FINAL MASTER UTILITY REPORT

FOR

REDTAIL RIDGE PRELIMINARY PLAT

&

REDTAIL RIDGE SUBDIVISION FILING NO. 1 & 2

CITY OF LOUISVILLE
BOULDER COUNTY
STATE OF COLORADO

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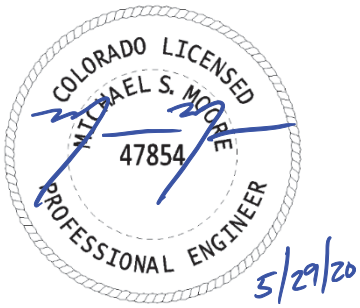
ENGINEER CERTIFICATION

"This report for the utility design of Redtail Ridge was prepared by me (or under my supervision) in accordance with the provisions of the City of Louisville Design and Construction Standards and the City of Broomfield criteria; and designed to comply with the provisions thereof. I understand that the City of Louisville does not, and will not, assume liability for water and sanitary sewer facilities designed by others."



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On behalf of Harris Kocher Smith

1. INTRODUCTION

A. Site Location and Description

The proposed Redtail Ridge Site (hereinafter referred to as "Site") is situated in the City of Louisville (hereinafter referred to as "City"); specifically the Northeast ½ and South ½ of Section 20, the North ½ of Section 29, and the Northwest ¼ of Section 28, Township 1 South, Range 69 West of the 6th P.M. Counties of Boulder and Broomfield, State of Colorado. The Site is generally located East of S. 88th Street, South of Campus Drive, West of S. 96th Street and Northwest Parkway, and Northeast of Highway 36. A Vicinity Map is included in Appendix A, for reference.

The Site is approximately 389.1 acres and was a formerly developed office campus with recreational facilities. The Site is currently covered with grass vegetation, remnants of building slabs, and several private roadways. The proposed uses for the Site include a senior living community, office campus, mixed-use, public open space, trail open space, and private open space.

B. Existing Water and Sewer Infrastructure

Maps provided by the City show existing water lines adjacent to the Site. These existing water lines consist of an 18-inch Polyvinyl Chloride ("PVC") main that runs south within S. 88th Street and downsizes to 12-inch PVC at the intersection of S. 88th Street and Campus Drive. A 12-inch main continues east within Campus Drive and then the public main terminates at the east end of the existing Campus Drive right-of-way/ There is also an existing 8-inch Ductile Iron Pipe ("DIP") main that runs south within S. 96th Street and terminates at the intersection of S. 96th Street and Disc Drive. Finally, there is an existing private main on-Site, not within any known easement, that connects to the 12-inch PVC at the terminus of the Campus Drive right-of-way and runs east and south throughout the Site, terminating at a facility on-Site near Disk Drive. The *Redtail Ridge Traffic and Mobility Study*, prepared by Fox Tuttle Transportation Group, LLC, dated September, 30, 2019, is attached to this submittal for reference and should be reviewed for details on the status of all roadways located directly adjacent to the Site or off-site roadways that are impacted by the proposed development.

A conceptual drawing of the existing water and proposed water can be found in Appendix F for reference. Copies of the Utility Maps provided by the City can be found in Appendix C for reference.

There are two sanitary sewer mains near the Site, according to the maps provided by the City. The first main terminates at the intersection of S. 88th Street and Campus Drive. At this location, the sanitary sewer main is an 8-inch PVC main which continues north into existing development north of the Site. The second main is an existing force main originating from an existing lift station on-Site and continuing north from the Site to the intersection of Dillon Road and S. 96th Street. A conceptual drawing of the existing sanitary sewer and proposed sanitary sewer can be found in Appendix F for

reference. Copies of the Utility Maps provided by the City can be found in Appendix C for reference. There are also two City Utility Atlas's in Appendix C. The first atlas is from the 2018 Utility Map Book Index and does not include the existing Sanitary Sewer force main mentioned above. The second atlas is from the 2007 Utility Atlas Index and does include the existing Sanitary Sewer force main mentioned above.

C. Previous Utility Studies

The City of Louisville's 2013 Comprehensive Plan, (hereinafter referred to as "Plan") analyzes generally both the existing water and sewer systems for the City. According to the Plan, the water supply originates from the South Boulder Creek Project, the Northern Colorado Water Conservancy District Colorado Big Thompson Project and the Windy Gap Project. Water from these projects is treated at the following two water treatment facilities: the Howard Berry Plant and the North Water Treatment Plant. The Plan concludes that the water supply and treatment capacity for the City is enough to accommodate the expected 20-year built-out of the City. Reference the Plan located in Appendix B for details. As far as the sewer for the City is concerned, the Plan indicates that the current City of Louisville Wastewater Treatment Plant (hereinafter referred to as "Plant") is currently operating at a daily average of 2 million gallons per day ("MGD"), which is approximately 59% of its operational capacity. In 1999, the Plant was updated to carry a maximum permitted capacity of 3.4 MGD; however, the Plan notes that the Plant had reached the end of its useful life by 2013. As such, the Plant will require upgrades to comply with current regulatory water quality requirements. The anticipated plan to update the Plant are discussed in the City of Louisville Wastewater Facility Plan and summarized below. Excerpts from the City of Louisville 2013 Comprehensive Plan are included in Appendix B for reference.

According to the *City of Louisville Water System Facilities Plan Final Report* (hereinafter referred to as "Water Plan") prepared by Hatch Mott MacDonald, dated July 2012, the water coming on to the Site is from the North Water Treatment Plant (hereinafter referred to as "NWTP") which supplies 8 MGD to the existing water system. Together with the Howard Berry Water Treatment Facility (hereinafter referred to as "HBWTF") with a supply of 5 MGD the City has a gross treatment capacity of 13 MGD. The NWTP's pump station was rebuilt and moved in 2018. At this time it is not known if the operations performed in 2018 increased pumping capacity. The NWTP supplies pressurized water to both the high-pressure and mid-pressure zone pressure areas and gravity feeds to the low-pressure zone. The HBWTF pumps water to the high-pressure zone and gravity feeds the mid-pressure zone. Water is also able to "download" from the high-pressure zone to the mid-pressure zone through pressure reducing valves and zone valves operated by City staff. The Site will connect to the existing mid-pressure zone water system within in Campus Drive and S. 88th Street. The mid-pressure zone system is intended to store 3.5 Million Gallons ("MG") of the 8.5 MG stored in the City's water system. As stated within the Water Plan, the 8.5 MG of storage is acceptable, and the entire storage should be maintained. Excerpts from the Water Plan are included in Appendix B for reference.

The *City of Louisville Wastewater Facility Plan* (hereinafter referred to as "Sewer Plan") prepared by Dewberry, dated April 2013, indicates that the Plant has a rated capacity of 3.4 MGD and receives wastewater from approximately 63 miles of sanitary sewer, ranging from 8-inch PVC to 27-inch PVC. The Sewer Plan predicts a full build-out of the City by 2034 that will produce an average daily maximum month influent flow of 2.45 MGD. That said, the Plant has enough capacity for the full build-out of the City as the Sewer Plan concludes that the current Plant's treatment facilities are out of date. The current regulations concerning water quality require stricter levels of regulation compared to when the Plant was upgraded in 1999. Given this information, the Plant needed to be upgraded to comply with current regulations in support of the proposed development of the City. These upgrades to the Plant were completed in 2018 based on the recommendations within the Sewer Plan. Excerpts from Sewer Plan are included in Appendix B for reference.

D. Design Criteria

The City of Louisville criteria (hereinafter referred to as "City Criteria") was used for this report and supplemented with historical data, City and County of Denver criteria ("Denver Criteria") and City of Westminster criteria ("Westminster Criteria"), where the City Criteria did not provide enough information for this type of development. Additionally, calculations and demands were also coordinated with Dewberry based on historical City data to ensure consistency and confidence in providing water and sewer service to the Site.

Denver Criteria was chosen for sizing of the on-Site sanitary mains because the criteria has specific sanitary system demand calculations for proposed uses. This data, along with flow demand data from Dewberry, were used to estimate the sanitary flows generated by each of the planned uses for development of the lift station and wastewater treatment plan upgrades. Reference "Table 1: Assumed Sanitary Flows," shown on page 7, for the assumed flow demand data. The Denver Criteria was also used to determine peak day sanitary flows, which were used to size the on-Site sanitary sewer mains.

The Westminster Criteria was used to water estimation purposes because the criteria have specific water system demand calculations for proposed uses. The Westminster Criteria, along with demand values from Dewberry, made this calculation method useful in determining how much water demand would be generated by each of the planned uses. This calculation method was also useful in estimating the peak day demand of the Site at full build-out. Reference "Table 5: Assumed Water Demands," shown on page 11, for these demand values.

Technical memos prepared by Dewberry, discussing the proposed sanitary sewer flows, the proposed lift station design, and the proposed improvements to the Plant. These memos, *Dewberry Technical Memo 1 - Flows and Loads* and *Dewberry Technical Memo 2 - Wastewater Treatment Infrastructure*, *Technical Memo 1 Amendment supplemental information, and Technical Memo 1 Amendment Redtail*

Ridge Projections Related to Retirement Community (hereinafter referred to as "WWTP Memos") are included in this GDP submittal as separate documents for reference. The WWTP Memos describing the flows and infrastructure enhancements to the Plant contain tables listing the criteria used for these elements of the proposed sanitary sewer system.

E. Project Timeline

At the time of this report, the Site is to be split into two subdivision filings. The first filing, Redtail Ridge Subdivision Filing No. 1, focuses on the development of Parcels B, C, and F. The second filing, Redtail Ridge Subdivision Filing No. 2, will plat Parcels A, D, and E. This Final Master Utility Report will be applicable to all Parcels within each filing, Parcels A, C, D, and E will have four development phases that will be completed over the course of 15-20 years. Reference "Table 6: Phased Development," on page 14, to view the development's planned phasing. The final build-out will be evaluated, along with the development of Parcel B, for sizing of the main public utilities in this report. A Filing Utility Plan can be found in Appendix F, showing the proposed utilities to be built with each filing. "Table 6: Phased Development," shown on page 14, details the anticipated use to be built with each development phase. As site-specific development applications are submitted to the City, each development will need to provide a compliance letter showing conformance with this Final Master Utility Report.

2. PROPOSED SANITARY SEWER SYSTEM

A. On-Site Layout and Connection Options to City of Louisville Sanitary Sewer System

The proposed sanitary sewer system on-Site will connect to the off-Site improvements at the intersection of Rockcress Drive (formally known as Tape Drive) and Northwest Parkway, near the southeast corner of the Site. This serves as the low point for the entire Site where all sanitary sewer flows can eventually reach via gravity flow. From this intersection, there will be proposed sanitary sewer mains running north and west to provide service to the Site.

The proposed sanitary sewer line within Campus Drive (hereinafter referred to as "Line A") will begin on the south side of Campus Drive, near the southeast corner of the Monarch School Campus, and will run east to cross Rock Creek Tributary I before moving north and back into Campus Drive. Line A will then run east to the intersection of Campus Drive and Sorrel Avenue, then south within Sorrel Avenue for roughly 675-feet, then east across private property within an easement dedicated to the City to the eastern property line of the Site, then south along the eastern Site boundary, under Rockcress Drive, finally terminating at the proposed lift station in the southeast corner of the Site. The entirety of Line A will be constructed with Redtail Ridge Filing No. 1.

The proposed sanitary sewer line within Rockcress Drive, east of Sorrel Avenue (hereinafter referred to as "Line B"), will begin at the intersection of Rockcress Drive

and Sorrel Avenue and run east to connect to Line A just before Northwest Parkway. Line B will be extended, as Line E described below, as a part of Redtail Ridge Filing No. 2 west in Rockcress Drive to serve future developments south of Rockcress Drive up to S. 88th Street.

The proposed sanitary sewer line within Sorrel Avenue (hereinafter referred to as "Line C") begins in Sorrel Avenue, at the manhole where Line A turns east across Parcel C will run approximately 250-feet south within Sorrel Avenue. The entirety of Line C will be constructed with Redtail Ridge Filing No. 1.

The proposed sanitary sewer line within Yucca Avenue (hereinafter referred to as "Line D") will connect to Line A at the intersection of Campus Drive and Yucca Avenue and run south approximately 800-feet within Yucca Avenue. Line D will only be constructed on an as needed basis, with Redtail Ridge Filing No. 2.

The proposed sanitary sewer line within Rockcress Drive, west of Sorrel Avenue, (hereinafter referred to as "Line E"), will connect to the termination of Line B at the intersection of Rockcress Drive Sorrel Avenue and will continue northwest within Rockcress Drive to provide sanitary services to the proposed developments south of Rockcress Drive. Line E will be constructed with Redtail Ridge Filing No. 2.

As shown in the WWTP Memos, the complete build-out condition for the Site has an estimated sanitary sewer peak day flow of 2.0 MGD. This flow amount was utilized to size both the on-Site and off-Site sanitary sewer mains. The on-Site sanitary sewer mains were sized based on City criteria. City criteria specifies mean velocities greater than 2.0 feet per second with an assumed Manning's "n" value of 0.013 when flowing full. Pipe capacity was evaluated at minimum slope to ensure the design had adequate capacity. These calculations, along with the average day demands coordinated with Dewberry, are included in "Table 1: Assumed Sanitary Flows," shown on page 7. These average day demands were used to estimate peak flows and were used to calculate which sanitary sewer main sizes the Site will need for the various developments proposed within the Parcels. Sanitary pipes were sized to convey the estimated peak day flows. The pipe capacity calculation tables can be found in Appendix D, and the Filing Utility Plan can be found in Appendix F for reference.

As shown in the Filing Utility Plan, there will be a need for a lift station on-Site to convey the flows via force main to the Connection Point mentioned below. This lift station location has been included in the Filing Utility Plan and will be analyzed and designed in the WWTP Memo's.

B. Off-Site Layout and Connection Options to City of Louisville Sanitary Sewer System

The proposed sanitary sewer system off-Site will convey the Site's sanitary sewer anticipated peak flows of 2.0 MGD, or approximately 1,389 GPM (3.095 cfs), from the just southwest of the intersection of Rockcress Drive and Northwest Parkway and route

the flows north approximately 2.6-miles to connect to an existing 21-inch main (hereinafter referred to as “the Connection Point”). The Connection Point is located near the intersection of County Road and Rex Street, east of Louisville Community Park.

Flow data was collected over a 4-week period to evaluate the capacity of the Connection Point. Over the collection period the highest measured flow was 958.68 GPM or 2.134 cfs. The projected peak day flow at full buildout is 3.095 cfs. Slope information for the Connection Point has not been obtained, so, for analysis purposes, the pipe was evaluated for a combined projected peak day flow of 5.229 cfs at the City Criteria minimum slope of 0.10% for a 21-inch pipe. At full build-out the Connection Point will have a flow depth of 18.24-inches which equates to approximately 92% full. A full flow analysis for the Connection Point was also performed. Full pipe capacity was evaluated for pipe slopes ranging from 0.01% to 0.20%, in 0.01% increments. This pipe capacity analysis can be found in Appendix D for reference. As each lot within the development is developed, over an estimated 15-30 year build-out, flow monitoring can be performed by the City (or future developers) to ensure pipe capacity remains within acceptable tolerances. The proposed lift station is being designed for a maximum capacity of 2.0 MGD. In the unlikely event that peak flows, at full build-out after 15-30 years, are greater than 2.0 MGD then on-Site emergency overflows vaults can be used or a capital improvement project can be funded by the City, if needed. At full build-out, the pipe downstream of the Connection Point is adequately sized to convey the existing peak day flows and the proposed full build-out peak day flows from the Site to the Plant. A conceptual drawing and the Filing Utility Plan can be found in Appendix F for reference.

The sanitary sewer Force Main (hereinafter referred to as “Line F”) conveys flows from the Site to the Connection Point. The Filing Utility Plan identifies a location for a lift station in the southeast corner of the Site. On-Site sanitary flows will gravity drain to this lift station location. The lift station will then pipe the sanitary flows though Line F to the Connection Point, then on to the Plant within existing sewer mains. The Sewer Plan indicates that the Plant will need to be upgraded to comply with current regulations on water quality and to accommodate future flows. This analysis and design information is included in the WWTP Memos which are included in this GDP submittal for reference.

C. Flow Calculations

The sanitary sewer peak instantaneous flow calculated for the Site is estimated in the WWTP Memos to be 2.0 MGD for the complete build-out condition of the Site. As previously mentioned, Denver Criteria calculation methodology, along with coordinated demands from Dewberry, were used to estimate the average sanitary demand for each parcel’s planned use per each development phase. Average day demands were coordinated with Dewberry for consistency and are the primary design consideration for the design of the lift station and Plant upgrades. “Table 1: Assumed Sanitary Flows,” shown on page 7 below, shows the coordinated sanitary flows by use and per capita. “Table 2: Mid-Range Average Daily Flow,” shown on page 7 below, shows the mid-

range projected average flows for each parcel from the WWTP Memos. “Table 3: Full Build-Out Sanitary Demand for Lift Station and Wastewater Treatment Plant Design,” shown below on page 8, shows the demand flows coordinated with Dewberry and the WWTP Memos. Peak day flows were then estimated for each phase of development based on the densities in “Table 6: Phased Development” on page 14. See Appendix D for the estimated cumulative sanitary loads by development phase based on the coordinated Dewberry assumed sanitary flows.

The on-Site gravity sewer mains were then sized based Denver Criteria, which is typically conservative and does not directly correlate to the above mentioned average sanitary demands for the lift station and Plant design. “Table 4: Full Build-Out Sanitary Design Estimate for on-Site Sanitary Sewer Main Sizing Design,” shown on page 8 below, shows the peak flows that were used for designing the on-Site sanitary mains, which are conservative and differ from the flow estimates in Table 3. The on-Site gravity mains were sized based on the final build-out peak day demand of each development parcel. Utilizing the pipe capacity information from Section 2 of this report, the proposed on-Site gravity mains will utilize a mix of 8-inch PVC, 12-inch PVC, 15-inch PVC and 21-inch PVC pipes to convey sanitary flows to the lift station (see Appendix F for proposed layout and pipe flow information). The force main will utilize (2) 8-inch PVC lines in parallel to be able to convey self-cleaning pipe velocities and to limit friction losses at full build-out. See Appendix D for the estimated peak flows for the on-Site gravity sewer main designs based on Denver Criteria.

Table 1: Assumed Sanitary Flows

45 gal/pers - 1.5 pers/room	Hotel
120 gal/pers - 2.1 pers/unit	Residential
108 gal/pers - 1.3 pers/unit	Retirement
0.38 gal/sq.ft.	Shopping
20 gal/pers - 300sq.ft./person	Office
20 gal/pers - 250sq.ft./person	Corporate Office

Table 2: Mid-Range Average Daily Flow (GPD)

Parcel	Type	Phase 1	Phase 2	Phase 3	Phase 4	Total
A	Senior Living	70,902	70,902	44,366	-	186,170
B	Corporate Office	40,000	-	-	-	40,000
C	Office	-	39,333	29,333	18,666	87,333
	Retail	3,800	5,700	7,600	9,500	26,600
	Hotel	16,200	-	-	-	16,200
	Multifamily	151,200	75,600	-	-	226,800
	Parcel C Subtotal	*171,200*	*85,233*	*36,933*	*9,500*	*313,967*
D	Office	-	-	-	26,000	26,000
E	Office	20,000	-	2,000	-	22,000
					Mid Projected Average Day Flow, GPD	631,104

Table 3: Full Build-Out Sanitary Demand for Lift Station and Wastewater Treatment Plant Design

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1326 Units	186170	129.3	0.288	3.2	432.9	0.965	29.0%
B	Corporate Offices	500000 sq. ft	40000	27.8	0.062	4.1	148.0	0.330	9.9%
C	Shopping Center	70000 sq. ft	26600	18.5	0.552	2.9	65.9	1.637	49.3%
	Business Hotel	240 Rooms	16200	11.3			42.7		
	General Office	1310000 sq. ft	87333	60.6			201.6		
	Residential Community	900 Units	226800	157.5			513.0		
D	General Office	390000 sq. ft	26000	18.1	0.040	4.3	93.8	0.209	6.3%
E	General Office	330000 sq. ft	22000	15.3	0.034	4.5	81.5	0.181	5.5%
		TOTAL	631104	438.3	0.976	NA	1579.4	3.322	

Table 4: Full Build-Out Sanitary Design Estimate for on-Site Sanitary Sewer Main Sizing Design

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1326 Units	334152	232.1	0.517	2.89	670.5	1.544	27.9%
B*	Corporate Offices	500000 sq. ft	143000	99.3	0.221	3.31	364.0	0.811	14.6%
C	Shopping Center	70000 sq. ft	21000	14.6	0.838	2.67	52.8	2.298	41.5%
	Business Hotel	90000 sq. ft	31500	21.9			76.0		
	General Office	1310000 sq. ft	262000	181.9			584.1		
	Residential Community	900 Units	226800	157.5			506.5		
D	General Office	390000 sq. ft	78000	54.2	0.121	3.65	212.9	0.474	8.6%
E	General Office	330000 sq. ft	66000	45.8	0.102	3.75	184.9	0.412	7.4%
		TOTAL	1162452	807	1.799	NA	2651.5	5.540	

As mentioned previously, the Connection Point has capacity to convey peak day flows at full build-out. “Figure 1: Connection Point Flow Monitoring” below shows the 4-weeks of flow monitoring that was collected in GPM. The peak value seen during the collection period was 958.68 GPM (2.134 cfs). This peak value, combined with the peak day flows from the Site, 1,389 GPM (3.095 cfs), totals 2,347 GPM or 5.229 cfs. At the criteria’s minimum slope of 0.10% the Connection Point will have a flow depth of 1.52-feet and will be 92% full. This said, it is important to note that the Site will have an average daily flow of 438 GPM, combined with the City’s average flow of 383 GPM from monitoring, equates to a daily average flow of 821 GPM. This average flow at minimum slope within the 21-inch main will have a pipe depth of 0.74 ft and will on average be 40% full at full build-out. The development and associated lift station will not be capable of pumping more than 2.0 MGD. In the unlikely event that peak flows exceed 2.0 MGD emergency overflow storage will be utilized

City maps show no additional connections to the 21-inch line downstream of the Connection Point, until where the main upsizes to a 24-inch pipe just west of the Plant. At this location west of the Plant there is an 18-inch pipe connection behind Empire Storage approximately 670-feet west of the Plant.

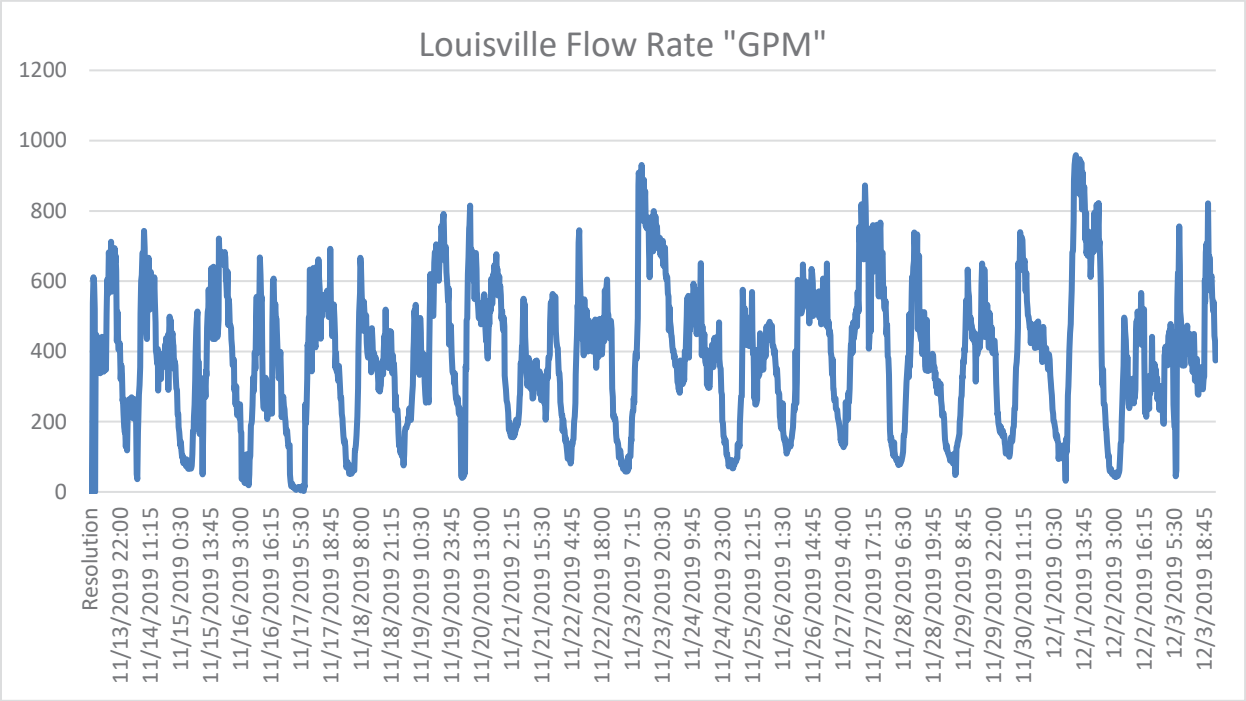


Figure 1: Connection Point Flow Monitoring

D. Available Downstream Capacity and Project Phasing

The WWTP Memos, in conjunction with the Sewer Plan, detail how much capacity the downstream sanitary sewer and Plant currently have available for additions to the system. It is known that the Site sanitary sewer flows will cause a need to increase the capacity of the Plant through various enhancements, including accommodations to increase in sanitary loading on the Plant. The WWTP Memos included in this GDP submittal detail the design and analysis of these Plant enhancements.

The Site phasing was broken out below such that the listed development parcel per Filing has listed the sanitary sewer improvements to be constructed during said Filing.

<u>Redtail Ridge Subdivision Filing No. 1 – Parcels B, C, and F</u>

- Sanitary Sewer Line A constructed in its entirety, see Section 2A on page 4 and Appendix F Filing Utility Plan to reference Line A's alignment.
- Sanitary Sewer Line B construction in its entirety, see Section 2A on page 4 and Appendix F Filing Utility Plan to reference Line A's alignment.
- Sanitary Sewer Line C construction in its entirety, see Section 2A on page 4 and Appendix F Filing Utility Plan to reference Line A's alignment.

<u>Redtail Ridge Subdivision Filing No. 2 – Parcels A, D, and E</u>

- Sanitary Sewer Line D constructed in its entirety, on an as needed basis, see Section 2A on page 4 and Appendix F Filing Utility Plan to reference Line A's alignment.
- Sanitary Sewer Line E construction in its entirety, see Section 2A on page 4 and Appendix F Filing Utility Plan to reference Line A's alignment.

Refer to the WWTP Memos for when the enhancements to the Plant will be required

Complete Build Out Condition

The complete build-out condition specified in this report represents the condition where Parcels A, B, C, D, and E, are all built-out and contributing sanitary sewer flow to the Plant. In this report, this condition is represented by an estimated sanitary sewer peak day flow rate of 2.0 MGD per the WWTP Memos included in this GDP submittal.

3. PROPOSED WATER SYSTEM

A. On-Site Layout and Connection Options to City of Louisville Water System

There will be several proposed water main segments needed within the Site. The first will be connecting to the existing 12-inch PVC main in Campus Drive near the southeast corner of the Monarch School Campus and will run east within the proposed Campus Drive extension to connect to the existing 8-inch DIP main in S. 96th Street at its future intersection with Campus Drive. A Pressure Reducing Valve ("PRV") will be installed north of this connection because the main in S. 96th Street is part of the City's low-pressure zone. See Section 3.B of this report on page 9 for further pressure information.

Another 12-inch PVC main is proposed to connect to the existing 18-inch DIP main at the intersection of Campus Drive and S. 88th Street and will continue south within S. 88th Street to the proposed intersection of Rockcress Drive and S. 88th Street. This 12-inch PVC main will then head south and east within Rockcress Drive to just west of the intersection of Rockcress Drive and Northwest Parkway. At this intersection, this 12-inch PVC main will downsize to an 8-inch PVC main and run north, within private property in an easement to be dedicated to the City along the eastern property line of the Site eventually connecting to the existing 8-inch DIP main within S. 96th Street. City maintenance staff will need to check the integrity of the above mentioned existing 8-inch DIP to determine if replacement is warranted. Typically, I DIP has a useful life of 100-years, so, replacement of the main may not be warranted.

A third proposed 12-inch PVC water line will connect the water main in Campus Drive to the water main in Rockcress Drive within Sorrel Avenue. Data received for development in Parcel B shows a 12-inch PVC loop from Campus Drive through Parcel B and connecting to Sorrel Avenue. It was assumed that Parcel C will connect to the water main in Campus Dr and Sorrel Avenue. Parcels A, D and E were assumed to connect to the proposed water main in Rockcress Drive.

Specific water main loops will be provided with the subdivision and PUD processes for each development parcel. As such, a single connection point was provided for each parcel and to a water main for the purposes of this report. A Filing Utility Plan showing the existing and proposed water mains has been provided in Appendix F for reference.

B. Available Pressure and Capacity

The Site lies within the City's Mid-Pressure Water Zone (hereinafter referred to as MPWZ) and adjacent to the Low-Pressure Water Zone (hereinafter referred to as LPWZ). The MPWZ has pumps from the NWTP and floating storage at HBWTF. The MPWZ is pressurized with pumps and maintains a pressure of 70-80 pounds per square inch ("psi"). It was assumed that a PRV will be installed on the water main within S. 96th Street north of Paradise Lane and serve as the new boundary of the MPWZ to the LPWZ. PRV's will allow water to move to the LPWZ when system demand lowers pressure in the low zone and will prevent backflow from the LPWZ to MPWZ. The PRV's are proposed to be set at 60 psi to ensure that the LPWZ does not become pressurized by the MPWZ.

Pressure information provided by the City indicates the following: a pressure range of 70-80 psi for the 18-inch PVC main within S. 88th Street in the pressurized MPWZ, and a pressure range of 60-70 psi for the 8-inch PVC main within S. 96th Street and within the LPWZ. A hydrant flow test was provided by the City of Louisville Fire Protection District that resulted in a static pressure of 85 psi. The location of the hydrant tested was within Campus Drive, at the southeast corner of the Monarch School Campus, and is connected to the MPWZ. For modeling of the water system, a static pressure of 85 psi was converted to an elevation head of 196-feet for a reservoir at the upstream end of the water main. The tested hydrant was at an approximate elevation of 5,430-feet, thus resulting in an elevation head of 5,626-feet. With the use of PRV's, it was assumed that water from the LPWZ will not flow "backwards" through the PRV's and into the MPWZ. An elevation head of 5,531.5-feet was assumed for the LPWZ based on a static pressure of 70 psi. As mentioned above, the PRV's have a pressure setting of 60 psi to limit flow from the MPWZ to the LPWZ. This model assumed that there is sufficient water supply to the LPWZ.

C. Average and Peak Water Demand Calculations

In order to estimate domestic water supply, an assumed demand of 120 gallons per day ("gpd") per person was used for the residential demand with 2 persons per unit assumed. The WWTP Memos estimate a different value, 2.5 people per unit, which is based off historical data and demands from the City. This report uses 2 persons per unit because most of the residential uses were assumed to be multifamily development based on the GDP application. As for the other proposed uses, the follow demands were used: 0.48 gallons per square foot (gal/sf) for the shopping / mixed use, 60 gallons per room (gal/room) for the hotels, and for office use it was estimated that there would be roughly 300 sq. ft. of space allocated to each employee and that each

employee would use 25 gallons per person. The Corporate user for Parcel B provided information justifying 250 sq. ft. per employee. These demands were then applied to the overall density for each build-out level as specified in “Table 6: Phased Development,” shown on page 14.

The Maximum Day Demand was calculated, per Westminster Criteria calculation methodology, to be 2.5 x Average Day Demand; and, peak day demands were calculated as 4.0 x Average Day Demand. Then, peak day demands per City Criteria were also calculated to be 9.0 GPM per developed acre for each parcel. These two calculations, from the Westminster Criteria and from the City Criteria, were used as a benchmark to compare to the peak day demand specified in the Water Plan as 2.68 x Average Day Demand. The peak day demand as calculated from the Water Plan was used in the model for the Site as requested by the City. Demands for each development phase can be found in Appendix E for reference and “Table 5: Assumed Water Demands” below contains the assumed water demands by use.

Table 5: Assumed Water Demands

60 gal/pers - 1.5 pers/room	Hotel
120 gal/pers - 2 pers/unit	Residential
130 gal/pers - 1.3 pers/unit	Retirement
0.48 gal/sq.ft.	Shopping
300 sq.ft/person - 25gal/person	General Office
250 sq.ft/person - 25gal/person	Corporate Office

The City has a high-zone storage capacity of 2.0 MGD and mid-zone storage capacity of 3.5 MGD. The NWTP has a firm pumping capacity of 3.0 MGD and the HBWTF has a firm pumping capacity of 3.5 MGD. The two combined results in a 6.5 MGD firm pumping capacity. Both plants combined have a total pumping capacity of 11.0 MGD.

Average demand values from the Water Plan indicated an average day demand of 3.385 MGD and a peak day demand of 8.420 MGD for all uses within the City. Using the requested peaking factor of 2.68 from the Water Plan, the Corporate user in Parcel B will have a peak day demand of 0.134 MGD. Then, adding in the peak day demand for parcels A, C, D, and E results in a total development phase 1 peak day demand of 0.886 MGD. This peak day demand would increase the City’s total peak day demand to 9.306 MGD. Following this logic, the peak day demands for development phases 2, 3, and 4 were 1.459 MGD, 1.732 MGD, and 1.915 MGD, respectively. This Resulted in a City peak day demand of 9.879 MGD, 10.152 MGD and 10.335 MGD, respectively. These demands do not include irrigation for the proposed parcels. The City has a treatment capacity of 13.0 MGD between both water plants. Additional storage may be necessary before complete build-out to ensure supply during peak day demand or fire scenarios. Storage increase in the high-pressure zone would benefit the entire City network as water gravity flows from the high-zone to the mid-zone and low-zone pressure areas.

Per the City's request, a yearly estimation of water demand was evaluated. Average day demand was multiplied by 365 to estimate the yearly water demand for each parcel at each phase of construction. Phases 1-4 have an estimated yearly demand of 121 MG, 199 MG, 236 MG, 261 MG annually. A summary of average yearly demand can be found in Appendix E.

D. Fire Flow Water Demand

According to the 2018 International Fire Code ("IFC") and using data from the potential developer, Parcel B was assumed to have the largest fire demand at 6,000 GPM (reduced to 3,000 GPM) with a 4-hour duration for Type II-A construction and a gross floor area of 160,000 sf. It was assumed that a building fire suppression system would be utilized to reduce the fire demand in Parcel B by 50% to 3,000 GPM with a 4-hour duration per table B105.2 in Appendix B of the IFC. The City's fire department provided a letter that approves a 50% reduction when an approved sprinkler system is used for fire suppression. This letter can be seen in Appendix E for reference. Fire flows greater than 3,000 GPM will have to be evaluated by parcel to determine impacts to the proposed water system. For the purposes of this model, a 3,000 GPM fire flow requirement was utilized for the fire demand of each parcel along with the peak day demands.

E. Irrigation Water Demand

Irrigation demands were calculated for each parcel, for each level of build-out, based on the available information at the time this report was written. "Table 6: Phased Development," shown on page 14, outlines when specific improvements are expected for each of the parcels. Irrigation demands were applied in 25% increments for each build-out level of the complete build-out condition. Parcel B is fully built-out in development phase 1, therefore 100% of the irrigation demand is applied at phase 1 of the analysis for that parcel. The acreage percentage of walks, landscape and amenities was estimated; and, used in turn, to determine how much of this area was proposed to be irrigated. Of the estimated area of walks, landscape, and amenities, the percentage of irrigated landscape was estimated at 30% sod, 30% drip irrigation/ landscape beds, and 40% native grass area. For these types of irrigated areas, irrigation demands were assumed for each planting type. The assumed demands were 2.5 ac-ft/yr/ac for sod, 1.0 ac-ft/yr/ac for drip irrigation/landscape beds, and 0.2 ac-ft/yr/ac for native grass area. The calculated irrigation demands for each development parcel and the proposed ROW can be seen in Appendix E for reference.

F. Water Modeling

In the analysis of the water system, this report models the maximum day + irrigation demands, peak day demands, and maximum day + irrigation + fire flow demands for each parcel. In addition to this analysis, an analysis for each level of build-out was also performed. The peak day demand + fire flow using the peaking factor of 2.68 was also analyzed in this model. An analysis of the maximum day+ irrigation + fire flow was also

completed for the full build-out condition. The water pressures for this condition were between 65 psi and 112 psi with pipe velocities under 9.15 ft/s. Additionally the worst-case peak day + fire flow demand was model was determined to indicate a maximum allowable fire flow for the water system. This worst-case scenario estimates a maximum allowable fire flow of 4,250 GPM fire flow per City Criteria while also keeping pressures within City thresholds and pipe velocities under 10 ft/s. These velocities are less than the City Criteria limit of 15 ft/s specified in Section 302 Main Size. Node pressures, node demands, and pipe velocities can be found in Appendix E for reference.

G. Project Phasing

The Site phasing was broken out below such that the listed development parcel per Filing has listed the water system improvements to be constructed during said Filing.

<u>Redtail Ridge Subdivision Filing No. 1 – Parcels B, C, and F</u>

- The water main will connect to the existing water main near Disk Drive and S. 96th Street and continue south within an easement dedicated to the City to the intersection of Rockcress Avenue and Northwest Parkway. From this intersection it will turn west and run within Rockcress Drive to the intersection of Rockcress Drive and Sorrel Avenue, see Section 3A on page 10 and Appendix F Filing Utility Plan to reference this alignment.
- The water main will be constructed from the intersection of Rockcress Drive and Sorrel Avenue north within Sorrel Avenue to the round-a-bout at Sorrel Avenue and Campus Drive. See Section 3A on page 10 and Appendix F Filing Utility Plan to reference this alignment.
- From the round-a-bout at Sorrel Avenue and Campus Drive, the water main will split to the west and east. To the west, it will continue within Campus Drive to where it connects to the existing water near the southeast corner of the Monarch School Campus. To the east, from the round-a-bout, the main will continue within Campus Drive to the intersection of Campus Drive and S. 96th Avenue where it will connect to the existing water main in S. 96th Street. See Section 3A on page 10 and Appendix F Filing Utility Plan to reference this alignment.

