PHOENIX DEER VALLEY AIRPORT

DVT TAXIWAY C CONNECTORS C4-C10 - GMP1

AV31000096 ADOT

FINAL ENGINEER'S DESIGN REPORT

JUNE 2024

► **Prepared for:**

PHX DVT GYR
City of Phoenix Aviation Department

PHOENIX DEER VALLEY AIRPORT
CITY OF PHOENIX AVIATION DEPARTMENT
3400 East Sky Harbor Boulevard, Suite 3300
Phoenix, Arizona 85034-4405

► **Prepared by:**

TRACE
CONSULTING

TRACE Consulting, LLC
1201 East Jefferson Street, Suite 3
Phoenix, Arizona 85034
Phone: (602) 680-8264
TC#190801

Registered Professional Engineer (Civil)
CERTIFICATE NO.
43820
CHINTAN S.
JHAVERI
Date Signed 06/14/24
ARIZONA, U.S.A.

LIST OF FIGURES

APPENDICES

1.0 GENERAL SCOPE OF PROJECT

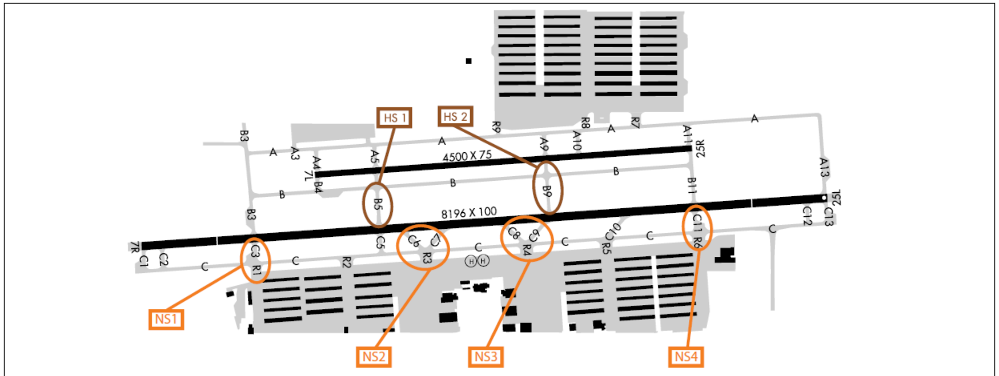
1.1 Project Narrative and Scope of Work

The purpose of this project is to increase airfield safety and improve airport operations through the demolition of nonstandard geometric connector Taxiways C6, C7, C8, and C9, the removal of Taxiways C5 and C10, and the placement of new connector Taxiways C4, C5, C6, C7, C8, C9, C10 at Phoenix Deer Valley Airport (DVT). The project will relocate the Taxiway C connectors to standard FAA geometric locations to remove direct apron access to Runway 7R-25L. To decrease the probability of runway incursions, taxiway connector relocation will address hot spot areas where pilots have historically crossed Runway 7R/25L without Air Traffic Control's (ATC) clearance. To improve airport operations, four acute angle taxiway connectors will be constructed to provide greater efficiency in runway usage by allowing aircraft to taxi off the runway at a higher speed than required for a 90-degree turn.

The relocation of the Taxiway C connector taxiways corrects nonstandard connector geometry issues as identified by the 2015 Master Plan Update for DVT (See Figure 1) by removing existing Taxiways C5, C6, C7, C8, C9 and C10 between Taxiway C to Runway 7R/25L and constructing new Taxiway C connectors.

Figure 1: DVT Hot Spots and Non-Standard Geometry per 2015 Master Plan Update for DVT

PHOENIX DEER VALLEY AIRPORT MASTER PLAN UPDATE



- Hot Spot 1 is located along Taxiway B5 between Taxiway B and Runway 7R-25L. Historically, some pilots have crossed Runway 7R-25L at B5 without ATC clearance.
- Hot Spot 2 is located along Taxiway B9 between Runways 7L-25R and Runway 7R-25L. Historically, some pilots have crossed Runway 7R-25L at B9 without ATC clearance.
- Non-standard Geometry 1 is located along Taxiway C3 between Runway 7R-25L and the non-movement area. Aircraft leaving the non-movement area can taxi directly beyond Taxiway C and onto Runway 7R-25L without an impediment. This intersection is critical because it is a primary access point to the north runway. The pavement width exceeds recommended FAA guidelines.
- Non-standard Geometry 2 is located at the intersection of Taxiways C6, C7, C, and the non-movement area. This five-node intersection point exceeds the FAA's recommendation for a maximum of four taxiway nodes. The pavement width exceeds recommended FAA guidelines.
- Non-standard Geometry 3 is located at the intersection of Taxiways C8, C9, C, and the non-movement area. This five-node intersection point exceeds the FAA's recommendation for a maximum of four taxiway nodes. The pavement width exceeds recommended FAA guidelines.
- Non-standard Geometry 4 is located along Taxiway C11 between Runway 7R-25L and the non-movement area. Aircraft leaving the non-movement area can taxi directly beyond Taxiway C and onto Runway 7R-25L without an impediment. This intersection is critical because it is a primary access point to the departure end of the north runway. The pavement width exceeds recommended FAA guidelines.

DVT Hot Spots and Non-standard geometry

Figure 3-3

DVT

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The City of Phoenix has contracted with TRACE Consulting, LLC (TRACE) to prepare construction documents for this project. The contract includes the following services:

- ✈ Investigation and inventory of available/visible utilities that affect the project
- ✈ Supplemental surveying services
- ✈ Geotechnical investigations
- ✈ Utility locating and subsurface utility exploration
- ✈ Preparation of Engineer's Design Report (EDR)
- ✈ Design development for the demolition and construction of Taxiways C4, C5, C6, C7, C8, C9 and C10 between Runway 7R-25L and Taxiway C.
- ✈ Removal of existing infield materials and construction of asphalt taxiway pavement with P-401 asphalt concrete
- ✈ Evaluation and reconstruction of infield drainage areas and construction / relocation of new storm drain as needed
- ✈ Evaluation, addition and replacement of electrical lighting and signage as needed
- ✈ Evaluation of airfield pavement marking for the new taxiway and connectors
- ✈ Development of detailed specifications
- ✈ Design documents for bid letting (ADOT funds requirements)
- ✈ Development of a Construction Management Plan (CMP)
- ✈ Development of a Construction Safety and Phasing Plan (CSPP)

1.2 Grant Eligible and Ineligible Work Items

All work items associated with this project are anticipated to be grant eligible at the time of this writing through ADOT grant funding.

The design scope of services for this project covers the removal and relocation of Taxiway C connectors C4 through C10. The project is anticipated to be delivered using the Construction Manager at Risk (CMAR) delivery method. Project deliverables will be divided into several design packages related to funding of the project after the 30% design submittal. Each GMP design package will correlate with a CMAR Guaranteed Maximum Price (GMP) from the CMAR.

1.3 Unique and Unusual Situations

There are no known unique or unusual situations about the project at the time of this writing.

1.4 History of Existing System

DVT was built in 1960 with a single runway, operating as a private airfield. There was no control tower and only minimal amenities. The City of Phoenix (City or COP) bought the 482-acre airport in 1971. A new terminal was constructed four years later when the FAA started directing the air traffic. The City Council adopted a master plan in 1986 that allowed for DVT to accommodate more and different types of aircraft. Operations grew and infrastructure was added throughout the years. In 2007, a new Air Traffic Control Tower (ATCT) was constructed.

Now, DVT is one of the busiest general aviation airports in the nation, with a complex movement area and a mix of traffic that includes business jets and turboprops, piston twins and single engine aircraft, sport aircraft and rotorcraft, as well as a significant level of student pilot activity from the airport’s two major flight training schools and by other smaller flight training entities.

The portion of existing Taxiway C pavement between Taxiway C3 and Taxiway C11 and the connector Taxiways C3, C5, C8, C9 and C11 were originally constructed in 1973. The portion of Taxiway C west of Taxiway C3 to Taxiway C1 along with the portion of Taxiway C east of Taxiway C11 to Taxiway C13 was constructed in 1986 in conjunction with the extension of Runway 7R-25L. The 1986 Runway 7R-25L extension included the construction of connector Taxiways C1, C2, C12 and C13. Taxiways C6 and C7 were constructed in 1999.

Typical AC pavement thickness placed during the original construction was 5 inches. Maintenance of the pavements to the present has included micro surfacing in 2008, seal coat in 2014, and a mill and overlay in 2015 on most of Taxiway C and the Taxiway C connectors.

1.5 GMP1

The overall project as described in sections above is broken into different GMPs based on available ADOT grant funding. For the initial GMP, the right-angle connectors C7 and C10 will be constructed. GMP1 will include the demolition of the existing Taxiway C10 and removal of airfield signage, lighting, and pavement markings associated with the existing Taxiway C7.

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2.0 AIP STANDARDS

2.1 AIP Advisory Circulars Applicable to this Project

This project will be susceptible to the guidelines set forth in FAA ACs. The core discipline ACs that will be applicable to this project are listed below:

150/5300-13B	Airport Design	Mar 31, 2022
150/5320-5G	Airport Drainage Design	Jun 7, 2021
150/5320-6F	Airport Pavement Design and Evaluation	Nov 10, 2016
150/5340-1M	Standards for Airport Markings	May 10, 2019
150/5340-18G	Standards for Airport Sign Systems	May 10, 2019
150/5340-30J	Design and Installation Details for Airport Visual Aids	Feb 12, 2018
150/5345-7F	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits	Aug 19, 2013
150/5345-26E	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories	Dec 16, 2021
150/5345-44K	Specification for Runway and Taxiway Signs	Oct 08, 2015
150/5345-46E	Specification for Runway and Taxiway Light Fixtures	Mar 02, 2016
150/5345-47C	Specification for Series to Series Isolation Transformers for Airport Lighting Systems	Jul 22, 2011
150/5345-53D	Airport Lighting Equipment Certification System	Sep 26, 2012
150/5360-12F	Airport Signing and Graphics	Sept 26, 2013
150/5370-2G	Operational Safety on Airports During Construction	Dec 13, 2017
150/5370-10H	Standards for Specifying Construction of Airports	Dec 21, 2018

Other FAA ACs not specifically identified above may be referenced throughout other ACs and be applicable to the project.

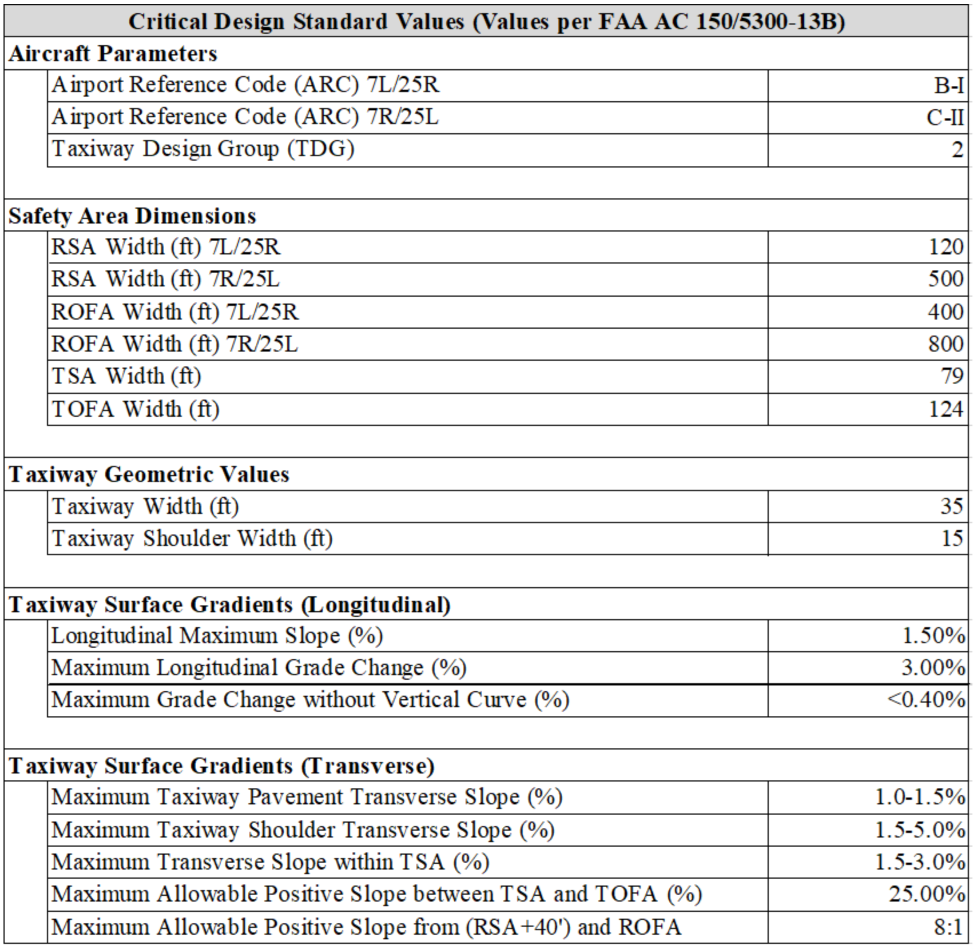
Other design standards and guidelines utilized for this project are the COP design standards (latest edition), COP Storm Water Policies and Standards (SWPS) (latest edition), and

Maricopa Association of Governments (MAG) Standard Details and Specifications (latest edition).

2.2 Critical Design Standard Values

Critical design standard values for this project are presented in Table 1:

Table 1: Critical Design Standard Values for This Project



Critical Design Standard Values (Values per FAA AC 150/5300-13B)	
Aircraft Parameters	
Airport Reference Code (ARC) 7L/25R	B-I
Airport Reference Code (ARC) 7R/25L	C-II
Taxiway Design Group (TDG)	2
Safety Area Dimensions	
RSA Width (ft) 7L/25R	120
RSA Width (ft) 7R/25L	500
ROFA Width (ft) 7L/25R	400
ROFA Width (ft) 7R/25L	800
TSA Width (ft)	79
TOFA Width (ft)	124
Taxiway Geometric Values	
Taxiway Width (ft)	35
Taxiway Shoulder Width (ft)	15
Taxiway Surface Gradients (Longitudinal)	
Longitudinal Maximum Slope (%)	1.50%
Maximum Longitudinal Grade Change (%)	3.00%
Maximum Grade Change without Vertical Curve (%)	<0.40%
Taxiway Surface Gradients (Transverse)	
Maximum Taxiway Pavement Transverse Slope (%)	1.0-1.5%
Maximum Taxiway Shoulder Transverse Slope (%)	1.5-5.0%
Maximum Transverse Slope within TSA (%)	1.5-3.0%
Maximum Allowable Positive Slope between TSA and TOFA (%)	25.00%
Maximum Allowable Positive Slope from (RSA+40') and ROFA	8:1

3.0 CONSIDERATIONS FOR AIRPORT OPERATIONAL SAFETY

3.1 CSPP Related Issues

A Construction Safety and Phasing Plan (CSPP) was developed for this project in conformance with FAA AC 150/5370-2G, *Operational Safety on Airports During Construction*. Phasing is discussed in detail in the Final CSPP document.

3.1.1 Proposed Phasing and Sequencing

Project phasing and sequencing was structured to accomplish two main objectives: eliminate taxiway identification sign modifications between phases and preserve cross-field taxi access throughout construction. The approach will attempt to minimize disruption to Airport Operations and minimize construction duration.

The phasing and sequencing for this project also considers the impacts of concurrent project Relocate Taxiway B and Construction Connectors B6 and B9, which have impacts on the cross-field taxi access.

3.1.2 Work Area Limits and Closures

Work area limits and closures will be discussed in detail in the CSPP. Closures for Runway 7R/25L are required to reconstruct the connectors on the north side of Taxiway C up to the runway edge. Portions of Taxiway C will be closed to accommodate the construction of the new taxiway connectors.

Work that is prohibited to occur within specific safety areas that are open to aircraft movements will be conducted at night during isolated closures when airport traffic is lower.

Work outside of restrictive safety areas may be conducted during the day or night depending on the construction schedule.

3.1.3 Haul Routes and Staging Area Location

The Haul Routes are identified on the Project Layout Plan sheet of the project plans. At the time of this writing it is assumed that there will be one Contractor staging and storage area on the airfield with its own haul route.

Construction access to the site will be provided at Gate 7 on the east side of the airfield along 7th Avenue north of Deer Valley Road. The haul routes will utilize the airport perimeter service road, where available. All existing pavements used for construction traffic are to be protected and restored to preconstruction conditions per the project specifications.

3.1.4 Impacts to Approach Procedures

Construction may impact approach procedures for runways 7R/25L at DVT. It is anticipated that there will be communication and coordination between DVT Airport Operations Staff and the Contractor to discuss work activities. DVT Airport Operations Staff will issue any appropriate Notice to Airmen (NOTAM) as necessary to communicate to pilots any impact to approach procedures.

3.1.5 Impacts to FAA Owned NAVAIDS

No portions of the NAVAID facilities at the Phoenix Deer Valley Airport are owned by the FAA.

4.0 PAVEMENT DESIGN

4.1 Geotechnical Report

The geotechnical field investigation was performed during the last week of March 2023. The final geotechnical report for this project was completed by Hoque and Associates, dated October 20, 2023 is included as Appendix A of this report.

4.1.1 Soil Investigation

Field investigation of the site soils is discussed within the geotechnical report provided in Appendix A of this report.

4.1.2 Soil Characteristics

Complete discussion of the soil characteristics is in the geotechnical report is included in Appendix A of this report.

4.2 Fleet Mix

The aircraft fleet mix was obtained by interpreting the Phoenix Deer Valley Airport Master Plan Update Aviation Activity Forecast dated August 2014.

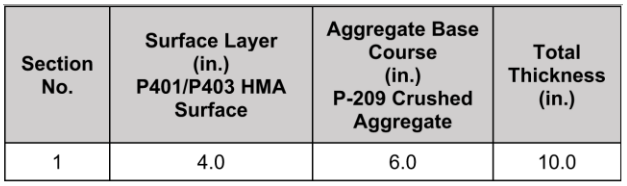
Table 2: Aircraft Fleet Mix

Aircraft Type	Maximum Takeoff Weight (MTOW) (lbs)	Annual Departures
BeechJet-400	15,500	72
Challenger-CL-604	38,650	790
Challenger-CL-604	41,400	731
Chancellor-414	6,000	415
Citation-525	11,800	22
Citation-525	11,800	15
Citation-525	10,500	126
Citation-525	8,650	91
Citation-550B	15,900	59
Citation-550B	12,500	17
Citation-550B	14,000	106
Citation-550B	14,800	96
Citation-V	16,500	118
Citation-V	13,870	141
Citation-VI/VII	23,200	9
Citation-X	35,700	195
D-30	36,000	18
EMB-175 STD	49,816	51
ERJ-135	36,000	71
Falcon-2000	35,000	34
Falcon-50	28,650	23
Falcon-50	38,800	14
Falcon-900	45,500	78
Gulfstream-G-IV	75,000	186
Gulfstream-G-V	90,900	20
Learjet-35A/65A	10,800	97
Learjet-35A/65A	11,800	12
Learjet-35A/65A	14,650	10
Learjet-35A/65A	21,000	49
Learjet-35A/65A	12,900	68
Learjet-55	21,500	34
S-10	10,759	10
S-10	8,600	125
S-10	10,000	18
S-12.5	12,500	50
S-12.5	12,500	54

4.3 Recommended Pavement Design

The geotechnical engineer has recommended the following pavement section for the project:

Table 3: Recommended Pavement Section



Section No.	Surface Layer (in.) P401/P403 HMA Surface	Aggregate Base Course (in.) P-209 Crushed Aggregate	Total Thickness (in.)
1	4.0	6.0	10.0

Further discussion of the recommended pavement section is found in geotechnical report in Appendix A.

4.4 Material Availability

On-site materials removed from excavation, grading, and/or trenches will generally be suitable for use as backfill, given that it meets compaction and moisture condition requirements as laid out in the project specifications.

If necessary, imported soils may also be utilized as fill, so long as it meets the project specifications.

4.5 Subgrade Stabilization

The site soils within the upper 3 feet, exhibit potentially high plasticity and have a low California Bearing Ratio. It is recommended that a minimum of 12” of subgrade be lime treated per the requirements of FAA Specification P-155.

4.6 Pavement Design

A description of the pavement design procedure is included within the geotechnical report in Appendix A.

4.6.1 FAARFIELD Results

FAARFIELD output is included in the geotechnical report in Appendix A.

5.0 DRAINAGE DESIGN

The final drainage report for this project was completed by HNTB, dated January 26, 2024. A copy of the drainage report is included as Appendix B of this report.

5.1 Existing Drainage Characteristics and Structures

Based on the available information, the existing drainage pattern shows that stormwater runoff within the Project limits flows towards the infield areas and is collected by a series of catch basins that drain the infields. There are two major storm drain systems present within the site, one located west of connector C7 running east to west, and the second system is located within the infield east of connector C7 and runs north-south.

The first system consists of an 18-inch RCP that begins at the infield located between connectors C6 and C7 and runs west, connecting to a SD manhole located approximately 39 feet past connector C5. From that SD manhole, 18-inch RCP outlets southwest across Taxiway C towards another manhole, which then outlets as a 24-inch RCP running west away from the project limits.

The second system is located within the infield east of connector C7 and is composed of a 54-inch RCP running south that transitions into a 72-inch RCP via a transition structure manhole located inside the infield. The 72-inch RCP continues south across Taxiway C away from the project limits. Additionally, there is a lateral 18-inch RCP that starts approximately 86 feet east of connector C10, runs west, and connects to the main system's transition structure manhole. This lateral line conveys all the stormwater runoff generated within taxiways C8 through C11, which is collected by a series of catch basins in the infields.

5.2 On-Site Hydrology

The peak discharges for the proposed inlets were calculated using the Rational Method as outlined in the Drainage Design Manual for Maricopa County (November 2009). The five-year (5-year) 24-hour storm was used as the design storm in accordance with AC 150/5320-5D. The minimum time of concentration was five (5) minutes, as required by AC 150/5320-5D. National Oceanic and Atmospheric Administration (NOAA) Atlas 14 was used to obtain rainfall intensity for Deer Valley Airport.

5.3 On-Site Hydraulics

The proposed drainage pattern will follow that of the existing conditions in which runoff generated within the taxiways will sheet flow onto the infield areas and drained by a series of proposed catch basins that will connect to the existing drainage systems either directly or via new storm drain RCP lines varying between 18-inch and 24-inch in diameter.

The proposed catch basins were designed for a 5-year storm event considering a maximum depth of no more than 4-inches. All the proposed catch basins were designed using FlowMaster by Bentley.

New storm drain pipes will be reinforced concrete pipe (RCP) Class V with a load capacity of 3000 lbs/ft. All pipes were designed for a 5-year storm event.

See hydrology calculations in the drainage report in Appendix B of this report.

6.0 AIRFIELD LIGHTING AND SIGNAGE

6.1 Existing System

The existing Taxiway C circuits, TWC East and TWC West were originally installed around 1976 and are providing low cable insulation resistance readings. The circuits ‘split’ at east side of existing Taxiway C7. Construction of new Taxiway C6 will affect circuit home runs of both TWC circuits east and west and existing duct bank that feeds TWA, RGL 7R, RGL 7L, primary wind cone and west end NAVAIDS to the north runway routing.

New Taxiway C8 / existing Taxiway C9 impacts the portion of existing duct bank that feeds Taxiway B east and west circuits as well as the east end NAVAIDS to north runway.

A new path to extend the new Airfield lighting home runs duct bank, installed during the TWD construction project, has been evaluated for extending north during the Taxiway B relocation project to provide enough conduit capacity to provide a bypass route to provide circuit separation, and maintain the operation of airfield lighting during construction phases to reconstruct Taxiway C connectors. Existing concrete handholes affected by new Taxiway C connectors will have to be removed and replaced with new structures, where conflicts with new pavement and connector geometry is required. Existing 4” conduit duct bank segments will be evaluated for reconstruction to preserve the existing duct bank routing with concrete encasement and new segments as required by pavement reconstruction.

The existing elevated L-861T incandescent taxiway edge lights, isolation transformers, L-867 bases and L-824 cable along parallel TWC will remain beyond the limits of where new taxiway connector construction prevents replacement. Existing incandescent edge lights, transformers, bases, conduit and cable will be removed at taxiway connectors affected by construction.

New LED Taxiway C hold position and Taxiway C signage was installed during TWD construction which included relocation of Taxiway C hold bars. The existing LED signage would be reinstalled and provided with new sign panels as phasing and placement requires. The existing 7R/25L runway exit signs were not replaced during TWD reconstruction and new LED signage will be specified to replace existing signs exceeding minimum useful service live of 10 years minimum, per Order 5100.38, Table 3-8.

LED Elevated runway guard lights (ERGLs) were added to the south runway RGL 7R circuit in 2018 construction of Taxiway D and relocation of the Taxiway C connector hold bars. The new LED fixtures will be reinstalled on new bases in new locations as required. The existing conduit and cable between the existing connectors were partially installed in 2010 and completed in 2018 to coincide with the Taxiway C hold positions relocations and will require modifications of the segment between C4 and C10.

7.2 Layout of Airfield Lights and Signage

Any new L-858(L) guidance signage required will be specified as Size 1 and placed in accordance with FAA AC 150/5340-18G Standards for Airport Sign Systems with a 3' asphalt maintenance pad around the new concrete sign bases where 3" rock is placed in infields. Phasing should consider that re-numbering new Taxiway C connectors would not be required unless the numbering system resulted in duplication of connector identification. New signage would be required for two new additional connectors that existing signage could not be reinstalled for.

New LED L-861T taxiway edge light fixtures will be installed for new Taxiway C connectors, in a manner to prevent mixing the LED and incandescent taxiway lighting systems in accordance with AC 150/5340-30J, 1.4.

