
FINAL UTILITY REPORT
for
PROJECT RIO
City of Thornton, Adams County, Colorado

Prepared For:

144 Bull Crossing Associates, LLC
1225 17th Street, Suite 3175
Denver, Colorado 80202

Prepared By:

Langan Engineering and Environmental Services, Inc.
300 Kimball Drive, 4th Floor
Parsippany, New Jersey 07054

Richard Burrow, P.E.
Registered Professional Engineer State of Colorado No. 0050315

LANGAN

24 February 2017
100612301

Certifications

144 Bull Crossing Associates, LLC hereby certifies that the sewer and water system for Project Rio will be constructed according to the design presented in this report. I understand that the City of Thornton does not and shall not assume liability for the sewer and water system designed and/or certified by my engineer. I understand that the City of Thornton reviews utility plans but cannot, on behalf of Project Rio, guarantee that final utility design review will absolve 144 Bull Crossing Associates, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Plat and/or Development Permit does not imply approval of my engineer's utility design.

Attest:

_____ Name of Responsible Party

_____ Authorized Signature

_____ Notary Public Authorized Signature

I hereby certify that this report (plan) for the Final Utility Design of Project Rio was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Thornton Standards and Specifications for the Design and Construction of Public and Private Improvements for the Responsible Parties thereof. I understand that the City of Thornton does not and shall not assume liability for utilities designed by others.

Richard Burrow, PE
Registered Professional Engineer State of Colorado No. 0050315

Date

(Affix Seal)

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1.0 INTRODUCTION

This report serves to document the impact of the proposed development Project Rio on the existing water and sanitary sewer infrastructure and to adequately size proposed infrastructure to service the users of this development and the surrounding area.

2.0 GENERAL LOCATION AND DESCRIPTION

2.1. Location and Description of Property

Project Rio is located on a parcel located in the southeast quarter of section 15, township 1 south, range 68 west of the sixth principal meridian, City of Thornton, County of Adams, State of Colorado. The site is bounded by Interstate I-25 to the west, East 144th Avenue to the south, Washington Street to the East, and undeveloped land to the north. The subject property is existing native grassland with topography generally sloping west to east. Major facilities and easements within the site include a Farmers Reservoir and Irrigation Company ("FRICO") irrigation canal and Shay Ditch.

2.2. Description of Project

Project Rio will consist of an 857,470±sf industrial warehouse along with approximately 2,500 auto parking spots and 375 trailer parking spots. In addition to the proposed warehouse facility, this project includes the construction of three public roads; Grant Street (extension), East 146th Avenue, and East 148th Avenue. Following the construction of the public roads, vacant parcels will have been created between the proposed Grant Street extension and existing Washington Street. There is no proposed development on the vacant parcels at this time.

3.0 WATER SERVICE

3.1. Existing Pressure Zone and Infrastructure

The proposed project site is located within the City of Thornton Pressure Zone 1 (see figure 2). This zone is served via gravity from the Thornton Water Treatment Plant (Thornton WTP) and via pumping from the Wes Brown Water Treatment Plant High Service Pump Station (ref: City of Thornton Water and Wastewater Systems Master

Plan). According to table VII-1 of the master plan, pressure zone 1 has the following service elevations

- High Service Elevation: 5250 ft
- Low Service Elevations: 5040 ft
- High Service Pressure: 117 psi
- Low Service Pressure: 40 psi

The City of Thornton has existing water infrastructure in the vicinity of this project. The existing water infrastructure includes and an existing 16-inch water main in East 144th Avenue and an existing 24-inch water main in Washington Street.

3.2. Proposed Water Infrastructure

Project Rio proposes a 12-inch C900 PVC water main extension to serve the project site along with provide water service for future developments along proposed Grant Street, East 146th Avenue, and East 148th Avenue. The proposed water main will tie into two locations into the existing 16-inch water main in East 144th Avenue and to a single location into the existing 24-inch water main in Washington Street. The water main was sized based on the fire service demand of Project Rio. Design criteria and calculations are discussed further in the Fire Water Service section of this report.

In addition to the 12-inch water main extension, Project Rio proposed a separate 10-inch fire loop around the building which will provide water pressurized from the building's internal fire pump to the sprinklers.

3.3. Domestic Water Service

Project Rio has a projected water demand of 206,000± gpd based on a warehouse water demand of 240 gallons per day per 1,000 square feet of building area in accordance with section 203.2.C. of the City of Thornton – Standards and Specification.

$$Water\ Demand_{city} = 857,470\ sf \times \frac{240\ gallons\ per\ day}{1,000\ sf} = 205,792\ gpd \xrightarrow{say} 206,000\ gpd$$

Although the projected water demand was estimated as 206,000 gpd in accordance with City Standards, we believe that this is not reflective of what the true water demand of the facility will be. The proposed building is a “prototype” building which currently exists in many other locations in the country. In a July 1, 2016 letter, Jordan & Skala Engineers approximated the monthly water usage of this facility to be 1,200,000 gallons based on data from existing facilities of this type. This monthly water usage equate to an average water use of 40,000± gallons per day. This load letter has been included in Appendix A of this report.

3.4. Fire Water Service

Fire service calculations and water main sizing was performed by the project’s fire protection engineer, The Harrington Group, and have been included as Appendix B.

4.0 SANITARY SEWER SERVICE

4.1. Existing Basin and Infrastructure

The proposed project site is located within the City of Thornton sanitary sewer basin H (see figure 3). Basin H is located at the northern-most reaches of the City and encompasses the largest area.

The City of Thornton has an existing 10-inch pvc sanitary sewer located in East 144th Avenue in the vicinity of the project.

4.2. Proposed Sewer Infrastructure

A proposed PVC sanitary sewer lateral is proposed along the eastern building face in order to provide sanitary sewer service to the project site. This sanitary sewer lateral ties into the existing 10-inch sewer main located in East 144th Avenue via a “wye” connection approximately 115-ft east of Lincoln Street. The sanitary sewer lateral was designed with a minimum drop of 1/16 inch per foot for 8-inch lines and 1/8 inch per foot for 6-inch lines in accordance with building code. Although manholes are not required by code on the lateral, manholes have been provided at a maximum spacing of

450-ft and include a 3/10 foot drop. Approximately 7% of the 8-inch lateral's capacity and 11% of the 6-inch lateral's capacity is used to convey the proposed sanitary flow (See appendix C for calculations).

A proposed 8-inch public sanitary sewer extension has been proposed within Grant Street to serve future developments in the area. This sewer extension begins at an existing sanitary sewer manhole in the intersection of East 144th Avenue and Grant Street, and continues approximately 1,600 ft north. The extent of the proposed sewer main extension was limited by the extent by which sewer service could be provided via gravity. Future pump stations may be required for future developments to connect into the proposed gravity sewer extension.

The proposed sanitary sewer main was designed in accordance with section 300 of the City of Thornton – Standards and Specification:

- 8" Pipe Min. Slope: 0.4%
- Minimum Cover: 4-ft
- Max. Manhole Spacing: 450-ft
- Min. Manhole Drop: 0.3-ft.

The capacity of the proposed 8-inch gravity main is 235,000 gallons per day based on the pipe flowing no more than 50% of maximum flow capacity (See appendix C for calculations).

4.3. Projected Sanitary Sewer Demand

Project Rio has a projected sanitary sewer demand of 48,000± gpd based on a commercial and industrial sanitary sewer demand of 600 gallons per acre per day in accordance with section 303.4.C.2 of the City of Thornton – Standards and Specification.

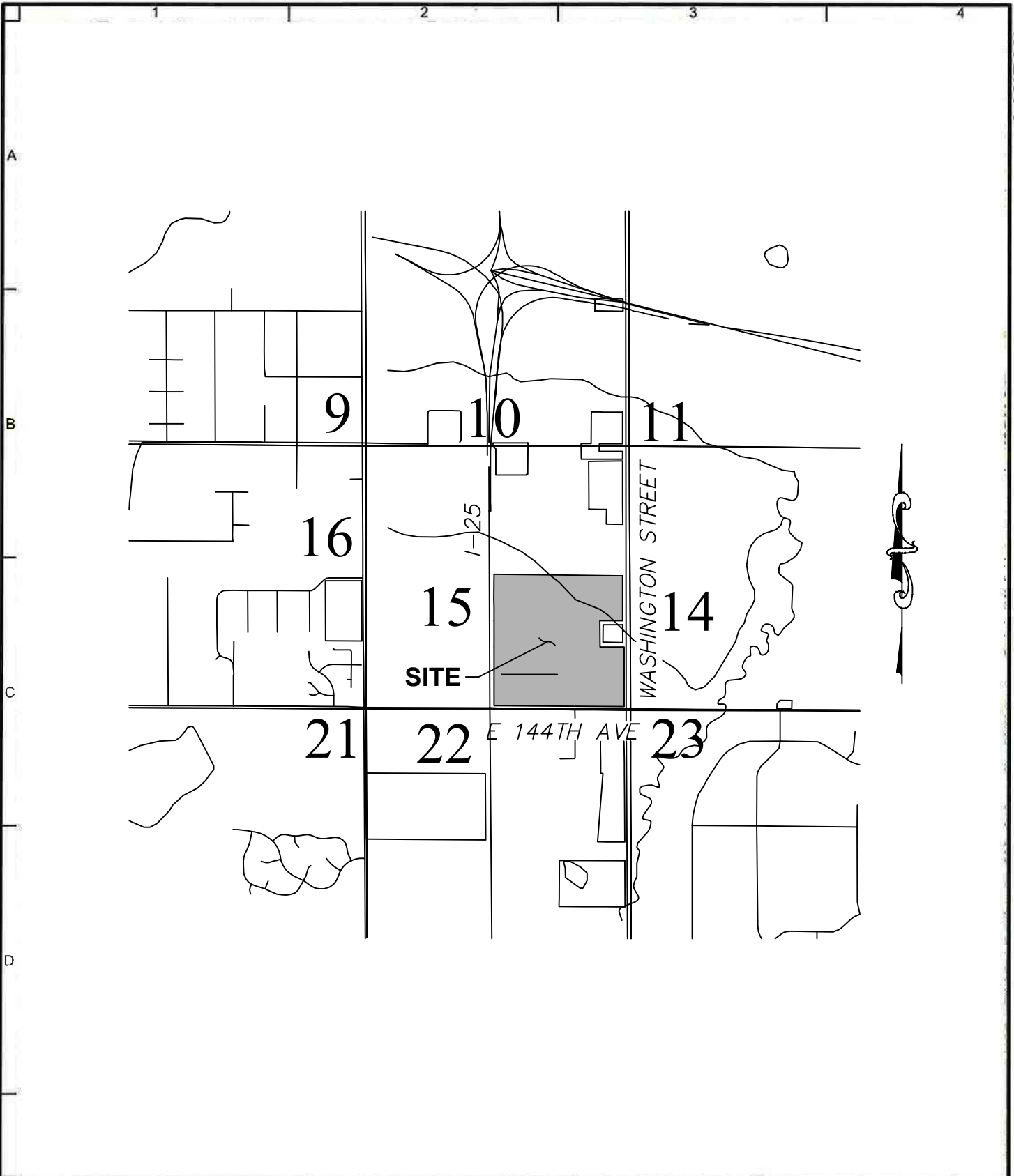
$$Sewer\ Demand_{City} = 80\ acre \times \frac{600\ gallons\ per\ day}{acre} = 48,000\ gpd$$

Although the projected sewer demand was estimated as 48,000 gpd in accordance with City Standards, we believe that this is not reflective of what the true sewer demand of the facility will be. The proposed building is a “prototype” building which currently exists in many other locations in the country. In a July 1, 2016 letter, Jordan & Skala Engineers approximated the monthly water usage of this facility to be 1,200,000 gallons based on data from existing facilities of this type. This monthly water usage equate to an average water use of 40,000± gallons per day. This load letter has been included in Appendix A of this report.

5.0 REFERENCES

1. City of Thornton Standards and Specifications, City of Thornton, October 2012.
2. Water and Wastewater Systems Master Plan – City of Thornton, The Engineering Company, May 2010

FIGURES



LANGAN

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 Lawrenceville, NJ 08648
 T: 609.282.8000 F: 609.282.8001 www.langan.com

Langan Engineering & Environmental Services, Inc.
 Langan Engineering, Environmental, Surveying and
 Landscape Architecture, D.P.C.
 Langan International LLC
 Collectively known as Langan

NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project

PROJECT RIO DEVELOPMENT PERMIT SET

A PARCEL LOCATED IN THE SOUTHEAST QUARTER OF
 SECTION 15, TOWNSHIP 1 SOUTH, RANGE 68 WEST
 OF THE SIXTH PRINCIPAL MERIDIAN,

CITY OF THORNTON

ADAMS COUNTY STATE OF COLORADO

Drawing Title

Vicinity Map

Project No.

