HUNTER
ENGINEERING
CIVIL AND SURVEY

Preliminary Water Basis of Design Report for Zoning Case at The Collector's Garages at Westworld 9909 E. McDowell Mountain Ranch Road Scottsdale, Arizona 85260

PRELIMINARY Basis of Design Report

- ☐ ACCEPTED
- ☑ ACCEPTED AS NOTED
- ☐ REVISE AND RESUBMIT

CITY OF SCOTTSDALE
SCOTTSDALE WATER
9379 E San Salvador Dr.
Scottsdale, AZ 85258

Disclaimer: If accepted; the preliminary approval is granted under the condition that a final basis of design report will also be submitted for city review and approval (typically during the DR or PP case). The final report shall incorporate further water or sewer design and analysis requirements as defined in the city design standards and policy manual and address those items noted in the preliminary review comments (both separate and included herein). The final report shall be submitted and approved prior to the plan review submission.
For questions or clarifications contact the Water Resources Planning and Engineering Department at 480-312-5685.

BY MRahman and RRahman **DATE** 5/30/2025

5-16-25

Address comments below and herein within the FINAL Basis of Design (BOD) report, which to be submitted with the Development Review (DR) case:

1) Include the coversheet of the 24”X36” preliminary civil improvement plan prior to the utility plan in the BOD report per DS&PM indicating locations of all relevant water/sewer connections and appurtenances. DS&PM 6-1.202. Show all symbols and legends that are used on the utility plan.
2) Identify the approximate elevations in feet as XXXX.XX (NAVD 88) for the static Residual hydrant (R) and the Flow hydrant (F) on the Flow Test Location Map. DS&PM 6-1.405.
3) Locate the meter for each building within an existing right-of-way (R.O.W.) or within a dedicated utility easement with a minimum of 3.0’ offset (horizontal clearance) from the meters and adjacent to the existing and/or proposed utility easements. Show and label all the existing and/or proposed utility easements on the utility plan. DS&PM 6-1.416.
4) Install backflow preventer on each waterline before and adjacent to the meter for each commercial building and show and label them on the Utility Plan. DS&PM 6-1.201.
5) If there are any multi-story buildings, call out the highest Finish Floor (FF) for each building. Based on the bottom water supply curve, demonstrate that a minimum pressure of 50 psi will be available during the peak hour at the highest FF elevation of each multi-story building based on the 2015 IFC Fire Flows Chart. DS&PM 6-1.202.
6) Show the profiles for all the sewer lines and show and label storm drain and waterline crossings on these profiles in the Utility Plan. Show and label the horizontal and vertical clearances between the sewer lines and the storm drain and waterlines. Also, show vertical cover over the sewer lines and waterline.

Preliminary Water Basis of Design Report for Zoning Case at The Collector's Garages at Westworld 9909 E. McDowell Mountain Ranch Road Scottsdale, Arizona 85260

PREPARED FOR:

LGE DESIGN BUILD
1200 NORTH 52ND STREET
PHOENIX, AZ 85008

PREPARED BY:

GRANT HIRNEISE
HUNTER ENGINEERING, INC.
10446 NORTH 74TH STREET, #140
SCOTTSDALE, AZ 85258
(480) 991-3985

H.E. PROJECT NO. LGEC324

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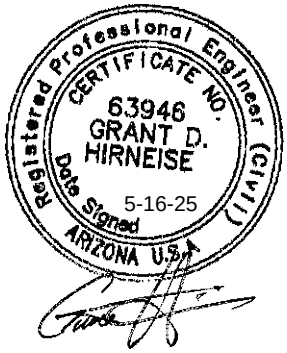


1.0 INTRODUCTION

This preliminary water basis of design report has been prepared under a contract from LGE Design Build, developer of the Collector's Garage at Westworld project. The purpose of this report is to provide a preliminary water analysis and determine if adequate water supply is available, required by the City of Scottsdale, to support this development. Preparation of this report has been done according to the procedures detailed in Chapter 6 of the *City of Scottsdale Design Standards & Policies Manual dated January 2018 (Reference 1).*

This development project is located along the south side of McDowell Mountain Ranch Road just northwest of Thompson Peak Pkwy within the City of Scottsdale, Maricopa County, Arizona. The proposed project is currently two undeveloped parcels within the Westworld master development.

The existing parcel is bound by McDowell Mountain Ranch Road to the north, existing development to the west, and a City of Scottsdale Park to the south and west. The site is specifically located within a portion of Section 5, Township 3 North, Range 5 East, of the Gila and Salt River Base and Meridian. Figure 1, in Appendix A, illustrates the location of the project site in relation to the City of Scottsdale Street system. Access to the site is provided off of McDowell Mountain Ranch Road.

The development proposes the construction of five new auto garage buildings along with a clubhouse. Site improvements will include construction of a driveway entrance, parking lot, sidewalk, landscaping, and supporting infrastructure including storm drain, water, sewer and fire lines. The overall project site is approximately 5 acres.

2.0 EXISTING CONDITIONS

The site is located in Pressure Zone 4. There is an existing 12" ductile iron water line within McDowell Mountain Ranch Road adjacent to the site that the project will tie in to.

3.0 PROPOSED WATER DISTRIBUTION SYSTEM

A new public waterline will be looped through the site within a public waterline easement and two points of connection to the public system. Domestic, landscape and fire services will be taken from the proposed public water line loop. See the Concept Utility Plans in Appendix A.

Per Figure 6-1.2 Average Day Demands in the City of Scottsdale *Design Standards & Policies Manual*, an average day demand (ADD) of 0.00111 gallons per minute per square foot was used (commercial). The Maximum Day Demand is 2.0 times the ADD, and the Peak Hour Demand is 3.5 times the ADD. See Appendix C for a summary of these calculations.

The largest proposed Buildings is 20,794 square feet and will be type V-B construction. Per the 2021 International Fire Code, the minimum base fire flow rate for a building of this size and construction type is 4,000 gallons per minute (GPM). Because this building will be protected by an approved sprinkler system, per NFPA 13, the required fire flow may be 25% of the table value, but not below 1,500 GPM. A fire flow of 1,500 GPM is used for the site analysis. Per City of Scottsdale, pressure requirements, minimum acceptable design pressures are 30 psi at the hydrant under design fire flow requirements and minimum residual pressure 50 psi at highest finished floor for domestic demand.

A fire flow test was completed on August 19, 2024 by Arizona Flow Testing, LLC. This test data was used to model the proposed system using WaterCad, a pipe network analysis program by Haestad Methods. A reservoir and pump were added to the model near the flow test locations to simulate pressure versus flow curve. Both hydrant tests were adjusted per the City of Scottsdale requirements. Note that the pipes P-11 and P-12, connecting the pumps and reservoirs, are not a part of the system and are oversized to 120-inches to minimize system losses. Pipes and junctions were added to the network model matching the pipe sizes, materials, and elevations of the proposed and existing system.

The fire flow model was set up such that 1,500 gpm is taken from the fire hydrants onsite. The lowest resultant pressure based upon the required max day plus fire flow was calculated to be 66.21 psi. This is above the 30-psi fire flow minimum pressure. The resultant pressure for the peak flow is 69.76 psi and is greater than the minimum peak flow pressure of 50 psi. Results and data from the WaterCAD are shown in Appendix C.