<u>Redtail Ridge Subdivision Filing No. 2 – Parcels A, D, and E</u>

- The water main will be constructed from the intersection of Rockcress Drive and Sorrel Avenue northwest within Rockcress Drive to the intersection of Rockcress Drive and S. 88th Street. See Section 3A on page 10 and Appendix F Filing Utility Plan to reference this alignment.
- The water main will continue within S. 88th Street north to connect to an existing main near Campus Drive and S. 88th Street. See Section 3A on page 10 and Appendix F Filing Utility Plan to reference this alignment.

<u>Complete Build Out Condition</u>

The complete build-out condition specified in this report represents the condition where Parcels A, B, C, D, and E, are all built-out and contributing demands to the water system. This report references development phases as associated with the timing of when uses and improvements are expected to be built. Phase 1 refers to the 2022 buildout, Phase 2 to the 2025 buildout, Phase 3 to the 2030 buildout, and Phase 4 to the 2040 buildout. “Table 6: Phased Development” below describes this type of phasing which was only used to determine demands for the water system.

Table 6: Phased Development

Parcel	Type	Units	Phase 1	Phase 2	Phase 3	Phase 4
A	Senior Living	Units	505	505	316	-
B	Office	Square Feet	500,000	-	-	-
C	Office	Square Feet	-	590,000	440,000	280,000
	Retail	Square Feet	10,000	15,000	20,000	25,000
	Hotel	Rooms	240	-	-	-
	Multifamily	Units	600	300	-	-
D	Office	Square Feet	-	-	-	390,000
E	Office	Square Feet	300,000	-	30,000	-

4. PARCEL B BUILD-OUT

At the time of this report Parcel B will be the first parcel to be developed in development phase 1 and will be provided water mains within Campus Drive, Sorrel Avenue, and Rockcress Drive as a part of Redtail Ridge Subdivision Filing No. 1.

5. CONCLUSIONS

A. Analysis Summary

The proposed sanitary sewer for the Site will be designed to have capacity for the estimated 2.0 MGD peak day flow expected with the full build-out condition of the Site based on coordinated sanitary loads with Dewberry. This flow will be conveyed from the Site to the Plant through an off-Site force main (Line F) and from the lift station in the southeast corner of the Site. Line F will have the capacity needed to accommodate flows from the Site’s development. At the Connection Point described above, Line F will connect to existing sanitary sewer infrastructure and convey both existing and proposed flows to the Plant for treatment. Per the WWTP Memos included in this GDP submittal, the Plant will undergo enhancements to accommodate the increase in flow and to comply with current regulatory water quality requirements. Based on provided flow monitoring an existing peak flow of 2.134 cfs was observed at the Connection Point. The full build-out peak flow for the Site will be 3.095 cfs. This totals 5.229 cfs at the Connection Point which results in a flow depth of 1.52-feet and equates to approximately 92% full. At the time this report was written, and with the data on the

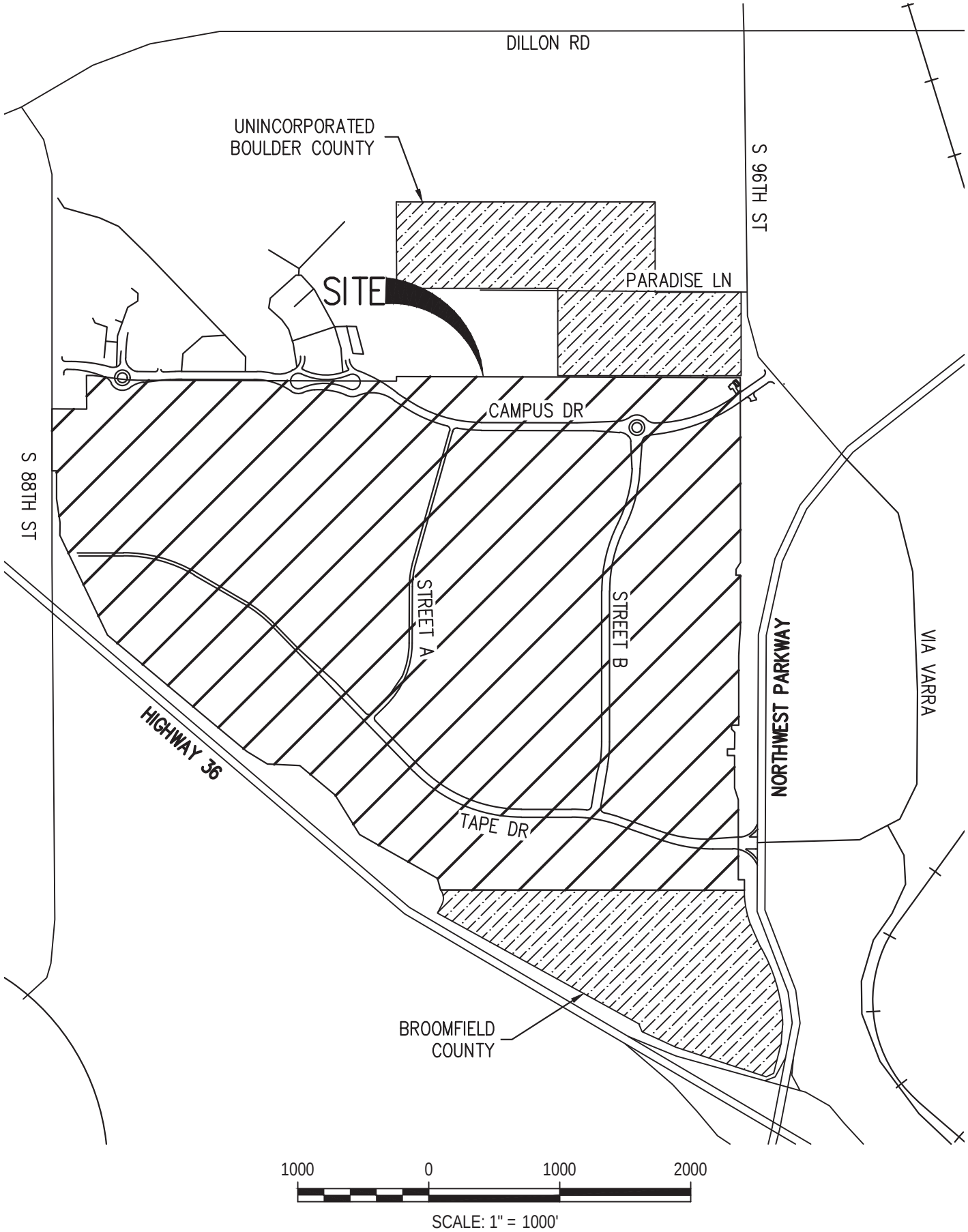
existing flows at the Connection Point, the Connection Point has enough capacity for existing peak flows and the anticipated peak flows at full build-out of the Site. The on-Site gravity sanitary sewer mains are designed in accordance with Denver Criteria and will have capacity to convey the sanitary flows from the development parcels to the on-Site lift station.

The analyzed water scenarios had pressure values between 65 psi and 112 psi with pipe velocities under 9.15 ft/s. Additionally the worst-case peak day + fire flow demand was model was determined to indicate a maximum allowable fire flow for the water system. This worst-case scenario estimates a maximum allowable fire flow of 4,250 GPM fire flow per City Criteria while also keeping pressures within City thresholds and pipe velocities under 10 ft/s. A model was also run for the first development phase of construction for Parcel B. The proposed 12-inch main within Campus Drive and Sorrel Avenue is large enough to supply the 3,000 GPM fire flow needed while maintaining pipe velocities below 10 ft/s. At full build-out the proposed water mains are sufficient to supply peak hour demand as well as fire flow scenarios for the Site. As previously stated, the City has a current treatment capacity of 13.0 MGD, a total pump capacity of 11.0 MGD, a firm pumping capacity of 6.5 MGD, and a storage capacity of 8.5 MGD. The Site has an estimated full build-out peak day demand of 1.915 MGD, resulting in a City peak demand of 10.335 MGD, which is still within the City's treatment capacity of 13.0 MGD. The City also had 5.5 MGD of storage between the HPWZ and MPWZ. Additional storage is recommended to supply the City and the Site at full build-out for these zones at peak day demand.

6. LIST OF REFERENCES

1. *City of Louisville Comprehensive Plan*, City of Louisville, May 2013
2. *City of Louisville and Redtail Ridge Development Flows,* Dewberry, February 2020
3. *City of Louisville Department of Public Works Engineering Division Design and Construction Standards,* City of Louisville, March 2015
4. *City of Westminster City Standards and Specifications,* City of Westminster, January 2018.
5. *Sanitary Sewer Design Technical Criterial Manual, City and County of Denver, March 2008*
6. *Redtail Ridge Traffic and Mobility Study*, For Tuttle Hernandez September 30, 2019
7. *Loads and Redtail Ridge Wastewater Pumping and Treatment Infrastructure Needs,* Dewberry, October 2019
8. *Wastewater Facility Plan,* City of Louisville, April 2013
9. *Water System Facilities Plan, Final Report,* City of Louisville, July 2012

APPENDIX A – Vicinity Map



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NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH.

ISSUE DATE: 06-06-2019	PROJECT #: 190108
DATE	REVISION COMMENTS

BRUE BAUKOL PARTNERS

REDTAIL RIDGE
VICINITY MAP

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SHEET NO.
1
1 OF 1

APPENDIX B – Reference Material

City of Louisville

Comprehensive Plan

Adopted

May 7, 2013

Resolution 18, Series 2013

Block Pattern

The City's street network, or block pattern, is the skeleton of the community. The block pattern dictates the development flexibility and ultimately the physical character of the community. The block pattern establishes the street network and street hierarchy of the community, which in turn dictate the mass, scale, and orientation of buildings. Together, the streets and buildings determine the City's walkablility.

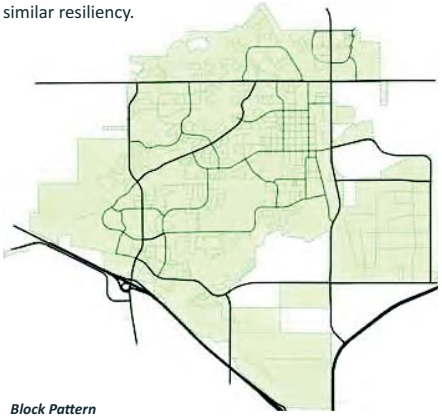
As existing streets are improved and new streets are proposed in the Comprehensive Plan, it is important to understand the block pattern that is envisioned will establish the character of development and redevelopment for years to come.

The City's existing block pattern creates three distinctive character zones within Louisville: *urban, suburban*, and *rural*. Downtown and Old Town (built before 1960) and the newer subdivisions of North End and Steel Ranch (built since 2008) have established interconnected streets with smaller block patterns and supporting alleys. The block structure in the northeastern portion of the City dictates smaller property parcels, interconnected smaller streets and a more walkable urban character.

Contrasting Downtown and Old Town are the suburban (less walkable) areas of the City along South Boulder Road and McCaslin Boulevard and everything built between 1961 and 2007. The character of these suburban and rural areas of town is influenced by their limited street networks and larger arterials, creating single purpose suburban retailing and employment environments.

A problem with suburban block patterns is that after 10 to 15 years, the retail centers built upon them are outperformed by newer competition. Significant public investment is then needed to reshape the blocks to accommodate a variety of retailing formats and land development patterns, allowing the retail centers to successfully compete again.

Block patterns and infrastructure inform an area's building inventory, development patterns, and land use types. It is important for the Comprehensive Plan to enable the development of more urban block patterns, building stock and community supported land uses. Urban block patterns, like that in Old Town and Downtown Louisville, have high resiliency and flexibility in accommodating development and redevelopment over time. Typical suburban block patterns have not demonstrated similar resiliency.



Block Pattern

Municipal Utilities and Infrastructure

Municipal utilities and infrastructure (water, sewer, and storm water) are critical in defining the economic vitality and physical character of the City. Their capacity defines the growth potential of the City. Their placement and design contribute to the physical character of the City.

Louisville's water supply originates from two primary sources: South Boulder Creek and the Northern Colorado Water Conservancy District consisting of the Colorado Big Thompson and Windy Gap projects.

The City is treating 4,000 acre-feet (AF) of water a year, with peak demands approaching 9.0 million gallons per day (mgd). Raw water from the City's established sources is treated and distributed to individual businesses and residences from the City's two water treatment facilities: *the Howard Berry Plant* and *the North Plant*. Currently, both plants operate at or under capacity.

Raw Water Sources

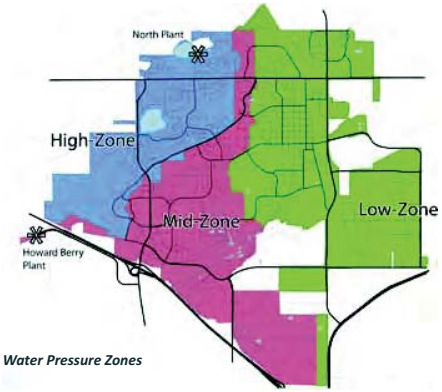
The two water treatment plants have a combined treatment capacity of 13 mgd. Together, the two facilities serve three pressure zones within the City. A water system capacity analysis examined both demand and location of the projected build-out of the City as well as the 20 year market forecast.

The existing water supply and treatment capacity are sufficient to accommodate the expected 20-year development absorption assumptions of the Framework.

However, it is important to note, the Howard Berry Plant may require additional capacity to serve the projected build-out of the mid and lower water pressure zones of the City. The primary driver of future water demand will be the office and industrial uses expected in the Centennial Valley, the Phillips 66 property, and the Colorado Technology Center (CTC).

The Wastewater Treatment Plant provides sanitary sewage treatment for the City of Louisville. There is a surplus of sanitary treatment capacity currently on-line to serve the projected demand of the City as reflected in the Framework.

The Sanitary Treatment Plant is currently operating at a daily average of 2 million gallons per day (mgd) or 59% of its capacity. Historically, the plant has seen flows as high as 2.8 mgd. Additional treatment capacity was added in 1999 giving the plant a maximum permitted capacity of 3.4 mgd.



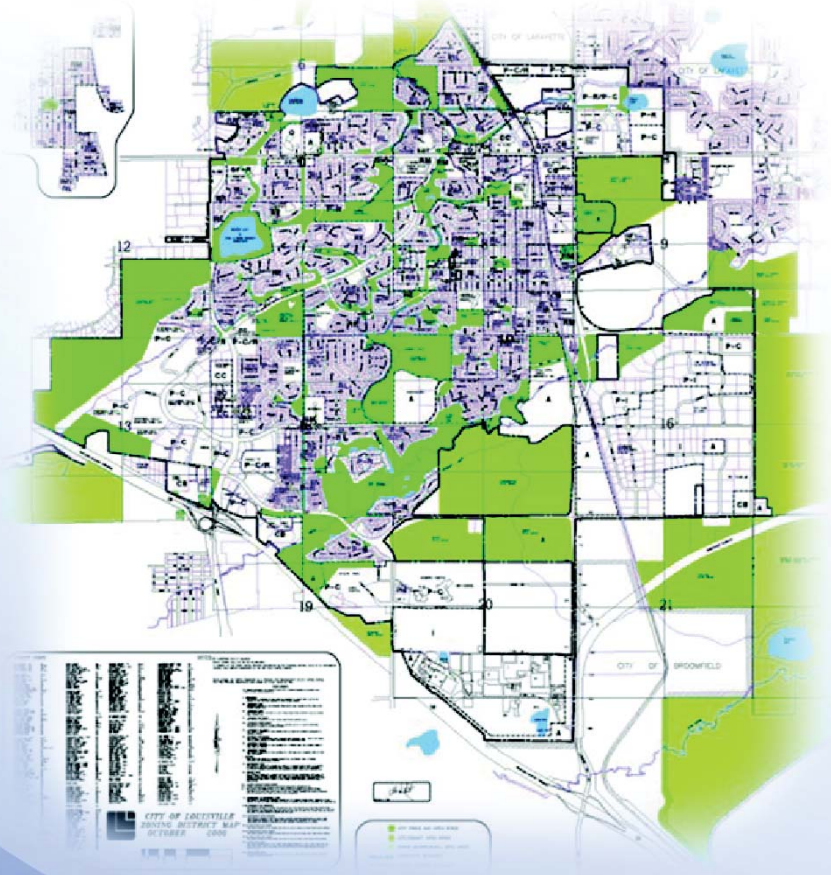
Water Pressure Zones

The Wastewater Treatment Plant has reached the end of its useful life based upon the age of the facility and upcoming regulatory water quality requirements.

Construction is currently being planned for the Wastewater Treatment Plant to meet regulatory and growth requirements. Improvements to transmission mains and lift stations will be needed with build out of the Colorado Technology Center and the Phillips 66 property.

There are also limitations in the sanitary sewer pipes located in the Downtown and Old Town areas. The pipes in this area are the original vitrified clay pipes, constructed in the mid 1900s. As the pipes have aged, they have begun to break down. The City annually replaces portions of these pipes with PVC pipes to maintain the integrity of the collection system.

Waste Water Treatment Plant Improvement Timelines



City of Louisville

Water System Facilities Plan
Final Report

July 2012

Hatch Mott
MacDonald
www.hatchmott.com

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Background

The City of Louisville initiated the Water System Facilities Plan project to provide the City with a detailed Capital Management Plan for the City's water system. The Water System Facilities Plan addresses the raw water delivery system, water treatment facilities, pump stations and water storage tanks. The Capital Management Plan provides a roadmap for planning upgrades, maintenance projects, and expansions for the system.

The identified planning period for the project is buildout of the water system, which is expected to occur around 2035. The Water System Facilities Plan is also focused on larger capital projects in lieu of smaller maintenance and repair projects that are addressed in other City planning documents.

Project Development

The Water System Facilities Plan identifies major capital improvement projects based on the evaluation of six key elements:

- An evaluation of water demands and future water use trends
- An evaluation of the treatment plant capacities
- A review of current and future regulations
- A review of water system operability
- An evaluation of water system security
- An evaluation of water system redundancy

Louisville Reservoir

In addition to the evaluations, a public outreach program was performed to receive input from the public on their level of satisfaction with the water system, as well as to identify customer expectations for level of service. Major elements of the public outreach program included public announcements, a mailed survey and a public meeting.

Water System Facilities Plan Results

A total of 26 projects were identified as a result of the above mentioned evaluations. The projects range from relatively minor rehabilitation projects with capital costs of less than $100,000, to major expansions of water treatment facilities with capital costs of several million dollars. It is anticipated that additional projects will be added to the Capital Management Plan over time as additional system needs are identified.

The following documents were produced as part of the Water System Facilities Plan:

- The Water System Facilities Plan report
- A Capital Management Plan developed in an electronic spreadsheet format
- A Survey Summary Report that was produced as part of a Public Outreach Program
- Supporting spreadsheet documents including water treatment facility capacity evaluations and water demand projections

CHAPTER 1
Project Introduction

1.0 PROJECT INTRODUCTION

This chapter provides a discussion of the project background and goals, as well as the organization of the final project documents.

1.1 PROJECT BACKGROUND

A key to successful management and growth of a water system is careful and thoughtful planning. Identifying critical infrastructure needs and developing adequate budgeting for improvements within a cost effective framework is critical to the success of a water utility.

The City of Louisville initiated this Water System Facilities Plan project to provide the City with a detailed Capital Management Plan for the City's raw water supply system, water treatment facilities, pumping stations and water storage tanks. The Capital Management Plan will provide a roadmap for planning upgrades, maintenance projects, and expansions that will meet the needs and expectations of both the City's residents and staff.

This Water System Facilities Plan and the associated Capital Management Plan cumulates work and knowledge that comes from evaluations of key planning components and provides the City with a road map for future improvements. The Water System Facilities Plan incorporates evaluation and review of six key components that impact the water system planning, including:

- An evaluation of water demands
- An evaluation of the treatment plant capacities
- A review of current and future regulations
- A review of water system operability
- An evaluation of water system security
- An evaluation of water system redundancy

These various components of water system planning, and general concepts on how they impact the Water System Facilities Plan, are represented in Diagram 1-1. The evaluation of these six projects components, both individually and in combination, leads to the identification of specific projects which are recommended for the water system. These evaluations are discussed in this report. A public outreach program was also completed as part of the project to receive input from the citizens regarding the six identified components and as they pertain to expectations for the level of service.

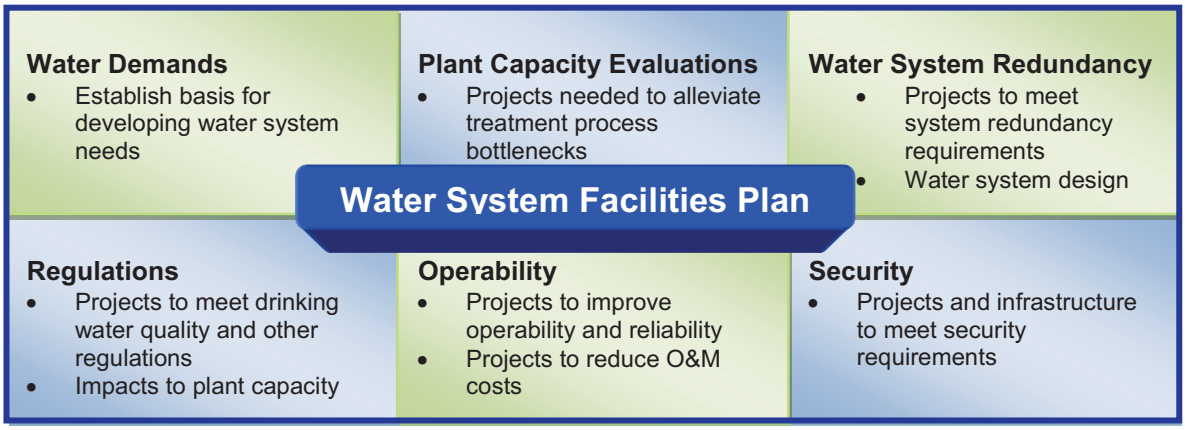


Diagram 1-1: Key Planning Components for the Water System Facilities Plan

Since this document contains information that may be considered sensitive, such as descriptions of the water system, discussions on systems redundancy and vulnerabilities, and facility security, this document should be handled carefully.

1.2 PROJECT SCOPE AND OBJECTIVES

The Water System Facilities Plan focuses on the raw water supply system, water treatment facilities, pumping stations and water storage tanks. Buried small diameter water distribution pipes and other "buried infrastructure" will be addressed in other planning documents.

In addition, the City maintains an updated and thorough maintenance program for all of their facilities, which includes replacement and rehab for most of the standard equipment inside of the facilities such as valves, pumps, compressors and chemical metering pumps. This type of equipment typically has predictable schedules for repair or replacement based on life expectancy, and is not impacted by the six evaluation components identified for the Water System Facilities Plan. This project is therefore focused on identifying either one time or otherwise unique projects that would not be captured in other City planning documents.

Two objectives for the project that were identified through workshops with City staff include:

> *Develop a Comprehensive and Well Developed List of Capital Improvements Projects*. Developing a comprehensive list of capital improvements projects provides the foundation for developing the Capital Management Plan. Essential to this effort is establishing the scope of the identified projects, identifying the correct triggers for these projects, and developing reliable cost information for completing these projects.
>
> *Ability for the Planning Documents to Remain Relevant*. One problem often encountered with planning documents is that they often become quickly dated, and end up collecting dust on a shelf. The reason for this is that all planning projects contain a number of assumptions and planning conditions that will inevitably change over time. In order to prevent this often encountered problem is to develop the planning tools so that they include decision trees and other items that allow modifications to be made with minimal work, thereby allowing changing conditions to be taken into account and the report recommendations to be updated.

1.3 PROJECT DOCUMENT ORGANIZATION

The Water System Facilities Plan consists of two primary documents, and several supporting documents, shown in Diagram 1-2. The two primary documents consist of:

- This Water System Facilities Report, which includes a description of the Capital Management Plan, and the overall work and evaluations that went into completing the project.
- The Capital Management Plan prepared in an electronic spreadsheet format.

Supporting documentation that was prepared as part of this Water System Facilities Plan includes the following:

- An electronic spreadsheet based Capacity Evaluation for each of the two water treatment facilities.
- A Summary Report prepared to summarize the Public Outreach Program, in particular the public survey.
- Individual Project Sheets describing each project.

A summary of the public outreach effort that was initiated in conjunction with this project is further discussed in Chapter 10.

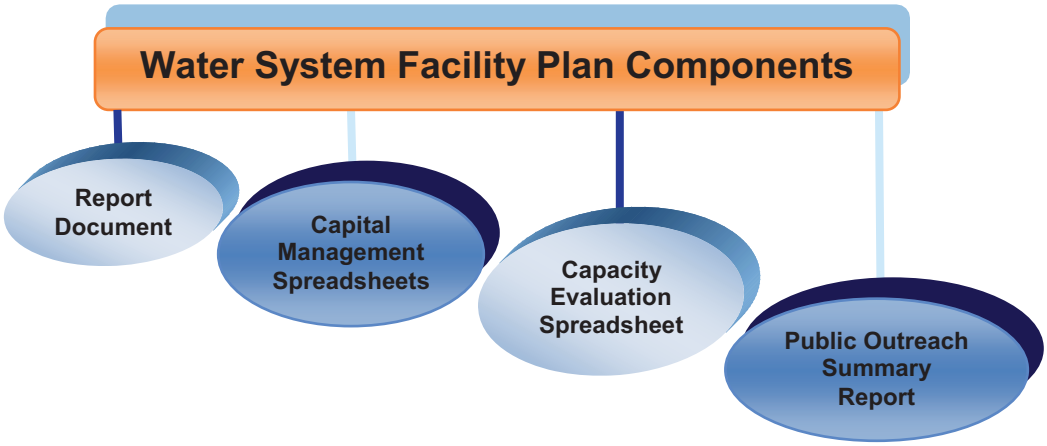


Diagram 1-2: Facilities Plan Documents

1.4 INFORMATION USED IN DEVELOPING THE WATER SYSTEM FACILITIES PLAN

A list of background documents that were reviewed and used in preparing this plan is included in Appendix A. Copies of reference articles are also included in the Appendix.

CHAPTER 2
Description of Water System

2.0 DESCRIPTION OF WATER SYSTEM

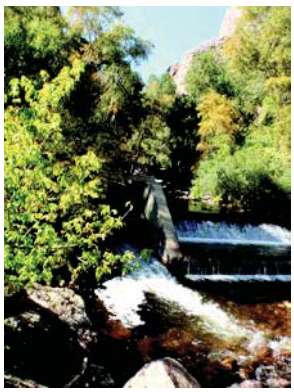
The following chapter provides a general description of the City of Louisville water system, including the raw water delivery system, water treatment facilities, distribution system and water storage tanks.

2.1 GENERAL DESCRIPTION

The City of Louisville receives raw water from South Boulder Creek near Eldorado Springs, Colorado Big Thompson and Windy Gap resources, and owns shares in the Farmers Reservoir and Irrigation Company (FRICO). A series of facilities and structures, including Louisville Reservoir, Marshall Lake and Harper Lake, are used to transmit and store these water sources. The City's raw water supply sources are partially inter-connected. The raw water is treated at two separate conventional dual-media water treatment plants that have a combined gross treatment capacity of 13 million gallons per day (mgd). The North Water Treatment Plant (NWTP) was constructed during the early 1980s, while the Howard Berry Water Treatment Facility (HBWTF) was constructed in 1993. Water is then delivered to the water distribution system, and stored in 8.5 million gallons (MG) of system storage. The water distribution system has three pressure zones; two feed by gravity and one is delivered by pump stations at either water treatment plant.

2.2 RAW WATER DELIVERY SYSTEM

The City of Louisville's raw water supply system consists of facilities that divert, convey, and store raw water supplies for delivery to the NWTP and the HBWTF. Historically, the community's water system was solely from the Louisville Reservoir, which was constructed in the late 1890's. Due to a drought in the 1950's, the Louisville Pipeline was constructed. Additional water rights have been acquired from South Boulder Creek due to growth. In the 1970s, as the community grew, additional efforts were taken to obtain and store water in Marshall Lake, a major reservoir in the Louisville area. Harper Lake Reservoir was constructed in 1985 to supplement the NWTP. The City is an allottee of the Northern Colorado Water Conservancy District and Municipal Sub District which provides the Colorado Big Thompson and Windy Gap water resources. Other resources include rights and storage on Coal Creek.

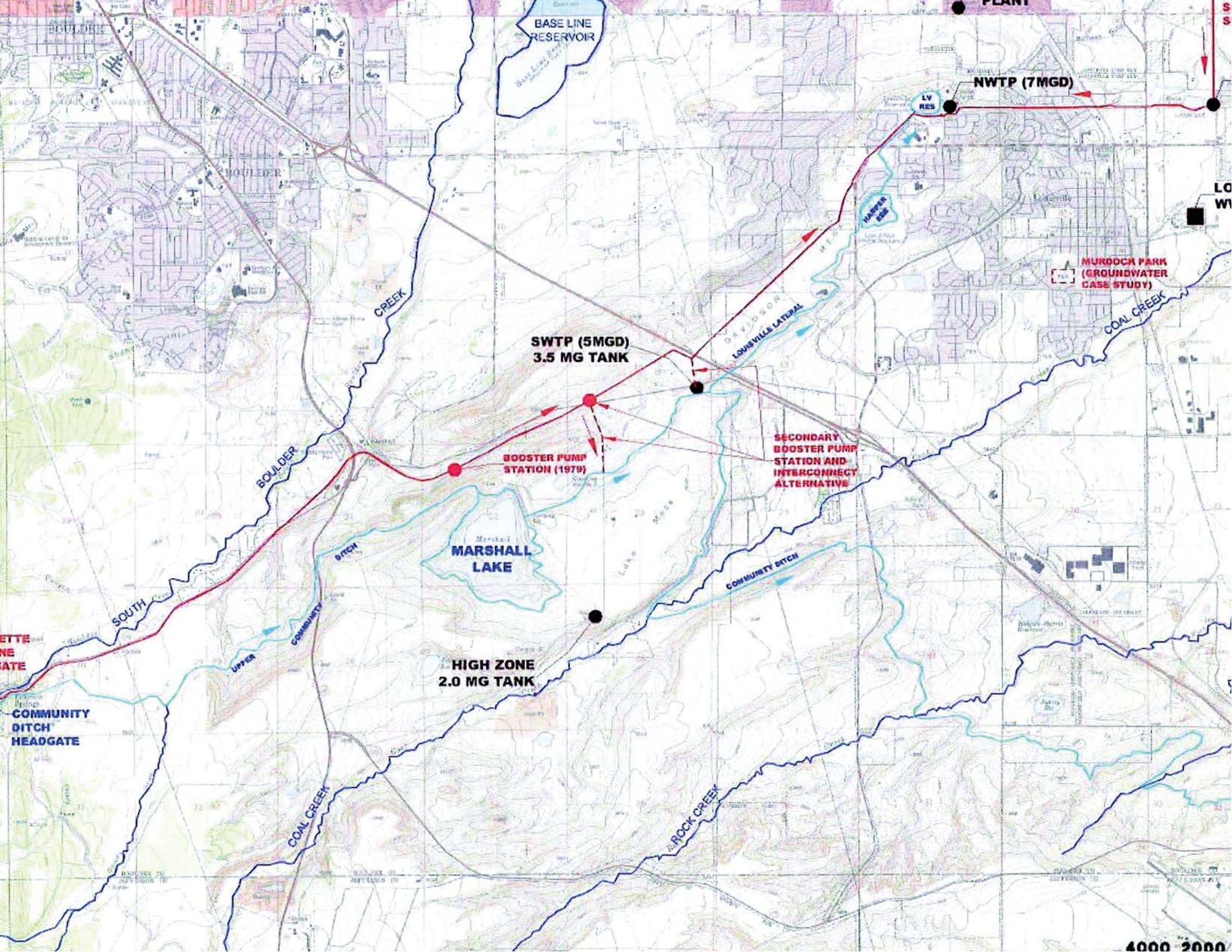


Water Diversion Structure in Eldorado Canyon

This raw water system includes 715 acre-feet in Harper Lake and 210 acre-feet in Louisville Reservoir. The City owns a portion of shares in FRICO's Marshall Lake division. The Southern Water Supply Pipeline carries CO-BT&WG water from Carter Lake to the Louisville Reservoir. The Louisville Pipeline transfers water from Eldorado Springs and it flows by gravity to the HBWTF, or to Harper Lake or Louisville Reservoir.

Water from Louisville Reservoir and Harper Lake are solely fed to the NWTP, while water stored in Marshall Lake feeds the HBWTF. Marshall Lake reserves can also flow through the Louisville Lateral to Harper Lake and Louisville Reservoir.

Key components of the water system are shown in the following map from the City's 2003 Raw Water Master Plan Update.


BASE LINE RESERVOIR
PLANT
NWTP (7MGD)
LV RES
HARPER EDE
MURDOCK PARK (GROUNDWATER CASE STUDY)
COAL CREEK
SWTP (5MGD)
3.5 MG TANK
DAVIDSON
LOUISVILLE LATERAL
SECONDARY BOOSTER PUMP STATION AND INTERCONNECT ALTERNATIVE
BOOSTER PUMP STATION (1979)
BOULDER
CREEK
MARSHALL LAKE
COMMUNITY DITCH
SOUTH
UPPER
HIGH ZONE
2.0 MG TANK
COMMUNITY DITCH HEADGATE
COAL CREEK
ROCK CREEK
4000 2000

2.3 WATER TREATMENT PLANTS

The current NWTP treatment train was constructed in several phases during the early 1980s, while the HBWTF was constructed in 1993. The plants were constructed as conventional dual-media filtration plants, to treat surface water sources. The WTPs were planned and constructed during a time period when there were significantly less stringent requirements for finished water turbidity, regardless, both plants are able to achieve current turbidity standards. Both plants were designed by the same engineering firm and within relatively close time frames, thus the designs of the facilities (technology and equipment selections, general process sizing) are very similar.

The NWTP and HBWTF are conventional water treatment facilities utilizing the following treatment processes: pre-oxidation with chlorine dioxide, coagulation and flocculation, sedimentation, and filtration followed by chlorine disinfection, fluoride treatment, pH adjustment and corrosion control. The major treatment processes are discussed in further detail below.

Coagulation and Flocculation. Most colloidal material in water (suspended solids that are small enough to pass through a conventional dual-media filter) have a negative surface electrochemical charge. Most pathogenic materials in water demonstrate similar negative surface charges. These materials are removed from water by adding a coagulant such as alum that acts to destabilize the negative surface charge of the particle thereby causing the colloidal material to become charge neutral. This allows the colloidal and pathogenic materials to agglomerate into larger particles. The water containing the charge neutral particles is then passed through a flocculation process which consists of multiple stages of gentle stirring causing these particles to collide and form larger solids. These solids become large enough to either be settled or filtered out of the water. The primary coagulant chemicals currently used by Louisville are alum and polymer.

Sedimentation. Sedimentation (settling) is used to remove flocs by gravity and removing a large percentage of the solids loading from the water, thereby extending the filter run time. Both water treatment plants uses tube settlers to enhance the natural settling process.

Filtration provides a positive barrier for pathogenic organisms

Filtration. Filtration provides a positive barrier for pathogenic organisms and other suspended solids remaining in the water. Flocculated particles that do not settle out in the sedimentation process are strained out of the water in the filter. The City's filters have a media depth of approximately 28 inches (not including the underlying support layers).

Disinfection and Chemical Treatment. Following filtration water flows into the clearwell, or chlorine contact tank. The clearwell volume provides contact time for disinfection of the water. Gaseous chlorine is fed to disinfect the water and maintain a residual chlorine concentration in the distribution system in order to provide protection from pathogenic organisms. Fluoride is added in small amounts to assist in preventing tooth decay, the pH is adjusted for stability, and silicate is added for corrosion control in order to protect pipelines to protect the pipelines and prevent elevated concentrations of metals that can occur with corrosive water.

The NWTP has two flocculation and sedimentation trains, and four filters, with a gross production capacity of 8.0 mgd. The HBWTF has one flocculation and sedimentation train, and two filters, with a gross production capacity of 5.0 mgd.

2.4 DISTRIBUTION SYSTEM

There are three pressure zones throughout the City of Louisville as shown in Figure 2-1; the Low Zone, Mid Zone and High Zone. Water from the NWTP flows into the Low Zone by gravity, and can be pumped to the High Zone from the High Zone Pump Station located at the plant. Water from the HBWTF flows to the Mid Zone by gravity, and can also be pumped to the High Zone by a High Zone Pump Station located at that facility. Water can download from the High Zone to the Mid Zone, or from the Mid Zone to the Low Zone, through interconnecting PRVs in emergencies, or from zone valves operated by City staff. Flow of water into the various pressure zones is summarized in Table 2-1.

Table 2-1: Current Pressure Zone Configuration

Zone	NWTP	HBWTF
Low Zone	Gravity Fed	Gravity fed to Mid Zone and download to Low Zone
Mid Zone	Pumped to High Zone and download to Mid Zone	Gravity fed
High Zone	Pumped	Pumped

The City prefers to pump water from the HBWTF to the High Zone to reduce electrical demands by taking advantage of lower pumping heads. However, during times of the year the City may only operate one plant, and pumping to the High Zone and downloading to lower zones may be used as a water delivery strategy.

Total and firm pumping capacity from each plant to the High Zone is summarized in Table 2-2. Pumping capacity from the NWTP is limited by high velocities in the transmission line and distribution system. The firm pumping capacity of the HBWTF is based on the largest pump being out of service.