100612301

Date

2/24/2017

Scale

1" = 3,000'

Drawn By

MRG

Figure

1

Exhibit VII-1 - City of Thornton: Existing Water System

FIGURE 2

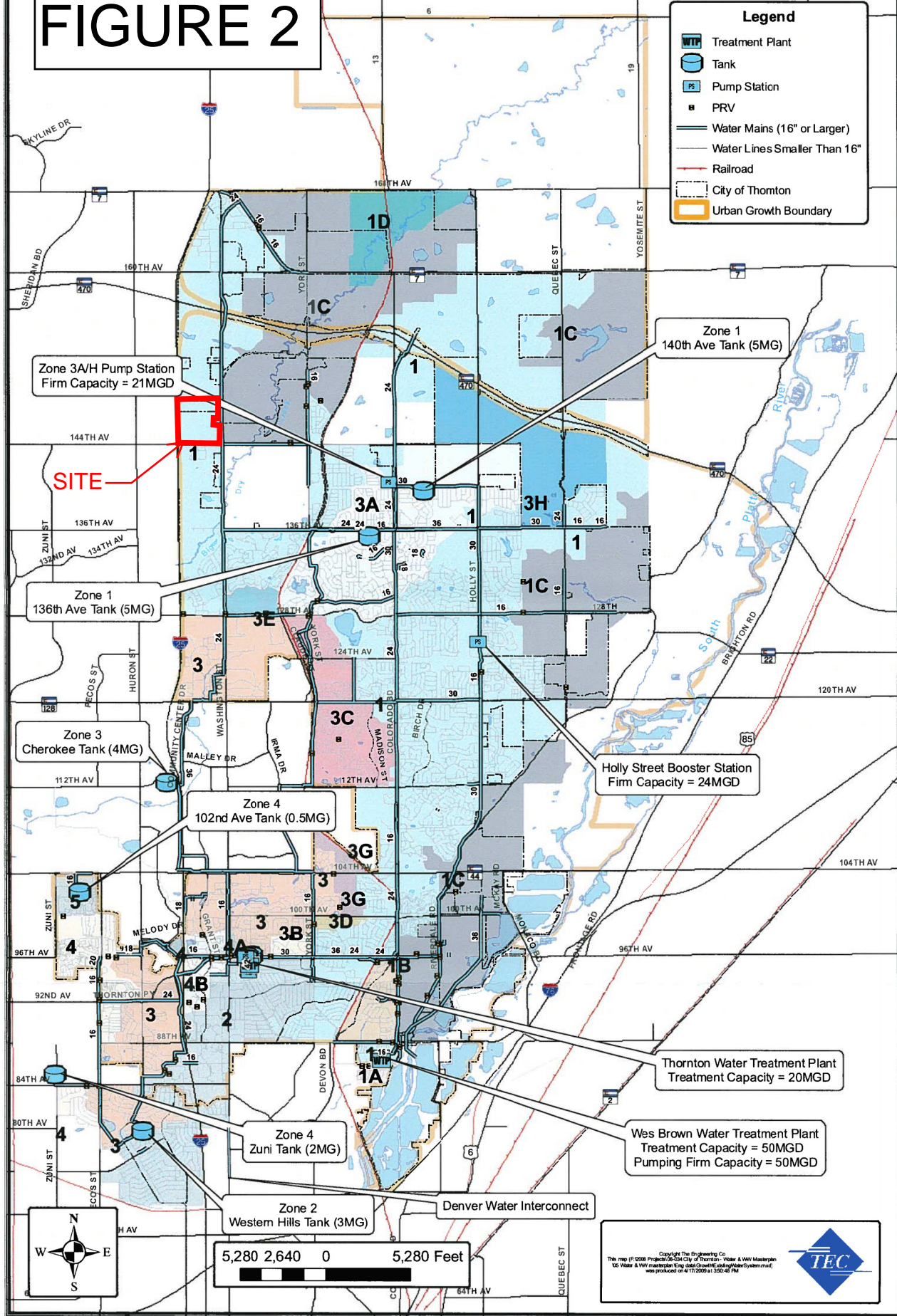
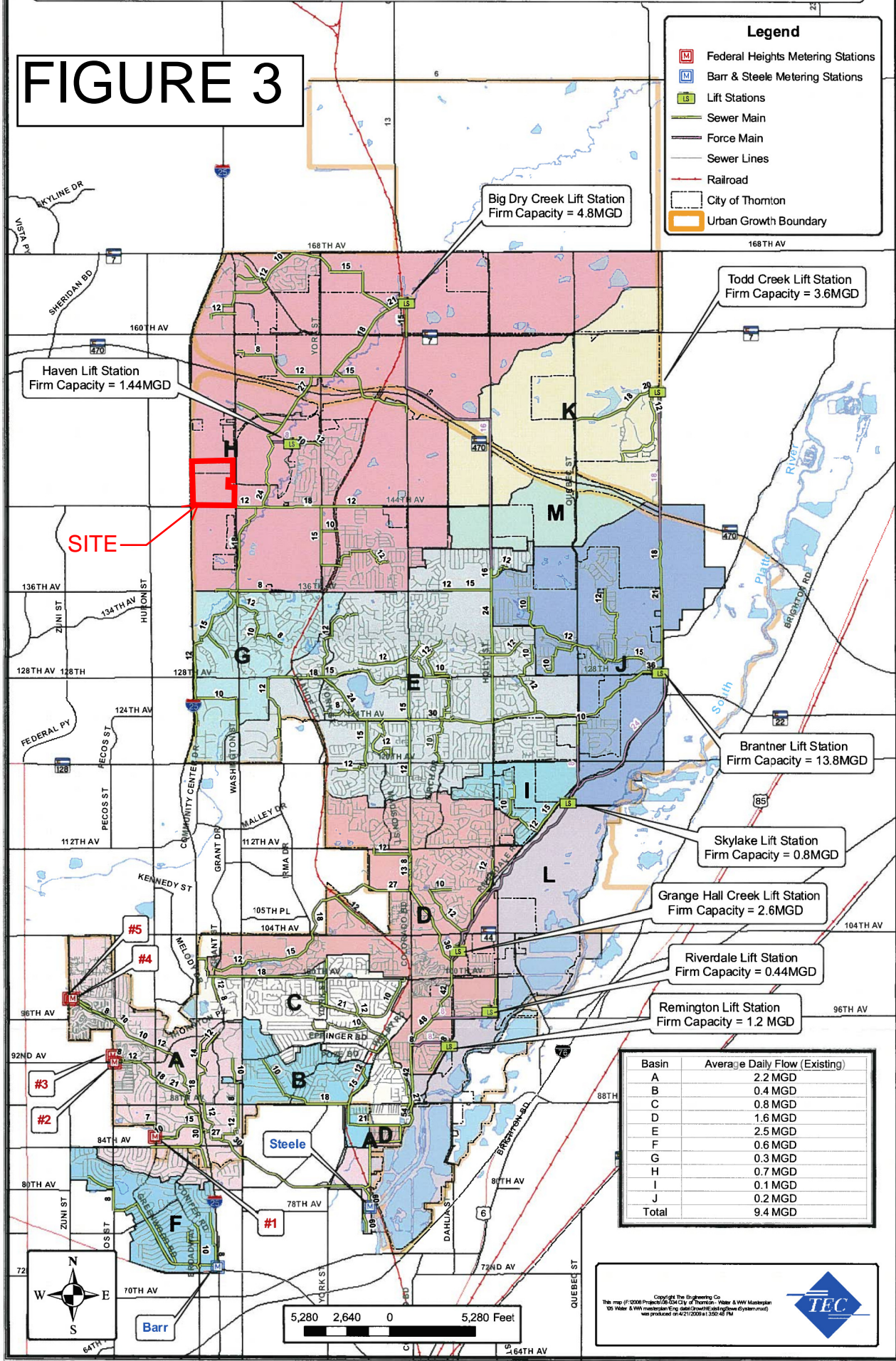


Exhibit XI-1 - City of Thornton: Existing Sewer System

FIGURE 3



APPENDIX A

DOMESTIC WATER AND SANITARY LOAD LETTER

Jordan & Skala Engineers

atlanta charlotte dallas houston las vegas washington

Sort Prototype

07/01/16

Domestic Water Load Summary

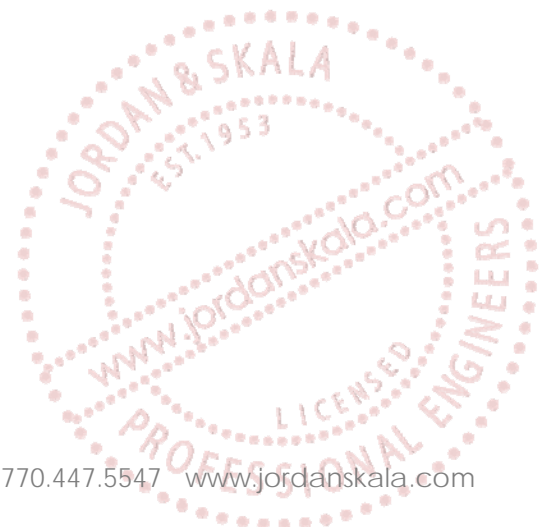
Domestic Water Service Size = 4" (includes future growth)

Peak Design Flow = 240 GPM

Monthly Usage = Approximately 1,200,000 Gallons

Peak load information from other similar facilities in operation for at least 12 months:

Dallas, TX - DFW7 -	1,437,820 gallons
Robbinsville, NJ - EWR4 -	1,236,900 gallons
Tracy, CA - OAK6 -	754,036 gallons



APPENDIX B

FIRE SERVICE CALCULATIONS



Atlanta, GA • Charlotte, NC
d/b/a HGI, Inc. in the State of North Carolina

Jeff L. Harrington, P.E.
James M. Rucci, P.E.
Dale C. Hansen, P.E.
Phillip A. Friday, P.E.

February 10, 2017

Via Email

Mr. Bob Sullivan
Interim Fire Marshal
Thornton Fire Department
9500 Civic Center Drive
Thornton, CO 80229
bob.sullivan@cityofthornton.net

RE: PROJECT RIO
NEC OF INTERSTATE I-25 & W 144TH AVE
THORNTON, COLORADO

HGI #: 16MAC0044.0000
FIRE FLOW CALCULATION

Dear Mr. Sullivan:

Harrington Group, Inc. ("HGI") has prepared a fire flow calculation for the subject project, which is included herein as **Attachment A**. An associated fire protection site plan with hydraulic node points is also included as **Attachment B**. The calculation shows that the required fire flow is met; as stipulated by the 2015 International Fire Code with City of Thornton Amendments. Appendix B – Fire Flow Requirements for Buildings subsection B105.2 is modified by the City of Thornton to permit a 50% reduction in water; or 4,000 gpm available at a residual pressure exceeding 20 psi from four (4) separate and hydraulically remote onsite fire hydrants.¹

The fire flow calculation uses the following as a design basis water supply, which is based upon raw water flow data obtained during flow testing performed on March 25, 2016 by Emily Hildreth, Civil Engineering Technician II, Development Engineering Division City of Thornton, Colorado provided as **Attachment C**:

- | Closed PRV | Open PRV |
|-------------------|-------------------|
| ➤ 97 psi static | ➤ 97 psi static |
| ➤ 85 psi residual | ➤ 95 psi residual |
| ➤ 2,248 gpm flow | ➤ 2,370 gpm flow |

The calculation includes all designed lengths of pipe, pipe material, fittings, valves, etc. on the public underground fire main that is proposed to loop around the building. The City water system is equipped with a pressure reducing valve (PRV) to limit high pressure on the public water supply in the area of this test. The "Closed PRV" data set was used under the assumption that the PRV will be closed under normal operations. However, the "Open PRV" test data has been provided as a point of comparison. Finally, the calculation also assumes an additional loss of pressure due to the 40 foot elevation difference between the test hydrant and the site.

¹ International Fire Code – Appendix B Subsection B102.1, Table B105.1(2)

Mr. Bob Sullivan
February 10, 2017
Page 2

If you have any questions or concerns regarding the included information, please do not hesitate to contact us.

Sincerely,

HARRINGTON GROUP, INC.



Benjamin Randle
Senior Fire Protection Consultant

REVIEWED BY:



Jeff Harrington, P.E.
Principal/Senior Fire Protection Engineer

Cc:

Phil Friday, Harrington Group, Inc. (pfriday@hgi-fire.com)
Andrew Dell, Macgregor Associates Architects (adell@maamail.com)
Taylor Nelson, Trammell Crow (tnelson@trammellcrow.com)
Michael Golias, Langan (mgolias@langan.com)



Enclosures

Attachment A
Fire Flow Calculation

HARRINGTON GROUP, INC.
2400 MEADOWBROOK PKWY SUITE 250
DULUTH, GA 30096-4635

HYDRAULIC CALCULATIONS FOR
Project Rio

DRAWING NUMBER: ATTACH. B DATE: FEB 9, 2017

-DESIGN DATA-

REMOTE AREA NUMBER: N/A REMOTE AREA LOCATION: N/A

OCCUPANCY CLASSIFICATION: Storage/ Group S-1

DENSITY: N/A gpm/sq. ft.

AREA OF APPLICATION: N/A sq. ft.

COVERAGE PER SPRINKLER: N/A sq. ft.

TYPE OF SPRINKLERS CALCULATED: N/A

NUMBER OF SPRINKLERS CALCULATED: N/A

*IN-RACK SPRINKLER DEMAND: N/A gpm

HOSE-STREAM DEMAND: 4,000 gpm

TOTAL WATER REQUIRED (INCLUDING HOSE): 4,000 gpm

FLOW AND PRESSURE (AT BASE OF RISER): gpm @ psi

TYPE OF SYSTEM: Underground Loop

*VOLUME OF DRY OR PREACTION SYSTEM: N/A

*DETAILS:

WATER SUPPLY

Source: City Test Date: 03/25/15 Test By: COT

Location: NEC of E 144th Ave and Washington St

Static: 97 psi Residual: 85 psi Flow: 2,248 gpm

Source Elevation Relative to Finished Floor Level: -40 ft.

