19th Street Redevelopment – Building 1 and 2 Project Definition Document

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Dallas Fort Worth International Airport

DALLAS
FORT WORTH
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1 Executive Summary

The goal for this site was to create an operationally functional cargo area large enough for a B747-8F to operate as the critical (design) aircraft. This development is focused on an incremental approach based on the expiration of leases, availability of ramp area, and need for additional capacity. The ultimate build-out of the northwest (NW) Cargo campus will be achieved through multiple phases.

This Project Definition Document (PDD) outlines the preparation and advanced planning analyses necessary for developing Buildings 1 and 2 in the NW Cargo Campus at the Airport. The contents of this document should be used as a guide by the design team stakeholders to understand the anticipated scope, physical layout, and overall project requirements/considerations. It summarizes background information and provides justification for the development of this project. This PDD serves as an initial project framework and is not intended to be a design document.

Primary Need and Justification

The 19th Street Redevelopment area consists of five vacant and obsolete, on and off ramp buildings. These include the Dallas/Fort Worth International Airport (Airport or DFW) Logistics Warehouse (formerly Evergreen), Building 220, and four off-ramp forwarder buildings (formerly AeroTerm A, B, C, and D), all of which are DFW assets. These five buildings have been slated for demolition in September 2021.

Based on actual cargo throughput and forecasted air cargo growth, the current DFW cargo facilities consisting of IAC I, IAC II, and IAC III limit the airport's cargo growth. The three IAC cargo buildings have an estimated throughput capacity of approximately 325,000 annual tons and the airport's actual 2019 throughput are 80% of capacity. Based on the projected growth, the capacity of the three IAC buildings will be exceeded by or before 2025. The addition of the proposed 328,500 square feet (SF) of building space will add enough capacity to accommodate cargo growth through 2035, based on the current forecast of 2.6% per year. DFW's most recent tonnage levels achieved in 2019 exceeded the forecast by 2-3 percentage points.

Scope of 19th Street Redevelopment – Buildings 1 and 2

Development of the Building 1 site will include a 177,600 SF cargo facility with a 30,000 SF mezzanine, and a landside depth of 230-feet allowing for commercial trucks and trailers to circulate, operate and park in front of the facility. The project also provides three parking positions for airplane design group (ADG) VI aircraft on the apron adjacent to the cargo facility, and the associated taxiway infrastructure to accommodate the ADG-VI movements at the Taxiway C/Taxiway Z entrance. Additionally, a realigned taxilane south of the development will be constructed to provide access to Buildings 201 and 202.

Development of the Building 2 site will include a 102,300 SF cargo facility with an 18,600 SF mezzanine level, and a landside depth of 150-feet for the adequate maneuverability of trucks and employee vehicles. Two ADG-VI aircraft parking positions will be provided to the east of the building, three ADG-VI aircraft parking positions are provided to the west of the landside, and an additional ADG-VI capable apron entrance will be provided to the north of the existing Taxiway C/Taxiway Y intersection.

Project Benefits

This project will expand the capabilities of the Airport to handle increased cargo tonnage through a new, right-sized facility and to accommodate additional 747-8F ramp parking positions. This project will begin transforming a portion of the Airport from being outdated and underutilized to a world-class, revenue generating air cargo complex.

Budget

The project budget is estimated at $118.7M. **Appendix A, *Draft Cost Estimate,*** presents the cost estimate.

2 Northwest Cargo Campus Inventory

2.1 Existing Facilities

Located in northwest quadrant of the Airport, the NW Cargo Campus is directly west of Taxiway C and Taxiway Y. As shown in **Figure 2-1, *Location of Northwest Cargo Area Facilities***; the Northwest Cargo Area is currently comprised of obsolete on- and off-ramp buildings, including the following:

1. DFW Logistics warehouse (formerly Evergreen) at 132,103 SF and 12.7 acres *(Building 220)*
   a. Address: 1530 W. 19th Street
   b. Lease expiration: N/A (DFW Board Asset)
2. Former Kitty Hawk facility at 47,700 SF and 4.79 acres *(Building 216)*
   a. Address: 1535 W. 20th Street
   b. Lease expiration: N/A (DFW Board Asset)
3. Ameriflight facility at 40,250 SF and 4.56 acres *(Building 202)*
   a. Address: 1515 W. 20th Street
   b. Lease expiration: September 30, 2027
4. Halbert & Associates, LLC facility at 12,500 SF and 2.71 acres *(Building 201)*
   a. Address: 1481 W. 20th Street
   b. Lease expiration: December 31, 2023
5. Four off-ramp freight forwarder buildings developed by AeroTerm totaling 132,092 SF and 10.12 acres
   a. Freight Forwarder A *(Building 203)*
      i. Address: 1900 W. Airfield Drive
   b. Freight Forwarder B *(Building 208)*
      i. Address: 1910 W. Airfield Drive
   c. Freight Forwarder C *(Building 210)*
      i. Address: 1920 W. Airfield Drive
   d. Freight Forwarder D *(Building 207)*
      i. Address: 1930 W. Airfield Drive
   e. Lease expirations: N/A (DFW Board Asset)
6. American Airlines Hangar 1 *(Building 217)*
   a. Address: 1631 W. 20th Street
   b. Lease expiration: November 30, 2026
7. American Airlines Hangar 2 *(Building 218)*
   a. Address: 1633 W. 20th Street
   b. Lease expiration: November 30, 2026
8. American Eagle Hangar *(Building 219)*

a. Address: 1725 W. 25th Street

b. Lease expiration: August 31, 2026

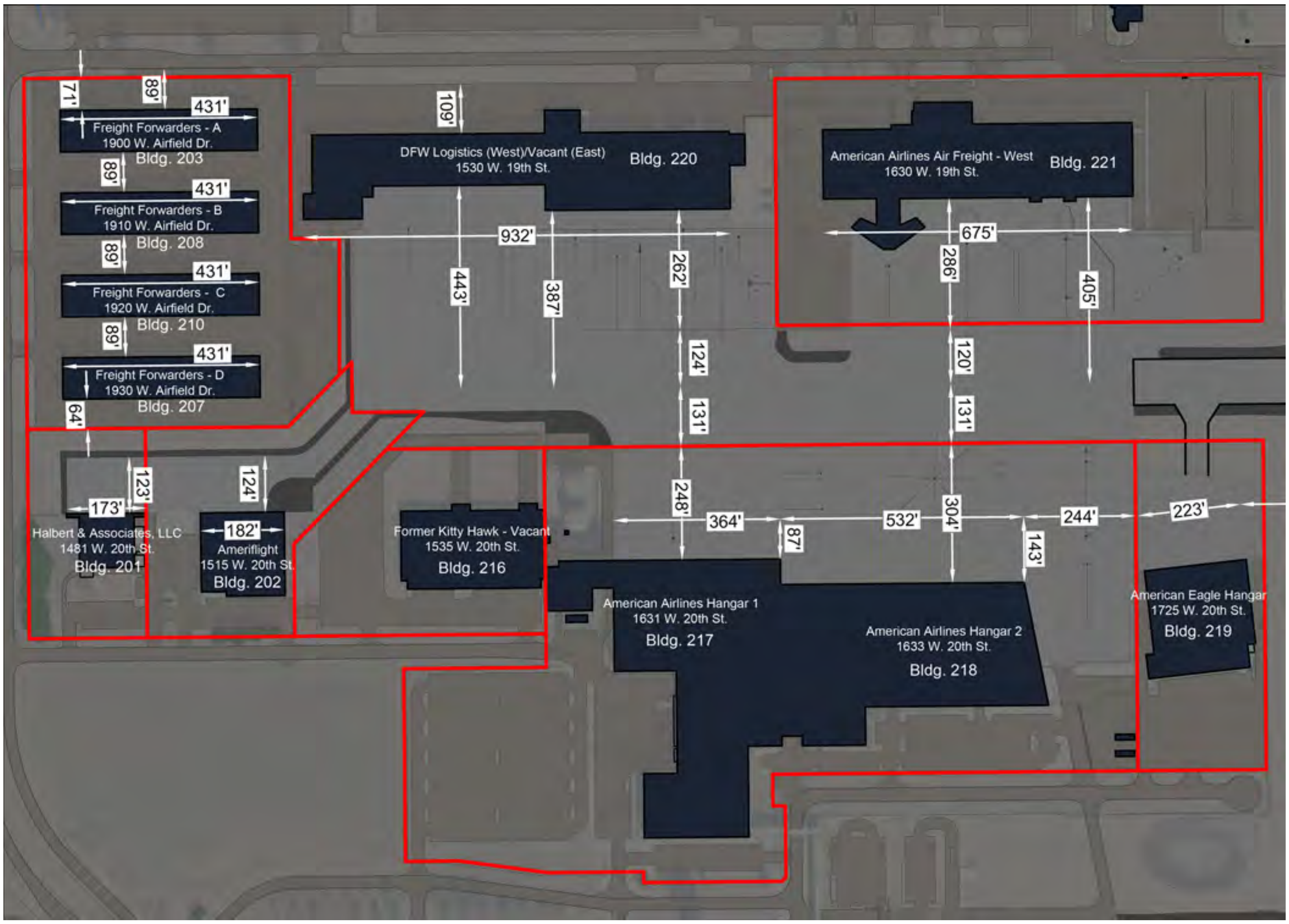
9. American Airlines Air Freight – West *(Building 221)*

a. Address: 1630 W. 19th Street

b. Lease expiration: December 31, 2022

In addition, there are three off-ramp warehouse buildings located at 1830, 1840, and 1850 W. Airfield Drive (north of the four off-ramp freight forwarders referenced above) that total about 195,000 SF, as well as additional freight forwarder buildings on the west side of W. Airfield Drive.

FIGURE 2-1 Location of Northwest Cargo Area Facilities

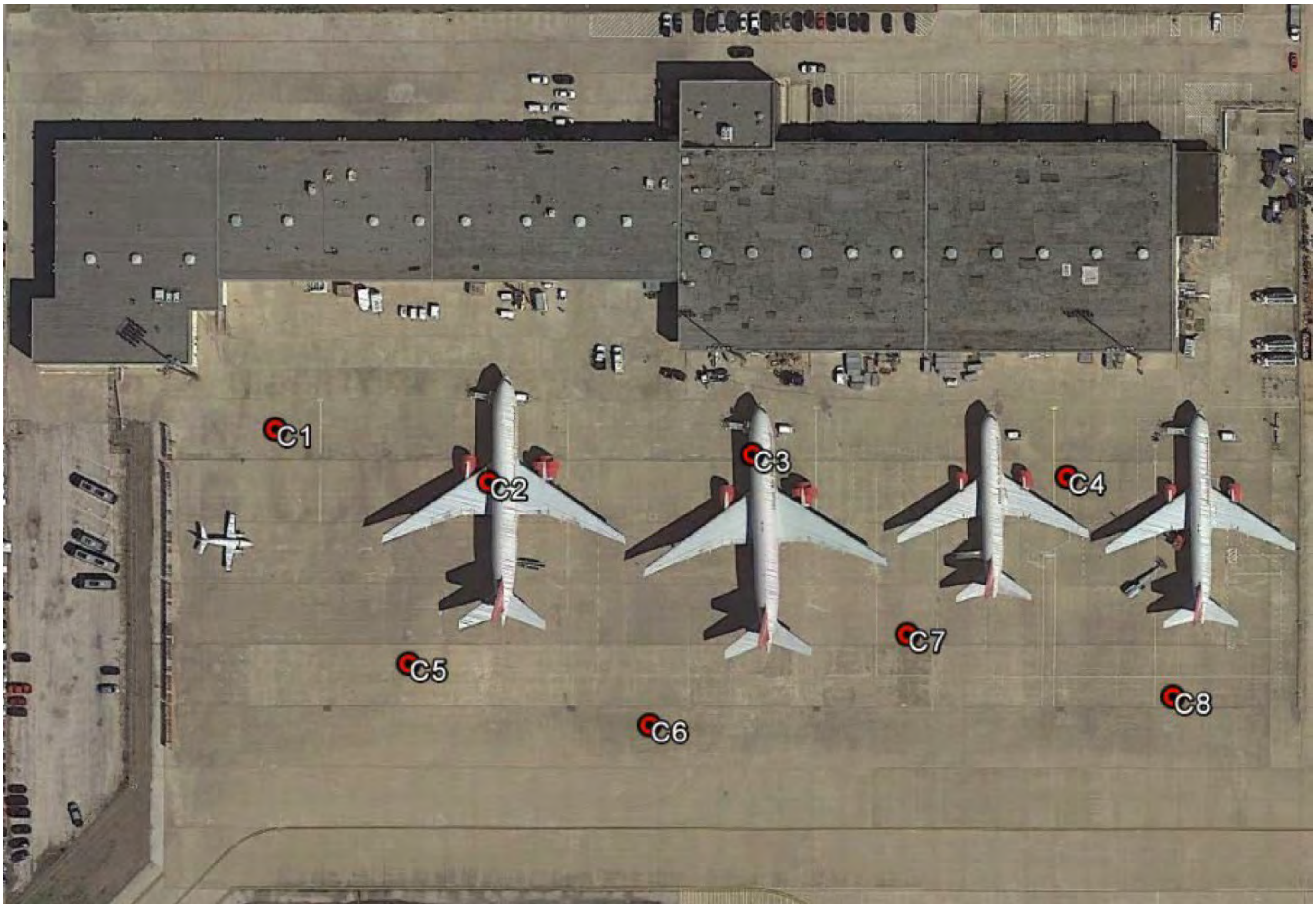


Source: Landrum & Brown, Inc., June 2020

2.2 2018 Pavement Assessment

In September 2018, a pavement assessment of the Evergreen Cargo Ramp was conducted by RS&H. For the geotechnical investigation, the existing concrete was cored in eight locations shown in **Figure 2-2*, Evergreen Cargo Ramp Coring Plan.***

FIGURE 2-2 Evergreen Cargo Ramp Coring Plan



Source: Alliance Geotechnical Group, RS&H, September 2018

For these eight locations, the pavement cores were tested for compressive strength and measured for thickness. The results of this analysis are presented in **Table 2-1, *Evergreen Cargo Ramp Geotechnical Analysis.***

TABLE 2-1 Evergreen Cargo Ramp Geotechnical Analysis

Core Location	Compressive Strength (PSI)	Concrete (in)	Cement Treated Base (in)
C1	6,619	12.3	13*
C2	4,961	13.0	8.0
C3	5,259	12.3	10.0
C4	7,671	16.4	8.1
C5	9,664	15.9	7.5
C6	6,813	16.5	9.0
C7	7,441	15.8	10.6
C8	5,504	17.4	8.8

Note: At C1, about four inches of CTB can't be retrieved. Thickness of CTB at C1 was estimated to be approximately 13.0".

Source: Alliance Geotechnical Group, RS&H, September 2018

In addition to the geotechnical analysis, a pavement condition index (PCI) survey was conducted to establish a PCI value for the existing Evergreen Cargo Ramp. Per the September 2018 PCI assessment, the existing Evergreen Cargo Ramp had a calculated PCI of eight-three (83). This was based on the distresses observed on the surface of the pavement which are indicative of the structural integrity and surface operational condition (localized roughness and safety). The PCI of 83 has a corresponding pavement condition rating of “Satisfactory”, as shown in **Table 2-2, *Pavement Condition Index Rating Scale***. For airfield pavement, the standard pavement condition rating is defined in FAA Advisory Circular (AC) 150/5380-7B, *Airport Pavement Management Program*.

TABLE 2-2 Pavement Condition Index Rating Scale

Pavement Condition		PCI Value
Good		100-86
Satisfactory		85-71
Fair		70-56
Poor		55-41
Very Poor		40-26
Serious		11-25
Failed		10-0

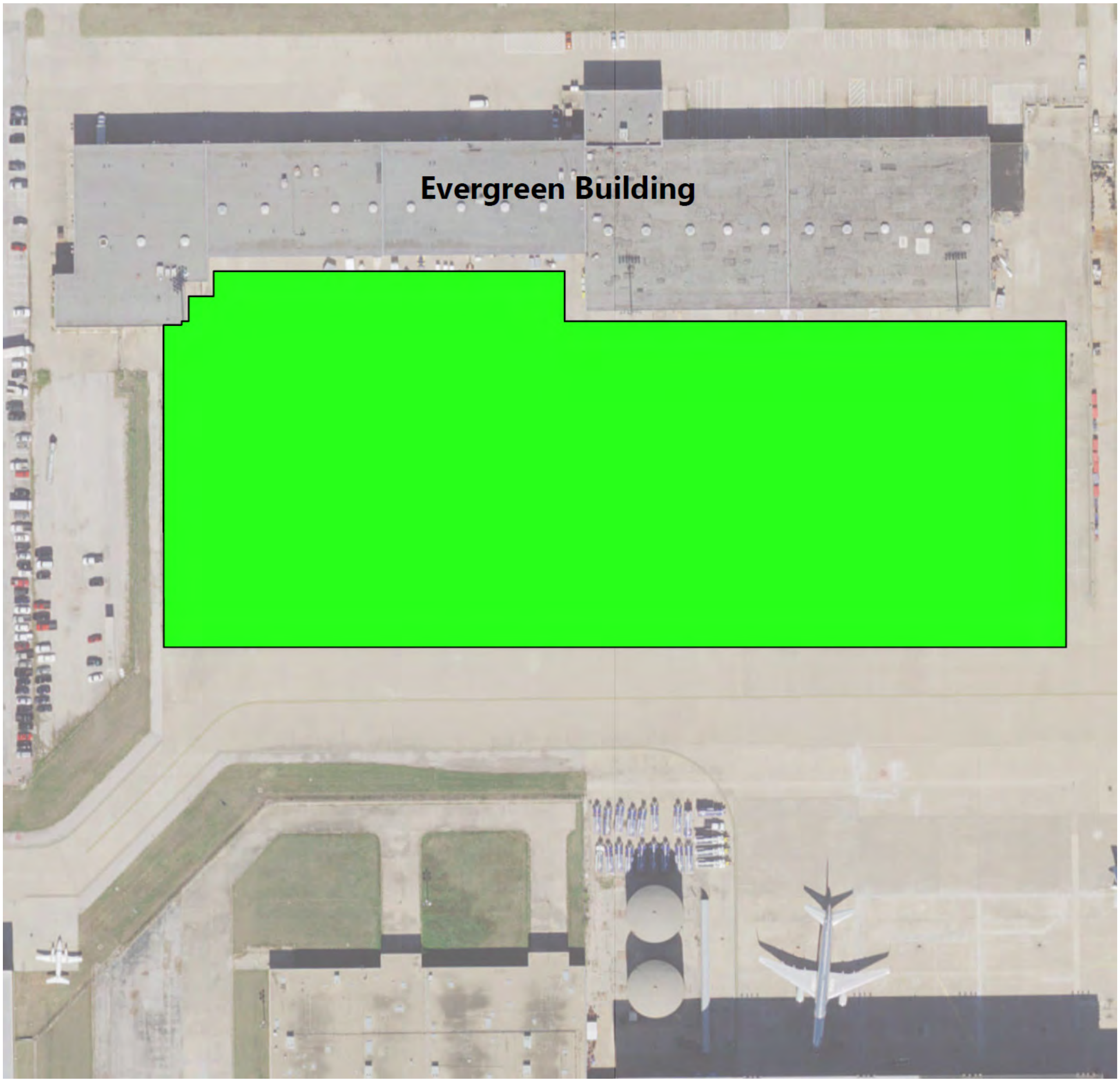
Source: FAA AC 150/5380-7B, October 2014

Figure 2-3*, Evergreen Cargo Ramp Area PCI Survey* presents the extents of the pavement sections included in the sample.

The full results of these analyses are presented in **Appendix B, *2018 Evergreen Cargo Ramp Pavement Assessment,*** which includes the following documents:

- *DO No. 17 OFA Analysis and Demolition of Evergreen Cargo - Pavement Condition Index Survey Technical Memorandum (DRAFT)*, RS&H, September 28, 2018
- *Pavement Coring & Laboratory Testing – Evergreen Cargo Ramp*, Alliance Geotechnical Group, September 28, 2018
- *DFW International Airport Cargo Ramp Evaluation [Falling (heavy) weight deflectometer (HWD) testing]*, The Transtec Group, September 30, 2018

FIGURE 2-3 Evergreen Cargo Ramp Area PCI Survey



Source: RS&H, September 2018

2.3 Existing Utilities

Having already been extensively developed, this area has access to all the necessary utilities such as power, water, lighting, and sanitary sewer. **Figure 2-4, *NW Cargo Campus Existing Utilities*** provides an overview of the existing utility infrastructure for this area.

FIGURE 2-4 NW Cargo Campus Existing Utilities

Source: DFW, Airport Layout Plan, June 2020; ETAM, March 2019

3 2019 DFW Cargo Forecast Review

In early 2019, DFW Planning, in conjunction with DFW Research and Analytics, updated the DFW Aviation Activity Forecast. A portion of that update included a forecast of cargo activity. The 20-year forecast of cargo tonnage and cargo freighter operations was prepared out to 2038. The result of the 2019 DFW Forecast update (or the "Forecast") was a projection of 1.5 million tons by 2038 for an average annual growth rate of 2.6 percent and an increase in freighter operations to 36,460.

3.1 Historical Cargo Traffic Analysis of the Forecast

In the Forecast development process, historical cargo data was analyzed from 2008 to 2018 with emphasis given to the most recent five years of traffic at DFW. At the time the Forecast was prepared, DFW was ranked as the 10th busiest cargo airport in the U.S according to ACI North America based on CY 2017 tonnage. The forecast report identified DFW as one of the largest North American air cargo airports in terms of total annual tonnage, but not a traditional cargo gateway such as LAX, MIA, JFK, and ORD or an airport with an integrated carrier national hub operation like MEM, SDF, and CVG.[1] The Airport ranked higher than other secondary cargo gateways such as Hartsfield-Jackson Atlanta International Airport (ATL), Houston George Bush Intercontinental Airport (IAH), and Denver International Airport (DEN) which ranked 12th, 17th, and 23rd respectively in CY 2017 total cargo tonnage. Furthermore, recent ACI reports show DFW has maintained the rank of 10th busiest cargo airport in the U.S. for 2018 and 2019.

DFW was identified in the Forecast as a gateway airport for passengers and is the largest hub airport for American Airlines, but is also a regional hub for UPS. The following historical cargo table **(Table 3-1, *Historical Cargo Tonnage (U.S. Tons)*)** from the 2019 DFW Forecast illustrates cargo segments being well diversified between passenger airlines, integrated cargo airlines, and all-cargo airlines.

TABLE 3-1 Historical Cargo Tonnage (U.S. Tons)

CARRIER TYPE	2014	2015	2016	2017	2018	CAGR 2014-2018
Passenger Airlines (Belly Cargo)	157,675	173,351	180,807	229,367	246,645	11.8%
Integrated Cargo Airlines	290,877	305,803	363,946	366,750	385,019	7.3%
All-Cargo Airlines	235,750	253,416	249,875	289,686	279,825	4.4%
Airport Total	684,302	732,569	794,628	885,804	911,489	7.4%
Annual growth	5.0%	7.1%	8.5%	11.5%	2.9%	

Note: CAGR = Compound Annual Growth Rate, Years shown are fiscal years (October to September)

Source: Dallas Fort Worth International Airport, September 2018

3.2 Air Cargo Forecast Methodology

In the Forecast, air cargo growth at DFW was observed as having experienced continued strong growth since the 2008/2009 Great Recession with strong influence from e-commerce. This key presumption was expected to continue and assumed that it would continue to drive global freight and DFW freight upward. The forecast was partially based on modified versions of the latest independent forecasts[2] prepared by aircraft manufacturers Airbus and Boeing, which projected long-term average growth rates of 4.2 percent and 3.7

[1] Los Angeles Int. Airport (LAX), Miami Int. Airport (MIA), New York-Kennedy Int. Airport (JFK), Chicago O'Hare Int. Airport (ORD), Memphis Int. Airport (MEM), Louisville Int. Airport (SDF), and Cincinnati/Northern Kentucky Int. Airport (CVG).

[2] Airbus Cargo Global Market Forecast 2017-2037, October 2018 and Boeing World Air Cargo Forecast 2017-2037, September 2018.

percent per year, respectively for the cargo industry worldwide. This was also based primarily on anticipated underlying global economic growth and increased global retail e-commerce sales.

According to the Airbus forecast reviewed in the 2019 DFW Forecast, the Asia-Pacific area was expected to become the largest region for international trade, representing about 39 percent in 2037. Asia will continue to lead the world in average annual air cargo growth, with domestic China and intra-East Asia markets expanding 6.3 percent and 5.8 percent per year, respectively. This was of particular interest in the forecast context for DFW, as six of the top ten cargo airlines serving DFW are Asian carriers. Air Cargo transported between the East Asia and North America markets are forecast to grow 4.7 percent or slightly faster than the world average growth rate. Latin American markets to North America are forecast to grow 4.1 percent over the next 20 years after experiencing negative growth from 2007-2017.

The freighter operations forecast is provided in **Table 3-2, *Freighter Operations Forecast*** and estimated that overall all-cargo flights will increase at a 3.3 percent CAGR through 2028 and then moderating to a 1.9 percent CAGR between 2028 and 2038 for an overall 2.6 percent CAGR over the 20-year planning period. Of the two main segments of freighter operations, the integrated carriers and the all-cargo airlines, the largest growth will be experienced by integrator operations. The integrated carriers at DFW, namely UPS and FedEx, were expected to continue to increase frequencies as e-commerce continues to grow. UPS continues to serve last mile delivery for many companies including Amazon. Speed and reliability were assumed to drive down tonnage per operation figures in the forecast and, therefore, increase the need for smaller more nimble aircraft such as the B757 and B767, which have grown operations by nearly 17 percent in the last two years of historical data.

TABLE 3-2 Freighter Operations Forecast

	2015	2018	2028	2038	CAGR 2018 – 2038
Integrated Carriers					
Volume (U.S. tons)	302,890	385,019	507,724	590,277	2.2%
Aircraft Operations	9,320	13,204	19,660	23,830	3.0%
Tonnage per Operation	32.5	29.2	25.8	24.8	-0.8%
All-Cargo Carriers					
Volume (U.S. tons)	251,002	279,825	355,630	414,514	2.0%
Aircraft Operations	5,534	7,334	9,954	12,630	2.8%
Tonnage per Operation	45.4	38.2	35.7	32.8	-0.9%
Total					
Volume (U.S tons)	553,892	664,844	863,354	1,004,791	2.1%
Aircraft Operations	14,854	20,538	28,495	34,554	2.9%
Tonnage per Operation	37.3	32.4	29.2	27.6	-0.8%

Note: CAGR = Compound annual growth rate.
Data from the Integrated Carrier group are included in the freighter volumes for those airlines operating freighter aircraft at the Airport.
Source: Dallas Fort Worth International Airport, April 2019

A detailed and complete review of the Forecast can be found in the 2020 Air Cargo Master Plan.

4 Requirements

Through discussions with stakeholders, the decision was made to develop Buildings 1 and 2 together in the NW Cargo Campus, along with the associated apron and landside infrastructure, versus only initially developing what was referred to in the Air Cargo Master Plan as Phase 1.

The following sections detail the requirements for three key components of the sites: the air cargo facilities, the aeronautical infrastructure (airside), and the landside infrastructure.

4.1 Air Cargo Facility Requirements

As of the draft of this PDD, DFW stakeholders are in the process of reviewing and interviewing potential tenants for these facilities. It is anticipated that once tenants have been selected,, the air cargo facility requirements will be refined based on the anticipated build-out from the tenants. Assessing the facility requirements entails the following:

- Calculating gross building requirements for warehouse, office, and ground service equipment (GSE), based on tailored throughput ratios.
- Identifying and accommodating any specialized facility needs to include perishables, high-risk material, animals, security inspection and clearance, etc.
- Planning the facilities to accommodate peak traffic requirements. Attention is given to options that impact cost and to any unique challenges represented by access and egress points.
- Considering the distances and travel time for cargo to and from the terminal, potential off-airport partners, and the regional highway system.
- Estimating the building footprint based on tenants' operations.

Typically, in larger facilities, mezzanine office space is recommended to reduce the footprint. For express carriers, office space is usually on the ground floor for both operating and security reasons. It is anticipated that a 30,000 SF mezzanine level will be provided for Building 1 and an 18,600 SF mezzanine level will be provided for Building 2.

4.2 Aeronautical Infrastructure Requirements

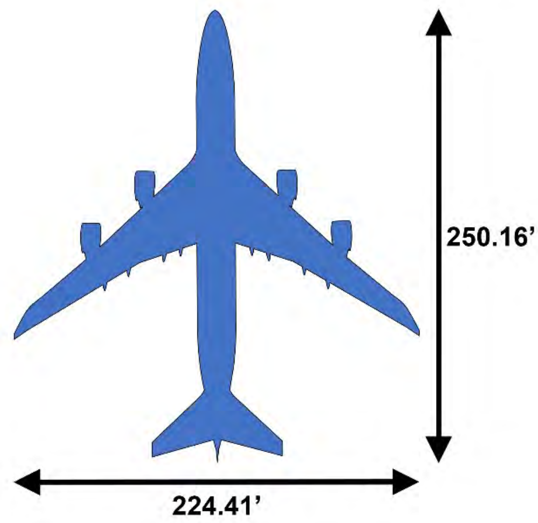
The aeronautical (airside) infrastructure requirements have three priorities:

- To minimize taxi-time and distance for freighter aircraft;
- To ensure sufficient aircraft ramp to accommodate peak demand for cargo terminal access and parking, specifically respecting average occupancy time for aircraft stands;
- To ensure that the aircraft apron has sufficient access and egress for operating peaks.

In addition, a minimum of 50 feet is provided between the rear of the cargo buildings and the nose of the aircraft for equipment and cargo staging, drive aisles, and equipment maneuvering. This distance is preferred and is available where space allocations between buildings, parking spots and taxi lane geometry allow. However, this setback is not a requirement and can be further refined once the tenants are selected.

The critical aircraft for the development of these facilities is the Boeing 747-8F. **Figure 4-1, *B747-8F*** provides an overview of the dimensions of this aircraft.

FIGURE 4-1 B747-8F



Source: AviPLAN Airside Pro 3

Per Federal Aviation Administration (FAA) Engineering Brief (EB) 78, the equation to calculate the B747-8F specific taxilane centerline to fixed or movable object is 0.6 multiplied by the B747-8F wingspan plus 10 feet. This equates to a B747-8F taxilane object free area (OFA) of 145-feet.

This OFA was used to determine the separation necessary from the ramp entries connecting to Taxiway C through the taxilanes that provide access to Buildings 1 and 2.

According to FAA AC 150/5300-13B, the recommended minimum clearances for aircraft parked on the apron are as follows:

- ADG I and II: 10-feet
- ADG III, IV, V, and VI: 25-feet

Therefore, 25-feet was provided from wingtip to wingtip for aircraft parked on the apron. Additionally, a 25-foot safety envelope was provided surrounding the aircraft in order to identify future GSE staging and storage areas.

4.3 Landside Infrastructure Requirements

All air cargo will eventually arrive and depart an airport by truck. Therefore, landside planning must consider trucking operations, as well as automobile parking at cargo buildings. Landside planning requirements include truck parking and queuing, roadway geometry, employee parking, customer parking, and potential alternative access for employees. These inputs were combined with industry planning guidelines to size requirements for the facilities and to understand potential traffic on roadways serving the cargo complex.

It is anticipated that two different size parking stalls will be required on the landside, truck docks and employee/customer parking. The employee/customer parking stalls should be 9-feet by 18-feet and the truck docks should be approximately 12.5-feet by 75-feet. An additional 75-feet of maneuvering area should be provided in front of the truck docks.

In order to understand the spatial limitations of the site, industry planning guidelines, specifically International Air Transport Association (IATA) Cargo Facility Guidelines, were used as factors to approximate the necessary number of parking stalls:

- Employee parking (office): 2-3 stalls per 1,000 square feet of office
- Employee parking (warehouse): 3-8 stalls per 10,000 square feet of warehouse
- Customer parking: 2 stalls per 10,000 square feet of warehouse

Based on these factors, an estimated range of parking stalls was calculated for each building:

- Building 1: 150 – 268 stalls
- Building 2: 89 – 159 stalls

Depending on how the facility is built and intended to operate, the number of stalls may fall within or below this range. The inclusion of certain characteristics, such as robotics and automation, would lower the number of required stalls. Once tenants are selected, these numbers should be refined and updated based on the anticipated staffing and operation of the facility.

4.4 Pavement Design Guidelines

Standard pavement designs for aprons at the Airport will be provided by Design, Code, and Construction (DCC) and should adhere to FAA AC 150/5320-6G, *Airport Pavement Design and Evaluation*.

Pavement composition and width for the landside portion of this effort should comply with Section 342 of the DFW Design Criteria Manual (DCM), which refers to the Texas Department of Transportation (TxDOT) Roadway Design Manual and Texas Manual on Uniform Traffic Control Devices.

Also included in the DCM is the requirement for the WB-67 design vehicle to be used when planning any roads at the Airport expected to handle moderate to high volumes of traffic. The WB-67 is a standard semi or tractor trailer with a trailer length of 53-feet and a cab length of approximately 20-feet.

An important consideration for the future pavement design is noted in the September 2018 Falling (heavy) weight deflectometer (HWD) testing document by The Transtec Group. Within this document, it is stated that an analysis was performed to evaluate what type of pavement section would be required for a new design construction. This analysis showed that based on an assumed 2,500 annual departures, 8 inches of CTB, 8-inches of lime treated subgrade, and a subgrade modulus value of 8,000 psi, a Portland Cement Concrete (PCC) section of 17.5 inches would be required. It was also noted that this is approximately 1.5 inches more of concrete than what was observed in the core locations. The design team should review these materials and the design progresses for the aeronautical infrastructure.

4.5 Building Design Guidelines

The main cargo facility and any additional structures included as part of this development effort should comply with those standards outlined in the following DFW Airport documents:

- DFW DCM
- DFW Development Design Guidelines
- DFW Space Planning Standards
- DFW Green Building Standards (included within the latest DFW DCM)

5 Project Overview

The goal for these sites is to create an operationally functional cargo area large enough for a B747-8F to operate as the critical (design) aircraft. The ultimate development of the NW Cargo Campus is focused on an incremental approach based on the expiration of leases, availability of ramp area, and need for additional capacity. To achieve the ultimate build-out,, multiple phases of development will be required. As mentioned previously, this PDD is focused on the development of Buildings 1 and 2.

5.1 Building 1 and 2 Development Overview

The scope for development of the Building 1 site consists of the following:

- 177,600 SF cargo warehouse with a 30,000 SF mezzanine
- Three ADG-VI (B747-8F) aircraft parking positions and associated ramp infrastructure
- 230-foot wide landside maneuvering and parking area for commercial trucks and trailers to circulate, operate, and park in front of the facility including employee parking
- Apron entrance modifications at Taxiway C/Taxiway Z for ADG-VI aircraft
- Airport Operations Area (AOA) fence along West 19th Street
- Realigned taxilane servings Buildings 201 and 202

The scope for development of the Building 2 site consists of the following:

- 102,300 SF cargo warehouse with an 18,600 SF mezzanine
- Five ADG-VI (B747-8F) aircraft parking positions and associated ramp infrastructure
- 150-foot wide landside maneuvering and parking area for commercial trucks and trailers to circulate, operate, and park in front of the facility including employee parking
- ADG-VI apron entrance construction at Taxiway C/Taxiway Y intersection
- AOA fence along West 19th Street

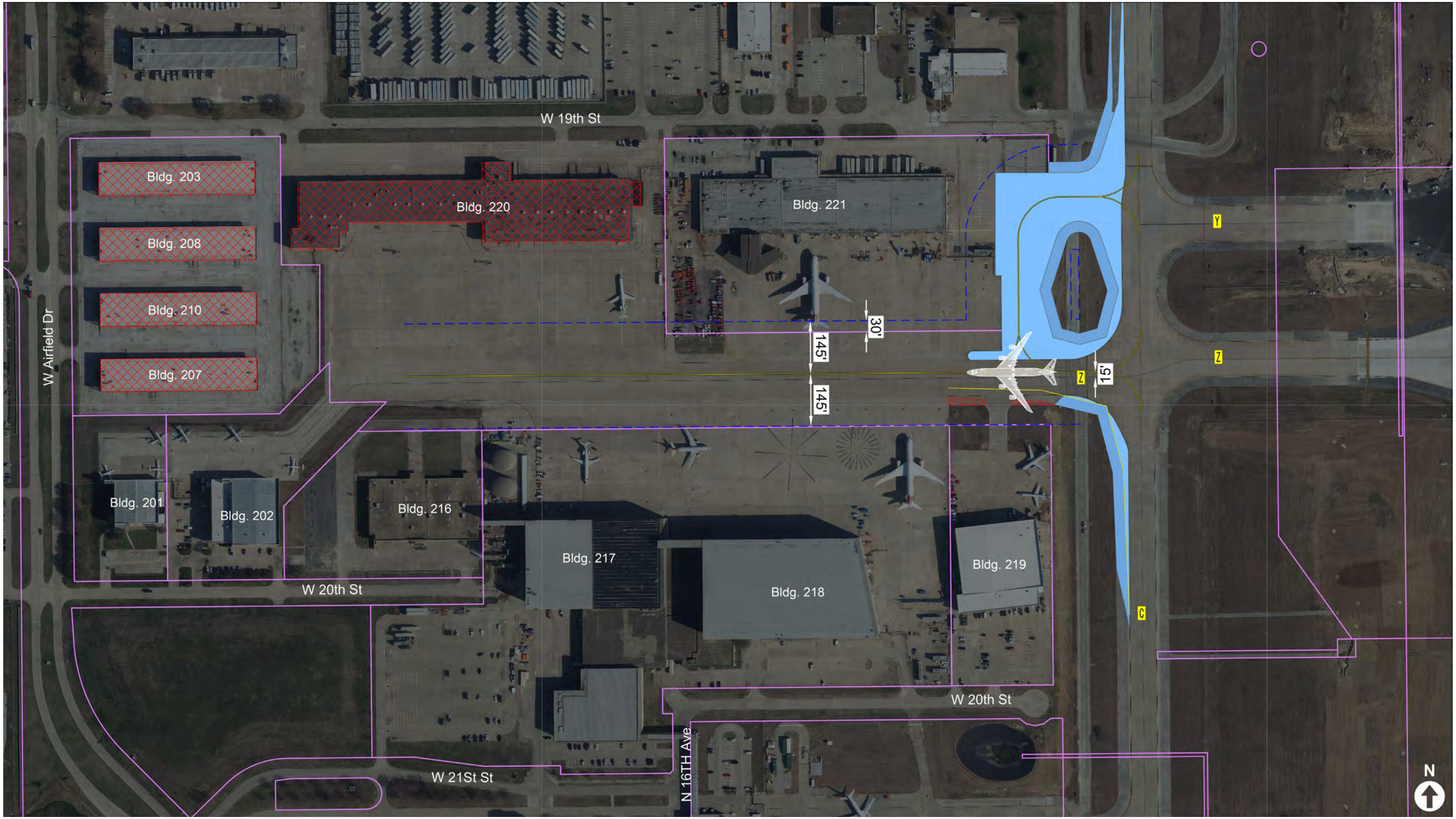
Development of the Building 1 site requires the demolition of the following facilities, which was completed in the fall of 2021: Freight Forwarder A (Bldg. 203), Freight Forwarder B (Bldg. 208) Freight Forwarder C (Bldg. 210), Freight Forwarder D (Bldg. 207), and Evergreen Building (Bldg. 220). The Building 2 site development requires the demolition of the Evergreen Building mentioned above, as well as the American Airlines Air Freight – West Facility (Bldg. 221), which is scheduled for demolition in January 2022.

5.1.1 Apron Infrastructure

The critical aircraft, the B747-8F, is larger than the current critical aircraft (ADG-V Boeing 747-400F) for the area. Therefore, the centerline for Taxilane Z would need to be relocated 15-feet to the north of its existing location, so that a B747-8F taxiing to the cargo area would not penetrate the leasehold to the south for Buildings 217 or 218. Shifting the taxilane centerline would allow American Airlines to continue to operate without disruption on the ramps in front of Buildings 217 and 218.

Two additional apron infrastructure components are required for the apron to be compliant with standards and to operate efficiently. The first is for the existing apron entrance taxiway and shoulder pavement geometry to be modified per FAA AC 150/5300-13B design standards to handle ADG-VI aircraft. The second is to construct a new apron entrance to the north of the existing entrance to provide an additional ingress/egress point into a ramp that currently operates with only a single taxilane. These improvements are highlighted in **Figure 5-1, *NW Cargo Apron Entrance Construction and Modifications***. These modifications will require the closure of Taxiway C where it intersects with Taxiway Y and Z at several points during construction. Therefore, the Airport will be continuously involved with coordination and phasing to maintain the operational capability of airfield pavement, specifically during times of peak aircraft ground movements in the vicinity of the project.

FIGURE 5-1 NW Cargo Apron Entrance Construction and Modifications



Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, September 2021

Figure 5-2, *Overall Apron Development*, provides an overview of the ramp infrastructure required to support the development of Buildings 1 and 2. Approximately 67,000 square yards (SY) of new pavement will be constructed to accommodate up to eight B747-8F aircraft. Three of the aircraft will be positioned east of Building 1, while two aircraft will be positioned east of Building 2. The remaining three aircraft positions are situated between the two buildings and can act as remote cargo loading positions or Remain Over Night (RON) parking positions based on the tenant's needs. With the identified safety envelopes for the B747-8F aircraft, it is anticipated that approximately 305,000 SF of apron space will be available for ground service equipment (GSE) staging, storage, and maneuvering.