The new LED systems will improve the guidance information to help pilots acquire and maintain the correct approach. The use of LEDs greatly increases light source life, reduces operating costs and significantly reduces ongoing maintenance costs and periodic re-lamping expenses. The LED light source improves safety and pilot recognition by eliminating color shifts typical of incandescent light sources at lower intensity settings.

6.2 Electrical Circuit Load Calculations

New Taxiway C connectors edge lighting and signage circuits will be evaluated, based on construction phasing to determine the incremental and overall load reductions associated with the new LED lighting and signage. The two existing Taxiway C East and West Constant Current Regulators are 15kW each, are ferroresonant type and have the capability to self-adjust to load reductions. The CCRs were installed during the 2017 ALCMS and Lighting Vault Modifications Project and are still within their useful service life. Based on 2019 Taxiway C loads, Taxiway C East is 9864 Volt-Amps and Taxiway C West is at 8142 Volt-Amps, both of which are below the 15kW CCR capacity to operate.

7.0 NAVAIDS

7.1 All NAVAIDs and Ownership

Deer Valley Airport owns and operates the NAVAIDS on airport property.

7.2 Impacts to FAA Owned Navigation Aids

There will be no impacts to FAA-owned NAVAIDs.

8.0 PAVEMENT MARKINGS

8.1 Layout of Markings

The layout of pavement markings is included in the construction plans for this project. At the time of this writing, anticipated pavement markings include the following:

- Runway Edge Markings
- Taxiway Centerline Markings
- Enhanced Taxiway Centerline Markings
- Continuous Taxiway Edge Markings
- Runway Holding Position Markings (Pattern A)
- Surface Painted Holding Position Sign Markings

8.2 Temporary Marking Application

Any temporary pavement markings will be applied at an application rate as defined in the project specifications.

The project specifications will address any application of glass beads for temporary pavement markings.

An appropriate waiting period will be defined for all paint types used for pavement marking. Once that period has expired, permanent pavement markings will be applied according to the project specifications.

9.0 ENVIRONMENTAL CONSIDERATIONS

9.1 Storm Water Management Measures

A Storm Water Pollution Prevention Plan will be implemented to mitigate construction debris from entering the storm drain network at DVT. A specification item will require that the Contractor comply with the Arizona Pollutant Discharge Elimination System (AZPDES) Permit Program.

9.2 Permits

The project specification and contract documents will include information for the Contractor to ensure that the necessary permits are acquired.

9.3 Soil and Paint Sampling

The City of Phoenix Environmental Department will need to collect representative samples of paint and soil within the proposed work areas to determine levels of contamination. The results of the environmental testing will assist in the Environmental Department's recommendation of mitigation methods and suitability of material export from the site.

10.0 UTILITY LINES IN WORK AREA

10.1 Existing Underground Utilities

Existing underground utilities consist of, but not limited to the following:

- ✈ Electric (Runway and Taxiway Circuits)
- ✈ Storm Drain

10.2 Potential Impacts of Existing Utilities

The project will construct new taxiway pavement. As a result, there may be impacts to existing underground utilities.

Overall, it is anticipated that portions of existing storm drain pipe will be removed when it interferes with the proposed drainage plan. Part of the project involves the removal of portions of storm drain and the construction of new storm drain to accommodate the modified infield drainage areas. New storm drain runs may tie into existing catch basin locations and may expose the existing storm drain pipe. Care shall be taken by the Contractor to preserve the existing storm drain pipe in accordance with the project specifications.

The only known electrical utilities in the project area are the airfield electrical lines and duct banks serving the lighting, signage, and various NAVAIDs. The exact layout of these lines is unknown, but they have been shown on the plans in the anticipated locations. The location of any electrical lines impacting the project shall be confirmed prior to underground work commencing.

Other underground utilities are not anticipated to be impacted.

10.3 Recommended Contacts of Utility Companies

Utility company representative contact information is included below:

Arizona Public Service (APS)	David McCasland	(602) 371-6451
FAA Facilities	Roger Gustafson	(602) 305-2532
Qwest	John O’Dell	(602) 530-0496
Gas (Southwest Gas)	Norma Jardin	(602) 484-5344
City Water/Sewer	Jami Erickson	(602) 261-8229
City Environmental	Rebecca Godley	(602) 273-3396
All Emergency, Fire, Police, Medical	Operator	911
City Electrical	David Thornton	(602) 273-7667
City Communications	Chad Blotkamp	(602) 708-0244
City Utilities	Chad Blotkamp	(602) 708-0244

10.4 Potholes on Potential Conflict Areas

Potholes on potential conflict areas may be necessary during the design phase of this project. Potential pothole locations, if necessary, will be identified on a map to request that the information be located.

11.0 MISCELLANEOUS WORK ITEMS

The following paragraphs identify anticipated miscellaneous work items associated with this project at the time of this writing.

A Storm Water Pollution Prevention Plan will be implemented to mitigate construction debris from entering the storm drain network at DVT. A specification item will require that the Contractor comply with the Arizona Pollutant Discharge Elimination System (AZPDES) Permit Program.

The Airport Operations Area (AOA) security fence will be maintained during construction. Details identifying the responsible party for safety maintenance will be addressed in the project specifications.

12.0 REQUESTED MODIFICATIONS TO AIP CONSTRUCTION STANDARDS

No modifications to AIP construction standards are anticipated at the time of this writing.

13.0 DELINEATION OF AIP NON-PARTICIPATING WORK

All work items associated with construction of Taxiway C connectors are anticipated to be AIP eligible at the time of this writing.

AIP Non-participating work will be quantified and tracked independent of the base quantities for the project. This will be represented in the construction plans and the opinion of probable cost.

14.0 DBE PARTICIPATION

At the time of this writing, the City does not establish DBE participation goals for AIP projects. No DBE participation goal has been established for this project.

15.0 PROJECT SCHEDULE

The following are anticipated milestone dates for this project. They are preliminary dates approximated by the anticipated design schedule. The dates presented below are subject to change.

1. Project Initiation (NTP for Design): October 18, 2022
2. Preliminary Investigation and Design: December 2022 through April 2023
3. Initial CMAR Selection: To Be Determined (based on grant timing)
4. Availability of final plans and specifications: To Be Determined (based on grant timing)
5. Award of GMP1 CMAR contract: To Be Determined (based on grant timing)
6. NTP: To Be Determined
7. Completion: To Be Determined
8. Closeout: To Be Determined

16.0 PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

An itemized summary of the GMP1 costs is being developed by the Construction Manager at Risk and is not published at the time of this writing.

17.0 PRE-DESIGN MEETING AGENDA

A pre-design meeting was held on October 24, 2022 The agenda from the pre-design meeting (design kick-off) is included as Appendix F.

Appendix A: Final Geotechnical Report

HOQUE & ASSOCIATES
Consulting Geotechnical, Materials and Environmental Engineers

Geotechnical Exploration Report and Pavement Recommendation

For

Deer Valley Airport Taxiway C Connectors at 1510 West Deer Valley Road

Phoenix, Arizona

COP# AV31000096

Prepared For:

Mr. Chintan S. Jhaveri, P.E.
Trace Consulting, LLC.
1201 East Jefferson Street, Suite 3
Phoenix, Arizona 85014

Prepared by:

Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040
Phone: (480) 921-1368

Project Number: 22070

October 20, 2023

HOQUE
& ASSOCIATES
Consulting Geotechnical, Materials and Environmental Engineers

October 20, 2023

Mr. Chintan S. Jhaveri, P.E.
Trace Consulting, LLC.
1201 East Jefferson Street, Suite 3
Phoenix, Arizona 85014

Subject: COP Project # AV31000096
Geotechnical Exploration Report for Deer Valley Airport Taxiway C
Connectors Located at 1510 West Deer Valley Road, Phoenix, Arizona

HA Project No. 22070

Dear Mr. Jhaveri:

Hoque & Associates, Inc. (HA) has completed a geotechnical exploration program for the proposed Taxiway C Connectors at Deer Valley Airport. HA was retained by Trace Consulting, LLC to perform a geotechnical exploration and engineering services to complete field borings, laboratory tests and recommend the taxiway C connectors pavement thickness. This report provides this information.

The subject site currently contains multiple connectors between Runway 7R/25L and taxiway C. The Deer Valley Airport has decided to demolish some of the taxiways including C5, C6, C7, C8, and C10 and modify C9. After demolition, new right angle taxiway connectors naming C4, C7 and C10 will be constructed. New acute angle connectors naming C5, C6, and C9 will be constructed while C9 will be renamed as C8. These reconstruction and upgrade taxiway C connectors between Taxiways C and Runway 7R25L, will enhance airplane mobility.

The scope of HA's services for this project included geotechnical exploration, laboratory testing, engineering analysis, and recommendations for the design parameters and construction of the proposed features. This report includes an introduction, scope of work, geotechnical field exploration, laboratory tests, data analysis, pavement recommendations, and recommendations for earthwork.

HA appreciates the opportunity to work on this project. If you have any questions, or if we can be of any further assistance, please contact us at (480) 921-1368.

Sincerely,
Hoque & Associates, Inc.

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ENAMUL
HOQUE
10-20-23

Dawson Gardiner, E.I.T.
Geotechnical Engineering Staff

Enamul Hoque, P.E.
President

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1.0 INTRODUCTION

1.1 General

Hoque & Associates, Inc. (HA) has completed a geotechnical exploration program and pavement design services for the reconstruction and upgrading of some of the taxiway C connectors. These connectors are at angles and acute angles. Some of them including C5, C6, C7, C8 and C10 will be demolished to have new connectors. The project also includes modifications of existing connector C9 and new design of right-angle connectors C4, C7 and C10. Design also called for new acute angle connectors C5, C6 and C9. The proposed taxiway connectors will come into the active area of the airport from the runway 7R/25L to south to connect to Taxiway C3 Taxiway alignment. These taxiway connectors will facilitate movement of planes between hangars, runways, and existing taxiways.

Figure 1: Project Site

1.2 Purpose and Scope of Work

The purpose of this geotechnical exploration was to characterize the site surface and subsurface conditions and provide geotechnical data for the design and construction of the proposed developments. To fulfill this purpose, HA has completed the following scope of work:

- Review of project background information provided by Trace Consulting, LLC (Trace);
- A site reconnaissance to document the site conditions that could influence the geotechnical field work, construction, and performance of the proposed taxiway;
- Drilling of six test borings at the site utilizing a truck mounted auger rig with eight-inch diameter continuous flight hollow stem augers. The borings were extended to 4.5 to 10 feet below the surrounding grade;

- Laboratory tests consisting of particle size analysis, Atterberg limits, Proctor compaction; and CBR testing;
- Completed discussions on test results and engineering analysis to develop recommendations for airport pavement section thickness, and provided recommendations for design parameters and earthwork construction for the proposed developments; and,
- Preparation of this geotechnical exploration report.

1.3 Project Background

Project information was gathered from Trace via telephone conversations and electronic transformation. HA was provided with a site plan depicting existing site features and proposed locations of soil borings. Based on the information provided by Trace, HA understands that Deer Valley Airport wishes to expand and modify the existing the airport runway infrastructure at this site to enable movement of airplanes. This will require the construction and modification of an existing taxiway C connectors suitable for proposed airport loads and subsequent adjustment and modification of site grading and drainage.

Trace provided to HA a fleet mix of aircrafts used by this airport to determine the loads imparted by the plans that utilize the airport. The fleet mix comes from a Speedie & Associates DVT-Run Up Aprons Report that was dated April 26, 2017. This fleet mix was utilized for the Taxiway C analysis per the direction of the City of Phoenix. Annual growth rates were taken from the City of Phoenix Aviation Department Report "Aviation Activity Forecast – Master Plan Update" report.

This fleet mix includes the plans that will use the taxiway and the number of annual departures for each airplane type. This mix includes a growth factor for projected increases in the number of annual operations for each of the plane types utilizing the airport over the next 20-year design life of the taxiway pavement. The fleet mix is provided in Table 1 below.

Table 1: Fleet Mix

Aircraft	Maximum Take-off Weight (lbs)	Yearly Operations	% Annual Growth
Cessna 172/180 (SEP)	2,450	29,490	2.5
Piper Archer (SEP)	2,550	29,490	2.5
Cessna 421 (MEP)	6,840	4,042	2.5
Beech King Air 200 (MEP)	12,500	4,042	2.5
Eclipse 500	5,950	126	2.5
Cessna 550 Citation Bravo	14,800	126	2.5
Learjet 45 Twin Jet	21,500	126	2.5
Cessna Citation 10 Twin Jet	36,600	126	2.5
Embraer 175	82,673	126	2.5
Learjet 34A Twin Jet	18,000	126	2.5
Gulfstream IV Twin Jet	73,200	126	2.5

The project site is located within the operational area of the Deer Valley Airport Runways and is secured by the operations department. Any access to the site requires special security clearance and coordination with numerous personnel. HA accessed the site overnight while the runway was closed. The corresponding table was input into the FAARFIELD program and can be seen in Appendix E.

2.0 GEOTECHNICAL EXPLORATION

2.1 Surface Conditions

HA visited the site during drilling operations to monitor the drilling and collect soil samples. HA coordinated with Trace, Arizona Blue Stake, and Deer Valley Airport to mark boring locations, locate existing utilities, or underground features, review the access for the drill rig and support vehicles during field explorations, and complete subsurface exploration. During site visits, HA observed and documented the site conditions. The site reconnaissance included observation of existing site features and structures which would influence the design and construction of the proposed taxiway at the site. Brief descriptions of the site conditions are presented below.

At the time of our site visit the runway site was developed. The site was developed with a fully paved runway (Runway 7R/25L), taxiway (Taxiway C), and taxiway C connectors on the southern portion of the site that run parallel to runway that runs along the southern boundary of the site. These connectors are on north side of taxiway C and taxiway C also is located north of taxiway D. The area between the runway 7R/25L and taxiway C is mostly undeveloped open areas with some rock mulch for dust and weed control. However, the area also has medium dense growth of vegetation.

The infill area that will house the proposed taxiway is graded and sloped away from existing runway and taxiway features as a storm water drainage control measure. As such, part of this area is below the runway and taxiway grade. The top of the infill area has received three to five inches of rock mulch. The gravel mulch consists of 3 inch minus crushed rock pieces, and they had been compacted to provide a firm, smooth, undulating, yet competent surface for the nose gears of potentially skidding aircrafts. This rock mulch is providing dust control, and the sizes are kept in uniform consistencies so that they do not create any flying debris during aircraft movements.

2.2 Field Soil Exploration

HA's field exploration included drilling of six soil test borings. The soil borings were completed to provide design information for the proposed pavement based on expected airplane loads.

A total of six (6) test borings were completed extending to depths of 4.5 to 10 feet. The locations of these test borings and detailed descriptions of the materials encountered at the boring locations are provided in Appendix C. The test borings were completed on March 30, 2023. HA completed soil test borings utilizing a Mobile CME-55 drill rig fitted with an 8-inch outside diameter continuous flight hollow-stem auger. The drilling operation was monitored and documented by experienced personnel from HA. HA collected representative bulk soil samples at the selected vertical spacing and classified the soils in the field utilizing the Unified Soil Classification System (USCS).

Split spoon samples were taken from borings B-1, B-3, and B-4. The bulk samples were collected from the full extent of the boring to collect sufficient sample to perform laboratory tests. Standard penetration testing, in conformance with ASTM D 1586, was performed in the field during drilling utilizing a two-inch diameter split spoon sampler driven 18 inches with a 140-pound hammer falling freely for 30 inches. The resistance or number of blows required to drive the last 12 inches of the split spoon sampler was recorded as N-values. For further information regarding soil classification and soil investigation methods, refer to Appendix B. A ring sample was collected from each boring at 2.5 feet below surface grade.

After the completion of the drilling, the boreholes were backfilled with site material. This material was compacted. All collected soil samples were secured and transported to HA's laboratory for testing. No ground water table was encountered.

2.3 Subsurface Conditions

Detailed information regarding the subsurface conditions encountered at each boring location is provided in the boring logs contained in Appendix C. A total of four test borings were completed extending to a maximum depth of 10 feet. Brief descriptions of subsurface conditions as depicted within the borings are described below.

The drilling at boring location B-1 consisted of brown, clayey SAND (SC) with clay and gravel. This material was moist near optimum. The boring was terminated at a depth of 10 feet. Bulk samples were taken every five vertical feet.

The drilling at boring location B-2 consisted of brown, moist gravelly SAND (SC) with clay. The boring was terminated at a depth of 4.5 feet due to auger refusal. As a result, the rig relocated 5 feet south of B-2 to attempt boring B-2a. This boring encountered brown, moist, clayey SAND with gravel and terminated at a depth of 5 feet due to auger refusal.

The drilling at boring location B-3 and B-4 consisted of light brown, gravel, and SAND with some clay. This material was damp. These borings were terminated at a depth of three feet after auger refusal. Bulk samples were not able to be sampled due to the excessive amount of rock and cobble sized particles as well as auger refusal.

The drilling at boring location B-5 consisted of brown, clayey SAND (SC) with gravel. This material was moist. The boring was terminated at a depth of 5 feet. Bulk samples were taken at five feet. The boring remained open without collapse for the full depth of the boring.

Boring B-6 encountered brown sandy GRAVEL (GC) with some clay. The boring was terminated at six feet depth on auger refusal.

Saturated conditions and/or a groundwater table were not encountered during the soil exploration.

Upon completion of drilling, all the boreholes were backfilled with site material. This material was compacted.

2.4 Laboratory and Field Tests

The laboratory testing program was designed to evaluate the physical properties of the subsurface soils. The results of the laboratory tests were utilized in the engineering analysis to estimate design parameters for the proposed taxiway construction. Laboratory test results were also utilized for earthwork construction recommendations.

The following laboratory tests were performed to characterize the subsurface soils encountered at the project site:

- Four Gradation (ASTM D 422);
- Four Atterberg Limits (ASTM D 4318);
- One Proctor Compaction (ASTM D 698); and,
- One California Bearing Ratio (CBR) (ASTM D1883) tests.

Gradation and Atterberg limits tests were conducted to classify the soil and estimate other physical properties by correlation such as strength, compressibility, and potential to change in volume due to exposure to environment especially excess water. Other tests were conducted to estimate soil resistance to traffic loading. All the tests were performed in accordance with ASTM, AASHTO, or other applicable standards. Detailed laboratory test results are contained in Appendix D with some of the select soil properties provided in the following table:

Table 2: Soil Classification

Boring Number	Depth (feet)	Fines Content (% Passing #200 Sieve)	Liquid Limit	Plasticity Index	Soil Classification (USCS)	Correlated R-Values
B-1	0-5	21.7	25	8	SC (w/gravel)	55
B-2	0-5	20.4	31	9	SC (w/gravel)	54
B-5	0-5	39.1	28	8	SC (w/gravel)	43
B-6	0-5	12.4	29	12	GC	53

Gradations, Atterberg limits, and CBR tests (performed by TERRACON) were performed on bulk samples collected from the borings to evaluate the different types of soils encountered at the site. The results of the laboratory tests indicated that the soils collected during the geotechnical exploration are mostly SAND and GRAVEL with clay and medium plasticity within the upper 0 to 10 feet. For these soils, fines contents are found to vary from 12 to 40 and plasticity indices vary from 8 to 12. While high value of plasticity index at boring B-6 indicates the presence of problematic soils at the site, amount of gravel will counteract the adverse impact.

The standard Proctor compaction and CBR tests were completed on samples from both borings completed at the site. The standard Proctor test indicated a maximum dry density of 137.7 pounds per cubic foot (pcf) and an optimum moisture content of 6.2 percent.

Resistance R-value test was not performed, but correlated R-values from the Arizona Department of Transportation Pavement Design Manual was reviewed and R-values are provided in the table above. R-values varied from 43 to 55 with an average value of 51.

CBR tests exhibited value of 21.6.

Resistivity and pH testing was completed in the laboratory. These values are 1,924 Ohm-cm and 8.4 respectively. Field sampling of the material showed the soil collected to be highly hydrochloric acid reactive in all locations, denoting corrosion potential.

3.0 PAVEMENT ANALYSIS

HA performed analysis for the proposed pavements at the site based on new traffic loads (airplane type, weight, number). HA utilized the FAA program FAARFIELD for flexible pavement designs.

3.1 Pavement Design and Construction

The design of airport pavement sections involves the consideration of the following items:

- Pavement performance under the loads imposed by aircrafts;
- Year-round all-weather support to operations of aircraft and other vehicular traffic by providing smooth, firm, stable surface free of dust or foreign particles that could be picked up by propeller wash or jet blast;
- Firm and unyielding subgrade soil that would provide support to the imposed loads under adverse weather condition and would not impose differential movement of soils under changing environment or under deleterious conditions;
- Materials of construction including Portland cement concrete pavement, asphalt concrete pavements, and any other courses that may be included. Generally economy, life cycle cost analysis, availability of materials and ease of construction are guiding factors to choose the pavement type;
- Drainage and Environmental consideration that could affect the performance of subgrade soils, unbound granular materials by reducing their strength or by pumping of concrete pavement with subsequent faulting, cracking, and general deterioration of pavements; and pumping of fines from subgrade to the granular base course resulting in loss of support; and
- Life cycle cost analysis including construction cost, maintenance costs, and rehabilitation costs.

The design of the taxiway pavement started with data collection. The data collection included aircraft volume and mix, design aircraft determination, and determination of equivalent design aircrafts. Based upon the Speedie and Associates report and telephone conversations with Trace, HA utilized a fleet mix with the number of annual departures for each airplane type and included projected increases in the number of annual operations for each of the plane types utilizing the airport over the next 20-year design life of the taxiway pavement. Information for FAARFIELD was compiled utilizing these sources. As FAARFIELD does not have a designation for all airplanes, generic terms of equivalent planes were utilized with specific airplanes from the fleet mix listed in parenthesis.

According to these sources, the aircraft with the heaviest takeoff weight is classified as a Regional Jet-700 (Embraer 175) with an 82,673-pound gross weight and 126 annual departures. The highest volume of takeoffs is completed by Single Wheel Aircraft (Cessna 172/180) and Skyhawk-172 (Piper Archer) aircraft with gross weights at 2,450 and 2,550 pounds. The annual departures for such planes were both 29,490. The full fleet mix is provided in Table 1.

Three CBR tests were performed on samples collected from a depth of zero to five feet from three borings. HA also estimated an R-value based on correlation of R-values with soil plasticity index and percent fines as per ADOT. The correlated R-values were determined to be 32. A design R-value of 25 was conservatively utilized to determine modulus of resilience (M_r) for flexible pavement. The flexible pavement design utilizes a value of M_r for thickness of the pavement sections.

The modulus of resilience was determined utilizing the R-values from the Arizona Department of Transportation Material Preliminary Engineering and Design Manual (Table 202.02 - 3).

$$M_r = 1{,}000 + 555*\text{R-value}$$

Resilient modulus determined was 28,440 psi.

A value of California Bearing Ratio (CBR) 12.51 was determined utilizing the following equation:

$$M_r = 1{,}500*\text{CBR}$$

A resilient modulus value was determined to be 32,400.

Laboratory testing resulted in a CBR of 21.6. A conservative value of 21.0 was utilized for further design analysis.

The asphalt concrete pavement design in the taxiway utilized the FAA program design guidelines for flexible pavements. Airport Pavement design method provided in Federal Aviation Administration’s Advisory Circular “Airport Pavement Design and Evaluation” (AC No. 150/5320-6D) was utilized for pavement design thickness. Design calculations including construction recommendations are provided below.

Based on available data and on the analysis, the following pavement section has been determined for the flexible pavement layer system.

Table 3: Flexible Pavement Section

Section No.	Surface Layer (in.) P401/P403 HMA Surface	Aggregate Base Course (in.) P-209 Crushed Aggregate	Total Thickness (in.)
1	4.0	6.0	10.0

Again, the pavement layer system should be chosen based on factors discussed earlier.

The above analyses assumes that at least twelve (12) inches of the native subgrade soils should be recompacted at or above 95 percent of its maximum dry density in relation to its modified Proctor compaction test (ASTM D 1557) placed within 3 percent of the optimum moisture content. Soils should be tested for plasticity index and CBR during construction. Plasticity index more than 15 or CBR less than 12 within the upper 12 inches of soil should be remedied by mixing (or replacing) the native soil with low plasticity native materials or imports.

Soils can be stabilized/modified during construction with chemicals such as lime to reduce or eliminate possible pumping. Lime treated soils may have to be cured for one to two weeks to achieve proper firmness before placement of ABC.

The P-209 base layer should achieve **100 percent of its maximum dry density in relation to its modified Proctor compaction (ASTM D 1557) test.** In addition, the surface of the pavement base consisting of P-209 material and prepared native subgrade surfaces should have a minimum of one percent positive slope to route any run-off water or infiltrated water away from the subgrade.

Aggregate base course and asphalt concrete should meet the requirements of FAA specifications or the specifications of the applicable local authority.

HA recommends that the following conditions be implemented to enhance the performance of the pavements by minimizing the infiltration of water into the pavement base:

- Provide a minimum of one percent, preferably two percent, surface grade.
- Provide drainage for any water trapped in the aggregate base course.

Shoulders shall be composed of a minimum of 8 inches of soil cement material or 12 inches of lime stabilized material. This subgrade soil beneath the stabilized soil shall have a minimum thickness of twelve (12) inches. This subgrade should be recompacted at or slightly above 90 percent of its maximum dry density in relation to its modified Proctor compaction test (ASTM D 1557) placed 3 percent points above its optimum moisture content.

The taxiway should have sufficient grade to divert runoff water out of the pavement structure. The subgrade of the taxiway should also be graded to route any infiltrating water away from the taxiway pavement.

HA recommends that the following conditions be implemented to enhance the performance of the shoulder by minimizing the infiltration of water into the pavement base:

- Provide a minimum of 1.5 percent to a maximum of 5 percent surface grade.
- Provide drainage for any trapped water.

Shoulder widths and lengths shall meet the requirements of FAA specifications.

