



TUCSON WATER DEPARTMENT

Tucson Airport Remediation Project (TARP)



DESIGN REPORT

TARP Water Treatment Plant Improvements Ion Exchange PFAS Treatment

FINAL / June 2024





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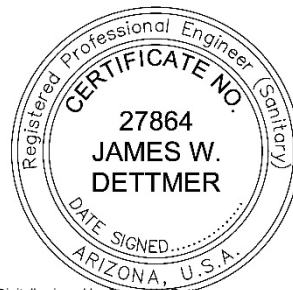
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Contents

SECTION 1	INTRODUCTION	1
1.1	Report Organization	1
SECTION 2	OPERATIONAL FLOWS AND WATER QUALITY	2
2.1	Operational Flows	2
2.2	Water Quality	3
2.2.1	Regulatory Background	3
2.2.2	Existing Water Quality	4
2.2.3	PFAS Removal via Ion Exchange	10
2.2.4	Sediment Removal	12
SECTION 3	TREATMENT FACILITY PROCESS UPGRADES	13
3.1	Treatment Approach	13
3.2	Modifications to Existing Facility	13
3.3	Design Criteria	13
3.3.1	Hydraulic Evaluation	13
3.3.2	Influent Booster Pump Station	19
3.3.3	Sediment Removal	19
3.3.4	Ion Exchange	23
SECTION 4	DESIGN SPECIALTIES	27
4.1	Civil	27
4.1.1	Site Access	27
4.1.2	Site Topography, Grading, and Drainage	27
4.1.3	Buried and Exposed Piping	28
4.1.4	Proposed Utilities	28
4.1.5	Coordination with Existing Utilities	29
4.1.6	Corrosion Control/Cathodic Protection	29
4.2	Geotechnical Considerations	30
4.2.1	Mass Earthwork and Structural Fill Recommendations	30
4.3	Structural	31
4.3.1	Wind	31
4.3.2	Seismic	31
4.3.3	Materials of Construction	31
4.3.4	Foundation Design Recommendations	32
4.4	Electrical	32

4.5	Instrumentation and Control/SCADA	34
4.5.1	Instrumentation and Control Equipment	34
4.5.2	Controls	35
4.5.3	PLC Considerations	35
4.5.4	Human Machine Interface	35
4.5.5	Networking	35
4.6	Security	35
SECTION 5	IMPACT TO EXISTING FACILITIES	36
5.1	Influent Booster Pump Station	36
5.2	Desanders	36
5.3	Automatic Backwashing Filters	36
5.4	Cartridge Filters	36
5.5	Ion Exchange	36
SECTION 6	START UP AND MONITORING	37
SECTION 7	REFERENCES	39

Appendices

APPENDIX A	SELECTED DESIGN DRAWINGS
APPENDIX B	ION EXCHANGE RESIN PRODUCT DATA SHEET
APPENDIX C	MCC-AOP LOAD STUDY REPORT

Tables

Table 1	TARP Remediation Well Production Rates and WTP Capacity	3
Table 2	USEPA Maximum Contaminant Levels for PFAS	4
Table 3	Tucson Water Internal Operational Water Quality Targets	6
Table 4	PFAS Water Quality Summary from Remediation Wells	6
Table 5	Historical TARP Raw Water and Treated Water Quality	7
Table 6	Historical TARP Remediation SWF Wells Water Quality	8
Table 7	Historical TARP Remediation NWF Wells Water Quality	9
Table 8	Major Equipment Head Loss Assumptions	15
Table 9	IBPS Design Criteria	19
Table 10	Desander Design Criteria	20
Table 11	Automatic Backwashing Filters Design Criteria	22
Table 12	Cartridge Filter Design Criteria	23
Table 13	Ion Exchange Design Criteria	26
Table 14	Buried Piping Design Criteria	28
Table 15	Exposed Piping Design Criteria	28
Table 16	2018 International Building Code Wind Design Parameters	31
Table 17	Material Values	32

Figures

Figure 1	Formula for Calculating the Hazard Index	4
Figure 2	TARP WTP Raw Water PFAS Concentrations Over Time	5
Figure 3	TARP IX RSSCT Breakthrough Curves for Purolite™ Purofine® PFA694E	11
Figure 4	Existing TARP WTP IBPS Pumps – New System Hydraulics	16
Figure 5	TARP WTP IBPS Upgrades Hydraulic Modeling Results	18

Abbreviations

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
ABF	automatic backwashing filter
AC	air conditioning
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AFT	Applied Flow Technology
amp	ampere
AOP	advanced oxidation process
AOR	allowable operating range
ASME	American Society of Mechanical Engineers
Avg	average
AWWA	American Water Works Association
BV	bed volumes
CaCO ₃	calcium carbonate
Carollo	Carollo Engineers
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of Tucson
Cr (VI)	hexavalent chromium
CTPP	Central Tucson PFAS Project
EBCT	empty bed contact time
GAC	granular activated carbon
GenX	hexafluoropropylene oxide dimer acid
gpm	gallons per minute
gpm/sf	gallons per minute per square foot
HI	Hazard Index
hp	horsepower
I/O	input/output
IBC	International Building Code
IBPS	influent booster pump station
IX	ion exchange
LSI	Langelier Saturation Index
MCC	motor control center
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
mg/L	milligrams per liter
mgd	million gallons per day
N/A	not available
NTU	nephelometric turbidity unit

NWF	North Well Field
O&M	operations and maintenance
PC	pressure class
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctyl sulfonate
pH	potential of hydrogen
PLC	programmable logic controller
ppt	parts per trillion
psf	pounds per square foot
psf/ft	pounds per square foot per foot
psi	pounds per square inch
psig	pounds per square inch gauge
RIO	remote input and output
rpm	revolutions per minute
RSSCT	rapid small-scale column test
RWS	Recycled Water System
SCADA	supervisory control and data acquisition
SES	service entrance switchboard
SWF	South Well Field
TARP	Tucson Airport Remediation Project
TCE	trichloroethene
TDH	total dynamic head
TDS	total dissolved solids
TEP	Tucson Electric Power Company
TOC	total organic carbon
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
UV	ultraviolet
UV AOP	ultraviolet light-hydrogen peroxide advanced oxidation process
VAC	volts alternating current
VFD	variable frequency drive
VOC	volatile organic chemicals
WTP	water treatment plant
µg/L	micrograms per liter

SECTION 1 INTRODUCTION

The Tucson Airport Remediation Project (TARP) Water Treatment Plant (WTP) currently consists of an ultraviolet light-hydrogen peroxide advanced oxidation process (UV AOP) followed by granular activated carbon (GAC) to treat groundwater from the TARP remediation wells by destruction of volatile organic chemicals (VOC), primarily trichloroethene (TCE), and 1,4-dioxane. Prior to June 2021, all treated water from TARP WTP was delivered to the potable system. Beginning in November 2021, TARP treated water could be delivered to the Santa Cruz River via a newly constructed outfall near the TARP WTP site. Beginning in April 2023, treated water from the TARP WTP could also be delivered to Tucson Water's Recycled Water System (RWS) via a newly constructed booster pump station.

Tucson Water has been monitoring per- and polyfluoroalkyl substances (PFAS) in groundwater at the TARP plume since the United States Environmental Protection Agency (USEPA) Provisional Drinking Water Health Advisories in January 2009. Water quality data from TARP remediation well samples indicate presence of PFAS. Tucson Water is implementing a dedicated PFAS treatment system upstream of the UV AOP system to protect consistent operation of the TARP remedy's remediation wells and WTP.

The PFAS treatment system comprises the following major components to be constructed upstream of the existing UV AOP system:

- Upgrades to the influent booster pump station (IBPS) that currently feeds the UV AOP system to overcome head losses introduced by installation of additional sediment removal equipment and ion exchange (IX) treatment vessels.
- Improved raw water sediment removal downstream of existing hydrocyclone desanders via new automatic backwashing filters (ABF) and re-instituting use of filter cartridges within the existing cartridge filter housings originally installed with the UV AOP system.
- An IX treatment system employing multiple parallel trains of dual lead/lag pressure vessels in series.

1.1 Report Organization

This Design Report describes the new IX system, additional sediment removal, and upgraded process flow pumping at TARP. The report is organized as follows:

- Section 1: Introduction.
- Section 2: Operational Flows and Water Quality.
- Section 3: Treatment Facility Process Upgrades.
- Section 4: Design Specialties.
- Section 5: Impact to Existing Facilities.
- Section 6: References.

SECTION 2 OPERATIONAL FLOWS AND WATER QUALITY

2.1 Operational Flows

The TARP groundwater remedy includes operation of two remediation well fields: the South Well Field (SWF) and the North Well Field (NWF). The objective of the TARP WTP, the NWF, and the SWF is to contain migration of groundwater contamination from the TARP plume and to remediate the aquifer by the removal of contaminant mass from groundwater. These contaminants include TCE and 1,4-dioxane. PFAS is also present in the TARP groundwater plume, but its extent has not been fully characterized, and PFAS remediation is not yet included in TARP governing documents issued by USEPA Region 9 that cover VOCs and 1,4-dioxane. As a proactive measure to remove PFAS in water produced by the TARP remediation wells prior to various uses of the water, PFAS treatment is being added upstream of VOC and 1,4-dioxane treatment. Treated water from TARP is directed to one or more uses available to Tucson Water.

The NWF includes five remediation wells (R-006A, R-007A, R-008B, R-009B, and R-127A) that withdraw groundwater from the Regional Undivided Aquifer. The main purpose of the NWF is to provide containment of the TARP plume. The SWF includes five remediation wells (R-001A, R-002A, R-003A, R-004A, and R-005A) that withdraw water from the Upper Divided Aquifer. The main purpose of the SWF is to remove contaminant mass before it migrates from the Upper Divided Aquifer into the Regional Undivided Aquifer. Table 1 summarizes approximate current production rates from operation of the TARP remediation wells.

Table 1 TARP Remediation Well Production Rates and WTP Capacity

Remediation Well	ADWR Well Registry Number	Approximate Current Production Capacity (gpm, except where indicated)
NWF		
R-006A	55-533856	1,250
R-007A	55-533857	1,150
R-008B	55-228449	1,250
R-009B	55-225318	1,250
R-127A	55-231613	1,300
NWF Total		6,200 (8.9 mgd)
SWF		
R-001A	55-533851	130
R-002A	55-533852	40
R-003A	55-533853	250
R-004A	55-533854	370
R-005A	55-533855	100
SWF Total		890 (1.3 mgd)
Combined Wellfields Total		7,090 (10.2 mgd)
Operational Flow Range for Treatment		
Minimum		2,500 (3.6 mgd)
Maximum		7,200 (10.4 mgd)

ADWR - Arizona Department of Water Resources; gpm - gallons per minute; mgd – million gallons per day

For operational/design purposes, the PFAS treatment system will accommodate the following approximate range of operational flows, including flows between these values:

- A minimum flow of 2,500 gpm (3.6 mgd), representing operation of two NWF wells.
- A nominal flow of 6,200 gpm (8.9 mgd) when operating the five NWF wells.
- A maximum flow of 7,200 gpm, representing combined production from all ten remediation wells.

2.2 Water Quality

This section presents a review of PFAS regulatory background, current TARP water quality, including general PFAS concentration trends and historic impacts of sediment on operations and maintenance (O&M), and the use of IX for PFAS removal.

2.2.1 Regulatory Background

On April 10, 2024, USEPA finalized National Primary Drinking Water Regulations establishing legally enforceable maximum contaminant levels (MCL) for six PFAS compounds. Perfluorooctanoic acid (PFOA), perfluorooctyl sulfonate (PFOS), perfluorohexanesulfonic acid (PFHxS), perfluorononanoic acid (PFNA), and hexafluoropropylene oxide dimer acid (commonly known as GenX chemicals), as contaminants with individual MCLs, and PFAS mixtures containing at least two or more of PFHxS, PFNA, GenX, and

perfluorobutane sulfonic acid (PFBS), using a Hazard Index (HI) to account for combined and co-occurring levels. The formula for calculating the HI, shown in Figure 1, involves dividing the concentration of each of the four individual PFAS compounds by their individual Health Based Water Concentration reference value (i.e., the level at which USEPA projects that no health effects are expected for that PFAS) and then summing these four values. When calculating the HI, all analysis results with no reportable PFAS are assumed to be zero. USEPA also finalized health based, non-enforceable maximum contaminant level goals (MCLG) for these PFAS compounds. Table 2 summarizes the MCLs and MCLGs set by the USEPA for all regulated PFAS compounds.

$$HI = \frac{[PFHxS]}{10 \text{ ppt}} + \frac{[GenX]}{10 \text{ ppt}} + \frac{[PFNA]}{10 \text{ ppt}} + \frac{[PFBS]}{2,000 \text{ ppt}}$$

Figure 1 Formula for Calculating the Hazard Index

Table 2 USEPA Maximum Contaminant Levels for PFAS

Compound/Parameter	Final Health-Based MCLG	Final MCL (enforceable levels)
PFOA	0 ppt	4 ppt
PFOS	0 ppt	4 ppt
HI	1 (unitless)	1 (unitless)
PFHxS	10 ppt	10 ppt
GenX	10 ppt	10 ppt
PFNA	10 ppt	10 ppt
PFBS	--	--

ppt - parts per trillion

The Drinking Water Health Advisories for GenX and PFBS were finalized in 2022 and are 10 ppt and 2,000 ppt, respectively. Additionally, on April 19, 2024, USEPA issued a final rule to designate PFOA and PFOS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). However, Tucson Water already manages spent GAC media from the TARP WTP in the same manner as hazardous waste from a Superfund site to comply with CERCLA Off-Site Rule (40 CFR 300.440) requirements, and the spent IX media to be used for PFAS removal in the future would follow this precedent.

2.2.2 Existing Water Quality

PFAS concentrations observed in raw water at the TARP WTP are shown in Figure 2 and Table 4. Figure 2 shows PFAS speciation of TARP raw water, while Table 4 summarizes recent PFAS concentrations in each remediation well, including PFAS compounds listed in the final MCLs and Tucson Water's internal operational water quality targets. Tucson Water's internal operational water quality targets are shown in Table 3.

Generally, PFAS concentrations have gradually increased since 2018, with higher increases in total PFAS concentrations observed in late 2021, corresponding with resumption of limited operation of NWF remediation wells and the TARP WTP after an extended shutdown from late June to early November 2021. When the TARP remedy was brought back online at reduced flow in November 2021, Tucson Water alternated operation of two original NWF wells, and plant-treated water was conveyed to the newly constructed TARP Santa Cruz River Outfall. The concentration variations shown after the June to November 2021 shutdown period was the result of alternating operation of NWF wells with different PFAS concentrations. Additionally, the highest total PFAS concentrations indicated in March to September 2022 were due to operation of new Well R-127A, which has the highest PFAS concentrations in the NWF. In October 2022, TARP raw water PFAS concentrations declined as operation of only the original four NWF remediation wells began, and Well R-127A was no longer in operation.

TARP raw water PFAS concentrations exceed the final MCLs for PFOA, PFOS, and HI, as seen in Figure 2 and Table 4. Additionally, increasing concentrations in PFHxS and PFBS will impact the calculated HI. As the HI is impacted by the concentrations of four different PFAS compounds, elevated concentrations of only one or two compounds could further increase the HI levels.

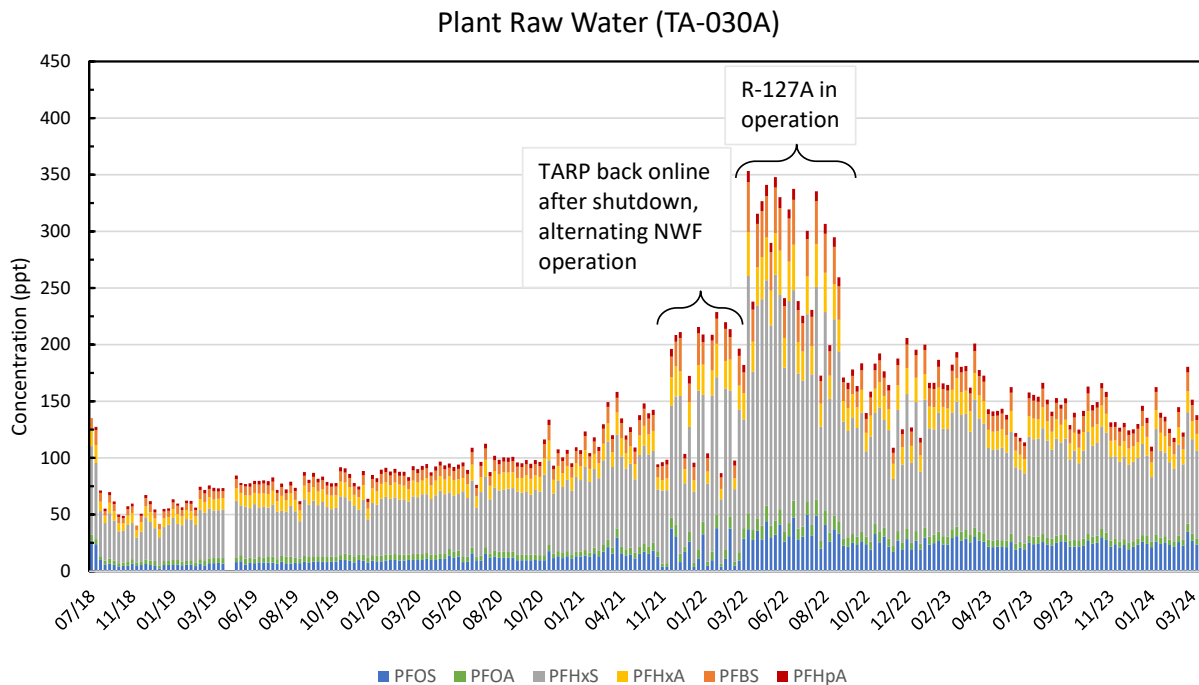


Figure 2 TARP WTP Raw Water PFAS Concentrations Over Time

Tucson Water monitors 25 different PFAS compounds in the TARP WTP raw water. Tucson Water's internal operational water quality targets are included in Table 3. These internal operation targets are subject to change based on regulatory developments and Tucson Water management direction.

Table 3 Tucson Water Internal Operational Water Quality Targets

Analyte	Tucson Water Operational Water Quality Target
PFOS	2 ppt
PFOA	2 ppt
PFHxS	7 ppt
PFHpA	7 ppt
PFHxA	200,000 ppt
PFBS	420 ppt
GenX	10 ppt
HI	1

PFHxA - perfluorohexanoic acid

Eight PFAS compounds are shown in Table 4, including PFHxA and perfluoroheptanoic acid (PFHpA), since those compounds are included in Tucson Water's internal operational water quality targets.

Table 4 PFAS Water Quality Summary from Remediation Wells

Sampling Location	PFOS (ppt)	PFOA (ppt)	PFHxS (ppt)	PFHxA (ppt)	PFBS (ppt)	PFHpA (ppt)	PFNA (ppt)	Gen-X (ppt)	HI (unitless)
R-001A ⁽¹⁾	204	7.8	399	38.2	58.7	4.1	<2	<2	39.9
R-002A ⁽²⁾	278	10.3	479	51.9	79.9	5.6	<2	<2	47.9
R-003A ⁽²⁾	257	14.8	481	69.7	88.5	9.8	<2	<2	48.1
R-004A ⁽²⁾	121	15.4	353	87.4	74.2	11.3	<2	<2	35.3
R-005A ⁽¹⁾	191	35	433	132	74.2	34.6	2.1	<2	43.5
R-006A ⁽⁴⁾	2.8	2.3	27.8	7.6	4.8	3.9	<2	<2	2.8
R-007A ⁽⁴⁾	8.0	4.4	88.4	12.2	14.9	3.6	<2	<2	8.8
R-008B ⁽⁴⁾	45	8.2	95.4	20.7	16.2	5.2	<2	<2	9.5
R-009B ⁽⁴⁾	48.5	9.0	112	23.2	19.4	5.3	<2	<2	11.2
R-127A ⁽³⁾	90	18.9	434	65.8	77.6	12.6	<2	<2	43.4
TA-030A ⁽⁴⁾	29.9	6.3	84	16.7	14.4	4.7	<2	<2	8.4

Notes:

(1) Data collected on December 19, 2023.

(2) Data collected on February 28, 2024.

(3) Data collected on August 31, 2023.

(4) Data collected on April 2, 2024.

(5) Data collected on April 2, 2024 from combined sample point.

Additionally, general water quality parameters for samples collected between 2014 and 2024 are summarized below. Table 5 presents a summary of data for both TARP raw water and treated water, while Table 6 summarizes data for the SWF wells, and Table 7 provides a summary for the NWF wells.

Table 5 Historical TARP Raw Water and Treated Water Quality

Sampling Location	Units	TARP Raw Water (TA-030A)				TARP Treated Water (TP-021T, TR-053T, and TR-054T) ⁽¹⁾			
		Count (N=)	5th Percentile	Avg	95 th Percentile	Count (N=)	5th Percentile	Avg	95th Percentile
Alkalinity	mg/L as CaCO ₃	4	157	163	175	167	112	138	169
Bromide	mg/L	4	0.27	0.39	0.45	19	0.1	0.3	0.4
Calcium	mg/L	N/A	N/A	N/A	N/A	172	61	67	73
Chloride	mg/L	4	33	48	54	20	31	39	45
Cr (VI)	µg/L	9	3.1	3.6	4.4	3	3.3	3.4	3.5
Fluoride	mg/L	4	0.7	0.7	0.8	20	0.6	0.7	0.7
Iron	mg/L	N/A	N/A	N/A	N/A	9	<0.02	<0.02	<0.02
LSI		N/A	N/A	N/A	N/A	6	-0.2	0.1	0.5
Manganese	mg/L	N/A	N/A	N/A	N/A	2	<0.02	<0.02	<0.02
Magnesium	mg/L	N/A	N/A	N/A	N/A	9	13.2	14.3	15.4
Nitrate as N	mg/L	4	2.1	2.5	2.7	20	1.83	2.2	2.6
Nitrite as N	mg/L	4	0.1	0.1	0.1	20	0.10	0.12	0.25
pH	S.U.	57	7.2	7.5	7.7	231	7.6	8.1	8.3
Potassium	mg/L	N/A	N/A	N/A	N/A	2	3.2	3.2	3.2
Sodium	mg/L	N/A	N/A	N/A	N/A	2	63	65	67
Sulfate	mg/L	4	136	160	171	20	125	139	156
Temperature	°C	57	22	25	27	231	14	20	26
TDS	mg/L	N/A	N/A	N/A	N/A	12	439	481	557
TOC	mg/L	4	0.4	0.4	0.4	N/A	N/A	N/A	N/A
TSS	mg/L	N/A	N/A	N/A	N/A	4	<1	<1	<1
Turbidity	NTU	7	0.3	0.8	1.8	9	0.3	0.5	0.7

Notes:

µg/L - micrograms per liter; Avg - average; °C - degree(s) Celsius; Cr (VI) - hexavalent chromium; LSI - Langelier Saturation Index; mg/L - milligrams per liter; N/A - not available; NTU - nephelometric turbidity unit; pH - potential of hydrogen; TDS - total dissolved solids; TOC - total organic carbon; TSS - total suspended solids

(1) TP-021T was the treated water sample point when water was sent to the drinking water system. TR-053T is a dedicated sample point from the RWS wet well that sends treated water to the Santa Cruz River via outfall TARP-01. TR-054T is a dedicated sample point from the RWS wet well going to the RWS.

Table 6 Historical TARP Remediation SWF Wells Water Quality

Parameter	Units	R-001A ⁽¹⁾				R-002A ⁽¹⁾				R-003A ⁽¹⁾				R-004A ⁽¹⁾				R-005A ⁽¹⁾			
		Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95 th Percentile
Bromide	mg/L	30	0.2	11.2	60.7	29	0.3	0.3	0.3	26	0.2	0.3	0.3	27	0.3	15	133	26	0.5	0.5	0.6
Chloride	mg/L	29	30	36	48	29	44	54	66	26	33	45	57	27	44	49	58	26	58	63	71
Cr (VI)	µg/L	5	1.0	5.6	8.5	5	0.2	2.6	5.2	5	0.9	3.8	5.8	5	3.6	6.1	7.9	3	6	7	8
Fluoride	mg/L	29	0.3	0.4	0.5	29	0.3	0.3	0.4	26	0.4	0.4	0.5	27	0.4	0.5	0.5	26	0.3	0.4	0.4
Nitrate as N	mg/L	29	2.03	2.28	3.12	29	2.7	2.8	3.0	26	2.0	2.4	2.7	27	2.0	2.3	2.5	26	2.8	3.1	3.7
Nitrite as N	mg/L	29	0.1	0.1	0.1	29	0.1	0.1	0.1	26	0.1	0.1	0.1	27	0.1	0.1	0.1	26	0.1	0.1	0.1
pH	S.U.	52	7.2	7.4	7.5	50	7.1	7.3	7.4	39	7.3	7.4	7.5	39	7.4	7.5	7.6	38	7.3	7.5	7.6
Sulfate	mg/L	29	152	165	193	29	179	197	216	26	163	178	190	27	167	172	180	26	169	181	191
Temperature	°C	52	22.2	23.8	25.1	50	22	24	25	39	23	24	25	39	23	25	26	38	24	25	26
TOC	mg/L	2	0.3	0.3	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	0.3	0.3	0.3	N/A	N/A	N/A	N/A
Turbidity	NTU	10	0.2	0.6	1.1	6	0.2	0.6	1.2	6	0.2	0.6	1.1	8	0.1	0.7	2.2	6	0.1	0.4	0.7

Notes:
(1) Sample range includes data from 2014 to 2018.

Table 7 Historical TARP Remediation NWF Wells Water Quality

Parameter	Units	R-006A				R-007A				R-008A/B				R-009A/B				R-127A			
		Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95th Percentile	Count (N)	5th Percentile	Avg	95th Percentile
Alkalinity	mg/L as CaCO ₃	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	151	151	151	1	160	160	160	2	148	148	148
Bromide	mg/L	30	0.25	0.29	0.34	30	0.19	14.9	82.7	13	0.1	8	42	17	0.14	0.20	0.26	4	0.20	0.39	0.50
Calcium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	43	43	43	1	46	46	46	1	82	82	82
Chloride	mg/L	30	28	33	38	29	24	34	41	13	13	22	26	17	16	24	31	4	55	60	65
Cr (VI)	µg/L	5	1.0	1.7	2.2	6	2.5	3.9	5.4	5	1.7	3.0	3.7	6	3.4	3.6	3.9	3	6.5	6.8	7.1
Fluoride	mg/L	30	0.6	0.7	0.7	29	0.7	0.8	1.0	13	0.8	0.9	1.1	17	0.76	0.84	1.0	3	0.6	0.6	0.6
LSI		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	-0.3	-0.3	-0.3	1	-0.12	-0.12	-0.12	1	0.1	0.1	0.1
Magnesium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	7.8	7.8	7.8	1	9.3	9.3	9.3	1	14.8	14.8	14.8
Nitrate as N	mg/L	30	2.6	2.9	3.1	29	1.8	2.2	2.6	13	0.4	1.0	1.3	17	0.8	1.3	1.7	4	2.8	2.9	3.0
Nitrite as N	mg/L	30	0.1	0.1	0.1	29	0.1	0.1	0.1	13	0.1	0.1	0.1	17	0.1	0.1	0.1	4	0.1	0.1	0.1
pH	S.U.	54	7.2	7.4	7.5	54	7.3	7.5	7.7	29	7.5	7.6	7.7	35	7.4	7.6	7.7	12	7.1	7.6	7.8
Sodium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	55	55	55	1	60	60	60	1	61	61	61
Sulfate	mg/L	30	137	144	152	29	112	127	142	13	88	107	114	17	92	106	120	3	168	174	182
Temperature	°C	54	22	24	25	54	23.2	24.7	25.7	29	25	27	28	35	24	25	26	12	22	24	27
TDS	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	329	329	329	1	341	341	341	1	552	552	552
TOC	mg/L	N/A	N/A	N/A	N/A	2	0.3	0.3	0.3	2	0.3	0.3	0.3	N/A	N/A	N/A	N/A	1	0.3	0.3	0.3
Turbidity	NTU	8	0.1	0.4	0.7	10	0.1	0.9	1.7	3	0.4	0.9	1.6	6	0.3	0.8	1.7	6	0.2	0.7	1.5
Uranium	µg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	3.2	3.2	3.2	1	8.6	8.6	8.6	1	6.5	6.5	6.5

Notes:
(1) Sample range includes data from 2014 to 2024.

2.2.3 PFAS Removal via Ion Exchange

Currently, the TARP WTP uses GAC to adsorb and remove PFAS from UV AOP treated water. While the original purpose of the GAC was to quench hydrogen peroxide in the UV AOP treated water, it is also effective at removing PFAS via adsorption. Since PFAS was detected in the TARP raw water, the GAC contactors have been Tucson Water's only means of removing PFAS from the TARP raw water. This operating strategy has resulted in the GAC media requiring replacement much more frequently, after treating approximately 25,000 to 50,000 bed volumes (BVs), to prevent PFAS breakthrough than is needed for hydrogen peroxide quenching. Additionally, the TARP GAC contactors are configured to operate in parallel and do not provide redundancy of dual vessel lead/lag trains.