INSTALLING CONTRACTOR

Name: TBD

Address:

Phone: Certification number:

NAME OF DESIGNER:

AUTHORITY HAVING JURISDICTION:

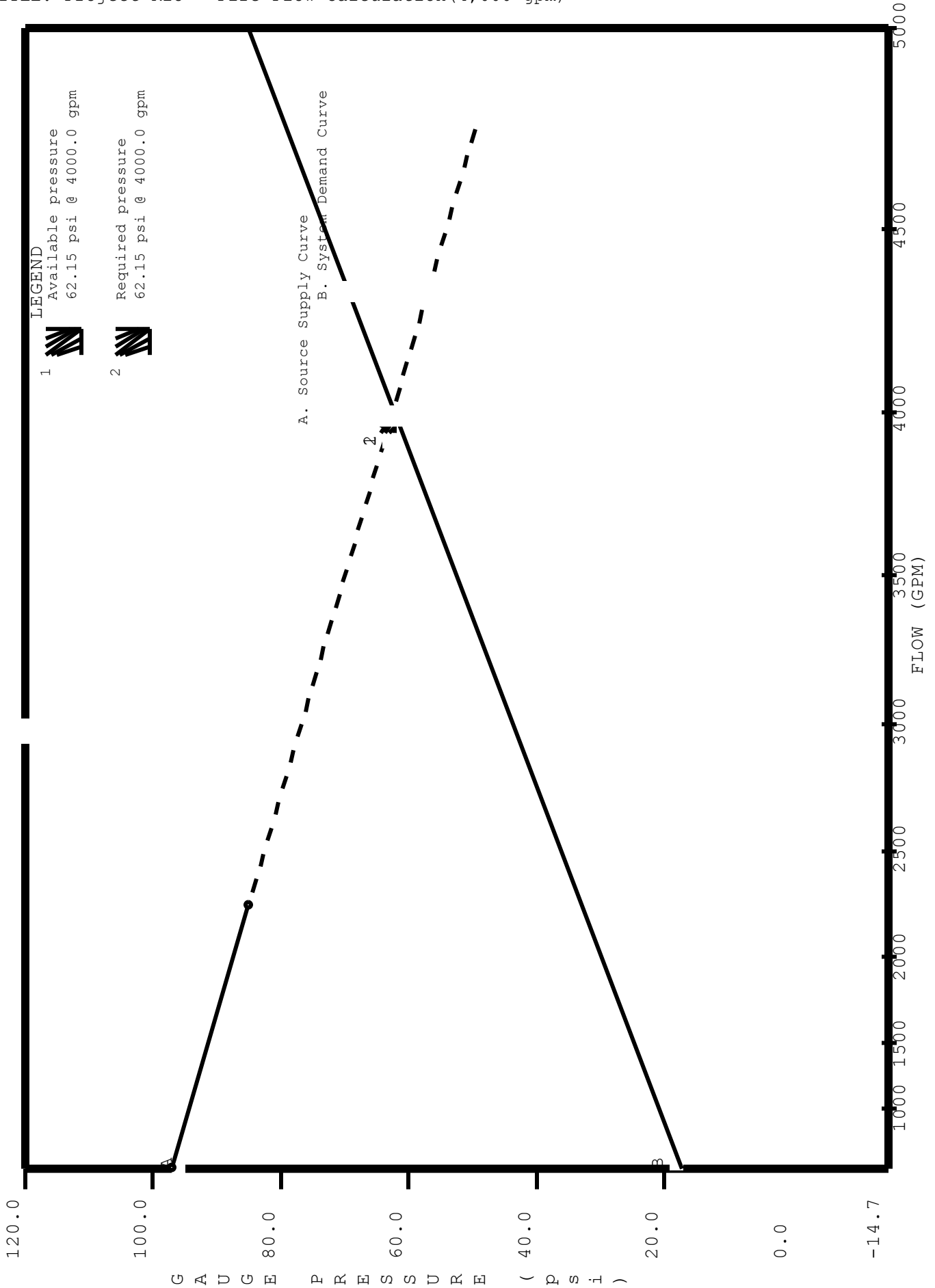
NOTES:

Calculations performed by HASS under license # 27070377 ,
granted by HRS SYSTEMS, INC.

(Notes continue after pipe calculations results.)

WATER SUPPLY ANALYSIS

Static: 97.00 psi Resid: 85.00 psi Flow: 2248.0 gpm



Note: (1) Dashed Lines indicate extrapolated values from Test Results
(2) On Site pressures are based on hose stream deduction at the source

DATE: 2/9/20175 BASIS OF DESIGN\FLOW TESTING\FIRE FLOW\FIRE FLOW 4000.SDF

JOB TITLE: Project Rio - Fire Flow Calculation(4,000 gpm)

NFPA WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	FLOW @ (GPM)	AVAIL. PRESS. (PSI)	TOTAL @ DEMAND (GPM)	REQ'D PRESS. (PSI)
TEST	97.0	85.0	2248.0	62.2	4000.0	

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	4000.0 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	0.0 GPM
OTHER HOSE STREAM ALLOWANCES	4000.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	0.0 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
PU1	-40.0	- - - -	62.1	- - -	
PU2	0.0	- - - -	43.2	- - -	
PU3	0.0	- - - -	42.7	- - -	
PU4	0.0	- - - -	38.0	- - -	
PU5	0.0	- - - -	37.4	- - -	
PU6	0.0	- - - -	37.4	- - -	
PU7	0.0	- - - -	38.1	- - -	
PU8	0.0	- - - -	41.6	- - -	
PU9	0.0	- - - -	44.7	- - -	
H1	0.0	HOSE STREAM	34.9	1000.0	
H2	0.0	HOSE STREAM	33.2	1000.0	
H3	0.0	HOSE STREAM	33.2	1000.0	
H4	0.0	HOSE STREAM	35.5	1000.0	
TEST	-40.0	SOURCE	62.1	4000.0	

DATE: 2/9/20175 BASIS OF DESIGN\FLOW TESTING\FIRE FLOW\FIRE FLOW 4000.SDF

JOB TITLE: Project Rio - Fire Flow Calculation(4,000 gpm)

NFPA2 PIPE DATA

Pipe Tag	K-fac	Add Fl	Add Fl To	Fit:	L	C	(Pt)	Notes
Frm Node	El (ft)	PT	Node/	Nom ID	Eq.Ln.	F	(Pe)	
To Node	El (ft)	PT	Tot.(Q) Disch	Act ID	(ft.)	T	Pf/ft.	(Pf)
Pipe: 1	Source	1215.1	PU9			1.00	150	62.1
TEST	-40.0	62.1	2784.9	PU2	E12.00	----	0.00	0.0
PU1	-40.0	62.1	4000.0		11.650	1.00	0.013	0.0
Pipe: 2	0.0	791.6	PU8			985.00	150	62.1
PU1	-40.0	62.1	1993.3	PU3	E16.00	T:144.8	173.81	17.3
PU2	0.0	43.2	2784.9		16.000	2G:29.0	1158.81	0.001
Pipe: 4	0.0	0.0				730.00	150	43.2
PU2	0.0	43.2	1993.3	PU4	E16.00	2G:29.0	28.97	0.0
PU3	0.0	42.7	1993.3		16.000		758.97	0.001
Pipe: 5	0.0	1000.0	H1		6E216.0	1010.00	150	42.7
PU3	0.0	42.7	993.3	PU5	E12.00	T:81.0	337.00	0.0
PU4	0.0	38.0	1993.3		11.650	5G:40.0	1347.00	0.003
Pipe: 6	0.0	1000.0	H2			475.00	150	38.0
PU4	0.0	38.0	-6.7	PU6	E12.00	2E:72.0	80.00	0.0
PU5	0.0	37.4	993.3		11.650	G: 8.0	555.00	0.001
Pipe: 7	0.0	1000.0	H2			500.00	150	37.4
PU6	0.0	37.4	-993.3	PU4	E12.00	----	0.00	0.0
PU5	0.0	37.4	6.7		11.650		500.00	0.000
Pipe: 8	0.0	1000.0	H3			615.00	150	38.1
PU7	0.0	38.1	6.7	PU5	E12.00	2E:72.0	80.00	0.0
PU6	0.0	37.4	1006.7		11.650	G: 8.0	695.00	0.001
Pipe: 9	0.0	1000.0	H4			885.00	150	41.6
PU8	0.0	41.6	1006.7	PU6	E12.00	2E:72.0	104.00	0.0
PU7	0.0	38.1	2006.7		11.650	4G:32.0	989.00	0.004
Pipe: 10	0.0	2006.7	PU7		4E144.0	2200.00	150	43.2
PU2	0.0	43.2	-1215.1	PU9	E12.00	2T162.0	362.00	0.0
PU8	0.0	41.6	791.6		11.650	7G:56.0	2562.00	0.001
Pipe: 11	0.0	2006.7	PU7		2E:72.0	1940.00	150	44.7
PU9	0.0	44.7	-791.6	PU2	E12.00	2T162.0	274.00	0.0
PU8	0.0	41.6	1215.1		11.650	5G:40.0	2214.00	0.001
Pipe: 12	0.0	0.0				2570.00	150	62.1
PU1	-40.0	62.1	1215.1	PU8	E24.00	2T451.0	531.59	17.3
PU9	0.0	44.7	1215.1		24.000	4G:80.5	3101.59	0.000
Pipe: 13	H.S.	1000.0	Disch		E:22.0	65.00	140	38.0
PU4	0.0	38.0	0.0		D6.000	T:47.0	74.00	0.0
H1	0.0	34.9	1000.0		6.280	G: 5.0	139.00	0.022

DATE: 2/9/20175 BASIS OF DESIGN\FLOW TESTING\FIRE FLOW\FIRE FLOW 4000.SDF

JOB TITLE: Project Rio - Fire Flow Calculation(4,000 gpm)

Pipe Tag	K-fac	Add Fl	Add Fl To	Fit:	L	C	(Pt)	Notes
Frm Node	El (ft)	PT	(q) Node/	Nom ID	Eq.Ln.	F	(Pe)	
To Node	El (ft)	PT	Tot.(Q) Disch	Act ID	(ft.)	T	Pf/ft.	

Pipe: 14	H.S.	1000.0	Disch		E:22.0	115.00	140	37.4
PU5	0.0	37.4	0.0	D6.000	T:47.0	74.00		0.0
H2	0.0	33.2	1000.0	6.280	G: 5.0	189.00	0.022	4.2

Pipe: 15	H.S.	1000.0	Disch		E:22.0	115.00	140	37.4
PU6	0.0	37.4	0.0	D6.000	T:47.0	74.00		0.0
H3	0.0	33.2	1000.0	6.280	G: 5.0	189.00	0.022	4.2

Pipe: 16	H.S.	1000.0	Disch		E:22.0	45.00	140	38.1
PU7	0.0	38.1	0.0	D6.000	T:47.0	74.00		0.0
H4	0.0	35.5	1000.0	6.280	G: 5.0	119.00	0.022	2.7

NOTES (HASS):

- Calculations were performed by the HASS 8.6 computer program in accordance with NFPA13 (2016) under license no. 27070377 granted by
 HRS Systems, Inc.
 208 Southside Square
 Petersburg, TN 37144
 (931) 659-9760
- The system has been calculated to provide an average imbalance at each node of 0.008 gpm and a maximum imbalance at any node of 0.054 gpm.
- Total pressure at each node is used in balancing the system. Maximum water velocity is 12.0 ft/sec at pipe 1.
- Items listed in bold print on the cover sheet

 are automatically transferred from the calculation report.

(5) PIPE FITTINGS TABLE

Pipe Table Name: STANDARD.PIP

PAGE: * MATERIAL: S40 HWC: 120

Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	N NPTee
15.000	35.00	70.00	28.00	87.00	24.00	7.00	60.00	60.00	70.00
22.626	49.00	112.00	42.00	126.00	37.00	10.00	95.00	95.00	112.00

DATE: 2/9/20175 BASIS OF DESIGN\FLOW TESTING\FIRE FLOW\FIRE FLOW 4000.SDF

JOB TITLE: Project Rio - Fire Flow Calculation(4,000 gpm)

PAGE: D MATERIAL: DIRON HWC: 140

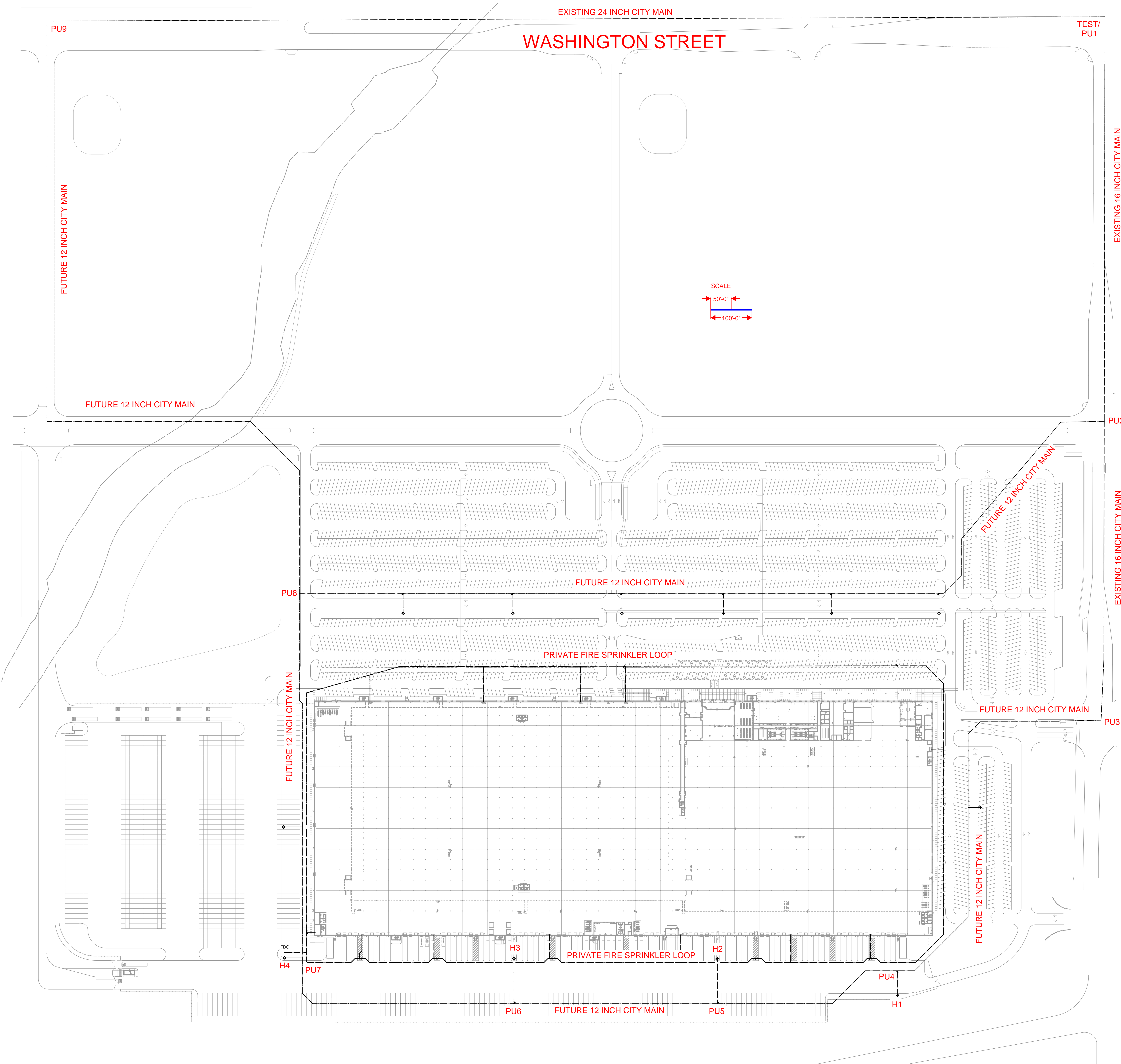
Diameter (in)	Equivalent Fitting Lengths in Feet						
	E	T	L	C	B	G	N
	Ell	Tee	LngEll	ChkVlv	BfyVlv	GatVlv	NPTee
6.280	22.00	47.00	14.00	51.00	16.00	5.00	47.00