At the time of construction, mix designs shall be performed to establish the required minimum lime content to stabilize the soil should lime stabilization be utilized at taxiway shoulders.

3.2 Surface and Subsurface Drainage

Moisture that infiltrates into pavement subgrade could adversely affect these features. Therefore, HA recommends that positive drainage be provided in the final design. The maintenance of storm water and subsurface drainage systems should be done during the entire life of the structures. Surface and subsurface drainage of water into the subsoil should be prevented. The design should divert water away from where it could infiltrate into the subsoil. All retention basins should be located away from pavement or other structures.

4.0 EARTHWORK CONSTRUCTION AND ENGINEERED FILL

The site of the proposed taxiway includes required grading for the maneuver of the larger size airplanes. During the grading of the site, it is possible that some localized spots on the subgrades could be disturbed. Also, the existing site may have disturbed areas due to past work related to control of storm drainage and utilities construction. After achieving the proposed grade, all disturbed subgrade areas should be proof rolled to delineate any soft or uncompacted areas. In addition, any disturbed or loose areas at the proposed grade should be backfilled and compacted. Thus, all excavations/pits created during excavation and grading should be backfilled with compacted fill as recommended herein.

4.1 On-Site Materials and Import Materials

On-site materials removed from excavation, grading, trenches, and/or foundations will be suitable for use as backfill provided they meet the compaction and moisture condition requirements. On-site materials to be used as fill shall be clean and free of deleterious matters. Soils from the excavation or grading should be suitable as fill soil provided they are free of particles of size larger than six inches in any dimension.

If necessary, import soils may also be utilized as fill. The swell potential of the compacted import soil should be less than 1.5 percent when tested under a vertical pressure of 100 psf in accordance with ASTM D4546 procedures.

On-site gravel mulch materials could be separated and reused as gravel mulch on the sides of the proposed taxiway. Excess gravel mulch may be utilized in other areas for use or removed from the site. Alternately, these excess gravel mulch may be mixed with fill materials and recompacted to the requirements of the specifications. Nesting of the gravel mulch in fill areas should not be allowed.

4.2 Fill Placement

HA recommends that on site soils beneath the pavements be scarified and moisture conditioned to a minimum depth of 8 inches and be compacted to a minimum of 95 percent of its maximum dry density in relation to its standard Proctor compaction test placed at or within three percent above optimum moisture content. Due to the presence of large cobbles within the upper depths of the site, disking of the site may be necessary as part of soil conditioning.

The fill surface should be adequately maintained during construction in order to achieve an acceptable compaction and interlift bonding. The surface should be sloped properly to prevent ponding and provide drainage of runoff water. If precipitation is anticipated, HA recommends that the fill surface be made smooth by rolling with a smooth drum roller.

4.3 Lime Modification/Stabilization

The pavement construction within the taxiway area may encounter localized soft clay soil with possible pumping phenomenon which can be resolved utilizing lime. Lime can modify almost all fine-grained soils, but the most dramatic improvement occurs in clay soils of moderate to high plasticity (plasticity index of 12 and higher) provided the lime treated material is allowed the proper curing length as noted in previous sections. Lime is an excellent choice for short-term modification of soil producing the following benefits:

- Plasticity reduction
- Reduction in moisture-holding capacity (drying)
- Swell reduction
- Improved stability
- The ability to construct a solid working platform.

4.4 Trenching, Pipe Bedding, and Backfilling

HA recommends that pipe trenches be excavated to the required depth. Trench excavation should be of sufficient width to provide working space at both sides of the trench and around the installed pipes as required for joining, backfilling, and compacting. Before backfilling, the trench bottom should be inspected for loose materials and for competent subgrade conditions by the geotechnical engineer or his/her representative. In areas where soft, unstable materials are encountered upon which cohesionless bedding materials are to be placed, remove unstable materials, and replace them with compacted materials approved by the geotechnical engineer. The removal should extend to suitable materials.

Based on the mechanics of load transfer in the circular or elliptical pipe, it is important to note that good lateral distribution of the upward reaction be considered. This is most readily achieved by pre-shaping bedding material by means of a template (or by other means) to fit the contour of the conduit. In general, the width of the pre-shaped cut may range from 0.5 to 0.6 times the diameter of the conduit with a height of 6 to 12 inches. The spaces adjacent to and under the conduit should be filled with granular materials and thoroughly tamped on each side in six-inch lifts for the full length of the pipes.

The practice of backfilling around conduits influences the development of active lateral earth pressure on the sides of pipes and hence influences the supporting reaction. HA recommends that backfill should continue on both sides of the pipes simultaneously.

Backfill materials surrounding the pipes should be placed and compacted in such a way that the elevations on two sides are even to ensure that the pipes are not displaced. The backfill within the spring line of the pipe especially below the sidewalls of the pipes may be placed and compacted by hand. Backfill over the pipe extending to 12 inches above the pipes should be placed and compacted carefully utilizing hand devices such as power tampers so that the pipes are not stressed. All pipeline backfills should be placed horizontally and compacted to its 95 percent relative compaction of ASTM D 698 with percent of density compensated for rock content larger than No. 4 Sieve size. At least one density test should be performed per 650 lineal feet of trench backfill per lift or layer of backfill.

4.5 Corrosion

Various metals and other materials corrode when placed on or in contact with soils. Some materials corrode more rapidly when in contact with certain types of soils than when in contact with others. Corrosion is a physical-biochemical process that converts metals into ions. For corrosion to take place, soil moisture is needed to form solutions of soluble salts. In addition, other factors such as pH, oxygen concentration (aeration), anaerobic conditions, site drainage, stray current created by different materials such as lenticularness of natural soils or housing pipes in natural medium, and activities of organisms capable of causing oxidation-reduction reaction also affect corrosion potential. Corrosion evaluation is commonly based on resistance of soil to the flow of electrical current (minimum resistivity), total acidity, soil drainage, soil texture, and some other properties of soils such as sulfate content, redox potential, chloride content.

No sulfates or soluble salts testing was completed as this soil is mostly granular with low plasticity fines. HA trusts that the corrosion will be at a minimum.

4.6 Inspections and Quality Control Testing

A geotechnical engineer should verify the nature and integrity of the subsurface soils and should inspect all subgrade excavations.

If the subgrade is disturbed or saturated, the disturbed or saturated materials should be recompacted or removed and replaced with suitable fill materials.

HA recommends that site preparation, subgrade preparation, backfill placement, re-compaction, and pavement subgrade are observed and/or tested by a qualified and experienced representative of a geotechnical engineer. This representative should at least observe and document the following:

- All deleterious objects are removed from the pavement areas;
- Subgrades are compacted, firm, and do not contain deleterious objects;

- All compaction and moisture contents of backfill soils meet the specified minimum values;
- Performance of on-site density testing in engineered fill or ABC at a required frequency;
- Preparation of a final report documenting all on-site activities, test results, and conclusions.

The prepared fill, subgrade, and/or trenches should not be exposed to the environment as this can affect the moisture content and density of the fill.

5.0 CONSTRUCTION CONSIDERATIONS

Based on the type of materials encountered at the site and the site geology, excavation for the construction of the proposed acute angle taxiway will be completed utilizing conventional construction equipment.

HA recommends that all excavation slopes in undisturbed soil should be maintained at 1.5:1 (horizontal to vertical) or flatter for the sandy clay soils. Slopes may have to be flattened to 2:1 or flatter in disturbed soil. If an excavation remains open for long time, to avoid raveling and spall off or localized caving, HA recommends that all cut slopes be stabilized with an application of shotcrete, gunite, or other polymer-based spray. If excavations are required to be steeper than the recommended slope, HA recommends that a shoring system be designed and installed at the site. Earth pressure parameters for a shoring design will be provided if requested. The shoring system may also have to be designed for vehicular traffic and highway loadings located within the vicinity of work.

6.0 LIMITATIONS

Due to the inherent natural variations of the soil stratification and the nature of geotechnical exploration, there is always a possibility that soil conditions between two borings may be different from those encountered at the boring locations. Therefore, HA should observe and document the construction to verify that the site conditions are as we anticipated during the preparation of this report, and to modify our recommendations to include the changed conditions, if encountered.

The practice of geotechnical engineering is such that the risks involved in building an efficient, functional and economical structure cannot be assessed with confidence until construction begins. Therefore, we recommend that our input is sought during design and a competent engineer makes engineering observations during the construction.

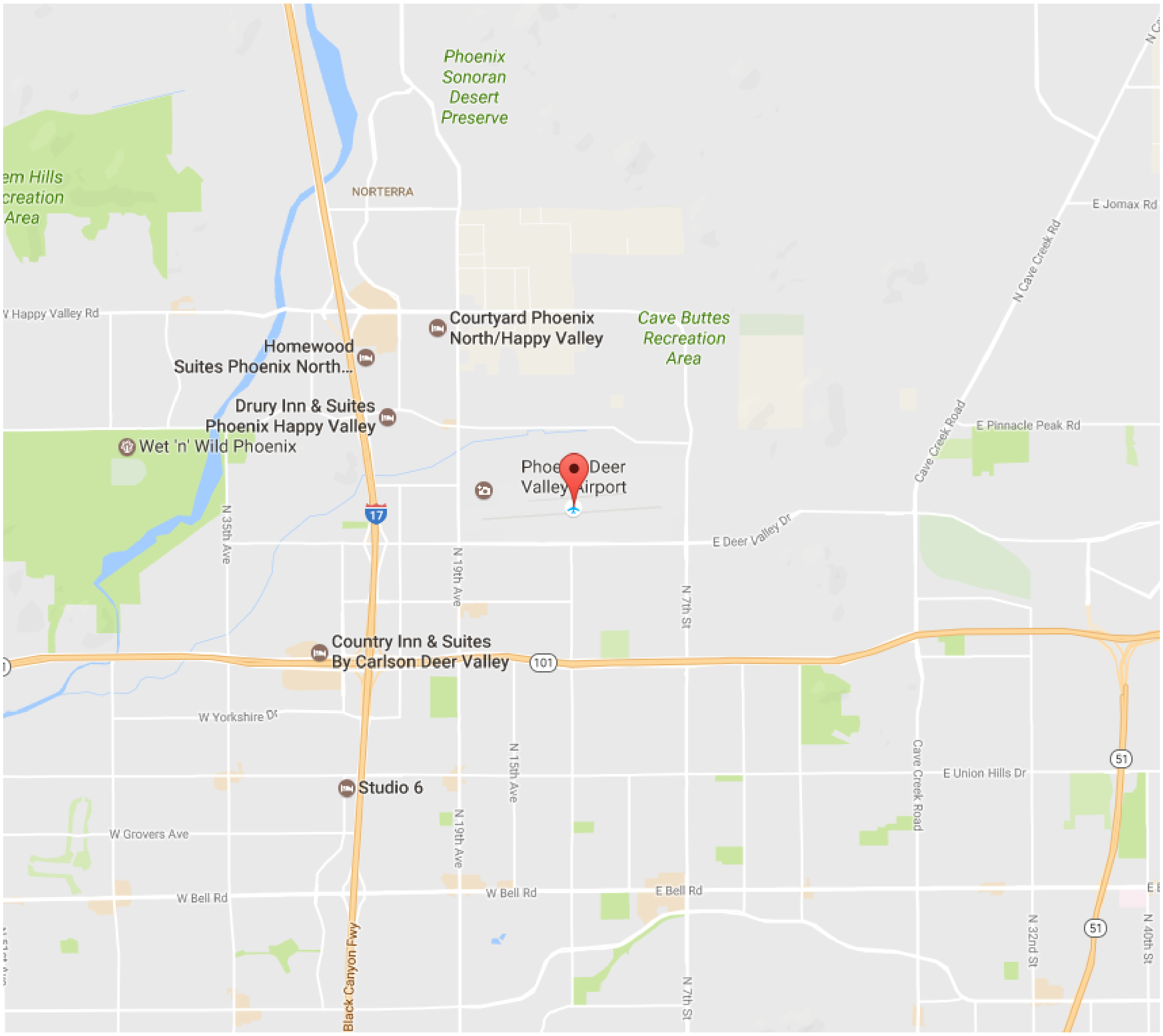
This report is not intended for use as a bid document. We provided some comments and discussed some construction techniques or procedures for the designer's guideline. HA's intentions are not to develop specifications. Therefore, this report should not be interpreted to dictate construction procedures or to relieve the contractor of his responsibility for construction.

Any pavements built on soil as a subgrade are subject to risks that cannot be entirely calculated or eliminated. Detrimental hazards such as settlement, concentrated drainage, fatigue, hydro-compaction, and expansive or collapsible soil movements due to unidentified geologic conditions are not uncommon. The geotechnical exploration performed with limited boreholes, limited laboratory tests, and extending to limited depths may not delineate these hazards. The geotechnical borings and laboratory tests only can identify the risks delineated at those points. However, risks from these hazards can be reduced by employing appropriate design professionals, qualified contractors, and proper maintenance.

HA would also like to disclose that our recommendations are valid for this proposed development at the issuance date of this report. Changes in the site by human activities, changes in codes due to legislative action, or broadening of knowledge may affect the conclusions and recommendations. Accordingly, these findings may be invalidated.

Appendices

Appendix A: Site Location Map



Not to Scale

SITE LOCATION MAP
Deer Valley Airport
Taxiway B3 Relocation
1510 West Deer Valley Road
Phoenix, Arizona
HA Project # 16105

Hoque & Associates, Inc.
Geotechnical, Materials, and Environmental Engineers
4325 South 34th Street
Phoenix, Arizona 85040
Tel: (480) 921-1368 Fax: (480) 921-0194
www.hoqueandassociates.com

Appendix B: Soil Classification and Soil Investigation Methods

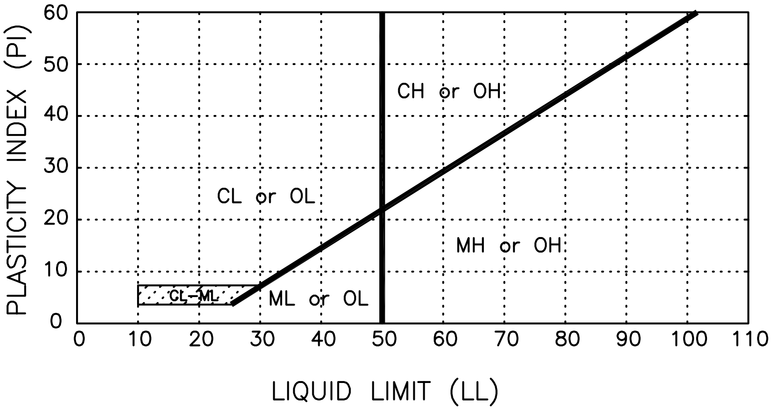
UNIFIED SOIL CLASSIFICATION SYSTEM

Soils are visually classified by the United Soil Classification System (USCS) on the boring logs presented in this report. Grain size analysis and Atterberg limits tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" Corps of Engineers, US Army Technical Memorandum No. 3-357 (Revised April 1960) or ASTM Designation: D2487-66T.

MAJOR DIVISIONS				GROUP SYMBOL	TYPICAL NAMES
COARSE - GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)		GW	Well graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
				GP	Poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below the "A" line & hatched zone on plasticity chart	GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above the "A" line & hatched zone on plasticity chart	GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)		SW	Well graded sands, gravelly sands.
				SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below the "A" line & hatched zone on plasticity chart	SM	Silty sands, sand-silt mixtures.
			Limits plot above the "A" line & hatched zone on plasticity chart	SC	Clayey sands, sand-clay mixtures.
FINE - GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (Limits Plot Below "A" Line & hatched Zone on Plasticity Chart)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)		ML	Inorganic silts, non-plastic or slightly plastic.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts.
	CLAYS (Limits Plot Above "A" Line & hatched Zone on Plasticity Chart)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)		CH	Inorganic clays of high plasticity, fat clays, sandy clays of high plasticity.

NOTE:
Coarse grained soils with between 5% & 12% passing the No. 200 sieve and fine grained soils with Atterberg limits plotting in the hatched zone on the plasticity chart shall have dual symbol. In Arizona, local streams contain sand, gravel & cobble type material, which are locally known as SGC or riverrun material. The USCS is not used to divide and symbolize this material.

PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
Cobbles	Above 3 in.
Gravel	3 in. to No. 4 sieve
Coarse gravel	3 in. to 3/4 in.
Fine gravel	3/4 in. to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt & clay)	Below No. 200 sieve
Clay	Smaller than 2 microns
Colloid	Smaller than 5 microns

Appendix C: Boring Locations Diagram and Boring Logs

NOTE: All relative and apparent locations of features including right angles and boundaries are approximate

Legend

⊗ - Approximate Boring Location

BORING LOCATION DIAGRAM

City of Phoenix
Deer Valley Airport
Phoenix, Arizona
HA Project # 22070

HOQUE & ASSOCIATES, INC.

4325 South 34th Street
Phoenix, Arizona 85040
Tel: (480) 921-1368 Cell: (602) 595-2460
dgardiner@hoqueandassociates.com
www.hoqueandassociates.com

BORING LOG

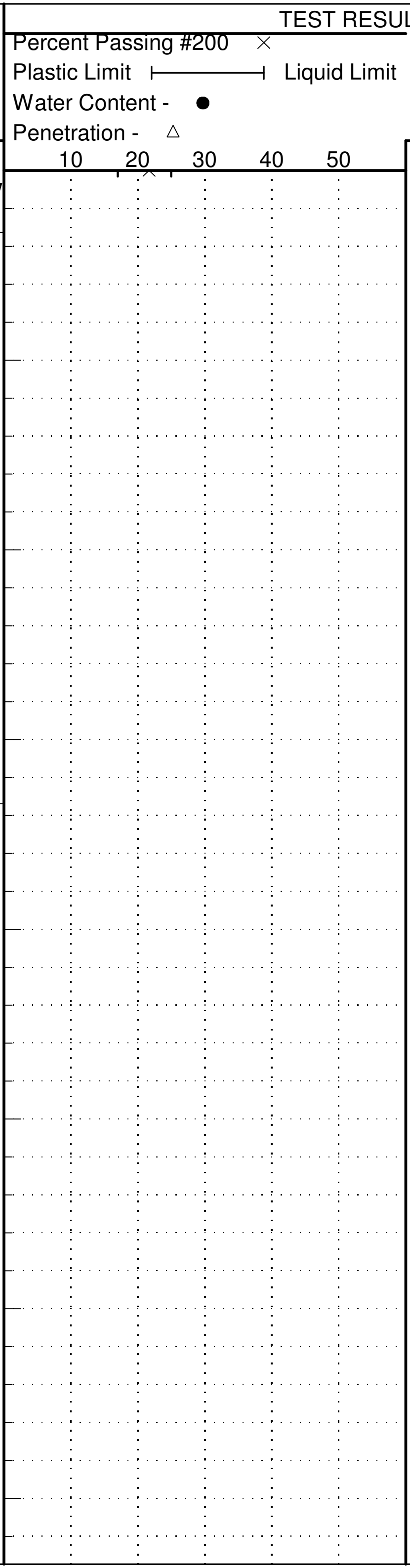
BORING NO. B-1

File: 22070 - Deer Valley Taxiway C
Date Printed: 8/22/2023

PROJECT: Deer Valley Taxiway C Connectors
PROJECT NO.: 22070
CLIENT: Trace Consulting
DATE: 3/30/2023
LOCATION: 702 W Deer Valley Road, Phoenix, AZ 85027
ELEVATION:
DRILLER: Wildcat Drilling | Mark/Quentin
LOGGED BY: Dawson G.
DRILLING METHOD: CME75
DEPTH TO - WATER> INITIAL: ⊽
AFTER 24 HOURS: ▼

DEPTH (feet)	Bulk	Samplers	Soil Type	USCS	Description
0	☒		SC	▨	Dark brown, damp to moist conditions, low PI, sand with clay and coarse aggregates.
2.5	☒			▨	
5				▨	
7.5				▨	
					Refusal/End of boring.

TEST RESULTS



This information pertains only to this boring and should not be interpreted as being indicitive of the site.

HOQUE & ASSOCIATES

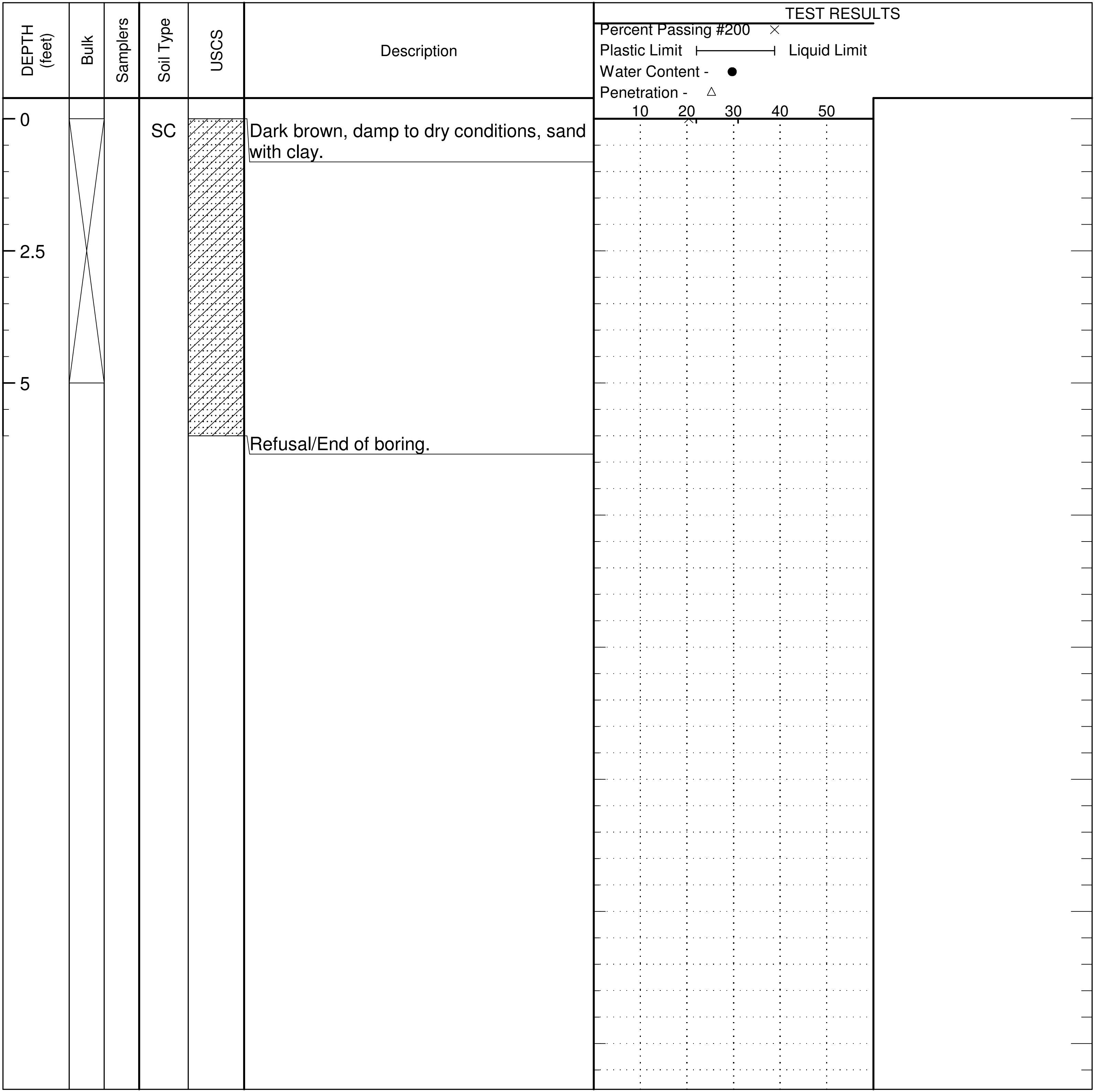
Figure

BORING LOG

BORING NO. B-2

File: 22070 - Deer Valley Taxiway C
Date Printed: 8/22/2023

PROJECT: Deer Valley Taxiway C Connectors
PROJECT NO.: 22070
CLIENT: Trace Consulting
DATE: 3/30/2023
LOCATION: 702 W Deer Valley Road, Phoenix, AZ 85027
ELEVATION:
DRILLER: Wildcat Drilling | Mark/Quentin
LOGGED BY: Dawson G.
DRILLING METHOD: CME75
DEPTH TO - WATER> INITIAL: ▽
AFTER 24 HOURS: ▼



Dark brown, damp to dry conditions, sand with clay.

Refusal/End of boring.

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& ASSOCIATES

BORING LOG

BORING NO. B-3

File: 22070 - Deer Valley Taxiway C Date Printed: 8/22/2023

PROJECT: Deer Valley Taxiway C Connectors
PROJECT NO.: 22070
CLIENT: Trace Consulting
DATE: 3/30/2023
LOCATION: 702 W Deer Valley Road, Phoenix, AZ 85027
ELEVATION:
DRILLER: Wildcat Drilling | Mark/Quentin
LOGGED BY: Dawson G.
DRILLING METHOD: CME75
DEPTH TO - WATER> INITIAL: ▽
AFTER 24 HOURS: ▼

DEPTH (feet)	Bulk	Samplers	Soil Type	USCS	Description
0	☒				Dark brown, damp, low PI.
2.5					
5					
					Refusal/End of boring.

TEST RESULTS
Percent Passing #200 ×
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - △
10 20 30 40 50

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

HOQUE & ASSOCIATES

BORING LOG

BORING NO. B-4

File: 22070 - Deer Valley Taxiway C Date Printed: 8/22/2023

PROJECT: Deer Valley Taxiway C Connectors
PROJECT NO.: 22070
CLIENT: Trace Consulting
DATE: 3/30/2023
LOCATION: 702 W Deer Valley Road, Phoenix, AZ 85027
ELEVATION:
DRILLER: Wildcat Drilling | Mark/Quentin
LOGGED BY: Dawson G.
DRILLING METHOD: CME75
DEPTH TO - WATER> INITIAL: ▽
AFTER 24 HOURS: ▼

TEST RESULTS

Percent Passing #200 ×
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - △

DEPTH (feet)	Bulk	Samplers	Soil Type	USCS	Description	10 20 30 40 50
0	☒				Dark brown, sand with clay, damp to moist.	
2.5						
5					Refusal/End of boring.	