The new PFAS treatment system at TARP will employ synthetic IX resin, a highly effective alternative to GAC for PFAS removal. IX resin provides dual-removal mechanisms of IX and adsorption technology to remove PFAS from groundwater and has higher PFAS removal capacity than GAC, meaning the media will last longer and require less frequent changeouts than GAC. The new IX system will be a dedicated PFAS "pretreatment" process upstream of UV AOP, which will allow the GAC system to be restored to its original purpose of hydrogen peroxide quenching only.

Rapid small-scale column tests (RSSCT) were performed on TARP raw water (sampling location TA-03A) in 2018 as part of overall PFAS evaluation strategies for TARP [Carollo Engineers (Carollo), June 2020]. These raw water samples taken for the RSSCTs were collected from a combination of wells with the highest PFAS concentrations.

Figure 3 shows breakthrough curves for regulated PFAS compounds for the Purolite™ Purofine® PFA694E RSSCT column, simulating an empty bed contact time (EBCT) of 3.3 minutes. The breakthrough of PFBS, PFHxS, and PFOA occurred at approximately 300,000 BVs treated, whereas PFOS did not break through by the end of testing. PFNA was not detected in the raw water. Projecting PFAS breakthrough BVs to full scale using RSSCTs can be challenging, especially for the TARP WTP. This is because of the historically variable operations at TARP with 10 wells operated in various combinations and subsequent varying plant influent PFAS concentrations (Figure 2). These factors make it difficult to predict treatment media life accurately using any testing method, including historical full-scale performance. Consequently, the media life for this IX resin can vary widely based on future well operations and influent PFAS concentrations.

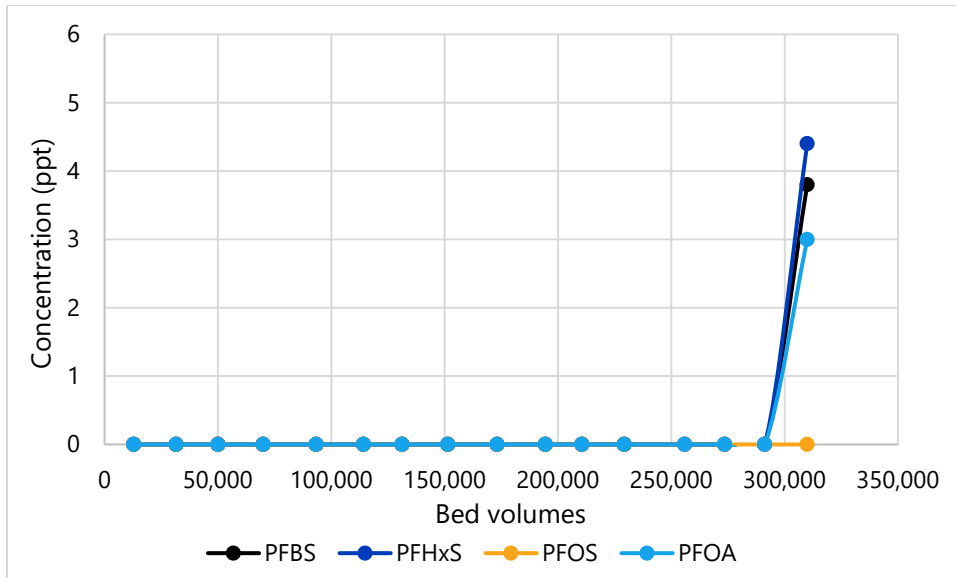


Figure 3 TARP IX RSSCT Breakthrough Curves for Purolite™ Purofine® PFA694E

Additionally, at the Arizona Department of Environmental Quality's (ADEQ) Central Tucson PFAS Project (CTPP), an IX facility with lead/lag treatment vessels also designed by Carollo was constructed on an inactive Tucson Water well just north of Tucson's Davis-Monthan Air Force Base. That system treats groundwater with PFAS concentrations two orders of magnitude greater than TARP raw water and a comparable background water quality matrix (anions and organics) has been operating for over two years. Over 175,000 BVs in the lead vessel have been treated, with no breakthrough of regulated PFAS compounds. This further underscores the effectiveness of these PFAS selective resins for local groundwaters with competing anions at relatively short EBCTs.

The IX resin used for PFAS removal is a single-use type, meaning that the resin is not regenerated in place like IX treatment media for some other contaminants, such as nitrate, and the PFAS resin's removal capacity decreases over time as it treats more water. Once the resin is exhausted, it must be replaced with new resin and transported off-site for disposal. Moreover, it's important to note that backwashing of IX resin beds during operation is not recommended, as it can result in premature PFAS breakthrough. The existing GAC system is backwashed periodically to remove sediment buildup and reverse compression head loss across the bed. Consequently, there is a significant emphasis on effective pretreatment measures that can remove sediment before it reaches the IX resin beds.

The following background water quality characteristics were considered for designing the IX system. The TARP raw water quality concentrations (TA-030A) are listed in Table 5:

- Oxidants like free chlorine or hydrogen peroxide could harm the IX resin. The IX system at TARP will receive raw groundwater before any oxidant addition.
- Average turbidity values are low, and the improved sediment removal system is anticipated to reduce turbidity.
- TOC concentrations measured are less than 0.4 mg/L, which is below the IX resin manufacturer recommended 1 mg/L. Therefore, no pretreatment for TOC is necessary.

- There are no microbial results available for the raw water; however, low organics generally correlate with low microbial activity, treated water chlorination is provided at the plant, and historical Safe Drinking Water Act compliance data from decades of operation with TARP treated water directed to the drinking water system indicate uniform compliance with all MCLs.
- Iron and manganese concentrations for TARP raw water (TA-030A) is not available; however, TARP GAC treated water listed in Table 5 is an alternative representative point, since GAC is not expected to remove these ions. Both iron and manganese are at concentrations less than 0.02 mg/L which is below the levels recommended by the IX resin manufacturer (less than 0.5 mg/L for iron and less than 0.02 mg/L for manganese).
- Anions such as chloride, sulfate, and nitrate may compete with PFAS for sites on the resins. However, the TARP RSSCT and the CTPP IX facility have demonstrated that despite TDS levels and competing anion concentrations, PFAS selective resins effectively remove PFAS compounds at relatively short EBCTs (generally between one and three minutes).

During initial startup, standard anion exchange resins remove alkalinity and other anions by exchanging chloride, resulting in treated water that is potentially corrosive, but typically limited to approximately the first 200 BVs treated. To mitigate this, the resin specified for TARP is an NSF 61 certified drinking water buffered resin (Purolite™ Purofine® PFA694EBF), which buffers the treated water against these changes and typically stabilizes the treated water within the first 50 BVs, reducing the volume of potentially corrosive water requiring forward flushing. A product data sheet for the specified IX resin for TARP can be found in Appendix B. The startup strategy for TARP is further discussed in Section 6.

2.2.4 Sediment Removal

All groundwater wells produce varying levels of sediment, and sediment production can increase with well age and casing/screen deterioration. Pretreatment to reduce sediment loading is prudent to protect groundwater treatment systems and downstream piping and equipment. In the event of a well casing/screen failure, or if sand, gravel, or other sediment are present in the well discharge flow, pretreatment will mitigate potentially damaging effects of sediment. For example, if sediment is deposited in advanced oxidation process (AOP) reactor vessels, ultraviolet (UV) lamp quartz sleeves can begin to foul or potentially break. If sediment gathers on top of GAC or IX resin beds, differential pressure across the media will increase, leading to additional backwash or other media maintenance requirements.

Historically, groundwater produced by the TARP remediation well network has been found to contain sediment that has negatively affected both operation and maintenance of TARP WTP by prematurely fouling filter cartridges and accumulating in pump basket strainers and other process equipment. Sediment events are unpredictable in terms of timing and severity, and even minor sediment accumulation over time incurs additional operator labor and maintenance efforts. Sediment can vary in size from sub-micron particles to small stones or grout fragments. The source of the sediment has been traced primarily to aging galvanized steel well casings/screens and gravel pack from the system's remediation wells. For optimum IX operations, resin manufacturers recommend removal of particle sizes above 5-microns upstream of IX, and IX resin beds should not be backwashed.

SECTION 3 TREATMENT FACILITY PROCESS UPGRADES

3.1 Treatment Approach

The new dedicated PFAS treatment consists of multi-stage sediment removal, an IX system for PFAS treatment, and IBPS upgrades. The multi-stage sediment removal system includes the existing desanders, existing basket strainers, a new ABF system, and existing (relocated) high-efficiency cartridge filters. The integration of this new treatment system into the existing facility is shown in the process flow diagrams included in Appendix A.

3.2 Modifications to Existing Facility

The existing facility will require the following modifications to integrate the new IX system:

- Relocation of the existing cartridge filters near the desanders, including associated piping modifications.
- Installation of 10 new IX vessels (5 parallel lead/lag trains) north of the existing 12-foot GAC contactors.
- Replacement of the existing influent booster pumps, motors, and variable frequency drives (VFD).
- Installation of ABF units, an associated backwash settling tank, and backwash recycle pumps and cartridge filters.
- Installation of new settled washwater recycle line that ties into the desanders influent.
- Installation of additional electrical building for the new IBPS VFDs.
- Installation of new filter cartridge elements in existing cartridge filter housings.
- Upgrade of site electrical power service due to the new electrical loads associated with these modifications.

The overall site plan can be found in Appendix A.

3.3 Design Criteria

The following sections include a description of the hydraulic evaluation, recommendations for the IBPS, and design criteria for the desanders, ABF, cartridge filters, and IX vessels.

3.3.1 Hydraulic Evaluation

The existing IBPS is located downstream of the desanders and conveys flow from the TARP remediation wellfield through the TARP WTP. The IBPS consists of three pumps that operate in a two-duty plus one standby configuration. The pumps operate at variable speed to maintain a pump inlet pressure of approximately 12.5 pounds per square inch gauge (psig). A hydraulic evaluation was completed for the existing IBPS to determine whether the IBPS can accommodate the additional head loss from the additional proposed equipment and piping without a reduction in well and plant flows or if the pumps require replacement.

A hydraulic model was developed using the Applied Flow Technology (AFT) Fathom™ software, a steady-state fluid simulation software used to analyze pump performance. The initial model was developed for the purpose of calibration to actual current conditions based on a combination of engineering drawings for the original plant and subsequent upgrades. System curves were developed for the TARP WTP using “clean”/“dirty” equipment head loss assumptions and piping losses from *TARP Additional Remediation Well and Treatment Upgrades* (Carollo, November 2019). Pump curves were overlaid on the system curves to determine the maximum system flow rate that can be supplied from the existing pumps, with redundancy. Assumptions include the following:

- Model calibration was performed by comparing model outputs to TARP WTP operational data.
- The existing plant model was evaluated for two head loss scenarios and compared to the previous plant model for consistency.

The hydraulic model was calibrated using current TARP WTP operational data. The model calibration process compared flow and pressure data from the hydraulic model to supervisory control and data acquisition (SCADA) data from the TARP WTP. Model calibration was done for the following existing operating conditions:

1. Current operating flow (4,800 gpm) high head loss condition.
2. Current operating flow (4,800 gpm) low head loss condition.
3. Minimum operating flow (1,300 gpm).

TARP WTP SCADA data was analyzed to identify specific days where flow and pressure conditions matched the three scenarios. High head loss conditions were assumed to occur right before a GAC backwash event, and low head loss conditions were assumed to occur after backwashing was complete. In the model, plant flow rate was updated to match the average flow from the selected date, and pressure and pump speed SCADA data were compared to model outputs. In all scenarios, model outputs closely correlated to plant SCADA data.

Following calibration of the existing plant model, the equipment and piping associated with the PFAS treatment system were added to the model. Two scenarios were used to evaluate the hydraulic impacts of the proposed process upgrades. These scenarios were:

1. “Dirty” scenario: Maximum head loss through equipment that may accumulate sediment or that has media, such as cartridge filters, ABFs, GAC contactors, and IX vessels.
2. “Clean” scenario: Minimum head loss through equipment that may accumulate sediment.

The hydraulic evaluation was based on the following new operating conditions:

- Low flow: 2,500 gpm (approximately two NWF wells in operation).
- Maximum flow: 7,200 gpm.
- Only the “clean” head loss scenario was modeled for the low flow condition.

Head loss assumptions for the major treatment equipment included in this hydraulic model are summarized in Table 8. Equipment upstream of the basket strainers was not included in this new hydraulic model, as no changes are being made to this equipment or piping. Previous head loss calculations were used to estimate the head loss in this equipment when the hydraulic grade line was developed.

Table 8 Major Equipment Head Loss Assumptions

Equipment	Head Loss (psi)	
	"Clean" Scenario	"Dirty" Scenario
ABF	1	7
Cartridge Filters	6.5	35
IX Vessels	20	35
Static Mixer	3.8	3.8
UV Reactors	1	1
GAC Contactors	5	20
Total	37.3	101.8

psi - pounds per square inch

Figure 4 shows the results of the existing IBPS hydraulic analysis. Minimum and maximum system curves and pumps operating at full and reduced speeds are shown for the existing pumps. Additionally, the minimum allowable operating range (AOR) for one and two pumps, and maximum AOR for two pumps, are shown. With the additional head loss from the IX vessels, ABF, and cartridge filters, the existing pump station would be unable to operate without dead-heading the pumps under the majority of required flow conditions.

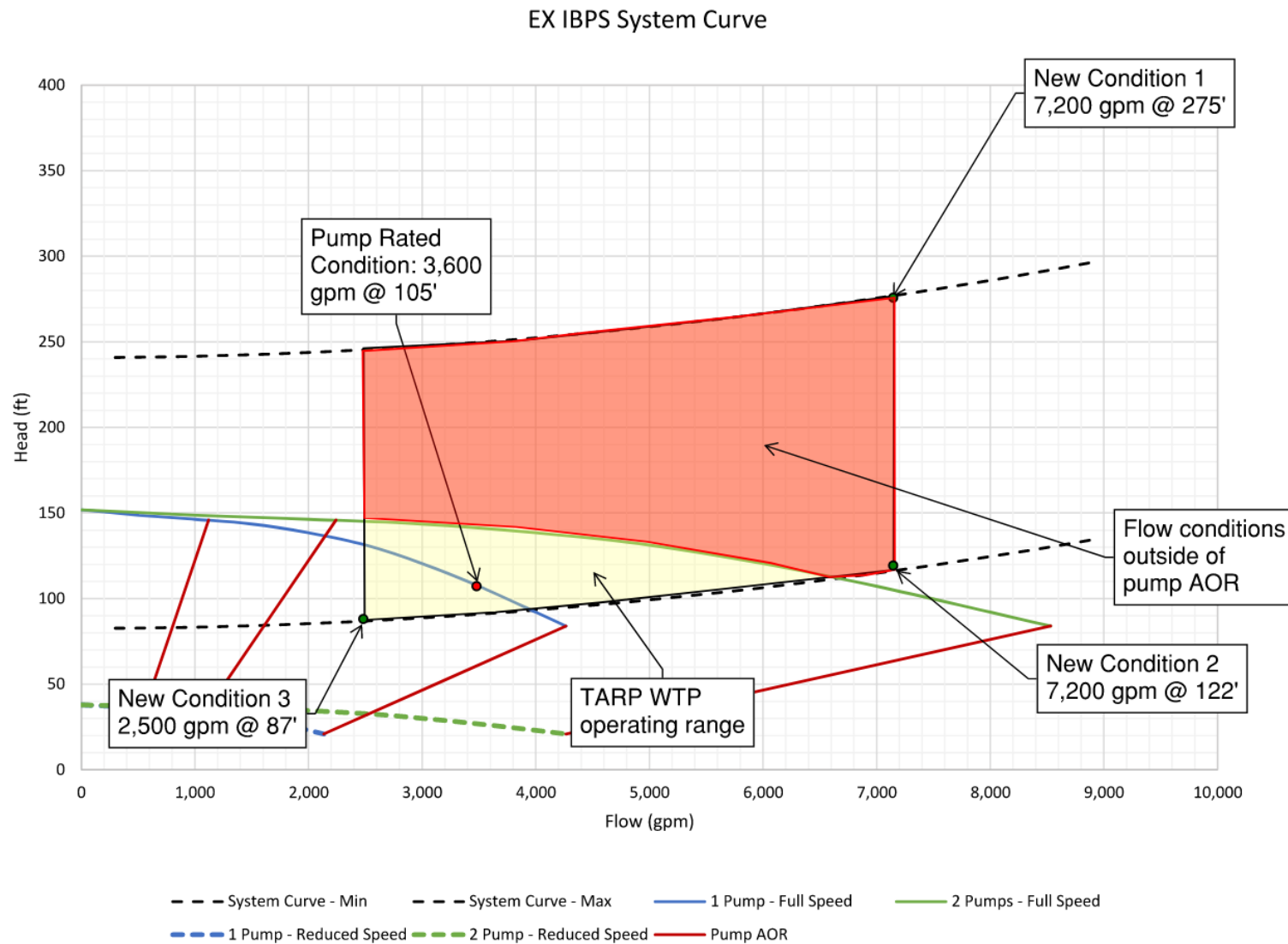


Figure 4 Existing TARP WTP IBPS Pumps – New System Hydraulics

Figure 5 shows the TARP system curve and the results of the IBPS upgrades evaluation. Minimum and maximum system curves and pumps operating at full and reduced speeds are shown for the proposed new pumps. Conditions 1 through 3, shown on the figure, correspond to the scenarios described above in the hydraulic evaluation. Multiple manufacturer's pumps were evaluated as replacements for the existing IBPS pumps. All pumps specified can meet the new system requirements. The Pentair 1824B pump has the same flange-to-flange dimension as the existing pump and would minimize effects on the IBPS piping. Further modifications to the IBPS are discussed in the following section. Figure 5 shows the Pentair 1824B pump curves compared to the new system curves.

As seen on Figure 5, a throttling valve will be required for the pumps to operate within the AOR during periods of high flow and low head loss. As discussed later in the report, the ABFs require a minimum system pressure of 40 psig. The throttling valve will be located downstream of the ABFs to maintain the minimum upstream pressure required for the ABFs and the influent booster pumps.

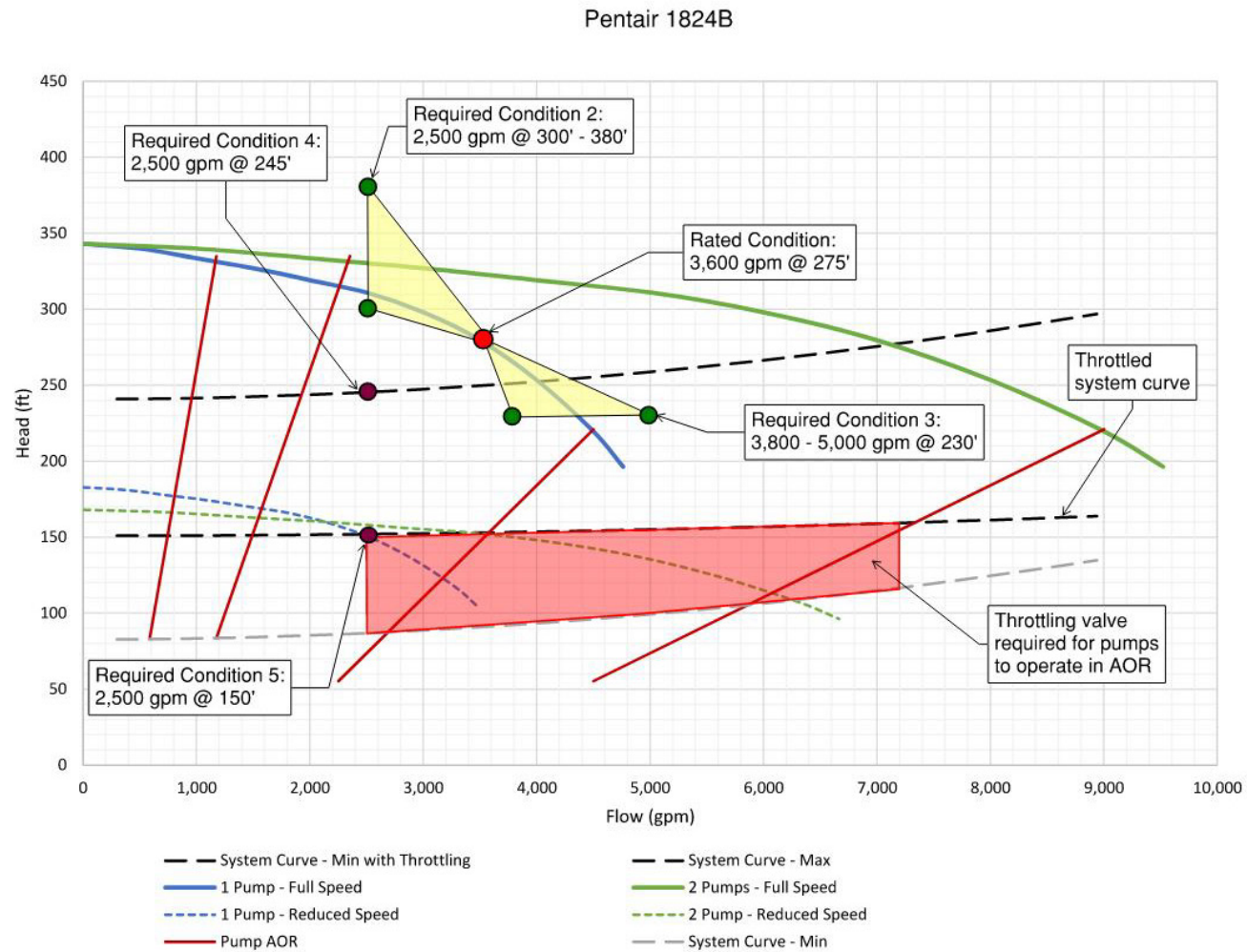


Figure 5 TARP WTP IBPS Upgrades Hydraulic Modeling Results

3.3.2 Influent Booster Pump Station

Based on the hydraulic evaluation, the IBPS design is based on replacing the three IBPS pumps, motors, and VFDs to meet the additional head requirements for the new process equipment and operate under all anticipated flow and head conditions. Pump sizing was performed based on the “dirty” head loss operating condition. The replacement pumps and motors will have a larger footprint than the existing pumps and will require larger pump housings and support bases. Based on discussions with the manufacturer, the Pentair 1824B replacement pumps will be a like-for-like replacement between the existing flanges but will require housings with approximately 1 foot of increased length. The existing clearance between the pump support base pads is approximately 2.5 feet, which will be reduced to 1.5 feet after the upgrades. Table 9 shows the design criteria for the existing IBPS and the recommended design criteria for the replacement pumps. The replacement pump specification lists four different replacement pumps with the Pentair Model 1824B being the first named manufacturer model. Information in Table 9 for the replacement pumps is for the Pentair Model 1824B. Additionally, a throttling valve will be required downstream of the IBPS that is discussed in more detail in Section 3.3.3.2. The IBPS plan can be found in Appendix A.

Table 9 IBPS Design Criteria

Parameter	Units	Existing Pumps	Replacement Pumps
Manufacturer	-	Pentair Fairbanks Nijhuis	Pentair Fairbanks Nijhuis
Model Number	-	8-inch 1822A	8-inch 1824B
Type	-	horizontal split case	horizontal split case
Quantity	-	2 duty + 1 standby	2 duty + 1 standby
Design Flow, Each	gpm	3,600	3,600
Design TDH	feet	105	275
Motor Horsepower (hp)	hp	125	350
Speed, Rated	rpm	1785	1775
Pump Efficiency	%	83	83.5
Drive	-	VFD	VFD

rpm - revolutions per minute; TDH - total dynamic head

3.3.3 Sediment Removal

The TARP WTP has encountered challenges in the past due to sediment, which has had adverse effects on both the operation and maintenance of the TARP WTP. In 2017, Carollo conducted a study to identify the most effective method for sediment removal at the TARP WTP. The findings of this study are summarized in *Water Treatment Plant Sediment Removal System* (Carollo, December 2017). According to the study, the most cost-effective sediment removal options were ABF and desanders. To address sediment issues, desanders were installed at TARP upstream of the IBPS. While they effectively remove coarse sediment, finer particles continue to pass through, leading to premature clogging of the cartridge filters and a need to replace the filters at a frequency that was not practical. Consequently, the current operations involve passing raw water through the empty cartridge filter housings without filter cartridge elements installed. The sediment removal area plan view can be found in Appendix A.

As previously mentioned in this report, effective sediment removal is crucial for the optimum operation of the IX system, and the resin manufacturer recommends sediment removal down to 5-micron size upstream of IX. To address this, a three-stage sediment removal approach is designed that includes the following processes:

- Existing hydrocyclone desanders.
- New ABF.
- Existing cartridge filter housings equipped with 5-micron absolute rated filter cartridge elements.

Basket strainers also protect the influent booster pumps.

3.3.3.1 Desanders

There are three Krebs desanders currently installed at the TARP WTP. Each desander has a nominal capacity of 3,600 gpm. At the full design flow of 7,200 gpm, the desanders can be operated with either two or three desanders in service. Table 10 shows design criteria for the desanders and associated purge water storage tank and return pumps. These units are designed to remove coarse solids/sediment to protect the downstream process equipment.

Table 10 Desander Design Criteria

Parameter	Units	Value
Manufacturer	-	FLSmidth KREBS®
Model	-	W30-783
Quantity	-	2 duty + 1 standby
Design Flow per Desander	gpm	3,600
Vortex Finder Diameter	inches	12
Solids Storage Tank Volume	gallons	500
Number of Return Pumps	-	1 duty + 1 standby
Return Pump TDH	feet	50
Return Pump Motor hp	hp	0.5
Material of Construction	-	Steel

3.3.3.2 Automatic Backwashing Filters

After passing through the desanders, raw water will be pumped by the IBPS to the ABF units situated atop the ABF's backwash settling tank. The basic construction of the ABF units includes a stainless-steel housing, inlet- and outlet-flanged connections, stainless steel coarse and fine filter screens, flush-/backwash-outlet valves and actuators, and electronic operating controls.

Raw water first passes through a coarse screen element followed by a fine screen inside the ABF with a 25-micron rating. The wedge-wire filter element captures solids, preventing their passage into the downstream process. As the quantity of solids loading into the screens increases, the differential pressure between the "dirty" and "clean" sides of the ABF rises. Once the accumulation of particles causes a predetermined differential pressure, the control system initiates a backwash cycle. A differential pressure transmitter will be positioned across the 24-inch diameter headers for both the feed and treated water

lines of the entire ABF system. A sequential backwash cycle is triggered once a predetermined target is reached across the headers, ensuring that all units that are online are backwashed in quick succession. Additionally, each ABF unit will have a dedicated differential pressure transmitter that will be connected to the plant control system for process monitoring purposes.

Throughout the entire backwash cycle, the ABF continues to filter the raw water flow, only diverting a partial flow to the backwash, thus avoiding disruption of operations. When the control system triggers a backwash cycle, the flush valve opens to atmospheric pressure and requires a minimum inlet pressure of 40 psig for an optimal backwash. Therefore, a high-performance butterfly valve, as previously detailed in the hydraulic evaluation section of this report, will be automatically modulated to ensure the minimum inlet pressure upstream of the automatic backwash filter is maintained.

The washwater stream is piped to the backwash settling tank inlet channel. This channel is hydraulically linked to the settling portion of the tank via four openings at its base. Within this settling section, adequate residence time is provided for the particles removed by the ABF to settle. Subsequently, the water flows over a weir and into the active storage volume of the tank. Here, backwash recycle pumps are employed to recycle the water upstream of the desanders. No raw groundwater stream can leave the TARP WTP site without undergoing treatment, and the following strategies will be employed to prevent unintentional discharges from the tank:

- To maintain consistent operation and prevent overflow, the backwash settling tank is equipped with four water level elevation set points, monitored and controlled by level indicating transmitters and float switches. These set points serve as operational inputs to the backwash recycle system. The set points are as follows:
 - » Low-low level: This triggers an interlock on the backwash recycle pumps to prevent operation if the water level is too low, avoiding cavitation or sediment intake.
 - » Low-level: Signals are sent to halt the operation of backwash recycle pumps if they are active, ensuring operation within safe limits.
 - » High-level: Signals prompt the activation of the next available backwash recycle pump to lower the tank level.
 - » High-high level: This level triggers an interlock on the 2-inch diameter backwash valve actuators on all ABF units, preventing further backwashes once the tank reaches capacity. Additionally, the high-high level triggers an overall plant shutdown.
- To ensure system redundancy, duplex (duty/standby) backwash recycle pumps are included, providing a backup in case of pump failure. Additionally, the common 2-inch diameter line that conveys the washwater stream for all units to the settling tank. This line is equipped with a float valve at the end that manually shuts off, restricting future backwashes if the tank reaches high-high level, adding an extra layer of safety against tank overfilling.
- Furthermore, vents are installed on the backwash settling tanks to regulate air flow and prevent pressure or vacuum buildup. As the washwater stream consists of untreated groundwater, overflow prevention relies on the aforementioned control equipment rather than overflow mechanisms on the tanks themselves.

