OCTOBER 25, 2021

SITE CHARACTERIZATION REPORT

CENTRAL TUCSON PFAS PROJECT
TUCSON, ARIZONA

PREPARED FOR:
ARIZONA DEPARTMENT OF
ENVIRONMENTAL QUALITY

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

Site Characterization Report

Central Tucson PFAS Project
Tucson, Arizona

October 25, 2021

Prepared for
Arizona Department of Environmental Quality
Tucson, Arizona

Prepared by
Hargis + Associates, Inc.
Tucson, Arizona

This report was prepared under supervision
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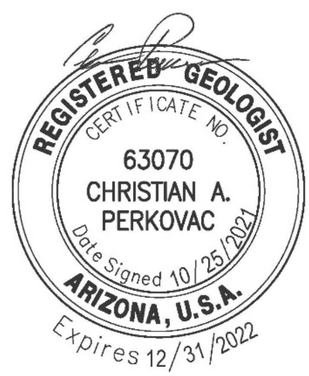

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ACRONYMS AND ABBREVIATIONS

%R	percent recovery
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AFCEC	Air Force Civil Engineer Center
AFFF	Aqueous Film Forming Foam
AMA	Tucson Active Management Area
amsl	above mean sea level
bgs	below ground surface
btw	below the top of the water table
CAP	Central Arizona Project
CSM	Conceptual Site Model
CTI	Chemical Transportation Inc.
CTPP	Central Tucson Per- and polyfluorinated alkyl substances (PFAS) Project
DMAFB	Davis Monthan Air Force Base
EB	equipment blank
EPA	United States Environmental Protection Agency
FCSM	Focused Conceptual Site Model
FRB	Field1 Reagent Blank
ft/ft	feet per foot
g/Kg	grams per kilogram
gpm	gallons per minute
H+A	Hargis + Associates, Inc.
HAL	health advisory level
KERP	Kino Environmental Restoration Project
LDC	Laboratory Data Consultants
MS	matrix spikes
MSD	matrix spike duplicates
ng/L	nanograms per liter
NOI	Notice of Intent
NTU	nephelometric turbidity units

ACRONYMS AND ABBREVIATIONS (continued)

PFAA	perfluoroalkyl acids
PFAS	per- and polyfluoroalkyl substances
PFBA	perfluorobutanoic acid
PFBS	perfluorobutanesulfonic acid / perfluorobutane sulfonate
PFHpA	perfluoroheptanoic acid / perfluoroheptanoate
PFHpS	perfluoroheptanesulfonic acid / perfluoroheptanesulfonate
PFHxA	perfluorohexanoic acid / perfluorohexanoate
PFHxS	perfluorohexanesulfonic acid / perfluorohexane sulfonate
PFOA	perfluorooctanoic acid / perfluorooctanoate
PFOS	perfluorooctanesulfonic acid / perfluorooctane sulfonate
PFOSA	perfluorooctanesuifonamide
PFPeA	perfluoropentanoic acid
PFPeS	perfluoropentanesulfonic acid
PID	photoionization detectors
ppt	parts per trillion measured in nanograms per liter
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan, Central Tucson PFAS Project
ROW	right of way
RPD	relative percent difference
SOP	standard operating procedure
TOC	total organic carbon
Trafficade	Trafficade Services Companies
TSI	Terra Sonic International
TW-OWQT	Tucson Water – operational water quality target
µg/Kg	micrograms per kilogram
USAF	United States Air Force
USCS	Unified Soil Classification System
VOC	volatile organic compound
YJD	Yellow Jacket Drilling Services

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ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

EXECUTIVE SUMMARY

Per and Poly-fluoroalkyl Substances (PFAS) are a group of man-made chemicals found in many consumer and industrial products (EPA, 2020). Airports and military installations that used PFAS-containing firefighting foams are some of the main sources of PFAS releases (EPA, 2020). PFAS have been detected in soil, sediment, and groundwater at Davis-Monthan Airforce Base (DMAFB) located in Tucson, Arizona (AMEC 2018, 2019b). In 2016, the United States Environmental Protection Agency (EPA) issued a drinking water Health Advisory Level (HAL) for two PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). The EPA HAL for combined PFOA and PFOS concentrations in water is 70 nanograms per liter (ng/l), commonly expressed as 70 parts per trillion (ppt) (EPA, 2016c). This report will use “ppt” for simplicity. Tucson Water, the primary drinking water service provider in the area, has set an internal operational water quality target (TW-OWQT) for the following six PFAS (Tucson Water, 2021).

- 18 ppt for combined total for PFOS, PFOA, Perfluorohexanesulfonic acid (PFHxS), and Perfluoroheptanoic acid (PFHpA),
- 11 ppt for PFOA,
- 7 ppt for PFOS,
- 7 ppt for PFHxS
- 200,000 ppt for Perfluorohexanoic acid (PFHxA), and
- 420 ppt for Perfluorobutanesulfonic acid (PFBS).

Tucson Water began sampling for PFAS, including PFOA and PFOS, in the regional aquifer wells near DMAFB in 2016 (Figure 2). Based on results of sampling, the utility has discontinued use of four drinking water supply wells located near DMAFB (C-007A, C-014B, C-036B and C-008B)

EXECUTIVE SUMMARY (continued)

because of PFAS contamination. If PFAS, including PFOA and PFOS, continue to migrate downgradient, several additional drinking water production wells in Tucson Water's central wellfield will be impacted and possibly removed from service, which will reduce the available water supply for the City of Tucson.

In 2020 the Arizona Department of Environmental Quality (ADEQ) initiated the Central Tucson PFAS Project (CTPP) to protect the central wellfield from PFOA+PFOS contamination. To accomplish the study objectives, several tasks, as outlined in the Work Plan, were performed concurrently. These included:

- Multi-media sampling has included the collection of soil and groundwater samples. The data collected has been used to develop a detailed conceptual site model (CSM) and will inform the modeling effort, remedial alternatives evaluation, and remedy design.
- Data collected during the field investigation and the results of treatability testing are being used to assess alternatives for remedial action. The final remedy design and construction will be based on a thorough evaluation of feasible alternatives as well as bench-, pilot-, and/or demonstration-scale tests.
- A groundwater model was developed based on the Arizona Department of Water Resources (ADWR) Tucson Active Management Area (AMA) regional groundwater flow model. This model has been refined and updated with the results of field characterization efforts. This modeling effort helped to inform decision making for fieldwork and will assist in remedial alternatives evaluation and remedy design. The results of the groundwater modeling will be reported separately.

Field data collection activities included the drilling of seven soil borings (AZSB-01 through -07), collection of soil and in situ groundwater samples, laboratory analyses of samples to determine soil characteristics and verify the presence and concentrations of PFAS, construction and development of seven monitor wells, and collection of groundwater samples from newly constructed monitor wells and select Tucson Water wells. A plume of dissolved PFAS exceeding the TW-OWQT has been detected that extends within the regional aquifer approximately 2 miles downgradient from DMAFB. Detected PFAS concentrations throughout the area have ranged from below the laboratory detection limit to thousands of ppt. The highest concentrations of PFAS north of DMAFB were detected in C-007A and during drilling of AZSB-01; these are located adjacent to each other, less than 400 ft downgradient of DMAFB. Concentrations decrease cross-gradient and downgradient from this location.

PFAS were detected above the TW-OWQT but below the HAL in wells B-019B and WR-127A, which are located west of the plume and separated from the plume by non-detect results in wells B-110A and AZMW-06. This may indicate a separate area of dissolved PFAS that has not been fully defined. However, PFAS were not detected above the HAL or TW-OWQT to the north/northwest (downgradient) of this area in wells WR-128A or B-013B, indicating the northern extent of PFAS detections in this area is limited.

The vertical distribution of PFAS within the regional aquifer was assessed by collecting and analyzing *in situ* groundwater samples during the drilling of AZSB-01 to AZSB-07 and multi-depth interval sampling in completed monitor wells. The highest concentrations of PFAS were detected at AZSB-01 from 325 to 385 feet below ground surface (bgs), or 35 feet to 95 feet below the top of the water table (btw). Farther downgradient at AZSB-02, the highest concentrations of PFAS were detected at 338 feet to 458 feet bgs, or 58 feet to 178 feet btw. Near the end of the PFAS plume at AZSB-03, the maximum concentration was detected at a depth of 475 feet bgs or 189 feet btw. Although these are *in situ* samples and constitute only a single sampling round, the observed changes in maximum concentration depths may indicate that the PFAS plume is diving slightly. PFAS exceeded the HAL as deep as 545 feet bgs in AZSB-01 and as deep as 458 feet bgs in AZSB-02.

Groundwater elevations in the area have historically been much higher. For example, near AZMW-01 and AZMW-02, the water table was approximately 70 feet higher in the 1970’s. However, groundwater elevations in the area have recently been steady or even increasing due

EXECUTIVE SUMMARY (continued)

to the City of Tucson's increased use of water from the Central Arizona Project, which has reduced pumping from the Central Wellfield. The estimated groundwater flow direction, based on the water level gauging event conducted in March 2021, is north to northwest across the area. The observed groundwater gradient near the northwest boundary of DMAFB was approximately 0.004 feet per foot (ft/ft) with a flow to the north. North of Broadway Blvd, the groundwater flow direction has a larger westerly component with a gradient of approximately 0.002 ft/ft.

No evidence of significant or continuous fine-grained layers that could cause perching of groundwater or confining of groundwater within the upper basin fill was observed, nor were any obvious continuous clean sand or gravel layers that could be preferential flow paths observed. Perched groundwater was not encountered during drilling activities. The lithologic sequence observed is typical of the alluvial fill associated with alluvial fans and fluvial systems that deposited the sediments in the Upper Santa Cruz Basin and are commonly observed in the Basin and Range Province.

Results of sampling and observations in the field do not indicate that geologic deposition is strongly affecting PFAS plume movement in this area. The observed downward movement does not appear to be caused by site geology but more likely has been influenced by temporal, pumping-induced gradients. A typical dispersed plume front has been observed that may be caused in part by adsorption to soils in the aquifer. However, the plume shape may also be impacted by source zone dynamics and release timing. The recreation of historical plume movement is presently speculative due to lack of knowledge about source area including the timing of release(s), release mass, and residual mass.

All Tucson Water production wells within the observed area of contamination exceeding the HAL and TW-OWQT have been removed from service. ADEQ also identified 24 properties within two miles of DMAFB where information indicated a private well might be present. Property owners were provided written notification with information on PFOA and PFOS and a request to contact ADEQ to confirm the existence and use of their well. Four property owners responded to the notification and each requested that their well be sampled. PFOA and PFOS were not detected in any of the samples collected. Because PFAS have not been identified above the EPA HAL or TW-OWQT in any active wells to date, no complete exposure pathways are known to exist.

Several additional actions are planned to support the design and implementation of a remedy that will hydraulically contain the PFAS plume and prevent further impact to the Tucson Water central wellfield. Additional sampling of the well network will be conducted to confirm previous sampling results and available data from the AF Remedial Investigation will be analyzed to improve understanding of contaminant fate and transport. A demonstration treatment system is currently being constructed with startup expected in late 2021. The system will utilize the inactive Tucson Water well C-007 to extract and treat contaminated groundwater in the area of highest concentration detected north of DMAFB. The system will provide valuable data on treatment technologies and mass removal. And finally, aquifer testing will be conducted in the area to enhance the groundwater model and provide data to be used in the design of a full-scale treatment system.

SITE CHARACTERIZATION REPORT

CENTRAL TUCSON PFAS PROJECT

TUCSON, ARIZONA

1.0 INTRODUCTION

This Site Characterization Report (Report) has been prepared by Hargis + Associates, Inc. (H+A) and the Arizona Department of Environmental Quality (ADEQ), for the Central Tucson Per- and Polyfluoroalkyl Substances (PFAS) Project (CTPP), located in Tucson, Arizona (the Site) (Figure 1).

PFAS are a group of man-made chemicals found in many consumer and industrial products (EPA, 2020). Airports and military installations that used PFAS-containing firefighting foams are some of the main sources of PFAS releases (EPA, 2020). PFAS have been detected in soil, sediment, and groundwater at Davis-Monthan Airforce Base (DMAFB) located in Tucson, Arizona (AMEC 2018, 2019b). In 2016, the United States Environmental Protection Agency (EPA) issued a drinking water Health Advisory Level (HAL) for two PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). The EPA HAL for combined PFOA and PFOS concentrations in water is 70 nanograms per liter (ng/l), (EPA, 2016c), commonly expressed as 70 parts per trillion (ppt). This report will use “ppt” for simplicity. Tucson Water, the primary drinking water service provider in the area, has set an internal operational water quality target (TW-OWQT) for the following six PFAS (Tucson Water, 2021).

- 18 ppt for combined total for PFOS, PFOA, Perfluorohexanesulfonic acid (PFHxS), and Perfluoroheptanoic acid (PFHpA),
- 11 ppt for PFOA,
- 7 ppt for PFOS,
- 7 ppt for PFHxS
- 200,000 ppt for Perfluorohexanoic acid (PFHxA), and
- 420 ppt for Perfluorobutanesulfonic acid (PFBS).

Tucson Water, which owns and operates numerous groundwater wells downgradient of DMAFB, began sampling for PFAS, including PFOA and PFOS, in the regional aquifer wells near DMAFB in 2016 (Figure 2). The maximum combined concentration of PFOA and PFOS has been 3,220 ppt, collected from well C-007A in October 2017. Tucson Water discontinued use of four drinking water supply wells located near DMAFB (C-007A, C-014B, C-036B and C-008B) because of PFAS contamination (Figure 2).

If PFAS, including PFOA and PFOS, continue to migrate downgradient, several additional drinking water production wells in Tucson Water's central wellfield will be impacted and possibly removed from service, which will reduce the available water supply for the City of Tucson. Tucson Water currently relies primarily on Colorado river water delivered by the Central Arizona Project (CAP). However, the central wellfield is the backup water source for over 600,000 people and is the sole alternate drinking water supply to the CAP for central Tucson.

In 2020 ADEQ initiated the CTPP to protect the central wellfield from PFOA+PFOS contamination above the EPA HAL of 70 ppt (ADEQ, 2020b). In August 2020 ADEQ published the "Final Work Plan, Central Tucson PFAS Project" (Work Plan) (ADEQ, 2020b) and "Quality Assurance Project Plan, Central Tucson PFAS Project" (QAPP) (ADEQ, 2020a). The Work Plan included drilling up to eight soil borings and monitor wells to help characterize the nature and extent of PFOA+PFOS exceeding the 70 ppt EPA HAL in the regional aquifer near DMAFB.

1.1 PURPOSE AND SCOPE

The purpose and scope of this report is to document the characterization of PFAS in groundwater north of DMAFB in accordance with the CTPP Work Plan (ADEQ, 2020b). The report includes incorporation of the hydrogeologic and groundwater quality monitoring results into a conceptual site model (CSM) for PFAS in groundwater and discusses the path forward for mitigation of the identified impacts.

1.2 PROJECT TASKS AND OBJECTIVES

As stated in the Work Plan, the primary objective of this study is to prevent PFAS in groundwater from reaching any additional Tucson drinking water supply wells by characterizing the nature and extent of PFOA+PFOS in the regional aquifer near DMAFB. Data collected will be used to evaluate potential remedial alternatives and to design and implement a remedy that will hydraulically contain the PFAS plume and prevent further impact to the Tucson Water Central Wellfield by PFOA+PFOS contamination. In addition to the EPA HAL, exceedances of the TW-OWQT are also noted in this report.

To accomplish the study objectives, several tasks, as outlined in the Work Plan, were performed concurrently. These included:

- A groundwater model was developed based on the Arizona Department of Water Resources (ADWR) Tucson Active Management Area (AMA) regional groundwater flow model. This model has been refined and updated with the results of field characterization efforts. This modeling effort helped to inform decision making for fieldwork and will assist in remedial alternatives evaluation and remedy design. The results of the groundwater modeling will be reported separately.
- Multi-media sampling has included collection of soil and groundwater samples. The data collected has been used to develop a detailed CSM and will inform the modeling effort, remedial alternatives evaluation, and remedy design.
- Data collected during the field investigation and the results of treatability testing are being used to assess alternatives for remedial action. The final remedy design and construction will be based on a thorough evaluation of feasible alternatives as well as bench-, pilot-, and/or demonstration-scale tests.

This report presents the results of multi-media sampling and includes:

- Discussion of drilling and sampling of seven soil borings (AZSB-01 to AZSB-07) downgradient of the DMAFB,
- Analytical results from the soil and groundwater samples collected from the soil borings during the drilling process,
- A description of conversion of the seven soil borings to monitor wells (AZMW-01 to AZMW-07),

- A description of development, monitoring and groundwater sampling of seven monitor wells, and
- A description of monitoring and groundwater sampling at select Tucson Water wells.

1.3 COMPLETION SCHEDULE

Drilling activities commenced on October 13, 2020, with the drilling of soil boring AZSB-01 utilizing a Terra Sonic International (TSi) 150T drill rig operated by Yellow Jacket Drilling Services (YJD). A second TSi 150T drill rig set up at the location of soil boring AZSB-02 on October 28, 2020. After the construction of monitor wells AZMW-01 and AZMW-02, the first drill rig moved to soil boring location AZSB-03 on November 20, 2020, and the second drill rig set up on location AZSB-04 on November 17, 2020. After the construction of monitor wells AZMW-03 and AZMW-04 were complete, the first drill rig moved to soil boring location AZSB-05 on December 15, 2020, and second drill rig moved to location AZSB-06 on December 15, 2020. After the construction of monitor wells AZMW-05 and AZMW-06 was complete drilling was paused over the Christmas holiday break. Drilling activities resumed on January 4, 2021, with the first rig drilling at soil boring location AZSB-07. Well construction activities concluded at monitor well AZMW-07 on February 08, 2021.

Between January 4 and February 23, 2021, monitor wells AZMW-01, AZMW-02, AZMW-03, AZMW-04, AZMW-05, AZMW-06 and AZMW-07 were developed by YJD. Subsequent to development, during the period February 23rd to March 4th, 2021, monitor wells AZMW-01, AZMW-02, AZMW-03, AZMW-04, AZMW-05, AZMW-06 and AZMW-07 were sampled for PFAS analysis.

In 2020 and 2021, groundwater samples were collected from 13 Tucson Water wells by H+A personnel. Between August 10 and 21, 2020, eight Tucson Water wells, B-013B, B-019A, C-045B, WR-127A, WR-128A, WR-129B, WR-130A, WR-130B were sampled for PFAS analysis. On January 22, 2021, two Tucson Water wells, C-004B and C-042A were sampled for PFAS analysis. Between March 4 and 30, 2021, five Tucson Water wells, B-007B, B-055A, B-059A, C-042A, C-045B were sampled for PFAS analysis.

In February 2021, Tucson Water measured water levels from numerous wells in the vicinity and provided results to ADEQ. Also in February 2021, H+A measured water levels in the newly constructed monitor wells AZMW-01 through AZMW-07.

1.4 ACKNOWLEDGEMENT

ADEQ would like to extend our appreciation for the support provided by Tucson Water in the timely completion of the work discussed in this report. The execution of this Work Plan was accelerated through the sharing of state and city resources in the form of staff support, hydrogeological and water quality data, and other information. The cooperative team approach taken by Tucson Water and ADEQ staff in the negotiation and emplacement of access agreements and permits has shortened the working timeframe for design of the demonstration remedy and will enable Tucson Water and ADEQ to implement our common goal of stopping the PFAS from reaching additional water supply wells. ADEQ looks forward to our continued cooperation and coordinated work as a team.

2.0 REGIONAL GEOLOGIC, HYDROGEOLOGIC AND HYDROLOGIC OVERVIEW

DMAFB is located within the Tucson Basin, a broad 1,000-square mile area in the upper Santa Cruz River basin. The basin receives relatively little precipitation (approximately 10 inches annually) and has a high evaporation rate (HGL, 2015). Surface streams and rivers are typically dry and convey water only during and immediately following precipitation events. Groundwater is recharged along mountain fronts at the basin periphery and by streambed infiltration along the Santa Cruz River and its tributaries. The basin is drained by the Santa Cruz River, which flows generally from south to north in the western portion of the basin (ITS, 2012).

The Tucson Basin is a sediment-filled structural depression surrounded by mountain ranges including the Santa Rita Mountains to the south, Rincon Mountains to the east, Santa Catalina and Tortolita Mountains to the north, and the Tucson Mountains to the west. The basin-fill sediments that form the regional aquifer have been divided into upper basin fill and lower basin-fill units based on their general hydrogeologic characteristics. The basin fill has also been subdivided into stratigraphic units based on lithologic descriptions, structural relationships, and depositional history. In ascending order, the lower basin-fill unit includes the Pantano Formation and the lower and middle Tinaja Beds. The upper basin fill unit includes the upper Tinaja Beds, the Fort Lowell Formation, and surficial alluvial deposits, the latter of which include stream channel deposits (AECOM, 2010).

The Pantano Formation, the Tinaja Beds, and the Fort Lowell Formation comprise the aquifer beneath DMAFB and have an estimated combined thickness of more than 5,000 feet (HGL, 2015). The top of the Pantano Formation occurs at approximately 1,200 feet above mean sea level (amsl) (approximately 1,400 feet below ground surface [bgs]) and is composed of silty sandstone, sand, and gravel. The Pantano Formation is overlain by the Tinaja Beds, which are composed of gravel and sand that grade into a thick sequence of gypsiferous clayey silt and mudstone in the center of the basin (HGL, 2015). Near DMAFB, the top of the Tinaja Beds occurs at approximately 2,400 feet amsl (approximately 300 feet bgs). Most wells in the area are completed within the Tinaja Beds (HGL, 2015). Near DMAFB, the hydraulic conductivity of the Tinaja Beds ranges from three to 4.6 feet per day and the formation has specific yield of 0.1 where unconfined, with a specific storage of 0.000001, based on data inputs used in ADWR's Tucson AMA groundwater flow model (ADWR, 2013).

The Fort Lowell Formation overlies the Tinaja Beds and consists of gravel near the edge of the basin, grading to silt in the center. The top of the Fort Lowell Formation occurs at approximately 2,500 feet amsl at DMAFB (approximately 50-100 feet bgs). Overlying the Fort Lowell Formation is a thin layer of surficial deposits emplaced by the present surface drainage system. The formations that comprise the aquifer of the Tucson Basin generally act as a single hydrologic unit (HGL, 2015). Near the site, the hydraulic conductivity of the Fort Lowell Formation ranges from 13 to 25 feet per day and has specific yield of 0.1 based on data inputs used in ADWR's Tucson AMA groundwater flow model (ADWR, 2013). Average groundwater flow velocities in the Fort Lowell formation are estimated to range from 0.6 feet per day to 0.8 feet per day based on preliminary particle tracking simulations using ADWR's Tucson AMA groundwater flow model.

Due to changes in topography, the water table near the northern boundary of DMAFB occurs from approximately 280 to 340 feet bgs (approximately 2,230 to 2,260 feet amsl) (Tucson Water, 2020). Groundwater generally flows to the north-northwest in the area but can be locally influenced by pumping (Figures 3 and 4). Water levels upgradient of and beneath DMAFB have been steadily declining for decades because groundwater withdrawals have exceeded the rate of recharge. However, water levels in many areas immediately north and west of the base have risen following decreased pumping from the central wellfield that began when Tucson began using Colorado River water from CAP. Water levels in some wells near DMAFB have increased more than 50 feet in the last 20 years (Tucson Water, 2020). Average hydraulic gradients range from 0.009 ft/ft on the southern half of DMAFB to 0.0015 to 0.004 ft/ft north of DMAFB, based on a groundwater elevation map prepared for the United States Air Force (USAF) in 2018 (Figure 3). Based on recent water level measurements (Figure 4), the observed groundwater gradient near the northwest boundary of DMAFB was approximately 0.004 ft/ft with a flow to the north. North of Broadway Blvd, the groundwater flow direction has a larger westerly component with a gradient of approximately 0.002 ft/ft. The hydraulic gradient is generally steeper on the southern half of DMAFB and appears to flatten on the north end of DMAFB and downgradient to the north of DMAFB. No evidence of significant vertical gradients was observed.

3.0 SOIL BORING, IN SITU GROUNDWATER SAMPLING, AND MONITOR WELL CONSTRUCTION

Activities performed as part of this investigation include the drilling of seven soil borings (AZSB-01 through -07) (Figure 5), collection of soil and *in situ* groundwater samples, laboratory analyses of samples to determine soil characteristics and verify the presence and concentrations of PFAS, construction and development of seven monitor wells, and collection of groundwater samples from newly constructed monitor wells and select Tucson Water wells. Details regarding these activities are provided below. Details regarding the sampling of wells are provided in Section 4.

3.1 DRILLING OF BOREHOLES AND IN SITU SAMPLING

Pre-drilling activities included obtaining access agreements, clearance for utilities, preparation of Notice of Intent (NOI) documents, and obtaining City of Tucson Right of Way (ROW) permits. ADEQ obtained access agreements with the City of Tucson for placement of monitor wells within City of Tucson right of ways and on Tucson Water properties. The proposed drilling locations were marked with white paint and Arizona 811 was contacted to notify utility companies of the planned drilling. Additional utility clearance was performed by T2UE and Subterra Utility Locating, LLC using geophysical methods. NOI documents were prepared by YJD and provided to the ADWR. Copies of the NOIs, the Well Driller Reports, and field notes are provided (Appendix A). City of Tucson right of way permits were obtained from the City of Tucson Department of Transportation.

All borings and monitor wells were drilled and installed by YJD, Phoenix, Arizona, under the oversight of H+A personnel. Drilling was performed by two TSi 150T drill rigs. Drilling was performed between October 19, 2020, through February 6, 2021, with a three-week holiday break from December 19, 2020 through January 4, 2021. Work on this project was performed in accordance with the Work Plan (ADEQ, 2020b) and Quality Assurance Project Plan, Central Tucson PFAS Project, (QAPP) (ADEQ, 2020). Exceptions and or modifications to the work plan are detailed in Section 8 below. Borings and wells were completed at the following locations (Figure 5):

- Soil Boring AZSB-01 was drilled on Tucson Water property located at 4301 East 32nd Street and completed as monitor well AZMW-01.
- Soil Boring AZSB-02 was drilled on Tucson Water property located at 4150 East Camino De La Colina and completed as monitor well AZMW-02.
- Soil Boring AZSB-03 was drilled in the City of Tucson ROW at 3801 East Calle Altar and completed as monitor well AZMW-03.
- Soil Boring AZSB-04 was drilled in the northwest part of the Randolph Dell Urich Golf Course near Randolph Way and completed as monitor well AZMW-04.
- Soil Boring AZSB-05 was drilled in the City of Tucson ROW just north of 4135 East Cooper Street and completed as monitor well AZMW-05.
- Soil Boring AZSB-06 was drilled in the City of Tucson ROW near the intersection of South Winstel Boulevard and East Juarez Street and completed as monitor well AZMW-06.
- Soil Boring AZSB-07 was drilled at Mel J. Toumey Park just south of 4433 E. Eastland Street and completed as monitor well AZMW-07.

City-owned property access and ROW permits were provided by the City of Tucson. Trafficade Service Companies (Trafficade) of Tucson, Arizona provided traffic control for each location to meet City of Tucson requirements. Traffic control devices included construction work warnings and flashing barricades for equipment within the ROW. Lane closures with detour signs were required at AZSB-03 and AZSB-05. Sidewalk closures were required at AZSB-03, AZSB-06 and AZSB-07.

