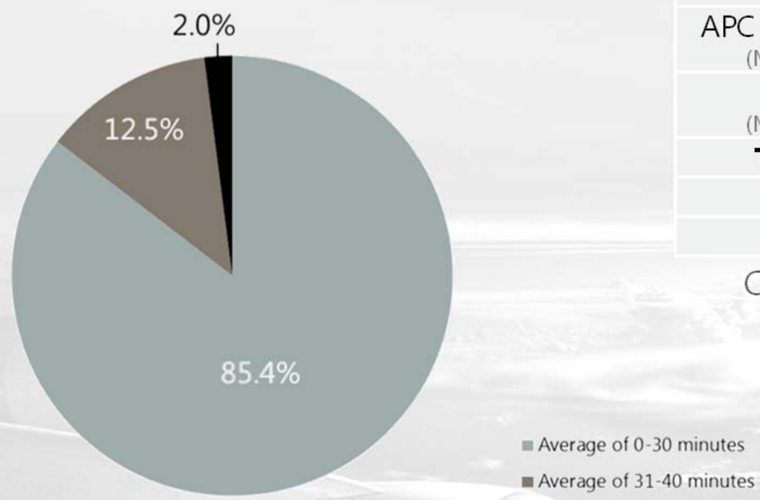
Primary Inspection Performance

Primary Inspection Processing Times (During the Peak Hour)

Analysis



Concept



Facility	Positions		Wait Time		Queue	
	Analysis	Concept	Goal	Concept	Capacity	Concept
Automation						
APC Kiosks (US/LPR)	34	34	15 minutes	14 minutes	960 pax	460 pax
APC Kiosks (VW, B1/B2)	40	40	15 minutes	12 minutes	540 pax	200 pax
Global Entry Kiosks	22	24	1 minute	1 minute	40 pax	30 pax
Total Kiosks	96	**98**			**1,540 pax**	**690 pax**
Staff Positions						
Visitor Officer Booths (NVW)	24	24(26)	30 minutes	28 minutes	660 pax	260 pax
Global Entry Verification Positions	2	4	1 minute	1 minute	70 pax	15 pax
APC Verification Positions (Mobile, US, LPR, VW, B1/B2)	22	22(24)	15 minutes	13 minutes	915 pax	370 pax
APC Triage Booths (Mobile, US, LPR, VW, B1/B2)	25	25(26)	15 minutes	11 minutes	340 pax	150 pax
Total Staff Positions	**73**	**75 (80)**			**1,985 pax**	**725 pax**

Note: Passengers in queue are rounded to nearest 5.

Conclusions:

- Equal facilities are needed for north and south processing to meet the level of service goal.
- Global Entry kiosks and verification officers required additional positions to meet the wait time goal.
- During the peak hour 85% of passengers process through Primary within 30 minutes.

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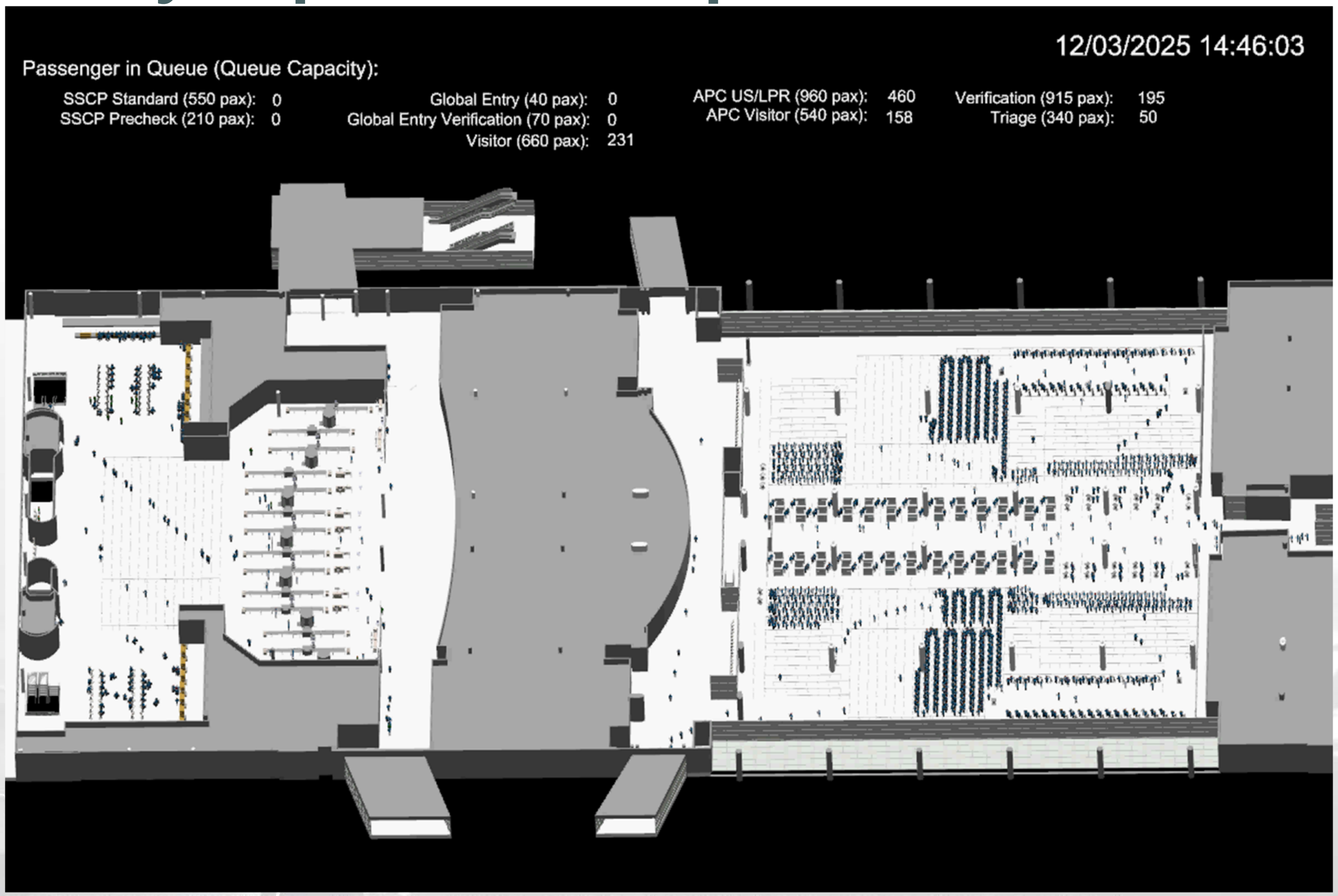
Primary Inspection Concept Simulation - Level 116



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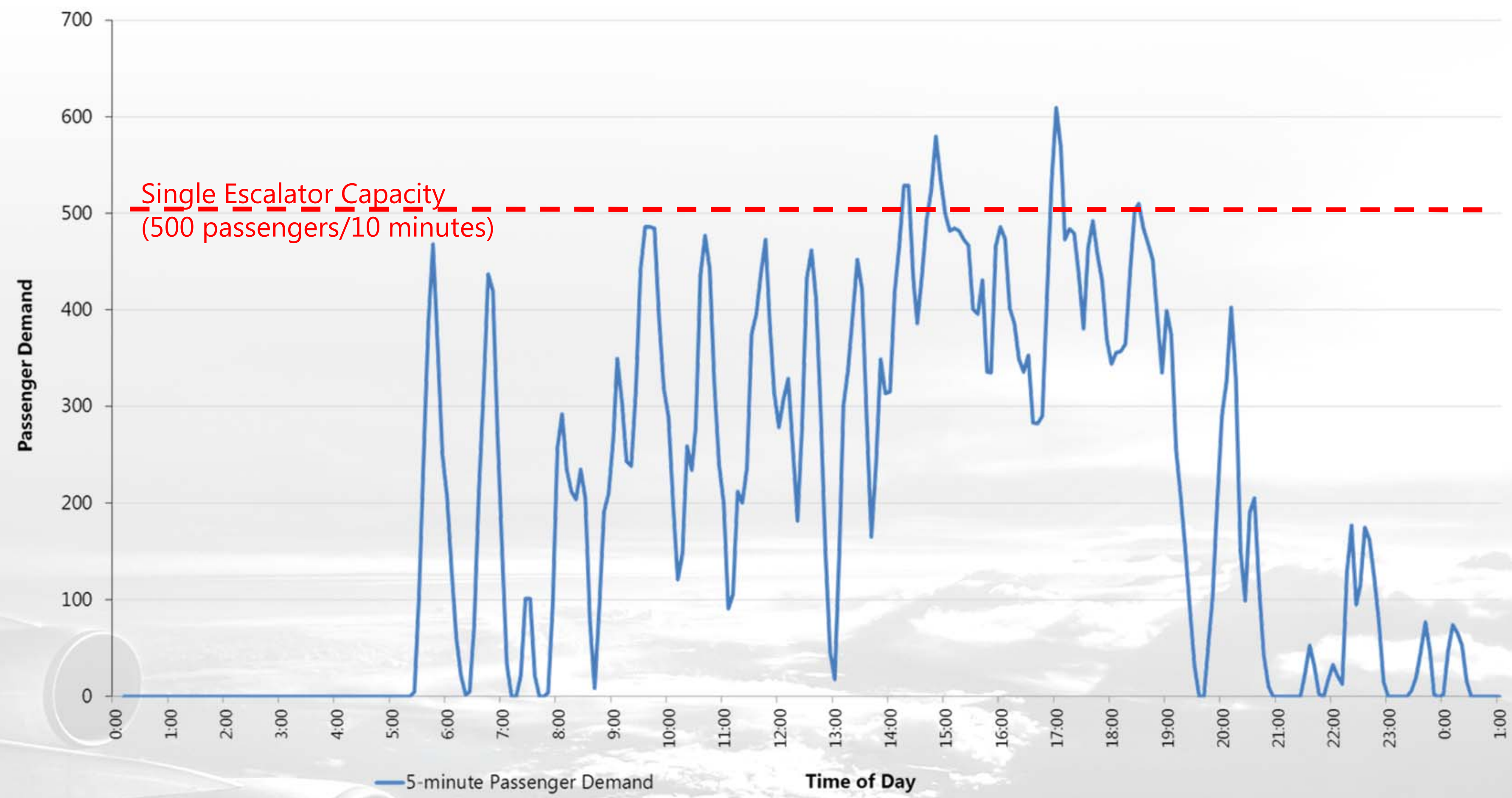
FIS Escalator Analysis

At PAL 33, a single operating down escalator between the CBP Primary and the International Baggage Claim area will experience sustained passenger queues several times a day if the adjacent stair or escalator can not be used for passengers to walk down.



Assumption: A standard down escalator with 32"-40" tread width has a throughput of 50 passengers per minute – Source: ACRP 67 – Airport Passenger Conveyance Systems Planning Guidebook

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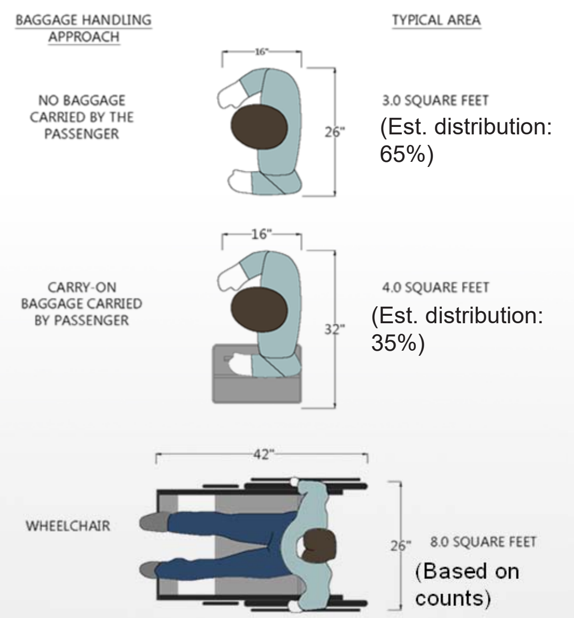
FIS Elevator Analysis



Elevator Demand

- During peak hour, around 13% of passengers use elevators
- During Middle East peak (17:15-18:14), 20% of passengers use elevators

Assumptions

- Elevator frequency (cycle): 75 seconds (4 cycles per 5 minute period)
- Elevator Area: 36 square feet
- Ratio: 37% wheelchairs/strollers to 63% passengers/pushers
- Peak 5 minute estimated PAL-33 demand = 19 wheelchairs/ strollers and 32 passengers
- Wait time for an elevator: 1 minute

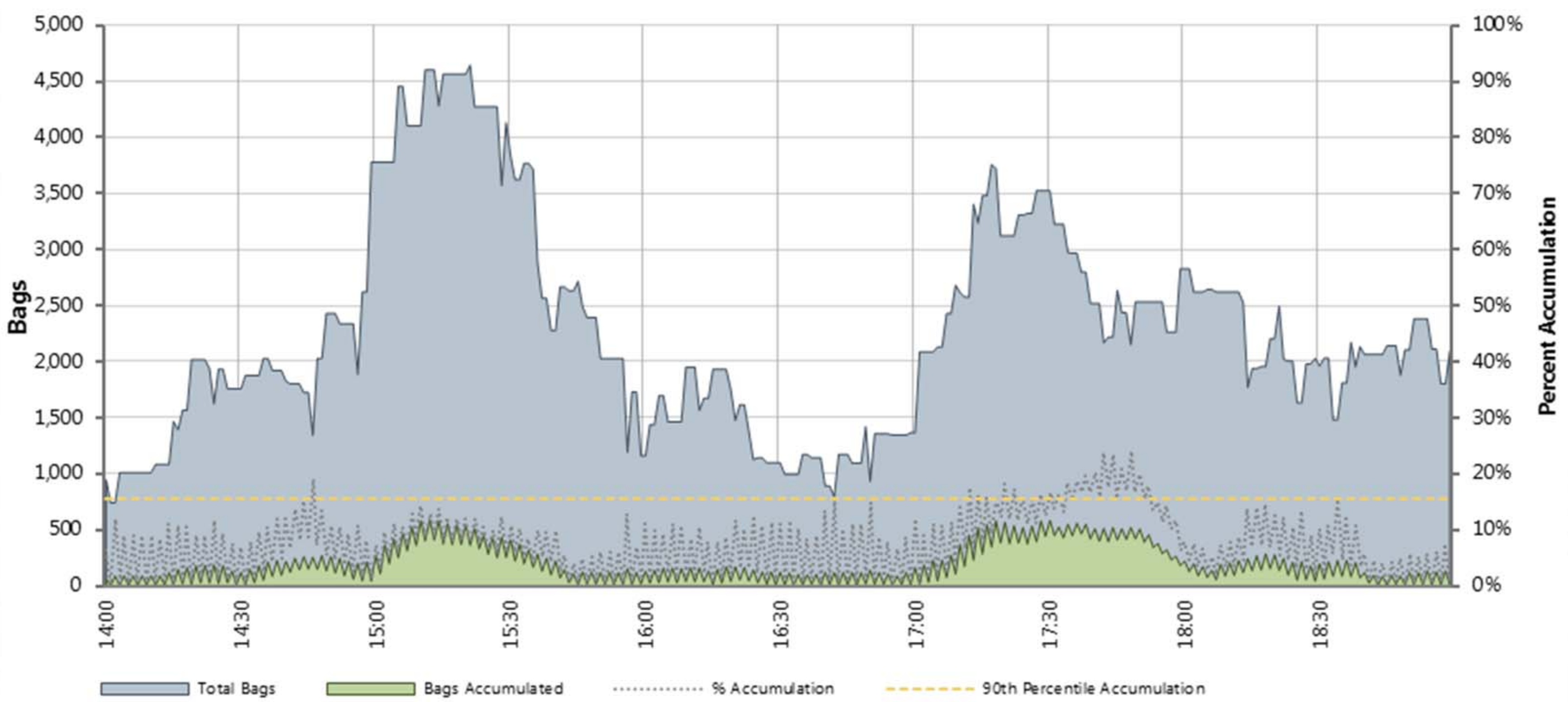
Results

- To maintain a 1-minute wait time, a minimum of 3 elevators is required to support the PAL-33 demand

International Baggage Claim Performance

International Bag Claim	Analysis	Concept
Average 260′ Claim Device	14	11
+300′ Claim Device	2	4
Total	**16**	**15**

- The average baggage claim accumulation is roughly 16%.



Aggregate Claim Devices

Exit Control Performance

Facility	Positions		Wait Time		Queue	
	Analysis	Concept	Goal	Concept	Capacity	Concept
Global Entry Exit Control (With bag)	1	1	1 minute	1 minute	35 pax	10 pax
Standard Exit Control	15	15	5 minutes	2 minute	300 pax	310 pax
Total	**16**	**16**			**335 pax**	**320 pax**

Note: Passengers in queue are rounded to nearest 5.

- One Stop, ITI, and Global Entry passengers without bags bypass exit control.
- Passengers metered through concept facility create a higher demand at standard exit control.
- Additional queue demand can be accommodated within the total queue area.
- Total available exit control positions in the concept is 16.

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Secondary Inspection Performance

Facility	Positions		Wait Time		Queue	
	Analysis	Concept	Goal	Concept	Capacity	Concept
Secondary Processing Units (Agriculture)	4	3	10 minutes	25 minutes	65 pax	55 pax
Secondary Processing Units (Customs – Pair of Lanes)	8 (4 pairs)	8 (4 pairs)	10 minutes	25 minutes		
Total	**12**	**11**			**65 pax**	

Note: Passengers in queue are rounded to nearest 5.

- 5% of passengers will be sent to secondary for additional screening.
- Concept does not provide an adequate secondary inspection facility based on LOS wait time goal.

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Recheck Lobby Performance

Facility	Positions		Wait Time		Queue	
	Analysis	Concept	Goal	Concept	Capacity	Concept
Baggage Drop-off Belts	6	6	1 minute	1 minute	50 pax	20 pax
Oversize Bag Assist Agent	1	1	1 minute	1 minute		5 pax
United Airlines Agents	13	13	20 minutes	16 minutes	115 pax	60 pax
Foreign Flag Carriers	17	17	20 minutes	11 minutes		40 pax
Total Agent Positions	**37**	**37**			**165 pax**	**125 pax**

Note: Passengers in queue are rounded to nearest 5.

- All level of service goals are fulfilled.