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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Figure PAGE 1 of 1

BORING LOG

BORING NO. B-5

File: 22070 - Deer Valley Taxiway C   Date Printed: 8/22/2023

PROJECT: Deer Valley Taxiway C Connectors
PROJECT NO.: 22070
CLIENT: Trace Consulting
DATE: 3/30/2023
LOCATION: 702 W Deer Valley Road, Phoenix, AZ 85027
ELEVATION:
DRILLER: Wildcat Drilling | Mark/Quentin
LOGGED BY: Dawson G.
DRILLING METHOD: CME75
DEPTH TO - WATER> INITIAL: ▽
AFTER 24 HOURS: ▼

TEST RESULTS
Percent Passing #200 ×
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - △
10 20 30 40 50

DEPTH (feet)	Bulk	Samplers	Soil Type	USCS	Description
0	☒		SC	▨	Dark brown, sand with clay, low PI.
2.5	☒			▨	
5				▨	
7.5				▨	
					Refusal/End of boring.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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& ASSOCIATES

BORING LOG

BORING NO. B-6

File: 22070 - Deer Valley Taxiway C Date Printed: 8/22/2023

PROJECT: Deer Valley Taxiway C Connectors
PROJECT NO.: 22070
CLIENT: Trace Consulting
DATE: 3/30/2023
LOCATION: 702 W Deer Valley Road, Phoenix, AZ 85027
ELEVATION:
DRILLER: Wildcat Drilling | Mark/Quentin
LOGGED BY: Dawson G.
DRILLING METHOD: CME75
DEPTH TO - WATER> INITIAL: ☐
AFTER 24 HOURS: ☐

DEPTH (feet)	Bulk	Samplers	Soil Type	USCS	Description
0	☒		GC	▨	Dark brown with hue of gray, sand with clay, large coarse aggregate present.
2.5	☒				Refusal/End of boring.

TEST RESULTS

Percent Passing #200 ×
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - △

10 20 30 40 50

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

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& ASSOCIATES

Figure PAGE 1 of 1

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
▨	Clayey sand
▩	Clayey gravel
Misc. Symbols	
×	Description not given for: "X"
Soil Samplers	
☒	Bulk sample

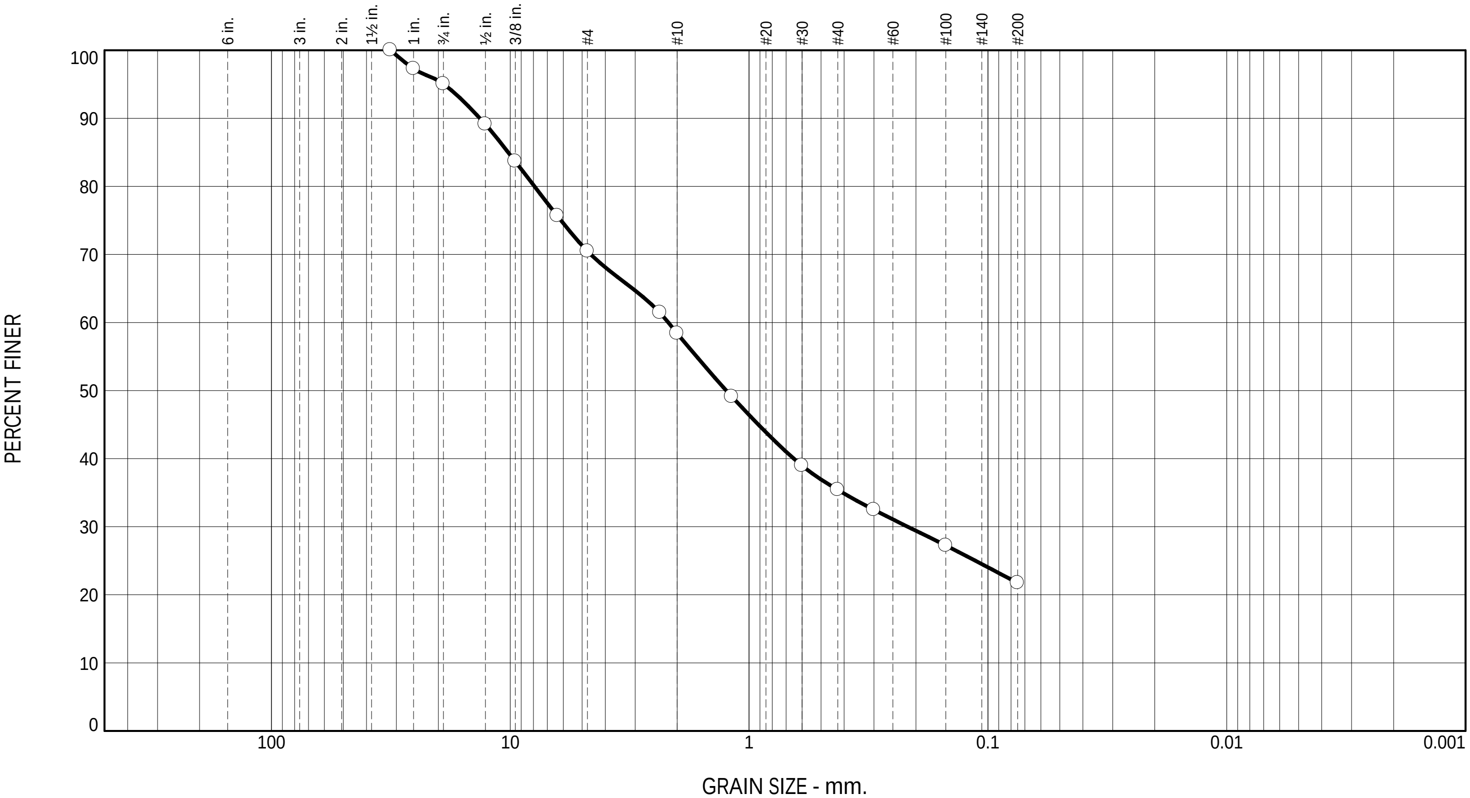
Notes:

1. Exploratory borings using auger.
2. Boring locations were selected by HA.
3. These logs are subject to the limitations, conclusions, and recommendations in this report.

Appendix D: Laboratory Test Results

Particle Size Distribution Report

ASTM C117 & C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.0	24.5	12.1	23.0	13.7	21.7	

Test Results (ASTM C117 & C136)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1-1/4"	100.0			
1"	97.3			
3/4"	95.0			
1/2"	89.1			
3/8"	83.7			
1/4"	75.7			
#4	70.5			
#8	61.4			87.2
#10	58.4			82.8
#16	49.1			69.7
#30	39.0			55.3
#40	35.4			50.3
#50	32.5			46.1
#100	27.2			38.6
#200	21.7			30.8

* (no specification provided)

Material Description

clayey sand with gravel

Atterberg Limits

PL= 17
LL= 25
PI= 8

Coefficients

D_{90}= 13.4015
D_{85}= 10.2030
D_{60}= 2.1773
D_{50}= 1.2461
D_{30}= 0.2167
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SC
AASHTO= A-2-4(0)

Test Remarks

Location: B-1
Sample Number: 23L0148 Depth: 0-5'
Sample Date: 3-31-23

Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

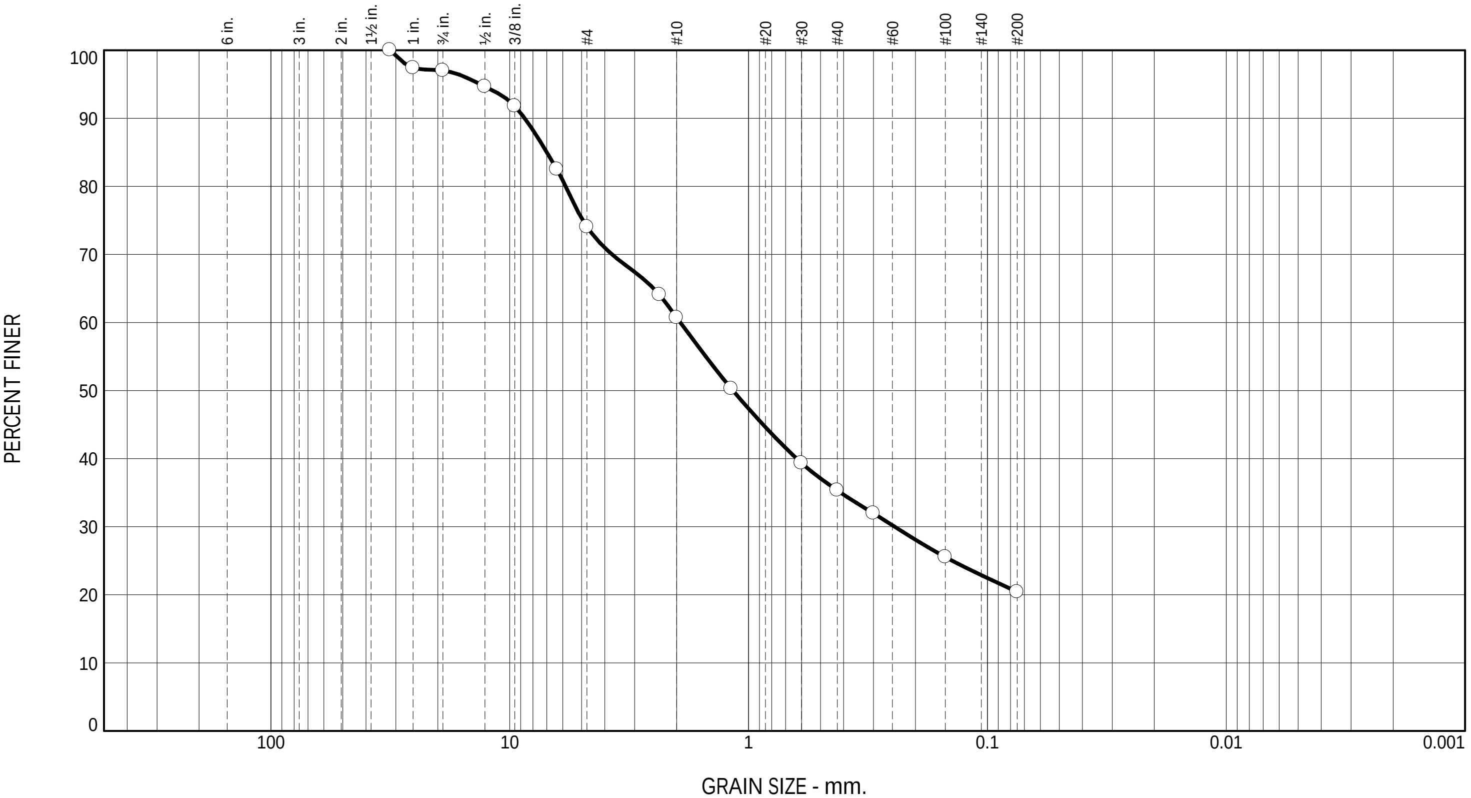
Client: Trace Consulting
Project: Deer Valley Airport

Project No: 22070
Lab Number 23L0148

Tested By: Drew Sutton
Checked By: Tyler Romano

Particle Size Distribution Report

ASTM C117 & C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.0	23.0	13.3	25.4	14.9	20.4	

Test Results (ASTM C117 & C136)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1-1/4"	100.0			
1"	97.4			
3/4"	97.0			
1/2"	94.7			
3/8"	91.8			
1/4"	82.5			
#4	74.0			
#8	64.1			86.6
#10	60.7			82.0
#16	50.3			67.9
#30	39.3			53.1
#40	35.3			47.7
#50	32.0			43.2
#100	25.5			34.5
#200	20.4			27.5

* (no specification provided)

Material Description

clayey sand with gravel

Atterberg Limits

PL= 22 LL= 31 PI= 9

Coefficients

D_{90}=	8.6565	D_{85}=	6.9981	D_{60}=	1.9307
D_{50}=	1.1623	D_{30}=	0.2444	D_{15}=	
D_{10}=		C_u=		C_c=	

Classification

USCS= SC AASHTO= A-2-4(0)

Test Remarks

Location: B-2
Sample Number: 23L0149 Depth: 0-5' Sample Date: 3-31-23

Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

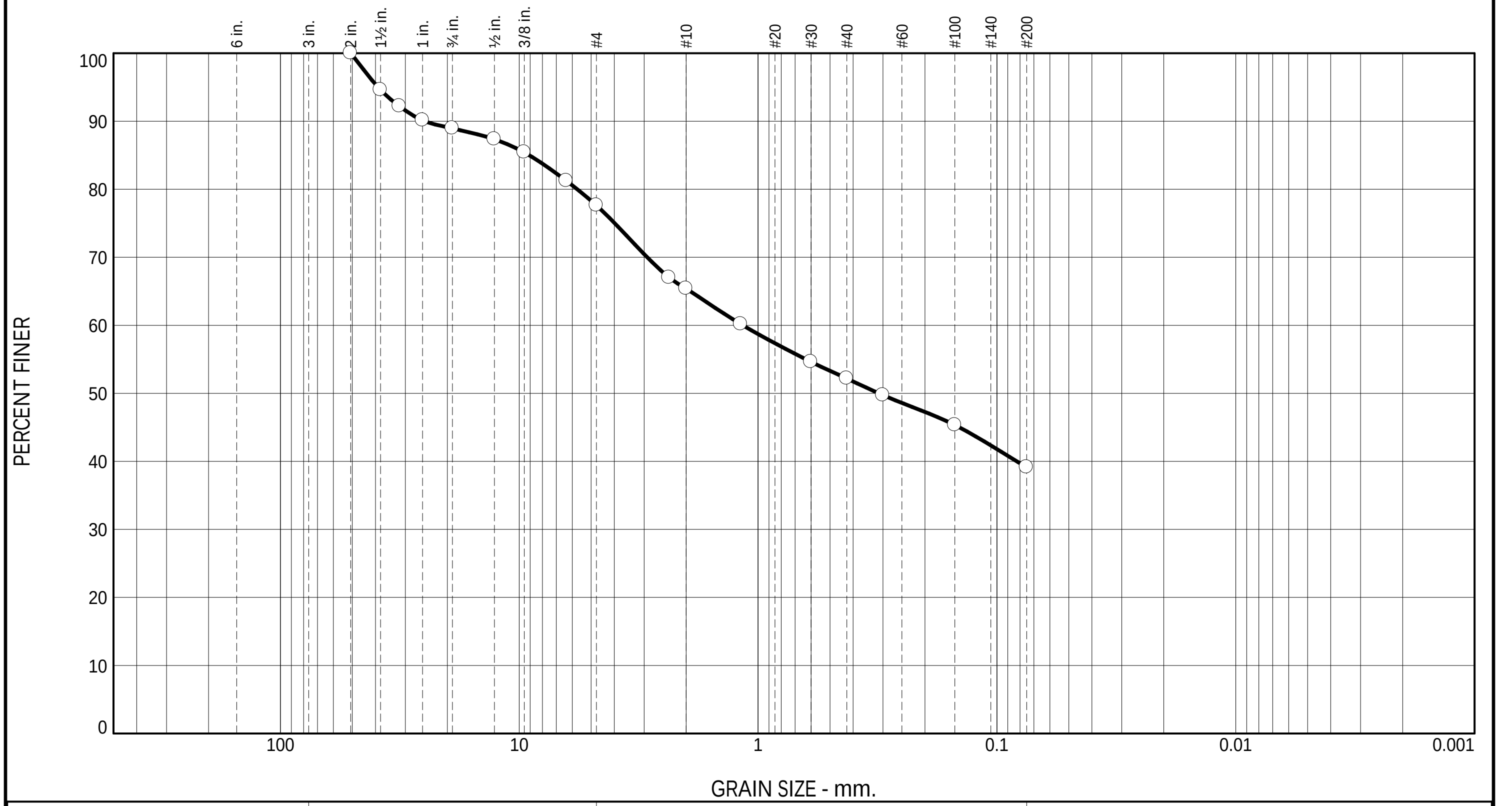
Client: Trace Consulting
Project: Deer Valley Airport

Project No: 22070 Lab Number 23L0149

Tested By: Dawson Gardiner Checked By: Tyler Romano

Particle Size Distribution Report

ASTM C117 & C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.0	11.4	12.2	13.2	13.1	39.1	

Test Results (ASTM C117 & C136)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
2"	100.0			
1-1/2"	94.6			
1-1/4"	92.2			
1"	90.1			
3/4"	89.0			
1/2"	87.3			
3/8"	85.4			
1/4"	81.2			
#4	77.6			
#8	67.0			86.3
#10	65.4			84.2
#16	60.2			77.5
#30	54.6			70.4
#40	52.2			67.2
#50	49.7			64.1
#100	45.3			58.4
#200	39.1			50.4

* (no specification provided)

Material Description

clayey sand with gravel

Atterberg Limits

PL= 20 LL= 28 PI= 8

Coefficients

D_{90}=	24.9190	D_{85}=	9.0841	D_{60}=	1.1579
D_{50}=	0.3120	D_{30}=		D_{15}=	
D_{10}=		C_u=		C_c=	

Classification

USCS= SC AASHTO= A-4(0)

Test Remarks

Location: B-5
Sample Number: 23L0152 Depth: 0-5' Sample Date: 3-31-23

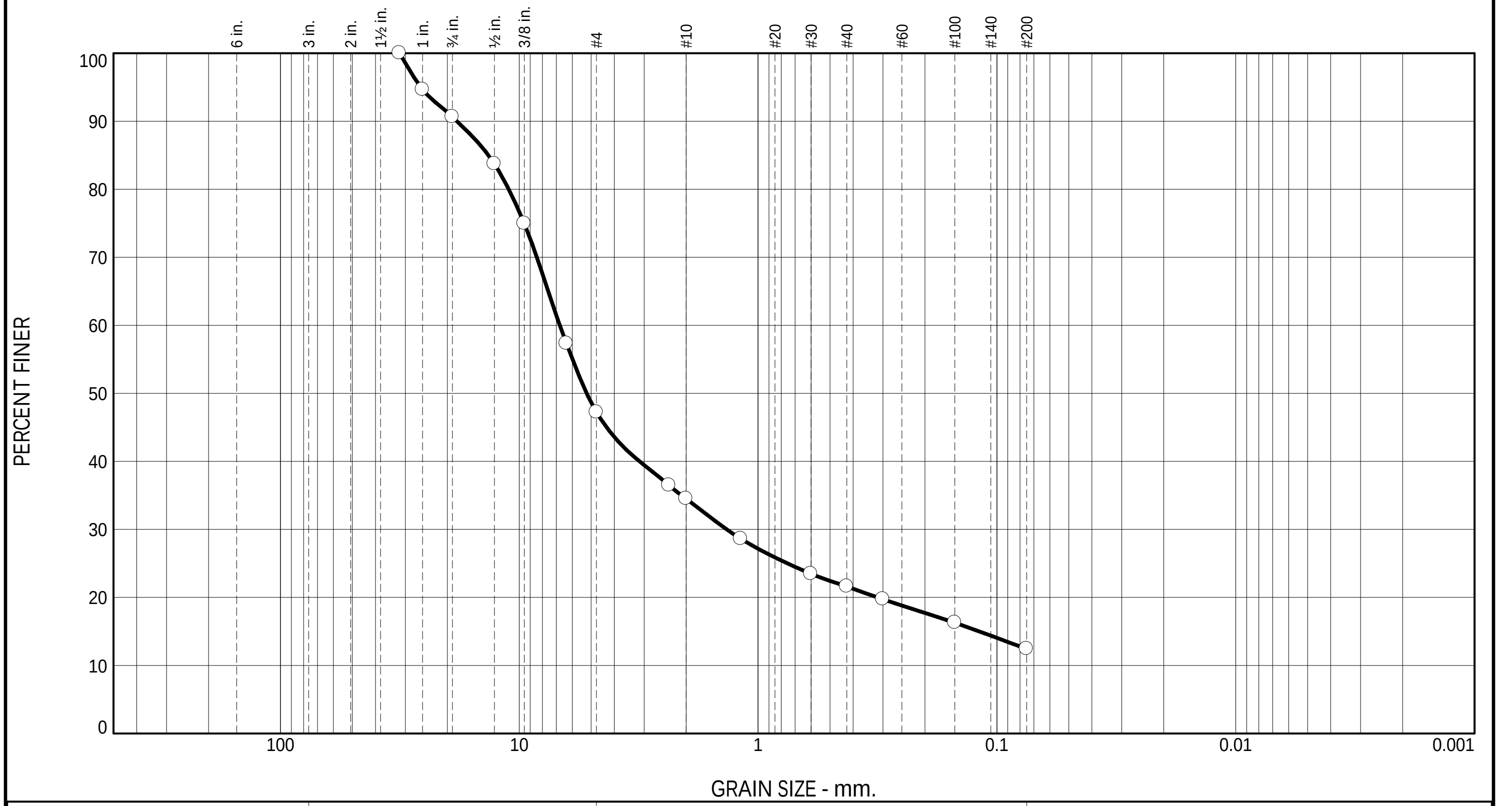
Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Client: Trace Consulting
Project: Deer Valley Airport
Project No: 22070 Lab Number 23L0152

Tested By: Jason Garnett Checked By: Tyler Romano

Particle Size Distribution Report

ASTM C117 & C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.4	43.4	12.7	12.9	9.2	12.4	

Test Results (ASTM C117 & C136)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
1-1/4"	100.0			
1"	94.7			
3/4"	90.6			
1/2"	83.7			
3/8"	75.0			
1/4"	57.3			
#4	47.2			
#8	36.5			77.2
#10	34.5			73.1
#16	28.6			60.6
#30	23.5			49.7
#40	21.6			45.7
#50	19.7			41.8
#100	16.3			34.5
#200	12.4			26.3

* (no specification provided)

Material Description

clayey gravel with sand

Atterberg Limits

PL= 17 LL= 29 PI= 12

Coefficients

D_{90}= 18.2598 D_{85}= 13.4491 D_{60}= 6.7724
D_{50}= 5.2195 D_{30}= 1.3531 D_{15}= 0.1186
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Test Remarks

Location: B-6
Sample Number: 23L0153 Depth: 0-5' Sample Date: 3-31-23

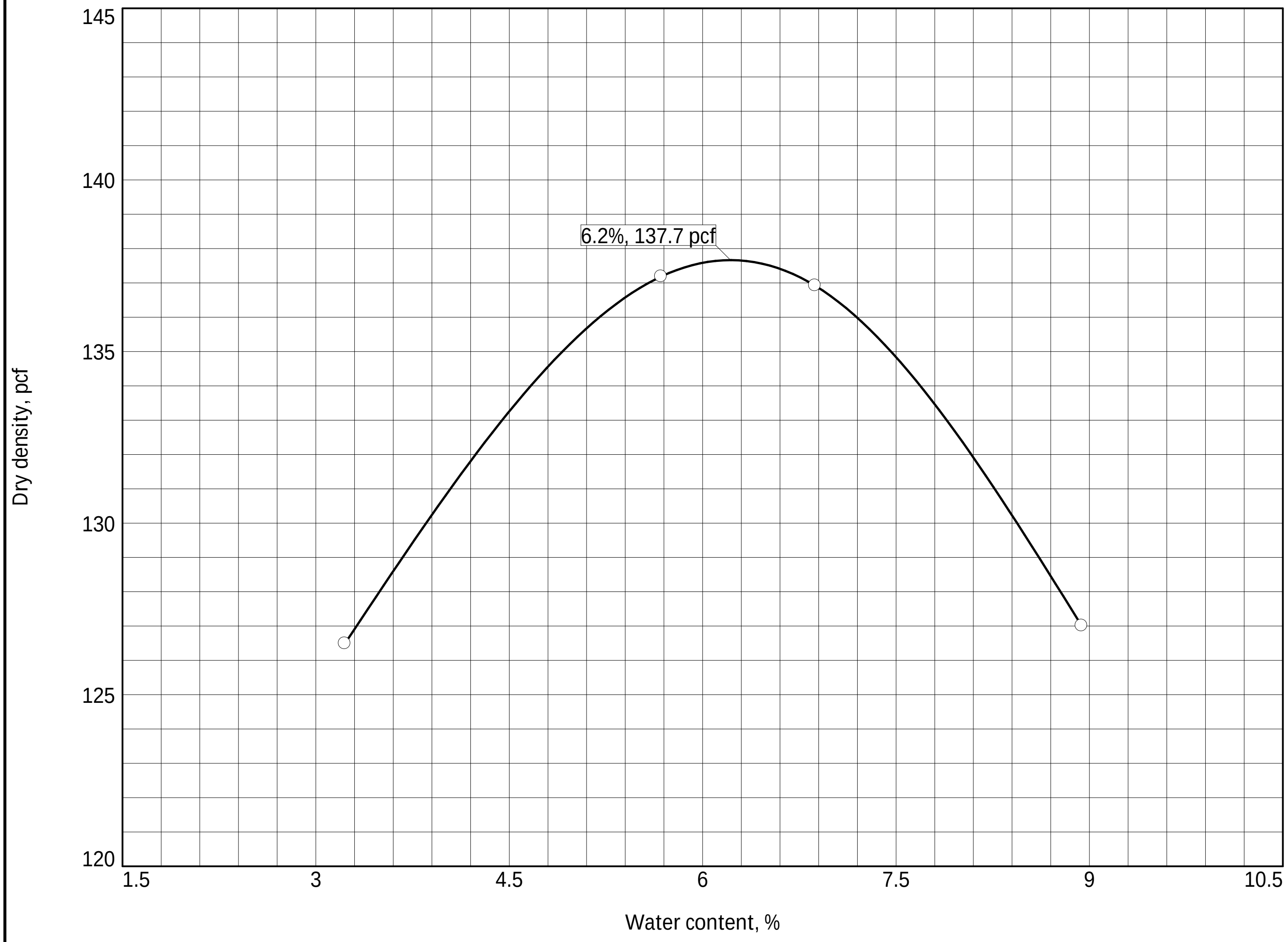
Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Client: Trace Consulting
Project: Deer Valley Airport