3.1.1 Procedures

Due to the nature of PFAS and their prevalence in many consumer products, special measures were used during data collection to prevent or otherwise minimize contamination by PFAS-containing materials brought onto the site. Likewise, precautions were exercised for the handling, packaging, and shipment of samples. Details of the standard operating procedures are provided in the Work Plan (ADEQ, 2020b) and QAPP (ADEQ, 2020a).

Drilling was conducted by YJD, Phoenix, Arizona, using sonic drilling techniques. Core samples were extruded into plastic bags, labeled, and provided to a H+A geologist for lithologic description. The H+A field geologists were under the direction of Chris Perkovac, an Arizona Registered

Geologist logged the borings using the Unified Soil Classification System (USCS), according to standard operating procedure (SOP) number 11 (ADEQ, 2020b). Observations and measurements including depth interval, moisture, relative density, color (using a Munsell soil color chart), and texture (using the USCS) were recorded on field forms (Appendix A). Lithologic logs are provided in Appendix B. Photographs taken of the boring cores are provided in Appendix C.

Soil samples were collected by drive sampler from soils extruded from the core barrel and analyzed for PFAS, grain size distribution, total organic carbon (TOC), porosity, and bulk density (Table 1). The drive sampler was a split barrel sampler lined with steel sleeve tubes. The drive sampler was pushed 18-inches into undisturbed soil and then retrieved at the surface for sample collection. Samples collected by the drive sampler were analyzed for PFAS, TOC, porosity, and bulk density. Grab samples were collected at the surface from soils extruded into plastic bags for lithologic logging. Grain size distribution analysis was performed on grab samples.

A total of 13 soil samples from three borings were collected and sent to Speedie & Associates, Inc., Phoenix, Arizona for analysis of physical parameters including porosity, bulk density, and grain size distribution. Two soil samples from AZSB-01 and two soil samples from AZSB-02 were collected from the vadose zone and sent to Eurofins Laboratory, Sacramento, California (Eurofins) for analysis of PFAS via EPA Method 537 (modified). Five soil samples from AZSB-02 and three samples from AZSB-03, collected from below the water table, were submitted for analysis of TOC using EPA Method 9060A. Table 1 provides a list of soil sample locations and requested analyses.

In situ groundwater samples were collected from each boring using a Hole Products' sonic water sampler. Groundwater samples were collected generally at 20-foot to 25-foot intervals from the water table to total borehole depth. A total of 72 in situ groundwater samples were collected from the seven borings completed. All groundwater samples were submitted to Eurofins in West Sacramento, California for analysis of PFAS using EPA Method 537 (modified). In situ groundwater sample locations, depths, and analyses are also summarized in Table 1.

3.1.2 Results

Samples from borings AZSB-01 through AZSB-07 were measured for physical soil parameters, PFAS in soils, TOC, and PFAS chemicals in groundwater. These results are summarized in Tables 2 through 5 and are discussed below.

3.1.2.1 Results for Depth to Groundwater and Lithology

The depth to the groundwater in the completed ADEQ monitoring wells ranged from 257 feet to 291 feet bgs. Perched groundwater was not encountered at any of the boring locations. The upper 220 feet of AZSB-01 and upper 180 feet of AZSB-06 were more gravelly than other borings. Otherwise, soil conditions at all seven boring locations were similar. The most common soil type encountered was silty sand followed by well graded sand with silt and sandy silt (Appendix B). Other soil types encountered included well graded sand, sandy clay, and clayey sand. Some gravels and cobbles were also encountered. The sands were generally fine- to coarse-grained with poor to moderate sorting. The fine-grained soils encountered below the water table do not appear to be continuous between the bore holes, thus there was no evidence that these fine-grained lenses act as a hydraulic barrier.

3.1.2.2 Results for Soil Physical Parameters

A total of 14 soil samples from borings AZSB-01, AZSB-02 and AZSB-03 were collected for analysis of physical soil parameters, including bulk density, grain-size distribution, porosity, and volumetric water content. Results of the physical parameter testing are presented in Table 2. These results indicate that the soils analyzed generally consist of silty sands with gravel. Sand contents ranged from approximately 53 percent to 85 percent, and silt contents ranged from approximately 9 percent to 25 percent (Table 2). Soil porosities of the samples collected ranged from approximately 20 percent to 41 percent with the highest porosities observed in AZSB-01 at a depth of 325 feet, in AZSB-02 at 479 feet, and in AZSB-03 at 380 feet. Specific gravities ranged from 2.610 to 2.671 and dry densities ranged from 97.0 to 133.0 pounds per cubic foot. Moisture contents ranged from 5.6 to 24.51 percent (Table 2).

3.1.2.3 Results for PFAS in Soil

Two soil samples were collected in the vadose zone above the water table in both AZSB-01 and AZSB-02 and analyzed for PFAS. In AZSB-01 soil samples were collected at 15 feet and 40 feet above the water table. In AZSB-01 four PFAS compounds; PFOA, PFHxS, PFHxA and PFBA were detected at maximum concentrations of 0.19, 0.18, 0.072, and 0.030 micrograms per kilogram (ug/Kg) respectively (Table 3). In AZSB-02 soil samples were collected at 4 and 29 feet above the water table. In AZSB-02 no PFAS chemicals were detected above the method detection limits (Table 3).

3.1.2.4 Results for Total Organic Carbon in Soil

A total of eight soil samples, collected from below the water table, were submitted for analysis of TOC from borings AZSB-02 and AZSB-03. From AZSB-02 five soil samples were analyzed, and TOC was detected at concentrations ranging between 3.2 and 5.1 grams per kilogram (g/Kg) (Table 3). From AZSB-03 three soil samples were analyzed, and TOC was not detected (Table 4).

3.1.2.5 Results for In Situ Groundwater

A total of 72 in situ groundwater samples were collected at borings AZSB-01 through AZSB-07 for PFAS analysis using EPA Method 537 (modified). A summary of analytical results for select PFAS is provided in Figure 6 and Table 5, and all laboratory reports are provided in Appendix D.

AZSB-01 From all the drilling locations the highest concentrations of PFASs were detected at AZSB-01. Concentrations of PFOS+PFOA ranged from 8.8 to 5,200 ppt (Table 5). Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from 8.8 to 10,130 ppt (Table 5). Concentrations exceeding the EPA HAL and the TW-OWQTs were detected from the samples collected between 305 feet bgs and 480 feet bgs and at the sample from 545 feet bgs. In samples collected at 500, 520, 575, 600 feet bgs, PFAS were not detected at concentrations exceeding the EPA HAL (Table 5, Figure 6).

AZSB-02 From all the drilling locations the second highest concentrations of PFAS were detected at AZSB-02 and generally an order of magnitude lower than at AZSB-01. Concentrations of PFOS+PFOA ranged from non-detect to 317 ppt (Table 5). Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from 15 to 589 ppt (Table 5). Concentrations exceeding the EPA HAL were detected from the samples collected between 338 feet bgs and 458 feet bgs, with PFOA detected at concentrations generally an order of magnitude higher than those of PFOS. Concentrations exceeding the TW-OWQTs were detected from each of the samples collected, with the highest concentrations ranging from 338 to 418 feet bgs (Table 5, Figure 6).

AZSB-03 At AZSB-03 concentrations of PFOS+PFOA ranged from non-detect to 42.9 ppt. Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from non-detect to 52 ppt (Table 5, Figure 6). No exceedances of the EPA HAL were detected (Table 5). Concentrations exceeding the TW-OWQTs were detected from samples collected between 375 feet bgs and 425 feet bgs and at the sample from 475 feet bgs.

AZSB-04 At AZSB-04 concentrations of PFOS+PFOA ranged from non-detect to 6.8 ppt (Table 5, Figure 6). Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from 1.78 to 23.8 ppt. No exceedances of the EPA HAL were detected (Table 5). Concentrations exceeding the TW-OWQTs were detected from samples collected between 302 feet bgs and 402 feet bgs.

AZSB-05 At AZSB-05 concentrations of PFOS+PFOA ranged from non-detect to 8.4 ppt (Table 5, Figure 6). Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from 1.49 to 13.1 ppt. No exceedances of the EPA HAL were detected. Concentrations exceeding the TW-OWQTs were detected from samples collected at 305 and 355 feet bgs.

AZSB-06 At AZSB-06 concentrations of PFOS+PFOA ranged from non-detect to 2.9 ppt (Table 5, Figure 6). Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from non-detect to 4.8 ppt. No exceedances of the EPA HAL or TW-OWQT were detected.

AZSB-07 At AZSB-07 concentrations of PFOS+PFOA ranged from non-detect to 8.1 ppt (Table 5, Figure 6). Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from non-detect to 12.5 ppt. No exceedances of the EPA HAL were detected. Concentrations exceeding the TW-OWQT were detected from the sample collected at 305 feet bgs.

3.1.3 QA/QC SOIL AND IN SITU GROUNDWATER SAMPLES

The soil and groundwater sampling for PFAS included collection of Quality Assurance/Quality Control (QA/QC) samples as described in the project Work Plan (ADEQ, 2020b) and QAPP (ADEQ, 2020a). QA/QC samples included field duplicates, matrix spikes (MS) and matrix spike duplicates (MSD) collected at the rate of at least 5 percent (one per 20 samples). In addition, one field reagent blank (FRB) was collected at each sample location per sample day and included with sample shipment for laboratory analysis. Equipment blanks (EBs) were also collected and analyzed for non-disposable sampling equipment used. The QA/QC samples were analyzed for the same parameters as the accompanying samples. Analysis of QA/QC samples (FRBs, MBs, EBs, MS/MSDs) was performed and data qualifiers were added to analytical results by the following:

- The qualifier J (estimate) was added to sample results when a compound was detected in a blank sample at a concentration greater than $1/10^{th}$ of the sample result.
- The qualifier J (estimate) was added to sample results when a compound was detected in a duplicate sample with a relative percent difference (RPD) outside of project RPD criteria.
- The qualifier J (estimate) was added when the percent recoveries in MS/MSD samples were outside of laboratory criteria.

After review of QA/QC samples no analytical results were removed. Level II data validation reports and a summary of data qualifiers added to analytical results are presented in Appendix E.

3.2 WELL CONSTRUCTION AND DEVELOPMENT

The monitor well construction and development were conducted by a field geologist under the direction of Chris Perkovac, an Arizona Registered Geologist. Individual well designs including well depths and screened intervals, were based on field observations, and PFAS laboratory results from *in situ* groundwater samples collected during drilling as outlined in the Work Plan

(ADEQ, 2020b). Decisions on the depth(s) and placement of the screened intervals at each monitor well were made collectively with ADEQ and project team members following thorough review and consideration of the *in situ* sampling results, lithology, and PFAS data from nearby wells. Details regarding selection of well design and construction of each monitor well are provided below. Well construction details are provided in Table 6 and well construction diagrams are provided in Appendix B.

3.2.1 AZMW-01 Design Considerations

AZMW-01 was constructed with a screen interval from 450 to 490 feet bgs. This design was based on the following considerations:

- While the highest groundwater PFOA+PFOS concentrations were reported at 305 to 385 feet bgs (Table 5), water quality in this interval can be adequately monitored using nearby Tucson Water production well C-007A. C-007A was modified in 2011, when a liner was installed with a screened interval of 270 to 370 feet bgs. AZMW-01 is located approximately 50 feet to the southwest of C-007A.
- A screen interval 450 to 490 feet bgs was selected for well AZMW-01 to allow observation of vertical gradient changes during the upcoming PFAS treatment demonstration project at C-007A. AZMW-01 can also be used to observe whether PFAS levels decline over time at this depth interval and may also help verify whether the deeper contamination is a result of a potential vertical conduit at C-007A and not an ongoing upgradient source.
- A screen interval at 450 to 490 feet bgs will provide earlier detection of pilot test-related pumping impacts.

The lower 100 feet of the borehole was backfilled with cement grout prior to well construction. A schematic diagram of well construction for well AZMW-01 is provided in Appendix B.

3.2.2 AZMW-02 Design Considerations

PFOA+PFOS concentrations ranged from 27 ppt to 317 ppt in groundwater from AZSB-02 (Table 5). The highest concentrations of these compounds were reported between 338 and 458 feet bgs (Appendix B). The construction design of AZMW-02 was based on two main considerations:

- The majority of the PFOA+PFOS mass is evenly distributed between 338 feet to 418 feet, and ranges from 205 ppt to 317 ppt. The PFAS concentrations at AZSB-02 gradually decreases below 418 feet, reaching 23 ppt at a depth of 508 feet.
- A screen interval of 350 to 400 feet bgs intersects the middle portion of PFOA+PFOS mass identified at this location.

Based on these data, AZMW-02 was constructed with a screen interval from 350 to 400 feet bgs with the bottom 119.5 feet of the boring backfilled with cement grout prior to well construction. A well construction diagram for AZMW-02 is provided in Appendix B.

3.2.3 AZMW-03 Design Considerations

AZMW-03 was designed with two screened intervals separated by a 20-foot blank interval (Appendix B). This design was based upon distribution of PFOA+PFOS identified in in situ groundwater samples (Table 5) which indicated the three highest concentrations observed in the middle portion of the boring (6.2 ppt at 375 feet, 7.5 ppt at 400 feet, and 6.9 ppt at 425 feet) were separated from detections lower in the boring (42.9 ppt at 475 feet) by a 50-foot interval without detections. Based on this information, monitor well AZMW-03 was designed with a well screened interval from a depth of 380 to 480 feet, with a blank section set from 430 to 450 feet sealed with 5 feet of bentonite. This blank section provides the option to isolate screen intervals if appropriate and will allow ADEQ to abandon the bottom screen if supported by subsequent investigations. A schematic diagram of construction for well AZMW-03 is provided in Appendix B.

3.2.4 AZMW-04 Design Considerations

A screened interval of 330 to 380 feet bgs was selected for AZMW-04 to center it on the three highest combined PFOA+PFOS concentrations observed in the boring (6.8 ppt at 327 feet, 5.9 ppt at 352 feet, and 6.6 ppt at 377 feet). This screened interval also provides partial overlap with recently installed up-gradient monitor well AZSB-02 which is screened from a depth of 350 to 400 feet. A schematic diagram of construction for well AZMW-04 is shown in Appendix B.

3.2.5 AZMW-05 Design Considerations

Monitor well AZMW-05 was designed with two screened intervals of 395 to 445 feet bgs and 465 to 495 feet bgs. These screened intervals were selected due to the relatively even distribution of

PFOA+PFOS, like that observed in AZMW-03. This design will approximately correspond with the two screened intervals at AZMW-03 and will allow monitoring for potential plume movement over a thicker interval of the aquifer. AZMW-05 was constructed with a 5-foot-thick bentonite seal outside of a blank well casing installed from 445 to 465 feet bgs. As with AZMW-03, this design provides the option to later isolate the top or bottom screened intervals if subsequent data indicates it would be beneficial. A schematic diagram of construction for well AZMW-05 is provided in Appendix B.

3.2.6 AZMW-06 Design Considerations

Monitor well AZSB-06 was constructed with a screened interval of 350 to 400 feet bgs after the lower 95 feet of the borehole was backfilled with cement grout. In situ groundwater sample results from this location, indicated a relatively even distribution of low level PFOA+PFOS at depths of 283 to 458 feet (Table 5). The 350 to 400 feet bgs screen interval is like cross-gradient well AZMW-02 which targets the interval with the highest combined PFOA+PFOS concentrations. A schematic diagram of construction for well AZMW-06 is provided in Appendix B.

3.2.7 AZMW-07 Design Considerations

Monitor well AZMW-07 was constructed with a screened interval of 375 to 405 feet bgs following backfilling of the lower part of the borehole. Well construction was based on the relatively even distribution of low level to non-detect concentrations of PFOA+PFOS in groundwater samples (Table 5), as well as ADEQ’s request to utilize a 30-foot screen interval to minimize potential effects vertical mixing between zones may have on sample results. This screened interval is like cross-gradient well AZMW-02 and will also be used to monitor the zone of higher PFOA+PFOS concentrations observed at that well.

3.3 MONITOR WELL DEVELOPMENT

After well constructions were completed, a pump rig was used for well development. Development activities included bailing, swabbing, and pumping. A bailer with a steel ball valve was used to remove the residual sediment and debris from the bottom of the wells. A swabbing tool was used to surge the well screen and dislodge sediment and debris from the casing and borehole walls. Each well was bailed and swabbed for 1 to 1.5 hours. To complete well development, a submersible electric pump was installed in each well. The pump was powered by an electrical generator. Each well was pumped at rates ranging from 1 to 2.5 gallons per minute (gpm) for three to six hours. During this time, water level (drawdown), pumping rate, and field water quality parameters (temperature, pH, electrical conductance, and turbidity) were monitored. At the end of development pumping, water appearance ranged from clear to slightly cloudy, with a turbidity range of <5 to 62 nephelometric turbidity units (NTU). It should be noted that in AZMW-07 the post development pH levels remained high, above 10, even after significant pumping. It is postulated that some cement may be present above the bottom bentonite zone at 408 to 413 feet accounting for the high pH level or that residual neat cement from the borehole construction is present on the borehole wall and is affecting the pH of the groundwater in the bore. The effect of the cement on the pH is likely to abate with time.

3.4 MONITOR WELL SURVEYING

The location and measurement point elevations of the newly installed monitor wells AZMW-01 to AZMW-07 were surveyed in February and March 2021 by T2 Utilities Engineers, Tucson, Arizona, a licensed surveyor. The latitudes and longitudes were surveyed to the North American 1983 datum (NAD83). The well measurement point elevations were surveyed to the North American Vertical Datum of 1988 (NGVD88). Coordinate and elevation data for each monitor well are provided in Table 6 and the survey report is provided in Appendix F.

3.5 WASTE DISPOSAL

Soil cuttings produced during drilling operations were stored in roll-off bins positioned near each drill site. Chemical Transportation Inc. (CTI) sampled soil bins and prepared waste profiles for disposal. Between December 23, 2020, and March 15, 2021, a total of 128.89 tons of soil were transported by CTI to Durham Regional Landfill located in Florence, Arizona for disposal (Table 7). The soils were shipped under manifest with the description of “Drill Cuttings RO”. Manifests are provided in Appendix G.

Decontamination and development water was containerized in several storage tanks stored at the Tucson Water supply well C-036B property at 4150 E Camino De La Colina. The tanks were located behind a locked fence and were not accessible to the public. CTI sampled the containers and prepared waste profiles for disposal. Approximately 5,678 gallons of water was disposed of in September 2021 at the US Ecology landfill in Beatty, Nevada (Table 7). Manifests are provided in Appendix G.

Other investigation derived wastes (e.g., plastic bags, used bailers, bailer string, etc.) were disposed of as municipal solid waste.

4.0 MONITOR WELL SAMPLING

After monitor well construction and development, depth-specific groundwater samples were collected from three or more depths in each monitor well. Groundwater samples were submitted to Eurofins for analysis of PFAS using EPA Method 537 (modified). Additionally, one sample from each well was submitted to Eurofins for analysis of general water quality parameters (Nitrate, Fluoride, Chloride and Sulfate using EPA Method 300.0); metals using EPA Methods 200.7; total hardness using Method SM2340B, and perchlorate using EPA Method 314.0. One sample from each of the wells AZMW-01 through AZMW-03 were submitted for hexavalent chromium analysis using EPA Method 218.6 and uranium analyses using Method 200.8. A summary of groundwater level measurements is provided in Table 8. The water level measurements collected in February 2021 by H+A (Table 8) were combined with water level measurement data provided by Tucson Water and are summarized in Figure 4 and Table 8. A summary of groundwater sample locations, depths, and analyses are summarized in Tables 9, 10 and 11.

4.1 SAMPLING PROCEDURES AND SAMPLE INTERVALS

Following development, the new monitor wells were sampled by installing PFAS-free HydraSleeve™ (no-purge) samplers at multiple depths to vertically profile the groundwater PFAS distribution. Sampling was conducted from February 22, 2021, through March 4, 2021. At wells with a single screened interval, depth intervals were selected to target the upper, middle, and bottom portions of the well screen. Monitor wells AZMW-03 and AZMW-05 were constructed with two screen intervals. At well AZMW-03 samples were collected to target the upper and lower portions of each screen. At well AZMW-05 samples were collected to target the upper and lower portions of the upper screen and the lower portion of the lower screen.

Each sample depth interval included the collection and analysis for PFAS. Within each monitor well a single depth interval was selected for collection and analysis for alkalinity, bromide, calcium, iron, magnesium, arsenic, manganese sodium chloride, fluoride, nitrate, sulfate, total dissolved solids, and TOC. Additionally, in AZMW-01, AZMW-02 and AZMW-03 a single sample interval was selected for collection and analysis for uranium, hexavalent chromium, and perchlorate. A summary of sampling depths and analysis is provided in Table 9; results are included in Table 10.

4.2 PFAS ANALYTICAL RESULTS

Twelve of twenty-nine PFAS compounds analyzed were detected in samples collected from monitor wells AZMW-01 to AZMW-07 (Appendix D). These include: PFOA; PFOS; PFHxS; PFHxA; PFBS; PFHpA; Perfluorobutanoic acid (PFBA); Perfluoropentanesulfonic acid (PFPeS); Perfluoropentanoic acid (PFPeA); 6:2 Fluorotelomer sulfonic acid (6:2 FTS); Perfluoroheptanesulfonic acid (PFHpS); and Perfluorooctanesulfonamide (PFOSA).

The most prevalently detected compound was PFHxA detected in 95 percent of the samples. PFHxS was the next most prevalently detected compound at 67 percent. PFBA; PFBS; PFHpA; PFPeS; and PFPeA were detected at a prevalence of 62 percent. PFOA was detected at a prevalence of 57 percent. PFOS; 6:2 FTS; PFHpS; and PFOS were all detected at prevalence's below 50 percent.

Evaluation of the analytical results indicate that concentrations of PFAS were higher in the discrete *in situ* groundwater samples collected from the boreholes than the groundwater samples collected from the completed monitor wells. At AZSB-01/AZMW-01, PFAS concentrations were up to 35 times greater from in situ groundwater samples when compared to monitor well groundwater samples collected at similar depths. At AZSB-02/AZMW-02 to AZSB-07/AZMW-07 PFAS detections ranged from 1.1 to 6.6 times greater from *in situ* groundwater samples when compared to monitor well groundwater samples collected at similar depths. Additionally, there was an observed difference in the specific PFAS compound detected between in situ and monitor well groundwater sample results. In situ samples collected from the borehole during drilling contained PFAS compounds with carbon chains up to C14, whereas groundwater samples collected from completed and developed monitor well samples contained no PFAS with carbon chains greater than C8.

4.3 ANALYTCAL RESULTS OF SELECTED PFAS VERSUS EPA HAL AND TW-OWQT

Site figures and cross sections have been prepared to summarize the exceedances of the EPA HAL and TW-OWQT levels (Figures 7, 8, 9A, 9B, 10A, 10B, Table 11).

AZMW-01 Concentrations of PFOS+PFOA ranged from 31.7 to 52 ppt, which are below the EPA HAL of 70 ppt. It should be noted that the selected screen interval for AZMW-01 does not intersect the highest concentrations of PFAS detected during in situ sampling and therefore concentrations of PFASs in groundwater exceeding the EPA HAL at this location are likely present at shallower depth as observed historically in well C-007A. Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from 63.4 to 102.2 ppt, which exceeds the TW-OWQT of 18 ppt. Individual compound exceedances of the TW-OWQT included PFHxS, PFOA and PFOS (Figures 7, 8 9A, and 9B, Table 11).

AZMW-02 Concentrations of PFOS+PFOA ranged from 124.2 to 135.6, which are above the EPA HAL of 70 ppt. Concentrations exceeding the EPA HAL were detected in each of the samples collected in AZMW-02. Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from 212.7 to 231.3 ppt, which exceeds the TW-OWQT of 18 ppt. Individual compound exceedances of the TW-OWQT included PFHxS and PFOA (Figures 7 9A, and 9B, Table 11).

AZMW-03 to AZMW-07 Concentrations of PFOS+PFOA ranged from non-detect to 2.87 ppt, which are below the EPA HAL of 70 ppt. Concentrations of PFOS+PFOA+PFHxS+PFHpA ranged from non-detect to 7.12 ppt, which are below the TW-OWQT of 18 ppt. The only exceedance of a TW-OWQT was from AZMW-04 at 353 feet bgs where PFHxS was detected at a concentration of 7.4 ppt, which exceeds the TW-OWQT of 7 ppt. (Figures 7, 9A, 9B, 10A, and 10B, Table 11)

4.4 ANALYTICAL RESULTS FOR OTHER COMPOUNDS

Results of hexavalent chromium analysis for groundwater samples collected from monitor wells AZMW-01, AZMW-02 and AZMW-03 indicated no detections above the reporting limit. Uranium was detected in groundwater samples collected from each of these wells at concentrations of 0.75, 2.6 and 1.6 µg/L, respectively. Results of these additional monitor well groundwater analyses are provided in Table 10.

4.5 QA/QC GROUNDWATER SAMPLES

The project data for the Central Tucson PFAS project monitoring event were evaluated for compliance with project QA/QC requirements in accordance with the QAPP (ADEQ, 2020a) and Work Plan (ADEQ, 2020b). EPA Level II verification was performed on 100 percent of the data. EPA Level IV was performed on select groundwater monitor well samples. Level II verification included a review of sample receipt information, confirmation that extraction and analysis was completed within required holding time and evaluation of sample isotope dilution analyte recoveries. Laboratory QC data including method blank detections and laboratory control sample/laboratory control sample duplicate and matrix spike/matrix spike duplicate recoveries and RPDs were also evaluated. Sample quality control data (e.g., equipment blank, field reagent blank, and field duplicate) were checked for impact on matrix sample results. All data was found to be acceptable, there was 100 percent completeness of data based on Level II verification. No data were rejected. Some data were qualified as estimated based on the results of the Level II evaluation.

Seven samples were submitted to Laboratory Data Consultants (LDC) for Level IV validation. The data validation was performed under Level IV guidelines. The analyses were validated using EPA Data Review and Validation Guidelines for Perfluoroalkyl Substances along with the project's QAPP (ADEQ, 2020a) and Work Plan (ADEQ, 2020b). In addition to the items evaluated for Level II verification, the analytical instrument performance and sensitivity checks, initial calibration data, initial and continuing calibration verification, recoveries of labeled compounds, analyte identification and analyte quantitation were reviewed. LDC found analysis was conducted within all specifications of the method. No results were rejected. Data were qualified as estimated in four samples due to MS/MSD percent recovery (%R), field duplicate RPO, labeled compound %R, and ion ratio.

The qualifiers are shown on Table 11. The qualified data do not significantly affect the assessment of the TW-OWQT or HAL exceedances. The E4 qualified data reflect data below the MRL but above the MDL. These are low concentrations and not significant in the summed values. The M2 qualified data are in samples that exceed the TW-OWQT so potential low bias is not a concern for usability.

Data validation reports and a summary of data qualifiers added to analytical results are presented in Appendix E.

5.0 TUCSON WELL SAMPLING

To help assess the distribution of PFAS in the groundwater and confirm prior results, select Tucson Water wells were sampled and analyzed for PFAS. Tucson Water assisted ADEQ with sampling of the wells and access to well sites.

5.1 SAMPLING PROCEDURES AND SAMPLE INTERVALS

Wells with dedicated pumps were sampled by purging the well and collecting samples from sample ports. Wells with no dedicated pumps were sampled using HydraSleeve^{TM} samplers placed at multiple depth intervals across the screen. Groundwater samples were submitted to Eurofins for analysis of PFAS using EPA Method 537 (modified).