The backwash recycle pumps will recycle the volume in the settling tank through absolute rated 5-micron single element cartridge filters. This setup ensures the capture of particles that were not settled in the tank, preventing closed-loop circulation of these sediments.

Additionally, the backwash settling tank is equipped with 3-inch diameter quick connect fittings serving as a means to drain the IX vessels directly to the backwash settling tank (described in the IX vessel section of this report). Access hatches positioned on top of the tank will facilitate visual inspections. Some hatches include permanently attached ladders and serve as access points into the tank, facilitating maintenance activities.

Table 11 provides a summary of the design criteria for the ABF system. Provisions are included for potential future expansion of the system in the event operating experience indicates that finer (10-micron) filter elements may be required.

Table 11 Automatic Backwashing Filters Design Criteria

Parameter	Units	Value
Automatic Backwashing Filters		
Design Flow (maximum)	gpm	7,200
Maximum Fine Screen Opening Size	micron	25
Total Number of Filters	--	10
Design Flow per Filter	gpm	720
Minimum Inlet Pressure During Backwash	psi	40
Backwash Flow	gpm	220
Estimated Backwash Duration	seconds	20
Timed Interval for Backwash Cycle	hours	4
Estimated Backwash Volume per Cycle	gallons	733
Total Estimated Backwash Volume per Day	gallons	4,400
Automatic Backwash Trigger	psi	7
Material of Construction	--	SS-316
Backwash Settling Tank		
Material of Construction	--	Concrete
Total Volume	gallons	67,000
Active Volume of Recycle Pump Wetwell	gallons	8,100
Backwash Recycle Pumps		
Type	--	Vertical Turbine
Number of Units	--	2
Design Capacity per Pump	gpm	250
Design Head	feet	94
Motor	hp	15
Backwash Recycle Cartridge Filters		
Number of Cartridge Filter Housings	--	2
Cartridge Diameter	in	6
Cartridge Length	in	60
Number of Cartridges per Housing	--	1
Cartridge Rating	micron	5

3.3.3.3 Existing Cartridge Filters

Two cartridge filter housings, with 17 element slots in each, are currently located downstream of the existing IBPS. Presently, these cartridge filter housings do not contain any filter elements. As part of the sediment removal process improvements upstream of the IX vessels, the cartridge filters will be physically relocated. They will be relocated adjacent to the ABF system to simplify piping between the IBPS and the sediment removal area.

These cartridge filters will be located hydraulically downstream of the ABFs, and high-efficiency 5-micron rated filter elements will be installed within the existing cartridge filter housings. Each cartridge filter housing has the capacity for 17 filter elements. Both cartridge filter housings will operate simultaneously to extend the duration between element changeouts. However, each housing is capable of handling the plant's design capacity independently. Therefore, filter element replacements can be conducted without interrupting plant operation by isolating one housing at a time.

Table 12 provides a summary of the design criteria for these cartridge filters. These absolute rated cartridge filters will be the final fines removal step and act as a final sediment barrier protecting the IX resin downstream.

Table 12 Cartridge Filter Design Criteria

Parameter	Units	Value
Manufacturer	-	Fil-Trek
Number of Housings	-	2
Cartridge Type	-	Parker Fulflo® ParMax™
Cartridge Diameter	inch	6
Cartridge Length	inch	60
Number of Cartridges per Housing	-	17
Filter Cartridge Rating (reduced for IX system)	micron	5
Nominal Design Flow		
per Housing	gpm	3,600
per Cartridge	gpm	211
Maximum Flow		
per Housing	gpm	7,200
per Cartridge	gpm	424
Material of Construction	-	SS-316L

3.3.4 Ion Exchange

After the raw water has passed through the sediment removal process, the next step is PFAS removal via IX. The IX vessels will be physically located north of the existing 12-foot diameter GAC contactors and hydraulically connected upstream of the UV AOP process. The IX system contains a total of 5 lead-lag dual vessel trains (10 vessels total), each train with a 3-tier piping/valve manifold. Additionally, each train will have a flow meter to monitor and control distribution of flow. The IX vessels plan can be found in Appendix A.

The lead/lag configuration of the IX system means that water flows first through one vessel (lead vessel) and then through the second vessel (lag vessel). Each vessel pair's piping and valve manifold allows vessels to alternate between the lead and lag position or to bypass one vessel if the other needs to be offline for resin replacement or maintenance. Different operational configurations at TARP will be accomplished using motor actuated valves. Breakthrough of PFAS will be monitored through the lead vessel's resin bed using sample ports at different heights and/or from the piping between the lead and lag vessels. The lag vessel provides an additional barrier for PFAS treatment and helps maximize media life for the lead bed. Once targeted PFAS levels determined by Tucson Water are observed in flows from the lead vessel, IX resin in the lead vessel will be replaced, and the previous lag vessel will be valved into the lead position.

The 3-tier manifold configuration equipped with nine butterfly valves support the modes for each lead/lag vessel pair described below. Only the normal operation modes are anticipated to be used. While the manifolds can also support parallel operation of all vessels, only lead/lag configuration of vessel pairs in parallel will be utilized at the TARP WTP.

- Normal operation, including for "forward flushing" after IX resin replacement while treated water is sent to non-potable uses (Santa Cruz River outfall and/or reclaimed water system):
 - » Series operation, with vessel 1 in lead and vessel 2 in lag position.
 - » Series operation, with vessel 2 in lead and vessel 1 in lag position.
 - » Vessel 1 in operation; vessel 2 offline for resin exchange.
 - » Vessel 2 in operation; vessel 1 offline for resin exchange.
- Limited contingency forward flush immediately following IX resin replacement, utilizing portable valves and quick-connect piping/hoses connected to the flush outlet on the valve manifold, which will be normally blind flanged, for discharge to the ABW settling tank:
 - » Vessel 1 in operation and vessel 2 is forward flushed.
 - » Vessel 2 in operation and vessel 1 is forward flushed.
 - » Vessel 1 and vessel 2 are forward flushed.

3.3.4.1 Resin Installation, Changeout, and Disposal

IX resin installation is expected to be accomplished either by slurry loading the resin through the media fill pipe or through unloading dry media sacks through the top manway using a reach lift. It is recommended to partially fill the vessels (one third of volume) with water before resin loading to reduce the impact of the resin on the vessel liner and allow for more even loading of the resin bed. Tucson Water will prepurchase the initial charge of IX resin for all vessels, which will be assigned to the Contractor for installation as detailed in the IX System specification.

For subsequent resin replacement events, there are two potential methods:

- Slurry unloading of the spent resin into tanker trailers for transport to disposal, using an air compressor as the motive force.
- Draining of the vessels and vacuum transfer of dewatered media into empty super sacks for subsequent transport by flatbed or box trailer to disposal.

Since water drained from the IX vessels will contain TCE and 1,4-dioxane, the drain ports for each vessel are equipped with quick-connect hose fittings to facilitate a lay-flat hose connection to direct the drain water to the ABF washwater settling tank. Additionally, stations for potable water supply and drainage fittings like those already provided at the GAC contactors will be added to facilitate IX resin replacement procedures without requiring lengthy hoses.

Once the resin replacement is completed, the vessel containing new resin will be returned to service in the lag position. The spent IX resin will be disposed in compliance with regulatory and established TARP/CERCLA-specific requirements. This disposal method will consist of transport and off-site thermal incineration or, as a backup contingency, landfilling. Either method will occur only utilizing Resource Conservation and Recovery Act Subtitle C hazardous waste permitted facilities that are also approved to receive off-site wastes generated at CERCLA sites.

3.3.4.2 Operations

The IX process will be operated in a lead/lag configuration, as specified in the design criteria outlined in Table 10. As indicated in Section 2, the facility will maintain a minimum flow of approximately 2,500 gpm and a maximum flow of 7,200 gpm. One additional consideration when operating IX vessels is the potential risk of stagnation during a TARP WTP shutdown. Under normal operations, all five trains of lead/lag IX vessels will be in service, with flow equally distributed to each train within the allowable range of liquid loading rates. To accommodate variation in plant flows and ensure effective performance of the IX vessels, the following operational strategy will be implemented:

- Minimum Flow (approximately 2,500 gpm):
 - » Three IX trains will remain online during minimum flow conditions.
 - » The IX trains will be rotated among the other two offline vessels to prevent any single vessel from sitting idle for more than 24 hours.
- All Other Flow Conditions:
 - » All IX vessels will be online to handle the remaining flow conditions.

In the unlikely event of extended shutdowns, it is recommended to drain the IX vessels, keeping the resin bed dewatered. Idled vessels brought back into service will be “flushed” to the available two non-potable uses, and sampling/analysis (Bac-T) will be conducted to verify absence of bacterial growth before resuming normal operation. Further details regarding startup and monitoring are included in Section 6.

Table 13 Ion Exchange Design Criteria

Parameter	Units	Value
IX Vessels		
Material of Construction	-	Carbon steel, with vessel internal walls epoxy-lined for corrosion protection
Rated Pressure	psi	125
Design Flow (maximum)	gpm	7,200
Configuration	--	Series or lead/lag operation
Number of Trains	number	5
Number of Vessel/Train	number	2
Number of Vessels Installed/Online	number	10
Vessel Diameter	feet	12
Vessel Height	feet	14.8
Vessel Straight Side Shell Height (minimum)	feet	5
Cross-sectional Surface Area	square feet	113
IX Resin Media	--	Purolite™ Purofine® PFA694EBF
Media Bed Depth	feet	4.8
Volume of Resin/Vessel	cubic feet	546
Design Flow		
Flow/Train	gpm	1,440
Liquid Loading Rate	gpm/sf	12.7
EBCT (Lead+Lag)	min	2.8 + 2.8
Maximum Flow (One Train Out of Service)		
Flow/Train	gpm	1,800
Liquid Loading Rate	gpm/sf	15.9
EBCT (Lead+Lag)	min	2.3 + 2.3
Minimum Flow/Train		
Flow/Train	gpm	679
Liquid Loading Rate	gpm/sf	6.0
EBCT (Lead+Lag)	min	6.0 + 6.0

SECTION 4 DESIGN SPECIALTIES

4.1 Civil

The proposed site plan for the TARP WTP upgrades is provided in Appendix A. Constructed improvements will occur within the existing TARP WTP site wall. Considerations for site planning and civil design for the project site are discussed in the following sections.

4.1.1 Site Access

Existing access to the TARP WTP is from Irvington Road via South Calle Santa Cruz to the plant's motorized security gate at the south end. A secondary paved access road exists along the outside of the east and north plant site walls to two 20-foot wide rolling gates in the northwest wall. The main purpose of the secondary access drive is for use by tanker trucks needed during GAC or IX media changeouts, as well as chemical delivery trucks. No further access to the TARP WTP site is planned as part of the upgrades.

4.1.2 Site Topography, Grading, and Drainage

Generally, the existing site slopes to the northwest, although a portion of the WTP drains to weepholes through the site's east side wall. The recent RWS booster pump station and wet well upgrades are graded gradually to the southeast and drain to these weepholes. Under post-construction conditions, the general pattern of stormwater runoff will not be altered. There will be a small increase in imperviousness due to the new concrete paving and slabs for the IX vessels, ABF system, and relocated cartridge filters. The new IX vessels support slab will be slightly crowned in the center to drain flow to the east and west. Flow in the western portion of the site will drain through an existing drainage weephole through the site wall in the northwest corner offsite to the Santa Cruz River. Site drainage will follow the existing topography.

The new sediment removal area will consist of relocated cartridge filters and an ABF system located to the north of the existing desanders. The new sediment removal area slab will be slightly crowned in the center and drain flow to the north and south. New decomposed granite that matches existing will be installed around the sediment removal slabs and in all areas disturbed by construction, including throughout the contractor's trailers, staging, and parking area north of the TARP WTP.

The concrete GAC unloading slab adjacent to the existing GAC contactors will be extended north to both sides of the new IX vessels for tanker truck access/parking. This pavement will be designed to support fully loaded and flooded GAC and IX tankers and in accordance with the geotechnical investigation recommendations. Asphalt pavement removal and replacement shall be in accordance with Pima Association of Governments Standard Specification Section 0211. The Paving and Grading plan can be found in Appendix A.

4.1.3 Buried and Exposed Piping

Buried pipe shall be ductile iron pipe and exposed piping shall be steel, consistent with Tucson Water practice and existing piping at TARP facilities. Ductile iron pipe shall conform to Tucson Water Standard Specification 1401 and American Water Works Association (AWWA) C150. Buried piping design criteria are shown in Table 14.

Table 14 Buried Piping Design Criteria

Parameter	Description
Pipe Material	Ductile iron pipe.
Design Pressure Class	PC250 for diameters greater than 12-inch. PC350 for diameters less than or equal to 12-inch.
Working Pressure/Design Pressure	100/200 psi.
Lining	Cement mortar per AWWA C104.
Coating	Bituminous with two layers of polyethylene encasement per AWWA C105.
Minimum Depth of Cover	44 inches or as shown on the design drawings

PC - pressure class

Exposed piping shall be steel conforming to American Society of Mechanical Engineers (ASME) 53 or AWWA C200 with ASME B36.10 Iron Pipe Size dimensions. Steel pipe fittings shall be wrought steel with dimensions in accordance with ASME B16.9 or fabricated in accordance with AWWA C208. Exposed piping design criteria is shown in Table 15.

Table 15 Exposed Piping Design Criteria

Parameter	Description
Pipe Material	Steel.
Design Pressure Class	Standard wall thickness per ASME B36.10.
Working Pressure/Design Pressure	100/150 psi.
Lining	Liquid applied epoxy per AWWA C210.
Coating	Epoxy polyurethane or powder coating system.

A portion of the existing 4-inch potable water line, sodium hypochlorite chemical feed line, and chemical feed pull boxes will be relocated as part of the work. The Yard Piping plan can be found in Appendix A.

4.1.4 Proposed Utilities

An abandoned Tucson Electric Power (TEP) electrical easement runs west-to-east across the north portion of the area inside the existing TARP site wall. During the *Tucson International Airport Area Groundwater Remediation Project (TARP) Recycled System Source Water Infrastructure* (Carollo, February 2022), TEP designed a new easement and electrical service routing to the TARP WTP that runs west-to-east along the north portion of the RWS upgrades and along the perimeter wall. Buried electrical service upgrades are required to service the upgraded IBPS, which includes construction of a new transformer, secondary electrical service, and electrical easement. See Section 4.4 for more information.

4.1.5 Coordination with Existing Utilities

Process modifications and location of the IX vessels and ABF require the construction of buried piping in the northern portion of the plant site. Existing utilities that may be in conflict with the pipeline alignments were identified from record documents and are shown below:

- 4-inch potable water piping.
- 8-inch backwash piping.
- 24-inch raw water piping.
- 24-inch treated water piping.
- Security and camera buried conduit.
- Buried electrical and communications conduit.

The contractor will be required to pothole and field verify locations and elevations of existing utilities prior to construction. Horizontal and vertical separation with sewer, storm drains, and dry utilities shall be maintained as follows:

- Sewer/water separation in accordance with Tucson Water SD-106 and ADEQ Engineering Bulletin No. 10.
- Drainage facility separation in accordance with Tucson Water SD-107.
- Gas, electrical, and communications separation in accordance with Tucson Water SD-108.

Two existing 60-inch storm drains run east-west through the RWS booster station site. The proposed screens backwash equalization/settling tank is located approximately 6 feet south of the centerline of the southernmost storm drain. The storm drains are buried with approximately 10 feet of cover and are aluminized steel corrugated storm sewer pipe according to record drawings. Two alternatives were considered to ensure that the no additional load from the backwash tank footing would be imparted to the storm drains:

- A strip footing extending along the north side of the settling tank will be added. The footing depth will be set to achieve 1-foot minimum distance from the tank footing surcharge zone of influence and the storm drain pipe wall.
- Permanent shoring along the north side of the settling tank between the tank footing and the storm drains will be added. The shoring system will be designed by the Contractor to deflect surcharge loads from the tank footing from the storm drain pipe wall.

4.1.6 Corrosion Control/Cathodic Protection

A corrosion protection evaluation was completed as part of *Tucson International Airport Area Groundwater Remediation Project (TARP) Recycled System Source Water Infrastructure* (Carollo, February 2022) that is used as the basis of design for corrosion protection of buried piping. Flange insulating kits will be provided at all steel to ductile iron transitions in accordance with Tucson Water SD-704 and all buried ductile iron pipe will be encased in polyethylene bags.

4.2 Geotechnical Considerations

Two geotechnical evaluations have been completed as part of the *Tucson International Airport Area Groundwater Remediation Project (TARP) Recycled System Source Water Infrastructure* (Carollo, February 2022) and the *Tucson International Airport Area Groundwater Remediation Project (TARP) Additional Remediation Well and Treatment Upgrades* (Carollo, November 2019). An additional geotechnical evaluation was completed as part of this design project as well. All three geotechnical evaluations used to aid this design are listed below:

- Geotechnical Evaluation TARP Facility Upgrades (ConformaTech, Inc., May 2019).
- Geotechnical Evaluation TARP Reclaimed Water Facility Addition and Distribution Main (ConformaTech, Inc., July 2021).
- Geotechnical Evaluation New Backwash Tank at TARP Facility 1100 West Irvington Road Tucson, Arizona (ConformaTech, Inc., March 2024).
- Pipe Trenching and Excavation Recommendations.

The geotechnical evaluation *TARP Reclaimed Water Facility Addition and Distribution Main* (ConformaTech, Inc., July 2021) included geotechnical analysis and recommendations for buried pipe design and was used for the basis of design on this project. The key conclusions of the geotechnical report, as they relate to pipe trenching and excavation, are as follows:

- Zones of strong or moderate lime cementation may be encountered. Expansive potential of backfill and natural soils is anticipated to be low.
- Use of onsite soils for pipe bedding materials is unlikely without extensive screening and blending processes and is not recommended. Native soils are suitable for trench backfill if particles larger than 3 inches are removed.
- No groundwater was encountered on any of the borings for the project.
- Pipeline bedding and installation shall meet the requirements of Tucson Water Standard Specification 0209.
- Estimated settlement of equipment pads should not exceed one half inch. Pipelines will be designed with sufficient flexibility to accommodate anticipated differential settlement.

Buried piping to and from the sediment removal area will be located through a narrow corridor between the existing desander purge tank and northwestern rolling gate. This piping will likely be buried at a minimum depth of 10 feet to avoid conflicts with other utilities in this area. A shored excavation in accordance with the geotechnical recommendations will be required in this area due to the width between the purge tank and rolling gate track/guideposts.

4.2.1 Mass Earthwork and Structural Fill Recommendations

The geotechnical evaluation *Geotechnical Evaluation New Backwash Tank at TARP Facility 1100 West Irvington Road Tucson, Arizona* (ConformaTech, Inc., March 2024) was used as basis for the design of the backwash settling tank, and the geotechnical evaluation *TARP Facility Upgrades* (ConformaTech, Inc., May 2019) was used as basis for the design of the structural equipment pad for the IX vessels.

Per the geotechnical evaluation *TARP Facility Upgrades* (ConformaTech, Inc., May 2019) the existing native clay soils in the equipment pad area should be removed to a depth of 3 feet below finished subgrade elevations and replaced with structural backfill meeting the specifications of the geotechnical report. The structural fill placed for the equipment pad should be compacted to a minimum of 95 percent of the maximum dry density determined per ASTM D698 at optimum moisture content of plus or minus 3 percent.

The existing native soils at subgrade elevation and at the bottom of the tank excavation should be scarified, moisture conditioned and compacted to a minimum depth of 8 inches. Near-surface clay and clayey soils are not recommended for use as structural fill.

All excavations should be sloped, braced, and maintained in accordance with applicable state or federal regulations. Permanent cut and fill slopes that will not be submerged under water should be constructed at a slope ratio of 2:1 (horizontal to vertical) or flatter. Where cut or fill slopes will be temporarily submerged under water, the slope ratio should be 4:1 (horizontal to vertical) or flatter.

4.3 Structural

Structural considerations for the project site are discussed in the following sections. A Structure Risk Category III was assumed.

4.3.1 Wind

The wind design parameters used for the project are summarized in Table 16.

Table 16 2018 International Building Code Wind Design Parameters

Parameter	Value
3 Second Gust Wind Speed	110 miles per hour
Exposure	C
Topographic Factor	1.0

4.3.2 Seismic

Per geotechnical evaluation *TARP Reclaimed Water Facility Addition and Distribution Main* (ConformaTech, Inc., July 2021), a site class designation of D may be used for seismic design per the International Building Code (IBC) 2018. Based on 2018 IBC, the ground motion values for a short (0.2s) period (S_s) and a one second period (S_1) are 0.271 and 0.083, respectively. The associated site amplification factors (F_a) and (F_v) are 1.58 and 2.40, respectively. Corresponding Seismic Design Category (SDC) is C.

4.3.3 Materials of Construction

The backwash settling tank and the equipment pad for IX vessels will be constructed of reinforced concrete. Metal used for stairs will be aluminum. See Table 17 for material values.

Table 17 **Material Values**

Material Values	
Reinforced Concrete	F'c = 4500 psi
Reinforcing Bars	Grade 60
Steel	A992 Grade 50 for W shapes, A36 for other structural steel
Aluminum	6061-T6
Masonry	ASTM C90 Normal weight

4.3.4 Foundation Design Recommendations

Per geotechnical evaluation *TARP Reclaimed Water Facility Addition and Distribution Main* (ConformaTech, Inc., July 2021):

- Total allowable bearing pressure below the base of the backwash settling tank is a maximum of 3,000 pounds per square foot (psf).
- The following lateral earth pressures (equivalent fluid pressures) may be used in the design of subsurface backwash settling tank. These values are predicated on level backfill and unsaturated conditions. If saturated conditions are anticipated, it will be necessary to revise these lateral earth pressure values:
 - » Active Earth Pressure: 35 pounds per square foot per foot (psf/ft).
 - » Passive Earth Pressure: 350 psf/ft.
 - » At-rest Earth Pressure: 55 psf/ft.

Per geotechnical evaluation *TARP Facility Upgrades* (ConformaTech, Inc., May 2019), total allowable bearing pressure below the base of the equipment pad is a maximum of 1,500 psf.

4.4 Electrical

This section provides information on the modifications and additions of electrical equipment to meet the additional electrical load requirements associated with the PFAS treatment upgrades.

The existing TARP WTP facility has three TEP electrical services currently. The existing influent pumps are powered from an existing 1600 amperes (amp), 480/277 volts alternating current (VAC), 3-phase, 4-wire, 65 kASC motor control center (MCC) AOP. MCC-AOP is powered from existing 1102 PLNT2 underground electrical service from TEP via an existing 1600 amps (A), 480/277 VAC, 3-phase, 4-wire service entrance switchboard (SES) AOP.

Upon performing the load study calculations, the existing 1102 PLNT2 service, SES-AOP and MCC-AOP are found to be not adequately rated for the new equipment noted below:

- New 350 hp influent pumps:
 - » The existing three 125-hp influent booster pumps will be replaced with three larger 350-hp pumps. The existing 125-hp influent pump VFDs powered from MCC-AOP will be salvaged.
- Equipment at IX vessels.
- Equipment at sediment removal area.
- Instruments and control panels.

Upon coordinating with TEP, it is determined that a new service is required for the new loads. A new TEP service 1102 PLNT3 will power a new SES (SES-IBPS), which will be located outside in a NEMA 3R non-walk-in enclosure. The SES-IBPS will power a switchboard (SWBD-IBPS) located in a new electrical building. The load study report calculation is included in Appendix C.

The new electrical building will be provided for installing the new electrical equipment SWBD-IBPS, standalone VFDs for the new influent pumps, 480 VAC and 120/208 distribution panelboards, distribution transformer, motor starters for the backwash pumps, remote input and output (RIO) control panel (RIO-IBPS) associated with the influent pumps and sediment removal area. The input and output (I/O) discrete and analog signals associated with IX vessels will be routed to an outdoor RIO panel (RIO-IX). RIO-IX will be provided with an air conditioning unit.

The new electrical building will be:

- Located outside of the AOP Building to the north of the hydrogen peroxide storage area and will be per Tucson Water's standard concrete masonry unit electrical building design, with blocks to match other construction at the TARP WTP.
- Constructed in accordance with the 2018 IBC. Heating, ventilation, and air conditioning design will be based on 2021 ASHRAE Climate Design Conditions for a one-percent cooling day in Tucson, Arizona, and will include the following:
 - » Outdoor temperature: 104-degree(s) Fahrenheit (°F) dry bulb / 66 °F wet bulb.
 - » Indoor temperature: 75 °F.

The locations of the new equipment, electrical building layout, and one-line diagram drawings are included in Appendix A.

Standards that will be followed as part of the electrical system upgrades include:

- The new VFDs shall be active front end VFD to reduce harmonic distortion.
- All 480 VAC process equipment will require disconnect switches:
 - » 120 VAC or 24 volts direct current instruments will not have disconnect switches.
- Control relays will be provided for the motor starters/VFDs.
- All control cables will be single conductor cables. Signal or 4-20 milliampere (mA) cables will be shielded twisted pair cables.
- Conduits below grade shall be direct buried schedule 40 PVC conduits:
 - » Areas at vehicular access conduit will be concrete encased.
 - » PVC coated galvanized rigid steel conduits will be used at 90-degree elbows and at risers in duct banks.
- Exposed conduits will be galvanized rigid steel conduit.
- The design will include conduits for security cameras. Cables and security cameras will be procured and installed by the City of Tucson's (City) security contractor.
- Compression-type grounding will be used for bonding the electrical equipment, control panels, and for other ground connections.

- The lighting for the new electrical building will be light-emitting diode designed to provide 40 average foot-candles.
- The electrical system study will be completed by the Contractor using a third-party consultant.

4.5 Instrumentation and Control/SCADA

The sediment removal and IX instrumentation and control will be designed to provide monitoring and control similar to other TARP WTP process areas. New process I/O will be integrated via an Allen-Bradley RIO panel to match City standards. Further modifications to the instrumentation, controls, and overall SCADA system are described in the following sections. Design drawings are included in Appendix A.

4.5.1 Instrumentation and Control Equipment

4.5.1.1 Ion Exchange

IX for PFAS removal will be installed upstream of the current AOP process. The IX vessels will require similar pressure monitoring, flow measurement, and sample taps as the existing GAC contactors. Modes of IX vessel operation include LEAD/LAG-1, LEAD/LAG-2, LEAD-1, LEAD-2, and OFFLINE. It is recommended that instruments and valve actuator models similar to the existing GAC system be specified to simplify maintenance and operations. Refer to Appendix A for typical P&ID with assumptions for each IX train.

4.5.1.2 Sediment Removal and Pumping

A sediment removal system consisting of ABF and an associated backwash settling tank and recycle pumps will be added upstream of the IX vessels to prevent media fouling. The existing cartridge filters associated with the influent booster pumps will be relocated downstream of the ABFs.

The new influent booster pumps will use pressure monitoring, flow measurement, and VFD control similar to the existing system.

Ten ABF provide sediment removal. Each ABF can be taken out of service or bypassed using manual valves. Active control of backwashing includes motorized flush valves. Backwashes can be initiated by time, differential pressure, or operator command. The ABF equipment can be integrated to SCADA via hardwired I/O. It is recommended to use hardwired I/O from the ABF control panels to an RIO panel. Pressure is monitored on the inlet and discharge header to determine differential pressure across the entire ABF system.

The backwash settling tank and recycle pumps will be equipped similarly to the existing GAC backwash system. The sediment removal backwash system will include tank level monitoring, and backwash recycle pump monitoring and control. Flow from the recycle pumps to the desanders is monitored by a magnetic flow meter. Refer to Appendix A for typical P&ID with assumptions for sediment removal.

4.5.2 Controls

Since sediment removal and IX will only operate simultaneously with the wells and AOP, a new, separate programmable logic controller (PLC) is not required. PLC-AOP, located in the network room of the main AOP building, coordinates all well and TARP operations except for sodium hypochlorite dosing and RWS infrastructure operations. Therefore, it is recommended that additional hardwired I/O for this design be integrated using RIO panels controlled by PLC-AOP.

New or modified field wiring for the new IBPS and associated instruments will integrate to the new RIO-IBPS in the new electrical building. RIO-IBPS will also be used for new field wiring I/O for sediment removal area equipment. The new field I/O wiring for IX will integrate to new the RIO-IX.

4.5.3 PLC Considerations

The Allen Bradley ControlLogix PLCs for PLC-main and PLC-AOP are still under active support. Therefore, no replacements are recommended for the existing PLCs. The firmware for PLC-main and PLC-AOP requires an older version of programming software (*RSLogix 5000*) for maintenance and troubleshooting. This firmware should be updated to match the programming version of PLC-RWS and TARP Well PLC upgrades (using *Studio 5000*). This will enable access to the latest firmware and software updates.

After the TARP well improvements are complete, PLC-main will only be responsible for control of the sodium hypochlorite storage and feed system and ancillary/building monitoring. This would allow PLC-main to be converted to an RIO, transitioning the remaining process logic to PLC-AOP. The remaining PLC components could be reclaimed for spares.