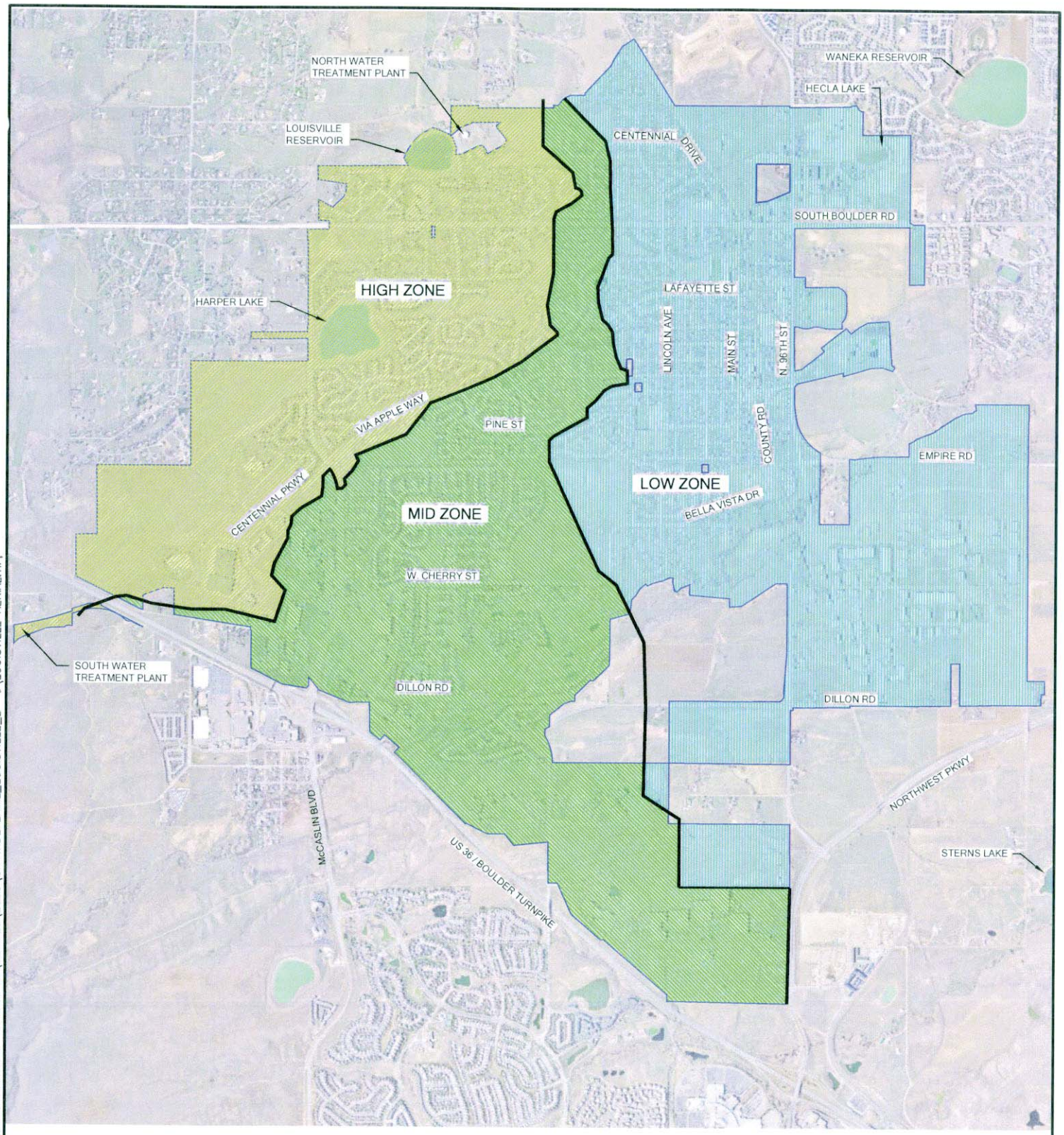
Table 2-2: High Zone Firm Pumping Capacity

Plant	Total Pumping Capacity	Firm Pumping Capacity
NWTP	5.0	3.0
HBWTF	6.0	3.5

2.5 WATER STORAGE

The industry standard is for water utilities to provide water treatment capacity to meet Peak Day Demands, while providing proper storage volume to meet emergency and fire storage needs as well as operational volume for daily flow variations. This approach generally provides the optimal balance between providing a durable system, controlling capital costs and managing water quality. Increasing water treatment capacity and offsetting storage volume is cost prohibitive, while decreasing treatment capacity and increasing storage can result in water quality problems as well as leave a community susceptible to water shortage when weather conditions result in sustained Peak Day Demands.

Various guidance documents such as AWWA Manuals of Practice, Colorado Department of Public Health and Environment (CDPHE) design criteria and Insurance Services Office (ISO)



INDICATED BOUNDARIES ARE APPROXIMATE LOCATION

LEGEND

- HIGH ZONE
- MID ZONE
- LOW ZONE

FIGURE 2-1

CITY OF LOUISVILLE - WATER FACILITY PLAN
LOUISVILLE WATER PRESSURE ZONES

Hatch Mott MacDonald

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guidelines can provide significantly different answers as to the amount of water storage that a water utility should provide. HMM's experience is that different water utilities across Colorado provide significantly different quantities of water storage as compared to their Peak Day Demands, and can be impacted by such things as water quality concerns, to the hydraulic condition of the distribution system.

While it was beyond the scope of this project to perform a storage evaluation, the issue of water storage is important in the evaluation of system needs and several identified projects, including evaluations of necessary water production capacity, pumping facilities and whether both the clearwell and 3 MG Tank at the NWTP should be maintained. Many water utilities in the Denver Metro area provide storage of approximately 70-80% of Peak Day Demand plus fire flow, although as noted there can be significant deviations from this rough guide. The City of Louisville stores approximately 8.5 million gallons of water, distributed as indicated in Table 2-3. An assessment of Table 2-3 shows that the City provides acceptable water storage, however may want to construct further storage in the Mid Zone in the future. The issue of storage volume will be reviewed by City staff through further planning. For the purposes of the Facilities Plan, it was decided that the 8.5 MG of storage is acceptable, but that the entire storage volume should be maintained.

Table 2-3: City of Louisville Water Storage

Pressure Zone	Water Storage Volume	Buildout Peak Day Demand
Low	3.0	3.0 – 3.5
Mid	3.5	4.7 – 5.9
High	2.0	2.7 – 2.8
Total	8.5	10.4 – 12.2

meeting water demands that actually occur in the system. If demand numbers are overly conservative, significant investment may be made in developing and maintaining unnecessary infrastructure. Based on the experience of HMM, a significant number of communities in the Colorado Front Range are currently revising Master Plan work completed either prior to or immediately following the drought of 2002, and are generally lowering water demands projections and revising Capital Investment Plans appropriately.

In order to address this problem in the Facilities Plan, both high and low water demand projections were developed to bracket a realistic range of future water demands. This methodology allows a reasonable range of demands to be considered when performing system planning.

In relation to the high end water demand projections shown in Table 4-4, average pre-drought water use projections were used in developing the demands. While this is not as conservative as using the highest demands from the highest year, the use of pre-drought demands does provide a reasonably conservative demand basis, considering that many items that result in water conservation such as low-flow fixtures are permanently in place. In addition, there is reason to believe that further water conservation measures will occur in future years further reducing customer water use, which provides an additional level of conservatism to the water demand projections. As an example, further legislation requiring even lower water usage for toilets and urinals has been in development, and most expect the legislation to be passed by legislation in upcoming years. While Louisville is currently at about 90% buildout, fixtures in existing homes and buildings will need to be replaced, and may be replaced with even more efficient fixtures.

Table 4-4: Average Day Demand Projection Summary

Year	Population [1][2]	Single Family Population [3][4]	Single Family Avg. Day Demand (MGD)	Multifamily Population [3][5]	Multifamily Avg. Day Demand (MGD)	Non-Residential Services [2][3][6]	Non-Residential Average Day Flow (MGD)	Total Demand Based on User Categories (MGD) [10]	Avg. Demand (MGD) [1]
1998	18,177	15,158	1.959	3,019	0.227	387	1.148	3.996	4.033
1999	18,062	15,306	1.865	2,756	0.225	482	1.129	3.859	3.973
2000	19,051	15,306	2.108	3,745	0.234	482	1.306	4.373	4.454
2001	19,088	15,306	1.993	3,782	0.236	482	1.216	4.129	4.253
2002	18,747	15,306	1.567	3,441	0.196	482	0.720	2.976	3.089
2003	18,419	15,296	1.691	3,123	0.204	496	0.989	3.457	3.408
2004	18,574	15,330	1.486	3,244	0.194	519	0.915	3.111	2.996
2005	18,427	15,337	1.658	3,090	0.229	522	1.061	3.534	3.496
2006	18,723	15,345	1.842	3,378	0.239	530	1.307	4.061	3.855
2007	18,989	No Data	No Data	No Data	No Data	No Data	No Data	No Data	3.72
2008	19,461	No Data	No Data	No Data	No Data	No Data	No Data	No Data	3.716
2009	19,656	No Data	No Data	No Data	No Data	No Data	No Data	No Data	3.251
2010	18,376	15,319	1.585	3,057	0.226	549	1.014	3.385	3.37
2011	18,410	15,415	No Data	2,995	No Data	550	No Data	No Data	No Data

PROJECTED	Population [2]	Single Family Population [2]	Single Family Avg. Day Demand (MGD)		Multifamily Population [2]	Multifamily Average Day Flow (MGD) [9]	Non-Residential Services [2][6]	Non-Residential Average Day Flow (MGD)		Total Demand Based on User Categories (MGD) [10]		Average Flow Based on Total Population(MGD)	
			Low [7]	High [8]				Low [7]	High [8]	Low	High	Low	High
2012	18,497	15,855	1.893	2.057	3,248	0.229	552	1.338	1.454	4.146	4.483	3.757	4.083
2013	18,584	15,920	1.901	2.066	3,267	0.230	553	1.341	1.458	4.161	4.499	3.769	4.103
2014	18,671	15,985	1.908	2.074	3,286	0.231	555	1.344	1.461	4.176	4.515	3.784	4.122
2015	18,758	16,050	1.916	2.083	3,305	0.233	556	1.348	1.465	4.191	4.531	3.800	4.141
2019	19,123	16,141	1.927	2.094	3,540	0.249	559	1.354	1.472	4.232	4.574	3.865	4.222
2020	19,215	16,165	1.930	2.098	3,601	0.254	570	1.381	1.502	4.273	4.618	3.881	4.242
2025	20,162	16,401	1.958	2.128	4,215	0.297	576	1.395	1.517	4.375	4.725	4.049	4.451
2030	22,192	16,908	2.018	2.194	5,529	0.389	604	1.465	1.592	4.642	5.005	4.409	4.899
BUILDOUT	**23,000**	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data	4.552	5.078

(1) Historical population values from PRJCTNS spreadsheet from City of Louisville.
(2) Population projections from Impact Fee Report dated 10 18 2011.
(3) Historical population from Meter Data Spreadsheet from City of Louisville. No data given for years 2007 - 2009.
(4) Single Family Units assumed to contain 2.6 people.
(5) Assumed 1.8 persons per unit based on previous data from 1998 - 2010 ex 2007-2009
(6) Non-residential services include irrigation, city, and commercial.
(7) Low single family use and low non-residential projections assumes no savings from programs. Low single family use projections assume 30% of future households conserve 14% of total use based on new fixture technology.
(8) High single family use and high non-residential projections assume 8% savings from 2 programs. High single family use projection assume 75% of future households conserve 21% of total use based on new fixture technology.
(9) Previous data for multifamily units showed no conservation, therefore no conservation was assumed for multifamily units.

4.3.4 Peaking Factor and System Peak Day Demands

Peak Day Demands are typically used to size water treatment facilities and other components of the water distribution system. The City has historically used a Peaking Factor of 2.64 for planning purposes. Previous flow data from 2003 through 2010 shows that the average peaking factor is 2.59. For the purposes of this study, a more conservative peaking factor was used to develop future Peak Day Demands in order to prevent underestimating future system demands. Therefore, the 75th percentile peaking factor of 2.68 was used in calculating Peak Day Demand projections.

The 75th percentile peaking factor was calculated using data from the post-drought years of 2003 – 2010, shown in Table 4-5. The 75th percentile value was considered appropriate considering that a conservative high and low based Average Day Demand are used in developing the projected Peak Day Demands.

Table 4-5: Historical Post Drought Peaking Factors

Year	Peak Day Demand	Average Day Demand	Peaking Factor
2003	9.717	3.408	2.85
2004	7.796	2.996	2.60
2005	9.473	3.496	2.71
2006	9.462	3.855	2.46
2007	8.923	3.720	2.40
2008	9.933	3.716	2.67
2009	7.880	3.251	2.42
2010	8.420	3.370	2.50
Average			2.59
75th Percentile			2.68

Figure 4-3 shows the resulting Peak Day Demand projection from the customer category projection, peak day demand projection, and total population projection. The graph includes the following:

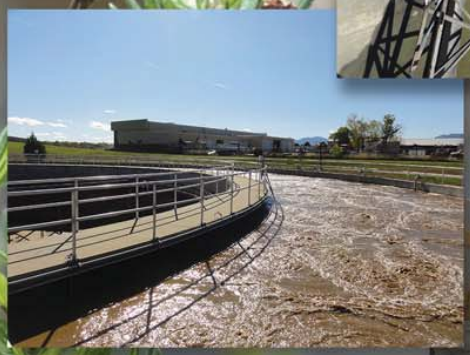
- The blue curve shows the historical Peak Day Demand in the City. The vertical red line in the year 2002 represents a marker for the drought year. A significant reduction in Peak Day Demands is indicated following the drought due to water conservation.

- A red bar in the year 2012 indicates the post-drought water use for the 2012 year. This bar captures a majority of Peak Day Demands following the drought. While recent years (2009 – 2011) show Peak Day Demands below this bar, using data from these years is not recommended, and is not considered conservative for water system planning. These recent years are likely impacted by economic downturn and higher summer month precipitation.

- The green and purple projection curves are the low and high demand projections, respectively, previously discussed in the chapter. These projections correspond well to the red bar indicating the expected range of “base” post drought Peak Day Demands. The high demand curve is a highly conservatively forecast based on pre-drought demand data. Water system planning typically requires a conservative approach as

City of Louisville

Wastewater Facility Plan



April 2013

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SECTION 1
EXECUTIVE SUMMARY

This Wastewater Facility Plan provides the City of Louisville with an analysis of their existing wastewater treatment infrastructure, a summary of the current and projected regulatory requirements, projections of future wastewater flows and loads, an evaluation of treatment alternatives, and recommended improvements to their wastewater treatment infrastructure. This Plan provides a roadmap infrastructure needs required to meet future the demands of population growth, address facility deficiencies, and meet anticipated regulatory changes.

1.1 Summary of Existing Wastewater Treatment Plant (WWTP)

The Louisville WWTP utilizes preliminary and secondary treatment with disinfection to treat wastewater. The WWTP also has tertiary effluent filters for effluent reuse during the summer months. The original facility, constructed in 1952, and has since undergone five major and two minor upgrades. The plant currently has a rated capacity of 3.4 million gallons per day (MGD) and 7,089 pounds per day (ppd) of BOD_5. The WWTP currently consists of:

- A headworks with 2 mechanical bar screens (each with a 3 MGD capacity), one screenings washer, one manual bar screen, two gravity grit chambers, and two parshall flumes for influent flow measurement.
- One 2.2 million gallon aeration basin with two dedicated blowers and fine bubble diffusers.
- Two secondary clarifiers. One 120 ft diameter and one 80 ft diameter.
- UV disinfection rated for 5.8 million gallons per day (MGD) installed in one channel.
- One 2 MGD filtration system for producing reuse water for irrigation.
- A gaseous chlorine disinfection system for disinfecting reuse water. This system, with a gaseous sulfur dioxide system, also serves as a backup disinfection system to the existing UV system.
- Solids handling including a rotary drum thickener, one aerobic digester with two blowers, and one dewatering centrifuge.
- A composting facility.
- Ancillary process equipment including return activated sludge (RAS) pumps, waste activated sludge (WAS) pumps, scum pumps, electrical gear, and instrumentation.

The City's WWTP receives wastewater from approximately 63 miles of sanitary sewer ranging in size from 8 to 27-inch diameter buried pipe. The wastewater collection system currently includes three lift stations which will soon be expanded to four with the North End development.

1.2 Planning Criteria

The City of Louisville currently has an estimated population of 18,500 that produces approximately 1.7 MGD and 3,700 pounds per day of BOD_5. The City is planning for growth to a buildout population of 23,000 in 2034. The growth in population will also increase wastewater flows and loads to the WWTP. Planning criteria for the City of Louisville WWTP

are provided in **Table 1-1.** Maximum month conditions are utilized to determine plant capacity and planning criteria. Average daily influent wastewater flow during the maximum month is projected to increase to 2.45 MGD at buildout. The flow projections represent an almost 25 percent increase in flow from 2011 to buildout as a result of the population growth within the service area. Projected maximum months loads at buildout for BOD_5, TSS, and NH_3 are 5,515, 6,340, and 664 pounds per day (ppd), respectively.

Table 1-1 Planning Criteria for City of Louisville WWTP

Parameter	Year 2022			Year 2032			Year 2034		
	AA	MM	PH	AA	MM	PH	AA	MM	PH
Flow, mgd	1.79	2.15	3.88	2.07	2.48	4.49	2.11	2.53	4.58
BOD_5, ppd	3,819	4,697		4,404	5,417		4,483	5,515	
TSS, ppd	4,001	5,401		4,614	6,229		4,696	6,340	
NH_3, ppd	439	566		506	653		515	664	
TKN, ppd	654	844		754	973		767	989	
Phosphorus, ppd	77	91		88	104		90	106	

1.3 WWTP Discharge Permit and Regulatory Review

The WWTP operates under permit number CO0023078. The last permit renewal was issued August 16, 2011 and expires at midnight on September 30, 2016. The facility has a permitted hydraulic capacity of 3.4 million gallons per day (MGD) and an organic capacity of 7,089 pounds per day (ppd) of BOD_5. Current ammonia discharge limits vary by month and range from a low of 7.5 mg/L in November to a high of 12.0 mg/L in February. The permit includes a compliance schedule to meet new lower Ammonia discharge limits that are effective on August 1, 2017. The ammonia limits effective on August 1, 2017 are significantly lower; they range from a low of 1.7 mg/L for the months of July, August, and September to a high of 2.6 mg/L in January.

In 2012, the Colorado Department of Public Health and Environment (CDPHE) approved a revised Regulation 31 – The Basic Standards and Methodologies for Surface Water and new Regulation 85 – Nutrients Management Control Regulation. Regulation 31, an extension of the EPA's EcoRegion Concept, sets water quality goals and standards for total nitrogen and phosphorus in Colorado's streams and rivers. Regulation 85 sets wastewater treatment facility effluent limits on total inorganic nitrogen (TIN) and phosphorus at 7 and 0.7 mg/L, respectively, for plants larger than 1 MGD. The requirements for TIN and phosphorus are projected to become effective in 2022.

1.4 Treatment Performance and Evaluation

Louisville's WWTP treated an annual average daily flow of 1.67 MGD in 2011 and 3,548 ppd of BOD_5 in 2011. The aeration basin was originally designed to reduce BOD_5 and total suspended solids (TSS) in the effluent to less than 30 mg/L each. The treatment plant is designed to reduce carbonaceous BOD_5 and total suspended solids (TSS) in the effluent to less than 30 mg/L each. It was not designed to provide the nitrification (the biological oxidation of ammonia) required to achieve

SECTION 4
HISTORICAL AND PROJECTED WASTEWATER PRODUCTION

This section presents the historical and projected wastewater production rates based on a review of the service area, projected population growth, and historical per capital wastewater flows and loads. The capacity and specific treatment facilities required to provide sufficient treatment at the City's Wastewater Treatment Plant (WWTP) depend in part on future development of the service area, flow variations, and waste characteristics.

4.1 HISTORICAL WASTEWATER PRODUCTION

Historical wastewater characteristics for the City are presented in this section based on a five and one half year record of flows and waste strength from 2007 through mid-2012.

HISTORICAL WASTEWATER FLOWS

Wastewater flows for the City's WWTP are given in **Table 4-1.** The highest recorded annual average flow (AAF) was 1.82 MGD in 2007 and the lowest recorded AAF was 1.67 MGD in 2011. The AAF for 2012 is trending slightly lower than 2011 through June. The average day maximum month flow (MMF) of 2.19 MGD recorded in June 2009 represents 64 percent of the nominal capacity of 3.4 MGD. The ratio of MMF to AAF ranged from 1.02 to 1.22. The 95 percent confidence interval for max month flow over the 5.5 years of data is 1.16.

Table 4-1 Historical Influent Flows

Month	Influent Flow, MGD					
	2007	2008	2009	2010	2011	2012
Jan	1.77	1.63	1.59	1.62	1.51	1.64
Feb	1.81	1.61	1.58	1.62	1.55	1.67
Mar	1.76	1.60	1.64	1.76	1.49	1.63
Apr	1.84	1.64	1.92	1.91	1.54	1.63
May	2.01	1.68	2.04	2.07	1.79	1.63
Jun	2.02	1.83	2.19	2.12	1.91	1.59
Jul	1.84	1.82	1.91	1.97	1.96	--
Aug	1.84	1.79	1.77	1.82	1.79	--
Sep	1.84	1.82	1.81	1.66	1.69	--
Oct	1.80	1.70	1.66	1.64	1.61	--
Nov	1.65	1.62	1.76	1.60	1.59	--
Dec	1.62	1.62	1.67	1.49	1.61	--
AAF	1.82	1.70	1.80	1.77	1.67	1.63
MMF	2.02	1.83	2.19	2.12	1.96	1.67
MMF/AAF	1.11	1.08	1.22	1.20	1.18	1.02

Note: AAF = Average Annual Daily Flow, MMF = Average Daily Flow in the Maximum Month

WASTEWATER SYSTEM PEAKING FACTORS

Peaking factors are a used in the planning process to help predict maximum conditions that must be accounted for in the facility design. The peaking factors represent the maximum day and maximum month conditions when compared to the average annual condition. The MMPFs represent the average daily value during the maximum month for each parameter.

The historical maximum day and maximum month peaking factors (MMPFs) for the City's WWTP are summarized in **Table 4-17**. Historical peaking factors for influent flow, BOD_5, TSS, and NH_3 were determined by dividing the monthly average by the corresponding annual average for each year from 2007 through mid-2012. The maximum day and maximum month peaking factors were determined based on a statistical analysis of the 95th and 99th percentile frequency of the monthly peaking factors over the five and one-half year historical record. Utilizing the 95th or 99th percentile values helps eliminate outliers in the data set; this reduces the potential for over planning or designing systems.

Table 4-17 Historical Maximum Month Peaking Factors

Parameter	Peaking Factors			
	Maximum Day		Maximum Month	
	95th percentile	99th percentile	95th percentile	99th percentile
Flow	1.23	1.62	1.21	1.22
BOD_5			1.20	1.21
TSS			1.29	1.31
Ammonia			1.33	1.35

Table 4-17 summarizes MMPFs selected as the planning criteria for evaluation of treatment alternatives included in this Master Plan. Each peaking factor was rounded to two significant digits. At two significant digits, the difference between the 95th and 99th percentile for flow, BOD_5, and TSS differed by one percent. The difference between the 95th and 99th percentile for ammonia differed by two percent. The 95th percentile MMPFs for flow, BOD_5, and NH_3 are values that are typical for communities in the Front Range of Colorado.

The City of Louisville is able to export flow information from the WWTP's Supervisory Control and Data Acquisition (SCADA) system. Flow information is collected at four minute intervals on a continuous basis. Flow data from the maximum flow days for 2009 and 2010 were exported therefore, allowing the peak hour flow to be determined from data. The peak flow day for 2009 occurred on April 18. Data for this day was not able as a result of a software problem that occurred while installing a new SCADA system. The next highest flow day for 2009 occurred on June 2 with a recorded flow of 2.549 MGD. The peak flow day for 2010 occurred on June 13 with a recorded flow of 2.396. **Table 4-18** provides a summary of the recorded peak daily flow, peak hour flow, and the calculated peaking factors.

Table 4-18 Calculated Wastewater Peaking Factors

Date	Recorded Daily Flow, MGD	Average Annual Daily Flow, MGD	Peak Hour Flow, MGD	Peak Hour Factor[1]
June 2, 2009	2.549	1.80	3.912	2.17
June 13, 2010	2.396	1.77	3.531	1.99

[1] Peak Hour Factor = Peak Hour Flow/Average Annual Daily Flow

The peak hour flow can also be estimated using an equation developed by the Denver Regional Council of Governments (DRCOG) for reviewing utility plans and for interceptor certification. The wastewater flow peaking factor used by DRCOG was established in the 1977 regional management plan, and subsequently confirmed through numerous planning processes. It is calculated by the following formula:

$$\text{Peaking Factor} = 3.65 / (\text{Average Total Flow MGD})^{0.167}$$

(The maximum peaking factor used in any assessment should be less than 5.0)

Typically, the average total flow is based on a monthly average. The maximum peaking factor of 5.0 generally applies to very small treatment works. Although no minimum peaking factor is recommended herein, a factor of less than 1.0 is not appropriate. Using this formula, the calculated average peak hour flow peaking factor for the Louisville WWTP is 3.33.

4.2 Wastewater Flow and Load Projections

Flow and load projections for the City of Louisville were calculated by multiplying the population projections (provided by the City) by the historical per capita flow/load contribution given in **Table 4-16**. Projections of flow and load from commercial and industrial are not calculated separately because the flow and load from commercial and industrial sources is a relatively minor contributor to the City's total wastewater flow and load. The contribution from commercial/industrial sources are included in the calculated historical per capita flow and loads and, thus, are inherent in the wastewater flow and load projections. Currently, the City has approximately 33 residents per commercial/industrial connection and is projected to have 35 residents per commercial/industrial connection in Year 2030.

The max month peaking factors used for planning purposes utilize the 95th percent confidence interval. Using the 95th percent confidence interval eliminates outliers and reduces the potential of planning and design for conditions not likely to be observed.

Flow Projections

The projected influent wastewater flows for years 2012 to buildout at a population of 23,000 (shown as year 2034) are given in **Table 4-19**. It is estimated that the annual average daily wastewater flows will increase to 2.11 MGD a buildout (estimated to be 2034). Average daily influent wastewater flow during the maximum month is projected to increase to 2.45 MGD. The flow projections represent an almost 25 percent increase from current (2012) through buildout. The increased flows are the result of the population growth within the service area. The ultimate

5.1 WASTEWATER TREATMENT PLANT SITE

The WWTP is located about a mile west of downtown Louisville at 1601 Empire Drive, Louisville, Colorado. As shown in **Figure 5-2**, the WWTP is located in the northeast portion of Louisville and is bordered by Empire Drive to the south, N. 96th Street (Highway 42) to the west, and W. South Boulder Road to the north. The Public Land Survey System coordinates for the site are NW 1/4 and NE 1/4 of SW 1/4 & SW 1/4 and SE 1/4 of the NW 1/4 of Section 9, T1S, Range 69W. Latitude and longitude of the WWTP are 39°58'30" North and 105° 7'30" West, respectively. The most recent FEMA floodplain map shows the facility to be located either outside the 500 year flood plain or above the base floodplain elevations.

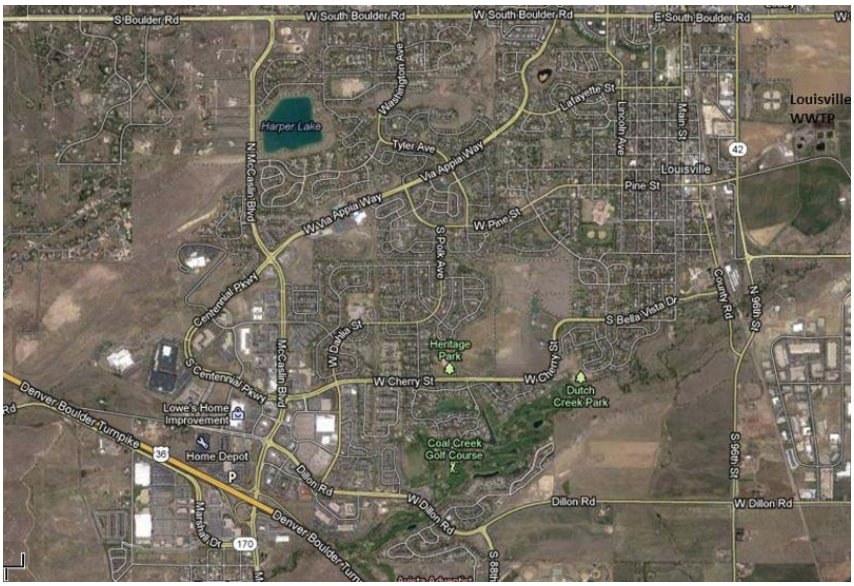

Figure 5-2 Location of the City of Louisville WWTP
(www.googlemaps.com, 2012)

5.2 WASTEWATER TREATMENT PLANT PERFORMANCE

The WWTP currently treats approximately 1.67 MGD and 3,548 ppd of BOD_5. The plant is currently rated for 3.4 MGD and 7,089 ppd of BOD_5. The treatment plant is designed to reduce carbonaceous BOD_5 and total suspended solids (TSS) in the effluent to less than 30 mg/L each. It was not designed for nitrification (the biological oxidation of ammonia) or for denitrification (the biological reduction of nitrate to nitrogen gas). The WWTP meets the current required ammonia discharge criteria through the efforts of Plant Operations Staff, who manage the biological processes to achieve nitrification and limited denitrification. This operations approach is currently possible because the WWTP is operating well below its rated capacity (underloaded). Historical performance of the facility in terms of BOD_5, TSS, and ammonia are presented in this section.

REDUCTION IN FIVE DAY BIOCHEMICAL OXYGEN DEMAND (BOD_5)

Monthly average influent and effluent BOD_5 for the WWTP are shown in **Figure 5-3** from January of 2007 through June of 2012. Influent BOD_5 concentrations range between a minimum of 137 mg/L and a maximum of 431 mg/L for data evaluated. The average influent BOD_5 concentration over this five and one-half year period was 250 mg/L. Between 2007 and 2012, the final effluent BOD_5 varied between a minimum of 0.4 mg/L to a maximum of 9 mg/L. The average effluent BOD_5 concentration over the five and one-half year period was 2.7 mg/L. Treatment efficiency averaged 99 percent removal, but varied between 99.5 and 97.8 percent

ELECTRICAL SYSTEMS

The electrical distribution equipment has been provided under numerous modification projects spanning a number of years at the WWTP. The Main Distribution Panel was provided in 1987, the standby generator was provided in 1999, and the Reclaimed Water System was added as recently as the mid 2000s. The equipment life for distribution equipment including switchboards/panelboards, switchgear, transformers, and motor control centers is typically 20-30 years. Moisture and dust are two of the main factors that decrease the life of the equipment. Most of the distribution equipment at the WWTP is located in dedicated electrical rooms and symptoms of moisture and dust on the equipment were not readily apparent. Electrical equipment that has not been exposed to moisture and dust can often stay in service much longer than its normal expected life. A NETA (International Electrical Testing Association) accredited acceptance testing firm should be hired to perform visual and mechanical inspection and testing of the equipment. An in depth assessment of the condition of major components can be performed after acceptance testing.

A thermographic survey was performed at the WWTP in October, 2011. The report noted a few items requiring attention, and the entity performing the survey tightened conductor connections. The thermographic survey report recommended monitoring of the equipment and did not indicate that any repairs were required.

The WWTP has a backup generator that provides power to essential plant equipment during a power failure. The connected loads to the generator exceed the rating of the generator which requires the Plant Operations Staff to monitor loads placed on the generator when it is in use.

ADMINISTRATION AND OPS BUILDINGS

The Administration and Ops Buildings at the Louisville WWTP appear to be in good condition, meet the building, electrical, and fire protection code that were applicable at time they were constructed, and no obvious safety concerns were noted. The existing Operations Lab is 25 years old could benefit from a new HVAC system and a new chemical hood. Additionally, there is currently minimal shop space available for Plant Operations Staff to perform maintenance of plant equipment, and to store tools and spare parts.

5.4 SUMMARY AND CONCLUSIONS

A majority of the facilities and equipment at the Louisville WWTP was constructed over 20 years ago and were designed to meet the effluent limits and regulatory requirements in place at the time. Effluent limits in the near future contain tighter limits on ammonia and, in less than 10 years, limits for both phosphorus and total inorganic nitrogen (TIN) are expected to be imposed. Additionally, regulatory requirements have become stricter and now require redundant process equipment and trains so that one train/piece of equipment can be out of service while treatment is maintained. The Louisville WWTP was not designed to meet the effluent limits for ammonia or TIN and redundant process trains/equipment are currently not provided for many of the processes. Below is a summary of the WWTP evaluation.

- The plant headworks will need to be replaced due to equipment age, structural condition, and operation and maintenance concerns. HVAC and electrical gear in the current headworks does not meet the current electrical and the current fire protection code (NFPA 820) and would need to be upgraded with any modifications to the facility.
- The secondary process lacks redundancy. Additional aeration basins will need to be constructed and capable of meeting the projected future regulatory criteria.
- For buildout conditions, the existing secondary process has capacity to meet the ammonia limits effective August 1, 2017; however, it cannot meet the phosphorus and TIN limits projected to be effective in 2022. The process cannot meet the new ammonia limits at its current rated capacity.
- It is possible to maintain the existing secondary process as part of the treatment process until the nutrient criteria (for phosphorus and TIN) become effective in 2022.
- Solids handling facilities at the WWTP have sufficient capacity to meet projected buildout conditions. Redundancy and equipment age/condition issues should be addressed.
- The UV system has sufficient capacity to meet the projected buildout conditions; however, the system lacks a redundant channel and is reaching its useful life and should be replaced. Currently, all the UV modules are located in one channel which makes it difficult to maintain. If two channels were utilized, one channel could be taken out of service for maintenance and cleaning while the other was in operation.
- Irrigation water for the WWTP site is currently taken from the chlorine contact chamber upstream of the UV disinfection system posing health concerns for staff. The irrigation system should be modified to use disinfected water from the Reclaimed Water System.
- Gaseous chlorine is a poisonous gas. It should be replaced with a less toxic compound such as sodium hypochlorite or an onsite generation system.
- Remodel existing Operations Lab and construct new 2,000 square foot Shop Building.

7.3 PROJECT PHASING

The recommended upgrades to the Louisville WWTP address equipment/structure age issues, City growth, redundancy requirements, and stricter effluent limits effective in 2017 and 2022. There is limited opportunity to construct the upgrades in phases to spread out the capital expenditures.

It is possible to construct two new secondary process trains now and utilize the existing secondary process as a redundant secondary process until the total inorganic nitrogen (TIN) and phosphorus limits become effective in 2022. In this scenario, the construction of the third new secondary process would be delayed by approximately five years. This approach was evaluated by Dewberry and City staff, and it was decided to construct the entire WWTP upgrades in one single phase based on the following:

1. Utilizing the existing secondary process until 2022 would require a new blower (to replace the unreliable high speed turbo blower), new 120 ft diameter clarifier mechanism, and structural repairs to the clarifier concrete. Estimated cost of these improvements is $1.2 million while the cost of the third secondary process train is estimated to be $3 million. It should be noted that these improvements would only delay the construction of the third process train and would not replace it, i.e., the upgraded equipment and structures would be decommissioned in 2022.
2. To improve plant hydraulics and minimize potential sewer backups, the hydraulic profile of the WWTP will be lowered. It would be extremely difficult to construct a new headworks to address the hydraulic issues in the influent sewer that would also fit the hydraulic profile of the existing secondary process and the new upgraded secondary process. Doing so would require compromises in the headworks design which would not be optimal for the new treatment processes. .
3. Phasing of the project would require two significant construction projects at the WWTP site in a span of seven years; phase one 2015-2017 and phase two 2020-2022. Construction generates traffic and noise and is disruptive to plant operations. Splitting the work into two phases would increase the amount and duration of construction activity and the associated impacts on City staff as well as surrounding residents.

7.4 REVISED CONSTRUCTION AND TOTAL PROJECT COSTS

The construction cost for the recommended upgrades presented in **Section 6** are refined in **Table 7-4**. The costs were refined to address wastewater data collected during the final planning stage of this plan, and several other issues identified by the project team. These issues are:

1. Upsizing the secondary process to accommodate the MMPFs listed in **Table 7-2** and the secondary process design criteria in **Table 7-3**.
2. Additional civil site work to address flood concerns related to the downtown Louisville stormwater issue.
3. Constructing a new building for the upgraded UV systems. The two proposed site layouts for the WWTP locate the new secondary process far from the existing UV

disinfection system and there is insufficient hydraulic elevation available l to accommodate reusing the existing system at its present location.

4. Additional site piping costs for constructing the influent sewer to the new headworks, located further east on the property.
5. Design and construct a new influent sewer from Highway 42 to the WWTP.
6. Design and construct a new 8" water line to the WWTP.
7. Repave all existing asphalt surface.

As shown **Table 7-4**, the total estimated construction cost for the recommended WWTP upgrades is $18.1 million and the estimated total project cost is $21.8 million. Detailed planning level cost estimates for the recommended upgrades are provided in **Appendix C**.

Table 7-4 Construction and Total Project Costs

Item	Cost
Headworks	1,978,000
Modified UCT Process	6,853,000
UV Disinfection	833,000
Aerobic Digestion	1,320,000
New Influent Sewer, new water line, Repave existing asphalt	492,000
Lab Remodel and New Shop Building	620,000
Subtotal	**12,096,000**
Contractor OH&P, Bonding, Mob/Demob	2,419,000
Contingency (25%)	3,629,000
Estimated Construction Cost	**18,144,000**
Legal, Permitting, Planning and Engineering (20%)	3,629,000
Total Project Cost	**21,773,000**

7.5 SCHEDULE

As shown in **Table 7-5,** design**,** bidding, and construction of the WWTP upgrades is estimated to have a duration of 46 months. This assumes 18 months for design, 20 months for construction, and 4 months for startup and commissioning. It is desirable to have the upgraded WWTP operational some period of time prior to effective date of the stricter limits on August 1, 2017 to give Plant Staff time to learn and optimize the new process. Incorporating two months into the schedule for Plant Staff increases the total project schedule to 4 years.