PAGE: E MATERIAL: PVC150 HWC: 150

Diameter (in)	Equivalent Fitting Lengths in Feet						
	E	T	L	C	B	G	N
	Ell	Tee	LngEll	ChkVlv	BfyVlv	GatVlv	NPTee
11.650	36.00	81.00	24.00	87.00	28.00	8.00	81.00

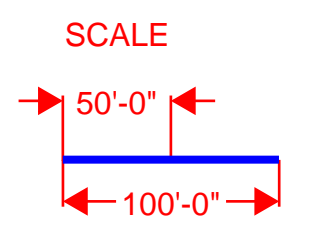
Attachment B
Fire Protection Site Plan - Hydraulic Nodes for Calculation

TEST LOCATION
40 FEET BELOW
SITE GRADE LEVEL



WASHINGTON STREET

WEST 144TH AVENUE



PU9

TEST/
PU1

FUTURE 12 INCH CITY MAIN

FUTURE 12 INCH CITY MAIN

EXISTING 16 INCH CITY MAIN

PU2

PU8

FUTURE 12 INCH CITY MAIN

EXISTING 16 INCH CITY MAIN

PRIVATE FIRE SPRINKLER LOOP

FUTURE 12 INCH CITY MAIN

FUTURE 12 INCH CITY MAIN

PU3

FUTURE 12 INCH CITY MAIN

FUTURE 12 INCH CITY MAIN

FDC
H4

PU7

H3

PRIVATE FIRE SPRINKLER LOOP

H2

PU4

H1

PU6

FUTURE 12 INCH CITY MAIN

PU5

Attachment C
Flow Test Reports

Fire Flow Test Closed PRV

Location of Test:
Date / Time of Test:
COT Employee:

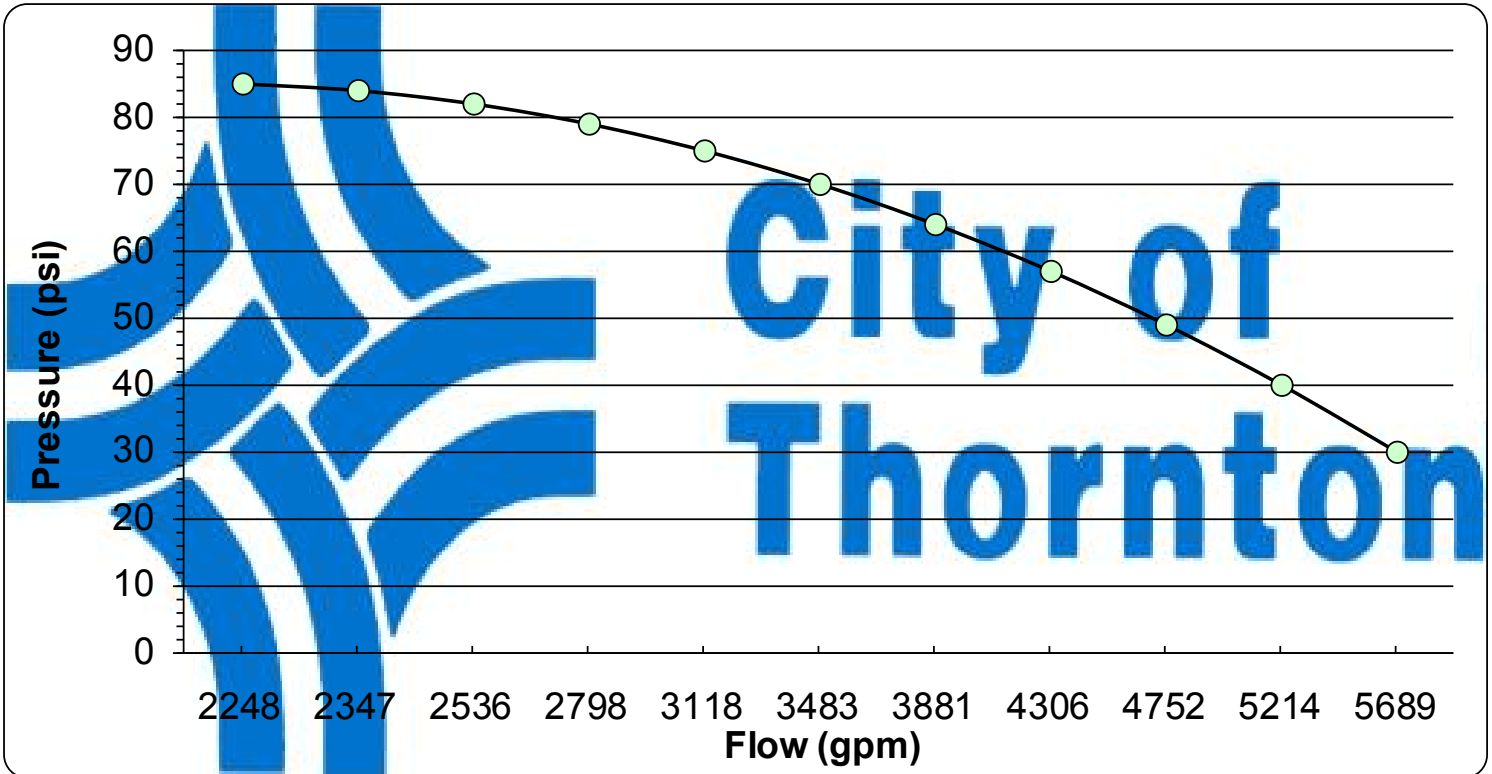
Stargate School, 144th and Washington
3/25/16 1:00 PM
Emily Hildreth

$$Q_t = C_f C_d D_1^2 \sqrt{P_1} + C_f C_d D_2^2 \sqrt{P_2}$$

Hydrant Test Discharge (Q_t) (gpm)	Unit Conversion	Discharge Coefficient	Diameter of Hydrant Outlet #1	Diameter of Hydrant Outlet #2	Pitot Pressure	Pitot Pressure	Hydrant Test Discharge
	C_f	C_d	D_1	D_2	P_1	P_2	Q_t
	(English)	(.7, .8, .9)	(2.5, 4.5 inches)	(2.5, 4.5 inches)	(psi)	(psi)	(gpm)
		29.83	0.9	2.5	2.5	40	50

$$Q_r = Q_t \left(\frac{P_s - P_r}{P_s - P_t} \right)^{0.54}$$

Fire Flow at 20 psi (Q_r) (gpm)	Hydrant Discharge	Static Pressure	Desired Residual Pressure	Residual Pressure	Fire Flow at 20 psi
	Q_t	P_s	P_r	P_t	Q_r
	(gpm)	(psi)	(psi)	(psi)	(gpm)
		2248	97	20	85



Fire Flow Test Open PRV

Location of Test:
Date / Time of Test:
COT Employee:

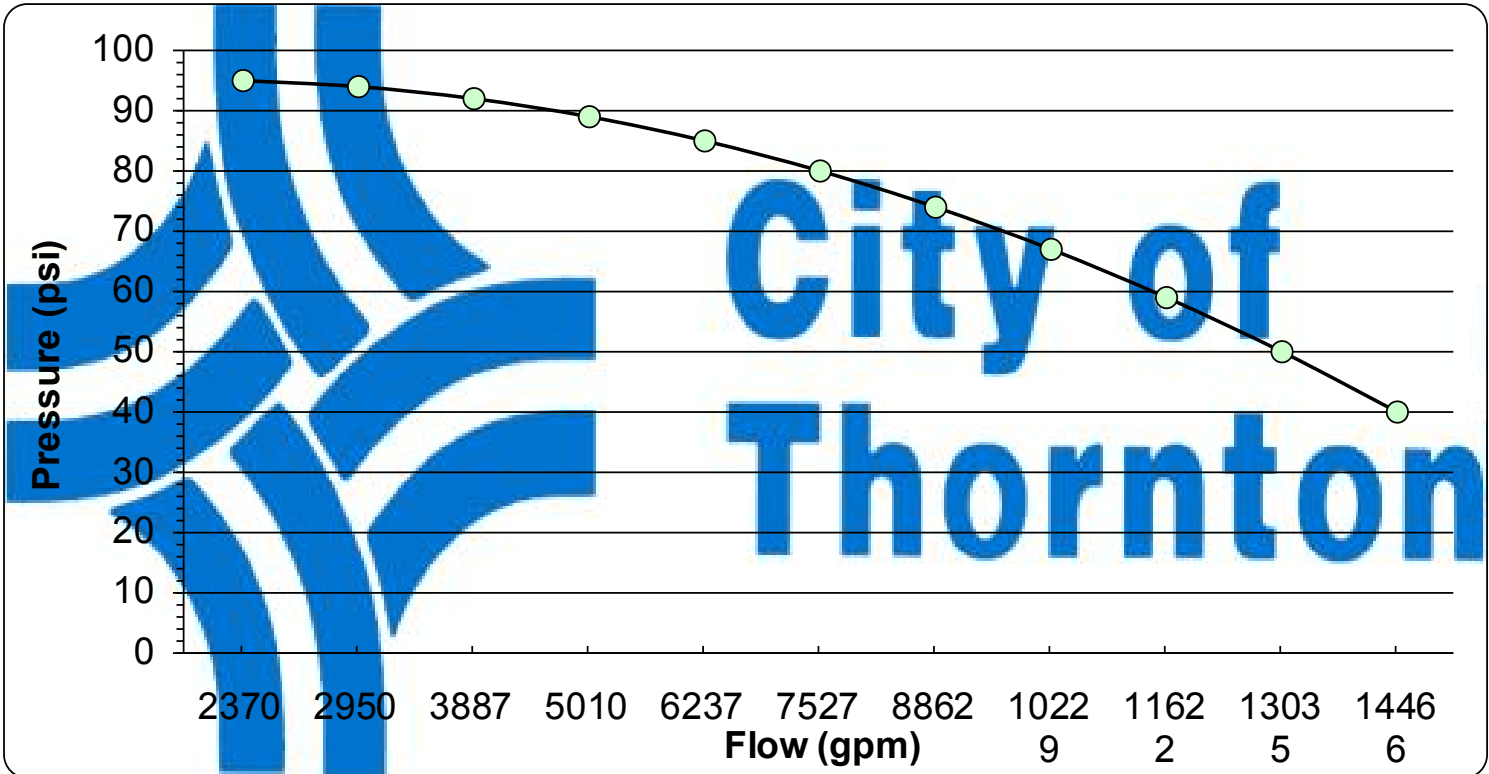
Stargate School, 144th and Washington
3/25/16 1:00 PM
Emily Hildreth

$$Q_t = C_f C_d D_1^2 \sqrt{P_1} + C_f C_d D_2^2 \sqrt{P_2}$$

Hydrant Test Discharge (Q_t) (gpm)	Unit Conversion	Discharge Coefficient	Diameter of Hydrant Outlet #1	Diameter of Hydrant Outlet #2	Pitot Pressure	Pitot Pressure	Hydrant Test Discharge
	C _f	C _d	D ₁	D ₂	P ₁	P ₂	Q _t
	(English)	(.7, .8, .9)	(2.5, 4.5 inches)	(2.5, 4.5 inches)	(psi)	(psi)	(gpm)
	29.83	0.9	2.5	2.5	45	55	2370

$$Q_r = Q_t \left(\frac{P_s - P_r}{P_s - P_t} \right)^{0.54}$$

Fire Flow at 20 psi (Q_r) (gpm)	Hydrant Discharge	Static Pressure	Desired Residual Pressure	Residual Pressure	Fire Flow at 20 psi
	Q _t	P _s	P _r	P _t	Q _r
	(gpm)	(psi)	(psi)	(psi)	(gpm)
	2370	97	20	95	17017