Project No: 22070 Lab Number 23L0153

Tested By: Jason Garnett Checked By: Tyler Romano

COMPACTION TEST REPORT



Test specification: ASTM D 1557-00 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
0-5'	SC	A-2-4(0)			25	8	5.0	21.7

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 137.7 pcf Optimum moisture = 6.2 %	clayey sand with gravel

Project No. 22070 Client: Trace Consulting

Project: Deer Valley Airport

Date: 4-19-23

○ Location: B-1 Sample Number: 23L0148

Hoque & Associates, Inc.
4325 South 34th Street
Phoenix, Arizona 85040

Remarks:

Lab Number 23L0148

Tested By: Alejandro Munoz Checked By: Tyler Romano

PROJECT: Deer Valley Airport
LOCATION: Phoenix, AZ
MATERIAL: Native
SAMPLE SOURCE: See below

CLIENT: Trace Consulting
JOB NO: 22070
LAB NO: See below
DATE ASSIGNED: 04/06/23

---

pH & RESISTIVITY (AZ 236)

LAB NO	SAMPLE SOURCE	RESISTIVITY (Ohm-cm)	pH
23L0150	B-3 @ 0-5'	1,924	8.4

REVIEWED BY

Trent Titchenal
Lab Manager

CBR(CALIFORNIA BEARING RATIO) OF LABORATORY-COMPACTED SOILS
ASTM D1883 (SOAKED)

Terracon

PROJECT: Hoque & Associates On-Call Testing
LOCATION: Phoenix, AZ
MATERIAL: CS-1
SAMPLE SOURCE: Project #22070

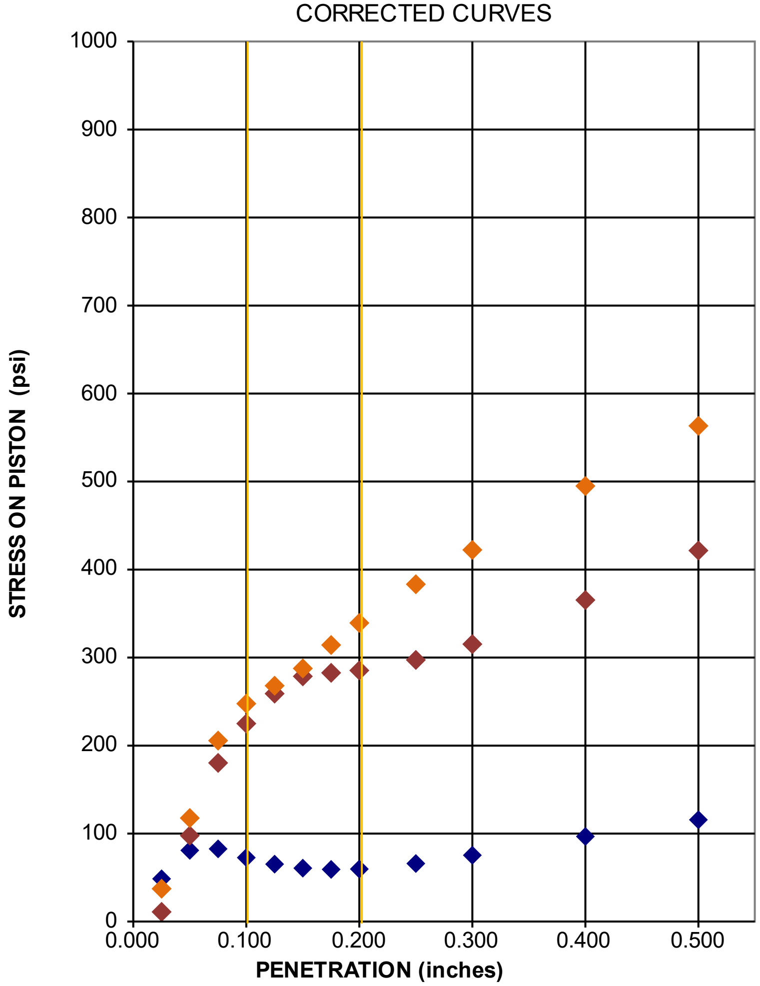
JOB NO: 65201096
WORK ORDER NO: 65201096.0028
LAB NO: 5715
DATE SAMPLED: 5/25/23

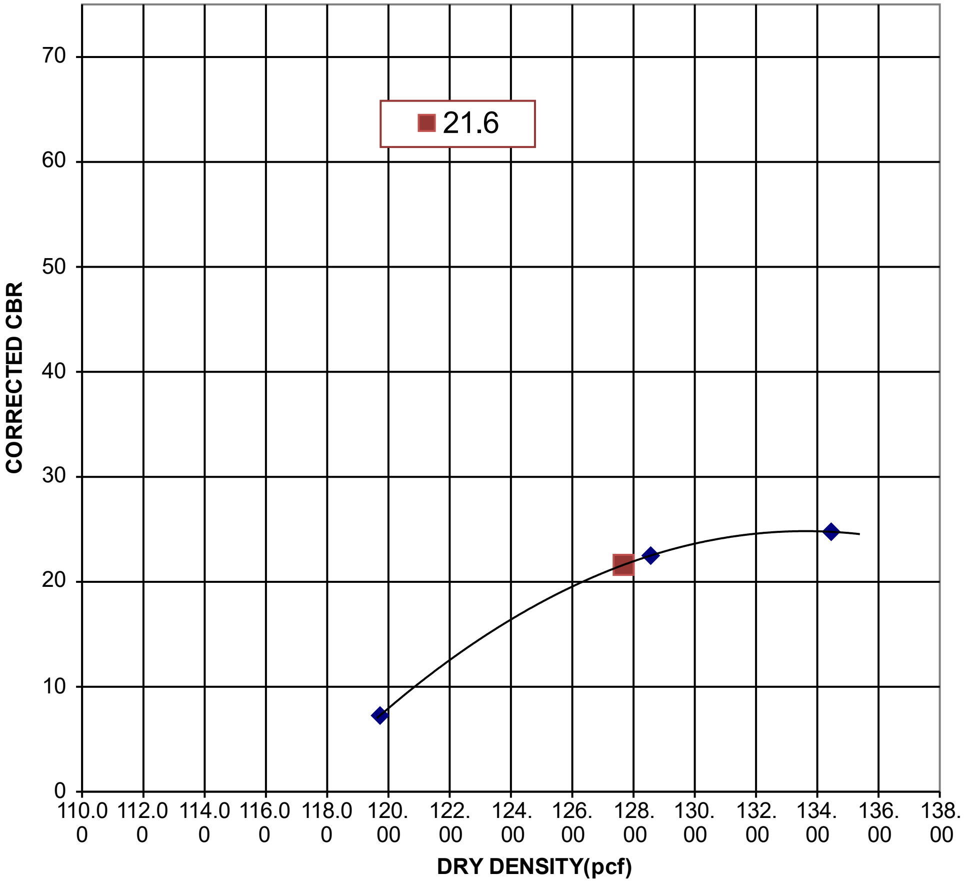
	Correction Factor		Corrected CBR		
	0.1"	0.2"	0.1"	0.2"	CBR
Point 1	0.00	0.00	7.3	4.0	7.3
Point 2	0.00	0.00	22.5	19.0	22.5
Point 3	0.00	0.00	24.8	22.6	24.8

ASTM D1557			
Moisture	Dry Density (pcf)		
%	100%	95%	90%
8.1	134.4	127.7	121.0

95% COMPACTION CBR

21.6





Appendix E: FAARFIELD – Airport Pavement Design

Federal Aviation Administration FAARFIELD 2.0 Section Report

FAARFIELD 2.0.18 (Build 05/26/2022)

Job Name: Deer Valley Airport Taxiway C Connectors

Section: Taxiway C Connectors

Analysis Type: HMA on Aggregate

Last Run: Thickness Design 2023-10-20 14:28:57

Design Life = 20 Years

Total thickness to the top of the subgrade = 10.0in.

Pavement Structure Information by Layer

No.	Type	Thickness (in.)	Modulus (psi)	Poisson's Ratio	Strength R (psi)
1	P-401/P-403 HMA Surface	4.0	200,000	0.35	0
2	P-209 Crushed Aggregate	6.0	70,191	0.35	0
3	Subgrade	0	32,400	0.35	0

Airplane Information

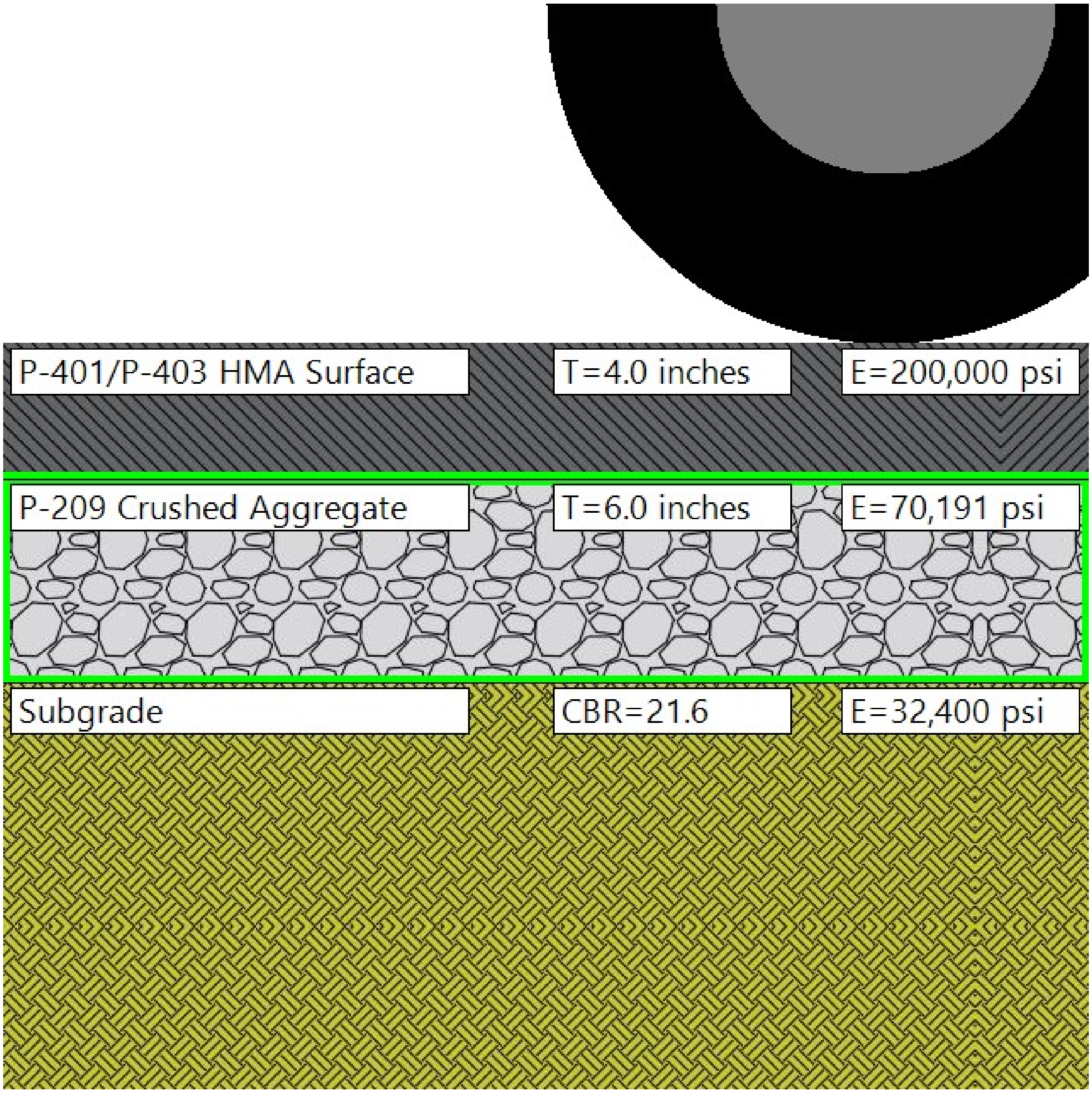
No.	Name	Gross Wt. (lbs)	Annual Departures	% Annual Growth
1	Cessna 172 Skyhawk	2,450	29,490	2.5
2	S-3	2,550	29,490	2.5
3	S-10	6,840	4,042	2.5
4	Beechcraft King Air B200	12,500	4,042	2.5
5	S-5	5,950	126	2.5
6	Cessna Citation II/Bravo C550/551	14,800	126	2.5
7	Learjet 45/55B	21,500	126	2.5
8	Cessna Citation X	36,600	126	2.5
9	EMB-175 STD	82,673	126	2.5
10	Learjet 35/36/35A/36A	18,000	126	2.5
11	Gulfstream-G-IV	73,200	126	2.5

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Cessna 172 Skyhawk	0.00	0.00	5.37
2	S-3	0.00	0.00	5.29
3	S-10	0.00	0.00	4.2
4	Beechcraft King Air B200	0.00	0.00	2.98
5	S-5	0.00	0.00	4.84
6	Cessna Citation II/Bravo C550/551	0.00	0.00	4.66
7	Learjet 45/55B	0.00	0.00	2.97
8	Cessna Citation X	0.00	0.00	2.81
9	EMB-175 STD	0.01	0.01	2.08
10	Learjet 35/36/35A/36A	0.00	0.00	2.97
11	Gulfstream-G-IV	0.06	0.06	2.33

User Is responsible For checking frost protection requirements.


P-401/P-403 HMA Surface
T=4.0 inches
E=200,000 psi
P-209 Crushed Aggregate
T=6.0 inches
E=70,191 psi
Subgrade
CBR=21.6
E=32,400 psi

Appendix B: Final Drainage Report

TECHNICAL DRAINAGE STUDY

Deer Valley Airport (DVT)
Phoenix, Arizona

Taxiway C Connectors C4-C10
Project No. AV31000096

Prepared For:

PHOENIX DEER VALLEY AIRPORT

Prepared By:

The HNTB Companies
Infrastructure Solutions

6033 W Century Blvd. Ste. 1050
Los Angeles, CA 90045

1/26/2024

Contents

Appendices

1 Introduction

Phoenix Deer Valley Airport (DVT) is planning to increase airfield safety and improve airport operations through the demolition of connector Taxiways C5, C6, C7, C8, and C9, and C10 and the placement of new connector Taxiways C4, C5, C6, C7, C8, C9, and C10 at Phoenix Deer Valley Airport (DVT). The project will relocate the Taxiway C connectors to standard FAA geometric locations to remove direct apron access to Runway 7R-25L.

The objective of the drainage analysis is to assess the impacts the proposed improvements will have on the existing drainage infrastructure and to mitigate the potential for localized flooding under the new taxiway connectors and adjacent infield construction.

Specifically, the drainage analysis first evaluates the existing drainage patterns, stormwater peaks, and capacity of the existing storm drainage systems. The analysis then estimates the stormwater peak and flow direction resulting from the proposed project and describes the proposed improvements. Finally, the analysis evaluates whether the proposed drainage systems have adequate capacity to accommodate the proposed project’s stormwater runoff.

2 Project Information

2.1 Project Description

The DVT Taxiway C Connectors C4-C10 (Project) involves the demolition of nonstandard geometric connector Taxiways C5, C6, C7, C8, C9, and C10 and the placement of new connector Taxiways C4-C10. The reconfiguration of the Taxiway connectors will necessitate the relocation of existing catch basins, and construction of new storm drain systems connecting the new catch basins to the existing storm drain system within the Project limits.

2.2 Project Location

DVT is located approximately 0.75 mile east of Interstate I-17 in the northern portion of the City of Phoenix. It is bounded in the north by Airport Boulevard, south by Deer Valley Road, west by 19th Avenue, and east by 7th Street. The proposed improvements are located along the southern portion of DVT, directly north of Taxiway C. Refer to **Figure 1** for the Project Location and Vicinity Map.

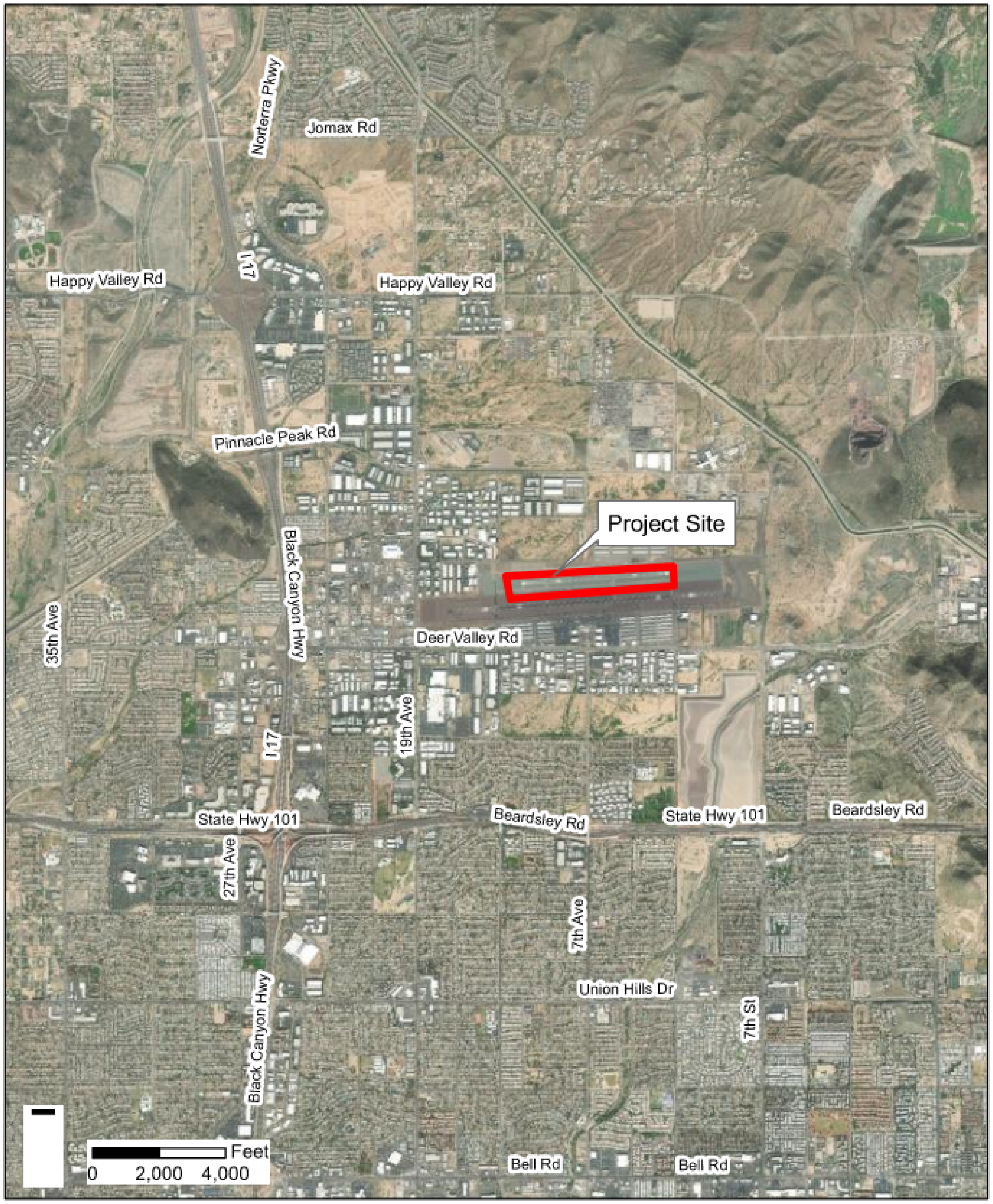


Figure 1 – Project Location and Vicinity Map

3 FEMA Floodplain Classification

The Project area does not lie within a Federal Emergency Management Agency (FEMA) regulatory floodway or floodplain. According to FEMA Flood Insurance Rate Map (FIRM), Maricopa County number 040051 panels 1280 L and 1290 L, revised October 16, 2013, the site is located within Zone X. Zone X is described as an area determined to be outside of the 0.2% chance floodplain. Refer to **Appendix A** for maps.

4 Existing Onsite Drainage

Based on the available information, the existing drainage pattern shows that stormwater runoff within the Project limits flows towards the infield areas and is collected by a series of catch basins that drain the infields. There are two major storm drain systems present within the site, one located west of connector C7 running east to west, and the second system is located within the infield east of connector C7 and runs north-south.

The first system consists of an 18-inch RCP that begins at the infield located between connectors C6 and C7 and runs west, connecting to a SD manhole located approximately 39 feet past connector C5. From that SD manhole, 18-inch RCP outlets southwest across Taxiway C towards another manhole, which then outlets as a 24-inch RCP running west away from the project limits.

The second system is located within the infield east of connector C7 and is composed of a 54-inch RCP running south that transitions into a 72-inch RCP via a transition structure manhole located inside the infield. The 72-inch RCP continues south across Taxiway C away from the project limits. Additionally, there is a lateral 18-inch RCP that starts approximately 86 feet east of connector C10, runs west, and connects to the main system's transition structure manhole. This lateral line conveys all the stormwater runoff generated within taxiways C8 through C11, which is collected by a series of catch basins in the infields.

The existing storm drain sizes and inverts were verified via survey by the team.

5 Proposed Hydrology

5.1 Methodology

5.1.1 Proposed Watershed Delineation

- The existing watershed delineations were analyzed per the provided topography and existing drainage system map.

- The proposed watershed intends to follow overall drainage pattern; however, modifications occur to sub areas. Any modification of the drainage pattern due to the proposed improvement limits will be taken into consideration.

5.1.2 Design Frequencies

The design for the Project considers a 5-year storm event in accordance with AC 150/5320-5D.

5.1.3 Peak Discharge – Rational Method

All Hydrologic Calculations followed the methodology outlined by the Drainage Design Manual for Maricopa County (DDMMC) (November 2009). Per the manual, the rational method was utilized to estimate peak runoff discharges for all project relevant watersheds.

- The Rational Method from DDMMC:

$Q = CIA$ Equation 3.1

Where:

Q = Volumetric Flow Rate (cfs)

C = Runoff Coefficient (dimensionless)

I = Rainfall Intensity at a given point in time, per time of concentration Tc (in/hr)

A = Subarea watershed Area (acres)

5.1.4 Time of Concentration

The minimum time of concentration is five (5) minutes, as required by AC 150/5320-5D.

5.1.5 Rainfall Intensity

National Oceanic and Atmospheric Administration (NOAA) Atlas 14 was used to obtain rainfall intensity at Deer Valley Airport. Refer to **Appendix B** for Rainfall intensity.

5.1.6 Runoff Coefficient

Runoff coefficients from DDMMC Table 3.2 for the project where takes an as follow:

C = 0.80 for "Pavement"

C = 0.65 for "Gravel Roadways"

5.2 Hydrology Results

Results from the Rational Method Calculation are shown in **Table 5.1** below. Refer to **Appendix C** for the proposed Hydrology Map and **Appendix D** for the hydrology calculations.

Table 1 – Rational Method Runoff Summary

Drainage Area ID	Inlet ID	Area	Time of Concentration (min)	5-year Rainfall Intensity (in/hr)	Composite C	5-year Runoff (cfs)
DA-1	CB-1	4.83	11.25	3.49	0.71	12.00
DA-2	CB-2	4.41	11.39	3.49	0.69	10.68
DA-3	CB-3	3.02	6.43	4.58	0.71	9.80
DA-4	CB-4	4.62	10.53	3.49	0.70	11.31
DA-5	CB-5	3.1	6.29	4.58	0.72	10.19
DA-6	CB-6	3.23	6.26	4.58	0.71	10.44

6 Proposed Hydraulic System

The proposed drainage pattern will follow that of the existing conditions in which runoff generated within the taxiways will sheet flow onto the infield areas and drained by a series of proposed catch basins that will connect to the existing drainage systems either directly or via new storm drain RCP lines varying between 18-inch and 24-inch in diameter. Refer to the Proposed Hydrology Map in **Appendix C** for a depiction of the proposed hydraulic infrastructure.

6.1 Inlet Design

The proposed catch basins were designed for a 5-year storm event limiting ponding at each inlet to prevent the encroachment of runoff on the taxiway and runway pavements. The Hec-22 Chart 9B was used to size the inlets. A clogging factor of 50% was applied per the City of Pheonix Storm Water Policies and Satandards (SWPS). Refer to **Appendix E** for calculations.