Table 7-5 Project Duration

Item	Duration
Design	18 months
PEL Development (part of design process)	2 months
CDPHE Review	2 months
Bidding Process	2 months
Construction	22 months
Startup and Commissioning	2 months
Total Project Duration	**46 months**

APPENDIX C – City of Louisville Utility Maps

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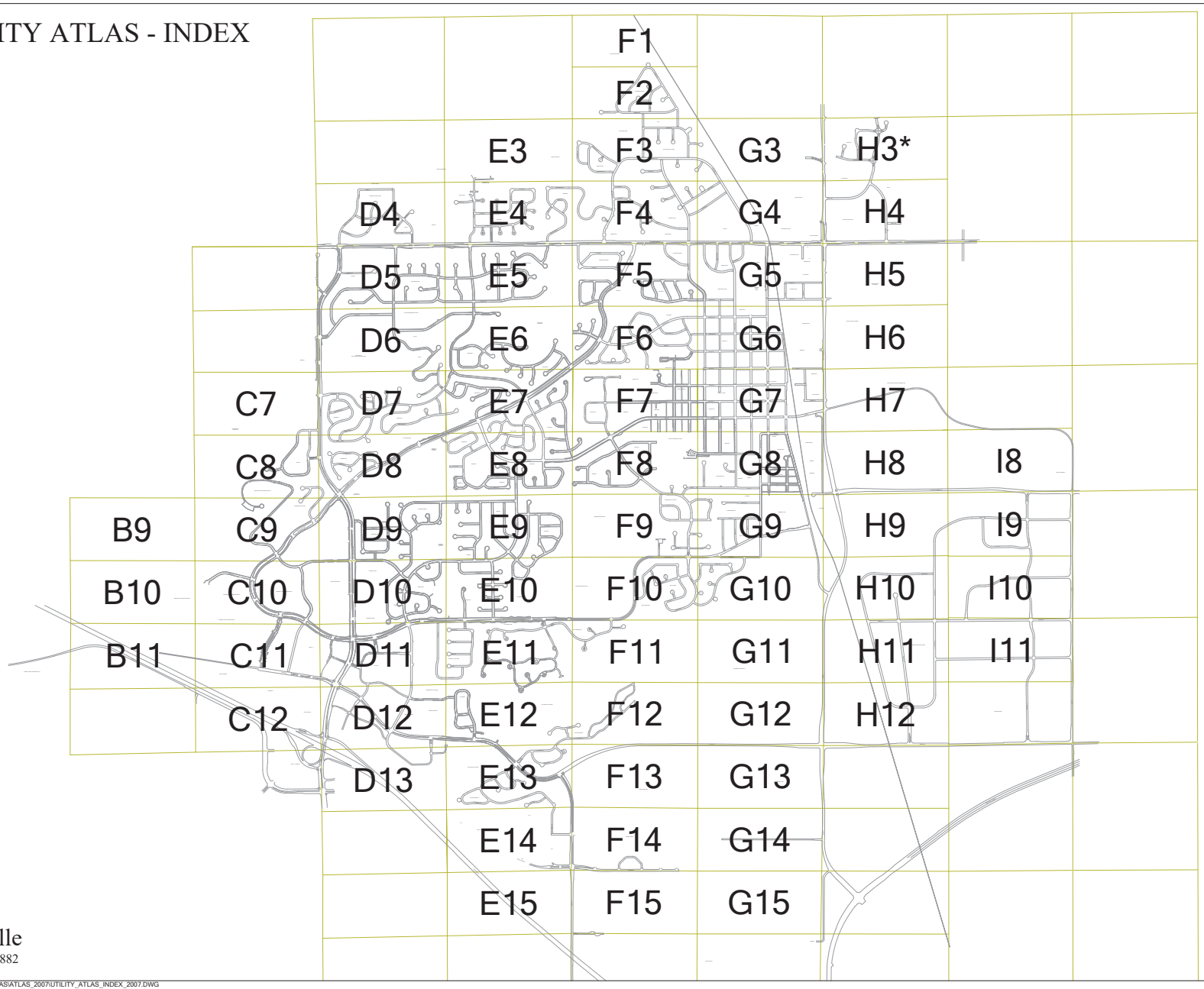

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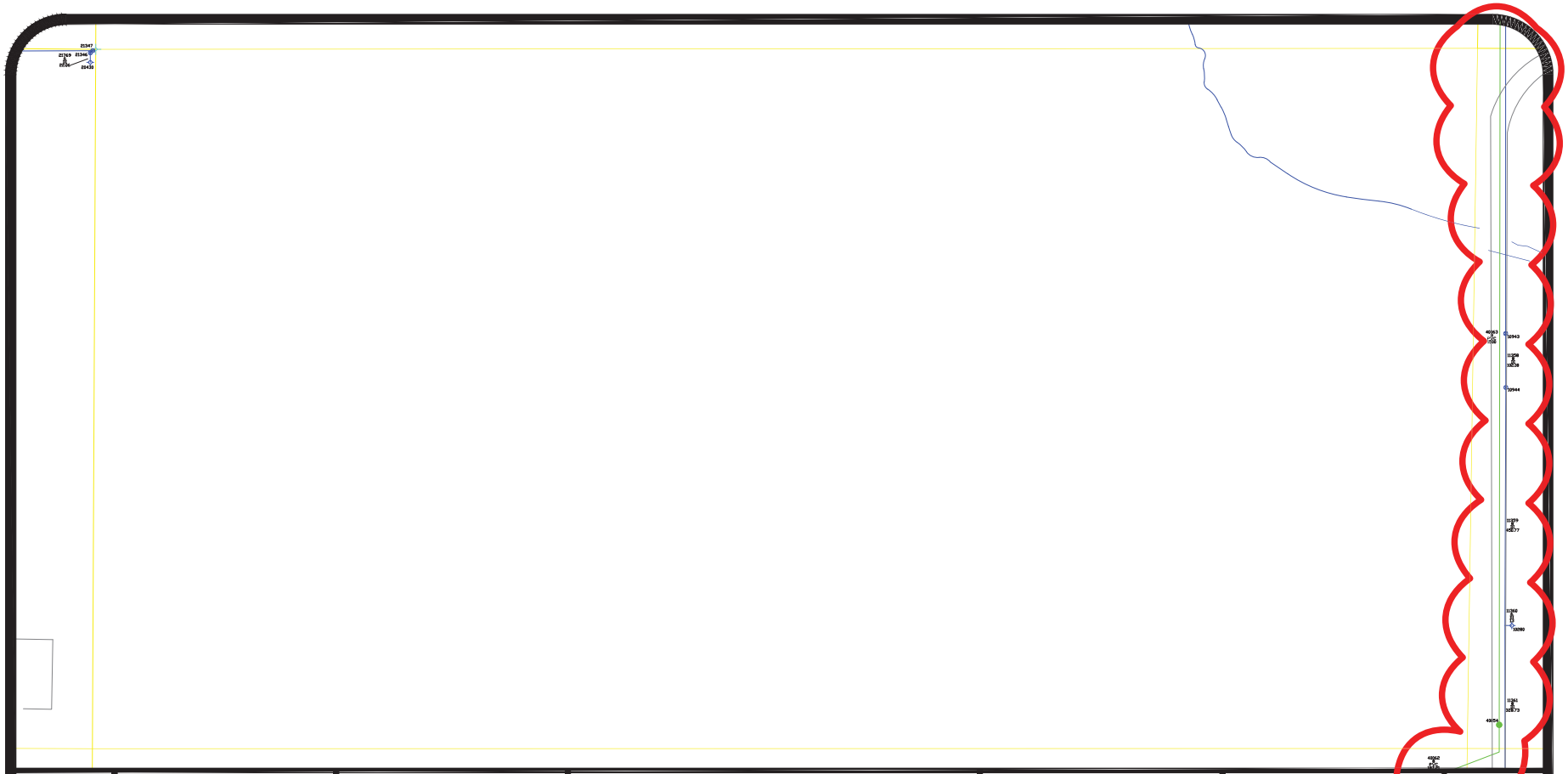

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- SEWER LINE
- STORM SEWER LINE
- RAW WATER LINE
- RECLAIM WATER LINE

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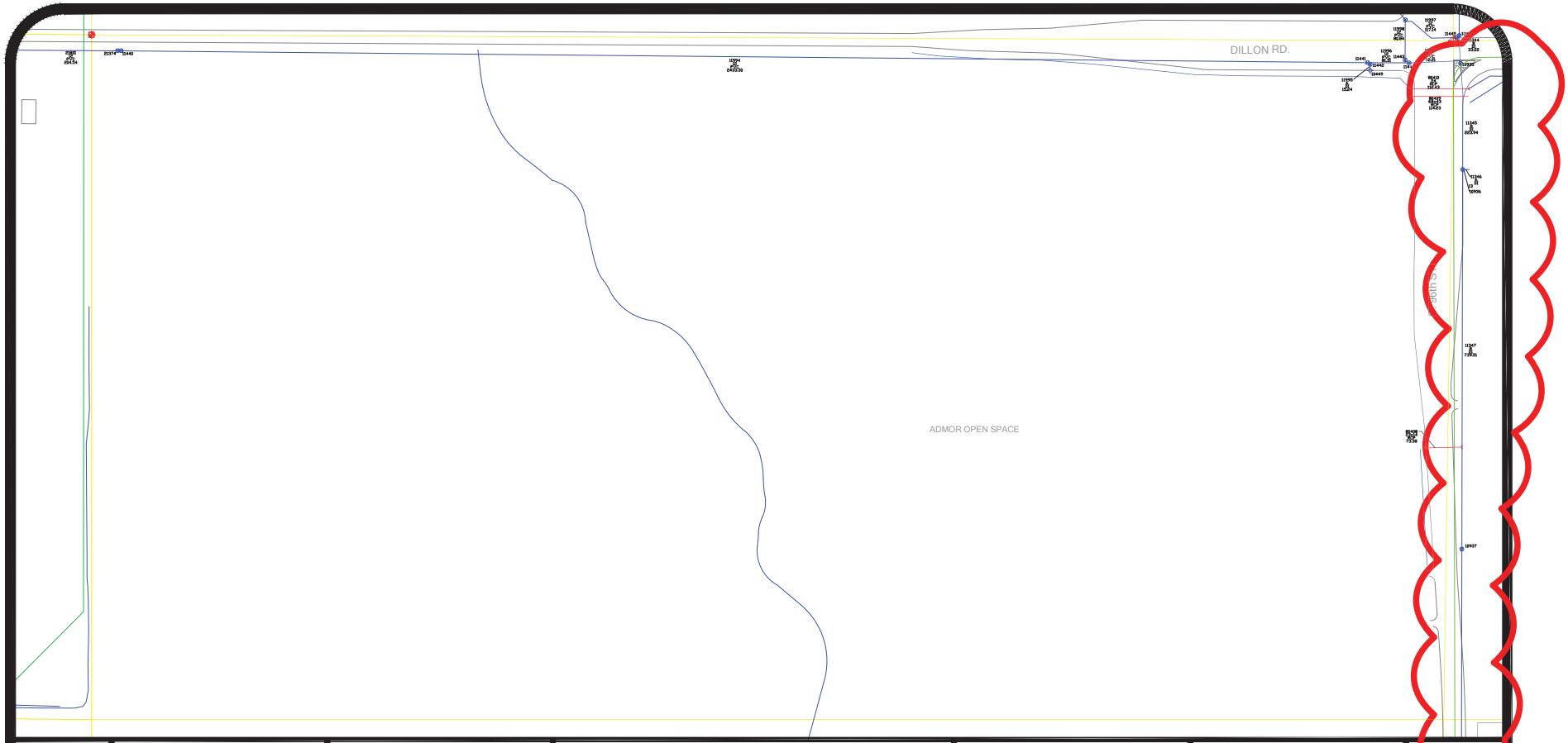

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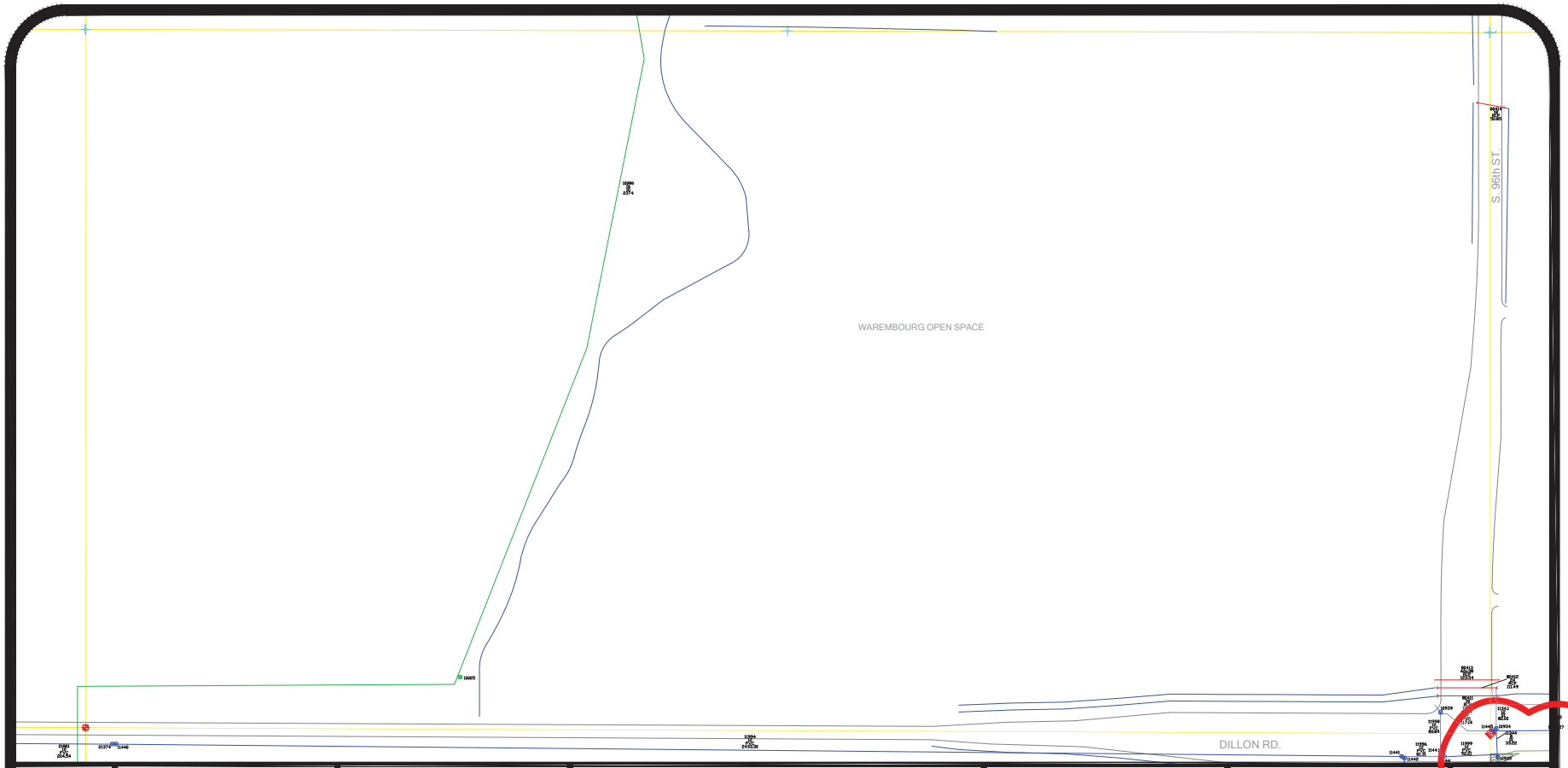

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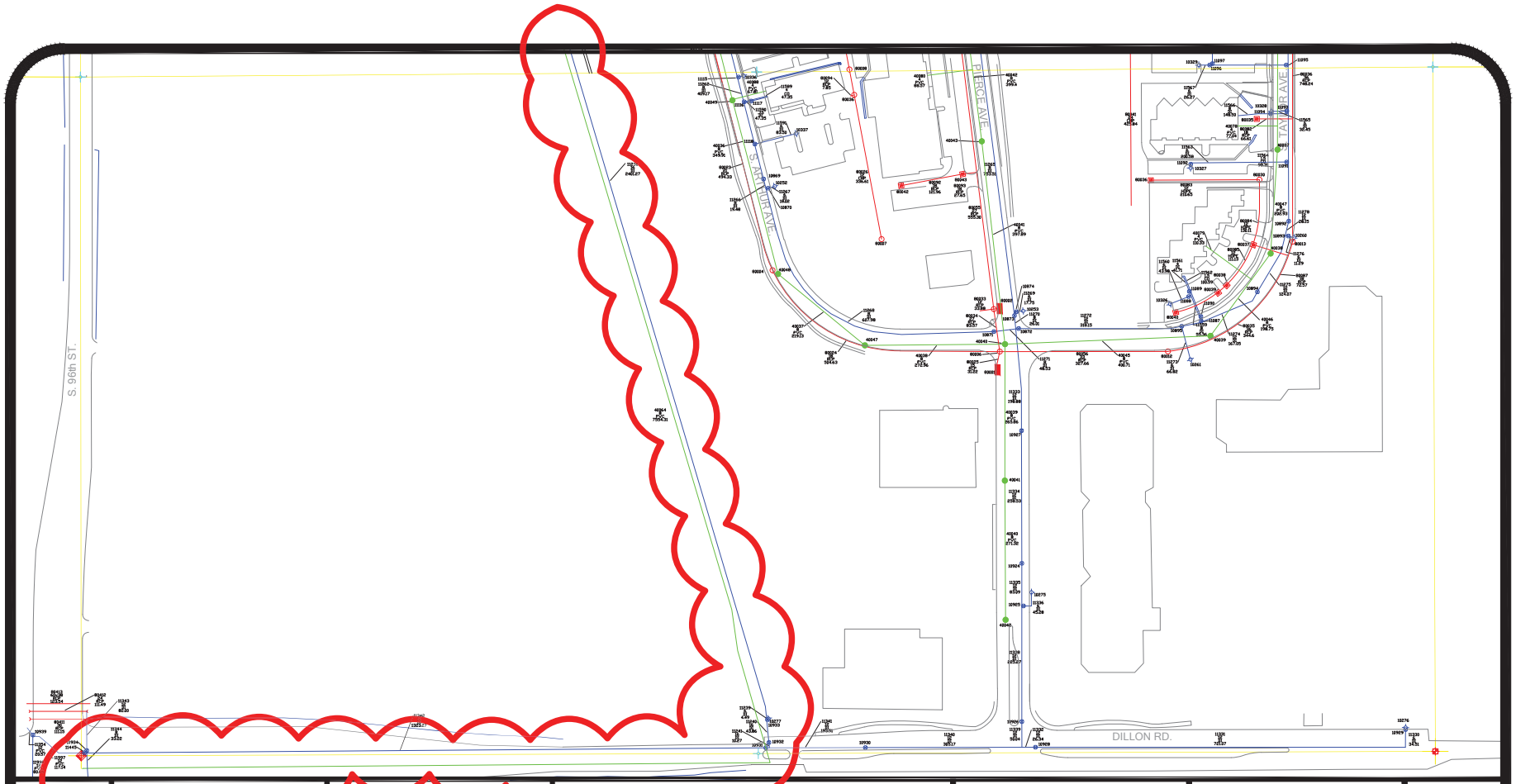

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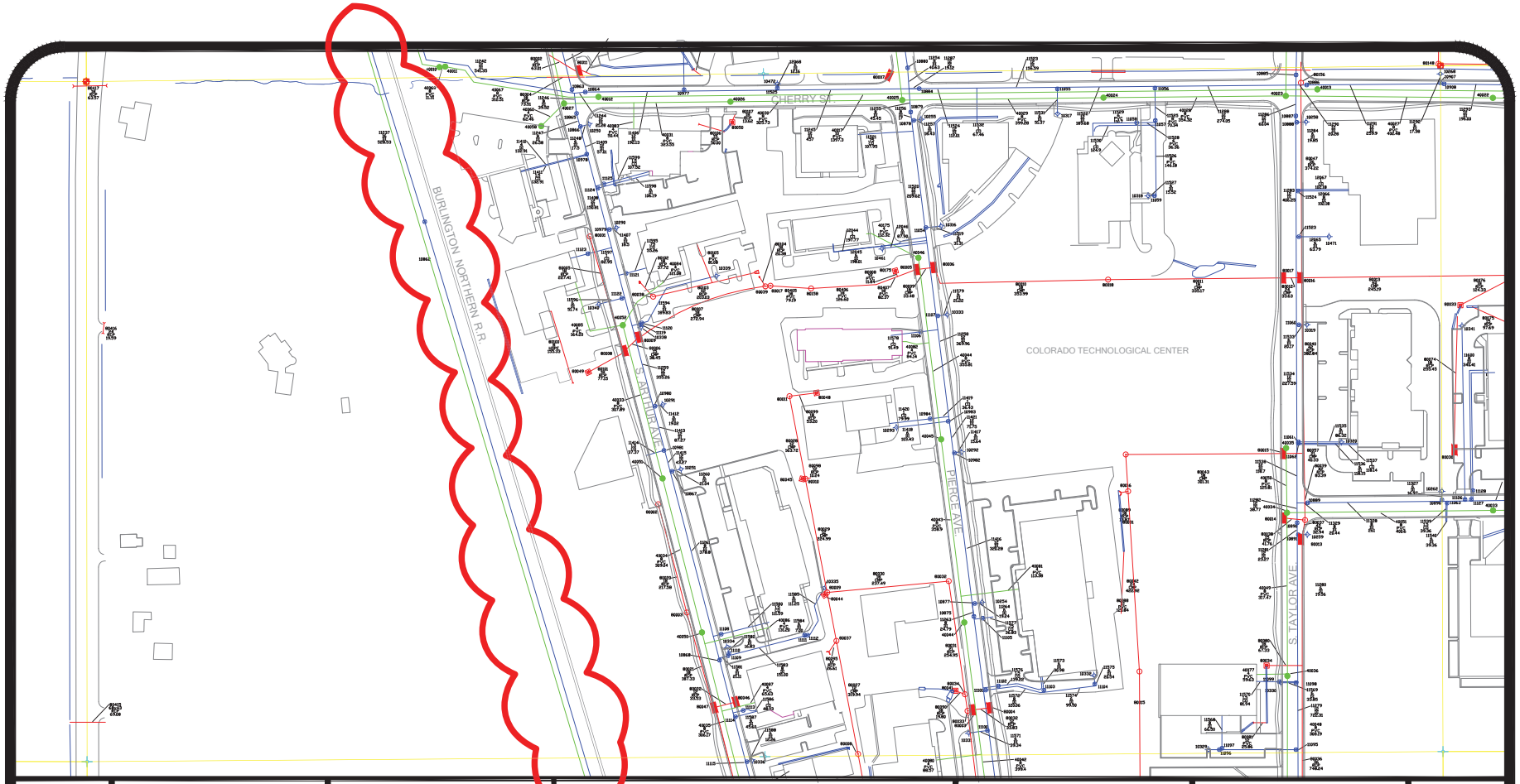

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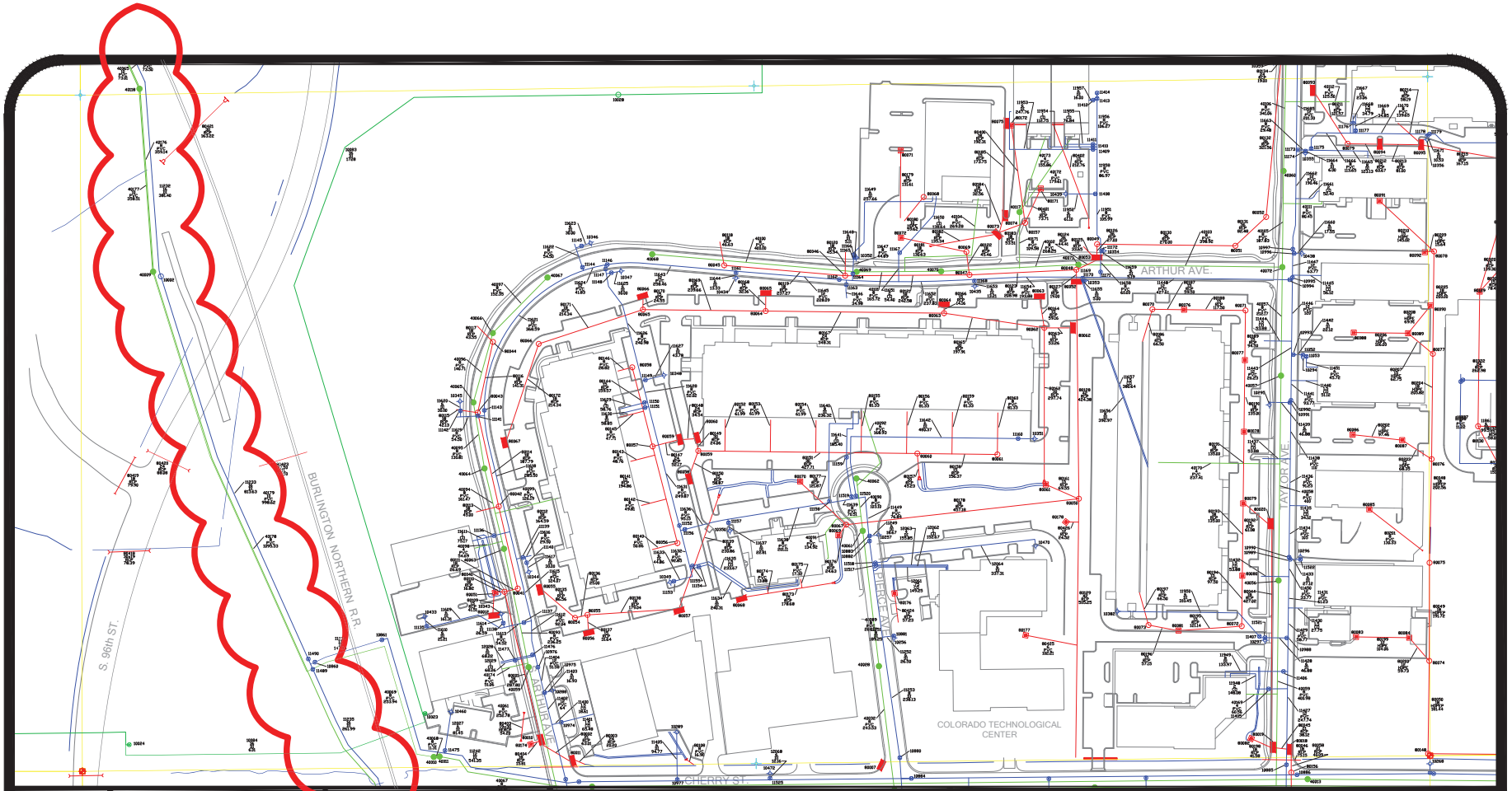

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RECLAIM WATER LINE

CITY OF LOUISVILLE UTILITY ATLAS

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G9 H9 I9
G10 H10 I10
G11 H11 I11

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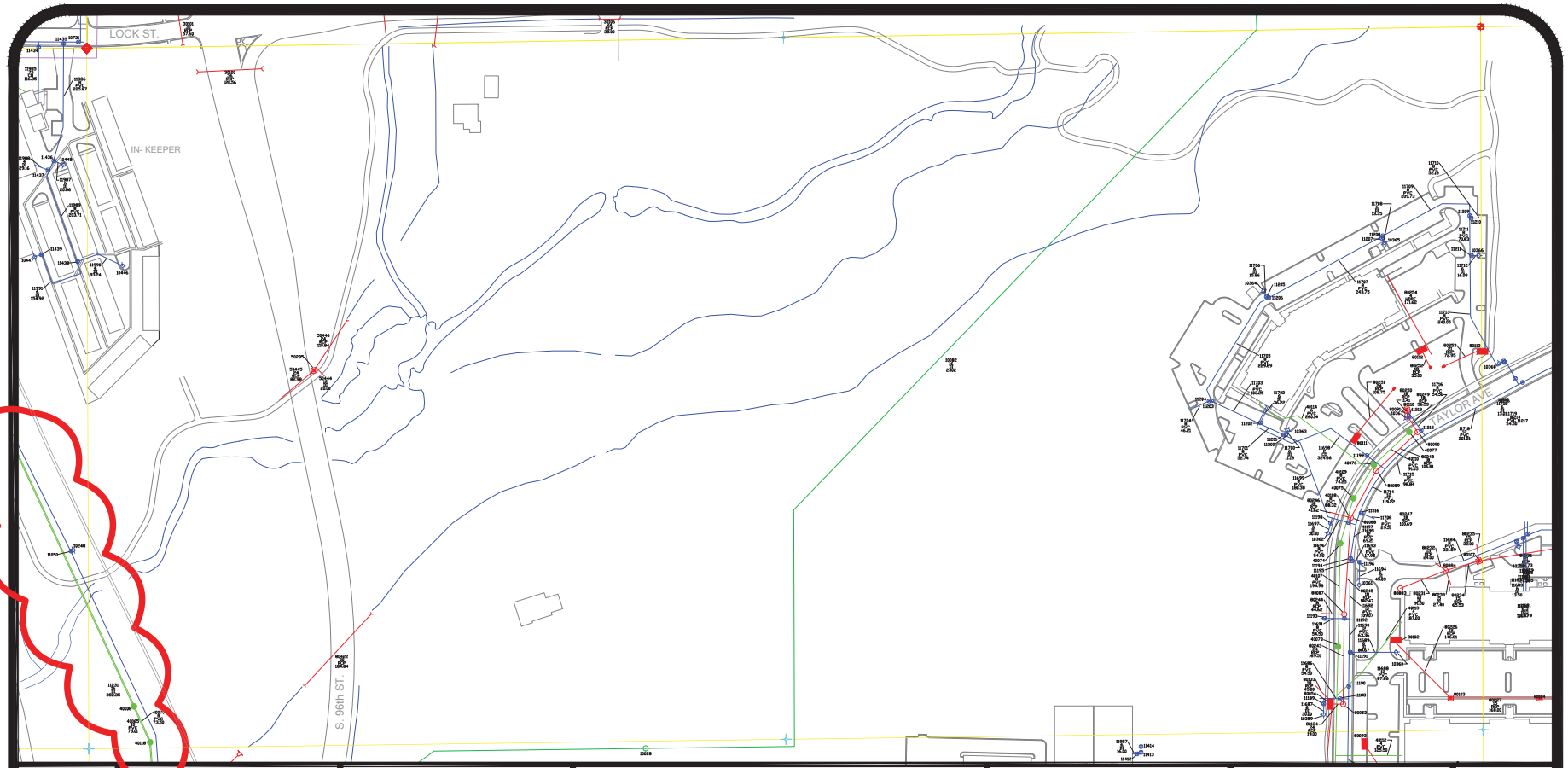

0' 50' 100' 150' 200'

SCALE 1" = 100'

REVISION DATE NOV - 20 - 07

WATER LINE
SEWER LINE
STORM SEWER LINE
RAW WATER LINE
RECLAIM WATER LINE

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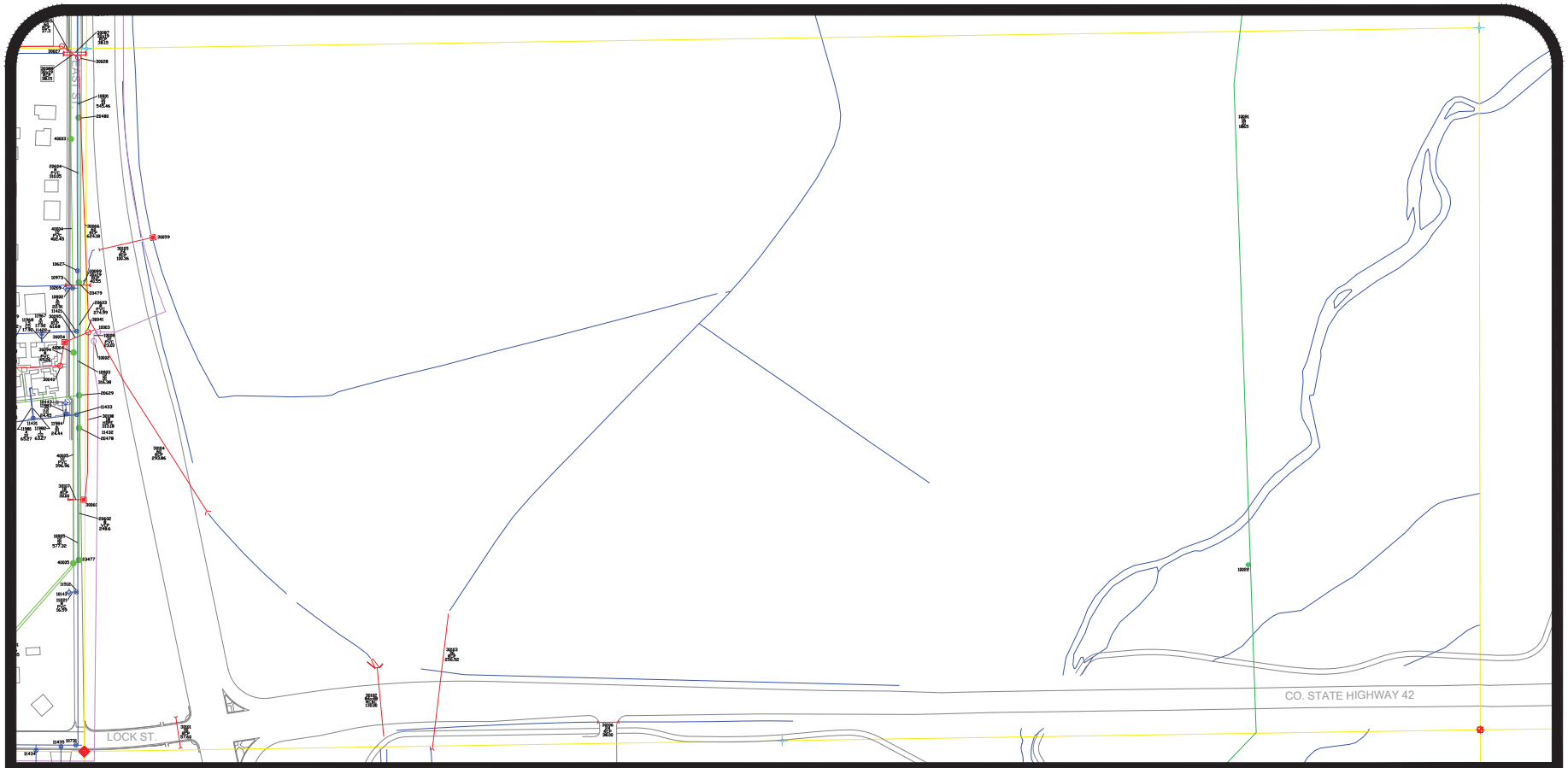

0' 50' 100' 150' 200'

SCALE 1" = 100'

REVISION DATE NOV - 19 - 07

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SEWER LINE
STORM SEWER LINE
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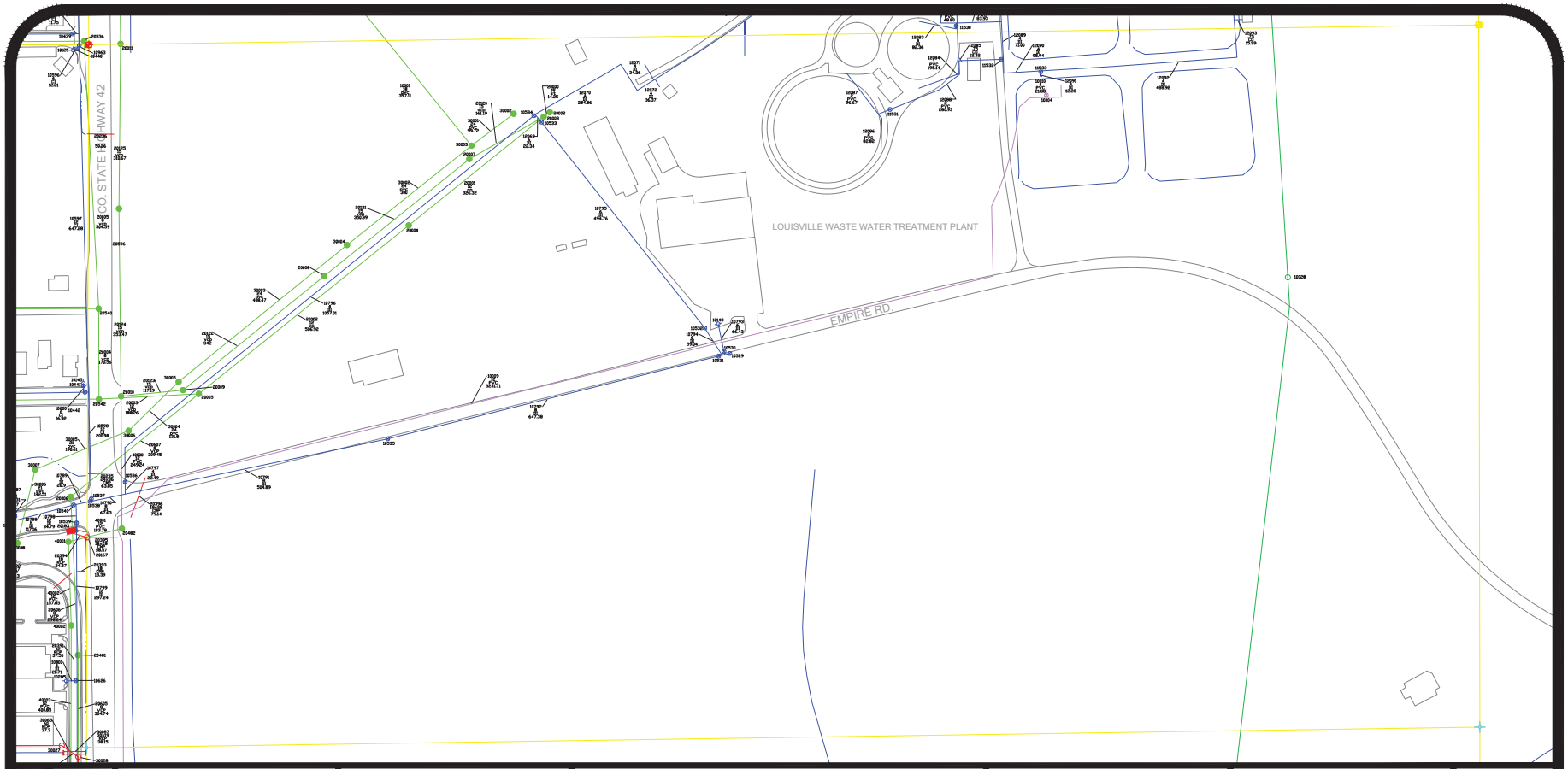