In August 2020, 13 groundwater samples were collected from eight Tucson Water wells B-013B; B-019A; C-045B; WR-127A; WR-128A; WR-129B; WR-130A and WR-130B. The water samples were collected and analyzed to support placement of soil borings and monitor wells. Wells B-019A and C-045B were sampled by HydraSleeve^{TM}. The other wells were sampled by dedicated pumps.

In January, and March 2021, 16 water samples were collected from six Tucson Water wells (B-007B; B-055A; B-059A; C-004B; C-042A; C-045B) and analyzed for PFAS. All wells were sampled by HydraSleeve^{TM} except for B-059A which was sampled by running the dedicated well pump.

5.2 ANALYTICAL RESULTS PFAS

A total of 28 groundwater samples were collected from 12 Tucson Water wells and analyzed for PFAS. PFOA+PFOS were not detected above the EPA HAL in these samples (Table 12). The maximum detected concentration of PFOS+PFOA was 43.2 ppt from WR-130B. PFAS exceeding the TW-OWQTs were detected in wells B-019 at 300, 350, and 400 feet bgs; C-045B at 325, 350, 505 and 540 feet; WR-127A; WR-128B, WR-130A, and WR-130B. The maximum combined concentration of PFOS+PFOA+PFHxS+PFHpA detected was 120.2 ppt from WR-130B. Summary of groundwater sample locations, depths, and analyses are summarized in Table 12.

6.0 OTHER SOURCES OF DATA

Tucson Water provided ADEQ with data to help the assessment of PFAS in groundwater. The data provided included historical and recent water levels, analytical results for PFAS, and well construction information. This data was incorporated within this report and is included in numerous tables and figures. Tucson Water PFAS results for wells within the study area are summarized in Table 13.

In February 2021 Tucson Water conducted a synoptic water level elevation survey and water quality sampling event at wells across the Site. Tucson Water provided ADEQ these data which was added to the monitoring data from AZMW-01 to AZMW-07 and summarized in Figure 4 and Table 8.

7.0 FOCUSED CONCEPTUAL MODEL

This Focused Conceptual Site Model (FCSM) addresses PFAS contamination that threatens Tucson Water's Central Wellfield in the area north of DMAFB. The FCSM does not include a detailed discussion of potential source areas on DMAFB nor does it specifically address areas immediately west of the base. The Air Force Civil Engineer Center (AFCEC) has conducted initial investigations into the use of aqueous film forming foam (AFFF) and the nature and extent of PFAS contamination at DMAFB (AMEC 2019a, 2019b) and a Remedial Investigation is ongoing.

7.1 SITE CONDITIONS

7.1.1 Contaminant Release

Tucson Water began analyzing PFAS in wells north of DMAFB in 2016. Since that time, three production wells, located within approximately one mile of the northwest base boundary, have been removed from service due to PFAS contamination (Figure 2). However, due to the limited investigations to date, the source and timing of the release remains unknown.

In the area south of the affected wells, on DMAFB, AFCEC has confirmed PFAS releases occurred at a Former Fire Training Area (FT-03), four plane crash locations where AFFF was used, and a stormwater outfall canal that collected stormwater and other runoff from across DMAFB (Figure 12) (AMEC 2019a, 2019b). The stormwater outfall canal extends from DMAFB west to the Kino Environmental Restoration Project (KERP) located approximately 1.4 miles west of DMAFB. From there, surface water flows through a series of ephemeral washes into the Santa Cruz River, which is located approximately 3.5 miles from KERP. PFOA+PFOS has been detected at a combined concentration of 176 ppt in well C-008B located approximately 0.25 miles north of KERP (Figure 2). This could be an indication that contaminated surface water has reached the aquifer. The Air Force has acknowledged this potential contaminant pathway and may collect additional data in this area as part of a Remedial Investigation (Ahtna, 2021).

7.1.2 Chemicals of Concern

PFAS are a family of thousands of fluorinated organic compounds with a wide range of chemical and physical properties (ITRC 2020b). A subgroup within PFAS is perfluoroalkyl acids (PFAAs), which are essentially non-degradable under normal environmental conditions (Table 14) (ITRC, 2020). Several PFAAs are identified as having health concerns that may prevent Tucson Water from using the regional aquifer as a drinking water source. Relevant health advisories and utility operating targets are outlined in Section 1.0.

7.1.3 Extent of Contamination

A plume of dissolved PFAS exceeding the TW-OWQT has been detected that extends within the regional aquifer approximately 2 miles downgradient from DMAFB to the area near AZMW-03 (Figure 7).

Detected PFAS concentrations throughout the area have ranged from the low ppts to thousands of ppt. The highest concentrations of PFAS north of DMAFB were detected in C-007A and during drilling of AZSB-01; these are located adjacent to each other, less than 400 ft downgradient of DMAFB. Concentrations decrease cross-gradient and downgradient from this location. The PFAS concentration at AZSB-02, approximately one mile downgradient of AZSB-01, is approximately an order of magnitude lower. The horizontal extent of PFAS exceedances, along with detected concentrations, is depicted in Figure 7.

PFAS were detected above the TW-OWQT but below the HAL in wells in wells B-019A and WR-127A which are located west of the plume and separated from the plume by non-detect results in wells B-110A and AZMW-06 (Figure 7). This may indicate a separate area of dissolved PFAS that has not been fully defined. However, PFAS were not detected above the HAL or TW-OWQT to the north/northwest (downgradient) of this area in wells WR-128A or B-013B, indicating the northern extent of PFAS detections in this area is limited.

7.1.3.1 Horizonal Extent of Contamination above EPA HAL

Exceedances of the EPA HAL have been detected in groundwater samples collected at C-007A, C-014B, C-036A and AZMW-02. Groundwater from the constructed monitor well AZMW-01 did not exceed the EPA HAL because the screen interval of this well was placed below the higher concentrations of PFAS detected during *in situ* sampling. EPA HAL exceedances extend up to approximately 1.4 miles downgradient of the DMAFB with a maximum width of approximately 0.75 miles.

7.1.3.2 Horizonal Extent of Contamination above TW-OWQT

Exceedances of the TW-OWQT have been detected in groundwater samples collected at C-007A, C-014B, C-036A, C-045A, WR-127A, WR-130B, WR-130A, WR-129B, WR-127A, B-019A, AZMW-01, and AZMW-02. Concentrations exceeded the TW-OWQT in several wells that did not exceed the EPA HAL and TW-OWQT exceedances were detected up to approximately 2 miles downgradient of DMAFB. As discussed above, there were exceedances detected to the west at B-019A and WR-127A.

7.1.3.3 Vertical Extent of Contamination

The vertical distribution of PFAS within the regional aquifer was assessed by collecting and analyzing *in situ* groundwater samples during the drilling of AZSB-01 to AZSB-07 and multi-depth interval sampling in completed monitor wells (Figures 6, 9A, 9B, 10A, 10B and Table 5). The highest concentrations of PFAS were detected at AZSB-01 from 325 to 385 feet bgs, or 35 feet to 95 feet below the top of the water table (btw). Farther downgradient at AZSB-02, the highest concentrations of PFAS were detected at 338 feet to 458 feet bgs, or 58 feet to 178 feet btw. Near the end of the PFAS plume at AZSB-03, the maximum concentration was detected at a depth of 475 feet bgs or 189 feet btw. Although these are *in situ* samples and constitute only a single sampling round, the observed changes in maximum concentration depths may indicate that the PFAS plume is diving slightly. PFAS exceeded the HAL as deep as 545 feet bgs in AZSB-01 and as deep as 458 feet bgs in AZSB-02. No evidence of significant vertical gradients was observed.

During sampling conducted in March 2021, the newly developed monitor wells were sampled, along with several Tucson Water wells. Where well construction and equipment would allow, samples were collected from multiple depths within the well screen. Sample results did not indicate significant vertical differences of PFAS over the intervals sampled (Table 11 and 13). This may be due mixing in the well casing given that some stratification was observed in the *in situ* samples.

7.1.4 Hydrogeology

The land surface in the area is generally flat, ranging in elevation from 2,570 feet at the southeast (at S Swan Road and Golf Links) down to 2,480 feet amsl to the west (S Country Club Road and E 17th Street). Groundwater in this area is encountered at approximately 257 to 291 feet bgs as an unconfined regional aquifer. Groundwater elevations in the area have historically been much higher (Figure 13). For example, near AZMW-01 and AZMW-02, the water table was approximately 70 feet higher in the 1970's (Figure 9A and 9B). However, groundwater elevations in the area have recently been steady or even increasing due to the City of Tucson's increased use of water from the CAP, which has reduced pumping from the Central Wellfield.

The estimated groundwater flow direction, based on the water level gauging event conducted in March 2021 (Figure 4), is north to northwest across the area. The observed groundwater gradient near the northwest boundary of DMAFB was approximately 0.004 ft/ft with a flow to the north. North of Broadway Blvd, the groundwater flow direction has a larger westerly component with a gradient of approximately 0.002 ft/ft.

The most common soil type encountered was silty sand followed by well graded sand with silt and sandy silt (Appendix B). Other soil types encountered included well graded sand, sandy clay, and clayey sand. Some gravels and cobbles were also encountered. The sands were generally fine- to coarse-grained with poor to moderate sorting. Soils and groundwater sampled had low levels of TOC (Table 4 and 10). Review of the lithologic logs and cross sections derived from the logs does not indicate major changes in lithology vertically or horizontally.

No evidence of significant or continuous fine-grained layers that could cause perching of groundwater or confining of groundwater within the upper basin fill was observed, nor were any obvious continuous clean sand or gravel layers that could be preferential flow paths observed. Perched groundwater was not encountered during drilling activities.

The lithologic sequence observed is typical of the alluvial fill associated with alluvial fans and fluvial systems that deposited the sediments in the Upper Santa Cruz Basin and are commonly observed in the Basin and Range Province. Consequently, no evidence of preferential pathways within the upper basin fill aquifer was observed. It should be noted, however, that within this area, there are relatively few detailed well logs and the distances between borings that have detailed logs is large.

7.2 CONTAMINANT FATE AND TRANSPORT

PFAS chemicals share common characteristics such as their strong carbon-fluorine (C-F) bonds. The structure of PFAS increase their resistance to degradation; the C-F bonds require a lot of energy to break. Therefore, these compounds do not readily degrade by most natural processes and are resistant to biodegradation, atmospheric photooxidation, direct photolysis, and hydrolysis. Despite their similarities, though, the fate and transport of individual PFAS in the environment can vary based on differences like carbon chain length and functional group. PFOS and PFOA, the compounds for which the EPA has issued a health advisory, each have an eight-carbon chain exhibiting an SO_3^- and CO_2^- functional group, respectively. Both of these compounds are generally highly soluble in water and typically present as an anion in solution. In general, they exhibit relatively low volatility due to their ionic nature (ATSDR, 2018).

A primary mechanism for movement of contaminants through an aquifer is advection, the process by which contaminants are carried by the bulk movement of water through an aquifer (Figure 13). Although they tend to be relatively soluble in water due to their structure, PFAS, like other organic compounds, do not simply move by advection alone. Instead, diffusion, dispersion and retardation are key mechanisms that can affect transport (Figure 13). PFAS are known to exhibit some partitioning to organic carbon in aquifers, with each compound having an individual sorption coefficient (Koc). Individual PFAS sorption coefficients cover a range similar to the more familiar organic and inorganic compounds (NGWA, 2021).

In addition to being affected by the specific characteristics of individual PFAS, the fate and transport of PFAS is also affected by the physical properties of the environment. Within the aquifer north of DMAB, very little TOC was measured. Although the number of samples collected was relatively small, this result is consistent with a previous study from the Tucson Basin (Tetra Tech Geo, 2011). Additionally, boring logs indicate the aquifer consists of relatively coarse media, with little evidence of extensive deposits of fine-grained materials (Figures 9B and 10B). Together, these observations suggest that PFAS interactions with solid media would be somewhat limited.

Results of sampling and observations in the field do not indicate that geologic deposition is strongly affecting PFAS plume movement in this area. The observed downward movement does not appear to be caused by site geology but more likely has been influenced by temporal, pumping-induced gradients (Figure 13). A typical dispersed plume front has been observed that may be caused in part by adsorption to soils in the aquifer. However, the plume shape may also be impacted by source zone dynamics and release timing. The recreation of historical plume movement is presently speculative due to lack of knowledge about source area including the timing of release(s), release mass, and residual mass. As noted, the Air Force is conducting a remedial investigation which may provide further information on these source mechanisms.

In addition to the groundwater samples collected, four vadose zone samples were collected in the depth interval between the historical water table and the current water table (Figure 13). This sampling was conducted to determine if there may be residual contamination present in the vadose zone soils and if such contamination may represent an ongoing source of contamination to the aquifer. The samples were collected at the two farthest upgradient borings (two samples each at borings AZSB-01 and AZSB-02). The samples were collected from 4 to 40 feet above the current water table. PFAS were not detected in samples from AZSB-02 (Table 3). However, the samples collected from AZSB-01 contained concentrations of four PFAS including PFBA, PFHxS, PFHxA and PFOA. These compounds were detected at concentrations less than the laboratory minimum reporting level but above the method detection limit and ranged from 0.030 to 0.19 ug/Kg (Table 3). Although these very low concentrations do not likely represent a source of contamination to the aquifer, their presence in soils that were most recently saturated in the 1980's (Figure 9B), may provide some evidence concerning the timing of release. It should be noted, however, that relatively few samples were collected.

7.3 POTENTIAL RECEPTORS

In the area of observed contamination depicted in Figure 7, there is a mix of residential properties with commercial properties located along main roads. The area includes 460 acres of park with Randolf Park, Reid Park Zoo, and the Gene C Reid Park. El Con Mall shopping center is located near the north end of this area.

As described previously, the current investigation focused only on the dilute plume area north of DMAFB and did not consider potential source areas. Because PFAS within this area of investigation is only present in soils and groundwater at depths of over 200 feet bgs, the only potentially complete exposure pathway would be through extraction of groundwater using a well. All Tucson Water production wells within the observed area of contamination exceeding the HAL and TW-OWQT (Figure 7) have been removed from service (Figure 13). The Air Force SI identified up to 277 potential drinking water wells (including Tucson Water wells) within four miles downgradient of the base (Figure 14). Using this list, along with other available databases and information provided by Tucson Water, ADEQ identified 24 properties within two miles downgradient of DMAFB where information indicated a private well might be present. Property owners were provided written notification with information on PFOA and PFOS and a request to contact ADEQ to confirm the existence and use of their well. Four property owners responded to the notification and each requested that their well be sampled. ADEQ sampled these four wells between November 2019 and January 2020. PFOA and PFOS were not detected in any of the samples collected (Figure 11). The Air Force is currently conducting additional outreach and sampling of private wells in this area. Because PFAS have not been identified above the EPA HAL or TW-OWQT in any active wells to date, no complete exposure pathways are known to exist (Figure 13).

7.4 DATA GAPS

Results of the investigation have identified several remaining data gaps. As discussed previously, there is uncertainty regarding historical plume movement and the rate of contaminant migration over time. Additionally, the specific mechanism by which PFAS have migrated vertically within the aquifer is not fully understood. As noted by dashed lines in Figure 7, there remains uncertainty regarding the exact plume extent in some areas. This is primarily due to the significant size of the study area which necessitates the installation of wells separated by large distances. However, these data gaps are not expected to limit the development of a remedy. Finally, a more detailed understanding of the hydraulic parameters of the aquifer is required prior to implementation of a remedy. These parameters will be measured during remedy design.

8.0 DEVIATIONS FROM WORKPLAN

Below is a summary of activity deviations from the Work Plan (ADEQ, 2020b) during the investigation.

Boring Locations: After the information from the first seven borings was reviewed, it was determined by ADEQ and H+A that the drilling the eighth location (AZSB-08) was not warranted at this time and it was removed from the program. Site AZSB-03 was moved northwest approximately 800 feet to provide better alignment with the axis of contaminant plume as understood at the time and to provide the best opportunity of constructing a downgradient well with PFOS+PFOA less than EPA HAL.

Soil Core Logging: Photoionization detectors (PID) were not utilized for screening core samples because PFAS compounds are not detected by PIDs and no sources of volatile organic compounds (VOCs) were anticipated.

Boring Depths: Analysis of *in situ* groundwater samples collected during drilling indicated that concentrations of PFOS+PFOA exceeding the EPA HAL were detected close to the 500-foot projected total depth at both AZSB-01 and AZSB-02. Based on these results, and discussion with ADEQ, borings AZSB-01 and AZSB-02 were advanced beyond 500 feet to characterize the occurrence of PFAS at depths below 500 feet and to verify the vertical extent of PFOS+PFOA greater than EPA HAL had been defined. In addition, based on the observed of the low levels of PFAS detected in *in situ* groundwater samples collected at AZSB-07 and because caving soils were encountered, the drilling of AZSB-07 was terminated at 480 feet.

Soil Sample Collection: The Work Plan specified soil sampling for PFAS analysis be conducted at AZSB-01 from 5 feet bgs and every 50 feet thereafter. However, after review of available data and discussion with ADEQ it was determined that surface infiltration of PFAS was not likely at AZSB-01. Thus, the collection of soil samples for PFAS analysis was limited to two samples collected just above the regional aquifer at 250 and 275 feet bgs in an effort to examine the potential effects of a fluctuating water table.

Sediment and Surface Water Sampling: As part of the Davis Monthan PFAS investigation the Air Force indicated that they would collect sediment and surface water samples from the drainage channel along the northwest corner of the base. Additionally, samples collected during drilling showed that the primary area of PFOA+PFOS greater than the EPA HAL was confined to the area immediately north of the base boundary. Therefore, the sediment and surface water sampling noted in the Work Plan was not performed.

In Situ Groundwater Sampling: The Work plan specified that groundwater samples should be obtained every 25 feet beginning at the water table. However, because the precise depth of the water table was not always apparent while drilling some of the initial samples were collected up to 15 feet below the water table. Based on discussions with ADEQ, a more conservative sample collection interval of approximately 20 feet was conducted at the first two soil boring locations, AZSB-01 and AZSB-02.

Field Reagent Blank Samples: The Work Plan specified that one FRB would be collected at each sample location, H+A generally collected one FRB per day at each sample location.

Well Completion: According to the Work Plan "Cement-bentonite grout will be placed in the well annulus from the top of the bentonite seal to ground surface." On November 11, 2020, H+A requested and received ADEQ approval to fill the annulus with bentonite slurry from the filter pack to 20 feet bgs and use a cement-bentonite slurry from 20 feet bgs to the surface. This was recommended to reduce work delays that would have ensued by the incremental application of cement-bentonite grout and curing time required to avoid heat damage to the PVC casing.

Additional Sampling and Analysis: As requested by ADEQ total organic carbon analysis was added to sample collection from AZSB-02 and AZSB-03. Total organic carbon samples were collected at 300, 326, 363, 428, and 479 feet bgs from AZSB-02 and 350, 430, and 480 feet bgs at AZSB-03.

9.0 REMEDIAL OBJECTIVES AND FUTURE WORK

As stated previously, the objective of the Central Tucson PFAS Project is to design and implement a remedy that will hydraulically contain the PFAS plume and prevent further impact to the Tucson Water Central Wellfield by PFOA+PFOS contamination. The investigation presented here developed the Conceptual Site Model necessary to proceed with meeting this objective.

Several additional actions are planned to meet this objective. Additional sampling of the well network will be conducted to confirm previous sampling results and available data from the AF Remedial Investigation will be analyzed to improve understanding of contaminant fate and transport. A demonstration treatment system is currently being constructed with startup expected in late 2021. The system will utilize the inactive Tucson Water well C-007 to extract and treat contaminated groundwater in the area of highest concentration detected north of DMAFB. The system will provide valuable data on treatment technologies and mass removal. And finally, aquifer testing will be conducted in the area to enhance the groundwater model and provide data to be used in the design of a full-scale treatment system.

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TABLES

TABLE 1
SUMMARY OF IN SITU SAMPLES

		IN-SITU GROUND-WATER	SOIL				
DEPTH (feet bls)	SAMPLE DATE	PFAS	PFAS	TOC	Porosity	Bulk Density	Grain Size
AZSB-01							
250	10/23/2020		X				
275	10/23/2020		X				
305	10/24/2020	X			X	X	X
325	10/24/2020	X			X	X	X
350	10/26/2020	X					X
365	10/27/2020	X			X	X	X
385	10/27/2020	X (&dup)					
410	10/28/2020	X (&dup)					
435	10/29/2020	X			X	X	X
460	10/30/2020	X					
480	10/30/2020	X					
500	10/31/2020	X					
520	11/2/2020	X					
545	11/3/2020	X					
575	11/10/2020	X					
600	11/11/2020	X					
AZSB-02							
250	10/31/2020		X				
275	10/31/2020		X				
294	11/2/2020	X					
300	11/3/2020			X	X	X	X
318	11/3/2020	X					
325/26	11/4/2020			X	X	X	X
338	11/4/2020	X (&dup)					
358	11/4/2020	X					
363	11/5/2020			X	X	X	X
378	11/5/2020	X					
398	11/5/2020	X					
418	11/6/2020	X					
428	11/6/2020			X	X	X	X
438	11/7/2020	X					
458	11/7/2020	X					
478	11/9/2020	X					
479	11/9/2020			X	X	X	X
508	11/10/2020	X					
528	11/11/2020	X					
AZSB-03							
300	11/30/2020	X (&dup)					
305					X	X	X
325	12/1/2020	X					

TABLE 1
SUMMARY OF IN SITU SAMPLES

		IN-SITU GROUND-WATER	SOIL				
DEPTH (feet bls)	SAMPLE DATE	PFAS	PFAS	TOC	Porosity	Bulk Density	Grain Size
AZSB-03 (cont'd)							
350	12/1/2020	X		X			
375	12/2/2020	X					
380	12/2/2020				X	X	X
400	12/2/2020	X					
425	12/3/2020	X					
430	12/3/2020			X	X	X	X
450	12/4/2020	X					
475	12/5/2020	X					
480	12/5/2020			X	X	X	X
500	12/5/2020	X					
AZSB-04							
277	11/20/2020	X					
302	11/30/2020	X					
327	12/1/2020	X					
352	12/1/2020	X					
377	12/2/2020	X (&dup)					
402	12/3/2020	X					
427	12/3/2020	X					
452	12/4/2020	X					
477	12/5/2020	X					
502	12/7/2020	X					
AZSB-05							
305	12/18/2020	X					
335	12/19/2020	X					
355	1/4/2021	X (&dup)					
380	1/5/2021	X					
405	1/5/2021	X					
430	1/6/2021	X					
455	1/6/2021	X					
480	1/7/2021	X					
500	1/8/2021	X					
AZSB-06							
283	12/17/2020	X (&dup)					
308	12/18/2020	X					
333	12/19/2020	X					
358	1/4/2021	X					
384	1/6/2021	X					
408	1/6/2021	X					
434	1/11/2021	X					
458	1/12/2021	X					
483	1/12/2021	X					
502	1/14/2021	X					

TABLE 1
SUMMARY OF IN SITU SAMPLES

		IN-SITU GROUND-WATER	SOIL				
DEPTH (feet bls)	SAMPLE DATE	PFAS	PFAS	TOC	Porosity	Bulk Density	Grain Size
AZSB-07							
305	1/19/2021	X					
330	1/20/2021	X					
355	1/20/2021	X (&dup)					
380	1/21/2021	X					
405	2/1/2021	X					
430	2/1/2021	X					
455	2/2/2021	X					
480	2/2/2021	X					

ACRONYMS/ABBREVIATIONS:

dup = Duplicate Sample
TOC = Total Organic Carbon
PFAS = Per- and polyfluoroalkyl substances
bls = Below Land Surface

TABLE 2
SUMMARY OF PHYSICAL PARAMETERS ANALYSIS

Boring Location	Depth (ft bls)	Wet Density (pcf)	Dry Density (pcf)	Moisture Content (%)	Soil Specific Gravity (20°C)	Porosity (%)	Volumetric Water Content (%)	% Gravel	% Sand	% Silt	% Clay
AZSB-01	305	130.7	123.0	5.60	2.617	24.92	12.42	1.5	66.8	25.5	6.2
	325	143.9	133.0	8.21	2.670	20.27	17.45	9.2	68.5	14.7	7.6
	350	--	--	--	--	--	--	9.7	60.4	19.5	10.4
	365	143.7	132.7	8.28	2.648	19.74	17.60	0.2	84.6	9.2	5.9
	435	133.3	115.8	15.11	2.627	29.39	27.93	2.0	75.9	13.3	8.8
AZSB-02	300	126.6	111.8	13.32	2.645	32.40	23.82	10.9	53.9	21.9	13.3
	326	137.4	121.3	13.45	2.639	26.43	25.82	5.3	68.5	16.9	9.3
	363	129.7	111.6	16.28	2.623	31.80	28.95	8.7	53.4	24.2	13.7
	428	134.6	122.4	10.98	2.671	26.58	19.37	18.3	60.6	12.6	8.5
	479	120.8	97.0	24.51	2.629	40.93	38.06	2.9	69.5	18.2	9.5
AZSB-03	305	137.6	118.6	16.08	2.635	25.48	22.70	2.8	65.7	19.9	11.6
	380	137.7	119.9	15.00	2.654	27.50	26.62	8	59.10	21.0	11.8
	430	140.1	129.2	8.79	2.617	20.93	17.44	8	67.00	14.7	10.7
	480	141.4	124.2	13.90	2.610	23.82	22.98	6.7	65.5	14.6	13.2

ACRONYMS/ABBREVIATIONS:

ft bls = feet below land surface
pcf = pounds per cubic foot
% = percent
C = centigrade
-- = Not analyzed

TABLE 3
SUMMARY OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN SOIL

					Parameter	ADONA	4:2 FTS	6:2 FTS	8:2 FTS	F-53B Major	F-53B Minor	GenX	NEtFOSAA	NMeFOSAA	PFBS	PFBA	PFDS	PFDA	PFDoA	PFHpS	PFHpA	PFHxS	PFHxA	PFNS	PFNA	PFOSA	PFOS	PFOA	PFPeS	PFPeA	PFTeA	PFTriA	PFUnA
					Units	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg
Location ID	Field ID	Approximate Feet Above Water Table	Sample Date	Laboratory ID	Sample Type																												
AZSB-01	AZSB-01-250 Soil	40	10/23/2020	320-65994-01	REG	<0.018	<0.38	<0.15	<0.26	<0.028	<0.023	<0.11	<0.38	<0.40	<0.026	<0.029	<0.040	<0.023	<0.069	<0.036	<0.030	**0.17 E4**	**0.058 E4**	<0.020	<0.037	<0.084	<0.20	**0.19 E4**	<0.020	<0.079	<0.055	<0.052	<0.037
AZSB-01	AZSB-01-275 Soil	15	10/23/2020	320-65994-02	REG	<0.019	<0.40	<0.16	<0.27	<0.029	<0.024	<0.12	<0.40	<0.42	<0.027	**0.030 E4**	<0.042	<0.024	<0.072	<0.037	<0.031	**0.18 E4**	**0.072 E4**	<0.021	<0.038	<0.088	<0.21	**0.14 E4**	<0.021	<0.082	<0.058	<0.055	<0.038
AZSB-02	AZSB-02-250 Soil	29	10/31/2020	320-66224-01	REG	<0.019	<0.38	<0.16	<0.26	<0.028	<0.023	<0.11	<0.38	<0.40	<0.026	<0.029	<0.040	<0.023	<0.069	<0.036	<0.030	<0.032	<0.044	<0.021	<0.037	<0.085	<0.21	<0.089	<0.021	<0.080	<0.056	<0.053	<0.037
AZSB-02	AZSB-02-275 Soil	4	10/31/2020	320-66224-02	REG	<0.070	<1.4	<0.58	<0.97	<0.11	<0.086	<0.43	<1.4	<1.5	<0.097	<0.11	<0.15	<0.086	<0.26	<0.14	<0.11	<0.12	<0.16	<0.078	<0.14	<0.32	<0.78	<0.34	<0.078	<0.30	<0.21	<0.20	<0.14

ACRONYMS/ABBREVIATIONS:

ADONA = 4,8-Dioxa-3H-perfluorononanoic acid
GenX = 2,3,3,3-tetrafluoro-2-(heptafluoropropoxy) propanoic acid
4:2 FTS = 4:2 Fluorotelomer sulfonic acid
6:2 FTS = 6:2 Fluorotelomer sulfonic acid
8:2 FTS = 8:2 Fluorotelomer sulfonic acid
F-53B Major = 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
F-53B Minor = 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid
NEtFOSAA = N-ethylperfluorooctanesulfonamidoacetic acid
PFHpS = Perfluoroheptanesulfonic acid
PFHpA = Perfluoroheptanoic acid

NMeFOSAA = N-methylperfluorooctanesulfonamidoacetic acid
PFBS = Perfluorobutanesulfonic acid
PFBA = Perfluorobutanoic acid
PFDS = Perfluorodecanesulfonic acid
PFDA = Perfluorodecanoic acid
PFDoA = Perfluorododecanoic acid
PFHxS = Perfluorohexanesulfonic acid
PFHxA = Perfluorohexanoic acid
PFNS = Perfluorononanesulfonic acid
µg/Kg = micrograms per kilogram

PFNA = Perfluorononanoic acid
PFOSA = Perfluorooctanesulfonamide
PFOS = Perfluorooctanesulfonic acid
PFOA = Perfluorooctanoic acid
PFPeS = Perfluoropentanesulfonic acid
PFPeA = Perfluoropentanoic acid
PFTeA = Perfluorotetradecanoic acid
PFTriA = Perfluorotridecanoic acid
PFUnA = Perfluoroundecanoic acid

NOTES:

BOLDING Indicates analyte detected above method detection limit (MDL).
E4 = Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL) but above MDL. EPA qualifier = J.
Depth to water in monitor well AZMW-01 (AZSB-01) was 289.97 feet below top of casing on 2/4/21.
Depth to water in monitor well AZMW-02 was 279.15 feet below the top of casing on 2/4/21.
Compound names for acidic states were generally reported by laboratory. The anionic form is the state, especially in groundwater, in which the compounds are found in the environment, In this table the abbreviations refer to the anionic and/or acid state as appropriate.