4.5.4 Human Machine Interface

It will be possible to build out the new human machine interface operator screens using the existing Rockwell FactoryTalk software. The current FactoryTalk license has a limitation of 99 unique screens. Upgrading the software license would not be required if operator screens for packed column equipment are reclaimed.

4.5.5 Networking

The plant fiber optic network will be modified to connect the new RIO-IBPS and RIO-IX panels. The new RIO panels will leverage the similar make and models of SCADA and security network switches recently installed in the PLC-RWS enclosure.

4.6 Security

The design will include conduits for security cameras. Cables and security cameras will be procured and installed by the City's security contractor.

SECTION 5 IMPACT TO EXISTING FACILITIES

Construction of process modifications to the TARP facilities will impact existing operations at several points during construction.

5.1 Influent Booster Pump Station

Influent booster pump unit replacements will be accomplished for one pump at a time, while the other two pumps remain in operation. Due to the need for larger pumps, the IBPS layout will need to be adjusted to accommodate a larger footprint for all three pumps.

Additionally, the new VFDs will not fit in the location of the existing VFDs. A new electrical room building will need to be constructed to house the VFDs. Electrical modifications in MCC-AOP will require plant shutdown time and will require a manual of permitted operations to minimize the downtime.

5.2 Desanders

Modifications will be made to the existing desander piping to allow for water from the ABF's backwash tank to be recycled back to the raw water transmission main. These modifications will include a new saddle tap (hot tap) or utilization of existing 2-inch connections.

5.3 Automatic Backwashing Filters

Installation of the ABF, backwash settling tank, and backwash pumps will not have an impact on the operation of TARP until connected with the system. Construction of the backwash settling tank partially below grade will require excavation and backfill equipment and utilization of shoring.

5.4 Cartridge Filters

TARP will need to be shut down while the cartridge filter housings are relocated and new piping is installed. During construction, temporary piping from the IBPS to the static mixer will be evaluated to minimize plant downtime. Currently, no cartridge filter elements are installed within the filter housing, so bypass piping would not change the existing treatment process.

5.5 Ion Exchange

Installation of the new IX vessels will not require a plant shutdown until piping connections are made. 3-tier piping/valve manifolds for each train can be installed prior to making any main connections to lead/lag vessel pairs.

SECTION 6 START UP AND MONITORING

A start-up plan will be prepared to supplement the updated TARP O&M Plan during the final phases of construction, referencing actual equipment installed at the facility. The start-up plan and updated O&M Plan will be submitted to ADEQ with the application for approval-of-construction. Major elements of the start-up plan for the major treatment processes to be integrated into the TARP WTP as part of this design are summarized below:

- ABF System:
 - » Inlet pressure will be monitored during startup to ensure that the backpressure valves maintain the necessary head for effective operation.
 - » The functionality of each ABF's backwash cycle and reset of differential pressure across the filters after each backwash will be verified.
 - » The automatic backwashing sequence of ABFs will be closely monitored, along with the backwash tank levels, to ensure that the units are being backwashed at the intended frequency.
- Cartridge Filters:
 - » Differential pressure for cartridge filter sediment loading, along with pressure trends as water process flow rate increases, will be monitored.
- IX Vessels:
 - » IX resin will be pre-rinsed and flushed with deionized water per NSF-61 certification at an off-site location by the resin provider before delivery and will be installed according to the manufacturer's recommendations.
 - » Startup of the IX vessels will adhere to the manufacturer's guidelines, including installing the resins in partially water-filled vessels to provide a water cushion and gradually increasing flow rates to prevent water hammer and promote uniform flow through the resin bed.
 - » Flow rates to each train, EBCT of each vessel and train, BVs processed by each train, and differential pressure across each vessel and train will be monitored.
 - » As mentioned in Section 2, buffered resins will be utilized to minimize flush water volume. However, initial flushing will be conducted as needed using the operational strategy listed below. Initial flush water will be sent to the Santa Cruz River using the existing TARP outfall or to the RWS using the on-site pump station.
- Treated Water Monitoring:
 - » At TARP, there are three available end uses for the treated water:
 - The potable water distribution system: Currently offline with pipelines sealed by blind flanges and hydraulically disconnected via an air gap.
 - The RWS, via the existing TARP RWS pump station fed by the RWS tank. The RWS tank is separated from the TARP WTP treated water pipe via an air gap.
 - The TARP Santa Cruz River outfall, located just outside the facility, fed by gravity from the RWS tank.

- » During initial startup, treated water will be discharged only to the river outfall for the first few hundred BVs and monitored for various water quality parameters including:
 - PFAS compounds.
 - pH.
 - Anions (sulfate, nitrate, chloride, alkalinity).
 - TOC.
 - TDS.
 - Nitrosamines [N-Nitrosodiethylamine, N-Nitrosodimethylamine, N-Nitrosodibutylamine, N-Nitrosodi-n-propylamine, N-Nitrosomethylethylamine, N-Nitrosopyrrolidine].
 - Corrosion indices [Langelier saturation index (LSI), calcium carbonate precipitation potential, and chloride to sulfate mass ratio].
 - Coliforms via Bac-T testing.
- » Once acceptable water quality is confirmed, treated water deliveries to the RWS system will resume in addition to river outfall usage. At a future date, City leadership will determine whether treated water deliveries from the TARP WTP to the drinking water distribution system may be restored, at the option of Tucson Water, after the leadership determines an acceptable period of time has elapsed during which reliable operation and consistent treated water quality have been demonstrated for the new PFAS IX treatment system.

SECTION 7 REFERENCES

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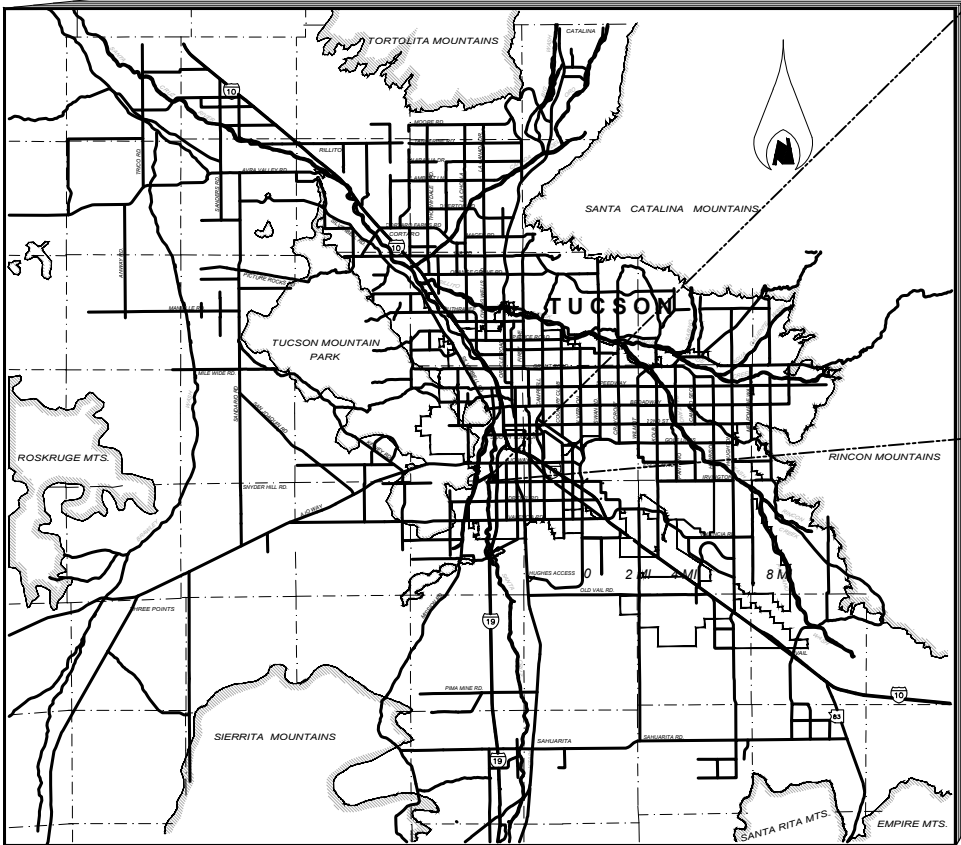
APPENDIX A

SELECTED DESIGN DRAWINGS

TARP TUCSON INTERNATIONAL AIRPORT AREA GROUNDWATER REMEDIATION PROJECT

TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT

DATE: MAY 2024



PROPERTY OWNER:
CITY OF TUCSON / TUCSON WATER
310 W. ALAMEDA STREET
P.O. BOX 27210
TUCSON, AZ 85726-7210
GABRIEL HERNANDEZ, 520-349-4575
GABRIEL.HERNANDEZ@TUCSONAZ.GOV

GEORGE MASEEH, P.E. (ARIZONA PE #23571)
CAROLLO ENGINEERS
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JAMES DETTMER, P.E. (ARIZONA PE #27864)
CAROLLO ENGINEERS
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JDETTMER@CAROLLO.COM
520-230-4717

INSPECTOR'S COPY

INSPCT. _____
CONTR. _____

START _____ FINAL _____
PIPE _____ DI ☐ PE ☐ PVC ☐
SVC LINE MAT _____
B.F.'S _____
GATES _____
F.H.'S _____ BRAND _____ MAT _____

MAGNETIC TAPE INST. YES ☐ NO ☐
REBAR RINGS INST. YES ☐ NO ☐

ZONE _____ PSI _____

MAPPING INFO
1"=200' _____ ON _____
checked _____ date _____

ALL VALVES WERE INSTALLED PER PLAN.

Signature _____
Date _____

RESERVED FOR
CITY OF TUCSON PDSD

RESERVED FOR PIMA
COUNTY ADDRESSING

PCDOT - ROW PERMIT

TARP WTP LEGAL DESCRIPTION: CTRL PTN SW4 E OF SOUTH VALLEY RD
TARP WTP ADDRESS: 1110 W. IRVINGTON RD.
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT
CASE NUMBER:

AZPDES STORMWATER CONSTRUCTION
GENERAL PERMIT ID#AZCN84927

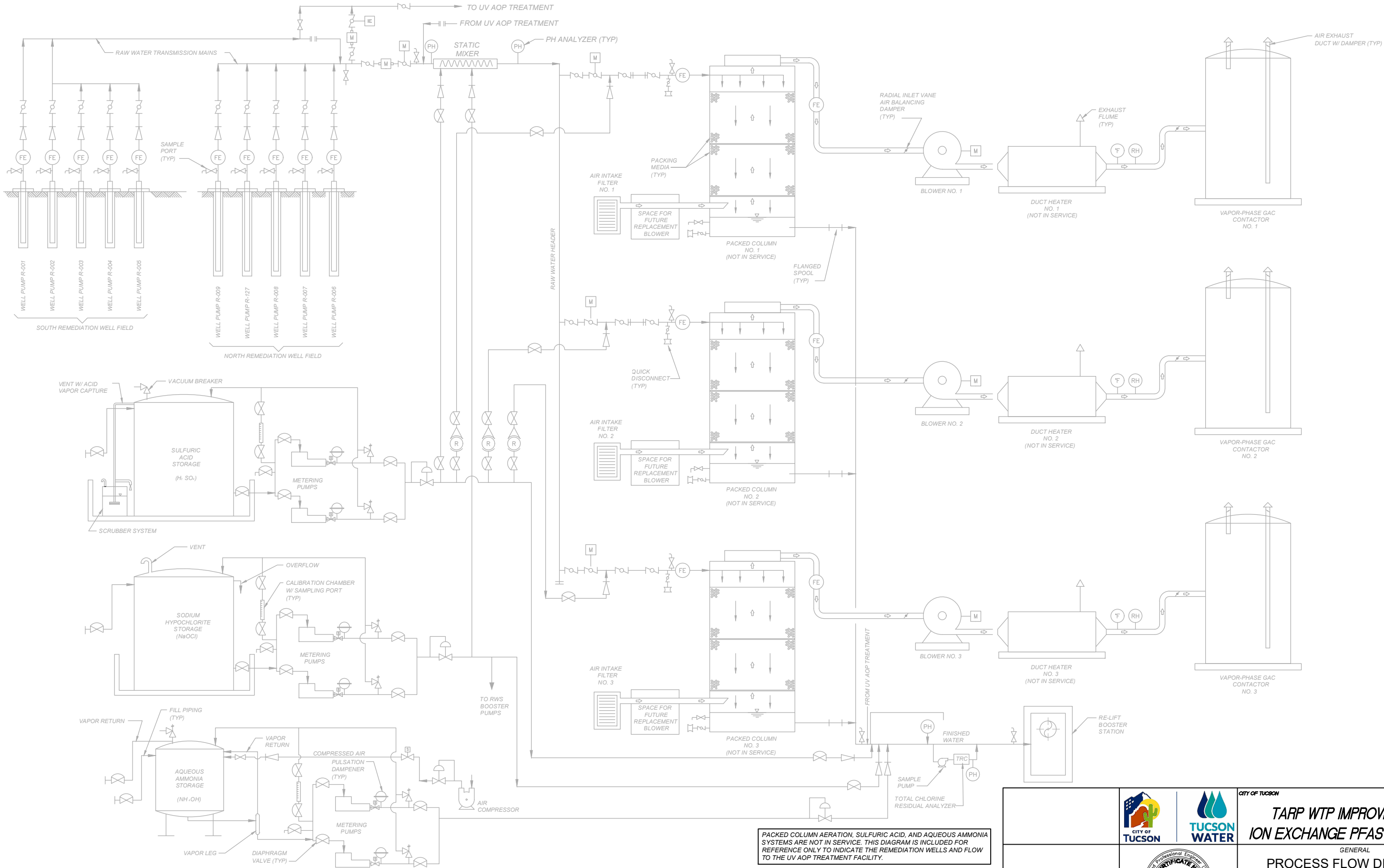
LOCATION PLAN
SITE PLAN
TARP WTP 1110 W. IRVINGTON RD.
TOWNSHIP 14S, RANGE 13E, SECTION 35,
QUARTER SECTION SW
LATITUDE 32 10' 02" N
LONGITUDE: 110 59' 21.5" W
COT COUNCIL WARD 1

AGENCY REVIEW SUBMITTAL



NO.	BY	DATE	REVISION	APPR.	DATE

		APPROVED:	CITY OF TUCSON
		CHIEF ENGINEER	TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT
		DEPUTY DIRECTOR	GENERAL COVER SHEET
			G01
DESIGNED BY KW	DATE 05/24	FIELD BOOK NO. XXX	SHEET NO. 1 OF 110
CHECKED BY AJE	DATE 05/24	NTS NTS	PLAN NO. 1-006-2023



LEGEND

- NEW
- EXISTING
- FUTURE



NO.	BY	DATE	REVISION	APPR.	DATE



CITY OF TUCSON

TARP WTP IMPROVEMENTS
ION EXCHANGE PFAS TREATMENT

GENERAL
PROCESS FLOW DIAGRAM 1

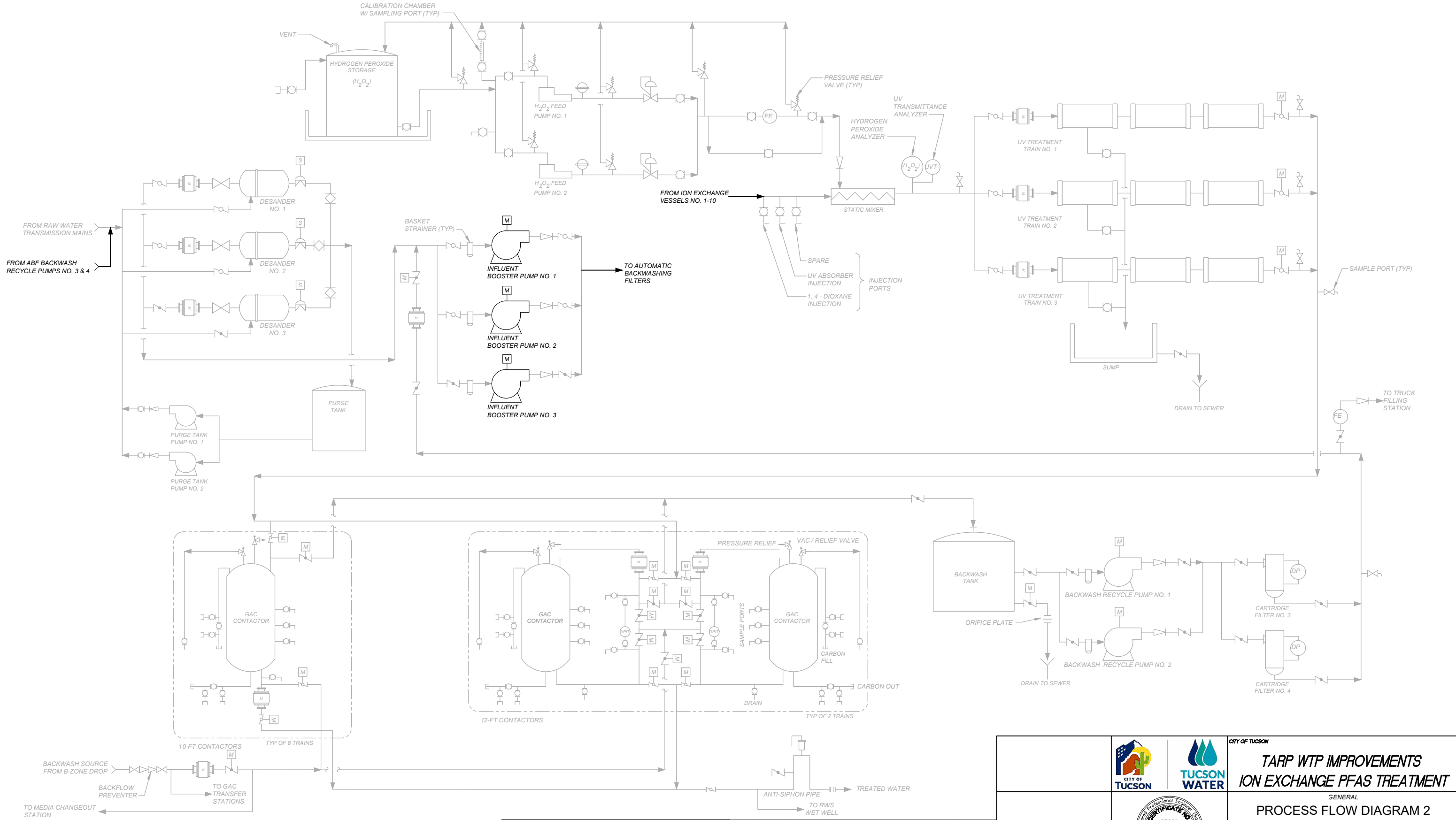
G07

DESIGNED BY KW	DATE 05/24	FIELD BOOK NO. XXX	SHEET NO. 7 OF 110
DRAWN BY AJE	DATE 05/24	WHP NTS	PLAN NO. 1-006-2023
CHECKED BY	DATE 05/24	HWP NTS	



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LEGEND

- NEW
- EXISTING
- FUTURE



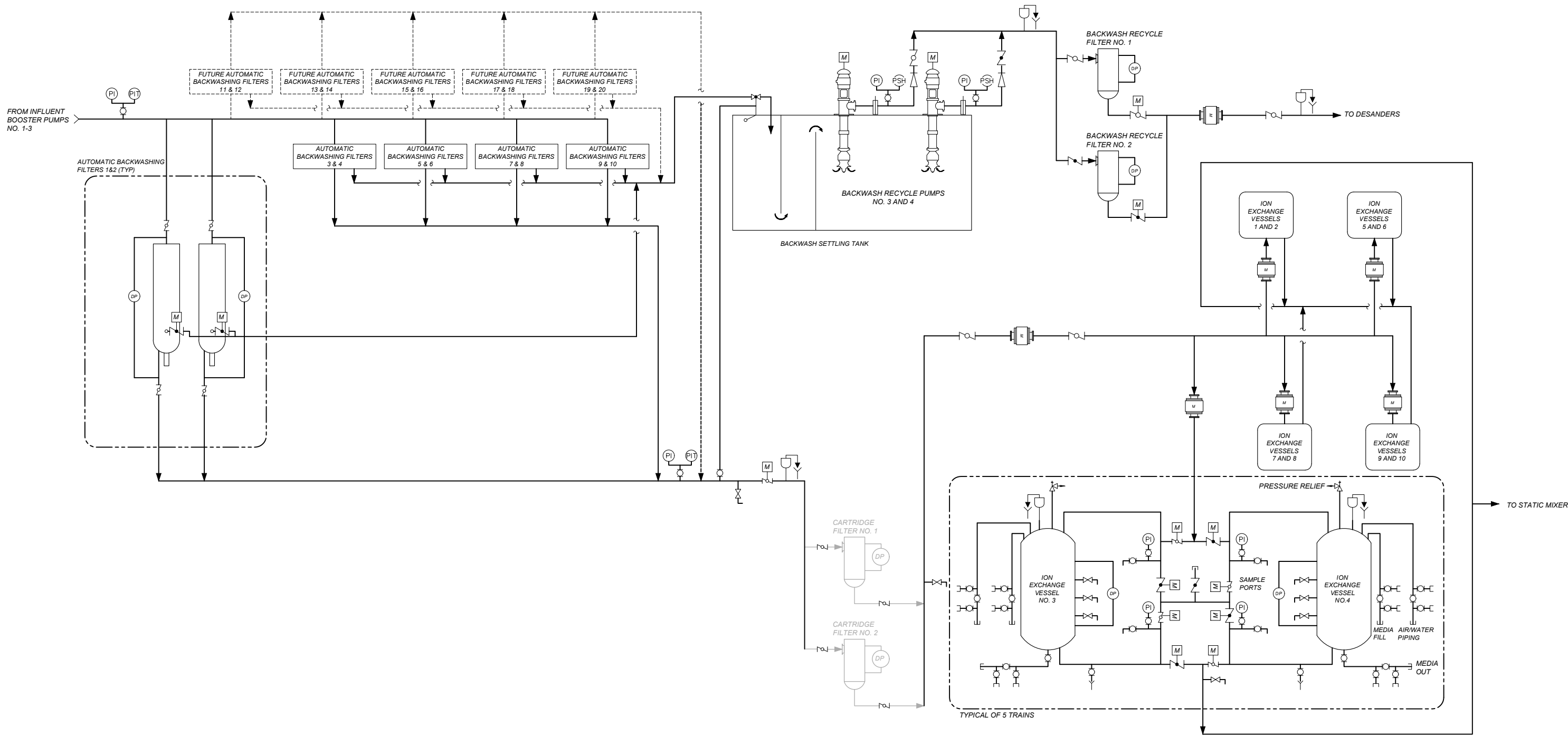
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TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT			
GENERAL			
PROCESS FLOW DIAGRAM 2			
DESIGNED BY	DATE	FIELD BOOK NO.	SHEET NO.
KW	05/24	XXX	8 OF 110
DRAWN BY	DATE	SCALE	PLAN NO.
AJE	05/24	NTS	1-006-2023
CHECKED BY	DATE	NTS	
	05/24	NTS	

G08

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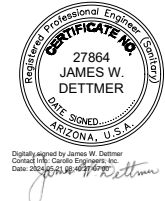


LEGEND

- NEW
- EXISTING
- FUTURE

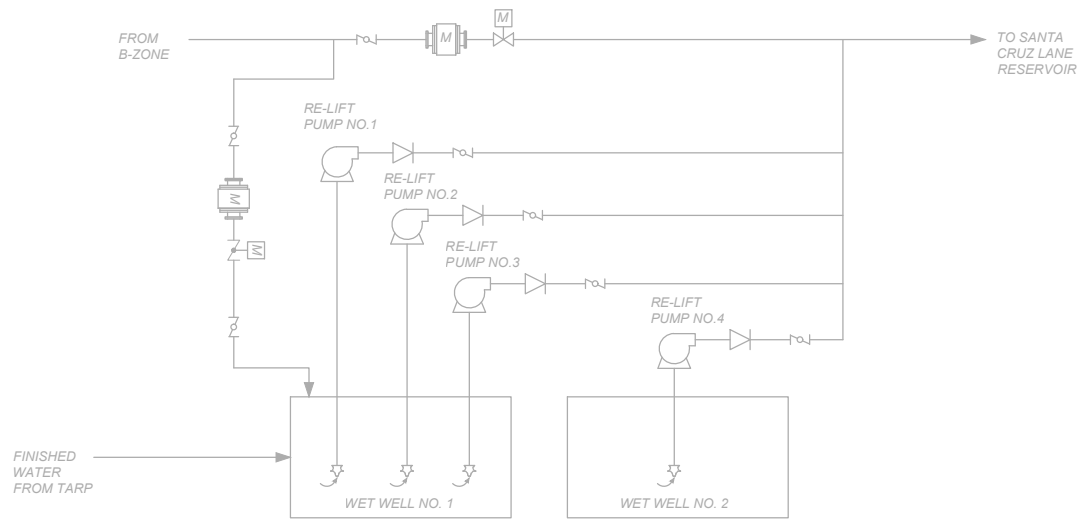
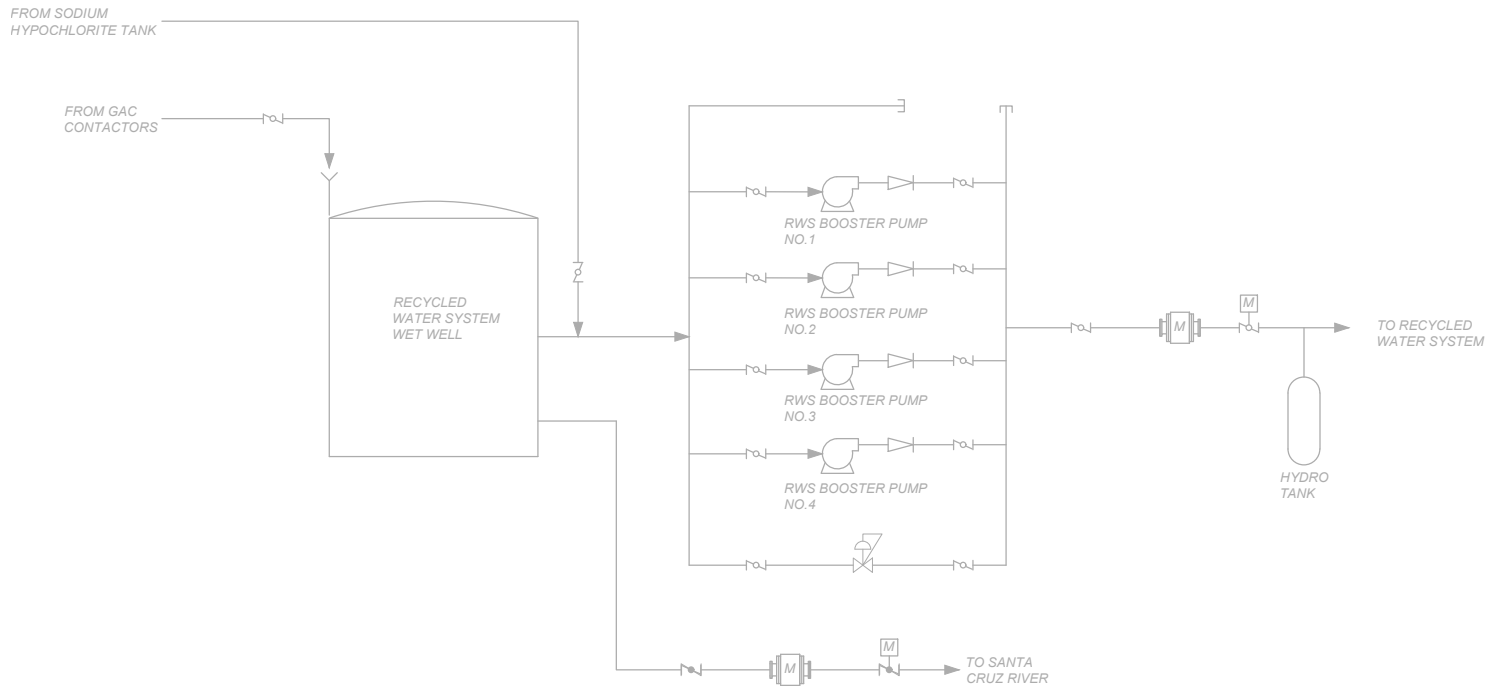


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CITY OF TUCSON			
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT			
GENERAL			
PROCESS FLOW DIAGRAM 3			
G09			
DESIGNED BY KW	DATE 05/24	FIELD BOOK NO. XXX	SHEET NO. 9 OF 110
DRAWN BY AJE	DATE 05/24	SCALE NTS	PLAN NO. 1-006-2023
CHECKED BY	DATE 05/24	DATE 05/24	DATE 05/24