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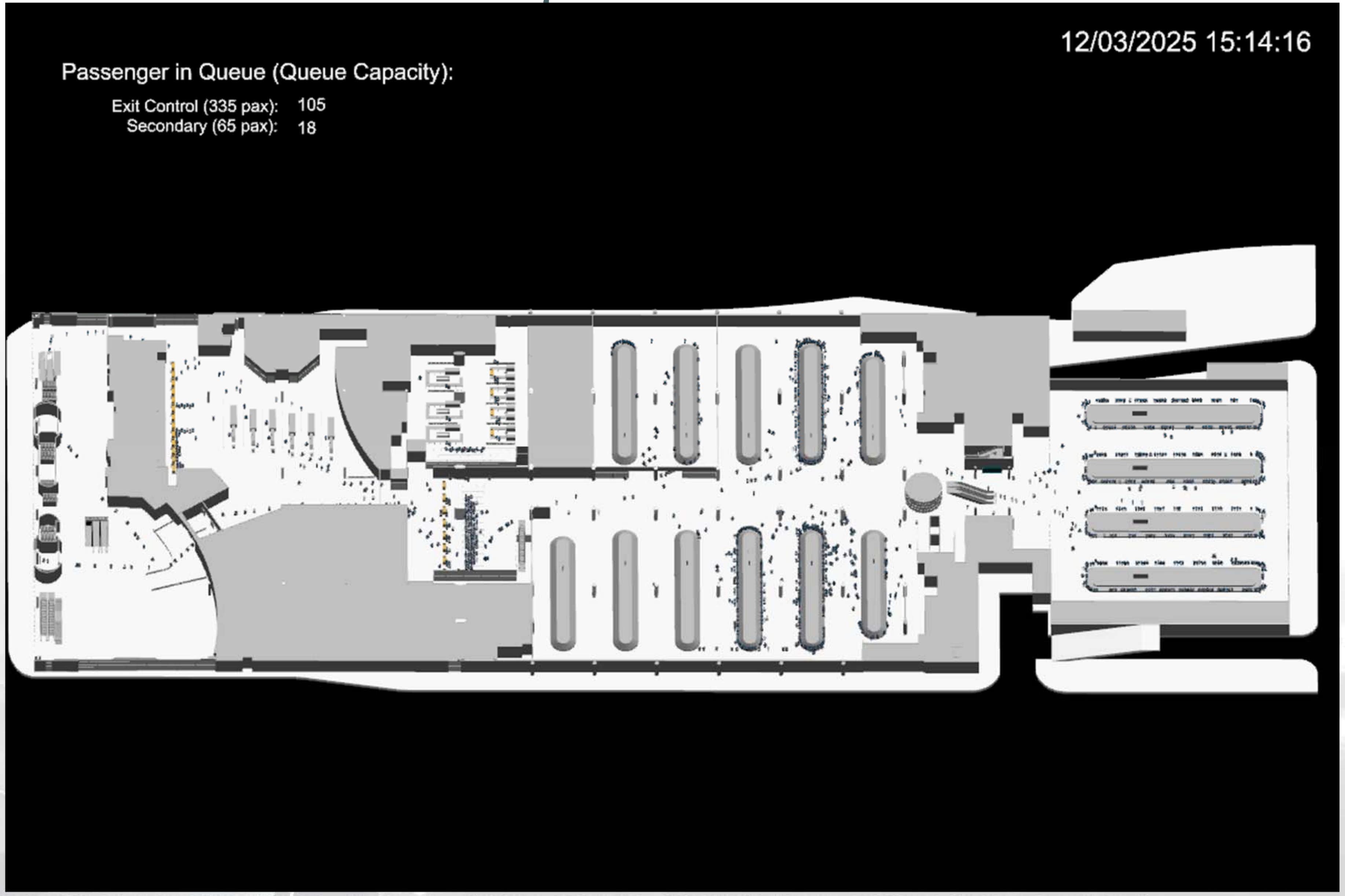
Baggage Claim, Exit Control, Secondary Inspection, and Recheck Lobby

Concept Simulation - Level 93



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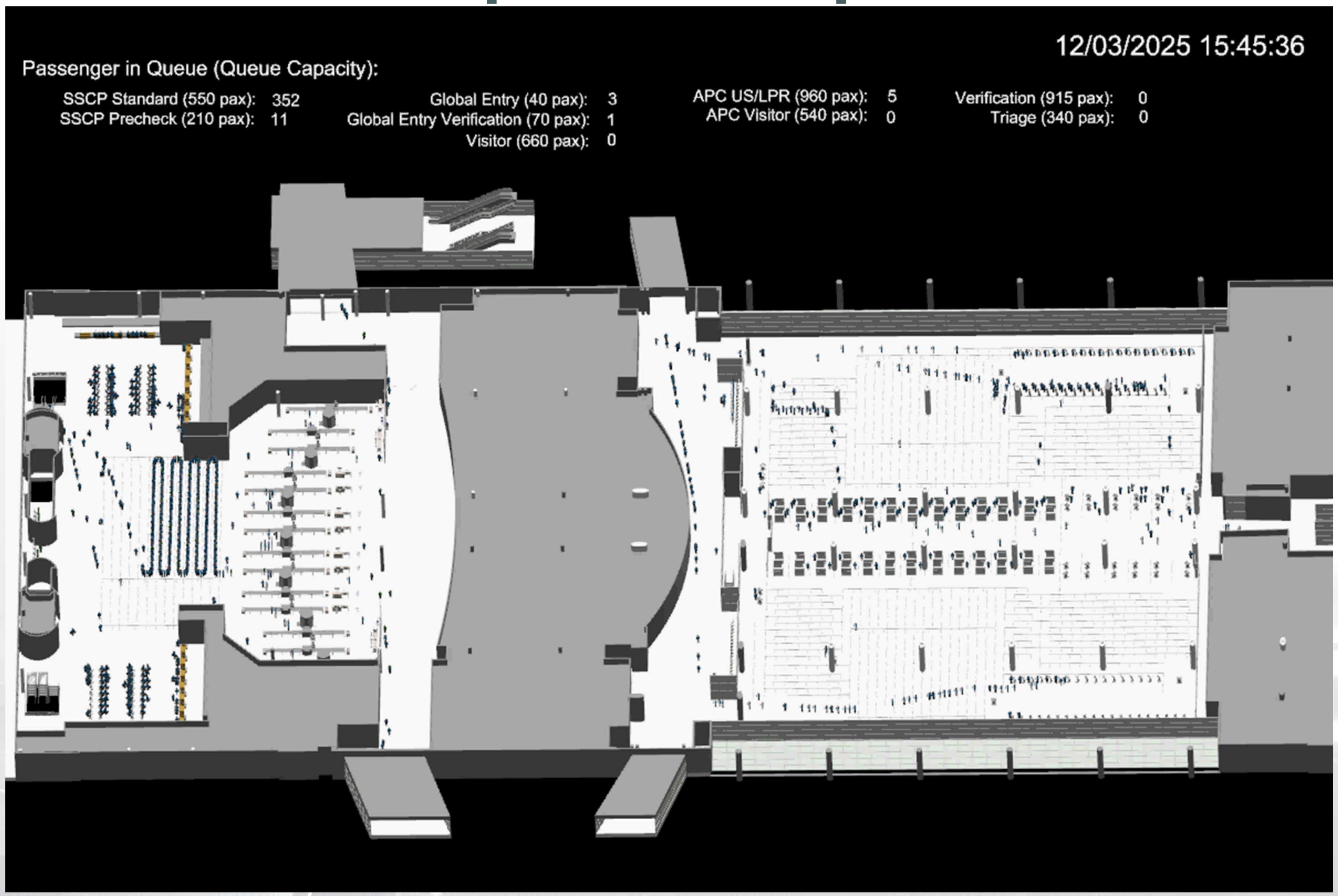
Consolidated Checkpoint Performance

Facility	Positions		Wait Time		Queue	
	Analysis	Concept	Goal	Concept	Capacity	Concept
Pre✓™	3	3	10 minutes	3 minutes	210 pax	30 pax
Standard	12	11	10 minutes	14 minutes	550 pax	365 pax
Total	**15**	**14**			**760 pax**	**395 pax**

Note: Passengers in queue are rounded to nearest 5.

- Standard security lanes exceed the level of service goal.
- Concept provides adequate passenger queue.

Consolidated Checkpoint Concept Simulation - Level 116



Summary

- Equal Primary facilities are needed for north and south processing to meet the level of service goal.
- Global Entry kiosks and verification officers required additional positions to meet the wait time goal.
- Passengers metered through concept facility create a higher demand for Standard exit control. However, additional queue demand can be accommodated within the total queue area.
- The 14 consolidated checkpoint lanes exceed the wait time goal.

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Appendix C | Elevator Study

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Appendix C - Elevator Analysis

D.1 Terminal E Elevator Analysis

The capacity of the existing Terminal E elevators at George Bush Intercontinental Airport (IAH) does not meet the demand of passengers exiting the Federal Inspection Services (FIS) facility, accessing the Subway Train level, or using the check-in lobby and parking garage levels above. During peak periods, long lines of passengers with baggage carts, strollers and wheelchairs form at the elevators on the International Arrivals level.

The Houston Airport System (HAS) engaged Ricondo & Associates, Inc. (R&A) to prepare a high-level assessment of the capacity of the Terminal E passenger elevators, which serve the Subway Level, Tunnel Level, Arrivals Level, Departures Level, and Levels 3 through 8 of the Terminal D and E parking garage. R&A worked with Knollwood Consulting LLC to determine alternatives to increase capacity by improving elevator mechanics (faster elevator technology) and/or adding additional elevators.

The planning team measured the mechanics and utilization of the existing elevators. Data collected through this effort included:

- Elevator operating mechanics
  - Average time doors are open
  - Travel time between floors (cycle time)
- Elevator capacity
- Photographs of existing conditions
- General observations of passenger usage during peak periods
- Use of HAS Security CCTV camera recordings of elevator use during peak periods to determine:
  - Passenger demand at each floor where cameras are present
  - Number of carts, strollers, and/or wheelchairs per trip
  - Unaccommodated queues outside elevators

Knollwood Consulting LLC provided vertical transportation consulting services, which includes an elevator equipment evaluation of the existing elevators. The elevator equipment evaluation consists of a summary of the existing equipment, maintenance routines, life cycle review, listing of any deficiencies, and a suggested preliminary modernization/repair outline with an estimated budget. The elevator equipment evaluation determines any physical and mechanical improvements that may be made to the existing elevators and how much reduction in the cycle time can be realistically expected through these improvements. The results of this analysis are documented in the following Existing Equipment Assessment report was prepared by Knollwood Consulting LLC. Additionally, Ricondo and Associates worked with Knollwood Consulting LLC to identify physical improvements required to implement any new technology or other changes identified (i.e. changes to elevator machine rooms, cabs, pits or shafts, etc.). Two concepts for adding additional elevator capacity are included in the Terminal E Elevator Analysis presentation following the Existing Equipment Assessment report prepared by Knollwood.

R&A worked with Knollwood Consulting LLC to identify physical improvements required to implement any new technology or other changes identified (i.e. changes to elevator machine rooms, cabs, pits or shafts, etc.). Two concepts for adding additional elevator capacity are included in the following Terminal E Elevator Analysis presentation.

EXISTING EQUIPMENT ASSESSMENT

AT

IAH AIRPORT
TERMINAL E
HOUSTON, TEXAS

Prepared for:

Ricondo & Associates
College Park, Georgia

Prepared by:

David Hollingsworth
Knollwood Consulting LLC
Vertical Transportation System Consultants

Date: August 8, 2015

TABLE OF CONTENTS:

IAH Airport Terminal E (#51, #52, #53 and #54):

IAH Airport Terminal E

A. Existing Elevator Configuration:

The elevators that were examined consisted of two separate groups of elevators that were operated in a Duplex Configuration. Elevators #51 and #52 were one group of elevators and elevators #53 and #54 were the other group.

B. Passenger Elevators:

There exist a total of four (4) passenger elevators (#51, #52, #53 & #54) which are configured in in two separate duplex operating systems that are located inside of the IAH Terminal E building envelope.

Thyssen Elevator Company originally installed the passenger elevators at the time of building erection, circa 2004.

The elevator machine room area is located directly overhead of the elevator hoistway in a confined and dedicated space located at the roof-top level.

The elevator machine room was noted as being adequate in size and configuration. (Please note that the majority of the elevator equipment manufacturers require that the elevator machine room area maintain an optimal temperature range of fifty-five (55) to ninety-five (95) degrees Fahrenheit.)

The passenger elevators have a rated capacity of 4500 lbs., and operate at a rated speed of three hundred fifty (350) feet per minute and serve a total of four (4) front openings @ T, W, 1 & 2 and five (5) rear openings @ 4, 5, 6, 7 and 8 for elevators #51 and #52, and two (2) front openings @ 1 & 2 and five (5) rear openings @ 4, 5, 6, 7 and 8 for elevators #53 and #54.

The elevators are an overhead geared traction type originally manufactured by Thyssen Elevator Company, circa 2004, and contain a AC hoist motor.

The geared machines contain a total of six (6) 5/8" hoisting cables in a 1:1, single-wrap traction configuration with a deflector sheave located in the machine room.

Thyssen Elevator Company originally installed the existing governors located in the machine room area.

The non-proprietary control system is manufactured by Motion Control Engineering, model IMC-AC, and was installed during the initial installation.

There is a total of one (1) riser of flush-mount vandal resistant hall buttons installed at each landing. The hall station buttons are of a mechanical illuminated round-button design.

The hall button station on the main floor of egress does contain a Phase 1 firefighter's service key switch and indicator.

The hoistway doors for all of the front door openings are of a two (2) speed side slide opening configuration, in a 4'-0" wide x 8'-0" high size and operated by a Thyssen Elevator closed loop AC car door operator located on top of the elevator.

The hoistway doors for all of the rear door openings are of a two (2) speed side slide opening configuration, in a 4'-0" wide x 7'-0" high size and operated by a Thyssen Elevator closed loop AC car door operator located on top of the elevator.

The hoistway door panels located at all of the landing are in a textured stainless steel finish and contain an emergency release hole at each landing served by the elevator.

The car door size is 4'-0" wide x 8'-0" high at the front opening and 4'-0" wide x 7' – 0" high at the rear opening. The car doors are configured in a two (2)-speed side side-opening configuration.

The cab consists of textured stainless steel wall panels on the sides of the elevator. The front and rear return panel, transom and jambs of the cab are in a #4 stainless steel finish. The cab has a suspended ceiling with a stainless steel frame, with down lights. The flooring is a standard tile floor that was installed flush to the car sill and did not pose a tripping hazard at the time of elevator survey.

The elevator interior contains a main and auxiliary car-operating panel with vandal proof mechanical illuminated round car buttons with an integral emergency car light device. The main car-operating panel is mounted in the front return panel. The elevator does contain a Phase 2 fire service key switch and written firefighter's instructions for Phase 2 operation that is a current code requirement.

The rails are a T-rail type with roller guides for the cars and counterweight installed at the top and bottom of the elevator cab and counterweight assembly. The counterweight rails are located on the side of each elevator hoistway.

Compensating chains (encapsulated) have been installed.

Access to the pit area of the elevators is via a code compliant pit ladder.

The pit areas contain one (1) oil buffer for the elevator, one oil buffer for the counterweight, pit ladder, stop switch, light and light switch, as well as a governor tension sheave device.

There is a sump hole and piping located in each pit area to remove water if necessary.

C. <u>Recommendations</u>:

Due to the heavy usage of the elevators at this location during peak operation there are several options that may be considered to improve the operation of the elevators.

1. Increase the signage in and around the elevators. Observations during the site visit indicated that there was mass confusion as to which elevators went to the train and walkway areas. Passengers entering from the parking areas were confused as to where the ticketing counter was located and most always seemed to go to the “T” or “W” floor first.
2. Initiate pre-opening of the elevator doors. This option allows for the car doors to slowly start opening when the elevator is within a predetermined distance from floor level (usually 2”) so that the door opening process has already started by the time the elevator stops at the floor.
3. Replace the car door operators with a newer more efficient door operator to increase the reliability and performance of the door operation.
4. Upgrade the control system to a newer more efficient controller, which has the ability to automatically sense changes in passenger demands and will dispatch the elevators accordingly.
5. Install and program a load-weighing device that will monitor the weight of the passengers on the elevators and bypass hall calls when the capacity becomes to great to accommodate more passengers. This system will also allow for the cancellation of the car calls if the amount of calls exceeds the probable amount expected for the weight in the car, commonly called the “anti-nuisance” feature.
6. Increase the speed of the elevator to 500 FPM. This will require a major modernization of the existing system.
7. Add additional elevators to the existing banks of elevators.
8. Extend the hoistways of elevators #53 & #54 down two (2) floors to match the existing landings of elevators #51 & #52. There is confusion when getting on the elevators in close proximity due to the difference in the floors served.

EQUIPMENT LIFE EXPECTANCY FOR <u>TRACTION</u> ELEVATORS

(The following is an actual vs. theoretical comparative of the existing equipment, in term of years of usage, as compared to acceptable industry averages for the life expectancy of the equipment. Matters such as the level and type of maintenance being provided, usage, obsolescence, vandalism, environmental conditions, etc., all have an impact upon the life expectancy of a component or piece of equipment; therefore, a recommendation may be made for replacement of a component even though there may be several years remaining of expected useful life.)

Elevator #51, #52, #53 and #54

Description of Major Component or System	Anticipated Life Expectancy	Present Age of Equip	Anticipated Remaining Life of Equip	Comments From Examination Of Equip			Recommended Course of Action
***** MACHINE ROOM AREA EQUIPMENT *****							
	(In Years)	(In Years)	(In Years)	(Poor)	(Fair)	(Good)	
➢ Hoist Machine, Sheaves, Bearings	25	12	13			√	Provide Routine Maintenance Procedures
➢ Hoist Motors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Motor Generator Sets, Power Drives (SCR)	N/A	N/A	N/A				N/A
➢ Selectors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Controllers	25	12	13		√		Provide Routine Maintenance Procedures
***** HOISTWAY AREA EQUIPMENT *****							
➢ Hoist, Governor, Comp Ropes/Cables	25	12	13			√	Provide Routine Maintenance Procedures
➢ Car & Counterweight ➢ Guide Rails	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Safety Equipment & Counterweight	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Hoistway Door Equipment	20	12	8		√		Provide Routine Maintenance Procedures
***** CAR INTERIOR, OPERATING AND SAFETY EQUIPMENT *****							
➢ Car Door Operator & Equip	20	12	8		√		Provide Routine Maintenance Procedures
➢ Cab Interior	25	12	8		√		Provide Routine Maintenance Procedures
➢ Car Frame & Platform	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Car Safety	70+	12	58+			√	Provide Routine Maintenance Procedures
***** CAR AND HALL PUSHBUTTON FIXTURES *****							
➢ Car & Hall Fixtures	20	12	8		√		Provide Routine Maintenance Procedures

THE AMERICANS WITH DISABILITIES ACT of 1990 (ADA)

The Title I of the Americans with Disabilities Act of 1990, (A.D.A) took effect on July 26, 1992. The ADA Act was past by the Senate and House of Representatives of the United States of America and is regarded as a Civil Rights Act which is currently being enforced by the United States Department of Justice.

The ADA Act prohibits discrimination of any kind against any disabled individual as it relates to any:

- ✓ Public accommodations
- ✓ Employment opportunities.
- ✓ State and local government services.
- ✓ Public transportation.
- ✓ Telecommunications.

Since ADA is not a local- or state-mandated law, local officials do not provide enforcement. Federal officials can only provide enforcement after they have received a complaint or lawsuit by an aggrieved person claiming discrimination under the Act.

The U.S. Equal Employment Opportunity Commission issued regulations to enforce the provisions of Title I of the ADA on July 26, 1991. The provisions originally took effect on July 26, 1992.

The information provided herein is only offered as assistance to our client for the elevators in operation at the time of the site survey and subject to the current applicable provisions of the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG). The examination provided offers an analysis of the existing operating features of the equipment related to current ADAAG requirements.

The client or their authorized representatives are then required to make the sole and final determination as to the extent of modifications that will be performed to adhere to the ADDAG requirements.

