

Master Utilities Report

for

Jamaso

Aurora, Colorado

Prepared for:

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FACSIMILE STATEMENT

THIS ELECTRONIC PLAN SET IS A FACSIMILE OF A SIGNED
AND SEALED PDF SET

A handwritten signature in black ink, appearing to read 'Alaina Kneebone Marler', written over a horizontal line.

07/16/2024

SIGNATURE

DATE

ALAINA KNEEBONE MARLER, P.E.

COLORADO P.E. #35781

Approved On This Date

AURORA WATER - UTILITIES DIVISION

DATE

FIRE DEPARTMENT

DATE

Jamaso

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Document history and status

Revision	Date	Description	By	Review	Approved

Engineer's Statement

This "Master Utility Report for Jamaso" was prepared under my direct supervision in accordance with the provisions of the City of Aurora Standards and Specifications Regarding Water, Sanitary Sewer and Storm Drainage Infrastructure. I understand that the City of Aurora does not and will not assume liability for facilities designed by others.



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TABLE OF CONTENTS

I.	Introduction.....	5
A.	Site Location.....	5
B.	Description of Property.....	5
C.	Existing Infrastructure.....	6
II.	Water Distribution System.....	6
A.	Existing Water Infrastructure.....	6
B.	Water Design Criteria.....	6
C.	Proposed Water System.....	7
D.	Water System Analysis.....	8
III.	Sanitary Sewer System.....	9
A.	Existing Sanitary Sewer System.....	9
B.	Sanitary Design Criteria.....	9
C.	Interim Sanitary Sewer System.....	10
D.	Future Sanitary Sewer Extension & Offsite Sanitary Basins.....	10
E.	Sanitary Sewer Analysis.....	11
IV.	Conclusion.....	13
V.	References.....	13

APPENDICES

A.	Demand and Flow Calculations.....	14
B.	Water Hydraulic Computations.....	17
C.	Sanitary Hydraulic Computations.....	37
D.	Utility Maps.....	45
E.	Referenced Documents.....	48

I. Introduction

A. Site Location

The Jamaso project site is located in the northwest quarter of Section 4, Township 4 South, Range 65 West of the 6th Principal Meridian, City of Aurora, County of Arapahoe, State of Colorado. Below is Exhibit A for a vicinity map of the area.

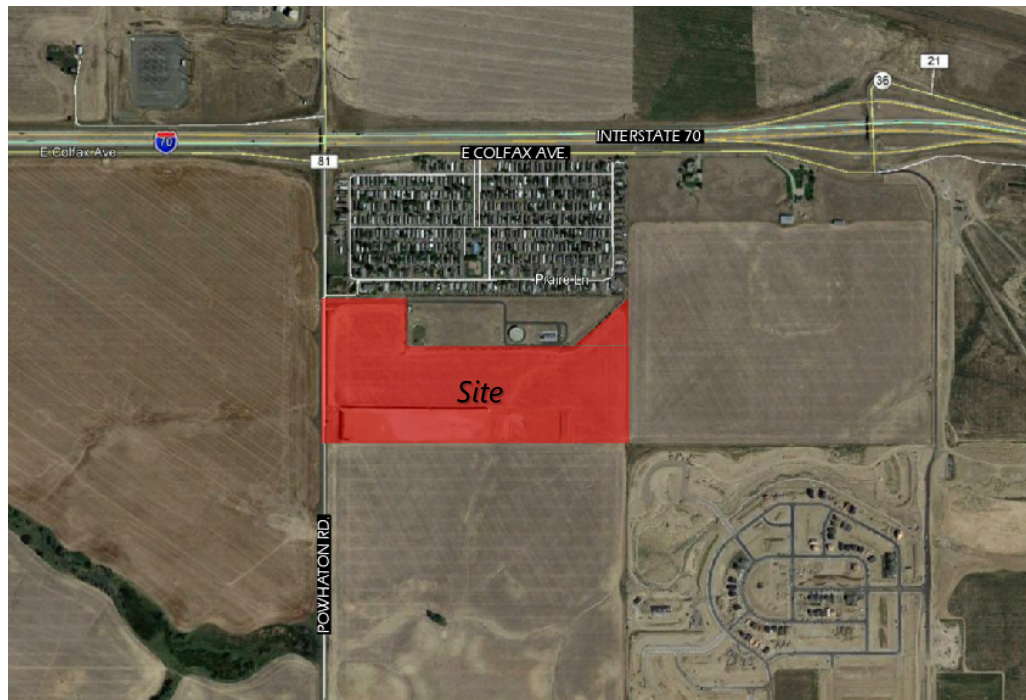


Exhibit A – Vicinity Map

B. Description of Property

The site is approximately 56.9 acres of land which is bounded by N. Powhatan Road to the west; Foxridge Farm mobile home park, Sable Altura Fire Station #1, and Aurora Water Pumping Station #3 to the north; Sky Ranch Subdivision to the southeast; and undeveloped land to the east and south. The proposed site is divided into eleven (11) planning areas which account for 37.3 acres of commercial area (PA-2, PA-3, PA-5, and PA-6); 10.1 acres of existing oil & gas (PA-7); 2.5 acres for full-spectrum detention (PA-4); and 7.0 acres of open-space/landscape buffer (PA-1, PA-8, PA-9, PA-10, and PA-11). The 37.3 acreage of commercial planning area is comprised of 26.1 acres of outdoor self-storage (PA-5 and PA-6) and 11.2 acres of indoor self-storage and retail (PA-2 and PA-3). Detention ponds and emergency accesses for the project will be dedicated from the planning areas.

Currently, the project site is zoned for Mixed Use – Airport (MU-A). The following table provides the land use and total area of each planning area within the site. Refer to

Appendix C for the Water Distribution Map, which shows the locations of the planning areas.

Planning Area	Area (Ac.)	Land Use
PA-1	1.0	Open space/ Landscape buffer (MU-A)
PA-2	6.6	Commercial - Retail/ Indoor self-storage
PA-3	4.6	Commercial - Retail/ Indoor self-storage
PA-4	2.5	Detention
PA-5	23.4	Commercial - Outdoor self-storage
PA-6	2.7	Commercial - Outdoor self-storage
PA-7	10.1	Existing Oil & Gas
PA-8	1.8	Open space/ Landscape buffer (MU-A)
PA-9	1.8	Open space/ Landscape buffer (MU-A)
PA-10	2.0	Open space/ Landscape buffer (MU-A)
PA-11	0.4	Open space/ Landscape buffer (MU-A)
Total Area	56.9	

C. Existing Infrastructure

Currently, there are existing utilities in N. Powhaton Road, and any work within or in the vicinity of the Powhaton ROW will require Aurora Water's Watch and Protect Team to be notified ten (10) days in advance. These utilities include a cable television line, a fiber optic line, a 16-in waterline, and a 60-in waterline. In addition to the in-ground utilities listed above, there are overhead electric lines to the west of N. Powhaton Road.

II. Water Distribution System

A. Existing Water Infrastructure

There are two waterlines that extend from Aurora Pumping Station #3 to N. Powhaton Road; an existing 16-in waterline that conveys potable water and an existing 60-in waterline that conveys raw water. There are two waterlines within N. Powhaton Road; a 16-in waterline and a 60-in waterline that extends along the entire eastern boundary of the Jamaso project site.

B. Water Design Criteria

Per sheet 05Y of Fire Hydrants from Aurora Water, the site is located within Pressure Zone 4 of the City of Aurora's Water Master Plan. The table below provides the Hydraulic Grade Line (HGL) of Zone 4 and provides site elevations with their corresponding pressure range. Refer to Appendix D for sheet 05Y of Fire Hydrants.

Pressure Zone	Static HGL	Site Elev. Range	Static Pressure Range
Zone 4	5850	5615-5585	102-115

As previously mentioned, this site incorporates 11.2 acres of commercial retail and indoor self-storage planning areas and 26.1 gross acres of outdoor self-storage area. This site does not include any residential development due to the proximity to existing oil and gas on site.

Per the City of Aurora's Water, Sanitary Sewer & Storm Drainage Infrastructure Standards & Specifications, below is a list of the demand criteria that are used:

- Average Day Demand (ADD): Commercial Demand = 1500 gpd/acre
- Max Day Peaking Factor = 2.8x
- Max Hour Peaking Factor = 4.5x
- Maximum Day Demand (MDD): Commercial Demand = 4200 gpd/acre
- Peak Hour Demand (PHD): Commercial Demand = 6750 gpd/acre
- Fire Flow: Commercial Demand = 2500 gpm
- Maximum Velocity = 3 fps in 8-in and 12-in WL during the PHD scenario.
- Head Loss Not to Exceed 0.005 ft/ft during the PHD scenario.

C. Proposed Water System

The proposed water system for Jamaso includes two waterline loops, and there is no phasing of water distribution infrastructure. However, as planning areas are developed, interior water line loops may be formed to align with required infrastructure limits and would be presented as part of the Site Plan review. Additionally, there is a proposed 30-in waterline (design by others, DBO) along the eastern boundary of the project site. Per conversations with the City of Aurora, the 30-in waterlines within the Jamaso project site are a necessary part of the future Zone 4 waterline that is being proposed by the City's Master Plan for the 'Eastern Utility Extension Zone 4 Waterline'. Refer to Appendix D for plan and profile views of the proposed 30-in waterline design by HDR, Inc., released for construction May 1, 2023, and reissued July 14, 2023.

The first 16-in waterline loop is proposed from the existing 16-in waterline in N. Powhatan Rd at the intersection with proposed E. 12th Avenue and encircles the commercial PA-3 parcel. The waterline loop will extend east along the southern boundary of PA-2 for approximately 650 feet in E. 12th Avenue. From there, the waterline loop extends south along the eastern edge of PA-3 approximately 230 feet to where it connects to the second proposed 12-in waterline loop at the northern boundary of PA-4. The waterline loop is completed by continuing west approximately 750 feet along the boundary of PA-4 where it reconnects with the existing 16-in waterline in N. Powhatan Road.

The second waterline loop is proposed as a 12-in waterline that connects the first proposed waterline loop to the proposed DBO 30-in waterline near the southeast corner of PA-6 and southeast corner of PA-5, encircling PA-5 entirely. In a clockwise fashion, the northern branch of the second waterline loop starts at the 16-in waterline in E. 12th Avenue at the southeast corner of PA-2, where it will be reduced to a 12-in waterline. From there, the 12-in waterline extends east in E. 12th Avenue for approximately 1,900 feet and interconnects with the DBO 30-in waterline near the southeast corner of PA-6. From there, the 12-in waterline extends south from the DBO 30-in waterline connection in the southeast corner of PA-6 approximately 700 feet within Road A and interconnects with the DBO 30-in waterline near the southeast corner of PA-5. From there, the 12-in waterline extends approximately 1,050 feet west from the southeast corner of PA-5. The loop is completed by continuing from the northwest corner of PA-8 approximately 1300 feet along the boundary of PA-5 where it reconnects with the first proposed 16-in waterline loop along the northern boundary of PA-4.

A minimum cover of four and one-half feet (4.5-ft) shall be maintained over all water mains and service laterals. The waterline connection in N. Powhatan Road will require a minimum of five feet (5-ft) of vertical separation from the 60-in waterline. Refer to Appendix C for the Water Distribution Map which details the proposed water distribution system.

D. Water System Analysis

On-site water demand calculations are provided in Appendix A. Per the City's criteria, the water system was analyzed under the following scenarios:

- Average Day Demand
- Peak Hour Demand
- Maximum Day Demand plus Fire Flow

The Maximum Day Demand plus Fire Flow scenario was analyzed twice; in the first scenario, the fire flow was modeled at the node of highest elevation; in the second scenario, the fire flow was modeled at the node of lowest elevation. These analyses were performed to confirm the water distribution system functions in compliance with Aurora standards for both residual pressure and maximum velocities.

Model Summary

The water model was created using Bentley's WaterCAD. The highest pressure observed for each scenario occurs at Junction J-9, which is the junction with the lowest elevation. The lowest pressure of 102 psi reported for each scenario occurs at Junction J-4, which is the junction with the highest elevation. A maximum pressure of 115 psi is reported at Junction J-9 during the average day demand, peak hour demand, and maximum day demand plus commercial fire flow (at junction of highest elevation) scenarios. A maximum pressure of 114 psi is reported at Junction J-1, J-8, & J-9 during the maximum day demand plus commercial fire flow (at junction of lowest elevation) scenario. During the peak hour

demand scenario, flows meet City of Aurora criteria. Refer to Appendix B for the Nodal Diagram and Water Hydraulic Computations.