TABLE 4
SUMMARY OF TOTAL ORGANIC CARBON IN SOIL

Location ID	Field ID	Sample Date	Laboratory ID	Total Organic Carbon (g/Kg)
AZSB-02	AZSB-02-300 SOIL	11/3/2020	280-142605-01	4.1 J
AZSB-02	AZSB-02-326 SOIL	11/4/2020	280-142605-02	3.2 J
AZSB-02	AZSB-02-363 SOIL	11/5/2020	280-142605-03	4.6 J
AZSB-02	AZSB-02-428 SOIL	11/6/2020	280-142605-04	3.6 J
AZSB-02	AZSB-02-479 SOIL	11/9/2020	280-142605-05	5.1 J
AZSB-03	AZSB-03-350 SOIL	12/1/2020	280-143545-01	<0.90
AZSB-03	AZSB-03-430 SOIL	12/3/2020	280-143545-02	<0.90
AZSB-03	AZSB-03-480 SOIL	12/5/2020	280-143545-03	<0.90

ACRONYMS/ABBREVIATIONS:

J = Compound was detected in a method blank at a concentration greater than 1/10th of the sample result. Detected concentrations in AZSB-02-326 and AZSB-02-428 below laboratory minimum reporting level (MRL) but above method detection limit (MDL).

g/Kg = grams per kilogram

HARGIS+ASSOCIATES, INC.

TABLE 5
SUMMARY OF SELECTED PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN IN SITU GROUNDWATER RESULTS

Boring	Depth	Sample Date	PFOS+ PFOA (ppt)	PFOS+ PFOA+ PFHxS+ PFHpA (ppt)	PFOS (ppt)	PFOA (ppt)	PFHxS (ppt)	PFHpA (ppt)	PFHxA (ppt)	PFBS (ppt)
		Analyte	PFOS+ PFOA (ppt)	PFOS+ PFOA+ PFHxS+ PFHpA (ppt)	PFOS (ppt)	PFOA (ppt)	PFHxS (ppt)	PFHpA (ppt)	PFHxA (ppt)	PFBS (ppt)
		EPA HAL	70	n/a	70	70	n/a	n/a	n/a	n/a
		TW Operational WQT	n/a	18	7	11	7	18	200000	420
AZSB-01	305	10/24/2020	630	1102	360	270	400	72	230	32
AZSB-01	325	10/24/2020	5200	10130	1900	3300	4000	930	2700	410
AZSB-01	350	10/26/2020	4200	8110	2400	1800	3200	710	2100	390
AZSB-01	365	10/27/2020	680	1340	410	270	540	120	420	60
AZSB-01	385	10/27/2020	1770	3350	1100	670	1300	280	890	150
AZSB-01	410	10/28/2020	76	138	49	27	51	11 E4	33	7.3 E4
AZSB-01	435	10/29/2020	95	167	62	33	59	13 E4	40	6.6 E4
AZSB-01	460	10/30/2020	660	1270	400	260	500	110	360	57
AZSB-01	480	10/30/2020	350	842	160	190	410	82	290	57
AZSB-01	500	10/31/2020	11	11	11 E4	<11	<7.1	<3.1	<7.3	2.5 E4
AZSB-01	520	11/2/2020	8.8	8.8	8.8 E4	<11	<7.1	<3.1	<7.3	<2.5
AZSB-01	545	11/3/2020	312	480	250	62	140	28	84	17
AZSB-01	575	11/10/2020	12.3	16.42	11	1.3 E4	3.4	0.72 E4	2.4	<0.17
AZSB-01	600	11/11/2020	9.6	14.74	7.5	2.1	4.4	0.74 E4	3.1	<0.18
AZSB-02	294	11/2/2020	ND	15	<6.8	<11	15 E4	<3.1	7.8 E4	<2.5
AZSB-02	318	11/3/2020	24	48.9	14	10	22	2.9	22	3.9
AZSB-02	338	11/4/2020	223	422	23	200	180	19	140	27
AZSB-02	358	11/4/2020	313	572	13	300	230	29	210	36
AZSB-02	378	11/5/2020	239	440	19	220	180	21	160	28
AZSB-02	398	11/5/2020	205	376	15	190	150	21	150	23
AZSB-02	418	11/6/2020	317	589	27	290	240	32	210	36
AZSB-02	438	11/7/2020	139.4	243.4	9.4	130	92	12	82	14
AZSB-02	458	11/7/2020	139.9	249.9	9.9	130	99	11	90	15
AZSB-02	478	11/9/2020	48.9	86.1	3.9	45	33	4.2	31	5.4
AZSB-02	508	11/10/2020	23	43.9	<6.6	23	18	2.9	38	4.3
AZSB-02	528	11/11/2020	27	49.5	2	25	20	2.5	19	3.1
AZSB-03	300	11/30/2020	3.4	8.7	2.1	1.3 E4 B	4	1.3 E4 B	11	5.5
AZSB-03	325	12/1/2020	0.78	1.88	0.78 E4	<0.79	1.1 E4	<0.23	1.1 E4	2.3
AZSB-03	350	12/1/2020	3.5	4.7	2.2	1.3 E4	1.2 E4	<0.23	1.5 E4	1.5 E4
AZSB-03	375	12/2/2020	6.2	20.6	2.4 B	3.8	12	2.4	5.3	5.1
AZSB-03	400	12/2/2020	7.5	22.8	2.9	4.6	13	2.3	5.9	5.6
AZSB-03	425	12/3/2020	6.9	20.1	2.8	4.1	11	2.2	6.2	<12
AZSB-03	450	12/4/2020	ND	ND	<0.48	<0.75	<0.50	<0.22	<0.51	<0.18
AZSB-03	475	12/5/2020	42.9	52	40	2.9	7.4	1.7 E4	12	7.8
AZSB-03	500	12/5/2020	0.85	2.27	<0.48	0.85 E4	0.77 E4	0.65 E4	6.2	<0.18
AZSB-04	277	11/20/2020	ND	1.78	<0.49	<0.76	1.5 E4	0.28 E4	1.9 B	2
AZSB-04	302	11/30/2020	5.3	23.8	<0.45	5.3	15	3.5	13 B	12
AZSB-04	327	12/1/2020	6.8	23.7	1.1 E4	5.7	13	3.9	17	14
AZSB-04	352	12/1/2020	5.9	19.9	1.4 E4	4.5	11	3	15	13
AZSB-04	377	12/2/2020	6.6	19.9	1.8	4.8	10	3.3	18	13
AZSB-04	402	12/3/2020	4.5	14.1	1.2 E4	3.3	7.4	2.2	11	10
AZSB-04	427	12/3/2020	2.64	8.04	0.74 E4	1.9	4.1	1.3 E4	7	5.7
AZSB-04	452	12/4/2020	2.23	6.43	0.63 E4	1.6	3.1	1.1 E4	5.8	4.3
AZSB-04	477	12/5/2020	0.79	0.79	0.79 E4	<0.76	<0.51	<0.22	<0.52	<0.18
AZSB-04	502	12/7/2020	2.1	4.26	1.0 E4	1.1 E4	1.7 E4	0.46 E4	1.6 E4 B	<0.19

TABLE 5
SUMMARY OF SELECTED PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN IN SITU GROUNDWATER RESULTS

Boring	Depth	Analyte / Sample Date	PFOS+ PFOA (ppt)	PFOS+ PFOA+ PFHxS+ PFHpA (ppt)	PFOS (ppt)	PFOA (ppt)	PFHxS (ppt)	PFHpA (ppt)	PFHxA (ppt)	PFBS (ppt)
		EPA HAL	70	n/a	70	70	n/a	n/a	n/a	n/a
		TW Operational WQT	n/a	18	7	11	7	18	200000	420
Boring	**Depth**	**Sample Date**								
AZSB-05	305	12/18/2020	**1.8**	**12**	<0.51	**1.8** E4	**8.5**	**1.7** E4	**4**	**1.4** E4
	335	12/19/2020	**5.4**	**7.38**	**3.6**	**1.8** E4	**1.2** E4	**0.78** E4	**1.6** E4	**3.1**
	355	1/4/2021	ND	**7.3**	<5.4	<8.5	**7.3** E4	<2.5	**6.4** E4	<2.0
	380	1/5/2021	**3.8**	**5.62**	**2.3**	**1.5** E4	**1.3** E4	**0.52** E4 B	**1.8**	<3.7
	405	1/5/2021	**2.35**	**4.27**	**0.75** E4	**1.6** E4	**1.4** E4	**0.52** E4 B	**2**	<3.2
	430	1/6/2021	**2.26**	**4.16**	**0.86** E4	**1.4** E4	**1.6** E4	**0.30** E4	**2.2**	<0.19
	455	1/6/2021	**0.62**	**1.49**	**0.62** E4	<0.76	**0.87** E4	<0.22	**0.87** E4	<0.18
	480	1/7/2021	**5.7**	**7.87**	**3.8**	**1.9** E4	**1.4** E4	**0.77** E4	**2.6**	<2.0
	500	1/8/2021	**8.4**	**13.1**	**4.7**	**3.7**	**2.5**	**2.2**	**5.2**	<0.17
AZSB-06	283	12/17/2020	ND	**3.9**	<0.51	<0.81	**2.1**	**1.8** E4 B	**12** B	**3.6**
	308	12/18/2020	**2.9**	**4.8**	**1.5** E4	**1.4** E4	**1.1** E4	**0.80** E4	**4.6**	**2.0**
	333	12/19/2020	ND	ND	<0.58	<0.92	<0.62	<0.27	**0.74** E4	**0.40** E4
	358	1/4/2021	ND	ND	<5.4	<8.5	<5.7	<2.5	**9.1** E4	<2.0
	384	1/6/2021	**2.19**	**3.41**	**1.2** E4	**0.99** E4	**0.68** E4	**0.54** E4	**3.5**	**1.00** E4
	408	1/6/2021	**1.46**	**1.92**	**0.72** E4	**0.74** E4	**0.46** E4	<0.20	**2.2**	**0.58** E4
	434	1/11/2021	**0.65**	**1.89**	**0.65** E4	<0.70	**0.88** E4	**0.36** E4 B	**1.8**	<0.16
	458	1/12/2021	**1.95**	**3.55**	**1.2** E4	**0.75** E4	**1.1** E4	**0.50** E4	**2.8**	<0.17
	483	1/12/2021	**1.1**	**2.1**	**1.1** E4	<0.73	**0.72** E4	**0.28** E4	**1.9**	**0.76** E4
	502	1/14/2021	**0.70**	**1.10**	<2.7	**0.70** E4	<0.47	**0.40** E4	**2.6**	<0.16
AZSB-07	305	1/19/2021	**3.7**	**12.5**	**2.1**	**1.6** E4 B	**7.6**	**1.2** E4 B	**9.0**	**8.7**
	330	1/20/2021	ND	**0.58**	<0.49	<0.77	**0.58** E4	<0.23	**0.59** E4	**0.64** E4
	355	1/20/2021	ND	ND	<0.49	<0.77	<0.51	<0.23	<0.52	<0.18
	380	1/21/2021	**8.1**	**11.76**	**3.6**	**4.5**	**0.96** E4	**2.7**	**4.9**	**5.0**
	405	2/1/2021	**0.84**	**1.88**	**0.84** E4	<0.83	**0.72** E4	**0.32** E4	**1.3** E4	**1.2** E4
	430	2/1/2021	ND	ND	<0.47	<0.74	<0.50	<0.22	<0.50	<0.17
	455	2/2/2021	**5.9**	**8.5**	**3.1**	**2.8**	**1.2** E4	**1.4** E4	**3.6**	**3.4**
	480	2/2/2021	**0.59**	**0.59**	**0.59** E4	<0.78	<0.52	<0.23	<0.53	<0.18

ACRONYMS/ABBREVIATIONS:

< = Less Than
n/a = not available / not applicable
ND = non-detect
ppt = Parts per trillion
PFHpA = Perfluoroheptanoic acid
PFBS = Perfluorobutanesulfonic acid
PFHxS = Perfluorohexanesulfonic acid
PFAS = Per- and Polyfluoroalkyl Substances
PFHxA = Perfluorohexanoic acid
PFOS = Perfluorooctanesulfonic acid
PFOA = Perfluorooctanoic acid
TW Operational WQT = Tucson Water Operational Water Quality Target

NOTES:

BOLDING Indicates analyte detected.
E4 = Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL) but above the method detection limit (MDL). EPA qualifier = J.
B = Target analyte detected in method blank at or above the method reporting limit.
EPA HAL = United States Environmental Protection Agency (EPA) drinking water health advisory level (HAL)
TW OWQT = Tucson Water's Operational Water Quality Target
= Exceeds TW-OWQT
= Exceeds EPA HAL and TW Operational WQT

Compound names for acidic states were generally reported by laboratory. The anionic form is the state, especially in groundwater, in which the compounds are found in the environment, In this table the abbreviations refer to the anionic and/or acid state as appropriate.

TABLE 6
MONITOR WELL CONSTRUCTION DETAILS

Well Identifier	DWR Identifer	Northing (feet)	Easting (feet)	Date Installed	Drilling Method	Current Land Surface Elevation (feet msl)	Current Reference Point Elevation (toc) (feet msl)	Total Depth of Borehole (feet bls)	Abandoned Interval (feet bls)		Screen Interval (feet bls)		Length of Screen Interval (feet)	Screen Slot Size (inches)	Borehole Diameter (inches)	Casing Diameter (a) (inches)	Filter Pack Interval (feet bls)		Filter Pack Sand Size	Grout Filter Interval (b) (feet bls)		Bentonite Seal Interval (c) (feet bls)		Annular Seal Interval (d) (feet bls)	
									Top	Bottom	Top	Bottom					Top	Bottom		Top	Bottom	Top	Bottom	Top	Bottom
AZMW-01	55-925021	436858.9641	1014348.469	11/13/20- 11/19/20	Sonic	2553.28	2552.995	600	495	600	450	490	50	0.020	9": 0-166' 8":166-565' 7": 565-600	4	445	495	12x20	440	445	435	440	0 20	20 435
AZMW-02	55-925064	441526.8435	1013303.017	11/12/20- 11/17/20	Sonic	2525.67	2525.29	525	405.5	525	350	400	50	0.020	9": 0-117' 8":117-525'	4	344	405.5	12x20	340	344	333	340	0 20	20 333
AZMW-03	55-925167	446169.0662	1010977.574	12/9/20- 12/14/20	Sonic	2515.71	2515.29	500	485	500	380 450	430 480	50 30	0.020 0.020	9": 0-105' 8":105-500'	4	375 443	437 485	#8x12 #8x12	372	375	366 437	372 443	0 135	135 366
AZMW-04	55-925166	443693.0813	1009557.185	12/8/20 - 12/14/20	Sonic	2493.8	2495.94	500	387	500	330	380	50	0.020	8":0-500'	4	322	387	12x20	322	325	312	322	0 20	20 312
AZMW-05	55-925168	445354.062	1013280.238	1/11/21- 1/14/21	Sonic	2525.21	2524.84	500	497	500	395 465	445 495	50 30	0.020	9": 0-125' 8":125-500'	4	390 458	452 497	#8x12 #8x12	387	390	385 452	387 458	0 20	20 385
AZMW-06	55-925291	439867.737	1011223.823	1/15/21 - 1/18/21	Sonic	2517.53	2517.11	500	405	500	350	400	50	0.020	8":0-500'	4	343	405	#8x12	331	343	323	331	0 20	20 323
AZMW-07	55-925576	442133.9875	1015370.809	2/5/21- 2/8/21	Sonic	2538.39	2537.83	485	413	485	375	405	30	0.020	9" 0-275' 8" 275-485'	4	370	408	#8x12	367	370	362	367	0 20	20 362

ACRONYMS/ABBREVIATIONS:

msl = mean sea level, National Geodetic Vertical Datum of 1929 (NGVD29)
bls = below current land surface
toc = top of 4-inch diameter PVC casing
DWR = Department of Water Resources

NOTES:

(a) = Schedule 80 polyvinyl chloride (PVC) well screen and casing
(b) = #60 Sand
(c) = hydrated bentonite chips/pellets
(d) = Upper 20 feet Portland cement with approximately 5% bentonite, unless otherwise indicated. Below 20 feet: Bentonite Slurr

TABLE 7
SUMMARY OF WASTE DISPOSAL

Location	Manifest	Profile	Disposal Date	Landfill	Ticket Number	Net Weight (pounds)	Quantity (tons)	Volume (Gallons)	Description
AZSB-01	RAD-16826	812-11255	12/23/2020	Durham	01-00042883	17,960	8.98	n/a	Drill Cuttings RO
AZSB-01	RAD-16829	812-11255	12/23/2020	Durham	01-00042677	32,460	16.23	n/a	Drill Cuttings RO
AZSB-02	RAD-16827	812-11255	12/23/2020	Durham	01-00042699	31,380	15.69	n/a	Drill Cuttings RO
AZSB-04	RAD-186515	812-11257	1/14/2021	Durham	01-00044160	30,000	15	n/a	Drill Cuttings RO
AZSB-03	RAD-186514	812-11257	1/14/2021	Durham	01-00044127	38,540	19.27	n/a	Drill Cuttings RO
AZSB-05	RAD-186540	812-11260	2/4/2021	Durham	01-00045673	36,420	18.21	n/a	Drill Cuttings RO
AZSB-06	RAD-186541	812-11261	2/4/2021	Durham	01-00045726	38,700	19.35	n/a	Drill Cuttings RO
AZSB-07	RAD-186757	812-11266	3/15/2021	Durham	01-00048397	32,320	16.16	n/a	Drill Cuttings RO
AZMW-01 to 07	21648CP-1	#070308286-0	9/8/2021	US Ecology	n/a	n/a	n/a	3853.72	Nonwastewater
AZMW-01 to 07	21648CP-2	#070308286-0	9/16/2021	US Ecology	n/a	n/a	n/a	1824.94	Nonwastewater
					TOTAL	257,780	128.89	5,678.66	

NOTES:

Durham RO = Durham Regional Landfill, Right Away Disposal, 22316 S. Harmon Road, Florence AZ
US Ecology = US Ecology Beatty, NV, Hwy 95, 11 Mi South of Beatty, Beatty, NV 89003
Nonwastewater = Development and decontamination water from wells mixed in storage tanks.
n/a = not available / not applicable

TABLE 8
WATER LEVEL ELEVATION DATA

Well Identifier	Northing (a)	Easting (a)	Measurement Point Elevation Reference Point Elevation (Feet AMSL)	Date of Measurement	Depth to Water (ft bmp)	Elevation (b)	Longitude	Latitude
AZMW-01	436858.9641	1014348.469	2552.995	2/4/2021	289.97	2263.03	-110.9004317	32.19692981
AZMW-02	441526.8435	1013303.017	2525.288	2/4/2021	279.15	2246.14	-110.9036688	32.20978664
AZMW-03	446169.0662	1010977.574	2515.291	2/4/2021	285.99	2229.30	-110.9110461	32.22260585
AZMW-04	443693.0813	1009557.185	2495.944	2/4/2021	256.84	2239.10	-110.9157133	32.21583703
AZMW-05	445354.062	1013280.238	2524.839	2/4/2021	291.54	2233.30	-110.9036258	32.22030636
AZMW-06	439867.737	1011223.823	2517.114	2/4/2021	264.41	2252.70	-110.9104407	32.20528025
AZMW-07	442133.9875	1015370.809	2537.829	3/2/2021	294.38	2243.45	-110.8969653	32.21140163
B-001A	450335.117	1000577.808	2461	2/4/2021	262.34	2198.66	-110.94455	32.23431944
B-002A	450432.236	1002258.842	2475	2/4/2021	269.50	2205.50	-110.9391111	32.23454444
B-003B	446280.59	1000707.281	2438.314	3/5/2021	215.68	2222.63	-110.94425	32.22317222
B-004A	450449.366	1003361.638	2471	2/4/2021	264.01	2206.99	-110.9355444	32.23456389
B-005A	449721.113	1005831.952	2485	2/4/2021	272.20	2212.80	-110.9275778	32.2325
B-007A	448474.391	1006863.125	2495	2/4/2021	276.99	2218.01	-110.9242806	32.22904722
B-007B	448527.035	1006872.948	2493.009	2/4/2021	272.35	2220.66	-110.9242472	32.22919167
B-011A	437685.822	1001566.17	2477.964	2/3/2021	223.18	2254.78	-110.941725	32.19952778
B-013B	443115.522	1003957.01	2460.625	2/4/2021	223.99	2236.64	-110.9338361	32.21439167
B-014A	441830.749	1002933.399	2457.298	2/4/2021	216.84	2240.46	-110.9371833	32.21088611
B-015A	442253.112	1004803.486	2468.93	2/4/2021	227.41	2241.52	-110.931125	32.212
B-019A	438569.095	1004667.981	2483.266	2/4/2021	230.16	2253.11	-110.9316722	32.20187778
B-042A	452849.744	1004806.772		2/4/2021	OBSTRUCTED		-110.9308	32.241125
B-042B	452803.565	1004840.695	2459.252	2/4/2021	247.86	2211.39	-110.9306917	32.24099722
B-043A	454747.373	1004767.019	2439.411	2/26/2021	232.55	2206.86	-110.9308722	32.24634167
B-043B	454685.634	1004757.279	2439.448	2/26/2021	230.92	2208.53	-110.9309056	32.24617222
B-050A	454395.074	1015521.136	2472.672	3/5/2021	248.90	2223.77	-110.8961028	32.24509722

TABLE 8
WATER LEVEL ELEVATION DATA

Well Identifier	Northing (a)	Easting (a)	Measurement Point Elevation Reference Point Elevation (Feet AMSL)	Date of Measurement	Depth to Water (ft bmp)	Elevation (b)	Longitude	Latitude
B-051B	452835.328	1015170.048	2477.04	3/5/2021	255.69	2221.35	-110.8972861	32.24081944
B-052A	454724.78	1018086.976	2478.048	3/3/2021	248.86	2229.19	-110.8877944	32.24593611
B-052B	454750.695	1018154.581	2477	3/3/2021	245.62	2231.38	-110.887575	32.24600556
B-053B	452577.497	1010329.722	2475.5	2/4/2021	259.18	2216.32	-110.9129472	32.24023611
B-054A				2/4/2021	OBSTRUCTED			
B-054B	452274.942	1007683.529	2457.64	2/4/2021	243.00	2214.64	-110.9215139	32.23947222
B-055A	450078.457	1009278.45	2484.555	3/5/2021	267.31	2217.25	-110.9164222	32.23339444
B-056A	452591.628	1011514.941	2473.44	2/4/2021	257.76	2215.68	-110.9091139	32.24024444
B-057A	455532.552	1010643.931	2450.333	2/8/2021	234.83	2215.50	-110.9118417	32.24835
B-057B	455520.521	1010654.35	2450.29	2/8/2021	235.25	2215.04	-110.9118083	32.24831667
B-058A	450095.433	1010491.219		3/5/2021	OBSTRUCTED		-110.9125	32.23341
B-110A	440624.994	1011133.947	2517.707	2/4/2021	261.27	2256.44	-110.9107083	32.20736389
B-111A	455126.146	1008354.517	2449	2/8/2021	236.00	2213.00	-110.9192583	32.24729167
C-004A	443742.213	1012746.663		1/25/2021	OBSTRUCTED		-110.9054	32.21589
C-004B	443747.775	1012736.3	2514.289	1/25/2021	276.33	2237.96	-110.9054333	32.21590556
C-007A	436849.492	1014280.154	2554.22	2/3/2021	290.48	2263.74	-110.9006528	32.19690556
C-009A	437856.225	1006826.262	2501.363	2/11/2021	244.02	2257.34	-110.9247167	32.19986389
C-012A	443511.764	1019586.269	2572.15	2/4/2021	328.77	2243.38	-110.8832944	32.21507778
C-012B	443456.946	1019561.02	2571.619	2/4/2021	327.39	2244.23	-110.8833778	32.21492778
C-014A	437131.127	1012850.968	2541	2/3/2021	280.71	2260.29	-110.9052639	32.19771667
C-014B	437198.826	1012849.472	2541.348	2/3/2021	278.90	2262.45	-110.9052667	32.19790278
C-030A	446874.216	1014715.454	2520.386	2/4/2021	291.08	2229.31	-110.8989389	32.22444722
C-030B	446919.414	1014685.817	2520.861	2/4/2021	291.32	2229.54	-110.8990333	32.22457222
C-032B	447110.42	1017341.195	2524.762	2/8/2021	291.42	2233.34	-110.8904417	32.22502778