THE AMERICANS WITH DISABILITIES ACT
ELEVATOR SYSTEMS ADA COMPLIANCE EXAMINATION AND SURVEY

Elevator #51, #52, #53 and #54

"Y" = ACCEPTABLE "N" = NOT ACCEPTABLE

DESCRIPTION OF ITEM	Y	N	COMMENTS
ASME A17.1 Safety Code	X		
Cab Enclosure, i.e. cab layout, car door size, cab illumination and cab flooring	X		
Car Operating Panel, i.e. design, button location and function	X		
Car Signals and Communications, i.e. car indicators and telephone/intercom	X		
Car and Hallway Entrances, i.e. door size, signage and door retracting device	X		
Hall Fixtures, i.e. signals and location	X		
Jamb Braille Plates	X		
Car Operational Functions, i.e. automatic leveling and door times	X		
Additional Notes, Comments or Clarifications			

EQUIPMENT PROFILE
FOR
TRACTION ELEVATORS

A. GENERAL DESCRIPTION

1. Elevator Identification: **#51, #52, #53 and #54**

2. Loading Classification: Passenger

   a) Capacity: (lbs.) 4500

   b) Floors Served (Front): **#51 and #52** - Four (4) Front Openings @ T, W, 1 and 2

      #53 & #54 – Two (2) Front Openings @ 1 and 2

   c) Floors Served (Rear): **#51 and #52** - Five (5) rear openings @ 4, 5, 6, 7 and 8

      #53 and #54 - Five (5) rear openings @ 4, 5, 6, 7 and 8

   d) Rated Speed: (fpm) 350 FPM

B. MACHINE ROOM AREA

1. Location: Overhead

2. Type Machine: Geared Traction

3. Manufacturer: Thyssen Elevator Company

4. Roping: 1:1, SWT, Six (6) 5/8" Diameter Steel Traction

5. Brake: DC Type

6. Drive Motor: Thyssen AC

7. Controller Type: Micro Processor with VVVF control

8. Controller Manufacturer: Motion Control Engineering, IMC - AC

9. Power Supply: 480 VAC

10. Governor Type: Centrifugal

11. Governor Manufacturer: Thyssen Elevator Company

12. Governor Rope Size: 3/8" Diameter Steel

13. Selector Type: Perforated Selector Tape

14. Sequence/Type of Operation: Duplex

15. Access/Door: Satisfactory/Satisfactory

16. Ventilation/Clearances: Satisfactory/Satisfactory

17. Lighting/Fire Extinguisher: Satisfactory/Satisfactory

C. HOISTWAY AREA

1. Floors Served Front: **#51 and #52** – Four (4)
   #53 and #54 – Two (2)

2. Floors Served Rear: **All Elevators** – Five (5)

3. Floors Served Side: None

4. Door Configuration: Two (2) Speed Side Slide

5. Clear Opening: 4'- 0" Wide x 8'- 0" High - Front
   4'–0" Wide x 7'–0" High - Rear

6. Tracks/Hangers: Thyssen Elevator

7. Safety Interlocks: Thyssen Elevator

8. Self Closing Devices: Spirator Closers

9. Guide Rails Car: Steel T's - 15#

10. Guide Rails Counterweight: Steel T's - 8#

11. Guides (Car/CWT.): Roller Guides

D. PIT AREA

1. Access/Ladder: Existing

2. Car Buffer: One (1) Oil

3. Counterweight Buffer: One (1) Oil

4. Compensation: Chain

5. Lighting/Safety Switch: Satisfactory/Satisfactory

E. CAB ENCLOSURE & INTERIOR

1. Car Door Panel: Two (2) Speed Side Slide

2. Clear Opening: 4'-0" Wide x 8'-0" High - Front
4'-0" Wide x 8'-0" High - Rear

3. Door Protection: Non-Contact Infrared

4. Tracks/Hangers: Thyssen Elevator

5. Power Door Operator: Thyssen Elevator

6. Cab Materials: Textured Stainless Steel Wall Panels, Suspended Ceiling

#4 Stainless Steel Front, Transom & Strike Jamb

7. Saddle Material: Nickel/Silver

8. Sill to Sill Clearance: Satisfactory

9. Top of Car Station: Existing

10. Work Lighting (Top): Existing

F. FIXTURES & SIGNALS

1. Car Station: (Main) Illuminated vandal resistant Car Call Buttons

2. Auxiliary Car Station: Illuminated vandal resistant Car Call Buttons

3. Number of Push Button Risers: One (1) Flush-Mount

4. Push Button Type: Illuminated vandal resistant Hall Call Buttons

5. Car Position Indicator: Integral with Main Car Operating Panel

6. Floor Position Indicator: (Hall) None

7. Hall Arrival Lanterns: Vertical next to door frame

8. Lobby Telltale Panel/C.R.T.: N/A

9. Starters Panel: N/A

10. Auxiliary Lobby Panels: N/A

11. Security Controls (Remote): N/A

G. EMERGENCY SIGNALS & OPERATIONS

1. Fire Service: Existing

   a) Phase I - Manual: Existing

   b) Phase I - Automatic: Existing

   c) Phase II Operation: Existing

   d) Signals/Engraving: Existing

   e) Smoke Sensors: Existing

2. Emergency Power Provisions: (Location of Controls) Existing

3. Emergency Car Lighting Existing

4. Emergency Car Communication: Existing

5. Emergency Car Alarm: Existing

6. Life Safety Provisions: Existing

H. EQUIPMENT HISTORY

1. Original Equipment Manufacturer: Thyssen Elevator Company

2. Date of Original Installation: Circa 2004

3. Date of Last Upgrading: N/A

4. Modernization Contractor: N/A

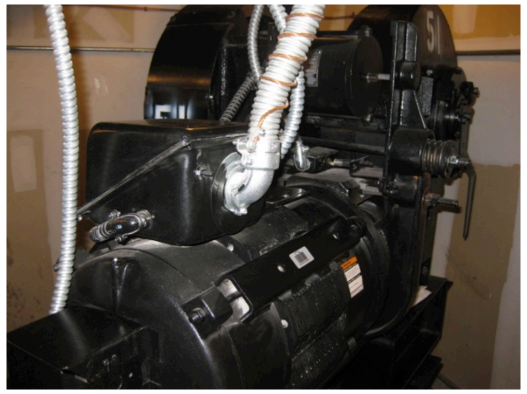
5. Present Service Company: Thyssen Elevator Company

ELEVATOR PERFORMNCE TIMES

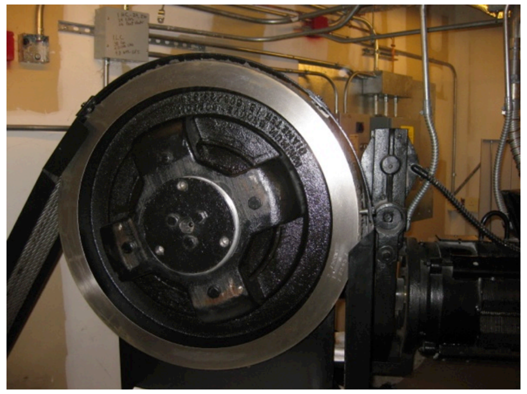
- **Floor-to-Floor Time:** Time required to make a one floor run. Measured from the time the hoistway doors start to close at one floor until they are fully opened at the next floor. Typical value for 350 fpm elevator with no more than 12 feet of travel – **12.1 seconds.**
- **Performance Time:** Measured from the time the doors start to close at one floor until they are significantly open to allow passenger exchange at the next floor. Typical value for 350 fpm with no more than 12 feet of travel – **10.1 seconds.**
- **Brake-to-Brake Time:** Measured from the time the elevator starts until it stops on a one floor run. Typical value for 350 fpm with no more than 12 feet of travel – **5.6 seconds.**
- **Door Open Time:** Measured from the time the doors start to open until fully open – **3.5 seconds.**
- **Door Dwell Time:** Length of time doors remains fully open by car or hall call without being affected by cancellation features – **5 seconds.**
- **Door Close Time – 3.5 seconds**

FUNCTION	ELEVATOR #51	ELEVATOR #52	ELEVATOR #53	ELEVATOR #54
Floor to Floor	**16.23**	**19.3**	**17.85**	**18.68**
Performance	**15.38**	**16.4**	**14.63**	**16.6**
Brake to Brake	**6.75**	**8**	**7.03**	**7.16**
Door Open	**3.99**	**4.9**	**4.56**	**4.68**
Door Dwell	**3.28**	**3.8**	**3.31**	**3.03**
Door Close	**5.49**	**6.4**	**6.26**	**6.84**

EXHIBIT "A" – PICTURES



TYPICAL GEARED HOIST MACHINE FRONT VIEW

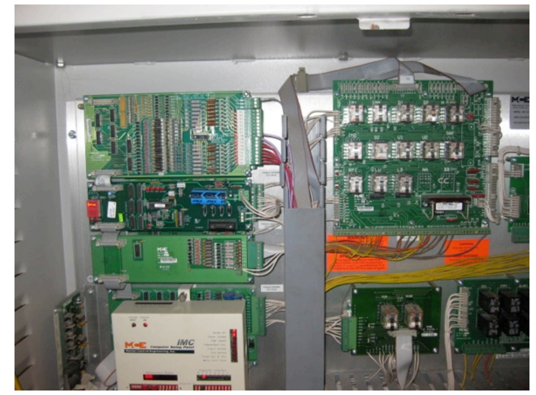


GEARED HOIST MACHINE SIDE VIEW

OVERSPEED GOVERNOR ASSEMBLY MOUNTED ON THE MACHINE ROOM FLOOR

MACHINE ROOM SMOKE DETECTOR

AC DRIVE UNIT MOUNTED IN THE ELEVATOR CONTROLLER



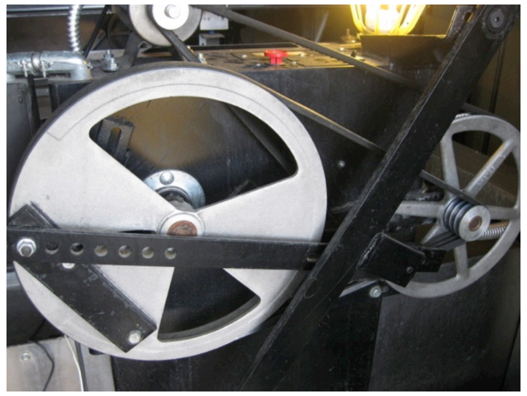
TYPICAL ELEVATOR CONTROLLER

MACHINE ROOM CLIMATE CONTROLL

ELEVATOR FIRE RECALL MODULES

TOP OF THE HOISTWAY AND UNDERSIDE OF THE MACHINE ROOM

TOP OF THE ELEVATOR CAB



TYPICAL CAR DOOR OPERATOR

ELEVATOR PIT WITH OIL BUFFER

ELEVATOR ARRIVAL LANTERS

TYPICAL SIGNAGE IN ELEVATOR LOBBY

MAIN FLOOR HALL FIXTURE WITH FIRE RECALL SWITCH

TYPICAL CAR OPERATING PANEL

TYPICAL HOISTWAY LOBBY DOOR

SUMP PUMP AREA IN THE ELEVATOR PIT

End of Document

R&A worked with Knollwood Consulting LLC to identify physical improvements required to implement any new technology or other changes identified (i.e. changes to elevator machine rooms, cabs, pits or shafts, etc.). Two concepts for adding additional elevator capacity are included in the following Terminal E Elevator Analysis presentation.


RICONDO®
& ASSOCIATES
IAH
George Bush Intercontinental Airport
Terminal E Elevator Analysis
17-December, 2015
RICONDO & ASSOCIATES, INC. | FROM GREAT COMPANIES COME GREAT IDEAS

TABLE OF CONTENTS:

IAH Airport Terminal E (#51, #52, #53 and #54):

Elevator 101

- Fundamental Physical Characteristics for Planning Elevators:
  - Operational Speed
  - Door Size
  - Cab Size
  - Hauling System Performance
  - Dwell Requirements
  - Elevator Boarding Areas
  - Wayfinding
  - Number of Floors Served
- Operational Speed: 350 feet per minute (maximum 500 feet per minute with modifications)
- Door Size: 4’-0” (wider doors increase speed of loading and unloading, better facilitates carts and wheelchairs)
- Existing Cab Size: 43.8 square feet

RICONDO & ASSOCIATES, INC. | FROM GREAT COMPANIES COME GREAT IDEAS 3

The hoistway doors for all of the front door openings are of a two (2) speed side slide opening configuration, in a 4’-0” wide x 8’-0” high size and operated by a Thyssen Elevator closed loop AC car door operator located on top of the elevator.

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The hoistway door panels located at all of the landing are in a textured stainless steel finish and contain an emergency release hole at each landing served by the elevator.

The car door size is 4’-0” wide x 8’-0” high at the front opening and 4’-0” wide x 7’ – 0” high at the rear opening. The car doors are configured in a two (2)-speed side side-opening configuration.

The cab consists of textured stainless steel wall panels on the sides of the elevator. The front and rear return panel, transom and jambs of the cab are in a #4 stainless steel finish. The cab has a suspended ceiling with a stainless steel frame, with down lights. The flooring is a standard tile floor that was installed flush to the car sill and did not pose a tripping hazard at the time of elevator survey.

The elevator interior contains a main and auxiliary car-operating panel with vandal proof mechanical illuminated round car buttons with an integral emergency car light device. The main car-operating panel is mounted in the front return panel. The elevator does contain a Phase 2 fire service key switch and written firefighter’s instructions for Phase 2 operation that is a current code requirement.

The rails are a T-rail type with roller guides for the cars and counterweight installed at the top and bottom of the elevator cab and counterweight assembly. The counterweight rails are located on the side of each elevator hoistway.

Compensating chains (encapsulated) have been installed.

Access to the pit area of the elevators is via a code compliant pit ladder.

The pit areas contain one (1) oil buffer for the elevator, one oil buffer for the counterweight, pit ladder, stop switch, light and light switch, as well as a governor tension sheave device.

There is a sump hole and piping located in each pit area to remove water if necessary.

C. Recommendations:

Due to the heavy usage of the elevators at this location during peak operation there are several options that may be considered to improve the operation of the elevators.

1. Increase the signage in and around the elevators. Observations during the site visit indicated that there was mass confusion as to which elevators went to the train and walkway areas. Passengers entering from the parking areas were confused as to where the ticketing counter was located and most always seemed to go to the “T” or “W” floor first.

2. Initiate pre-opening of the elevator doors. This option allows for the car doors to slowly start opening when the elevator is within a predetermined distance from floor level (usually 2”) so that the door opening process has already started by the time the elevator stops at the floor.

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4. Upgrade the control system to a newer more efficient controller, which has the ability to automatically sense changes in passenger demands and will dispatch the elevators accordingly.

5. Install and program a load-weighing device that will monitor the weight of the passengers on the elevators and bypass hall calls when the capacity becomes to great to accommodate more passengers. This system will also allow for the cancellation of the car calls if the amount of calls exceeds the probable amount expected for the weight in the car, commonly called the “anti-nuisance” feature.

6. Increase the speed of the elevator to 500 FPM. This will require a major modernization of the existing system.

7. Add additional elevators to the existing banks of elevators.

8. Extend the hoistways of elevators #53 & #54 down two (2) floors to match the existing landings of elevators #51 & #52. There is confusion when getting on the elevators in close proximity due to the difference in the floors served.

EQUIPMENT LIFE EXPECTANCY FOR TRACTION ELEVATORS

(The following is an actual vs. theoretical comparative of the existing equipment, in term of years of usage, as compared to acceptable industry averages for the life expectancy of the equipment. Matters such as the level and type of maintenance being provided, usage, obsolescence, vandalism, environmental conditions, etc., all have an impact upon the life expectancy of a component or piece of equipment; therefore, a recommendation may be made for replacement of a component even though there may be several years remaining of expected useful life.)

Elevator #51, #52, #53 and #54

Description of Major Component or System	Anticipated Life Expectancy	Present Age of Equip	Anticipated Remaining Life of Equip	Comments From Examination Of Equip			Recommended Course of Action
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	(In Years)	(In Years)	(In Years)	(Poor)	(Fair)	(Good)	
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➢ Hoist Motors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Motor Generator Sets, Power Drives (SCR)	N/A	N/A	N/A				N/A
➢ Selectors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Controllers	25	12	13		√		Provide Routine Maintenance Procedures
***** HOISTWAY AREA EQUIPMENT *****							
➢ Hoist, Governor, Comp Ropes/Cables	25	12	13			√	Provide Routine Maintenance Procedures
➢ Car & Counterweight ➢ Guide Rails	70+	12	58+			√	Provide Routine Maintenance Procedures
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***** CAR AND HALL PUSHBUTTON FIXTURES *****							
➢ Car & Hall Fixtures	20	12	8		√		Provide Routine Maintenance Procedures

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The Title I of the Americans with Disabilities Act of 1990, (A.D.A) took effect on July 26, 1992. The ADA Act was past by the Senate and House of Representatives of the United States of America and is regarded as a Civil Rights Act which is currently being enforced by the United States Department of Justice.

The ADA Act prohibits discrimination of any kind against any disabled individual as it relates to any:

- ✓ Public accommodations
- ✓ Employment opportunities.
- ✓ State and local government services.
- ✓ Public transportation.
- ✓ Telecommunications.

Since ADA is not a local- or state-mandated law, local officials do not provide enforcement. Federal officials can only provide enforcement after they have received a complaint or lawsuit by an aggrieved person claiming discrimination under the Act.

The U.S. Equal Employment Opportunity Commission issued regulations to enforce the provisions of Title I of the ADA on July 26, 1991. The provisions originally took effect on July 26, 1992.

The information provided herein is only offered as assistance to our client for the elevators in operation at the time of the site survey and subject to the current applicable provisions of the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG). The examination provided offers an analysis of the existing operating features of the equipment related to current ADAAG requirements.

The client or their authorized representatives are then required to make the sole and final determination as to the extent of modifications that will be performed to adhere to the ADDAG requirements.

THE AMERICANS WITH DISABILITIES ACT
ELEVATOR SYSTEMS ADA COMPLIANCE EXAMINATION AND SURVEY

Elevator #51, #52, #53 and #54

"Y" = ACCEPTABLE "N" = NOT ACCEPTABLE

DESCRIPTION OF ITEM	Y	N	COMMENTS
ASME A17.1 Safety Code	X		
Cab Enclosure, i.e. cab layout, car door size, cab illumination and cab flooring	X		
Car Operating Panel, i.e. design, button location and function	X		
Car Signals and Communications, i.e. car indicators and telephone/intercom	X		
Car and Hallway Entrances, i.e. door size, signage and door retracting device	X		
Hall Fixtures, i.e. signals and location	X		
Jamb Braille Plates	X		
Car Operational Functions, i.e. automatic leveling and door times	X		
Additional Notes, Comments or Clarifications			

EQUIPMENT PROFILE
FOR
TRACTION ELEVATORS

A. GENERAL DESCRIPTION

1. Elevator Identification: **#51, #52, #53 and #54**

2. Loading Classification: Passenger

   a) Capacity: (lbs.) 4500

   b) Floors Served (Front): **#51 and #52** - Four (4) Front Openings @ T, W, 1 and 2

      #53 & #54 – Two (2) Front Openings @ 1 and 2

   c) Floors Served (Rear): **#51 and #52** - Five (5) rear openings @ 4, 5, 6, 7 and 8

      #53 and #54 - Five (5) rear openings @ 4, 5, 6, 7 and 8

   d) Rated Speed: (fpm) 350 FPM

B. MACHINE ROOM AREA

1. Location: Overhead

2. Type Machine: Geared Traction

3. Manufacturer: Thyssen Elevator Company

4. Roping: 1:1, SWT, Six (6) 5/8" Diameter Steel Traction

5. Brake: DC Type

6. Drive Motor: Thyssen AC

7.	Controller Type:	Micro Processor with VVVF control
8.	Controller Manufacturer:	Motion Control Engineering, IMC - AC
9.	Power Supply:	480 VAC
10.	Governor Type:	Centrifugal
11.	Governor Manufacturer:	Thyssen Elevator Company
12.	Governor Rope Size:	3/8” Diameter Steel
13.	Selector Type:	Perforated Selector Tape
14.	Sequence/Type of Operation:	Duplex
15.	Access/Door:	Satisfactory/Satisfactory
16.	Ventilation/Clearances:	Satisfactory/Satisfactory
17.	Lighting/Fire Extinguisher:	Satisfactory/Satisfactory

C. HOISTWAY AREA

1.	Floors Served Front:	**#51 and #52** – Four (4) **#53 and #54** – Two (2)
2.	Floors Served Rear:	**All Elevators** – Five (5)
3.	Floors Served Side:	None
4.	Door Configuration:	Two (2) Speed Side Slide
5.	Clear Opening:	4’- 0” Wide x 8’- 0” High - Front 4’–0” Wide x 7’–0” High - Rear
6.	Tracks/Hangers:	Thyssen Elevator
7.	Safety Interlocks:	Thyssen Elevator
8.	Self Closing Devices:	Spirator Closers
9.	Guide Rails Car:	Steel T’s - 15#

10.	Guide Rails Counterweight:	Steel T's - 8#
11.	Guides (Car/CWT.):	Roller Guides

D. PIT AREA

1.	Access/Ladder:	Existing
2.	Car Buffer:	One (1) Oil
3.	Counterweight Buffer:	One (1) Oil
4.	Compensation:	Chain
5.	Lighting/Safety Switch:	Satisfactory/Satisfactory

E. CAB ENCLOSURE & INTERIOR

1.	Car Door Panel:	Two (2) Speed Side Slide
2.	Clear Opening:	4'-0" Wide x 8'-0" High - Front 4'-0" Wide x 8'-0" High - Rear
3.	Door Protection:	Non-Contact Infrared
4.	Tracks/Hangers:	Thyssen Elevator
5.	Power Door Operator:	Thyssen Elevator
6.	Cab Materials:	Textured Stainless Steel Wall Panels, Suspended Ceiling #4 Stainless Steel Front, Transom & Strike Jamb
7.	Saddle Material:	Nickel/Silver
8.	Sill to Sill Clearance:	Satisfactory
9.	Top of Car Station:	Existing
10.	Work Lighting (Top):	Existing

F. FIXTURES & SIGNALS

1.	Car Station: (Main)	Illuminated vandal resistant Car Call Buttons
2.	Auxiliary Car Station:	Illuminated vandal resistant Car Call Buttons
3.	Number of Push Button Risers:	One (1) Flush-Mount
4.	Push Button Type:	Illuminated vandal resistant Hall Call Buttons
5.	Car Position Indicator:	Integral with Main Car Operating Panel
6.	Floor Position Indicator: (Hall)	None
7.	Hall Arrival Lanterns:	Vertical next to door frame
8.	Lobby Telltale Panel/C.R.T.:	N/A
9.	Starters Panel:	N/A
10.	Auxiliary Lobby Panels:	N/A
11.	Security Controls (Remote):	N/A

G. EMERGENCY SIGNALS & OPERATIONS

1.	Fire Service:	Existing
a)	Phase I - Manual:	Existing
b)	Phase I - Automatic:	Existing
c)	Phase II Operation:	Existing
d)	Signals/Engraving:	Existing
e)	Smoke Sensors:	Existing