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LEGEND

- NEW
- EXISTING
- FUTURE



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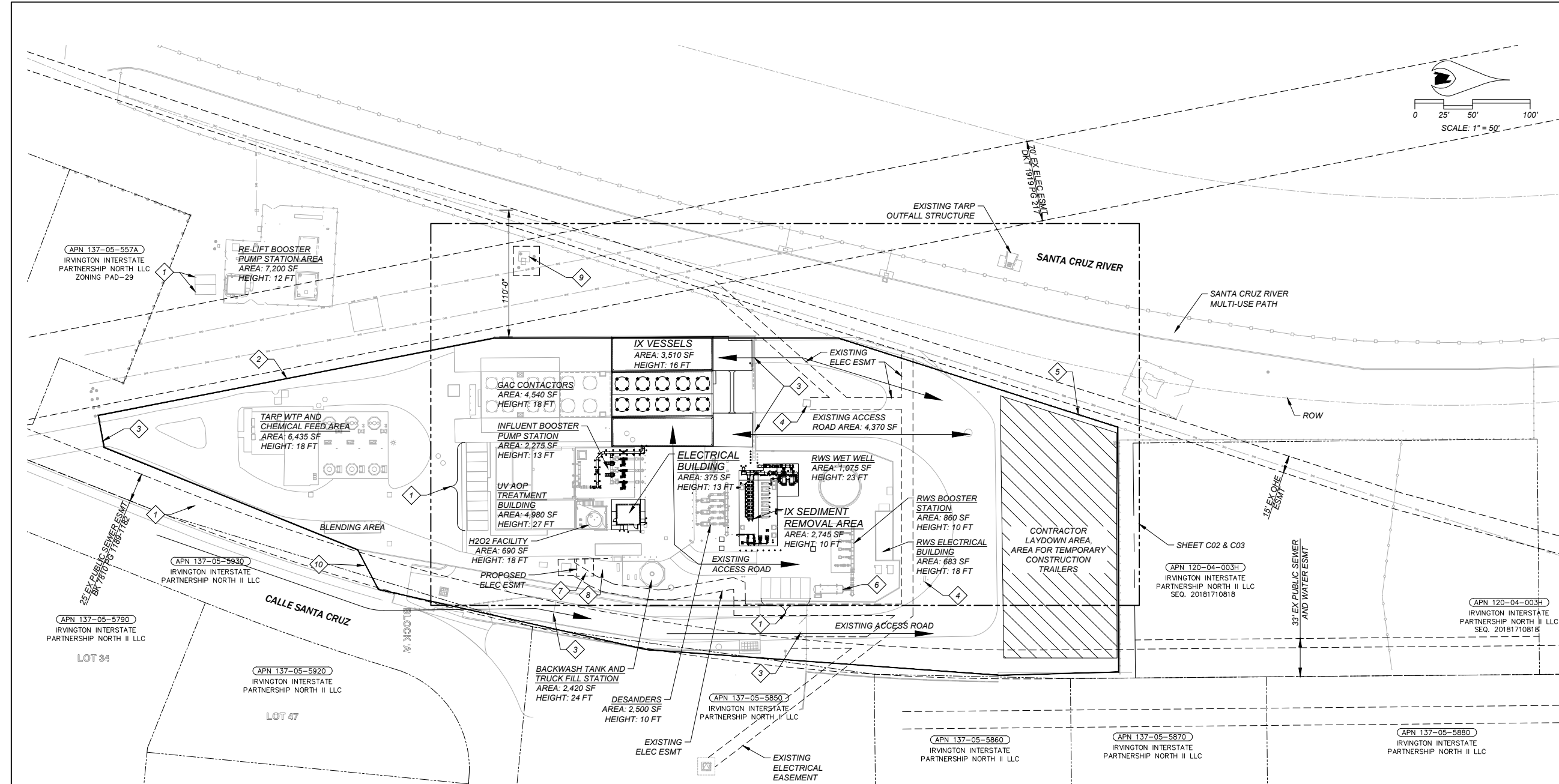


CITY OF TUCSON
**TARP WTP IMPROVEMENTS
ION EXCHANGE PFAS TREATMENT**



GENERAL				G10	
DESIGNED BY	DATE	FIELD BOOK NO.	SHEET NO.	10 OF 110	
KW	05/24	XXX			
DRAWN BY	DATE	SCALES		1-006-2023	
AJE	05/24	NTS			
CHECKED BY	DATE	NTS			
	05/24	NTS			

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GENERAL NOTES:

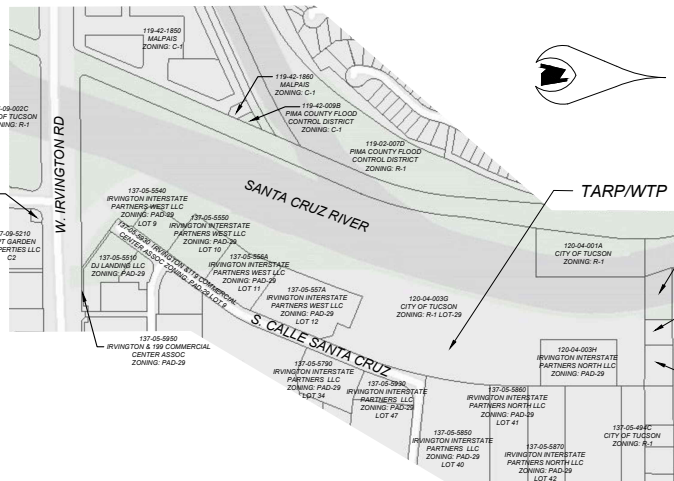
- ALL MEASUREMENTS OF EXISTING TOPOGRAPHY, STRUCTURES AND UTILITIES ARE SUBJECT TO VERIFICATION IN THE FIELD BY THE CONTRACTOR. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES ON THE DRAWINGS PRIOR TO FABRICATION OR CONSTRUCTION. THE CONTRACTOR WILL BE RESPONSIBLE FOR ANY ERRORS, WHICH MAY HAVE BEEN AVOIDED BY FIELD VERIFICATION.
- DO NOT INTERRUPT EXISTING UTILITIES SERVING OCCUPIED OR USED FACILITIES, EXCEPT WHEN AUTHORIZED BY THE ENGINEER. PROVIDE TEMPORARY SERVICES DURING INTERRUPTIONS TO EXISTING UTILITIES AS REQUIRED.
- REPLACE IN KIND ALL EXISTING STRUCTURES, PAVING, AND LANDSCAPING DISTURBED BY CONSTRUCTION UNLESS NOTED OTHERWISE.
- EXISTING UTILITIES ARE SHOWN PER THE RECORD DRAWINGS. POTHOLE AT ALL POINTS OF CROSSINGS AND CONNECTIONS TO VERIFY DEPTHS, PIPE MATERIAL, AND SIZE. NOTIFY OWNER OF ANY DISCREPANCIES WHICH MAY IMPACT PIPE ALIGNMENT.
- FLOOR AREAS:
 - TARP WATER TREATMENT PLANT AND CHEMICAL FEED AREA: 6,435 SQ FT (EXISTING).
 - RE-LIFT BOOSTER PUMP STATION AREA: 7,200 SQ FT (EXISTING)
 - GAC CONTACTORS: 4,540 SQ FT (EXISTING).
 - UV AOP TREATMENT BUILDING: 4,980 SQ FT (EXISTING).
 - INFLUENT BOOSTER PUMP STATION: 2,275 SQ FT (EXISTING).
 - H2O2 FACILITY: 690 SQ FT (EXISTING).
 - BACKWASH TANK AND TRUCK FILL STATION: 2,420 SQ FT (EXISTING).
 - DESANDERS: 2,500 SQ FT (EXISTING).
 - RWS BOOSTER STATION: 860 SQ FT (EXISTING).
 - RWS WET WELL: 1,075 SQ FT (EXISTING).
 - RWS ELECTRICAL BUILDING: 683 SQ FT (EXISTING).
 - IX VESSELS: 3,510 SQ FT (NEW).
 - IX SEDIMENT REMOVAL AREA: 2,745 SQ FT (NEW).
 - ELECTRICAL BUILDING: 375 SQ FT (NEW).
- THE DEVELOPER, ANY SUCCESSORS AND ASSIGNS, WILL HOLD THE CITY OF TUCSON, ITS OFFICERS, EMPLOYEES, AND AGENTS HARMLESS FROM ANY AND ALL CLAIMS FOR DAMAGES RELATED TO THE USE OF THIS DEVELOPMENT AS SHOWN HEREON, NOW AND IN THE FUTURE, BY REASON OF FLOODING, FLOWAGE, EROSION, OR DAMAGE CAUSED BY WATER, WHETHER SURFACE FLOOD OR RAINFALL.
- DRAINAGE WILL REMAIN IN ITS NATURAL STATE AND WILL NOT BE ALTERED, DISTURBED, OR OBSTRUCTED OTHER THAN AS SHOWN ON THIS SITE PLAN.
- NO STRUCTURE OR VEGETATION SHALL BE LOCATED OR MAINTAINED SO AS TO INTERFERE WITH THE SIGHT VISIBILITY TRIANGLES IN ACCORDANCE WITH SECTION 10-01.5.0, SIGHT VISIBILITY, OF THE CITY OF TUCSON TECHNICAL STANDARDS MANUAL.
- ANY RELOCATION OR MODIFICATION OF EXISTING UTILITIES AND/OR PUBLIC IMPROVEMENTS NECESSITATED BY THE PROPOSED DEVELOPMENT WILL BE AT NO EXPENSE TO THE PUBLIC.
- ANY WASTEWATER DISCHARGED INTO THE PUBLIC SANITARY SEWERAGE SYSTEM SHALL MEET THE REQUIREMENTS OF PIMA COUNTY ORDINANCE NO. 1991-140, OR AS AMENDED.
- TOTAL MILES OF NEW PUBLIC STREETS IS 0, TOTAL MILES OF NEW PRIVATE STREETS IS 0.
- EXISTING ZONING IS R-1.
- SITE AREA: 357,200 SF (8.2 AC) ON 1,463,000 SF (33.6 AC) PARCEL.
- EXPANSION CALCULATIONS: EXISTING STRUCTURE AREA: 33,658 SF, NEW STRUCTURE: 6,630 SF, EXPANSION 20%.
- ALL AREAS THAT ARE DISTURBED DURING CONSTRUCTION, OR THAT DO NOT HAVE SURFACE FINISHING, WITHIN THE WORK LIMITS SHOULD HAVE DECOMPOSED GRANITE PER UNIFIED DEVELOPMENT CODE SECTION 7.6.4 LANDSCAPE STANDARDS. FOR AREAS NORTH OF THE SITE WALL, MATCH EXISTING DECOMPOSED GRANITE. FOR AREAS NORTH OF THE UV AOP TREATMENT BUILDING AND SOUTH OF THE SITE WALL, MATCH EXISTING DECOMPOSED GRANITE BY THE RWS WET WELL.

KEY NOTES: #

- EXISTING PARKING SPACES
- EXISTING SITE WALL
- EXISTING ACCESS GATE
- EXISTING POWER UTILITY SERVICE TRANSFORMER
- EXISTING SITE FENCE
- EXISTING HYDROPNEUMATIC TANK
- NEW POWER UTILITY SERVICE TRANSFORMER
- NEW ELECTRICAL SERVICE ENTRANCE SWITCHBOARD
- EXISTING JUNCTION BOX
- LIMITS OF WORK

LEGEND:

- GENERAL ACCESS ROUTE
- LAYDOWN AND STAGING AREAS



OVERVIEW MAP

TARP WTP LEGAL DESCRIPTION: CTRL PTN SW4 E OF SOUTH VALLEY RD
TARP WTP ADDRESS: 1110 W. IRVINGTON RD
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT
CASE NUMBER:

RESERVED FOR
CITY OF TUCSON PSDS



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NO.	BY	DATE	REVISION	APPR.	DATE



CITY OF TUCSON

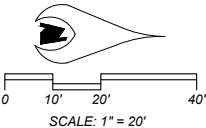
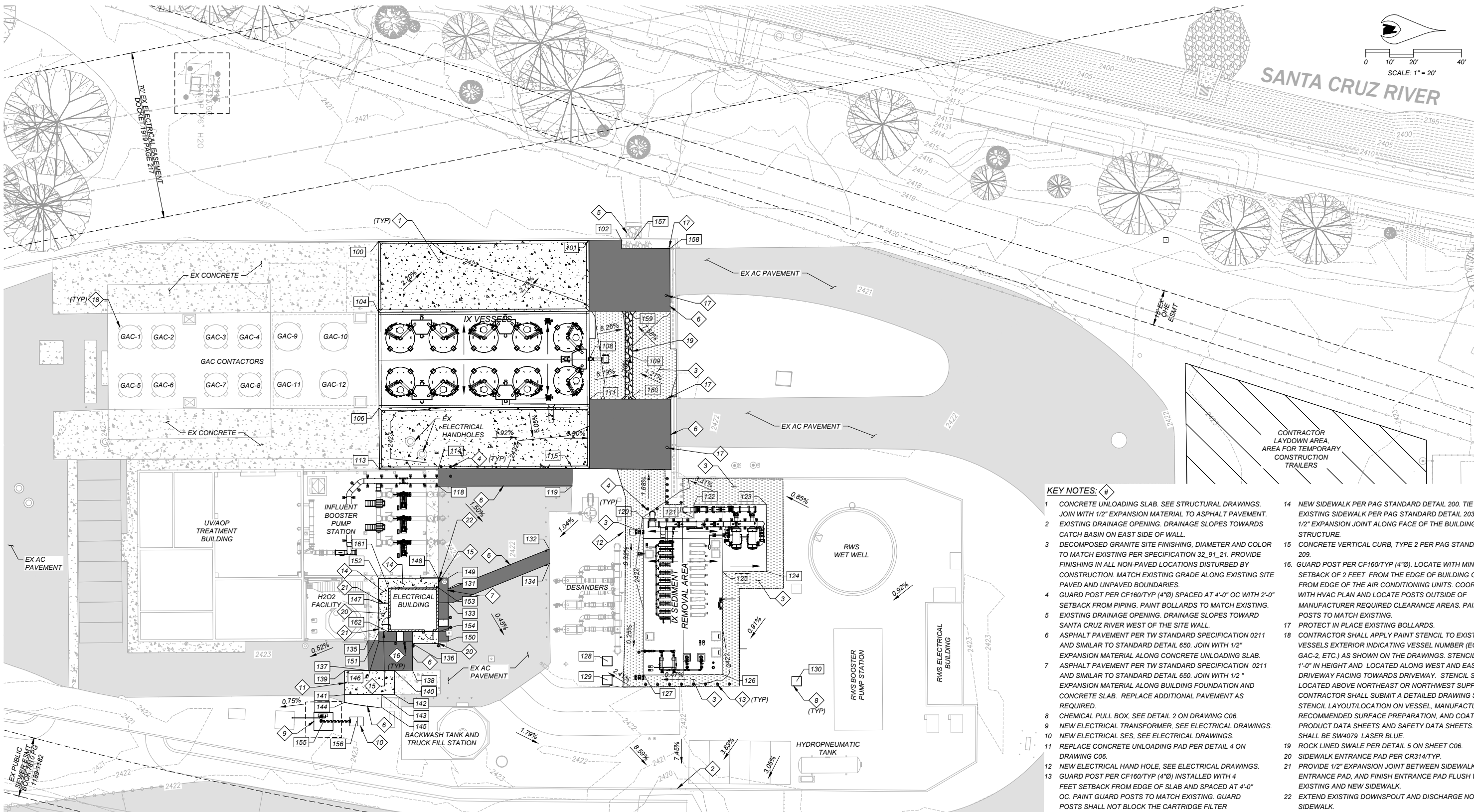
TARP WTP IMPROVEMENTS
ION EXCHANGE PFAS TREATMENT

CIVIL
OVERALL SITE DEVELOPMENT PLAN

C01

DESIGNED BY DWS	DATE 05/24	FIELD BOOK NO. XXX	SHEET NO. 14 OF 110
DRAWN BY ADL	DATE 05/24	SCALE 1"=50'	PLAN NO. 1-006-2023
CHECKED BY	DATE 05/24	DATE SIGNED 05/24	





SANTA CRUZ RIVER

KEY NOTES: ◆

- CONCRETE UNLOADING SLAB. SEE STRUCTURAL DRAWINGS. JOIN WITH 1/2" EXPANSION MATERIAL TO ASPHALT PAVEMENT.
- EXISTING DRAINAGE OPENING. DRAINAGE SLOPES TOWARDS CATCH BASIN ON EAST SIDE OF WALL.
- DECOMPOSED GRANITE SITE FINISHING, DIAMETER AND COLOR TO MATCH EXISTING PER SPECIFICATION 32_91_21. PROVIDE FINISHING IN ALL NON-PAVED LOCATIONS DISTURBED BY CONSTRUCTION. MATCH EXISTING GRADE ALONG EXISTING SITE PAVED AND UNPAVED BOUNDARIES.
- GUARD POST PER CF160/TYP (4"Ø) SPACED AT 4'-0" OC WITH 2'-0" SETBACK FROM PIPING. PAINT BOLLARDS TO MATCH EXISTING.
- EXISTING DRAINAGE OPENING. DRAINAGE SLOPES TOWARD SANTA CRUZ RIVER WEST OF THE SITE WALL.
- ASPHALT PAVEMENT PER TW STANDARD SPECIFICATION 0211 AND SIMILAR TO STANDARD DETAIL 650. JOIN WITH 1/2" EXPANSION MATERIAL ALONG CONCRETE UNLOADING SLAB.
- ASPHALT PAVEMENT PER TW STANDARD SPECIFICATION 0211 AND SIMILAR TO STANDARD DETAIL 650. JOIN WITH 1/2" EXPANSION MATERIAL ALONG BUILDING FOUNDATION AND CONCRETE SLAB. REPLACE ADDITIONAL PAVEMENT AS REQUIRED.
- CHEMICAL PULL BOX, SEE DETAIL 2 ON DRAWING C06.
- NEW ELECTRICAL TRANSFORMER, SEE ELECTRICAL DRAWINGS.
- NEW ELECTRICAL SES, SEE ELECTRICAL DRAWINGS.
- REPLACE CONCRETE UNLOADING PAD PER DETAIL 4 ON DRAWING C06.
- NEW ELECTRICAL HAND HOLE, SEE ELECTRICAL DRAWINGS.
- GUARD POST PER CF160/TYP (4"Ø) INSTALLED WITH 4'-0" FEET SETBACK FROM EDGE OF SLAB AND SPACED AT 4'-0" OC. PAINT GUARD POSTS TO MATCH EXISTING. GUARD POSTS SHALL NOT BLOCK THE CARTRIDGE FILTER CHANGEOUT FOOTPRINT AS SHOWN ON DRAWING M06.
- NEW SIDEWALK PER PAG STANDARD DETAIL 200. TIE INTO EXISTING SIDEWALK PER PAG STANDARD DETAIL 203. PROVIDE 1/2" EXPANSION JOINT ALONG FACE OF THE BUILDING STRUCTURE.
- CONCRETE VERTICAL CURB, TYPE 2 PER PAG STANDARD DETAIL 209.
- GUARD POST PER CF160/TYP (4"Ø). LOCATE WITH MINIMUM SETBACK OF 2 FEET FROM THE EDGE OF BUILDING OR 1 FOOT FROM EDGE OF THE AIR CONDITIONING UNITS. COORDINATE WITH HVAC PLAN AND LOCATE POSTS OUTSIDE OF MANUFACTURER REQUIRED CLEARANCE AREAS. PAINT GUARD POSTS TO MATCH EXISTING.
- PROTECT IN PLACE EXISTING BOLLARDS.
- CONTRACTOR SHALL APPLY PAINT STENCIL TO EXISTING GAC VESSELS EXTERIOR INDICATING VESSEL NUMBER (EG GAC-1, GAC-2, ETC.) AS SHOWN ON THE DRAWINGS. STENCILS SHALL BE 1'-0" IN HEIGHT AND LOCATED ALONG WEST AND EAST DRIVEWAY FACING TOWARDS DRIVEWAY. STENCIL SHALL BE LOCATED ABOVE NORTHEAST OR NORTHWEST SUPPORT LEG. CONTRACTOR SHALL SUBMIT A DETAILED DRAWING SHOWING STENCIL LAYOUT/LOCATION ON VESSEL, MANUFACTURER RECOMMENDED SURFACE PREPARATION, AND COATING PRODUCT DATA SHEETS AND SAFETY DATA SHEETS. COLOR SHALL BE SW4079 LASER BLUE.
- ROCK LINED SWALE PER DETAIL 5 ON SHEET C06.
- SIDEWALK ENTRANCE PAD PER CR314/TYP.
- PROVIDE 1/2" EXPANSION JOINT BETWEEN SIDEWALK AND ENTRANCE PAD, AND FINISH ENTRANCE PAD FLUSH WITH EXISTING AND NEW SIDEWALK.
- EXTEND EXISTING DOWNSPOUT AND DISCHARGE NORTH OF SIDEWALK.

GENERAL NOTES:

- AREAS MARKED "MATCH EXISTING" SHALL TAKE PRECEDENCE OVER CONTOURS IN THE EVENT OF A CONFLICT. GRADE EVENLY BETWEEN MATCHED GRADE AND GIVEN CONTOUR AT CLOSEST REASONABLE DISTANCE.
- ELEVATIONS AT EXISTING HARDSCAPES AND EXISTING CONTOURS ARE BASED ON RECORD DRAWINGS AND SURVEY. MATCH NEW HARDSCAPES TO EXISTING FEATURES TO PROVIDE POSITIVE DRAINAGE AND NOTIFY ENGINEER OF DEVIATION(S) THAT AFFECT DRAINAGE AND FINISHING.
- SEE DRAWING G04 FOR GENERAL NOTES.
- ASPHALT PAVEMENT REPLACEMENT COORDINATES INCLUDED ON DRAWING C04.



NO.	BY	DATE	REVISION	APPR.	DATE



CITY OF TUCSON

TARP WTP IMPROVEMENTS
ION EXCHANGE PFAS TREATMENT

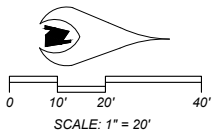
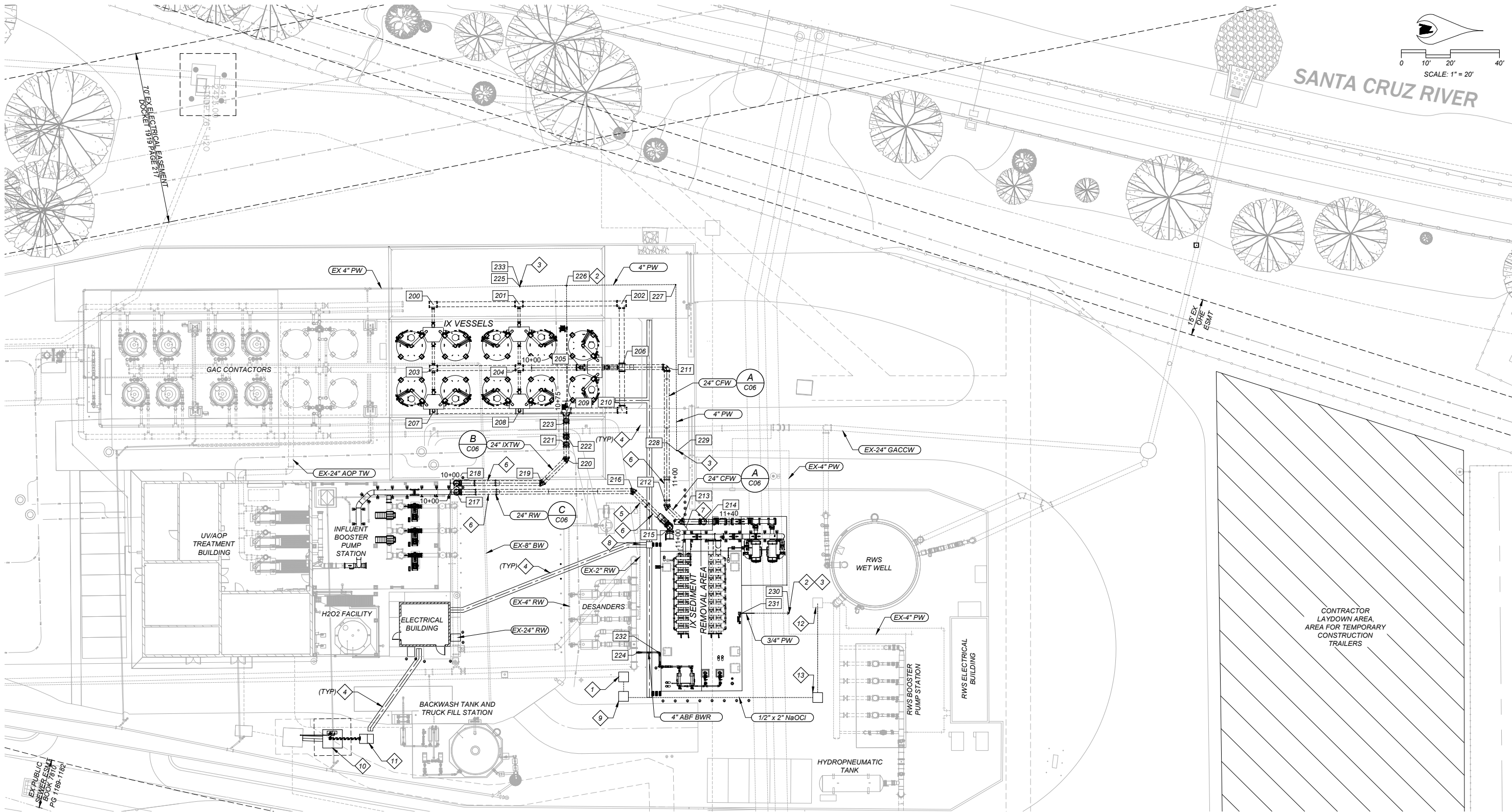
CIVIL
PAVING AND GRADING

C02

DESIGNED BY	DATE	FIELD BOOK NO.	SHEET NO.
VE	05/24	XXX	15 OF 110
DRAWN BY	DATE	SCALES	PLAN NO.
ADL	05/24	1"=20'	1-006-2023
CHECKED BY	DATE	NO.	
	05/24		



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- KEY NOTES:**
- 1 TIE INTO EXISTING CHEMICAL LINE WITH NEW CHEMICAL PULL BOX, NON-TRAFFIC RATED. CONNECT EXISTING PFA TUBING USING COMPRESSION FITTING CENTERED IN PULL BOX FOR THE FUTURE LEAK INSPECTION.
 - 2 SERVICE SADDLE WITH CORPORATION STOP ON BRANCH LINE.
 - 3 TIE-IN TO EXISTING 4" PW.
 - 4 ELECTRICAL DUCT BANK AND HANDHOLES, SEE ELECTRICAL DRAWINGS FOR CONTINUATION.
 - 5 RELOCATE EXISTING 2" AND 4" DESANDER RECYCLE LINE AS REQUIRED.
 - 6 INSTALL RESTRAINED PIPE TO STRUCTURE CONNECTION PER MP553/TYP.
 - 7 BACKFILL PIPING WITH CLSM WITHIN LIMITS OF STRUCTURE EXCAVATION.
 - 8 NEW ELECTRICAL HANDHOLE, SEE ELECTRICAL DRAWINGS.
 - 9 NEW CHEMICAL PULL BOX, NON-TRAFFIC RATED, SEE DETAIL 2 ON DRAWING C04.
 - 10 NEW ELECTRICAL TRANSFORMER, SEE ELECTRICAL DRAWINGS.
 - 11 NEW ELECTRICAL SES, SEE ELECTRICAL DRAWINGS.
 - 12 PULL NEW PFA TUBING FOR ENTIRETY OF REPLACEMENT RUN FROM EXISTING TUBING ENDPOINT LOCATED NEAR INJECTION POINT.
 - 13 RELOCATE EXISTING TRAFFIC RATED PULL BOX.

- GENERAL NOTES:**
1. CONTRACTOR SHALL FIELD VERIFY ALL LOCATIONS, ELEVATIONS, AND SIZES OF UTILITIES SHOWN PRIOR TO AND DURING CONSTRUCTION BY POTHOLING AND SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT UTILITY LINES WHETHER SHOWN OR NOT SHOWN.
 2. FOR PIPE DETAILS, SEE MECHANICAL DRAWINGS FOR EACH PROCESS AREA.
 3. SEE ELECTRICAL DRAWINGS FOR ELECTRICAL AND CONTROLS CONDUIT AND DUCT BANK INFORMATION.
 4. PIPELINE INSTALLATION SHALL BE IN ACCORDANCE WITH TW STANDARD SPECIFICATION 0209.
 5. REFER TO DRAWING C04 YARD PIPING HORIZONTAL CONTROL DATA.
 6. REFER TO DRAWING C05 FOR YARD PIPING PROFILES. PROFILES PER ALIGNMENT SHOWN AT CL OF PIPE.