III. Sanitary Sewer System

A. Existing Sanitary Sewer System

The Jamaso project site lies within the First Creek Sanitary Basin. Currently, the closest available existing sanitary sewer connection is a 12-in sanitary sewer approximately two miles away at Prologis Park 70. Prologis Park 70 is located at E-470 and E. 19th Avenue. The existing Prologis lift station which is located to the west of E-470 and south of Smith Road is planned to be removed and replaced by a 21-in sanitary sewer main which will gravity flow to the existing First Creek Interceptor that is located west of E-470 within Smith Road. Per the Master Utility Study and Sanitary Sewer Plans for Aurora Crossroads by Martin/Martin, dated November 25, 2020 and October 27, 2021, respectively, the sanitary sewer is to be extended east from the Aurora Crossroads development by others during the construction of future projects that are within the vicinity of the Aurora Crossroads development. Generally, the sanitary sewer extension from Aurora Crossroads is to follow the First Creek Drainageway. Refer to Appendix D for the Aurora Crossroads Sanitary Map from the Master Utility Study by Martin/Martin, Inc and the pertinent sheets from the Aurora Crossroads Offsite Sanitary Sewer Construction Plans which show the locations of the existing and proposed sanitary infrastructure.

B. Sanitary Design Criteria

Sanitary design criteria per the City of Aurora's Water, Sanitary Sewer & Storm Drainage Infrastructure Standards and Specifications is defined below.

- Average Residential Loading = 68 gpcd
- Average Day Loading (Commercial) = 1500 gpd/acre
- Equivalent Population per Acre (Commercial) = 22
- Population per Residence = 2.77 people/dwelling unit
- Peaking Factor (PF) = $5 / p^{0.167}$, where p = population (in thousands)
- Maximum Peaking Factor = 4.0
- Minimum Peaking Factor = 1.7
- Maximum Velocity = 10 ft/s
- Manning's: N=0.011 for PVC and N=0.013 for RCP or VCP.

Design criteria for the sanitary sewer system is based upon Section 5 of the Water, Sanitary Sewer & Storm Drainage Infrastructure Standards & Specifications by Aurora Water. Per section 5.03.6 of the standards and specifications from the City of Aurora, the sanitary sewer mains that are 12-in diameter and smaller are designed to carry the peak discharge with the pipe operating at no more than 75% of the maximum flow capacity; 80% for larger diameter pipes.

The Aurora water plant, shown as OS6 in the Aurora Crossroads Sanitary Map from the Master Utility Study by Martin/Martin, Inc, will continue without sanitary loading to the sanitary main extension.

C. Interim Sanitary Sewer System

Prior to the completion of the sanitary sewer extension from the Aurora Crossroads development, if the individual lots within the Jamaso project site are to be developed as self-storage facilities like they are anticipated, then those lots will be serviced via septic systems which may include sanitary vaults and/or septic tanks with an associated leach bed, as a temporary measure. If heavier commercial loading per allowable uses is placed in the Planning Areas during the Site Plan phase, additional State and County permits would be required to provide adequate treatment and storage capacity.

Permitting of Septic Systems is managed by the Arapahoe County Public Health Department and shall be completed prior to the construction of each lot. Designs of the individual lots shall include the locations of all proposed buildings and septic systems. Septic systems shall be designed and constructed per the requirements of the Arapahoe County Public Health Department. Per the Arapahoe County On-site Wastewater Regulations and conversations with representatives of Arapahoe County Public Health Department, development of these planning areas utilizing septic systems would be acceptable as long as the proposed development does not load the septic system with more than 2,000 gpd. Sanitary loading greater than 2,000 gpd would require additional approval and permitting with Arapahoe County and with Colorado Department of Public Health & Environment. Septic systems within the Jamaso project site will be independently owned and maintained by the owner of the lots in which they reside until they can be connected to the sanitary mains.

D. Future Sanitary Sewer Extension & Offsite Sanitary Basins

Once the First Creek Interceptor Sanitary Sewer has been extended justifiably close to the Jamaso project site, a sewer main shall be constructed within E. 12th Avenue. At that time an amendment to this Master Utility Study could be provided to confirm that capacity requirements are met if master planning has been altered in such a way as to affect utilities. The proposed Jamaso design is in conformance with the Master Utility Study Addendum Letter (EDN: 221029), prepared by Martin & Martin Consulting Engineers and dated February 22, 2022. Refer to Section III.E of this report for detailed discussion of conformance the MUS Addendum Letter. Refer to Appendix E for excerpted material from the Master Utility Study Addendum Letter (EDN: 221029).

The sanitary sewer within E. 12th Avenue shall extend from the outfall connection in N. Powhaton Road to the eastern site boundary and will provide a sanitary connection the east for future expansions. The sanitary extension in N. Powhaton Road to the First Creek Interceptor will also require capacity for three off-site properties adjacent to Jamaso which

are currently zoned for Residential development. For detailed information on the future sanitary sewer interceptor, refer to the excerpted material from the Master Utility Study Addendum Letter (EDN: 221029) included in Appendix E.

The table below provides the sanitary loading of each on-site planning area of Jamaso if it were to be fully developed per zoning allowable uses. The full development of any of these planning areas per zoning allowable uses would require the sanitary sewer extension in N. Powhatan Road to be completed.

On-Site Sanitary Loading Calculations - Commercial Areas Only					
Planning Area	PA-2	PA-3	PA-5	PA-6	Total - Jamaso
Average Sanitary Load	9,900 gpd	6,900 gpd	35,100 gpd	4,050 gpd	55,950 gpd
Peak Sanitary Load + I/I	40,590 gpd	28,290 gpd	143,910 gpd	16,605 gpd	229,395 gpd
	0.063 cfs	0.044 cfs	0.223 cfs	0.026 cfs	0.355 cfs

Per the MUS Addendum Letter, in the ultimate condition, sanitary loading from offsite sanitary basins OS7 (Jamaso), OS8, OS9, and OS10 will be conveyed southward through the sanitary sewer in N. Powhatan Road where they outfall into the future sanitary sewer interceptor. At Node G, OS10 will outfall directly into a future 8-in sanitary sewer near the northwest corner of the Jamaso project site, formerly known as OS7. At Node F, OS9 will outfall into the future 12-in sanitary sewer in E. 12th Avenue at the eastern property boundary for the Jamaso project site. Sanitary loading from Jamaso, OS9, and OS10 will converge at Node H and outfall into a future 12-in sanitary sewer in N. Powhatan Road, west of Jamaso. After sanitary loading from Jamaso, OS9, and OS10 converge, they will be conveyed south until converging with the sanitary loading from OS8 at Node I. Contributions to the flows in the future sanitary sewer extension in N. Powhatan Road are provided in the table below. Refer to Appendix A for detailed sanitary flow calculations and refer to Appendix D for the sanitary sewer system map which provides the locations of the sanitary basins and the loading at each of the nodes that are analyzed in this report.

Sanitary Loading Calculations						
Planning Area	Jamaso	OS8	OS9	OS10	Total	
Contributing Area	37.3	116.0	144.2	74.3	334.5	37.3
	Acres Commercial	Acres Residential	Acres Residential	Acres Residential	Acres Residential	Acres Commercial
Maximum Dwelling Density	N/A units/acre	5.5 units/acre	5.5 units/acre	5.5 units/acre	5.5 units/acre	
Equivalent # of Residents	821	1768	2,197	1,132	5,917	
Peak Factor (PF)	4.00	4.00	4.00	4.00	3.72	
Average Sanitary Load	55,950 gpd	120,224 gpd	149,368 gpd	76,973 gpd	402,356	gpd
Peak Sanitary Load + I/I	229,395 gpd	492,918 gpd	612,410 gpd	315,591 gpd	1,535,230	gpd
	0.355 cfs	0.763 cfs	0.948 cfs	0.488 cfs	2.293	cfs

E. Sanitary Sewer Analysis

There are four (4) commercial planning areas and three offsite residential areas which will produce sanitary flows that need to be considered in this report. Assuming future full development of Planning Areas PA-2, PA-3, PA-5 and PA-6, the onsite sanitary basin generates a total peak flow of 0.355 cfs (0.229 MGD); offsite sanitary basin OS8 generates

a total peak flow of 0.763 cfs (0.493 MGD); offsite sanitary basin OS9 generates a total peak flow of 0.948 cfs (0.612 MGD); offsite sanitary basin OS10 generates a total peak flow of 0.488 cfs (0.316 MGD); and the total flow rate in the future sanitary sewer extension in N. Powhaton Road is 2.293 cfs (1.535 MGD) at Node I.

With the percent full being defined as normal depth divided by diameter (d/D), a 12-in PVC pipe at a minimum slope of 0.40% and at the maximum 75% full can convey a maximum of 2.385 cfs and an 8-in PVC pipe at a minimum slope of 0.40% and at the maximum 75% full can convey a maximum of 0.809 cfs. Therefore, an 8-in PVC sanitary sewer is sufficient to convey flows from OS8 and OS10 to the extended sewer main in N. Powhaton Road and a 12-in PVC sanitary sewer is sufficient to convey flows from OS9, through Jamaso, and south to the future sanitary sewer interceptor. Refer to Appendix C for detailed hydraulic computations.

The Aurora Crossroads Filing No. 1 Master Utility Study Addendum Letter (EDN: 221029), prepared by Martin & Martin Consulting Engineers and dated February 22, 2022, anticipates an average daily flow of 0.070 MGD from the Jamaso project site (denoted OS7 in the MUS Addendum Letter). At maximum development, Jamaso would produce an average daily flow of 0.057 MGD. The formula for the peaking factor used in the Aurora Crossroads MUS Addendum Letter is in conformance with City of Aurora Standards, Section 5.03 (presented in Section III.B of this report). Therefore, the proposed development of Jamaso is in conformance with the Master Utility Study and the design intent of the future sanitary sewer interceptor.

The Aurora Crossroads Filing No. 1 MUS Addendum Letter also anticipates an average daily flow of 0.1316 MGD from the future residential area immediately adjacent to the southern boundary of the Jamaso project site (denoted OS8 in the MUS Addendum Letter). OS8 encompasses an area of 127 acres which includes portions of Riverwood Tributary and the First Creek Tributary. Additionally, OS8 includes portions of the Jamaso project site totaling approximately 10.5 acres; this overlap includes the existing oil & gas site in PA-7. Approximately, 116 acres of OS8 would be able to contribute to the 12-in sanitary line in N. Powhaton Rd. Currently with this development, the 12-in sanitary line within N. Powhaton Rd is approximately 71.7% full, with a normal depth of 8.6 inches. Further analysis of OS8, OS9, or OS10 is not within the scope of this study. Development of any of these offsite basins would require further analysis. Therefore, the anticipated offsite developments discussed in this report are in conformance with the Master Utility Study and the design intent of the future sanitary sewer interceptor.

Refer to Appendix A for detailed loading and demand calculations. Refer to Appendix E for loading and demand calculations and annotated maps excerpted from the Aurora Crossroads Filing No. 1 MUS Addendum Letter (EDN: 221029).

IV. Conclusion

The proposed water systems conform to the Water, Sanitary Sewer & Storm Drainage Infrastructure Standards & Specifications from Aurora Water. Septic systems are an acceptable temporary measure for limited commercial uses until such time as sanitary sewer mains are extended closer to service the project. The sanitary loads generated by the Jamaso project amount to approximately 0.057 million gallons per day (MGD), which falls below the projected 0.070 MGD outlined in the MUS Addendum Letter (EDN: 221029). Consequently, this report conforms to the parameters set in the master study.