TABLE 8
WATER LEVEL ELEVATION DATA

Well Identifier	Northing (a)	Easting (a)	Measurement Point Elevation Reference Point Elevation (Feet AMSL)	Date of Measurement	Depth to Water (ft bmp)	Elevation (b)	Longitude	Latitude
C-033A	448696.682	1014422.433	2519.514	3/3/2021	294.21	2225.30	-110.8998306	32.22946389
C-036A	441388.879	1013161.48	2526.327	2/4/2021	279.92	2246.41	-110.9041306	32.20941111
C-036B	441395.542	1013225.001	2526.606	2/4/2021	279.69	2246.92	-110.903925	32.20942778
C-037A	444399.096	1018741.763	2564.053	3/3/2021	323.29	2240.76	-110.8859972	32.21753889
C-038A	443932.783	1015416.051	2534.388	3/5/2021	296.92	2237.47	-110.8967639	32.21634444
C-041A	443090.356	1019169.311	2565.93	2/4/2021	322.80	2243.13	-110.8846556	32.21393056
C-042A	443138.564	1015538.722	2541.78	2/4/2021	299.61	2242.17	-110.8963917	32.21415833
C-043A	441924.082	1018539.521	2564.108	2/4/2021	318.62	2245.49	-110.8867278	32.21074167
C-045A	438907.395	1015584.041	2553	3/5/2021	297.21	2255.79	-110.896375	32.20252778
C-045B	438733.587	1015586.55	2555.864	3/5/2021	296.12	2259.74	-110.8963722	32.20205
C-050A	449985.476	1018053.35	2508.36	2/4/2021	281.76	2226.60	-110.88805	32.23291111
C-050B	449923.651	1018035.044	2511.375	2/4/2021	282.67	2228.71	-110.8881111	32.23274167
C-055B	448790.445	1011932.875	2502.514	3/3/2021	278.15	2224.36	-110.9078778	32.22978611
C-122A	443854.341	1017050.1	2549.056	3/3/2021	309.39	2239.67	-110.8914833	32.21608611
C-124A	450772.202	1015875.114	2496.428	3/5/2021	269.52	2226.91	-110.8950694	32.23513056
C-125A	452333.09	1018249.044	2497.35	3/3/2021	267.28	2230.07	-110.8873444	32.23935833
D-061A	437797.528	1018217.276	2579.49	3/5/2021	316.24	2263.25	-110.8878972	32.19940833
WR-127A	439277.454	1010231.41	2515.785	2/9/2021	262.65	2253.14	-110.9136667	32.20368333
WR-127B	439271.559	1010249.51	2516.342	2/9/2021	261.30	2255.04	-110.9136083	32.20366667
WR-128A	442793.069	1006262.607	2475.367	2/9/2021	234.47	2240.90	-110.9263917	32.21344722
WR-129A	445042.807	1008888.031	2501.506	2/9/2021	269.02	2232.49	-110.9178361	32.21956389
WR-129B	444831.704	1008901.162	2499	2/9/2021	266.76	2232.24	-110.9178	32.21898333
WR-130A	445544.566	1011321.581	2518.146	2/9/2021	286.23	2231.92	-110.9099528	32.22088056
WR-130B	444019.734	1011347.036	2507.769	2/9/2021	271.10	2236.67	-110.9099167	32.21668889

TABLE 8
WATER LEVEL ELEVATION DATA

Well Identifier	Northing (a)	Easting (a)	Measurement Point Elevation Reference Point Elevation (Feet AMSL)	Date of Measurement	Depth to Water (ft bmp)	Elevation (b)	Longitude	Latitude
WR-140A	450558.483	1004021.208	2481	2/8/2021	272.99	2208.01	-110.9334083	32.23484722
WR-140B	450556.281	1004001.471	2480.5	2/8/2021	272.52	2207.98	-110.9334722	32.23484167
WR-141A	450549.641	1003496.443	2476.5	2/8/2021	266.82	2209.68	-110.9351056	32.23483611
WR-141B	450538.611	1003505.993	2474.5	2/8/2021	266.78	2207.72	-110.935075	32.23480556
WR-142A	450083.6	1003481.804	2478.5	2/8/2021	259.45	2219.05	-110.9351667	32.23355556
WR-142B	450095.774	1003486.847	2468.5	2/8/2021	259.14	2209.36	-110.93515	32.23358889

ACRONYMS/ABBREVIATIONS:

AMSL = Above Mean Sea Level

ft bmp = feet below measuring point

NOTES:

(a) = Coordinate System: Arizona State Plane 1983 (feet)

(b) = Vertical Datum: NAVD88

TABLE 9
SUMMARY OF MONITOR WELLS SAMPLING AND ANALYSIS

MONITOR WELL DEPTH	SAMPLE DATE	COLLECTION METHOD	PFAS	Alkalinity as CaCO3	BROMIDE	Ca, Fe, Mg, As, Mn Na	Chloride, Fluoride, Nitrate as N; Sulfate	TOTAL DISSOLVED SOLIDS	TOTAL ORGANIC CARBON	URANIUM	Cr+6	PECHLORATE
AZMW-01												
457	3/1/2021	Hydrasleeve	J70732 (+Dup)									
470	3/1/2021 & 3/4/21	Hydrasleeve	J70892	J159326	J70633	J159326	J159326	J159326	J159326	J159326	J70633	J159326
483	3/1/2021	Hydrasleeve	J70732									
AZMW-02												
358	2/23/21 & 3/1/2021	Hydrasleeve	J70732	J159326	J70633	J159149	J159326 J159039	J159149	J159149			
375	2/23/21 & 3/1/2021	Hydrasleeve	J70732							J159149	J70633	J159149
392	3/1/2021	Hydrasleeve	J70732									
AZMW-03												
393	3/1/2021	Hydrasleeve	J70732									
417	2/23/21 & 3/1/2021	Hydrasleeve	J70732							J159149	J70633	J159326
460	3/1/2021	Hydrasleeve	J70732									
475/480	2/23/21 & 3/1/2021	Hydrasleeve	J70732	J159326	J70633	J159326	J159326	J159149	J159149			
AZMW-04												
336	2/23/2021	Hydrasleeve	J70585									
353	2/23/2021	Hydrasleeve	J70585	J159149	J70633	J159149	J159039	J159149	J159149			
371	2/23/2021	Hydrasleeve	J70585									
AZMW-05												
408	2/23/2021	Hydrasleeve	J70585									
433	2/23/2021	Hydrasleeve	J70585									
485	2/23/2021	Hydrasleeve	J70585	J159149	J70633	J159149	J159039	J159149	J159149			

TABLE 9
SUMMARY OF MONITOR WELLS SAMPLING AND ANALYSIS

MONITOR WELL DEPTH	SAMPLE DATE	COLLECTION METHOD	PFAS	Alkalinity as CaCO3	BROMIDE	Ca, Fe, Mg, As, Mn Na	Chloride, Fluoride, Nitrate as N; Sulfate	TOTAL DISSOLVED SOLIDS	TOTAL ORGANIC CARBON	URANIUM	Cr+6	PECHLORATE
AZMW-06												
358	2/23/2021	Hydrasleeve	J70585									
375	2/23/2021	Hydrasleeve	J70585	J159149	J70633	J159149	J159039	J159149	J159149			
392	2/23/2021	Hydrasleeve	J70585									
AZMW-07												
383	3/4/2021	Hydrasleeve	J70892	J159548	J159548	J159548	J159548	J159548	J159548			
397	3/4/2021	Hydrasleeve	J70892									

ACRONYMS/ABBREVIATIONS:

As = Arsenic
as N = as Nitrogen
Ca = Calcium
CaCO3 = Calcium Carbonate
Cr+6 = Hexavalent Chromium
dup = duplicate
Fe = Iron
Mg = Magnesium
Mn = Manganese
Na = Sodium
PFAS = Per- and Polyfluoroalkyl Substances
TOC = Total Organic Carbon

HARGIS+ASSOCIATES, INC.

TABLE 10
SUMMARY OF OTHER GROUNDWATER ANALYTICAL RESULTS

Location ID	Field ID	Depth (feet bls)	Sample Date	Sample Type	Arsenic	Bromide	Calcium	Chloride	Fluoride	Hardness	Iron	Magnesium	Manganese	Nitrate as N	Potassium	Sodium	Sulfate	Total Alkalinity	Total Dissolved Solids	Total Organic Carbon	Uranium	Hexavalent Chromium	Perchlorate
				Analytical Method	EPA 200.8	EPA 300.1	EPA 200.7	EPA 300.0	EPA 300.0	SM 2340B	EPA 200.7	EPA 200.7	EPA 200.8	EPA 300.0	EPA 200.7	EPA 200.7	EPA 300.0	SM 2320B	SM 2540C	SM 5310B	EPA 200.8	EPA 218.6	EPA 314.0
				Units	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L
AZMW-01	AZMW-01-470-GW	470	3/1/2021	REG	7.0	81	73	12	0.18 E4	230	15	11	510	0.17	5.0	47	89	130	260	<2.6	2.6	<0.25	<0.31
AZMW-02	AZMW-02-358-GW	358	2/23/2021	REG	6.9	120	22	27	0.38 E4	59	1.1	1.2 E4	17	<0.014	3.2	61	110	37	210	5.5	--	--	--
AZMW-02	AZMW-02-375-GW	375	2/23/2021; 3/1/2021	REG	--	--	--	28	0.40	--	--	--	--	<0.014	--	--	110	--	--	--	0.75	<0.25	<0.31
AZMW-03	AZMW-03-417-GW	417	3/1/2021	REG	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.6	<0.25	4.9
AZMW-03	AZMW-03-475-GW	475	2/23/2021	REG	--	720	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AZMW-03	AZMW-03-480-GW	480	2/23/2021; 3/1/2021	REG	1.9		81	110	0.20 E4	250	8.4	11	300	2.6	4.3	68	88	130	450	2.8	--	--	--
AZMW-04	AZMW-04-353-GW	353	2/23/2021	REG	2.7	640	140	140	0.24 E4	390	4.8	13	160	2.4	6.4	77	310	30	560	1.9 E4	--	--	--
AZMW-05	AZMW-05-485-GW	485	2/23/2021	REG	0.87	68	36	9.9	0.50	120	9.1	6.8	330	<0.014	7.1	46	17	130	220	8.3	--	--	--
AZMW-06	AZMW-06-375-GW	375	2/23/2021	REG	2.0	84	46	12	0.33 E4	150	12	9.3	470	<0.014	4.5	45	59	140	240	1.6 E4	--	--	--
AZMW-07	AZMW-07-383-GW	383	3/4/2021	REG	1.3	130	200	49	0.25 E4	510	0.23	0.58 E4	5.9	0.78	25	86	58	670	930	7.2	--	--	--

ACRONYMS/ABBREVIATIONS:

E4 = Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL) but above the method detection limit (MDL). EPA qualifier = J.
bls = below land surface
µg/L = micrograms per liter
mg/L = milligrams per liter
SM = Standard method
EPA = U.S. Environmental Protection Agency
< = less than

TABLE 11
SUMMARY OF PER- AND POLYFLUOROALKYL SUBSTANCES IN GROUNDWATER

			ANALYTE	PFOS+ PFOA	PFOS+ PFOA+ PFHxS+ PFHpA	4:2 FTS	6:2 FTS	8:2 FTS	ADONA	F-53B Major	F-53B Minor	GenX	NEtFOSAA	NMeFOSAA	PFBA	PFBS	PFDA	PFDoA	PFDS	PFHpA	PFHpS	PFHxA	PFHxS	PFNA	PFNS	PFOA	PFOS	PFOSA	PFPeA	PFPeS	PFTeA	PFTriA	PFUnA
			Prev.																														
			EPA HAL	70	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	70	70	n/a	n/a	n/a	n/a	n/a	n/a
			TW Operational WQT	n/a	18	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	420	n/a	n/a	n/a	18	n/a	200000	7	n/a	n/a	11	7	n/a	n/a	n/a	n/a	n/a	n/a
Field ID	Sample Date	Laboratory ID	Sample Type																														
AZMW-01-457-GW	3/1/2021	320-70732-10	REG	31.7	63.4	<0.22	16	<0.43	<0.37	<0.22	<0.30	<1.4	<1.2	<1.1	3.8 E4	2.6	<0.29	<0.51	<0.30	4.7	0.49 E4	17	27	<0.25	<0.34	22	9.7	0.92 E4	9.2	2.7	<0.68	<1.2	<1.0
AZMW-01-457-D-GW	3/1/2021	320-70732-12	FD	33	64.5	<0.22	20	<0.42	<0.37	<0.22	<0.29	<1.4	<1.2	<1.1	4.0 E4	3.2	<0.29	<0.51	<0.29	5.5	0.53 E4	17	26	<0.25	<0.34	23	10	<0.90	11	2.8	<0.67	<1.2	<1.0
AZMW-01-470-GW	3/4/2021	320-70892-04	REG	52	102.2	<0.20	34 M2 J	<0.39	<0.34	<0.20	<0.27	<1.3	<1.1	<1.0	6.4	4.9 J	<0.26	<0.47	<0.27	7.2 J	0.95 E4 J	26 M2 J	43 M2 J	<0.23	<0.32	36 J	16 J	1.3 E4 J	18 M2 J	5 J	<0.62	<1.1	<0.94
AZMW-01-470-D-GW	3/4/2021	320-70892-05	FD	17.8	35.5	<0.21	8.9 J	<0.40	<0.34	<0.21	<0.28	<1.3	<1.1	<1.0	<2.1	1.4 E4 J	<0.27	<0.47	<0.28	2.7 J	0.28 E4 J	8.7 J	15 J	<0.23	<0.32	12 J	5.8 J	<0.84	6.0 J	1.8 J	<0.63	<1.1	<0.95
AZMW-01-483-GW	3/1/2021	320-70732-11	REG	33.3	64.4	<0.22	18	<0.42	<0.37	<0.22	<0.29	<1.4	<1.2	<1.1	4.4 E4	3	<0.29	<0.51	<0.29	5.1	0.54 E4	18	26	<0.25	<0.34	24	9.3	<0.90	10	2.6	<0.67	<1.2	<1.0
AZMW-02-358-GW	2/23/2021	320-70732-06	REG	134.8	229.4	<0.23	<2.4	<0.44	<0.39	<0.23	<0.31	<1.4	<1.3	<1.2	6.8	9.6	<0.30	<0.53	<0.31	9.6	0.73 E4	68	85	<0.26	<0.36	130	4.8	<0.94	11	8.9	<0.70	<1.3	<1.1
AZMW-02-375-GW	3/1/2021	320-70732-07	REG	135.6	231.3	<0.22	<2.3	<0.43	<0.37	<0.22	<0.30	<1.4	<1.2	<1.1	6.6	9.3	<0.29	<0.51	<0.30	8.7	0.72 E4	67	87	<0.25	<0.35	130	5.6	<0.92	9.9	8.1	<0.68	<1.2	<1.0
AZMW-02-392-GW	3/1/2021	320-70732-08	REG	124.2	212.7	<0.23	<2.4	<0.43	<0.38	<0.23	<0.30	<1.4	<1.2	<1.1	6.1	9.4	<0.29	<0.52	<0.30	8.5	0.64 E4	60	80	<0.26	<0.35	120	4.2	<0.93	9.7	8.2	<0.69	<1.2	<1.0
AZMW-03-393-GW	3/1/2021	320-70732-01	REG	2.87	7.12	<0.23	<2.4	<0.44	<0.38	<0.23	<0.31	<1.4	<1.2	<1.2	2.6 E4	5.3	<0.30	<0.53	<0.31	0.65 E4	<0.18	5.3	3.6	<0.26	<0.36	0.97 E4	1.9	<0.94	6.4	1.9	<0.70	<1.2	<1.1
AZMW-03-417-GW	3/1/2021	320-70732-02	REG	<1.36	4.27	<0.23	<2.4	<0.45	<0.39	<0.23	<0.31	<1.5	<1.3	<1.2	2.8 E4	4.9	<0.30	<0.54	<0.31	0.87 E4	<0.19	5.5	3.4	<0.26	<0.36	<0.83	<0.53	<0.96	6.0	1.6 E4	<0.71	<1.3	<1.1
AZMW-03-460-GW	3/1/2021	320-70732-03	REG	0.91	4.97	<0.22	<2.3	<0.42	<0.36	<0.22	<0.29	<1.4	<1.2	<1.1	2.6 E4	4.3	<0.28	<0.50	<0.29	0.66 E4	<0.17	4.3	3.4	<0.24	<0.33	0.91 E4	<0.49	<0.89	1.6 E4	1.8	<0.66	<1.2	<0.99
AZMW-03-480-GW	3/1/2021	320-70732-04	REG	1.1	5.64	<0.22	<2.3	<0.43	<0.37	<0.22	<0.30	<1.4	<1.2	<1.1	2.5 E4	4.4	<0.29	<0.52	<0.30	0.94 E4	<0.18	4.7	3.6	<0.25	<0.35	1.1 E4	<0.51	<0.92	1.6 E4	1.9	<0.68	<1.2	<1.0
AZMW-04-336-GW	2/23/2021	320-70585-09	REG	1.3	9	<0.20	2.5 E4	<0.39	<0.34	<0.20	<0.27	<1.3	<1.1	<1.0	3.3 E4	11	<0.26	<0.47	<0.27	1.5 E4	<0.16	7.1	6.2	<0.23	<0.31	1.3 E4	<0.46	<0.83	3.8	2.7	<0.62	<1.1	<0.93
AZMW-04-353-GW	2/23/2021	320-70585-10	REG	1.3	10.2	<0.20	2.8 E4	<0.38	<0.33	<0.20	<0.26	<1.2	<1.1	<0.98	4.0 E4	14	<0.25	<0.45	<0.26	1.5 E4	<0.16	7.7	7.4	<0.22	<0.30	1.3 E4	<0.44	<0.80	3.7	3.3	<0.60	<1.1	<0.90
AZMW-04-371-GW	2/23/2021	320-70585-11	REG	1.3	9	<0.21	2.3 E4	<0.40	<0.35	<0.21	<0.28	<1.3	<1.1	<1.0	4.0 E4	13	<0.27	<0.48	<0.28	1.4 E4	<0.17	7.4	6.3	<0.23	<0.32	1.3 E4	<0.47	<0.85	3.9	3.3	<0.63	<1.1	<0.96
AZMW-05-408-GW	2/23/2021	320-70585-01	REG	<1.18	0.49	<0.20	<2.1	<0.39	<0.34	<0.20	<0.27	<1.3	<1.1	<1.0	<2.0	<0.17	<0.26	<0.47	<0.27	<0.21	<0.16	0.60 E4	0.49 E4	<0.23	<0.32	<0.72	<0.46	<0.84	<0.42	<0.26	<0.62	<1.1	<0.94
AZMW-05-433-GW	2/23/2021	320-70585-02	REG	<1.20	<1.91	<0.21	<2.2	<0.40	<0.35	<0.21	<0.28	<1.3	<1.1	<1.0	<2.1	<0.17	<0.27	<0.47	<0.28	<0.22	<0.16	0.62 E4	<0.49	<0.23	<0.32	<0.73	<0.47	<0.85	<0.42	<0.26	<0.63	<1.1	<0.95
AZMW-05-485-GW	2/23/2021	320-70585-03	REG	<1.23	0.61	<0.21	14	<0.41	<0.35	<0.21	<0.28	<1.3	<1.2	<1.1	<2.1	<0.18	<0.27	<0.49	<0.28	<0.22	<0.17	<0.51	0.61 E4	<0.24	<0.33	<0.75	<0.48	<0.87	<0.43	<0.27	<0.65	<1.2	<0.97
AZMW-06-358-GW	2/23/2021	320-70585-05	REG	<1.18	<1.87	<0.20	<2.1	<0.39	<0.34	<0.20	<0.27	<1.3	<1.1	<1.0	<2.0	<0.17	<0.26	<0.47	<0.27	<0.21	<0.16	0.52 E4	<0.48	<0.23	<0.31	<0.72	<0.46	<0.83	<0.42	<0.26	<0.62	<1.1	<0.94
AZMW-06-375-GW	2/23/2021	320-70585-06	REG	<1.16	<1.85	<0.20	<2.1	<0.39	<0.33	<0.20	<0.27	<1.3	<1.1	<1.0	<2.0	<0.17	<0.26	<0.46	<0.27	<0.21	<0.16	0.53 E4	<0.48	<0.23	<0.31	<0.71	<0.45	<0.82	<0.41	<0.25	<0.61	<1.1	<0.92
AZMW-06-392-GW	2/23/2021	320-70585-07	REG	<1.21	<1.93	<0.21	<2.2	<0.40	<0.35	<0.21	<0.28	<1.3	<1.1	<1.0	<2.1	<0.17	<0.27	<0.48	<0.28	<0.22	<0.17	0.63 E4	<0.50	<0.24	<0.32	<0.74	<0.47	<0.86	<0.43	<0.26	<0.64	<1.1	<0.96
AZMW-07-383-GW	3/4/2021	320-70892-01	REG	<1.31	<2.09	<0.23 UJ	<2.4 UJ	<0.44 UJ	<0.38	<0.23	<0.30	<1.4	<1.2	<1.1	<2.3 UJ	<0.19	<0.29	<0.52	<0.30	<0.24	<0.18	0.70 E4 J	<0.54	<0.26	<0.35	<0.80	<0.51	<0.93	<0.46	<0.28	<0.69	<1.2	<1.0
AZMW-07-397-GW	3/4/2021	320-70892-02	REG	<1.27	<2.02	<0.22 UJ	<2.36 UJ	<0.42 UJ	<0.37	<0.22	<0.29	<1.4	<1.2	<1.1	<2.2 UJ	<0.18	<0.28	<0.50	<0.29	<0.23	<0.17	0.76 E4 J	<0.52	<0.25	<0.34	<0.78	<0.49	<0.90	<0.45	<0.27	<0.67	<1.2	<1.0

ACRONYMS/ABBREVIATIONS:

ADONA = 4,8-Dioxa-3H-perfluorononanoic acid
GenX = 2,3,3,3-tetrafluoro-2-(heptafluoropropoxy)propanoic acid
4:2 FTS = 4:2 Fluorotelomer sulfonic acid
6:2 FTS = 6:2 Fluorotelomer sulfonic acid
8:2 FTS = 8:2 Fluorotelomer sulfonic acid
F-53B Major = 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid
F-53B Minor = 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid
NEtFOSAA = N-ethylperfluorooctanesulfonamidoacetic acid
n/a = not avalable / not applicable
ppt = Parts per trillion

PFHpS = Perfluoroheptanesulfonic acid
PFHpA = Perfluoroheptanoic acid
NMeFOSAA = N-methylperfluorooctanesulfonamidoacetic acid
PFBS = Perfluorobutanesulfonic acid
PFBA = Perfluorobutanoic acid
PFDS = Perfluorodecanesulfonic acid
PFDA = Perfluorodecanoic acid
PFDoA = Perfluorododecanoic acid
< = less than

PFHxS = Perfluorohexanesulfonic acid
PFHxA = Perfluorohexanoic acid
PFNS = Perfluorononanesulfonic acid
PFNA = Perfluorononanoic acid
PFOSA = Perfluorooctanesulfonamide
PFOS = Perfluorooctanesulfonic acid
PFOA = Perfluorooctanoic acid
PFPeS = Perfluoropentanesulfonic acid

PFPeA = Perfluoropentanoic acid
PFTeA = Perfluorotetradecanoic acid
PFTriA = Perfluorotridecanoic acid
PFUnA = Perfluoroundecanoic acid
J = Concentration estimated; qualifier added by data validator
UJ = Analyte non-detect, reporting limit estimated; qualifier added by d

NOTES:

BOLDING Indicates analyte detected.
E4 = Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL) but above the method detection limit (MDL). EPA qualifier = J.
M2 = Matrix spike recovery was low, the associated blank spike recovery was acceptable.
EPA HAL = United States Environmental Protection Agency (EPA) drinking water health advisory level (HAL)
TW OWQT = Tucson Water's Operational Water Quality Target
= Exceeds TW-OWQT
= Exceeds EPA HAL and TW-OWQT
All results in parts per trillion.
Compound names for acidic states were generally reported by laboratory. The anionic form is the state, especially in groundwater, in which the compounds are found in the environment, In this table the abbreviations refer to the anionic and/or acid state as appropriate.