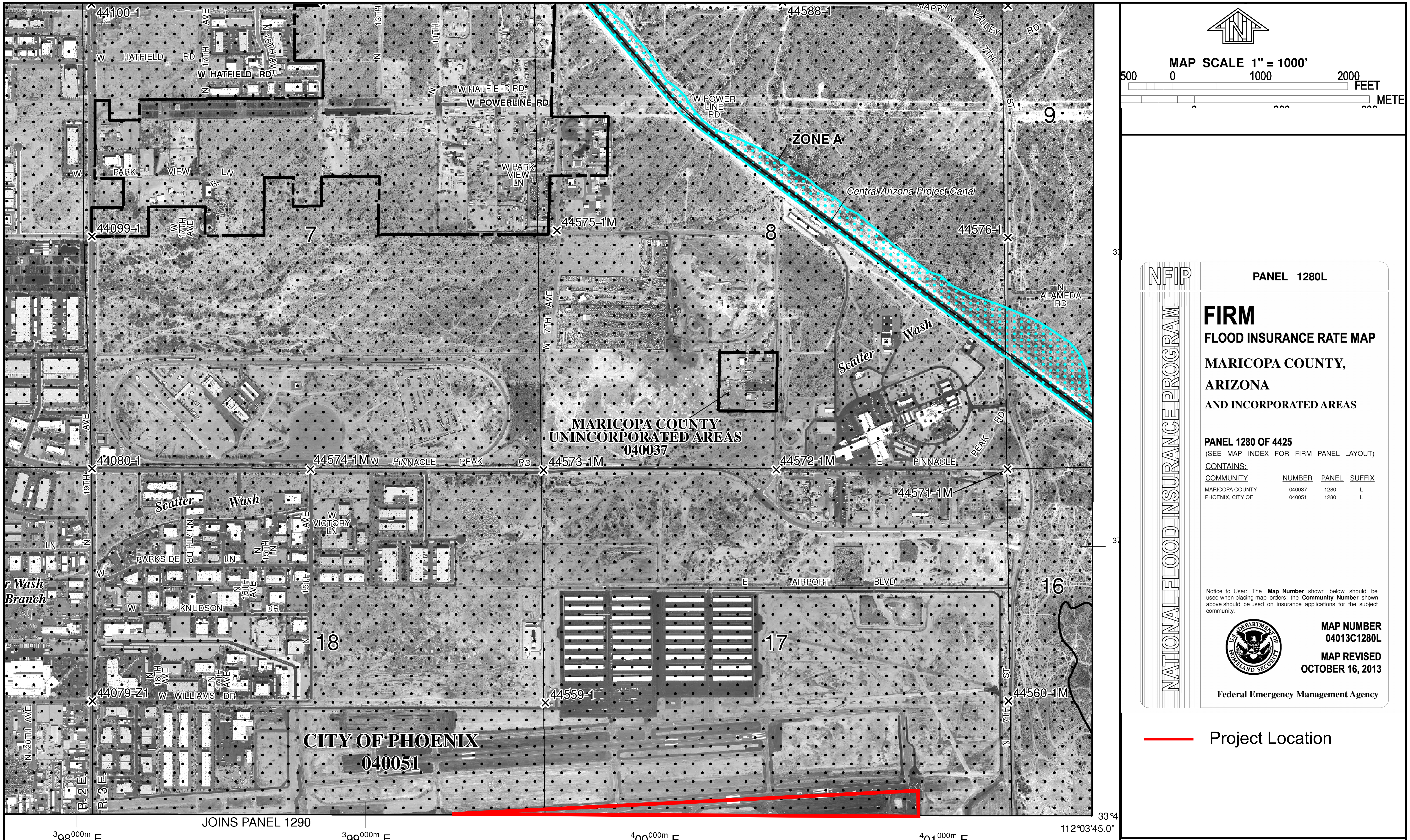
6.2 Pipe Design

New storm drain pipes will be reinforced concrete pipe (RCP)(CLASS V) with a load capacity of 3000 lbs/ft/ft. All pipes were designed for a 5-year storm event. Refer to **Appendix E** for calculations.

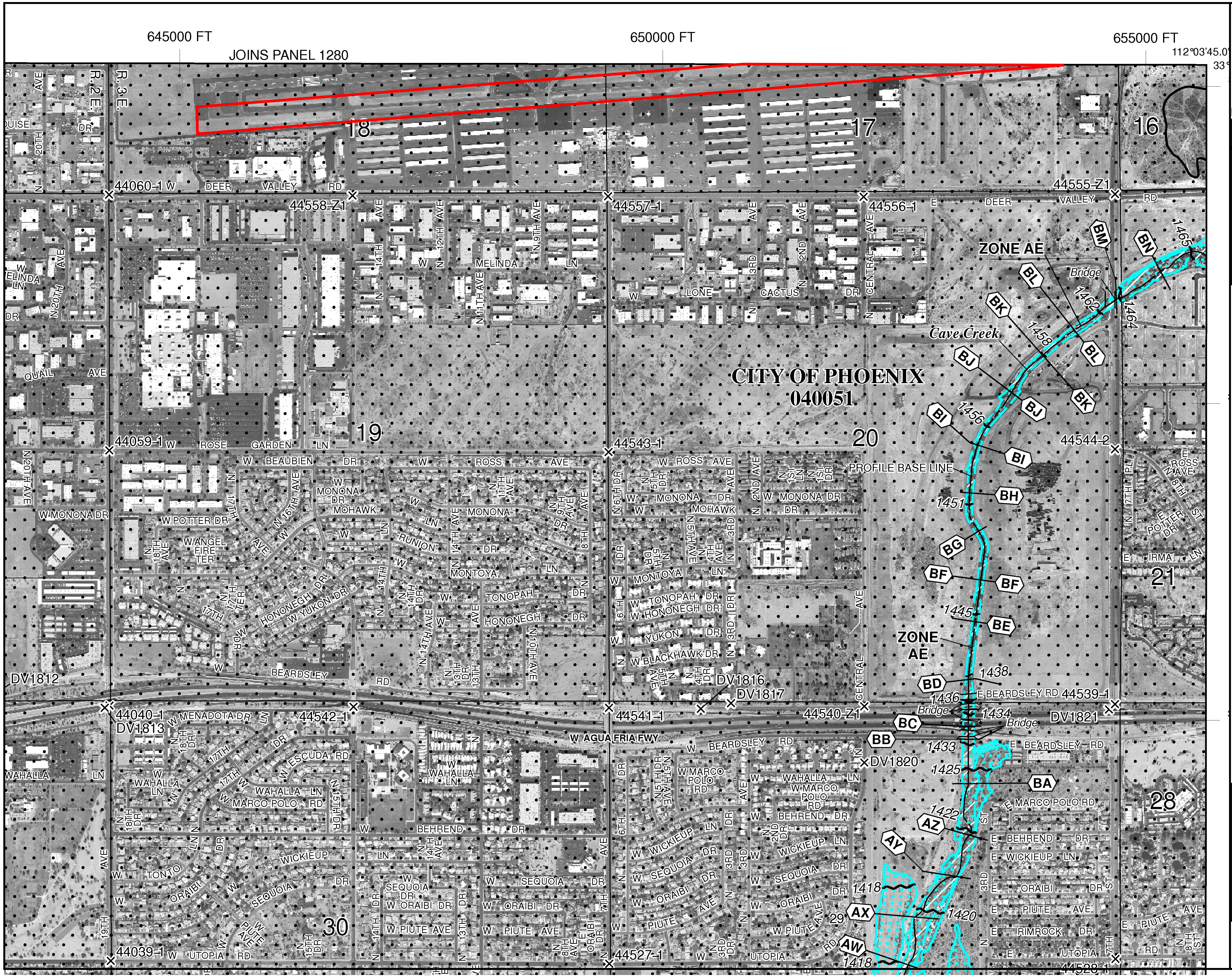
Appendix A

FEMA Maps

Figure 2. FEMA Floodplain Map



This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

NFIP

PANEL 1290L

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1290 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PHOENIX, CITY OF	040051	1290	L

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C1290L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

Project Location

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix B

NOAA Atlas 14 Data

NOAA Atlas 14, Volume 1, Version 5
Location name: Phoenix, Arizona, USA*
Latitude: 33.6885°, Longitude: -112.0824°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**2.60** (2.15-3.23)	**3.40** (2.82-4.20)	**4.58** (3.76-5.65)	**5.50** (4.48-6.76)	**6.71** (5.38-8.22)	**7.63** (6.05-9.30)	**8.58** (6.68-10.4)	**9.54** (7.31-11.6)	**10.8** (8.09-13.1)	**11.8** (8.64-14.4)
10-min	**1.99** (1.64-2.45)	**2.59** (2.14-3.20)	**3.49** (2.86-4.30)	**4.19** (3.41-5.14)	**5.11** (4.09-6.25)	**5.81** (4.61-7.08)	**6.53** (5.09-7.93)	**7.25** (5.56-8.80)	**8.22** (6.16-9.98)	**8.97** (6.58-10.9)
15-min	**1.64** (1.35-2.03)	**2.14** (1.77-2.65)	**2.88** (2.36-3.56)	**3.46** (2.82-4.25)	**4.22** (3.38-5.17)	**4.80** (3.81-5.85)	**5.40** (4.20-6.55)	**6.00** (4.60-7.28)	**6.80** (5.09-8.25)	**7.41** (5.43-9.03)
30-min	**1.10** (0.912-1.37)	**1.44** (1.19-1.78)	**1.94** (1.59-2.40)	**2.33** (1.90-2.86)	**2.84** (2.28-3.48)	**3.23** (2.56-3.94)	**3.63** (2.83-4.41)	**4.04** (3.10-4.90)	**4.58** (3.43-5.56)	**4.99** (3.66-6.08)
60-min	**0.684** (0.564-0.845)	**0.891** (0.739-1.10)	**1.20** (0.984-1.48)	**1.44** (1.17-1.77)	**1.76** (1.41-2.15)	**2.00** (1.59-2.44)	**2.25** (1.75-2.73)	**2.50** (1.92-3.03)	**2.83** (2.12-3.44)	**3.09** (2.26-3.76)
2-hr	**0.398** (0.333-0.482)	**0.512** (0.428-0.625)	**0.683** (0.567-0.826)	**0.813** (0.669-0.982)	**0.989** (0.802-1.19)	**1.12** (0.900-1.35)	**1.26** (0.994-1.51)	**1.40** (1.09-1.67)	**1.59** (1.21-1.90)	**1.73** (1.29-2.08)
3-hr	**0.278** (0.233-0.341)	**0.355** (0.298-0.436)	**0.466** (0.389-0.570)	**0.554** (0.459-0.673)	**0.675** (0.550-0.813)	**0.770** (0.619-0.924)	**0.869** (0.687-1.04)	**0.974** (0.758-1.17)	**1.12** (0.846-1.34)	**1.23** (0.911-1.48)
6-hr	**0.165** (0.142-0.196)	**0.208** (0.179-0.247)	**0.265** (0.227-0.314)	**0.311** (0.263-0.366)	**0.374** (0.311-0.438)	**0.423** (0.347-0.493)	**0.473** (0.384-0.553)	**0.525** (0.418-0.613)	**0.596** (0.463-0.697)	**0.652** (0.495-0.763)
12-hr	**0.093** (0.081-0.109)	**0.117** (0.101-0.138)	**0.148** (0.127-0.173)	**0.172** (0.147-0.201)	**0.205** (0.173-0.239)	**0.230** (0.192-0.267)	**0.255** (0.210-0.297)	**0.281** (0.229-0.327)	**0.316** (0.251-0.369)	**0.343** (0.267-0.403)
24-hr	**0.053** (0.046-0.062)	**0.067** (0.058-0.078)	**0.087** (0.075-0.101)	**0.103** (0.088-0.119)	**0.124** (0.106-0.144)	**0.142** (0.120-0.163)	**0.160** (0.134-0.185)	**0.178** (0.148-0.206)	**0.204** (0.166-0.237)	**0.225** (0.181-0.263)
2-day	**0.028** (0.024-0.033)	**0.036** (0.031-0.042)	**0.047** (0.040-0.055)	**0.056** (0.048-0.065)	**0.068** (0.058-0.079)	**0.078** (0.066-0.090)	**0.088** (0.074-0.102)	**0.099** (0.082-0.115)	**0.114** (0.093-0.133)	**0.126** (0.101-0.147)
3-day	**0.020** (0.017-0.023)	**0.026** (0.022-0.030)	**0.034** (0.029-0.039)	**0.040** (0.035-0.046)	**0.049** (0.042-0.057)	**0.057** (0.048-0.065)	**0.065** (0.054-0.075)	**0.073** (0.061-0.084)	**0.084** (0.069-0.098)	**0.094** (0.076-0.110)
4-day	**0.016** (0.014-0.018)	**0.020** (0.018-0.024)	**0.027** (0.023-0.031)	**0.032** (0.028-0.037)	**0.040** (0.034-0.046)	**0.046** (0.039-0.053)	**0.053** (0.044-0.061)	**0.060** (0.050-0.069)	**0.070** (0.058-0.081)	**0.078** (0.064-0.091)
7-day	**0.010** (0.009-0.012)	**0.013** (0.011-0.015)	**0.017** (0.015-0.020)	**0.021** (0.018-0.024)	**0.026** (0.022-0.030)	**0.030** (0.025-0.034)	**0.034** (0.029-0.039)	**0.039** (0.032-0.045)	**0.045** (0.037-0.052)	**0.050** (0.041-0.059)
10-day	**0.008** (0.007-0.009)	**0.010** (0.009-0.012)	**0.013** (0.011-0.015)	**0.016** (0.014-0.018)	**0.020** (0.017-0.022)	**0.022** (0.019-0.026)	**0.026** (0.022-0.030)	**0.029** (0.024-0.034)	**0.034** (0.028-0.039)	**0.038** (0.031-0.044)
20-day	**0.005** (0.004-0.005)	**0.006** (0.005-0.007)	**0.008** (0.007-0.009)	**0.010** (0.008-0.011)	**0.012** (0.010-0.013)	**0.013** (0.011-0.015)	**0.015** (0.013-0.017)	**0.017** (0.014-0.019)	**0.019** (0.016-0.022)	**0.021** (0.017-0.024)
30-day	**0.004** (0.003-0.004)	**0.005** (0.004-0.006)	**0.006** (0.006-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.010** (0.009-0.012)	**0.012** (0.010-0.013)	**0.013** (0.011-0.015)	**0.015** (0.012-0.017)	**0.016** (0.013-0.019)
45-day	**0.003** (0.003-0.003)	**0.004** (0.003-0.004)	**0.005** (0.004-0.006)	**0.006** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.008-0.011)	**0.011** (0.009-0.013)	**0.012** (0.010-0.014)
60-day	**0.002** (0.002-0.003)	**0.003** (0.003-0.004)	**0.004** (0.004-0.005)	**0.005** (0.004-0.006)	**0.006** (0.005-0.007)	**0.007** (0.006-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.008-0.011)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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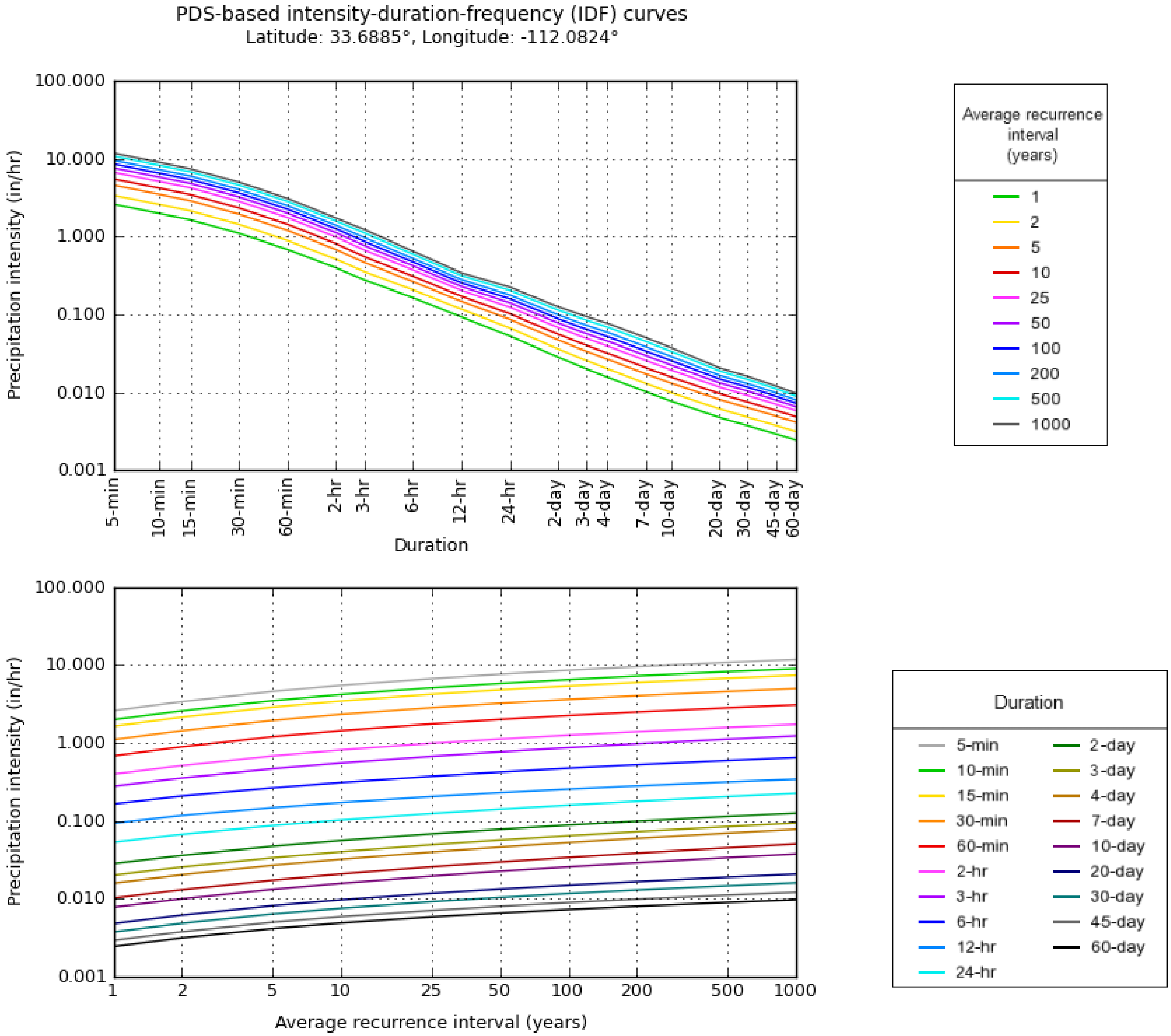
PF graphical



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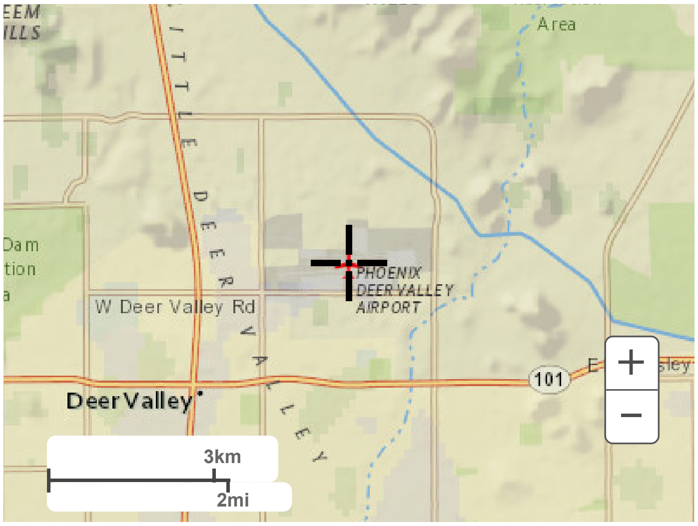
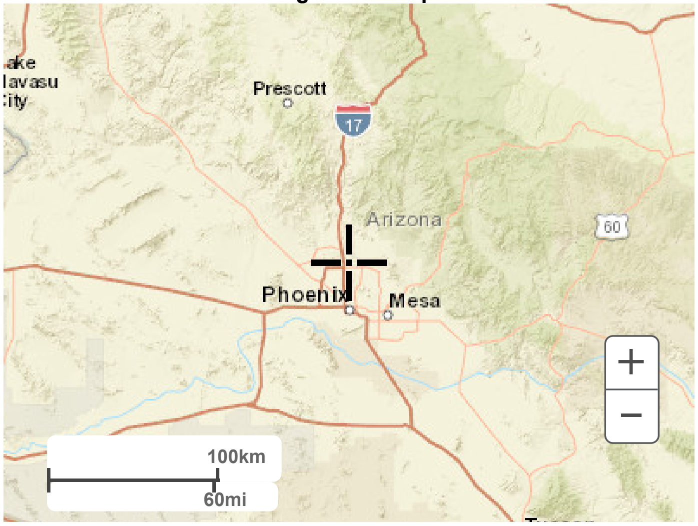
Maps & aerials

Small scale terrain

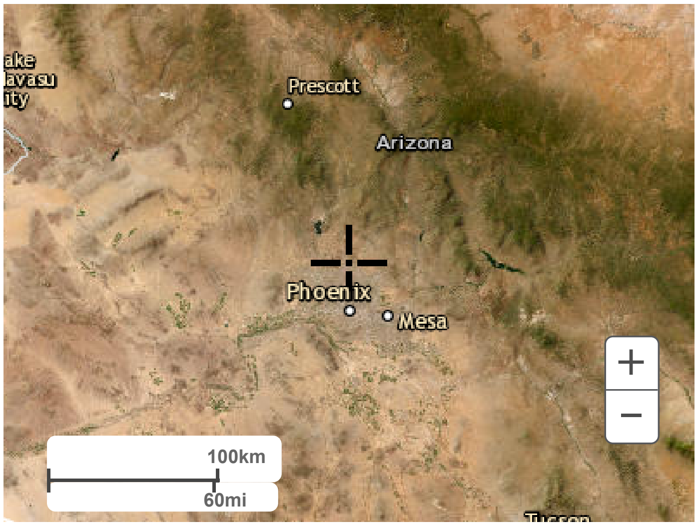


Large scale terrain

Large scale map



Large scale aerial



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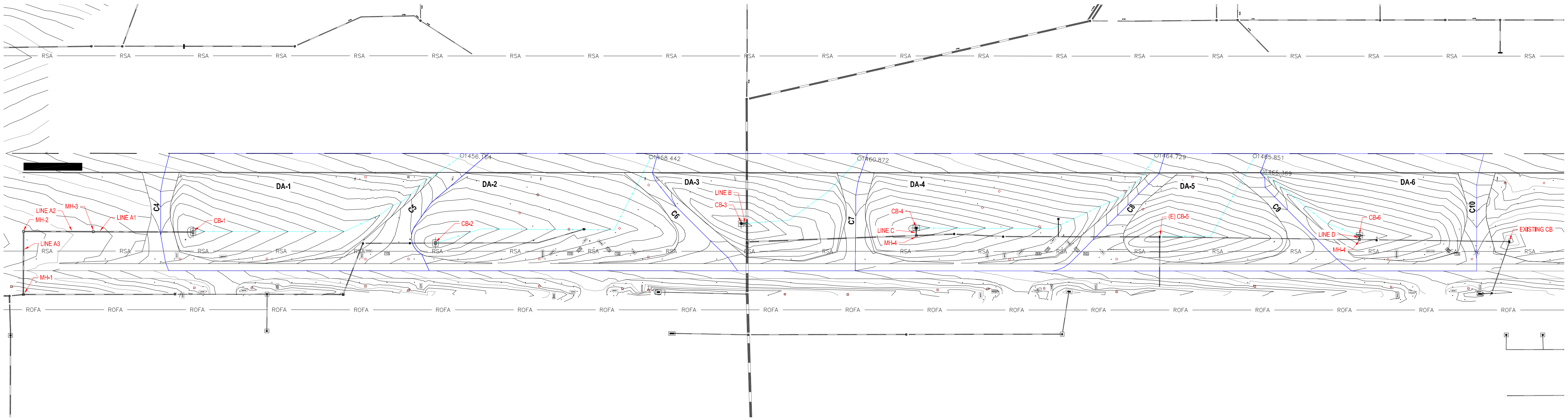
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Appendix C

Proposed Hydrology Map



LEGEND

FLOW PATH

WATERSHED BOUNDARY

EXISTING STORM DRAIN

Drainage Area ID	Inlet ID	Area	Time of Concentration (min)	5-year Rainfall Intensity (in/hr)	Composite C	5-year Runoff (cfs)
DA-1	CB-1	4.83	11.25	3.49	0.71	12.00
DA-2	CB-2	4.41	11.39	3.49	0.69	10.68
DA-3	CB-3	3.02	6.43	4.58	0.71	9.80
DA-4	CB-4	4.62	10.53	3.49	0.70	11.31
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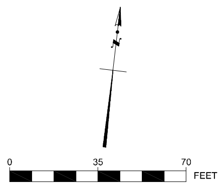
DA-6	CB-6	3.23	6.26	4.58	0.71	10.44



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PROPOSED HYDROLOGY MAP
TWY C

DVT
PHOENIX DEER VALLEY AIRPORT

HNTB

Appendix D

Hydrology Calculations

	Kb				Flow Path							
Area ID	**Area**	**m**	**b**	**Kb**	**L**	**E1**	**E2**	**S**	**i**	**Tc**	**C**	**Q**
DA-1	4.83	-0.01375	0.08	0.07	0.136	1456.16	1448.33	57.57	3.49	11.25	0.71	12.00
DA-2	4.41	-0.01375	0.08	0.07	0.127	1458.44	1452.07	50.16	3.49	11.39	0.69	10.68
DA-3	3.02	-0.01375	0.08	0.07	0.068	1460.87	1454.93	87.35	4.58	6.43	0.71	9.80
DA-4	4.62	-0.01375	0.08	0.07	0.1287	1464.73	1456.29	65.58	3.49	10.53	0.70	11.31
DA-5	3.10	-0.01375	0.08	0.07	0.0696	1465.85	1459.08	97.27	4.58	6.29	0.72	10.19
DA-6	3.23	-0.01375	0.08	0.07	0.056	1465.34	1461.47	69.11	4.58	6.26	0.71	10.44

$$Q = CiA$$

where:

Q = the peak discharge, in cfs, from a given area.

C = a coefficient relating the runoff to rainfall.

i = average rainfall intensity, in inches/hour, lasting for a T_c.

T_c = the time of concentration, in hours.

A = drainage area, in acres.

$$T_c = 11.4L^{0.5}K_b{}^{0.52}S^{-0.31}i^{-0.38}$$

where:

T_c = time of concentration, in hours.

L = length of the longest flow path, in miles.