APPENDIX C

GRAVITY SEWER CALCULATIONS

Table C-1: 8-Inch Sanitary Lateral Gravity Pipe Design

TYPICAL PROPOSED 8-INCH SEWER LATERAL							
Q_{design}							
Q_{full}		$1.49/n * A_{pipe} * R^{2/3} * S^{1/2}$					
Q_{half}		FLOW AT HALF FULL = $0.48 * Q_{full}$					
V_{max}		VELOCITY AT 80% FULL = $1.15 * Q_{full} / A_{pipe}$					
$V_{half, fps}$		VELOCITY OF FLOW AT HALF FULL = $Q_{half} / (A_{pipe} * 0.5)$					
PIPE SIZED ACCORDINGLY		CHECKS IF Q_{design} IS LESS THAN Q_{half} .					
PIPE CAPACITY							
MATERIAL	PVC	$Q_{full, cfs}$	$Q_{full, gpd}$	$Q_{half, cfs}$	$Q_{half, gpd}$	$V_{max, fps}$	$V_{half, fps}$
DIAMETER, in	8	0.87	564,429	0.42	270,926	2.88	2.40
SLOPE	0.52%	PIPE SIZED ACCORDINGLY:		TRUE			
n	0.013	2 fps < VELOCITY < 10 fps:		TRUE			
$Q_{design, gpd}$	40,000						

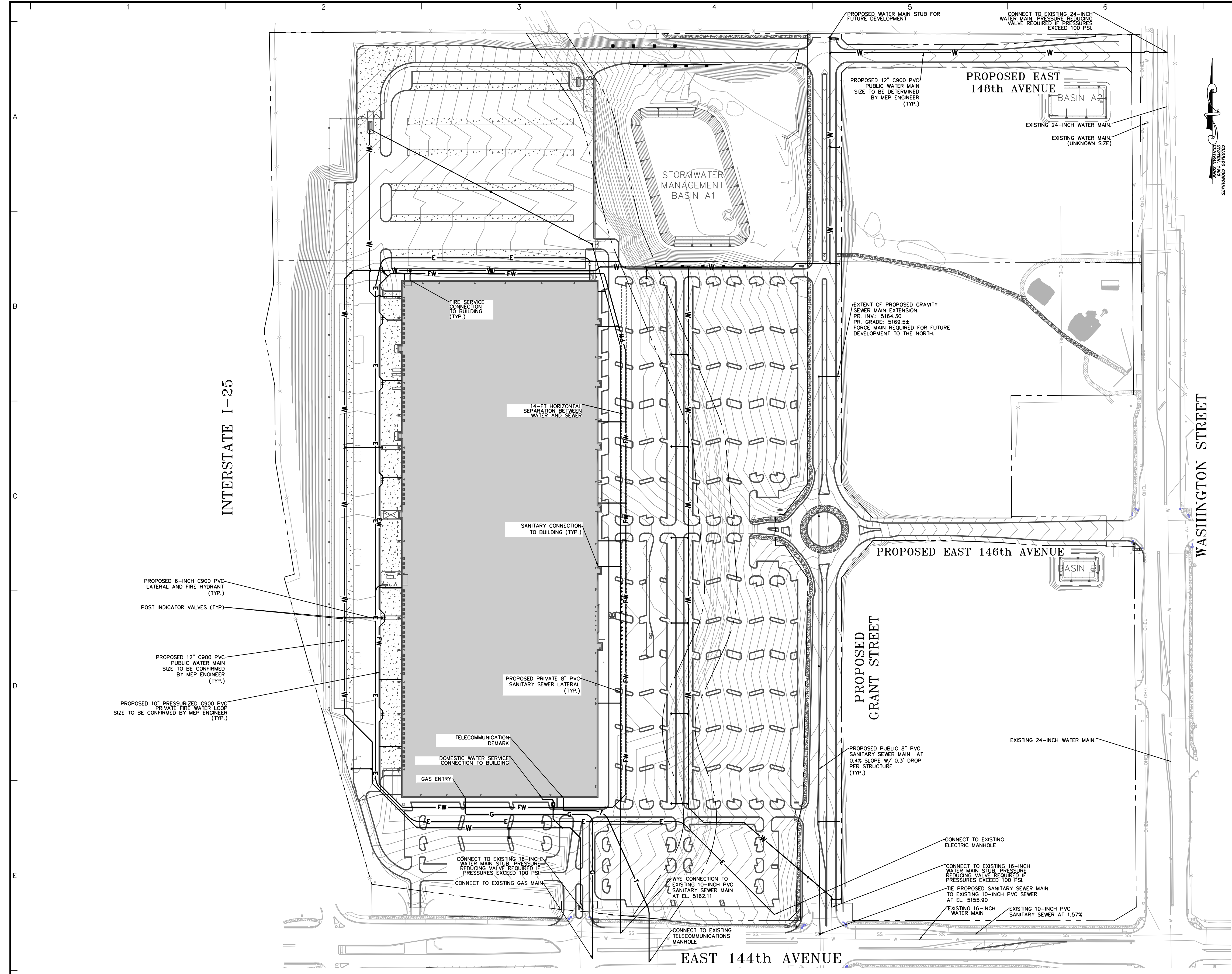
Table C-2: 6-Inch Sanitary Lateral Gravity Pipe Design

TYPICAL PROPOSED 6-INCH SEWER LATERAL							
Q_{design}		$1.49/n * A_{pipe} * R^{2/3} * S^{1/2}$					
Q_{full}		FLOW AT HALF FULL = $0.48 * Q_{full}$					
Q_{half}		VELOCITY AT 80% FULL = $1.15 * Q_{full} / A_{pipe}$					
V_{max}		VELOCITY OF FLOW AT HALF FULL = $Q_{half} / (A_{pipe} * 0.5)$					
V_{half} , fps		CHECKS IF Q_{design} IS LESS THAN Q_{half}					
PIPE SIZED ACCORDINGLY							
PIPE CAPACITY							
MATERIAL	PVC	Q_{full} , cfs	Q_{full} , gpd	Q_{half} , cfs	Q_{half} , gpd	V_{max} , fps	V_{half} , fps
DIAMETER, in	6	0.56	363,444	0.27	174,453	3.30	2.75
SLOPE	1.00%	PIPE SIZED ACCORDINGLY:		TRUE			
n	0.013	2 fps < VELOCITY < 10 fps:		TRUE			
Q_{design} , gpd	40,000						

Table C-1: 8-Inch Sanitary Main Gravity Pipe Design

TYPICAL PROPOSED 8-INCH SEWER MAIN							
Q_{design}							
Q_{full}		$1.49/n * A_{pipe} * R^{2/3} * S^{1/2}$					
Q_{half}		FLOW AT HALF FULL = $0.48 * Q_{full}$					
V_{max}		VELOCITY AT 80% FULL = $1.15 * Q_{full} / A_{pipe}$					
$V_{half, fps}$		VELOCITY OF FLOW AT HALF FULL = $Q_{half} / (A_{pipe} * 0.5)$					
PIPE SIZED ACCORDINGLY		CHECKS IF Q_{design} IS LESS THAN Q_{half} .					
PIPE CAPACITY							
MATERIAL	PVC	$Q_{full, cfs}$	$Q_{full, gpd}$	$Q_{half, cfs}$	$Q_{half, gpd}$	$V_{max, fps}$	$V_{half, fps}$
DIAMETER, in	8	0.77	495,037	0.37	237,618	2.52	2.11
SLOPE	0.40%	PIPE SIZED ACCORDINGLY:		TRUE			
n	0.013	2 fps < VELOCITY < 10 fps:		TRUE			
$Q_{design, gpd}$	235,000						

DRAWINGS



NOTES

- PLAN REFERENCES:
- BOUNDARY INFORMATION FROM:
 - A PLAN SET ENTITLED "ALTA/NSPS LAND TITLE SURVEY, SE 1/4 SEC 15, T1S, R68W, 6TH P.M. ADAMS COUNTY COLORADO" PREPARED BY AZTEC CONSULTANTS, INC. DATED 8/16/2017. (BULL CROSSING - PARCELS A & B).
 - A PLAN SET ENTITLED "ALTA/NSPS LAND TITLE SURVEY, SE 1/4 SEC 15, T1S, R68W, 6TH P.M. ADAMS COUNTY COLORADO" PREPARED BY AZTEC CONSULTANTS, INC. DATED 8/16/2017, LAST REVISED 9/16/2016. (THORNTON 40 - PARCELS C & D).
 - TOPOGRAPHIC AND UTILITY INFORMATION FROM A CAD FILE RECEIVED ELECTRONICALLY FROM AZTEC CONSULTANTS, INC. ON 9/14/2016 AND 1/24/2017.
 - FLOOD PLAIN INFORMATION FROM FEMA MAP NUMBER 08001C0303J (VERSION 2.3.2.2), REVISED TO REFLECT LOMR EFFECTIVE: NOVEMBER 25TH, 2016.
 - WETLAND BOUNDARIES AS FIELD DELINEATED BY LANGAN ENGINEERING ON DECEMBER 8TH, 2016. PLANS SHOW APPROXIMATE LOCATION. DELINEATION PENDING JURISDICTIONAL DETERMINATION FROM USACE.



INTERSTATE I-25

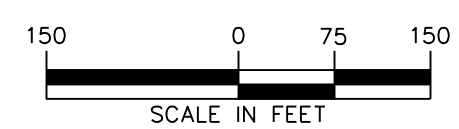
WASHINGTON STREET

PROPOSED GRANT STREET

EAST 144th AVENUE

PROPOSED EAST 148th AVENUE

PROPOSED EAST 146th AVENUE



Date	Description	No.
REVISIONS		

SIGNATURE	DATE SIGNED
RICHARD BURROW	
PROFESSIONAL ENGINEER CO Lic. No. PE.0050315	

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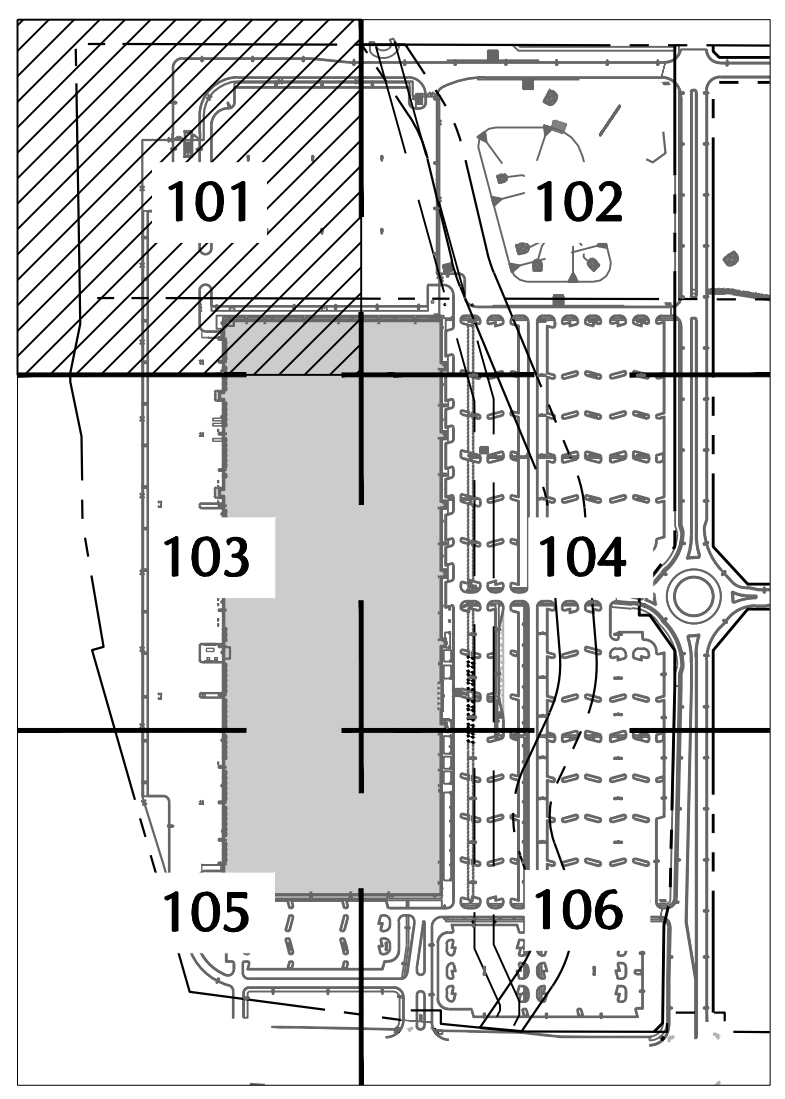
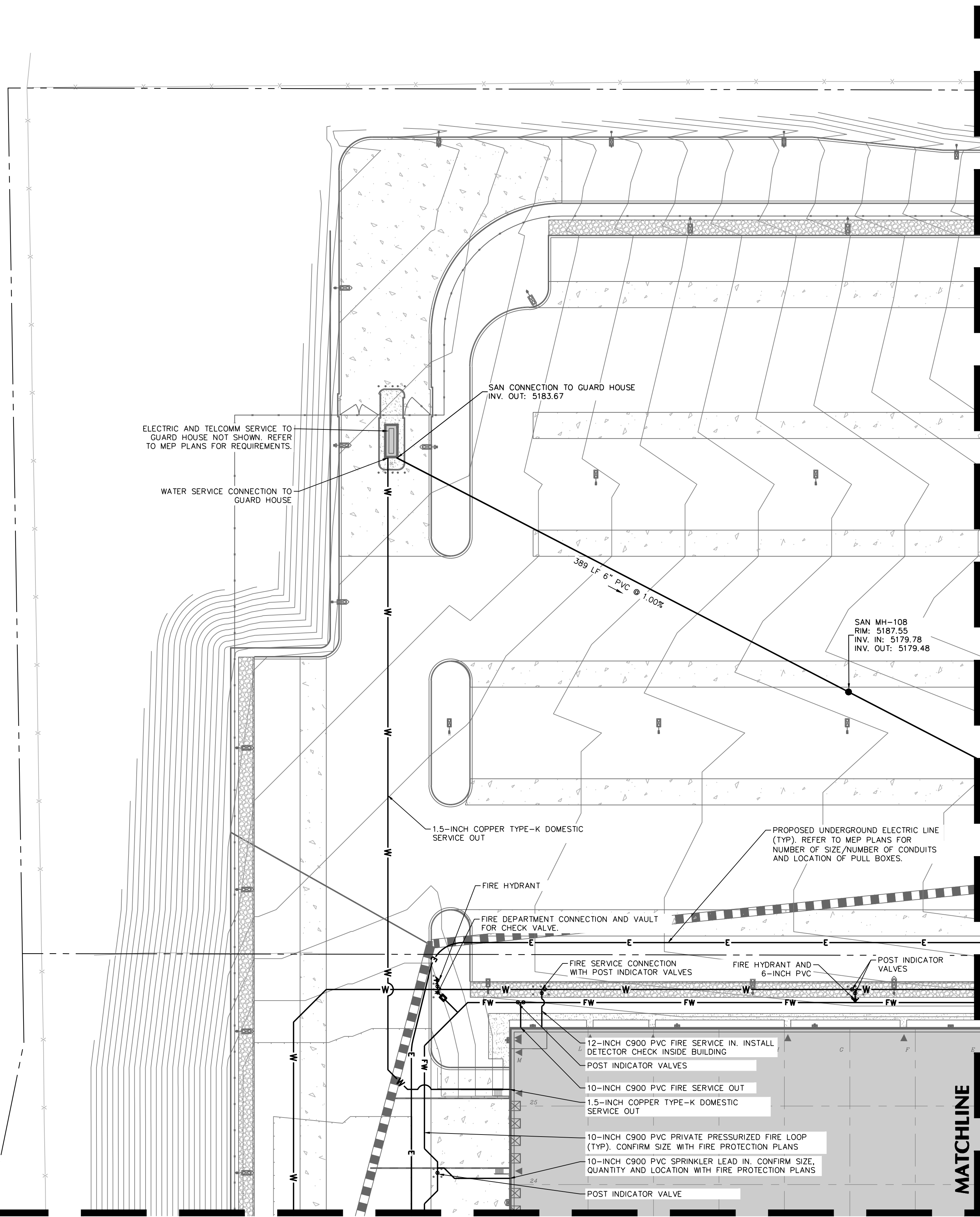
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PROJECT RIO
 DEVELOPMENT PERMIT SET
 A PARCEL LOCATED IN THE SOUTHEAST QUARTER OF SECTION 15, TOWNSHIP 1 SOUTH, RANGE 68 WEST OF THE SIXTH PRINCIPAL MERIDIAN,
 CITY OF THORNTON
 ADAMS COUNTY STATE OF COLORADO