4.0 CONCLUSIONS

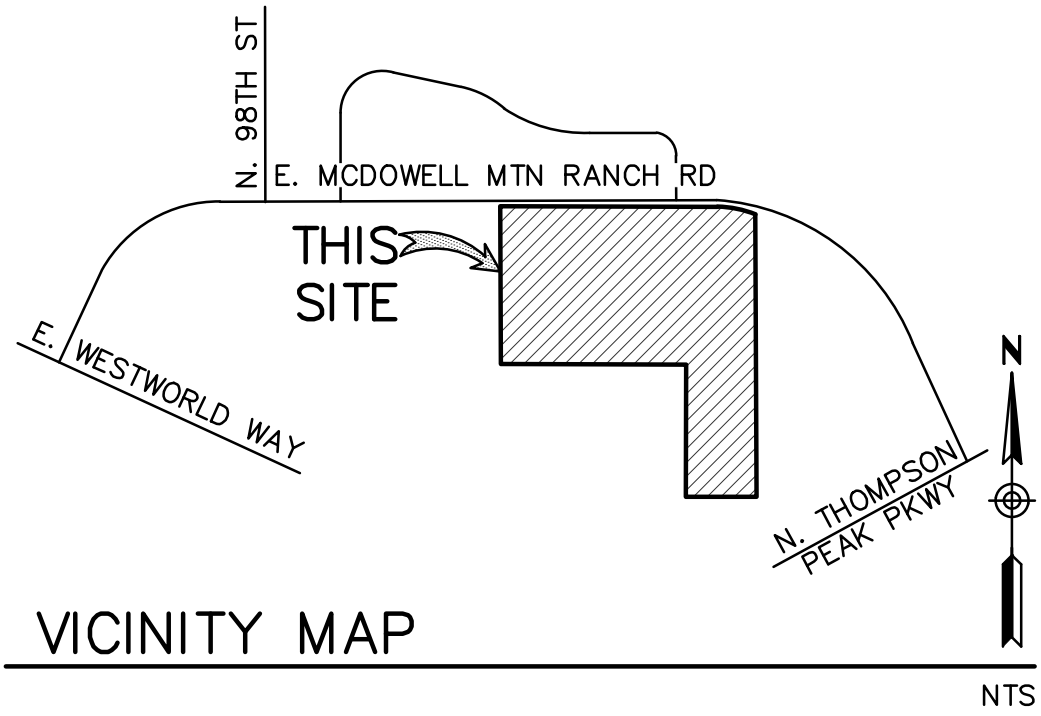
Based on the results of this study, it can be concluded that:

- The proposed water services are adequate to support this development.

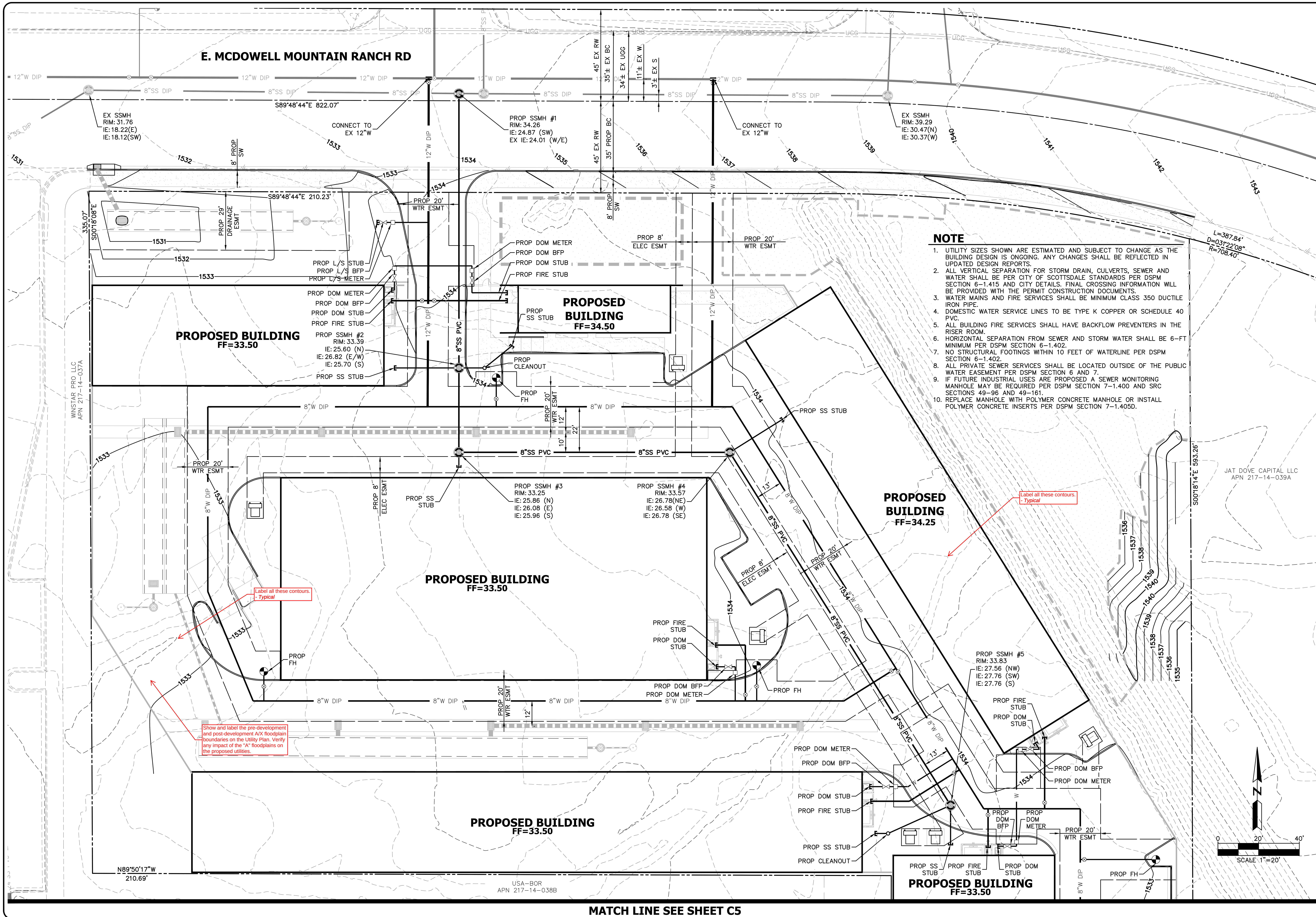
5.0 REFERENCES

1) City of Scottsdale Design Standard & Policies Manual, January 2018.

APPENDIX A
FIGURES



VICINITY MAP


E. MCDOWELL MOUNTAIN RANCH RD
12"W DIP
8"SS DIP
S89°48'44"E 822.07'
EX SSMH
RIM: 31.76
IE: 18.22(E)
IE: 18.12(SW)
CONNECT TO
EX 12"W
PROP SSMH #1
RIM: 34.26
IE: 24.87 (SW)
EX IE: 24.01 (W/E)
45' EX RW
35'± EX BC
34'± EX UGG
11'± EX W
3'± EX S
45' EX RW
35' PROP BC
8' PROP SW
EX SSMH
RIM: 39.29
IE: 30.47(N)
IE: 30.37(W)
S89°48'44"E 210.23'
PROP 29' DRAINAGE ESMT
335.07'
S00°18'08"E
PROP 20' WTR ESMT
PROP 8' ELEC ESMT
PROP DOM METER
PROP DOM BFP
PROP DOM STUB
PROP FIRE STUB
PROP L/S STUB
PROP L/S BFP
PROP L/S METER
PROPOSED BUILDING
FF=34.50
PROP SS STUB
PROPOSED BUILDING
FF=33.50
PROP SSMH #2
RIM: 33.39
IE: 25.60 (N)
IE: 26.82 (E/W)
IE: 25.70 (S)
PROP SS STUB
PROP CLEANOUT
PROP FH
8"SS PVC
12"W DIP
8"W DIP
WINSTAR PRO LLC
APN 217-14-037A
PROP SSMH #3
RIM: 33.25
IE: 25.86 (N)
IE: 26.08 (E)
IE: 25.96 (S)
PROP SSMH #4
RIM: 33.57
IE: 26.78(NE)
IE: 26.58 (W)
IE: 26.78 (SE)
PROP SS STUB
PROP 8' ELEC ESMT
PROPOSED BUILDING
FF=33.50
PROPOSED BUILDING
FF=34.25
Label all these contours.
- Typical
PROP FIRE STUB
PROP DOM STUB
PROP DOM BFP
PROP DOM METER
PROP FH
Show and label the pre-development and post-development A/X floodplain boundaries on the Utility Plan. Verify any impact of the "A" floodplains on the proposed utilities.
PROP SSMH #5
RIM: 33.83
IE: 27.56 (NW)
IE: 27.76 (SW)
IE: 27.76 (S)
L=387.84'
D=031°22'08"
R=708.40'
S00°18'14"E 593.26'
JAT DOVE CAPITAL LLC
APN 217-14-039A
PROP DOM METER
PROP DOM BFP
PROP DOM STUB
PROP FIRE STUB
PROP SS STUB
PROP CLEANOUT
PROPOSED BUILDING
FF=33.50
PROP SS STUB
PROP FIRE STUB
PROP DOM STUB
PROP DOM BFP
PROP DOM METER
PROPOSED BUILDING
FF=33.50
N89°50'17"W
210.69'
USA-BOR
APN 217-14-038B
SCALE 1"=20'
MATCH LINE SEE SHEET C5