To maximize the usable apron adjacent to Building 1 for the three B747-8F aircraft, the taxilane leading into the Ameriflight (Bldg. 202) and Halbert & Associates, LLC (Bldg. 201) ramp would need to be realigned. This taxilane would accommodate ADG-III aircraft with a taxilane OFA of 79-feet to the north and south of the taxilane centerline. Though it currently sits vacant, the former Kitty Hawk facility (Bldg. 216), would have a reduction in leasable area to the north. The facility itself would not be impacted nor would it need to be demolished during the realignment of the taxilane. Additionally, during stakeholder coordination meetings it was indicated that there are elevation issues in the vicinity of this taxilane and Building 216. Therefore, careful consideration should be given to the grade and topography of the realigned taxiway.

To show the flexibility of the site, **Figure 5-3*, Overall Apron Development with B777F Parking***, presents the development with eight B777F aircraft. Due to the design evolution of this project, the ramp provides ultimate flexibility to accommodate different aircraft types as needed by the tenants.

5.1.2 Landside Infrastructure

Figure 5-4*, Building 1 – Landside Alternative 1*, and **Figure 5-5*, Building 1 – Landside Alternative 2***, provide two different layouts to visualize the capacity and capability of the landside at Building 1. Each of these alternatives provide three different components: employee/customer parking, truck docks, and truck staging/queueing. The first landside alternative segregates the trucking and employee traffic while providing 182 employee stalls, 26 truck docks, and 22 truck staging stalls. The second landside alternative integrates the trucking operation by providing truck docks the length of the building and providing employee parking on the northern and southern ends of the landside with truck staging in the middle. The second landside alternative provides 66 employee stalls, 46 truck docks, and 19 truck staging stalls.

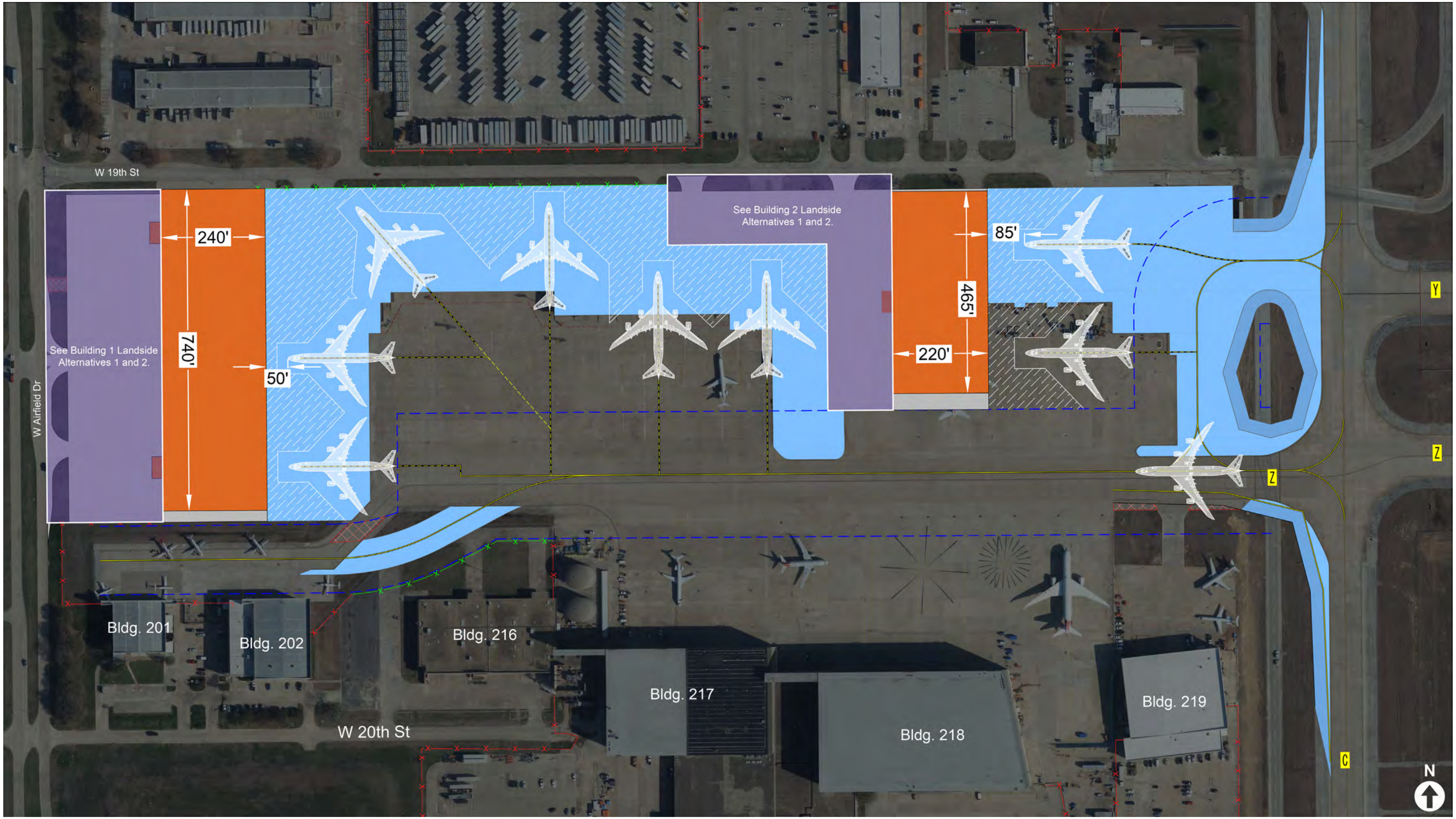
Based on coordination with the stakeholders, two entrances are preferred to segregate truck traffic. The two landside alternatives for Building 1 both show a centralized entry/exit point into the facility with a dedicated turning lane. A second entrance is also provided just south of the centralized entrance. However, TxDOT's Access Management Manual indicates that entrances need to be separated by a lateral distance of at least 360-feet for a one-way 45 MPH road. In both of these alternatives, the southern entrance is approximately 160-feet south of the centralized entrance, nearly 200-feet short of the required separation. Further coordination during the design phase is recommended to identify the opportunities and constraints with siting two entrances.

Figure 5-6, *Building 2 – Landside Alternative 1*, and **Figure 5-7, *Building 2 – Landside Alternative 2***, highlight two development options for the landside pavement west of Building 2. The first alternative provides 30 employee parking spaces, 18 truck docks connected to the building, and 14 truck/trailer staging positions west of the building. The second alternative, which has a similar layout to the first, provides 80 employee parking spaces, 17 truck docks, and 4 truck/trailer staging positions. The main difference between the two layouts is the number of employee vehicle parking spaces provided. Once a tenant is selected for this building, requirements for the amount of parking and truck staging can be refined.

The layout for both alternatives includes two entrances to provide more efficient ingress/egress for the landside operations. The idea is for all truck traffic to enter the site through the western entrance upon arrival, utilize the truck staging spaces if needed, and then once unloaded, proceed through the eastern exit back onto W. 19th Street.

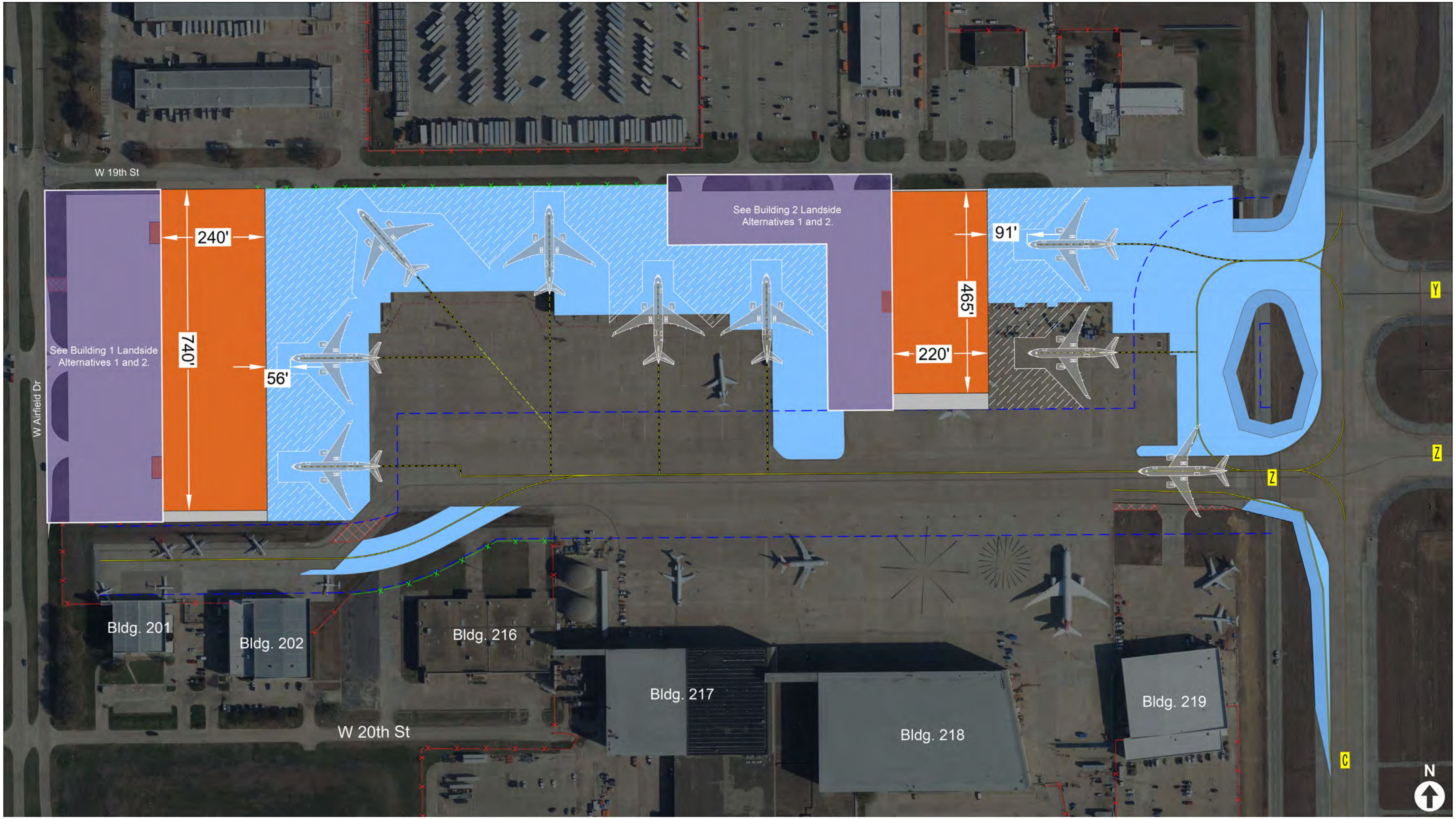
It is anticipated that the truck staging stalls can be modified as needed based on tenant needs for both buildings. Though truck staging is provided within these sites, an airport-wide truck staging and queuing study is recommended to assess the capacity for the overall system at the Airport.

FIGURE 5-2 **Overall Apron Development**



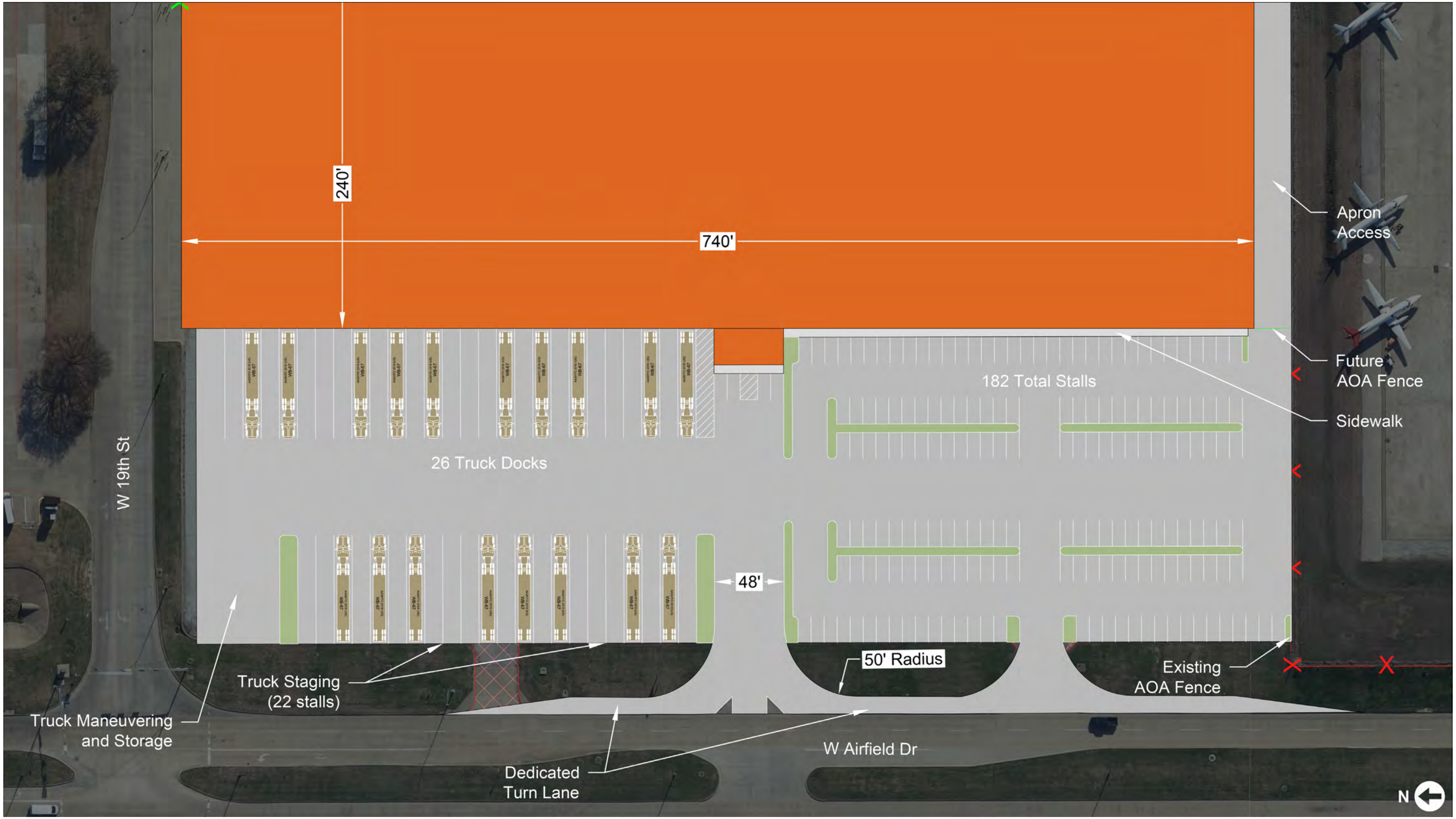
Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, January 2022

FIGURE 5-3 Overall Apron Development with B777F Parking



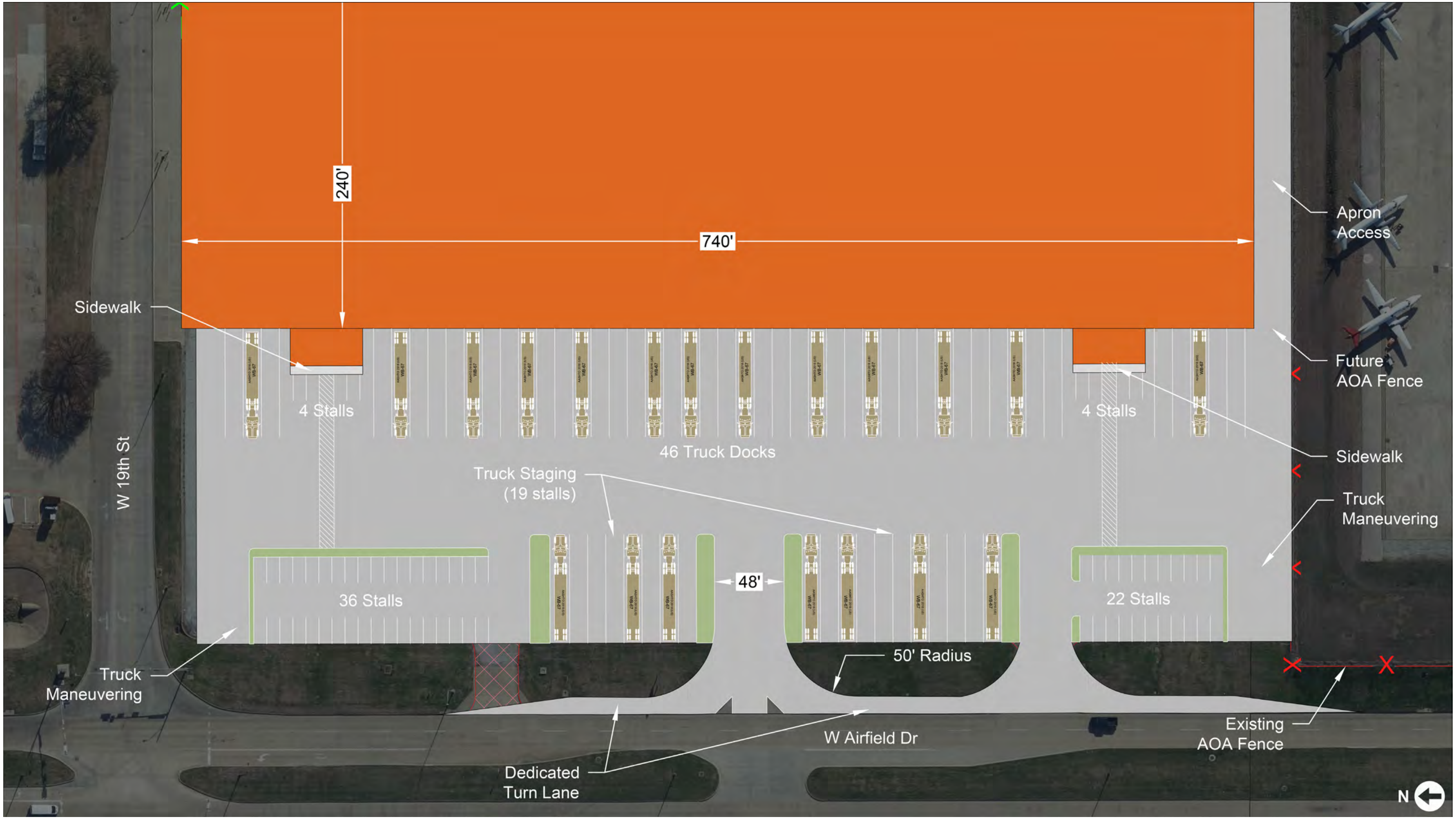
Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, January 2022

FIGURE 5-4 Building 1 – Landside Alternative 1



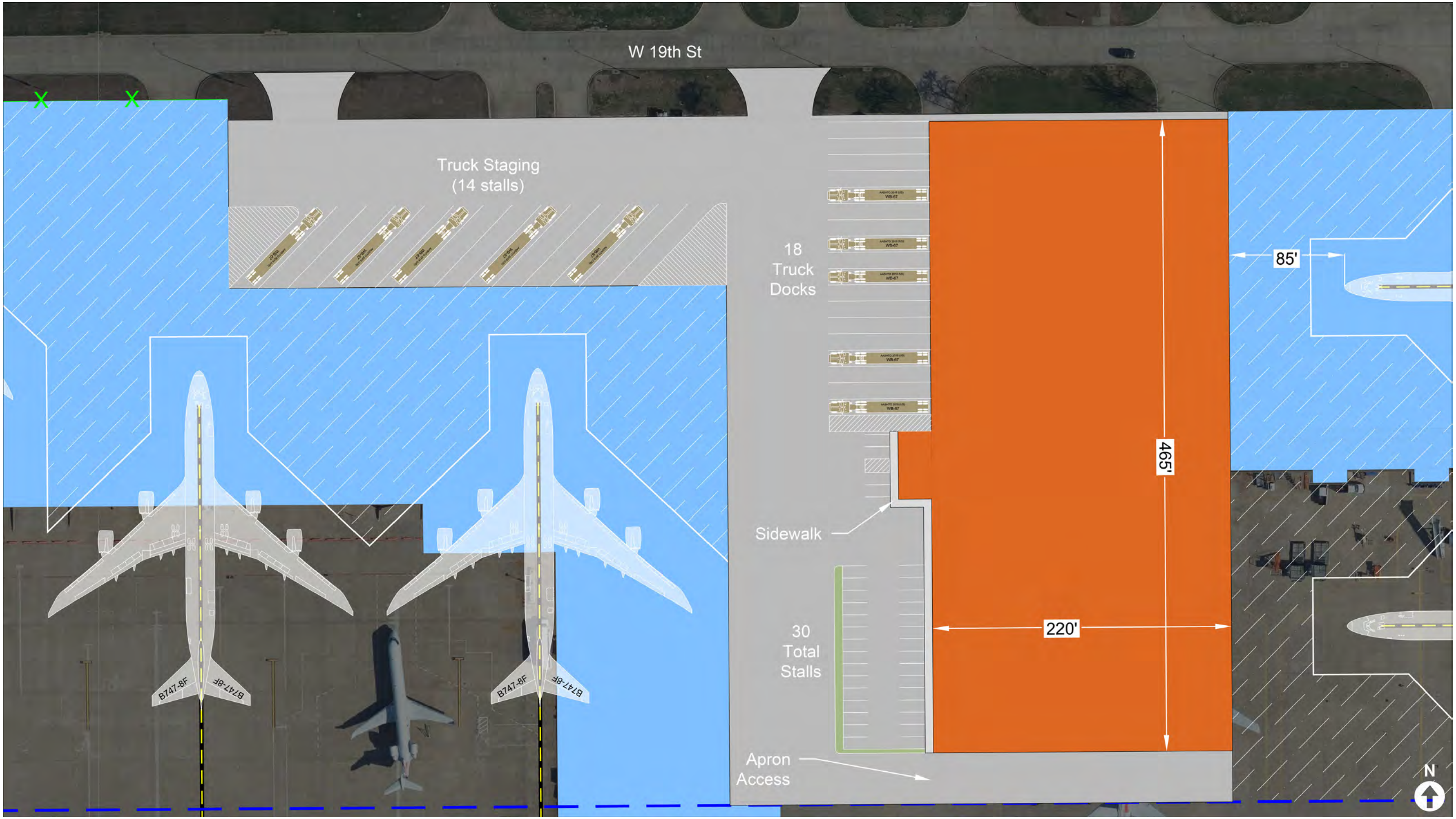
Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, September 2021

FIGURE 5-5 Building 1 – Landside Alternative 2



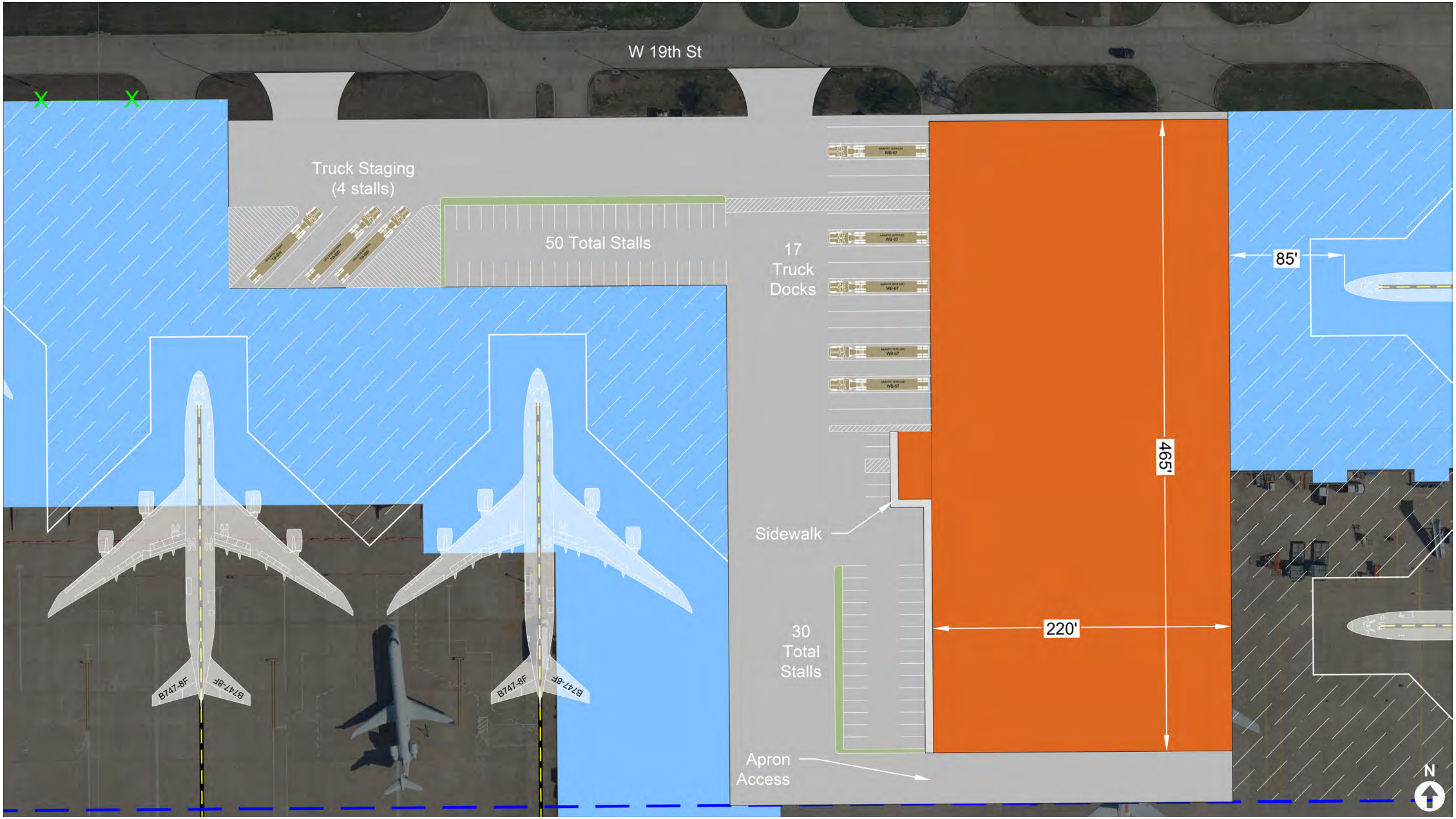
Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, September 2021

FIGURE 5-6 Building 2 – Landside Alternative 1



Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, January 2022

FIGURE 5-7 Building 2 – Landside Alternative 2



Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, January 2022

Figure 5-8, *Combined Development Alternative,* presents landside alternative 2 for both Buildings 1 and 2, combined with the overall apron development to represent a complete development alternative. Either landside alternatives for each Building could be paired with one another to create a recommended alternative based on the tenant's and Airport's evaluation.

Appendix C, *Representative Landside Renderings,* presents several preliminary renderings to provide an overview and scale of the available Building 1 site.

5.2 Additional Infrastructure Requirements

Based on stakeholder coordination, it anticipated that three additional infrastructure needs are required as part of developing Buildings 1 and 2:

- Underground Stormwater Collection Tank
- Oil/Water Separator
- Conduit for High-Mast Lighting

Further analysis is needed to assess the location, requirements, and associated impacts of these three infrastructure needs.

5.3 Development Quantities

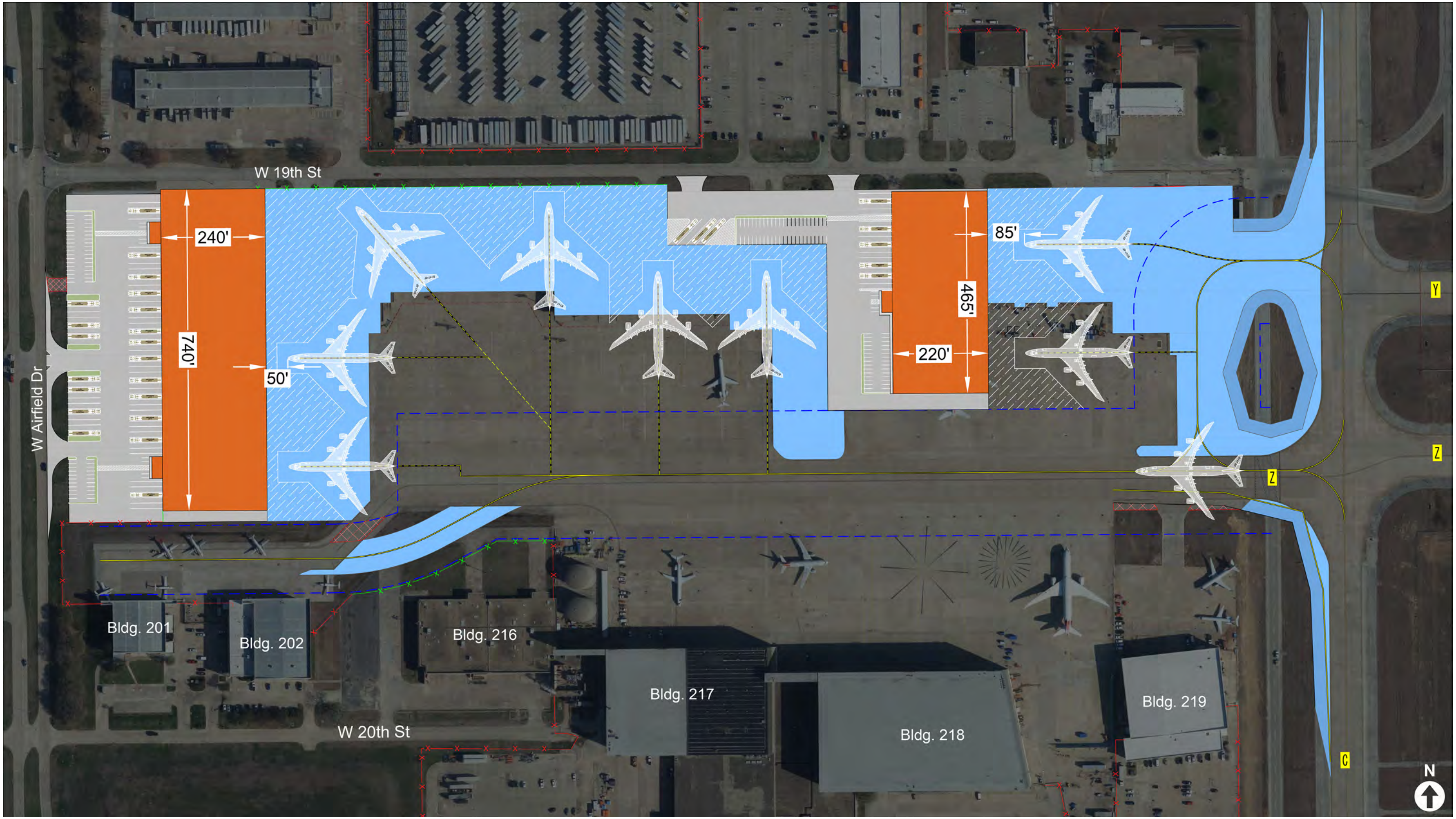
Table 5-1 through Table 5-6 provide quantities for the apron entrance construction and modifications, , the overall apron development, and two landside alternatives each for Buildings 1 and 2. It should be noted that while these quantities cover a large portion of the required infrastructure for this effort, they are not exhaustive and serve only as a basis for the development of the Rough Order of Magnitude (ROM) cost estimates. The quantities will be further refined and adjusted as the project moves forward into design.

TABLE 5-1 NW Cargo Apron Entrance Construction and Modifications Quantities

Item No.	Description	Units	Estimated Quantities	Estimated Unit Price	Subtotal
1.01	17.5" Continuously Reinforced Concrete Pavement	SY	16,600	-	-
1.02	8" Cement Treated Base	SY	17,150	-	-
1.03	3" P-401 Asphalt Taxiway Shoulder Pavement	TONS	800	-	-
1.04	6" P-401 Asphalt Taxiway Shoulder Pavement (Base) Layer	TONS	1,800	-	-
1.05	Pavement Markings - Yellow	SF	6,300	-	-
1.06	Pavement Markings - Black Border	SF	10,800	-	-
1.07	Taxiway Edge Light	EA	30	-	-
1.08	Taxiway Edge Light Removal	EA	17	-	-
1.09	Taxiway Centerline Light	EA	40	-	-
1.10	Taxiway Centerline Light Removal	EA	12	-	-

Source: Centurion Planning & Design, September 2021

FIGURE 5-8 Combined Development Alternative



Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, January 2022

TABLE 5-2 Overall Apron Development Quantities

Item No.	Description	Units	Estimated Quantities	Estimated Unit Price	Subtotal
1.01	17.5" Continuously Reinforced Concrete Pavement	SY	69,650	-	-
1.02	8” Cement Treated Base	SY	71,350	-	-
1.03	Pavement Demolition	SY	375	-	-
1.04	Pavement Markings - Yellow	SF	4,950	-	-
1.05	Pavement Markings - Black Border	SF	7,450	-	-
1.06	Pavement Markings - White (Angled)	SF	305,000	-	-
1.07	High-Mast Ramp Light	EA	10	-	-
1.08	Aircraft Parking Guidance System	EA	8	-	-
1.10	AOA Fence	LF	3,450	-	-

Source: Centurion Planning & Design, September 2021

TABLE 5-3 Landside Alternative 1 – Building 1 Quantities

Item No.	Description	Units	Estimated Quantities	Estimated Unit Price	Subtotal
1.01	10" TxDOT 360 PCC Pavement	SY	20,200	-	-
1.02	8" TxDOT 247 Type A Grade 1-2 Flex-Base	SY	20,850	-	-
1.03	8" Lime-Treated Subgrade	SY	21,900	-	-
1.04	6" Raised Curb - Perimeter	LF	2,100	-	-
1.05	6" Raised Curb – Grass Island	SF	7,000	-	-
1.06	Drainage Inlets	EA	4	-	-
1.07	Excavation and Enbankment	CY	-	-	-
1.08	Pavement Markings - 4" White (Solid)	LF	7,650	-	-
1.09	Pavement Markings - 4" White (Angled Stripe)	SF	1,200	-	-
1.10	Landscaping	LS	1	-	-
1.11	High-Mast Light Pole	EA	-	-	-
1.12	Cargo Building	SF	149,200	-	-
1.13	Pavement Demolition	SY	310	-	-
1.14	Sidewalk	SF	2,110	-	-
1.15	Ramp Access Gate	LF	25		

Source: Centurion Planning & Design, September 2021

TABLE 5-4 Landside Alternative 2 – Building 1 Quantities

Item No.	Description	Units	Estimated Quantities	Estimated Unit Price	Subtotal
1.01	10" TxDOT 360 PCC Pavement	SY	20,200	-	-
1.02	8" TxDOT 247 Type A Grade 1-2 Flex-Base	SY	20,850	-	-
1.03	8" Lime-Treated Subgrade	SY	21,900	-	-
1.04	6" Raised Curb - Perimeter	LF	2,100	-	-
1.05	6" Raised Curb – Grass Island	SF	5,900	-	-
1.06	Drainage Inlets	EA	4	-	-
1.07	Excavation and Enbankment	CY	-	-	-
1.08	Pavement Markings - 4" White (Solid)	LF	12,400	-	-
1.09	Pavement Markings - 4" White (Angled Stripe)	SF	2,600	-	-
1.10	Landscaping	LS	1	-	-
1.11	High-Mast Light Pole	EA	-	-	-
1.12	Cargo Building	SF	150,500	-	-
1.13	Pavement Demolition	SY	310	-	-
1.14	Sidewalk	SF	600	-	-
1.15	Ramp Access Gate	LF	25	-	-

Source: Centurion Planning & Design, September 2021

TABLE 5-5 Landside Alternative 1 – Building 2 Quantities

Item No.	Description	Units	Estimated Quantities	Estimated Unit Price	Subtotal
1.01	10" TxDOT 360 PCC Pavement	SY	15,050	-	-
1.02	8" TxDOT 247 Type A Grade 1-2 Flex-Base	SY	15,450	-	-
1.03	8" Lime-Treated Subgrade	SY	16,100	-	-
1.04	6" Raised Curb - Perimeter	LF	1,000	-	-
1.05	6" Raised Curb – Grass Island	SF	1,050	-	-
1.06	Drainage Inlets	EA		-	-
1.07	Excavation and Enbankment	CY	-	-	-
1.08	Pavement Markings - 4" White (Solid)	LF	3,700	-	-
1.09	Pavement Markings - 4" White (Angled Stripe)	SF	5,000	-	-
1.10	Landscaping	LS	1	-	-
1.11	High-Mast Light Pole	EA	-	-	-
1.12	Cargo Building	SF	102,300	-	-
1.13	Pavement Demolition	SY	350	-	-
1.14	Sidewalk	SF	1,600	-	-
1.15	Ramp Access Gate	LF	40	-	-

Source: Centurion Planning & Design, September 2021

TABLE 5-6 Landside Alternative 2 – Building 2 Quantities

Item No.	Description	Units	Estimated Quantities	Estimated Unit Price	Subtotal
1.01	10" TxDOT 360 PCC Pavement	SY	15,050	-	-
1.02	8" TxDOT 247 Type A Grade 1-2 Flex-Base	SY	15,450	-	-
1.03	8" Lime-Treated Subgrade	SY	16,100	-	-
1.04	6" Raised Curb - Perimeter	LF	1,000	-	-
1.05	6" Raised Curb – Grass Island	SF	2,500	-	-
1.06	Drainage Inlets	EA		-	-
1.07	Excavation and Enbankment	CY	-	-	-
1.08	Pavement Markings - 4" White (Solid)	LF	4,050	-	-
1.09	Pavement Markings - 4" White (Angled Stripe)	SF	6,200	-	-
1.10	Landscaping	LS	1	-	-
1.11	High-Mast Light Pole	EA	-	-	-
1.12	Cargo Building	SF	102,300	-	-
1.13	Pavement Demolition	SY	350	-	-
1.14	Sidewalk	SF	1,600	-	-
1.15	Ramp Access Gate	LF	40	-	-

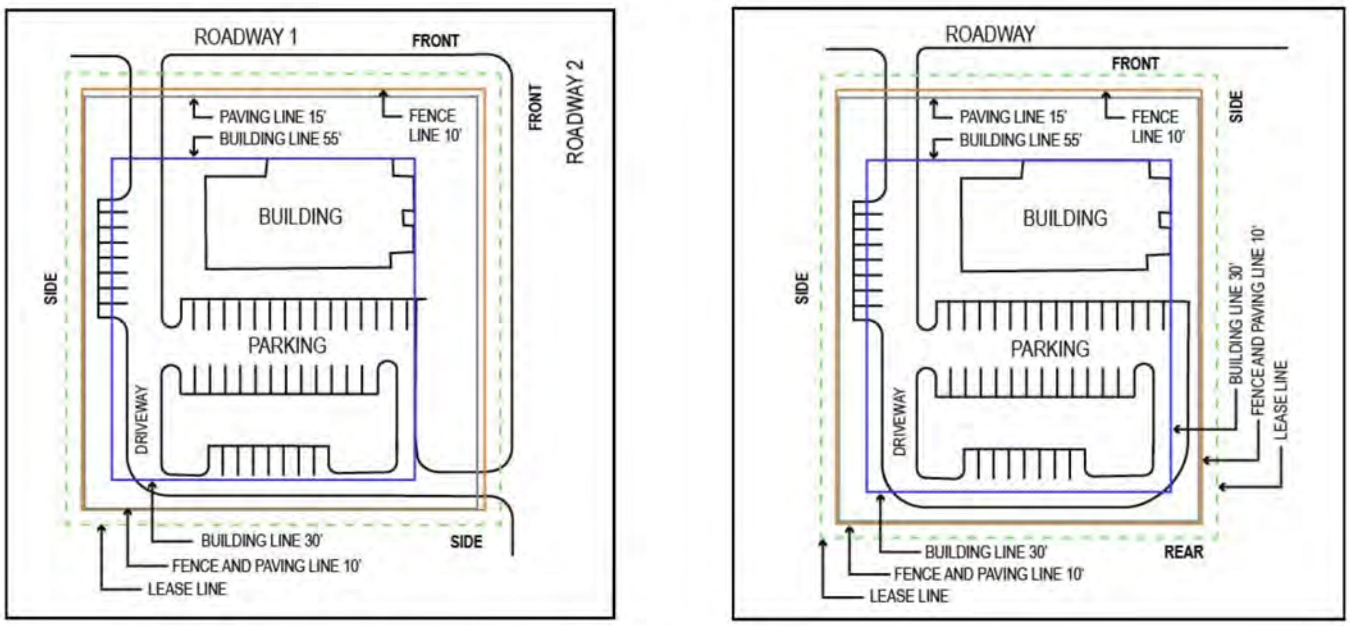
Source: Centurion Planning & Design, September 2021

5.4 Development Design Guidelines

5.4.1 Lease Line Setbacks

One of the development guidelines for the site is the DFW Development Design Guidelines from June 2020. Upon recent discussions with stakeholders, it is anticipated that the project will need to follow these standards. Included within these guidelines are provisions for setbacks from the lease lines. Section 2.2.1.1., Front, Side, and Rear Yard Setbacks details the possible requirements for the site which are shown below in **Figure 5-9, *DFW Development Design Guideline Setbacks.***

FIGURE 5-9 DFW Development Design Guideline Setbacks



Source: DFW Development Design Guidelines, June 2020

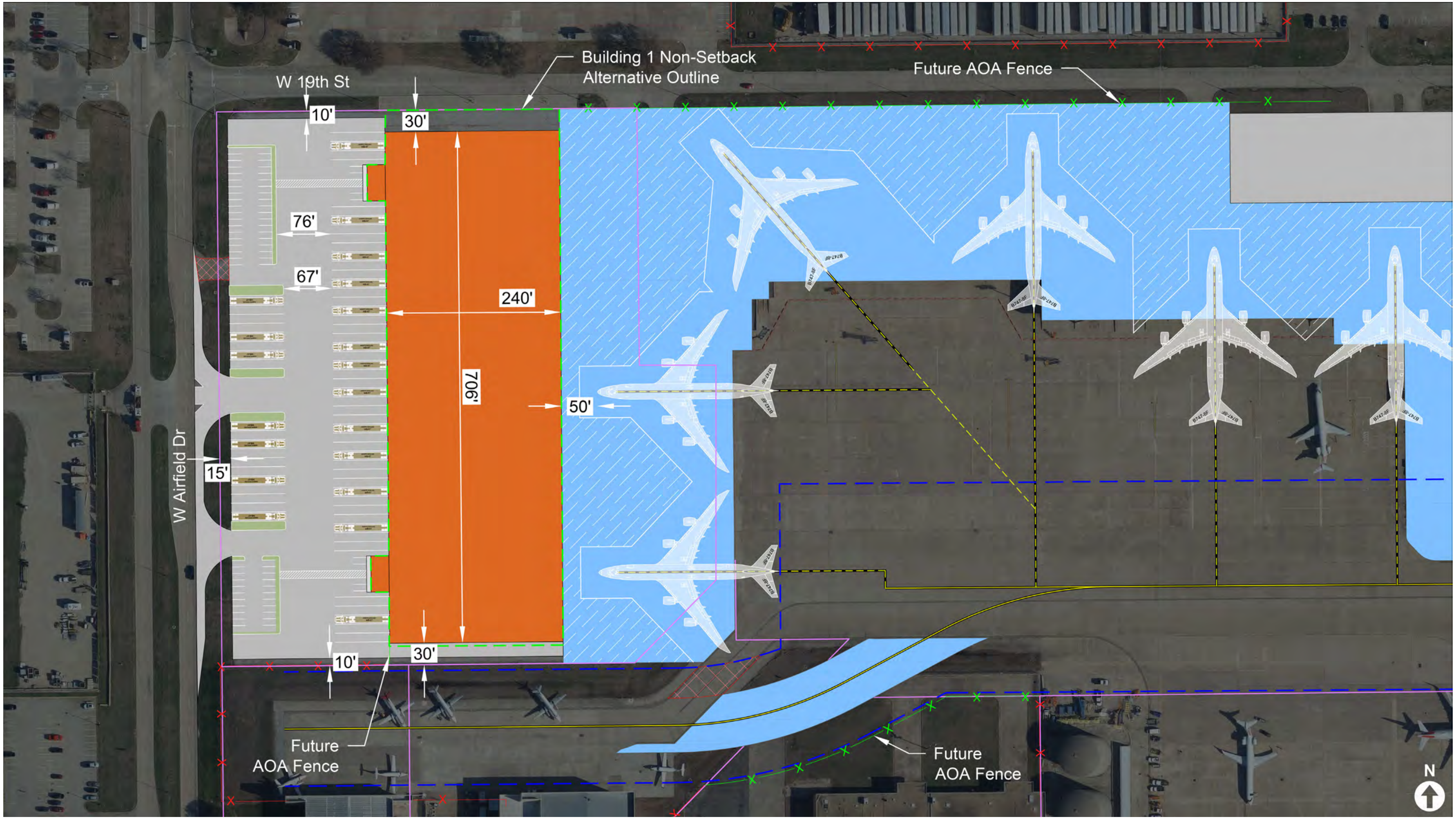
The alternatives mentioned above provide for development out to the lease line. Should these lease line setbacks need to be implemented, there are varying impacts to the development of the sites. The Building 1 site will be referenced when discussing these impacts. With Building 1's landside area adjacent to West Airfield Drive, it is anticipated that a 15-foot setback from the lease line to the paved lot would be required due to the egress point and this being considered a front yard. For the northern and southern sides, since there is no egress point, it is anticipated that these would be considered side yards and would require a 10-foot setback to paved areas or a fence and a 30-foot setback to the building. **Figure 5-10, *DFW Development Design Guideline Setback Alternative,*** presents a future alternative for the Building 1 site that follows these guidelines. Additionally,

An additional consideration that should be further investigated in the design phase is the potential expansion of West 19th Street. Specific workshops detailing the additional requirements should be conducted in the early part of the design phase to address these additional requirements.