NO.	BY	DATE	REVISION	APPR.	DATE

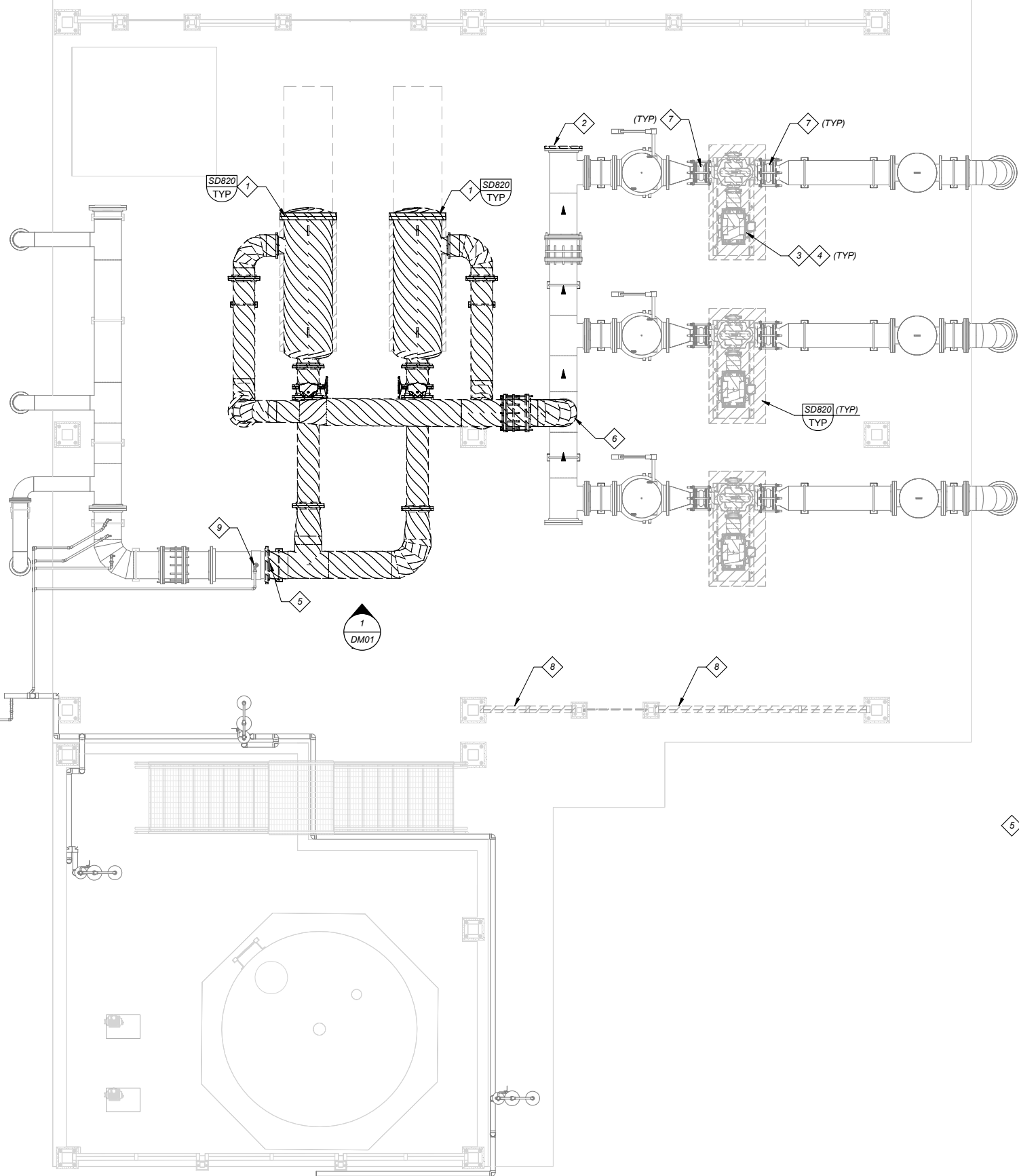
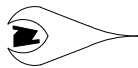




Digitally signed by Viking Edeback
Contact Info: Viking Edeback, Inc.
Date: 2024.05.24 11:25:05 -07'00'

CITY OF TUCSON				
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT				
CIVIL YARD PIPING PLAN				
DESIGNED BY DWS	DATE 05/24	FIELD BOOK NO. XXX	SHEET NO. 16 OF 110	
ADL	05/24	SCALE 1"=20'	PLAN NO. 1-006-2023	

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A PLAN
SCALE: 1/4" = 1'-0"



CARTRIDGE FILTER HOUSING & ASSOCIATED PIPING

1 PHOTO
SCALE: NO SCALE

- GENERAL NOTES:**
- COORDINATE ALL DEMOLISH WORK WITH NEW WORK PER SPECIFICATION SECTION 01_14_00 AND AS DIRECTED BY ENGINEER.
 - SALVAGE EQUIPMENT PER SPECIFICATION SECTION 01_35_21 AND AS DIRECTED BY ENGINEER. CARE SHALL BE TAKEN TO ENSURE THAT DAMAGE TO SALVAGED ITEM IS MINIMIZED.
 - EXISTING PIPING SYSTEMS ARE NOT SHOWN IN THEIR ENTIRETY. LOCATION AND SIZE OF PIPING SHALL BE FIELD VERIFIED AS REQUIRED TO FACILITATE NEW WORK.
 - CONTRACTOR SHALL FIELD VERIFY LOCATION OF EXISTING FIXTURES, SUPPORTS AND EQUIPMENT AS REQUIRED TO FACILITATE NEW WORK.
 - EXISTING STRUCTURES WHICH ARE CUT REMOVED, DAMAGED OR LEFT WITH OPENINGS BY THE DEMOLITION WORK SHALL BE REPAIRED AND FINISHED OFF TO MATCH THE ADJACENT EXISTING STRUCTURE.
 - REMOVE ALL ABANDONED PIPE SUPPORTS, ANCHOR BOLTS AND CONCRETE ANCHORS. PATCH WITH REMOVAL OF ANCHOR BOLTS, CONCRETE ANCHORS, PIPING, ETC.

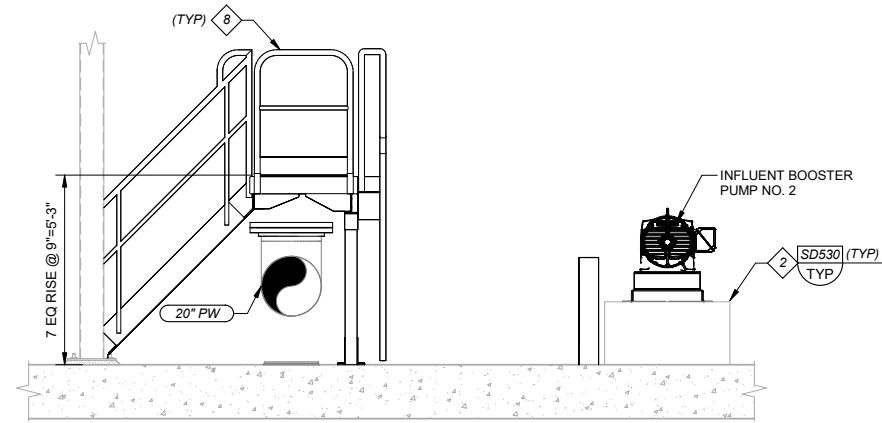
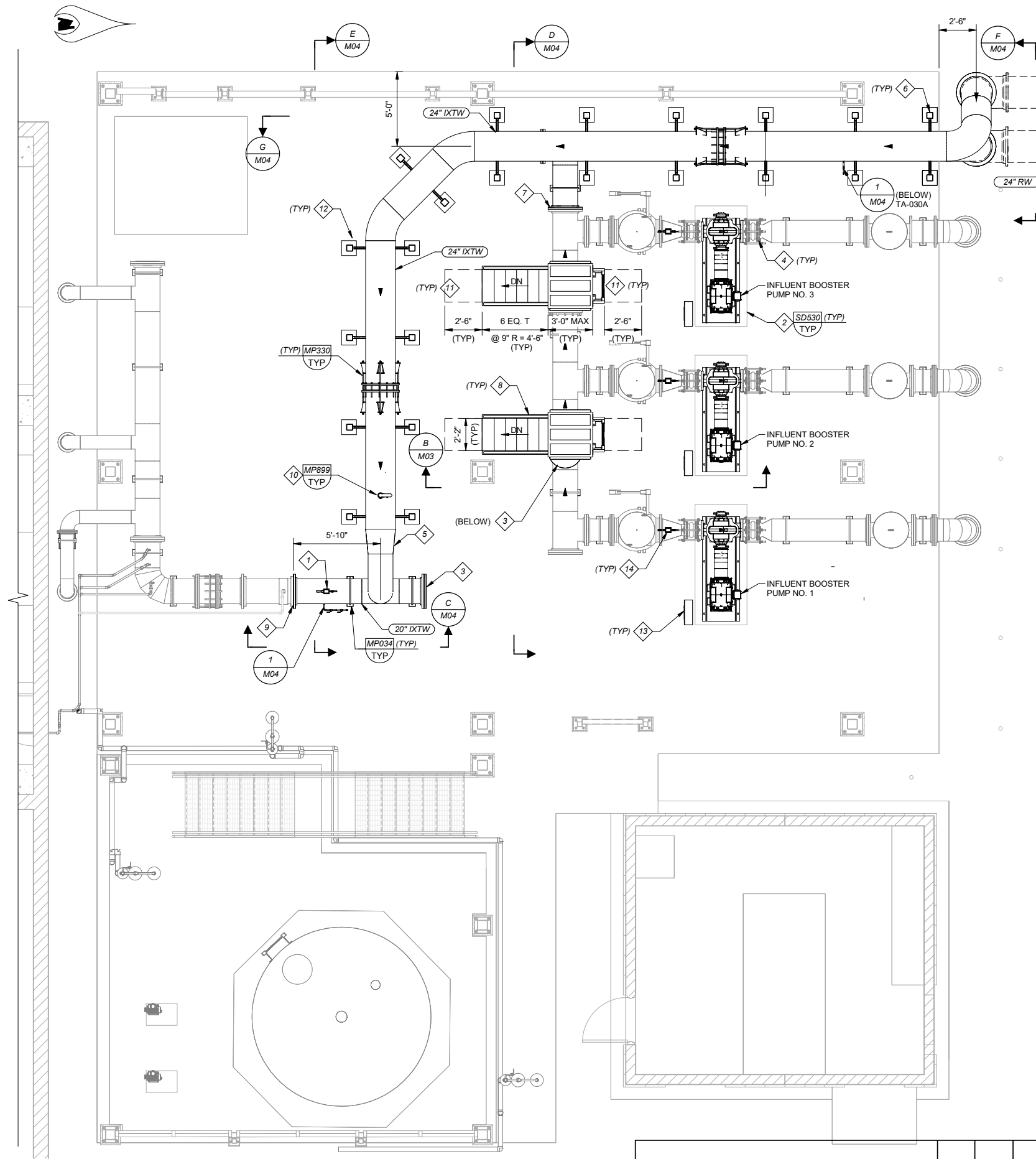
- KEY NOTES:**
- RELOCATE EXISTING CARTRIDGE FILTERS AND ASSOCIATED PIPING PER MECHANICAL SHEET M06. DEMOLISH HOUSEKEEPING PAD.
 - DEMOLISH 20" BLIND FLANGE FOR PIPING INSTALLATION.
 - REMOVE EXISTING PUMP AND MOTOR. TO BE REPLACED WITH NEW PUMP AND MOTOR ON EXPANDED BASE PER SHEET M03.
 - DISCONNECT AND DEMOLISH ALL EXISTING CABLES TO THE VFD. PROTECT EMBEDDED CONDUIT TO BE REUSED TO INSTALL NEW CABLE AFTER MOTOR REPLACEMENT. EXISTING CONDUIT WILL BE CLOSED AND SEALED AND NEW CONDUITS WILL BE RUN FROM THE NEW ELECTRICAL ROOM TO THE INFLUENT BOOSTER PUMPS.
 - MERCOID PRESSURE SWITCH AND PRESSURE TRANSMITTER MUST BE MAINTAINED THROUGHOUT CONSTRUCTION WITHIN TEMPORARY OR PERMANENT PIPING. SHEET M03 SHOWS NEW PIPELINE WITH NEW PRESSURE SWITCH AND TRANSMITTER.
 - SAMPLE POINT TA-030A MUST BE MAINTAINED THROUGHOUT CONSTRUCTION WITHIN TEMPORARY OR PERMANENT PIPING. PERMANENT SAMPLE PORT DETAIL FOR TA-030A IS SHOWN ON SHEET M04.
 - DEMOLISH AND REPLACE RUBBER EXPANSION JOINTS, REDUCER, SPOOL PIECES, AND INLET/OUTLET PIPING AS REQUIRED TO FIT NEW PUMP DIMENSIONS.
 - DEMOLISH EXISTING SUN SCREEN BETWEEN EXSITING CANOPY SUPPORTS AND WIND COLUMNS.
 - HYDROGEN PEROXIDE INJECTION POINT TO BE PROTECTED IN PLACE DURING CONSTRUCTION.



NO.	BY	DATE	REVISION	APPR.	DATE



CITY OF TUCSON			
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT			
DEMOLITION INFLUENT BOOSTER PUMP STATION DEMOLITION PLAN			
DM01			
DESIGNED BY:	DATE:	FIELD BOOK NO:	SHEET NO:
KW	05/24	XXX	13 OF 110
DRAWN BY:	DATE:	SCALE:	PLAN NO:
MM	05/24		
CHECKED BY:	DATE:	VERT:	
	05/24	HORZ: As indicated	1-006-2023



B SECTION
M03 SCALE: 3/8" = 1'-0"

- GENERAL NOTES:**
1. TEMPORARILY REMOVE EXISTING PIPE SUPPORTS AND USE TEMPORARY SUPPORTS AS NEEDED TO COMPLETE REPLACEMENT OF EQUIPMENT AND PIPING.
 2. FOR CONTINUATION OF BURIED PIPE, SEE CIVIL YARD PIPING DRAWINGS.
- # KEY NOTES:**
1. PRESSURE SWITCH AND PRESSURE INDICATING TRANSMITTER.
 2. EQUIPMENT BASE WIDTH TO MATCH EXISTING AT MINIMUM.
 3. 20" BLIND FLANGE.
 4. RUBBER EXPANSION JOINTS WITH LIMIT/CONTROL RODS, REDUCERS, AND SPOOL AS REQUIRED.
 5. 20"x24" ECCENTRIC REDUCER, FLAT SIDE ON TOP.
 6. DOUBLE PIPE SUPPORT RACK PER DETAIL 5/S05.
 7. CONNECT TO EXISTING FLANGE, REPAIR AND RECOAT INTERIOR AFTER INSTALLATION AS REQUIRED.
 8. PRE-ENGINEERED, OSHA COMPLIANT, MODULAR PUMP ACCESS WALKOVER PLATFORM WITH STAIRS, PLATFORM, LADDER AND INTEGRAL RAILINGS AND GUARDS, PER SPECIFICATION 05_51_16.
 9. CONNECT TO EXISTING STATIC MIXER FLANGE.
 10. 2" COMBINATION AIR/VACUUM VALVE.
 11. MINIMUM CLEARANCE FOR STAIRWAY LANDING.
 12. SINGLE PIPE SUPPORT RACK DETAIL 4/S05.
 13. PUMP ELECTRICAL DISCONNECT AND LOCAL CONTROL PANEL.
 14. PRESSURE INDICATOR AND PRESSURE SWITCH

A PLAN
SCALE: 1/4" = 1'-0"



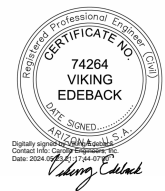
NO.	BY	DATE	REVISION	APPR.	DATE



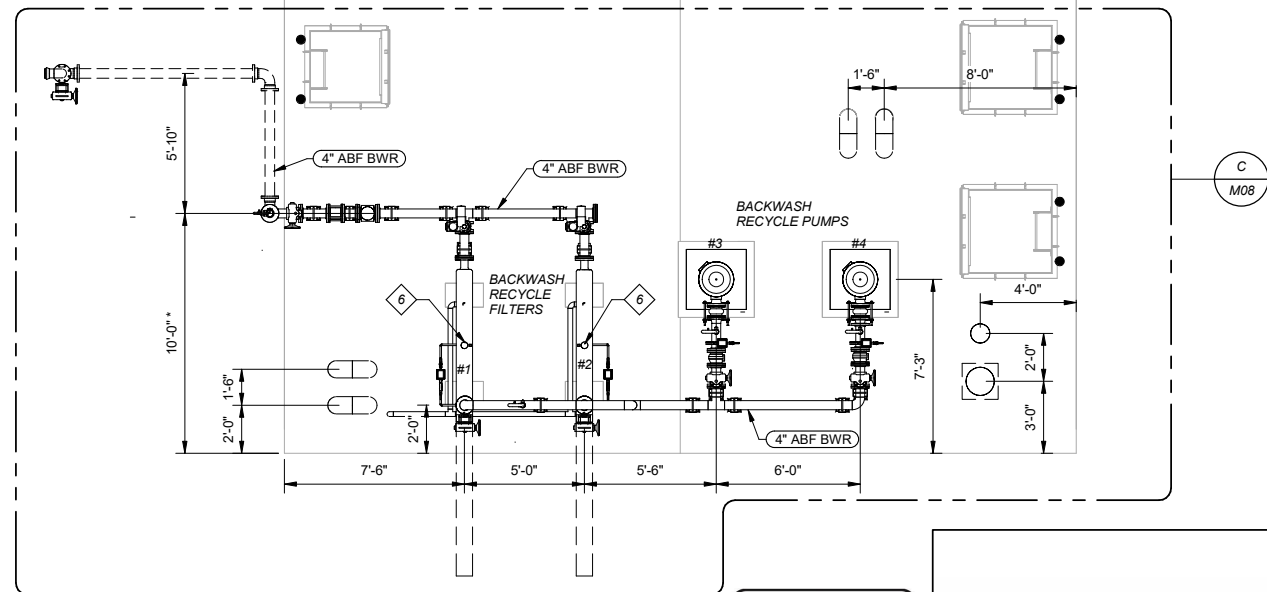
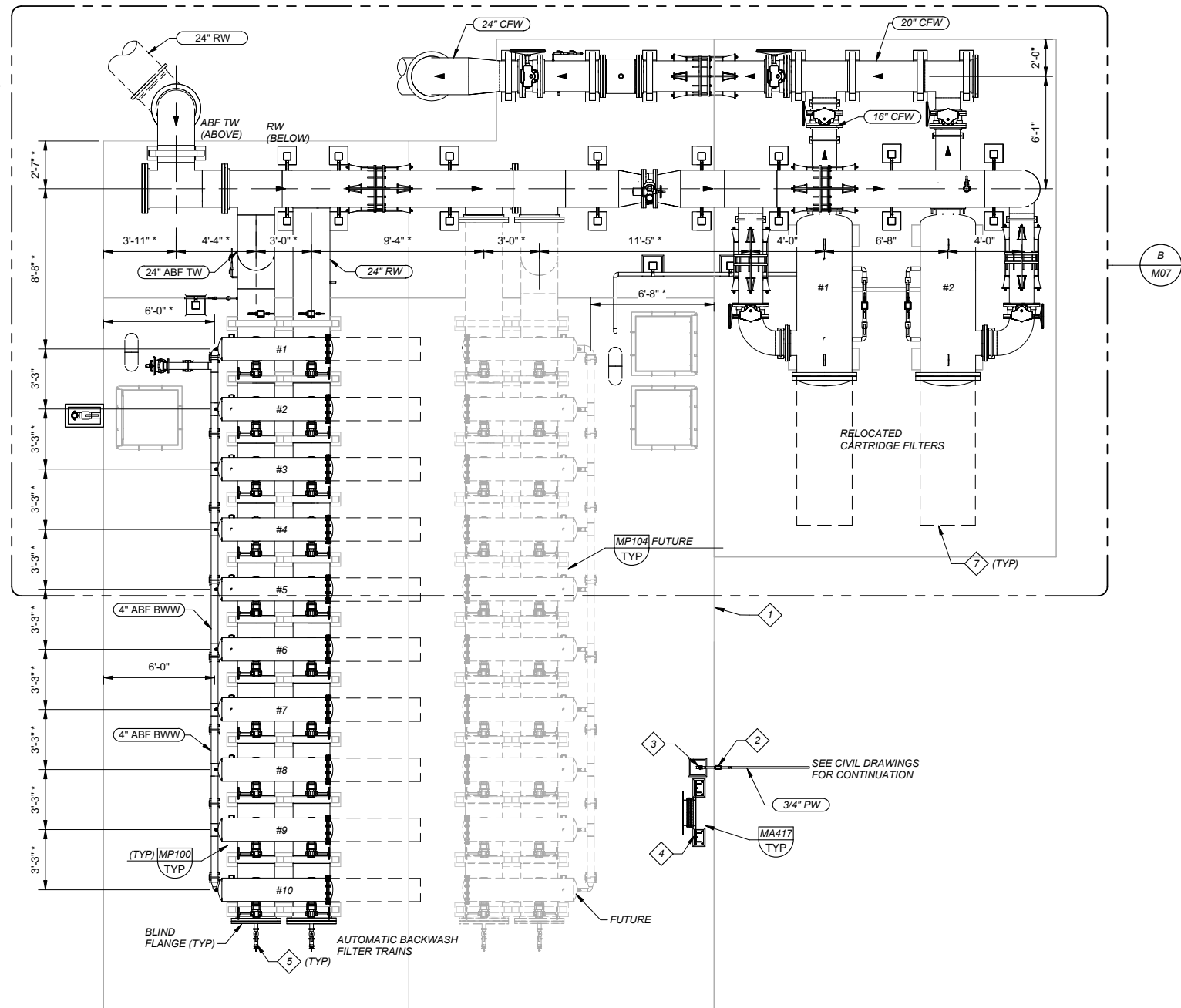
TARP WTP IMPROVEMENTS
ION EXCHANGE PFAS TREATMENT

MECHANICAL
INFLUENT BOOSTER PUMP STATION PLAN

M03



DESIGNED BY:	DATE:	FIELD BOOK NO:	SHEET NO:
KW	05/24	XXX	45 OF 110
DRAWN BY:	DATE:	SCALE:	PLAN NO:
MM	05/24	VERT:	1-006-2023
CHECKED BY:	DATE:	HORIZ: As indicated	
	05/24		



A PLAN
SCALE: 1/4" = 1'-0"

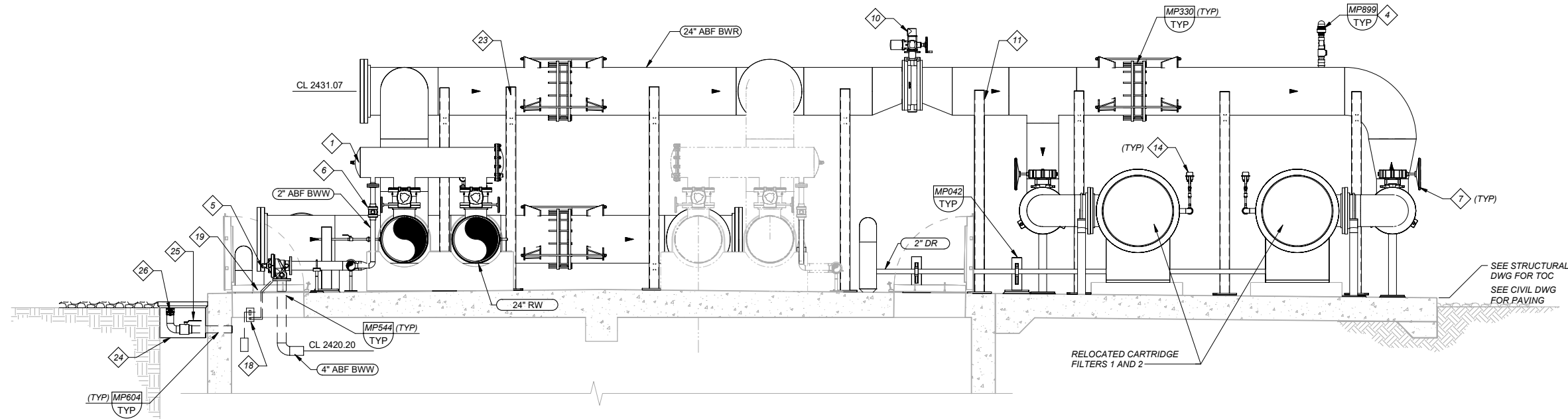


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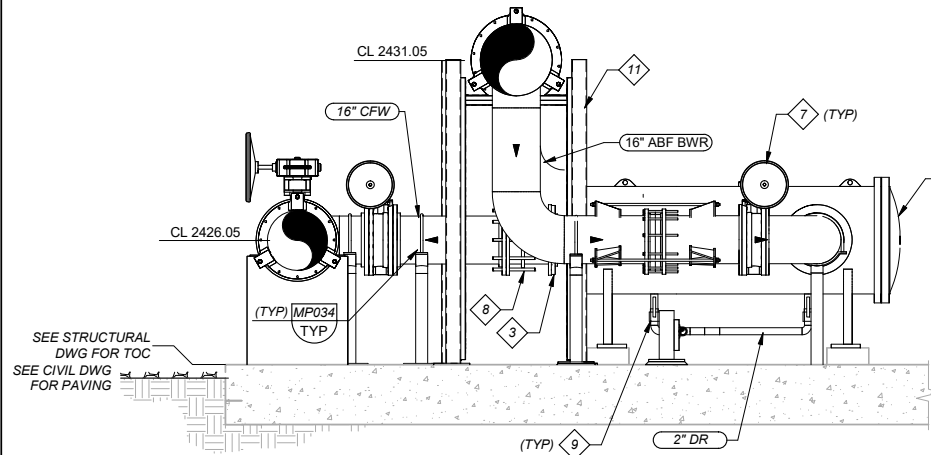
- GENERAL NOTES:**
1. RELOCATED EXISTING CARTRIDGE FILTERS AND ASSOCIATED VALVES, INSTRUMENTATION, AND APPURTENANCES.
 2. (*) INDICATES CONTRACTOR TO COORDINATE WITH MANUFACTURER
- KEY NOTES:**
1. BACKWASH SETTLING TANK, SEE STRUCTURAL DRAWINGS.
 2. BALL VALVE.
 3. HOSE VALVE BIBB WITH VACUUM BREAKER. MOUNT NOZZLE 3'-0" ABOVE SLAB AND SUPPORT WITH UNISTRUT AS REQUIRED.
 4. 100', 3/4" HOSE AND SPRAY NOZZLE.
 5. DRILL AND TAP BLIND FLANGE WITH 2" NPT DRAIN CONNECTION AND INSTALL BALL VALVE, 316 SS QUICK CONNECT COUPLING, AND DUST CAP. LOCATE CONNECTION AS CLOSE TO PIPE INVERT AS FEASIBLE WITHOUT INTERFERING WITH THE SEATING FACE OF THE FLANGE.
 6. 2" VENT, NPT CONNECTION
 7. CARTRIDGE FILTER ELEMENT REMOVAL FOOTPRINT.