NOTE

1. UTILITY SIZES SHOWN ARE ESTIMATED AND SUBJECT TO CHANGE AS THE BUILDING DESIGN IS ONGOING. ANY CHANGES SHALL BE REFLECTED IN UPDATED DESIGN REPORTS.
2. ALL VERTICAL SEPARATION FOR STORM DRAIN, CULVERTS, SEWER AND WATER SHALL BE PER CITY OF SCOTTSDALE STANDARDS PER DSPM SECTION 6-1.415 AND CITY DETAILS. FINAL CROSSING INFORMATION WILL BE PROVIDED WITH THE PERMIT CONSTRUCTION DOCUMENTS.
3. WATER MAINS AND FIRE SERVICES SHALL BE MINIMUM CLASS 350 DUCTILE IRON PIPE.
4. DOMESTIC WATER SERVICE LINES TO BE TYPE K COPPER OR SCHEDULE 40 PVC.
5. ALL BUILDING FIRE SERVICES SHALL HAVE BACKFLOW PREVENTERS IN THE RISER ROOM.
6. HORIZONTAL SEPARATION FROM SEWER AND STORM WATER SHALL BE 6-FT MINIMUM PER DSPM SECTION 6-1.402.
7. NO STRUCTURAL FOOTINGS WITHIN 10 FEET OF WATERLINE PER DSPM SECTION 6-1.402.
8. ALL PRIVATE SEWER SERVICES SHALL BE LOCATED OUTSIDE OF THE PUBLIC WATER EASEMENT PER DSPM SECTION 6 AND 7.
9. IF FUTURE INDUSTRIAL USES ARE PROPOSED A SEWER MONITORING MANHOLE MAY BE REQUIRED PER DSPM SECTION 7-1.400 AND SRC SECTIONS 49-96 AND 49-161.
10. REPLACE MANHOLE WITH POLYMER CONCRETE MANHOLE OR INSTALL POLYMER CONCRETE INSERTS PER DSPM SECTION 7-1.405D.

NO.	DATE	REVISION	BY

PURPOSE: 5th ZONING SUBMITTAL

DESIGN BY: GH
DRAWN BY: DS
CHECKED BY: BL

HUNTER ENGINEERING
CIVIL AND SURVEY
10446 NORTH 74th STREET
SUITE 140
SCOTTSDALE, AZ 85258
P 480 991 3985

Registered Professional Engineer
CERTIFICATE NO. 63946
GRANT D. HIRNEISE
Date Signed 5/16/25
ARIZONA, U.S.A.

CONCEPTUAL UTILITY PLAN FOR COLLECTOR'S GARAGES AT WESTWORLD
9909 E. MCDOWELL MOUNTAIN RANCH ROAD SCOTTSDALE, ARIZONA

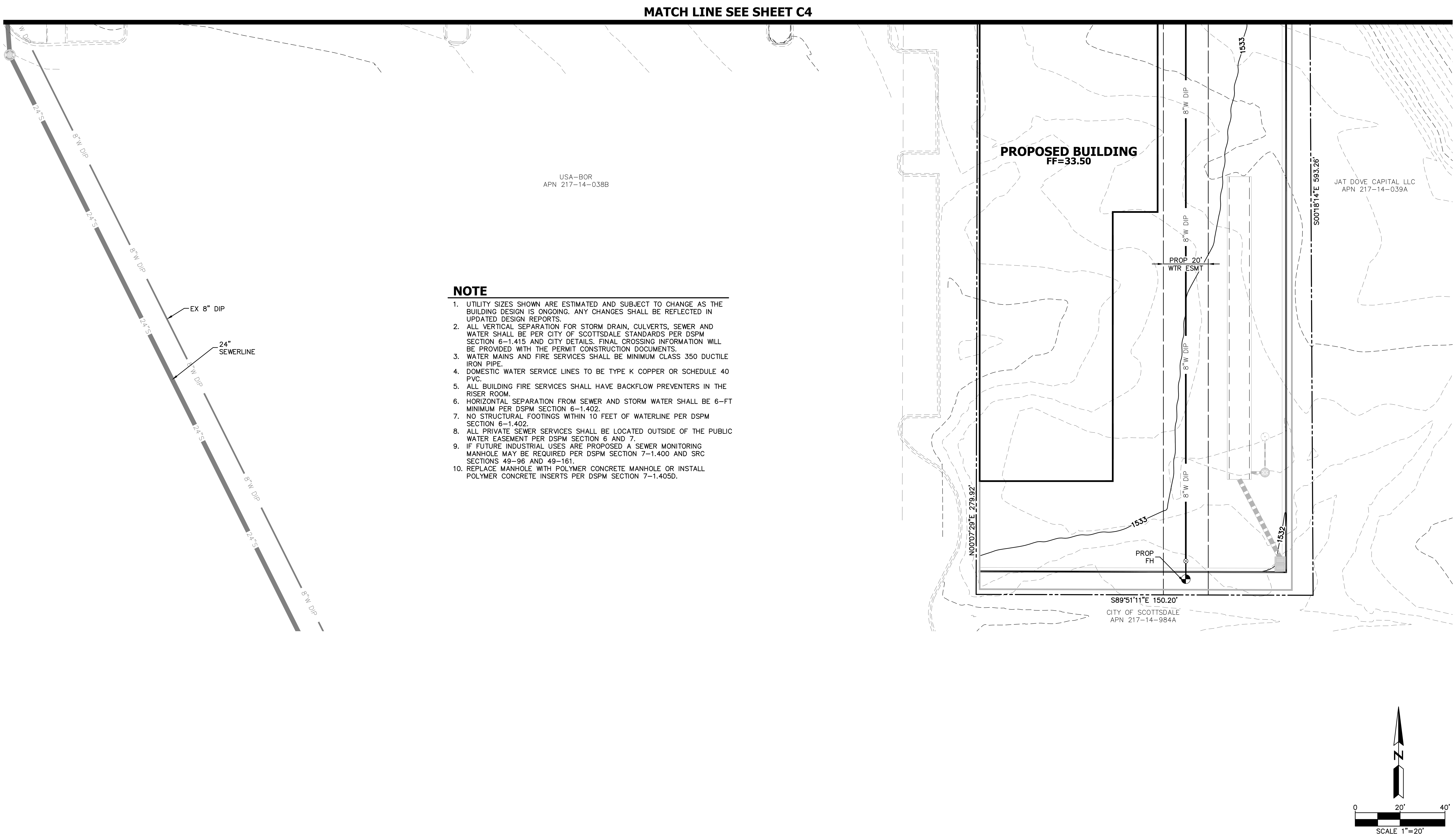
CONTACT ARIZONA 811 AT LEAST 2 FULL WORKING DAYS BEFORE YOU BEGIN EXCAVATION
ARIZONA811
CALL 811 OR CLICK ARIZONA811.COM

THESE PLANS ARE NOT APPROVED FOR CONSTRUCTION WITHOUT AN APPROVED SIGNATURE FROM THE GOVERNING MUNICIPALITY.

PROJECT NAME: COLLECTOR'S GARAGES WESTWORLD

HE NO.: LGEC324
SCALE: 1"=20'

SHEET: C4



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HUNTER ENGINEERING CIVIL AND SURVEY
10446 NORTH 74TH STREET
SUITE 140
SCOTTSDALE, AZ 85258
P 480 991 3985

Registered Professional Engineer
CERTIFICATE NO. 63946
GRANT D. HIRNEISE
(Civil)
Date Signed 5/16/25
ARIZONA, U.S.A

CONCEPTUAL UTILITY PLAN FOR COLLECTOR'S GARAGES AT WESTWORLD 9909 E. MCDOWELL MOUNTAIN RANCH ROAD SCOTTSDALE, ARIZONA

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PROJECT NAME: COLLECTOR'S GARAGES WESTWORLD

HE NO.: LGEC324
SCALE: 1"=20'

SHEET:
C5

APPENDIX B
FIRE HYDRANT FLOW TEST

Arizona Flow Testing LLC

HYDRANT FLOW TEST REPORT

Project Name:	98th St and McDowell Mountain Ranch Rd
Project Address:	98th St & McDowell Mountain Ranch Rd, Scottsdale, Arizona 85260
Client Project No.:	LGEC324
Arizona Flow Testing Project No.:	24665
Flow Test Permit No.:	C76087
Date and time flow test conducted:	August 19, 2024 at 8:10 AM
Data is current and reliable until:	February 19, 2025
Conducted by:	Floyd Vaughan – Arizona Flow Testing, LLC (480-250-8154)
Witnessed by:	Chris Mendez – City of Scottsdale-Inspector (602-9028-9046)

Raw Test Data

Static Pressure: **100.0 PSI**
(Measured in pounds per square inch)

Residual Pressure: **88.0 PSI**
(Measured in pounds per square inch)

Pitot Pressure: **32.0 PSI Hyd A**

(Measured in pounds per square inch)

Diffuser Orifice Diameter: Two 4-inch Pollard Diffuser
(Measured in inches)

Coefficient of Diffuser: 0.9

Flowing GPM: 2431 GPM
(Measured in gallons per minute)
2,431 GPM

GPM @ 30 PSI: 6307 GPM

Data with 28 PSI Safety Factor

Static Pressure: **72.0 PSI**
(Measured in pounds per square inch)

Residual Pressure: **60.0 PSI**
(Measured in pounds per square inch)

Scottsdale requires a maximum Static Pressure of 72 PSI for AFES Design.