5.4.2 Landscape Requirements

It is expected that the landscape design for this project will adhere to the requirements established in the Development Design Guidelines. This pertains to design, plants, hardscape, drainage, and street furniture.

FIGURE 5-10 **DFW Development Design Guideline Setback Alternative**



Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, January 2022

5.5 Overview of Future Development Phase

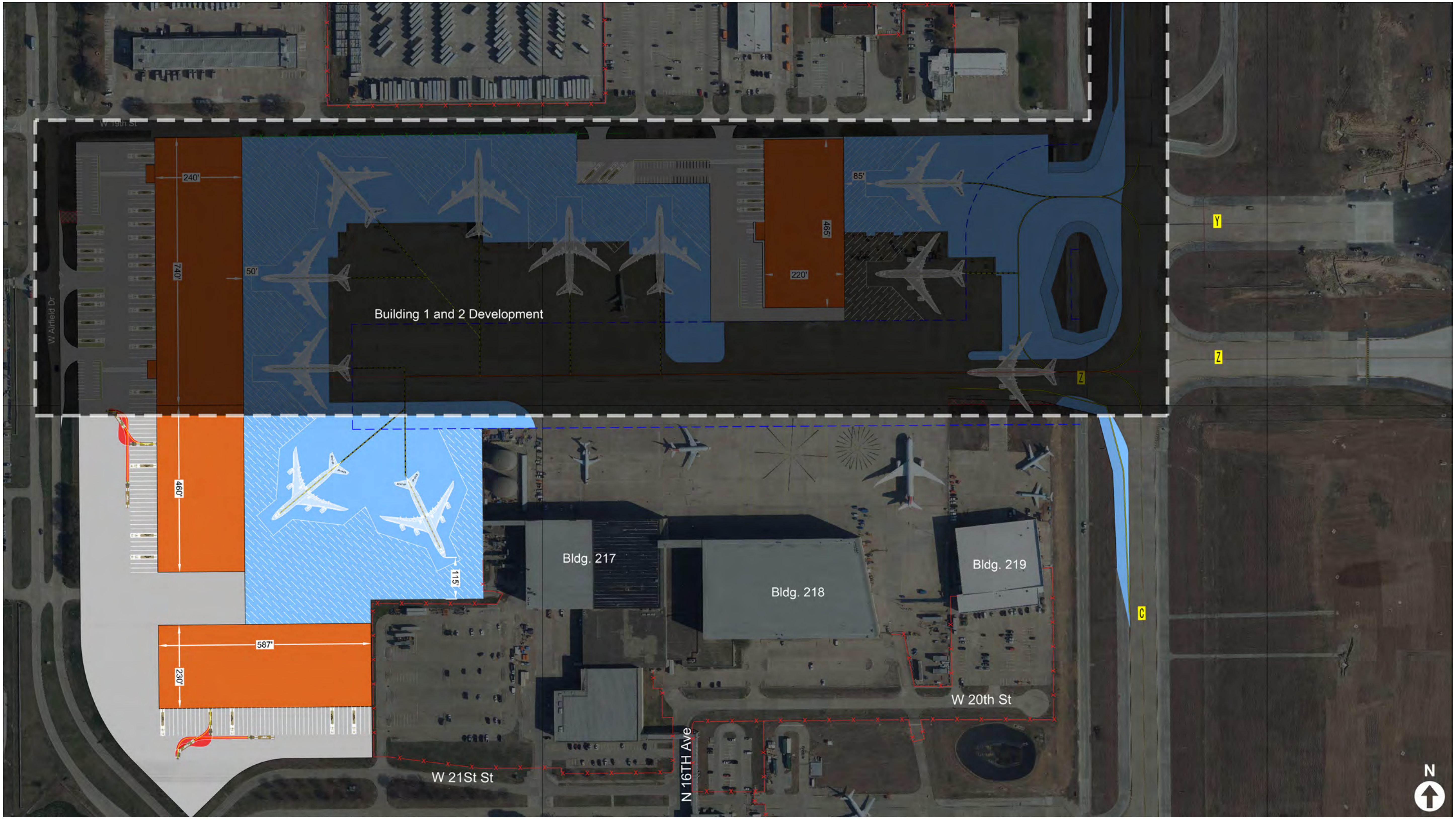
The 2020 Cargo Master Plan, developed through coordination with all Airport stakeholders, encompasses cargo development across the entire Airport, including future expansions of the 19th Street cargo campus. Initiating the future phase of redevelopment for the NW Cargo Campus requires the relocation of Ameriflight (Bldg. 202) and Halbert & Associates, LLC (Bldg. 201), as their existing facilities would need to be demolished. This phase also requires the demolition of the former Kitty Hawk building (Bldg. 216). While Ameriflight (in particular) serves a critical function in the air cargo industry, providing FAA Part 121 and Part 135 service for integrated carriers, the development of a complex with B747-8F freighters as the design aircraft would be incompatible with the small feeder aircraft operated by Ameriflight. The relatively small footprint of the Ameriflight operation would allow it to be relocated to another part of the airfield with relative ease.

As shown in **Figure 5-11, *Future Phase of the NW Cargo Campus,*** a 110,400 SF facility is provided to the south. Overall, this phase provides five B747-8F contact stands and five remote B747-8F positions. A landside depth of 230-feet would allow commercial trucks and trailers (75-foot length) to circulate, operate, and park in front of the building. This depth would also allow for ultimate flexibility in the use of this space for employee parking, storage, etc.

Additionally, a facility of approximately 135,000 SF would be constructed to the west of AA Hangar 1. The ramp would expand south over W. 20th St., to connect to the new 135,000 SF facility. With this additional ramp area, a total of 10 B747-8F parking positions are provided along with a total facility footprint of approximately 525,000 SF.

For all future development initiatives, please refer to the 2020 Cargo Master Plan.

FIGURE 5-11 Future Phase of the NW Cargo Campus



Source: DFW Airport Layout Plan, June 2020; Landrum & Brown, Inc., Centurion Planning & Design, January 2022

6 Environmental Considerations

An approved Environmental Assessment (EA) is required for any potential request for federal funding. An EA is a concise document used to describe a proposed action's anticipated environmental impacts. The EA will be developed following the PDD, concurrently with the design of the project. If it is found that significant impacts would not occur, then a Finding of No Significant Impact (FONSI) can be prepared. However, if it is found that significant impacts would occur, then an Environmental Impact Statement (EIS) must be prepared. The following environmental resources will be assessed in the EA:

- Air Quality
- Biological resources
- Climate
- Coastal resources
- Department of Transportation, Section 4(f) resources
- Farmlands
- Hazardous materials, solid waste, and pollution prevention
- Historical, architectural, archeological, and cultural resources
- Land use
- Natural resources and energy supply
- Socioeconomics, environmental justice, and children's environmental health and safety risks
- Visual effects
- Water resources (including wetlands, floodplains, surface waters, groundwater, and wild and scenic rivers)
- Topographical Conditions, Drainage, and Stormwater Management

In addition to the list above, community outreach is an important component of the project, specifically regarding the EA. The communities surrounding the Airport need to be engaged through regular communication and information sharing and have an opportunity to provide input on the EA on an as needed basis based on the project's impact to the community.

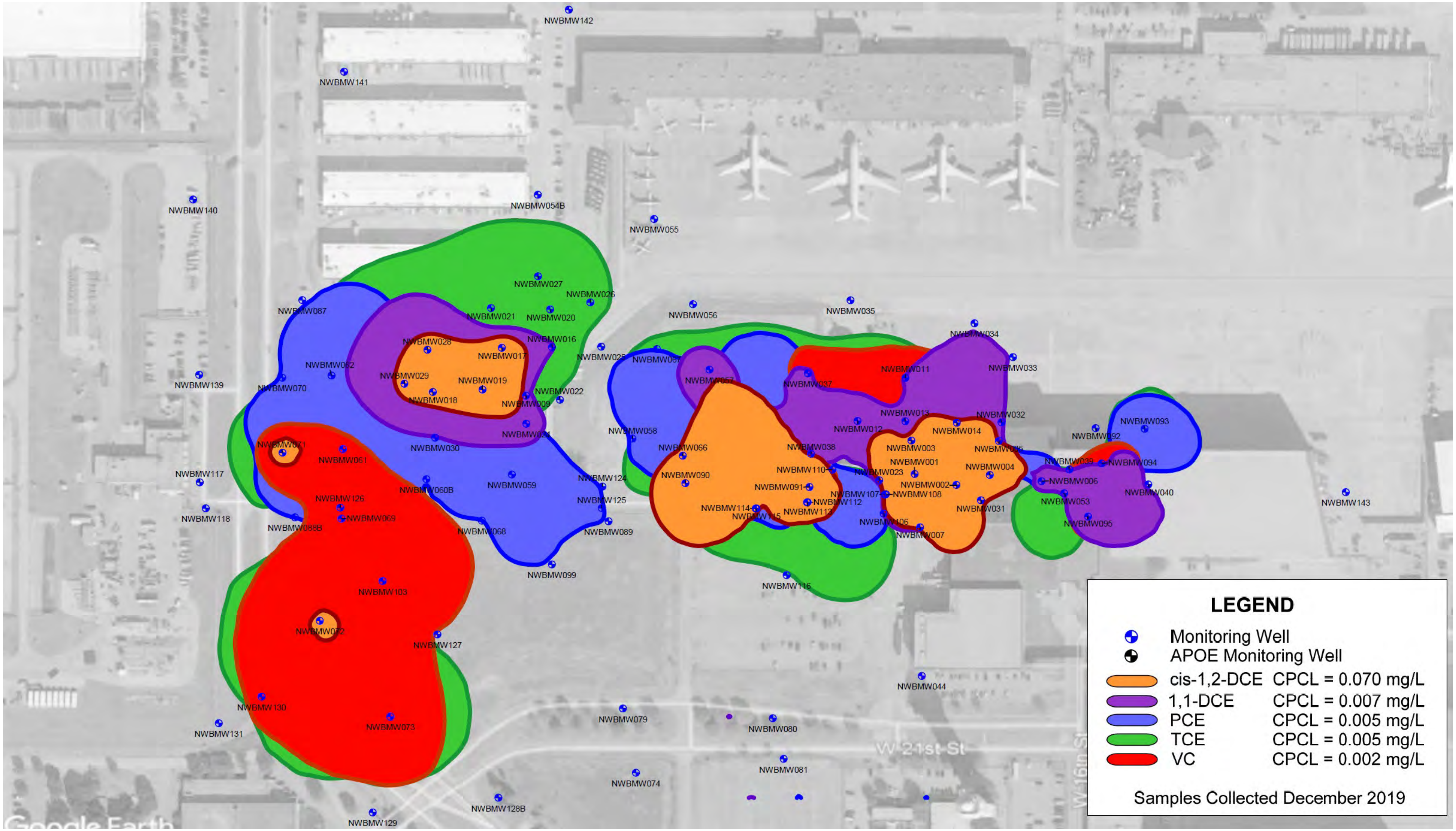
6.1 Groundwater and Soil

Environmental Affairs (EAD) provided multiple exhibits for the Northwest Cargo area that show various plumes of chemicals that have leached into the soil as part of previous developments, as shown in **Figure 6-1, *Plume Footprint Map for all COCs above CPCL***. The monitoring wells throughout this area constantly monitor the directional movement and overall size of these plumes. Currently, the depth at which construction efforts would encounter these chemicals would be approximately 20-feet below the surface. EAD noted that the only task that will likely need to be completed for this area would be soil remediation. In addition, given the location of the future cargo facility, several of the monitoring wells will need to be relocated.

Additionally, **Appendix D, *Concentration Maps at West Cargo,*** provides the actual concentrations contours for each of the five contaminants in the area. This includes the following documents:

- *1, 1-DCE Groundwater Concentration Map*, EAD, December 2019
- *CIS-1, 2-DCE Groundwater Concentration Map*, EAD, December 2019
- *PCE Groundwater Concentration Map*, EAD, December 2019
- *TCE Groundwater Concentration Map*, EAD, December 2019
- *Vinyl Chloride Groundwater Concentration Map*, EAD, December 2019

FIGURE 6-1 Plume Footprint Map for all COCs above CPCL



Source: DFW EAD, December 2019

6.2 Materials Management

To reduce project cost and reuse acceptable scrap materials/millings from other projects at the Airport, it is recommended that a materials management plan be developed. This plan should include the discard of scrap materials/millings from the Northwest Cargo development and the use of materials for new facility construction from other projects at the Airport (e.g., Runway 18R/36L Rehabilitation, NE EAT. As of December 12, 2020, the following quantities were inventoried at the East Materials Management Site (EMMS):

- Asphalt: 36,803 cubic yards
- Concrete (processed): 35,790 cubic yards
- Cement Treated Base (CTB): 19,845 cubic yards
- Reinforced Concrete Base (RCB): 14 cubic yards
- Suitable Fill: 457,043 cubic yards
- Topsoil: 8,605 cubic yards

It is recommended that this material be considered as much as possible for the Northwest Cargo development.

7 Operational Considerations

7.1 Construction Staging Areas, Logistics, and Airfield Security

Construction staging areas and operational logistics for this project have yet to be determined. However, airfield security will be maintained by a temporary construction fence for the facility and apron buildout. The only time construction operations will occur within the AOA is for the fillet modifications to the existing apron entrance and construction of the future apron entrance. The contractor must always coordinate with DFW Operations with regards to construction efforts. This communication is critical as the Airport has a requirement to maintain at least one active apron entrance into the NW Cargo area throughout construction.

7.2 Design and Construction Schedule

The initial project schedule is currently in development with PCG, and NEPA timelines are still being determined. The goal is to commence construction of both Buildings 1 and 2 as soon as possible, with asset handover to the tenants planned to occur as early as 2024.

7.3 Permitting Overview

It is expected that FAA Form 7460-1, Notice of Proposed Construction or Alternation, will be required for all work as part of the project and must be submitted in a timely manner to avoid project delays. Additionally, all contractors, consultants, and other individuals working on the project must follow "The Code of Rules and Regulations of the Dallas-Fort Worth International Airport Board." A copy of this code can be found on the Airport's website at: https://www.dfwairport.com/about/publications/index.php.

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Appendix A: Draft Cost Estimate

DRAFT

DESIGN, CODE & CONSTRUCTION
Project Controls Group

19th Street Redevelopment Ph1 & 3
CIP BUDGET ESTIMATE SUMMARY

DFW

					Owner's Soft Cost as a % of Construction Cost									
	Construction				Design/Study /Planning	Staff /Consultant	CM /Inspection	Testing /Surveying	Commissioning	Miscellaneous	Total SoftCost	CIP Budget		
Description	Qty	Unit	Unit Cost	Total	9.00%	5.00%	4.00%	2.00%	1.00%	5.00%	26.00%	Subtotal	Contingency	Total
19th St. Redevelopment Ph 1 rev11/18/21	1.00	LS		43,554,410	3,919,897	2,177,721	1,742,176	871,088	435,544	2,177,721	11,324,147	54,878,557	5,487,856	60,366,413
Civil Contract- Site/Utilities/Paving	1.00	LS		16,695,891	1,502,630	834,795	667,836	333,918	166,959	834,795	4,340,932	21,036,823	2,103,682	23,140,505
Sitework	1.00	LS		2,067,740	186,097	103,387	82,710	41,355	20,677	103,387	537,612	2,605,352	260,535	2,865,887
Preliminary Ramp	301,680.00	SF	35.23	10,628,967	956,607	531,448	425,159	212,579	106,290	531,448	2,763,531	13,392,498	1,339,250	14,731,748
Pushback Pavement Area	29,320.00	SF	34.05	998,237	89,841	49,912	39,929	19,965	9,982	49,912	259,542	1,257,779	125,778	1,383,557
Access Taxiway ADG-III	27,200.00	SF	32.05	871,626	78,446	43,581	34,865	17,433	8,716	43,581	226,623	1,098,249	109,825	1,208,074
Taxiway Z Entrance	66,915.00	SF	31.82	2,129,321	191,639	106,466	85,173	42,586	21,293	106,466	553,623	2,682,944	268,294	2,951,239
DB Building Contract-Cargo Facility w/Paving	1.00	LS		21,258,520	1,913,267	1,062,926	850,341	425,170	212,585	1,062,926	5,527,215	26,785,735	2,678,573	29,464,308
Personnel Parking/ Truck Court	176,150.00	SF	12.59	2,217,143	199,543	110,857	88,686	44,343	22,171	110,857	576,457	2,793,600	279,360	3,072,960
Cargo Facility- Ph 1	207,600.00	GSF	91.72	19,041,376	1,713,724	952,069	761,655	380,828	190,414	952,069	4,950,758	23,992,134	2,399,213	26,391,348
Other Costs	1.00	LS		5,600,000	504,000	280,000	224,000	112,000	56,000	280,000	1,456,000	7,056,000	705,600	7,761,600
Direct Cost Development Allowance	1.00	LS		3,500,000	315,000	175,000	140,000	70,000	35,000	175,000	910,000	4,410,000	441,000	4,851,000
Escalation	1.00	LS		2,100,000	189,000	105,000	84,000	42,000	21,000	105,000	546,000	2,646,000	264,600	2,910,600
Add Alternate-Cold Storage	20,000.00	SF	29.92	598,454	53,861	29,923	23,938	11,969	5,985	29,923	155,598	754,052	75,405	829,457
19th St. Redevelopment Ph 3 rev11/19/21	1.00	LS		37,061,668	3,335,550	1,853,083	1,482,467	741,233	370,617	1,853,083	9,636,034	46,697,702	4,669,770	51,367,472
Civil Contract- Demo/Utilities/Paving	1.00	LS		20,223,014	1,820,071	1,011,151	808,921	404,460	202,230	1,011,151	5,257,984	25,480,998	2,548,100	28,029,098
Sitework	1.00	LS		4,921,291	442,916	246,065	196,852	98,426	49,213	246,065	1,279,536	6,200,827	620,083	6,820,910
Airside Pavement/Ramp /Twy	431,370.00	SF	35.47	15,301,723	1,377,155	765,086	612,069	306,034	153,017	765,086	3,978,448	19,280,171	1,928,017	21,208,188
DB Building Contract-Cargo Facility w/Paving	1.00	LS		12,038,653	1,083,479	601,933	481,546	240,773	120,387	601,933	3,130,050	15,168,703	1,516,870	16,685,574
Landside Pavement/Parking/Truck Court	130,950.00	SF	14.89	1,949,334	175,440	97,467	77,973	38,987	19,493	97,467	506,827	2,456,161	245,616	2,701,777
Cargo Facility-Ph 3	102,300.00	SF	98.62	10,089,319	908,039	504,466	403,573	201,786	100,893	504,466	2,623,223	12,712,542	1,271,254	13,983,796
Other Costs	1.00	LS		4,800,000	432,000	240,000	192,000	96,000	48,000	240,000	1,248,000	6,048,000	604,800	6,652,800
Direct Cost Development Allowance	1.00	LS		3,000,000	270,000	150,000	120,000	60,000	30,000	150,000	780,000	3,780,000	378,000	4,158,000
Escalation	1.00	LS		1,800,000	162,000	90,000	72,000	36,000	18,000	90,000	468,000	2,268,000	226,800	2,494,800
Add Alternate-Cold Storage	15,000.00	SF	29.92	448,841	40,396	22,442	17,954	8,977	4,488	22,442	116,699	565,540	56,554	622,094
Construction Subtotal			$0.00	$81,663,373	$7,349,704	$4,083,169	$3,266,535	$1,633,267	$816,634	$4,083,169	$21,232,478	$102,895,851	$10,289,585	$113,185,436
Add Alternates	1.00	LS		5,000,000								5,000,000	500,000	5,500,000
Add Alternate-Tenant Improvements-Ph 1	15,000.00	SF	200.00	3,000,000								3,000,000	300,000	3,300,000
Add Alternate-Tenant Improvements-Ph 3	10,000.00	SF	200.00	2,000,000								2,000,000	200,000	2,200,000
TOTAL: NW 19th St. Redevelopment				**$86,663,373**	**7,349,704**	**4,083,169**	**3,266,535**	**1,633,267**	**816,634**	**4,083,169**	**21,232,478**	**107,895,851**	**10,789,585**	**$118,685,436**

Appendix B: 2018 Evergreen Cargo Ramp Pavement Assessment

RS&H
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Suite 800
Dallas, TX 75244
O 469-857-7721
F 214-292-8555
rsandh.com

MEMORANDUM:

Date: September 28, 2018

To: Dallas Fort Worth International Airport (Design, Code and Construction)

From: RS&H

Subject: DO No. 17 OFA Analysis and Demolition of Evergreen Cargo - Pavement Condition Index Survey Technical Memorandum **(DRAFT)**

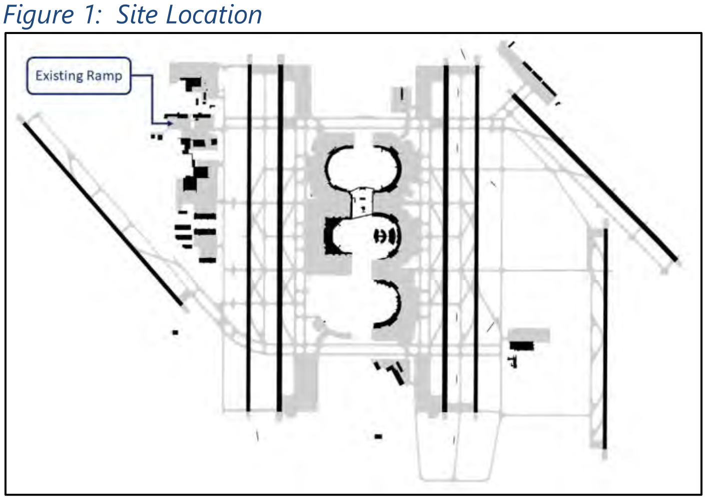
This technical memorandum is part of deliverable for Dallas Fort Worth International Airport (DFW) Contract Number 8500346, Delivery Order (DO) number 17 - OFA Analysis and Demolition of Evergreen Cargo. This technical memorandum presents the results of the Pavement Condition Index (PCI) Survey for the Existing Ramp at the Evergreen cargo building.

1.0 Background

RS&H was requested by DFW Design, Code and Construction as part of DO 17 to perform a PCI survey and determine a PCI value for the Existing Ramp (**Figure 1**) at the air cargo facility currently known as the Evergreen building located at 1530 W 19th Street, within the Northwest (NW) Cargo area of DFW Airport.

The NW Cargo area is under-utilized and redevelopment of the area for cargo operations is the established highest and best use for that Airport real estate. DFW's total air cargo tonnage is predicted to grow over 4% through 2020, moderating to 2.5% 2020 onwards. Existing cargo facilities are not geared to support this growth without significant redevelopment and optimization of existing assets. This PCI survey is part of the due-diligence analysis required as a first step to determine and document the conditions of the Existing Ramp at the Evergreen cargo building.

Figure 1: Site Location



Source: Federal Aviation Administration, 2018; RS&H, 2018

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2.0 Pavement Condition Index Survey

Overview

A PCI survey, as defined in American Society for Testing and Materials (ASTM) D5340 *Standard Test Method for Airport Pavement Condition Index Surveys,* provides a measure of the present condition of the pavement based on the distresses visually observed on the surface of the pavement and indicates the structural integrity and surface operational condition (localized roughness and safety). Additionally, a PCI survey provides an objective and rational basis for determining maintenance and repair needs and priorities. It is important to note that a PCI survey cannot measure the structural capacity[1], nor can it provide direct measurement of skid resistance or roughness.

Pavement distresses are external indicators of pavement deterioration caused by loading, environmental factors, construction deficiencies, or a combination thereof. The Existing Ramp, which is approximately 310,000 square feet, is constructed of rigid pavement (portland concrete cement (PCC)[2]). Typical rigid pavement distresses include cracks, joint seal damage, and spalling. A complete list of airfield rigid pavement distresses is listed in **Table 1**.

Table 1: Rigid Pavement Distresses

Rigid Pavement Distresses	
Alkali Silica Reaction (ASR)	Popouts
Blow up	Pumping
Corner Break	Scaling
Cracks (Longitudinal, Transverse, and Diagonal)	Settlement or Faulting
Durability ("D") Cracking	Shattered Slab/Intersecting Cracks
Joint Seal Damage	Shrinkage Cracking
Patching (Small)	Spalling (Corner)
Patching (Large and Utility Cut)	Spalling (Longitudinal and Transverse Joint)

Source: ASTM D5340, 2012

The result of a PCI survey is a PCI which is a numerical rating of the pavement condition that ranges from 0 to 100 with 0 being the worst possible condition and 100 being the best possible condition. The PCI is based on visually observed distresses in the pavement and the PCI is reduced based on the distress type, severity, and quantity.

To conduct a PCI survey, the pavement areas are classified using a hierarchical-based pavement network model. A pavement network contains pavement branches which in turn contain one or many pavement sections. A pavement branch is an identifiable part of the pavement network that is a single entity and has a distinct function such as a runway, taxiway, or ramp. A pavement section is a contiguous pavement area having uniform construction, maintenance, usage history (traffic volume/load intensity), and condition. A PCI is calculated for each pavement section.

The Existing Ramp is defined as a single pavement branch. Information relating to the construction and history of any previous maintenance efforts were unknown at the time of the PCI survey. This PCI survey assumes that the Existing Ramp has uniform construction, maintenance, and usage history and therefore defined as a single pavement section.

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[1] Concurrent to the PCI survey, a structural capacity analysis was performed and the results are contained in a separate technical memorandum.

[2] Concurrent to the PCI survey, a geotechnical investigation was conducted and the results are contained in a separate technical memorandum.

PCI Survey and Observed Distresses

A PCI survey of the Existing Ramp was performed on September 25, 2018. To facilitate the PCI survey, the pavement section was subdivided into pavement sample units that, for rigid pavement, have a standard size range of 20 contiguous slabs (± 8 slabs). All sample units (**Figure 2**) were visually inspected for airfield pavement distresses.

During the PCI survey, observed pavement distresses were documented based on the distress type, quantity, and severity as defined in ASTM D5430 *Standard Test Method for Airport Pavement Condition Index Surveys*. The observed distresses were then recorded in PAVER™, a windows-based pavement management software, and verified for accuracy.

Various types of pavement distresses were observed and documented. Below is a description and distress analysis of the distresses observed during the PCI survey. **Appendix A** contains a summary of distresses for each inspected sample unit.

Cracks (Longitudinal, Transverse, and Diagonal)

Cracks can include longitudinal, transverse, and diagonal cracks that divide the slab into two or three pieces. Cracks are usually caused by a combination of load repetition, curling stresses, and shrinkage stresses.

Longitudinal and transverse cracks were observed in 17 out of the 497 inspected slabs and located primarily in the inspected sample units located in the northern portion of the ramp (sample units 19, 20, 22, 24, and 25). These distresses had a minimal impact on the overall PCI of the section.

Joint Seal Damage

Joint seal damage is any condition that enables soil or rocks to accumulate in the joints or allows significant infiltration of water. Typical types of joint seal damage are: stripping of joint sealant, extrusion of joint sealant, weed growth, hardening of the filler (oxidation), loss of bond to the slab edges, and lack or absence of sealant in the joint. Joint seal damage is not counted on a slab-by-slab basis but is rated based on the overall condition of the sealant in the sample unit. Note that

Joint seal damage was observed in all inspected sample units. The primary cause of the joint seal damage observed appeared to be from a previous spall repair project were the saw-cutting was performed but the areas were either not patched or not filled in with joint sealant. The observed unfilled, previously saw-cut areas were less than 1 to 2 inches wide and per ASTM D5340 *Standard Test Method for Airport Pavement Condition Index Surveys*, if a joint spall is small enough, less than 3 inches wide, to be filled during a joint seal repair, it should not be recorded as a joint spall. These distresses had a significant impact on the overall PCI of the section.

Patching (Small)

A patch is an area where the original pavement has been removed and replaced by a filler material. A small patch less than 5 square feet.

Small patching was observed in 37 out of the 497 inspected slabs and located in multiple sample units throughout the Existing Ramp. All patches except for one patch in the northern portion of the ramp were in good condition. These distresses had a minimal impact on the overall PCI of the section.

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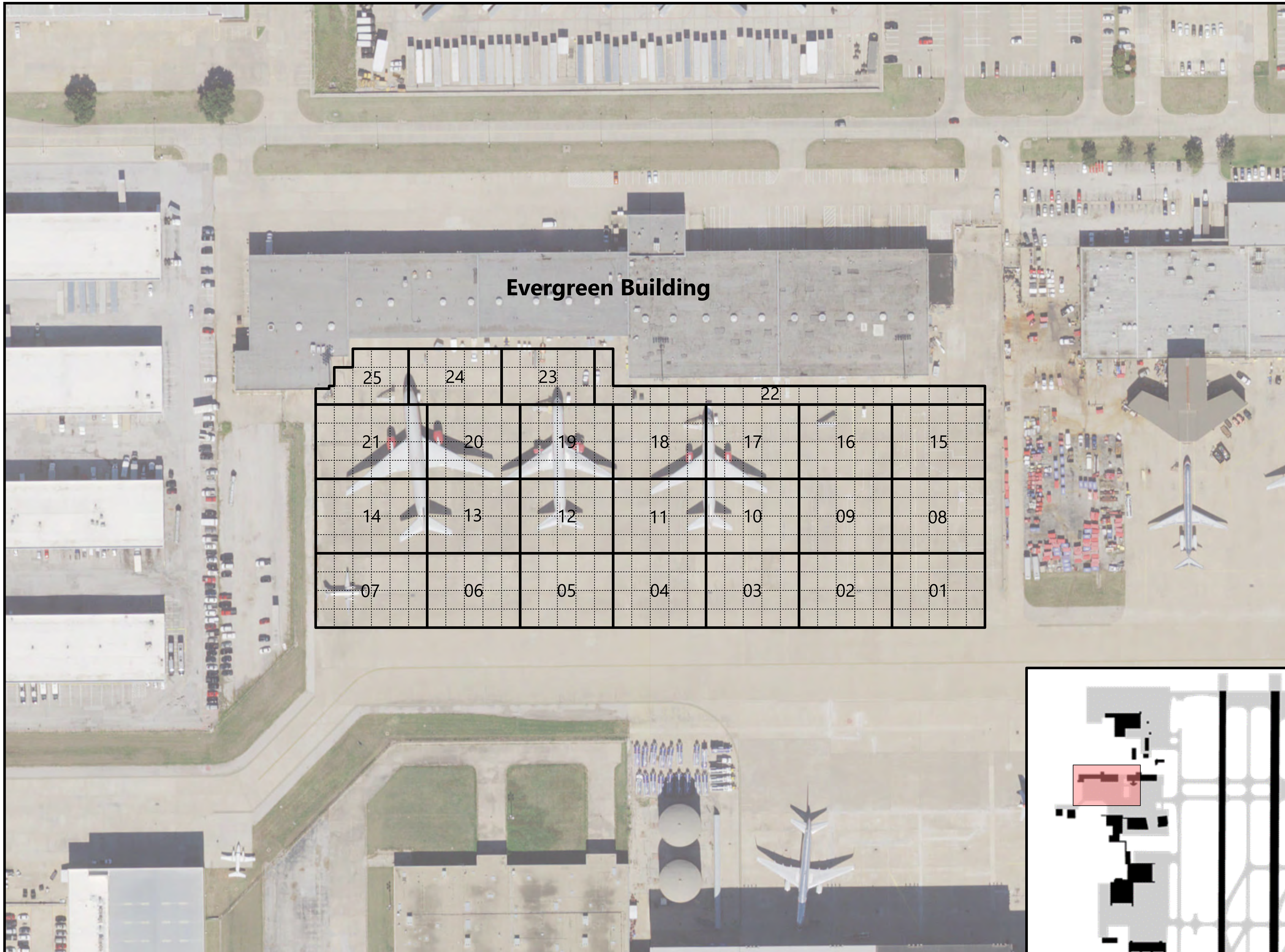

Dallas Fort Worth International Airport

Evergreen Building Existing Ramp PCI Survey

Figure 2
Pavement Sample Units

Legend

Pavement Slabs

Pavement Samples

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Patching (Large and Utility Cut)
A patch is an area where the original pavement has been removed and replaced by a filler material. A large patch is more than 5 square feet.

A single large patch, located in sample unit 13, was observed and was in good condition. This distress had a minor impact on the overall PCI of the section *Popouts*
A popout is a small piece of pavement that breaks loose from the surface due to freeze-thaw action in combination with expansive aggregates. Popouts usually range from approximately 1 to 4 inches in diameter and from 1⁄2 to 2 inches deep.

Popouts were observed on 2 out of the 497 inspected slabs and located in sample units 03 and 16. These distresses had a minimal impact on the overall PCI of the section.

Shrinkage Cracking
Shrinkage cracking occurs due to both drying shrinkage and plastic shrinkage. Drying shrinkage occurs over time as moisture leaves the pavement or when a hardened pavement continues to shrink as excess water evaporates. The shrinkage cracks form when subsurface resistance to the shrinkage is present and may extend through the entire depth of the slab. Plastic shrinkage occurs shortly after the pavement is placed and rapid drying of the surface occurs while the pavement is still plastic.

Shrinkage cracking was observed on four slabs out of the 497 inspected slabs and located in sample units 01 and 08. These distresses had a minimal impact on the overall PCI of the section.

Spalling (Longitudinal and Transverse Joint)
Spalling located at longitudinal and transverse joints is known as joint spalling and is the breakdown of the slab edges within 2 feet of the side of the joint. A joint spall usually does not extend vertically through the slab but intersects the joint at an angle. Joint spalling results from excessive stresses at the joint or crack caused by infiltration of incompressible materials or traffic load.

Joint spalling was observed in 18 out of the 497 inspected slabs located in multiple inspected sample units throughout the Existing Ramp. These distresses had a minor impact on the overall PCI of the section

Spalling (Corner)
Corner spalling is the raveling or breakdown of the slab within approximately 2 feet of the corner. A corner spall differs from a corner break in that the spall usually angles downward to intersect the joint, while a break extends vertically through the slab.

Corner spalling was observed in 4 out of the 497 inspected slabs located in sample units 03, 10 and 22. These distresses had a minimal impact on the overall PCI of the section.

Alkali Silica Reaction (ASR)
Alkali Silica Reaction (ASR) is caused by chemical reaction between alkalis and certain reactive silica minerals. This reaction forms a gel that absorbs water, causing expansion which may damage the concrete and adjacent structures. Alkalis are most often introduced by portland cement within the pavement. ASR cracking may be accelerated by chemical pavement deicers. Symptoms of ASR include: (1) cracking of the concrete, often in a map pattern, (2) white, brown, gray, or other colored gel or staining may be present at the crack surface, (3) aggregate popouts, and (4) increase in concrete volume (expansion) that may result in distortion of the adjacent or integral structures

ASR was observed in 88 out of the 497 inspected slabs and located in multiple inspected sample units throughout the Existing Ramp. These distresses had a significant impact on the overall PCI of the section.

PCI Results

With the pavement distresses recorded and verified in PAVER™, a distress deduct value was automatically calculated for each distress based on the severity and density of the distress related to the overall area of the sample unit. The deduct values are calculated based on the pavement deduct curves defined in ASTM D5430 *Standard Test Method for Airport Pavement Condition Index Surveys*.

Once all pavement distresses were recorded for a single inspected sample unit, an individual sample unit PCI was calculated. Once the pavement distresses for all inspected sample units were recorded and individual sample unit PCIs calculated, the section PCI was determined by calculating the inspected sample unit PCIs. The section PCI is based on each individual sample unit's PCI combined with the total area (i.e. number of slabs) per sample unit in relation to the overall section area. Although a PCI is calculated for each inspected sample unit, the PCI value for the section is the only reported PCI.

The PCI has a corresponding pavement condition rating which a verbal description of pavement condition as a function of the PCI value. For airfield pavements, the standard pavement condition rating (**Figure 3**) is defined in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5380-7B *Airport Pavement Management Program*.