V. References

1. ***Water, Sanitary Sewer & Storm Drainage Infrastructure Standards & Specifications***, Aurora Water, January 2022.
2. ***Fire Hydrants***, Aurora Water, plot date February 2, 2020.
3. ***Aurora Prairie Waters Project Conveyance System Pumping Station 3 Civil Utility Extension – Water CSP excerpt***, plot date September 18, 2007 and prepared by MWH (2007-6046-00).
4. ***Jamaso Multi-well Pad Civil Plans***, approved November 13, 2018 and prepared by Lamp Rynearson & Associates (218185).
5. ***Regulation No. O-17 On-Site Wastewater Treatment Systems***, effective October 1, 2017 and prepared by Tri-County Health Department.
6. ***Aurora Crossroads – Master Utility Study***, dated November 25, 2020 and prepared by Martin/Martin, Inc (221029).
7. ***Aurora Crossroads Offsite Sanitary Sewer Construction Plans***, approved June 21, 2021 and prepared by Martin/Martin, Inc (221191).
8. ***Eastern Utility Extension Zone 4 Waterline Construction Plans***, revised July 14, 2023 and prepared by HDR, Inc.
9. ***Master Utility Study Addendum Letter***, dated February 22, 2022 and prepared by Martin/Martin, Inc (221029)

APPENDIX A

Demand and Flow Calculations

Jamaso Water Demand Calculations							
					Average Day Demand (gpd / acre)	Maximum Day Demand (gpd / acre)	Peak Hour Demand (gpd / acre)
Commercial/Self Storage					1500	4200	6750
Parks & Landscaping					1800	5040	N/A
Industrial					1200	3360	5400
Junction	Planning Area	PA Usage	Total Area	Contributing Area (acre)	Average Day Demand (gpm)	Maximum Day Demand (gpm)	Peak Hour Demand (gpm)
J-2	PA-1	Landscape	1.0	0.4	0.53	1.49	N/A
J-1	PA-2	Commercial	6.6	5.6	5.86	16.40	26.36
J-1	PA-3	Commercial	4.6	4.1	4.23	11.83	19.02
J-9	PA-4	Detention	2.5	0.3	0.33	0.92	N/A
J-7	PA-5	Commercial	23.4	21.1	21.95	61.47	98.79
J-3	PA-6	Commercial	2.7	2.3	2.42	6.78	10.90
J-8	PA-7	Industrial	10.1	10.1	8.42	23.57	37.88
J-6	PA-8	Landscape	1.8	1.8	2.22	6.21	N/A
J-2	PA-9	Landscape	1.8	0.4	0.44	1.24	N/A
J-5	PA-10	Landscape	2.0	1.2	1.53	4.30	N/A
J-2	PA-11	Landscape	0.4	0.4	0.50	1.41	N/A
Total =					48.44	135.63	192.94

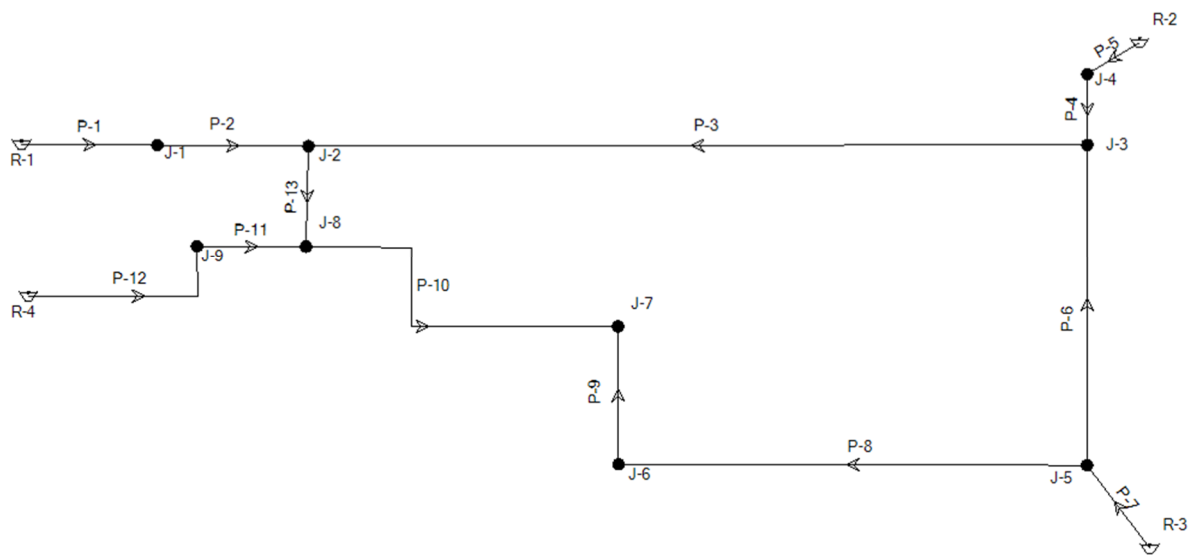
On-Site Sanitary Loading Calculations					
Planning Area	PA-2	PA-3	PA-5	PA-6	Jamaso - Total
Contributing Area	6.6 Acres Commercial (Retail)	4.6 Acres Commercial (Retail)	23.4 Acres Commercial (Self Storage)	2.7 Acres Commercial (Self Storage)	37.3 Acres Commercial
	0.0 Acres Residential	0.0 Acres Residential	0.0 Acres Residential	0.0 Acres Residential	0.0 Acres Residential
Residential Dwelling Density	N/A	N/A	N/A	N/A	N/A
Equivalent # of Residents	146	102	515	60	821
Peak Factor (PF)	4.00	4.00	4.00	4.00	0.00
Average Sanitary Load	9,900 gpd	6,900 gpd	35,100 gpd	4,050 gpd	55,950 gpd
Infiltration & Inflow (I/I)	990 gpd	690 gpd	3,510 gpd	405 gpd	5,595 gpd
Peak Sanitary Load + I/I	40,590 gpd	28,290 gpd	143,910 gpd	16,605 gpd	229,395 gpd
	0.063 cfs	0.044 cfs	0.223 cfs	0.026 cfs	0.355 cfs

Sanitary Loading Calculations					
Design Node	Node E	Node F	Node G	Node H	Node I
Planning Area(s)	OS8	OS9	OS10	Jamaso, OS9 & OS10	Jamaso, OS8, OS9 & OS10
Contributing Area	0.0 Acres Commercial	0.0 Acres Commercial	0.0 Acres Commercial	37.3 Acres Commercial	37.3 Acres Commercial
	116.0 Acres Residential	144.2 Acres Residential	74.3 Acres Residential	218.5 Acres Residential	334.5 Acres Residential
Residential Dwelling Density	5.5 units/ acre	5.5 units/ acre	5.5 units/ acre	5.5 units/ acre	5.5 units/ acre
Equivalent # of Residents	1768	2,197	1,132	4,150	5,917
Peak Factor (PF)	4.00	4.00	4.00	3.94	3.72
Average Sanitary Load	120,224 gpd	149,368 gpd	76,973 gpd	282,200 gpd	402,356 gpd
Infiltration & Inflow (I/I)	12,022 gpd	14,937 gpd	7,697 gpd	28,220 gpd	40,236 gpd
Peak Sanitary Load + I/I	492,918 gpd	612,410 gpd	315,591 gpd	1,140,753 gpd	1,535,230 gpd
	0.763 cfs	0.948 cfs	0.488 cfs	1.723 cfs	2.293 cfs

APPENDIX B

Water Hydraulic Computations

Jamaso Nodal Diagram



Static
Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Material	Length (User Defined) (ft)	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-12	R-4	J-9	16.0	PVC	340	130.0	0.000	0.00	0.00	0.000
P-1	R-1	J-1	16.0	PVC	480	130.0	0.000	0.00	0.00	0.000
P-2	J-1	J-2	16.0	PVC	320	130.0	0.000	0.00	0.00	0.000
P-8	J-6	J-5	12.0	PVC	1,070	130.0	0.000	0.00	0.00	0.000
P-6	J-5	J-3	30.0	PVC	880	130.0	0.000	0.01	0.00	0.000
P-3	J-3	J-2	12.0	PVC	1,885	130.0	0.000	0.00	0.00	0.000
P-4	J-3	J-4	30.0	PVC	395	130.0	0.000	0.01	0.00	0.000
P-9	J-7	J-6	12.0	PVC	300	130.0	0.000	0.00	0.00	0.000
P-7	R-3	J-5	30.0	PVC	85	130.0	0.000	0.01	0.00	0.000
P-5	R-2	J-4	30.0	PVC	70	130.0	0.000	-0.01	0.00	0.000
P-11	J-9	J-8	16.0	PVC	362	130.0	0.000	0.00	0.00	0.000
P-10	J-8	J-7	12.0	PVC	843	130.0	0.000	0.00	0.00	0.000
P-13	J-2	J-8	16.0	PVC	355	130.0	0.000	0.00	0.00	0.000

Static

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-9	5,586.12	0.00	5,850.00	115
J-1	5,587.40	0.00	5,850.00	114
J-2	5,599.00	0.00	5,850.00	109
J-6	5,588.28	0.00	5,850.00	113
J-5	5,604.10	0.00	5,850.00	106
J-3	5,610.50	0.00	5,850.00	104
J-4	5,614.70	0.00	5,850.00	102
J-7	5,591.39	0.00	5,850.00	112
J-8	5,588.51	0.00	5,850.00	114

Static

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	5,850.00	0.00	5,850.00
R-4	5,850.00	0.00	5,850.00
R-3	5,850.00	0.01	5,850.00
R-2	5,850.00	-0.01	5,850.00

Average Day Demand (ADD)
Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Material	Length (User Defined) (ft)	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-12	R-4	J-9	16.0	PVC	340	130.0	0.000	14.27	0.02	0.000
P-1	R-1	J-1	16.0	PVC	480	130.0	0.000	15.19	0.02	0.000
P-2	J-1	J-2	16.0	PVC	320	130.0	0.000	5.11	0.01	0.000
P-8	J-6	J-5	12.0	PVC	1,070	130.0	0.000	-11.47	0.03	0.000
P-6	J-5	J-3	30.0	PVC	880	130.0	0.000	0.51	0.00	0.000
P-3	J-3	J-2	12.0	PVC	1,885	130.0	0.000	3.55	0.01	0.000
P-4	J-3	J-4	30.0	PVC	395	130.0	0.000	-5.46	0.00	0.000
P-9	J-7	J-6	12.0	PVC	300	130.0	0.000	-9.25	0.03	0.000
P-7	R-3	J-5	30.0	PVC	85	130.0	0.000	13.51	0.01	0.000
P-5	R-2	J-4	30.0	PVC	70	130.0	0.000	5.46	0.00	0.000
P-11	J-9	J-8	16.0	PVC	362	130.0	0.000	13.94	0.02	0.000
P-10	J-8	J-7	12.0	PVC	843	130.0	0.000	12.70	0.04	0.000
P-13	J-2	J-8	16.0	PVC	355	130.0	0.000	7.18	0.01	0.000

Average Day Demand (ADD)

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-9	5,586.12	0.33	5,850.00	114
J-1	5,587.40	10.08	5,850.00	114
J-2	5,599.00	1.48	5,850.00	109
J-6	5,588.28	2.22	5,850.00	113
J-5	5,604.10	1.53	5,850.00	106
J-3	5,610.50	2.42	5,850.00	104
J-4	5,614.70	0.00	5,850.00	102
J-7	5,591.39	21.95	5,850.00	112
J-8	5,588.51	8.42	5,850.00	113

Average Day Demand (ADD)

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	5,850.00	15.19	5,850.00
R-4	5,850.00	14.27	5,850.00
R-3	5,850.00	13.51	5,850.00
R-2	5,850.00	5.46	5,850.00

Maximum Day Demand (MDD)
Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Material	Length (User Defined) (ft)	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-12	R-4	J-9	16.0	PVC	340	130.0	0.000	40.54	0.06	0.000
P-1	R-1	J-1	16.0	PVC	480	130.0	0.000	43.07	0.07	0.000
P-2	J-1	J-2	16.0	PVC	320	130.0	0.000	13.56	0.02	0.000
P-8	J-6	J-5	12.0	PVC	1,070	130.0	0.000	-34.17	0.10	0.000
P-6	J-5	J-3	30.0	PVC	880	130.0	0.000	0.96	0.00	0.000
P-3	J-3	J-2	12.0	PVC	1,885	130.0	0.000	10.02	0.03	0.000
P-4	J-3	J-4	30.0	PVC	395	130.0	0.000	-15.84	0.01	0.000
P-9	J-7	J-6	12.0	PVC	300	130.0	0.000	-24.96	0.07	0.000
P-7	R-3	J-5	30.0	PVC	85	130.0	0.000	39.43	0.02	0.000
P-5	R-2	J-4	30.0	PVC	70	130.0	0.000	15.84	0.01	0.000
P-11	J-9	J-8	16.0	PVC	362	130.0	0.000	38.58	0.06	0.000
P-10	J-8	J-7	12.0	PVC	843	130.0	0.000	37.72	0.11	0.000
P-13	J-2	J-8	16.0	PVC	355	130.0	0.000	19.44	0.03	0.000