Approx distance between hydrants: See Below

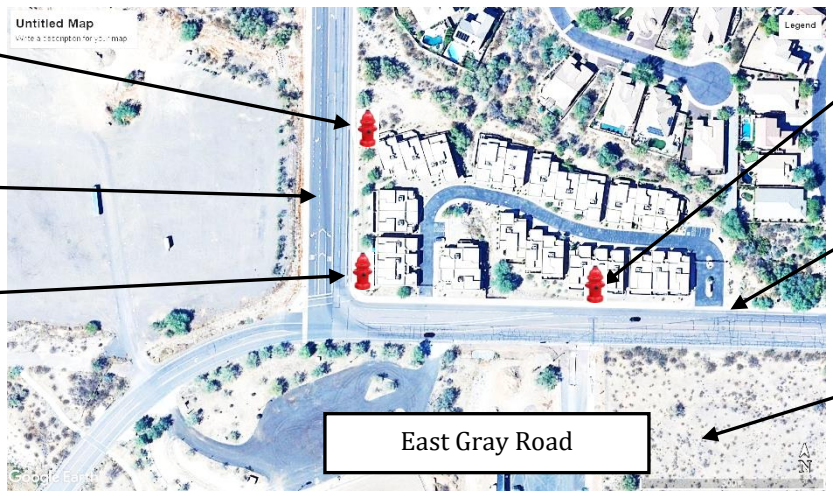
Main size: Not Provided

Flowing GPM: 2431 GPM

GPM @ 30 PSI: 4785 GPM

Flow Test Location

North



NOT USED

Flow Fire Hydrant B
(Approx. 320 Feet from Pressure Hydrant)

North 98th Street

Pressure Fire Hydrant

Flow Fire Hydrant A
(Approx. 44 Feet from Pressure Hydrant)

East McDowell Mountain Ranch Road

Project Site
98th St & McDowell Mountain Ranch Rd.

East Gray Road

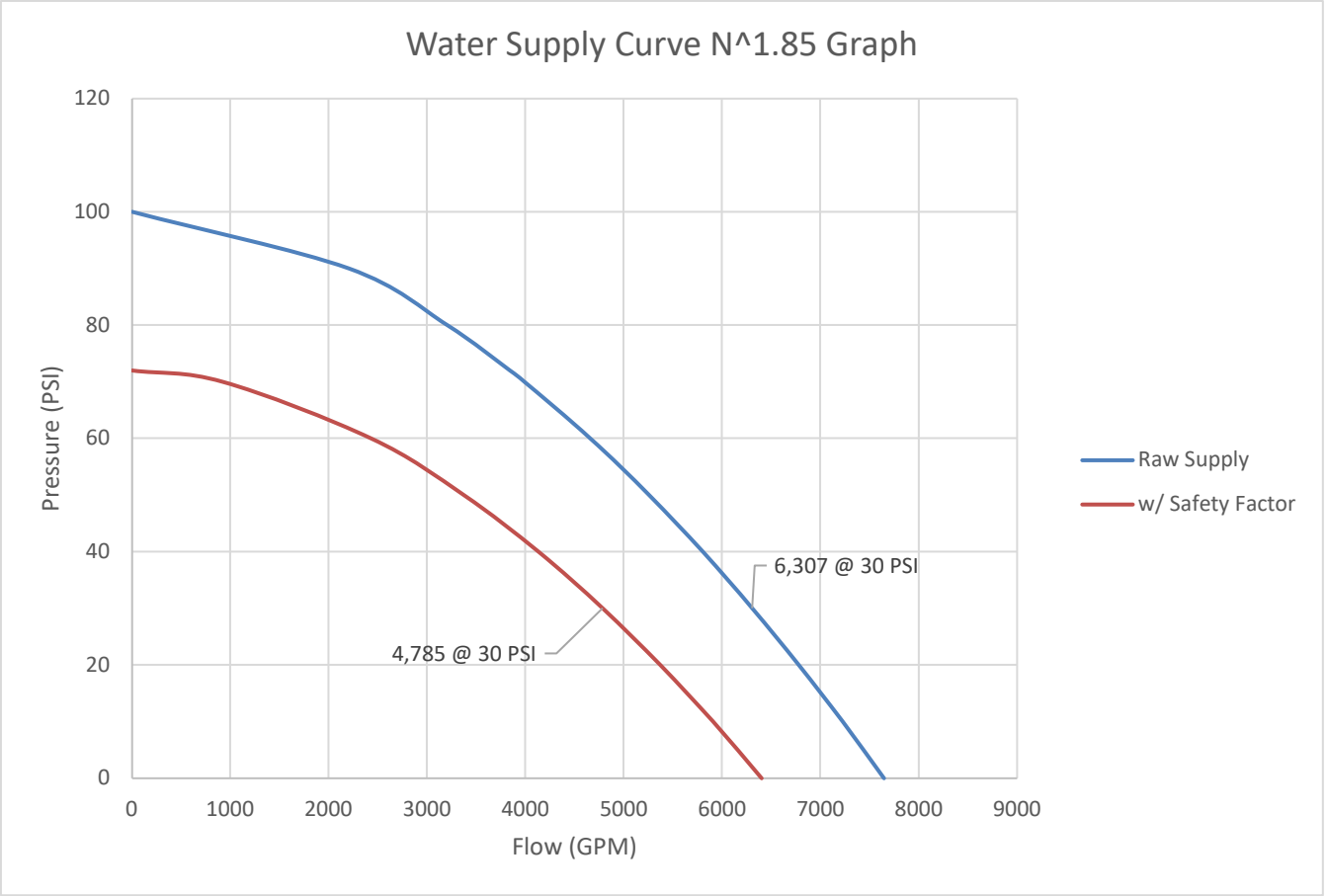
WATER FLOW TEST REPORT

Project: **Collector's Garage at Westworld**
Project Number: LGEC324

TOTAL FLOW DURING TEST: **2431** GPM
STATIC READING: 72 PSI RESIDUAL: 60 PSI

RESULTS: AT 30 PSI RESIDUAL **4785** GPM AT 0 PSI **6397** GPM
REMARKS:

	Shutoff Head	Design	Max Operating
	72 psi	60 psi	0 psi
psi X 2.31 = ft	166.32 ft	138.6 ft	0 ft
		2431 flow	6397 flow