Drawing Title
OVERALL UTILITY PLAN

Project No.	100612301	Drawing No.	DP CU100
Date	2/24/2017	Scale	1" = 150'
Drawn By	DTF	Checked By	MRG
		Sheet 17 of 52	



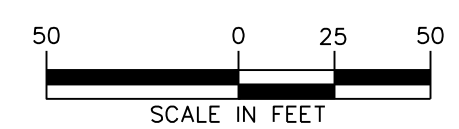
INTERSTATE I-25



NOTES

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- ALL SANITARY SEWER GRAVITY LINES SHALL BE SDR-35 PVC PIPE UNLESS OTHERWISE NOTED.



Date	Description	No.
REVISIONS		

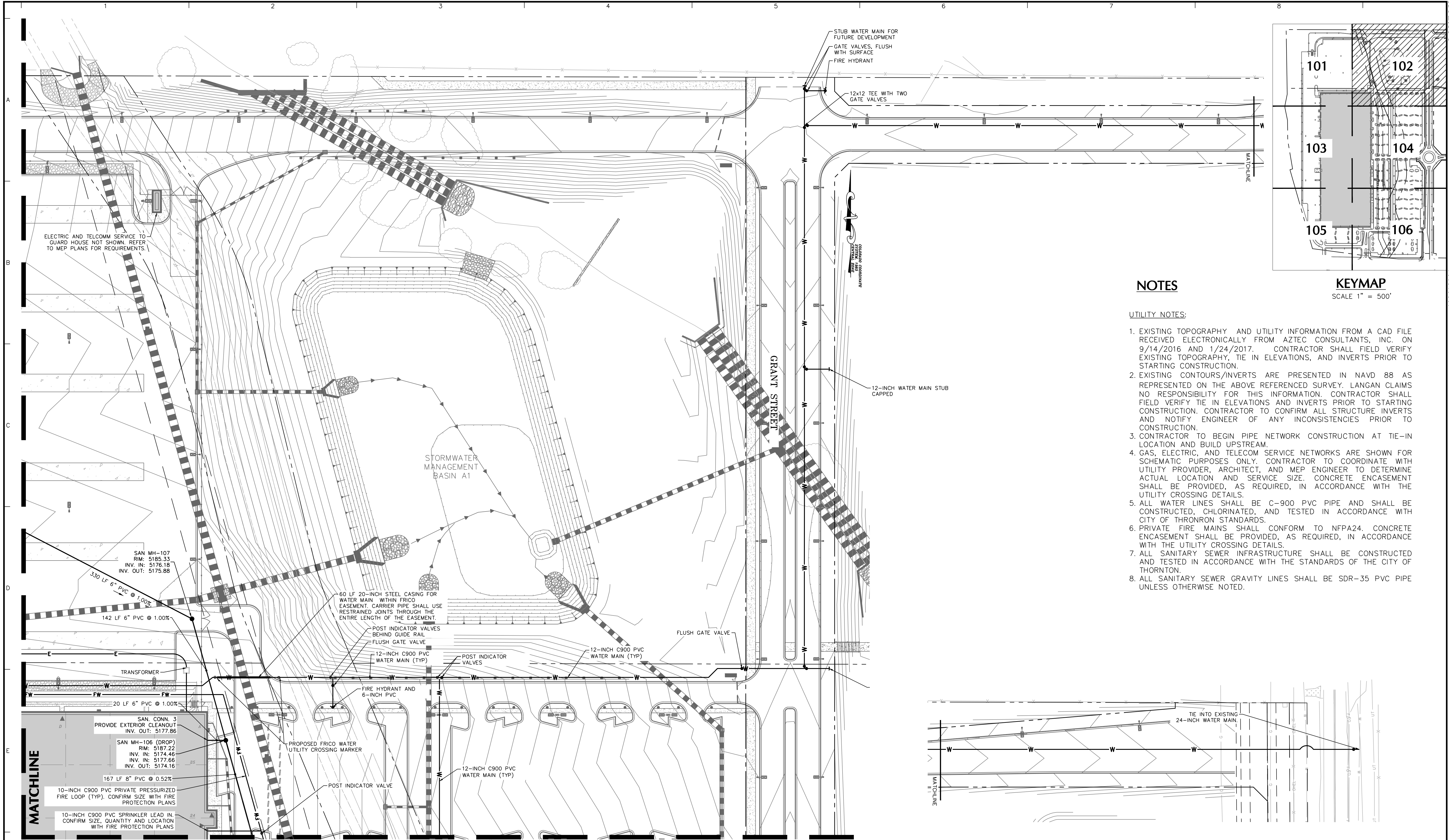
SIGNATURE: RICHARD BURROW
DATE SIGNED: _____
PROFESSIONAL ENGINEER CO Lic. No. PE.0050315

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Langan Engineering and Environmental Services, Inc.
Langan CI, Inc.
Langan International LLC
Collectively known as Langan

Project: **PROJECT RIO DEVELOPMENT PERMIT SET**
A PARCEL LOCATED IN THE SOUTHEAST QUARTER OF SECTION 15, TOWNSHIP 1 SOUTH, RANGE 68 WEST OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF THORNTON
ADAMS COUNTY STATE OF COLORADO

Drawing Title: **PARTIAL UTILITY PLAN 1**

Project No. 100612301	Drawing No. DP CU101
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Drawn By DTF	Checked By MRG
Sheet 18 of 52	



Date	Description	No.
REVISIONS		

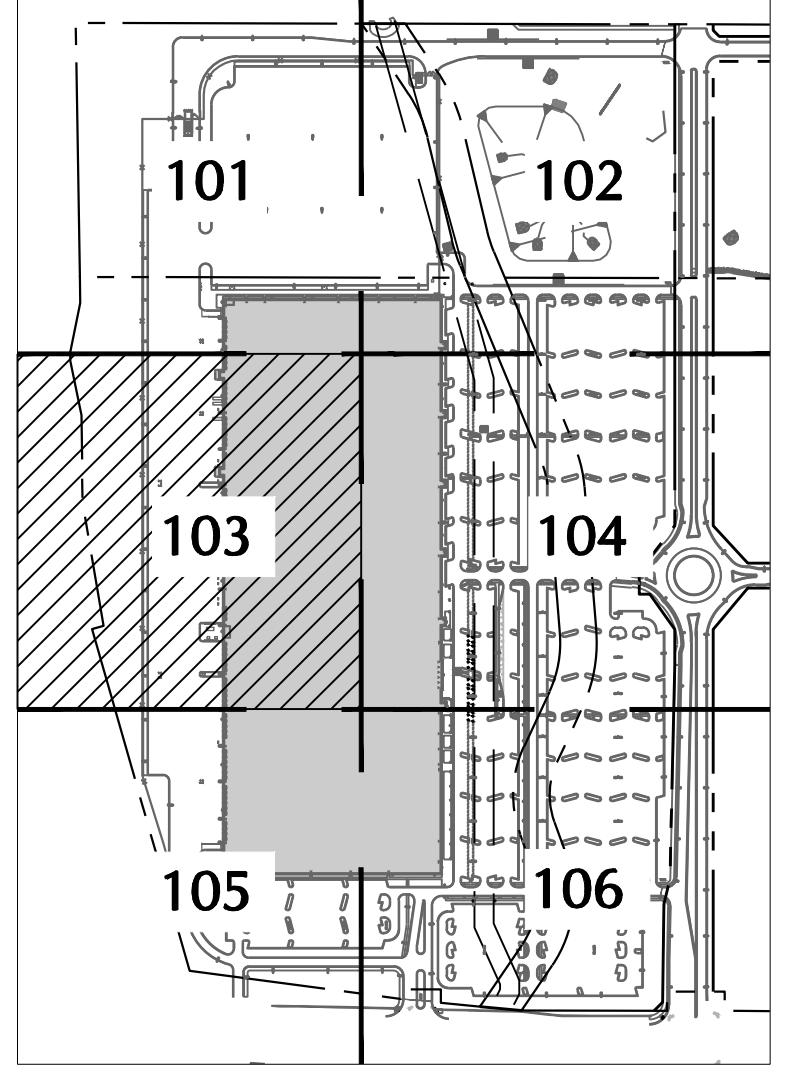
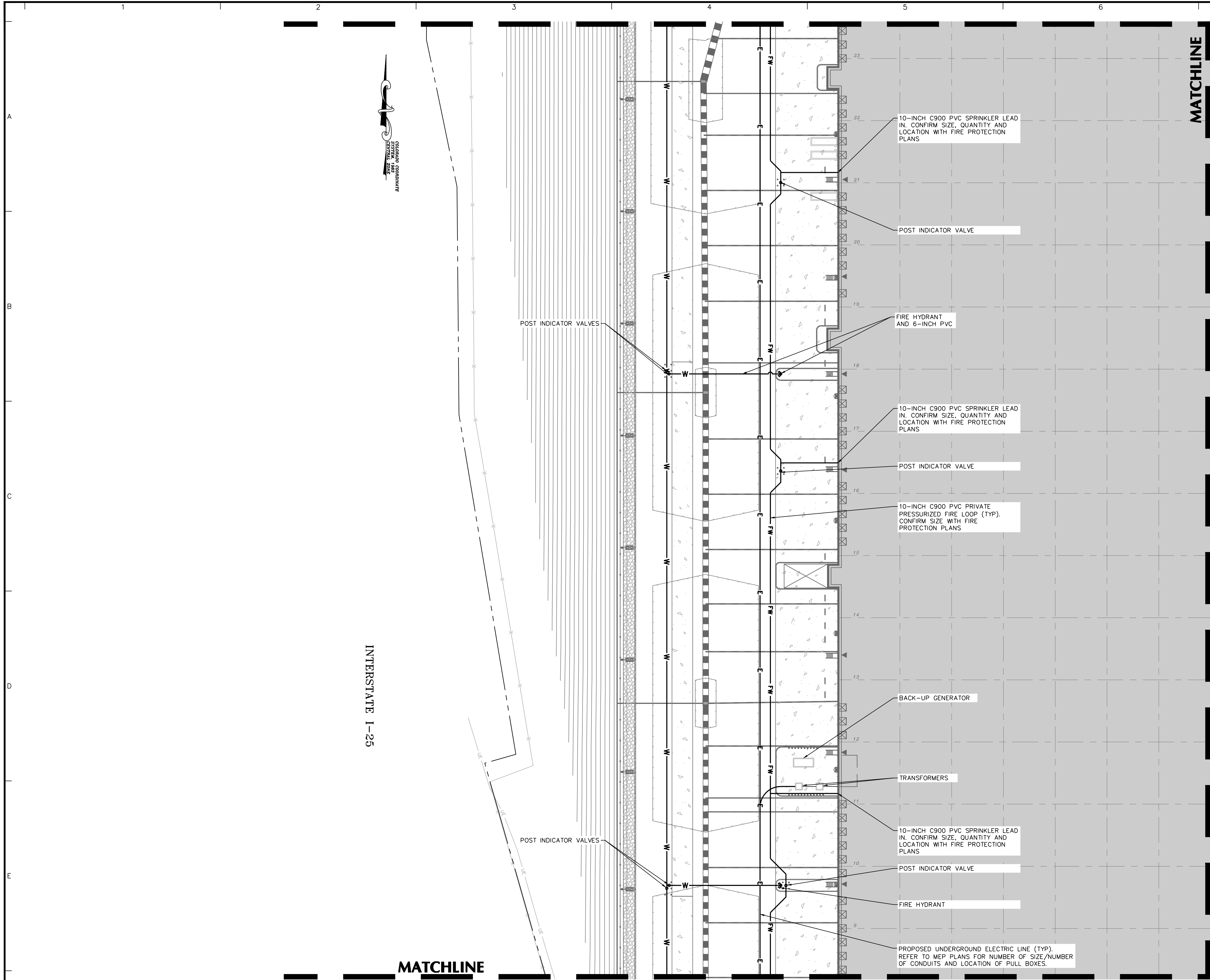
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DEVELOPMENT PERMIT SET
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CITY OF THORNTON
ADAMS COUNTY STATE OF COLORADO