Figure 3: Pavement Condition Rating Scale

Pavement Condition		PCI Value
Good		100-86
Satisfactory		85-71
Fair		70-56
Poor		55-41
Very Poor		40-26
Serious		11-25
Failed		10-0

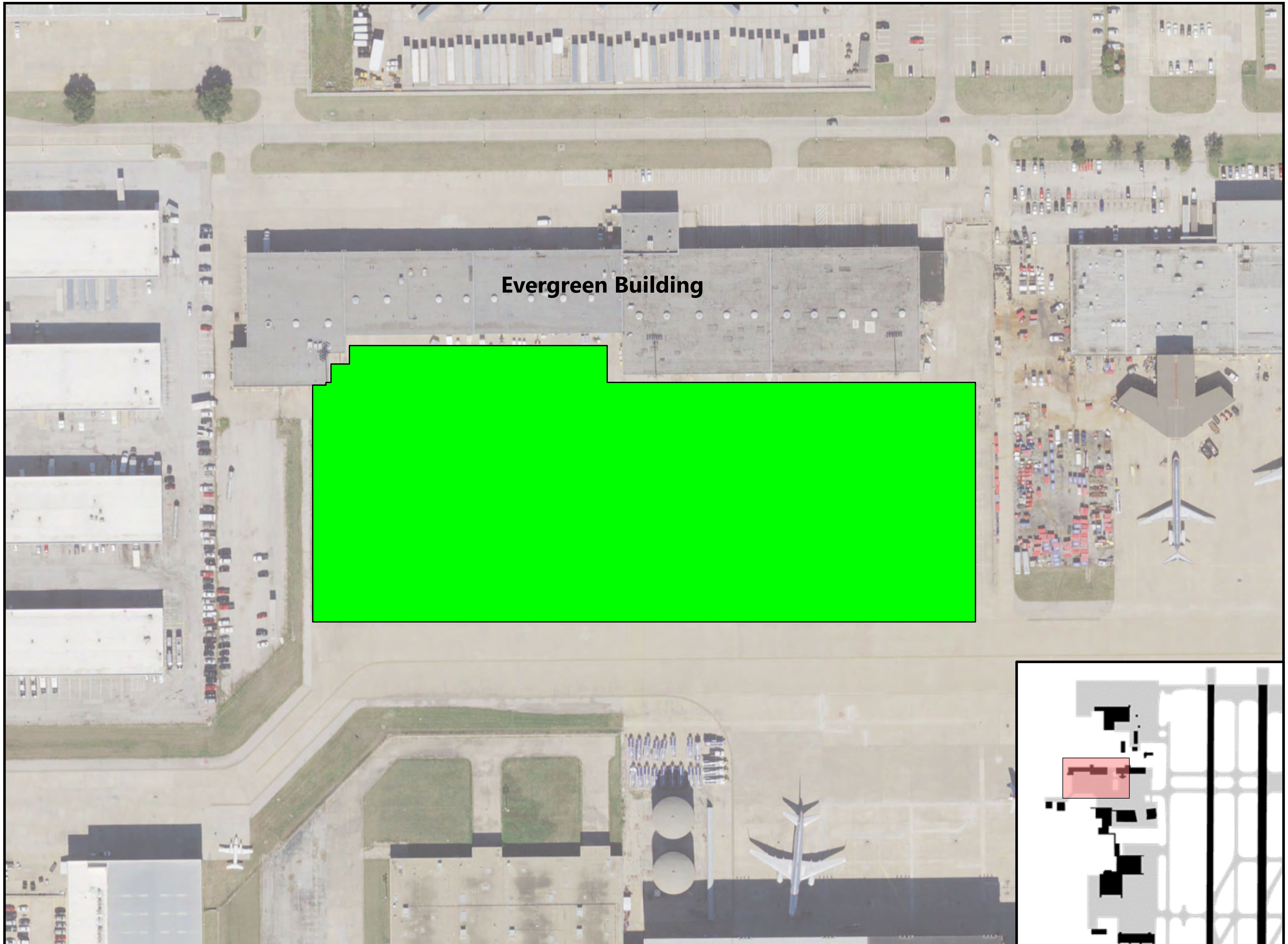
Source: FAA AC 150/5380-7B, 2014

The Existing Ramp has calculated PCI of eight-three (**83**) based on the distresses observed on the surface of the pavement indicative of the structural integrity and surface operational condition (localized roughness and safety). The Existing Ramp PCI of 83 has a corresponding pavement condition rating of "Satisfactory" (**Figure 4**).

Dallas Fort Worth International Airport

Evergreen Building Existing Ramp PCI Survey

Figure 4
Pavement Condition Rating



Legend

Pavement Condition Rating

- Failing (0-10)
- Serious (11-25)
- Very Poor (26-40)
- Poor (41-55)
- Fair (56-70)
- Satisfactory (71-85)
- Good (86-100)

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PCI Analysis

With the calculated PCI of 83 and corresponding "Satisfactory" pavement condition rating, this indicates that the Existing Ramp has scattered low-severity distresses and very few, if any, medium- or high-severity distresses that should only require routine maintenance.

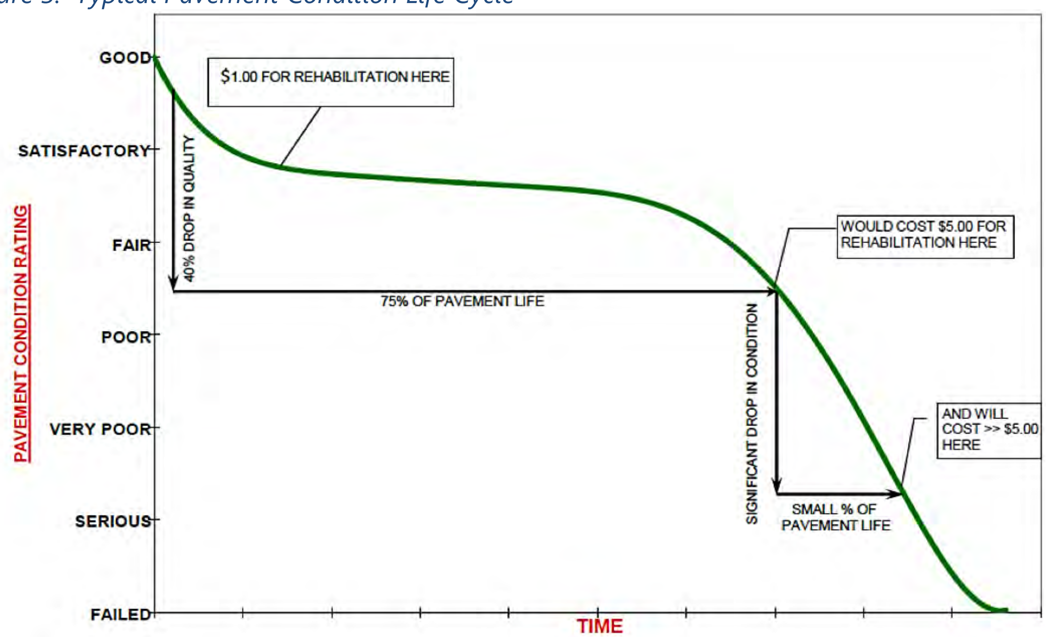
In the typical pavement condition life cycle (**Figure 5**), pavement deteriorates slowly at first, while in "Good" to "Satisfactory" condition. This is the most opportune time perform routine maintenance such as spall repairs and crack sealing to preserve pavement life. When the pavement is in this condition, the relative cost for maintenance or rehabilitation is $1.00.

Once a pavement falls into "Fair" condition, maintenance and rehabilitation efforts should be routine to major in the near term. Then, when the pavement is in "Poor" condition, maintenance and repair needs should range from routine to reconstruction in the near term. With the pavement condition degraded, the relative cost of rehabilitation is increased to $5.00.

Without any maintenance or rehabilitation efforts, the pavement condition will continue to deteriorate and become rated as "Very Poor" condition. When the pavement is in this condition, near-term maintenance and rehabilitation needs will be intensive. If maintenance and rehabilitation is not conducted, the pavement will fall into "Serious" condition where operational restrictions typically exist and repair needs are immediate. With the pavement condition severely degraded, the relative cost of rehabilitation exceeds $5.00.

Lastly, when the pavement is rated as "Failed", the pavement has deteriorated and progressed to the point that safe aircraft operations are no longer possible. Maintenance and rehabilitation efforts are no longer possible and complete reconstruction is required.

Figure 5: Typical Pavement Condition Life Cycle



Source: FAA AC 150/5380-7B, 2014

3.0 Recommendations

The PCI of 83 and corresponding pavement condition rating of "Satisfactory" for the Existing Ramp is primarily due to the observation of the following two pavement distresses: alkali silica reaction (ASR) and joint seal damage. The following maintenance and periodic observation actions are recommended.

Alkali Silica Reaction (ASR).
For ASR, there are no maintenance efforts to reduce or eliminate ASR. It is recommended that periodic observations are conducted to monitor the severity level on the PCC slabs exhibiting signs of ASR. As the severity of the distress increases (i.e. the ASR get worse), it will eventually require a complete slab replacement.

Joint Seal Damage
The primary cause of the joint seal damage appeared to be from a previous spall repair project were the saw-cutting was performed but the areas were neither patched or not filled in with joint sealant. The observed unfilled, previously saw-cut areas were less than 1 to 2 inches wide and per ASTM D5340 *Standard Test Method for Airport Pavement Condition Index Surveys*, if a joint spall is small enough, less than 3 inches wide, to be filled during a joint seal repair, it should not be recorded as a joint spall.

By filling in the unfilled, previously saw-cut areas with joint sealant material, it will eliminate the joint seal damage distresses documented and recorded as part of this PCI Survey. This maintenance effort will improve the PCI and potentially increase the pavement condition rating to "Good".

*** End ***

Existing Ramp Pavement Condition Index (PCI) Survey
Appendix A - Summary of Distresses by Sample

Branch ID	**Section ID**	**Sample Number**	**Rigid Pavement (PCC) Distresses**															
			61- Blowup *	**62- Corner Break ***	**63- Cracks (Longitudinal, Transverse, and Diagonal)***	64- Durability "D" Cracking *	65- Joint Seal Damage *	66- Patch, Small (< 5 sf) *	**67- Patch, Large/Utility Cut (> 5 sf) ***	68- Popouts *	**69- Pumping ***	70- Scaling *	**71- Settlement / Faulting**	**72- Shattered Slab / Intersecting Cracks ***	73- Shrinkage Cracking	74- Spalling, Joints *	75- Spalling, Corner *	76- Alkali Silica Reaction (ASR)
Existing Apron	01	01					L									L		L, M
		02					L											L
		03					L	L		N							L	L
		04			L		L	L										L
		05					L	L										L
		06					L	L										L
		07					L	L										L
		08					L								N			L
		09					L											L
		10					L									L	L	L

1. The **bold** distresses indicate those that are usually related to problems in the pavement structure and their identification is important in assessing the pavement load-carrying capability.
2. The distresses followed by an asterisk are those that may produce FOD. Although they all may not significantly impact the computed allowable passes, they may limit the operational capability of the pavement.
3. Distress Severity Levels: L = Low M = Medium H = High N = No specific degree of severity

Existing Ramp Pavement Condition Index (PCI) Survey
Appendix A - Summary of Distresses by Sample

Branch ID	Section ID	Sample Number	Rigid Pavement (PCC) Distresses															
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Existing Apron	01	11					L											L
		12					L											
		13					L	L	L									
		14					L									M		
		15					L											L
		16					L			N								L
		17			L		L											L
		18					L											L
		19			L		L											L
		20			L		L	L										L

1. The **bold** distresses indicate those that are usually related to problems in the pavement structure and their identification is important in assessing the pavement load-carrying capability.
2. The distresses followed by an asterisk are those that may produce FOD. Although they all may not significantly impact the computed allowable passes, they may limit the operational capability of the pavement.
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Existing Ramp Pavement Condition Index (PCI) Survey
Appendix A - Summary of Distresses by Sample

Branch ID	**Section ID**	**Sample Number**	**Rigid Pavement (PCC) Distresses**															
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Existing Apron	01	21					L									L		L
		22			L, M		L		H							M	L	L
		23					L		L							L		L
		24			L		L		L							L		L
		25			L		L		L							L		L

1. The **bold** distresses indicate those that are usually related to problems in the pavement structure and their identification is important in assessing the pavement load-carrying capability.
2. The distresses followed by an asterisk are those that may produce FOD. Although they all may not significantly impact the computed allowable passes, they may limit the operational capability of the pavement.
3. Distress Severity Levels: L = Low M = Medium H = High N = No specific degree of severity

ALLIANCE GEOTECHNICAL GROUP

- Geotechnical Engineering
- Environmental Consulting
- Construction Materials Engineering and Testing
- Construction Inspection

September 28, 2018

Mr. Steve Creamer, P.E.
RS&H
4832 LBJ Freeway, Suite 800
Dallas, Texas 75244

Phone: (469) 857-7727
Cell: (972) 369-9152
Email: Steve.Creamer@rsandh.com

Re: Pavement Coring & Laboratory Testing
Evergreen Cargo Ramp
DFW International Airport, Texas
AGG Project No. DE18-143

Dear Mr. Creamer:

As requested, pavement coring and laboratory testing services were performed in order to determine the thickness of the existing concrete pavement and subbase materials and strength of the existing concrete pavement at the Evergreen Cargo Ramp located at Dallas Fort Worth International Airport in Texas. The field investigation consisted of coring the existing concrete pavement at eight (8) locations that were selected by the client.

The pavement was cored using a coring machine and a 4 inch diameter core bit. The location of the pavement cores are shown on the Plan of Corings (Figure 1). The pavement cores were measured for thickness and the results were reported in Appendix A. Photographs of the pavement cores are attached to this letter report. The pavement cores were also tested for compressive strength. The results of the compressive strength testing are provided in Table 1 below.

Table 1: Compressive Strengths of Pavement Cores

Corings	Compressive Strength (psi)
C-1	6,619
C-2	4,961
C-3	5,259
C-4	7,671

C-5	9,664
C-6	6,813
C-7	7,441
C-8	5,504

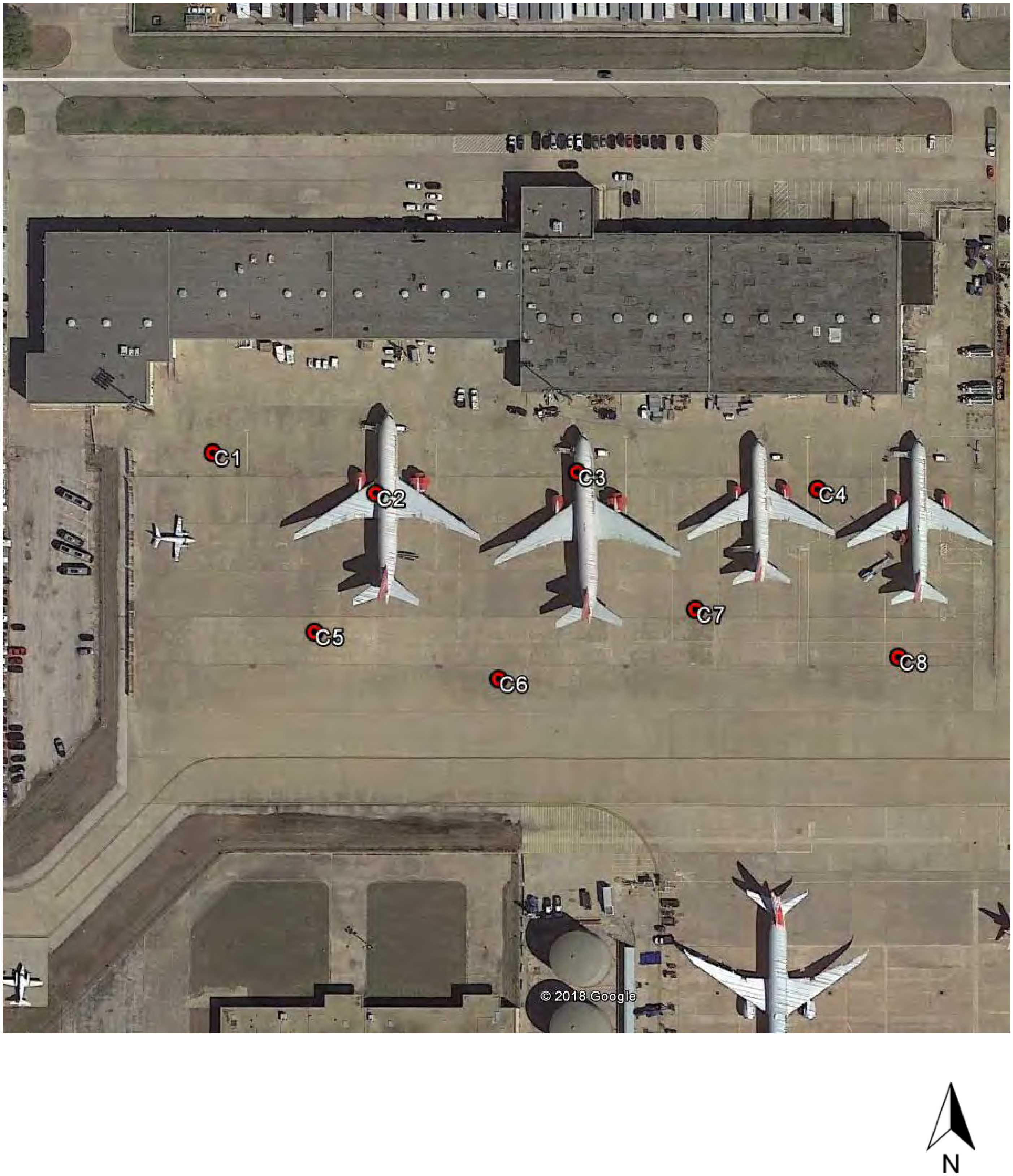
The base beneath the pavement consists of Cement Treated Base. The Cement Treated Base ranged in thickness from 7.5 to 13 inches. In addition, Dynamic Cone Penetration (DCP Test) were performed on the sub-base upon coring completion to evaluate the in-situ conditions of the sub-base below the existing cargo ramp. The DCP test consists of dropping a 17.6 pound sliding hammer from a height of 575 millimeter. The hammer drop is then recorded at every 30 millimeter penetration increment. The DCP test data with CBR and bearing capacity are attached in Appendix B.

We thank you for the opportunity to provide you with our subsurface exploration services. If we can be of further assistance, please do not hesitate to contact us.

Sincerely,
ALLIANCE GEOTECHNICAL GROUP

Kai Wong, P.E.
Project Engineer

Attachments: Plan of Corings – Figure 1
Pavement Thickness – Appendix A
DCP Test Data –Appendix B
Photographs of Pavement Cores – Appendix C



ALLIANCE GEOTECHNICAL GROUP

Project No: DE18-143

PLAN OF CORING

EVERGREEN CARGO RAMP
DFW INTERNATIONAL AIRPORT, TEXAS

FIGURE NO: 1

APPENDIX A

DE18-143 Evergreen Cargo Ramp

Coring	Concrete (in)	Cement Treated Base (in)
C1	12.3	13*
C2	13.0	8.0
C3	12.3	10.0
C4	16.4	8.1
C5	15.9	7.5
C6	16.5	9.0
C7	15.8	10.6
C8	17.4	8.8

Note: *At C1, about 4 inches of CTB can't be retrieved. Thickness of CTB at C1 was estimated to be approximately 13.0"

APPENDIX B

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-1
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
3	30	1
8	60	1
26	90	1
40	120	1
*Refusal		1
		1
		1
		1
		1
		1
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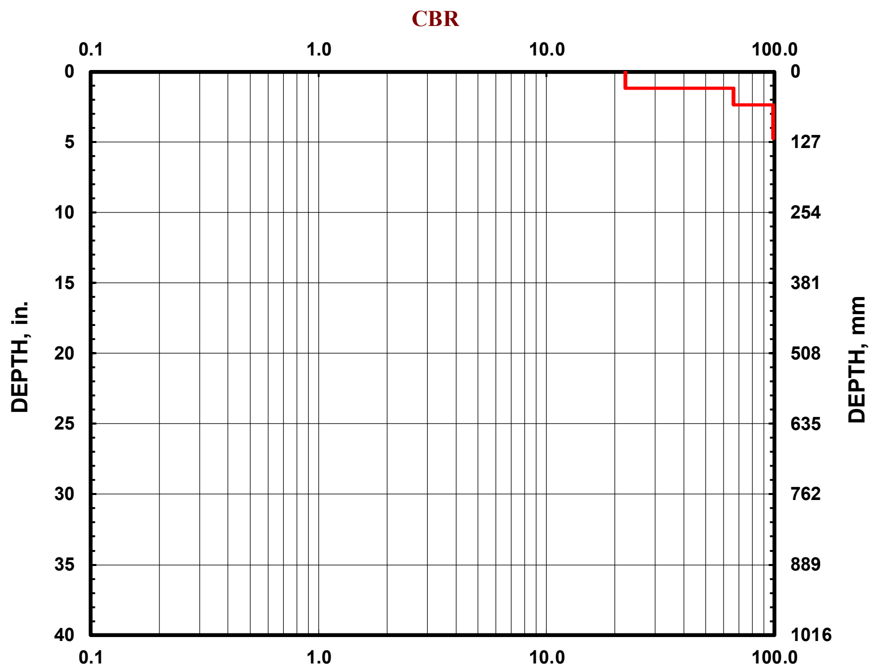

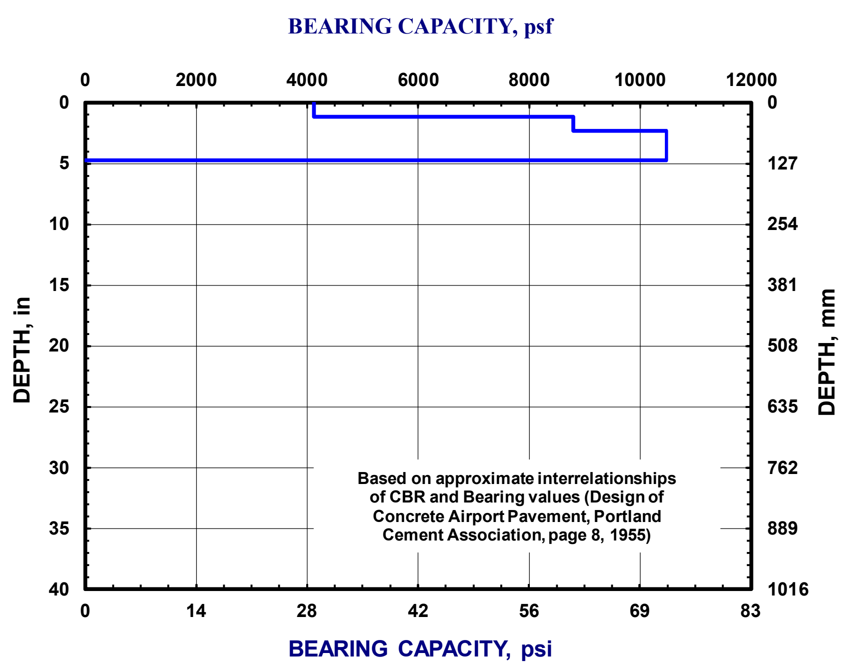

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-2
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	35	1
3	65	1
4	100	1
4	135	1
4	165	1
4	195	1
4	230	1
4	265	1
3	295	1
3	335	1
1	365	1
1	435	1
1	485	1
1	515	1
2	560	1
2	595	1
1	605	1
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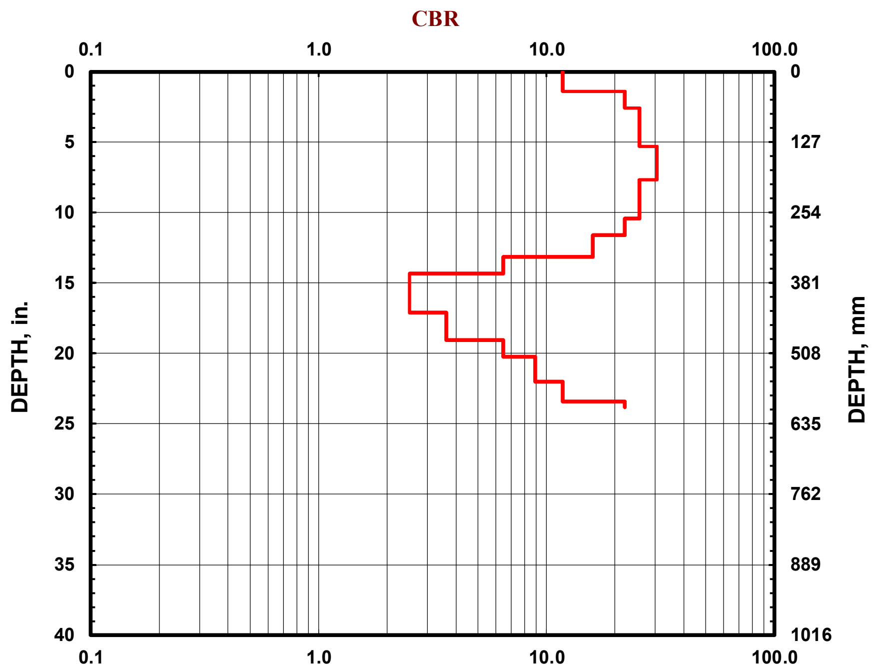

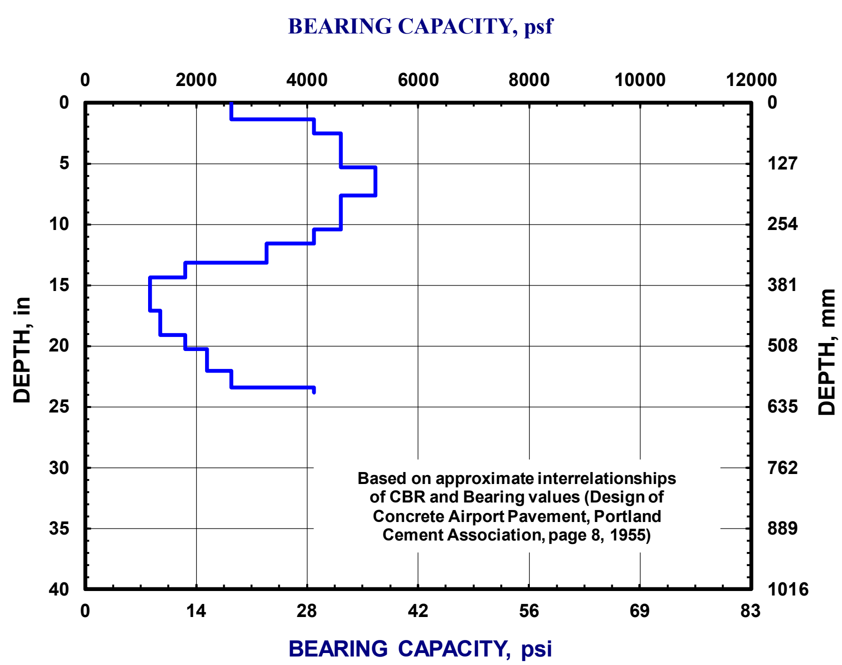

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-3
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	30	1
8	60	1
9	90	1
17	120	1
16	150	1
24	180	1
18	210	1
24	240	1
17	270	1
17	300	1
15	330	1
15	360	1
13	390	1
10	420	1
8	455	1
4	485	1
4	520	1
3	550	1
4	595	1
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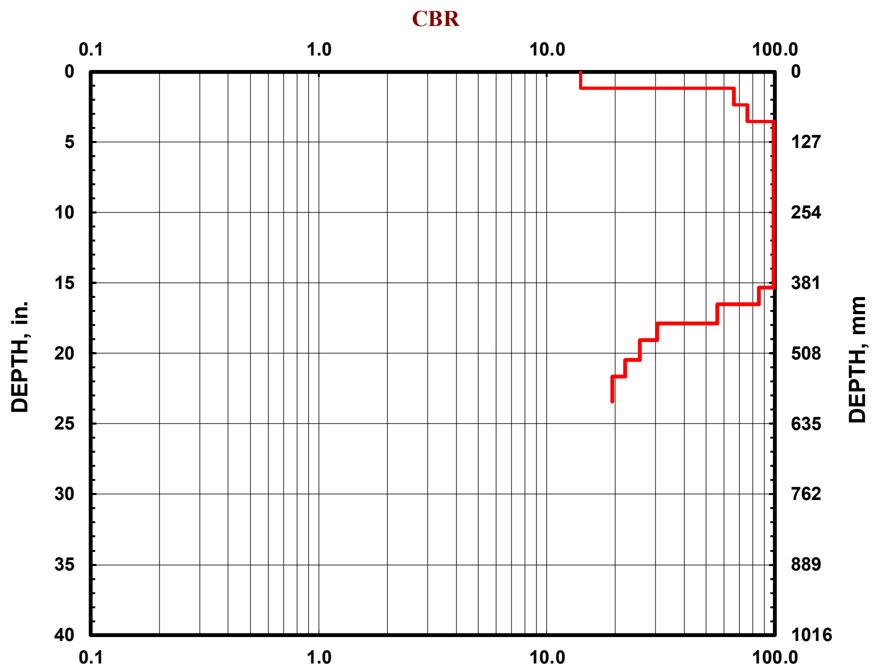

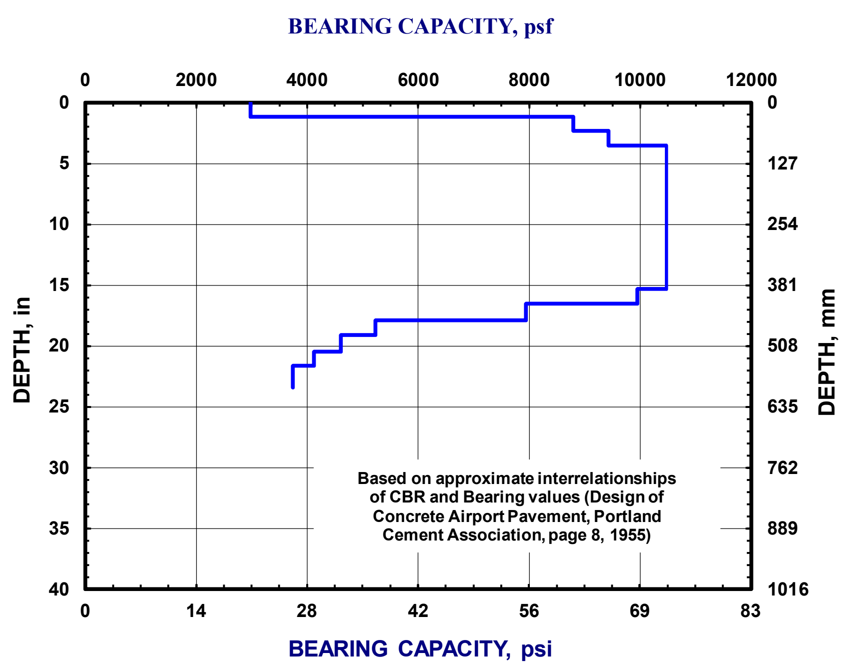

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-4
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	35	1
3	75	1
3	115	1
3	160	1
3	200	1
3	235	1
3	265	1
5	300	1
10	335	1
8	365	1
6	395	1
4	425	1
4	460	1
2	490	1
2	535	1
1	565	1
1	600	1
		1
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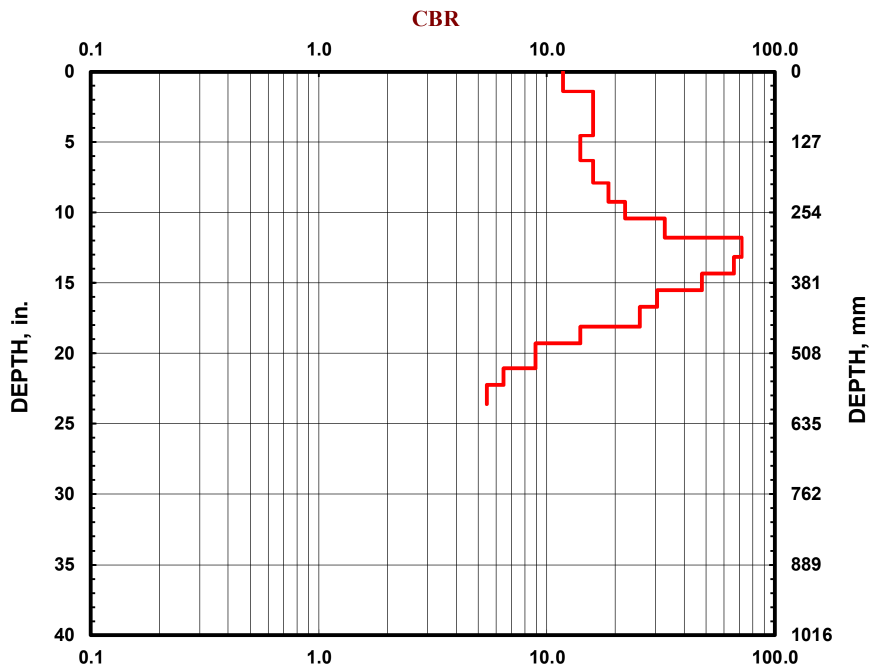

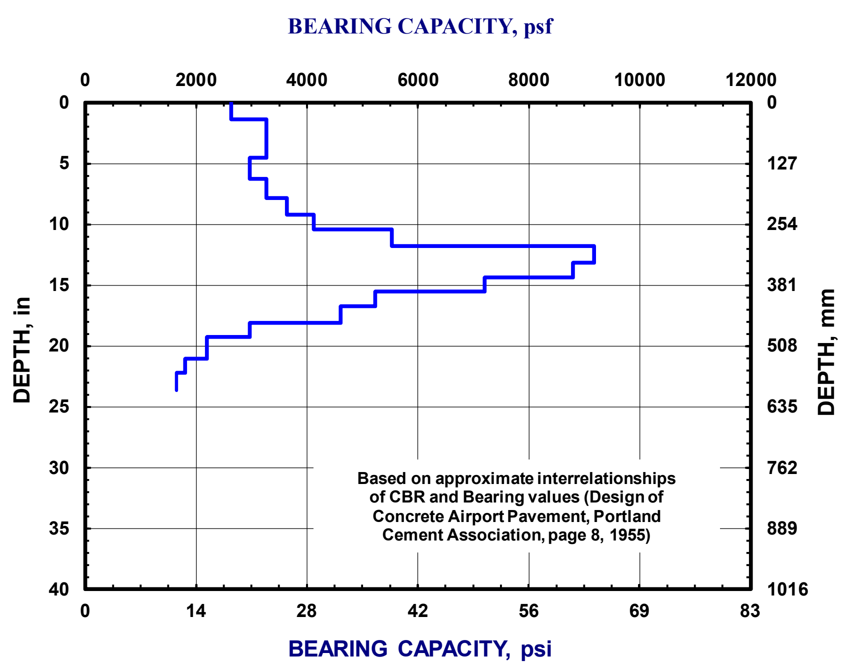

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-5
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	40	1
3	75	1
3	115	1
3	160	1
2	200	1
2	240	1
2	285	1
2	345	1
1	375	1
1	405	1
2	455	1
1	520	1
1	570	1
1	620	1
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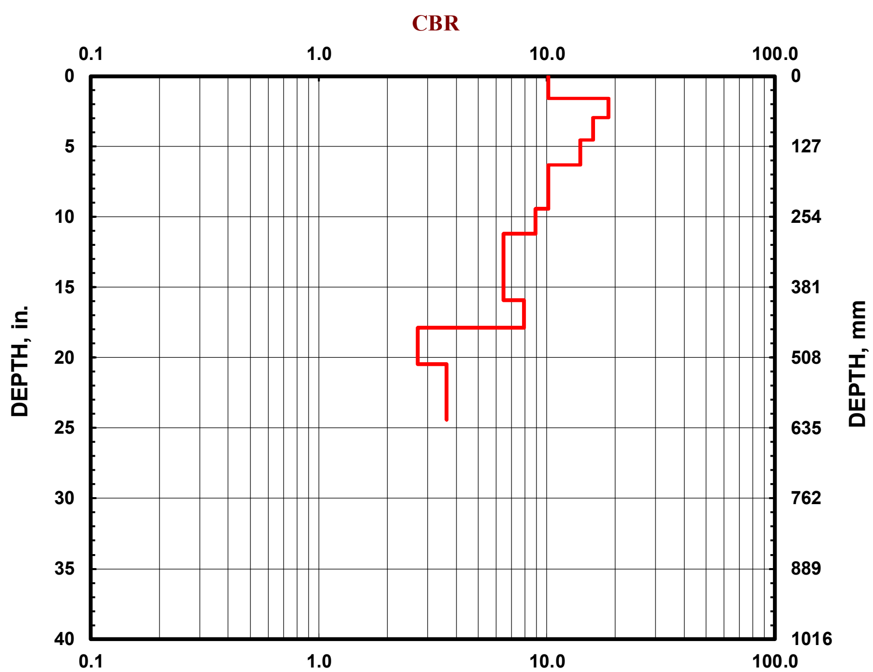

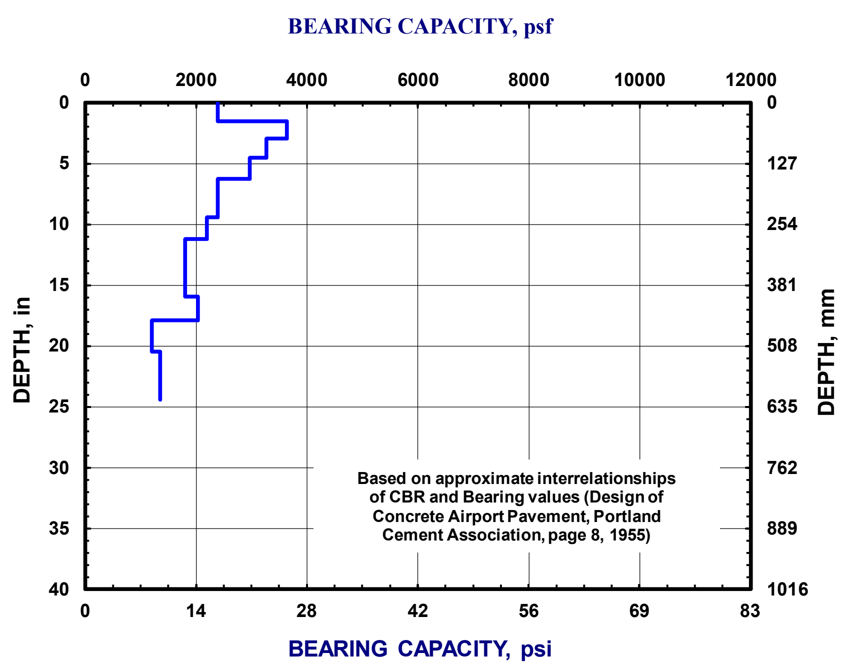

DCP TEST DATA

Project: *Evergreen Cargo Ramp* **Date:** 24-Sep-18
Location: C-6 **Soil Type(s):** Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
3	40	1
3	80	1
4	110	1
8	140	1
9	170	1
10	200	1
11	230	1
9	265	1
7	295	1
5	325	1
4	365	1
2	400	1
1	435	1
1	485	1
1	525	1
1	560	1
1	595	1
1	620	1
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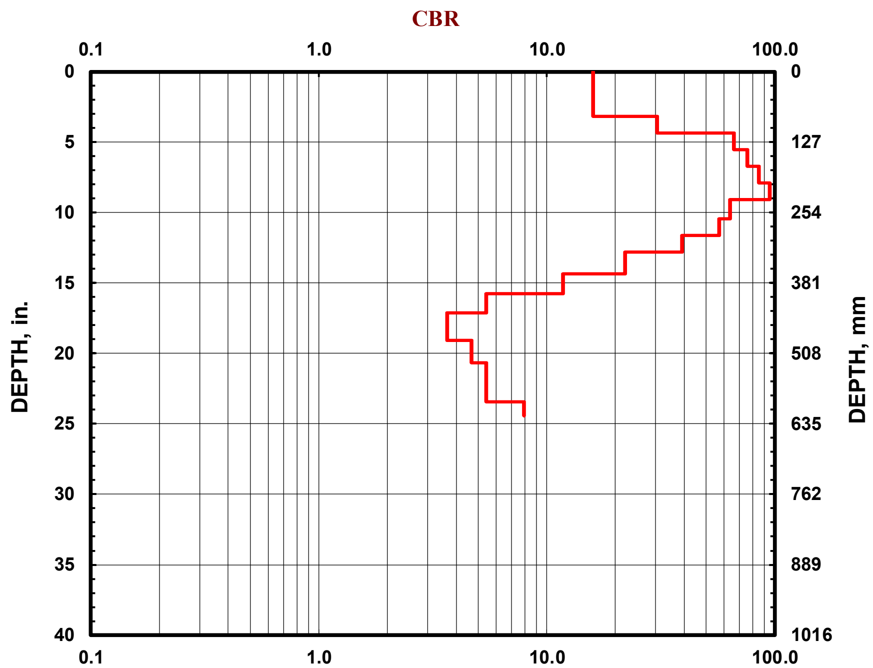

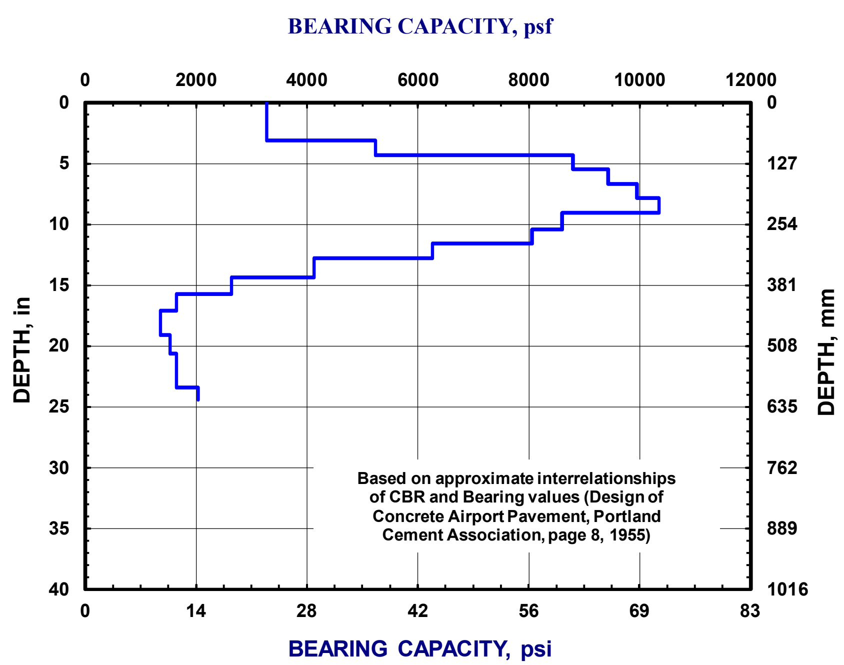

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-7
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
1	45	1
1	75	1
3	105	1
5	135	1
4	170	1
4	205	1
3	235	1
4	280	1
2	310	1
2	340	1
2	370	1
2	400	1
2	440	1
2	515	1
1	575	1
1	625	1
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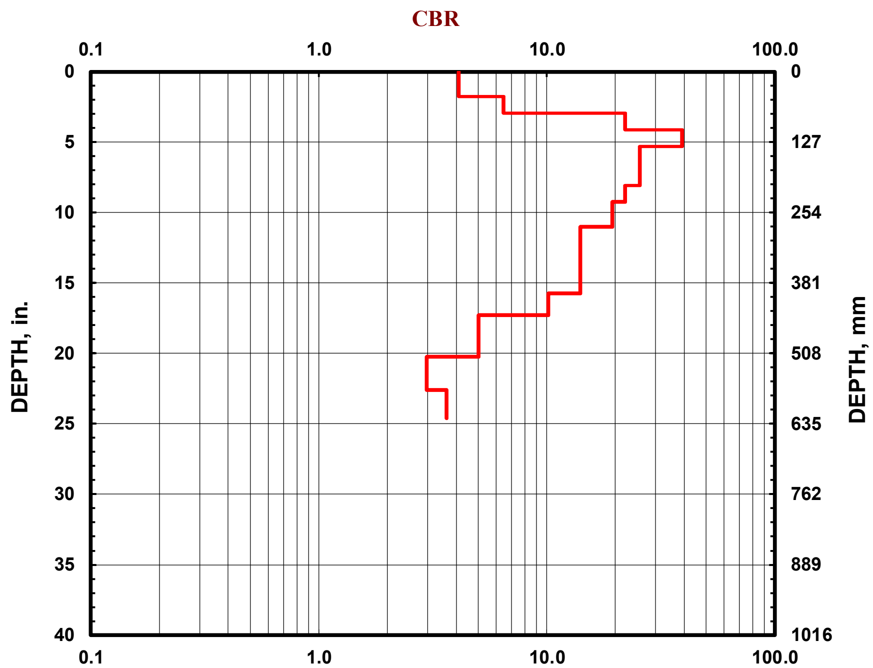