Maximum Day Demand (MDD)

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-9	5,586.12	1.96	5,850.00	114
J-1	5,587.40	29.51	5,850.00	114
J-2	5,599.00	4.14	5,850.00	109
J-6	5,588.28	9.21	5,849.99	113
J-5	5,604.10	4.30	5,850.00	106
J-3	5,610.50	6.78	5,850.00	104
J-4	5,614.70	0.00	5,850.00	102
J-7	5,591.39	62.68	5,849.99	112
J-8	5,588.51	20.30	5,850.00	113

Maximum Day Demand (MDD)

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	5,850.00	43.07	5,850.00
R-4	5,850.00	40.54	5,850.00
R-3	5,850.00	39.43	5,850.00
R-2	5,850.00	15.84	5,850.00

Max. Day Demand + Fire Flow at Highest Elevation (MDD+FF High)

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Material	Length (User Defined) (ft)	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-12	R-4	J-9	16.0	PVC	340	130.0	0.000	54.36	0.09	0.000
P-1	R-1	J-1	16.0	PVC	480	130.0	0.000	59.48	0.09	0.000
P-2	J-1	J-2	16.0	PVC	320	130.0	0.000	29.97	0.05	0.000
P-8	J-6	J-5	12.0	PVC	1,070	130.0	0.000	-34.61	0.10	0.000
P-6	J-5	J-3	30.0	PVC	880	130.0	0.000	411.49	0.19	0.000
P-3	J-3	J-2	12.0	PVC	1,885	130.0	0.000	-20.66	0.06	0.000
P-4	J-3	J-4	30.0	PVC	395	130.0	0.000	425.36	0.19	0.000
P-9	J-7	J-6	12.0	PVC	300	130.0	0.000	-25.40	0.07	0.000
P-7	R-3	J-5	30.0	PVC	85	130.0	0.000	450.40	0.20	0.000
P-5	R-2	J-4	30.0	PVC	70	130.0	0.000	2,074.64	0.94	0.000
P-11	J-9	J-8	16.0	PVC	362	130.0	0.000	52.40	0.08	0.000
P-10	J-8	J-7	12.0	PVC	843	130.0	0.000	37.28	0.11	0.000
P-13	J-2	J-8	16.0	PVC	355	130.0	0.000	5.18	0.01	0.000

Max. Day Demand + Fire Flow at Highest Elevation (MDD+FF High)
Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-9	5,586.12	1.96	5,850.00	115
J-1	5,587.40	29.51	5,850.00	114
J-2	5,599.00	4.14	5,850.00	109
J-6	5,588.28	9.21	5,849.99	113
J-5	5,604.10	4.30	5,850.00	106
J-3	5,610.50	6.78	5,849.99	104
J-4	5,614.70	2,500.00	5,849.99	102
J-7	5,591.39	62.68	5,849.99	112
J-8	5,588.51	20.30	5,850.00	114

Max. Day Demand + Fire Flow at Highest Elevation (MDD+FF High)

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	5,850.00	59.48	5,850.00
R-4	5,850.00	54.36	5,850.00
R-3	5,850.00	450.40	5,850.00
R-2	5,850.00	2,074.64	5,850.00

Max. Day Demand + Fire Flow at Lowest Elevation (MDD+FF Low)

Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Material	Length (User Defined) (ft)	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-12	R-4	J-9	16.0	PVC	340	130.0	0.000	1,602.53	2.56	0.001
P-1	R-1	J-1	16.0	PVC	480	130.0	0.000	608.83	0.97	0.000
P-2	J-1	J-2	16.0	PVC	320	130.0	0.000	579.32	0.92	0.000
P-8	J-6	J-5	12.0	PVC	1,070	130.0	0.000	-240.20	0.68	0.000
P-6	J-5	J-3	30.0	PVC	880	130.0	0.000	46.50	0.02	0.000
P-3	J-3	J-2	12.0	PVC	1,885	130.0	0.000	176.24	0.50	0.000
P-4	J-3	J-4	30.0	PVC	395	130.0	0.000	-136.52	0.06	0.000
P-9	J-7	J-6	12.0	PVC	300	130.0	0.000	-230.99	0.66	0.000
P-7	R-3	J-5	30.0	PVC	85	130.0	0.000	291.00	0.13	0.000
P-5	R-2	J-4	30.0	PVC	70	130.0	0.000	136.52	0.06	0.000
P-11	J-9	J-8	16.0	PVC	362	130.0	0.000	-899.43	1.44	0.001
P-10	J-8	J-7	12.0	PVC	843	130.0	0.000	-168.31	0.48	0.000
P-13	J-2	J-8	16.0	PVC	355	130.0	0.000	751.41	1.20	0.000

Max. Day Demand + Fire Flow at Lowest Elevation (MDD+FF Low)
Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-9	5,586.12	2,501.96	5,849.49	114
J-1	5,587.40	29.51	5,849.88	114
J-2	5,599.00	4.14	5,849.81	109
J-6	5,588.28	9.21	5,849.81	113
J-5	5,604.10	4.30	5,850.00	106
J-3	5,610.50	6.78	5,850.00	104
J-4	5,614.70	0.00	5,850.00	102
J-7	5,591.39	62.68	5,849.76	112
J-8	5,588.51	20.30	5,849.68	114

Max. Day Demand + Fire Flow at Lowest Elevation (MDD+FF Low)

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	5,850.00	608.83	5,850.00
R-4	5,850.00	1,602.53	5,850.00
R-3	5,850.00	291.00	5,850.00
R-2	5,850.00	136.52	5,850.00

Peak Hourly Demand
Pipe Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Material	Length (User Defined) (ft)	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-12	R-4	J-9	16.0	PVC	340	130.0	0.000	57.19	0.09	0.000
P-1	R-1	J-1	16.0	PVC	480	130.0	0.000	62.68	0.10	0.000
P-2	J-1	J-2	16.0	PVC	320	130.0	0.000	15.26	0.02	0.000
P-8	J-6	J-5	12.0	PVC	1,070	130.0	0.000	-46.54	0.13	0.000
P-6	J-5	J-3	30.0	PVC	880	130.0	0.000	4.04	0.00	0.000
P-3	J-3	J-2	12.0	PVC	1,885	130.0	0.000	14.37	0.04	0.000
P-4	J-3	J-4	30.0	PVC	395	130.0	0.000	-21.23	0.01	0.000
P-9	J-7	J-6	12.0	PVC	300	130.0	0.000	-46.54	0.13	0.000
P-7	R-3	J-5	30.0	PVC	85	130.0	0.000	50.58	0.02	0.000
P-5	R-2	J-4	30.0	PVC	70	130.0	0.000	21.23	0.01	0.000
P-11	J-9	J-8	16.0	PVC	362	130.0	0.000	57.19	0.09	0.000
P-10	J-8	J-7	12.0	PVC	843	130.0	0.000	54.19	0.15	0.000
P-13	J-2	J-8	16.0	PVC	355	130.0	0.000	29.64	0.05	0.000

Peak Hourly Demand

Junction Table - Time: 0.00 hours

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
J-9	5,586.12	0.00	5,850.00	115
J-1	5,587.40	47.42	5,850.00	114
J-2	5,599.00	0.00	5,850.00	109
J-6	5,588.28	0.00	5,849.99	113
J-5	5,604.10	0.00	5,850.00	106
J-3	5,610.50	10.90	5,850.00	104
J-4	5,614.70	0.00	5,850.00	102
J-7	5,591.39	100.73	5,849.99	112
J-8	5,588.51	32.63	5,850.00	114

Peak Hourly Demand

Reservoir Table - Time: 0.00 hours

Label	Elevation (ft)	Flow (Out net) (gpm)	Hydraulic Grade (ft)
R-1	5,850.00	62.68	5,850.00
R-4	5,850.00	57.19	5,850.00
R-3	5,850.00	50.58	5,850.00
R-2	5,850.00	21.23	5,850.00

APPENDIX C

Sanitary Hydraulic Computations

Maximum Discharge of an 8" PVC Pipe Sloped at 0.40%

Project Description	
Friction Method	Manning Formula
Solve For	Discharge
Input Data	
Roughness Coefficient	0.011
Channel Slope	0.40
Normal Depth	6.0
Diameter	8.0
Results	
Discharge	0.824
Flow Area	0.3
Wetted Perimeter	1.4
Hydraulic Radius	2.4
Top Width	0.58
Critical Depth	5.2
Percent Full	75.0
Critical Slope	0.60
Velocity	2.93
Velocity Head	0.13
Specific Energy	0.63
Froude Number	0.741
Maximum Discharge	0.972
Discharge Full	0.903
Slope Full	0.33
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0
Length	0.0
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0
Profile Description	N/A
Profile Headloss	0.00
Average End Depth Over Rise	0.0
Normal Depth Over Rise	37.9
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	6.0
Critical Depth	5.2
Channel Slope	0.40
Critical Slope	0.60

Maximum Discharge of an 12" PVC Pipe Sloped at 0.40%

Project Description	
Friction Method	Manning Formula
Solve For	Discharge
Input Data	
Roughness Coefficient	0.011
Channel Slope	0.40
Normal Depth	9.0
Diameter	12.0
Results	
Discharge	2.428
Flow Area	0.6
Wetted Perimeter	2.1
Hydraulic Radius	3.6
Top Width	0.87
Critical Depth	8.0
Percent Full	75.0
Critical Slope	0.54
Velocity	3.84
Velocity Head	0.23
Specific Energy	0.98
Froude Number	0.793
Maximum Discharge	2.864
Discharge Full	2.663
Slope Full	0.33
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0
Length	0.0
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0
Profile Description	N/A
Profile Headloss	0.00
Average End Depth Over Rise	0.0
Normal Depth Over Rise	37.9
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	9.0
Critical Depth	8.0
Channel Slope	0.40
Critical Slope	0.54

8" PVC Capacity - Basin OS8 - Node E

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.011
Channel Slope	0.40
Diameter	8.0
Discharge	0.763
Results	
Normal Depth	5.6
Flow Area	0.3
Wetted Perimeter	1.3
Hydraulic Radius	2.4
Top Width	0.61
Critical Depth	5.0
Percent Full	70.5
Critical Slope	0.57
Velocity	2.90
Velocity Head	0.13
Specific Energy	0.60
Froude Number	0.778
Maximum Discharge	0.972
Discharge Full	0.903
Slope Full	0.29
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0
Length	0.0
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0
Profile Description	N/A
Profile Headloss	0.00
Average End Depth Over Rise	0.0
Normal Depth Over Rise	37.9
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	5.6
Critical Depth	5.0
Channel Slope	0.40
Critical Slope	0.57

12" PVC Capacity - Basin OS9 - Node F

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.011
Channel Slope	0.40
Diameter	12.0
Discharge	0.948
Results	
Normal Depth	4.9
Flow Area	0.3
Wetted Perimeter	1.4
Hydraulic Radius	2.6
Top Width	0.98
Critical Depth	4.9
Percent Full	41.2
Critical Slope	0.41
Velocity	3.10
Velocity Head	0.15
Specific Energy	0.56
Froude Number	0.981
Maximum Discharge	2.864
Discharge Full	2.663
Slope Full	0.05
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0
Length	0.0
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0
Profile Description	N/A
Profile Headloss	0.00
Average End Depth Over Rise	0.0
Normal Depth Over Rise	38.2
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	4.9
Critical Depth	4.9
Channel Slope	0.40
Critical Slope	0.41

8" PVC Capacity - Basin OS10 - Node G

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.011
Channel Slope	0.40
Diameter	8.0
Discharge	0.488
Results	
Normal Depth	4.2
Flow Area	0.2
Wetted Perimeter	1.1
Hydraulic Radius	2.1
Top Width	0.67
Critical Depth	3.9
Percent Full	52.4
Critical Slope	0.50
Velocity	2.64
Velocity Head	0.11
Specific Energy	0.46
Froude Number	0.882
Maximum Discharge	0.972
Discharge Full	0.903
Slope Full	0.12
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0
Length	0.0
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0
Profile Description	N/A
Profile Headloss	0.00
Average End Depth Over Rise	0.0
Normal Depth Over Rise	27.8
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	4.2
Critical Depth	3.9
Channel Slope	0.40
Critical Slope	0.50