TABLE 12
SUMMARY OF SELECTED PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN GROUNDWATER RESULTS FROM TUCSON WATER WELLS

			ANALYTE	**PFOS+ PFOA** (ppt)	**PFOS+ PFOA+ PFHxS+ PFHpA** (ppt)	**PFOS** (ppt)	**PFOA** (ppt)	**PFHxS** (ppt)	**PFHpA** (ppt)	**PFHxA** (ppt)	**PFBS** (ppt)	**Lab Report**
			EPA HAL	70	n/a	70	70	n/a	n/a	n/a	n/a	
			TW Operational WQT	n/a	18	7	11	7	18	200000	420	
Boring	**Depth (ft brp)**	**Sample Method**	**Sample Date**									
B-007B	365	Hydrasleeve	3/30/2021	<1.36	<2.16	<0.53	<0.83	<0.56	<0.24	<0.57	<0.20	J71892
B-007B	450	Hydrasleeve	3/30/2021	<1.32	<2.1	<0.51	<0.81	<0.54	<0.24	<0.55	<0.19	J71892
B-007B	521	Hydrasleeve	3/30/2021	<1.37	<2.18	<0.53	<0.84	<0.56	<0.25	<0.57	<0.20	J71892
B-013B	Screen Interval	Pump	8/10/2020	<1.28	**0.37**	<0.5	<0.78	0.37 J	<0.23	<0.53	<0.18	J63690
B-019A	300	Hydrasleeve	8/14/2020	**7**	**44.4**	<2.7 L3	**7** J	**34**	**3.4** J	**9.3** J	<1	J63820
B-019A	350	Hydrasleeve	8/14/2020	**11**	**46.8**	<5.4	**11** J	**31**	**4.8** J	**11** J	<2	J63820
B-019A	400	Hydrasleeve	8/14/2020	**8.9**	**42.6**	<2.7 L3	**8.9** J	**30**	**3.7** J	**10**	**2.1** J	J63820
B-055A	358	Hydrasleeve	3/30/2021	<1.29	<2.05	<0.50	<0.79	<0.53	<0.23	<0.54	**0.24 J**	J71892
B-055A	438	Hydrasleeve	3/30/2021	<1.29	<2.05	<0.50	<0.79	<0.53	<0.23	0.58 J	**0.24 J**	J71892
B-055A	513	Hydrasleeve	3/30/2021	<1.29	<2.05	<0.50	<0.79	<0.53	<0.23	<0.54	<0.19	J71892
B-059A	Screen Interval	Pump	3/30/2021	<1.29	<2.05	<0.50	<0.79	<0.53	<0.23	<0.54	<0.19	J71892
C-004B	310	Hydrasleeve	1/22/2021	<1.26	**2.99**	<0.49	<0.77	**2.1**	**0.89** J	**6.5**	**4.3**	J69240
C-042A	320	Hydrasleeve	1/22/2021	<1.29	<2.05	<0.5	<0.79	<0.53	<0.23	<0.54	<0.19	J69240
C-042A	400	Hydrasleeve	1/22/2021	<1.28	<2.03	<0.5	<0.78	<0.52	<0.23	<0.53	<0.18	J69240
C-042A	480	Hydrasleeve	1/22/2021	<1.27	<2.02	<0.49	<0.78	<0.52	<0.23	<0.53	<0.18	J69240
C-042A	320	Hydrasleeve	3/4/2021	<1.24	<1.97	<0.48	<0.76	<0.51	<0.22	<0.52	<0.18	J70892
C-045B	325	Hydrasleeve	8/21/2020	**25**	**103.6**	<0.49	**25**	**73**	**5.6**	**51**	**10**	J63990
C-045B	350	Hydrasleeve	8/14/2020	**25**	**98.6**	<0.49 L3	**25**	**68**	**5.6**	**46**	**9.4**	J63820
C-045B	505	Hydrasleeve	8/14/2020	**23**	**92.2**	<0.47 L3	**23**	**64**	**5.2**	**42**	**8.8**	J63820
C-045B	540	Hydrasleeve	8/14/2020	**25**	**97.4**	<2.7 L3	**25**	**67**	**5.4** J	**43**	**9.2** J	J63820
C-045B	325	Hydrasleeve	3/4/2021	**30**	**123**	<0.48	**30**	**86**	**7**	**71**	**16**	J70892
C-045B	350	Hydrasleeve	3/4/2021	**27**	**106.6**	<0.48	**27**	**73**	**6.6**	**63**	**13**	J70892
C-045B	505	Hydrasleeve	3/4/2021	**27**	**102.5**	<0.48	**27**	**70**	**5.5**	**54**	**13**	J70892
C-045B	540	Hydrasleeve	3/4/2021	**26**	**107.4**	<0.49	**26**	**76**	**5.4**	**61**	**12**	J70892
WR-127A	Screen Interval	Pump	8/10/2020	**9.7**	**90.7**	<0.54	**9.7**	**59**	**22**	**54**	**36**	J63690
WR-127A	Screen Interval	Pump	2/25/2021	**9.25**	**116.95**	<2	**9.25**	**81.6**	**26.1**		**44.8**	L210252(TW)
WR-127B			2/25/2021	<4	**2.02**	<2	<2	**2.02**	<2		<2	L210252(TW)
WR-128A	Screen Interval	Pump	8/10/2020	**1.4**	**6.79**	<0.47	**1.4** J	**4.6**	**0.79** J	**4.8**	**3.7**	J63690
WR-128A	Screen Interval	Pump	2/25/2021	<4	**5.2**	<2	<2	**5.2**	<2		**4.19**	L210252(TW)
WR-129B	Screen Interval	Pump	8/10/2020	**3.8**	**24.3**	<0.46	**3.8**	**17**	**3.5**	**12**	**14**	J63690
WR-129B	Screen Interval	Pump	2/24/2021	**2.91**	**28.62**	<2	**2.91**	**22.1**	**3.61**		**15.4**	L210252(TW)
WR-130A	Screen Interval	Pump	8/10/2020	**7.9**	**18.4**	**4.3**	**3.6**	**9.1**	**1.4** J	**6.1**	**4.8**	J63690

TABLE 12
SUMMARY OF SELECTED PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN GROUNDWATER RESULTS FROM TUCSON WATER WELLS

			ANALYTE	PFOS+ PFOA (ppt)	PFOS+ PFOA+ PFHxS+ PFHpA (ppt)	PFOS (ppt)	PFOA (ppt)	PFHxS (ppt)	PFHpA (ppt)	PFHxA (ppt)	PFBS (ppt)	Lab Report
			EPA HAL	70	n/a	70	70	n/a	n/a	n/a	n/a	
			TW Operational WQT	n/a	18	7	11	7	18	200000	420	
Boring	**Depth (ft brp)**	**Sample Method**	**Sample Date**									
WR-130B	Screen Interval	Pump	8/10/2020	**43.2**	**120.2**	**9.2** N1	**34**	**61**	**16**	**29**	**33**	J63690
WR-130B	Screen Interval	Pump	2/24/2021	**41.62**	**134.02**	**8.52**	**33.1**	**76.5**	**15.9**		**38.5**	L210252(TW)

ACRONYM/ABBREVIATIONS:

< = less than
ft brp = feet below reference point
J = estimate
n/a = not available / not applicable
ppt = Parts per trillion
PFHpA = Perfluoroheptanoic acid
PFBS = Perfluorobutanesulfonic acid
PFHxS = Perfluorohexanesulfonic acid
PFAS = Per- and Polyfluoroalkyl Substances
PFHxA = Perfluorohexanoic acid
PFOS = Perfluorooctanesulfonic acid
PFOA = Perfluorooctanoic acid

NOTES:

BOLDING Indicates analyte detected.
L3 = The associated blank spike
N1 = See case narrative.
(TW) = Data provided by Tucson Water
EPA HAL = United States Environmental Protection Agency (EPA) drinking water health advisory level (HAL)
TW OWQT = Tucson Water's Operational Water Quality Target
[yellow highlight] = Exceeds TW-OWQT

TABLE 13
SUMMARY OF HISTORICAL SELECTED PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN GROUNDWATER RESULTS PROVIDED BY TUCSON WATER

		Parameter	PFOS+ PFOA (ppt)	PFOS+ PFOA+ PFHxS+ PFHpA (ppt)	PFOS (ppt)	PFOA (ppt)	PFHxS (ppt)	PFHpA (ppt)	PFHxA (ppt)	PFBS (ppt)
		Federal Guidelines	70	n/a	70	70	n/a	n/a	n/a	n/a
		TW Operational WQT	n/a	18	7	11	7	18	200000	420
Boring	**Depth**	**Sample Date**								
A-005B	175 - 495	11/2/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
A-008B	111 - 492	11/2/18	<4	<8	<2	<2	<2	<2		<2
A-009B	230 - 410	11/2/18	**4.5**	**6.9**	**2.3**	**2.2**	**2.4**	<2		<2
" "	" "	3/6/19	**2**	**4.3**	**2**	<2	**2.3**	<2		<2
" "	" "	9/10/19	**2.6**	**4.6**	<2	**2.6**	**2**	<2	<2	<2
A-027A	120 - 438	11/2/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
A-031A	125 - 535	11/2/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
A-036A	360 - 492	11/2/18	**2.5**	**2.5**	**2.5**	<2	<2	<2		<2
" "	" "	3/6/19	**2.7**	**4.7**	**2.7**	<2	**2**	<2		<2
" "	" "	9/10/19	**2.6**	**2.6**	**2.6**	<2	<2	<2	<2	<2
B-010B	320 - 563	11/5/18	<4	<8	<2	<2	<2	<2		<2
B-013B	300 - 550	11/5/18	<4	<8	<2	<2	<2	<2		<2
B-026B	200 - 520	11/5/18	**3.8**	**7.6**	**3.8**	<2	**3.8**	<2		<2
" "	" "	3/7/19	<4	**2.1**	<2	<2	**2.1**	<2		<2
" "	" "	6/27/19	**3.5**	**6.9**	**3.5**	<2	**3.4**	<2	<2	<2
" "	" "	7/10/19	**2.1**	**4.7**	**2.1**	<2	**2.6**	<2	<2	<2
" "	" "	8/6/19	**2.2**	**4.8**	**2.2**	<2	**2.6**	<2	<2	<2
B-039B	138 - 400	11/16/17	<5	<5	<2.5	<2.5				
" "	" "	10/11/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
" "	" "	11/20/18	<4	**2.8**	<2	<2	**2.8**	<2		<2
" "	" "	12/27/18	<4	<8	<2	<2	<2	<2		<2
" "	" "	3/26/19	<4	<8	<2	<2	<2	<2		<2
" "	" "	9/20/19	<4	**2.4**	<2	<2	**2.4**	<2	<2	<2
" "	" "	11/5/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	12/5/19	<4	**2.1**	<2	<2	2.1	<2	<2	<2
B-042B	240 - 620	11/5/18	<4	<8	<2	<2	<2	<2		<2
B-043B	230 - 570	11/5/18	<4	<8	<2	<2	<2	<2		<2
B-044C	380 - 740	5/2/19	<4	<8	<2	<2	<2	<2		<2
" "	" "	6/18/19	<4	<8	<2	<2	<2	<2	<2	<2
B-045B	240 - 480	11/5/18	<4	<8	<2	<2	<2	<2		<2
B-048B	220 - 620	11/5/18	**6.7**	**10.5**	**4.3**	**2.4**	**3.8**	<2		2
" "	" "	3/7/19	**5.5**	**8.8**	**3.4**	**2.1**	**3.3**	<2		<2
" "	" "	9/12/19	**5.7**	**8.6**	**3.4**	**2.3**	**2.9**	<2	<2	<2
B-050A	220 - 525	10/17/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
B-051B	200 - 780	11/1/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
B-053B		11/5/18	<4	<8	<2	<2	<2	<2		<2
B-054B	180 - 780	12/5/18	<4	<8	<2	<2	<2	<2		<2
B-056A	173 - 511	12/4/19	<4	<8	<2	<2	<2	<2	<2	<2
B-057B	151 - 500	12/5/18	<4	<8	<2	<2	<2	<2		<2
B-059A	218 - 615	12/5/18	<4	<8	<2	<2	<2	<2		<2
B-075A	490 - 627	10/29/19	<4	**4.3**	<2	<2	**4.3**	<2	<2	2
B-110A	440 - 980	7/11/17	<5	<5	<2.5	<2.5				
" "	" "	6/28/18	<5	<5	<2.5	<2.5				
" "	" "	2/14/19	<4	<8	<2	<2	<2	<2		<2
" "	" "	6/20/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	12/5/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	2/27/20	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	3/4/20	<4	<8	<2	<2	<2	<2	<2	<2
B-111A	420 - 840	1/23/19	<4	<8	<2	<2	<2	<2		<2
C-007A	360 - 410	5/8/17	**940**	**940**	**670**	**270**				
" "	" "	10/12/17	**3220**	**3220**	**2700**	**520**				
" "	" "	3/20/18	**2950**	**2950**	**2400**	**550**				
" "	" "	3/19/19	**26800** [1]	**38390**	**21000**	**5800**	**11000**	**590**		**250**
" "	" "	7/31/19	**2910**	**4540**	**2200**	**710**	**1400**	**230**	**730**	**150**
C-008B	240 - 1180	3/4/19	**176**	**304**	**140**	**36**	**110**	**18**		**5.3**
C-012B	322 - 765	9/26/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
" "	" "	1/28/20	<4	<8	<2	<2	<2	<2	<2	<2
C-014B	260 - 780	11/30/16	**79**	**79**	**21**	**58**				
" "	" "	10/12/17	**133**	**133**	**13**	**120**				
" "	" "	3/20/18	**97**	**97**	**11**	**86**				
" "	" "	12/27/18	**115.2**	**585.2**	**5.2**	**110**	**280**	**190**		**29**
" "	" "	3/19/19	**158**	**658**	**8**	**150**	**310**	**190**		**37**
" "	" "	12/17/19	**216.5**	**926.5**	**6.5**	**210**	**420**	**290**	**610**	**51**
C-015A	174 - 504	5/8/17	<5	<5	<2.5	<2.5				
C-016B	460 - 920	11/30/16	<5	<5	<2.5	<2.5				
" "	" "	6/28/18	<5	<5	<2.5	<2.5				
" "	" "	2/14/19	<4	<8	<2	<2	<2	<2		<2
C-030B	270 - 640	9/26/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
C-033A	285 - 555	12/5/18	<4	<8	<2	<2	<2	<2		<2
" "	" "	1/23/20	<4	<8	<2	<2	<2	<2	<2	<2
C-036B	222 - 802	6/28/18	**39.8**	**39.8**	**4.8**	**35**				
" "	" "	12/27/18	**131**	**283**	**11**	**120**	**140**	**12**		**17**
C-046B	360 - 620	12/22/16	<5	<5	<2.5	<2.5				
" "	" "	6/27/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	12/5/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	1/23/20	<4	<8	<2	<2	<2	<2	<2	<2
C-048B	250 - 500	12/5/18	<4	<8	<2	<2	<2	<2		<2
	" "	1/28/20	<4	<8	<2	<2	<2	<2	<2	<2
C-050B	300 - 580	12/21/18	<4	<8	<2	<2	<2	<2		<2
" "	" "	1/23/20	<4	<8	<2	<2	<2	<2	<2	<2
C-051B	208 - 780	12/22/16	<5	<5	<2.5	<2.5				
" "	" "	10/3/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	1/28/20	<4	<8	<2	<2	<2	<2	<2	<2
C-055B	390 - 910	12/5/18	<4	<8	<2	<2	<2	<2		<2
" "	" "	1/23/20	<4	<8	<2	<2	<2	<2	<2	<2
C-069A	160 - 700	11/30/16	<5	<5	<2.5	<2.5				
" "	" "	11/16/17	<5	<5	<2.5	<2.5				
" "	" "	10/24/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	2/18/20	<4	<8	<2	<2	<2	<2	<2	<2
C-076A	317 - 500	11/1/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
C-082A	101 - 323	11/21/18	**8.7**	**30.7**	**5.9**	**2.8**	**22**	<2		**4.1**
" "	" "	3/7/19	<4	<8	<2	<2	<2	<2		<2
" "	" "	6/27/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	7/10/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	8/6/19	<4	<8	<2	<2	<2	<2	<2	<2

TABLE 13
SUMMARY OF HISTORICAL SELECTED PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN GROUNDWATER RESULTS PROVIDED BY TUCSON WATER

		Parameter	PFOS+ PFOA (ppt)	PFOS+ PFOA+ PFHxS+ PFHpA (ppt)	PFOS (ppt)	PFOA (ppt)	PFHxS (ppt)	PFHpA (ppt)	PFHxA (ppt)	PFBS (ppt)
		Federal Guidelines	70	n/a	70	70	n/a	n/a	n/a	n/a
		TW Operational WQT	n/a	18	7	11	7	18	200000	420
Boring	**Depth**	**Sample Date**								
C-083B	160 - 620	10/12/17	<6	<6	<3	<3				
" "	" "	10/3/19	<4	<8	<2	<2	<2	<2	<2	2.1
" "	" "	1/23/20	<4	<8	<2	<2	<2	<2	<2	2.5
C-109A	250 - 537	10/12/17	<5	<5	<2.5	<2.5				
" "	" "	10/15/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	3/9/20	<4	**2.5**	<2	<2	**2.5**	<2	<2	<2
C-112A	0 - 416	1/23/19	<4	**3.4**	<2	<2	**3.4**	<2		<2
" "	" "	1/23/20	<4	**3.8**	<2	<2	**3.8**	<2	<2	<2
C-115A	220 - 420	10/7/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	3/9/20	<4	<8	<2	<2	<2	<2	<2	<2
C-116A	90 - 397	11/21/18	<4	<8	<2	<2	<2	<2		<2
" "	" "	1/23/20	<4	<8	<2	<2	<2	<2	<2	<2
C-119A	200 - 720	12/21/18	<4	<8	<2	<2	<2	<2		<2
" "	" "	1/23/20	<4	<8	<2	<2	<2	<2	<2	<2
C-122A	400 - 940	7/11/17	<5	<5	<2.5	<2.5				
" "	" "	6/28/18	<5	<5	<2.5	<2.5				
" "	" "	11/5/19	<4	**4**	<2	<2	**4**	<2	<2	<2
" "	" "	3/9/20	<4	<8	<2	<2	<2	<2	<2	<2
C-123B	85 - 300	10/12/17	<6	<6	<3	<3				
" "	" "	10/15/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	3/5/20	**2.1**	**2.1**	**2.1**	<2	<2	<2	<2	<2
C-124A	410 - 970	10/17/18	<3.9	<7.7	<1.9	<2	<1.8	<2		<1.8
" "	" "	3/5/20	<4	<8	<2	<2	<2	<2	<2	<2
C-125A	440 - 1000	11/21/18	<4	<8	<2	<2	<2	<2		<2
D-001A	455 - 700	11/30/16	<5	<5	<2.5	<2.5				
" "	" "	10/3/19	<4	<8	<2	<2	<2	<2	<2	<2
" "	" "	1/28/20	<4	<8	<2	<2	<2	<2	<2	<2
D-007A	536 - 686	11/30/16	<5	<5	<2.5	<2.5				
" "	" "	11/12/19	<4	<8	<2	<2	<2	<2	<2	<2
D-016B	340 - 650	11/21/18	<4	<8	<2	<2	<2	<2		<2
D-023A	535 - 1025	12/22/16	<5	<5	<2.5	<2.5				
" "	" "	11/12/19	<4	<8	<2	<2	<2	<2	<2	<2
D-034B	360 - 780	11/26/18	<4	<8	<2	<2	<2	<2	--	<2
D-035A	200 - 502	11/19/18	<4	<8	<2	<2	<2	<2	--	<2
D-036A	169 - 488	11/26/18	<4	<8	<2	<2	<2	<2	--	<2
D-048A	348 - 602	11/26/18	<4	<8	<2	<2	<2	<2	--	<2
D-049A	301 - 552	12/22/16	<5	<5	<2.5	<2.5	--	--	--	--
" "	" "	10/3/19	<4	<8	<2	<2	<2	<2	<2	<2
WR-127A	230 - 300	4/24/18	**3.2**	**3.2**	**3.2**	<2.5	--	--	--	--
" "	" "	3/27/19	**6.5**	**74.5**	<2	**6.5**	**50**	**18**	--	**34**
" "	" "	9/17/19	**13**	**88**	<1.7	**13**	**52**	**23**	--	**35**
" "	" "	1/22/20	**12**	**90**	<2	**12**	**56**	**22**	--	**33**
" "	" "	2/25/21	**9.25**	**116.95**	<2	**9.25**	**81.6**	**26.1**	--	**44.8**
WR-127B	300 - 360	2/25/21	<4	**2.02**	<2	<2	**2.02**	<2	--	<2
WR-128A	210 - 300	6/18/19	<4	**4.6**	<2	<2	**4.6**	<2	--	**6.1**
" "	" "	2/25/21	<4	**5.2**	<2	<2	**5.2**	<2	--	**4.19**
WR-129B	240 - 400	7/19/16	<5	<5	<2.5	<2.5	--	--	--	--
" "	" "	1/22/20	**3.3**	**23.9**	<2	**3.3**	**17**	**3.6**	--	**14**
" "	" "	2/24/21	**2.91**	**28.62**	<2	**2.91**	**22.1**	**3.61**	--	**15.4**
WR-130A	250 - 370	9/18/19	**9**	**20**	**4.9**	**4.1**	**11**	**<1.7**	--	**4.9**
WR-130B	320 - 420	9/18/19	**36.9**	**116.9**	**5.9**	**31**	**64**	**16**	--	**32**
" "	" "	2/24/21	**33.1**	**125.5**	**8.52**	**33.1**	**76.5**	**15.9**	--	**38.5**

ACRONYMS/ABBREVIATIONS:

n/a = not applicable
ppt = Parts per trillion
PFHpA = Perfluoroheptanoic acid
PFBS = Perfluorobutanesulfonic acid
PFHxS = Perfluorohexanesulfonic acid
PFAS = Per- and Polyfluoroalkyl Substances
PFHxA = Perfluorohexanoic acid
PFOS = Perfluorooctanesulfonic acid
PFOA = Perfluorooctanoic acid
TW Operational WQT = Tucson Water Operational Water Quality Target
EPA HAL = United States Environmental Protection Agency (EPA) drinking water health advisory level (HAL)
TW OWQT = Tucson Water's Operational Water Quality Target
= Exceeds TW-OWQT
= Exceeds EPA HAL and TW-OWQT

1) Tucson Water confirmed result for C-007 on 3/19/19. They could not find any evidence that the sample was analyzed or input incorrectly. Compound names for acidic states were generally reported by laboratory. The anionic form is the state, especially in groundwater, in which the compounds are found in the environment, In this table the abbreviations refer to the anionic and/or acid state as appropriate.

TABLE 14
CHEMICALS OF CONCERN

FUNCTIONAL GROUP	CARBONS	ACRONYM	NAME	MOLECULAR WEIGHT (g/mol)	MOLECULAR FORMULA	CAS No.
Carboxylates or Carboxylic Acids	6	PFHxA	Perfluorohexanoate	313.04	$C_5F_{11}CO_2^-$	92612-52-7
			Perfluorohexanoic acid	314.05	$C_5F_{11}COOH$	307-24-4
	7	PFHpA	Perfluoroheptanoate	363.05	$C_6F_{13}CO_2^-$	120885-29-2
			Perfluoroheptanoic acid	364.06	$C_6F_{13}COOH$	375-85-9
	8	PFOA	Perfluorooctanoate	413.06	$C_7F_{15}CO_2^-$	45285-51-6
			Perfluorooctanoic acid	414.07	$C_7F_{15}COOH$	335-67-1
Sulfonates or Sulfonic Acids	4	PFBS	Perfluorobutane sulfonate	299.09	$C_4F_9SO_3^-$	45187-15-3
			Perfluorobutane sulfonic acid	300.1	$C_4F_9SO_3H$	375-73-5
	6	PFHxS	Perfluorohexane sulfonate	399.11	$C_6F_{13}SO_3^-$	108427-53-8
			Perfluorohexane sulfonic acid	400.11	$C_6F_{13}SO_3H$	355-46-4
	8	PFOS	Perfluorooctane sulfonate	499.12	$C_8F_{17}SO_3^-$	45298-90-6
			Perfluorooctane sulfonic acid	500.13	$C_8F_{17}SO_3H$	1763-23-1

ACRONYMS/ABBREVIATIONS:

g/mol = grams mole
g/cm3 = grams per cubic centimeter
CAS No. = Chemical Abstracts Service Number

NOTES:

Source: Per- and Polyfluoroalkyl Substances (PFAS). By ITRC. Dated September 2020.

Molecular weight calculated on line:
https://www.lenntech.com/calculators/molecular/molecular-weight-calculator.htm

FIGURES

Thursday, September 30, 2021 4:30:47 PM -- X:\H+A GIS FILES\1289 CTPP\GIS_maps\Figure 01.mxd

FIGURE 1 - SITE LOCATION

CENTRAL TUCSON PFAS PROJECT

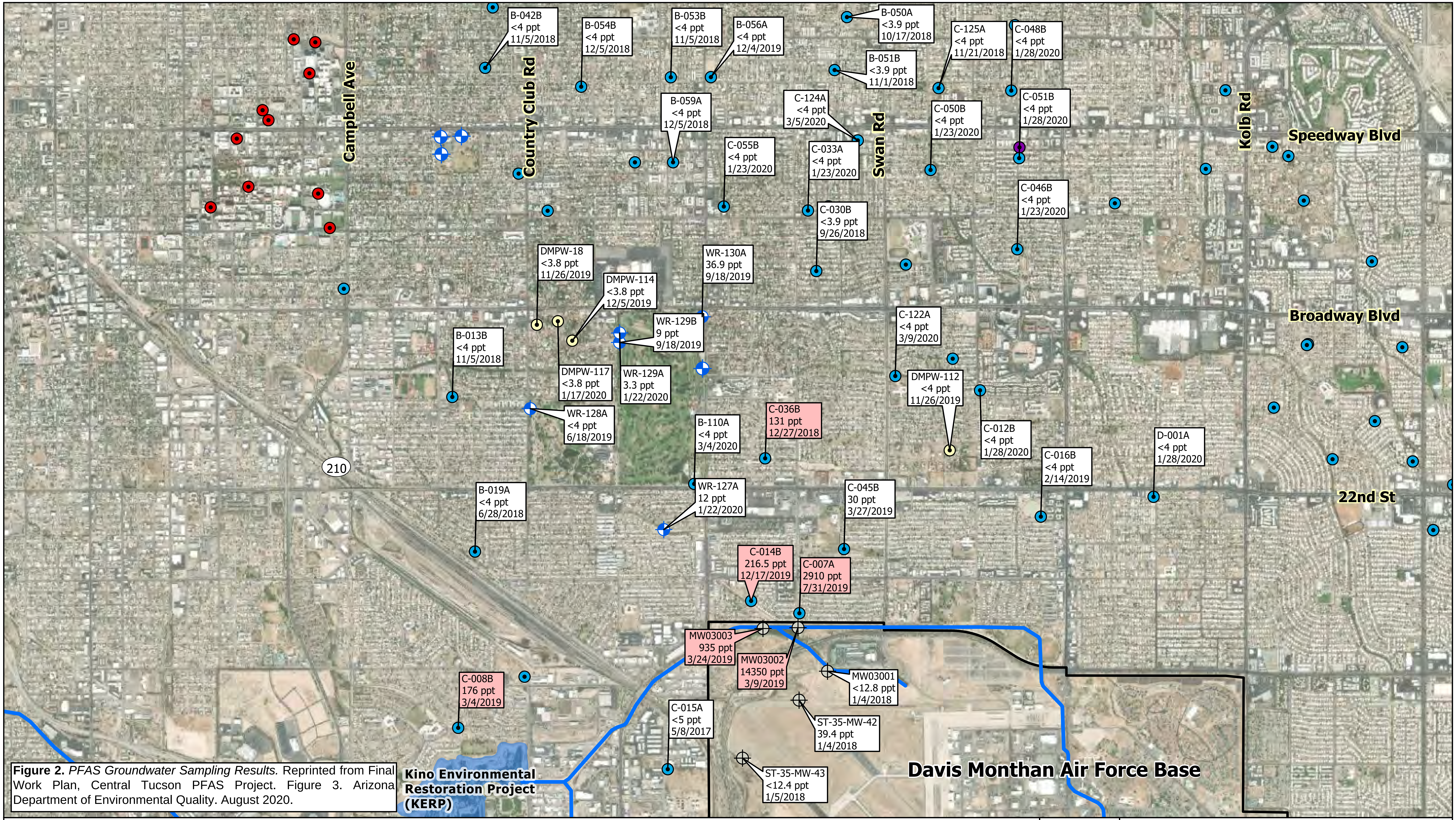


Figure 2. *PFAS Groundwater Sampling Results.* Reprinted from Final Work Plan, Central Tucson PFAS Project. Figure 3. Arizona Department of Environmental Quality. August 2020.