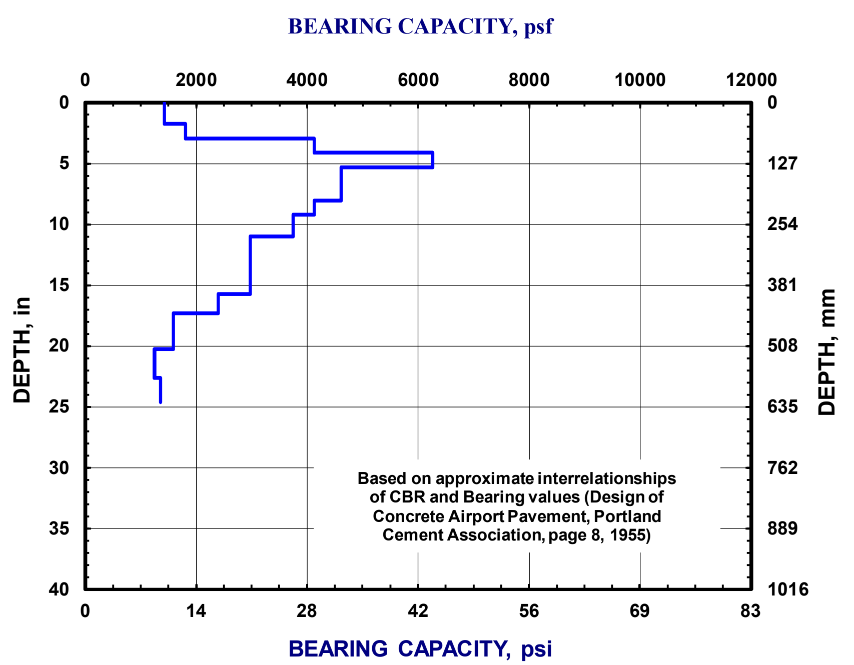

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-8
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	45	1
3	80	1
3	115	1
3	145	1
3	180	1
3	210	1
3	245	1
3	285	1
3	325	1
2	365	1
2	425	1
2	495	1
1	540	1
2	585	1
1	605	1
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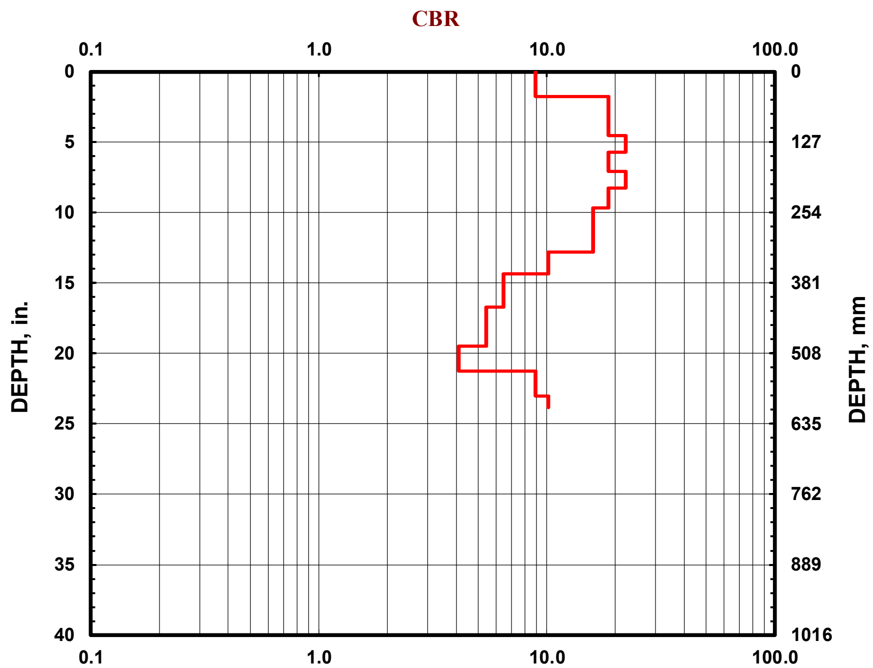

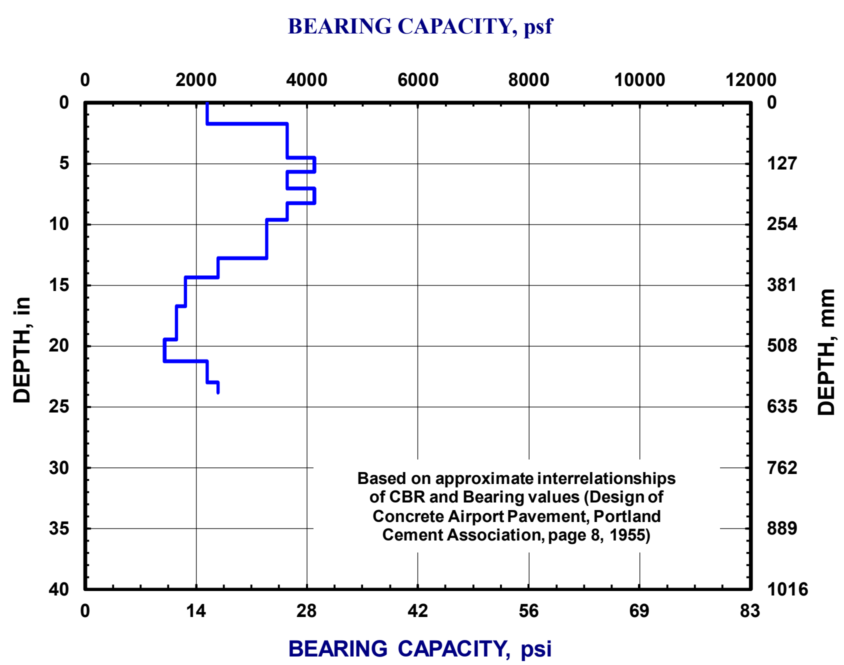

APPENDIX C

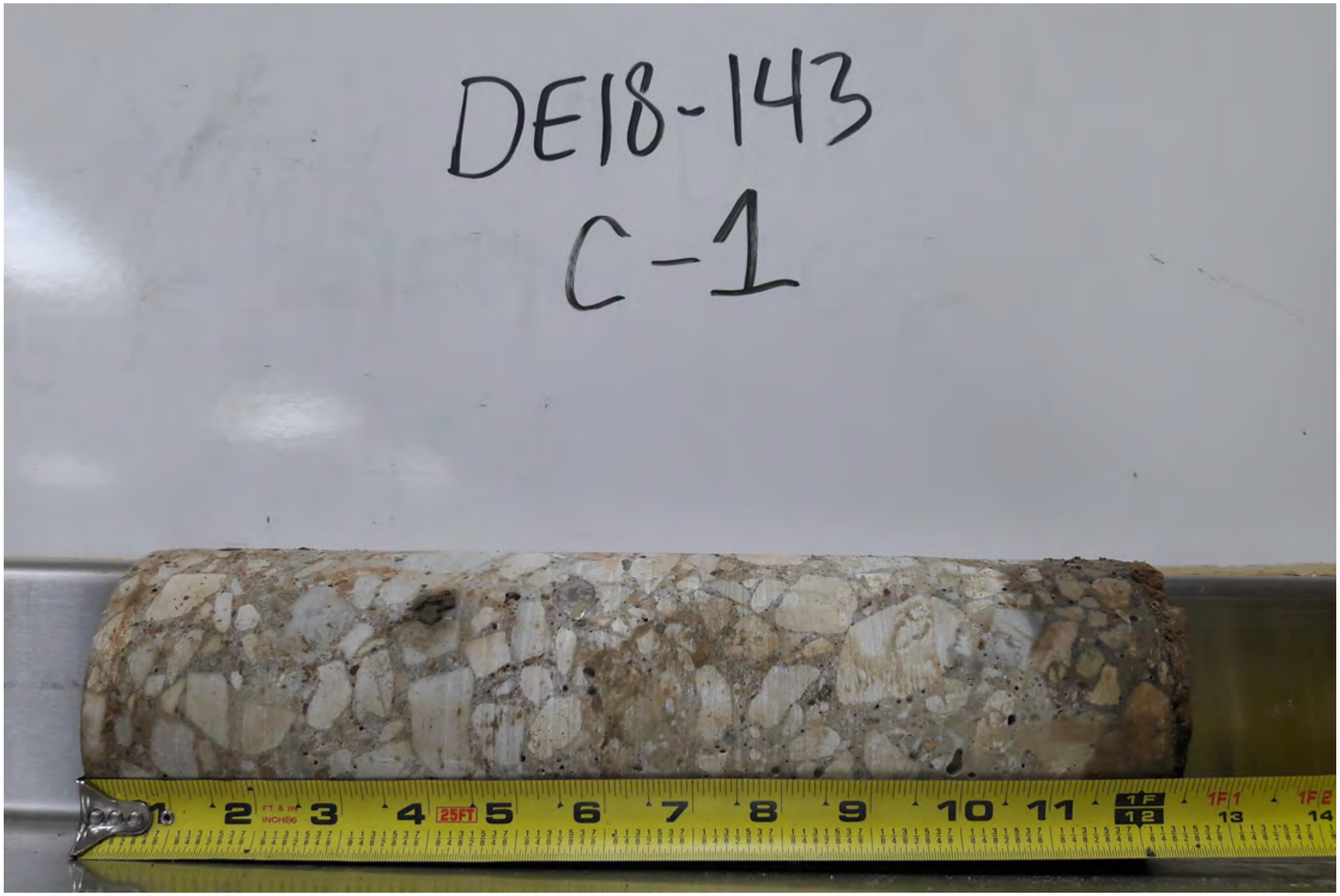

Photo 1: Photo of Pavement Core at Boring C-1.

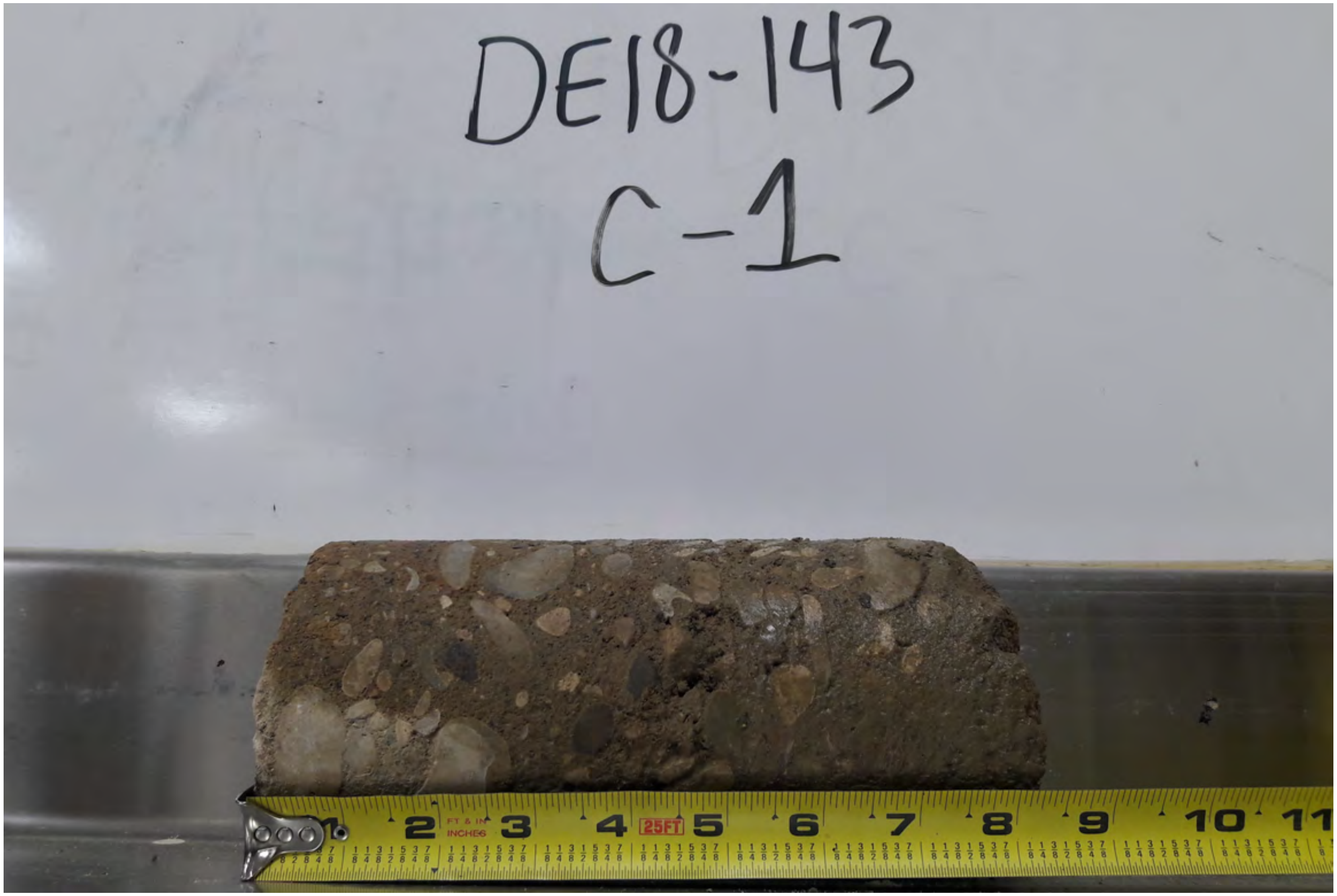

Photo 2: Photo of Pavement Core at Boring C-1.

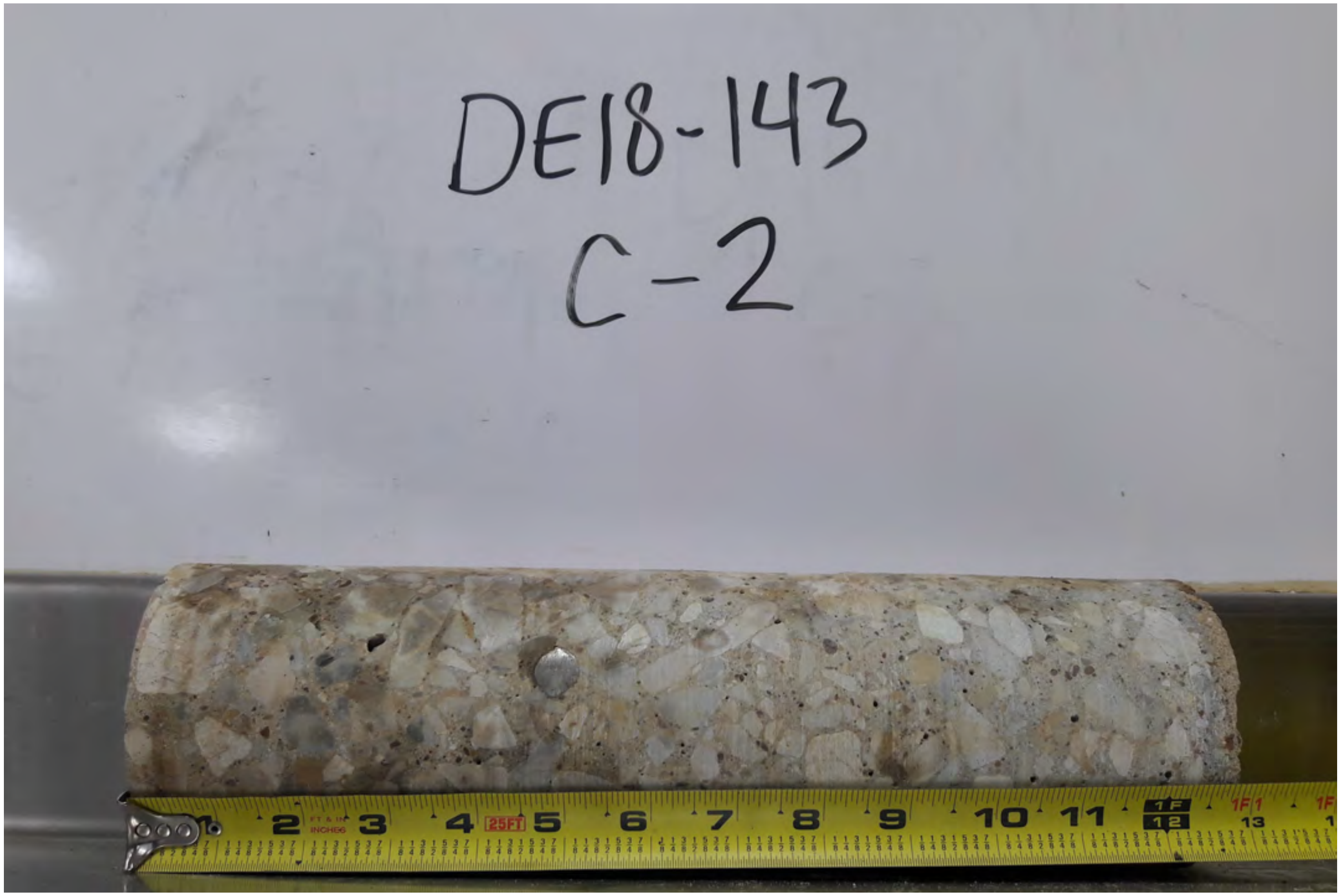

Photo 3: Photo of Pavement Core at Boring C-2.

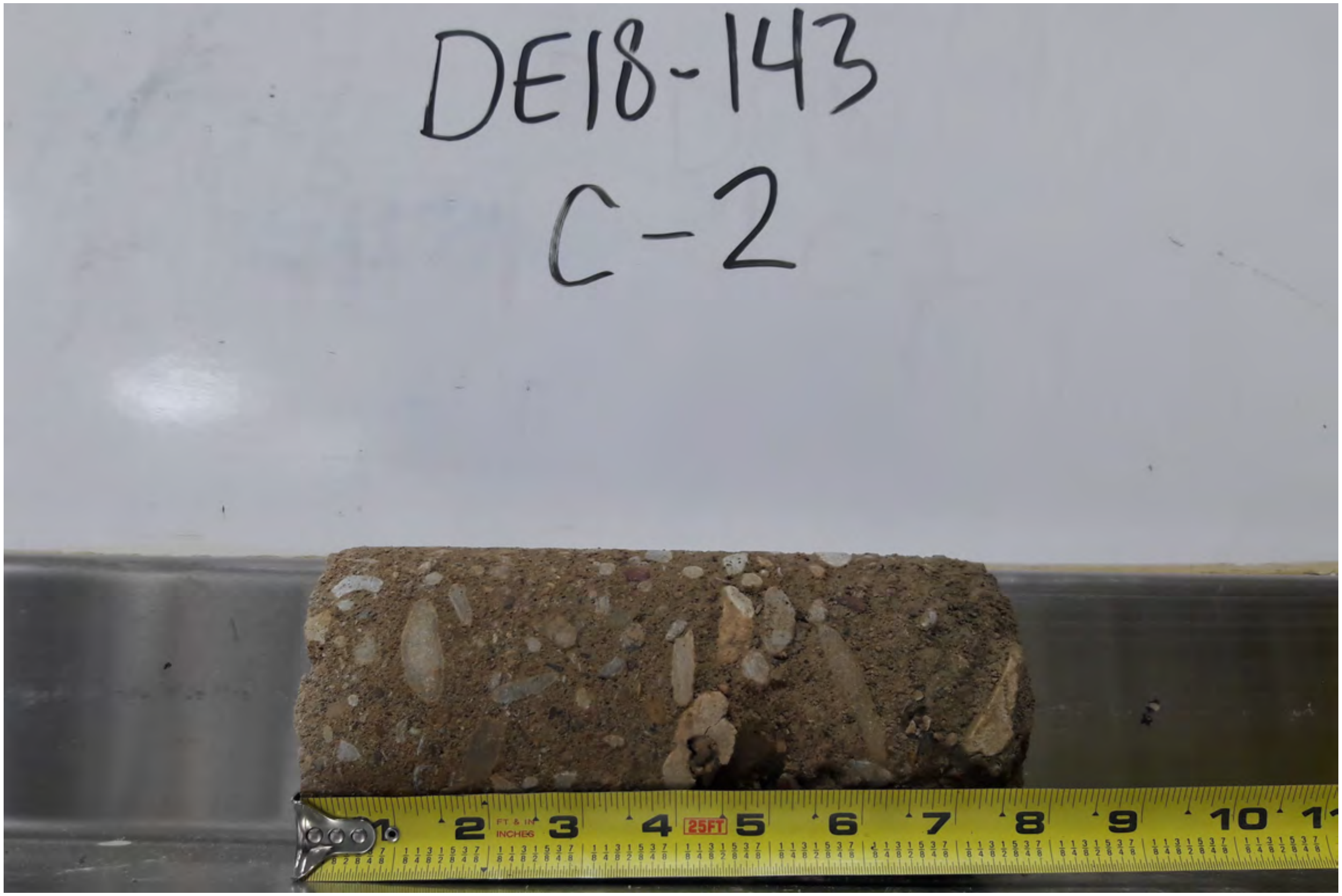

Photo 4: Photo of Pavement Core at Boring C-2.

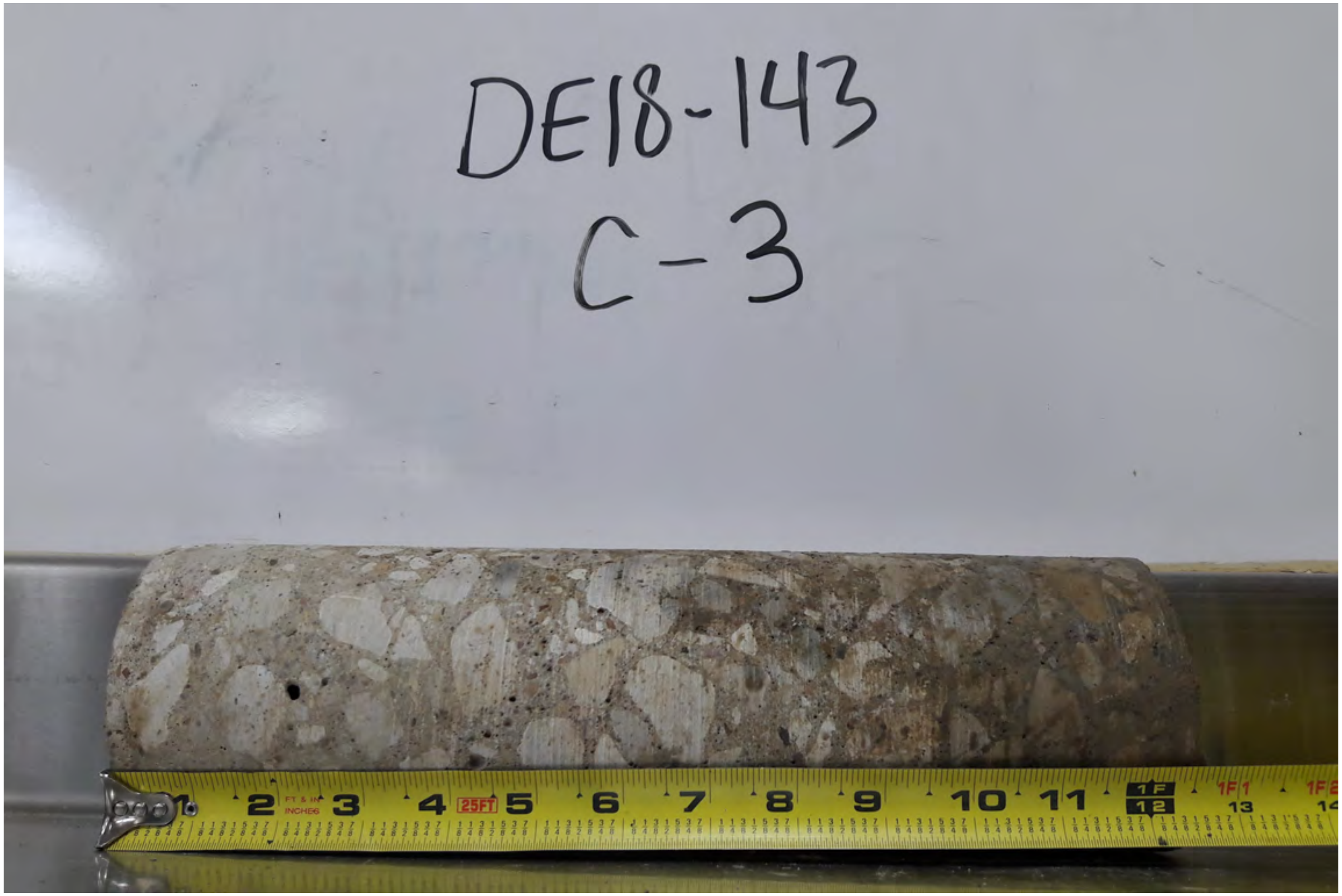

Photo 5: Photo of Pavement Core at Boring C-3.

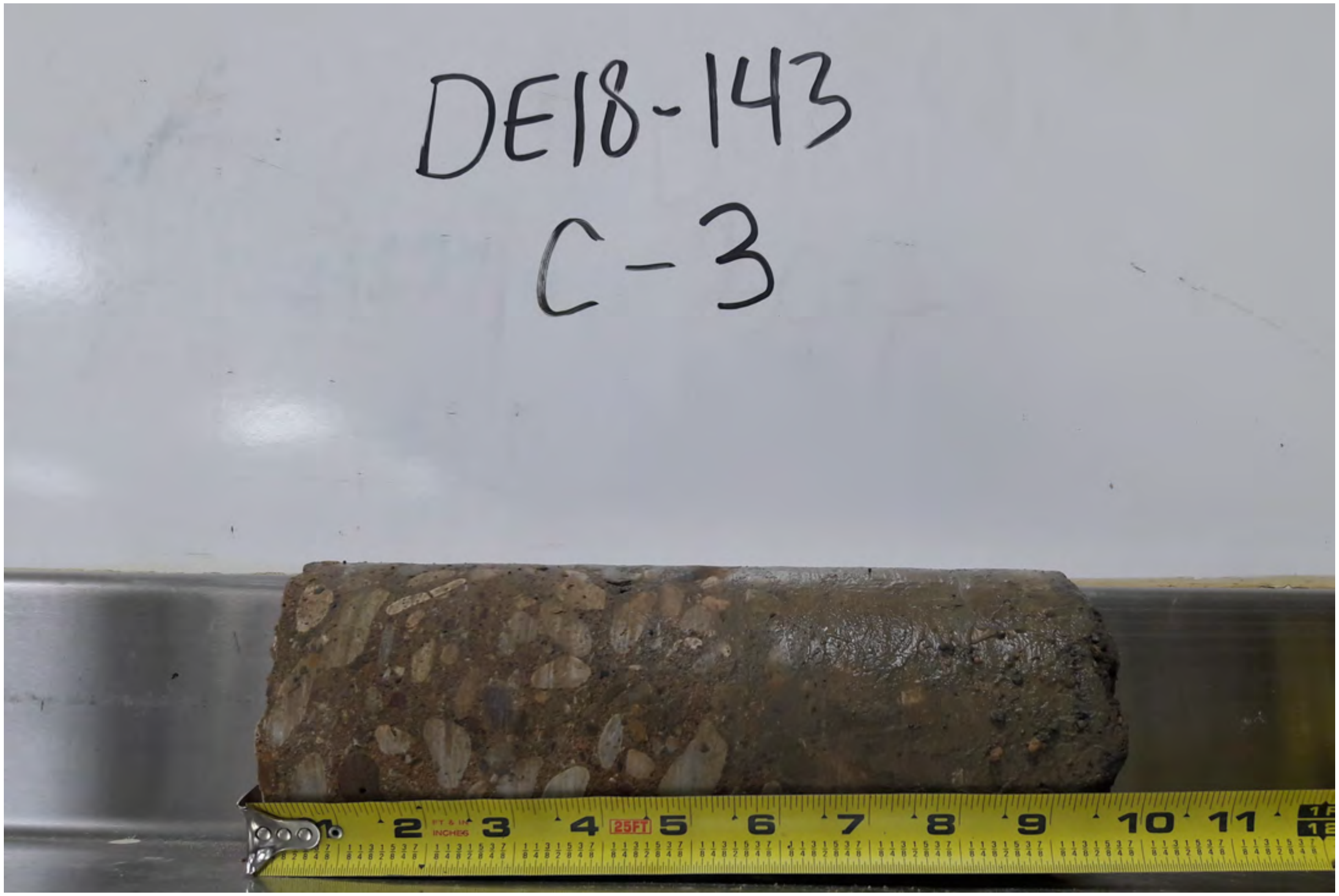

Photo 6: Photo of Pavement Core at Boring C-3.

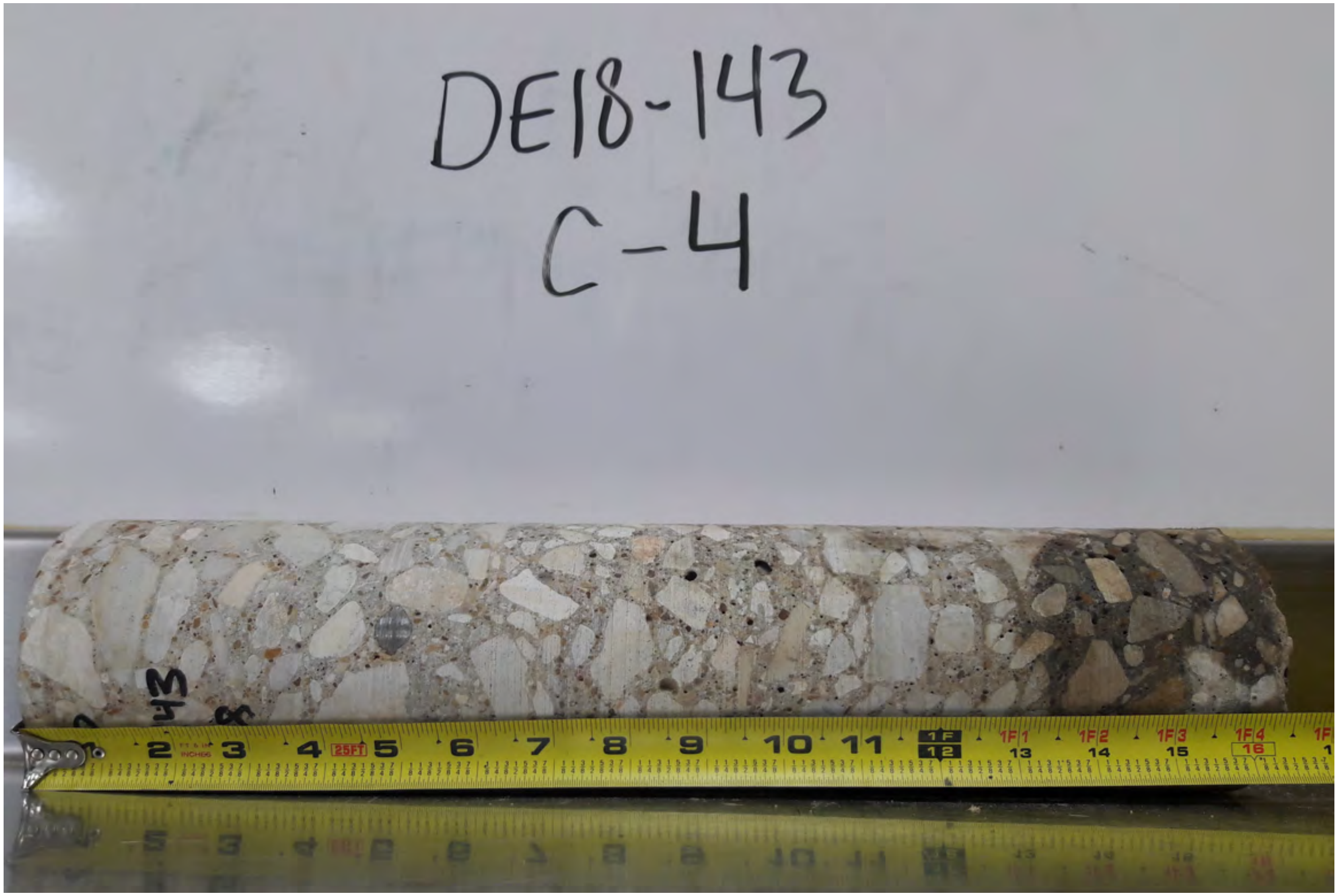

Photo 7: Photo of Pavement Core at Boring C-4.

Photo 8: Photo of Pavement Core at Boring C-4.

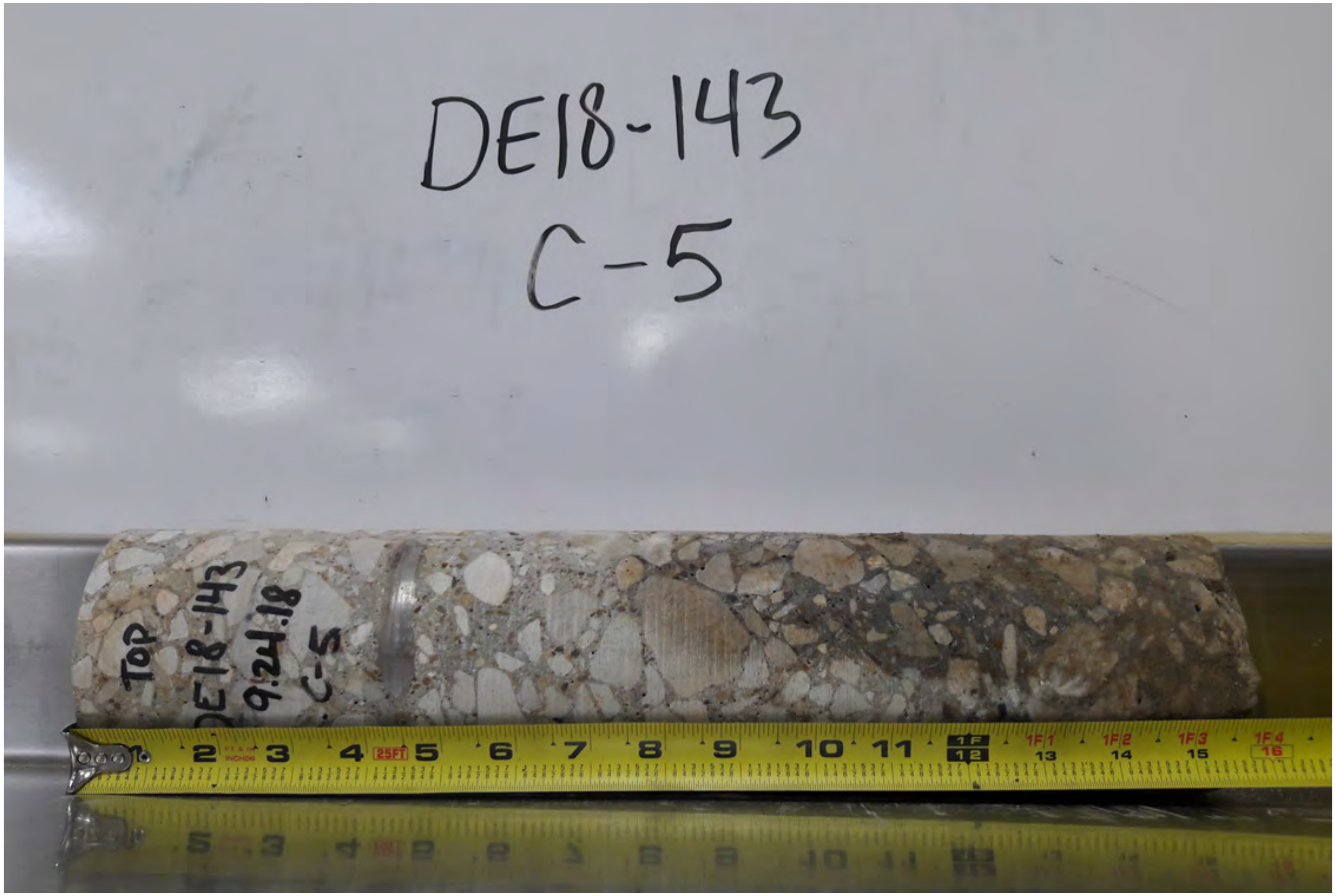

Photo 9: Photo of Pavement Core at Boring C-5.

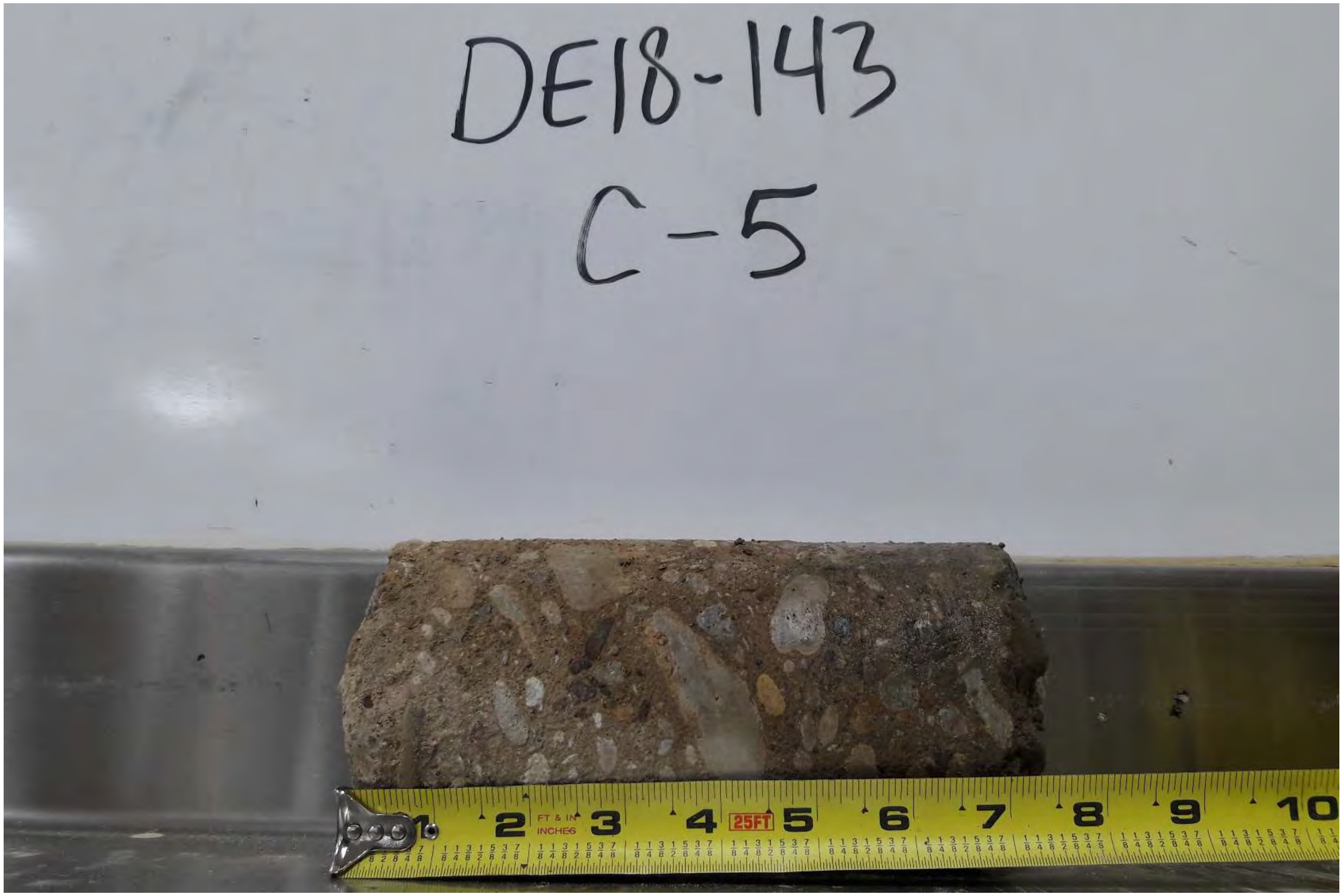

Photo 10: Photo of Pavement Core at Boring C-5.