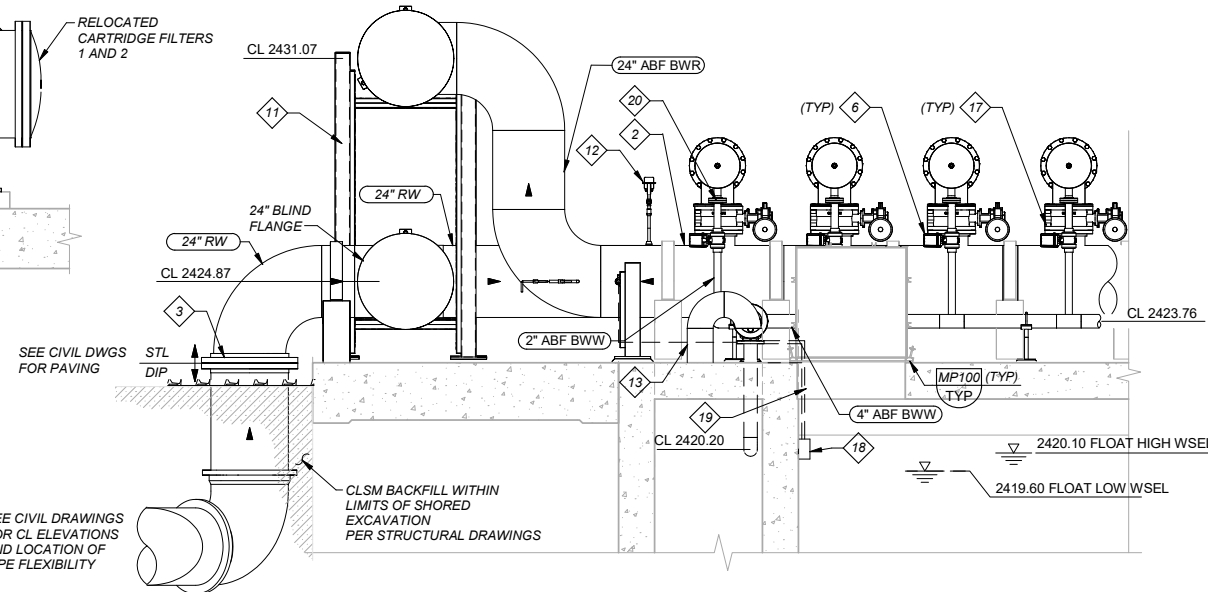
CITY OF TUCSON			
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT			
MECHANICAL SEDIMENT REMOVAL PLAN			
DESIGNED BY: KV/DS	DATE: 05/24	FIELD BOOK NO: XXX	SHEET NO: 48 OF 110
DRAWN BY: MM	DATE: 05/24	SCALE: VERT: AS NOTED	PLAN NO: 1-006-2023
CHECKED BY:	DATE: 05/24		



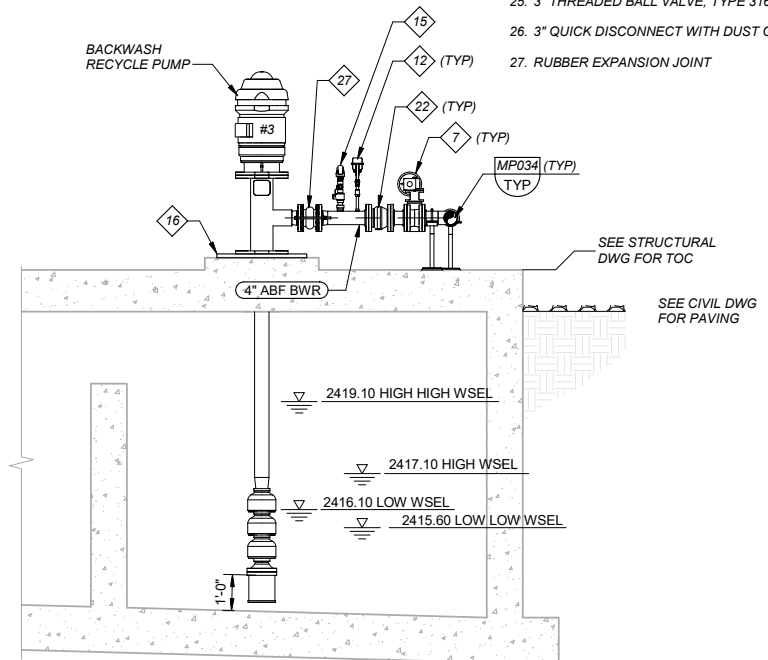
E SECTION
M07 SCALE: 3/8" = 1'-0"



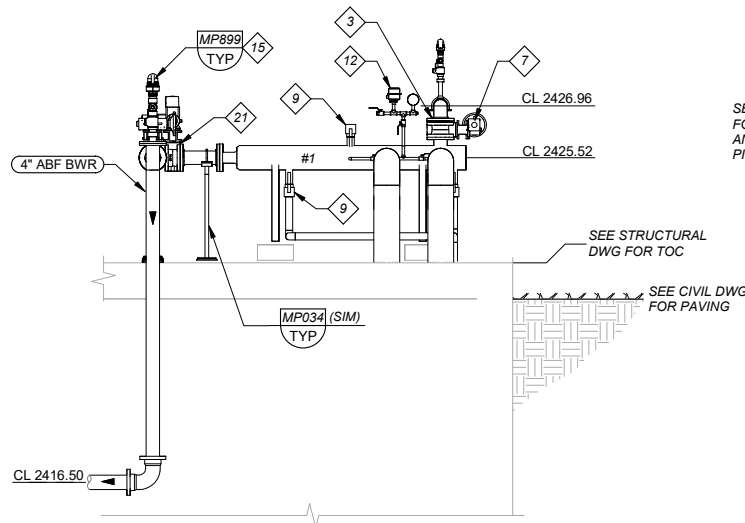
F SECTION
M07 SCALE: 3/8" = 1'-0"



G SECTION
M07 SCALE: 3/8" = 1'-0"



H SECTION
M08 SCALE: 3/8" = 1'-0"



J SECTION
M08 SCALE: 3/8" = 1'-0"

GENERAL NOTES:

1. RELOCATED EXISTING CARTRIDGE FILTERS AND ASSOCIATED VALVES, INSTRUMENTATION, AND APPURTENANCES.

KEY NOTES:

1. AUTOMATIC BACKWASHING FILTER SYSTEM.
2. 24"x10" REDUCING TEE OR 10" OUTLET.
3. FLANGE INSULATING KIT PER TW STANDARD DETAIL 704.
4. 2" COMBINATION AIR/VACUUM VALVE.
5. FLOAT VALVE.
6. VENDOR SUPPLIED 2" MOTOR OPERATED BALL VALVE.
7. MANUALLY OPERATED AWWA BUTTERFLY VALVE.
8. DISMANTLING JOINT.
9. 2" BALL VALVE.
10. MOTOR OPERATED HIGH PERFORMANCE BUTTERFLY VALVE.
11. SINGLE PIPE SUPPORT RACK PER DETAIL 4/S05.
12. PRESSURE GAUGE AND PRESSURE INDICATING TRANSMITTER.
13. 8" ROOF VENT, SEE DETAIL 1/M07.
14. PRESSURE DIFFERENTIAL INDICATING TRANSMITTER, SEE ELECTRICAL AND I&C DRAWINGS.
15. 1" AIR/VACUUM VALVE.
16. PUMP FOUNDATION PLATE.
17. VENDOR SUPPLIED, MANUALLY OPERATED ISOLATION VALVE.
18. REMOTE FLOAT CONTROL, MOUNTED TO INTERIOR WALL.
19. FLOAT CONTROL PILOT TUBING.
20. VENDOR SUPPLIED DIELECTRIC UNION AND PIPING.
21. MOTOR OPERATED AWWA BUTTERFLY VALVE.
22. SILENT GLOBE STYLE CHECK VALVE.
23. DOUBLE PIPE SUPPORT RACK PER DETAIL 5/S05.
24. PRECAST CONCRETE VALVE BOX.
25. 3" THREADED BALL VALVE, TYPE 316 SS.
26. 3" QUICK DISCONNECT WITH DUST CAP, TYPE 316 SS.
27. RUBBER EXPANSION JOINT.



NO.	BY	DATE	REVISION	APPR.	DATE



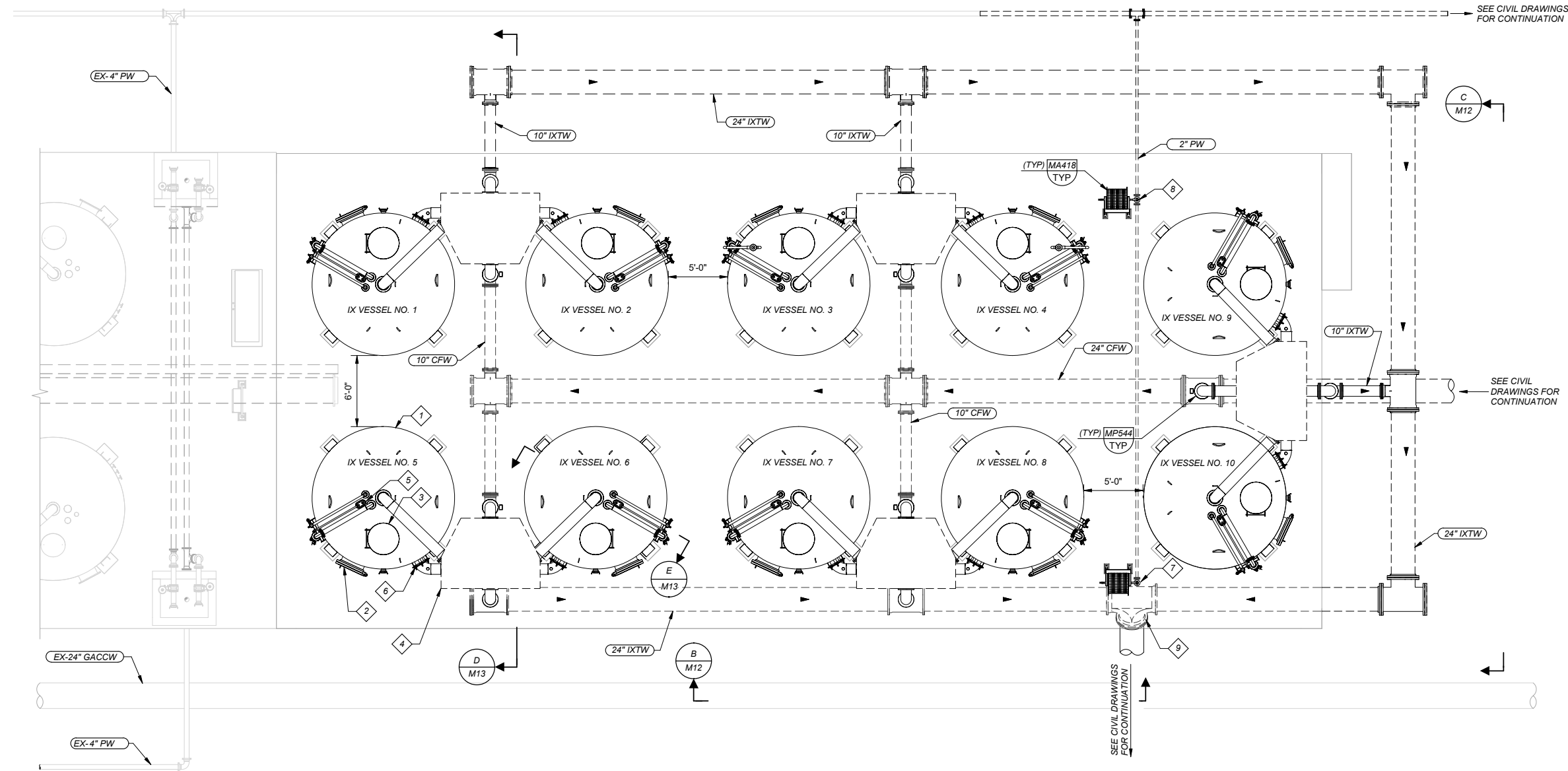
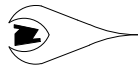
**TARP WTP IMPROVEMENTS
ION EXCHANGE PFAS TREATMENT**

**MECHANICAL
SEDIMENT REMOVAL
SECTION AND DETAILS**

M09

DESIGNED BY:	DATE:	FIELD BOOK NO:	SHEET NO:
KV/DS	05/24	XXX	51 OF 110
DRAWN BY:	DATE:	SCALE:	PLAN NO.
MM	05/24		
CHECKED BY:	DATE:	VERT:	1-006-2023
	05/24	HORIZ: As indicated	





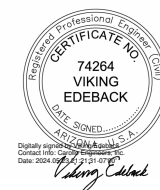
- GENERAL NOTES:**
- PRESSURE RELIEF VALVE SHALL BE SIZED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
 - FOR CONTINUATION OF BURIED PIPE, SEE CIVIL YARD PIPING DRAWINGS.
 - CONTRACTOR SHALL FIELD VERIFY ALL MEASUREMENTS, SIZE, SCHEDULE, AND MATERIAL OF PIPE AND NOTIFY ENGINEER/ OWNER OF FIELD CONDITIONS PRIOR TO ORDERING MATERIALS.
 - PROTECT ALL EXISTING PIPING IN PLACE.
 - PLAN AND SECTION FOR IX VESSELS ARE DEPICTED BASED ON PRELIMINARY MANUFACTURER CUT SHEET ACTUAL DIMENSIONS, PIPING LAYOUTS, AND APPURTENANCE LOCATIONS MAY VARY FROM OTHER MANUFACTURERS.

- KEY NOTES:**
- 12" DIAMETER ION EXCHANGE VESSELS (TYP)
 - 24" SIDE MANWAY, FLANGED (TYP)
 - 20" TOP MANWAY, FLANGED (TYP)
 - LOCATION OF 10" PIPING AND VALVE MANIFOLD ASSEMBLY PER MANUFACTURER STANDARD SPECIFICATION. CONTRACTOR WILL COORDINATE WITH PRESSURE VESSEL SUPPLIER TO MATCH CENTERLINE ELEVATIONS OF VALVE MANIFOLD ASSEMBLY. CONTRACTOR WILL ADJUST ELEVATIONS OF PROCESS PIPING AND STRUCTURAL SUPPORT OR ADD FITTINGS AS REQUIRED TO ENSURE PROPER ALIGNMENT AND CONNECTION TO VALVE MANIFOLD.
 - AIR/VAC VALVE WITH DISCHARGE (TYP)
 - SAMPLE PORTS PER IX MANUFACTURER AND SPECIFICATION 46_31_15 (TYP)
 - 2" 90° BEND
 - 2" TEE
 - 24" TEE

A PLAN
SCALE: 3/16" = 1'-0"



NO.	BY	DATE	REVISION	APPR.	DATE



CITY OF TUCSON			
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT			
MECHANICAL			
ION EXCHANGE VESSELS PLAN			
M11			
DESIGNED BY:	DATE:	FIELD BOOK NO:	SHEET NO:
KW	05/24	XXX	53 OF 110
DRAWN BY:	DATE:	SCALE:	PLAN NO:
MM	05/24		1-006-2023
CHECKED BY:	DATE:	VERT:	
VE	05/24	HORZ: AS NOTED	

KEY NOTES:

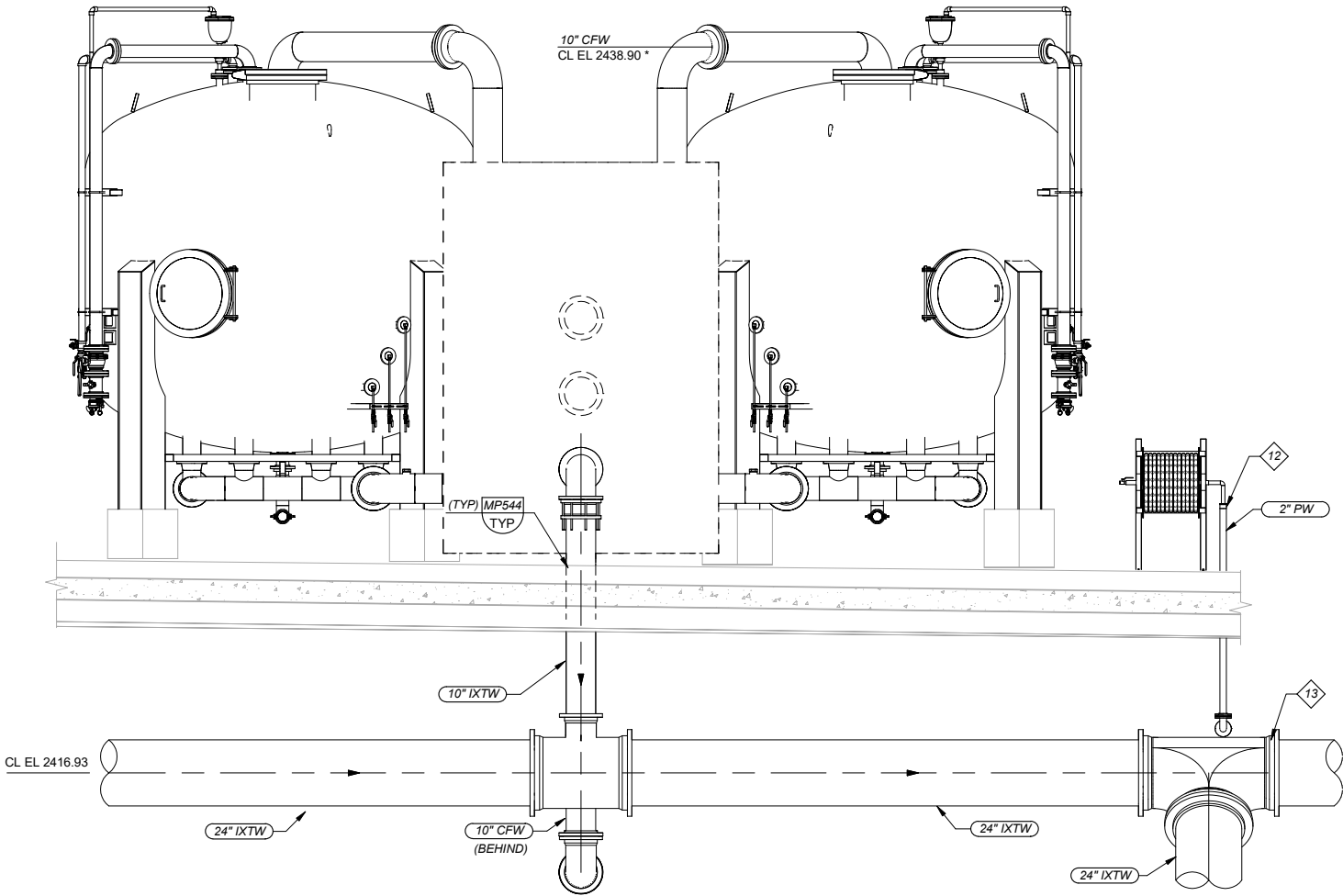
1. 12" DIAMETER ION EXCHANGE VESSELS (TYP)
2. 24" SIDE MANWAY, FLANGED (TYP)
3. 20" TOP MANWAY, FLANGED (TYP)
4. LOCATION OF 10" PIPING AND VALVE MANIFOLD ASSEMBLY PER MANUFACTURER STANDARD SPECIFICATION. CONTRACTOR WILL COORDINATE WITH PRESSURE VESSEL SUPPLIER TO MATCH CENTERLINE ELEVATIONS OF VALVE MANIFOLD ASSEMBLY. CONTRACTOR WILL ADJUST ELEVATIONS OF PROCESS PIPING AND STRUCTURAL SUPPORT OR ADD FITTINGS AS REQUIRED TO ENSURE PROPER ALIGNMENT AND CONNECTION TO VALVE MANIFOLD.
5. 1" AIR/VAC VALVE WITH DISCHARGE (TYP)

KEY NOTES (CONT.):

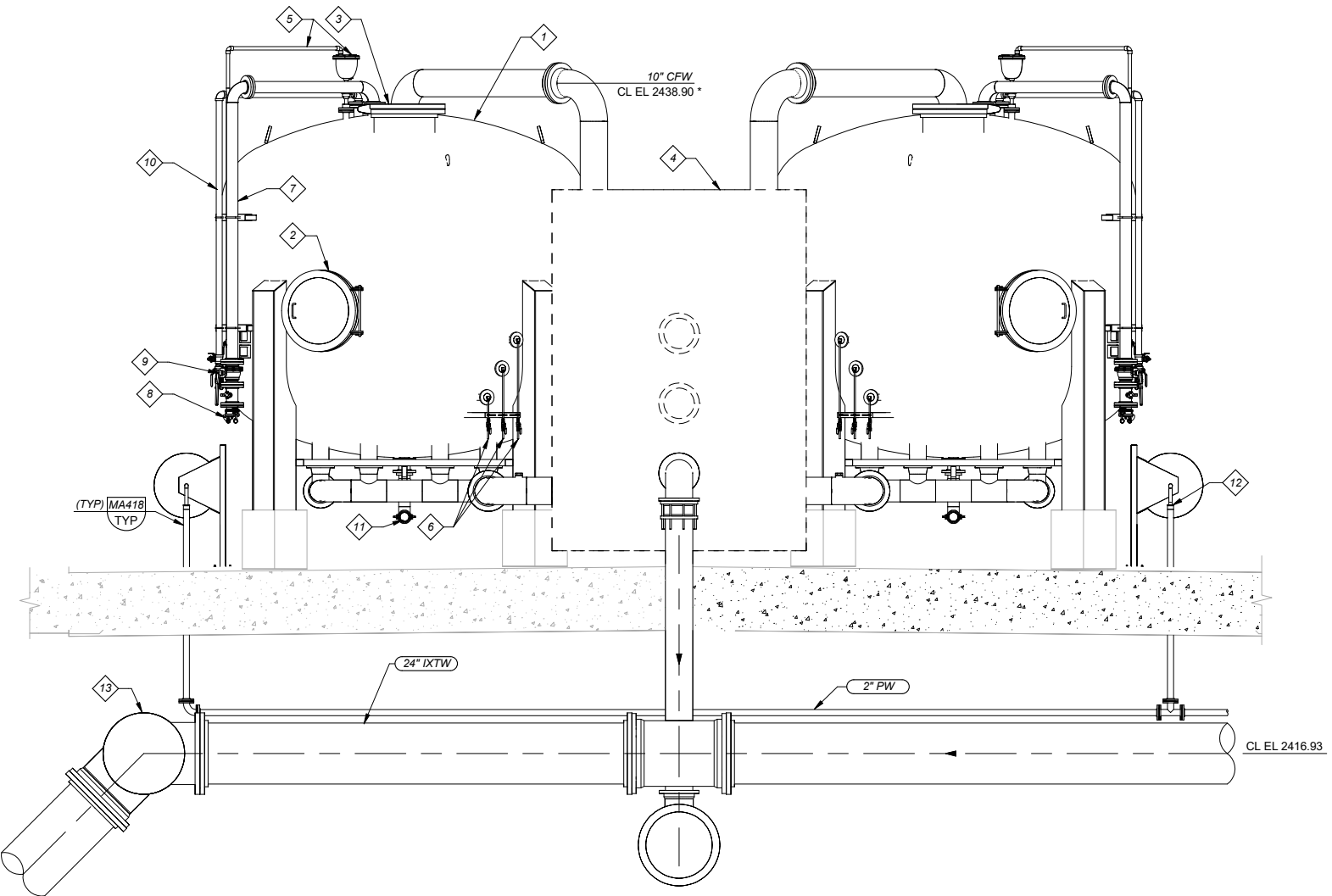
6. 1/2" SAMPLE PORTS PER ION MANUFACTURER AND SPECIFICATION 46_31_15 (TYP)
7. 4" MEDIA FILL PIPE (TYP)
8. 4" QUICK DISCONNECT WITH CAP (TYP)
9. 4" BALL VALVE (TYP)
10. 2" AIR/WATER PIPING (TYP)
11. 4" SPENT MEDIA DRAIN (TYP)
12. 1"x2" CONCENTRIC REDUCER
13. 24" TEE

GENERAL NOTES:

1. PRESSURE RELIEF VALVE SHALL BE SIZED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.
2. FOR CONTINUATION OF BURIED PIPE, SEE CIVIL YARD PIPING DRAWINGS.
3. CONTRACTOR SHALL FIELD VERIFY ALL MEASUREMENTS, SIZE, SCHEDULE, AND MATERIAL OF PIPE AND NOTIFY ENGINEER/OWNER OF FIELD CONDITIONS PRIOR TO ORDERING MATERIALS.
4. PROTECT ALL EXISTING PIPING IN PLACE.
5. PLAN AND SECTIONS FOR ION VESSELS ARE DEPICTED BASED ON PRELIMINARY MANUFACTURER CUT SHEET. ACTUAL DIMENSIONS, PIPING LAYOUTS, AND APPURTENANCE LOCATIONS MAY VARY FROM OTHER MANUFACTURERS.



B SECTION
M11 SCALE: 3/8" = 1'-0"



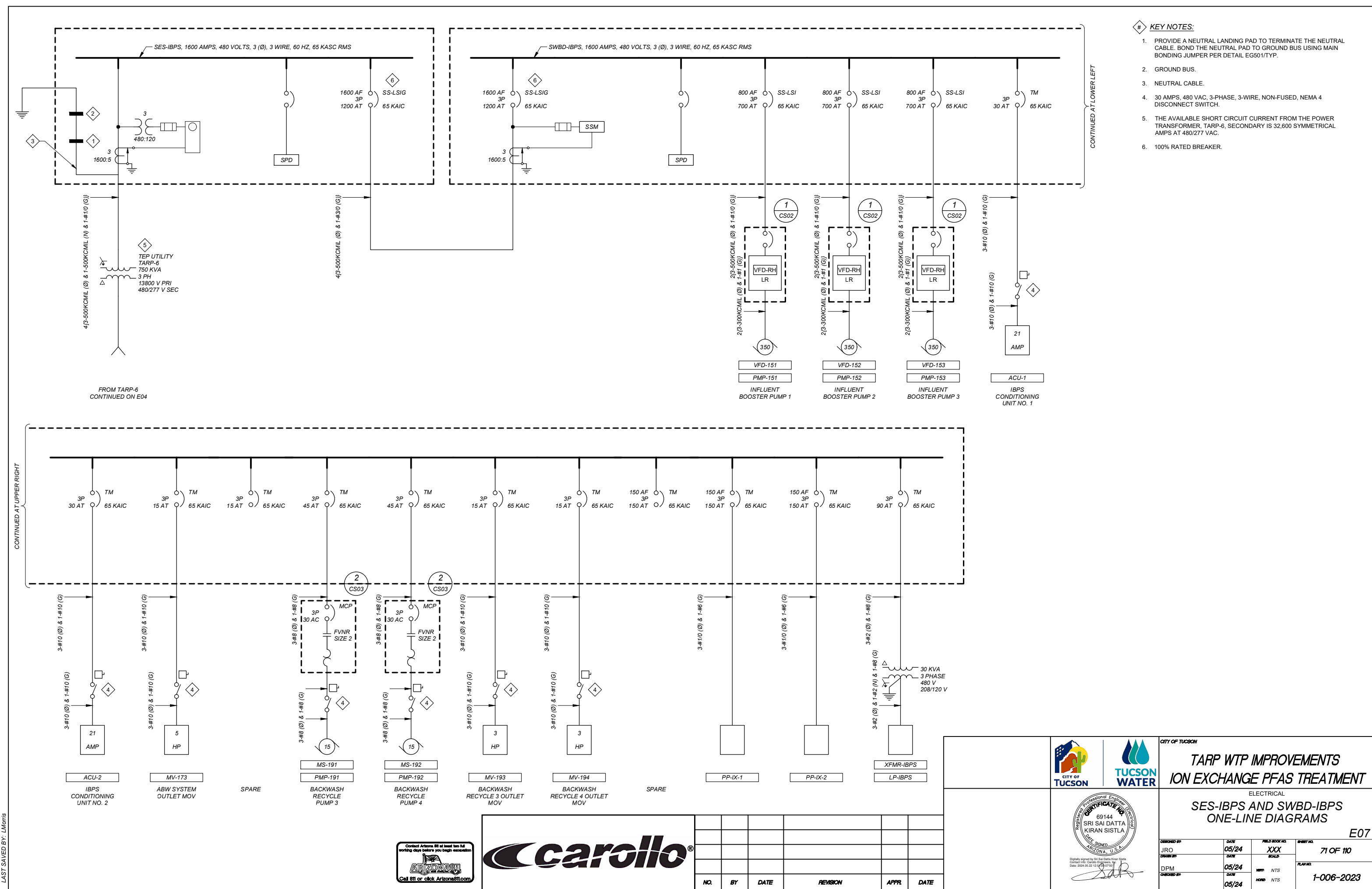
C SECTION
M11 SCALE: 3/8" = 1'-0"



NO.	BY	DATE	REVISION	APPR.	DATE



CITY OF TUCSON			
TARP WTP IMPROVEMENTS			
ION EXCHANGE PFAS TREATMENT			
MECHANICAL			
ION EXCHANGE VESSELS			
SECTIONS 1			
M12			
DESIGNED BY: KW	DATE: 05/24	FIELD BOOK NO: XXX	SHEET NO: 54 OF 110
DRAWN BY: MM	DATE: 05/24	SCALE:	PLAN NO:
CHECKED BY: VE	DATE: 05/24	VERT: As indicated	1-006-2023

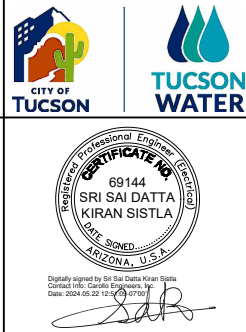


- # KEY NOTES:
1. PROVIDE A NEUTRAL LANDING PAD TO TERMINATE THE NEUTRAL CABLE. BOND THE NEUTRAL PAD TO GROUND BUS USING MAIN BONDING JUMPER PER DETAIL EG501/TYP.
 2. GROUND BUS.
 3. NEUTRAL CABLE.
 4. 30 AMPS, 480 VAC, 3-PHASE, 3-WIRE, NON-FUSED, NEMA 4 DISCONNECT SWITCH.
 5. THE AVAILABLE SHORT CIRCUIT CURRENT FROM THE POWER TRANSFORMER, TARP-6, SECONDARY IS 32,600 SYMMETRICAL AMPS AT 480/277 VAC.
 6. 100% RATED BREAKER.