0' 50' 100' 150' 200'

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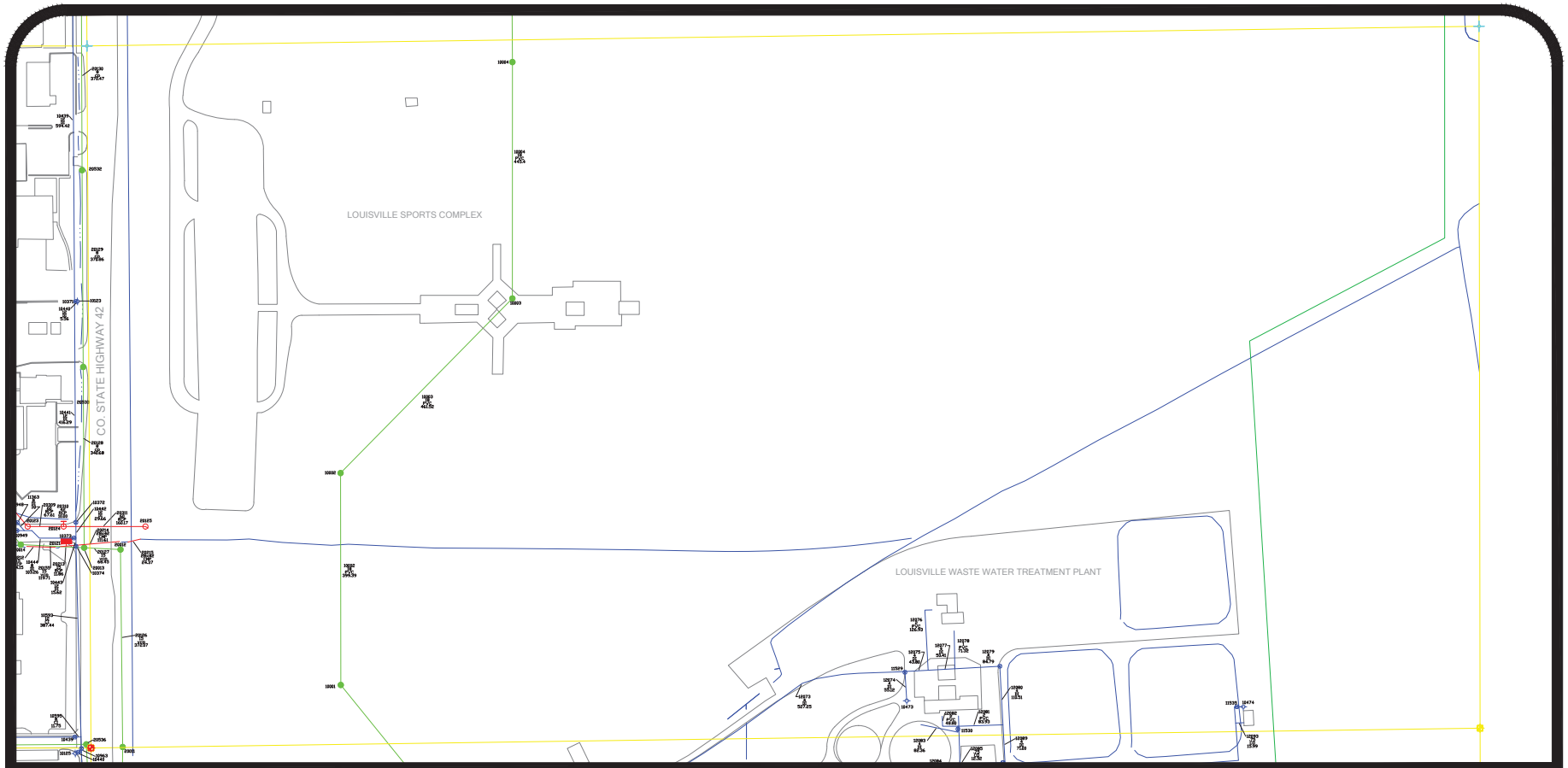

0' 50' 100' 150' 200'

SCALE 1" = 100'

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G5 H5 N/A
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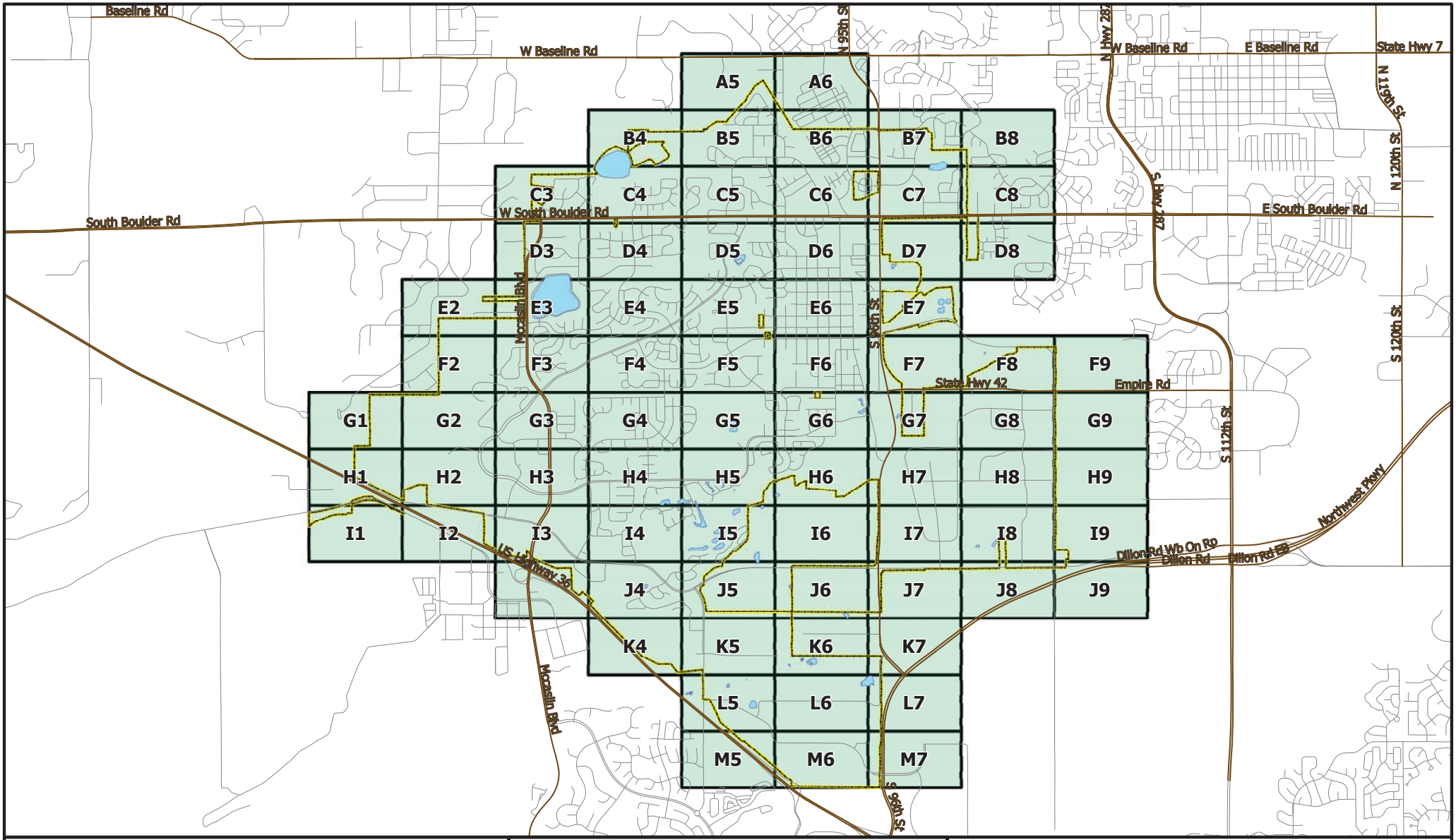

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N W E S

0 0.5 1
Miles

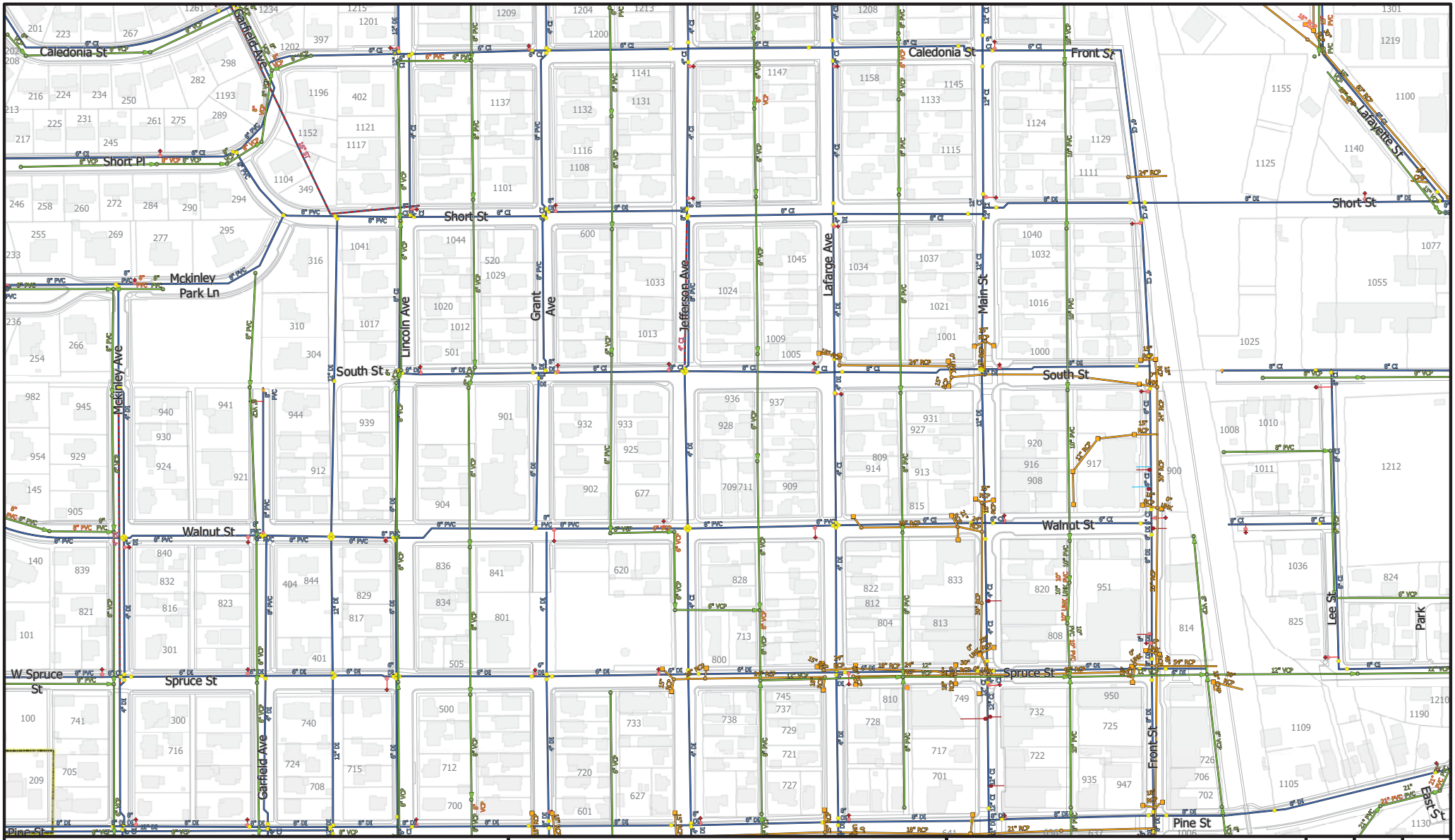
1 in = 0.25 miles at 22"x34" size

The City of **Louisville, Colorado**

2018 Utility Map Book Index

Map Index
City Limit
Lake
Major Street
Minor Street

Date Updated: 9/6/2018 3:40:45 PM



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0 200 400
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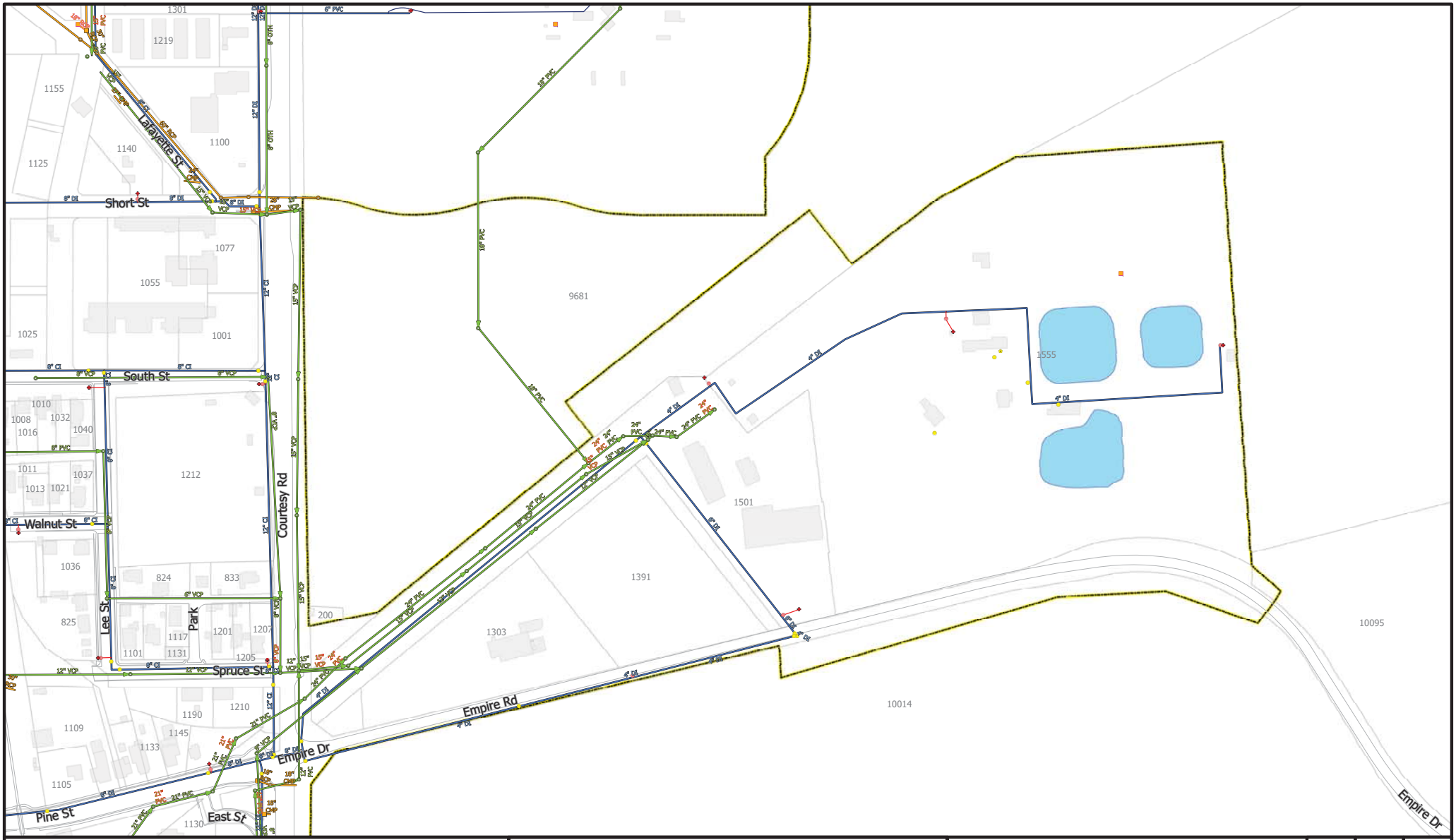
D5	D6	D7
E5	E6	E7
F5	F6	F7



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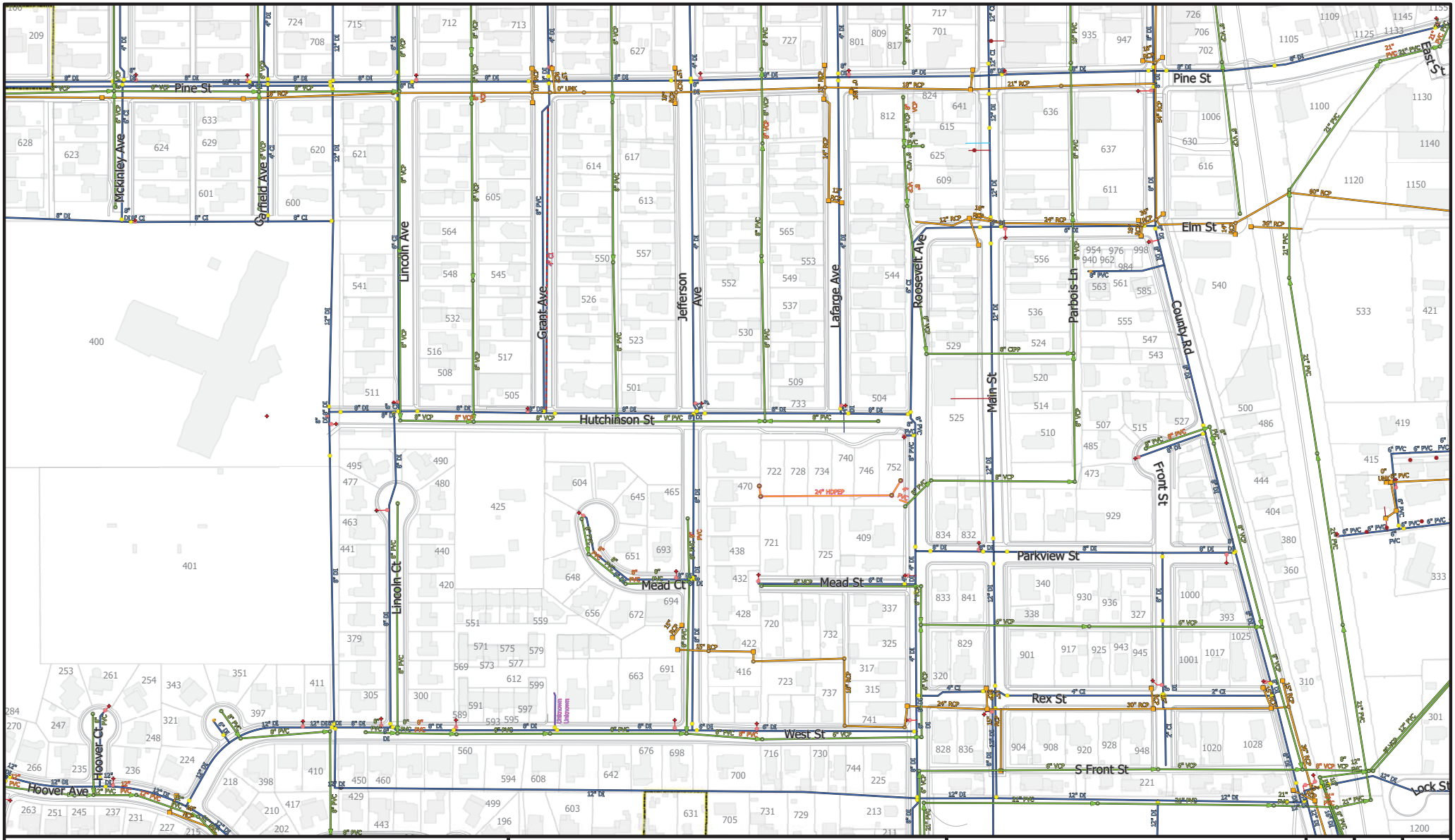
D6	D7	D8
E6	E7	--
F6	F7	F8



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E5	E6	E7
F5	F6	F7
G5	G6	G7

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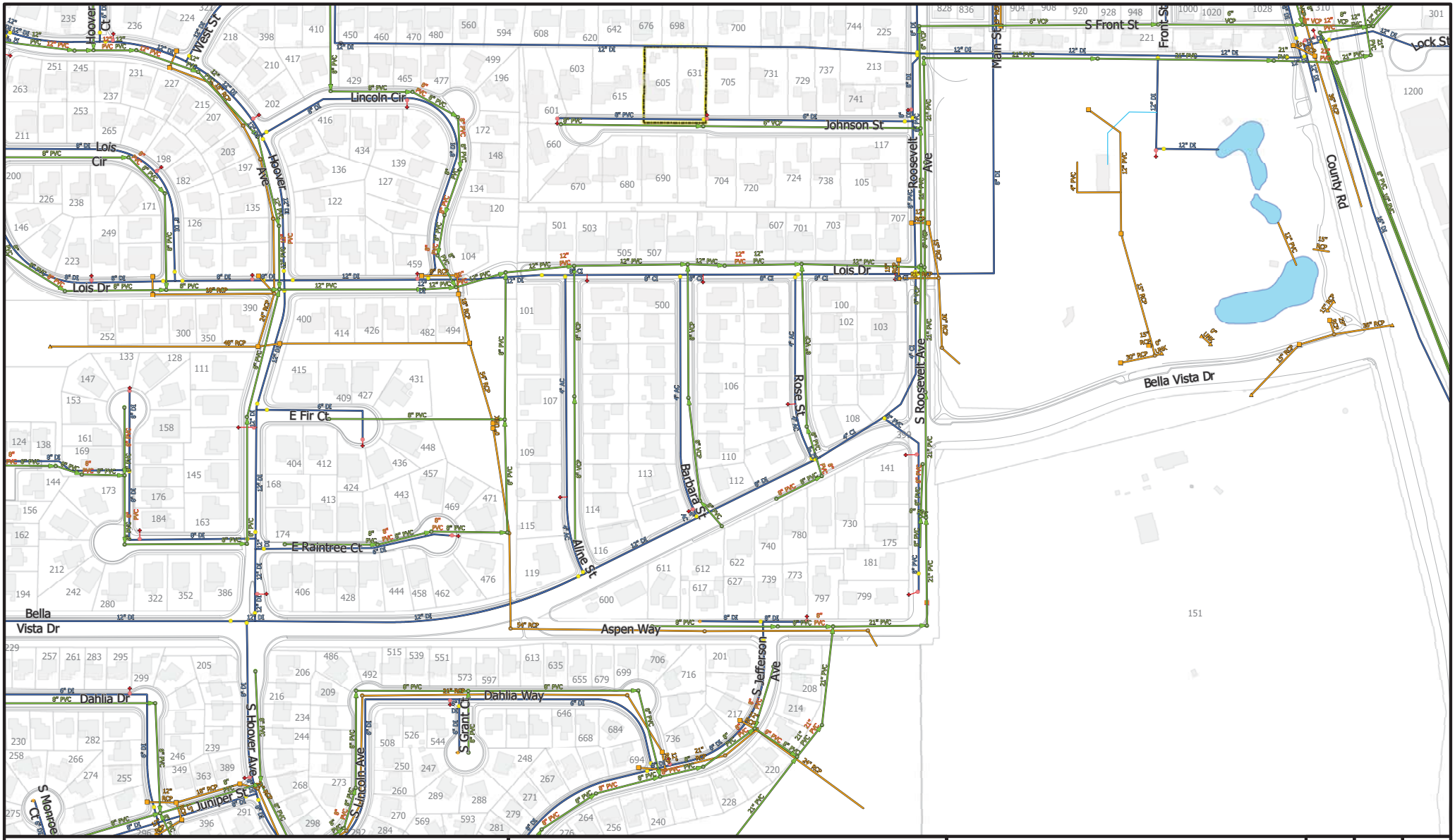
E6	E7	--
F6	F7	F8
G6	G7	G8



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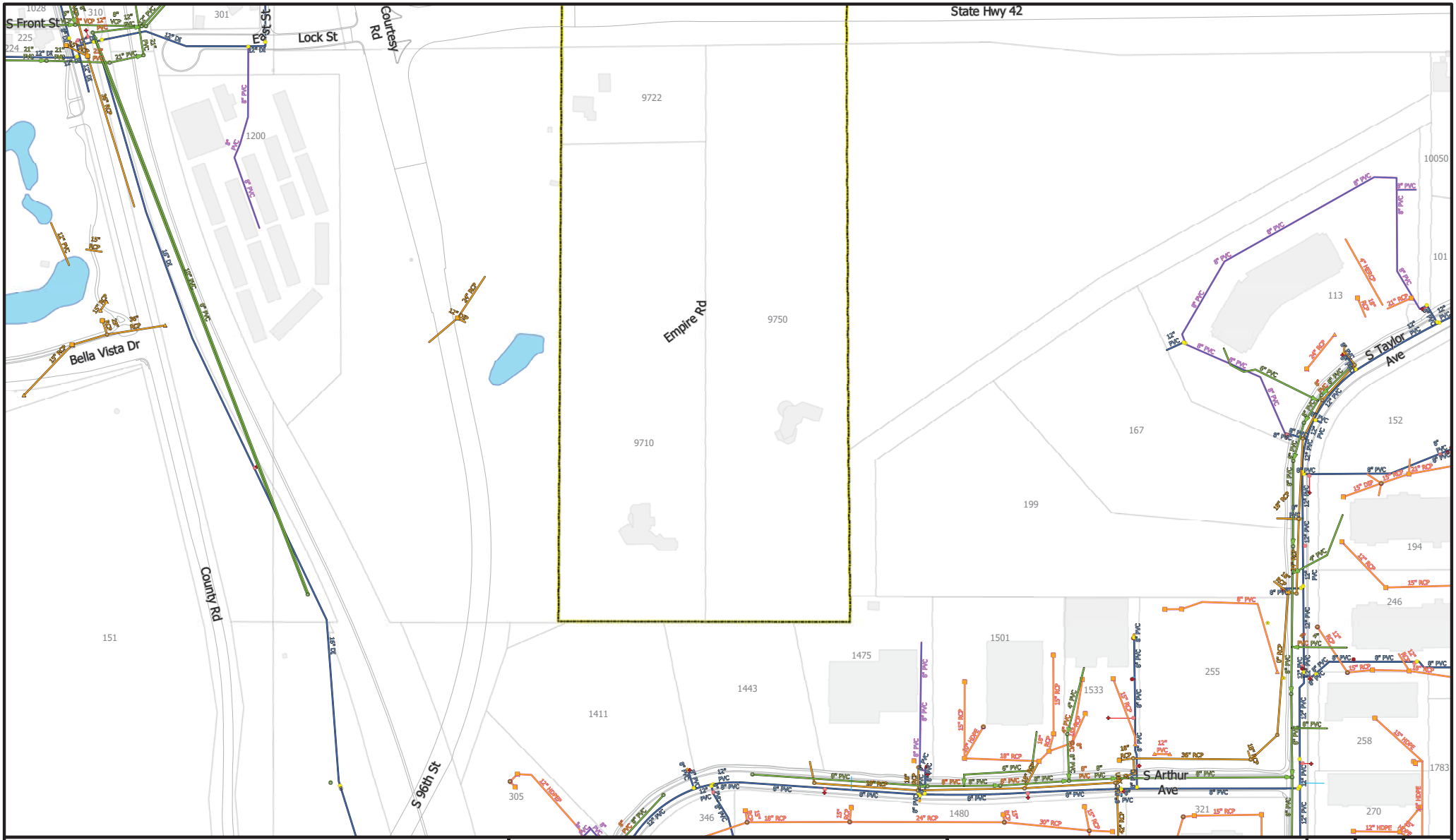
F5	F6	F7
G5	G6	G7
H5	H6	H7



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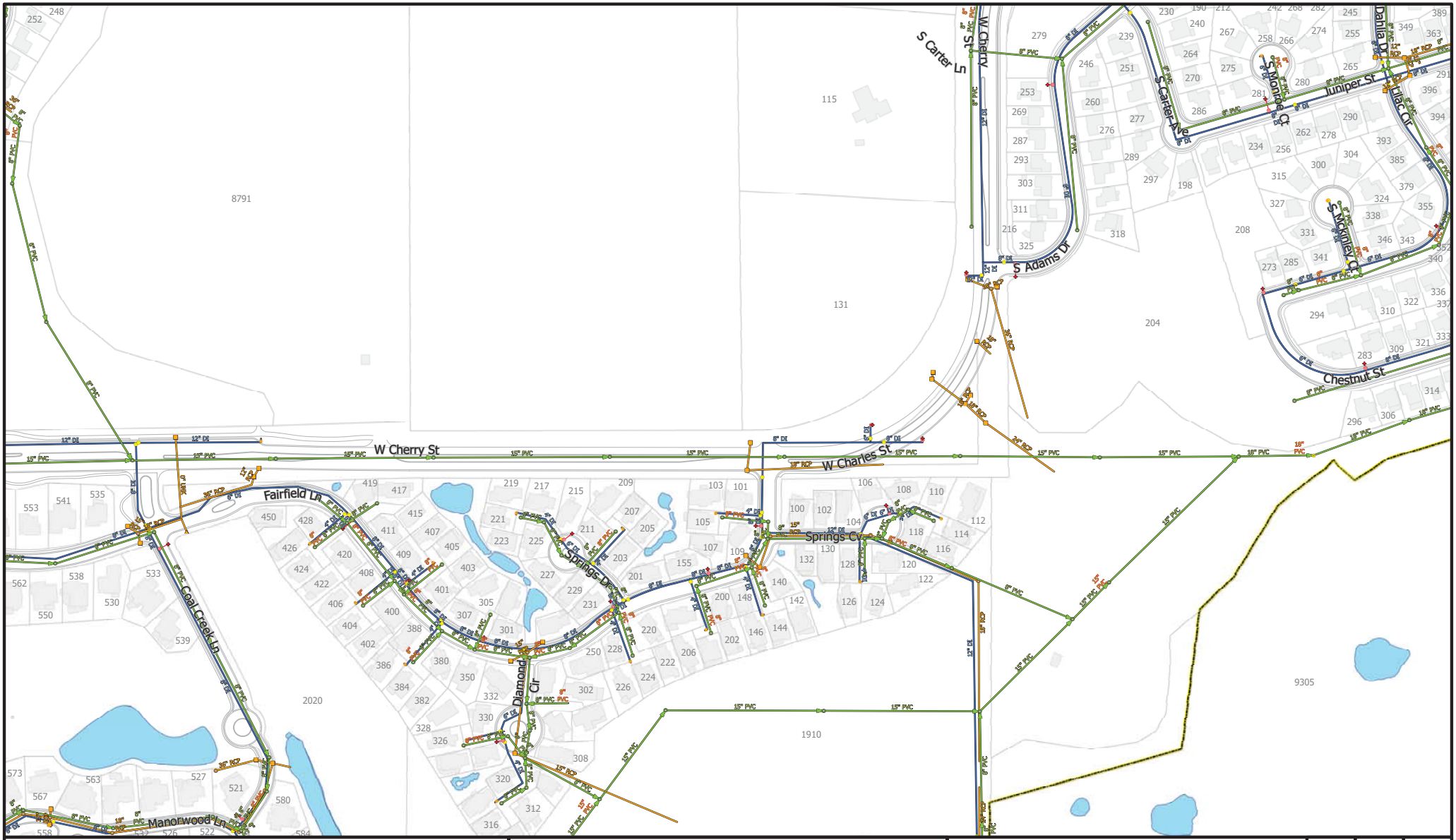
F6	F7	F8
G6	G7	G8
H6	H7	H8



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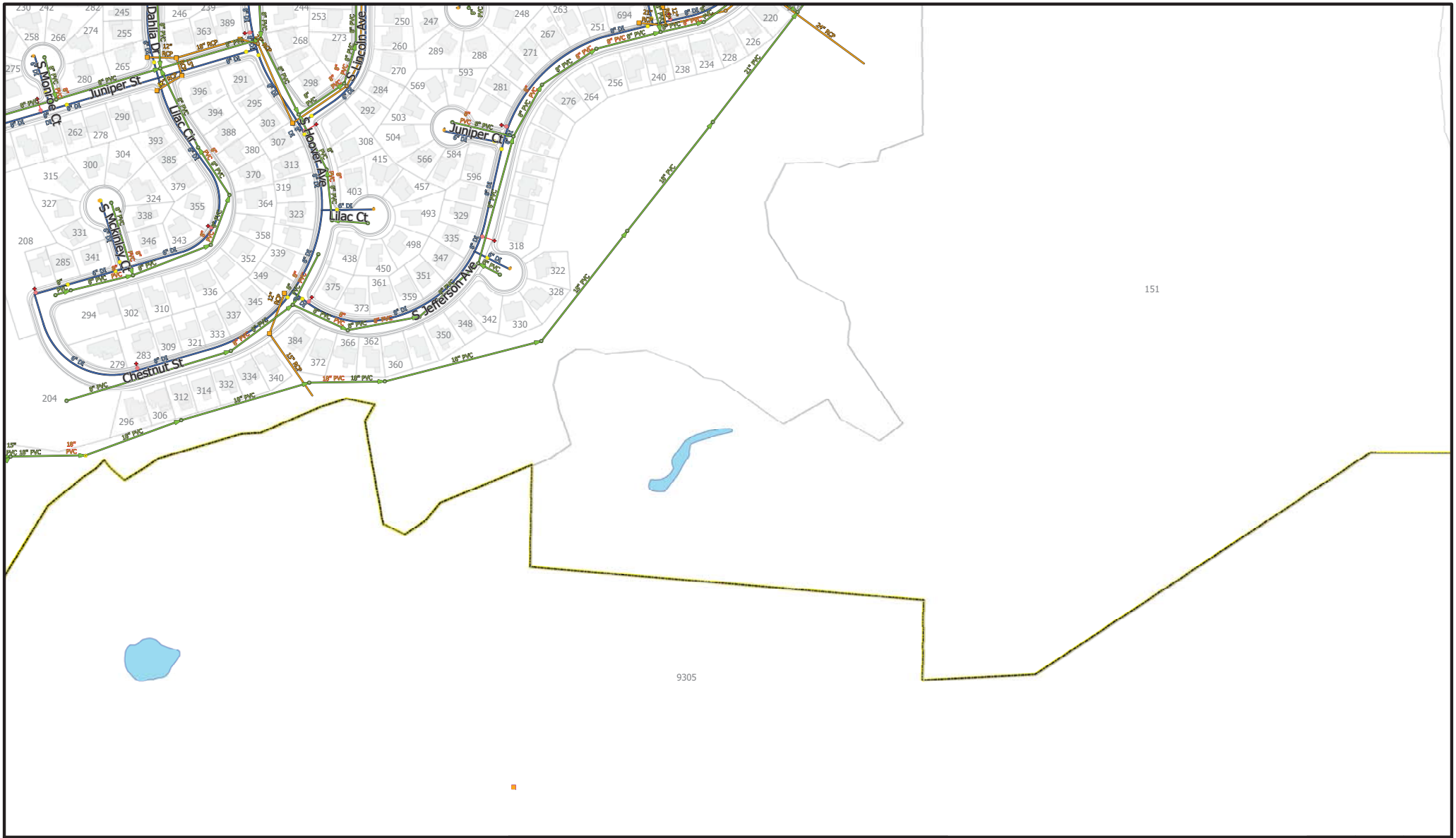
G4	G5	G6
H4	H5	H6
I4	I5	I6



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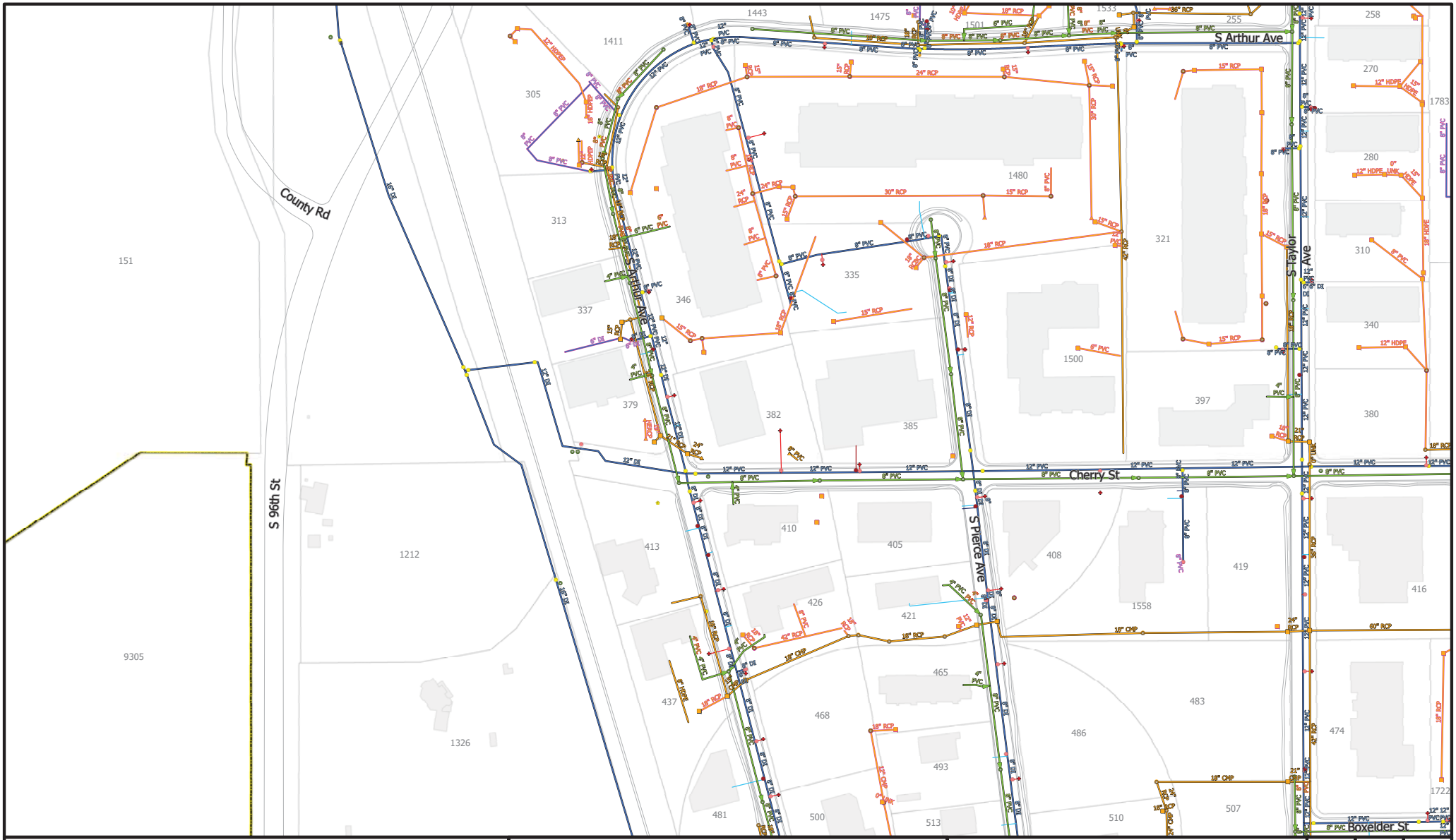
G5	G6	G7
H5	H6	H7
I5	I6	I7