APPENDIX C
CALCULATIONS AND DATA

DOMESTIC DEMAND SUMMARY

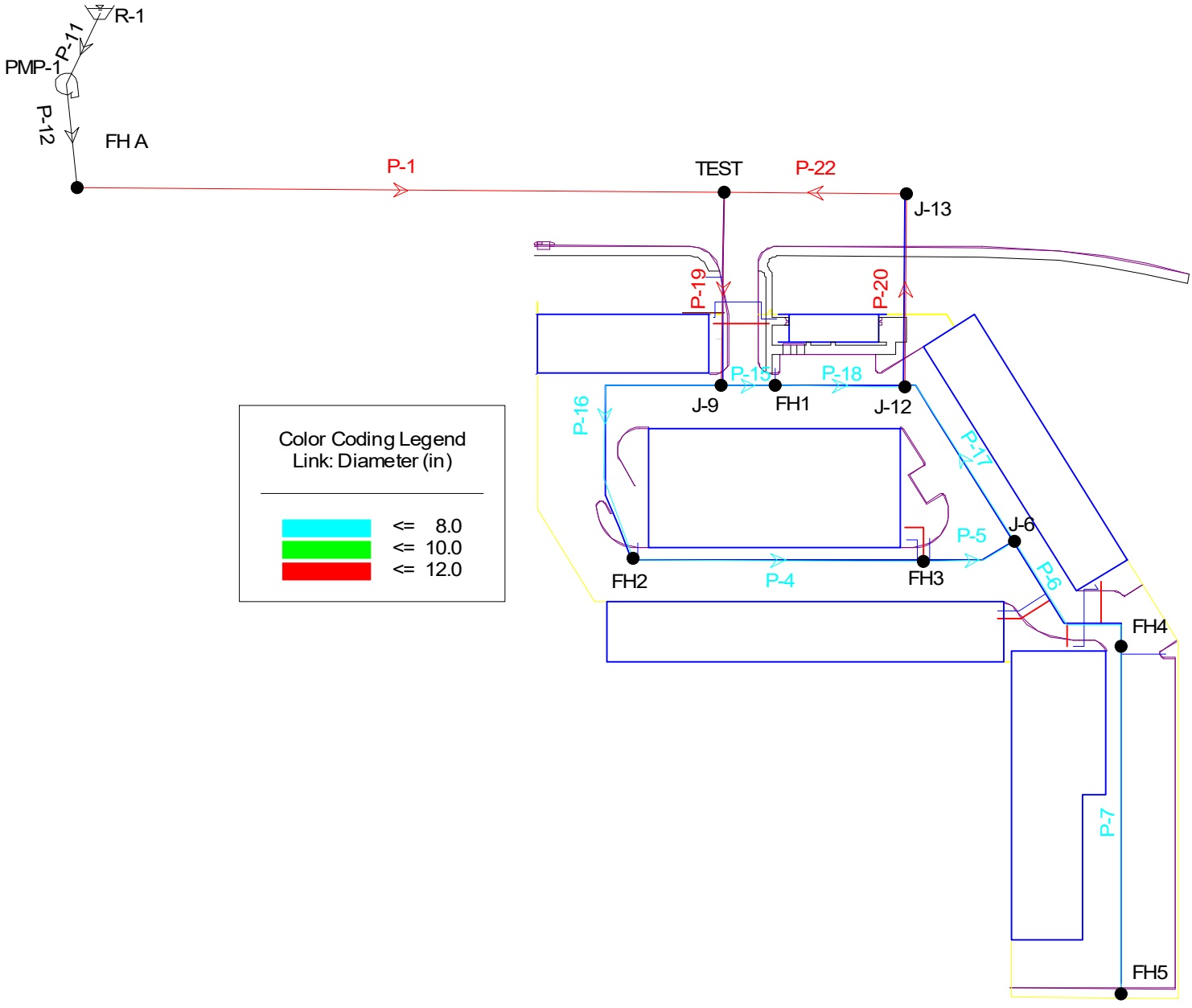
Building	Units	Building Area (sf)	Average Daily Water Demands per Square Foot per Table 6-1.2 Average Day Water Demand		Average Day Demand (ADD) (gpm)	Max Day Demand (MDD) (ADD*2.0) (gpm)	Peak Hour Demand (PHD) (ADD*3.5) (gpm)
A	5	7,072	0.00111	gpm/sf	7.8	15.7	27.5
B	14	20,794	0.00111	gpm/sf	23.1	46.2	80.8
C	11	16,248	0.00111	gpm/sf	18.0	36.1	63.1
D	8	16,588	0.00111	gpm/sf	18.4	36.8	64.4
E	8	11,808	0.00111	gpm/sf	13.1	26.2	45.9
Clubhouse	1	1,945	0.00111	gpm/sf	2.2	4.3	7.6
Total	**47**	**74,455**			**82.6**	**165.3**	**289.3**

FIRE FLOW SUMMARY

Building	Const. Type	Building Area (sf)	Minimum Required Fire Flow for Buildings Table B105.1 2003 Internation Fire Code		25% Reduced Min Required Fire Flow (gpm)	*Available Fire Flow (gpm)	Max Day + Fire Flow	Model Node
A	V-B	7,072	2,250	gpm	1,500	4,785	1,516	Test FH
B	V-B	20,794	4,000	gpm	1,500	4,785	1,546	Test FH
C	V-B	16,248	3,500	gpm	1,500	4,785	1,536	Test FH
D	V-B	16,588	3,500	gpm	1,500	4,785	1,537	Test FH
E	V-B	11,808	3,000	gpm	1,500	4,785	1,526	Test FH
Clubhouse	V-B	1,945	1,750	gpm	1,500	4,785	1,504	Test FH
Total		**74,455**						

* Available Fire Flow at 30 psi residual pressure.

Scenario: CALC



Scenario: STATIC
Steady State Analysis
Junction Report

Label	Elevation (ft)	Base Flow (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH A	1,529.79	0.00	1,696.11	71.96
TEST	1,533.89	0.00	1,696.11	70.18
FH3	1,534.09	0.00	1,696.11	70.10
J-6	1,533.74	0.00	1,696.11	70.25
FH4	1,532.98	0.00	1,696.11	70.58
FH5	1,531.62	0.00	1,696.11	71.17
J-9	1,533.26	0.00	1,696.11	70.46
J-12	1,533.47	0.00	1,696.11	70.37
J-13	1,537.16	0.00	1,696.11	68.77
FH2	1,533.79	0.00	1,696.11	70.23
FH1	1,533.93	0.00	1,696.11	70.17

Pipe Report

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Discharge (gpm)	Material	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	450.00	FH A	TEST	12.0	130.0	0.00	Ductile Iron	0.00	0.00
P-5	80.00	FH3	J-6	8.0	150.0	0.03	PVC	0.00	0.00
P-6	145.00	J-6	FH4	8.0	150.0	0.00	PVC	0.00	0.00
P-7	290.00	FH4	FH5	8.0	150.0	0.00	PVC	0.00	0.00
P-11	1.00	R-1	PMP-1	120.0	150.0	0.00	PVC	0.00	0.00
P-12	1.00	PMP-1	FH A	120.0	150.0	0.00	PVC	0.00	0.00
P-17	162.00	J-6	J-12	8.0	150.0	0.03	PVC	0.00	0.00
P-20	160.00	J-13	J-12	12.0	150.0	-0.04	PVC	0.00	0.00
P-22	151.00	J-13	TEST	12.0	130.0	0.04	Ductile Iron	0.00	0.00
P-4	242.00	FH2	FH3	8.0	150.0	0.03	PVC	0.00	0.00
P-16	244.00	J-9	FH2	8.0	150.0	0.03	PVC	0.00	0.00
P-15	44.00	J-9	FH1	6.0	150.0	0.01	PVC	0.00	0.00
P-18	108.00	FH1	J-12	6.0	150.0	0.01	PVC	0.00	0.00
P-19	161.00	TEST	J-9	12.0	150.0	0.04	PVC	0.00	0.00

Pump Report

Label	Elevation (ft)	Pump Definition	Initial Pump Status	Intake Enhanced HGL (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-1	1,529.79	Pump Definition	On	1,529.79	1,696.11	0.00	166.32

Reservoir Report

Label	Elevation (ft)	Zone	Outflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,529.79	Zone	0.00	1,529.79

Scenario: RESIDUAL
Steady State Analysis
Junction Report

Label	Elevation (ft)	Base Flow (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH A	1,529.79	2,431.00	1,668.39	59.97
TEST	1,533.89	0.00	1,668.39	58.19
FH3	1,534.09	0.00	1,668.39	58.11
J-6	1,533.74	0.00	1,668.39	58.26
FH4	1,532.98	0.00	1,668.39	58.59
FH5	1,531.62	0.00	1,668.39	59.17
J-9	1,533.26	0.00	1,668.39	58.46
J-12	1,533.47	0.00	1,668.39	58.37
J-13	1,537.16	0.00	1,668.39	56.78
FH2	1,533.79	0.00	1,668.39	58.24
FH1	1,533.93	0.00	1,668.39	58.17