2.	Emergency Power Provisions: (Location of Controls)	Existing
3.	Emergency Car Lighting	Existing
4.	Emergency Car Communication:	Existing
5.	Emergency Car Alarm:	Existing
6.	Life Safety Provisions:	Existing

H. EQUIPMENT HISTORY

1.	Original Equipment Manufacturer:	Thyssen Elevator Company
2.	Date of Original Installation:	Circa 2004
3.	Date of Last Upgrading:	N/A
4.	Modernization Contractor:	N/A
5.	Present Service Company:	Thyssen Elevator Company

ELEVATOR PERFORMNCE TIMES

- **Floor-to-Floor Time:** Time required to make a one floor run. Measured from the time the hoistway doors start to close at one floor until they are fully opened at the next floor. Typical value for 350 fpm elevator with no more than 12 feet of travel – **12.1 seconds.**

- **Performance Time:** Measured from the time the doors start to close at one floor until they are significantly open to allow passenger exchange at the next floor. Typical value for 350 fpm with no more than 12 feet of travel – **10.1 seconds.**

- **Brake-to-Brake Time:** Measured from the time the elevator starts until it stops on a one floor run. Typical value for 350 fpm with no more than 12 feet of travel – **5.6 seconds.**

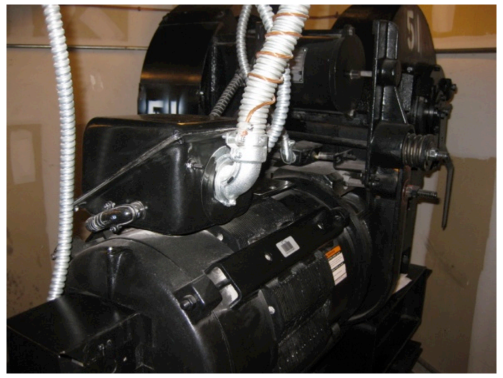
- **Door Open Time:** Measured from the time the doors start to open until fully open – **3.5 seconds.**

- **Door Dwell Time:** Length of time doors remains fully open by car or hall call without being affected by cancellation features – **5 seconds.**

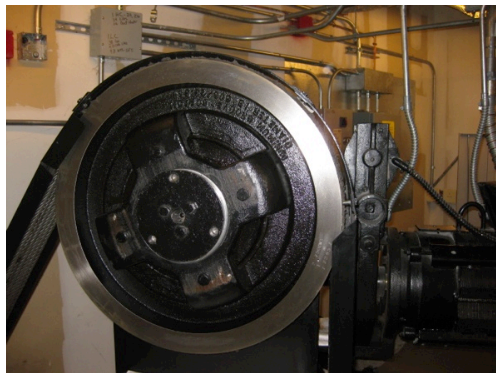
- **Door Close Time – 3.5 seconds**

FUNCTION	ELEVATOR #51	ELEVATOR #52	ELEVATOR #53	ELEVATOR #54
Floor to Floor	16.23	19.3	17.85	18.68
Performance	15.38	16.4	14.63	16.6
Brake to Brake	6.75	8	7.03	7.16
Door Open	3.99	4.9	4.56	4.68
Door Dwell	3.28	3.8	3.31	3.03
Door Close	5.49	6.4	6.26	6.84

EXHIBIT "A" – PICTURES



TYPICAL GEARED HOIST MACHINE FRONT VIEW



GEARED HOIST MACHINE SIDE VIEW

OVERSPEED GOVERNOR ASSEMBLY MOUNTED ON THE MACHINE ROOM FLOOR

MACHINE ROOM SMOKE DETECTOR

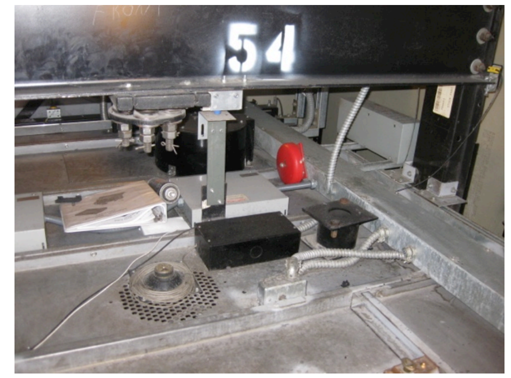
AC DRIVE UNIT MOUNTED IN THE ELEVATOR CONTROLLER

TYPICAL ELEVATOR CONTROLLER

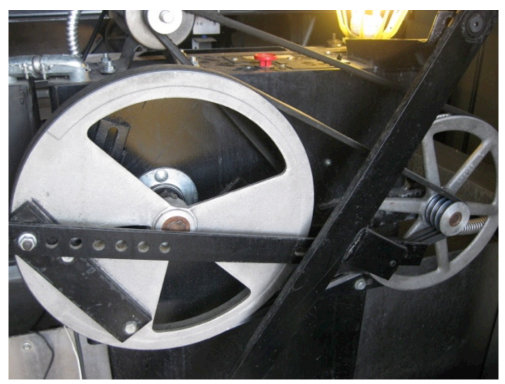
MACHINE ROOM CLIMATE CONTROLL

ELEVATOR FIRE RECALL MODULES

TOP OF THE HOISTWAY AND UNDERSIDE OF THE MACHINE ROOM



TOP OF THE ELEVATOR CAB



TYPICAL CAR DOOR OPERATOR

ELEVATOR PIT WITH OIL BUFFER

IAH Airport
Houston, Texas
8/8/2015

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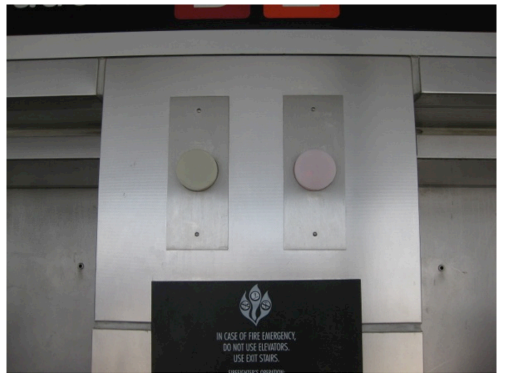
Existing Equipment Assessment



ELEVATOR ARRIVAL LANTERS

TYPICAL SIGNAGE IN ELEVATOR LOBBY

MAIN FLOOR HALL FIXTURE WITH FIRE RECALL SWITCH

TYPICAL CAR OPERATING PANEL

TYPICAL HOISTWAY LOBBY DOOR

SUMP PUMP AREA IN THE ELEVATOR PIT

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Appendix D

Existing FIS Modeling/ Simulation Results

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RICONDO® & ASSOCIATES
IAH
George Bush Intercontinental Airport
Federal Inspection Services Facility
Facility Requirements (Existing Conditions)
18-March, 2016
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Agenda

- Assumptions
- Existing Conditions
- Analysis
  - Requirements

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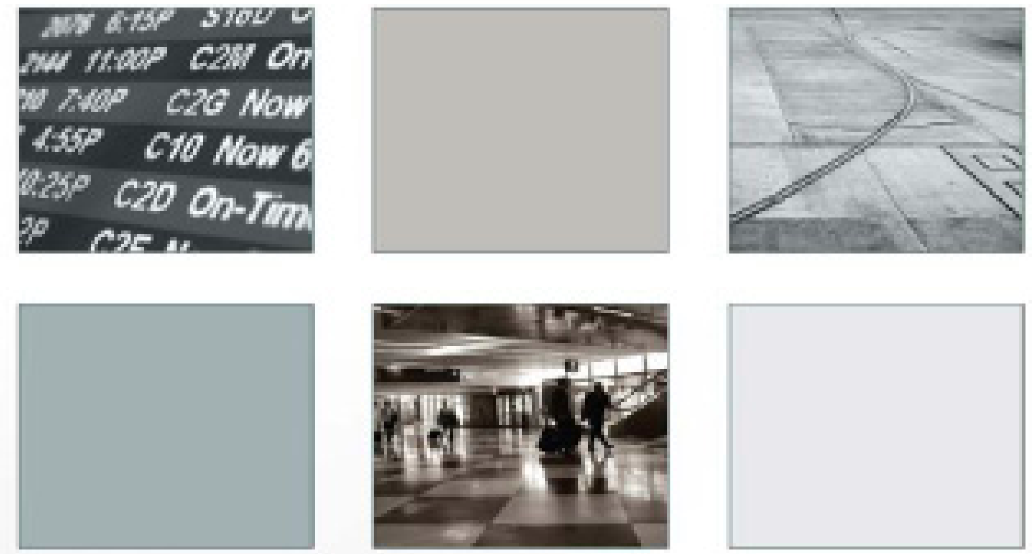
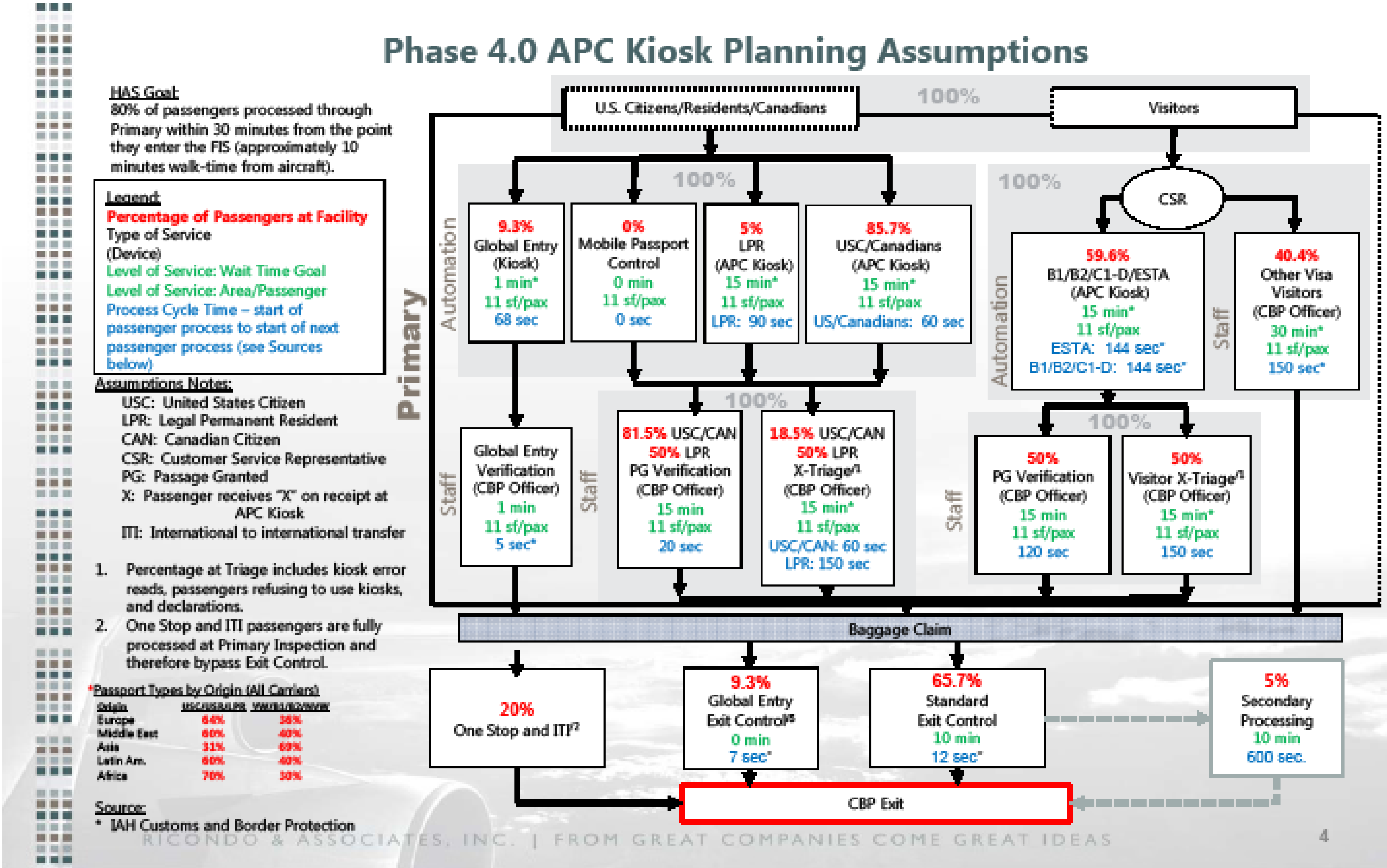


FEDERAL INSPECTION SERVICES (FIS)


Phase 4.0 APC Kiosk Planning Assumptions
HAS Goal:
80% of passengers processed through Primary within 30 minutes from the point they enter the FIS (approximately 10 minutes walk-time from aircraft).
Legend:
Percentage of Passengers at Facility
Type of Service
(Device)
Level of Service: Wait Time Goal
Level of Service: Area/Passenger
Process Cycle Time – start of passenger process to start of next passenger process (see Sources below)
Assumptions Notes:
USC: United States Citizen
LPR: Legal Permanent Resident
CAN: Canadian Citizen
CSR: Customer Service Representative
PG: Passage Granted
X: Passenger receives "X" on receipt at APC Kiosk
ITI: International to international transfer
1. Percentage at Triage includes kiosk error reads, passengers refusing to use kiosks, and declarations.
2. One Stop and ITI passengers are fully processed at Primary Inspection and therefore bypass Exit Control.
*Passport Types by Origin (All Carriers)
Origin
Europe 64% 36%
Middle East 60% 40%
Asia 31% 69%
Latin Am. 60% 40%
Africa 70% 30%
Source:
* IAH Customs and Border Protection
Primary
U.S. Citizens/Residents/Canadians
100%
Visitors
Automation
100%
9.3% Global Entry (Kiosk) 1 min* 11 sf/pax 68 sec
0% Mobile Passport Control 0 min 11 sf/pax 0 sec
5% LPR (APC Kiosk) 15 min* 11 sf/pax LPR: 90 sec
85.7% USC/Canadians (APC Kiosk) 15 min* 11 sf/pax US/Canadians: 60 sec
100%
CSR
Automation
59.6% B1/B2/C1-D/ESTA (APC Kiosk) 15 min* 11 sf/pax ESTA: 144 sec* B1/B2/C1-D: 144 sec*
Staff
40.4% Other Visa Visitors (CBP Officer) 30 min* 11 sf/pax 150 sec*
Staff
Global Entry Verification (CBP Officer) 1 min 11 sf/pax 5 sec*
Staff
100%
81.5% USC/CAN 50% LPR PG Verification (CBP Officer) 15 min 11 sf/pax 20 sec
18.5% USC/CAN 50% LPR X-Triage[1] (CBP Officer) 15 min* 11 sf/pax USC/CAN: 60 sec LPR: 150 sec
Staff
100%
50% PG Verification (CBP Officer) 15 min 11 sf/pax 120 sec
50% Visitor X-Triage[1] (CBP Officer) 15 min* 11 sf/pax 150 sec
Baggage Claim
20% One Stop and ITI[2]
9.3% Global Entry Exit Control[3] 0 min 7 sec*
65.7% Standard Exit Control 10 min 12 sec*
5% Secondary Processing 10 min 600 sec.
CBP Exit
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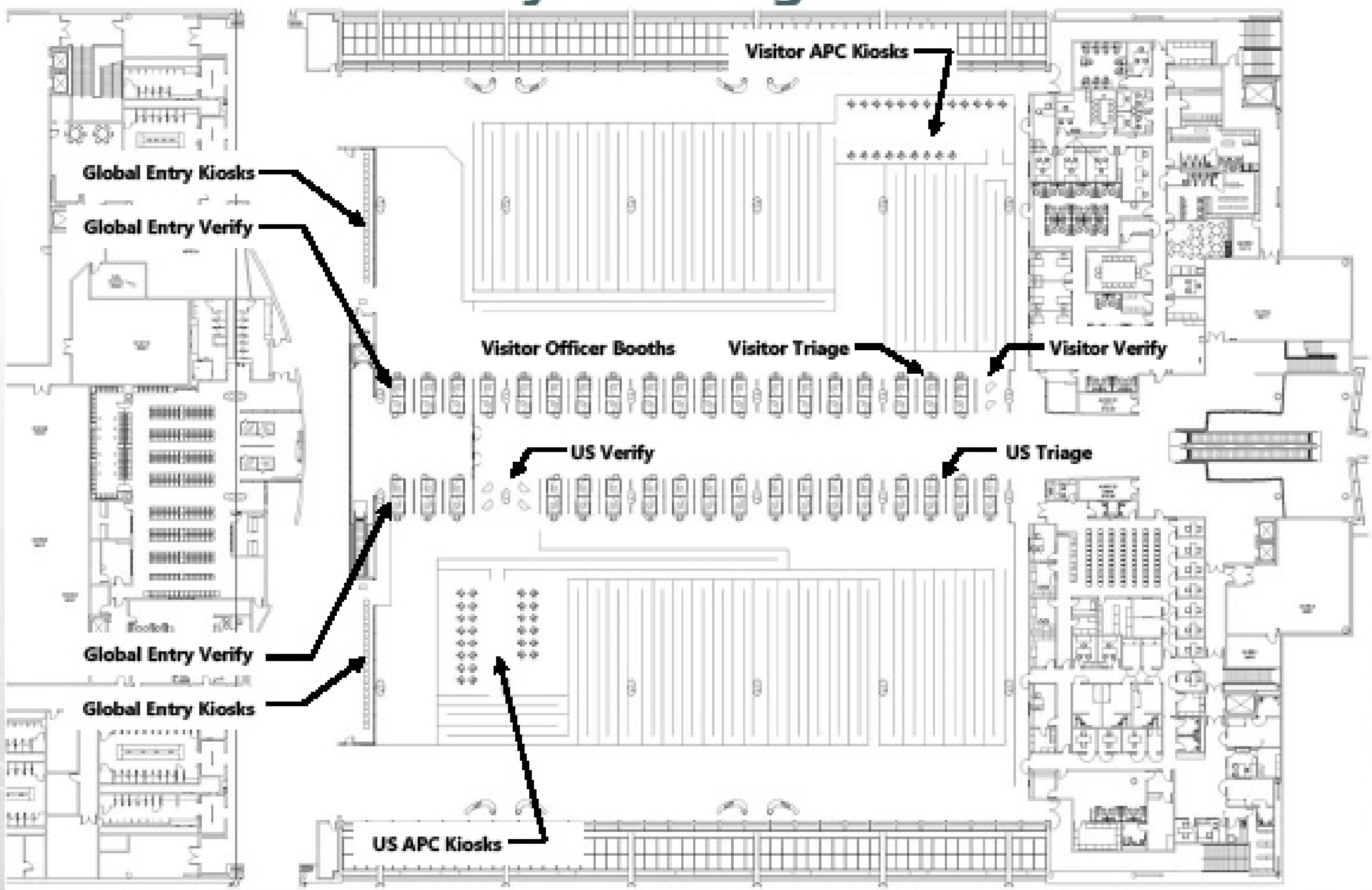
Primary: Existing Conditions