K_b = watershed resistance coefficient (see Table 3.1

S = watercourse slope, in feet/mile.

i = rainfall intensity, in inches/hour.*

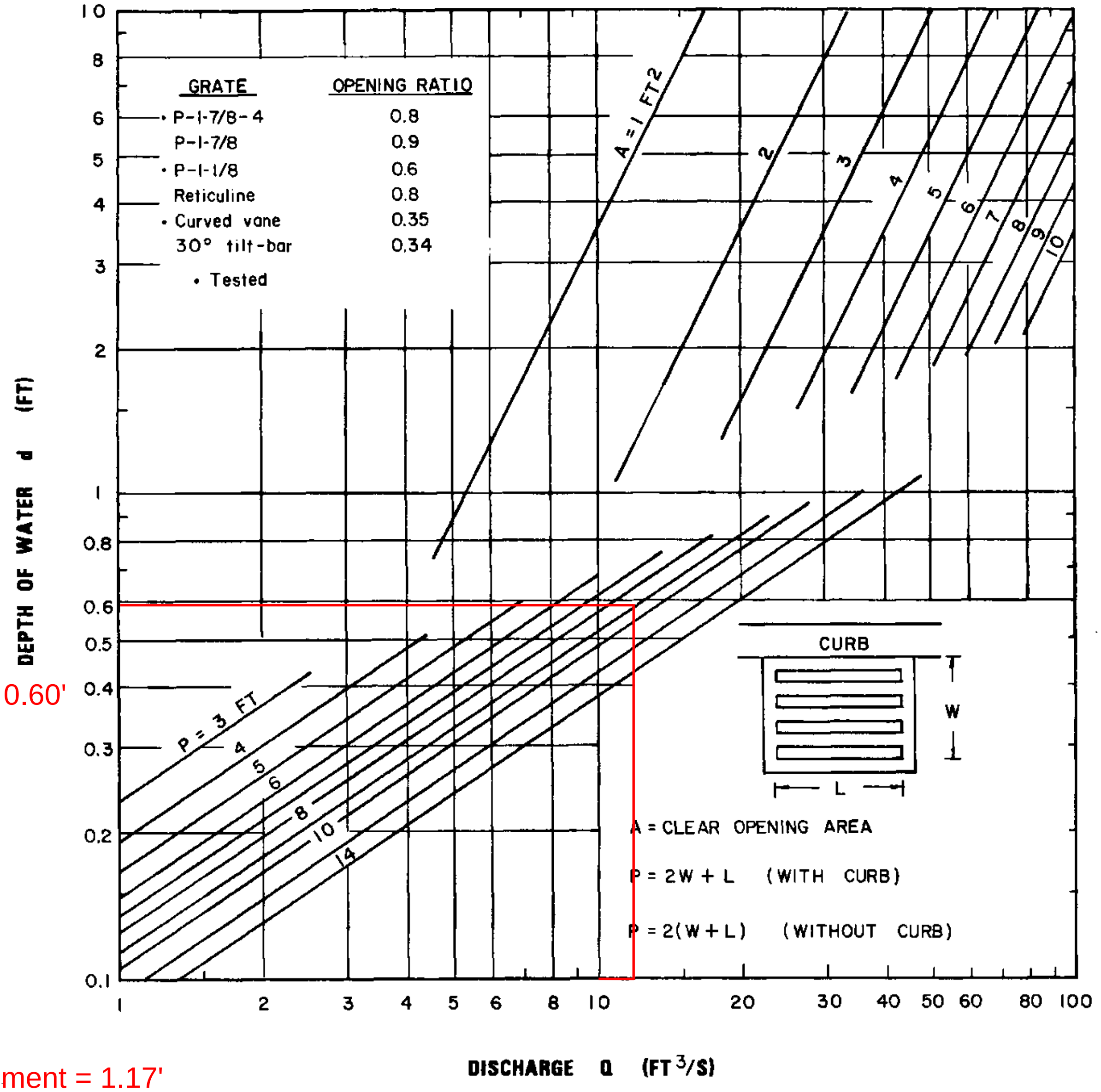
Appendix E

Hydraulic Calculations

Catch Basins Calculations

CB-1

CHART 9B



d = 0.60'

Depth to pavement = 1.17'

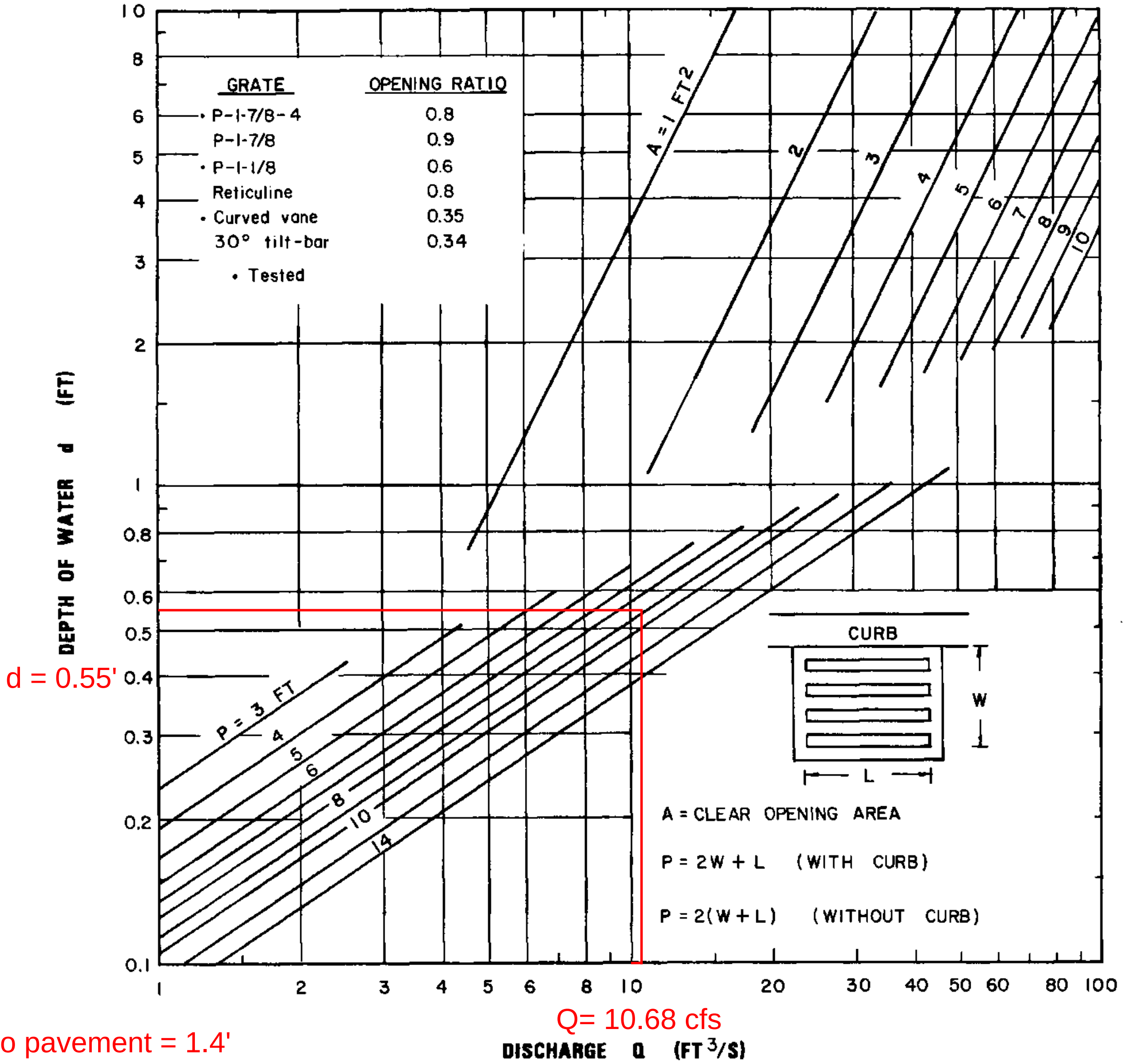
Grate Inlet Capacity in Sump Conditions - English Units

Q= 12 cfs

Neenah R-3475G (3 Grates):
P= 8.9 ft with 50% clogging factor

CB-2

CHART 9B



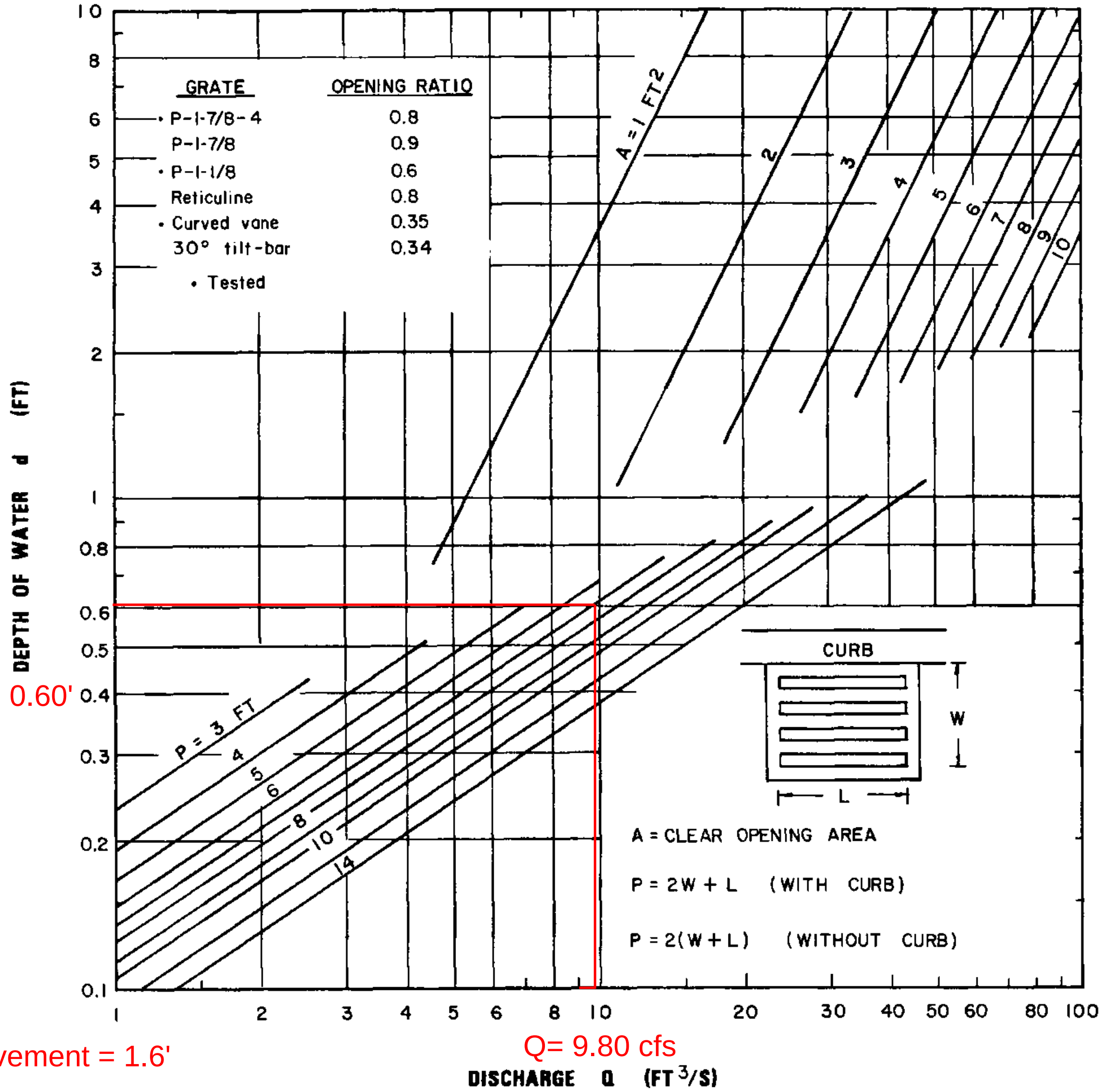
Depth to pavement = 1.4'

Grate Inlet Capacity in Sump Conditions - English Units

Neenah R-3475G (3 Grates):
P= 8.9 ft with 50% clogging factor

CB-3

CHART 9B



d = 0.60'

Q= 9.80 cfs

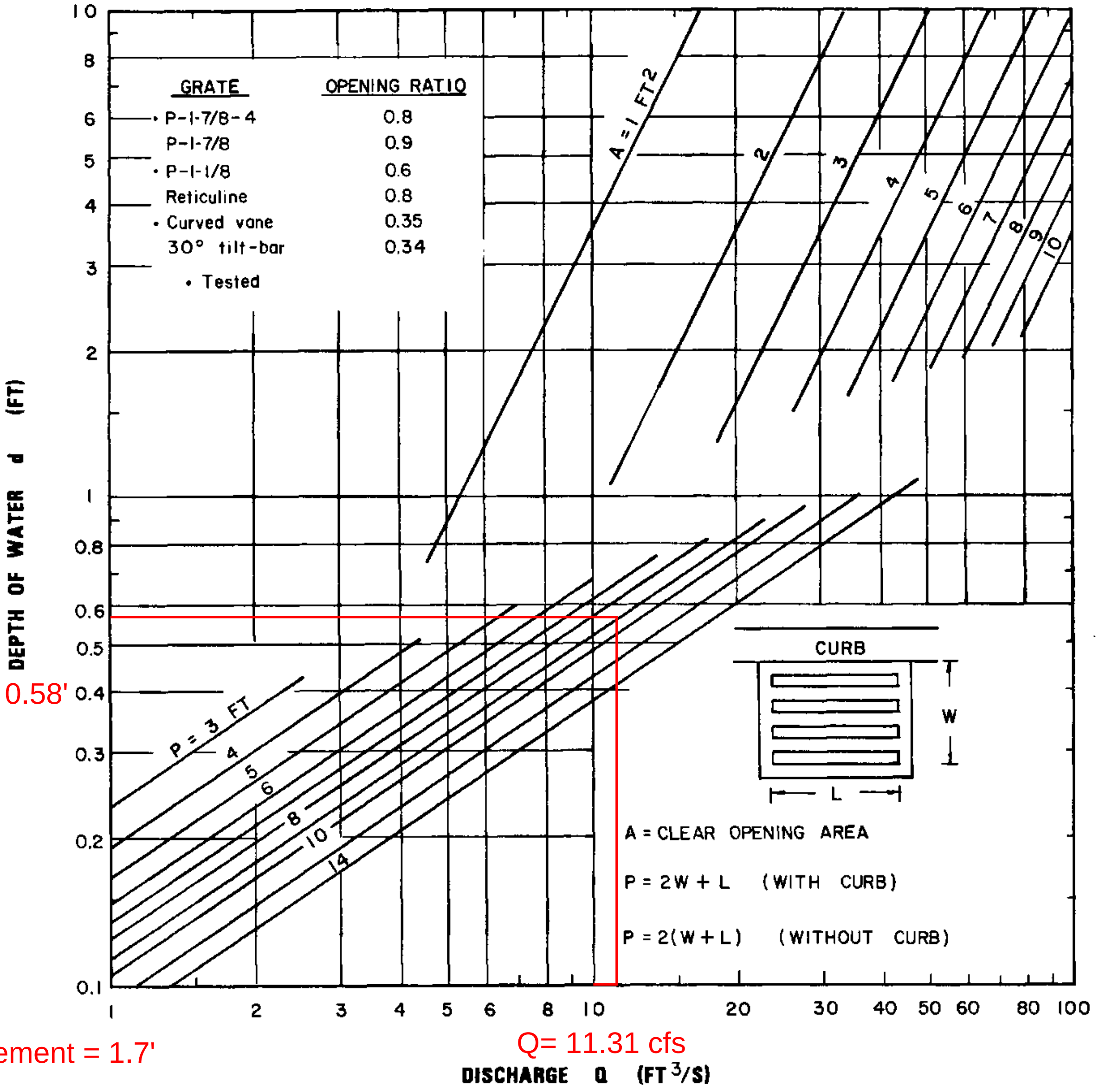
Depth to pavement = 1.6'

Grate Inlet Capacity in Sump Conditions - English Units

Neenah R-3475G (2 Grates):
P= 8.9 ft with 50% clogging factor

CB-4

CHART 9B



d = 0.58'

Q= 11.31 cfs

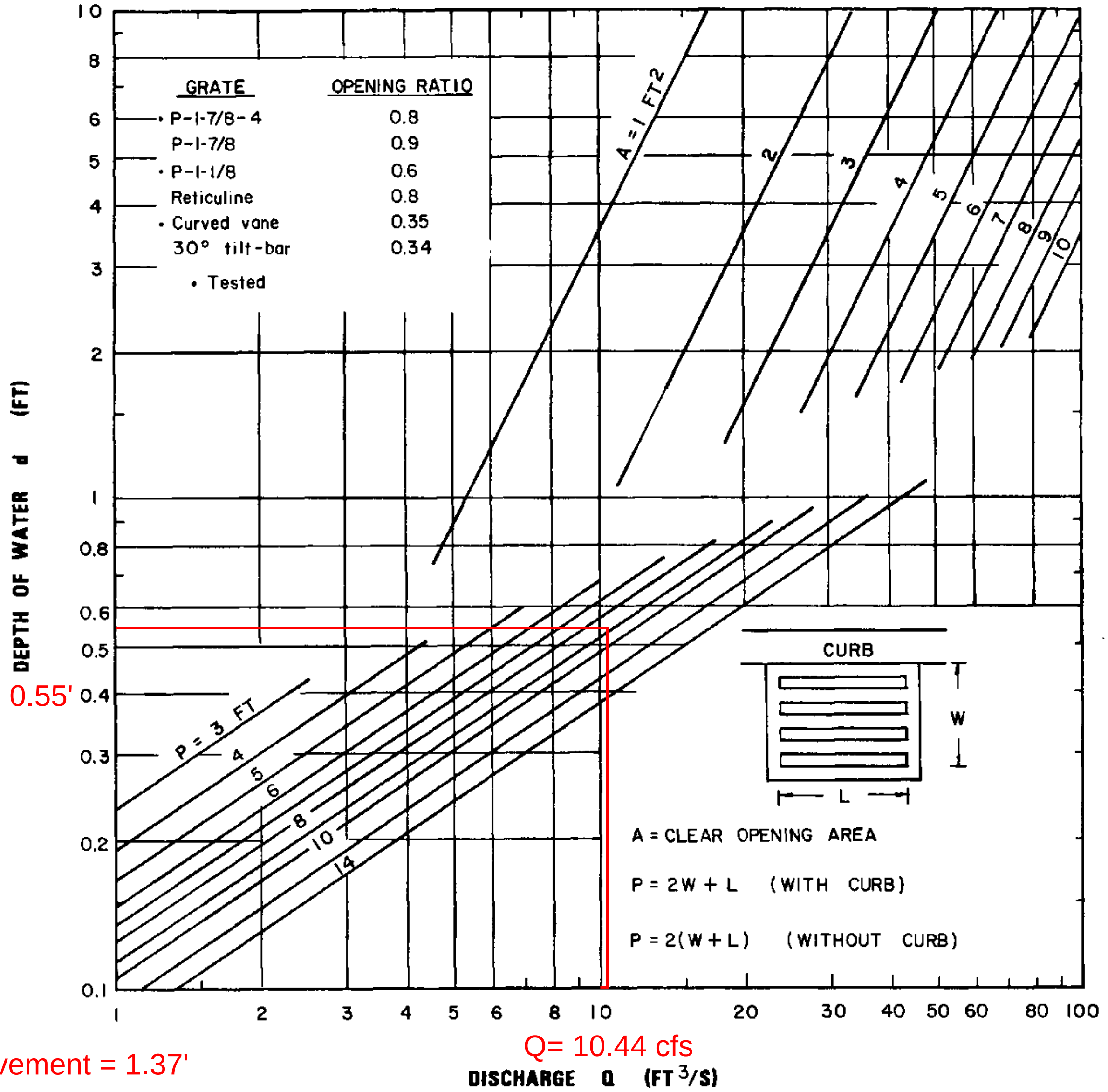
Depth to pavement = 1.7'

Grate Inlet Capacity in Sump Conditions - English Units

Neenah R-3475G (3 Grates):
P= 8.9 ft with 50% clogging factor

CB-6

CHART 9B



d = 0.55'

Q= 10.44 cfs

Depth to pavement = 1.37'

Grate Inlet Capacity in Sump Conditions - English Units

Neenah R-3475G (3 Grates):
P= 8.9 ft with 50% clogging factor

Pipe Calculations

Line A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	12.00 cfs

Results

Normal Depth	15.5 in
Flow Area	2.1 ft²
Wetted Perimeter	3.7 ft
Hydraulic Radius	6.9 in
Top Width	1.91 ft
Critical Depth	14.9 in
Percent Full	64.6 %
Critical Slope	0.006 ft/ft
Velocity	5.59 ft/s
Velocity Head	0.49 ft
Specific Energy	1.78 ft
Froude Number	0.930
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	30.2 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	15.5 in
Critical Depth	14.9 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

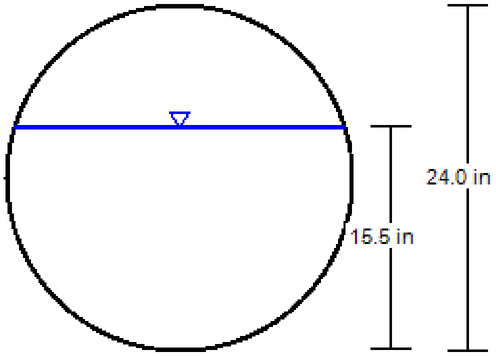
Cross Section for Line A

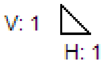
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Normal Depth	15.5 in
Diameter	24.0 in
Discharge	12.00 cfs





Line B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.048 ft/ft
Diameter	24.0 in
Discharge	9.80 cfs

Results

Normal Depth	7.2 in
Flow Area	0.8 ft²
Wetted Perimeter	2.3 ft
Hydraulic Radius	4.1 in
Top Width	1.84 ft
Critical Depth	13.4 in
Percent Full	30.2 %
Critical Slope	0.005 ft/ft
Velocity	12.28 ft/s
Velocity Head	2.34 ft
Specific Energy	2.95 ft
Froude Number	3.282
Maximum Discharge	53.31 cfs
Discharge Full	49.56 cfs
Slope Full	0.002 ft/ft
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	30.2 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	7.2 in
Critical Depth	13.4 in
Channel Slope	0.048 ft/ft
Critical Slope	0.005 ft/ft

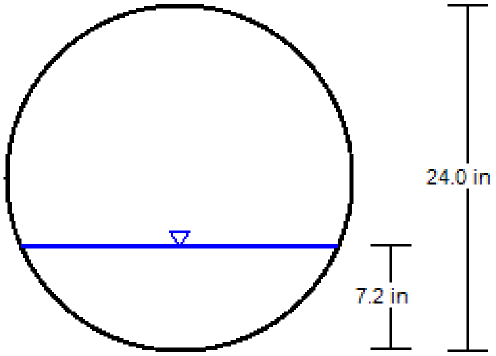
Cross Section for Line B

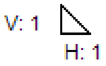
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.048 ft/ft
Normal Depth	7.2 in
Diameter	24.0 in
Discharge	9.80 cfs





Line C

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.038 ft/ft
Diameter	24.0 in
Discharge	11.31 cfs

Results

Normal Depth	8.3 in
Flow Area	1.0 ft²
Wetted Perimeter	2.5 ft
Hydraulic Radius	4.6 in
Top Width	1.90 ft
Critical Depth	14.5 in
Percent Full	34.5 %
Critical Slope	0.005 ft/ft
Velocity	11.75 ft/s
Velocity Head	2.15 ft
Specific Energy	2.84 ft
Froude Number	2.912
Maximum Discharge	47.44 cfs
Discharge Full	44.10 cfs
Slope Full	0.002 ft/ft
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	34.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.3 in
Critical Depth	14.5 in
Channel Slope	0.038 ft/ft
Critical Slope	0.005 ft/ft

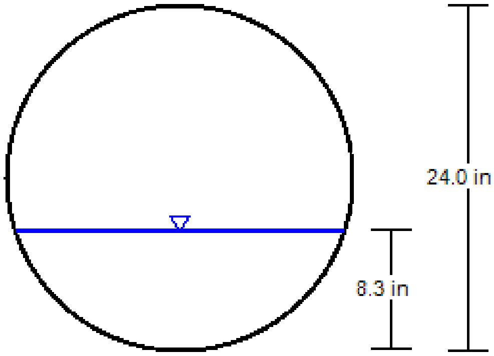
Cross Section for Line C

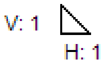
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.038 ft/ft
Normal Depth	8.3 in
Diameter	24.0 in
Discharge	11.31 cfs





Line D

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.034 ft/ft
Diameter	24.0 in
Discharge	10.44 cfs

Results

Normal Depth	8.2 in
Flow Area	0.9 ft²
Wetted Perimeter	2.5 ft
Hydraulic Radius	4.5 in
Top Width	1.90 ft
Critical Depth	13.9 in
Percent Full	34.1 %
Critical Slope	0.005 ft/ft
Velocity	11.04 ft/s
Velocity Head	1.89 ft
Specific Energy	2.58 ft
Froude Number	2.756
Maximum Discharge	44.87 cfs
Discharge Full	41.71 cfs
Slope Full	0.002 ft/ft
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	34.1 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.2 in
Critical Depth	13.9 in
Channel Slope	0.034 ft/ft
Critical Slope	0.005 ft/ft

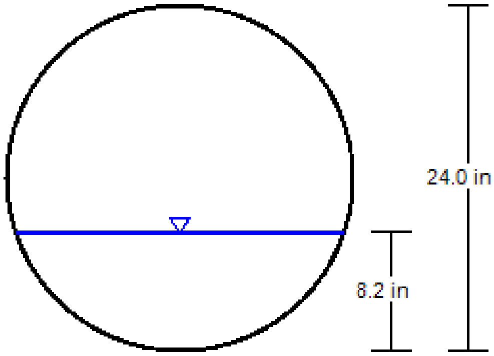
Cross Section for Line D

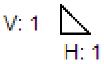
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.034 ft/ft
Normal Depth	8.2 in
Diameter	24.0 in
Discharge	10.44 cfs