Pipe Report

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Discharge (gpm)	Material	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	450.00	FH A	TEST	12.0	130.0	0.00	Ductile Iron	0.00	0.00
P-5	80.00	FH3	J-6	8.0	150.0	0.62	PVC	0.00	0.00
P-6	145.00	J-6	FH4	8.0	150.0	0.00	PVC	0.00	0.00
P-7	290.00	FH4	FH5	8.0	150.0	0.00	PVC	0.00	0.00
P-11	1.00	R-1	PMP-1	120.0	150.0	2,431.00	PVC	0.07	0.00
P-12	1.00	PMP-1	FH A	120.0	150.0	2,431.00	PVC	0.07	0.00
P-17	162.00	J-6	J-12	8.0	150.0	0.61	PVC	0.00	0.00
P-20	160.00	J-13	J-12	12.0	150.0	-0.87	PVC	0.00	0.00
P-22	151.00	J-13	TEST	12.0	130.0	0.87	Ductile Iron	0.00	0.00
P-4	242.00	FH2	FH3	8.0	150.0	0.62	PVC	0.00	0.00
P-16	244.00	J-9	FH2	8.0	150.0	0.62	PVC	0.00	0.00
P-15	44.00	J-9	FH1	6.0	150.0	0.25	PVC	0.00	0.00
P-18	108.00	FH1	J-12	6.0	150.0	0.25	PVC	0.00	0.00
P-19	161.00	TEST	J-9	12.0	150.0	0.87	PVC	0.00	0.00

Pump Report

Label	Elevation (ft)	Pump Definition	Initial Pump Status	Intake Enhanced HGL (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-1	1,529.79	Pump Definition	On	1,529.79	1,668.39	2,431.00	138.60

Reservoir Report

Label	Elevation (ft)	Zone	Outflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,529.79	Zone	2,431.00	1,529.79

Scenario: CALC
Steady State Analysis
Junction Report

Label	Elevation (ft)	Base Flow (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH A	1,529.79	0.00	1,275.23	-110.13
TEST	1,533.89	10,561.00	1,185.49	-150.74
FH3	1,534.09	0.00	1,185.49	-150.82
J-6	1,533.74	0.00	1,185.49	-150.67
FH4	1,532.98	0.00	1,185.49	-150.34
FH5	1,531.62	0.00	1,185.49	-149.76
J-9	1,533.26	0.00	1,185.49	-150.47
J-12	1,533.47	0.00	1,185.49	-150.56
J-13	1,537.16	0.00	1,185.49	-152.15
FH2	1,533.79	0.00	1,185.49	-150.69
FH1	1,533.93	0.00	1,185.49	-150.76

Pipe Report

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Discharge (gpm)	Material	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	450.00	FH A	TEST	12.0	130.0	10,561.00	Ductile Iron	29.96	199.44
P-5	80.00	FH3	J-6	8.0	150.0	2.91	PVC	0.02	0.00
P-6	145.00	J-6	FH4	8.0	150.0	0.00	PVC	0.00	0.00
P-7	290.00	FH4	FH5	8.0	150.0	0.00	PVC	0.00	0.00
P-11	1.00	R-1	PMP-1	120.0	150.0	10,561.00	PVC	0.30	0.00
P-12	1.00	PMP-1	FH A	120.0	150.0	10,561.00	PVC	0.30	0.00
P-17	162.00	J-6	J-12	8.0	150.0	2.91	PVC	0.02	0.00
P-20	160.00	J-13	J-12	12.0	150.0	-4.11	PVC	0.01	0.00
P-22	151.00	J-13	TEST	12.0	130.0	4.11	Ductile Iron	0.01	0.00
P-4	242.00	FH2	FH3	8.0	150.0	2.91	PVC	0.02	0.00
P-16	244.00	J-9	FH2	8.0	150.0	2.91	PVC	0.02	0.00
P-15	44.00	J-9	FH1	6.0	150.0	1.20	PVC	0.01	0.00
P-18	108.00	FH1	J-12	6.0	150.0	1.20	PVC	0.01	0.00
P-19	161.00	TEST	J-9	12.0	150.0	4.11	PVC	0.01	0.00

Pump Report

Label	Elevation (ft)	Pump Definition	Initial Pump Status	Intake Enhanced HGL (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-1	1,529.79	Pump Definition	On	1,529.79	1,275.23	10,561.00	-254.56

Reservoir Report

Label	Elevation (ft)	Zone	Outflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,529.79	Zone	10,561.00	1,529.79

Scenario: PEAK
Steady State Analysis
Junction Report

Label	Elevation (ft)	Base Flow (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH A	1,529.79	0.00	1,695.57	71.73
TEST	1,533.89	0.00	1,695.46	69.90
FH3	1,534.09	0.00	1,695.32	69.76
J-6	1,533.74	289.30	1,695.30	69.90
FH4	1,532.98	0.00	1,695.30	70.23
FH5	1,531.62	0.00	1,695.30	70.82
J-9	1,533.26	0.00	1,695.45	70.17
J-12	1,533.47	0.00	1,695.43	70.07
J-13	1,537.16	0.00	1,695.44	68.48
FH2	1,533.79	0.00	1,695.38	69.91
FH1	1,533.93	0.00	1,695.44	69.88

Pipe Report

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Discharge (gpm)	Material	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	450.00	FH A	TEST	12.0	130.0	289.30	Ductile Iron	0.82	0.25
P-5	80.00	FH3	J-6	8.0	150.0	101.67	PVC	0.65	0.26
P-6	145.00	J-6	FH4	8.0	150.0	0.00	PVC	0.00	0.00
P-7	290.00	FH4	FH5	8.0	150.0	0.00	PVC	0.00	0.00
P-11	1.00	R-1	PMP-1	120.0	150.0	289.30	PVC	0.01	0.00
P-12	1.00	PMP-1	FH A	120.0	150.0	289.30	PVC	0.01	0.00
P-17	162.00	J-6	J-12	8.0	150.0	-187.63	PVC	1.20	0.82
P-20	160.00	J-13	J-12	12.0	150.0	158.21	PVC	0.45	0.08
P-22	151.00	J-13	TEST	12.0	130.0	-158.21	Ductile Iron	0.45	0.08
P-4	242.00	FH2	FH3	8.0	150.0	101.67	PVC	0.65	0.26
P-16	244.00	J-9	FH2	8.0	150.0	101.67	PVC	0.65	0.26
P-15	44.00	J-9	FH1	6.0	150.0	29.42	PVC	0.33	0.11
P-18	108.00	FH1	J-12	6.0	150.0	29.42	PVC	0.33	0.11
P-19	161.00	TEST	J-9	12.0	150.0	131.09	PVC	0.37	0.06

Pump Report

Label	Elevation (ft)	Pump Definition	Initial Pump Status	Intake Enhanced HGL (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-1	1,529.79	Pump Definition	On	1,529.79	1,695.57	289.30	165.78

Reservoir Report

Label	Elevation (ft)	Zone	Outflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,529.79	Zone	289.30	1,529.79

Scenario: FIRE
Steady State Analysis
Junction Report

Label	Elevation (ft)	Base Flow (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH A	1,529.79	0.00	1,691.71	70.05
TEST	1,533.89	0.00	1,690.77	67.87
FH3	1,534.09	300.00	1,689.53	67.25
J-6	1,533.74	0.00	1,689.53	67.40
FH4	1,532.98	300.00	1,688.50	67.29
FH5	1,531.62	300.00	1,687.93	67.63
J-9	1,533.26	0.00	1,690.69	68.11
J-12	1,533.47	0.00	1,690.57	67.97
J-13	1,537.16	0.00	1,690.67	66.42
FH2	1,533.79	300.00	1,690.11	67.63
FH1	1,533.93	0.00	1,690.65	67.81

Pipe Report

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Discharge (gpm)	Material	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	450.00	FH A	TEST	12.0	130.0	900.00	Ductile Iron	2.55	2.09
P-5	80.00	FH3	J-6	8.0	150.0	32.52	PVC	0.21	0.03
P-6	145.00	J-6	FH4	8.0	150.0	600.00	PVC	3.83	7.09
P-7	290.00	FH4	FH5	8.0	150.0	300.00	PVC	1.91	1.96
P-11	1.00	R-1	PMP-1	120.0	150.0	900.00	PVC	0.03	0.00
P-12	1.00	PMP-1	FH A	120.0	150.0	900.00	PVC	0.03	0.00
P-17	162.00	J-6	J-12	8.0	150.0	-567.48	PVC	3.62	6.40
P-20	160.00	J-13	J-12	12.0	150.0	480.83	PVC	1.36	0.65
P-22	151.00	J-13	TEST	12.0	130.0	-480.83	Ductile Iron	1.36	0.65
P-4	242.00	FH2	FH3	8.0	150.0	332.52	PVC	2.12	2.38
P-16	244.00	J-9	FH2	8.0	150.0	332.52	PVC	2.12	2.38
P-15	44.00	J-9	FH1	6.0	150.0	86.65	PVC	0.98	0.80
P-18	108.00	FH1	J-12	6.0	150.0	86.65	PVC	0.98	0.80
P-19	161.00	TEST	J-9	12.0	150.0	419.17	PVC	1.19	0.51