12" PVC Capacity - Outfall from Jamaso - Node H

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.011
Channel Slope	0.40
Diameter	12.0
Discharge	1.723
Results	
Normal Depth	7.0
Flow Area	0.5
Wetted Perimeter	1.7
Hydraulic Radius	3.3
Top Width	0.99
Critical Depth	6.7
Percent Full	58.6
Critical Slope	0.47
Velocity	3.61
Velocity Head	0.20
Specific Energy	0.79
Froude Number	0.913
Maximum Discharge	2.864
Discharge Full	2.663
Slope Full	0.17
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0
Length	0.0
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0
Profile Description	N/A
Profile Headloss	0.00
Average End Depth Over Rise	0.0
Normal Depth Over Rise	0.0
Downstream Velocity	0.00
Upstream Velocity	0.00
Normal Depth	7.0
Critical Depth	6.7
Channel Slope	0.40
Critical Slope	0.47

12" PVC Capacity - Outfall from OS8 - Node I

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.011
Channel Slope	0.40
Diameter	12.0
Discharge	2.293
Results	
Normal Depth	8.6
Flow Area	0.6
Wetted Perimeter	2.0
Hydraulic Radius	3.6
Top Width	0.90
Critical Depth	7.8
Percent Full	71.5
Critical Slope	0.52
Velocity	3.81
Velocity Head	0.23
Specific Energy	0.94
Froude Number	0.824
Maximum Discharge	2.864
Discharge Full	2.663
Slope Full	0.30
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0
Length	0.0
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0
Profile Description	N/A
Profile Headloss	0.00
Average End Depth Over Rise	0.0
Normal Depth Over Rise	11.6
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	8.6
Critical Depth	7.8
Channel Slope	0.40
Critical Slope	0.52

APPENDIX D

Utility Maps

Water Distribution Map
Sanitary Sewer System Map

APPENDIX E

Referenced Documents

Fire Hydrants

**by
Aurora Water**



 Flow_Hydrants
 Proposed_Flow_Hydrants
Water_Fittings
UNIT_TYPE
 ARV
 Back
 Battery
 BZ
 CK
 OK
 FLAPGATE
 GV
 Plug
 PUV
 ZV
 Proposed_Water_Valves
Water_Fittings
UNIT_TYPE
 Building
 Cap
 Cess
 Enforce End
 Hydrant Test
 Meter
 Meter Test
 Outlet
 Other
 Plug
 Reducer
 Service Tee
 Split
 Wail Tap
 Proposed_Water_Fittings
 Water Test Station
 Meter, Meter, Slip Meter
 Water, Manhole
 Proposed_Water_Manhole
 Water, Storage
 Water, Wells

*** RESTRICTED AREA ***
AURORA WATER SECURITY AREA
**THIS INFORMATION HAS BEEN
BLOCKED FOR SECURITY
PURPOSES. CONTACT AURORA
WATER, ENGINEERING DIVISION
FOR DETAILS AT (303)-739-7376**

THE CITY OF AURORA, WATER DEPARTMENT ASSUMES NO RESPONSIBILITY OR LIABILITY OF ANY KIND TO ANY USER OF THIS MAP.

LOCATIONS ON THIS MAP ARE APPROXIMATE AND ARE INTENDED TO SERVE AS AN AID IN GRAPHIC REPRESENTATION ONLY.

BEFORE EXCAVATION CALL THE CITY OF AURORA WATER OPERATIONS AT (303) 336-8645 TO SCHEDULE FIELD LOCATIONS OF WATER, STORM AND SANITARY LINES.

PLEASE REPORT ANY ERRORS OR OMISSIONS ON THIS MAP TO THE CITY OF AURORA, AURORA WATER, ENGINEERING DIVISION, GIS SECTION.

PLOT DATE:
February 2, 2020

2020

City of Aurora, Colorado - Aurora Water
15151 East Alameda Parkway, Aurora, Colorado 80012
website: www.auroragov.org phone: 303.739.7370 fax: 303.739.7371



FIRE
HYDRANTS

05Y

RD
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POWHATON

ZONE 4

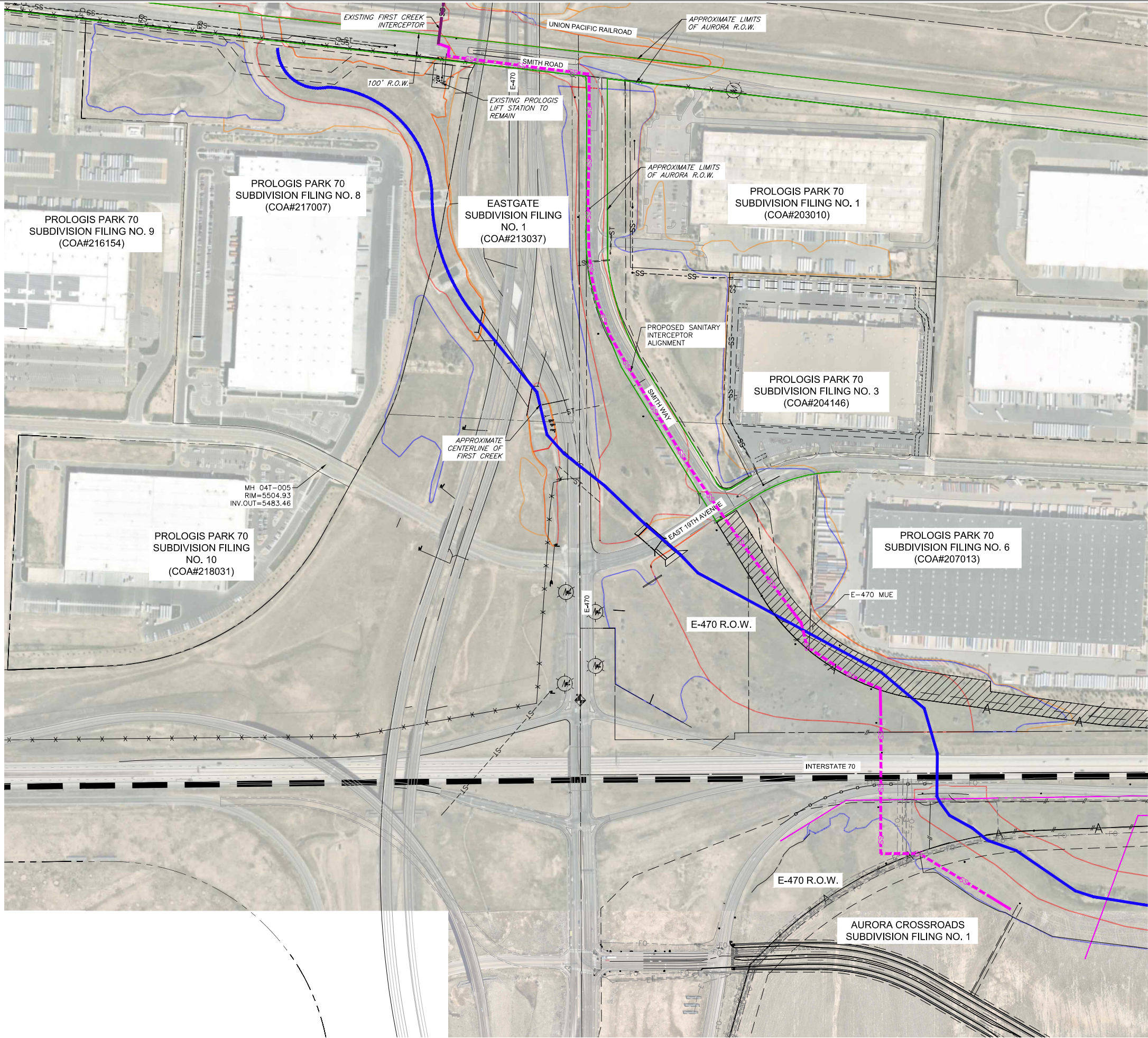
*** RESTRICTED
AREA: Contact
Aurora Water**

50

SEE PAGE - 06Y

Excerpted Selections
from
Construction Plans
for
Aurora Crossroads Offsite Sanitary Sewer
EDN: 221191
by
Martin & Martin Consulting Engineers

PLOT DATE: Tuesday, May 25, 2021 2:00 PM LAST SAVED BY: RSCHALL
DRAWING LOCATION: G:\HORN\19.1522-Aurora Crossroads - FDP\PLANS\OFF-SITE SANITARY CDS\OVERALL KEYMAP AND OWNERSHIP.dwg



LEGEND

- APPROXIMATE FIRST CREEK CENTERLINE
- E-470 MUE
- CITY OF AURORA R.O.W.
- OFF-SITE SANITARY SEWER ALIGNMENT
- EXISTING SANITARY SEWER
- REGULATORY FLOODWAY
- 100-YEAR FLOODPLAIN
- 500-YEAR FLOODPLAIN

NOTES:

1. A FLOODPLAIN DEVELOPMENT PERMIT IS REQUIRED PRIOR TO ANY WORK WITHIN THE FLOODPLAIN. NO FILL, NO STOCKPILING OF MATERIAL, OR STORAGE OF EQUIPMENT WILL BE PERMITTED IN THE FLOODWAY.
2. 100-YEAR FLOODPLAIN, 500-YEAR FLOODPLAIN, REGULATORY FLOODWAY, CHANNEL SECTIONS, AND BASE FLOOD ELEVATIONS NORTH OF I-70 OBTAINED PER FEMA FLOOD INSURANCE RATE MAP (FIRM) FOR ARAPAHOE/ADAMS COUNTY, COLORADO, MAP NUMBERS 08005C0202L AND 08005C0201L, MAPS REVISED: FEBRUARY 17, 2017. 100-YEAR FLOODPLAIN, REGULATORY FLOODWAY, CHANNEL SECTIONS, AND BASE FLOOD ELEVATIONS SOUTH OF I-70 OBTAINED PER APPROVED CITY OF AURORA FLOODPLAIN DEVELOPMENT PERMIT 2021-002, PREPARED BY MARTIN/MARTIN INC., AND DATED DECEMBER 3, 2020.

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OF THE SIGNED AND SEALED PDF PLAN

Jeffrey A. White
(PRINTED NAME)

DATE 05/25/21

JEFFREY A. WHITE
(PRINTED NAME)

AURORA CROSSROADS

OFFSITE SANITARY SEWER

OVERALL PLAN AND OWNERSHIP MAP

No.	Description of Revisions	Date	Name
1	MYLAR SUBMITTAL	05-25-21	JAW

Job Number 19.1522	Project Manager J. WHITE
Design By R. SCHALL	Drawn By S. HUDGENS
Principal In Charge P. HORN	

Sheet Number:

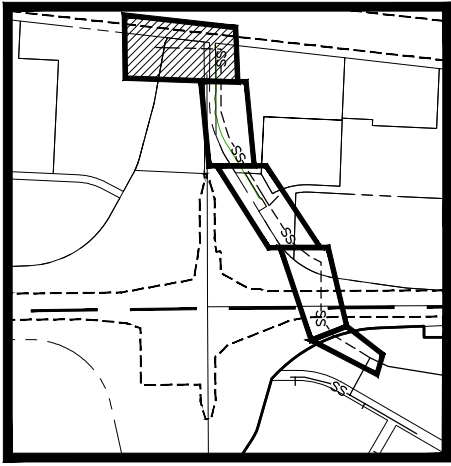
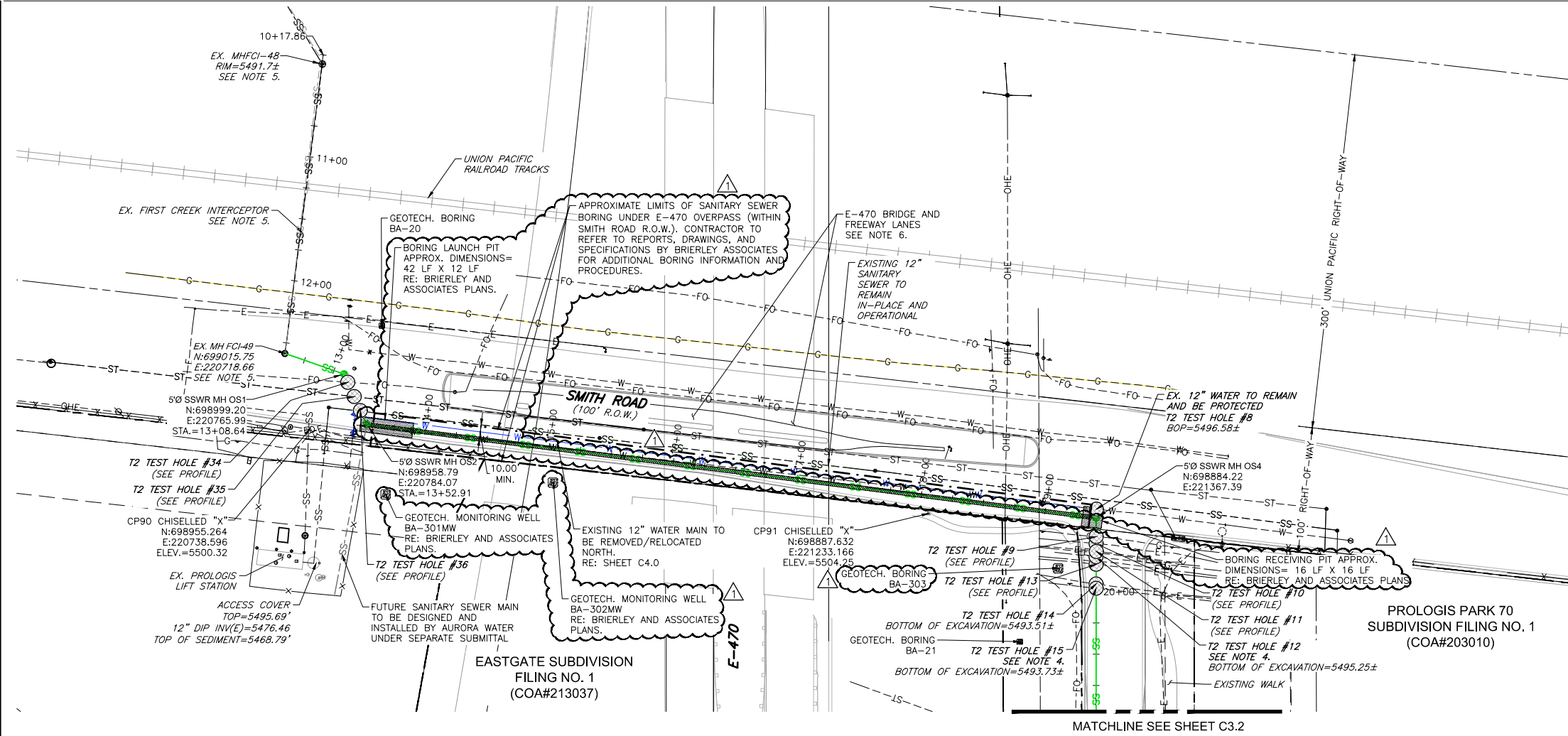
C1.2

3

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLfax AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

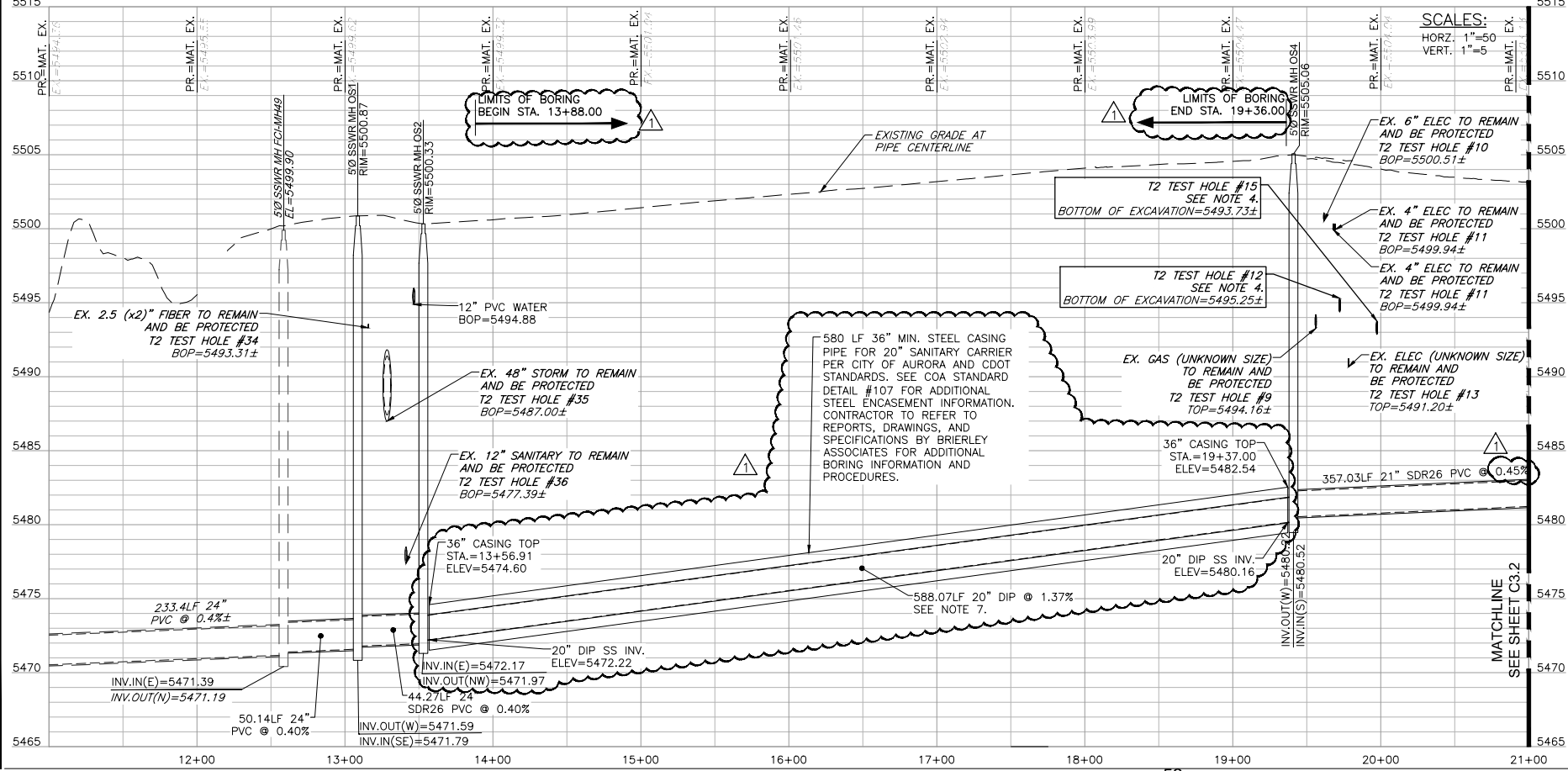
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KEYMAP
SCALE: 1"=1000'

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Jeffrey A. White
(E-SIGNATURE)
DATE 10/01/21

JEFFREY A. WHITE
(PRINTED NAME)

NOTES:

- ALL WATER AND SANITARY MAINS SHALL HAVE CLASS "B" ALTERNATE BEDDING. ALL TRENCHES SHALL USE THE GRANULAR BEDDING MATERIAL SPECIFIED IN SECTION 9.05 ("CLASSES OF BEDDING (METHODS)") OF THE CITY OF AURORA STANDARDS DATED SEPTEMBER 2019.
- REFER TO COVER SHEET FOR LEGEND AND ADDITIONAL NOTES.
- 100-YEAR FLOODPLAIN, 500-YEAR FLOODPLAIN, REGULATORY FLOODWAY, CHANNEL SECTIONS, AND BASE FLOOD ELEVATIONS OBTAINED PER FEMA FLOOD INSURANCE RATE MAP (FIRM) FOR ARAPAHOE COUNTY, COLORADO, MAP NUMBER 08005C0202L, MAP REVISED: FEBRUARY 17, 2017.
- T2 UTILITY ENGINEERS UNABLE TO LOCATE EXISTING UTILITY DURING POTHOLE OPERATIONS. CONTRACTOR TO VERIFY LOCATION AND DEPTH PRIOR TO CONSTRUCTION AND NOTIFY ENGINEER OF ANY DISCREPANCIES.
- REFER TO FIRST CREEK INTERCEPTOR VOLUME 2 CONSTRUCTION DRAWINGS BY HDR AND DATED JULY 11, 2019 (COA#219046) FOR FUTURE INTERCEPTOR CONTINUATION.
- E-470 BRIDGE AND SUPPORT STRUCTURES NOT TO BE DISTURBED. CONTRACTOR TO DETERMINE CONSTRUCTION MEANS AND METHODS OF SANITARY SEWER INSTALLATION TO AVOID AND PROTECT THE E-470 BRIDGE AT ALL TIMES. CONTRACTOR TO NOTIFY ENGINEER, CITY OF AURORA PUBLIC WORKS, AND E-470 AUTHORITIES OF ANY PLAN DISCREPANCIES AND FIELD CONSTRAINTS.
- DUCTILE IRON PIPE TO BE LINED WITH PROTECTO 401 CERAMIC EPOXY LINING OR APPROVED EQUAL WITH JOINT RESTRAINTS PER PER COA CRITERIA.

BENCHMARK:
BENCHMARK ID 456506NW001: ELEVATIONS ARE BASED ON THE CITY OF AURORA VERTICAL CONTROL NETWORK. ELEVATIONS ARE BASED ON THE CITY OF AURORA VERTICAL CONTROL NETWORK. BM #G0-95 A FOUND STEEL PIPE WITH A 3" BRASS CAP IN CONCRETE ABOUT 1/2 A MILE EAST OF E-470 (GUN CLUB ROAD) ON THE SOUTHERLY RIGHT-OF-WAY OF I-70 FRONTAGE ROAD (EAST COLFAX AVENUE).

ELEVATION = 5515.52' (NAVD1988) DATUM.