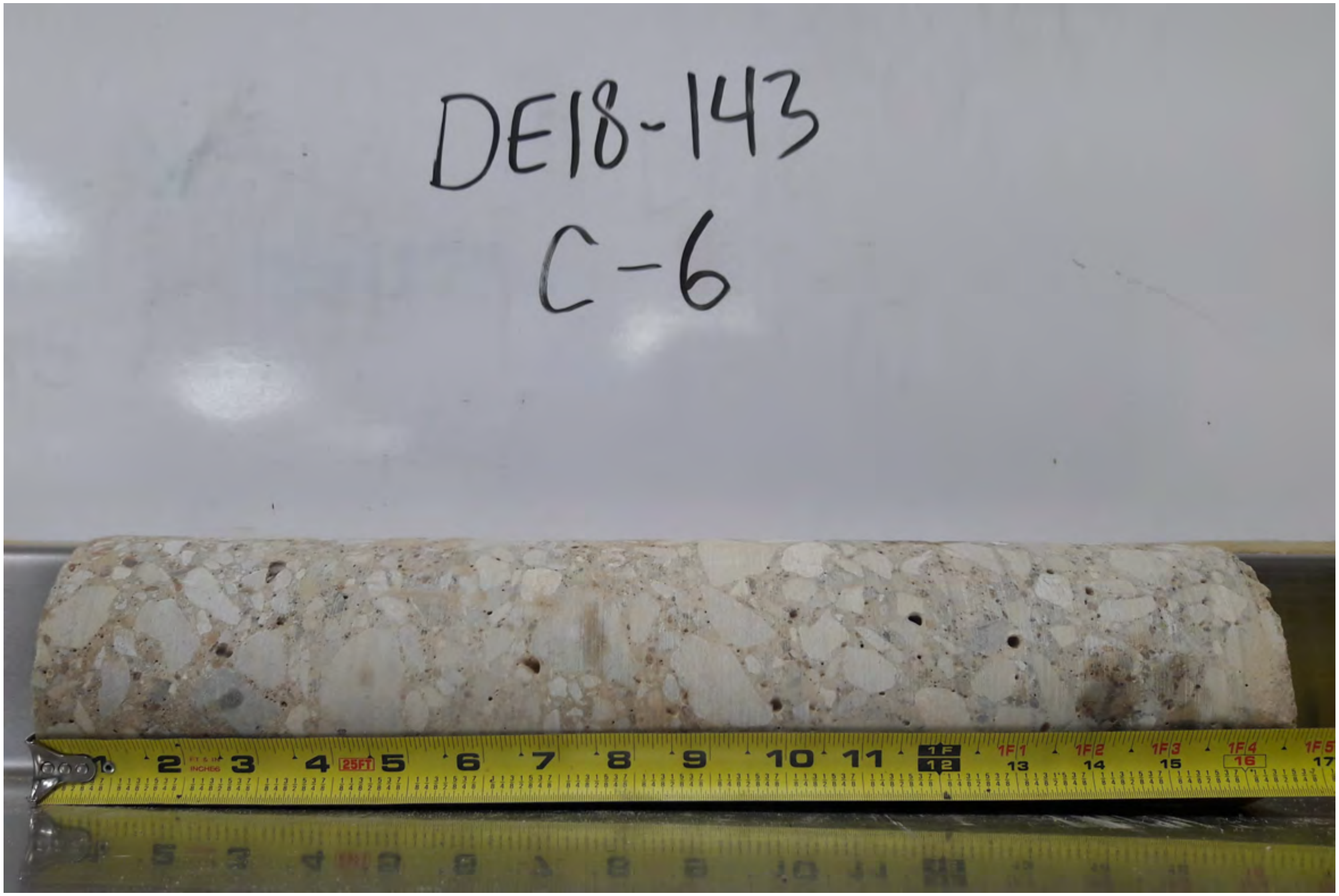

Photo 11: Photo of Pavement Core at Boring C-6.

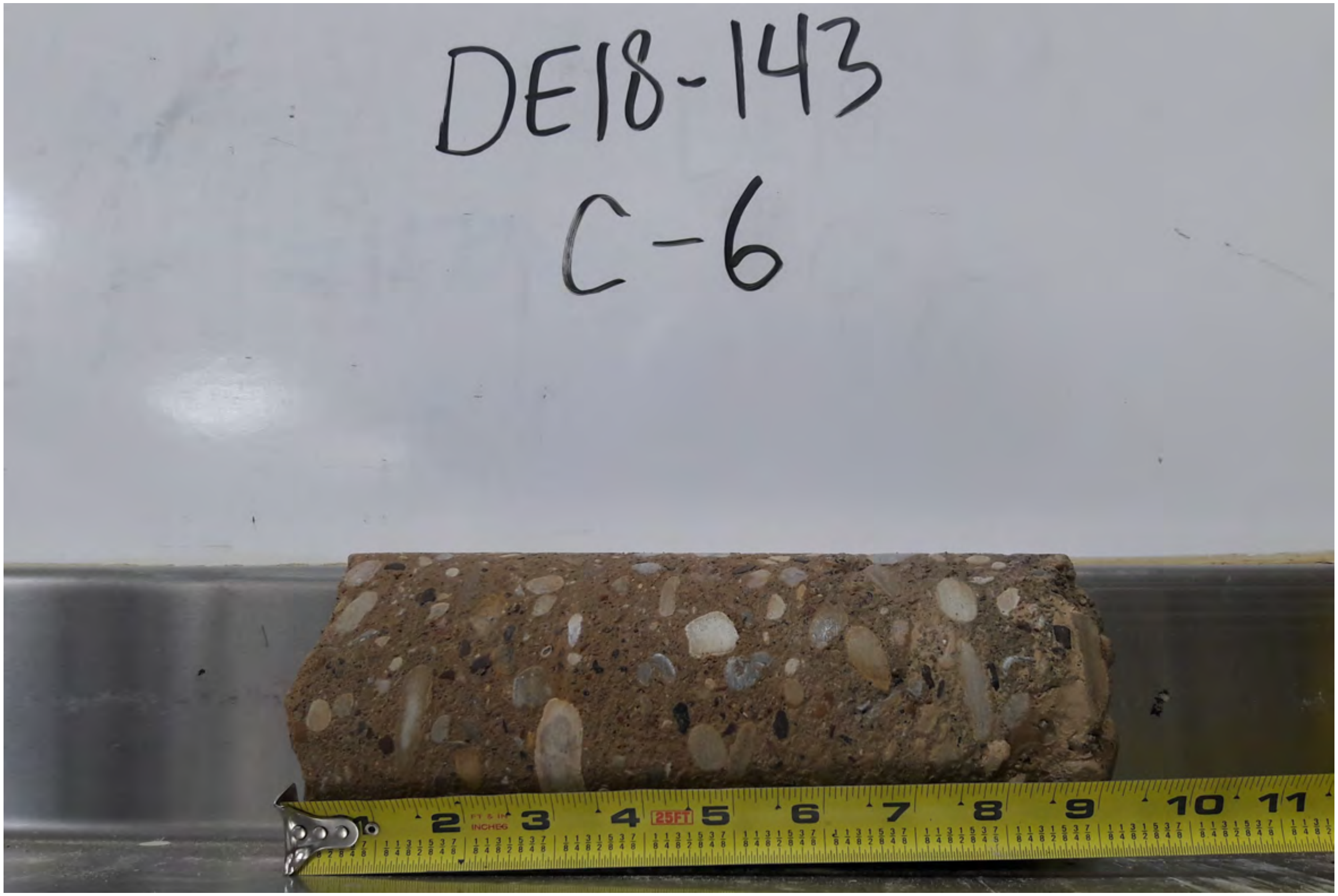

Photo 12: Photo of Pavement Core at Boring C-6.

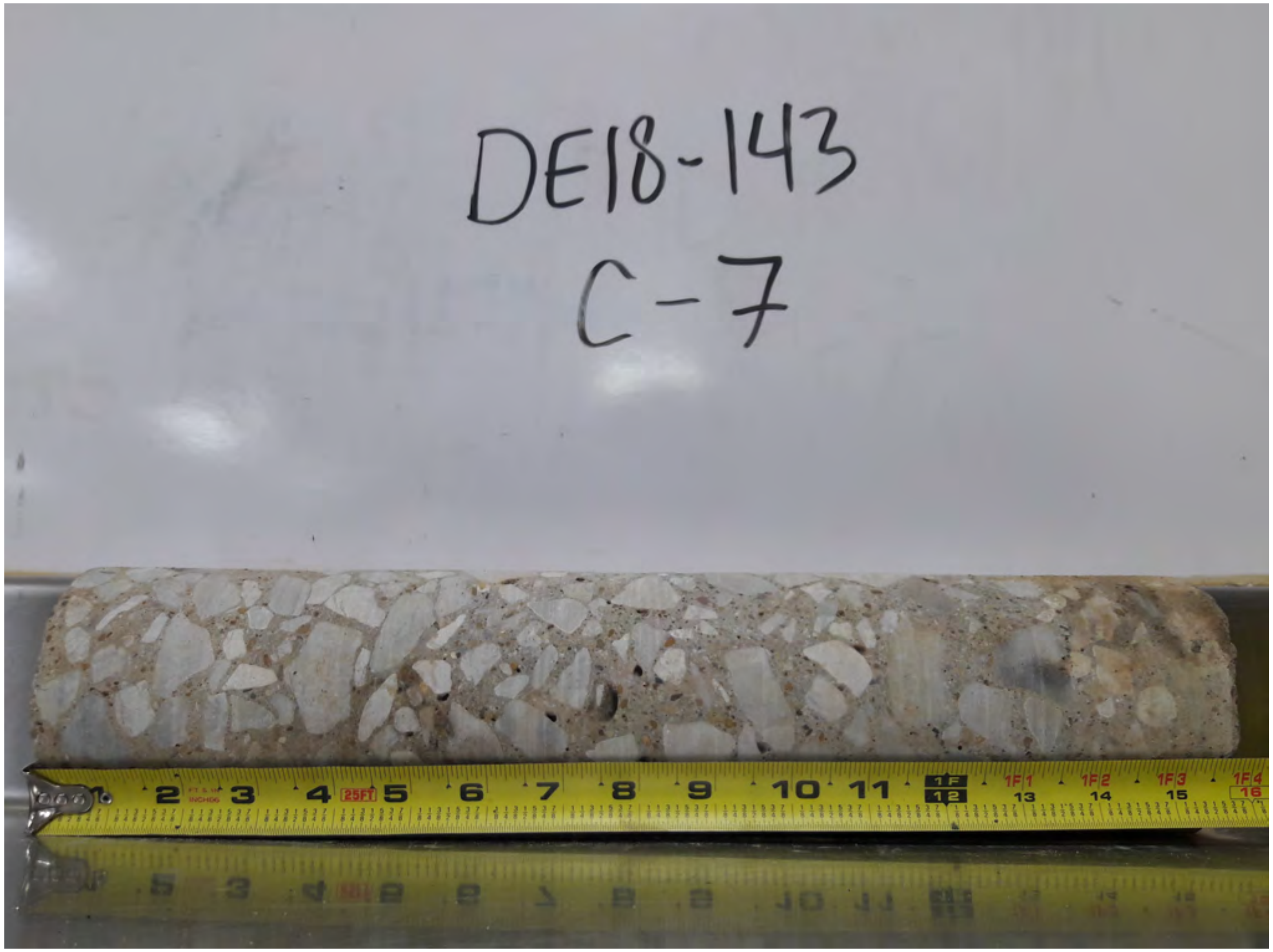

Photo 13: Photo of Pavement Core at Boring C-7.

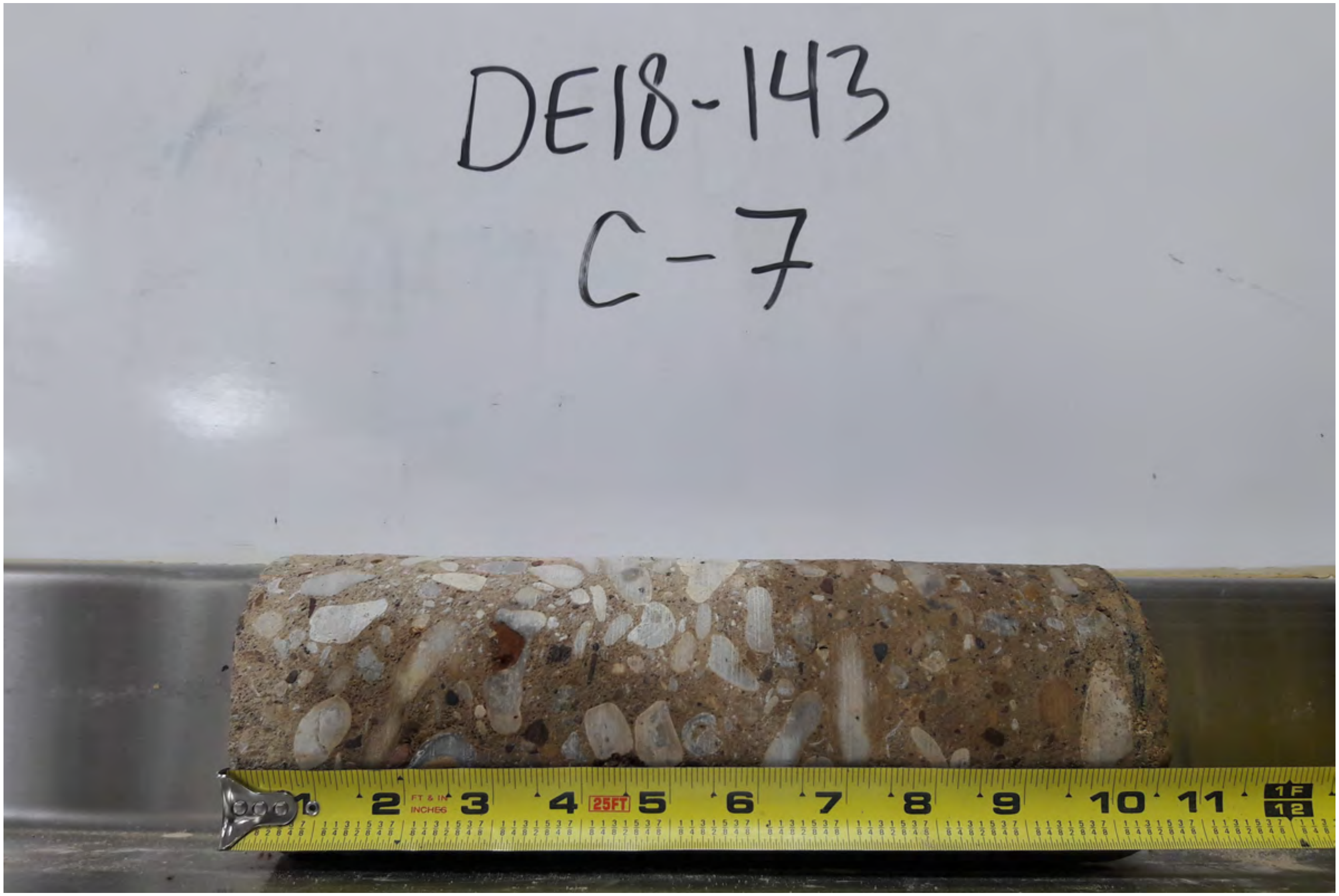

Photo 14: Photo of Pavement Core at Boring C-7.

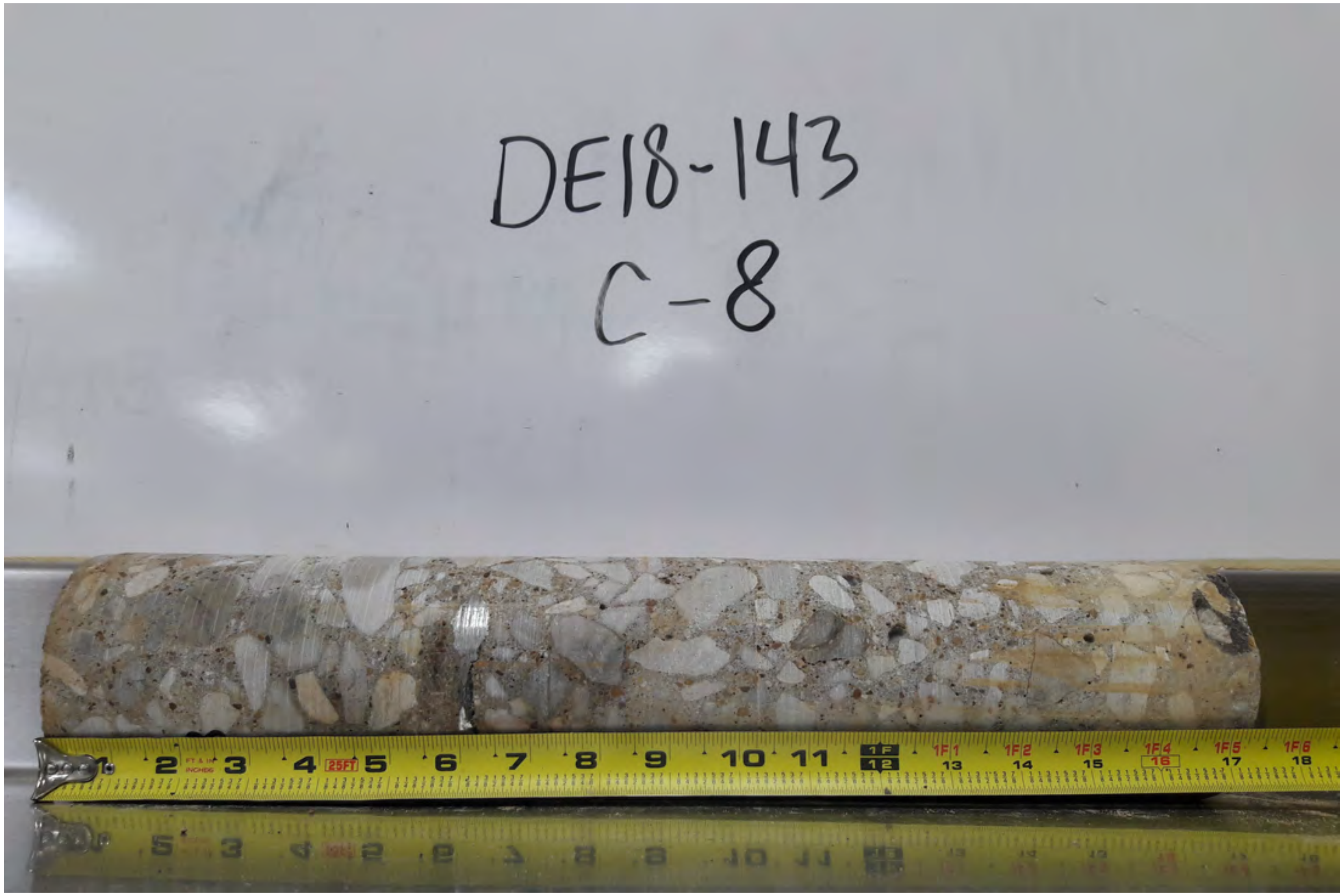

Photo 15: Photo of Pavement Core at Boring C-8.

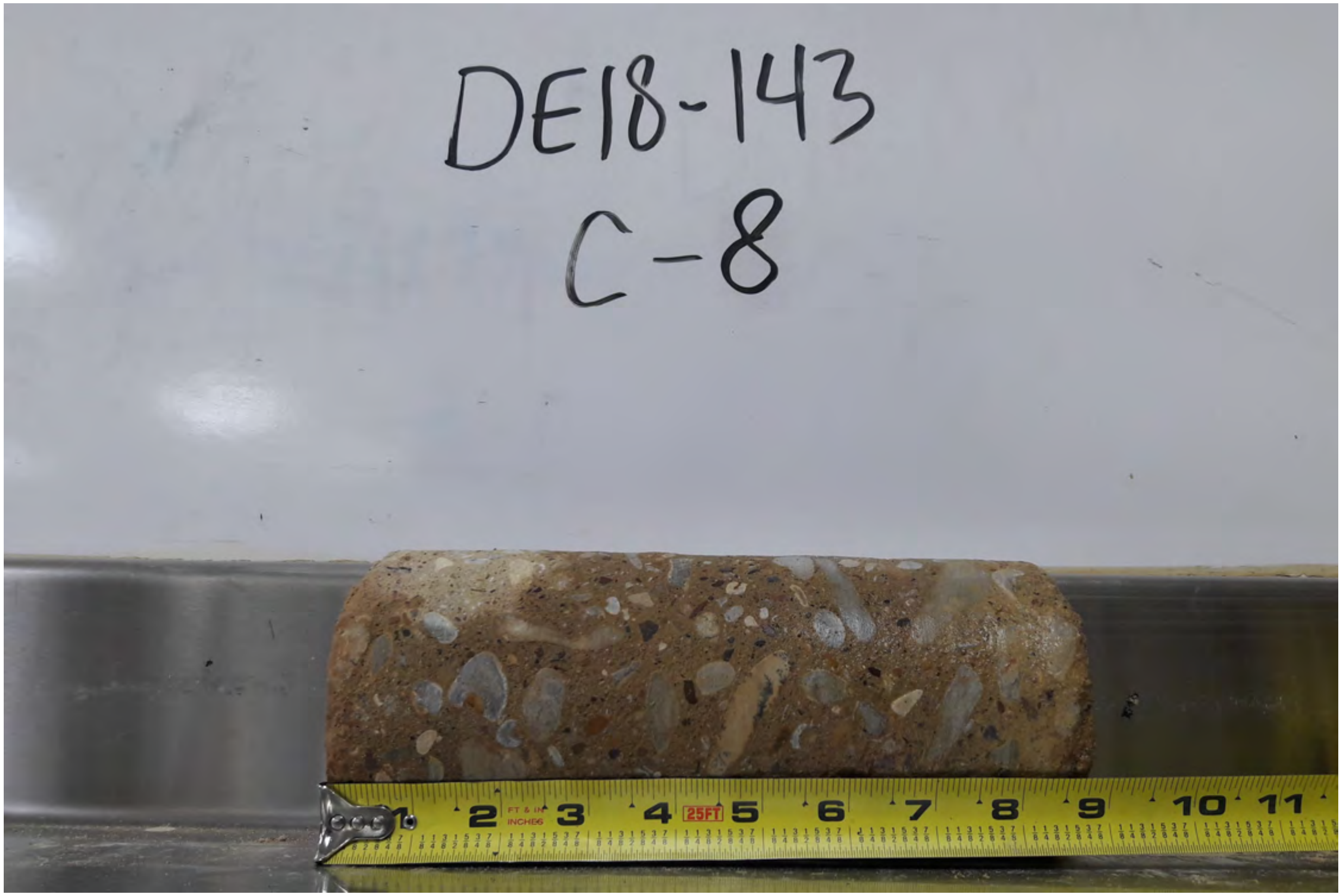

Photo 16: Photo of Pavement Core at Boring C-8.

THE TRANSTEC GROUP
The World's Pavement Engineering Specialists

EF 0006414

DRAFT - TECHNICAL MEMORANDUM

To:	RS&H Mr. Steve Creamer, P.E.	Memo No.	218051-001
From:	Mauricio Ruiz, P.E. Todd B. Hanke, P.E.	Date:	30 September 2018
Re:	DFW International Airport Cargo Ramp Evaluation		

Overview

This technical memorandum presents a summary of findings from the analysis performed of the falling (heavy) weight deflectometer (HWD) testing. The work was conducted at the Evergreen cargo ramp, located on the west side of Dallas Fort Worth International Airport (DFW). The approximate project location and limits are shown in Figure 1.

We understand that the project consists of modifications of the existing Evergreen building and ramp on the west side of DFW. The new facility will be used to support frequent, fully loaded, Boeing 747-8 freighter planes. As a result, there is a desire to conduct a pavement structural strength assessment of the existing ramp pavement. The goal of the evaluation is to verify if the existing pavement can support the anticipated loading conditions. At this time, the actual number of operations is unknown, therefore the analysis includes multiple scenarios.

Figure 1 Overview of Evergreen Cargo Ramp

Pavement Evaluation

To provide inputs and aid in the evaluation of the structural capacity of the pavement, a limited pavement evaluation was conducted. The pavement evaluation consisted of a geotechnical investigation, a pavement condition survey, and non-destructive testing. The geotechnical investigation was conducted by Alliance Geotechnical Group (Alliance) with the goal of determining the pavement layer thicknesses and general subbase/subgrade information, at a limited number of locations. The pavement condition survey was conducted by RS&H with the purpose of assessing any visual pavement distress. To supplement the geotechnical information and conduct back-calculation analysis, non-destructive testing using an HWD was carried out by HVJ Associates, using a Dynatest HWD. Field work was done under the supervision of a Transtec project manager.

Geotechnical Investigation and Borings

A limited geotechnical investigation was conducted by Alliance. The investigation consisted of coring the pavement in a total of 8 locations, spread throughout the limits of the ramp. At each location the existing concrete pavement was cored, along with any underlying cement treated base (CTB). Upon removal of the PCC and CTB, a dynamic cone penetrometer (DCP) was used to evaluate the relative stiffness of the subbase and subgrade. The approximate core locations are shown in Figure 2.

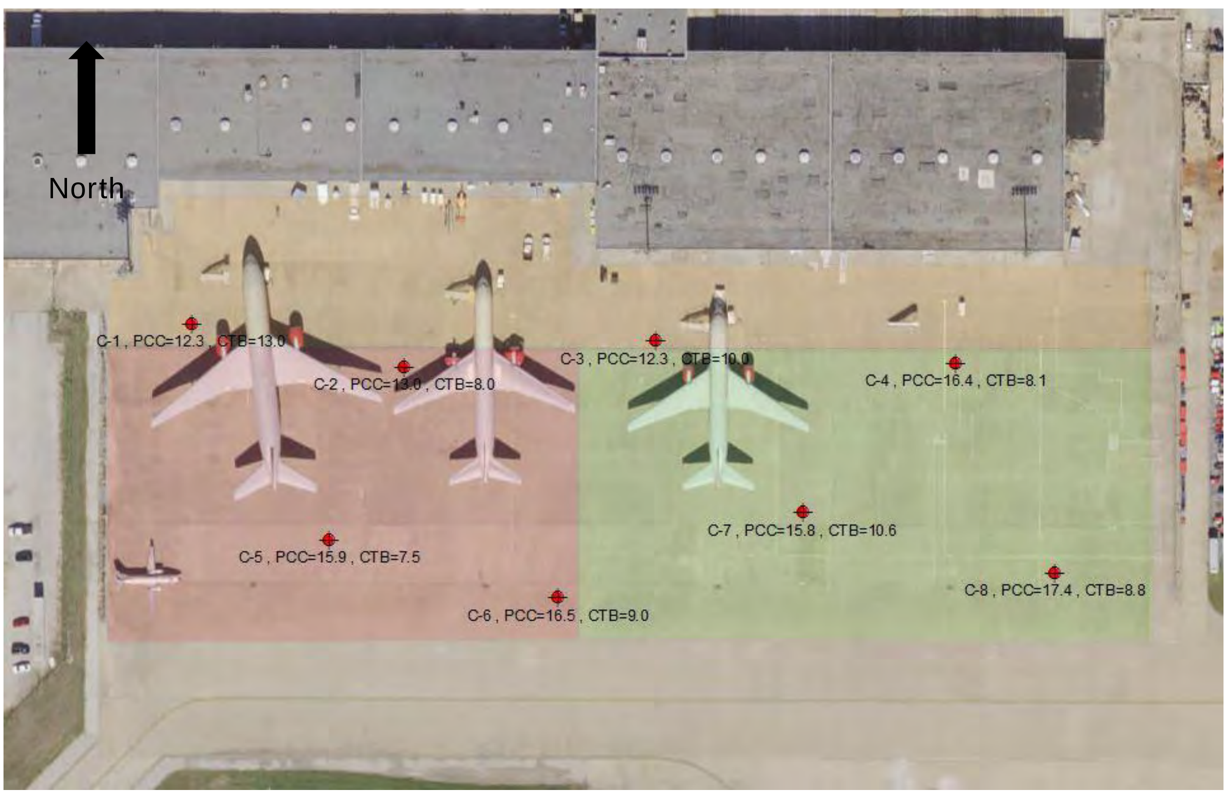

Figure 2 Geotechnical Core Locations

Findings from pavement cores are summarized in Table 1 below. Figure 2 also includes this information plotted at each core location, to assist in understanding how the pavement changes within the project limits.

Table 1 Summary of Core Data

Core Location	Concrete (in)	Cement Treated Base (in)
C-1	12.3	13*
C-2	13.0	8.0
C-3	12.3	10.0
C-4	16.4	8.1
C-5	15.9	7.5
C-6	16.5	9.0
C-7	15.8	10.6
C-8	17.4	8.8

**Estimated thickness based on coring.*

Based on the findings from the 8 core locations it appears that the pavement section is generally broken up into two areas. The northern area (shaded yellow in Figure 2) contains a slightly thinner section consisting of approximately 12-13 inches of concrete on 8 to 13 inches of cement treated base. The southern half (shaded red and green in Figure 2) contains a thicker pavement section consisting of approximately 16 to 17 inches of concrete on 8 to 10 inches of cement treated base. Based on this data and average conditions, a section of 13 inches of concrete on 8 inches of cement treated base was assumed for the northern portion, and 16 inches of concrete on 8 inches of cement treated base was assumed for the southern portion, for the back-calculation analysis.

In addition to the cores, Alliance conducted dynamic cone penetration tests (DCP) at each location to assist in evaluation of the stiffness of the subbase and subgrade. DCP testing generally indicates a variable subbase layer, likely consisting of lime stabilized subgrade. The thickness of this subbase layer was variable and ranged from 6 to 8 inches, when present. This stiffer subbase layer was not observed in all locations, indicating that the layer either was not present, or that it was possibly impacted by moisture. The results from the DCP testing are attached to this Technical Memorandum and have been taken into consideration when developing the estimated CBR and resilient modulus values of the subgrade. The data obtained from the geotechnical investigation is the basis of the back-calculation analysis.

Non-Destructive Testing and HWD data analysis

Non-destructive deflection testing was conducted on the ramp with an HWD to determine the structural capacity of the existing pavement. The deflection testing consisted of both mid-slab testing for determination of the modulus values and joint testing for load transfer efficiency (LTE). Testing was generally spaced on a grid pattern throughout the ramp. Field adjustments were made to the testing locations to account for parked aircraft and other vehicles. The testing plan was developed based on the guidance of FAA Advisory Circular AC 150/5370-11B. Mid-slab test locations are shown in Figure 3.

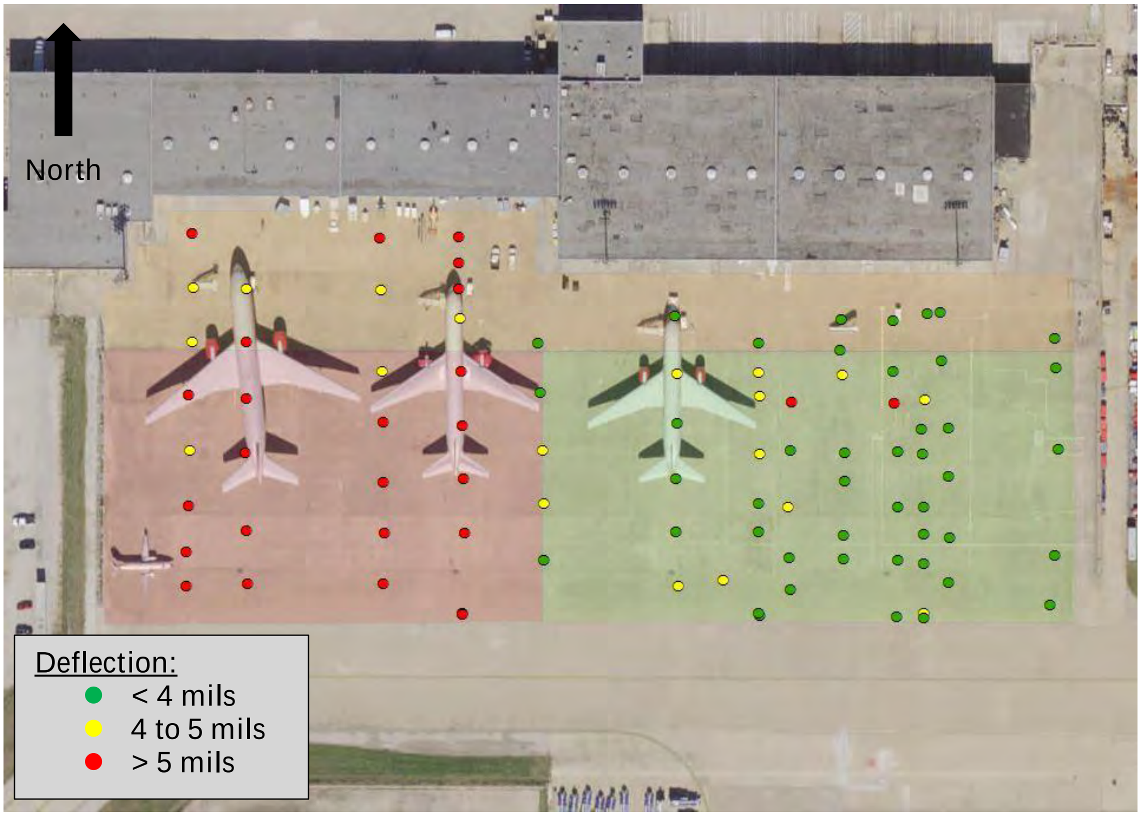

Figure 3 Mid-slab HWD Test Locations

Figure 3 shows the results of the mid-slab HWD testing. Each of the markers represent one mid-slab test. The test locations are color coded based on the amount of deflection from sensor 1, which is located at the loading plate. Based on this data it is possible to see that there is a distinct difference between the east and west sides of the ramp (color coded red and green). Higher deflections were observed along the western half compared to the eastern half. Based on the geotechnical information and this deflection data, the pavement was sub-divided into three areas for the evaluation of the structural capacity. This was done to account for the change in condition, including pavement thickness and pavement variability.

Figure 4 shows how the three pavement areas are defined for the analysis of the pavement structural support. Pavement Area 1 represents the thicker pavement section with higher deflections, Pavement Area 2 represents the thicker pavement section with lower deflections, and Pavement Area 3 represents the thinner pavement section with variable deflection results.

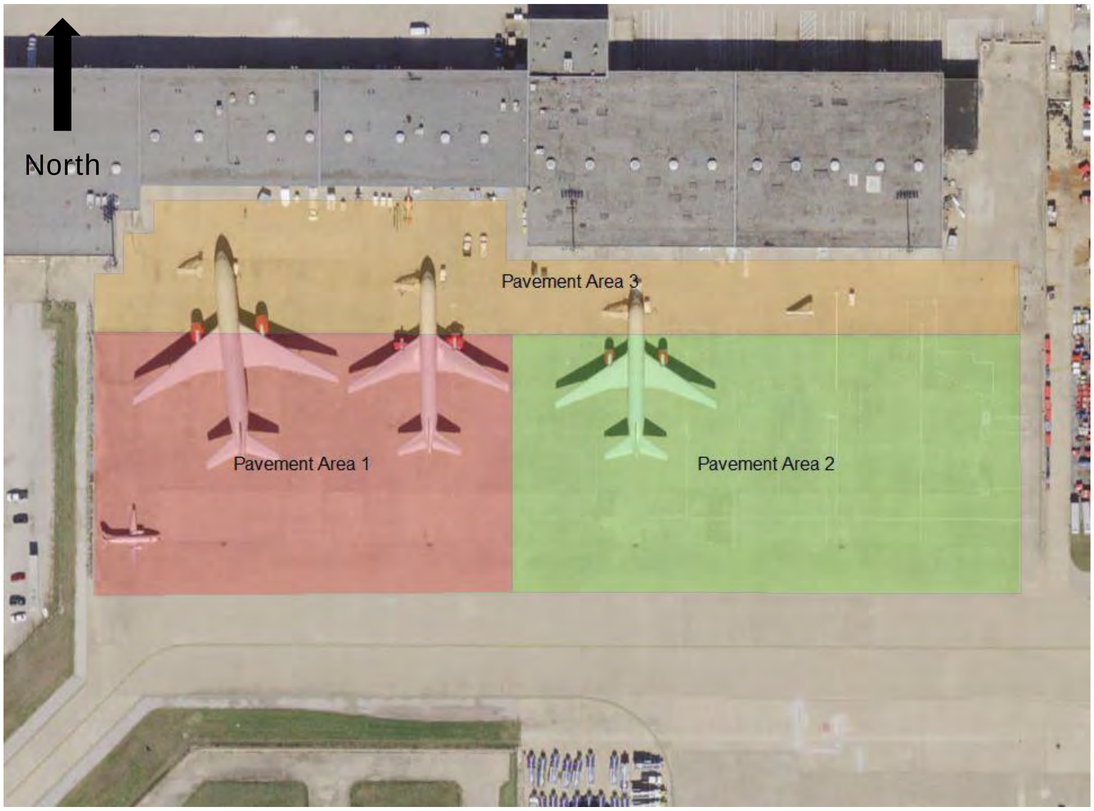

Figure 4 Pavement Areas

Analysis of HWD deflection data was performed using Texas Transportation Institute's Modulus 7.0, as well as Federal Aviation Administration's BAKFAA. Average layer thicknesses based on the geotechnical investigation, as shown in Table 1, were used to analyze deflections. For Pavement Areas 1 and 2, a section of 16 inches of concrete on 8 inches of CTB was used. For Pavement Area 3 a section of 13 inches of concrete on 8 inches of CTB was used. Due to the variability in the lime treated subbase, a separate layer was not included in the back-calculation analysis.

Table 2 provides a summary of back-calculated layer moduli (dynamic) with further details shown in Appendix B. Note, average pavement sections, as discussed, were used for this analysis. Variability in the pavement section can result in changes to the back-calculated modulus values. In addition, the variability of the lime treated subbase layer will affect the results of the analysis. The values presented in Table 2 represent dynamic layer moduli. A correction factor from dynamic to static modulus should be applied prior to using in the analysis of the structural capacity.

Table 2 Summary of back-calculated layer moduli

Pavement Area	Assumed Average Pavement Section		Average Calculated Modulus (psi)		
	PCC	CTB	PCC	CTB	Subgrade*
Pavement Area 1	16.0	8.0	6,000,000	640,000	21,515
Pavement Area 2	16.0	8.0	7,000,000	745,000	33,030
Pavement Area 3	13.0	8.0	6,000,000	640,000	21,515

*Represents the dynamic value

The above dynamic layer moduli were converted to design resilient moduli by using a factor of 0.33, and corresponding California Bearing Ratio (CBR) were calculated using the relationship Mr = 1500*CBR. In addition, the PCC surface modulus was converted to a modulus of rupture following the guidelines presented in FAA Advisory Circular AC 150/5370-11B. These values are summarized in Table 3 and were used in the analysis of the pavement structural capacity.

Table 3 Evaluation Design Values

Pavement Area	Assumed Average Pavement Section		Estimated Design Value (psi)		
	PCCP	CTB	PCC Modulus of Rupture	CTB	Subgrade
Pavement Area 1	16.0	8.0	720	640,000	7,100
Pavement Area 2	16.0	8.0	740	745,000	10,900
Pavement Area 3	13.0	8.0	720	640,000	7,100

The data from Table 3 was used as the basis of the analysis for the structural capacity of the ramp pavement. It is understood that the design aircraft consists of a 747-8 freighter, with frequent operations. The exact number of operations is unknown currently. Therefore, the analysis was done with variable number of annual operations, resulting in a chart for estimating the performance of the pavement given a certain number of annual operations. This analysis was done for each of the three pavement areas that were previously defined. Analysis was done using the FAA computer program FAARFIELD v 1.41 with the default configuration for a 747-8 freighter.

Figure 5 presents a chart plotting the estimated number of annual operations for each pavement area as a function of estimated life. The analysis is based on limited geotechnical information and HWD testing. It should be noted that this analysis is highly sensitive to the various inputs. Variations to pavement thickness, subgrade moisture, and existing pavement distress can affect the results significantly. Based on the DCP testing, it appears that there is a variable subbase layer that may be a lime treated subgrade. As a result, an 8-inch area of a weak lime treated soil was included as part of the analysis.

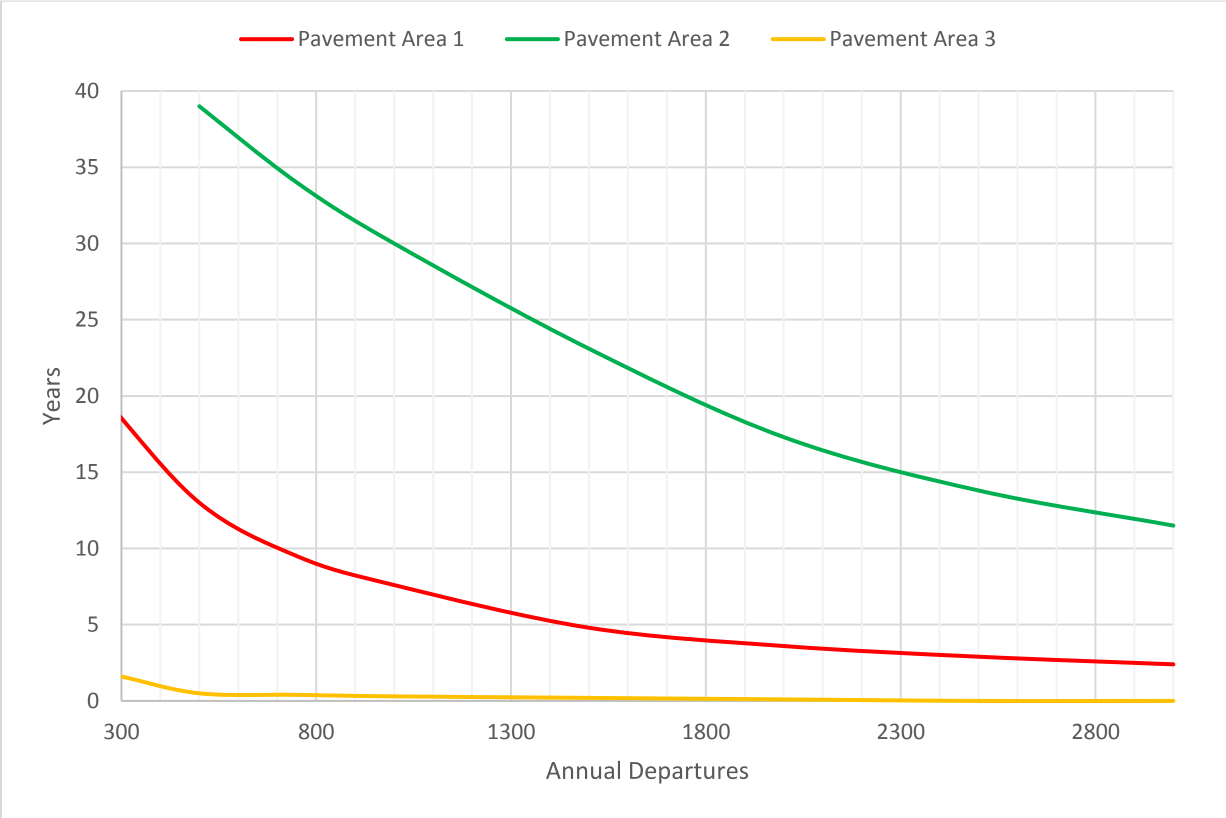

Figure 5 Pavement Structural Capacity

In general, the results of this analysis indicate that the northern portion of the ramp is inadequate for structural support of the proposed aircraft. The western portion of the ramp is marginal for support of the aircraft loading, depending on the number of operations. The eastern portion of the ramp generally performs better and would support a low to moderate number of operations.