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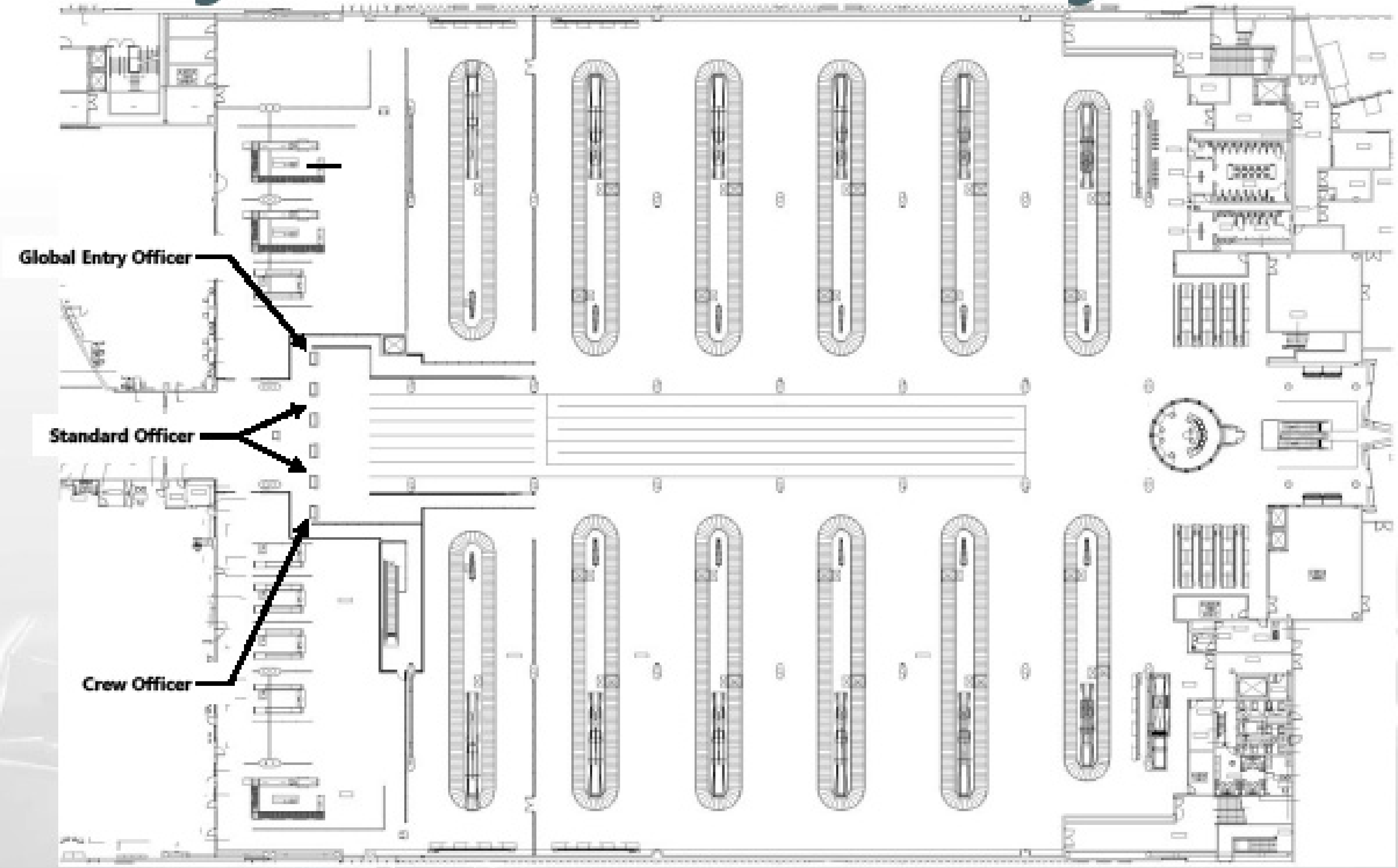
Bag Claim and Exit Control: Existing Conditions



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IAH FIS: Analysis Summary

Facility	Inventory	Queue Capacity		Wait Time Goal	Peak Hour Requirements: Requirements	Queue Capacity		Max Wait Time
Primary Inspection	Units	Passengers	Area (sf)	mm:ss	Units	Passengers	Area (sf)	mm:ss
Automation								
USC/LPR/Canadians APC Kiosks	28	3,630	39,160	15:00	23	360	3,890	14:50
B1/B2/C1-D/ESTA APC Kiosks	22			15:00	23	160	1,730	14:05
Global Entry Kiosks	40			1:00	22	30	320	1:00
Total Kiosks	**90**			-	**68**	**550**	**5,940**	-
Staff Positions								
US Verification Podium Officer	4			15:00	6	30	320	1:10
Visitor Verification Podium Officer	2			15:00	9	50	540	9:20
US Triage Booth Officer	8			15:00	5	50	540	11:00
Visitor Triage Booth Officer	6			15:00	10	65	700	14:25
Other Visa Visitors Booth Officer	26			30:00	14	180	1,940	29:50
Global Entry Verification Podium Officer	2			1:00	2	5	50	0:33
Total Staff Positions	**48**			-	**46**	**380**	**4,090**	-
Exit Control Inspection								
Staff Positions								
Standard Exit Control Officer	10	690	13,380	10:00	11	55	1,070	1:15
Global Entry Exit Control Officer	1			0:00	1	5	100	0:25
Crew Exit Control Officer	1			-	-	-	-	-
Total Staff Positions	**12**				**12**	**60**	**1,170**	-
Description								

Conclusions:

- 46 total APC Kiosks are needed to the meet wait time goal
- 22 total Global Entry Kiosks are needed to meet the wait time goal
- 46 total CBP staffed officer positions in Primary
- 12 total CBP staffed officer positions at Exit Control
- All customer service goals have been met; 100% of peak hour passengers processed through Primary Inspection in 30 minutes or less.

Notes:
- Passengers rounded to nearest 5.
- Area (sf) rounded to nearest 10..

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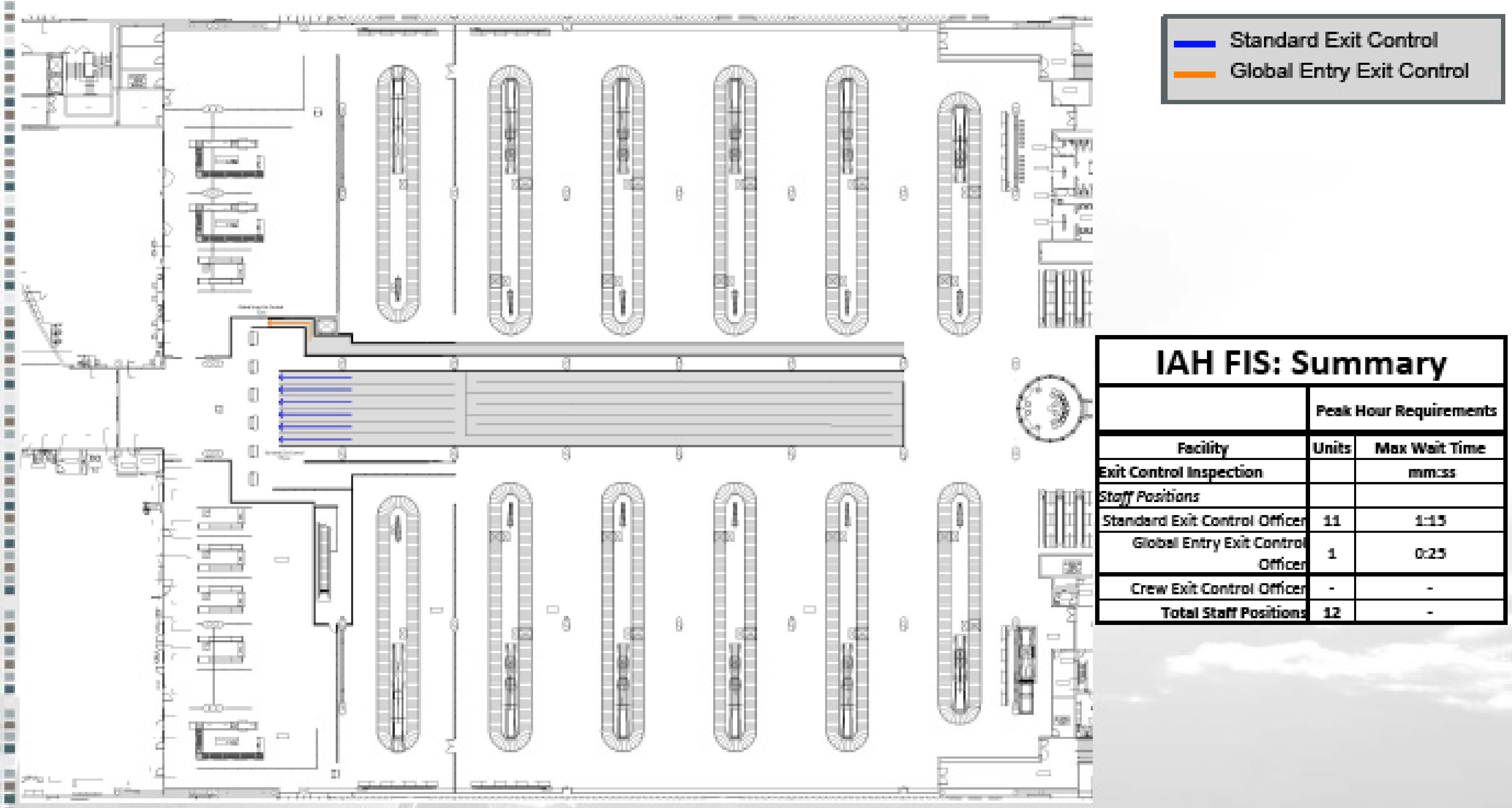
Primary: Requirements

IAH FIS: Summary

Facility	Peak Hour Requirements: Units	Peak Hour Requirements: Max Wait Time
Primary Inspection		mm:ss
Automation		
USC/LPR/Canadians APC Kiosks	23	14:30
B1/B2/C1-D/ESTA APC Kiosks	23	14:05
Global Entry Kiosks	22	1:00
Total Kiosks	68	-
Staff Positions		
US Verification Podium Officer	6	1:10
Visitor Verification Podium Officer	9	9:20
US Triage Booth Officer	5	11:00
Visitor Triage Booth Officer	10	14:25
Other Visa Visitors Booth Officer	14	29:30
Global Entry Verification Podium Officer	2	0:33
Total Staff Positions	46	-

Bag Claim and Exit Control: Requirements



IAH FIS: Summary

	Peak Hour Requirements	
Facility	Units	Max Wait Time
Exit Control Inspection		mm:ss
Staff Positions		
Standard Exit Control Officer	11	1:15
Global Entry Exit Control Officer	1	0:25
Crew Exit Control Officer	-	-
Total Staff Positions	12	-

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Appendix E

Staffing Sensitivity Study

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Appendix E - Staffing Sensitivity Study

F.1 FIS Facility CBP Staffing Sensitivity Analysis

Concerns were raised during FIS Stakeholder meetings about the level of service passengers experience during peak periods if the FIS facility is not fully staffed by Customs and Border Protection (CBP) officers. R&A performed sensitivity tests using the CAST passenger proof of concept simulation model developed for the IAH FIS Program Definition Manual (PDM) to determine at what level of staffing 80 percent of passengers are no longer processed through CBP Primary Processing within 30 minutes or less.

Building on the efforts of the IAH FIS PDM facility requirements modeling, R&A developed a sensitivity study based on reduced CBP staffing at CBP Primary Processing and at CBP Exit Control. The study investigated the effects of the overall FIS process including the international baggage claim facility, the Recheck Hall and the consolidated passenger security screening checkpoint. R&A used the following approach to analyze the impacts of reduced staffing on the FIS:

- Reduce each CBP Primary Processing and Exit Control staffed position by one officer per model run at each of the following positions until fewer than 80 percent of the deplaning international passengers are processed through CBP Primary Processing within 30 minutes (HAS performance goal):

    - Global Entry Verification Counters
    - APC Verification Counters
    - APC Triage Booths
    - Visitor Agent Booths
    - Exit Control Global Entry Lanes
    - Exit Control Standard Lanes

The Exit Control staffing was reduced by one officer per model run until the passenger queue overflowed the allocated Exit Control area. R&A's analysis did not include modeling of CBP Secondary Processing.

Results of the analysis are documented in the following PowerPoint presentation shared with the Houston Airports System staff on July 22, 2015 and again on October 1, 2015.

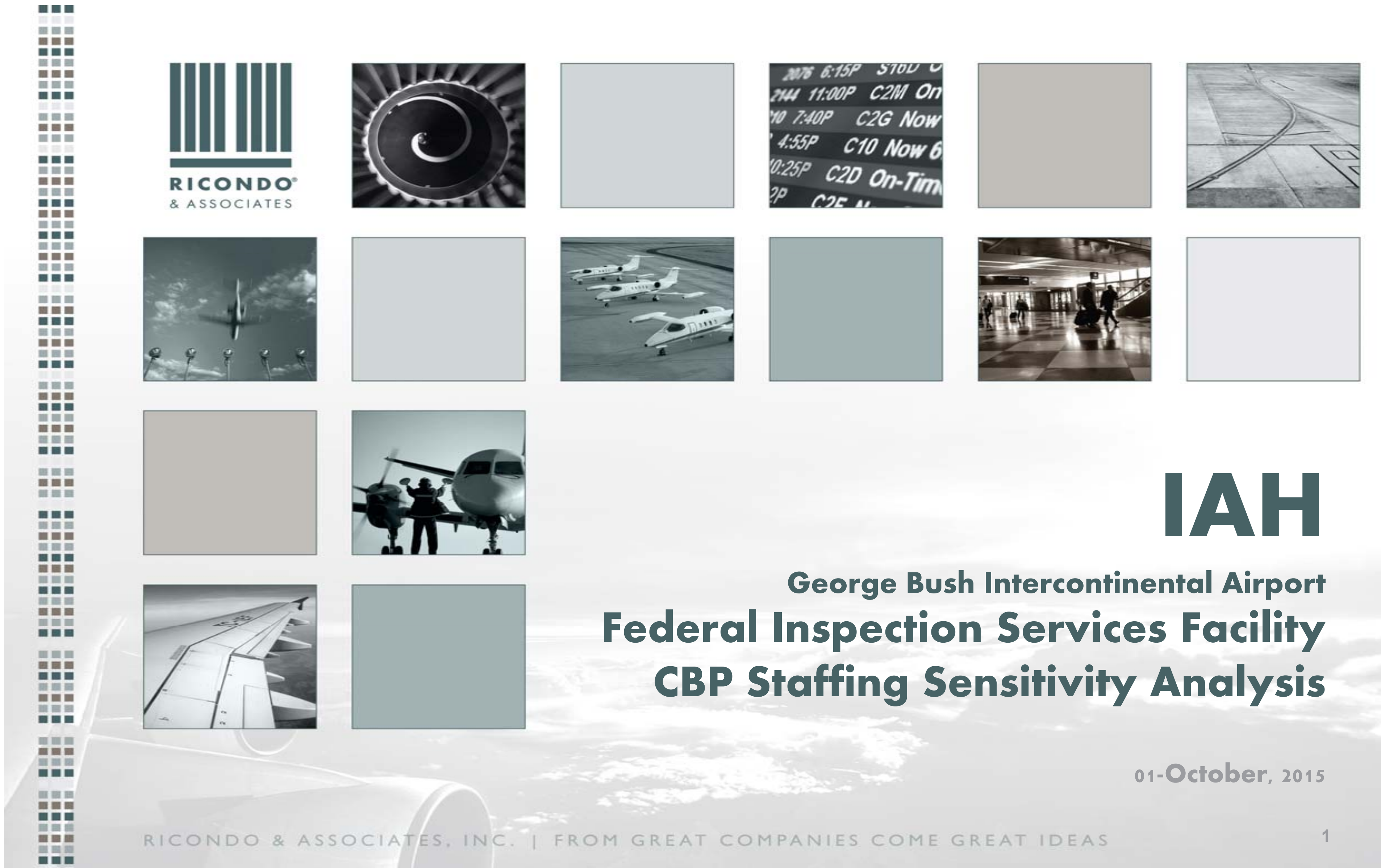
RICONDO & ASSOCIATES
2076 6:15P S16D
2144 11:00P C2M On
7:40P C2G Now
4:55P C10 Now
0:25P C2D On-Tim
IAH
George Bush Intercontinental Airport
Federal Inspection Services Facility
CBP Staffing Sensitivity Analysis
01-October, 2015
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TABLE OF CONTENTS:

<u>IAH Airport Terminal E (#51, #52, #53 and #54)</u>:

IAH Airport Terminal E

A. Existing Elevator Configuration:

The elevators that were examined consisted of two separate groups of elevators that were operated in a Duplex Configuration. Elevators #51 and #52 were one group of elevators and elevators #53 and #54 were the other group.

B. Passenger Elevators:

There exist a total of four (4) passenger elevators (#51, #52, #53 & #54) which are configured in in two separate duplex operating systems that are located inside of the IAH Terminal E building envelope.

Thyssen Elevator Company originally installed the passenger elevators at the time of building erection, circa 2004.

The elevator machine room area is located directly overhead of the elevator hoistway in a confined and dedicated space located at the roof-top level.

The elevator machine room was noted as being adequate in size and configuration. (Please note that the majority of the elevator equipment manufacturers require that the elevator machine room area maintain an optimal temperature range of fifty-five (55) to ninety-five (95) degrees Fahrenheit.)

The passenger elevators have a rated capacity of 4500 lbs., and operate at a rated speed of three hundred fifty (350) feet per minute and serve a total of four (4) front openings @ T, W, 1 & 2 and five (5) rear openings @ 4, 5, 6, 7 and 8 for elevators #51 and #52, and two (2) front openings @ 1 & 2 and five (5) rear openings @ 4, 5, 6, 7 and 8 for elevators #53 and #54.

The elevators are an overhead geared traction type originally manufactured by Thyssen Elevator Company, circa 2004, and contain a AC hoist motor.

The geared machines contain a total of six (6) 5/8” hoisting cables in a 1:1, single-wrap traction configuration with a deflector sheave located in the machine room.

Thyssen Elevator Company originally installed the existing governors located in the machine room area.

The non-proprietary control system is manufactured by Motion Control Engineering, model IMC-AC, and was installed during the initial installation.

There is a total of one (1) riser of flush-mount vandal resistant hall buttons installed at each landing. The hall station buttons are of a mechanical illuminated round-button design.

The hall button station on the main floor of egress does contain a Phase 1 firefighter’s service key switch and indicator.

The hoistway doors for all of the front door openings are of a two (2) speed side slide opening configuration, in a 4'-0" wide x 8'-0" high size and operated by a Thyssen Elevator closed loop AC car door operator located on top of the elevator.

The hoistway doors for all of the rear door openings are of a two (2) speed side slide opening configuration, in a 4'-0" wide x 7'-0" high size and operated by a Thyssen Elevator closed loop AC car door operator located on top of the elevator.

The hoistway door panels located at all of the landing are in a textured stainless steel finish and contain an emergency release hole at each landing served by the elevator.

The car door size is 4'-0" wide x 8'-0" high at the front opening and 4'-0" wide x 7' – 0" high at the rear opening. The car doors are configured in a two (2)-speed side side-opening configuration.

The cab consists of textured stainless steel wall panels on the sides of the elevator. The front and rear return panel, transom and jambs of the cab are in a #4 stainless steel finish. The cab has a suspended ceiling with a stainless steel frame, with down lights. The flooring is a standard tile floor that was installed flush to the car sill and did not pose a tripping hazard at the time of elevator survey.

The elevator interior contains a main and auxiliary car-operating panel with vandal proof mechanical illuminated round car buttons with an integral emergency car light device. The main car-operating panel is mounted in the front return panel. The elevator does contain a Phase 2 fire service key switch and written firefighter's instructions for Phase 2 operation that is a current code requirement.

The rails are a T-rail type with roller guides for the cars and counterweight installed at the top and bottom of the elevator cab and counterweight assembly. The counterweight rails are located on the side of each elevator hoistway.

Compensating chains (encapsulated) have been installed.

Access to the pit area of the elevators is via a code compliant pit ladder.

The pit areas contain one (1) oil buffer for the elevator, one oil buffer for the counterweight, pit ladder, stop switch, light and light switch, as well as a governor tension sheave device.

There is a sump hole and piping located in each pit area to remove water if necessary.

C. Recommendations:

Due to the heavy usage of the elevators at this location during peak operation there are several options that may be considered to improve the operation of the elevators.

1. Increase the signage in and around the elevators. Observations during the site visit indicated that there was mass confusion as to which elevators went to the train and walkway areas. Passengers entering from the parking areas were confused as to where the ticketing counter was located and most always seemed to go to the "T" or "W" floor first.

2. Initiate pre-opening of the elevator doors. This option allows for the car doors to slowly start opening when the elevator is within a predetermined distance from floor level (usually 2") so that the door opening process has already started by the time the elevator stops at the floor.

3. Replace the car door operators with a newer more efficient door operator to increase the reliability and performance of the door operation.

4. Upgrade the control system to a newer more efficient controller, which has the ability to automatically sense changes in passenger demands and will dispatch the elevators accordingly.

5. Install and program a load-weighing device that will monitor the weight of the passengers on the elevators and bypass hall calls when the capacity becomes to great to accommodate more passengers. This system will also allow for the cancellation of the car calls if the amount of calls exceeds the probable amount expected for the weight in the car, commonly called the "anti-nuisance" feature.

6. Increase the speed of the elevator to 500 FPM. This will require a major modernization of the existing system.

7. Add additional elevators to the existing banks of elevators.

8. Extend the hoistways of elevators #53 & #54 down two (2) floors to match the existing landings of elevators #51 & #52. There is confusion when getting on the elevators in close proximity due to the difference in the floors served.

EQUIPMENT LIFE EXPECTANCY FOR TRACTION ELEVATORS

(The following is an actual vs. theoretical comparative of the existing equipment, in term of years of usage, as compared to acceptable industry averages for the life expectancy of the equipment. Matters such as the level and type of maintenance being provided, usage, obsolescence, vandalism, environmental conditions, etc., all have an impact upon the life expectancy of a component or piece of equipment; therefore, a recommendation may be made for replacement of a component even though there may be several years remaining of expected useful life.)