Drawing Title
PARTIAL UTILITY PLAN 2

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Sheet 19 of 52	



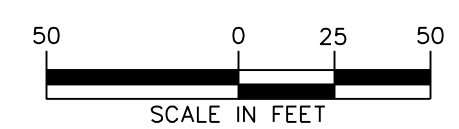
KEYMAP
SCALE 1" = 500'

NOTES

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INTERSTATE I-25



Date	Description	No.
REVISIONS		

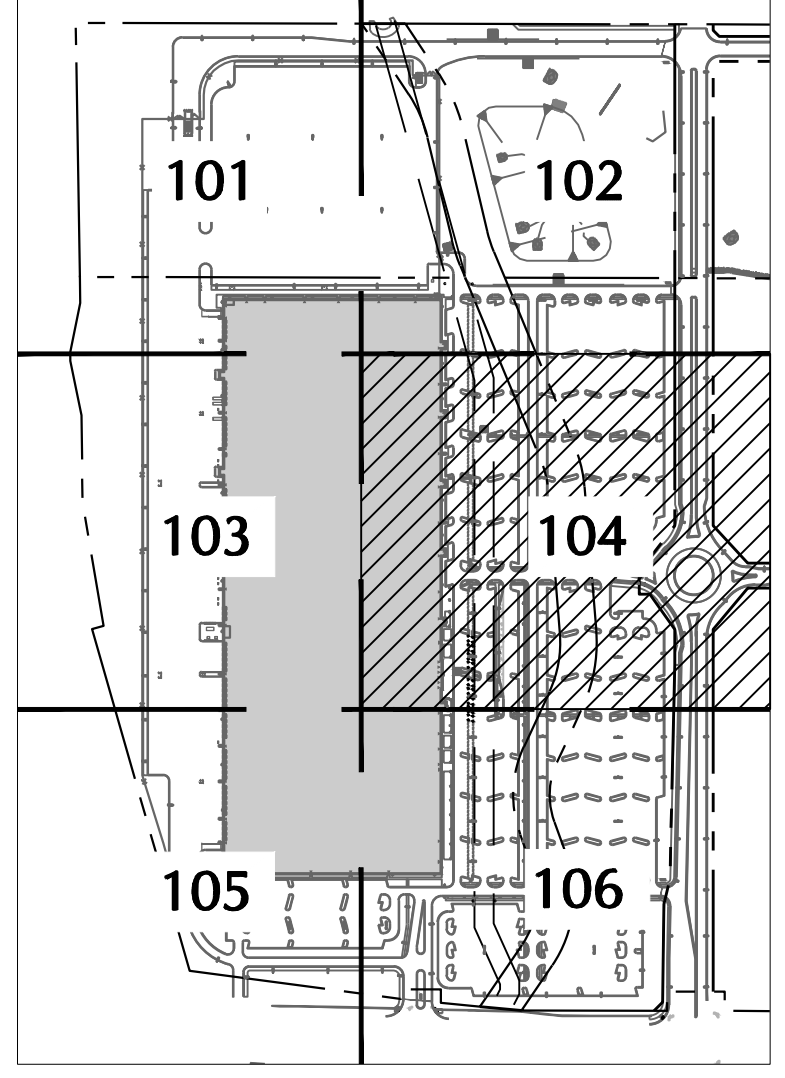
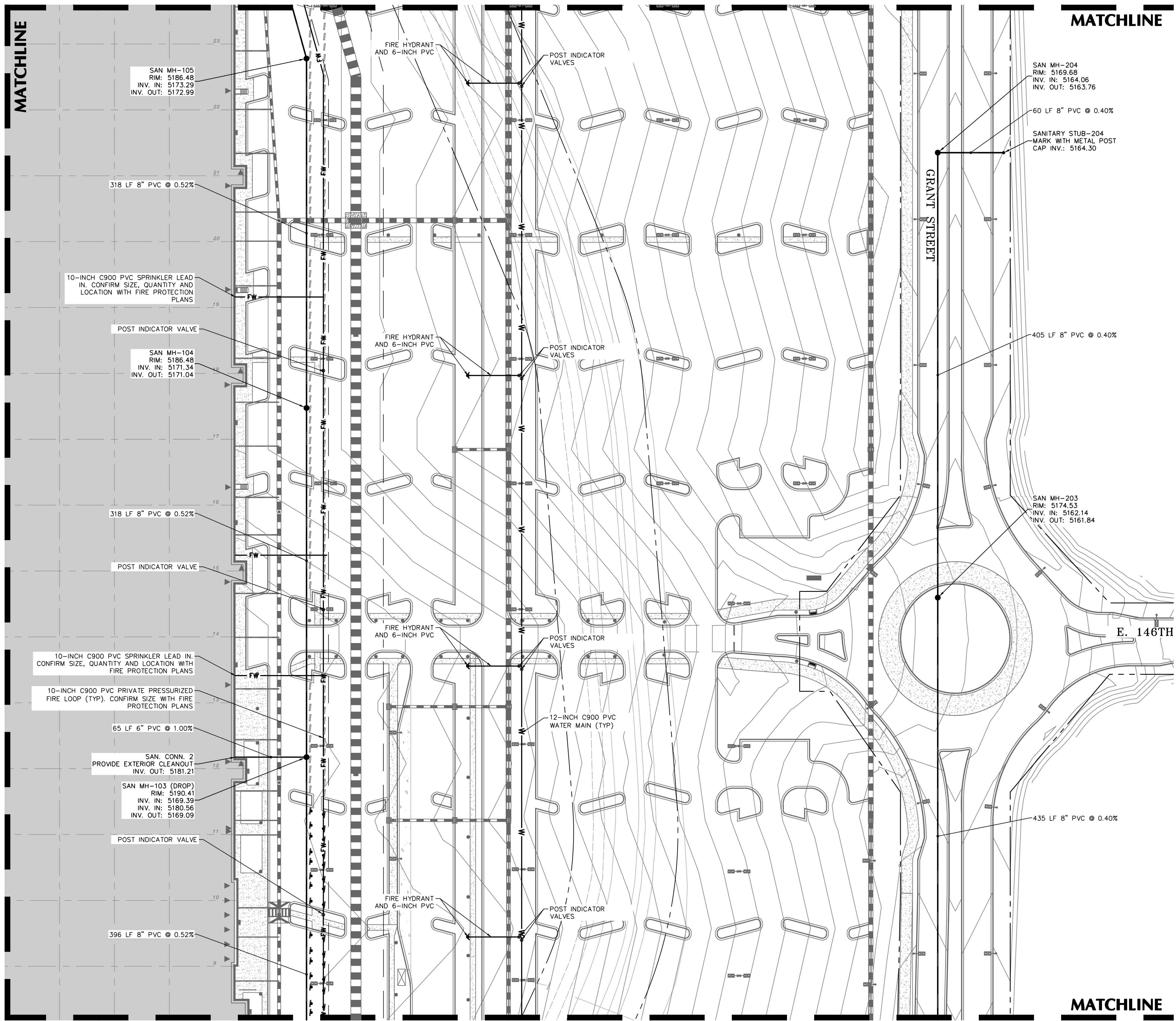
SIGNATURE: RICHARD BURROW
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Project: **PROJECT RIO**
DEVELOPMENT PERMIT SET
A PARCEL LOCATED IN THE SOUTHEAST QUARTER OF SECTION 15, TOWNSHIP 1 SOUTH, RANGE 68 WEST OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF THORNTON
ADAMS COUNTY STATE OF COLORADO

Drawing Title: **PARTIAL UTILITY PLAN 3**

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Drawn By DTF	Checked By MRG
Sheet 20 of 52	

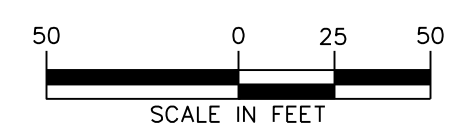


KEYMAP
SCALE 1" = 500'

NOTES

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Date	Description	No.
REVISIONS		

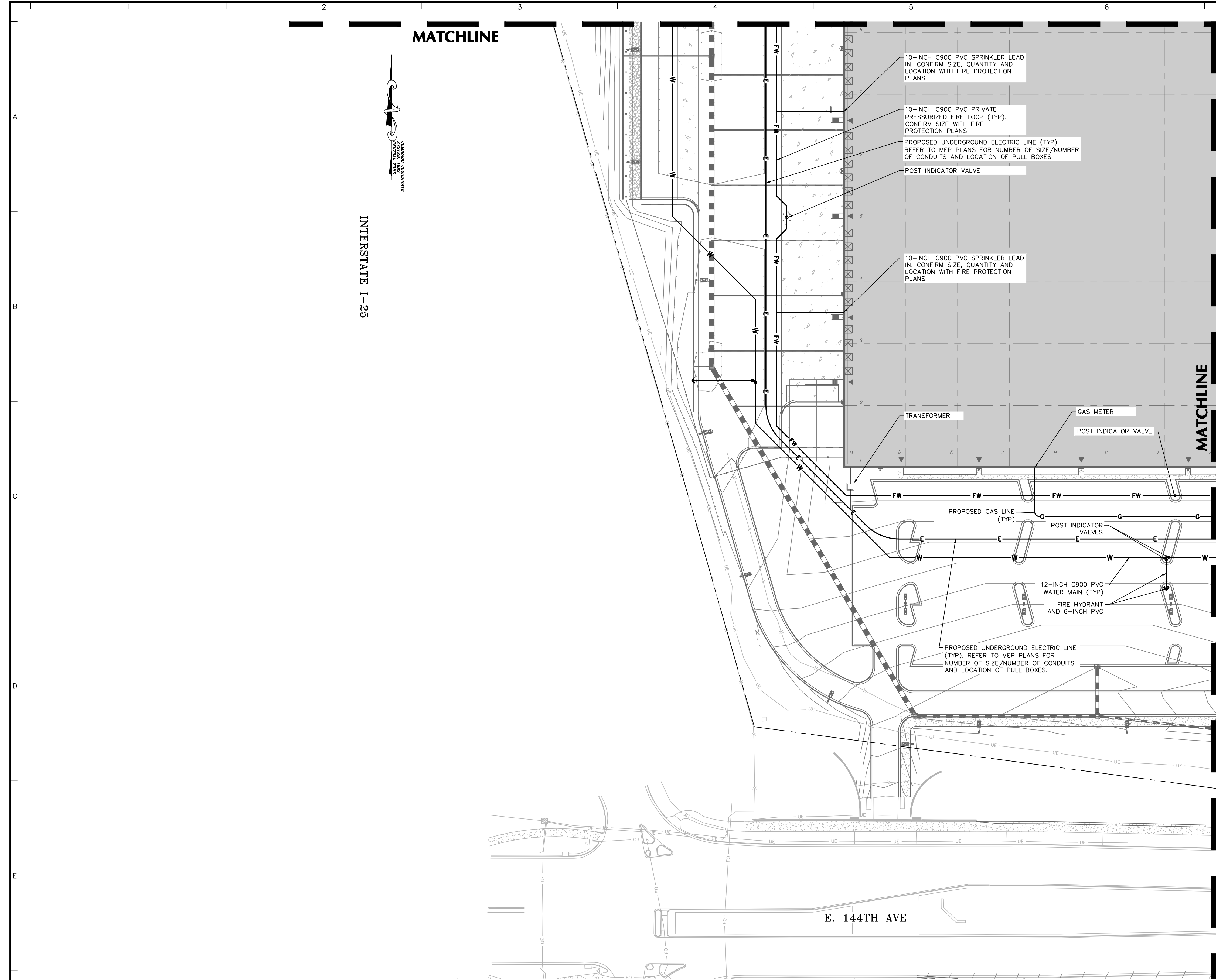
SIGNATURE	DATE SIGNED
RICHARD BURROW PROFESSIONAL ENGINEER CO Lic. No. PE.0050315	

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CITY OF THORNTON
ADAMS COUNTY STATE OF COLORADO

Drawing Title
PARTIAL UTILITY PLAN 4

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Date 2/24/2017	
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Drawn By DTF	Checked By MRG
Sheet 21 of 52	