FLOODPLAIN DEVELOPMENT NOTE:
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AURORA CROSSROADS

OFFSITE SANITARY SEWER

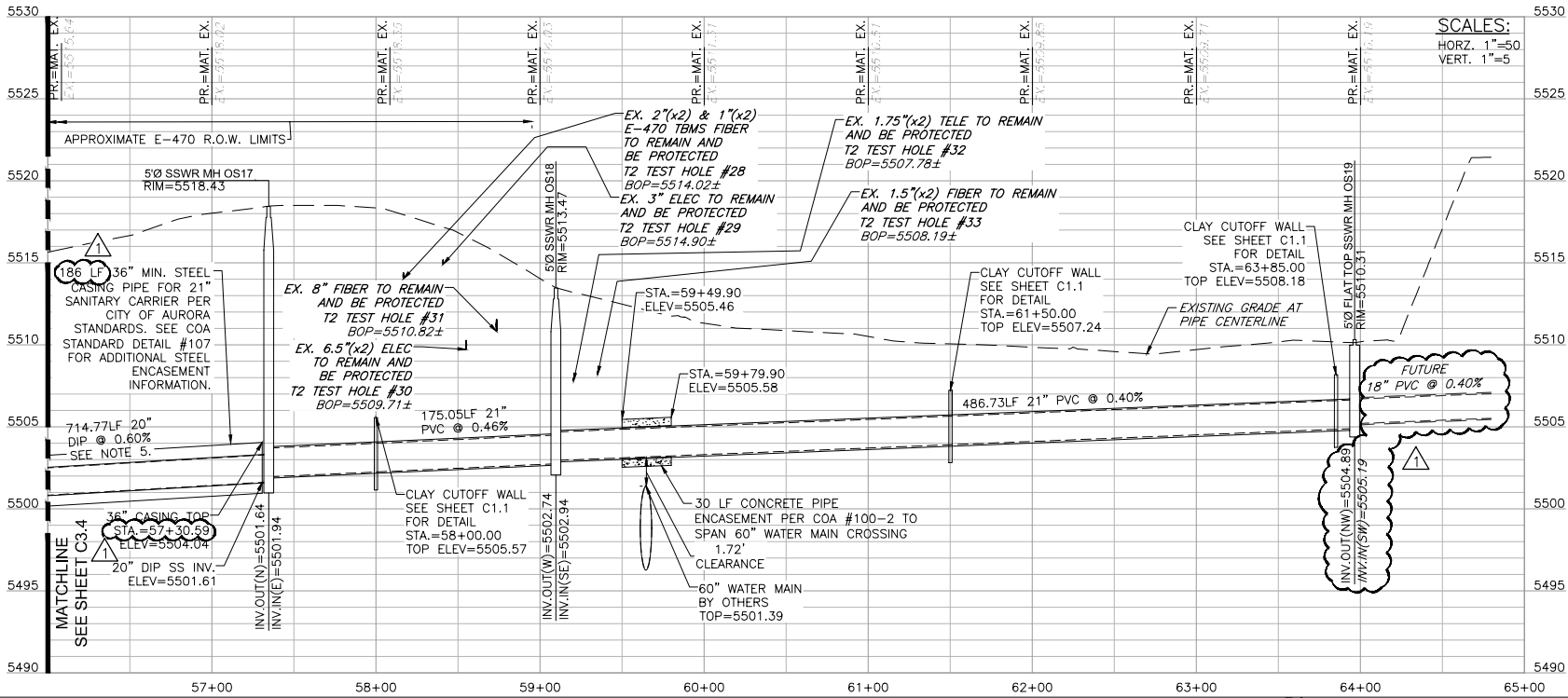
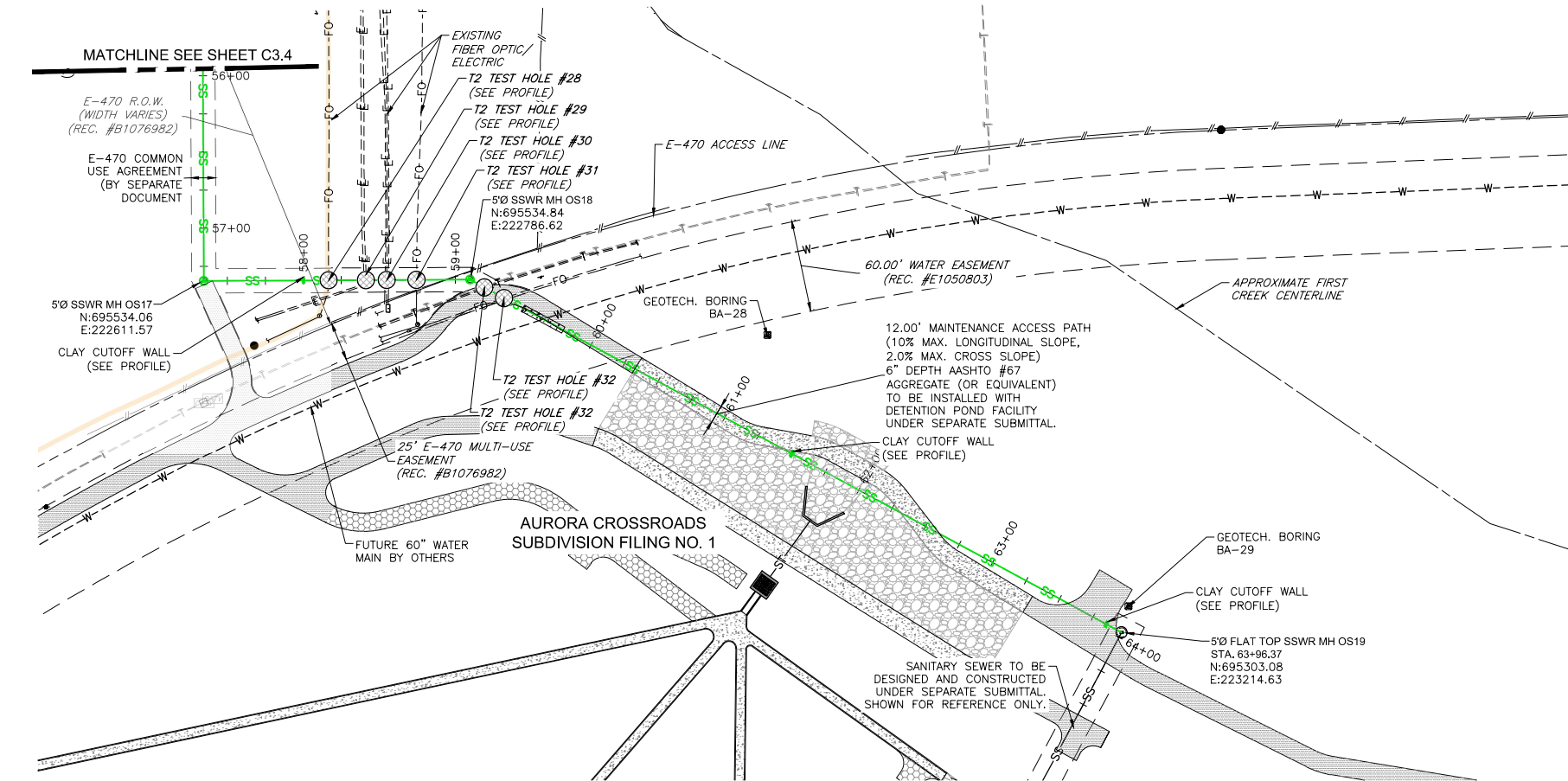
SANITARY PLAN AND PROFILE

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2	MYLAR REVISION	10-01-21	JAW

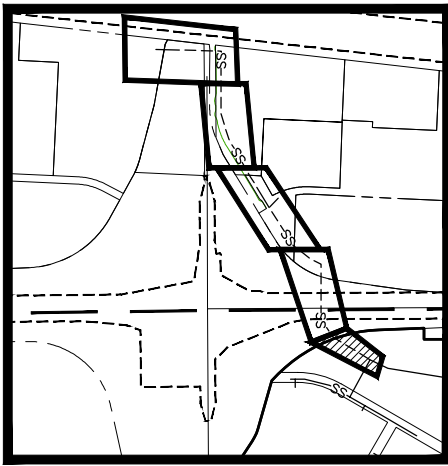
Job Number	19.1522
Project Manager	J. WHITE
Design By	R. SCHALL
Drawn By	S. HUDGENS
Principal In Charge	P. HORN

Sheet Number:
C3.1
11

PLOT DATE: Thursday, September 30, 2021 2:12 PM LAST SAVED BY: SHUDGENS
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REVISED ON 10/27/2021



KEYMAP
SCALE: 1"=1000'

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Jeffrey A. White
(PRINTED NAME)

DATE 10/01/21

AURORA CROSSROADS

OFFSITE SANITARY SEWER

SANITARY PLAN AND PROFILE

No.	Description of Revisions	Date	Name
1	MYLAR SUBMITTAL	08-25-21	JAW
2	MYLAR REVISION	10-01-21	JAW

Job Number 19.1522	Project Manager J. WHITE
Design By R. SCHALL	Drawn By S. HUDGENS
Principal In Charge P. HORN	

Sheet Number:
C3.5
15

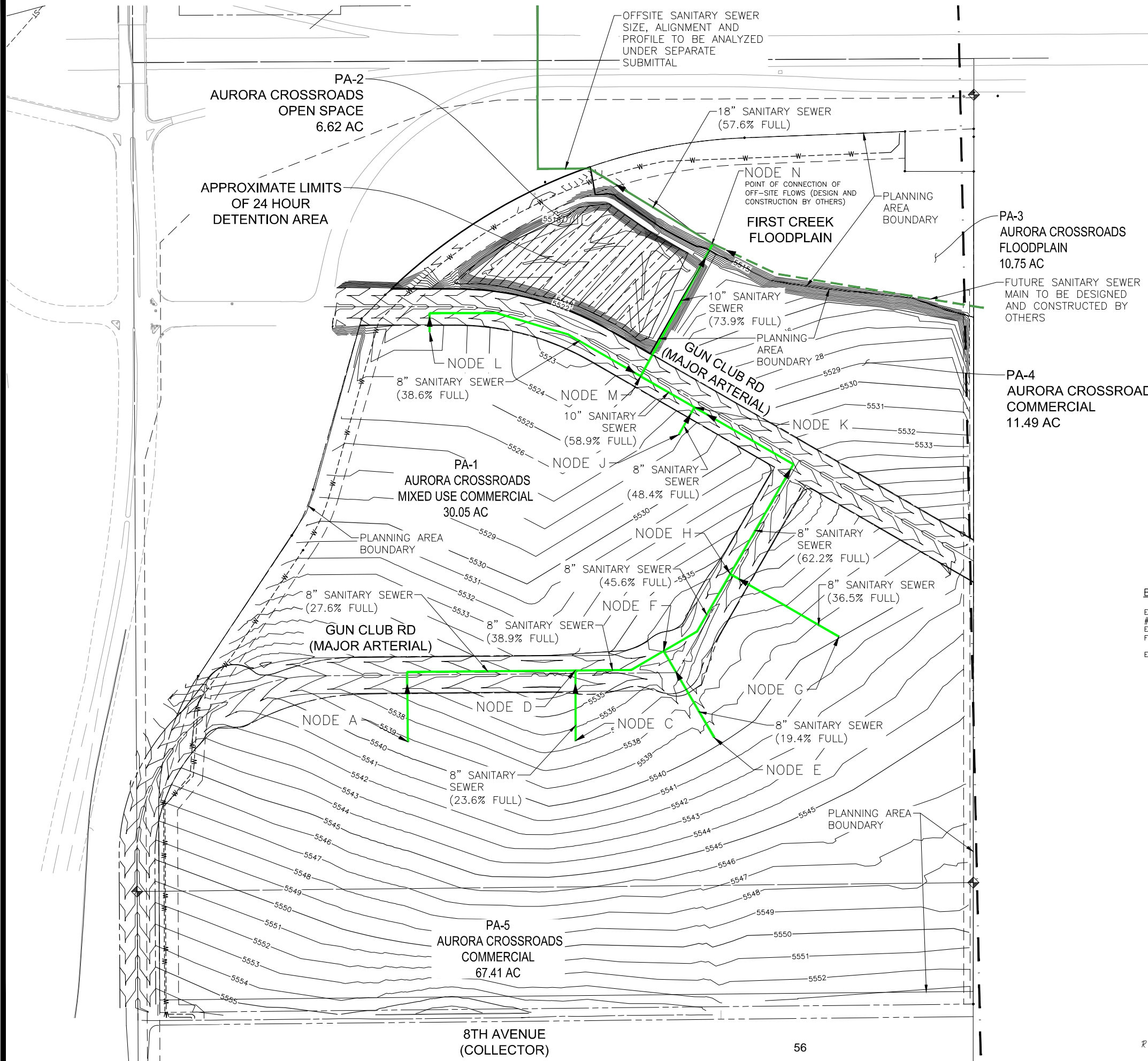
Excerpted Selections

**from
Master Utility Study**

**for
Aurora Crossroads**

EDN: 221029

**by
Martin & Martin Consulting Engineers**



LEGEND


<i>EXISTING</i>		PROPOSED
—————	PROPERTY LINE	—————
- - - - -	RIGHT-OF-WAY LINE	- - - - -
—————	SECTION LINE	—————
- - - - -SS- - - - -	SANITARY SEWER	—————
	SANITARY SEWER (BY OTHERS)	—————
<i>DRIVE</i>	DESCRIPTIONS	DRIVE

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 DATE 1/21/21

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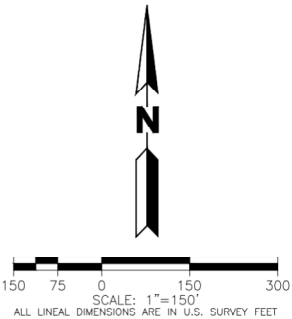
JEFFREY A. WHITE

(PRINTED NAME)

BENCHMARK

ELEVATIONS ARE BASED ON THE CITY OF AURORA VERTICAL CONTROL NETWORK BM #60-95 A FOUND STEEL PIPE WITH A 3" BRASS CAP IN CONCRETE ABOUT 1/2 A MILE EAST OF E-470 (GUN CLUB ROAD) ON THE SOUTHERLY RIGHT-OF-WAY OF I-70 FRONTAGE ROAD (EAST COLFAX AVENUE).

ELEVATION = 5515.52' (NAVD1988) DATUM.