Elevator #51, #52, #53 and #54

Description of Major Component or System	Anticipated Life Expectancy	Present Age of Equip	Anticipated Remaining Life of Equip	Comments From Examination Of Equip			Recommended Course of Action
***** MACHINE ROOM AREA EQUIPMENT *****							
	(In Years)	(In Years)	(In Years)	(Poor)	(Fair)	(Good)	
➢ Hoist Machine, Sheaves, Bearings	25	12	13			√	Provide Routine Maintenance Procedures
➢ Hoist Motors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Motor Generator Sets, Power Drives (SCR)	N/A	N/A	N/A				N/A
➢ Selectors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Controllers	25	12	13		√		Provide Routine Maintenance Procedures
***** HOISTWAY AREA EQUIPMENT *****							
➢ Hoist, Governor, Comp Ropes/Cables	25	12	13			√	Provide Routine Maintenance Procedures
➢ Car & Counterweight ➢ Guide Rails	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Safety Equipment & Counterweight	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Hoistway Door Equipment	20	12	8		√		Provide Routine Maintenance Procedures
***** CAR INTERIOR, OPERATING AND SAFETY EQUIPMENT *****							
➢ Car Door Operator & Equip	20	12	8		√		Provide Routine Maintenance Procedures
➢ Cab Interior	25	12	8		√		Provide Routine Maintenance Procedures
➢ Car Frame & Platform	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Car Safety	70+	12	58+			√	Provide Routine Maintenance Procedures
***** CAR AND HALL PUSHBUTTON FIXTURES *****							
➢ Car & Hall Fixtures	20	12	8		√		Provide Routine Maintenance Procedures

THE AMERICANS WITH DISABILITIES ACT of 1990 (ADA)

The Title I of the Americans with Disabilities Act of 1990, (A.D.A) took effect on July 26, 1992. The ADA Act was past by the Senate and House of Representatives of the United States of America and is regarded as a Civil Rights Act which is currently being enforced by the United States Department of Justice.

The ADA Act prohibits discrimination of any kind against any disabled individual as it relates to any:

- ✓ Public accommodations
- ✓ Employment opportunities.
- ✓ State and local government services.
- ✓ Public transportation.
- ✓ Telecommunications.

Since ADA is not a local- or state-mandated law, local officials do not provide enforcement. Federal officials can only provide enforcement after they have received a complaint or lawsuit by an aggrieved person claiming discrimination under the Act.

The U.S. Equal Employment Opportunity Commission issued regulations to enforce the provisions of Title I of the ADA on July 26, 1991. The provisions originally took effect on July 26, 1992.

The information provided herein is only offered as assistance to our client for the elevators in operation at the time of the site survey and subject to the current applicable provisions of the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG). The examination provided offers an analysis of the existing operating features of the equipment related to current ADAAG requirements.

The client or their authorized representatives are then required to make the sole and final determination as to the extent of modifications that will be performed to adhere to the ADDAG requirements.

THE AMERICANS WITH DISABILITIES ACT
ELEVATOR SYSTEMS ADA COMPLIANCE EXAMINATION AND SURVEY

Elevator #51, #52, #53 and #54

"Y" = ACCEPTABLE "N" = NOT ACCEPTABLE

DESCRIPTION OF ITEM	Y	N	COMMENTS
ASME A17.1 Safety Code	X		
Cab Enclosure, i.e. cab layout, car door size, cab illumination and cab flooring	X		
Car Operating Panel, i.e. design, button location and function	X		
Car Signals and Communications, i.e. car indicators and telephone/intercom	X		
Car and Hallway Entrances, i.e. door size, signage and door retracting device	X		
Hall Fixtures, i.e. signals and location	X		
Jamb Braille Plates	X		
Car Operational Functions, i.e. automatic leveling and door times	X		

Additional Notes, Comments or Clarifications

EQUIPMENT PROFILE
FOR
TRACTION ELEVATORS

A. GENERAL DESCRIPTION

1.	Elevator Identification:		**#51, #52, #53 and #54**
2.	Loading Classification:		Passenger
	a)	Capacity: (lbs.)	4500
	b)	Floors Served (Front):	**#51 and #52** - Four (4) Front Openings @ T, W, 1 and 2
			#53 & #54 – Two (2) Front Openings @ 1 and 2
	c)	Floors Served (Rear):	**#51 and #52** - Five (5) rear openings @ 4, 5, 6, 7 and 8
			#53 and #54 - Five (5) rear openings @ 4, 5, 6, 7 and 8
	d)	Rated Speed: (fpm)	350 FPM

B. MACHINE ROOM AREA

1.	Location:	Overhead
2.	Type Machine:	Geared Traction
3.	Manufacturer:	Thyssen Elevator Company
4.	Roping:	1:1, SWT, Six (6) 5/8" Diameter Steel Traction
5.	Brake:	DC Type
6.	Drive Motor:	Thyssen AC

7.	Controller Type:	Micro Processor with VVVF control
8.	Controller Manufacturer:	Motion Control Engineering, IMC - AC
9.	Power Supply:	480 VAC
10.	Governor Type:	Centrifugal
11.	Governor Manufacturer:	Thyssen Elevator Company
12.	Governor Rope Size:	3/8" Diameter Steel
13.	Selector Type:	Perforated Selector Tape
14.	Sequence/Type of Operation:	Duplex
15.	Access/Door:	Satisfactory/Satisfactory
16.	Ventilation/Clearances:	Satisfactory/Satisfactory
17.	Lighting/Fire Extinguisher:	Satisfactory/Satisfactory

C. HOISTWAY AREA

1.	Floors Served Front:	**#51 and #52** – Four (4) **#53 and #54** – Two (2)
2.	Floors Served Rear:	**All Elevators** – Five (5)
3.	Floors Served Side:	None
4.	Door Configuration:	Two (2) Speed Side Slide
5.	Clear Opening:	4'- 0" Wide x 8'- 0" High - Front 4'–0" Wide x 7'–0" High - Rear
6.	Tracks/Hangers:	Thyssen Elevator
7.	Safety Interlocks:	Thyssen Elevator
8.	Self Closing Devices:	Spirator Closers
9.	Guide Rails Car:	Steel T's - 15#

10.	Guide Rails Counterweight:	Steel T's - 8#
11.	Guides (Car/CWT.):	Roller Guides

D. PIT AREA

1.	Access/Ladder:	Existing
2.	Car Buffer:	One (1) Oil
3.	Counterweight Buffer:	One (1) Oil
4.	Compensation:	Chain
5.	Lighting/Safety Switch:	Satisfactory/Satisfactory

E. CAB ENCLOSURE & INTERIOR

1.	Car Door Panel:	Two (2) Speed Side Slide
2.	Clear Opening:	4'-0" Wide x 8'-0" High - Front 4'-0" Wide x 8'-0" High - Rear
3.	Door Protection:	Non-Contact Infrared
4.	Tracks/Hangers:	Thyssen Elevator
5.	Power Door Operator:	Thyssen Elevator
6.	Cab Materials:	Textured Stainless Steel Wall Panels, Suspended Ceiling #4 Stainless Steel Front, Transom & Strike Jamb
7.	Saddle Material:	Nickel/Silver
8.	Sill to Sill Clearance:	Satisfactory
9.	Top of Car Station:	Existing
10.	Work Lighting (Top):	Existing

F. FIXTURES & SIGNALS

1.	Car Station: (Main)	Illuminated vandal resistant Car Call Buttons
2.	Auxiliary Car Station:	Illuminated vandal resistant Car Call Buttons
3.	Number of Push Button Risers:	One (1) Flush-Mount
4.	Push Button Type:	Illuminated vandal resistant Hall Call Buttons
5.	Car Position Indicator:	Integral with Main Car Operating Panel
6.	Floor Position Indicator: (Hall)	None
7.	Hall Arrival Lanterns:	Vertical next to door frame
8.	Lobby Telltale Panel/C.R.T.:	N/A
9.	Starters Panel:	N/A
10.	Auxiliary Lobby Panels:	N/A
11.	Security Controls (Remote):	N/A

G. EMERGENCY SIGNALS & OPERATIONS

1.	Fire Service:	Existing
a)	Phase I - Manual:	Existing
b)	Phase I - Automatic:	Existing
c)	Phase II Operation:	Existing
d)	Signals/Engraving:	Existing
e)	Smoke Sensors:	Existing

2.	Emergency Power Provisions: (Location of Controls)	Existing
3.	Emergency Car Lighting	Existing
4.	Emergency Car Communication:	Existing
5.	Emergency Car Alarm:	Existing
6.	Life Safety Provisions:	Existing

H. EQUIPMENT HISTORY

1.	Original Equipment Manufacturer:	Thyssen Elevator Company
2.	Date of Original Installation:	Circa 2004
3.	Date of Last Upgrading:	N/A
4.	Modernization Contractor:	N/A
5.	Present Service Company:	Thyssen Elevator Company

ELEVATOR PERFORMNCE TIMES

- **Floor-to-Floor Time:** Time required to make a one floor run. Measured from the time the hoistway doors start to close at one floor until they are fully opened at the next floor. Typical value for 350 fpm elevator with no more than 12 feet of travel – **12.1 seconds.**

- **Performance Time:** Measured from the time the doors start to close at one floor until they are significantly open to allow passenger exchange at the next floor. Typical value for 350 fpm with no more than 12 feet of travel – **10.1 seconds.**

- **Brake-to-Brake Time:** Measured from the time the elevator starts until it stops on a one floor run. Typical value for 350 fpm with no more than 12 feet of travel – **5.6 seconds.**

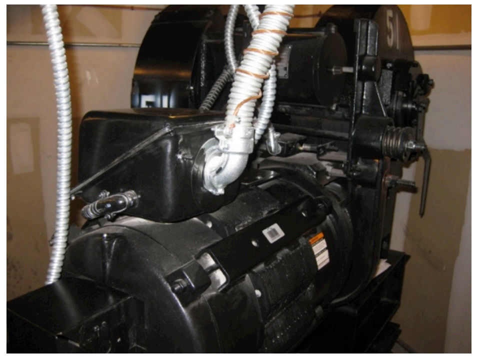
- **Door Open Time:** Measured from the time the doors start to open until fully open – **3.5 seconds.**

- **Door Dwell Time:** Length of time doors remains fully open by car or hall call without being affected by cancellation features – **5 seconds.**

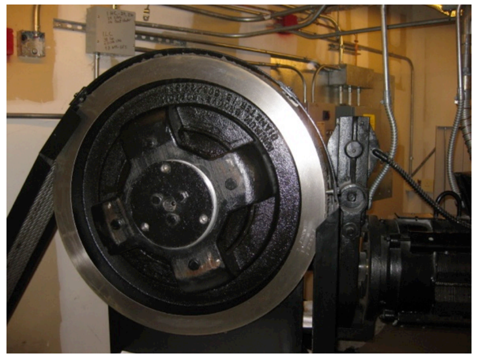
- **Door Close Time – 3.5 seconds**

FUNCTION	ELEVATOR #51	ELEVATOR #52	ELEVATOR #53	ELEVATOR #54
Floor to Floor	16.23	19.3	17.85	18.68
Performance	15.38	16.4	14.63	16.6
Brake to Brake	6.75	8	7.03	7.16
Door Open	3.99	4.9	4.56	4.68
Door Dwell	3.28	3.8	3.31	3.03
Door Close	5.49	6.4	6.26	6.84

EXHIBIT "A" – PICTURES



TYPICAL GEARED HOIST MACHINE FRONT VIEW



GEARED HOIST MACHINE SIDE VIEW

OVERSPEED GOVERNOR ASSEMBLY MOUNTED ON THE MACHINE ROOM FLOOR

MACHINE ROOM SMOKE DETECTOR

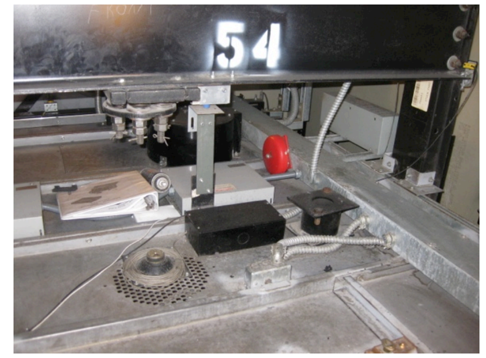
AC DRIVE UNIT MOUNTED IN THE ELEVATOR CONTROLLER

TYPICAL ELEVATOR CONTROLLER

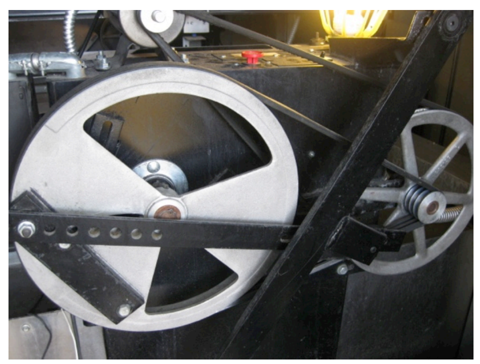
MACHINE ROOM CLIMATE CONTROLL

ELEVATOR FIRE RECALL MODULES

TOP OF THE HOISTWAY AND UNDERSIDE OF THE MACHINE ROOM



TOP OF THE ELEVATOR CAB



TYPICAL CAR DOOR OPERATOR

ELEVATOR PIT WITH OIL BUFFER

ELEVATOR ARRIVAL LANTERS

TYPICAL SIGNAGE IN ELEVATOR LOBBY

MAIN FLOOR HALL FIXTURE WITH FIRE RECALL SWITCH

TYPICAL CAR OPERATING PANEL

TYPICAL HOISTWAY LOBBY DOOR

SUMP PUMP AREA IN THE ELEVATOR PIT

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Appendix F

I to D Baggage Claim Sensitivity Analysis

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Appendix F - I to D Baggage Claim Sensitivity Analysis

G.1 FIS Facility Baggage Claim Sensitivity Analysis

The Houston Airport System (HAS) engaged Ricondo & Associates (R&A) to develop a sensitivity study that investigates the effects of eliminating the need for all international arriving passengers that will be transferring to another flight – domestic or international - to retrieve their baggage at the international baggage claim facility. Building on the efforts of the Federal Inspection Services (FIS) Facility Program Requirements task, R&A developed a sensitivity study based on removing all transfer baggage from the FIS process. The concept explores inserting all transfer baggage after it comes off the aircraft directly into the baggage handling system (BHS) where it is screened by the TSA for explosives and CBP for contraband, money and agricultural products. Suspect bags are pulled from the BHS and matched with passengers before they exit the FIS. Primary processing facilities are not affected by this study and remain the same according to the initial FIS task. The baggage claim sensitivity study investigates the effects on the FIS process beginning at the international baggage claim facility through the passenger security screening checkpoint.

R&A's analysis did not include detailed planning or modeling of the BHS to accommodate international to domestic and international to international transfer baggage, baggage screening systems, or the transport system required to match suspect bags with their owner.

The following issues were unable to be addressed during this study:

- CBP does not support the concept of International to Domestic (I to D) baggage transfer except in special circumstances and only if used on random flights to reduce congestion at a constrained FIS facility (e.g. Dallas Fort Worth International Airport).
- Requests to clarify potential I to D protocols with CBP were not resolved:
  - Do passengers need to be contained until their baggage has cleared CBP inspection before passengers are processed at Primary Inspection? Options include using the In-transit Lounge.
  - What happens if passengers are not contained and they process through Primary Inspection before the need for baggage reconciliation is identified?
  - What legal issues occur if a passenger exits the FIS before a baggage issue is identified?
  - How and where should suspect bags be reconciled with passengers? How will passengers know they need to meet with CBP for baggage reconciliation?
- Where are bags screened and what is the best method for transporting suspect bags to FIS Secondary?

The following analysis does not resolve these issues and does not assume that passengers are contained until their baggage is screened.

INSERT FIS TRANSFER BAGGAGE SENSITIVITY PRESENTATION


RICONDO® & ASSOCIATES
IAH
George Bush Intercontinental Airport
Federal Inspection Services Facility
and
Security Screening Checkpoint
Transfer baggage Sensitivity
06-April, 2015
RICONDO & ASSOCIATES, INC. | FROM GREAT COMPANIES COME GREAT IDEAS
1

Agenda

Facilities

- International Baggage Claim
- Exit Control
- Consolidated Checkpoint

Topics

- Facility:
  - International to Domestic Transfer Baggage Sensitivity Demand
  - International to Domestic Transfer Baggage Sensitivity Performance
- Summary

IAH Airport Terminal E

A. Existing Elevator Configuration:

The elevators that were examined consisted of two separate groups of elevators that were operated in a Duplex Configuration. Elevators #51 and #52 were one group of elevators and elevators #53 and #54 were the other group.

B. Passenger Elevators:

There exist a total of four (4) passenger elevators (#51, #52, #53 & #54) which are configured in in two separate duplex operating systems that are located inside of the IAH Terminal E building envelope.

Thyssen Elevator Company originally installed the passenger elevators at the time of building erection, circa 2004.

The elevator machine room area is located directly overhead of the elevator hoistway in a confined and dedicated space located at the roof-top level.

The elevator machine room was noted as being adequate in size and configuration. (Please note that the majority of the elevator equipment manufacturers require that the elevator machine room area maintain an optimal temperature range of fifty-five (55) to ninety-five (95) degrees Fahrenheit.)

The passenger elevators have a rated capacity of 4500 lbs., and operate at a rated speed of three hundred fifty (350) feet per minute and serve a total of four (4) front openings @ T, W, 1 & 2 and five (5) rear openings @ 4, 5, 6, 7 and 8 for elevators #51 and #52, and two (2) front openings @ 1 & 2 and five (5) rear openings @ 4, 5, 6, 7 and 8 for elevators #53 and #54.

The elevators are an overhead geared traction type originally manufactured by Thyssen Elevator Company, circa 2004, and contain a AC hoist motor.

The geared machines contain a total of six (6) 5/8" hoisting cables in a 1:1, single-wrap traction configuration with a deflector sheave located in the machine room.

Thyssen Elevator Company originally installed the existing governors located in the machine room area.

The non-proprietary control system is manufactured by Motion Control Engineering, model IMC-AC, and was installed during the initial installation.

There is a total of one (1) riser of flush-mount vandal resistant hall buttons installed at each landing. The hall station buttons are of a mechanical illuminated round-button design.

The hall button station on the main floor of egress does contain a Phase 1 firefighter's service key switch and indicator.

The hoistway doors for all of the front door openings are of a two (2) speed side slide opening configuration, in a 4'-0" wide x 8'-0" high size and operated by a Thyssen Elevator closed loop AC car door operator located on top of the elevator.

The hoistway doors for all of the rear door openings are of a two (2) speed side slide opening configuration, in a 4'-0" wide x 7'-0" high size and operated by a Thyssen Elevator closed loop AC car door operator located on top of the elevator.

The hoistway door panels located at all of the landing are in a textured stainless steel finish and contain an emergency release hole at each landing served by the elevator.

The car door size is 4'-0" wide x 8'-0" high at the front opening and 4'-0" wide x 7' – 0" high at the rear opening. The car doors are configured in a two (2)-speed side side-opening configuration.

The cab consists of textured stainless steel wall panels on the sides of the elevator. The front and rear return panel, transom and jambs of the cab are in a #4 stainless steel finish. The cab has a suspended ceiling with a stainless steel frame, with down lights. The flooring is a standard tile floor that was installed flush to the car sill and did not pose a tripping hazard at the time of elevator survey.

The elevator interior contains a main and auxiliary car-operating panel with vandal proof mechanical illuminated round car buttons with an integral emergency car light device. The main car-operating panel is mounted in the front return panel. The elevator does contain a Phase 2 fire service key switch and written firefighter's instructions for Phase 2 operation that is a current code requirement.

The rails are a T-rail type with roller guides for the cars and counterweight installed at the top and bottom of the elevator cab and counterweight assembly. The counterweight rails are located on the side of each elevator hoistway.

Compensating chains (encapsulated) have been installed.

Access to the pit area of the elevators is via a code compliant pit ladder.

The pit areas contain one (1) oil buffer for the elevator, one oil buffer for the counterweight, pit ladder, stop switch, light and light switch, as well as a governor tension sheave device.

There is a sump hole and piping located in each pit area to remove water if necessary.

C. Recommendations:

Due to the heavy usage of the elevators at this location during peak operation there are several options that may be considered to improve the operation of the elevators.