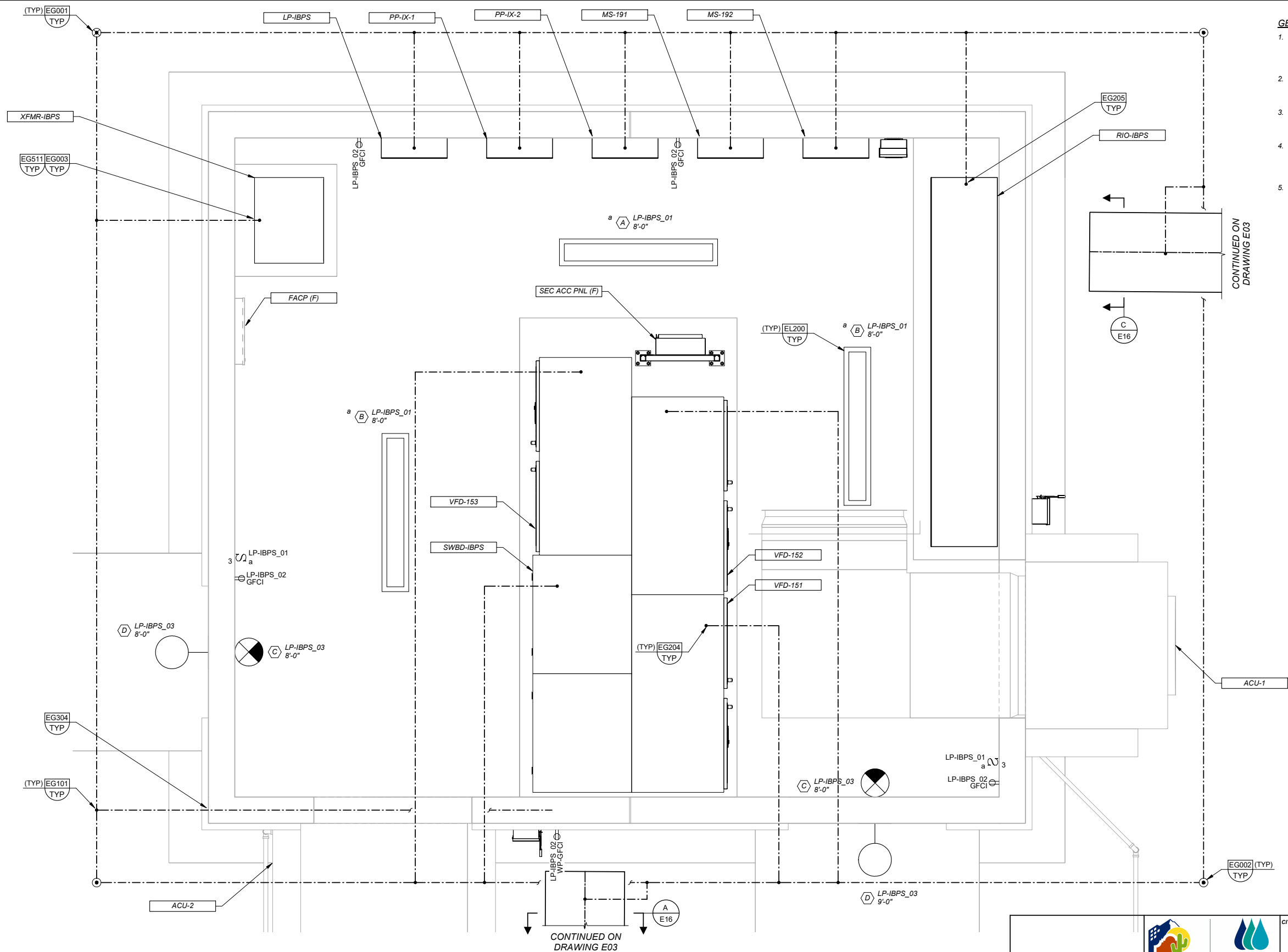
LAST SAVED BY: LMorris



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CITY OF TUCSON			
TARP WTP IMPROVEMENTS ION EXCHANGE PFAS TREATMENT			
ELECTRICAL SES-IBPS AND SWBD-IBPS ONE-LINE DIAGRAMS			
E07			
DESIGNED BY JRO	DATE 05/24	FIELD BOOK NO. XXX	SHEET NO. 71 OF 110
DRAWN BY DPM	DATE 05/24	SCALE NTS	PLAN NO. 1-006-2023
CHECKED BY	DATE 05/24	NOTED NTS	



GENERAL NOTES:

1. CONDUIT ROUTING FOR LIGHTS AND RECEPTACLES IS NOT SHOWN. USE THE PROCESS POWER AND CONTROL CONDUIT ROUTING AS A GUIDE AND INSTALL LIGHTING AND RECEPTACLE CONDUITS AND WIRING IN A SIMILAR MANNER.
2. CONDUIT AND CONDUIT FITTING TYPES SHALL BE THE SAME AS THOSE FOR THE PROCESS POWER AND CONTROL CONDUIT INSTALLATION WITHIN THE AREA.
3. CONDUITS SHALL BE SIZED IN ACCORDANCE WITH THE CONDUIT FILL REQUIREMENTS IN THE SPECIFICATIONS. CONDUIT SHALL NOT BE SMALLER THAN 0.75 INCH.
4. CONDUCTORS FOR LIGHTING AND RECEPTACLE CIRCUITS SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND SHALL BE DERATED TO ACCOUNT FOR MULTIPLE CONDUCTORS IN THE SAME WAY.
5. LIGHTNING PROTECTION SHALL BE PROVIDED TO THE ELECTRICAL BUILDING PER SECTION 26_41_01.

CONTINUED ON
DRAWING E03

CONTINUED ON
DRAWING E03

H PLAN
E03 SCALE: 3/4" = 1'-0"



NO.	BY	DATE	REVISION	APPR.	DATE



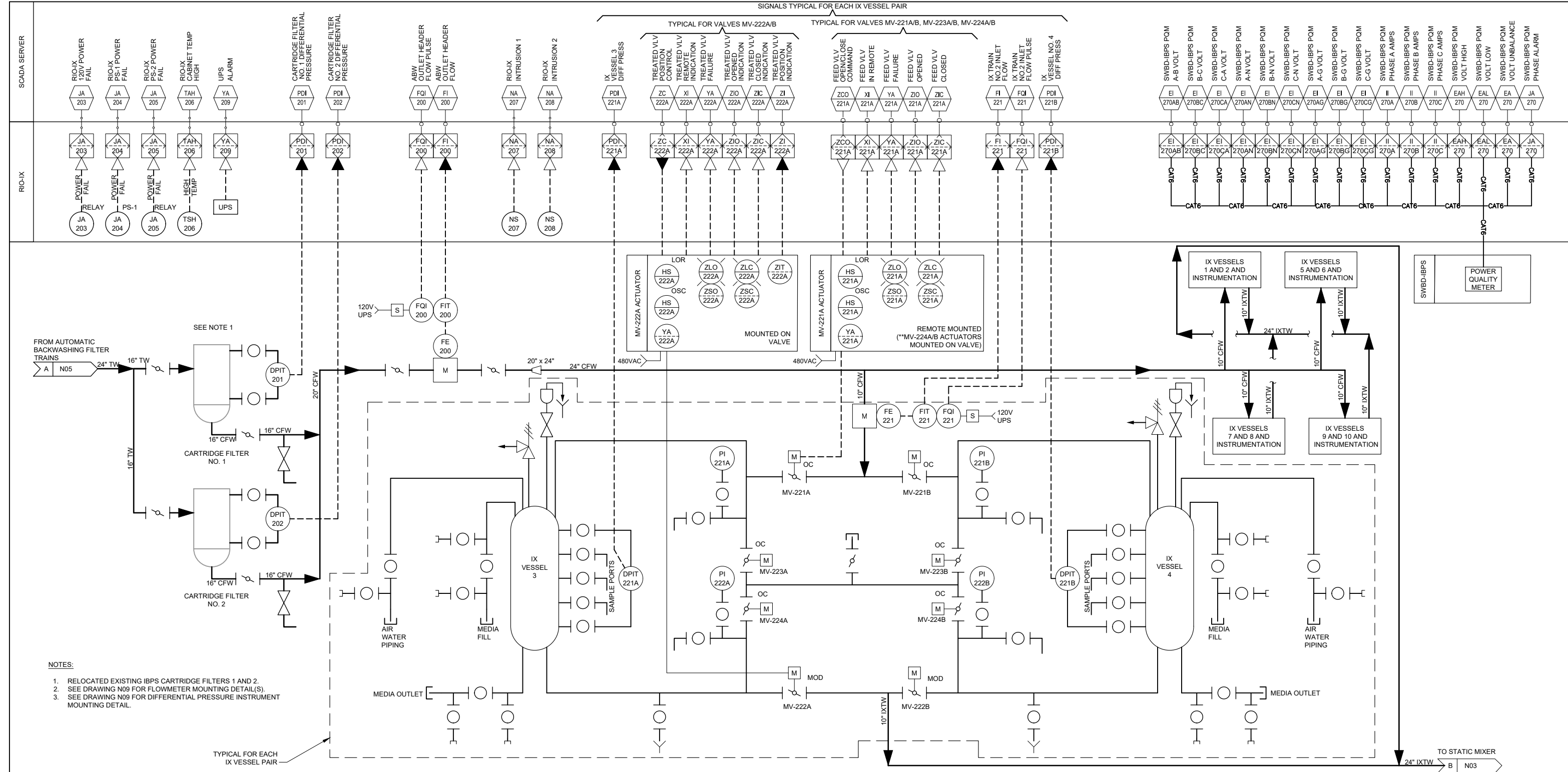
CITY OF TUCSON

**TARP WTP IMPROVEMENTS
ION EXCHANGE PFAS TREATMENT**

**ELECTRICAL
ROOM LIGHTING,
RECEPTACLE, AND GROUNDING
PLAN E15**

DESIGNED BY: JRO	DATE: 05/24	FILES ROOM NO: XXX	SHEET NO: 79 OF 109
DRAWN BY: DPM	DATE: 05/24	VERT: As indicated	PLAN NO: 1-006-2023
CHECKED BY: CE	DATE: 05/24	HORIZ:	





- NOTES:
- 1. RELOCATED EXISTING IBPS CARTRIDGE FILTERS 1 AND 2.
 - 2. SEE DRAWING N09 FOR FLOWMETER MOUNTING DETAIL(S).
 - 3. SEE DRAWING N09 FOR DIFFERENTIAL PRESSURE INSTRUMENT MOUNTING DETAIL.

	TRAIN 1		TRAIN 2		TRAIN 3		TRAIN 4		TRAIN 5	
DEVICE	IX VESSEL 1	IX VESSEL 2	IX VESSEL 3	IX VESSEL 4	IX VESSEL 5	IX VESSEL 6	IX VESSEL 7	IX VESSEL 8	IX VESSEL 9	IX VESSEL 10
DIFF. PRESSURE	DPIT-211A	DPIT-211B	DPIT-221A	DPIT-221B	DPIT-231A	DPIT-231B	DPIT-241A	DPIT-241B	DPIT-251A	DPIT-251B
FEED VALVE	MV-211A	MV-211B	MV-221A	MV-221B	MV-231A	MV-231B	MV-241A	MV-241B	MV-251A	MV-251B
TREATED VALVE	MV-212A	MV-212B	MV-222A	MV-222B	MV-232A	MV-232B	MV-242A	MV-242B	MV-252A	MV-252B
INTERMEDIATE VALVE 1	MV-213A	MV-213B	MV-223A	MV-223B	MV-233A	MV-233B	MV-243A	MV-243B	MV-253A	MV-253B
INTERMEDIATE VALVE 2	MV-214A	MV-214B	MV-224A	MV-224B	MV-234A	MV-234B	MV-244A	MV-244B	MV-254A	MV-254B
FLOW	FE/FIT-211		FE/FIT-221		FE/FIT-231		FE/FIT-241		FE/FIT-251	



NO.	BY	DATE	REVISION	APPR.	DATE

TARP WTP IMPROVEMENTS

ION EXCHANGE PFAS TREATMENT

INSTRUMENTATION

IX TRAIN 2

TYPICAL P&ID

DESIGNED BY: ZW
DATE: 05/24
WY
CHECKED BY: JS

DATE: 05/24
NTS
DATE: 05/24
NTS

FIELD BOOK NO: XXX
SCALE: AS SHOWN
SHEET NO: 95 OF 110
PLAN NO: 1-006-2023

39548
ZANE WILSTERMAN
REGISTERED PROFESSIONAL ENGINEER (Electrical Engineering)
Expires 9-30-24

N06

LAST SAVED BY: Arturo Gutierrez

APPENDIX B

ION EXCHANGE RESIN PRODUCT DATA SHEET

PRODUCT DATA SHEET

Purofine® PFA694EBF

Polystyrenic Gel, Buffered Resin,
Potable Water Grade

PRINCIPAL APPLICATIONS

- Removal of per- and polyfluoroalkyl substances

ADVANTAGES

- Buffered resin
- Stable pH and CSMR* output
- Very high operating capacity
- Excellent kinetics
- Reduces PFAS to non-detect levels ranging from 1 – 5 parts per trillion

SYSTEMS

- Municipal

REGULATORY APPROVALS

- Certified by the WQA to NSF/ANSI-61 Standard

TYPICAL PACKAGING

- 1 ft³ Sack
- 25 L Sack
- 5 ft³ Drum (Fiber)
- 1 m³ Supersack
- 42 ft³ Supersack

* CSMR = Chloride to Sulfate Mass Ratio

TYPICAL PHYSICAL & CHEMICAL CHARACTERISTICS:

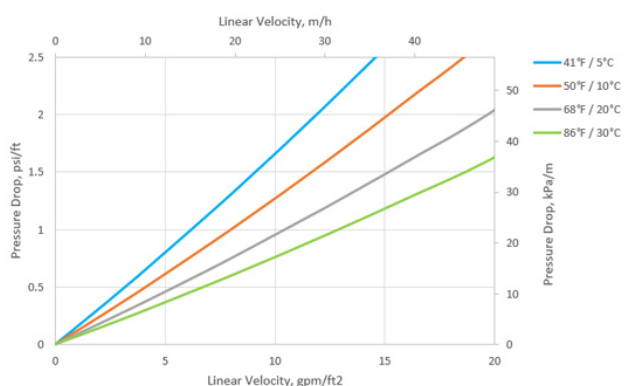
Polymer Structure	Polystyrene crosslinked with divinylbenzene
Appearance	Spherical Beads
Functional Group	Complex Amino
Mean Diameter	700 ± 80 µm
Uniformity Coefficient (max.)	1.3
Specific Gravity	1.05
Shipping Weight (approx.)	650 - 700 g/L (40.6 - 43.8 lb/ft³)
Temperature Limit	100 °C (212.0 °F) (Cl⁻ form)
Temperature Limit	60 °C (140.0 °F) (OH⁻ form)

Hydraulic Characteristics

PRESSURE DROP

The pressure drop across a bed of ion exchange resin depends on the particle size distribution, bed depth, and voids volume of the exchange material, as well as on the flow rate and viscosity of the influent solution. Factors affecting any of these parameters—such as the presence of particulate matter filtered out by the bed, abnormal compressibility of the resin, or the incomplete classification of the bed—will have an adverse effect, and result in an increased head loss. Depending on the quality of the influent water, the application and the design of the plant, service flow rates may vary from 10 to 40 BV/h.

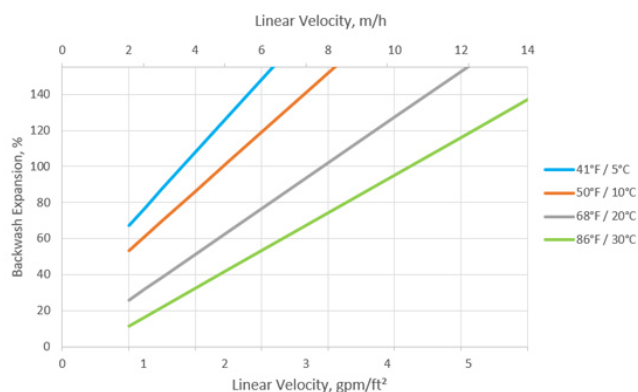
PRESSURE DROP ACROSS RESIN BED



BACKWASH

A 20 BV downflow rinse is required before the vessel is put into service. This rinse can be done onsite or offsite pre-installation. Once the resin is put into service, backwashing is not permitted as this will lead to shortened bed life. This is a uniform grade resin with beads of similar size and will not require backwashing for classification / stratification before use. If it is determined, before startup, that air bubbles or particulate matter are trapped within the bed, then backwashing can be done. In that case, the resin bed should be expanded by 50-70% for 10-15 minutes. Please note that bed expansion increases with higher flow rate and lower water temperature. Avoid loss of resin through the top of the vessel by over expansion of the bed.

BACKWASH EXPANSION OF RESIN BED



Purolite, an Ecolab company, is a leading manufacturer of quality ion exchange, catalyst, adsorbent and specialty high-performance resins with global sales support.



We're ready to solve your process challenges.

For further information on Purolite products and services, visit www.purolite.com or contact us at the addresses below.

Americas
americas@purolite.com

Asia Pacific
asiapacific@purolite.com

EMEA
emea@purolite.com

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APPENDIX C

MCC-AOP LOAD STUDY REPORT



LOAD STUDY REPORT



PROJECT INFORMATION

PROJECT	TARP ADDENDUM 14 - TARGETED PFAS TREATMENT DESIGN
CLIENT	TUCSON WATER
PROJECT NUMBER	202035
REPORT BY	CAROLLO JORCHARD
REPORT DATE	10/12/2023 11:55 AM

EQUIPMENT INFORMATION

TAG	MCC-AOP		
DESCRIPTION	PHASE, WIRE, KASC 3PH, 4W, 65 KAIC KASC		
LOCATION	UV/AOP TREATMENT BUILDING	LARGEST MOTOR	300HP
VOLTAGE	480	COMMENTS	
BUS AMPS	1600		

LOAD TOTALS

OPERATING KVA	OPERATING AMPS
1316.4	1583.3

NEC 215 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
1607.2	1933.2

NEC 430 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
1527.5	1837.3

DEFINITIONS

OPERATING = CONTINUOUS + INTERMITTENT
NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)
NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)
EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)
Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.
Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.

SUBFED EQUIPMENT

TAG	DESCRIPTION	EQUIPMENT SIZE	EQUIPMENT UNITS	STATUS	OPERATING KVA	OPERATING AMPS	BUS COMMENTS
MCC-AOP-U		800.0	AMPS	EXISTING	351.9	423.3	
PP-GAC-1		100.0	AMPS	EXISTING	27.0	32.5	
PP-GAC-2		100.0	AMPS	EXISTING	45.0	54.1	
PP-IX		100.0	AMPS	NEW	47.9	57.6	
T-AOP		75.0	KVA	EXISTING	75.0	90.2	
XFMR-IX		30.0	KVA	NEW	30.0	36.1	
OPERATING LOAD SUBFED SUBTOTAL					576.8	693.8	

LOADS

TAG	DESCRIPTION	LOAD VALUE	LOAD UNITS	STARTING METHOD	LOAD DESIGNATION	LOAD STATUS	OPERATING KVA	OPERATING AMPS	COMMENTS
BIB	BYPASS ISOLATION BREAKER	0	KVA		STANDBY	NEW			
MBB-1	MAINTENANCE BYPASS BREAKER	0	KVA		STANDBY	NEW			
UPS-AOP-U	MAIN RECTIFIER INPUT	0	KVA		STANDBY	EXISTING			
UPS-AOP-U BIB	BYPASS ISOLATION BREAKER (TO BIB)	0	KVA		STANDBY	DEMO			
MCC-AOP-U MBB	MAINTENANCE BYPASS BREAKER (TO MBB-2)	0	KVA		STANDBY	DEMO			
PMP-151	INFLUENT BOOSTER PUMP 1	300	HP	VFD-RH	DUTY / CONTINUOUS	NEW	300.1	361.0	
PMP-152	INFLUENT BOOSTER PUMP 2	300	HP	VFD-RH	DUTY / CONTINUOUS	NEW	300.1	361.0	
	MV-495	1/2	KVA		DUTY / CONTINUOUS	EXISTING	0.5	0.6	

Date/Time displayed in this report reflect time in PST



LOAD STUDY REPORT



PROJECT INFORMATION

PROJECT	TARP ADDENDUM 14 - TARGETED PFAS TREATMENT DESIGN
CLIENT	TUCSON WATER
PROJECT NUMBER	202035
REPORT BY	CAROLLO JORCHARD
REPORT DATE	10/12/2023 11:55 AM

EQUIPMENT INFORMATION

TAG	MCC-AOP
DESCRIPTION	
LOCATION	UV/AOP TREATMENT BUILDING
VOLTAGE	480
BUS AMPS	1600
PHASE, WIRE, KASC	3PH, 4W, 65 KAIC KASC
LARGEST MOTOR	300HP
COMMENTS	

LOADS

TAG	DESCRIPTION	LOAD VALUE	LOAD UNITS	STARTING METHOD	LOAD DESIGNATION	LOAD STATUS	OPERATING KVA	OPERATING AMPS	COMMENTS
PMP-153	MV-550	1/2	KVA		DUTY / CONTINUOUS	EXISTING	0.5	0.6	
	BACKWASH PUMP 3	5	HP	FVNR	DUTY / CONTINUOUS	NEW	6.3	7.6	
	BACKWASH PUMP 4	5	HP	FVNR	STANDBY	NEW			
	INFLUENT BOOSTER PUMP 3	300	HP	VFD-RH	STANDBY	NEW			
ACU-3	AIR CONDITIONER	22	KVA		DUTY / CONTINUOUS	EXISTING	22.0	26.5	
ACU-4	AIR CONDITIONER	22	KVA		DUTY / CONTINUOUS	EXISTING	22.0	26.5	
ACC-1	MV-580	1/2	KVA		DUTY / CONTINUOUS	EXISTING	0.5	0.6	
	AIR COOLED CONDENSER	4	KVA		DUTY / CONTINUOUS	EXISTING	4.0	4.8	
	BACKWASH PUMP 1	5	HP	FVNR	DUTY / CONTINUOUS	EXISTING	6.3	7.6	
EC-1	BACKWASH PUMP 2	5	HP	FVNR	DUTY / CONTINUOUS	EXISTING	6.3	7.6	
	EVAP COOLER	1/2	KVA		DUTY / CONTINUOUS	EXISTING	0.5	0.6	
	BRIDGE CRANE	13	KVA		DUTY / CONTINUOUS	EXISTING	13.0	15.6	
	MV-004, MV-005	2	KVA		DUTY / CONTINUOUS	EXISTING	2.0	2.4	
ACC-2	OVERHEAD COILING DOOR	4	AMP		DUTY / CONTINUOUS	EXISTING	3.3	4.0	
	AIR COOLED CONDENSER	4	KVA		DUTY / CONTINUOUS	EXISTING	4.0	4.8	
	AIR COOLED CONDENSER	4	KVA		DUTY / CONTINUOUS	EXISTING	4.0	4.8	
	AIR COOLED CONDENSER	4	KVA		DUTY / CONTINUOUS	EXISTING	4.0	4.8	
ACU-1	AIR CONDITIONER	20	KVA		DUTY / CONTINUOUS	EXISTING	20.0	24.1	
ACU-2	AIR CONDITIONER	20	KVA		DUTY / CONTINUOUS	EXISTING	20.0	24.1	
OPERATING LOAD SUBTOTAL							739.5	889.5	

Date/Time displayed in this report reflect time in PST

PROJECT INFORMATION

PROJECT	TARP ADDENDUM 14 - TARGETED PFAS TREATMENT DESIGN
CLIENT	TUCSON WATER
PROJECT NUMBER	202035
REPORT BY	CAROLLO JORCHARD
REPORT DATE	10/12/2023 11:55 AM

EQUIPMENT INFORMATION

TAG	MCC-AOP-U
DESCRIPTION	PHASE, WIRE, KASC 3PH, 4W, 65 KAIC KASC
LOCATION	UV/AOP TREATMENT BUILDING
VOLTAGE	480
BUS AMPS	800
	LARGEST MOTOR 0HP
	COMMENTS

LOAD TOTALS

OPERATING KVA	OPERATING AMPS
351.9	423.3

NEC 215 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
439.9	529.1

NEC 430 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
439.9	529.1

DEFINITIONS

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.

Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.

LOADS

TAG	DESCRIPTION	LOAD VALUE	LOAD UNITS	STARTING METHOD	LOAD DESIGNATION	LOAD STATUS	OPERATING KVA	OPERATING AMPS	COMMENTS
	MV-251	3	KVA		DUTY / CONTINUOUS	EXISTING	3.0	3.6	
	MV-001	3	KVA		DUTY / CONTINUOUS	EXISTING	3.0	3.6	
PDC-T3C1	POWER DISTRIBUTION CENTER 5	45	AMP		DUTY / CONTINUOUS	EXISTING	37.4	45.0	
PDC-T3C2	POWER DISTRIBUTION CENTER 6	45	AMP		DUTY / CONTINUOUS	EXISTING	37.4	45.0	
PDC-T2C1	POWER DISTRIBUTION CENTER 3	45	AMP		DUTY / CONTINUOUS	EXISTING	37.4	45.0	
PDC-T2C2	POWER DISTRIBUTION CENTER 4	45	AMP		DUTY / CONTINUOUS	EXISTING	37.4	45.0	
PDC-T1C1	POWER DISTRIBUTION CENTER 1	45	AMP		DUTY / CONTINUOUS	EXISTING	37.4	45.0	
PDC-T1C2	POWER DISTRIBUTION CENTER 2	45	AMP		DUTY / CONTINUOUS	EXISTING	37.4	45.0	
PDC-T1C3	UV AOP CHAMBER PDR-7	48.70	AMP		DUTY / CONTINUOUS	EXISTING	40.5	48.7	120.9 KVA IS FOR ALL 3 NEW CHAMBERS
PDC-T2T3	UV AOP CHAMBER PDR-8	48.70	AMP		DUTY / CONTINUOUS	EXISTING	40.5	48.7	120.9 KVA IS FOR ALL 3 NEW CHAMBERS
PDC-T3C3	UV AOP CHAMBER PDR-9	48.70	AMP		DUTY / CONTINUOUS	EXISTING	40.5	48.7	120.9 KVA IS FOR ALL 3 NEW CHAMBERS
OPERATING LOAD SUBTOTAL							351.9	423.3	

Date/Time displayed in this report reflect time in PST

PROJECT INFORMATION

PROJECT	TARP ADDENDUM 14 - TARGETED PFAS TREATMENT DESIGN
CLIENT	TUCSON WATER
PROJECT NUMBER	202035
REPORT BY	CAROLLO JORCHARD
REPORT DATE	10/12/2023 11:55 AM

EQUIPMENT INFORMATION

TAG	PP-GAC-1		
DESCRIPTION		PHASE, WIRE, KASC	3PH, 3W, 65 KAIC KASC
LOCATION	UV/AOP TREATMENT BUILDING	LARGEST MOTOR	0HP
VOLTAGE	480	COMMENTS	
BUS AMPS	100		

LOAD TOTALS

OPERATING KVA	OPERATING AMPS
27.0	32.5

NEC 215 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
33.8	40.6

NEC 430 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
33.8	40.6

DEFINITIONS

OPERATING = CONTINUOUS + INTERMITTENT
NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)
NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)
EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)
Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.
Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.

LOADS

TAG	DESCRIPTION	LOAD VALUE	LOAD UNITS	STARTING METHOD	LOAD DESIGNATION	LOAD STATUS	OPERATING KVA	OPERATING AMPS	COMMENTS
	PANEL LOAD 1	27	KVA		DUTY / CONTINUOUS	EXISTING	27.0	32.5	
					OPERATING LOAD SUBTOTAL		27.0	32.5	

PROJECT INFORMATION

PROJECT	TARP ADDENDUM 14 - TARGETED PFAS TREATMENT DESIGN
CLIENT	TUCSON WATER
PROJECT NUMBER	202035
REPORT BY	CAROLLO JORCHARD
REPORT DATE	10/12/2023 11:55 AM

EQUIPMENT INFORMATION

TAG	PP-GAC-2
DESCRIPTION	PHASE, WIRE, KASC 3PH, 3W, 65 KAIC KASC
LOCATION	LARGEST MOTOR 0HP
VOLTAGE	COMMENTS
BUS AMPS	

LOAD TOTALS

OPERATING KVA	OPERATING AMPS
45.0	54.1

NEC 215 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
56.3	67.7

NEC 430 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
56.3	67.7

DEFINITIONS

OPERATING = CONTINUOUS + INTERMITTENT
NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)
NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)
EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)
Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.
Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.

LOADS

TAG	DESCRIPTION	LOAD VALUE	LOAD UNITS	STARTING METHOD	LOAD DESIGNATION	LOAD STATUS	OPERATING KVA	OPERATING AMPS	COMMENTS
	PANEL LOAD 2	45	KVA		DUTY / CONTINUOUS	EXISTING	45.0	54.1	
					OPERATING LOAD SUBTOTAL		45.0	54.1	

PROJECT INFORMATION

PROJECT	TARP ADDENDUM 14 - TARGETED PFAS TREATMENT DESIGN
CLIENT	TUCSON WATER
PROJECT NUMBER	202035
REPORT BY	CAROLLO JORCHARD
REPORT DATE	10/12/2023 11:55 AM

EQUIPMENT INFORMATION

TAG	PP-IX
DESCRIPTION	PHASE, WIRE, KASC 3PH, 3W, 65 KAIC KASC
LOCATION	LARGEST MOTOR 3HP
VOLTAGE	480
BUS AMPS	100
COMMENTS	

LOAD TOTALS

OPERATING KVA	OPERATING AMPS
47.9	57.6

NEC 215 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
47.9	57.6

NEC 430 EQUIPMENT SIZING

EQUIPMENT KVA	EQUIPMENT AMPS
48.9	58.8

DEFINITIONS

OPERATING = CONTINUOUS + INTERMITTENT
NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)
NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)
EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)
Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.
Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.

LOADS

TAG	DESCRIPTION	LOAD VALUE	LOAD UNITS	STARTING METHOD	LOAD DESIGNATION	LOAD STATUS	OPERATING KVA	OPERATING AMPS	COMMENTS
	ACTUATOR 1	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 2	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 3	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 4	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 5	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 6	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 7	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 8	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 9	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 10	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 11	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
	ACTUATOR 12	3	HP		DUTY / INTERMITTENT	NEW	4.0	4.8	
OPERATING LOAD SUBTOTAL							47.9	57.6	

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