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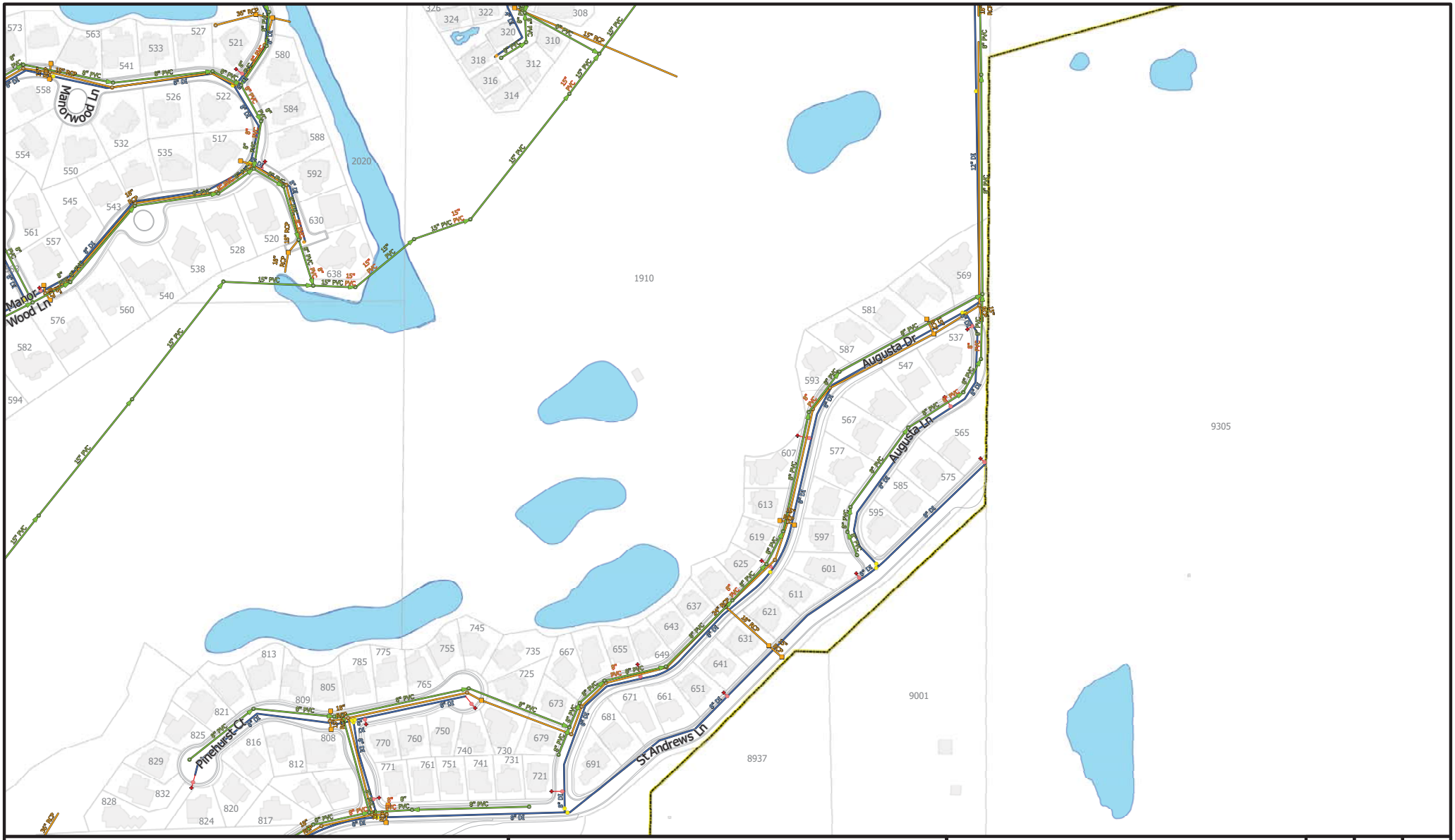
G6	G7	G8
H6	H7	H8
I6	I7	I8



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H4	H5	H6
I4	I5	I6
J4	J5	J6

9305

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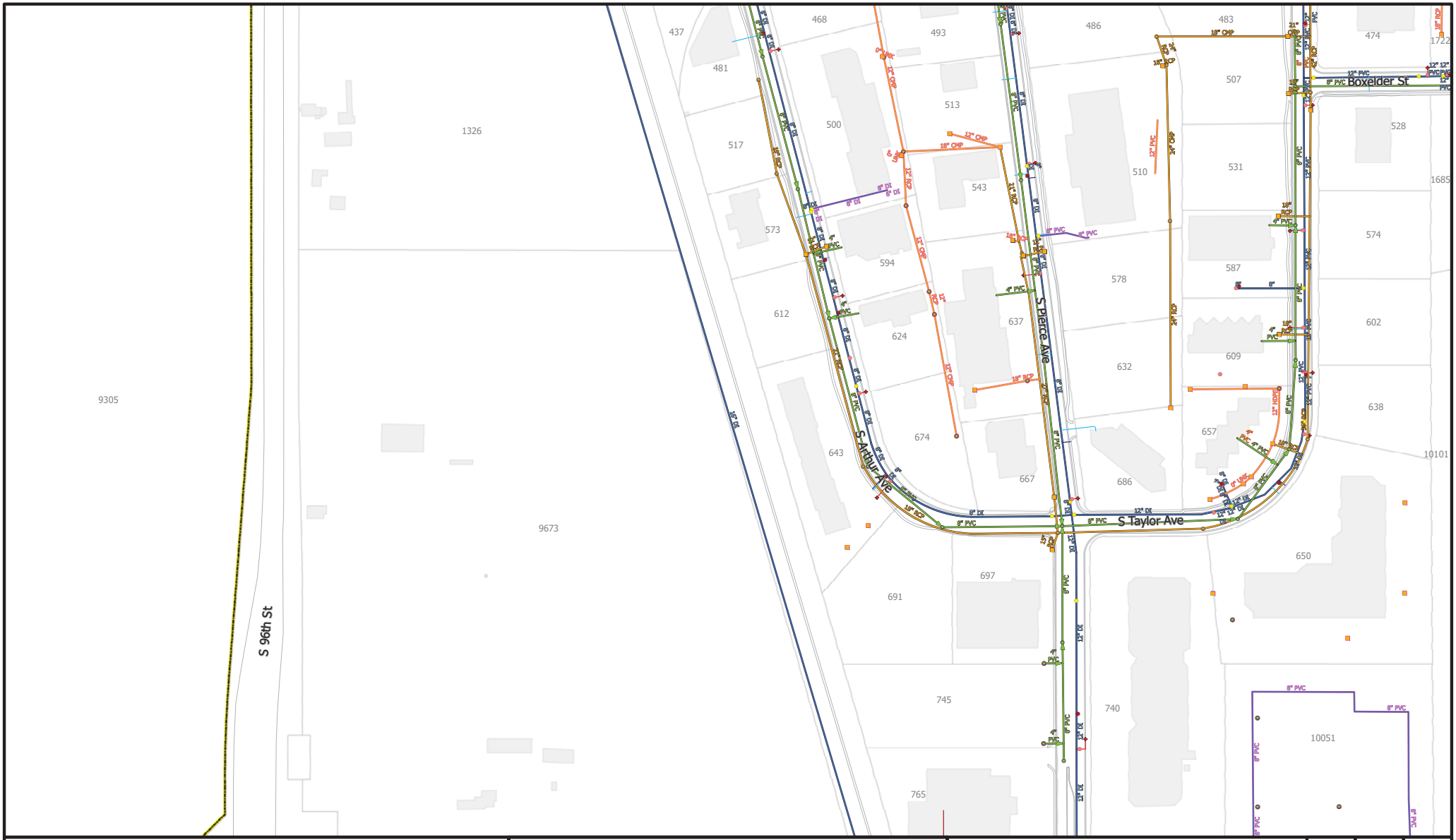
H5	H6	H7
I5	I6	I7
J5	J6	J7



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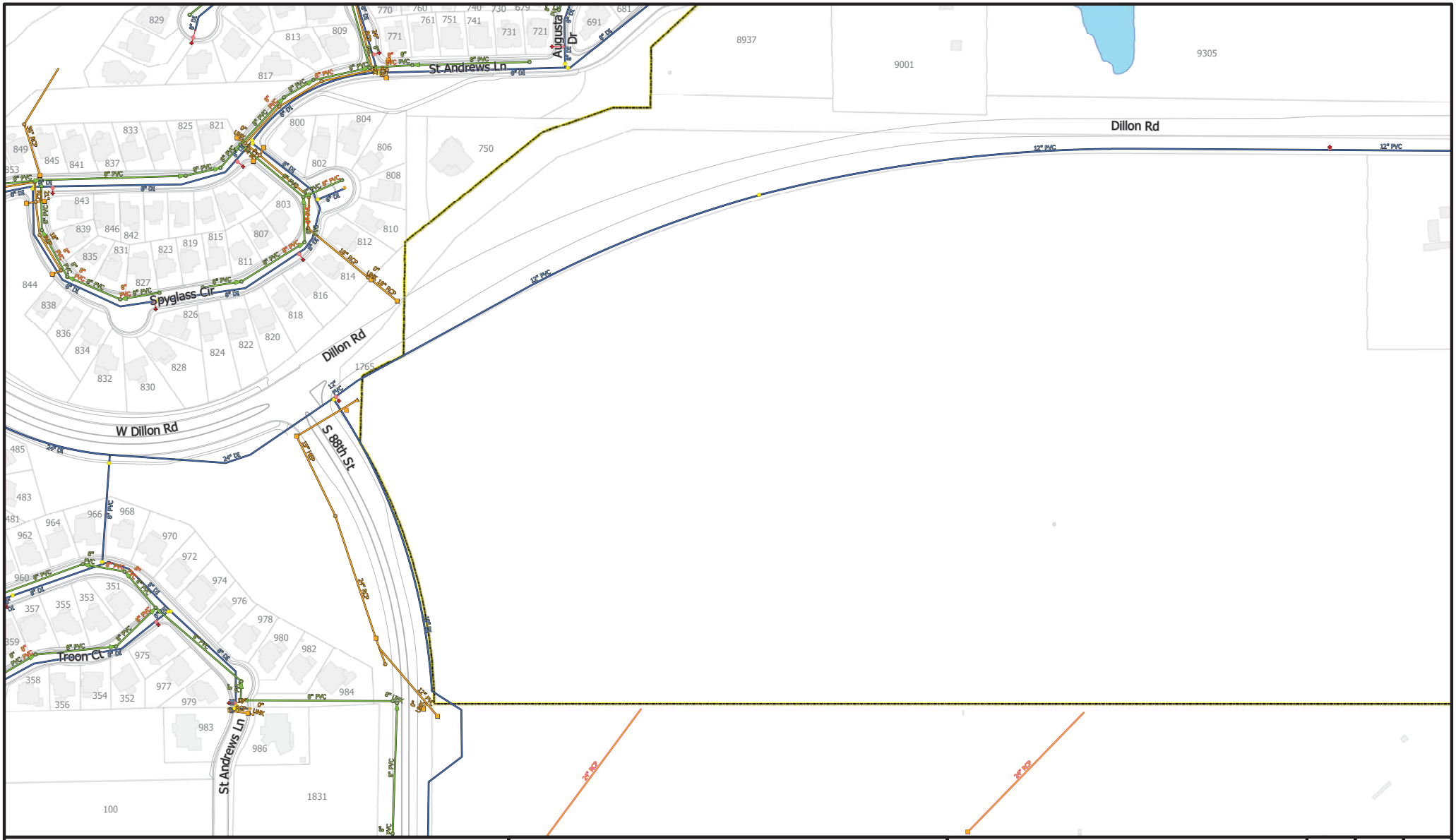

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I4	I5	I6
J4	J5	J6
K4	K5	K6

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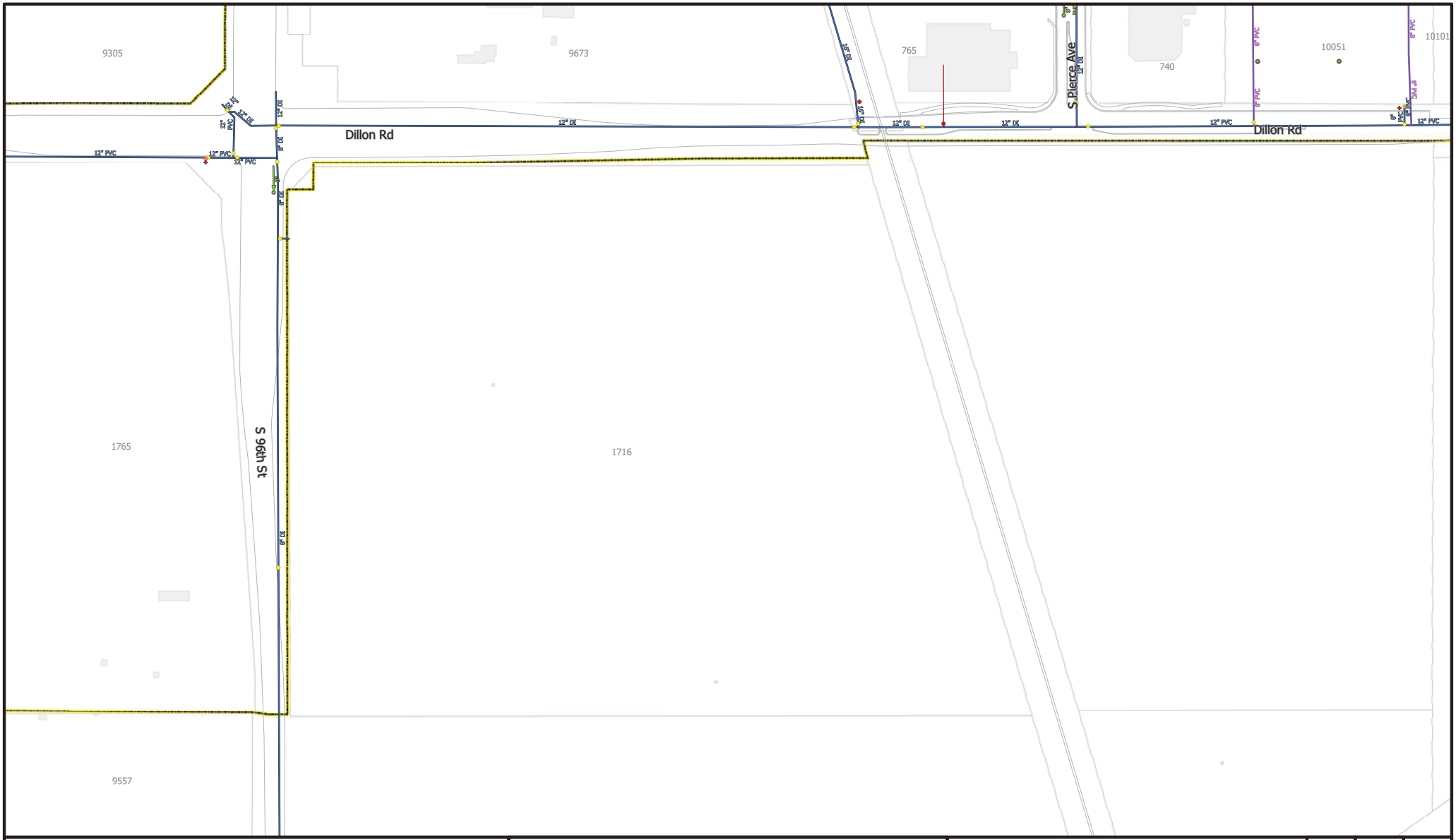
I5	I6	I7
J5	J6	J7
K5	K6	K7



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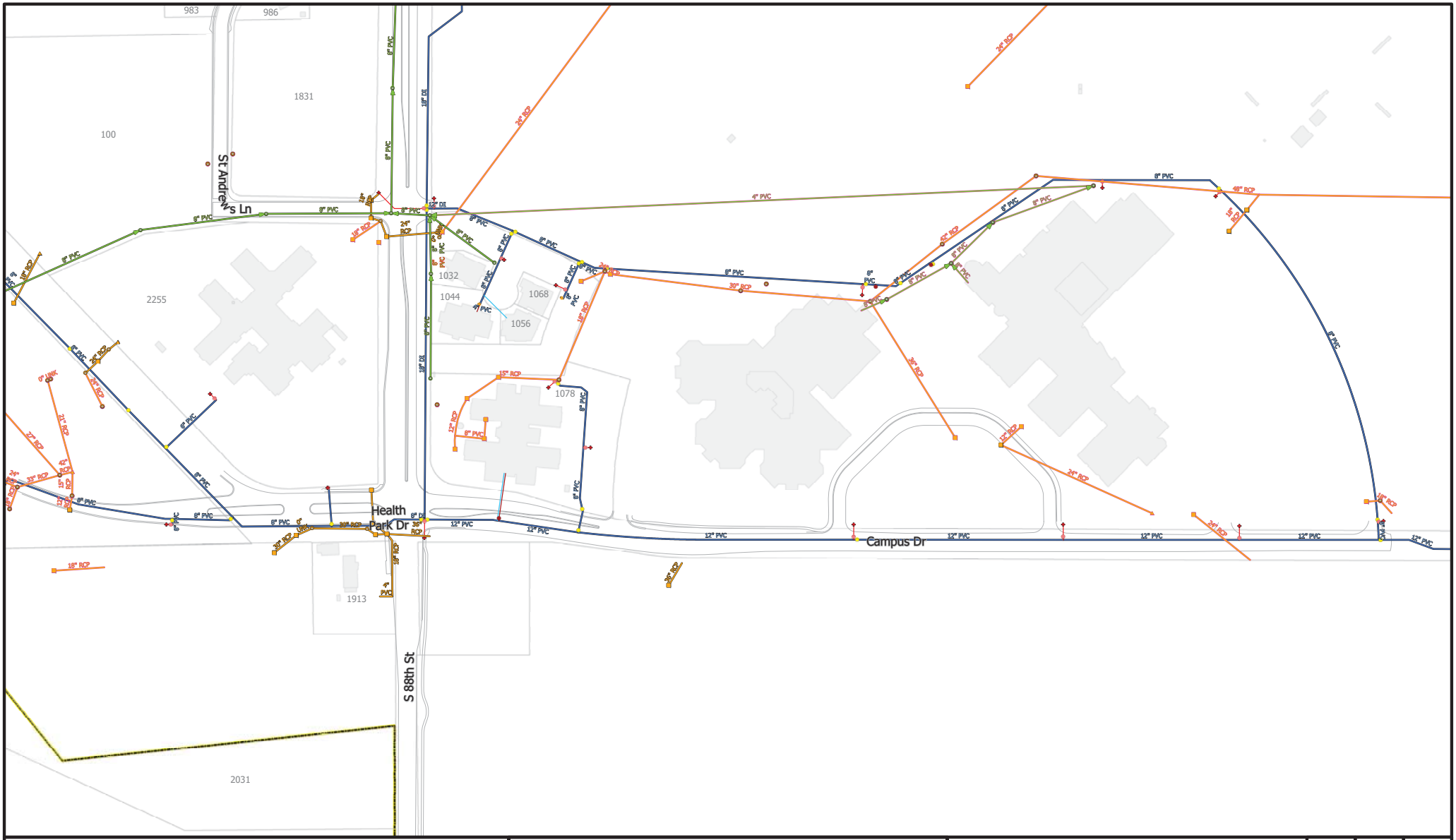
I6	I7	I8
J6	J7	J8
K6	K7	--



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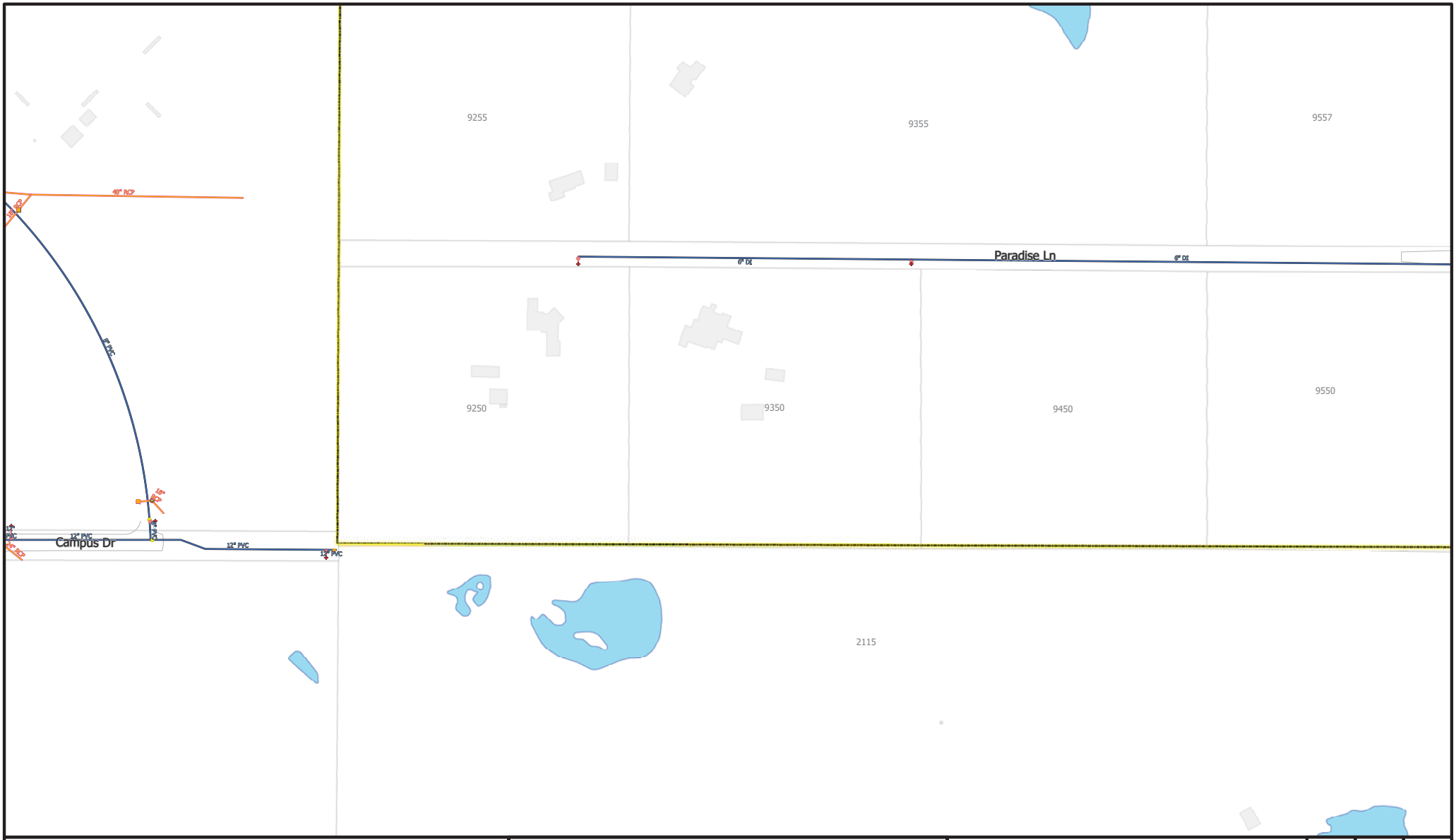
J4	J5	J6
K4	K5	K6
--	L5	L6



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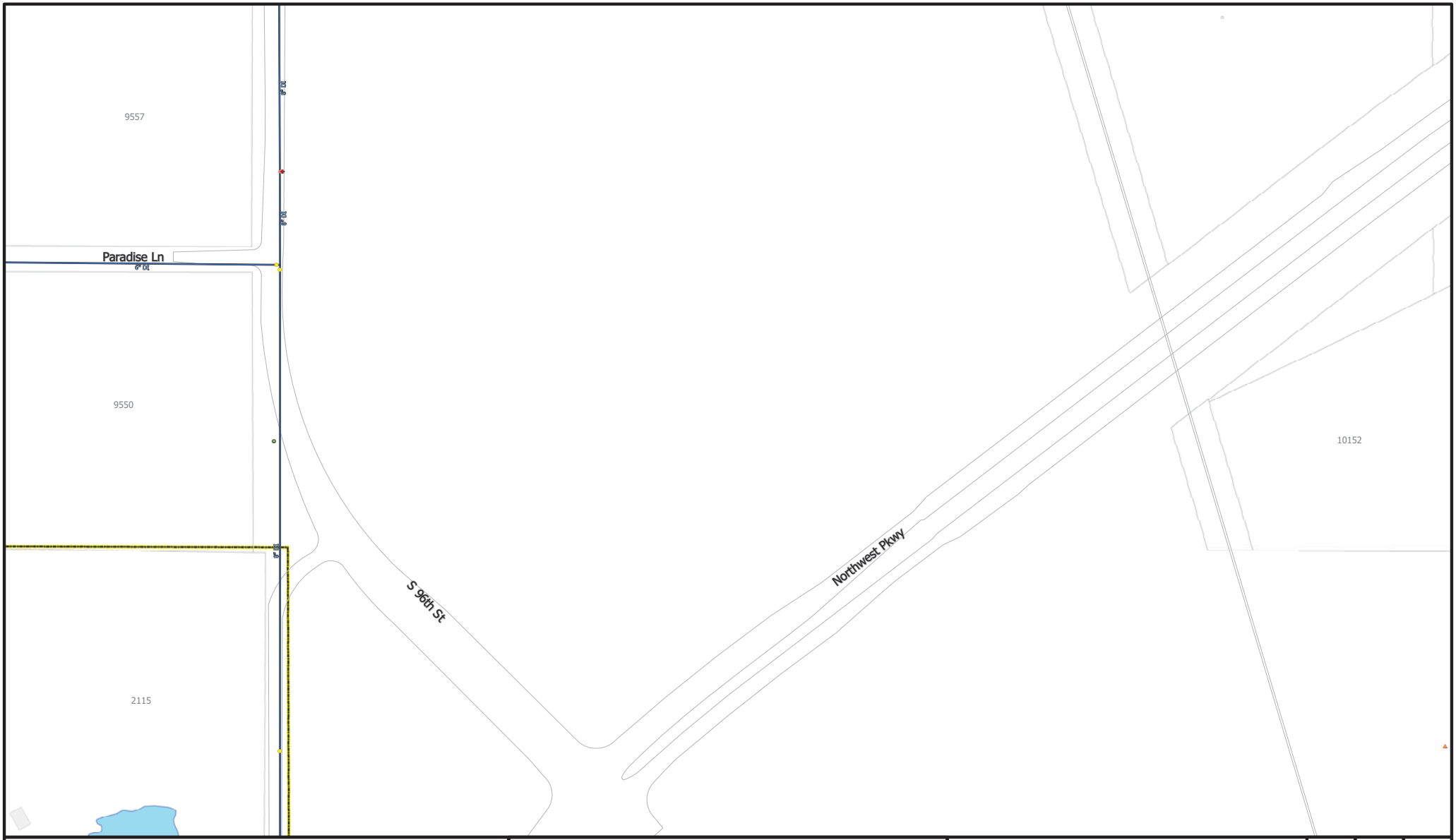
J5	J6	J7
K5	K6	K7
L5	L6	L7



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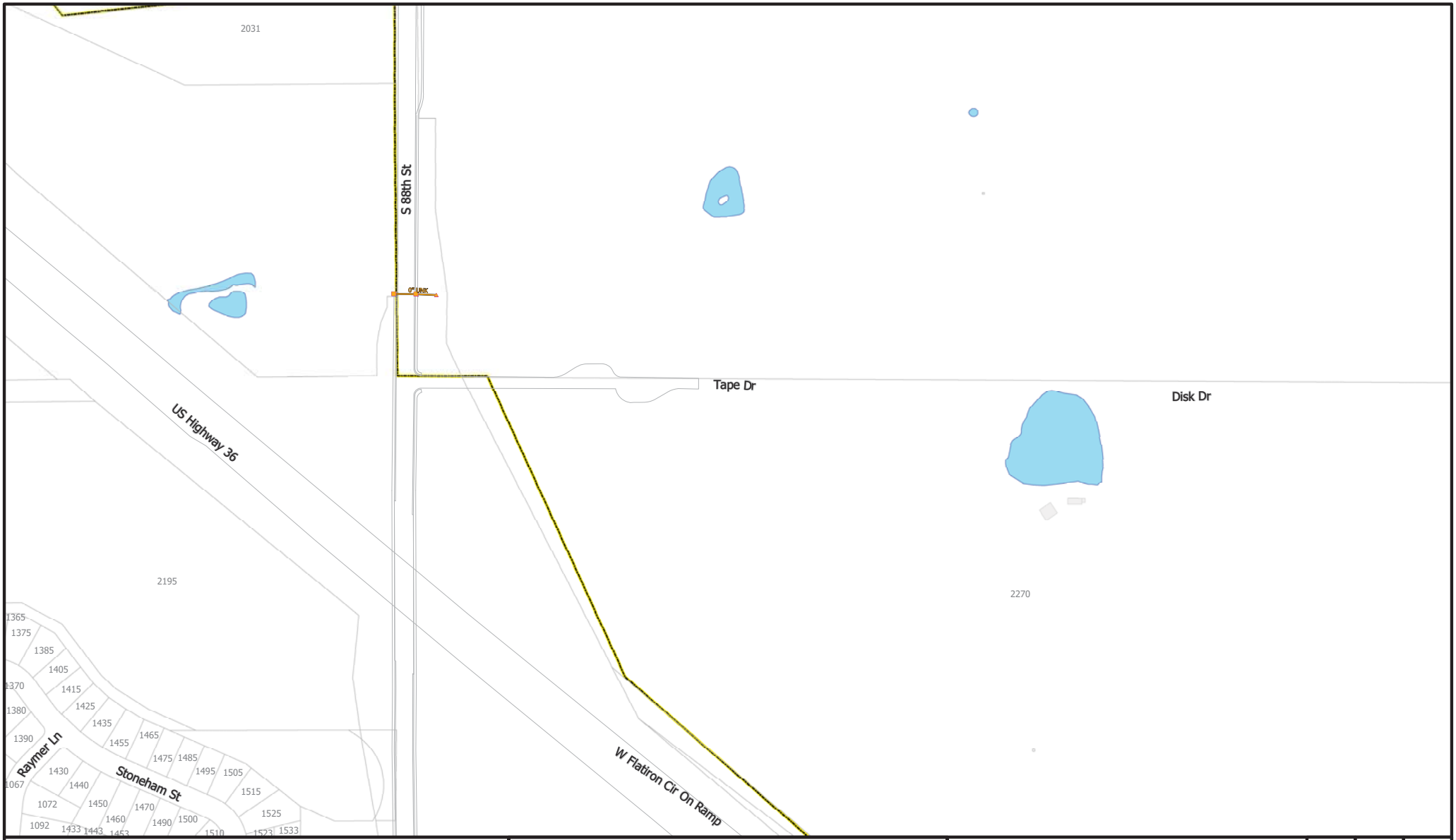
K6	K7	--
L6	L7	--



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K4	K5	K6
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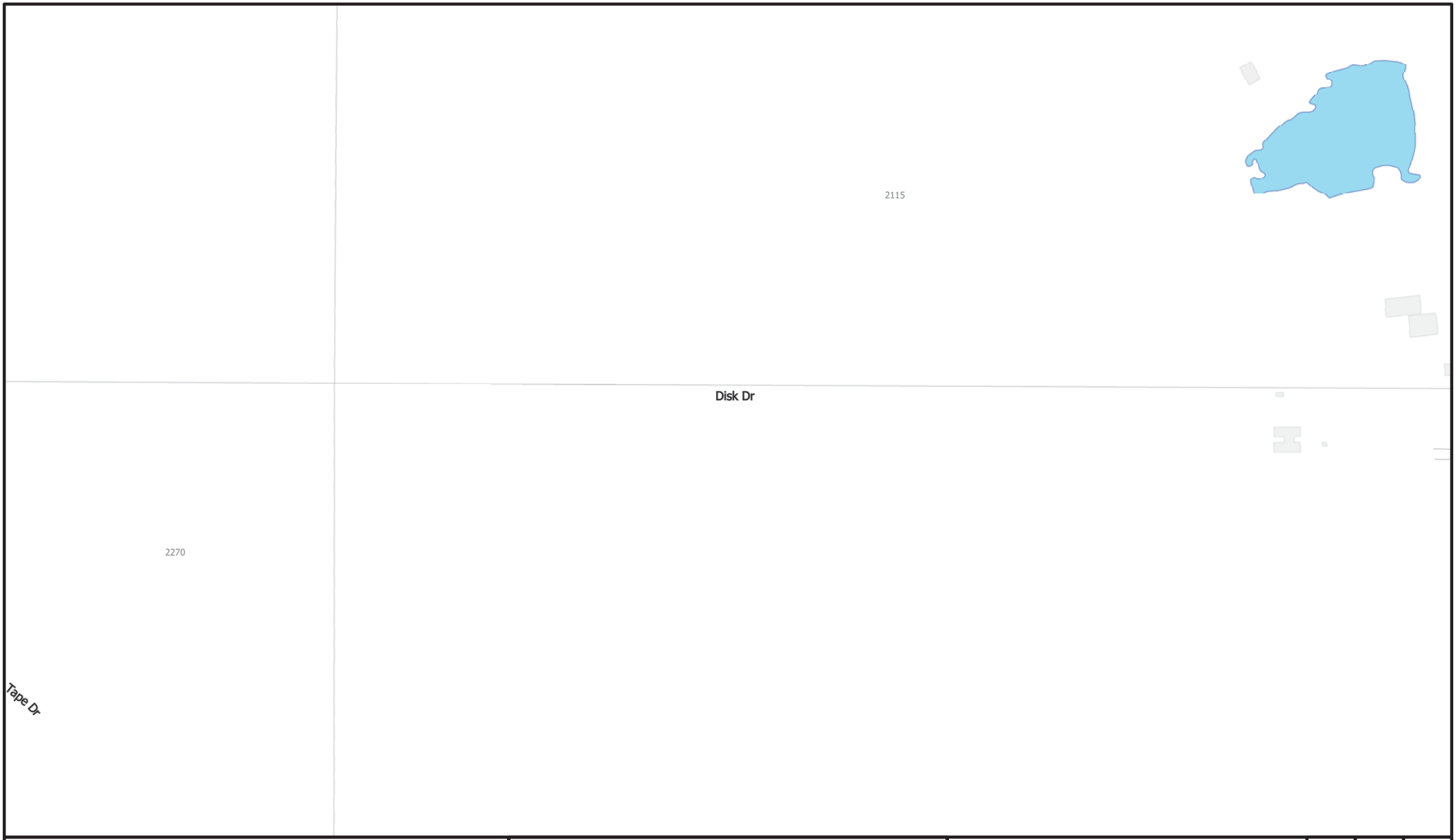

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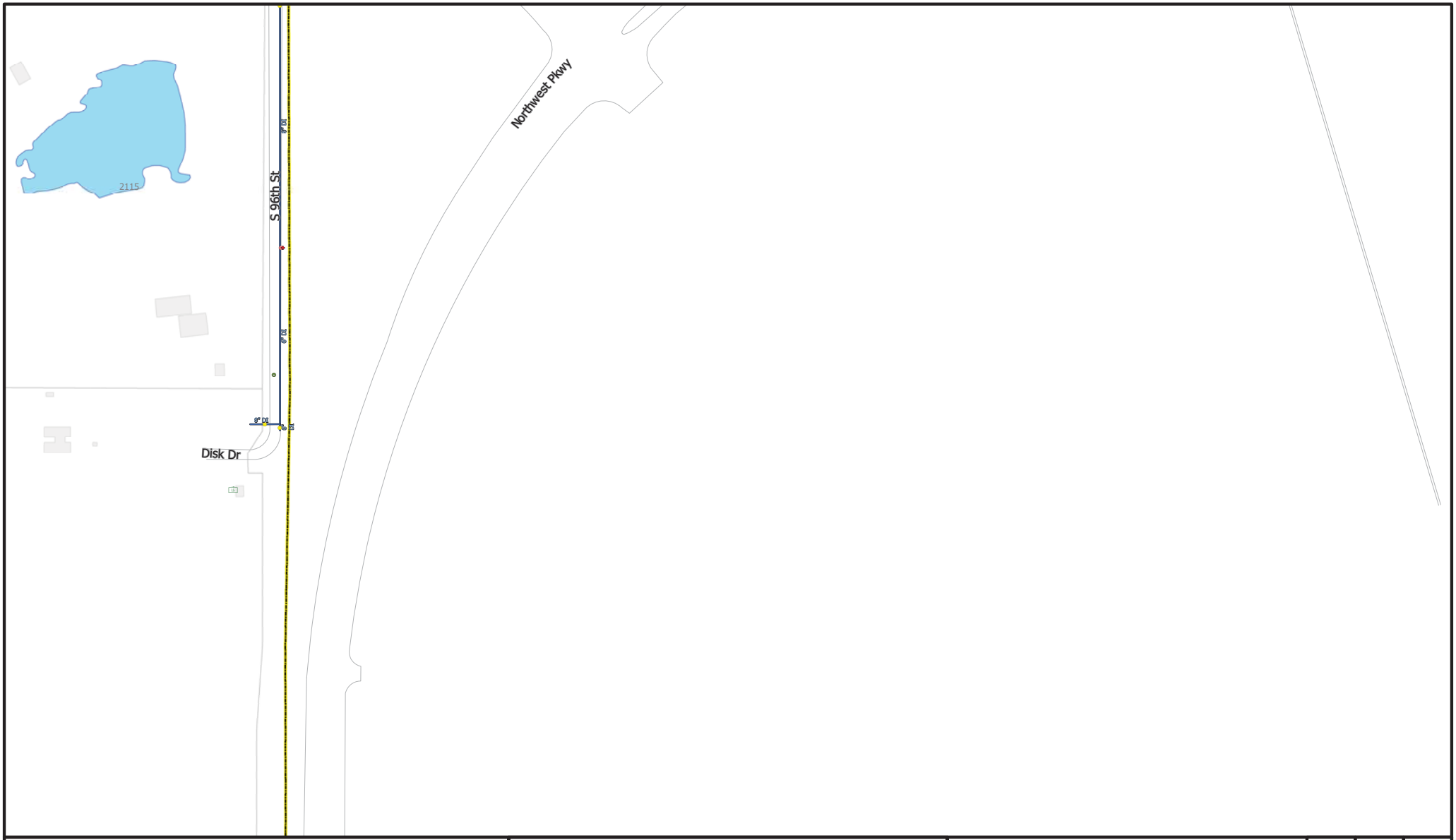
M5	M6	M7