1. Increase the signage in and around the elevators. Observations during the site visit indicated that there was mass confusion as to which elevators went to the train and walkway areas. Passengers entering from the parking areas were confused as to where the ticketing counter was located and most always seemed to go to the "T" or "W" floor first.
2. Initiate pre-opening of the elevator doors. This option allows for the car doors to slowly start opening when the elevator is within a predetermined distance from floor level (usually 2") so that the door opening process has already started by the time the elevator stops at the floor.
3. Replace the car door operators with a newer more efficient door operator to increase the reliability and performance of the door operation.
4. Upgrade the control system to a newer more efficient controller, which has the ability to automatically sense changes in passenger demands and will dispatch the elevators accordingly.
5. Install and program a load-weighing device that will monitor the weight of the passengers on the elevators and bypass hall calls when the capacity becomes to great to accommodate more passengers. This system will also allow for the cancellation of the car calls if the amount of calls exceeds the probable amount expected for the weight in the car, commonly called the "anti-nuisance" feature.
6. Increase the speed of the elevator to 500 FPM. This will require a major modernization of the existing system.
7. Add additional elevators to the existing banks of elevators.
8. Extend the hoistways of elevators #53 & #54 down two (2) floors to match the existing landings of elevators #51 & #52. There is confusion when getting on the elevators in close proximity due to the difference in the floors served.

EQUIPMENT LIFE EXPECTANCY FOR TRACTION ELEVATORS

(The following is an actual vs. theoretical comparative of the existing equipment, in term of years of usage, as compared to acceptable industry averages for the life expectancy of the equipment. Matters such as the level and type of maintenance being provided, usage, obsolescence, vandalism, environmental conditions, etc., all have an impact upon the life expectancy of a component or piece of equipment; therefore, a recommendation may be made for replacement of a component even though there may be several years remaining of expected useful life.)

Elevator #51, #52, #53 and #54

Description of Major Component or System	Anticipated Life Expectancy	Present Age of Equip	Anticipated Remaining Life of Equip	Comments From Examination Of Equip			Recommended Course of Action
***** MACHINE ROOM AREA EQUIPMENT *****							
	(In Years)	(In Years)	(In Years)	(Poor)	(Fair)	(Good)	
➢ Hoist Machine, Sheaves, Bearings	25	12	13			√	Provide Routine Maintenance Procedures
➢ Hoist Motors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Motor Generator Sets, Power Drives (SCR)	N/A	N/A	N/A				N/A
➢ Selectors	25	12	13			√	Provide Routine Maintenance Procedures
➢ Controllers	25	12	13		√		Provide Routine Maintenance Procedures
***** HOISTWAY AREA EQUIPMENT *****							
➢ Hoist, Governor, Comp Ropes/Cables	25	12	13			√	Provide Routine Maintenance Procedures
➢ Car & Counterweight ➢ Guide Rails	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Safety Equipment & Counterweight	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Hoistway Door Equipment	20	12	8		√		Provide Routine Maintenance Procedures
***** CAR INTERIOR, OPERATING AND SAFETY EQUIPMENT *****							
➢ Car Door Operator & Equip	20	12	8		√		Provide Routine Maintenance Procedures
➢ Cab Interior	25	12	8		√		Provide Routine Maintenance Procedures
➢ Car Frame & Platform	70+	12	58+			√	Provide Routine Maintenance Procedures
➢ Car Safety	70+	12	58+			√	Provide Routine Maintenance Procedures
***** CAR AND HALL PUSHBUTTON FIXTURES *****							
➢ Car & Hall Fixtures	20	12	8		√		Provide Routine Maintenance Procedures

THE AMERICANS WITH DISABILITIES ACT of 1990 (ADA)

The Title I of the Americans with Disabilities Act of 1990, (A.D.A) took effect on July 26, 1992. The ADA Act was past by the Senate and House of Representatives of the United States of America and is regarded as a Civil Rights Act which is currently being enforced by the United States Department of Justice.

The ADA Act prohibits discrimination of any kind against any disabled individual as it relates to any:

- ✓ Public accommodations
- ✓ Employment opportunities.
- ✓ State and local government services.
- ✓ Public transportation.
- ✓ Telecommunications.

Since ADA is not a local- or state-mandated law, local officials do not provide enforcement. Federal officials can only provide enforcement after they have received a complaint or lawsuit by an aggrieved person claiming discrimination under the Act.

The U.S. Equal Employment Opportunity Commission issued regulations to enforce the provisions of Title I of the ADA on July 26, 1991. The provisions originally took effect on July 26, 1992.

The information provided herein is only offered as assistance to our client for the elevators in operation at the time of the site survey and subject to the current applicable provisions of the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG). The examination provided offers an analysis of the existing operating features of the equipment related to current ADAAG requirements.

The client or their authorized representatives are then required to make the sole and final determination as to the extent of modifications that will be performed to adhere to the ADDAG requirements.

THE AMERICANS WITH DISABILITIES ACT
ELEVATOR SYSTEMS ADA COMPLIANCE EXAMINATION AND SURVEY

Elevator #51, #52, #53 and #54

"Y" = ACCEPTABLE "N" = NOT ACCEPTABLE

DESCRIPTION OF ITEM	Y	N	COMMENTS
ASME A17.1 Safety Code	X		
Cab Enclosure, i.e. cab layout, car door size, cab illumination and cab flooring	X		
Car Operating Panel, i.e. design, button location and function	X		
Car Signals and Communications, i.e. car indicators and telephone/intercom	X		
Car and Hallway Entrances, i.e. door size, signage and door retracting device	X		
Hall Fixtures, i.e. signals and location	X		
Jamb Braille Plates	X		
Car Operational Functions, i.e. automatic leveling and door times	X		
Additional Notes, Comments or Clarifications			

EQUIPMENT PROFILE
FOR
TRACTION ELEVATORS

A. GENERAL DESCRIPTION

1. Elevator Identification: **#51, #52, #53 and #54**

2. Loading Classification: Passenger

a) Capacity: (lbs.) 4500

b) Floors Served (Front): **#51 and #52** - Four (4) Front Openings @ T, W, 1 and 2

#53 & #54 – Two (2) Front Openings @ 1 and 2

c) Floors Served (Rear): **#51 and #52** - Five (5) rear openings @ 4, 5, 6, 7 and 8

#53 and #54 - Five (5) rear openings @ 4, 5, 6, 7 and 8

d) Rated Speed: (fpm) 350 FPM

B. MACHINE ROOM AREA

1. Location: Overhead
2. Type Machine: Geared Traction
3. Manufacturer: Thyssen Elevator Company
4. Roping: 1:1, SWT, Six (6) 5/8" Diameter Steel Traction
5. Brake: DC Type
6. Drive Motor: Thyssen AC

7. Controller Type: Micro Processor with VVVF control
8. Controller Manufacturer: Motion Control Engineering, IMC - AC
9. Power Supply: 480 VAC
10. Governor Type: Centrifugal
11. Governor Manufacturer: Thyssen Elevator Company
12. Governor Rope Size: 3/8" Diameter Steel
13. Selector Type: Perforated Selector Tape
14. Sequence/Type of Operation: Duplex
15. Access/Door: Satisfactory/Satisfactory
16. Ventilation/Clearances: Satisfactory/Satisfactory
17. Lighting/Fire Extinguisher: Satisfactory/Satisfactory

C. HOISTWAY AREA

1. Floors Served Front: **#51 and #52** – Four (4)
#53 and #54 – Two (2)
2. Floors Served Rear: **All Elevators** – Five (5)
3. Floors Served Side: None
4. Door Configuration: Two (2) Speed Side Slide
5. Clear Opening: 4'- 0" Wide x 8'- 0" High - Front
4'–0" Wide x 7'–0" High - Rear
6. Tracks/Hangers: Thyssen Elevator
7. Safety Interlocks: Thyssen Elevator
8. Self Closing Devices: Spirator Closers
9. Guide Rails Car: Steel T's - 15#

10.	Guide Rails Counterweight:	Steel T's - 8#
11.	Guides (Car/CWT.):	Roller Guides

D. PIT AREA

1.	Access/Ladder:	Existing
2.	Car Buffer:	One (1) Oil
3.	Counterweight Buffer:	One (1) Oil
4.	Compensation:	Chain
5.	Lighting/Safety Switch:	Satisfactory/Satisfactory

E. CAB ENCLOSURE & INTERIOR

1.	Car Door Panel:	Two (2) Speed Side Slide
2.	Clear Opening:	4'-0" Wide x 8'-0" High - Front 4'-0" Wide x 8'-0" High - Rear
3.	Door Protection:	Non-Contact Infrared
4.	Tracks/Hangers:	Thyssen Elevator
5.	Power Door Operator:	Thyssen Elevator
6.	Cab Materials:	Textured Stainless Steel Wall Panels, Suspended Ceiling #4 Stainless Steel Front, Transom & Strike Jamb
7.	Saddle Material:	Nickel/Silver
8.	Sill to Sill Clearance:	Satisfactory
9.	Top of Car Station:	Existing
10.	Work Lighting (Top):	Existing

F. FIXTURES & SIGNALS

1.	Car Station: (Main)	Illuminated vandal resistant Car Call Buttons
2.	Auxiliary Car Station:	Illuminated vandal resistant Car Call Buttons
3.	Number of Push Button Risers:	One (1) Flush-Mount
4.	Push Button Type:	Illuminated vandal resistant Hall Call Buttons
5.	Car Position Indicator:	Integral with Main Car Operating Panel
6.	Floor Position Indicator: (Hall)	None
7.	Hall Arrival Lanterns:	Vertical next to door frame
8.	Lobby Telltale Panel/C.R.T.:	N/A
9.	Starters Panel:	N/A
10.	Auxiliary Lobby Panels:	N/A
11.	Security Controls (Remote):	N/A

G. EMERGENCY SIGNALS & OPERATIONS

1.	Fire Service:	Existing
a)	Phase I - Manual:	Existing
b)	Phase I - Automatic:	Existing
c)	Phase II Operation:	Existing
d)	Signals/Engraving:	Existing
e)	Smoke Sensors:	Existing

2. Emergency Power Provisions: (Location of Controls) — Existing

3. Emergency Car Lighting — Existing

4. Emergency Car Communication: — Existing

5. Emergency Car Alarm: — Existing

6. Life Safety Provisions: — Existing

H. EQUIPMENT HISTORY

1. Original Equipment Manufacturer: — Thyssen Elevator Company

2. Date of Original Installation: — Circa 2004

3. Date of Last Upgrading: — N/A

4. Modernization Contractor: — N/A

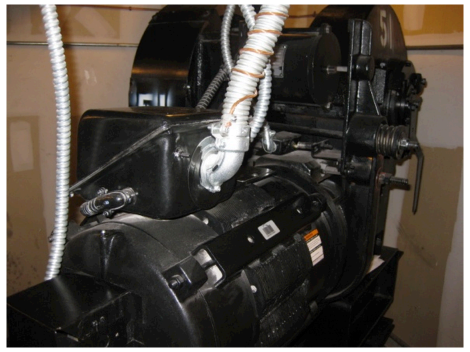
5. Present Service Company: — Thyssen Elevator Company

ELEVATOR PERFORMNCE TIMES

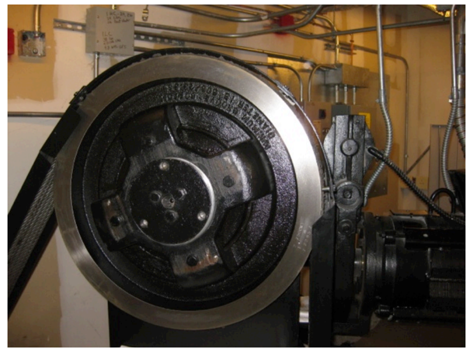
- **Floor-to-Floor Time:** Time required to make a one floor run. Measured from the time the hoistway doors start to close at one floor until they are fully opened at the next floor. Typical value for 350 fpm elevator with no more than 12 feet of travel – **12.1 seconds.**
- **Performance Time:** Measured from the time the doors start to close at one floor until they are significantly open to allow passenger exchange at the next floor. Typical value for 350 fpm with no more than 12 feet of travel – **10.1 seconds.**
- **Brake-to-Brake Time:** Measured from the time the elevator starts until it stops on a one floor run. Typical value for 350 fpm with no more than 12 feet of travel – **5.6 seconds.**
- **Door Open Time:** Measured from the time the doors start to open until fully open – **3.5 seconds.**
- **Door Dwell Time:** Length of time doors remains fully open by car or hall call without being affected by cancellation features – **5 seconds.**
- **Door Close Time – 3.5 seconds**

FUNCTION	ELEVATOR #51	ELEVATOR #52	ELEVATOR #53	ELEVATOR #54
Floor to Floor	16.23	19.3	17.85	18.68
Performance	15.38	16.4	14.63	16.6
Brake to Brake	6.75	8	7.03	7.16
Door Open	3.99	4.9	4.56	4.68
Door Dwell	3.28	3.8	3.31	3.03
Door Close	5.49	6.4	6.26	6.84

EXHIBIT "A" – PICTURES



TYPICAL GEARED HOIST MACHINE FRONT VIEW



GEARED HOIST MACHINE SIDE VIEW

OVERSPEED GOVERNOR ASSEMBLY MOUNTED ON THE MACHINE ROOM FLOOR

MACHINE ROOM SMOKE DETECTOR

AC DRIVE UNIT MOUNTED IN THE ELEVATOR CONTROLLER

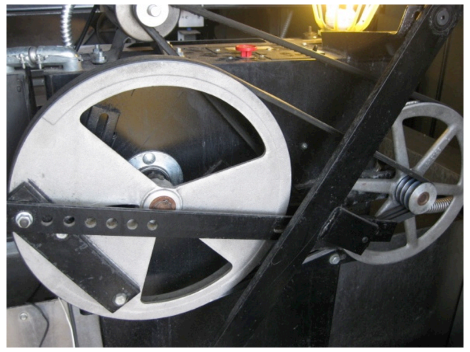
TYPICAL ELEVATOR CONTROLLER

MACHINE ROOM CLIMATE CONTROLL

ELEVATOR FIRE RECALL MODULES

TOP OF THE HOISTWAY AND UNDERSIDE OF THE MACHINE ROOM

TOP OF THE ELEVATOR CAB



TYPICAL CAR DOOR OPERATOR

ELEVATOR PIT WITH OIL BUFFER

ELEVATOR ARRIVAL LANTERS

TYPICAL SIGNAGE IN ELEVATOR LOBBY

MAIN FLOOR HALL FIXTURE WITH FIRE RECALL SWITCH

TYPICAL CAR OPERATING PANEL

TYPICAL HOISTWAY LOBBY DOOR

SUMP PUMP AREA IN THE ELEVATOR PIT

End of Document

Appendix G

First/Last
CBP
Passenger
Observations

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Appendix G - First/Last CBP Passenger Observations

H.1 FIS Passenger Observations

The Houston Airports System engaged Ricondo & Associates to conduct passenger observations to measure the time it takes the first and last international passengers to deplane, process through the FIS, pass through the Recheck Hall, and exit the facility to either the Meeter/Greeter lobby or the TSA Recheck Security Screening Checkpoint (SSCP). The data was compared to flight schedules (passenger load factors, arrival time deviation) and CBP staffing levels.

The planning team followed the first and last passengers of seven international arriving Terminal D and Terminal E flights during peak period operations observing 18 passengers. The team conducted observations between 07:00 and 18:00 recording the time for each of the following milestones in the passenger journey:

- Aircraft block time
- First passenger to deplane
- Last walking passenger to deplane (wheelchair passengers were not be timed due to special treatment in queues)
- First/last passenger reaches end of Primary Processing queue
- First/last passenger finishes Primary Processing (including transaction time)
- First/last passenger arrival at baggage claim device (if applicable)
- First/last passenger departs baggage claim device (if applicable)
- First/last passenger enters Exit Control Queue
- First/last passenger exits FIS facility
- First/last passenger exits recheck hall into Meeter/Greeter Hall or boards escalator/elevator/stair to Recheck SSCP

Collected data was compared to the published flight schedule and the actual times of arrival (including passenger load factors, arrival time deviation, size of aircraft, etc.), and CBP staffing levels (reported by United Airlines as well as those listed on AWT.CBP.gov).

The following single-page infographic and PowerPoint presentation were developed and presented to Houston Airports System staff on June 29, 2015.

INSERT INFOGRAPHIC AND JUNE 29 PRESENTATION HERE


RICONDO®
& ASSOCIATES
IAH
George Bush Intercontinental Airport
Terminal E FIS Observations
22-July, 2015
Updated 27-July, 2015
RICONDO & ASSOCIATES, INC. | FROM GREAT COMPANIES COME GREAT IDEAS

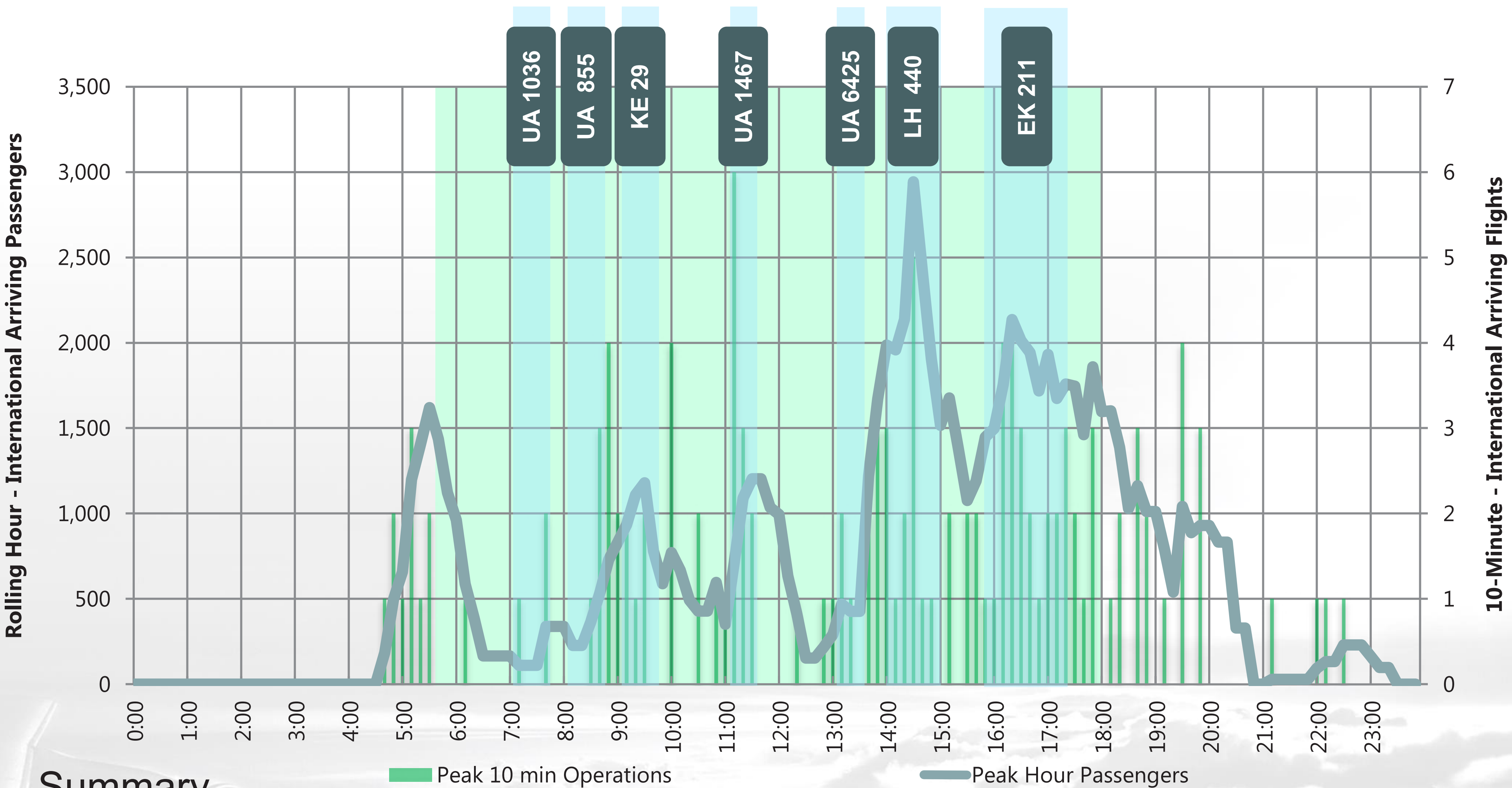
CBP Observations Overview

- Observations conducted on Monday, June 29, 2015
- Team of four staff observed seven flights covering 18 “first” and “last” passengers deplaning international arriving aircraft
- United Airlines provided hourly CBP officer counts and hourly wait time observations throughout day
- CBP Website officer and wait time data shown for comparison