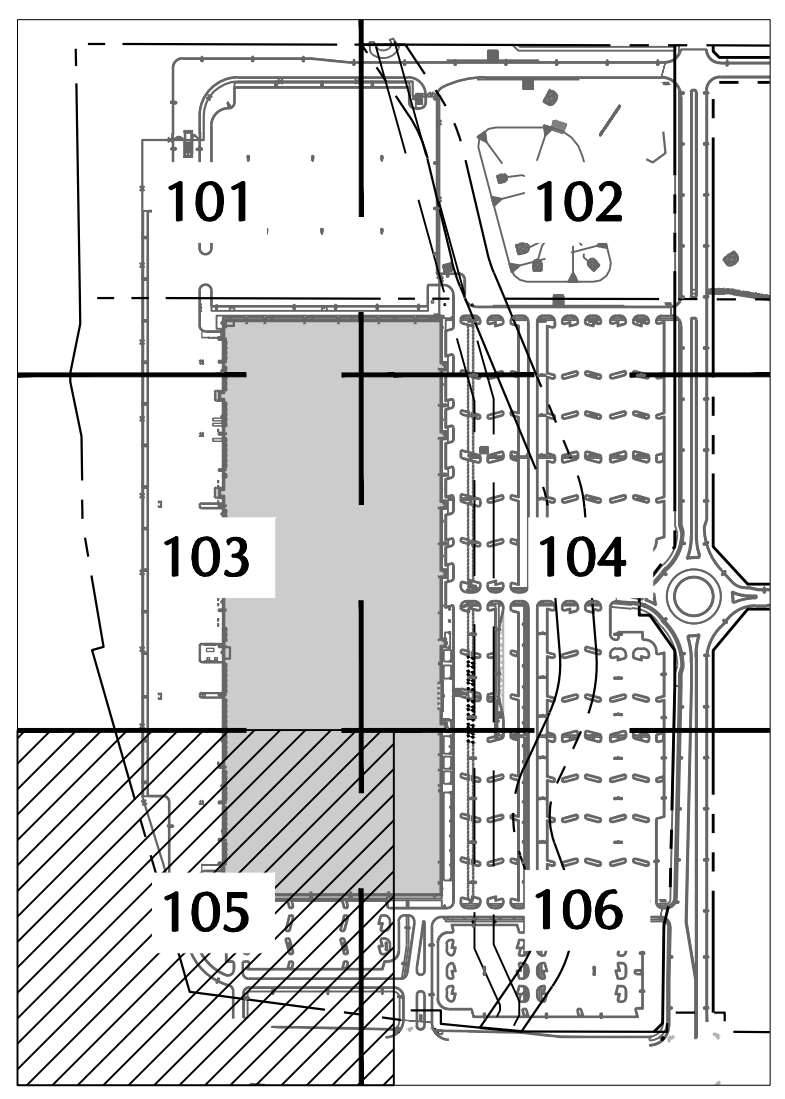
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INTERSTATE I-25

MATCHLINE

MATCHLINE

E. 144TH AVE

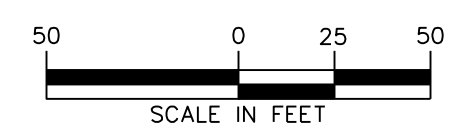


KEYMAP
SCALE 1" = 500'

NOTES

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Date	Description	No.
REVISIONS		

SIGNATURE _____ DATE SIGNED _____
 RICHARD BURROW
 PROFESSIONAL ENGINEER CO Lic. No. PE.0050315

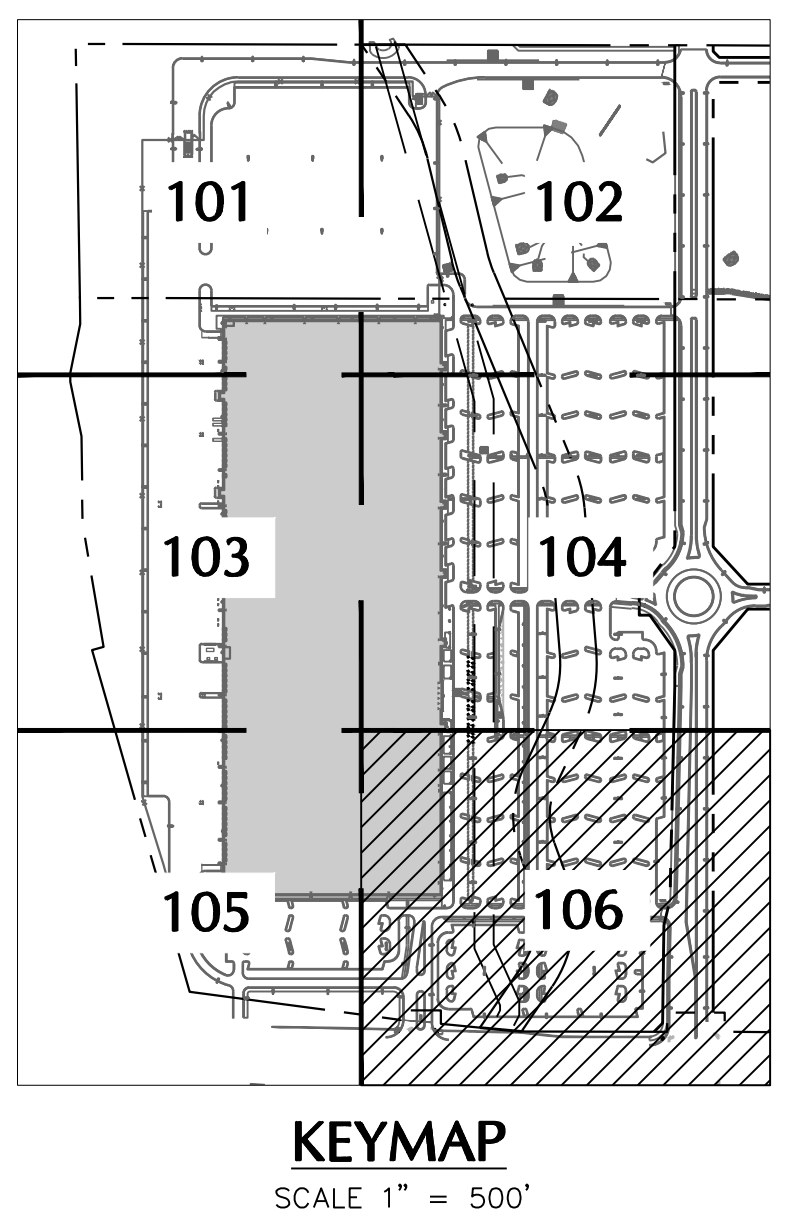
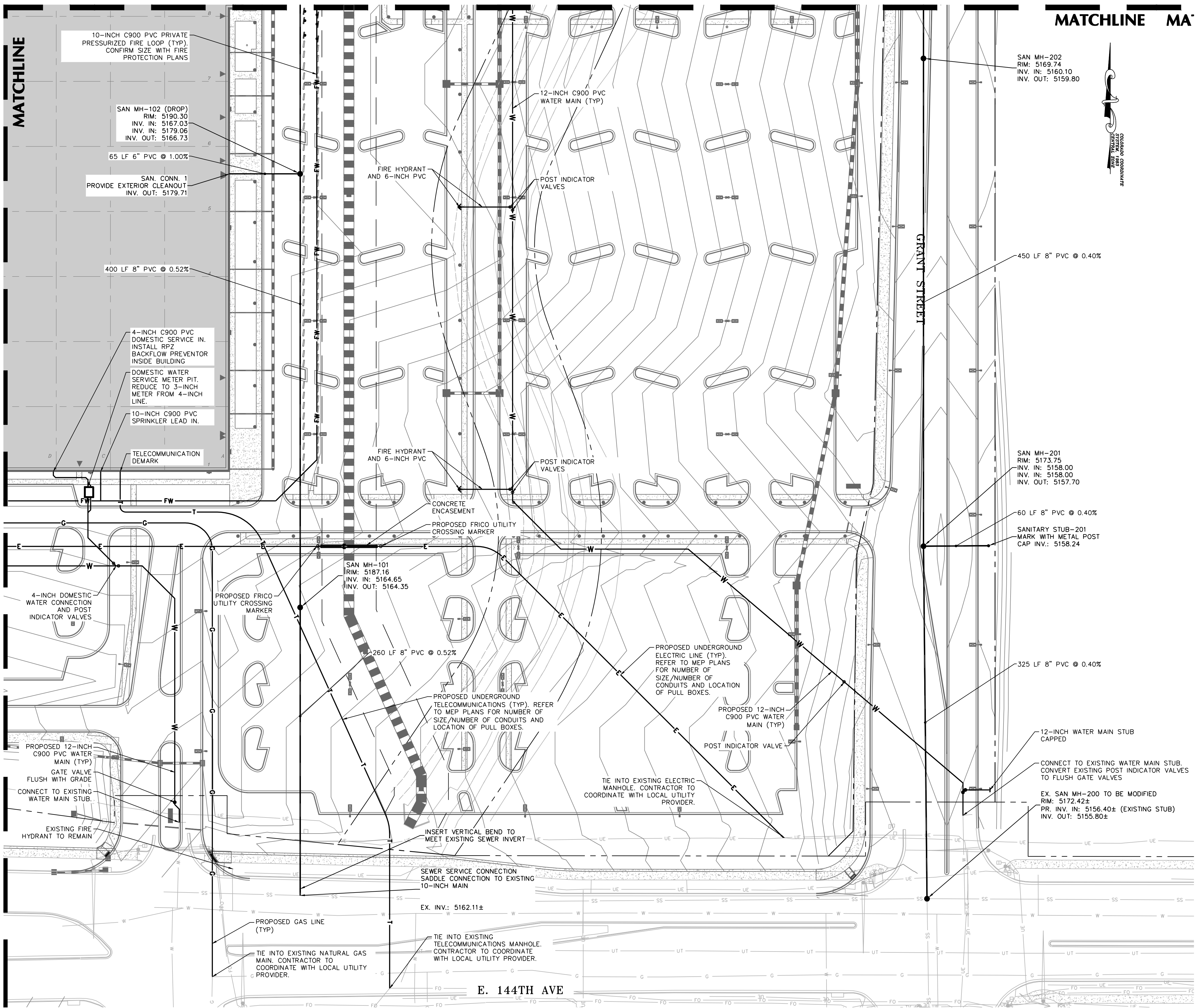
LANGAN
 300 Kimball Drive, Parsippany, NJ 07054
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 Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C. S.A.
 Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.
 Langan Engineering and Environmental Services, Inc.
 Langan CT, Inc.
 Langan International LLC
 Collectively known as Langan

Project
PROJECT RIO
 DEVELOPMENT PERMIT SET
 A PARCEL LOCATED IN THE SOUTHEAST QUARTER OF SECTION 15, TOWNSHIP 1 SOUTH, RANGE 68 WEST OF THE SIXTH PRINCIPAL MERIDIAN,
 CITY OF THORNTON
 ADAMS COUNTY STATE OF COLORADO

Drawing Title
PARTIAL UTILITY PLAN 5

Project No. 100612301	Drawing No. DP CU105
Date 2/24/2017	
Scale 1" = 50'	
Drawn By DTF	Checked By MRG
Sheet 22 of 52	

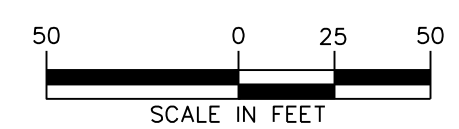
LANGAN Project No. 100612301



NOTES

UTILITY NOTES:

- EXISTING TOPOGRAPHY AND UTILITY INFORMATION FROM A CAD FILE RECEIVED ELECTRONICALLY FROM AZTEC CONSULTANTS, INC. ON 9/14/2016 AND 1/24/2017. CONTRACTOR SHALL FIELD VERIFY EXISTING TOPOGRAPHY, TIE IN ELEVATIONS, AND INVERTS PRIOR TO STARTING CONSTRUCTION.
- EXISTING CONTOURS/INVERTS ARE PRESENTED IN NAVD 88 AS REPRESENTED ON THE ABOVE REFERENCED SURVEY. LANGAN CLAIMS NO RESPONSIBILITY FOR THIS INFORMATION. CONTRACTOR SHALL FIELD VERIFY TIE IN ELEVATIONS AND INVERTS PRIOR TO STARTING CONSTRUCTION. CONTRACTOR TO CONFIRM ALL STRUCTURE INVERTS AND NOTIFY ENGINEER OF ANY INCONSISTENCIES PRIOR TO CONSTRUCTION.
- CONTRACTOR TO BEGIN PIPE NETWORK CONSTRUCTION AT TIE-IN LOCATION AND BUILD UPSTREAM.
- GAS, ELECTRIC, AND TELECOM SERVICE NETWORKS ARE SHOWN FOR SCHEMATIC PURPOSES ONLY. CONTRACTOR TO COORDINATE WITH UTILITY PROVIDER, ARCHITECT, AND MEP ENGINEER TO DETERMINE ACTUAL LOCATION AND SERVICE SIZE. CONCRETE ENCASEMENT SHALL BE PROVIDED, AS REQUIRED, IN ACCORDANCE WITH THE UTILITY CROSSING DETAILS.
- ALL WATER LINES SHALL BE C-900 PVC PIPE AND SHALL BE CONSTRUCTED, CHLORINATED, AND TESTED IN ACCORDANCE WITH CITY OF THORNTON STANDARDS.
- PRIVATE FIRE MAINS SHALL CONFORM TO NFPA24. CONCRETE ENCASEMENT SHALL BE PROVIDED, AS REQUIRED, IN ACCORDANCE WITH THE UTILITY CROSSING DETAILS.
- ALL SANITARY SEWER INFRASTRUCTURE SHALL BE CONSTRUCTED AND TESTED IN ACCORDANCE WITH THE STANDARDS OF THE CITY OF THORNTON.
- ALL SANITARY SEWER GRAVITY LINES SHALL BE SDR-35 PVC PIPE UNLESS OTHERWISE NOTED.



Date	Description	No.	SIGNATURE	DATE SIGNED
			RICHARD BURROW	
REVISIONS				
PROFESSIONAL ENGINEER CO Lic. No. PE.0050315				

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Drawing Title
PARTIAL UTILITY PLAN 6

Project No. 100612301	Drawing No. DP CU106
Date 2/24/2017	
Scale 1" = 50'	
Drawn By DTF	Checked By MRG
Sheet 23 of 52	