The difference between the north (Pavement Area 3) and the south (Pavement Area 1 and 2) is a result of the thinner pavement section. The difference between the east and west sides is likely due to the variable subbase and subgrade conditions. Lower modulus values were observed for the subgrade along the western portion. This may be a result of several factors, including increased moisture and/or variations in the cement treated base and lime treated subbase.

For comparison, an analysis was done to evaluate what type of pavement section would be required for a new design construction. Based on an assumed 2,500 annual departures, 8 inches of CTB, 8-inches of lime treated subgrade, and a subgrade modulus value of 8,000 psi, a PCC section of 17.5 inches would be required. This is approximately 1.5 inches more of concrete than what was observed in the core locations.

In addition to evaluation of the deflection data and back-calculation, additional analysis of load transfer efficiency (LTE) was conducted to determine how the pavement joints would handle the increased loading. This is done by taking the deflection from the unloaded slab and dividing it by the deflection of the loaded slab. This process is outlined in more detail in FAA AC 150/5370-11B. The LTE data was calculated and then tabulated and plotted based on the percent LTE and the location. Figure 6 provides the results of the LTE calculation at each station/location. Based on Figure 36 of FAA AC 150/5370-11B, the LTE is considered acceptable when greater than 70 percent, fair when between 50 and 70 percent, and poor when less than 50 percent.

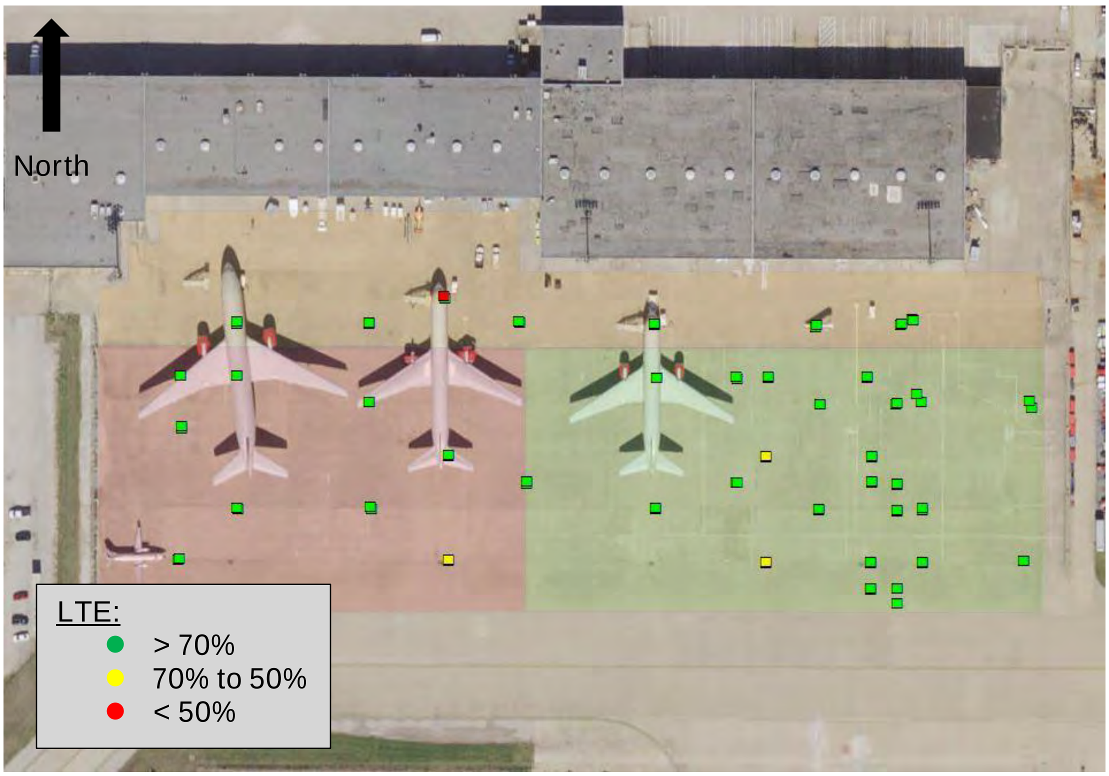

Figure 6 LTE Analysis

Figure 6 shows that the majority of the pavement has satisfactory LTE, at the tested locations. Only 4 test locations showed fair or poor LTE. Based on this testing, it appears that the LTE is generally satisfactory and should not result in poor performance of the pavement.

In addition to the LTE analysis, a comparison between measured deflections and the load level applied during HWD testing was evaluated. This process can be used to assist in the detection of potential voids beneath the concrete slabs. This analysis method is demonstrated in Fig. 37 of FAA Advisory Circular 150/5370-11B. The AC states that when the data for at least two load levels is plotted from the same location, and the x-intercept of the generated line is greater than 3 mils, voids may be present.

The individual intercept was calculated for each of the LTE test locations, resulting in 82 data points. Of those 82 points, no locations showed an intercept of greater than 3 mils. Therefore, the potential for voids and loss of support is minimal, based on this test data.

Analysis and Conclusion

The analysis and results, summarized in Figure 5, indicate that the eastern portion of the ramp may be suitable for support of a 747-8 freighter, depending on the number of operations and desired life. The western half of the ramp would provide limited to marginal support for the anticipated aircraft loading conditions. The northern portion of the ramp, closer to the existing building would not be suitable for heavy aircraft loading due to the thinner pavement section.

It appears that there are variable subgrade conditions, resulting in the lower capacity on the west side of the ramp. The cause of these conditions is not known but could be a result of higher moisture levels in the subbase and subgrade.

The analysis also determined that there was generally good load transfer along the transverse joints (east/west direction). There was also not evidence of major loss of support or voids based on the HWD testing.

The analysis was performed using limited geotechnical pavement investigation data to verify the current pavement structural section. As noted above, variable pavement sections were observed and may contribute to the variability observed for the various modulus values of the PCC, base, and subbase layers. If there is a desire to refine these values additional borings or ground penetration radar (GPR) could be carried out to confirm the consistency of pavement structure.

The findings obtained, and the recommendations prepared in this report constitute professional services, the essence of which entails professional judgment, opinion and/or skill. These are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. The findings, results, conclusions, opinions and recommendations provided in this report are not a representation, warranty, or guarantee regarding the current or future performance of pavement for this Project; and the report is directed at, and intended to be utilized within, the scope of work contained in the proposal and agreement executed by Transtec and the client.

This report has been prepared for the exclusive use of the client, and no other party may rely on it. The report shall not be transmitted to third parties, in whole or in part, except with the express written approval from Transtec. All information contained in or disclosed in this report is considered by Transtec to be confidential and proprietary information.

Client shall provide all criteria and full information as to client's requirements for the Project, all of which Transtec may rely upon in performing its professional services. The various pavement analyses and construction recommendations cited herein are based on numerous assumptions, both explicitly stated and implicit to the analysis methodology. If it is found that any condition deviates from these assumptions or from the information provided to Transtec by the client, Transtec should be contacted immediately since this may materially alter the report.

Appendix A

Dynamic Cone Penetrometer Results

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-1

Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
3	30	1
8	60	1
26	90	1
40	120	1
*Refusal		1
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		1
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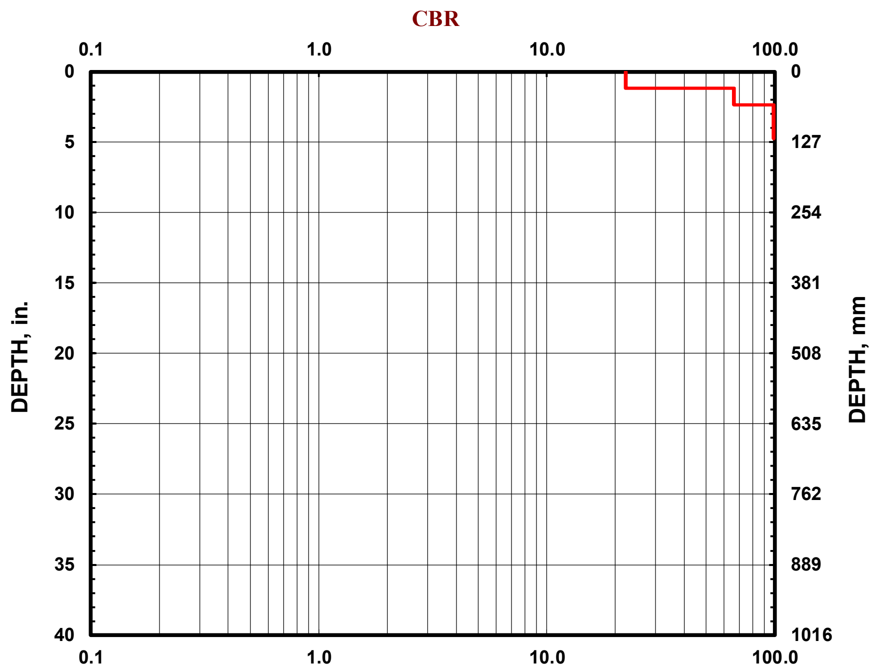

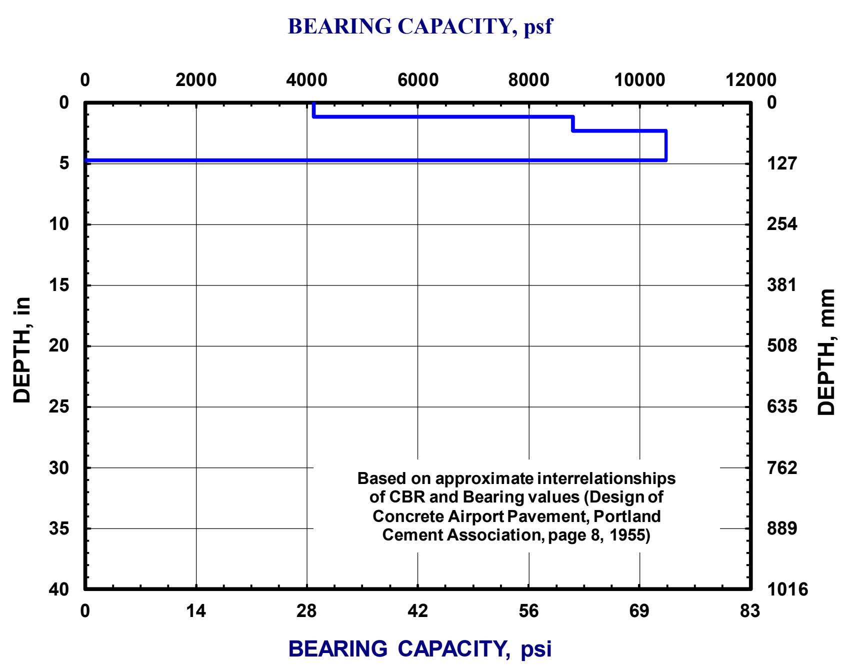

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-2
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	35	1
3	65	1
4	100	1
4	135	1
4	165	1
4	195	1
4	230	1
4	265	1
3	295	1
3	335	1
1	365	1
1	435	1
1	485	1
1	515	1
2	560	1
2	595	1
1	605	1
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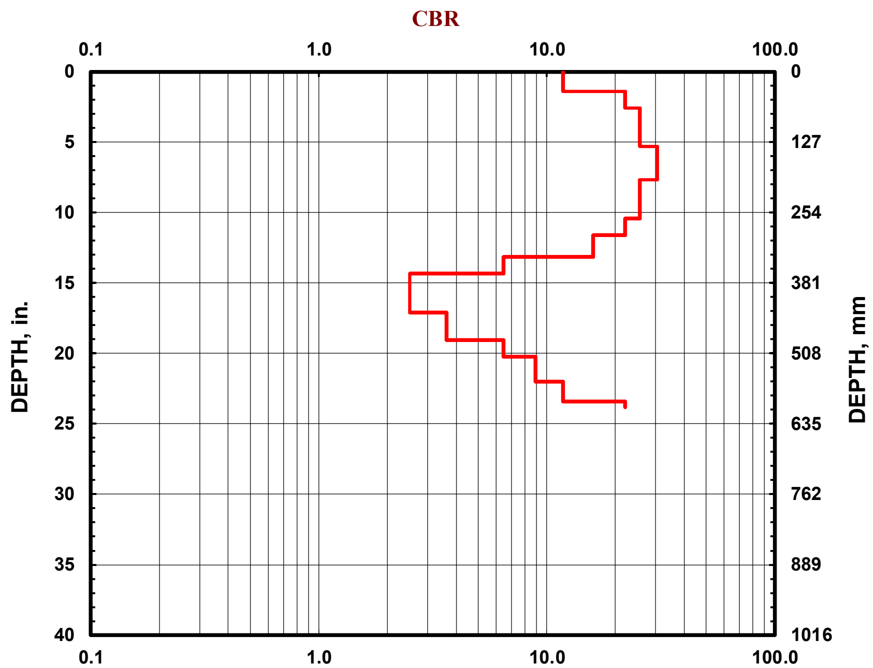

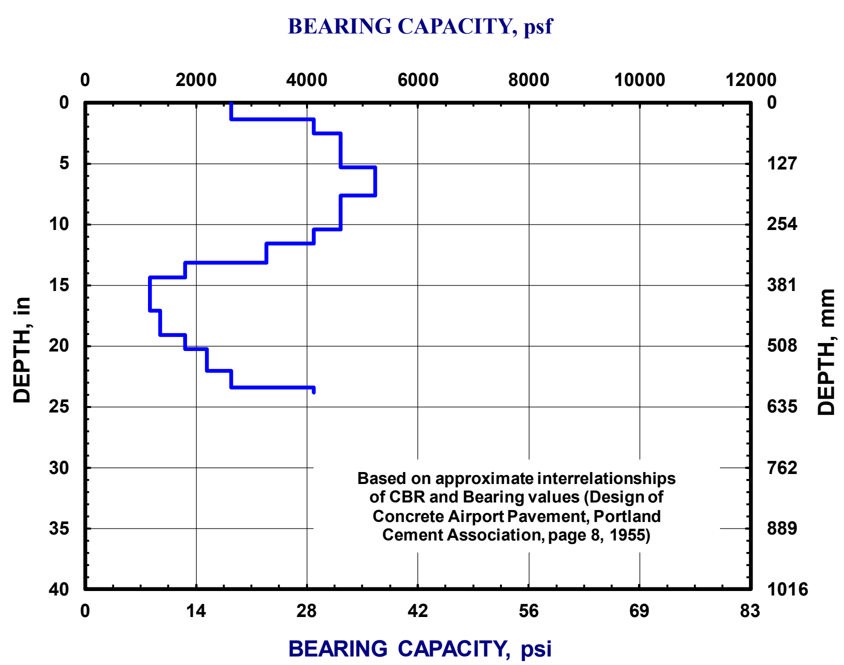

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-3
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	30	1
8	60	1
9	90	1
17	120	1
16	150	1
24	180	1
18	210	1
24	240	1
17	270	1
17	300	1
15	330	1
15	360	1
13	390	1
10	420	1
8	455	1
4	485	1
4	520	1
3	550	1
4	595	1
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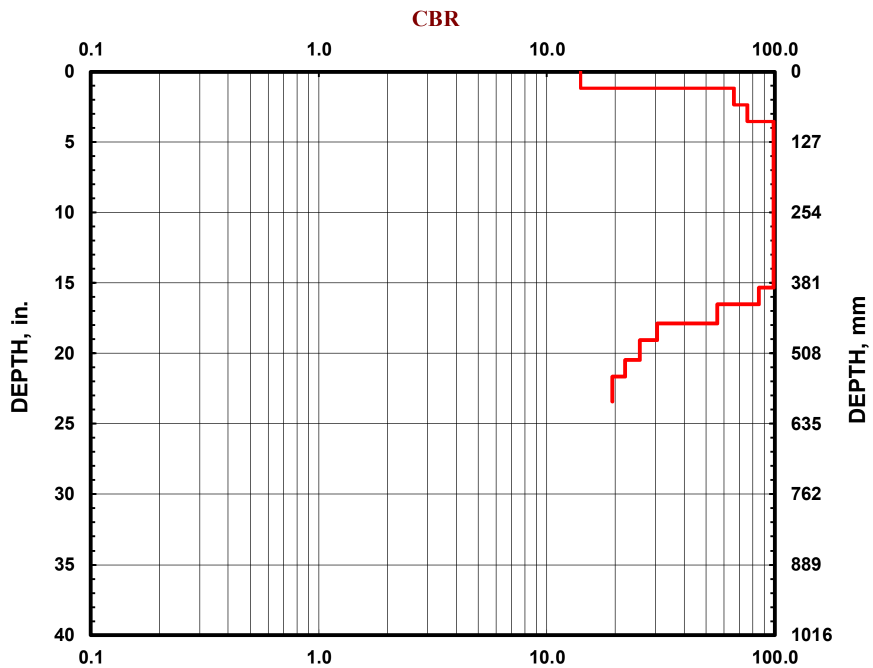

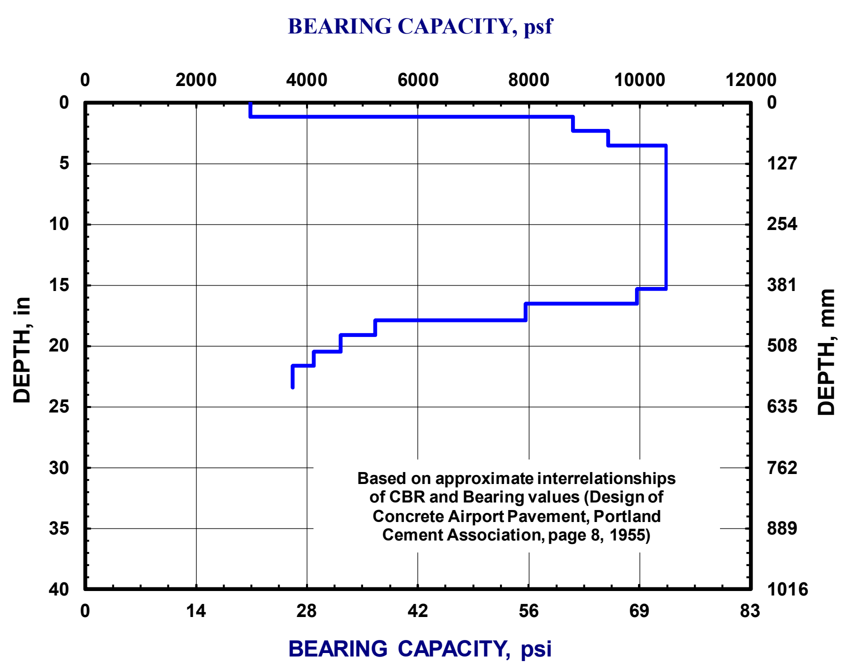

DCP TEST DATA

Project: *Evergreen Cargo Ramp* **Date:** 24-Sep-18
Location: C-4 **Soil Type(s):** Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	35	1
3	75	1
3	115	1
3	160	1
3	200	1
3	235	1
3	265	1
5	300	1
10	335	1
8	365	1
6	395	1
4	425	1
4	460	1
2	490	1
2	535	1
1	565	1
1	600	1
		1
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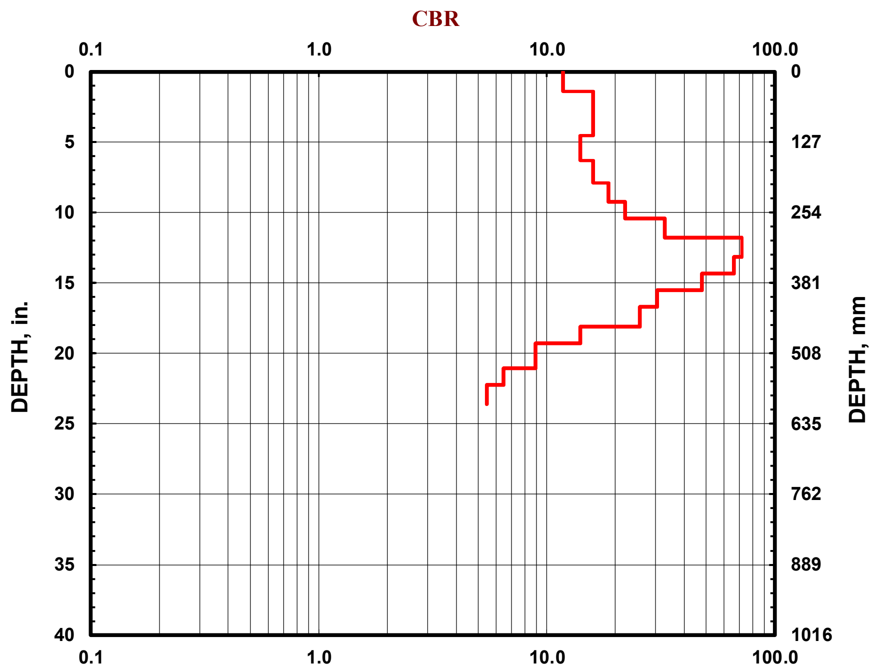

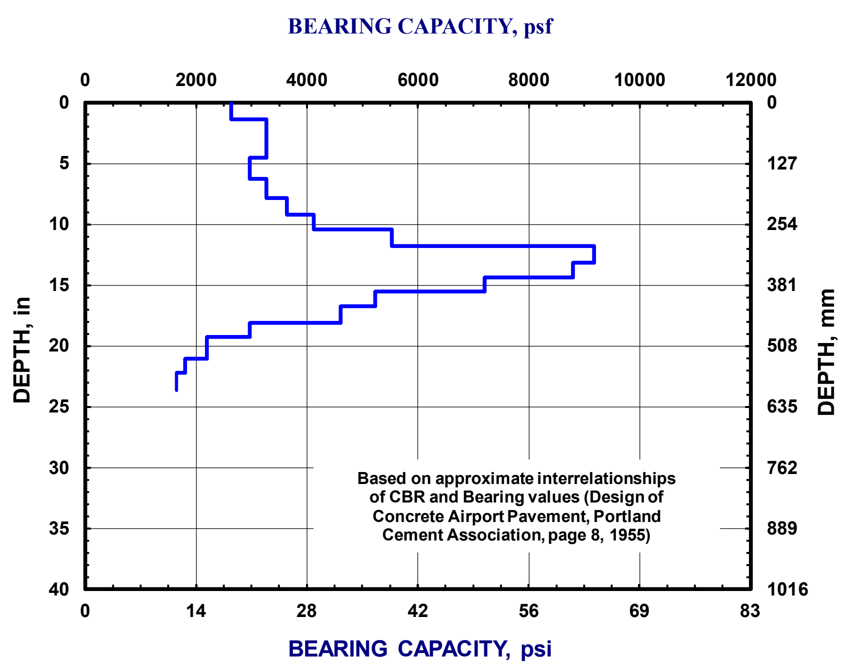

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-5

Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- 10.1 lbs.
- 17.6 lbs. (selected)
- Both hammers used

Soil Type
- CH
- CL
- All other soils (selected)

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	40	1
3	75	1
3	115	1
3	160	1
2	200	1
2	240	1
2	285	1
2	345	1
1	375	1
1	405	1
2	455	1
1	520	1
1	570	1
1	620	1
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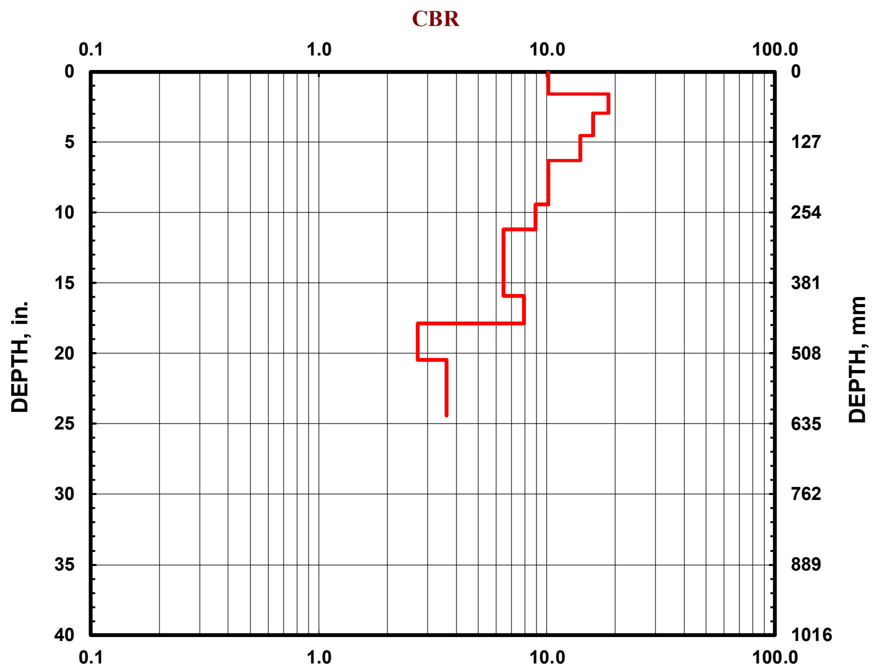

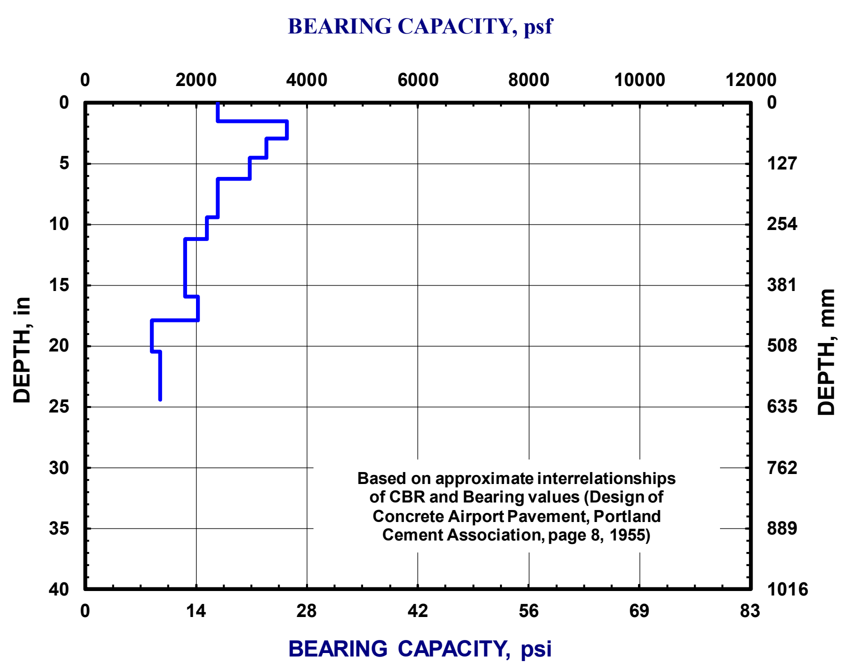

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-6
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
3	40	1
3	80	1
4	110	1
8	140	1
9	170	1
10	200	1
11	230	1
9	265	1
7	295	1
5	325	1
4	365	1
2	400	1
1	435	1
1	485	1
1	525	1
1	560	1
1	595	1
1	620	1
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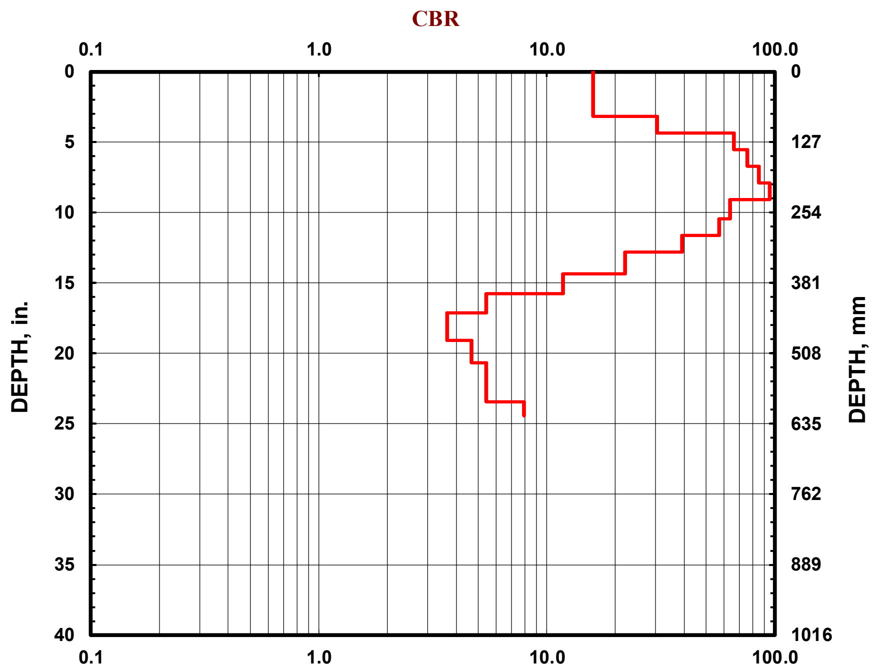

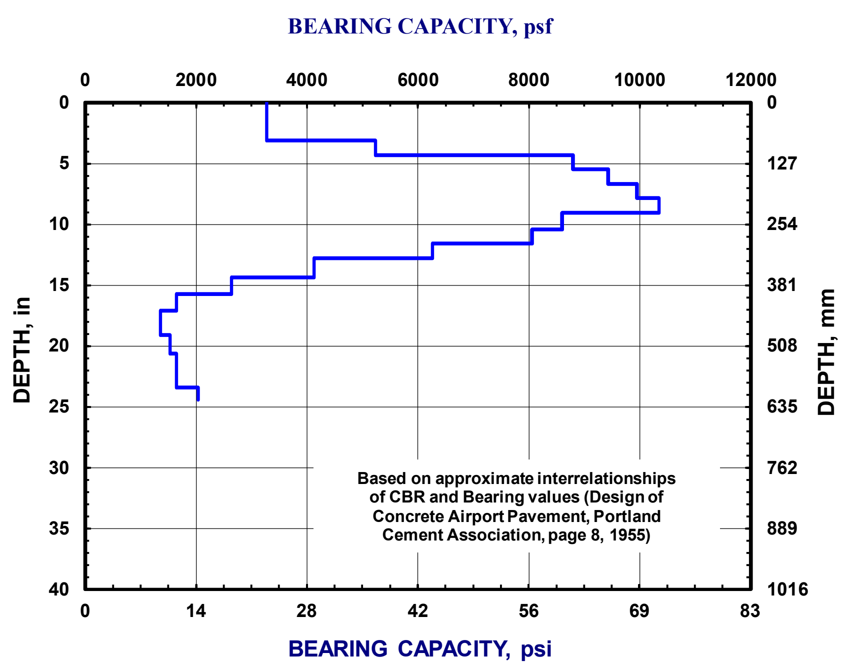

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-7
Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
1	45	1
1	75	1
3	105	1
5	135	1
4	170	1
4	205	1
3	235	1
4	280	1
2	310	1
2	340	1
2	370	1
2	400	1
2	440	1
2	515	1
1	575	1
1	625	1
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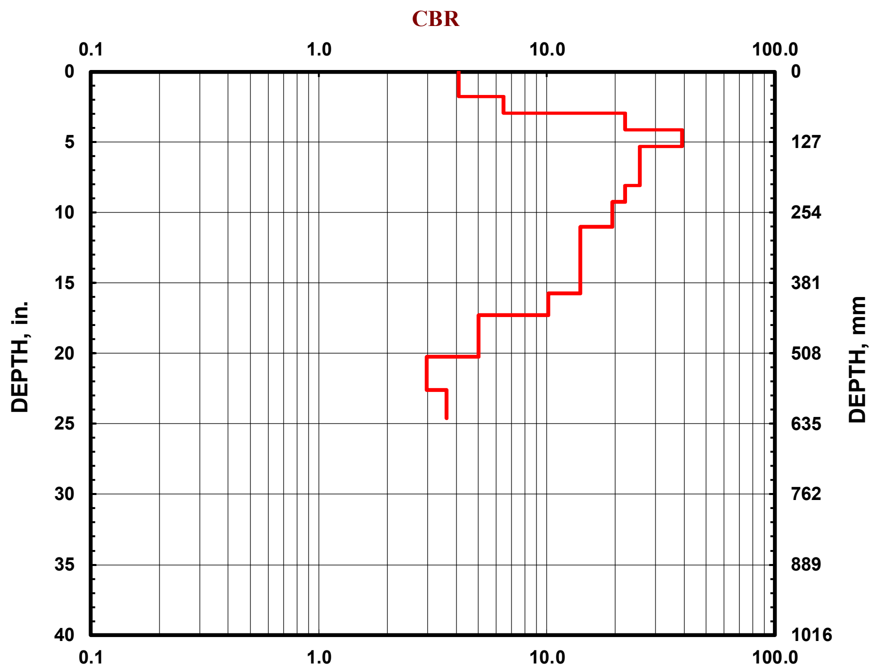

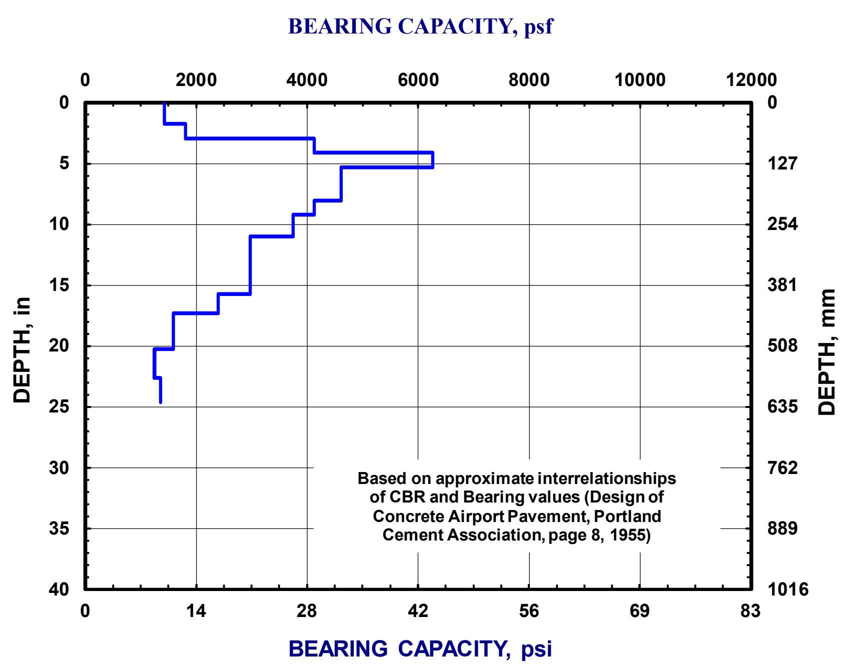

DCP TEST DATA

Project: *Evergreen Cargo Ramp*
Location: C-8

Date: 24-Sep-18
Soil Type(s): Type in the soil type

Hammer
- ○ 10.1 lbs.
- ● 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ● All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	0	1
2	45	1
3	80	1
3	115	1
3	145	1
3	180	1
3	210	1
3	245	1
3	285	1
3	325	1
2	365	1
2	425	1
2	495	1
1	540	1
2	585	1
1	605	1
		1
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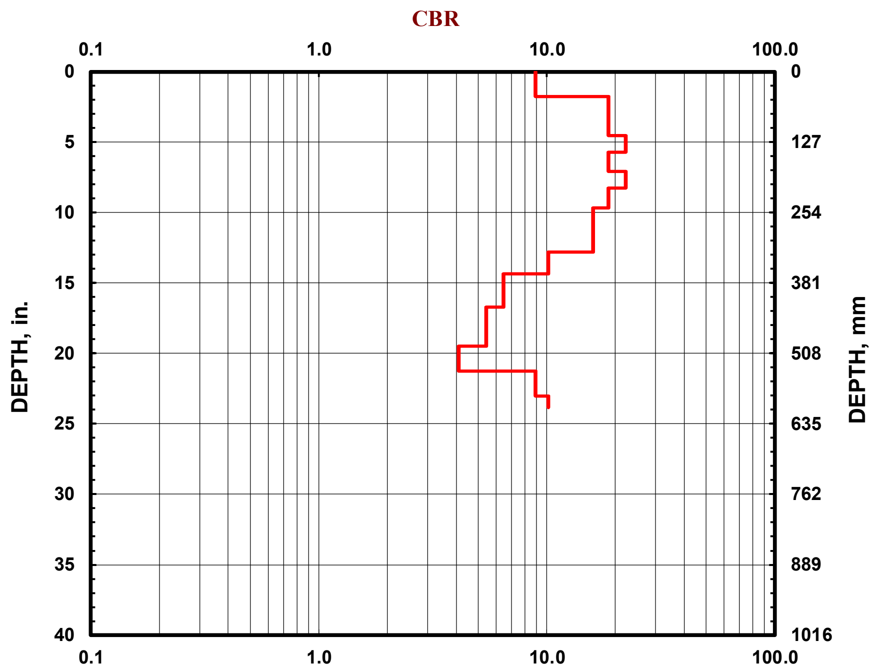
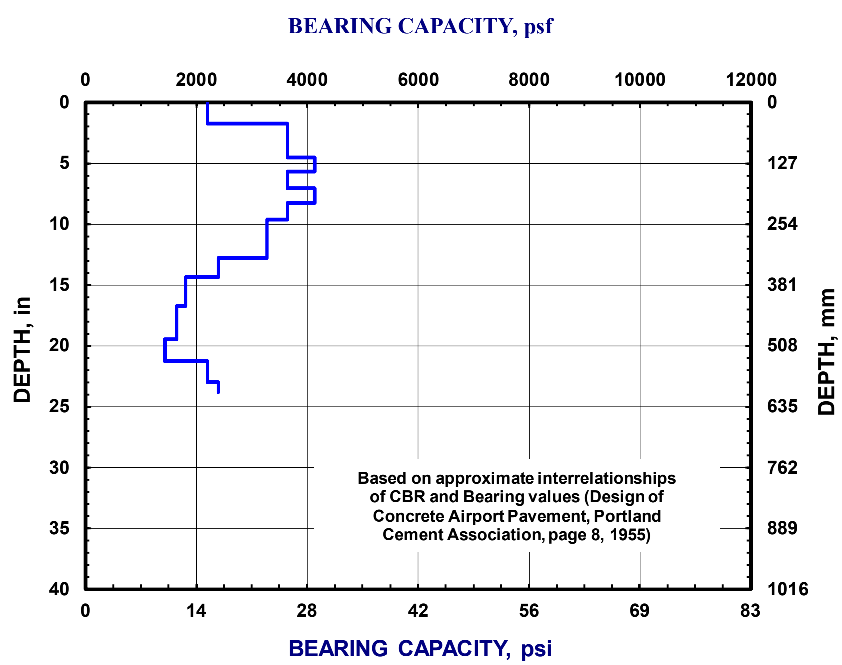