Pump Report

Label	Elevation (ft)	Pump Definition	Initial Pump Status	Intake Enhanced HGL (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-1	1,529.79	Pump Definition	On	1,529.79	1,691.71	900.00	161.92

Reservoir Report

Label	Elevation (ft)	Zone	Outflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,529.79	Zone	900.00	1,529.79

Scenario: MAX DAY+FIRE
Steady State Analysis
Junction Report

Label	Elevation (ft)	Base Flow (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH A	1,529.79	0.00	1,690.10	69.36
TEST	1,533.89	0.00	1,688.81	67.03
FH3	1,534.09	300.00	1,687.13	66.21
J-6	1,533.74	165.30	1,687.11	66.36
FH4	1,532.98	300.00	1,686.09	66.24
FH5	1,531.62	300.00	1,685.52	66.58
J-9	1,533.26	0.00	1,688.70	67.25
J-12	1,533.47	0.00	1,688.53	67.09
J-13	1,537.16	0.00	1,688.68	65.55
FH2	1,533.79	300.00	1,687.91	66.68
FH1	1,533.93	0.00	1,688.65	66.94

Pipe Report

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Discharge (gpm)	Material	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	450.00	FH A	TEST	12.0	130.0	1,065.30	Ductile Iron	3.02	2.85
P-5	80.00	FH3	J-6	8.0	150.0	92.43	PVC	0.59	0.22
P-6	145.00	J-6	FH4	8.0	150.0	600.00	PVC	3.83	7.09
P-7	290.00	FH4	FH5	8.0	150.0	300.00	PVC	1.91	1.96
P-11	1.00	R-1	PMP-1	120.0	150.0	1,065.30	PVC	0.03	0.00
P-12	1.00	PMP-1	FH A	120.0	150.0	1,065.30	PVC	0.03	0.00
P-17	162.00	J-6	J-12	8.0	150.0	-672.87	PVC	4.29	8.77
P-20	160.00	J-13	J-12	12.0	150.0	569.95	PVC	1.62	0.89
P-22	151.00	J-13	TEST	12.0	130.0	-569.95	Ductile Iron	1.62	0.89
P-4	242.00	FH2	FH3	8.0	150.0	392.43	PVC	2.50	3.23
P-16	244.00	J-9	FH2	8.0	150.0	392.43	PVC	2.50	3.23
P-15	44.00	J-9	FH1	6.0	150.0	102.92	PVC	1.17	1.10
P-18	108.00	FH1	J-12	6.0	150.0	102.92	PVC	1.17	1.10
P-19	161.00	TEST	J-9	12.0	150.0	495.35	PVC	1.41	0.69

Pump Report

Label	Elevation (ft)	Pump Definition	Initial Pump Status	Intake Enhanced HGL (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-1	1,529.79	Pump Definition	On	1,529.79	1,690.10	1,065.30	160.31

Reservoir Report

Label	Elevation (ft)	Zone	Outflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,529.79	Zone	1,065.30	1,529.79

Scenario: AVG DAY
Steady State Analysis
Junction Report

Label	Elevation (ft)	Base Flow (gpm)	Calculated Hydraulic Grade (ft)	Pressure (psi)
FH A	1,529.79	0.00	1,696.06	71.94
TEST	1,533.89	0.00	1,696.05	70.16
FH3	1,534.09	0.00	1,696.03	70.06
J-6	1,533.74	82.60	1,696.03	70.22
FH4	1,532.98	0.00	1,696.03	70.54
FH5	1,531.62	0.00	1,696.03	71.13
J-9	1,533.26	0.00	1,696.05	70.43
J-12	1,533.47	0.00	1,696.04	70.34
J-13	1,537.16	0.00	1,696.04	68.74
FH2	1,533.79	0.00	1,696.04	70.20
FH1	1,533.93	0.00	1,696.04	70.14

Pipe Report

Label	Length (ft)	Start Node	Stop Node	Diameter (in)	Hazen-Williams C	Discharge (gpm)	Material	Velocity (ft/s)	Headloss Gradient (ft/1000ft)
P-1	450.00	FH A	TEST	12.0	130.0	82.60	Ductile Iron	0.23	0.02
P-5	80.00	FH3	J-6	8.0	150.0	29.03	PVC	0.19	0.03
P-6	145.00	J-6	FH4	8.0	150.0	0.00	PVC	0.00	0.00
P-7	290.00	FH4	FH5	8.0	150.0	0.00	PVC	0.00	0.00
P-11	1.00	R-1	PMP-1	120.0	150.0	82.60	PVC	0.00	0.00
P-12	1.00	PMP-1	FH A	120.0	150.0	82.60	PVC	0.00	0.00
P-17	162.00	J-6	J-12	8.0	150.0	-53.57	PVC	0.34	0.08
P-20	160.00	J-13	J-12	12.0	150.0	45.17	PVC	0.13	0.01
P-22	151.00	J-13	TEST	12.0	130.0	-45.17	Ductile Iron	0.13	0.01
P-4	242.00	FH2	FH3	8.0	150.0	29.03	PVC	0.19	0.03
P-16	244.00	J-9	FH2	8.0	150.0	29.03	PVC	0.19	0.03
P-15	44.00	J-9	FH1	6.0	150.0	8.40	PVC	0.10	0.01
P-18	108.00	FH1	J-12	6.0	150.0	8.40	PVC	0.10	0.01
P-19	161.00	TEST	J-9	12.0	150.0	37.43	PVC	0.11	0.01

Pump Report

Label	Elevation (ft)	Pump Definition	Initial Pump Status	Intake Enhanced HGL (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)
PMP-1	1,529.79	Pump Definition	On	1,529.79	1,696.06	82.60	166.27

Reservoir Report

Label	Elevation (ft)	Zone	Outflow (gpm)	Calculated Hydraulic Grade (ft)
R-1	1,529.79	Zone	82.60	1,529.79

APPENDIX D
REFERENCES

CITY OF SCOTTSDALE

DESIGN STANDARDS & POLICIES MANUAL

are met. The necessary process to develop the design system supply curve or grade line from the hydrant test results is described in Section 6-1.405.

3. Water demands shall generally be determined based on the unit demands in gallons per minute (gpm) listed in Figure 6-1.2, or as accepted or directed by the Water Resources Department, or as described within this chapter. The Water Resources Department reserves the right to require the use of potentially higher water demand peaking factors or directly apply demand flows for developments if deemed justified e.g. some restaurants or specialty developments.
4. Computer hydraulic modeling shall use H2ONET, WATERCAD, or EPANET software, or other Water Resource Department approved software.
5. In addition to network diagrams clearly present all inputs, details, and analysis output in organized tables.
6. Include all relevant hydraulic network diagrams listed for each of the following required hydraulic analysis scenarios:
    a. Model Scenario 1: Average day demand in gpm at all demand nodes. (Refer to Figure 6-1.2)
    b. Model Scenario 2: Peak hour demand in gpm at all demand nodes. (Refer to Figure 6-1.2 and Section 6-1.404 for peak hour demand)
    c. Model Scenario 3: Maximum day demand in gpm at all demand nodes with worst case fire flow (Refer to section 6-1.501 describing fire flow determination. Refer to Figure 6-1.2 and Section 6-1.404 for maximum day demand)
    Requirements:
        i. The determined fire flow must be applied to the single worst-case location in the proposed system where fire flow will be required. Typically, this is the furthest and/or highest point from the main water supply connection. If not clear what the worst-case fire flow demand point is, the fire flow shall be applied to each potential point in the model until the worst-case point is determined.
        ii. A minimum of 30 pounds per square inch (psi) must be maintained at the worst-case hydrant supply line tee/tap under this condition with a simultaneous minimum of 15 psi maintained at all domestic demand nodes (i.e., at the highest finished floor elevation and post service line and appurtenances) (Refer to scenario 4 for guidance on modeling the service line up to the demand nodes).
    d. Model Scenario 4: Maintain the minimum domestic service pressure at the worst case domestic demand node (location/elevation) under normal daily operating flow conditions termed henceforth as the *Initial Service Line Design Flow*.
    Notes: A minimum of 50 psi must be maintained at the highest proposed finished floor elevation to be served, for the worst hydraulic case domestic demand node, while applying the Initial Service Line Design Flow to the node. Typically, this will be the demand node with the lowest modeled pressure in the previous scenarios. The engineer shall define the service line

details, demand node location, and determine normal daily operating hydraulic conditions/criteria as follows:

i. Demand point location: the furthest, highest (i.e. worst case hydraulic metered node). If the service line distances and building heights are unknown, the demand node shall be located at the geometric center of the lot at elevation 12 feet above the planned finished floor elevation for single family residential. Otherwise a typical highest finished floor elevation for the development type shall be used.