- Tucson Water Well
- Tucson Water Monitoring Well
- Private Supply Well*
- Davis Monthan AFB Monitoring Well**
- University of Arizona Supply Well
- Other Public Supply Well
- Surface Water Drainage

Notes:

The most recent available PFOA+PFOS results are displayed in units of parts per trillion (ppt); pink = result exceeding the USEPA Health Advisory Level (HAL) of 70 ppt

*For private wells, only wells with available PFAS data are displayed

** PFAS concentrations in MW03002 and MW03003 represent the highest concentration encountered during borehole advancement

PFAS = per- and polyfluorinated alkyl substances
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonic acid

0 0.25 0.5 1 Miles

N

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

8/17/2020

FIGURE 2

SUMMARY OF PRE-INVESTIGATION PER- AND POLYFLUOROALKYL SUBSTANCES IN GROUNDWATER

CENTRAL TUCSON PFAS PROJECT, Tucson, AZ

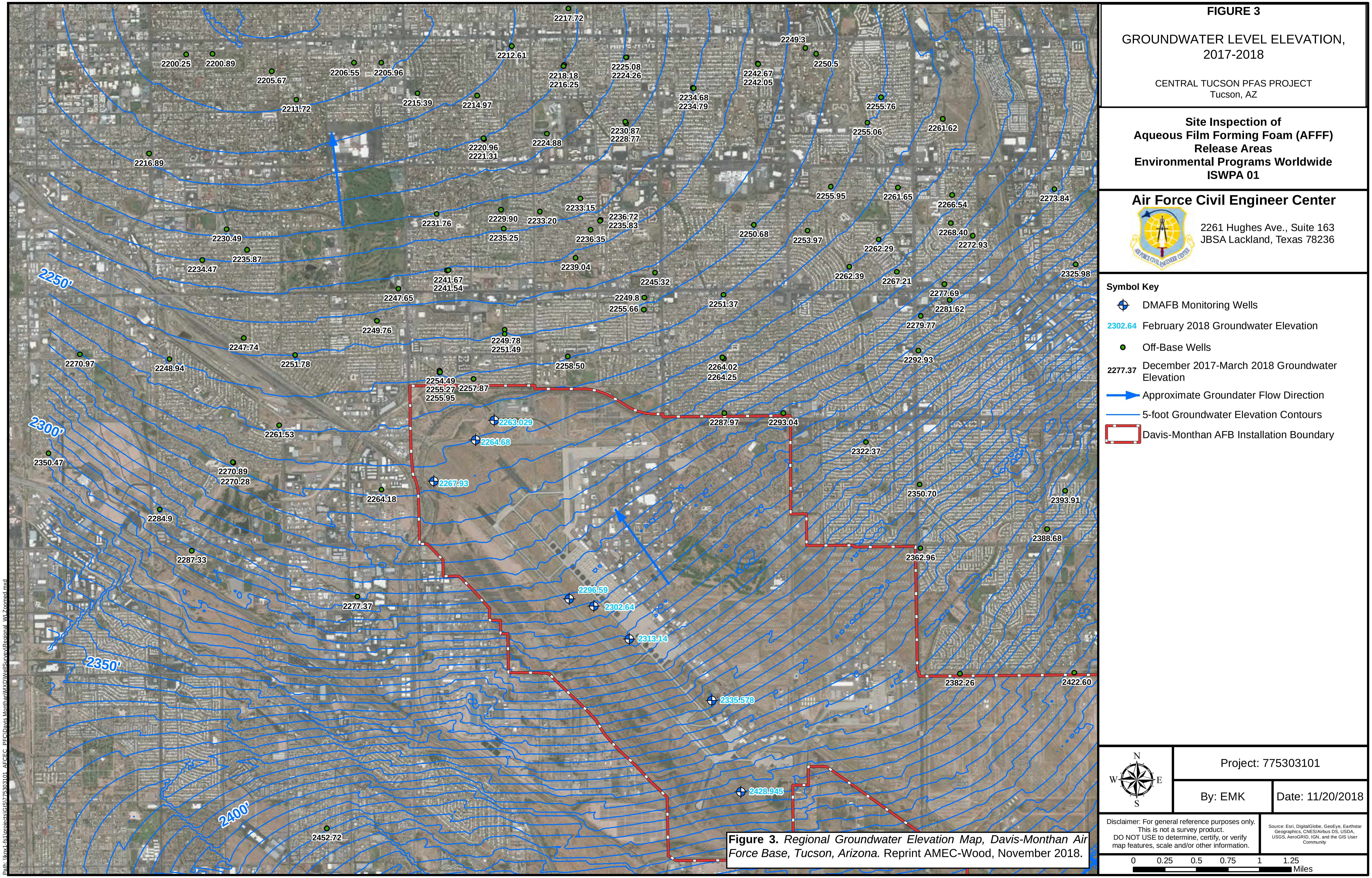
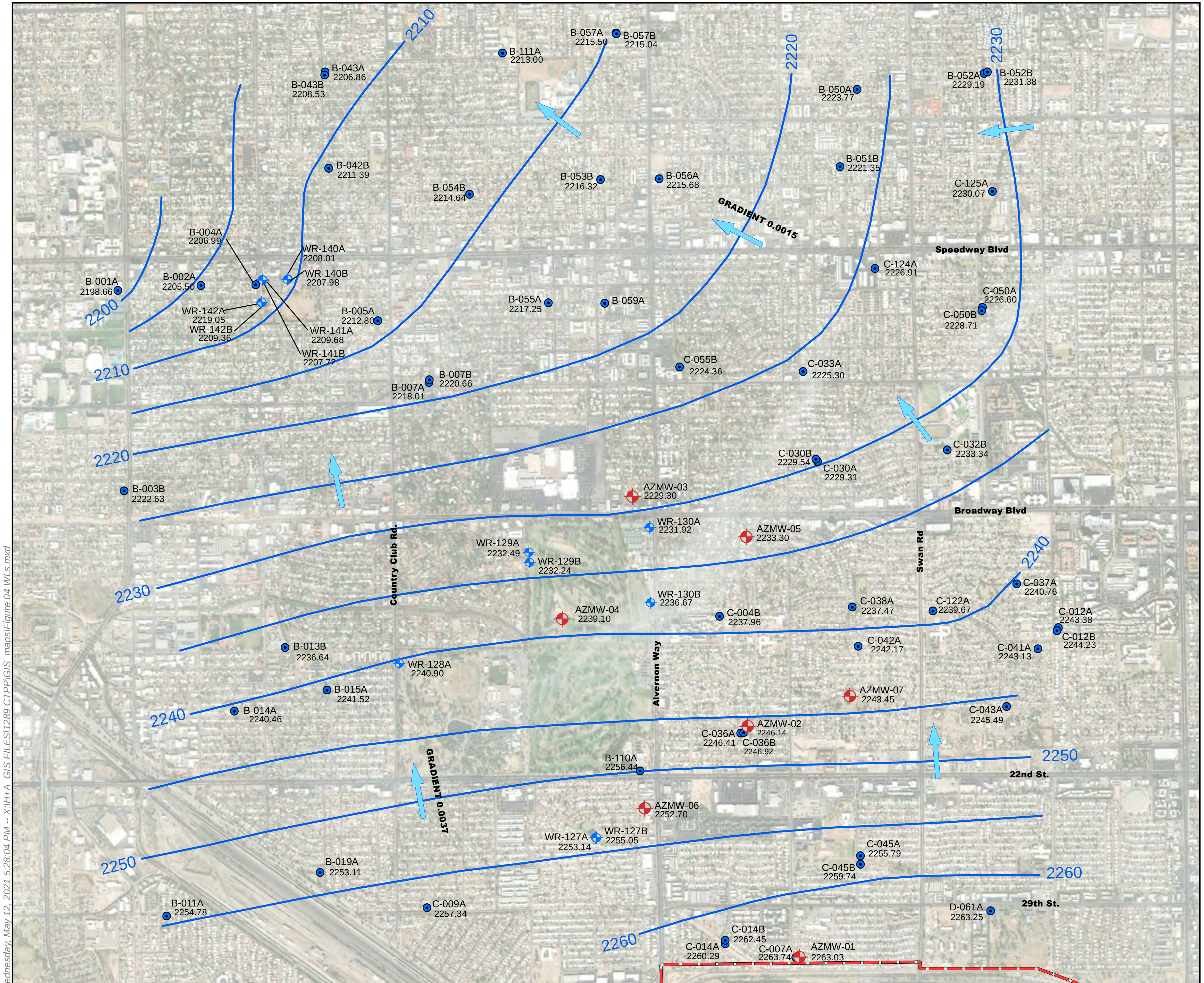


Figure 3. *Regional Groundwater Elevation Map, Davis-Monthan Air Force Base, Tucson, Arizona.* Reprint AMEC-Wood, November 2018.



Wednesday, May 12, 2021 5:28:04 PM -- X:\H+A GIS FILES\1289 CTPP\GIS_maps\Figure 04 WLs.mxd

EXPLANATION

CTPP Monitor Well

Tucson Water Monitor Well

Tucson Water Supply Well

Water Level Contour, In Feet Above Mean Sea Level

Approximate Groundwater Flow Direction

WR-127A Well Identification

2395 February 2021 Groundwater Elevation in Feet Above Mean Sea Level

Davis-Monthan Air Force Base Installation Boundary

N

0 0.125 0.25 0.5

Miles

NOTE: Groundwater Levels Measured February 2021.

CENTRAL TUCSON PFAS PROJECT
Tucson, AZ

GROUNDWATER LEVEL ELEVATION
FEBRUARY 2021

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY / ENGINEERING

05 / 2021

FIGURE 4

PREP BY: CAP REV BY: ZZZ RPT NO.: 1289.3 | Figure 04 WLs | Rev.

CTPP Monitor Well

AZSB-04 Soil Boring Identification

Davis-Monthan Air Force Base Installation Boundary

NOTE:

CTPP = Central Tucson PFAS Project

N

0 0.125 0.25 0.5

Miles

CENTRAL TUCSON PFAS PROJECT
Tucson, AZ

LOCATION OF SOIL BORINGS AND MONITOR WELLS

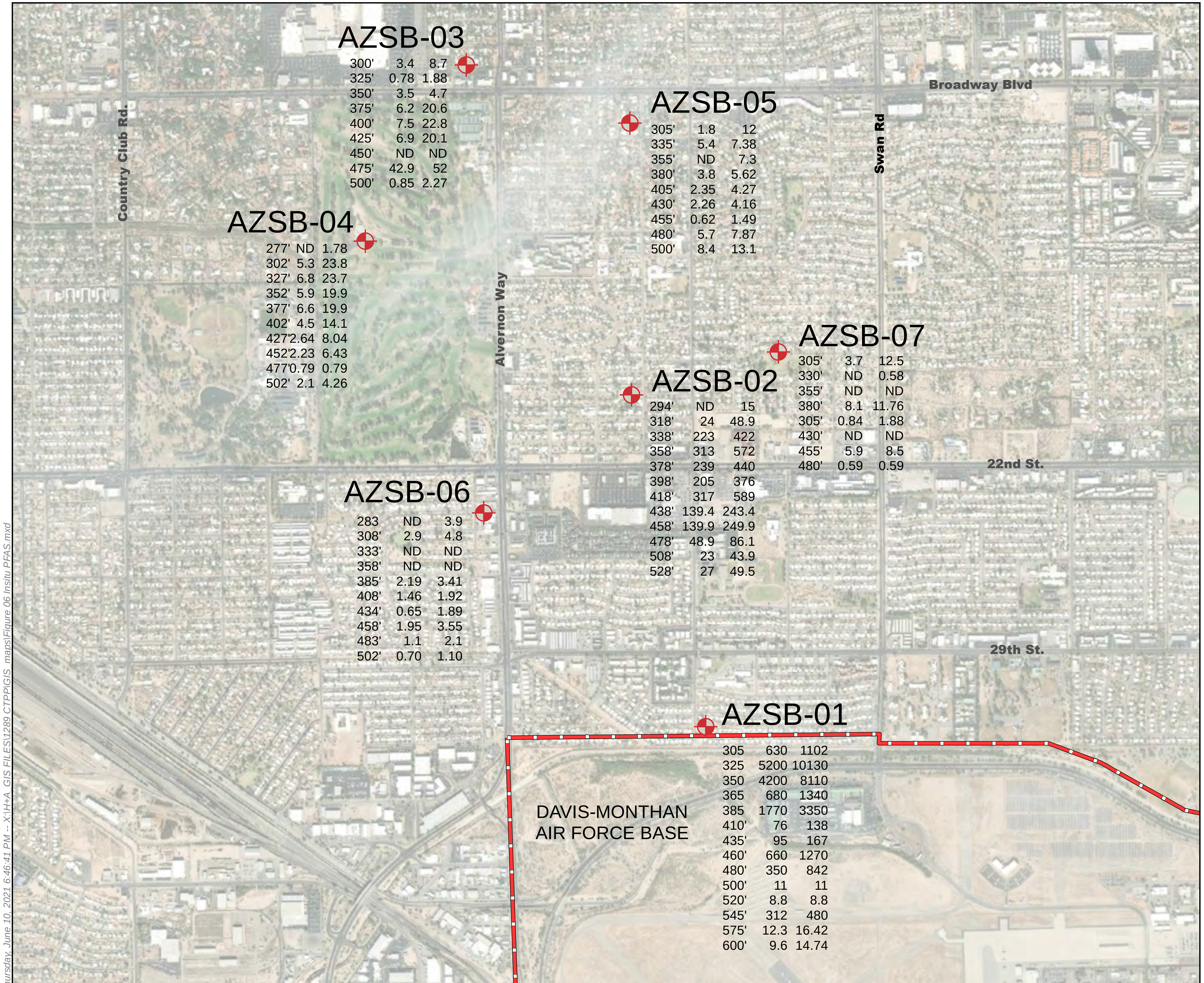
HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY / ENGINEERING

FIGURE 5

June 2021

PREP BY: CAP REV BY: MRL RPT NO.: 1289.3 | Figure 05 CTPP MWs | Rev.

Thursday, June 10, 2021 6:45:07 PM -- X:\H+A GIS FILES\1289 CTPP\GIS_maps\Figure 05 CTPP MWs.mxd



EXPLANATION

CTPP Monitor Well

AZSB-04 Soil Boring Identification

Sample Depth
Concentration of PFOA + PFOS
Concentration of PFOA + PFOS + PFHxS + PFHpA

305'	3.7	12.5
330'	ND	0.58
355'	ND	ND
380'	8.1	11.76
305'	0.84	1.88
430'	ND	ND
455'	5.9	8.5
480'	0.59	0.59

Davis-Monthan Air Force Base Installation Boundary

NOTE:

PFOS = Perfluorooctanesulfonic acid;
PFOA = Perfluorooctanoic acid;
PFHxS = Perfluorohexanesulfonic acid;
PFHpA = Perfluoroheptanoic acid
ppt = Parts Per Trillion
CTPP = Central Tucson PFAS Project

N

0 0.125 0.25 0.5
Miles

CENTRAL TUCSON PFAS PROJECT
Tucson, AZ

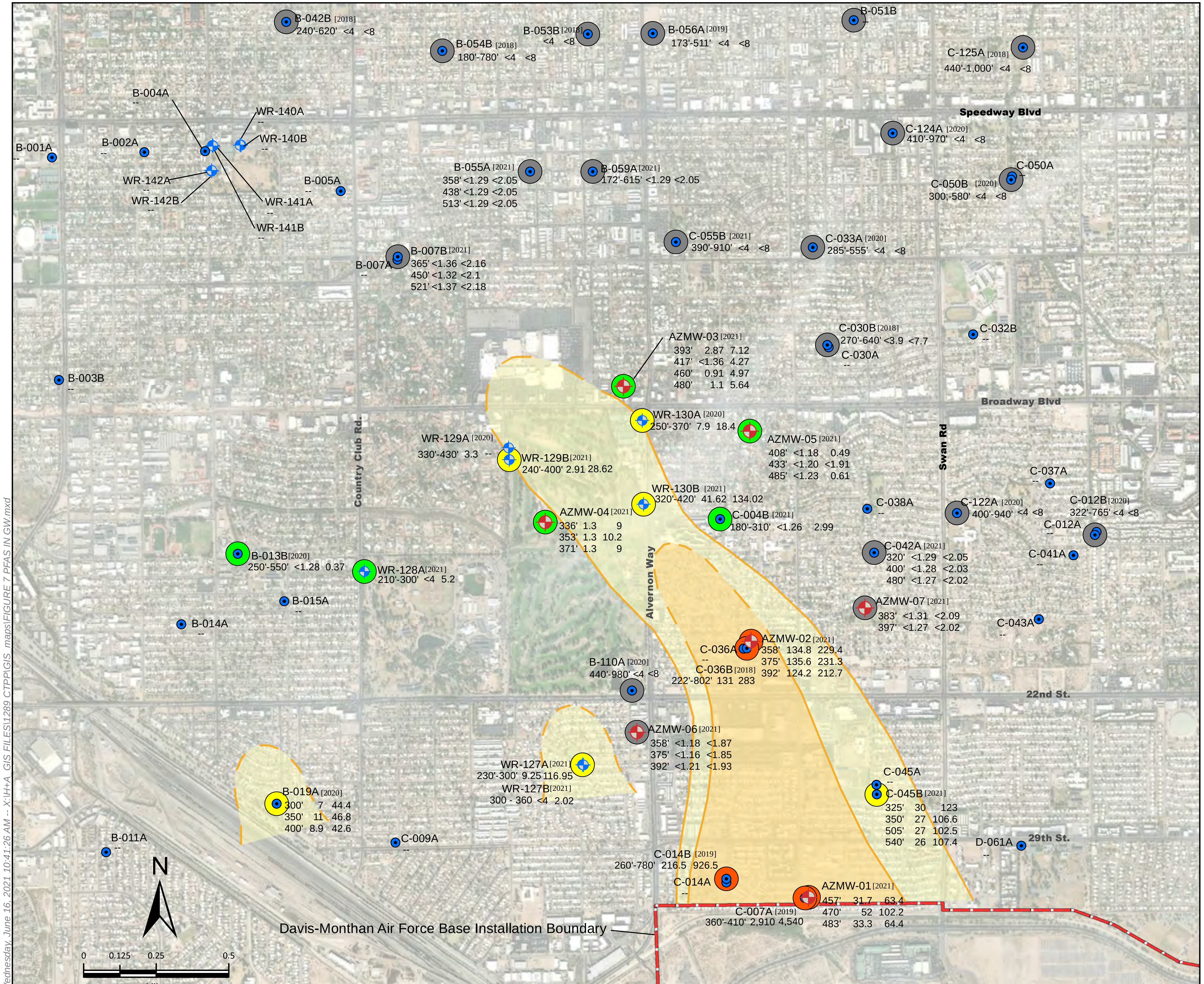
PER- AND POLYFLUOROALKYL SUBSTANCES IN INSITU GROUNDWATER

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY / ENGINEERING

FIGURE 6

June 2021

PREP BY: CAP REV BY: MRL RPT NO.: 1289.3 Figure 06 Insitu PFAS Rev.



EXPLANATION

- CTPP Monitor Well
- Tucson Water Monitor Well
- Tucson Water Supply Well
- Not Detected
- Detected below 18 ppt and 70 ppt screening levels
- Detected above18 ppt and below 70 ppt screening levels
- Detected above18 ppt and above 70 ppt screening levels
- PFOA + PFOS + PFHpA + PFHxS >18 ppt (Dashed where inferred)
- PFOA + PFOS > 70 PPT (Dashed where inferred)

AZMW-07 Well Identification

[2021] Sample Collection Year

Sample Depth / Screen Interval

Concentration of PFOA + PFOS

Concentration of PFOA + PFOS + PFHxS + PFHpA

383' <1.31 <2.09
397' <1.27 <2.02
Units in ppt.

NOTE:

PFOS = Perfluorooctanesulfonic acid;
PFOA = Perfluorooctanoic acid;
PFHxS = Perfluorohexanesulfonic acid;
PFHpA = Perfluoroheptanoic acid
ppt = Parts per trillion
CTPP = Central Tucson PFAS Project

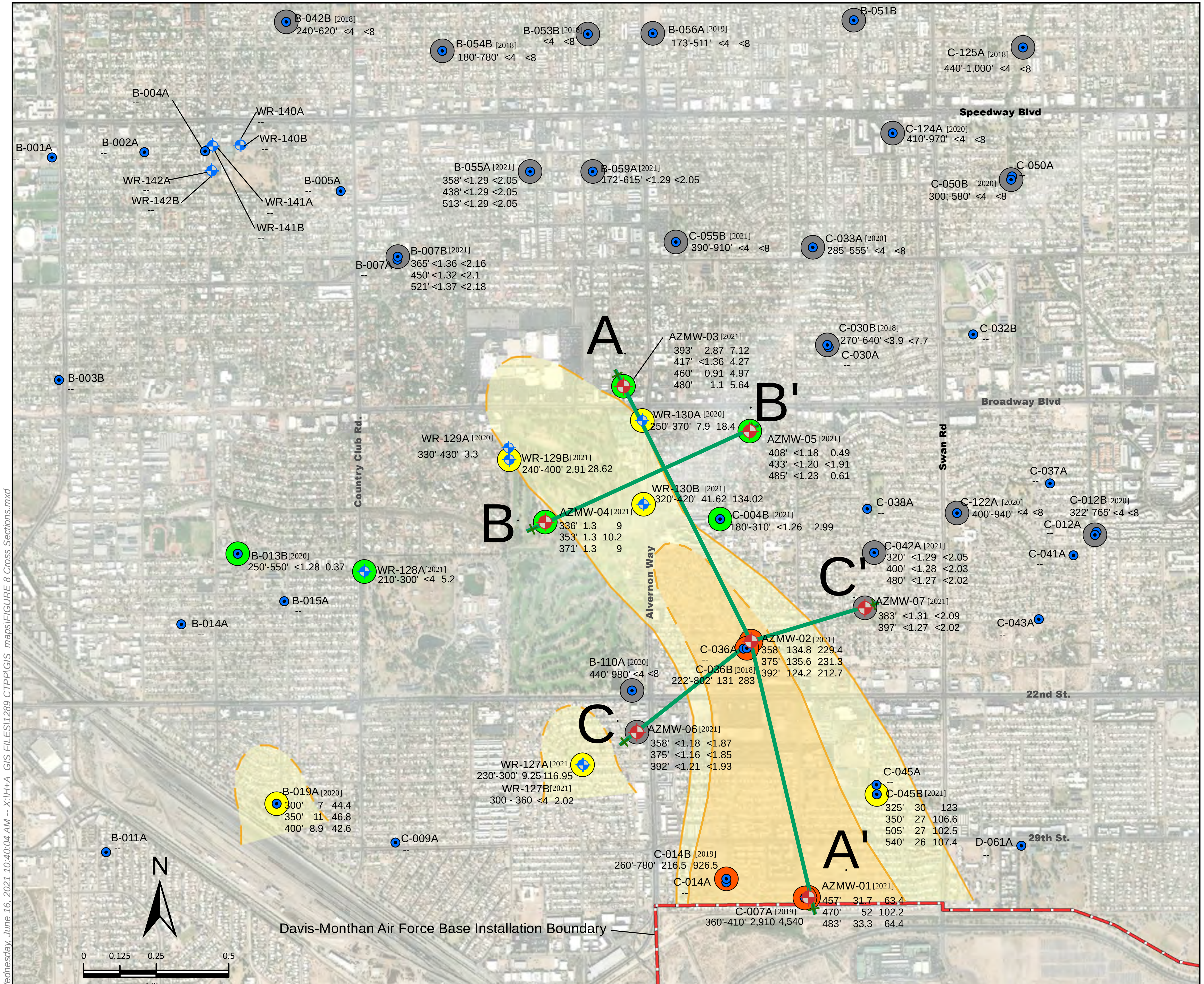
CENTRAL TUCSON PFAS PROJECT
Tucson, AZ

PER- AND POLYFLUOROALKYL SUBSTANCES IN GROUNDWATER

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY / ENGINEERING

FIGURE 7

PREP BY: AAA REV BY: ZZZ RPT NO.: 0000.00 | FIGURE 7 PFAS IN GW | Rev.



Wednesday, June 16, 2021 10:40:04 AM -- X:\H+A_GIS FILES\1289 CTPP\GIS_maps\FIGURE 8 Cross Sections.mxd

EXPLANATION

- CTPP Monitor Well
- Tucson Water Monitor Well
- Tucson Water Supply Well
- Not Detected
- Detected below 18 ppt and 70 ppt screening levels
- Detected above18 ppt and below 70 ppt screening levels
- Detected above18 ppt and above 70 ppt screening levels
- PFOA + PFOS + PFHpA + PFHxS >18 ppt (Dashed where inferred)
- PFOA + PFOS > 70 PPT (Dashed where inferred)

AZMW-07 Well Identification

[2021] Sample Collection Year

Sample Depth / Screen Interval

Concentration of PFOA + PFOS

Concentration of PFOA + PFOS + PFHxS + PFHpA

383' <1.31 <2.09
397' <1.27 <2.02
Units in ppt.

- Cross Section

NOTE:

PFOS = Perfluorooctanesulfonic acid;
PFOA = Perfluorooctanoic acid;
PFHxS = Perfluorohexanesulfonic acid;
PFHpA = Perfluoroheptanoic acid
ppt = Parts per trillion
CTPP = Central Tucson PFAS Project

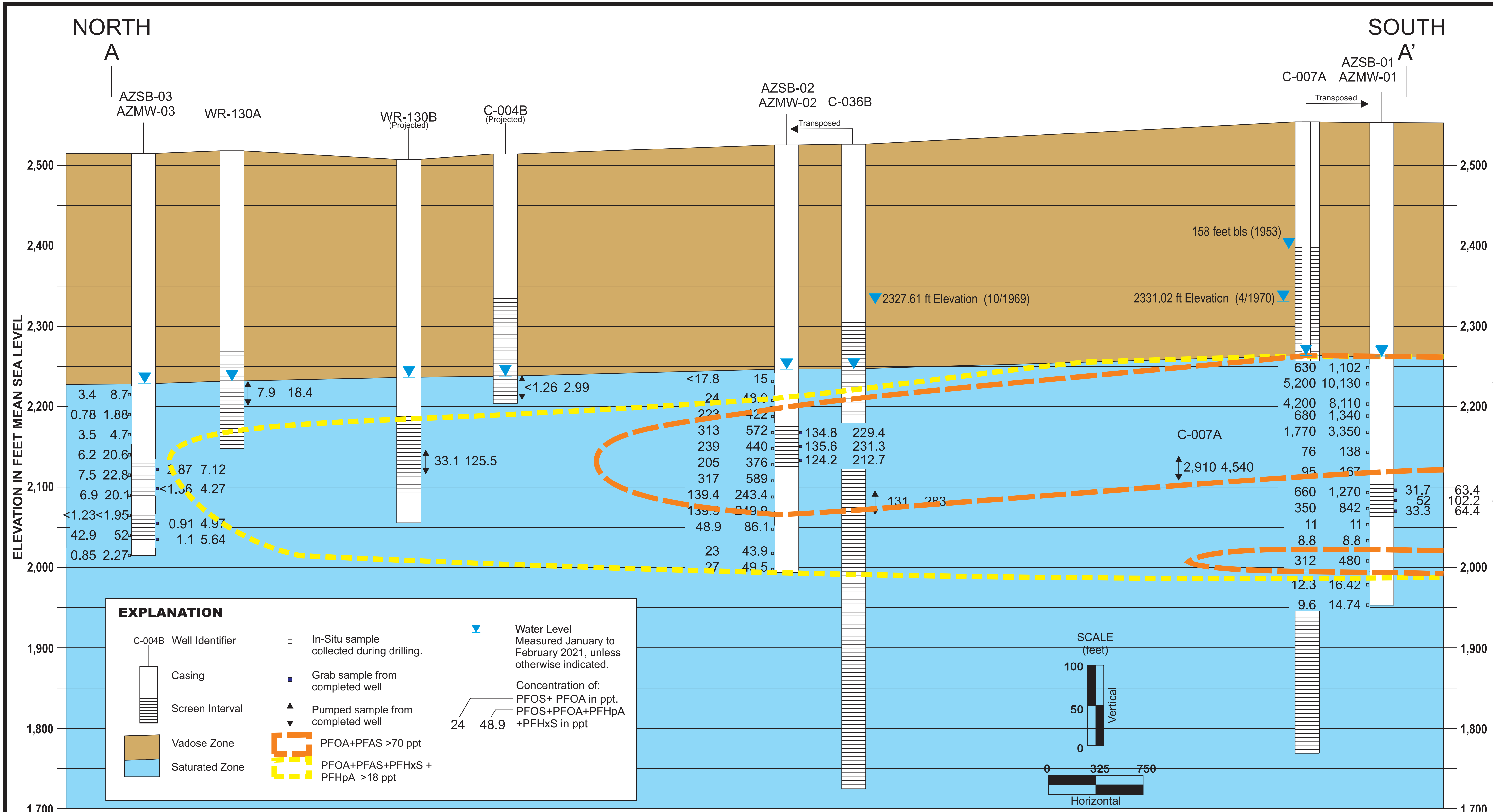
CENTRAL TUCSON PFAS PROJECT
Tucson, AZ

LOCATION OF CROSS SECTIONS

HARGIS + ASSOCIATES, INC. HYDROGEOLOGY / ENGINEERING

FIGURE 8

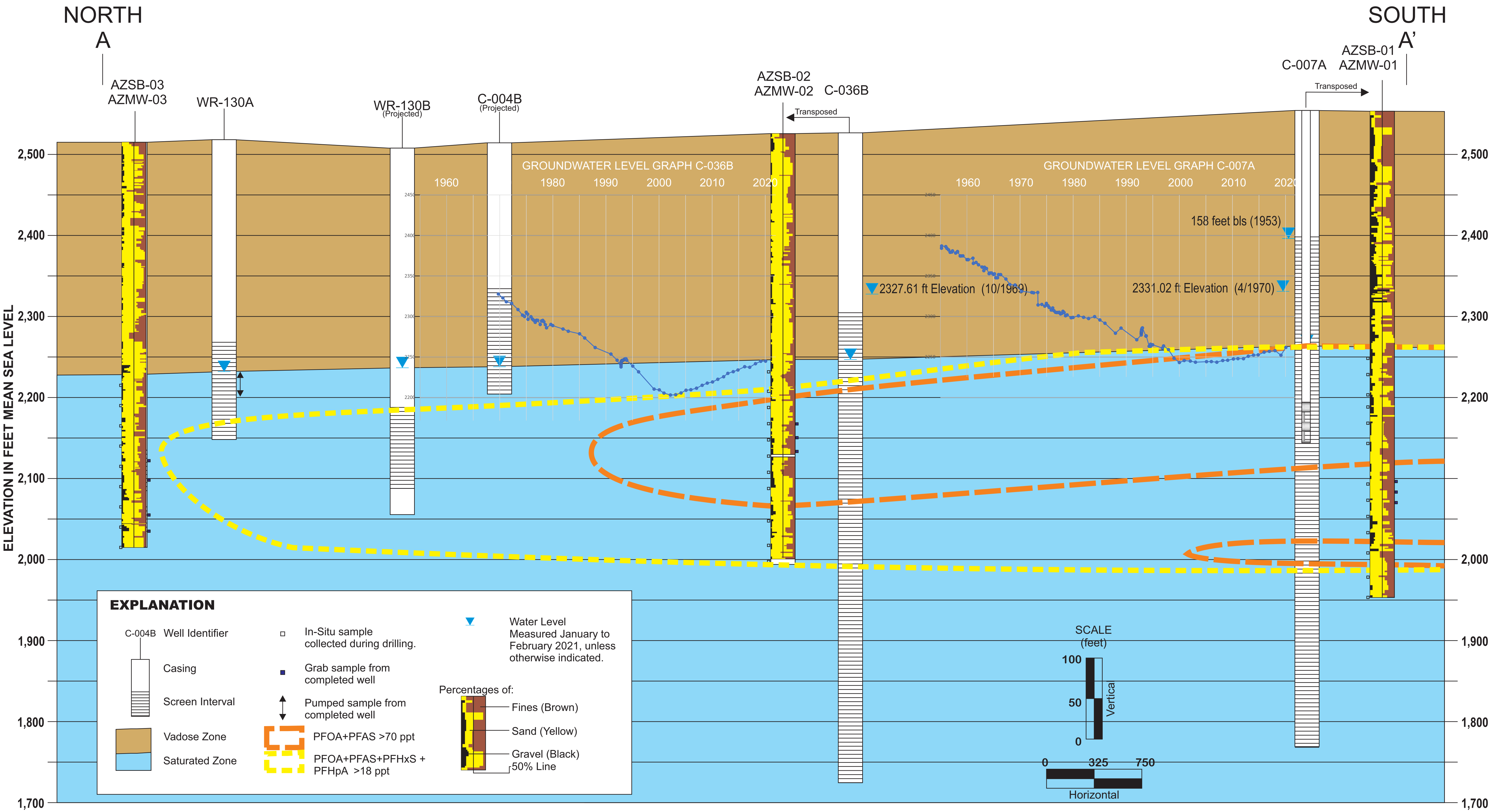
PREP BY: AAA REV BY: ZZZ RPT NO.: 0000.00 | FIGURE 8 Cross Sections | Rev.