WSPG (HGL)

```
FILE: DeerValley_TWC_Line-A.WSW             W S P G W  - EDIT LISTING - Version 14.10               Date: 1-25-2024  Time: 7: 4:23
                                        WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING                              PAGE    1
 CARD  SECT  CHN   NO OF  AVE PIER  HEIGHT 1  BASE    ZL    ZR   INV   Y(1)  Y(2)  Y(3)  Y(4)  Y(5)  Y(6)  Y(7)  Y(8)  Y(9)  Y(10)
 CODE   NO   TYPE PIER/PIP WIDTH    DIAMETER  WIDTH              DROP

 CD      1    4      1             2.000
 CD      2    4      1             2.000
 CD      3    4      1             2.000
                                                       W S P G W                                                      PAGE NO   1
                            WATER SURFACE PROFILE - TITLE CARD LISTING
HEADING LINE NO 1 IS -
                              Deer Valley TWC
HEADING LINE NO 2 IS -
                              Line A
HEADING LINE NO 3 IS -
                              5-year HGL
                                                       W S P G W                                                      PAGE NO   2
                            WATER SURFACE PROFILE - ELEMENT CARD LISTING
 ELEMENT NO   1 IS A SYSTEM OUTLET     *         *     *
                     U/S DATA   STATION    INVERT  SECT                                     W S ELEV
                                    .000 1440.620    1                                       1442.580
 ELEMENT NO   2 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT               N                           RADIUS    ANGLE     ANG PT  MAN H
                                 158.510 1441.810    1               .013                          .000     .000      .000     0
 ELEMENT NO   3 IS A JUNCTION          *         *     *     *                  *                   *               *
                     U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                                 164.180 1441.840    2     0     0   .013      .000      .000      .000      .000    .000     .000
                                                                                                  RADIUS    ANGLE
                                                                                                    .000    .000
 ELEMENT NO   4 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT               N                           RADIUS    ANGLE     ANG PT  MAN H
                                 337.220 1442.710    2               .013                          .000     .000      .000     0
 ELEMENT NO   5 IS A JUNCTION          *         *     *     *                  *                   *               *
                     U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                                 342.890 1442.740    3     0     0   .013      .000      .000      .000      .000    .000     .000
                                                                                                  RADIUS    ANGLE
                                                                                                    .000    .000
 ELEMENT NO   6 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT               N                           RADIUS    ANGLE     ANG PT  MAN H
                                 592.890 1443.990    3               .013                          .000     .000      .000     0
 ELEMENT NO   7 IS A SYSTEM HEADWORKS                  *                      *
                     U/S DATA   STATION    INVERT  SECT                                     W S ELEV
                                 592.890 1443.990    3                                     1443.990
```

```
T1 Deer Valley TWC                                                             0
T2 Line A
T3 5-year HGL
SO       .0001440.620  1                          1442.580
R     158.5101441.810  1      .013                                  .000    .000 0
JX    164.1801441.840  2      .013
R     337.2201442.710  2      .013                                  .000    .000 0
JX    342.8901442.740  3      .013
R     592.8901443.990  3      .013                                  .000    .000 0
SH    592.8901443.990  3                          1443.990
CD   1  4   1    .000   2.000     .000  .000  .000   .00
CD   2  4   1    .000   2.000     .000  .000  .000   .00
CD   3  4   1    .000   2.000     .000  .000  .000   .00
Q            12.000   .0
```

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↑ FILE: DeerValley_TWC_Line-A.WSW             W S P G W - CIVILDESIGN Version 14.08                                         PAGE    1
                                Program Package Serial Number: 7218
                                                    WATER SURFACE PROFILE LISTING                    Date: 1-25-2024  Time: 7: 4:39
                          Deer Valley TWC
                          Line A
                          5-year HGL
 ************************************************************************************************************************** ********
          | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
  Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
  L/Elem  |Ch Slope |        |         |         |       |  SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
 *********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
          |         |        |         |         |               |         |       |        |        |       |       |      |
      .000  1440.620    1.960  1442.580     12.00    3.84     .23  1442.81     .00    1.24      .56    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    26.877    .0075                                              .0025      .07     1.96     .29    1.13    .013       .00   .00  PIPE
          |         |        |         |         |               |         |       |        |        |       |       |      |
    26.877  1440.822    1.802  1442.624     12.00    4.03     .25  1442.88     .00    1.24     1.19    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    16.173    .0075                                              .0026      .04     1.80     .45    1.13    .013       .00   .00  PIPE
          |         |        |         |         |               |         |       |        |        |       |       |      |
    43.050  1440.943    1.697  1442.641     12.00    4.22     .28  1442.92     .00    1.24     1.43    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    12.640    .0075                                              .0028      .04     1.70     .53    1.13    .013       .00   .00  PIPE
          |         |        |         |         |               |         |       |        |        |       |       |      |
    55.690  1441.038    1.610  1442.648     12.00    4.43     .30  1442.95     .00    1.24     1.58    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    10.457    .0075                                              .0031      .03     1.61     .60    1.13    .013       .00   .00  PIPE
          |         |        |         |         |               |         |       |        |        |       |       |      |
    66.147  1441.117    1.533  1442.650     12.00    4.64     .33  1442.98     .00    1.24     1.69    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
     8.751    .0075                                              .0034      .03     1.53     .66    1.13    .013       .00   .00  PIPE
          |         |        |         |         |               |         |       |        |        |       |       |      |
    74.897  1441.182    1.464  1442.646     12.00    4.87     .37  1443.01     .00    1.24     1.77    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
     7.218    .0075                                              .0038      .03     1.46     .73    1.13    .013       .00   .00  PIPE
          |         |        |         |         |               |         |       |        |        |       |       |      |
    82.116  1441.236    1.400  1442.636     12.00    5.11     .41  1443.04     .00    1.24     1.83    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
     3.456    .0075                                              .0043      .01     1.40     .80    1.13    .013       .00   .00  PIPE
          |         |        |         |         |               |         |       |        |        |       |       |      |
    85.572  1441.262    1.341  1442.604     12.00    5.36     .45  1443.05     .00    1.24     1.88    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
 HYDRAULIC JUMP
          |         |        |         |         |               |         |       |        |        |       |       |      |
    85.572  1441.262    1.131  1442.393     12.00    6.55     .67  1443.06     .00    1.24     1.98    2.000     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    14.712    .0075                                              .0075      .11     1.13    1.20    1.13    .013       .00   .00  PIPE
↑ FILE: DeerValley_TWC_Line-A.WSW             W S P G W - CIVILDESIGN Version 14.08                                         PAGE    2
                                Program Package Serial Number: 7218
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                                             WATER SURFACE PROFILE LISTING                   Date: 1-25-2024  Time: 7: 4:39
                          Deer Valley TWC
                          Line A
                          50-year HGL
************************************************************************************************************** ********
         | Invert  |  Depth  |  Water   |    Q     |  Vel     Vel   |  Energy  | Super  |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)   |  Elev    |  (CFS)   | (FPS)    Head  | Grd.El.|  Elev  | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-       -|-        -|-        -|-      -|-      -|-       -|-      -|-      -|-      -|-      -|-      -|-    -|
 L/Elem  |Ch Slope |         |          |          |               SF Ave|    HF    |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
  100.284  1441.373    1.131  1442.504     12.00    6.55     .67  1443.17     .00     1.24     1.98    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   39.848    .0075                                           .0073      .29     1.13     1.20     1.13    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  140.132  1441.672    1.148  1442.820     12.00    6.43     .64  1443.46     .00     1.24     1.98    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   15.713    .0075                                           .0067      .11     1.15     1.17     1.13    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  155.844  1441.790    1.194  1442.984     12.00    6.13     .58  1443.57     .00     1.24     1.96    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
    2.666    .0075                                           .0060      .02     1.19     1.08     1.13    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  158.510  1441.810    1.244  1443.054     12.00    5.84     .53  1443.58     .00     1.24     1.94    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
JUNCT STR   .0053                                            .0054      .03    1.24     1.00              .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  164.180  1441.840    1.268  1443.108     12.00    5.71     .51  1443.61     .00     1.24     1.93    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   20.271    .0050                                           .0051      .10     1.27      .96     1.29    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  184.451  1441.942    1.290  1443.232     12.00    5.60     .49  1443.72     .00     1.24     1.91    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
  152.769    .0050                                           .0050      .76     1.29      .93     1.29    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  337.220  1442.710    1.290  1444.000     12.00    5.60     .49  1444.49     .00     1.24     1.91    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
JUNCT STR   .0053                                            .0051      .03    1.29      .93              .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  342.890  1442.740    1.279  1444.019     12.00    5.66     .50  1444.52     .00     1.24     1.92    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
   27.424    .0050                                           .0051      .14     1.28      .95     1.29    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
  370.314  1442.877    1.292  1444.170     12.00    5.59     .48  1444.65     .00     1.24     1.91    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
  222.576    .0050                                           .0050     1.10     1.29      .93     1.29    .013      .00   .00  PIPE
```

```
                         Line A
                         5-year HGL
************************************************************************************************************************** ********
         | Invert  |  Depth |  Water   |    Q    |  Vel      Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev    |  (CFS)  | (FPS)     Head |  Grd.El.|  Elev |  Depth | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |          |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |          |         |               |         |       |        |        |       |       |      |
  592.890  1443.990    1.292  1445.282     12.00    5.59      .48  1445.77     .00    1.24     1.91    2.000     .000    .00   1   .0
        -|-       -|-      -|-        -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
↑
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 N O T E S
 1. GLOSSARY
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    C = CRITICAL DEPTH
    W = WATER SURFACE ELEVATION
    S = SUPER-ELEVATION
    H = HEIGHT OF CHANNEL
    E = ENERGY GRADE LINE
    X = CURVES CROSSING OVER
    B = BRIDGE ENTRANCE OR EXIT
    Y = WALL ENTRANCE OR EXIT
 2. STATIONS FOR POINTS AT A JUMP MAY NOT BE PLOTTED EXACTLY
```

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FILE: DeerValley_TWC_Line-B.WSW             W S P G W  - EDIT LISTING - Version 14.10              Date: 1-25-2024  Time: 7:43: 1
                                        WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING                         PAGE    1
 CARD  SECT  CHN   NO OF  AVE PIER  HEIGHT 1  BASE     ZL     ZR    INV    Y(1)  Y(2)  Y(3)  Y(4)  Y(5)  Y(6)  Y(7)  Y(8)  Y(9)  Y(10)
 CODE   NO   TYPE PIER/PIP WIDTH    DIAMETER  WIDTH               DROP

 CD      1    4      1             2.000
                                                       W S P G W                                                  PAGE NO   1
                            WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -
                              Deer Valley TWC

HEADING LINE NO 2 IS -
                              Line B

HEADING LINE NO 3 IS -
                              5-year HGL
                                                       W S P G W                                                  PAGE NO   2
                            WATER SURFACE PROFILE - ELEMENT CARD LISTING
 ELEMENT NO   1 IS A SYSTEM OUTLET     *         *     *
                     U/S DATA   STATION    INVERT  SECT                                        W S ELEV
                                   2.560 1449.220    1                                          1452.330
 ELEMENT NO   2 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT              N                               RADIUS    ANGLE     ANG PT  MAN H
                                  12.230 1449.690    1              .013                              .000      .000      .000     0
 ELEMENT NO   3 IS A SYSTEM HEADWORKS                  *                      *
                     U/S DATA   STATION    INVERT  SECT                                        W S ELEV
                                  12.230 1449.690    1                                        1449.690
```

```
T1 Deer Valley TWC                                                             0
T2 Line A
T3 5-year HGL
SO       .0001440.620  1                          1442.580
R     158.5101441.810  1      .013                                  .000    .000 0
JX    164.1801441.840  2      .013
R     337.2201442.710  2      .013                                  .000    .000 0
JX    342.8901442.740  3      .013
R     592.8901443.990  3      .013                                  .000    .000 0
SH    592.8901443.990  3                          1443.990
CD   1  4   1    .000   2.000     .000  .000  .000   .00
CD   2  4   1    .000   2.000     .000  .000  .000   .00
CD   3  4   1    .000   2.000     .000  .000  .000   .00
Q            12.000   .0
```

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↑ FILE: DeerValley_TWC_Line-B.WSW            W S P G W - CIVILDESIGN Version 14.08                                        PAGE    1
                                Program Package Serial Number: 7218
                                                    WATER SURFACE PROFILE LISTING                   Date: 1-25-2024  Time: 7:43: 8
                       Deer Valley TWC
                       Line B
                       5-year HGL
 ************************************************************************************************************************* ********
         | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
 Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
 L/Elem  |Ch Slope |        |         |         |        SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
 *********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |               |         |       |        |        |       |       |      |
    2.560  1449.220   3.110  1452.330     9.80    3.12      .15  1452.48     .00    1.12      .00    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
    9.670    .0486                                         .0019      .02     3.11     .00      .60    .013      .00   .00  PIPE
         |         |        |         |         |               |         |       |        |        |       |       |      |
   12.230  1449.690   2.658  1452.348     9.80    3.12      .15  1452.50     .00    1.12      .00    2.000     .000   .00   1   .0
        -|-       -|-      -|-       -|-       -|-      -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    |-
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 FILE: DeerValley_TWC_Line-C.WSW             W S P G W  - EDIT LISTING - Version 14.10              Date:
1-25-2024  Time: 7:46:44
                                         WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING
            PAGE    1
  CARD  SECT  CHN   NO OF  AVE PIER  HEIGHT 1  BASE    ZL    ZR   INV   Y(1)  Y(2)  Y(3)  Y(4)  Y(5)  Y(6)
Y(7)  Y(8)  Y(9)  Y(10)
  CODE   NO   TYPE PIER/PIP WIDTH    DIAMETER  WIDTH              DROP

  CD      1    4      1             2.000
                                                        W S P G W
          PAGE NO   1
                             WATER SURFACE PROFILE - TITLE CARD LISTING

 HEADING LINE NO 1 IS -        Deer Valley TWC

 HEADING LINE NO 2 IS -        Line C

 HEADING LINE NO 3 IS -        5-year HGL
                                                        W S P G W
          PAGE NO   2
                             WATER SURFACE PROFILE - ELEMENT CARD LISTING
  ELEMENT NO    1 IS A SYSTEM OUTLET     *         *     *
                      U/S DATA   STATION    INVERT  SECT                                        W S ELEV
                                    2.840 1450.650    1                                          1452.850
  ELEMENT NO    2 IS A REACH             *         *     *
                      U/S DATA   STATION    INVERT  SECT              N                               RADIUS
ANGLE     ANG PT  MAN H
                                   16.600 1451.190    1              .013                              .000
.000      .000     0
  ELEMENT NO    3 IS A SYSTEM HEADWORKS                  *                      *
                      U/S DATA   STATION    INVERT  SECT                                        W S ELEV
                                   16.600 1451.190    1                                        1451.190
```

```
T1 Deer Valley TWC                                                             0
T2 Line C
T3 5-year HGL
SO      2.8401450.650  1                          1452.850
R      16.6001451.190  1      .013                                  .000    .000 0
SH     16.6001451.190  1                          1451.190
CD   1  4   1    .000   2.000     .000  .000  .000   .00
Q            11.310   .0
```

```
100
↑
↑ FILE: DeerValley_TWC_Line-C.WSW            W S P G W - CIVILDESIGN Version 14.08                                        PAGE    1
                                 Program Package Serial Number: 7218
                                                     WATER SURFACE PROFILE LISTING                      Date: 1-25-2024  Time: 7:46:50
                         Deer Valley TWC
                         Line C
                         5-year HGL
 ************************************************************************************************************************* ********
          | Invert  | Depth  | Water   |    Q    | Vel     Vel  | Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
  Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)   Head | Grd.El.| Elev  | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
         -|-       -|-      -|-       -|-       -|-      -|-    -|-      -|-     -|-      -|-      -|-     -|-     -|-    -|
  L/Elem  |Ch Slope |        |         |         |        SF Ave|   HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
*********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
         |         |        |         |         |              |         |       |        |        |       |       |       |
    2.840  1450.650    2.200  1452.850     11.31     3.60     .20  1453.05     .00     1.21      .00    2.000     .000    .00   1    .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-      -|-     -|-      -|-      -|-     -|-     -|-    |-
    5.443    .0392                                       .0025      .01     2.20      .00      .68    .013       .00    .00  PIPE
         |         |        |         |         |              |         |       |        |        |       |       |       |
    8.283  1450.864    2.000  1452.864     11.31     3.60     .20  1453.06     .00     1.21      .00    2.000     .000    .00   1    .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-      -|-     -|-      -|-      -|-     -|-     -|-    |-
    4.449    .0392                                       .0023      .01     2.00      .00      .68    .013       .00    .00  PIPE
         |         |        |         |         |              |         |       |        |        |       |       |       |
   12.732  1451.038    1.815  1452.853     11.31     3.78     .22  1453.07     .00     1.21     1.16    2.000     .000    .00   1    .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-      -|-     -|-      -|-      -|-     -|-     -|-    |-
    2.314    .0392                                       .0023      .01     1.81      .41      .68    .013       .00    .00  PIPE
         |         |        |         |         |              |         |       |        |        |       |       |       |
   15.046  1451.129    1.707  1452.836     11.31     3.96     .24  1453.08     .00     1.21     1.41    2.000     .000    .00   1    .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-      -|-     -|-      -|-      -|-     -|-     -|-    |-
    1.554    .0392                                       .0024      .00     1.71      .49      .68    .013       .00    .00  PIPE
         |         |        |         |         |              |         |       |        |        |       |       |       |
   16.600  1451.190    1.629  1452.819     11.31     4.13     .26  1453.08     .00     1.21     1.56    2.000     .000    .00   1    .0
        -|-       -|-      -|-       -|-       -|-      -|-    -|-      -|-     -|-      -|-      -|-     -|-     -|-    |-
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 N O T E S
 1. GLOSSARY
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 2. STATIONS FOR POINTS AT A JUMP MAY NOT BE PLOTTED EXACTLY
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FILE: DeerValley_TWC_Line-D.WSW             W S P G W  - EDIT LISTING - Version 14.10               Date: 1-25-2024  Time: 7:50:34
                                        WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING                              PAGE    1
 CARD  SECT  CHN   NO OF  AVE PIER  HEIGHT 1  BASE    ZL    ZR   INV   Y(1)  Y(2)  Y(3)  Y(4)  Y(5)  Y(6)  Y(7)  Y(8)  Y(9)  Y(10)
 CODE   NO   TYPE PIER/PIP WIDTH    DIAMETER  WIDTH              DROP

 CD      1    4      1             1.500
                                                       W S P G W                                                      PAGE NO   1
                            WATER SURFACE PROFILE - TITLE CARD LISTING
HEADING LINE NO 1 IS -
                              Deer Valley TWC
HEADING LINE NO 2 IS -
                              Line D
HEADING LINE NO 3 IS -
                              5-year HGL
                                                       W S P G W                                                      PAGE NO   2
                            WATER SURFACE PROFILE - ELEMENT CARD LISTING
 ELEMENT NO   1 IS A SYSTEM OUTLET     *         *     *
                     U/S DATA   STATION    INVERT  SECT                                     W S ELEV
                                   2.840 1457.680    1                                       1459.000
 ELEMENT NO   2 IS A REACH             *         *     *
                     U/S DATA   STATION    INVERT  SECT               N                           RADIUS    ANGLE     ANG PT  MAN H
                                   7.980 1457.850    1               .013                          .000     .000      .000     0
 ELEMENT NO   3 IS A SYSTEM HEADWORKS                  *                      *
                     U/S DATA   STATION    INVERT  SECT                                     W S ELEV
                                   7.980 1457.850    1                                     1457.850
```

```
T1 Deer Valley TWC                                                                      0
T2 Line D
T3 5-year HGL
SO      2.8401457.680  1                          1459.000
R       7.9801457.850  1      .013                                          .000    .000 0
SH      7.9801457.850  1                          1457.850
CD   1  4   1    .000   1.500     .000  .000  .000   .00
Q            10.440   .0
```

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↑ FILE: DeerValley_TWC_Line-D.WSW             W S P G W - CIVILDESIGN Version 14.08                                         PAGE    1
                                Program Package Serial Number: 7218
                                                    WATER SURFACE PROFILE LISTING                    Date: 1-25-2024  Time: 7:50:45
                          Deer Valley TWC
                          Line D
                          5-year HGL
 ************************************************************************************************************************** ********
          | Invert  |  Depth |  Water  |    Q    |  Vel     Vel  |  Energy | Super |Critical|Flow Top|Height/|Base Wt|      |No Wth
  Station |  Elev   |  (FT)  |  Elev   |  (CFS)  | (FPS)    Head |  Grd.El.|  Elev | Depth  | Width  |Dia.-FT|or I.D.|  ZL  |Prs/Pip
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-    -|
  L/Elem  |Ch Slope |        |         |         |         SF Ave|    HF   |SE Dpth|Froude N|Norm Dp |  "N"  | X-Fall|  ZR  |Type Ch
 *********|*********|********|*********|*********|*******|*******|*********|*******|********|********|*******|*******|***** |*******
          |         |        |         |         |       |       |         |       |        |        |       |       |      |
     2.840  1457.680    1.033  1458.713     10.44    8.04    1.00  1459.72     .00    1.24     1.39    1.500     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
     2.165    .0331                                         .0140      .03    1.03     1.47     .79    .013       .00   .00  PIPE
          |         |        |         |         |       |       |         |       |        |        |       |       |      |
     5.005  1457.752    1.075  1458.826     10.44    7.70     .92  1459.75     .00    1.24     1.35    1.500     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
     1.654    .0331                                         .0126      .02    1.07     1.36     .79    .013       .00   .00  PIPE
          |         |        |         |         |       |       |         |       |        |        |       |       |      |
     6.660  1457.806    1.125  1458.931     10.44    7.35     .84  1459.77     .00    1.24     1.30    1.500     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
      .982    .0331                                         .0113      .01    1.12     1.24     .79    .013       .00   .00  PIPE
          |         |        |         |         |       |       |         |       |        |        |       |       |      |
     7.641  1457.839    1.180  1459.018     10.44    7.00     .76  1459.78     .00    1.24     1.23    1.500     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
      .339    .0331                                         .0102      .00    1.18     1.12     .79    .013       .00   .00  PIPE
          |         |        |         |         |       |       |         |       |        |        |       |       |      |
     7.980  1457.850    1.242  1459.092     10.44    6.67     .69  1459.78     .00    1.24     1.13    1.500     .000   .00   1   .0
         -|-       -|-      -|-       -|-       -|-     -|-     -|-       -|-     -|-      -|-      -|-     -|-     -|-     |-
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    H = HEIGHT OF CHANNEL
    E = ENERGY GRADE LINE
    X = CURVES CROSSING OVER
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 2. STATIONS FOR POINTS AT A JUMP MAY NOT BE PLOTTED EXACTLY
```

Appendix C: Construction Documents (Under Separate Cover)

Appendix D: Pre-Design Meeting Agenda

MEETING AGENDA

Date: October 24, 2022 **Time:** 2:00 PM – 3:00 PM

Project: DVT Taxiway C Connectors C4-C10 – AV31000096 FAA | TC# 221004

Subject: **Design Kick-off Meeting**

Attendees: See sign-in sheet

I. INTRODUCTIONS

II. KEY DESIGN PHASE CONTACTS

COP Aviation	Bennett Sloan, PE	bennett.sloan@phoenix.gov	602-316-0588
TRACE Consulting	Chintan Jhaveri, PE	cjhaveri@traceconsulting.us	602-680-8264
TRACE Consulting	Greg Shaw, PE	gshaw@traceconsulting.us	480-229-9401

III. PROJECT OVERVIEW, SCOPE AND FUNDING

- Project Scope
  - Design of three new 90-degree connectors – C4, C7 and C10
  - Design of three new acute angle connectors – C5, C6 and C9
  - Design of fillet geometry for existing connector C9 (rename to C8)
  - Drainage and Electrical Improvements as needed
- Design Criteria
  - Design Aircraft / ADG / TDG
- Project Funding and Phasing

IV. KEY PROJECT TASKS AND ISSUES

- Records Research and Data Collection
- Field Data Collection
  - Topographic Survey
  - Soil Exploration
  - Utility Designating
- Geotechnical Investigation / Pavement Section
  - Fleet Mix
- Geometrics Development
- Grading / Drainage Design
- Electrical Design
  - Airfield Electrical
- Construction Safety and Phasing Plan

- Other Issues
    - Operations Issues
    - Environmental Issues and Clearances

V. PROJECT SCHEDULE

- NTP Received – Friday, October 21, 2022
- Design Kick-off – Monday, October 24, 2022
- 30% Submittal – Friday, April 28, 2022
- Future Submittals and Packaging to be determined based on available funding

VI. OTHER ITEMS

- Anticipated Construction Schedule

Distribution: All attendees

N:\2022\221004 - DVT Taxiway C Connectors C4-C10\Project Support\Meetings\Kick-off Meetings 2022-10-24\DVT TWY C Connectors C4-C10 - Design Kickoff Agenda 2022-10-24.docx

Aviation Design and Construction Services
Meeting Sign-In

Date: October 24, 2022

Meeting Purpose: Design Kick-Off Meeting

Location: Sky Harbor Airport

Project: DVT Taxiway C Connectors C4-C10

Project No. AV31000096

Project Manager: Bennett Sloan

	NAME (Please Print)	FIRM	PHONE NUMBER	E-MAIL
1.	Bennett Sloan	Aviation-DCS (Hill/Red Brick)	602-316-0588	bennett.sloan@phoenix.gov
2.	Amy Santilli	TRACE Consulting	480-321-5375	asantilli@traceconsulting.us
3.	Cathy Alcorn	CR Engineers	602-448-9570	Calcorn@creng.com
4.	Chintan Jhaveri	TRACE Consulting	602-680-8264	cjhaveri@traceconsulting.us
5.	MARIO Mejia	City of Phoenix	602-273-8887	Mario.mejia@phoenix.gov
6.				
7.	Ed Faron	COP/		joined online.
8.	Joel Quinn			
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				