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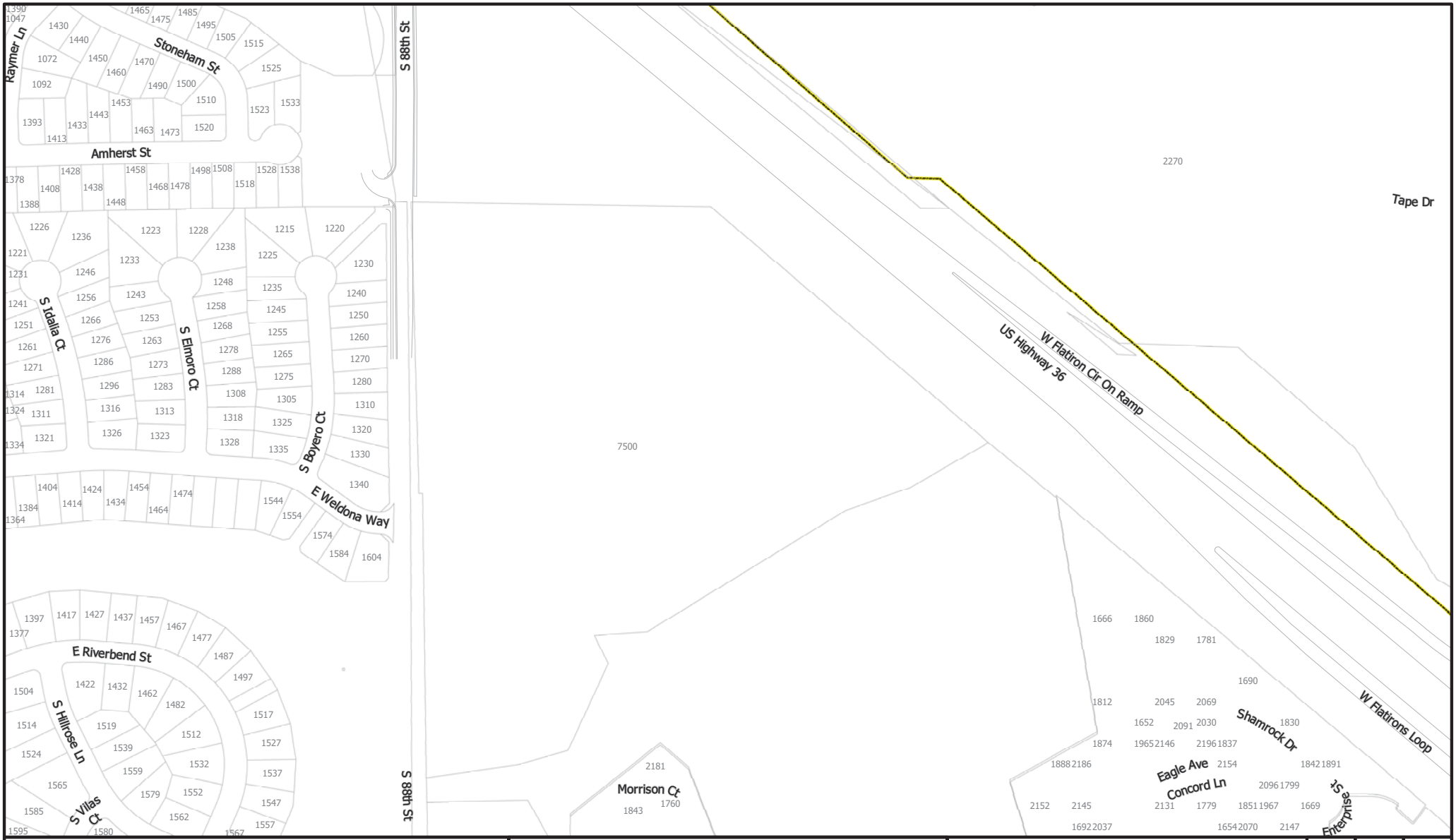

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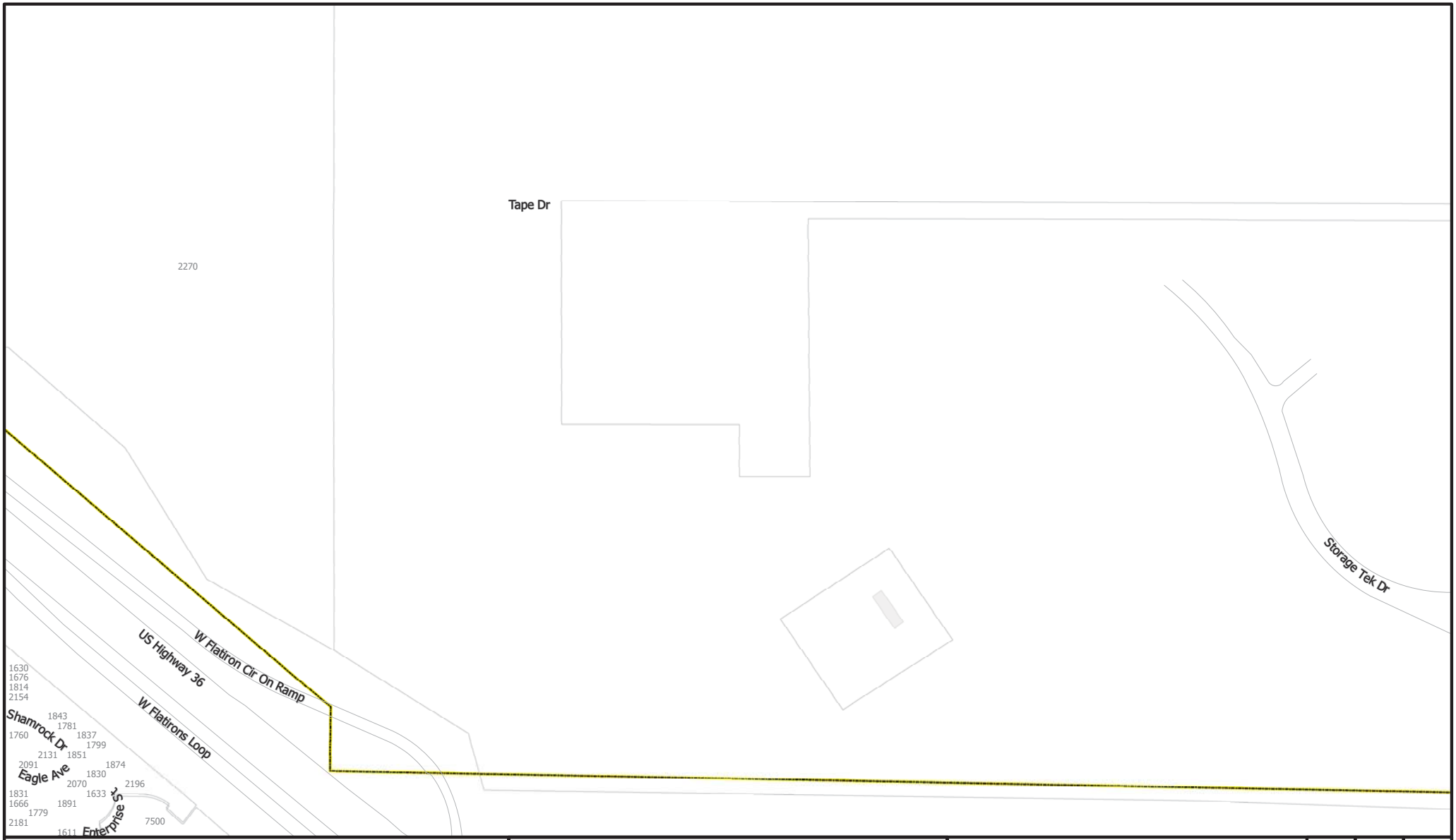

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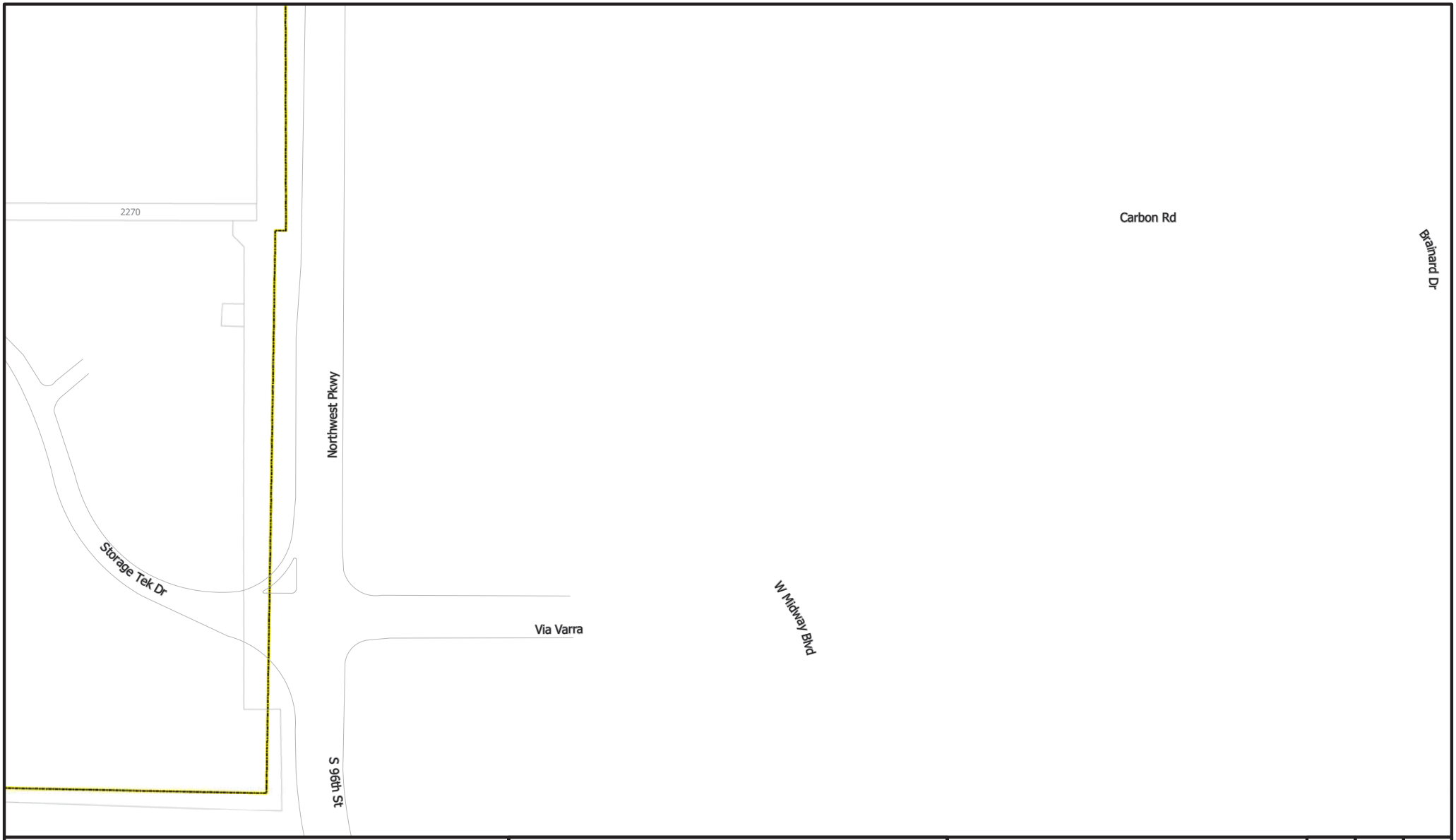

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L6	L7	--
M6	M7	--
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APPENDIX D – Sanitary Sewer Capacity Calculations

Redtail Ridge
Project #190108
Date: 2020-05-27

Infiltration/Inflow (I/I)

Parcel	A	B	C	D	E
Contributing area	65.43	101.68	75.15	44.19	38.1
GPD	32715	50840	37575	22095	19050
GPM	22.7	35.3	26.1	15.3	13.2
CFS	0.051	0.079	0.058	0.034	0.029

Cumulative Sanitary Loads by Phase (Denver Crieteria)

Phase 1

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	500 Units	126000	87.5	0.195	3.38	318.2	0.709	24.7%
B*	Corporate Offices	500000 sq. ft	143000	99.3	0.221	3.31	364.0	0.811	28.2%
C	Shopping Center	10000 sq. ft	3000	2.1	0.287	3.17	13.1	0.970	33.8%
	Business Hotel	90,000 sq. ft	31500	21.9			76.0		
	General Office	0 sq. ft	0	0.0			6.5		
	Residential Community	600 Units	151200	105.0			339.8		
D	General Office	0 sq. ft	0	0.0	0.000	0.00	0.0	0.000	0.0%
E	General Office	300000 sq. ft	60000	41.7	0.093	3.80	171.7	0.383	13.3%
		TOTAL	514700	357	0.796	NA	1289.3	2.873	

Phase 2

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1000 Units	252000	175.0	0.390	3.02	529.0	1.229	29.6%
B*	Corporate Offices	500000 sq. ft	143000	99.3	0.221	3.31	328.7	0.811	19.5%
C	Shopping Center	25000 sq. ft	7500	5.2	0.594	2.83	23.1	1.736	41.7%
	Business Hotel	90000 sq. ft	31500	21.9			76.0		
	General Office	590000 sq. ft	118000	81.9			266.6		
	Residential Community	900 Units	226800	157.5			506.5		
D	General Office	0 sq. ft	0	0.0	0.000	0.00	0.0	0.000	0.0%
E	General Office	300000 sq. ft	60000	41.7	0.093	3.80	171.7	0.383	9.2%
		TOTAL	838800	583	1.298	NA	1901.5	4.159	

Phase 3

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1326 Units	334152	232.1	0.517	2.89	670.5	1.544	31.9%
B*	Corporate Offices	500000 sq. ft	143000	99.3	0.221	3.31	328.7	0.811	16.7%
C	Shopping Center	45000 sq. ft	13500	9.4	0.739	2.73	36.3	2.075	42.9%
	Business Hotel	90000 sq. ft	31500	21.9			76.0		
	General Office	1030000 sq. ft	206000	143.1			460.6		
	Residential Community	900 Units	226800	157.5			506.5		
D	General Office	0 sq. ft	0	0.0	0.000	0.00	0.0	0.000	0.0%
E	General Office	330000 sq. ft	66000	45.8	0.102	3.75	184.9	0.412	8.5%
		TOTAL	1020952	709	1.580	NA	2263.4	4.843	

Phase 4

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1326 Units	334152	232.1	0.517	2.89	670.5	1.544	27.9%
B*	Corporate Offices	500000 sq. ft	143000	99.3	0.221	3.31	364.0	0.811	14.6%
C	Shopping Center	70000 sq. ft	21000	14.6	0.838	2.67	52.8	2.298	41.5%
	Business Hotel	90000 sq. ft	31500	21.9			76.0		
	General Office	1310000 sq. ft	262000	181.9			584.1		
	Residential Community	900 Units	226800	157.5			506.5		
D	General Office	390000 sq. ft	78000	54.2	0.121	3.65	212.9	0.474	8.6%
E	General Office	330000 sq. ft	66000	45.8	0.102	3.75	184.9	0.412	7.4%
		TOTAL	1162452	807	1.799	NA	2651.5	5.540	

45 gal/pers - 1.5 pers/room	**Hotel**
120 gal/pers - 2.1 pers/unit	**Residential**
108 gal/pers - 1.3 pers/unit	**Retirement**
0.38 gal/sq.ft.	**Shopping**
20 gal/pers - 300sq.ft./person	**Office**
20 gal/pers - 250sq.ft./person	**Corporate Office**

Infiltration/inflow = 500 gal/net acre
1 cfs = 646316.88 gpd

*** Parcel B loads have been changed to reflect loads coordinated with applicant at time of submittal.**

Redtail Ridge
Project #190108
Date: 2020-05-27

Infiltration/Inflow (I/I)

Parcel	A	B	C	D	E
Contributing area	65.43	101.68	75.15	44.19	38.1
GPD	32715	50840	37575	22095	19050
GPM	22.7	35.3	26.1	15.3	13.2
CFS	0.051	0.079	0.058	0.034	0.029

Cumulative Sanitary Loads by Phase (Coordinated Dewberry Loads)

Phase 1

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	500 Units	70200	48.8	0.109	3.7	203.5	0.453	24.3%
B	Corporate Offices	500000 sq. ft	40000	27.8	0.062	4.1	148.0	0.330	17.7%
C	Shopping Center	10000 sq. ft	3800	2.6	0.265	3.2	15.0	0.910	48.8%
	Business Hotel	240 Rooms	16200	11.3			42.7		
	General Office	0 sq. ft	0	0.0			6.5		
	Residential Community	600 Units	151200	105.0			344.2		
D	General Office	0 sq. ft	0	0.0	0.000	0.0	0.0	0.000	0.0%
E	General Office	300000 sq. ft	20000	13.9	0.031	4.5	76.2	0.170	9.1%
		TOTAL	301400	209	0.466	NA	836.2	1.863	

Phase 2

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1000 Units	140400	97.5	0.217	3.3	346.4	0.772	29.0%
B	Corporate Offices	500000 sq. ft	40000	27.8	0.062	4.1	148.0	0.330	12.4%
C	Shopping Center	25000 sq. ft	9500	6.6	0.452	3.0	27.7	1.391	52.3%
	Business Hotel	240 Rooms	16200	11.3			42.7		
	General Office	590000 sq. ft	39333	27.3			94.4		
	Residential Community	900 Units	226800	157.5			513.0		
D	General Office	0 sq. ft	0	0.0	0.000	0	0.0	0.000	0.0%
E	General Office	300000 sq. ft	20000	13.9	0.031	4.5	76.2	0.170	6.4%
		TOTAL	492233	342	0.762	NA	1248.4	2.663	

Phase 3

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1326 Units	186170	129.3	0.288	3.2	432.9	0.965	32.1%
B	Corporate Offices	500000 sq. ft	40000	27.8	0.062	4.1	148.0	0.330	11.0%
C	Shopping Center	45000 sq. ft	17100	11.9	0.509	2.9	44.7	1.532	50.9%
	Business Hotel	240 Rooms	16200	11.3			42.7		
	General Office	1030000 sq. ft	68667	47.7			159.9		
	Residential Community	900 Units	226800	157.5			513.0		
D	General Office	0 sq. ft	0	0.0	0.000	0.0	0.0	0.000	0.0%
E	General Office	330000 sq. ft	22000	15.3	0.034	4.5	81.5	0.181	6.0%
		TOTAL	576937	401	0.893	NA	1422.7	3.008	

Phase 4

Parcel	Use	Intensity	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Average Daily Demand (CFS)	Peak Factor	Peak Hour Demand + I/I (GPM)	Peak Hour Demand +I/I (CFS)	Contributing %
A	Retirement Community	1326 Units	186170	129.3	0.288	3.2	432.9	0.965	29.0%
B	Corporate Offices	500000 sq. ft	40000	27.8	0.062	4.1	148.0	0.330	9.9%
C	Shopping Center	70000 sq. ft	26600	18.5	0.552	2.9	65.9	1.637	49.3%
	Business Hotel	240 Rooms	16200	11.3			42.7		
	General Office	1310000 sq. ft	87333	60.6			201.6		
	Residential Community	900 Units	226800	157.5			513.0		
D	General Office	390000 sq. ft	26000	18.1	0.040	4.3	93.8	0.209	6.3%
E	General Office	330000 sq. ft	22000	15.3	0.034	4.5	81.5	0.181	5.5%
		TOTAL	631104	438.3	0.976	NA	1579.4	3.322	

45 gal/pers - 1.5 pers/room	**Hotel**
120 gal/pers - 2.1 pers/unit	**Residential**
108 gal/pers - 1.3 pers/unit	**Retirement**
0.38 gal/sq.ft.	**Shopping**
20 gal/pers - 300sq.ft./person	**Office**
20 gal/pers - 250sq.ft./person	**Corporate Office**

Infiltration/inflow = 500 gal/net acre
1 cfs = 646316.88 gpd

On Site Sanitary Sewer Pipe Capacity (Known Depth)

Pipe Diameter (in)	Min Slope (%)	Max Flow Area (ft^2)	% Full	Flow (cfs)	Flow (MGD)	Velocity (fps)
8	0.40	0.35	100	0.83	0.54	2.42
10	0.28	0.54	100	1.22	0.79	2.29
12	0.22	0.79	100	1.76	1.14	2.26
15	0.15	1.23	100	2.50	1.62	2.04

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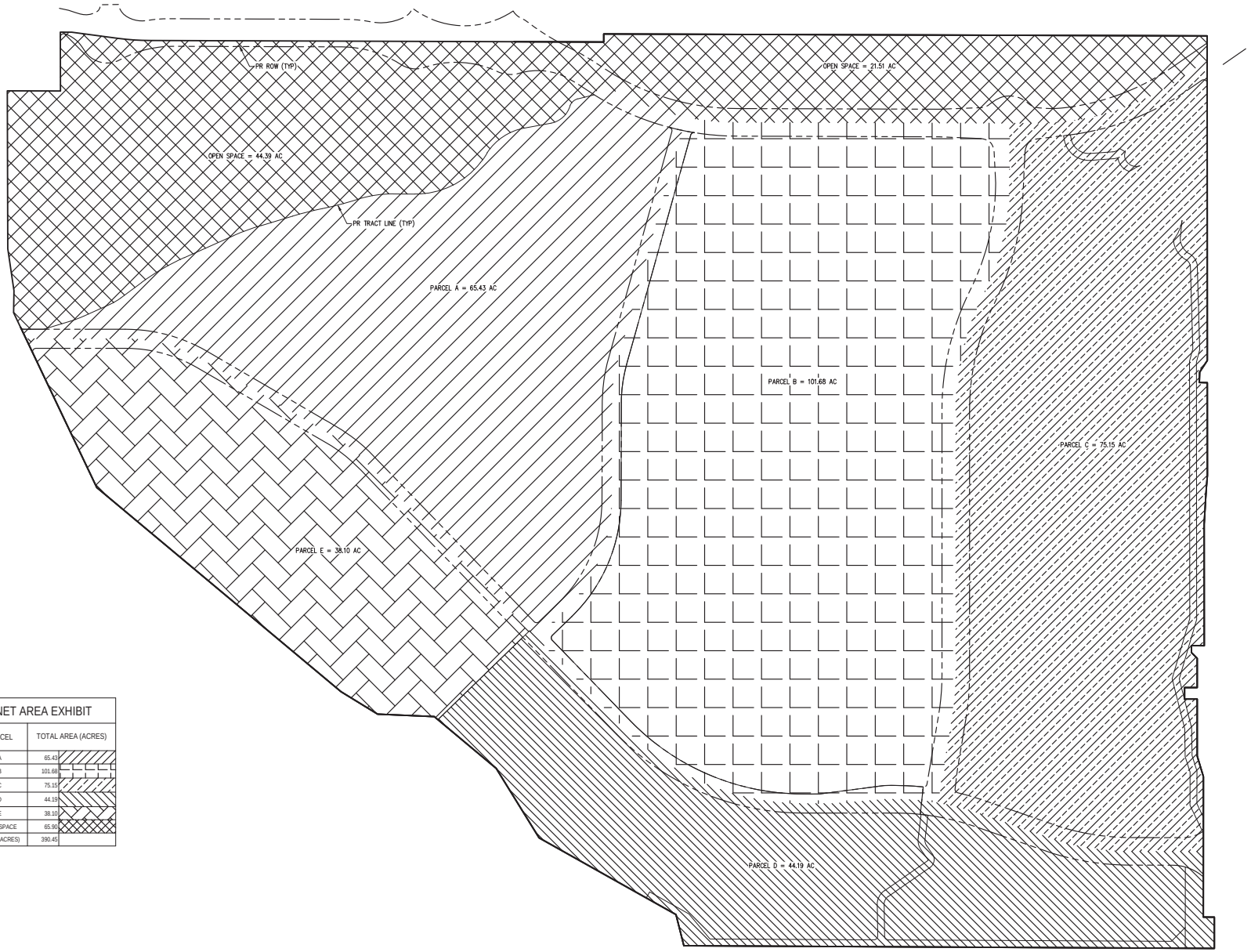
Off Site Sanitary Sewer Pipe Capacity (Known Flow)

Pipe Diameter (in)	Min Slope (%)	Flow Area (ft^2)	% Full	Flow (cfs)	Flow (MGD)	Velocity (fps)
18	0.12	1.35	77	3.09	2.00	2.29
21	0.10	1.42	59	3.09	2.00	2.18
24	0.08	1.54	49	3.09	2.00	2.01

Assumptions:
Minimum pipe slopes per City of Louisville standards.
Mannings n-value = 0.013 per City of Louisville standards.

Note: The maximum buildout flow for the site is 2.0 MGD per the City of Louisville WWTP Expansion Redtail Ridge Report prepared by Dewberry.



NET AREA EXHIBIT	
PARCEL	TOTAL AREA (ACRES)
A	65.43
B	101.68
C	75.15
D	44.19
E	38.10
OPEN SPACE	65.90
TOTAL (ACRES)	390.45

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

200 0 200 400
SCALE: 1" = 200'

NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH

Plotted: Fri 6/2/2023 12:52:58P By: Mike Sadaf Plotsyle: P:\0001\BRIGHTEN\EXHIBIT\NET AREA EXHIBIT.DWG Layout: LAYOUT1

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 10 2020

21-inch Interceptor Peak Flow

Circular

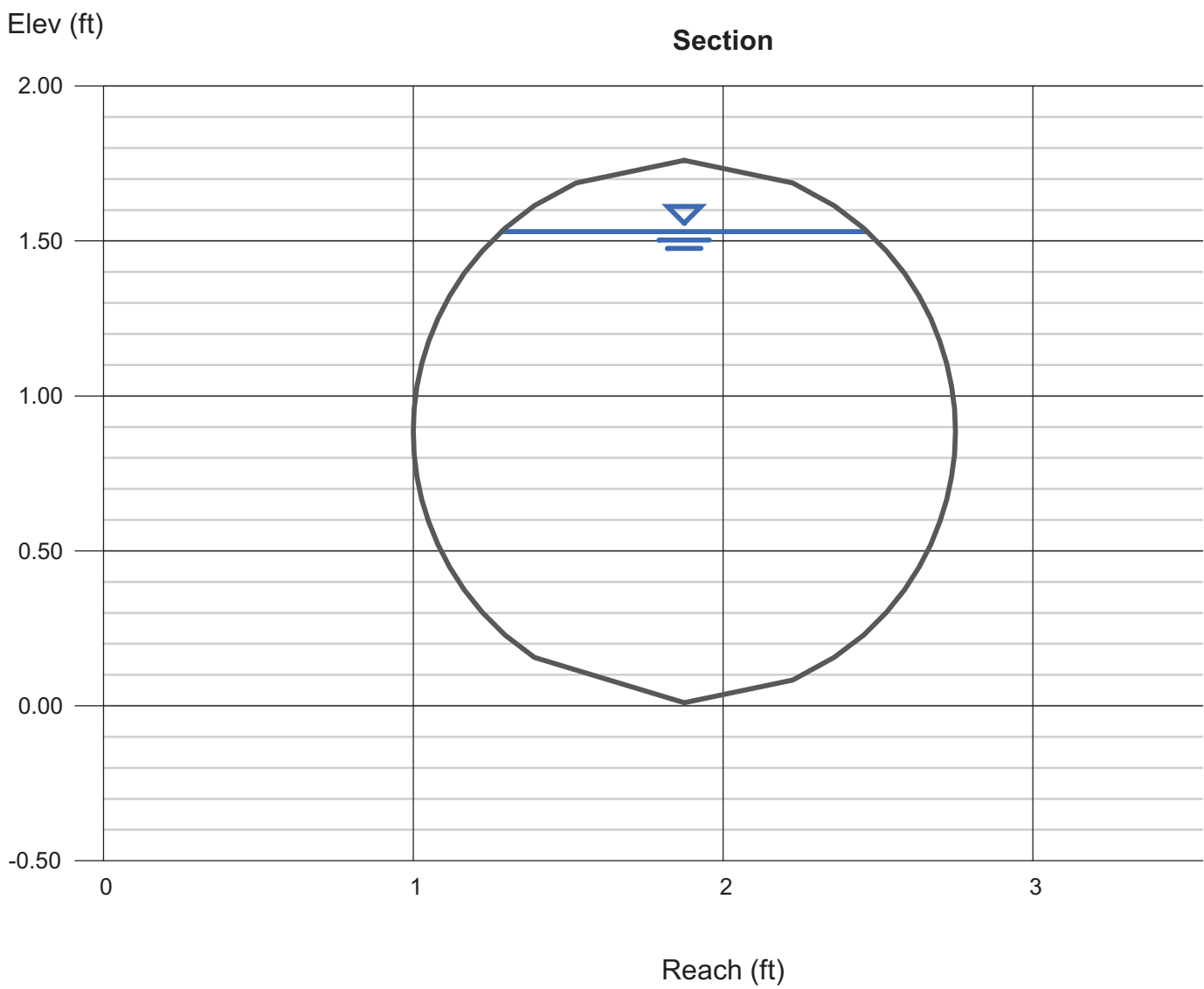
Diameter (ft)	= 1.75
Invert Elev (ft)	= 0.01
Slope (%)	= 0.10
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.24

Highlighted

Depth (ft)	= 1.52
Q (cfs)	= 5.235
Area (sqft)	= 2.22
Velocity (ft/s)	= 2.36
Wetted Perim (ft)	= 4.20
Crit Depth, Yc (ft)	= 0.84
Top Width (ft)	= 1.18
EGL (ft)	= 1.61



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, May 28 2020

Sanitary Line A - Parcel A

Circular

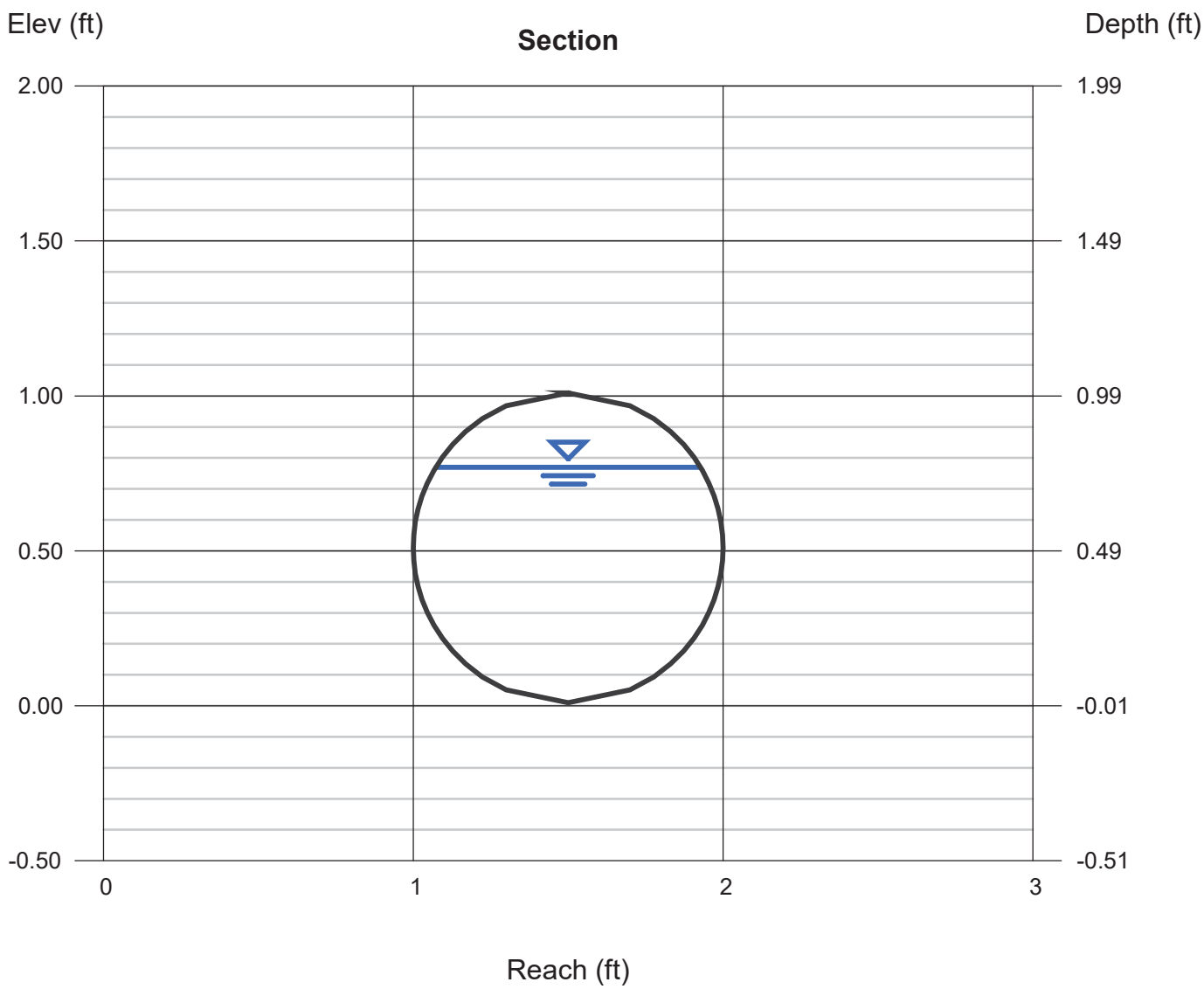
Diameter (ft)	= 1.00
Invert Elev (ft)	= 0.01
Slope (%)	= 0.22
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.54

Highlighted

Depth (ft)	= 0.76
Q (cfs)	= 1.540
Area (sqft)	= 0.64
Velocity (ft/s)	= 2.40
Wetted Perim (ft)	= 2.12
Crit Depth, Yc (ft)	= 0.53
Top Width (ft)	= 0.85
EGL (ft)	= 0.85



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, May 28 2020

Sanitary Line A - Parcel A & B

Circular

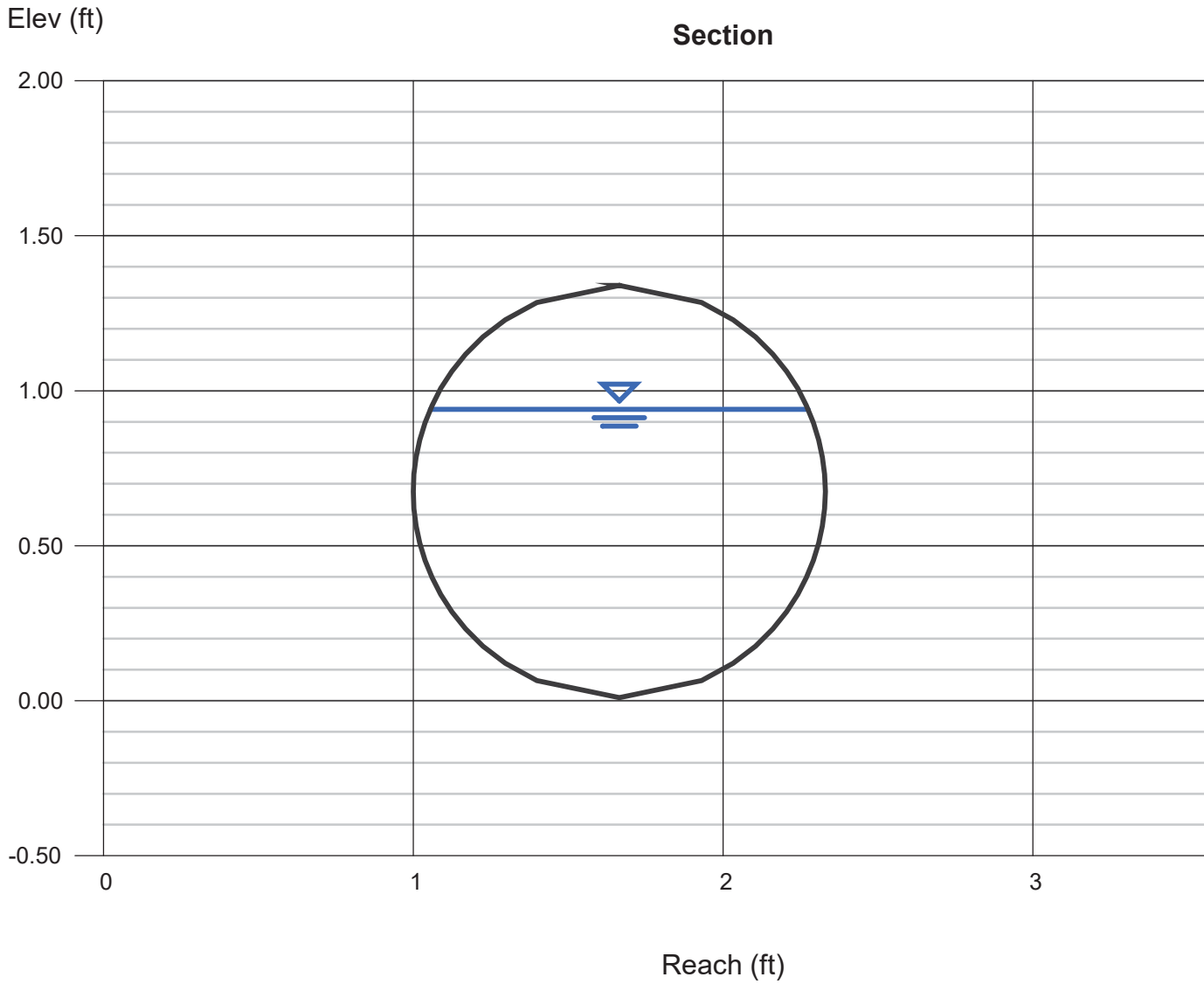
Diameter (ft)	= 1.33
Invert Elev (ft)	= 0.01
Slope (%)	= 0.14
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.36