- Data collected:
  - Aircraft block time
  - Passenger deplanes
  - Walking time to end of Primary queue
  - Time in queue
  - Primary transaction time (Global Entry/APC Kiosk /Triage/ Verification/ Visitor booth)
  - Exit Primary
  - Walk to baggage claim (if applicable)
  - Time at baggage claim
  - Entry to Exit Control queue
  - Exit FIS facility
  - Exit Recheck Hall

Flight Schedule

12:00AM-11:59PM



Summary

- Daily passengers: 16,091
- Peak Hour International Arrival Operations:
  - 13:40-14:39: 16 operations
  - 16:10-17:09: 16 operations
- Peak 10-Minute Passengers: 805
- Peak Hour Passengers:
  - 13:40-14:39: 2,943 passengers (primary peak)
  - 15:30-16:29: 2,136 passengers (secondary peak)

SOURCES: United Airlines Terminal E Operations and Houston Airport System Flight Schedules, July 2015

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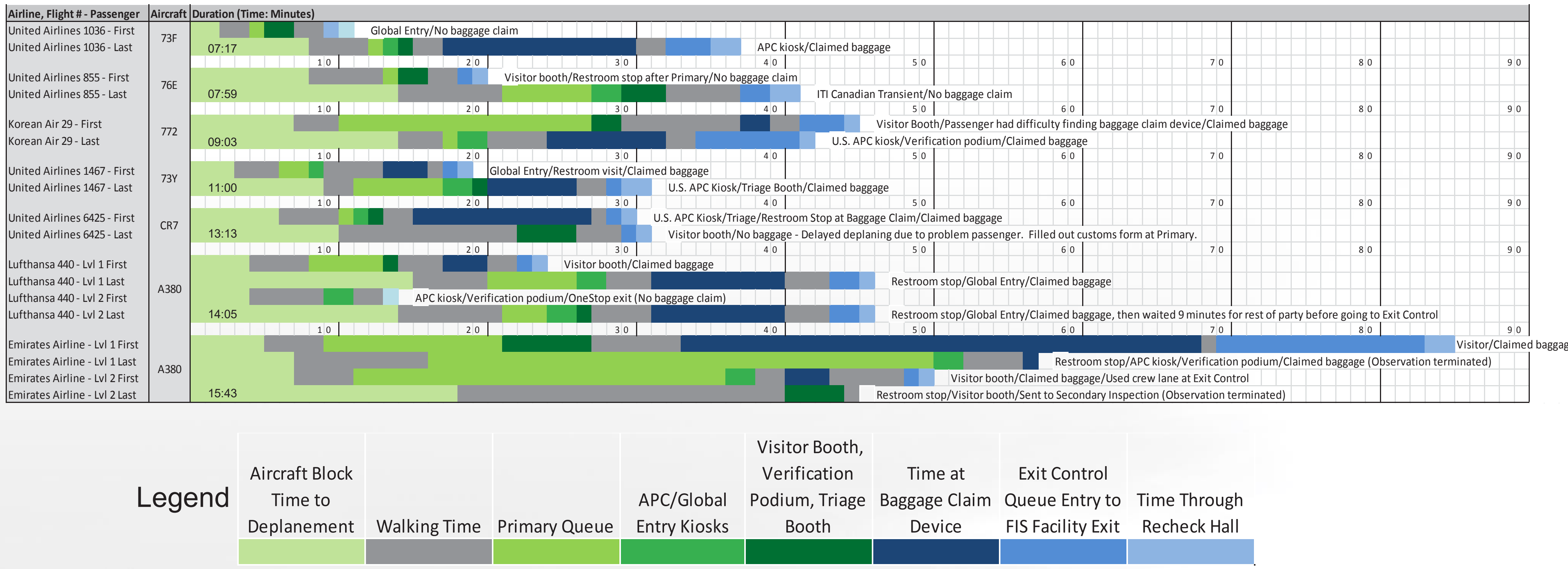
Individual Passenger Observations



Summary

- Tracked 18 first and last passengers (from 7 flights) and their progress through CBP Primary, Baggage Claim, Exit Control, and to Recheck Hall exit.
- Each color corresponds to a different stage of the FIS process. *(see legend)*
- Maximum time through FIS facility during secondary peak – 01:25:30 (hh:mm:ss)
- Maximum wait time at APC Kiosk – 00:33:30 (hh:mm:ss)
- Maximum wait time at Visitor Booth – 00:24:13 (hh:mm:ss)
- Maximum wait time at Baggage Claim – 00:33:52 (hh:mm:ss)
- Maximum wait time at Exit Control – 00:14:18 (hh:mm:ss)

SOURCES: Ricondo and Associates, Inc., July 2015

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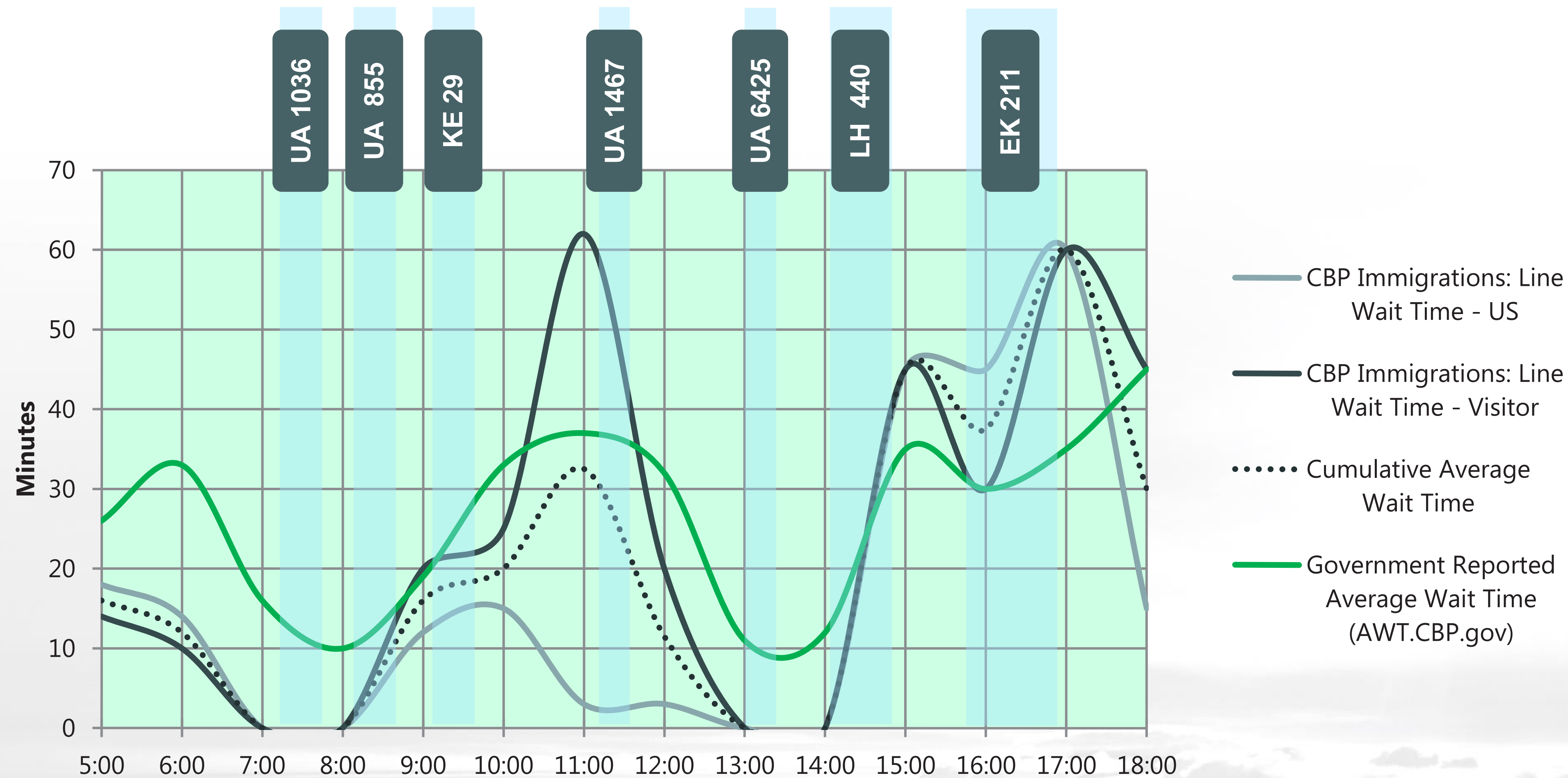
Wait Times

5:00AM-6:00PM



Notes

- Government reported wait time does not match observations by UAL and Planning Team during 16:00-17:00 period)
- Fewer officers at Primary when Emirates flight arrives leads to a significant rise in passenger wait times (45 minutes for LH flight versus 60 minutes for EK flight)

SOURCES: United Airlines Terminal E Operations and Website: AWT.CBP.gov, July 2015

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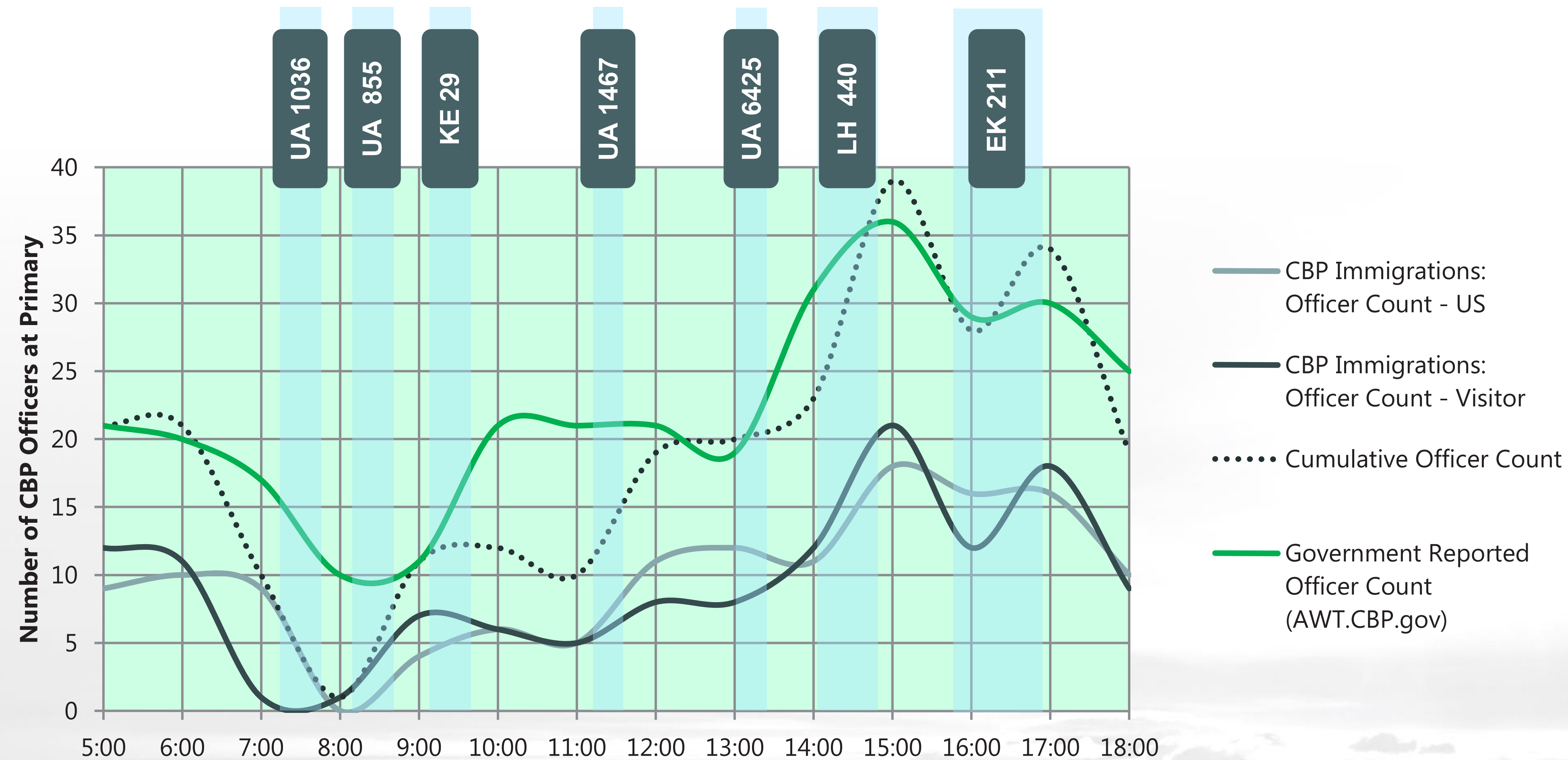
CBP Officers

5:00AM-6:00PM



Notes

- Government reported CBP staffing may not reflect lunch and other breaks (note differences between CBP reported and UAL reported officer counts during 10:00-11:00 period)
- UAL reports 11 fewer officers at Primary when Emirates flight arrives just before 16:00 than at 15:00 after Lufthansa flight is finishing processing (CBP reports 8 fewer officers during same period)

SOURCES: United Airlines Terminal E Operations and Website: AWT.CBP.gov, July 2015

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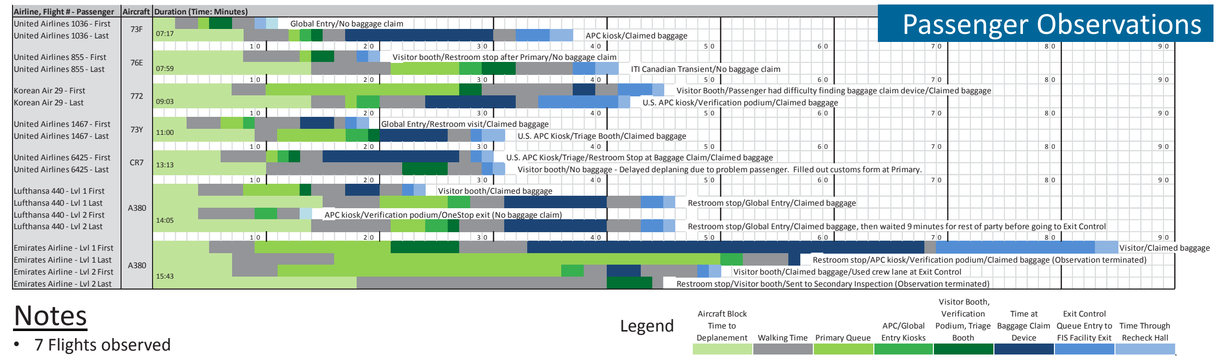
Conclusions

- Data collected provides a snapshot that confirms HAS staff observations and suspicions
- Additional data collection would be required for statistically valid data presentation
- CBP reported staffing (green line) appears to be estimated based on staffing levels (not reflecting lunch and break periods), not necessarily based on active processing positions
- While CBP staffing appears to rise and fall in relation to passenger loads, a large A380 flight (Emirates) can quickly overwhelm CBP Primary, leading to lengthy passenger wait times
- Additional data collection at Exit Control is recommended to confirm CBP processing times used in Simulation models

CBP Observations – June 29, 2015



Notes

- 7 Flights observed
- First and last passenger followed (18 total)
- Data collected:
  - Aircraft block time
  - Passenger deplanes
  - Walking time to end of Primary queue
  - Time in queue
  - Primary transaction time (Global Entry/APC Kiosk /Triage/ Verification/ Visitor booth)
  - Exit Primary
  - Walk to baggage claim (if applicable)
  - Time at baggage claim
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  - Exit Recheck Hall
- Maximum time through FIS facility during secondary peak - 01:25:30 (hh:mm:ss)
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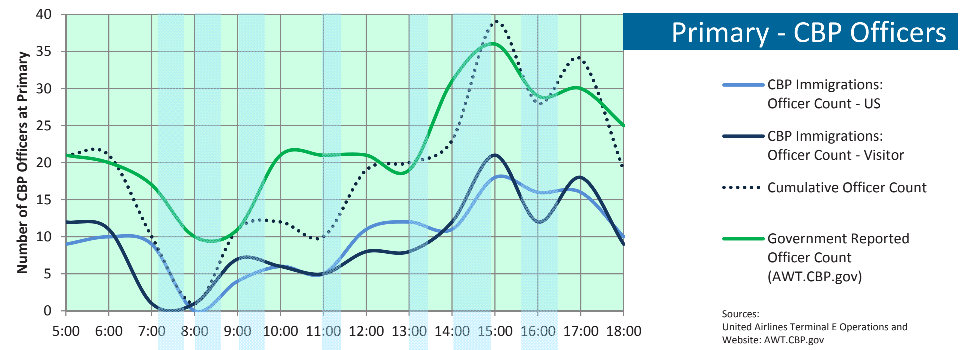

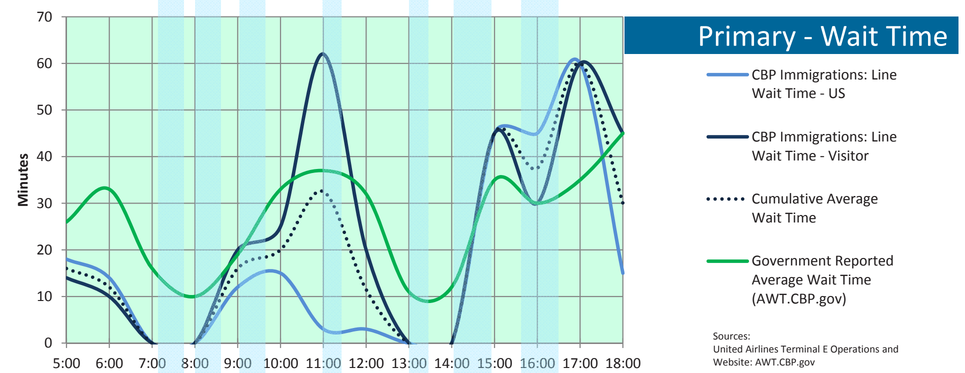

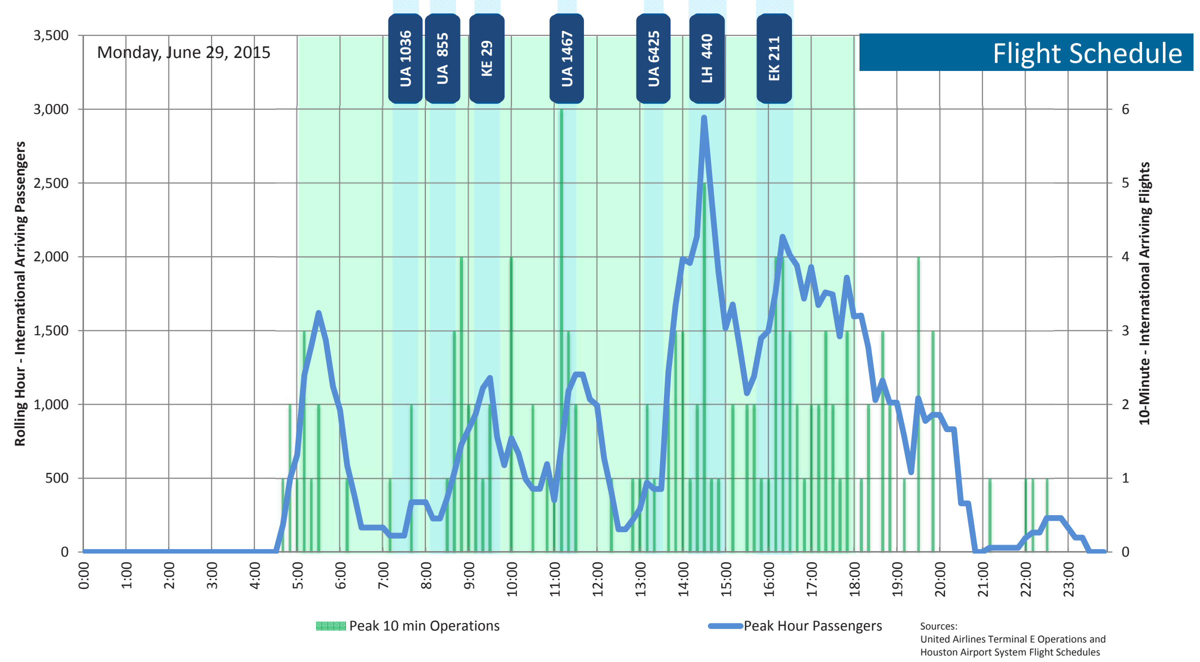

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