ii. Initial Service Line Design Flow: 1) Estimate the average number of water fixtures served by the subject node; 2) Use the 2015 International Plumbing Code, Appendix E, Table E103.3(2)-total load values and Table E103.3(3) to determine the normal operating flow rate; 3) Add 10 gpm minimum to the normal operating flow to account for either a hose bib or a single irrigation sprinkler zone or estimate a higher applicable intermittent or constant base flow; 4) Apply a 1.5 safety factor to the resultant total flow rate to obtain the Initial Service Line Design Flow. Note that this flow also factors into meter sizing, refer to section 6-1.416 Service Lines and Meters.

iii. Determine the required service line and appurtenance sizing: If the sprinkler system and the domestic uses are metered through a shared meter use the greater of the resultant flow in step above, or the required fire sprinkler flow. Refer to the applicable Fire Code for sprinkler system flow and pressure requirements. Refer to section 6-1.404 Design Flows and Head Loss for design criteria on service lines.

iv. Model pressure losses between the service tap and the demand node: Determine the losses through the water meter and the pressure reducing valve for the resultant flow and sizing from the step above. A combined 10 psi or greater loss shall be used for meter and pressure reducing valve (PRV) in scenario 4. A 5 psi or greater loss shall be used for the meter and PRV in other modeled scenarios. The service pipe friction loss portion will be per its length and diameter as included in the model.

v. All other demand nodes in the network, other than the worst-case node shall be assigned their corresponding peak hour total use demand per Figure 6.1-2 and Section 6-1.404 during this scenario.

vi. No fire flows are to be applied for this scenario.

H. **Network Diagrams**

1. Network Diagram 1: Describe the Physical Modeled Network
   Refer to Sections 6-1.300, 6-1.400, and 6-1.500 and their related subsections for water network design requirements.
   Present all the nodes, valves, pipes, tanks, hydrants, and pumps within the network and present the following:
   a. Network components with IDs
   b. Existing distributions system pipelines (label as existing) and connection to the proposed system

c. Complete proposed water system, including:
d. Each/all individually metered service lines ending in a demand node
    i. Irrigation connections with demand nodes (show both dedicated metered lines and where shared with the domestic service line post-meter)
    ii. Fire sprinkler riser connections with demand nodes (typically dedicated connections are used for developments other than single family residential)
e. Elevations (ft.)
f. Pipe lengths (ft.)
g. Friction head loss coefficients used
h. Pipe/valve diameters (in)
i. Point of any changes in pipe diameter
j. Valve types and positions (open/closed/modulating)
k. Tanks: working volumes (gal), heights (ft.), diameters (ft.)
l. Pump curves (3-point min) or hydraulic grade line (HGL)
m. Note: Developments supplied from the city's water distribution system should be modeled as a pumped supply using a pump curve developed from the required hydrant test to simulate the dynamic flow vs. pressure supplied from the water distribution system. Alternatively, differing supply HGLs derived from the flow test results can be used for the different modeling scenarios.
n. Provide all valve, tank, pump, and system settings (levels, pressures/control set points, valve open/close/modulation rates and settings, valve coefficients, initial conditions, etc.)
o. Static system supply pressure (if supply is from system, develop pump curve or HGL from hydrant test)

Shows all numerical units or provide a legend that indicates the units used

2. Network Diagram 2: Describe the Specific Demand Scenario
    a. Label the figure with the title of specific modeling scenario
    b. Indicate the demand (gpm) being applied to each applicable node for the scenario
    c. Demand nodes shall include all applicable demands for the defined scenario including domestic use (indoor), irrigation (outdoor), fire sprinkler or hydrant, etc. If a node is a summation of more than one demand type describe this in a notes column in the associated tables
    d. Provide all valve, tank, pump, or system settings that are specific to the modeling scenario
    e. Shows all units or provide a legend that indicates the units used
3. Network Diagram 3: Present the Scenario Analysis Results
    Label the figure with the title of the specific modeling scenario and present the following output:
    a. Node pressures (psi or HGL elevation)
    b. Pipe flow (gpm)
    c. Flow direction arrows

d. Pipe flow velocity in feet per second (fps)
e. Each pipe segment's head loss rate (ft. /1,000ft or psi/ft.)
f. PRVs: Upstream and downstream pressures (psi or HGL elevation)
g. Tanks: Inflow and outflow (gpm)
h. Shows all units for the values presented or provide a legend on the diagram page that indicates the units used

AVERAGE DAY WATER DEMANDS [1]							
IN GALLONS PER DAY (GPD) [2]				IN GALLONS PER MINUTE (GPM) [2][3]			
Land Use	Inside Use	Outside Use	Total Use	Inside Use	Outside Use	Total Use	Units
Residential Demand per Dwelling Unit							
< 2 dwelling unit per acre (DU/ac)	208.9	276.7	485.6	0.30	0.39	0.69	per unit
2 – 2.9 DU/ac	193.7	276.7	470.4	0.27	0.39	0.66	per unit
3 – 7.9 DU/ac	175.9	72.3	248.2	0.25	0.11	0.36	per unit
8 – 11.9 DU/ac	155.3	72.3	227.6	0.22	0.11	0.33	per unit
12 – 22 DU/ac	155.3	72.3	227.6	0.22	0.11	0.33	per unit
High Density Condominium (condo)	155.3	30	185.3	0.22	0.05	0.27	per unit
Resort Hotel (includes site amenities)	401.7	44.6	446.3	0.56	0.07	0.63	per room
Service and Employment							
Restaurant	1.2	0.1	1.3	1.67E-03	1.39E-04	1.81E-03	per square foot (sq.ft.)
Commercial/ Retail	0.7	0.1	0.8	9.73E-04	1.39E-04	1.11E-03	per sq.ft.
Commercial High Rise	0.5	0.1	0.6	6.95E-04	1.39E-04	8.34E-04	per sq.ft.

AVERAGE DAY WATER DEMANDS [1]							
IN GALLONS PER DAY (GPD) [2]				IN GALLONS PER MINUTE (GPM) [2][3]			
Office	0.5	0.1	0.6	6.95E-04	1.39E-04	8.34E-04	per sq.ft.
Institutional	670	670	1340	0.94	0.94	1.88	per acre
Industrial	873	154	1027	1.22	0.22	1.44	per acre
Research and Development	1092	192	1284	1.52	0.27	1.79	per acre
Special Use Areas							
Natural Area Open Space	0	0	0	0.0	0.0	0.0	per acre
Developed Open Space – Parks	0	1786	1786	0.0	2.49	2.49	per acre
Developed Open Space – Golf Course	0	4285	4285	0.0	5.96	5.96	per acre

Notes:
(1) These values shall not be used directly for service line or water meter sizing.
(2) Gallon per day values are provided for reference only. The instantaneous gallon per minute flow rates presented are intended for use in the required hydraulic modeling scenarios. The gpm values assume a 12-hour active water use period per 24-hour day. In large or specialty developments or master plans the hydraulic analysis criteria and parameters should be discussed with the Water Resources Department. Seasonal peaking should also be considered. Upon review, the Water Resources Department reserves the right to designate flows to be used in hydraulic modeling scenarios that may be different from those presented here.
(3) The hydraulic modeling peaking factors used in select modeling scenarios are to be applied to the gpm values shown here. Max day and peak hour peaking factors can be found in Section 6-1.404.

FIGURE 6-1.2 AVERAGE DAY WATER DEMANDS

TABLE B105.1(2)
REFERENCE TABLE FOR TABLES B105.1(1) AND B105.2

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute)[b]	FLOW DURATION (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	2
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	3
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	4
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.

a. Types of construction are based on the *International Building Code*.

b. Measured at 20 psi residual pressure.