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APPROVED ONE YEAR FROM THIS DATE 02.11.2021

CITY OF AURORA APPROVAL BLOCK

 01/27/2021
CITY ENGINEER DATE

Mark Apotaca 01/27/2021
FIRE DEPARTMENT DATE

Vernon A. Adam 02/10/2021
AURORA WATER DEPARTMENT DATE

AURORA CROSSROADS

MASTER UTILITY STUDY

SANITARY MAP

Job Number 19.1522		No.	Issue / Revision	Date	Name
Project Manager	J. WHITE				
Design By	J. BELTRAN				
Drawn By	J. BELTRAN				
Principal In Charge	P. HORN				

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Sheet Number:

SS

Excerpted Selections

from

Eastern Utility Extension Zone 4 Waterline Construction Plans

for

City of Aurora, Colorado

by

HDR

Excerpted Selections
from
Master Utility Study Addendum
for
Aurora Crossroads
EDN: 221029MU2-LETTER
by
Martin & Martin Consulting Engineers

February 22, 2022

City of Aurora
Aurora Water
15151 E. Alameda Parkway Ste. 3200
Aurora, CO 80012

Re: Aurora Crossroads Filing No. 1
Martin/Martin, Inc. Project No.: 19.1522

The purpose of the following utility report addendum is to analyze the off-site sanitary sewer tributary basins and size the offsite sanitary sewer infrastructure required to support the Aurora Crossroads development. As outlined in the approved "Aurora Crossroads-Master Utility Study," (MASTER UTILITY STUDY) by Martin/Martin, Inc., dated November 25, 2020 (COA#221029), a sanitary sewer interceptor will be required along First Creek and under I-70 to connect to the First Creek Interceptor that is under construction.

Through collaboration with Aurora Water, this addendum provides sizing for the interceptor from the Crossroads property, under I-70 and to the point of connection to the First Creek interceptor. Sizing for the future sanitary mains for the tributary basins east and west of the Crossroads development has been provided for information only and should be verified by others under a separate submittal. It is anticipated this off-site sewer alignment will parallel First Creek and will be submitted to the city for approval at time of development by others. The sewer systems will combine prior to crossing Interstate 70 as identified in the MASTER UTILITY STUDY.

Sanitary Sewer Design Criteria

The latest City of Aurora criteria, dated September 2019, was used to determine the developed sanitary flows for future tributary basins.

Consistent with the MASTER UTILITY STUDY, analysis of the hydraulic capacity and characteristics of the pipe assumed open channel flow (not pressurized) and was completed using Manning's Equation. Bentley Flowmaster was utilized for computations. Based on Aurora Water's Requirements, a minimum slope of 0.40% was used for the basis of design and a Manning's n value of 0.011 was used for PVC pipe unless specified differently. The depth of flow in the pipes shall not exceed 75% of capacity for pipes 12 inches or smaller and 80% for pipes larger than 12 inches. Peak factors were calculated by using the equation:

$$\text{Peaking Factor} = 5 \div p^{0.167}$$

where p = population in thousands. A minimum peaking factor of 1.7 and a maximum peaking factor of 4 was used for the calculations. Infiltration and inflow were calculated at 10% of average day flows and added to the peaked flows.



Sanitary Sewer Design Analysis

Per coordination with Aurora Water and consistent with the "Cross Creek Initial Phase Development Utility Report," prepared by High Country Engineering, Inc. and revised October 21, 2002 (COA#202189), the First Creek sanitary sewer basin upstream of the proposed Interstate 70 crossing is bounded to the west by E-470, to the north by Interstate 70, to the east by N. Monaghan Road, and to the south by East 6th Avenue (the south 800' of these planning areas are tributary to the E. 6th Avenue sanitary interceptor). The Aurora Crossroads development is located within this boundary, west of E-470 and south of First Creek. Sanitary sewer flows will be routed as outlined in the MASTER UTILITY STUDY. Refer to the attached Cross Creek Sanitary Regional Utility Exhibit and First Creek Offsite Sanitary Basin Map for more information.

Analysis of the proposed sanitary flows consists of using the acreage for each basin area and applying demands based on current zoning and anticipated zoning for future annexation areas (see attached zoning map). The land usage and associated size of each planning area was obtained by GIS and is shown in the attached First Creek Offsite Sanitary Basin Map. FlowMaster software was used to calculate the pipe velocities and pipe sizes for each segment of pipe between the design points. The calculated demands, updated routing diagram, peak flows, and pipe cross sections are enclosed.

Conclusion

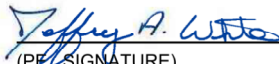
The proposed off-site sanitary sewer from the Aurora Crossroads development to the connection to the First Creek interceptor in Smith Road has been designed to accommodate the anticipated flows for the planning areas and assumptions outlined in this report and comply with the City of Aurora's *Water, Sanitary Sewer & Storm Drainage Infrastructure Standards & Specifications*.

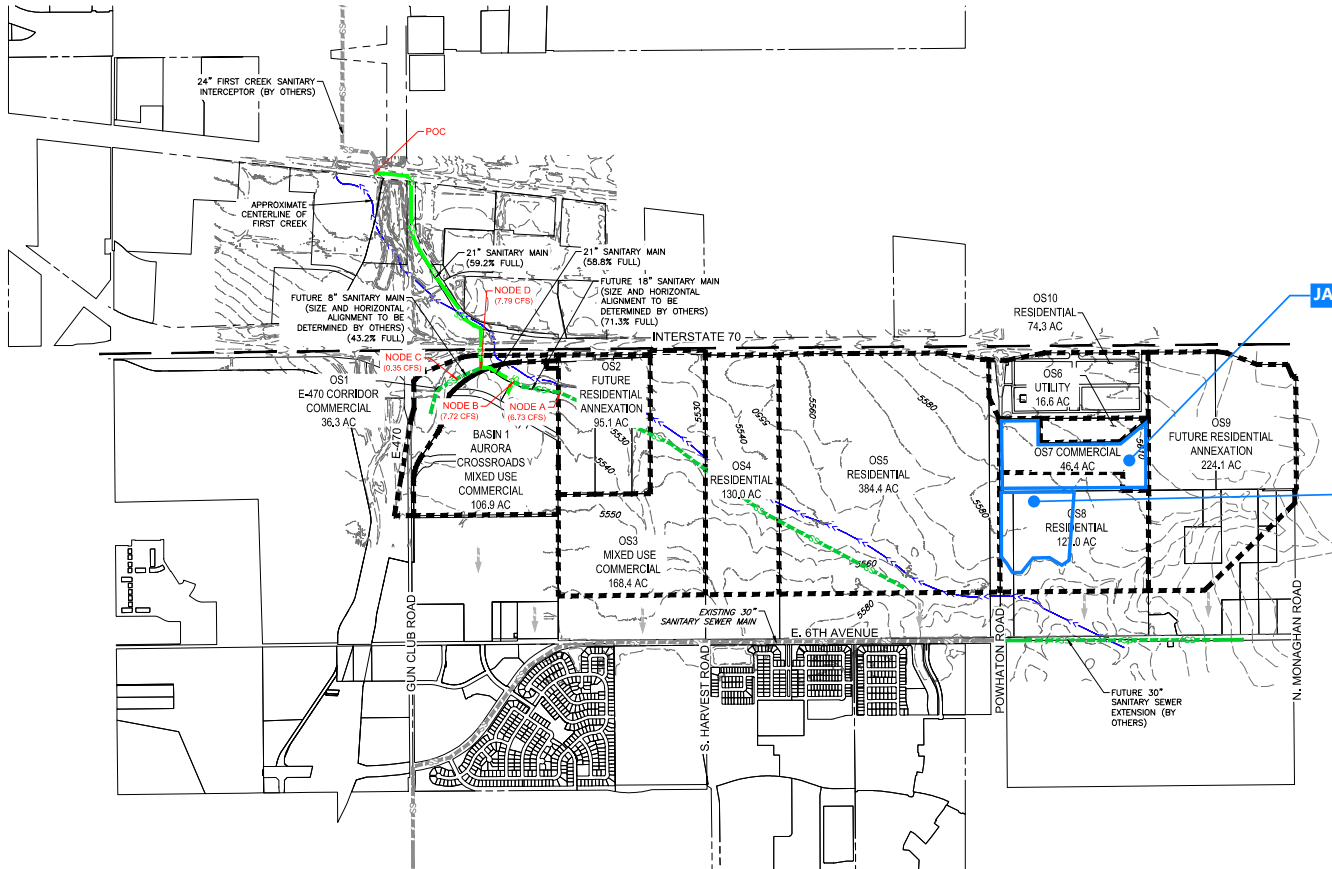
Respectfully,

Jeff A. White, PE

Encl:

Cross Creek Sanitary Regional Utility Exhibit
First Creek Offsite Sanitary Map
City of Aurora Zoning Map
Sanitary Sewer Demand Calculations
Sanitary Sewer Flowmaster Calculations

FACSIMILE	
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 (PE SIGNATURE)	DATE <u>02/23/22</u>
<u>JEFFREY A. WHITE</u> (PRINTED NAME)	



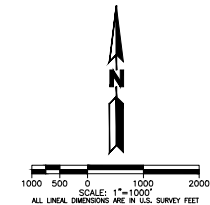
LEGEND	
EXISTING	PROPOSED
-----	PROPERTY LINE
-----	RIGHT-OF-WAY LINE
-----	SECTION LINE
-----	SANITARY SEWER
-----	SANITARY SEWER (BY OTHERS)
-----	SANITARY BASIN
-----	CENTERLINE OF FIRST CREEK
-----	DRIVE
-----	DESCRIPTIONS
-----	DRIVE

NOTES:

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2. REFER TO "AURORA CROSSROADS-MASTER UTILITY STUDY", PREPARED BY MARTIN/MARTIN, INC., DATED NOVEMBER 25, 2020 (COM) FOR BASIN 1 SANITARY DEMAND CALCULATIONS AND ON-SITE SANITARY MAIN SIZING.

JAMASO

FUTURE OFFSITE
SANITARY BASIN
(38.0 ACRES)



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CITY OF AURORA APPROVAL BLOCK

CITY ENGINEER	DATE
FIRE DEPARTMENT	DATE
AURORA WATER DEPARTMENT	DATE



AURORA CROSSROADS

MASTER UTILITY STUDY ADDENDUM

FIRST CREEK OFFSITE SANITARY BASIN MAP

NOT FOR CONSTRUCTION

No.	Issue / Revision	Date	Name
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Sheet Number:

OS1

**AURORA CROSSROADS
SANITARY SEWER AVERAGE FLOWS AND POPULATION**

OFFSITE NON-RESIDENTIAL

Basin	Area (Ac)	Type of Development	Avg. Daily Flow/Ac (gpd)	Avg. Daily Flow (MGD)	Equivalent Population /Ac	Population
BASIN 1-PA1	30.05	MIXED COMM	**	0.113	22	661.10
BASIN 1-PA4	11.49	MIXED COMM	1500	0.017	22	252.78
BASIN 1-PA5	67.41	MIXED COMM	1500	0.101	22	1483.02
OS1	36.30	COMMERCIAL	1500	0.054	22	798.60
OS3	168.40	COMMERCIAL	1500	0.253	22	3704.80
OS6	16.60	UTILITY	0	0.000	0	0.00
OS7	46.40	MIXED COMM	1500	0.070	22	1020.80

JAMASO

BASIN 1-PA FLOW CALCULATIONS PROVIDED IN AURORA CROSSROADS MASTER UTILITY STUDY DATED NOVEMBER 25, 2020

OFF-SITE RESIDENTIAL

Basin	Area (AC)	Type of Development	Dwelling Units (DU/AC)	CAP/DU	Population (CAP)	Avg. Daily Demand (gpd/CAP)	Avg. Daily Flow (MGD)
OS2	95.1	RESIDENTIAL	5.5	2.77	1448,8485	68	0.0985
OS4	130	RESIDENTIAL	5.5	2.77	1980.55	68	0.1347
OS5	384.4	RESIDENTIAL	5.5	2.77	5856.334	68	0.3982
OS8	127	RESIDENTIAL	5.5	2.77	1934.845	68	0.1316
OS9	224.1	RESIDENTIAL	5.5	2.77	3414.1635	68	0.2322
OS10	74.3	RESIDENTIAL	5.5	2.77	1131.9605	68	0.0770

**FUTURE OFFSITE
SANITARY BASIN
(38.0 ACRES)**