NOTE: PFOS = Perfluorooctane sulfonate or Perfluorooctane sulfonic acid; PFHxS = Perfluorohexane sulfonate or Perfluorohexane sulfonic acid; PFOA = Perfluorooctanoate or Perfluorooctanoic acid; and PFHpA = Perfluoroheptanoate or Perfluoroheptanoic acid
ppt = Parts per trillion
Transposed = The location of a well has been moved along the cross section axis for clarity because multiple wells were located at the same location. Projected = A well located off of the cross section axis was projected onto the axis at 90 degrees from the axis.

1289.3	Figure 9A Cross Section.CDR	10/21

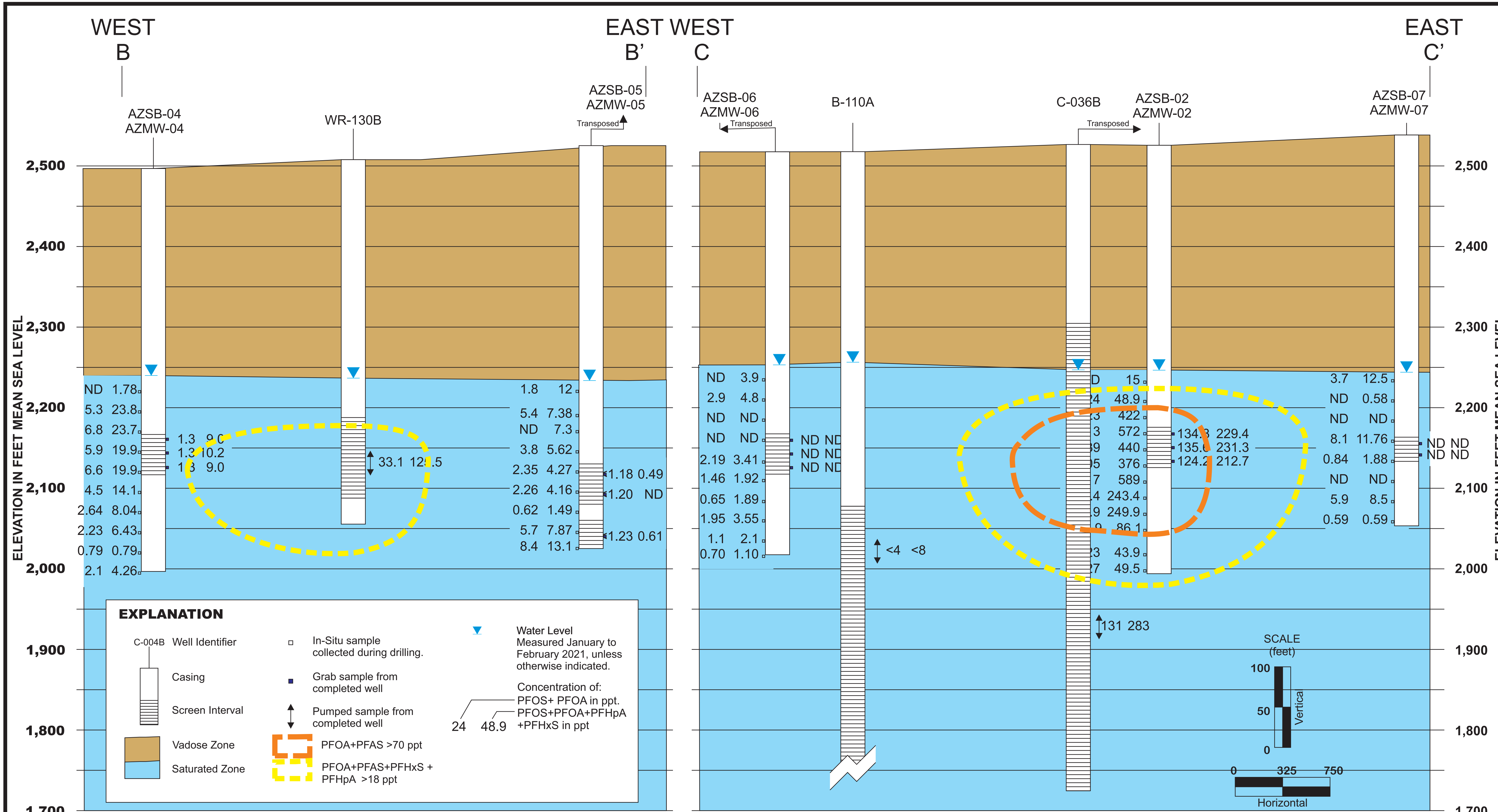
FIGURE 9A - CROSS SECTION A-A'
CENTRAL TUCSON PFAS PROJECT



NOTE: PFOS = Perfluorooctane sulfonate or Perfluorooctane sulfonic acid; PFHxS = Perfluorohexane sulfonate or Perfluorohexane sulfonic acid; PFOA = Perfluorooctanoate or Perfluorooctanoic acid; and PFHpA = Perfluoroheptanoate or Perfluoroheptanoic acid
ppt = Parts per trillion
Transposed = The location of a well has been moved along the cross section axis for clarity because multiple wells were located at the same location. Projected = A well located off of the cross section axis was projected onto the axis at 90 degrees from the axis.

1289.3	Figure 9B Cross Section.CDR	10/21

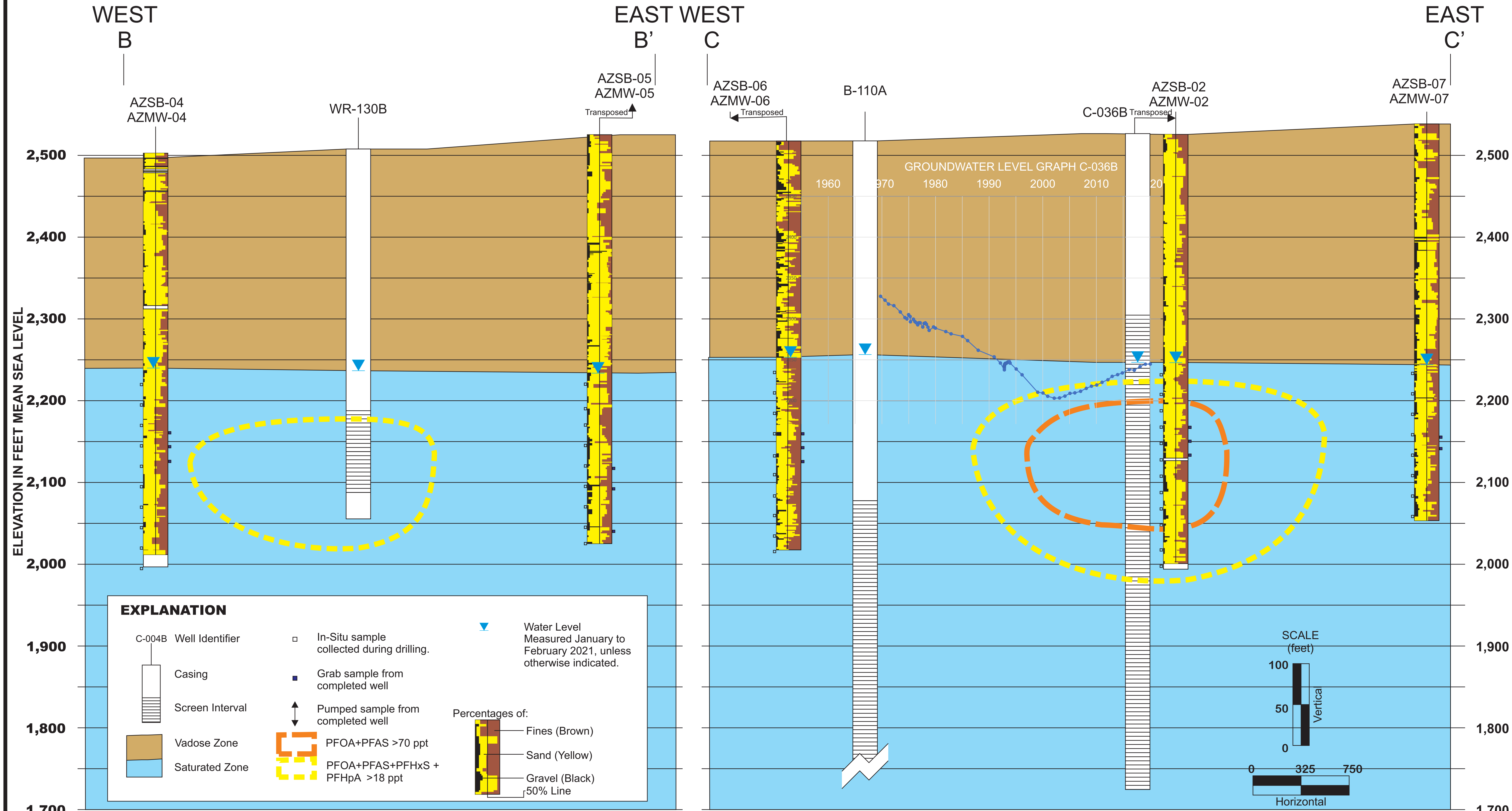
FIGURE 9B - CROSS SECTION A-A' WITH LITHOLOGIC INFORMATION
CENTRAL TUCSON PFAS PROJECT



NOTE: PFOS = Perfluorooctane sulfonate or Perfluorooctane sulfonic acid; PFHxS = Perfluorohexane sulfonate or Perfluorohexane sulfonic acid; PFOA = Perfluorooctanoate or Perfluorooctanoic acid; and PFHpA = Perfluoroheptanoate or Perfluoroheptanoic acid
ppt = Parts per trillion
Transposed = The location of a well has been moved along the cross section axis for clarity because multiple wells were located at the same location. Projected = A well located off of the cross section axis was projected onto the axis at 90 degrees from the axis.

1289.3	Figure 10A.CDR	10/21

FIGURE 10A - CROSS SECTIONS B-B' AND C-C'
CENTRAL TUCSON PFAS PROJECT



NOTE: PFOS = Perfluorooctane sulfonate or Perfluorooctane sulfonic acid; PFHxS = Perfluorohexane sulfonate or Perfluorohexane sulfonic acid; PFOA = Perfluorooctanoate or Perfluorooctanoic acid; and PFHpA = Perfluoroheptanoate or Perfluoroheptanoic acid
ppt = Parts per trillion
Transposed = The location of a well has been moved along the cross section axis for clarity because multiple wells were located at the same location. Projected = A well located off of the cross section axis was projected onto the axis at 90 degrees from the axis.

1289.3	Figure 10B.CDR	10/21

FIGURE 10B - CROSS SECTIONS B-B' AND C-C' WITH LITHOLOGIC INFORMATION
CENTRAL TUCSON PFAS PROJECT

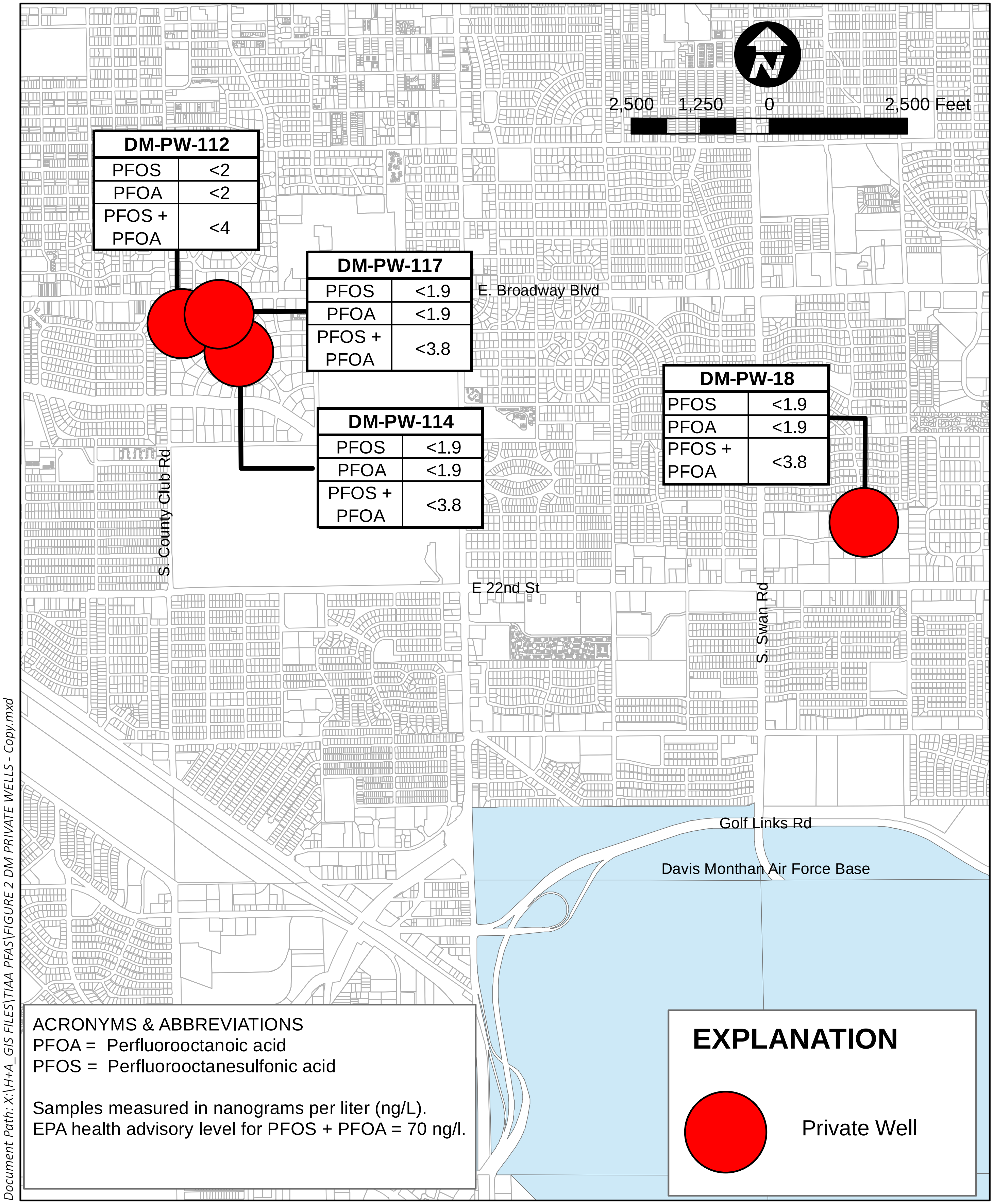


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Figure 11
Private Well Sampling for PFAS 2019.

Reference: Figure 2 from Results of Sampling Program for PFAS in Groundwater Davis Monthan Air Force Base Vicinity, Tucson, Arizona. March 20, 2020.

Air Force Civil Engineer Center

2261 Hughes Ave., Suite 163
JBSA Lackland, Texas 78236

Symbol Key

- AFFF Release Area
- Davis-Monthan AFB Installation Boundary

AFFF Release Areas
Davis-Monthan AFB
Tucson, Arizona

N W E S

Project: 775303101

By: EMK | Date: 8/10/2018

0 1,300 2,600 Feet

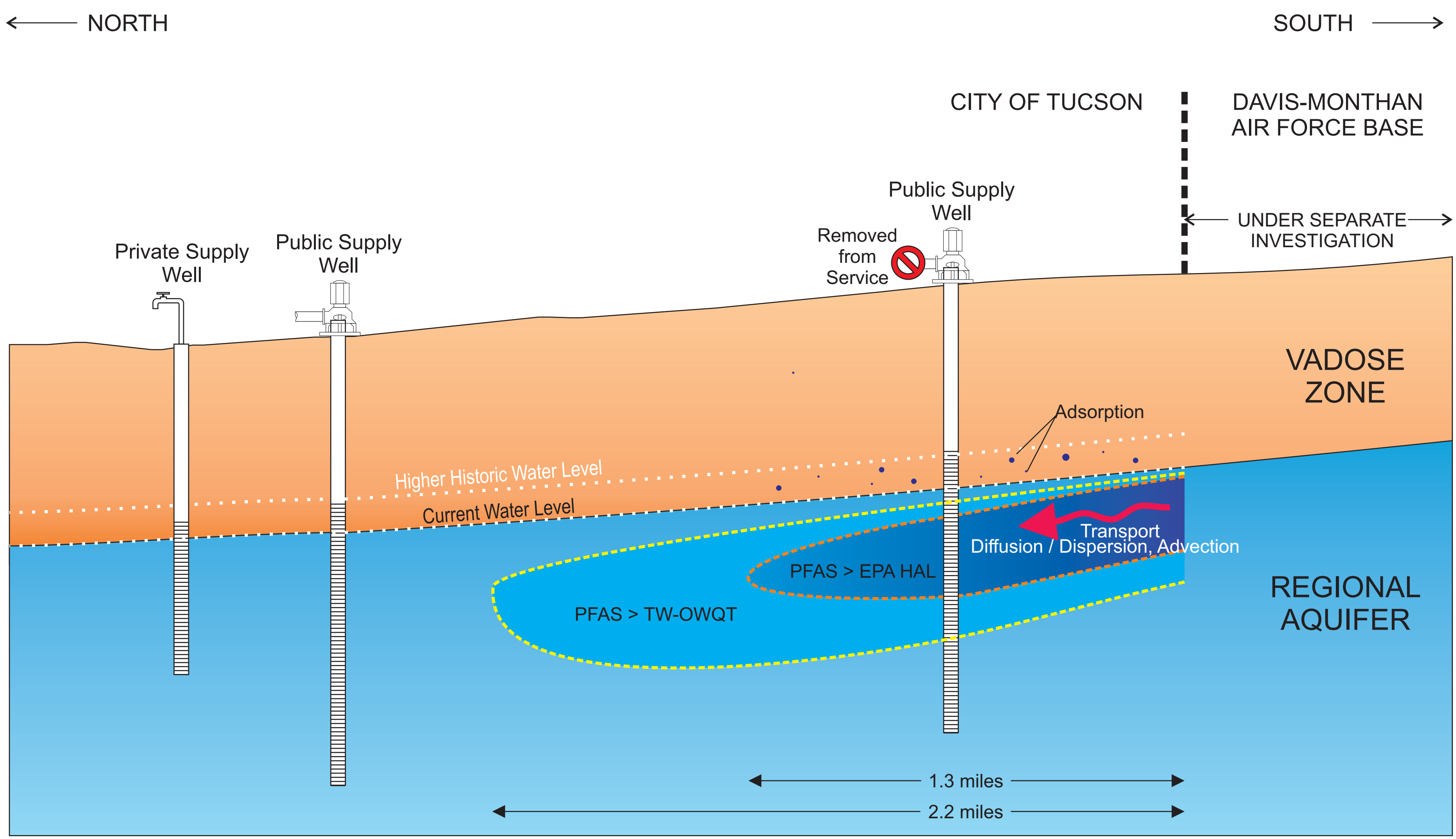
Disclaimer: For general reference purposes only. This is not a survey product. DO NOT USE to determine, certify, or verify map features, scale and/or other information.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Site Inspection of
Aqueous Film Forming Foam (AFFF)
Release Areas
Environmental Programs Worldwide
Site Inspection Report

Path: \\knx1-fs1\projects\GIS\775303101_AFCEC_PFC\Davis Monthan\MXD\SIR\F2.3-1_AFFF_Release_Areas.mxd

FIGURE 12



NOTES:
EPA HAL = EPA Health advisory level
TW-OWQT = Tucson Water Operational Water Quality Target.

NOT TO SCALE

10/2021	RPT NO 1289.3	FIGURE 13.CDR

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FIGURE 13 - CONCEPTUAL SITE MODEL
CENTRAL TUCSON PFAS PROJECT

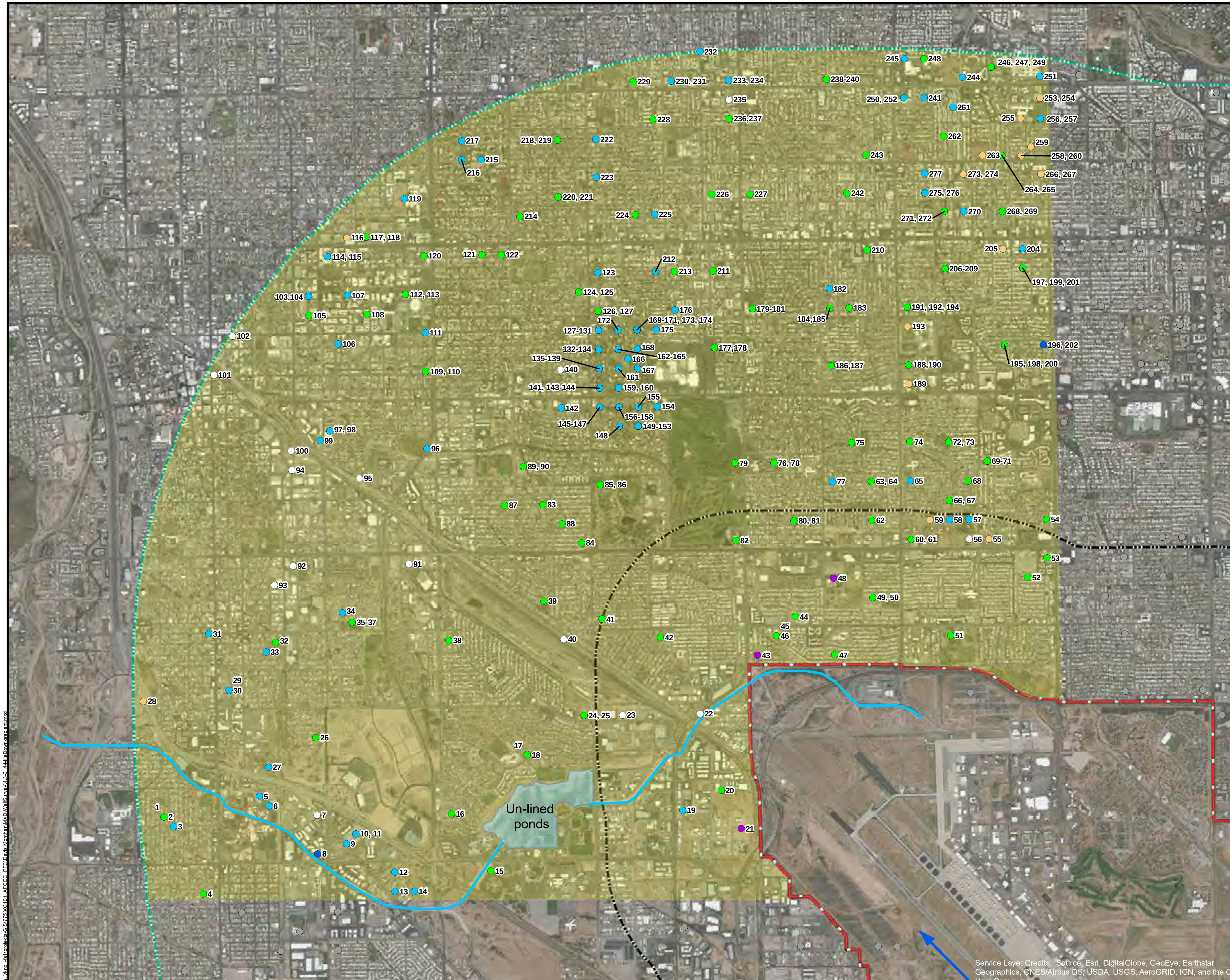

FIGURE 14
4- mile Well Inventory (Downgradient Production Wells)
Davis-Monthan Air Force Base
Tuscon, Arizona

Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas
Environmental Programs Worldwide
Site Inspection Report

Air Force Civil Engineer Center

2261 Hughes Avenue
Building 171, Suite 155
JBSA Lackland, Texas 78236

Symbol Key

- 200 Map Reference Number
- Domestic Well
- Municipal Use Well
- Well with No Use Code on NOI
- Other- Production Well
- Reserved Well
- Unknown Well
- Upgradient Wells
- General Groundwater Flow Direction
- Stream
- Potentially impacted groundwater in downgradient direction
- Search Area (4-miles from Davis-Monthan AFB)
- Search Area (1-mile from Davis-Monthan AFB)
- Davis-Monthan AFB Installation Boundary

The following well categories are excluded from this figure for clarity: Commercial, Industrial, Irrigation, Monitoring, Test, Stock, and Remediation

Well source data: ADWR Wells 55 Registry
https://new.azwater.gov/gis

N W E S

Project: 775303101

By: EMK

Date: 6/26/2018

For general reference purposes only.

0 0.25 0.5 0.75 1 Miles