Appendix B

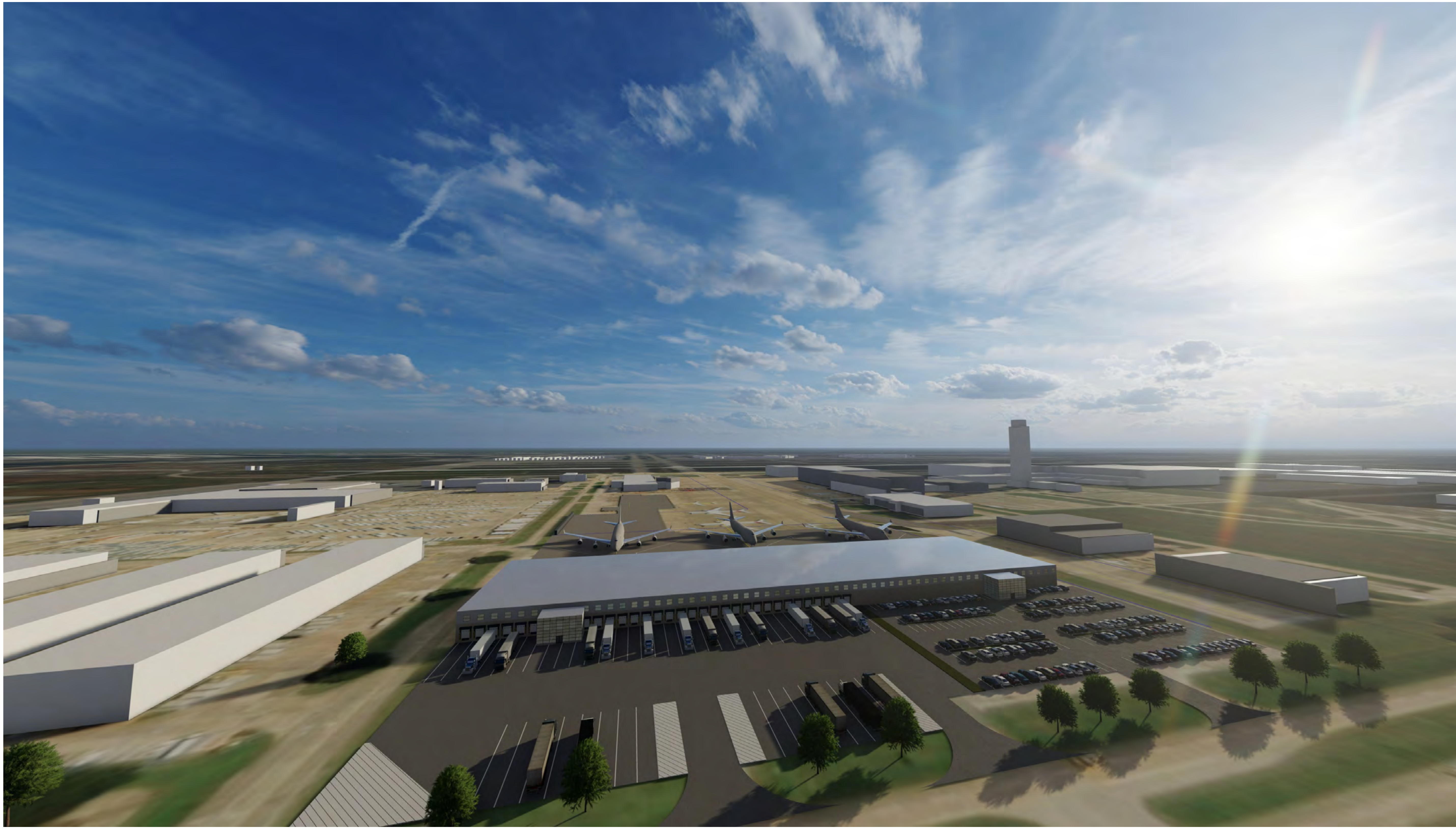
Non-Destructive Testing Analysis

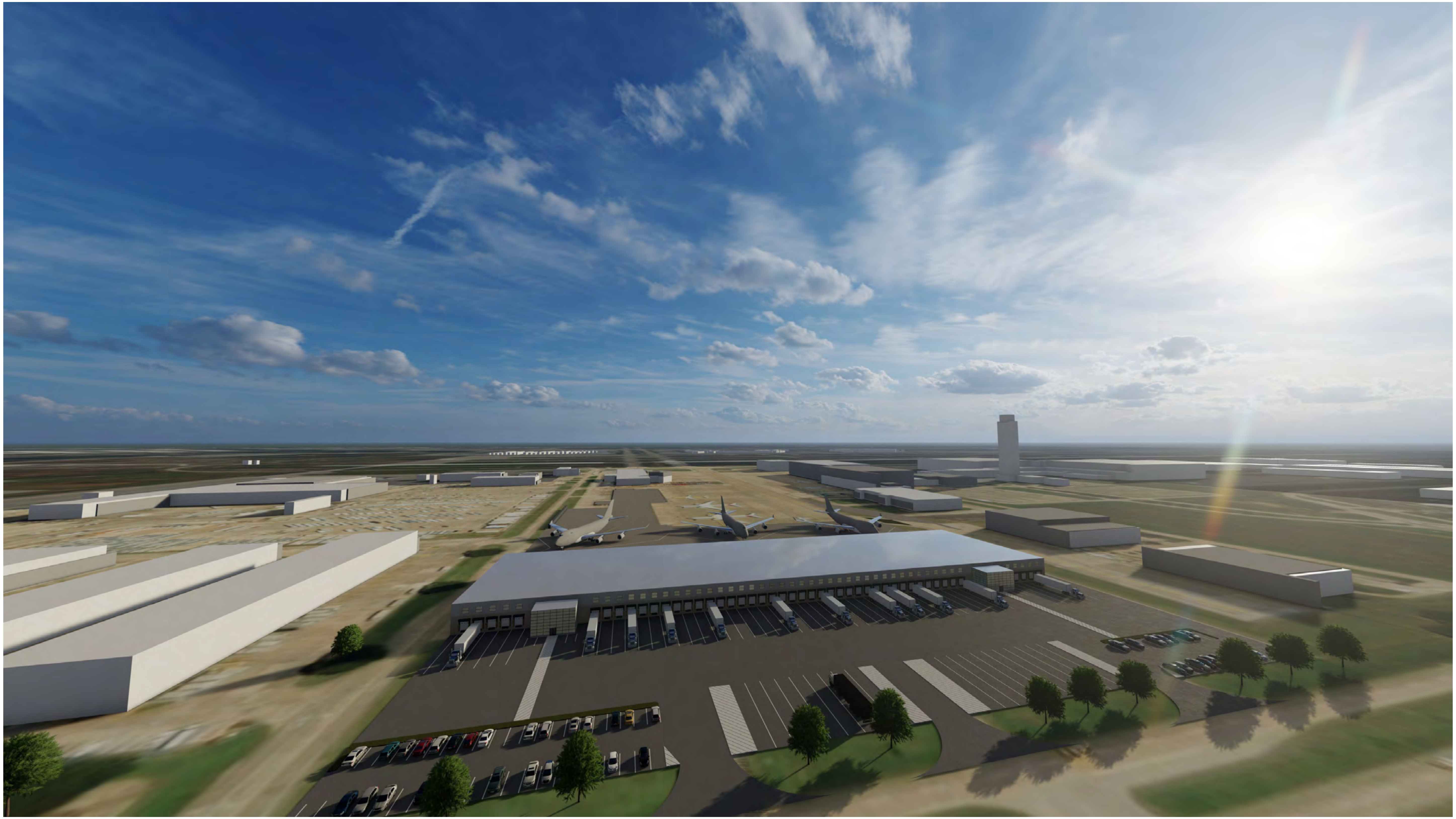
StationID	Station (ft)	Test Type	RunID	Latitude	Longitude	Surface Modulus (ksi)	Base Modulus (ksi)	Subgrade Modulus (ksi)
1	0	Center	12A	32.90927	-97.062579	7,000	575	48.10
4	40.6	Center	12A	32.90938	-97.062577	7,000	1,169	48.30
7	97.1	Center	12A	32.90953	-97.06258	7,000	1,002	55.20
8	143.9	Center	12A	32.90966	-97.062581	7,000	1,410	35.40
11	194.7	Center	12A	32.90983	-97.062602	7,000	701	43.80
14	244.9	Center	12A	32.90995	-97.062607	7,000	1,760	53.00
2	4.3	Center	9A	32.90919	-97.063155	7,000	952	52.20
3	77.8	Center	9A	32.90939	-97.063153	7,000	1,002	52.50
4	103.9	Center	9A	32.90947	-97.063154	7,000	1,002	45.10
7	150.7	Center	9A	32.90959	-97.063151	7,000	776	51.00
8	203.4	Center	9A	32.90974	-97.063151	7,000	860	41.00
11	224.1	Center	9A	32.9098	-97.063153	7,000	543	34.00
12	250.7	Center	9A	32.90987	-97.063156	7,000	1,230	35.20
1	595.6	Center	9A	32.90918	-97.06315	7,000	860	42.00
1	0	Center	Row1	32.90926	-97.064882	6,091	895	20.30
4	31.4	Center	Row1	32.90935	-97.064882	6,366	1,008	21.20
5	74.4	Center	Row1	32.90946	-97.064877	5,875	1,738	19.60
6	125.1	Center	Row1	32.9096	-97.064875	7,000	875	27.50
9	176.3	Center	Row1	32.90974	-97.064875	6,888	874	23.00
12	225.1	Center	Row1	32.90988	-97.064864	7,000	890	25.60
13	274.8	Center	Row1	32.91002	-97.064862	7,000	1,950	29.40
14	325.1	Center	Row1	32.91015	-97.064864	7,000	737	27.50
1	3.4	Center	Row10	32.90933	-97.062896	7,000	2,000	46.30
2	25.1	Center	Row10	32.90939	-97.062896	7,000	1,363	45.80
5	74.9	Center	Row10	32.90952	-97.062895	7,000	1,363	49.90
6	101	Center	Row10	32.9096	-97.062892	7,000	776	52.00
9	172.4	Center	Row10	32.90979	-97.062902	7,000	860	46.60
10	196.6	Center	Row10	32.90986	-97.062907	7,000	737	53.00
13	222.7	Center	Row10	32.90993	-97.062906	7,000	1,002	58.10
1	-1	Center	Row11	32.90918	-97.062736	7,000	1,285	43.60
6	51.7	Center	Row11	32.90933	-97.062735	7,000	2,000	46.50
7	99	Center	Row11	32.90946	-97.062735	7,000	776	52.60
12	150.2	Center	Row11	32.9096	-97.062734	7,000	1,055	43.30
13	194.7	Center	Row11	32.90972	-97.062746	7,000	1,933	28.40
16	224.1	Center	Row11	32.9098	-97.062748	7,000	860	44.10
17	270.5	Center	Row11	32.90993	-97.062749	7,000	1,760	53.00
4	-3.9	Center	Row12	32.90918	-97.062657	7,000	1,038	42.40
1	0	Center	Row12	32.90919	-97.062657	7,000	1,100	40.60
5	47.3	Center	Row12	32.90932	-97.062655	7,000	1,760	48.80
6	74.4	Center	Row12	32.90939	-97.062655	7,000	969	46.20
9	99.5	Center	Row12	32.90946	-97.062656	7,000	1,002	51.70
12	147.3	Center	Row12	32.90959	-97.06266	7,000	633	41.90
13	170	Center	Row12	32.90966	-97.062661	7,000	1,055	49.00

StationID	Station (ft)	Test Type	RunID	Latitude	Longitude	Surface Modulus (ksi)	Base Modulus (ksi)	Subgrade Modulus (ksi)
16	195.1	Center	Row12	32.90973	-97.062652	7,000	2,000	28.70
19	274.8	Center	Row12	32.90995	-97.062644	7,000	1,672	55.60
1	2.9	Center	Row13	32.90921	-97.062274	7,000	776	69.10
4	52.2	Center	Row13	32.90934	-97.062259	7,000	1,169	70.40
5	148.3	Center	Row13	32.9096	-97.062249	7,000	571	44.00
8	219.8	Center	Row13	32.90981	-97.062256	7,000	817	39.80
9	247.8	Center	Row13	32.90989	-97.06226	7,000	1,110	43.30
1	0	Center	Row2	32.90926	-97.0647	7,000	515	31.40
2	49.3	Center	Row2	32.9094	-97.0647	7,000	969	23.70
5	121.2	Center	Row2	32.9096	-97.064705	7,000	875	26.60
6	169.5	Center	Row2	32.90973	-97.064701	7,000	1,002	24.90
9	222.7	Center	Row2	32.90988	-97.064704	7,000	947	26.40
12	270.5	Center	Row2	32.91001	-97.064701	7,000	1,950	29.50
1	0	Center	Row4	32.90926	-97.06429	7,000	1,230	26.30
2	46.9	Center	Row4	32.90939	-97.064286	7,000	1,459	23.60
5	92.7	Center	Row4	32.90952	-97.064289	6,627	1,918	27.10
6	148.3	Center	Row4	32.90967	-97.064289	7,000	1,309	25.50
9	195.1	Center	Row4	32.9098	-97.064291	7,000	1,672	30.70
12	269.5	Center	Row4	32.91001	-97.064297	7,000	1,672	38.80
13	316.4	Center	Row4	32.91014	-97.0643	5,943	550	22.80
2	0	Center	Row5	32.90919	-97.06405	7,000	1,399	27.10
5	74.9	Center	Row5	32.90939	-97.064043	7,000	1,329	27.40
6	124.1	Center	Row5	32.90953	-97.064045	7,000	725	25.00
9	173.4	Center	Row5	32.90966	-97.06405	7,000	860	38.80
10	223.2	Center	Row5	32.9098	-97.064052	7,000	543	34.30
11	271.5	Center	Row5	32.90994	-97.064055	7,000	1,020	25.80
14	298	Center	Row5	32.91001	-97.064059	7,000	860	39.10
15	321.2	Center	Row5	32.91008	-97.064059	5,686	362	19.10
16	344.9	Center	Row5	32.91014	-97.064059	4,486	1,579	22.20
1	794.1	Center	Row5	32.90919	-97.064049	4,773	470	23.20
1	0	Center	Row6	32.90932	-97.063803	7,000	1,509	37.40
2	52.2	Center	Row6	32.90947	-97.063803	7,000	701	44.10
5	98.5	Center	Row6	32.9096	-97.063806	7,000	1,589	32.90
6	152.2	Center	Row6	32.90975	-97.063813	7,000	571	43.40
7	197.1	Center	Row6	32.90987	-97.063823	7,000	1,169	43.80
1	0	Center	Row8	32.90927	-97.063261	7,000	1,509	32.80
2	0	Center	Row8	32.90926	-97.063395	7,000	845	41.30
3	49.3	Center	Row8	32.90939	-97.063403	7,000	860	39.80
6	99	Center	Row8	32.90953	-97.063403	7,000	1,852	45.70
7	149.7	Center	Row8	32.90967	-97.063401	7,000	1,760	31.00
10	195.6	Center	Row8	32.9098	-97.063402	7,000	1,852	30.60
13	249.2	Center	Row8	32.90994	-97.063408	7,000	1,760	49.30
1	20.8	Center	Row9	32.90925	-97.063057	7,000	1,760	54.10

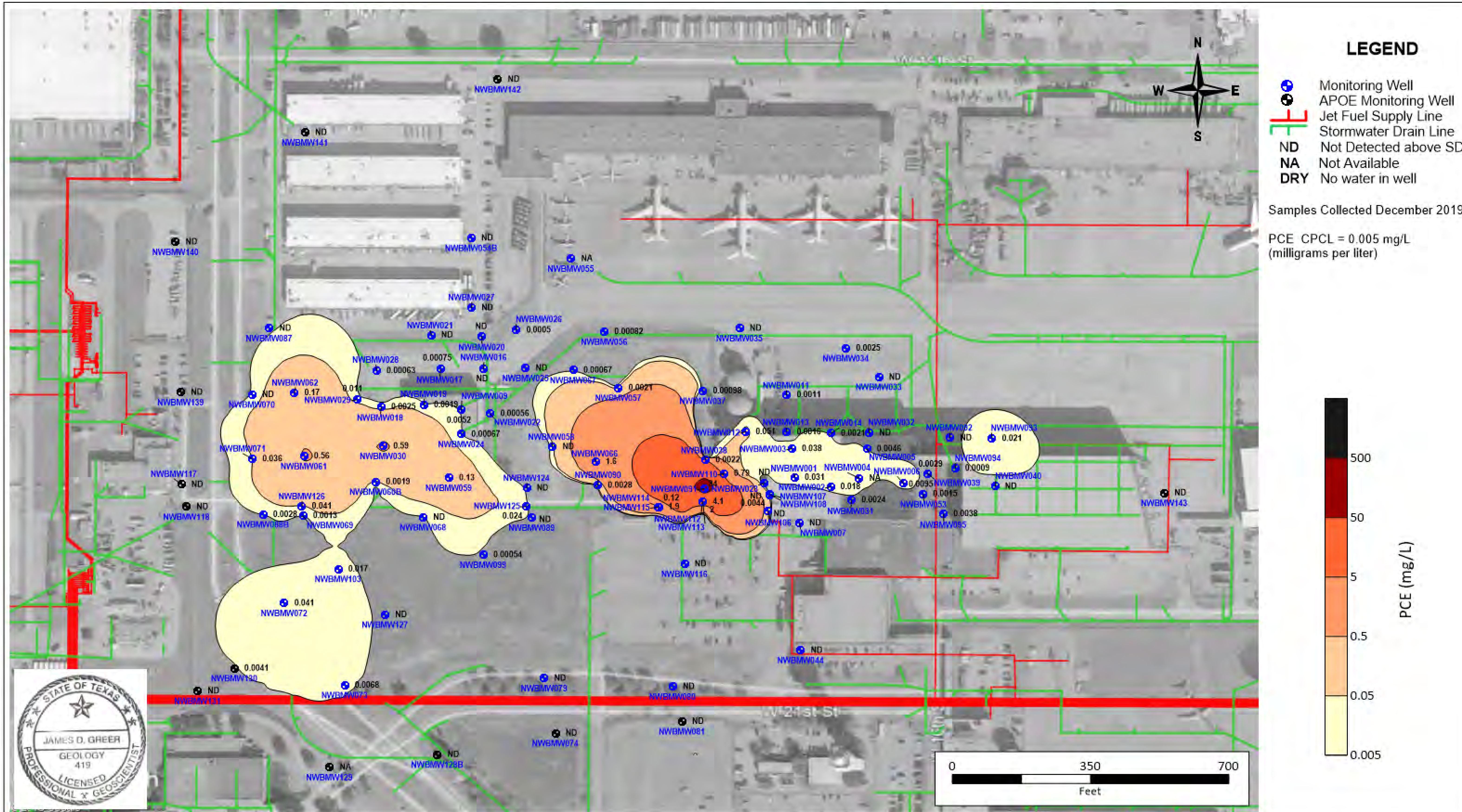
StationID	Station (ft)	Test Type	RunID	Latitude	Longitude	Surface Modulus (ksi)	Base Modulus (ksi)	Subgrade Modulus (ksi)
4	48.8	Center	Row9	32.90933	-97.063063	7,000	776	52.30
5	95.6	Center	Row9	32.90946	-97.063065	7,000	1,950	33.60
8	148.3	Center	Row9	32.9096	-97.063059	7,000	1,055	42.80
9	191.8	Center	Row9	32.90972	-97.063055	7,000	1,295	28.80

Appendix C: Representative Landside Renderings



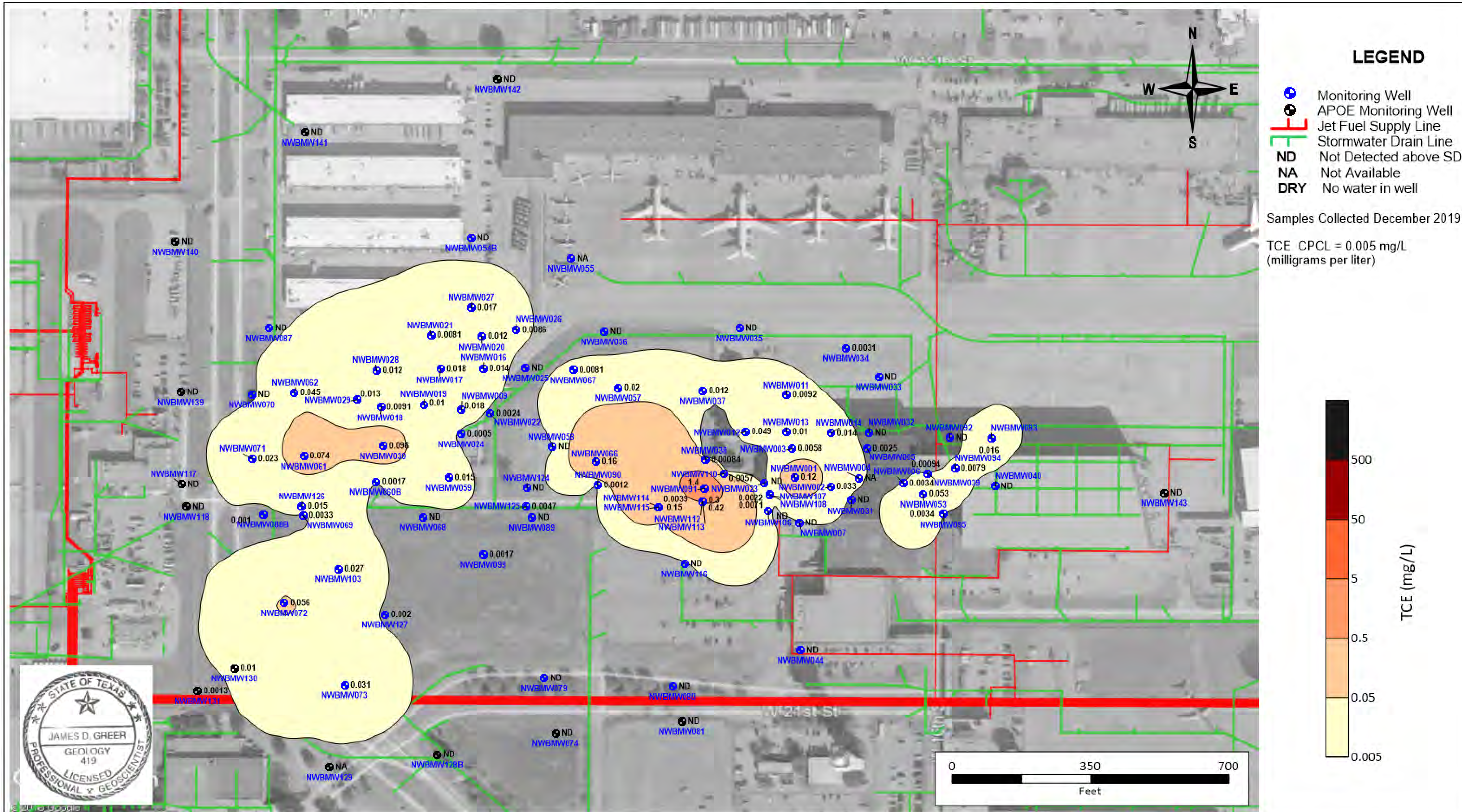


Appendix D: Concentration Maps at West Cargo



AOC B1
PCE Groundwater Concentration Map
December 2019

Attachment 1A2-6



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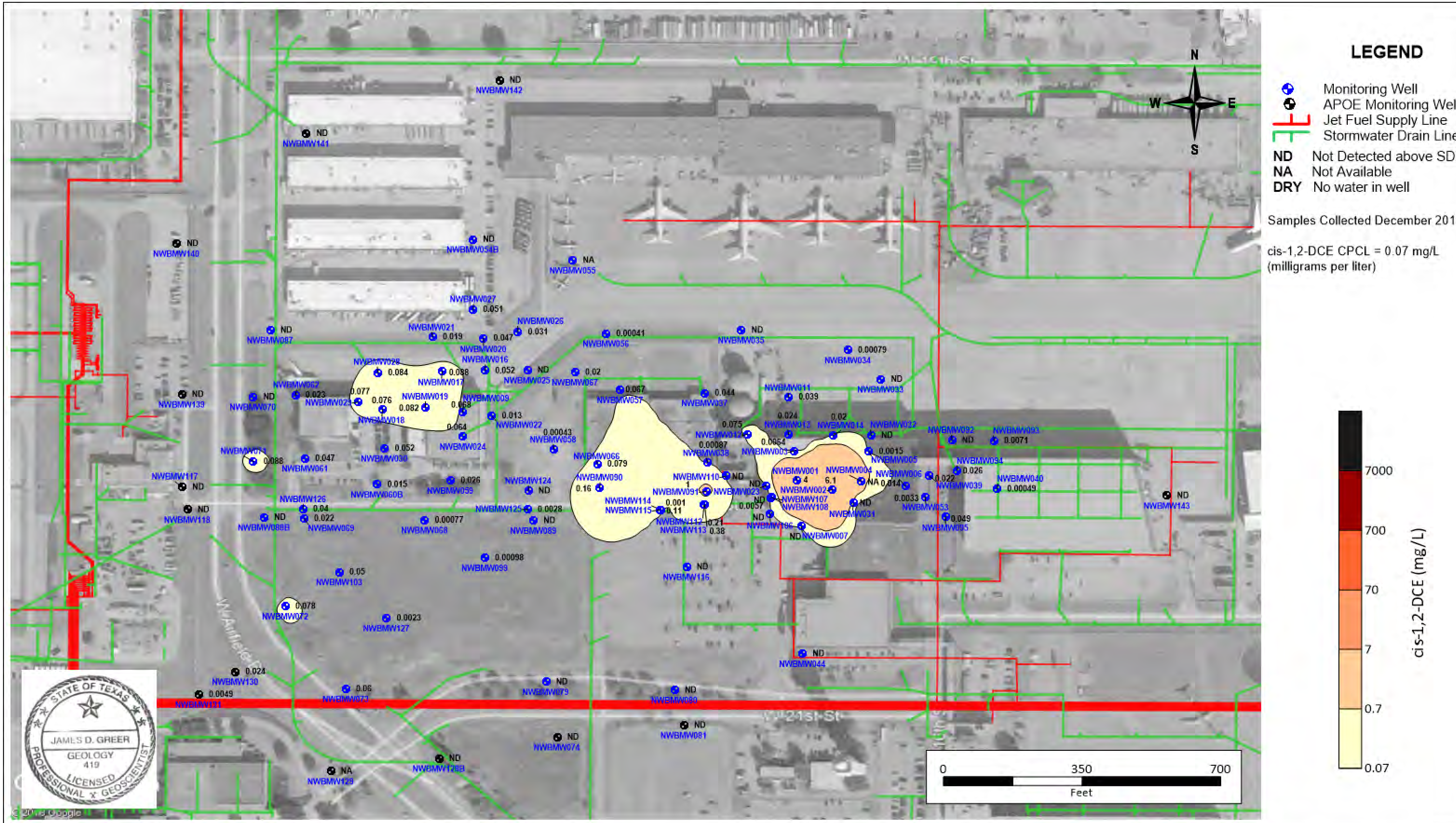
AOC B1
TCE Groundwater Concentration Map
December 2019

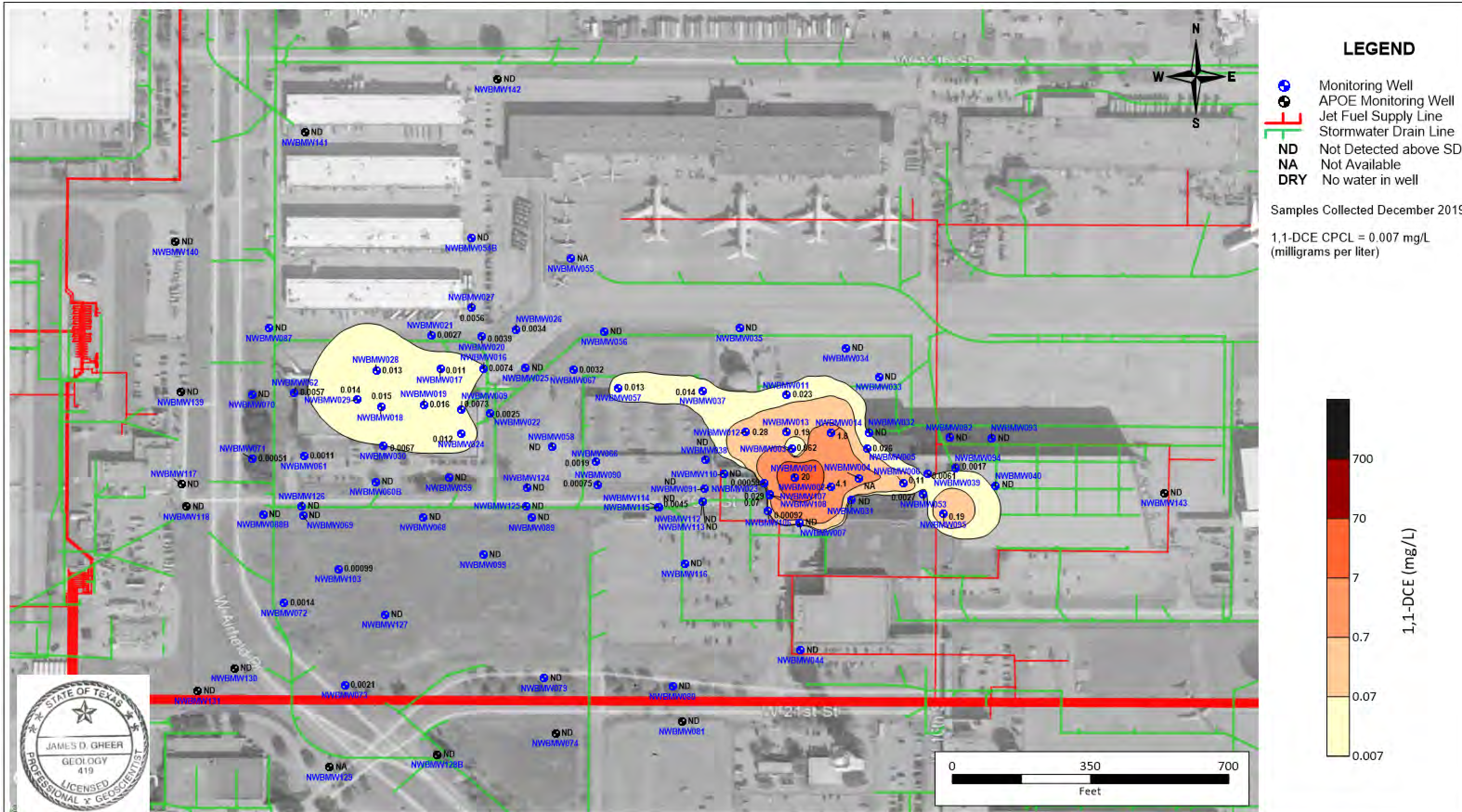
Attachment 1A3-6



DALLAS
FORT WORTH
INTERNATIONAL
AIRPORT

AOC B1
CIS-1,2-DCE Groundwater Concentration Map
December 2019

Attachment 1A4-6



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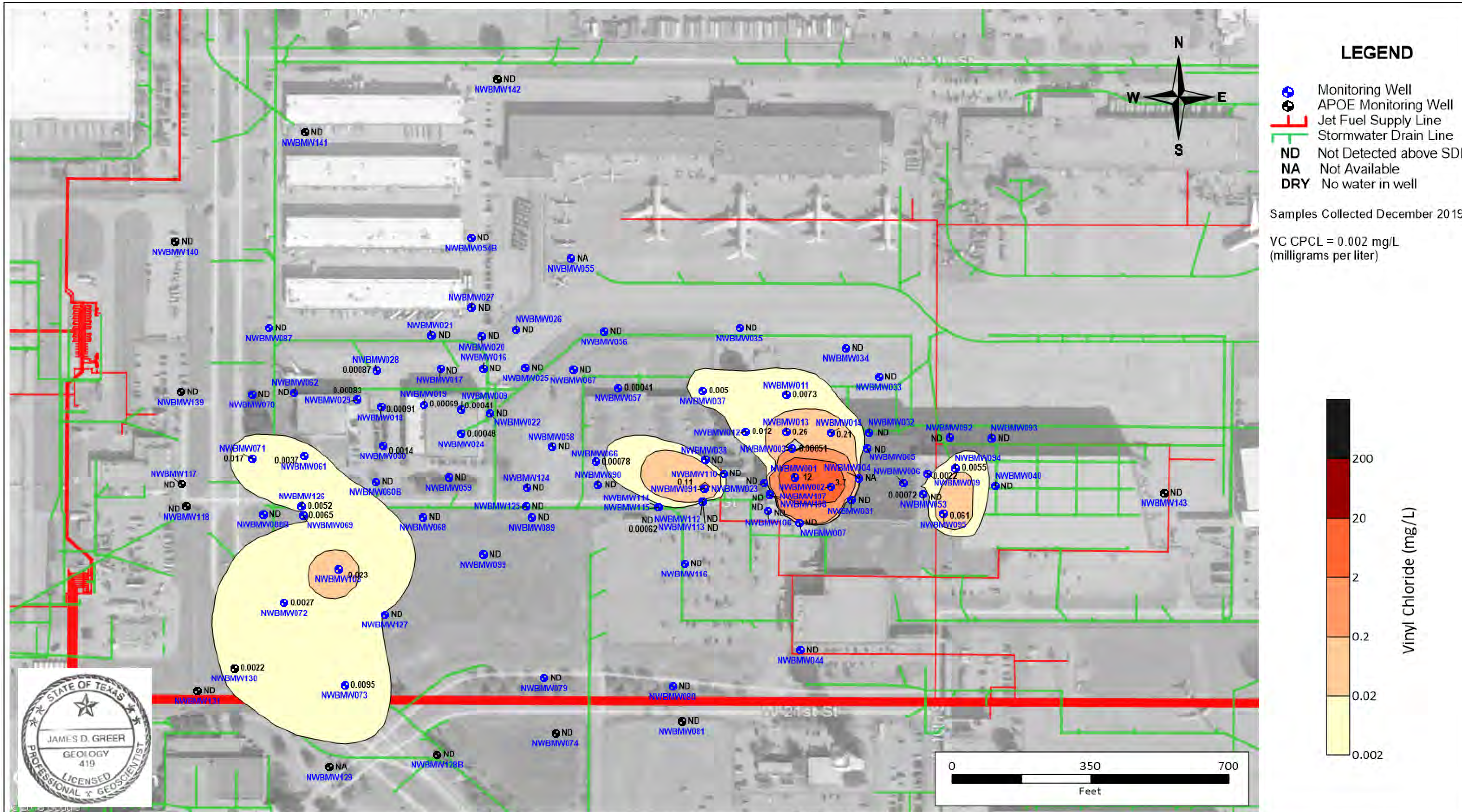
AOC B1
1,1-DCE Groundwater Concentration Map
December 2019

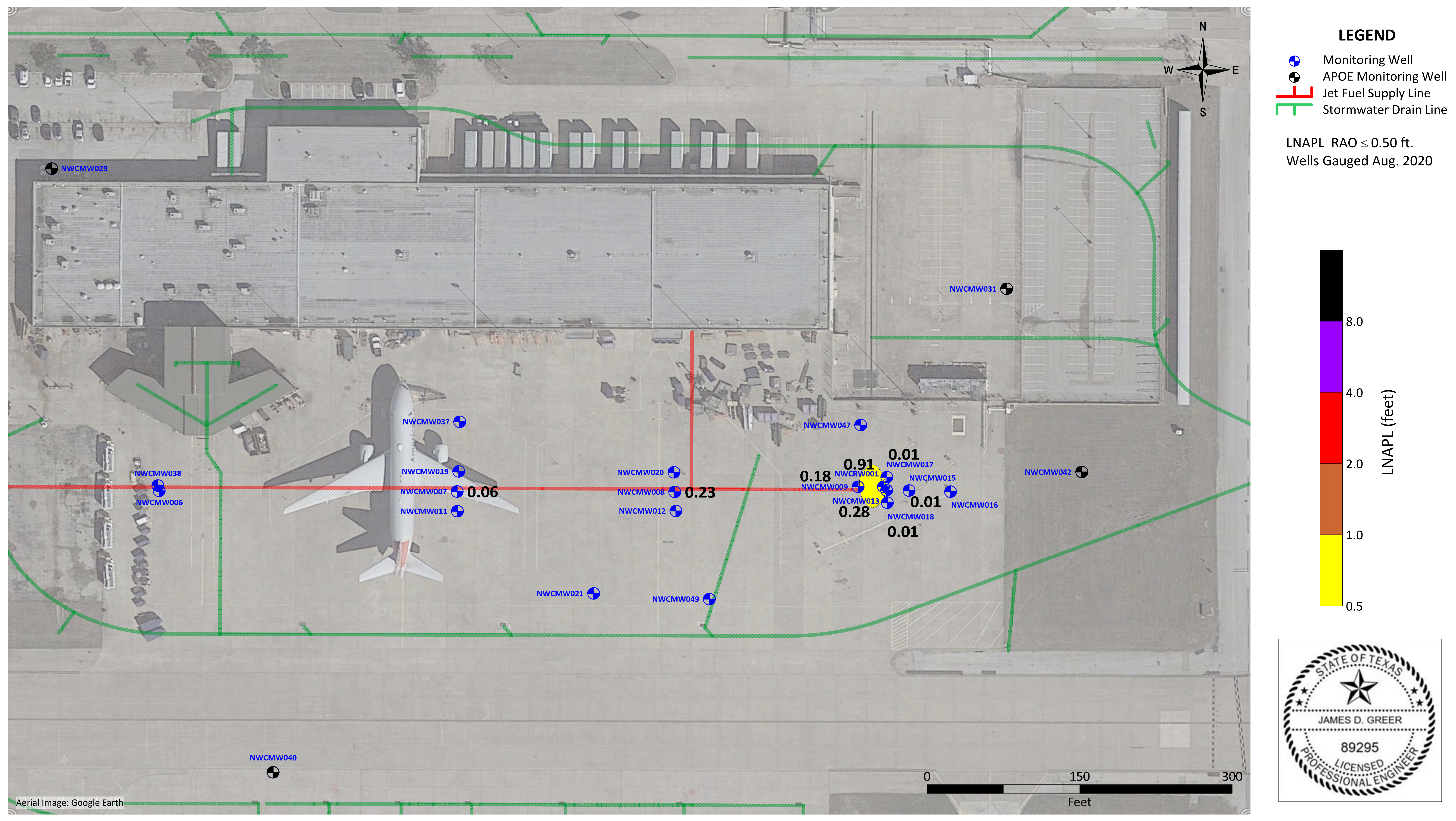
Attachment
1A5-6



DFW DALLAS FORT WORTH INTERNATIONAL AIRPORT

AOC B1
Vinyl Chloride Groundwater Concentration Map
December 2019

Attachment 1A6-6



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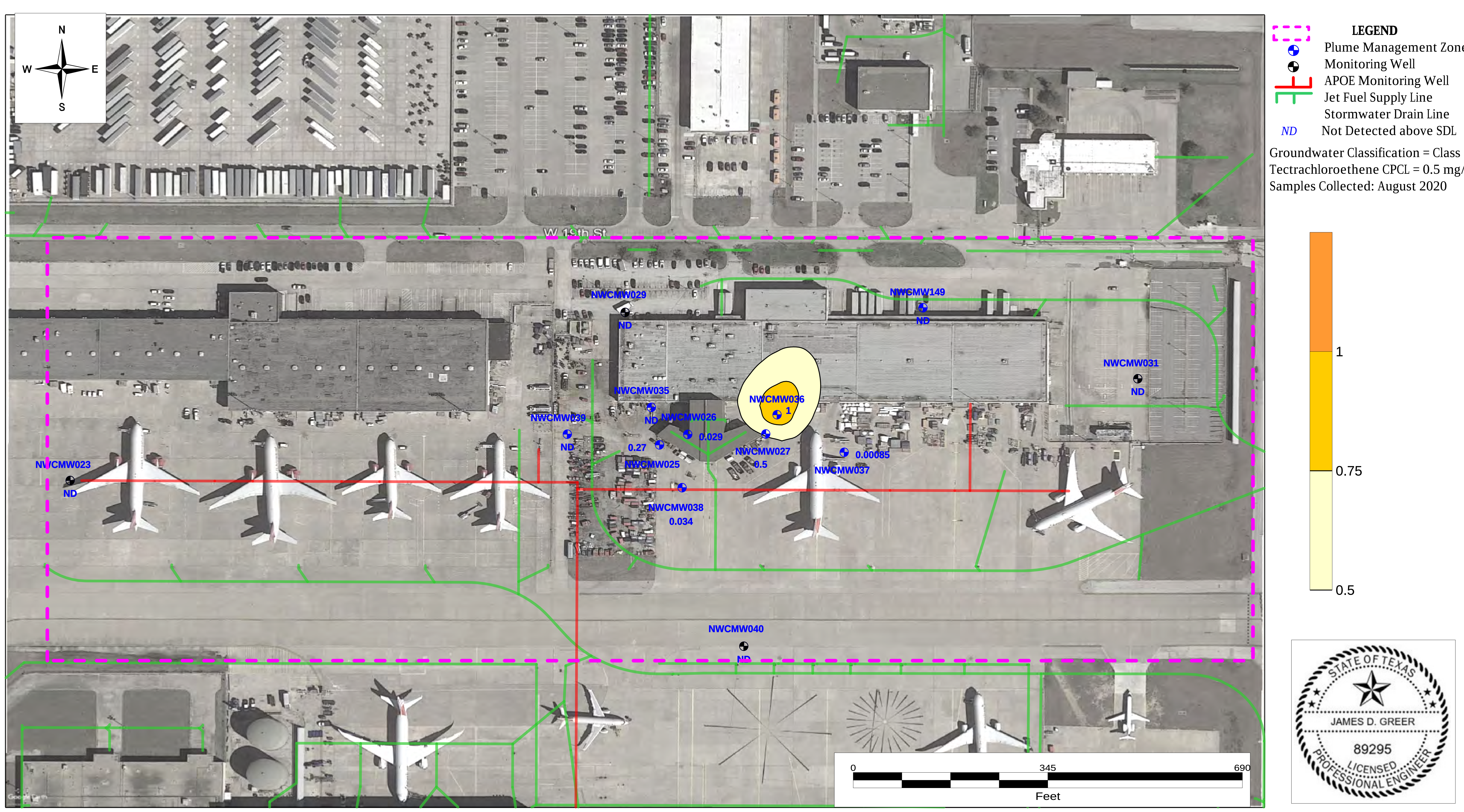
AOC C2 LNAPL Thickness 3rd Quarter 2020

Attachment 1A-15



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AOC C5 - PCE GROUNDWATER CONCENTRATION MAP September 2020

Attachment 3C

Appendix E: Abbreviations

AC	–	Advisory Circular
ADG	–	Airplane Design Group
AOA	–	Airport Operations Area
CTB	–	Cement Treated Base
DCC	–	Design, Code, and Construction
DCM	–	Design Criteria Manual
EA	–	Environmental Assessment
EAD	–	Environmental Affairs Department
EIS	–	Environmental Impact Statement
EMMS	–	East Materials Management Site
ETAM	–	Energy, Transportation, and Asset Management
FAA	–	Federal Aviation Administration
FONSI	–	Finding of No Significant Impact
GSE	–	Ground Service Equipment
HWD	–	Heavy weight deflectometer
IATA	–	International Air Transport Association
MOS	–	Modification of Standards
NW	–	Northwest
OFA	–	Object Free Area
PCC	–	Portland Cement Concrete
PCI	–	Pavement Condition Index
PDD	–	Project Definition Document
RCB	–	Reinforced Concrete Base
ROM	–	Rough Order of Magnitude
TxDOT	–	Texas Department of Transportation