Highlighted

Depth (ft)	= 0.93
Q (cfs)	= 2.360
Area (sqft)	= 1.04
Velocity (ft/s)	= 2.27
Wetted Perim (ft)	= 2.64
Crit Depth, Yc (ft)	= 0.61
Top Width (ft)	= 1.22
EGL (ft)	= 1.01



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, May 28 2020

Sanitary Line A - Parcel A, B, & C

Circular

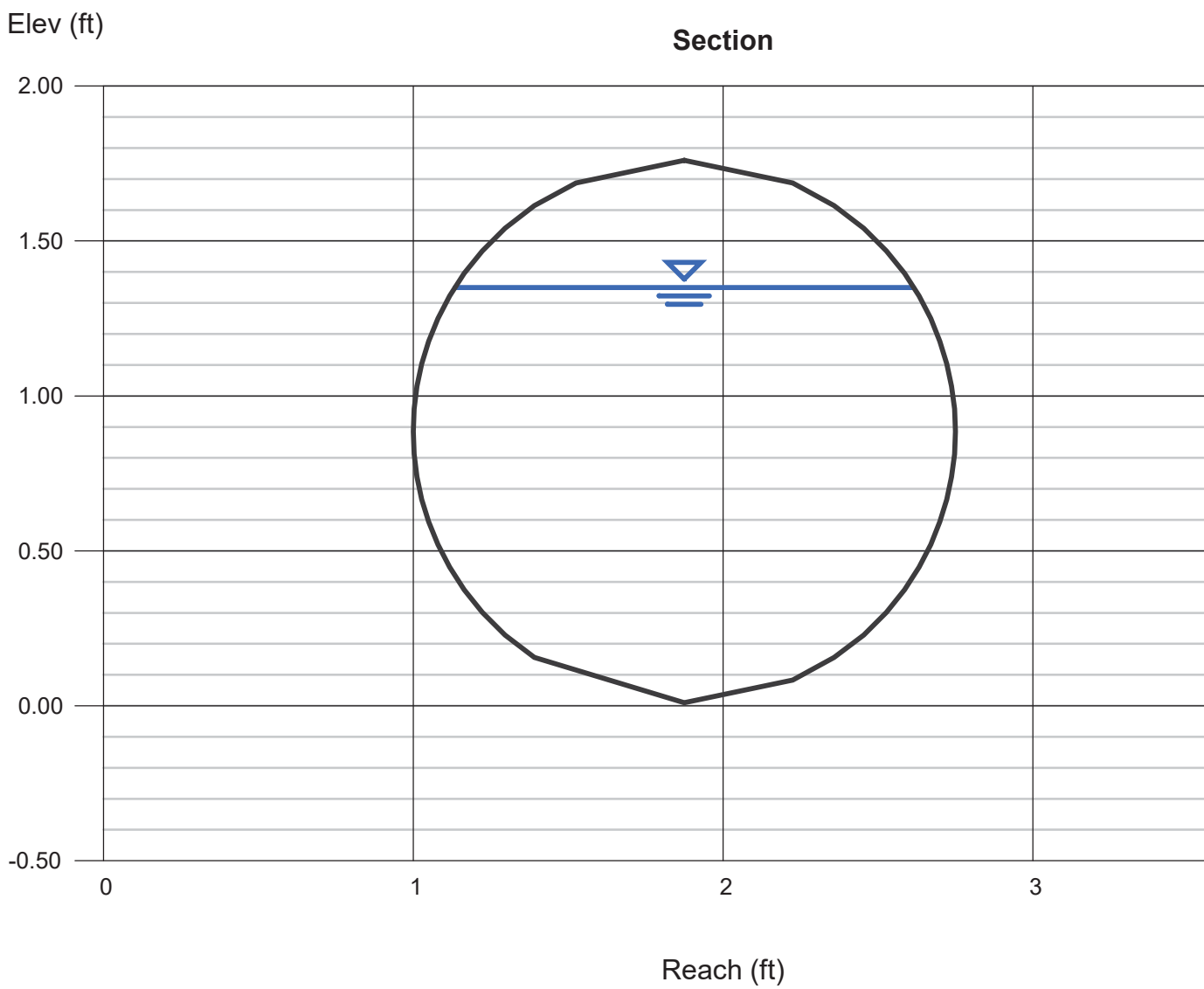
Diameter (ft)	= 1.75
Invert Elev (ft)	= 0.01
Slope (%)	= 0.10
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.65

Highlighted

Depth (ft)	= 1.34
Q (cfs)	= 4.650
Area (sqft)	= 1.98
Velocity (ft/s)	= 2.35
Wetted Perim (ft)	= 3.74
Crit Depth, Yc (ft)	= 0.79
Top Width (ft)	= 1.48
EGL (ft)	= 1.43



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, May 28 2020

Sanitary Line A - Parcel A, B, C, D, & E

Circular

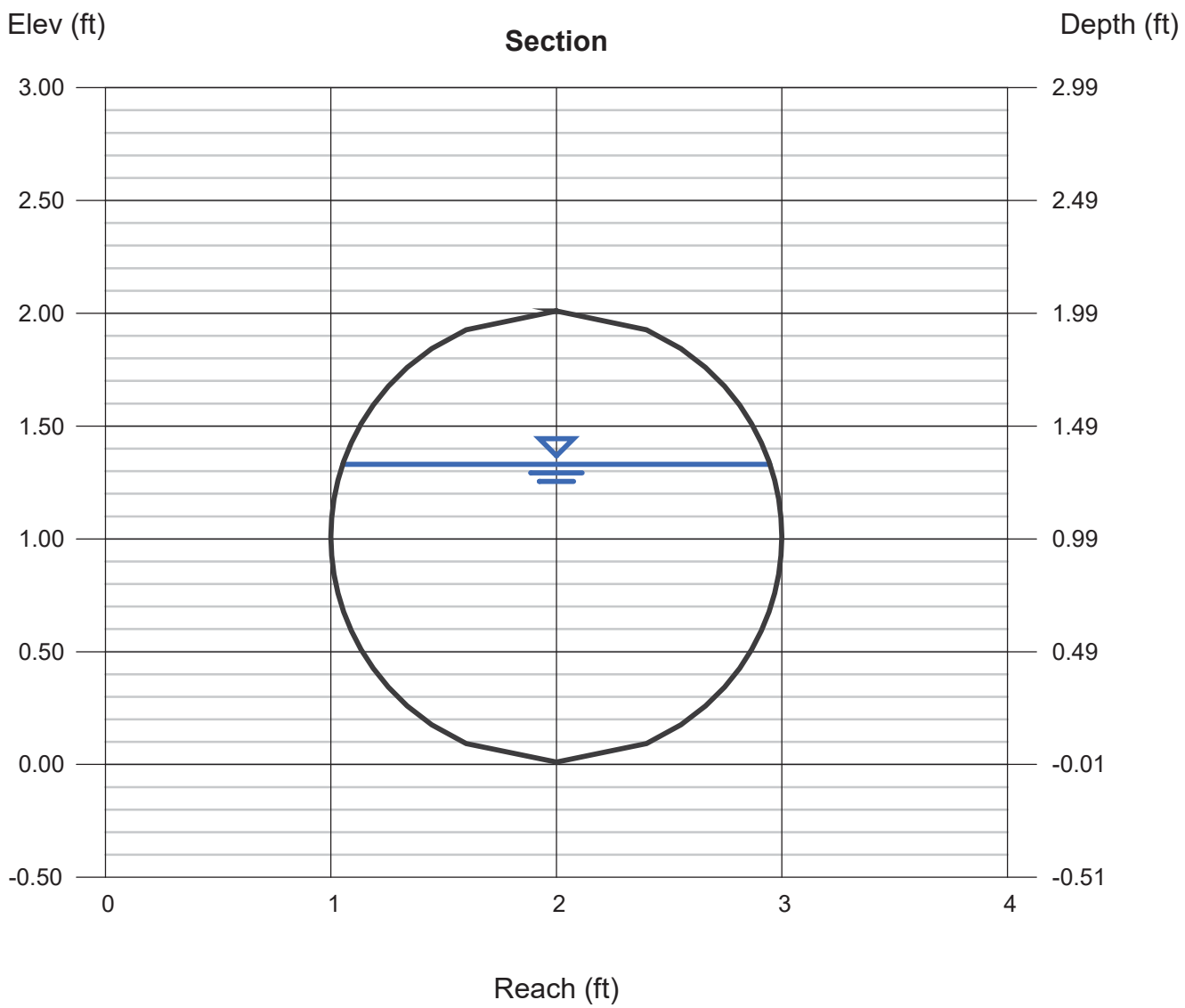
Diameter (ft)	= 2.00
Invert Elev (ft)	= 0.01
Slope (%)	= 0.10
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.54

Highlighted

Depth (ft)	= 1.32
Q (cfs)	= 5.540
Area (sqft)	= 2.21
Velocity (ft/s)	= 2.51
Wetted Perim (ft)	= 3.80
Crit Depth, Yc (ft)	= 0.84
Top Width (ft)	= 1.89
EGL (ft)	= 1.42



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, May 28 2020

Sanitary Line B - Parcel E

Circular

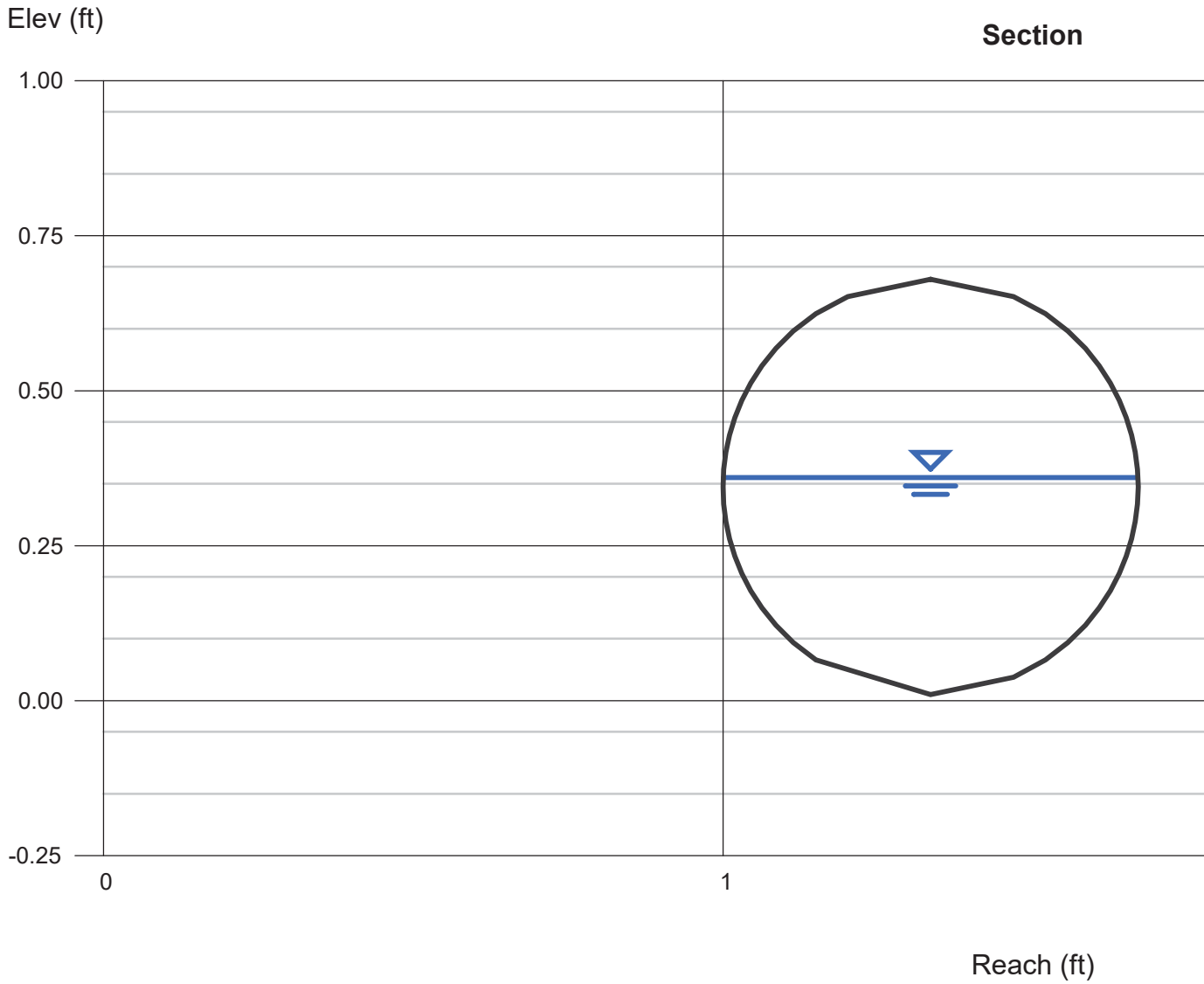
Diameter (ft)	= 0.67
Invert Elev (ft)	= 0.01
Slope (%)	= 0.40
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.41

Highlighted

Depth (ft)	= 0.35
Q (cfs)	= 0.410
Area (sqft)	= 0.19
Velocity (ft/s)	= 2.19
Wetted Perim (ft)	= 1.09
Crit Depth, Yc (ft)	= 0.30
Top Width (ft)	= 0.67
EGL (ft)	= 0.42



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, May 28 2020

Sanitary Line B - Parcel D & E

Circular

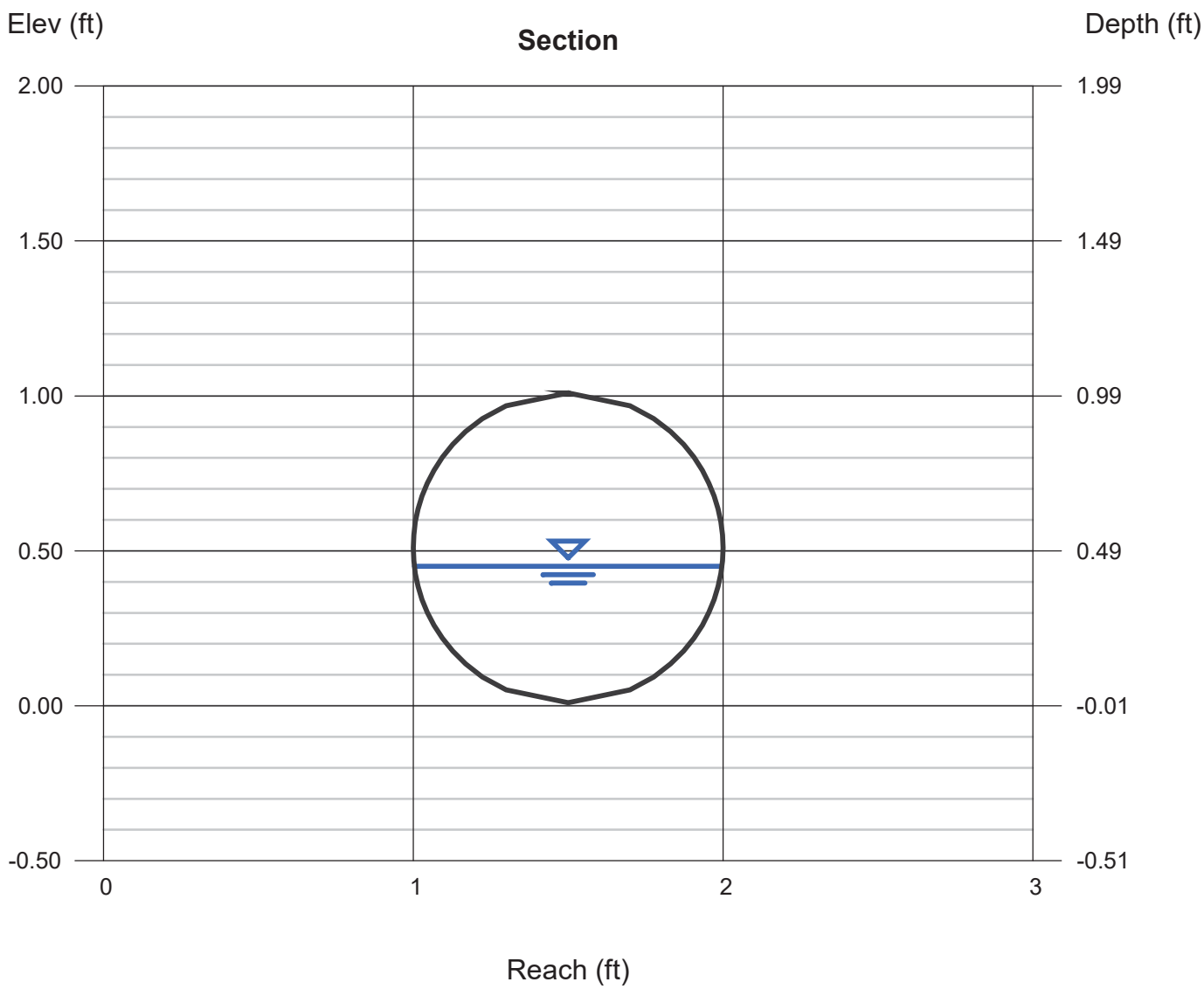
Diameter (ft)	= 1.00
Invert Elev (ft)	= 0.01
Slope (%)	= 0.40
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.89

Highlighted

Depth (ft)	= 0.44
Q (cfs)	= 0.890
Area (sqft)	= 0.34
Velocity (ft/s)	= 2.66
Wetted Perim (ft)	= 1.45
Crit Depth, Yc (ft)	= 0.40
Top Width (ft)	= 0.99
EGL (ft)	= 0.55



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, May 28 2020

Sanitary Line C - Parcel B

Circular

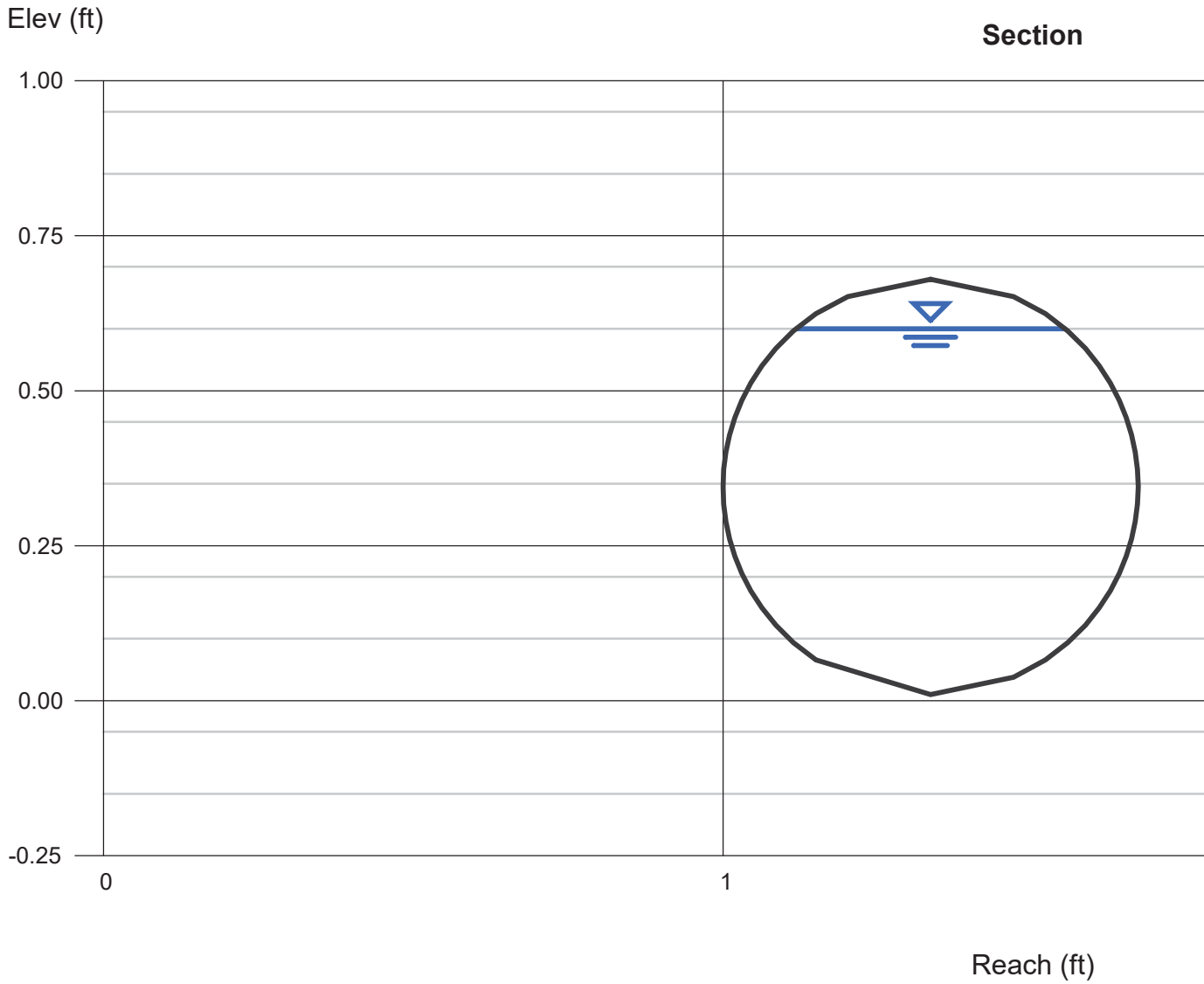
Diameter (ft)	= 0.67
Invert Elev (ft)	= 0.01
Slope (%)	= 0.40
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.81

Highlighted

Depth (ft)	= 0.59
Q (cfs)	= 0.810
Area (sqft)	= 0.33
Velocity (ft/s)	= 2.46
Wetted Perim (ft)	= 1.63
Crit Depth, Yc (ft)	= 0.43
Top Width (ft)	= 0.43
EGL (ft)	= 0.68



APPENDIX E – Water System Calculations and Model

REDTAIL RIDGE
DOMESTIC WATER DEMAND CALCULATIONS
BY PHASE

Redtail Ridge
Project #190108
Date: 2020-05-29
Phase 1

Parcel	Use	Intensity	Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand	Fire Flow Demand**** (GPM)
A	Retirement Community	505 Units	130 gal/pers - 1.3 pers/unit	85345	59.3	148.2	237.1	205.2	228724.6	158.8	11.5	3000
B	Corporate Offices	500000 sq. ft	250 sq.ft/person - 25gal/person	50000	34.7	86.8	138.9	822.6	134000.0	93.1	56.3	3000
C	Shopping Center	10000 sq. ft	0.48 gal/sf	4800	3.3	8.3	13.3	76.2	456672.0	317.1	3.9	3000
	Business Hotel	240 Rooms	60 gal/pers - 1.5 pers/room	21600	15.0	37.5	60.0					3000
	General Office	0 sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0					3000
	Residential Community	600 Units	240 gal / Unit	144000	100.0	250.0	400.0					3000
D	General Office	0 sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	3000
E	General Office	300000 sq. ft	300 sq.ft/person - 25gal/person	25000	17.4	43.4	69.4	90.9	67000.0	46.5	2.6	3000
			Total:	**330745**	**230**	**574**	**919**	**1195**	**886397**	**616**	**77**	
							1322980 GPD					

Phase 2

Parcel	Use	Intensity	Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand	Fire Flow Demand**** (GPM)
A	Retirement Community	505 Units	130 gal/pers - 1.3 pers/unit	85345	59.3	148.2	237.1	205.2	228724.6	158.8	23.0	3000
B	Corporate Offices	0 sq. ft	250 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	0.0	0.0	0.0	56.3	3000
C	Shopping Center	15000 sq. ft	0.48 gal/sf	7200	5.0	12.5	20.0	152.5	344022.7	238.9	7.8	3000
	Business Hotel	0 Rooms	60 gal/pers - 1.5 pers/room	0	0.0	0.0	0.0					3000
	General Office	590000 sq. ft	300 sq.ft/person - 25gal/person	49167	34.1	85.4	136.6					3000
	Residential Community	300 Units	240 gal / Unit	72000	50.0	125.0	200.0					3000
D	General Office	0 sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	107.8	0.0	0.0	6.3	3000
E	General Office	0 sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	123.9	0.0	0.0	5.3	3000
			Total:	**213712**	**148**	**371**	**594**	**589**	**572747**	**398**	**99**	
							854847 GPD					

Phase 3

Parcel	Use	Intensity	Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand	Fire Flow Demand**** (GPM)
A	Retirement Community	316 Units	130 gal/pers - 1.3 pers/unit	53404	37.1	92.7	148.3	129.6	143122.7	99.4	34.5	3000
B	Corporate Offices	0 sq. ft	250 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	0.0	0.0	0.0	56.3	3000
C	Shopping Center	20000 sq. ft	0.48 gal/sf	9600	6.7	16.7	26.7	163.4	123994.7	86.1	11.7	3000
	Business Hotel	0 Rooms	60 gal/pers - 1.5 pers/room	0	0.0	0.0	0.0					3000
	General Office	440000 sq. ft	300 sq.ft/person - 25gal/person	36667	25.5	63.7	101.9					3000
	Residential Community	0 Units	240 gal / Unit	0	0.0	0.0	0.0					3000
D	General Office	0 sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	111.1	0.0	0.0	9.4	3000
E	General Office	30000 sq. ft	300 sq.ft/person - 25gal/person	2500	1.7	4.3	6.9	60.6	6700.0	4.7	7.9	3000
			Total:	**102171**	**71**	**177**	**284**	**465**	**273817**	**190**	**120**	
							408683 GPD					

Phase 4

Parcel	Use	Intensity	Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand	Fire Flow Demand**** (GPM)
A	Retirement Community	0 Units	130 gal/pers - 1.3 pers/unit	0	0.0	0.0	0.0	0.0	0.0	0.0	46.0	3000
B	Corporate Offices	0 sq. ft	250 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	0.0	0.0	0.0	56.3	3000
C	Shopping Center	25000 sq. ft	0.48 gal/sf	12000	8.3	20.8	33.3	152.5	32160.0	22.3	15.7	3000
	Business Hotel	0 Rooms	60 gal/pers - 1.5 pers/room	0	0.0	0.0	0.0					3000
	General Office	0 sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0					3000
	Residential Community	0 Units	240 gal / Unit	0	0.0	0.0	0.0					3000
D	General Office	390000 sq. ft	300 sq.ft/person - 25gal/person	32500	22.6	56.4	90.3	107.8	87100.0	60.5	12.5	3000
E	General Office	0 sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	3000
			Total:	**44500**	**31**	**77**	**124**	**260**	**119260**	**83**	**141**	
							178000 GPD					

Existing Demands	Use	Intensity	Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***
Integrative Family Medicine (IFM)	Medical/Office	72000 sq. ft	0.2 gal/sf	14400	10.0	25.0	40.0	38592.0	26.8
Juniper Village at Lousiville (JVL)	Senior living	52 Units	72 gal/unit	3744	2.6	6.5	10.4	10033.9	7.0
Monarch K-8 (MK8)	School	172800 sq. ft	0.06 gal/sf	10368	7.2	18.0	28.8	27786.2	19.3
Monarch High School (MHS)	School	180000 sq. ft	0.06 gal/sf	10800	7.5	18.8	30.0	28944.0	20.1

*** Per City of Westminster Design Criteria**
****Per City of Louisville Design Criteria**
*****By Request of City of Lousiville**
****** 4 Hour fire duration**

60 gal/pers - 1.5 pers/room	**Hotel**
120 gal/pers - 2 pers/unit	**Residential**
130 gal/pers - 1.3 pers/unit	**Retirement**
0.48 gal/sq.ft.	**Shopping**
300 sq.ft/person - 25gal/person	**General Office**
250 sq.ft/person - 25gal/person	**Corporate Office**

REDTAIL RIDGE
DOMESTIC WATER DEMAND CALCULATIONS
CUMULATIVE TOTALS

Redtail Ridge
Project #190108
Date: 2020-05-29
Phase 1

Parcel	Use	Intensity		Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand	Fire Flow Demand (GPM)
A	Retirement Community	505	Units	130 gal/pers - 1.3 pers/unit	85345	59.3	148.2	237.1	205.2	228724.6	158.8	11.5	3000
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	50000	34.7	86.8	138.9	822.6	134000.0	93.1	56.3	3000
C	Shopping Center	10000	sq. ft	0.48 gal/sf	4800	3.3	8.3	13.3	76.2	456672.0	317.1	3.9	3000
	Business Hotel	240	Rooms	60 gal/pers - 1.5 pers/room	21600	15.0	37.5	60.0					3000
	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0					3000
	Residential Community	600	Units	240 gal / Unit	144000	100.0	250.0	400.0					3000
D	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	3000
E	General Office	300000	sq. ft	300 sq.ft/person - 25gal/person	25000	17.4	43.4	69.4	90.9	67000.0	46.5	2.6	3000
				Total:	**330745**	**229.7**	**574.2**	**918.7**	**1195**	**886397**	**616**	**77.5**	

Phase 2

Parcel	Use	Intensity		Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand (gpm)	Fire Flow Demand (GPM)
A	Retirement Community	1010	Units	130 gal/pers - 1.3 pers/unit	170690	118.5	296.3	474.1	410.4	457449.2	317.7	23.0	3000
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	50000	34.7	86.8	138.9	822.6	134000.0	93.1	56.3	3000
C	Shopping Center	25000	sq. ft	0.48 gal/sf	12000	8.3	20.8	33.3	228.7	800694.7	556.0	7.8	3000
	Business Hotel	240	11	60 gal/pers - 1.5 pers/room	21600	15.0	37.5	60.0					3000
	General Office	590000	sq. ft	300 sq.ft/person - 25gal/person	49167	34.1	85.4	136.6					3000
	Residential Community	900	Units	240 gal / Unit	216000	150.0	375.0	600.0					3000
D	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	107.8	0.0	0.0	6.3	3000
E	General Office	300000	sq. ft	300 sq.ft/person - 25gal/person	25000	17.4	43.4	69.4	214.8	67000.0	46.5	5.3	3000
				Total:	**544457**	**378**	**945**	**1512**	**1784**	**1459144**	**1013**	**99**	

Phase 3

Parcel	Use	Intensity		Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand	Fire Flow Demand (GPM)
A	Retirement Community	1326	Units	130 gal/pers - 1.3 pers/unit	224094	155.6	389.1	622.5	540.0	600571.9	417.1	34.5	3000
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	50000	34.7	86.8	138.9	822.6	134000.0	93.1	56.3	3000
C	Shopping Center	45000	sq. ft	0.48 gal/sf	21600	15.0	37.5	60.0	392.0	924689.3	642.1	11.7	3000
	Business Hotel	240	Rooms	60 gal/pers - 1.5 pers/room	21600	15.0	37.5	60.0					3000
	General Office	1030000	sq. ft	300 sq.ft/person - 25gal/person	85833	59.6	149.0	238.4					3000
	Residential Community	900	Units	240 gal / Unit	216000	150.0	375.0	600.0					3000
D	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0	0.0	0.0	0.0	218.9	0.0	0.0	9.4	3000
E	General Office	330000	sq. ft	300 sq.ft/person - 25gal/person	27500	19.1	47.7	76.4	275.4	73700.0	51.2	7.9	3000
				Total:	**646627**	**449**	**1123**	**1796**	**2249**	**1732961**	**1203**	**120**	

Phase 4

Parcel	Use	Intensity		Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (GPM)**	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***	Irrigation Demand	Fire Flow Demand (GPM)
A	Retirement Community	1326	Units	130 gal/pers - 1.3 pers/unit	224094	155.6	389.1	622.5	540.0	600571.9	417.1	46.0	3000
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	50000	34.7	86.8	138.9	822.6	134000.0	93.1	56.3	3000
C	Shopping Center	70000	sq. ft	0.48 gal/sf	33600	23.3	58.3	93.3	544.5	1019382.7	707.9	15.7	3000
	Business Hotel	240	Rooms	60 gal/pers - 1.5 pers/room	21600	15.0	37.5	60.0					3000
	General Office	1310000	sq. ft	300 sq.ft/person - 25gal/person	109167	75.8	189.5	303.2					3000
	Residential Community	900	Units	240 gal / Unit	216000	150.0	375.0	600.0					3000
D	General Office	390000	sq. ft	300 sq.ft/person - 25gal/person	32500	22.6	56.4	90.3	326.7	87100.0	60.5	12.5	3000
E	General Office	330000	sq. ft	300 sq.ft/person - 25gal/person	27500	19.1	47.7	76.4	275.4	73700.0	51.2	10.6	3000
				Total:	**714461**	**496**	**1240**	**1985**	**2509**	**1914755**	**1330**	**141**	

Existing Demands	Use	Intensity		Demand/ Unit	Average Daily Demand (GPD)	Average Daily Demand (GPM)	Max Day Demand (GPM)*	Peak Day Demand (GPM) *	Peak Day Demand (2.68*Avg day) (GPD)***	Peak Day Demand (2.68*Avg day) (GPM)***
Integrative Family Medicine (IFM)	Medical/Office	72000	sq. ft	0.2 gal/sf	14400	10.0	25.0	40.0	38592.0	26.8
Juniper Village at Lousiville (JVL)	Senior living	52	Units	72 gal/unit	3744	2.6	6.5	10.4	10033.9	7.0
Monarch K-8 (MK8)	School	172800	sq. ft	0.06 gal/sf	10368	7.2	18.0	28.8	27786.2	19.3
Monarch High School (MHS)	School	180000	sq. ft	0.06 gal/sf	10800	7.5	18.8	30.0	28944.0	20.1

*** Per City of Westminster Design Criteria**
****Per City of Louisville Design Criteria**
*****By Request of City of Lousiville**
****** 4 Hour fire duration**

60 gal/pers - 1.5 pers/room	**Hotel**
120 gal/pers - 2 pers/unit	**Residential**
130 gal/pers - 1.3 pers/unit	**Retirement**
0.48 gal/sq.ft.	**Shopping**
300 sq.ft/person - 25gal/person	**General Office**
250 sq.ft/person - 25gal/person	**Corporate Office**

REDTAIL RIDGE
IRRIGATION DEMAND CALCULATIONS

Redtail Ridge
Project #190108
Date: 2020-05-29
Irrigation Demands

Parcel	Use	Acreage	Walks, Landscape & Ammenities %	Walks, Landscape & Ammenities (AC)	Irrigated Landscape %	Total Estimated Landscape (AC)	Sod/Grass (AC)	Drip (AC)	Native (AC)	Irrigation Demand (AC-ft/yr)*	Irrigation Demand (gpm)
A	Retirement community	60.00	40	24.0	50	12.00	3.6	3.6	4.8	17.40	25.89
	Park	15.50	100	15.5	60	9.30	2.8	2.8	3.7	13.49	20.07
	TOTAL	**75.5**		**39.5**		**21.30**	**6.4**	**6.4**	**8.5**	**30.9**	**45.96**
B	Office Space	91.40	45	41.1	80	32.90	3.3	4.9	24.7	37.84	56.31
	TOTAL	**91.4**		**41.1**		**32.90**	**3.3**	**4.9**	**24.7**	**37.8**	**56.31**
C	Mixed use	60.50	30	18.2	40	7.26	2.2	2.2	2.9	10.53	15.66
	TOTAL	**60.5**		**18.2**		**7.26**	**2.2**	**2.2**	**2.9**	**10.5**	**15.66**
D	Mixed use	36.30	40	14.5	40	5.81	1.7	1.7	2.3	8.42	12.53
	TOTAL	**36.3**		**14.5**		**5.81**	**1.7**	**1.7**	**2.3**	**8.4**	**12.53**
E	Mixed use	30.60	40	12.2	40	4.90	1.5	1.5	2.0	7.10	10.56
	TOTAL	**30.6**		**12.2**		**4.90**	**1.5**	**1.5**	**2.0**	**7.1**	**10.56**
ROW	ROW	37.00	40	14.8	100	14.80	4.4	4.4	5.9	21.46	31.93
	TOTAL	**37**		**14.8**		**14.80**	**4.4**	**4.4**	**7.9**	**23.4**	**31.93**

***Sod = 2.5 AC-ft/yr**
***Drip = 1.0 AC-ft/yr**
***Native = 1.0 AC-ft/yr**

DEVELOPMENT ACREAGE

	TOTAL ACRES	OTHER (AC)	PUBLIC LANDS (AC)				Developable (AC)
		Easement	Open Space	Trail Corridor	Park	Fire & Police	
Parcel A	101.10	1.61	23.99	-	15.50	0.99	60.00
Parcel B	91.40	-	-	-	-	-	91.40
Parcel C	68.20	6.27	-	1.43	-	0.02	60.50
Parcel D	38.70	0.10	-	2.23	-	-	36.30
Parcel E	35.60	5.00	-	-	-	-	30.60
Parcel F	17.10	0.16	8.60	-	-	-	-
ROW	37.00						
Total	**389.10**	**13.14**	**32.59**	**3.66**	**15.50**	**1.02**	**278.80**

Redtail Ridge
Project #190108
Date: 2020-05-29
Yearly Demand (Cumulative by Phase)

Phase 1

Parcel	Use	Intensity		Demand/ Unit	Average Yearly Demand (GPY)
A	Retirement Community	500	Units	130 gal/pers - 1.3 pers/unit	31150925
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	18250000
C	Shopping Center	10000	sq. ft	0.48 gal/sf	1752000
	Business Hotel	240	Rooms	60 gal/room	7884000
	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0
	Residential Community	600	Units	240 gal / Unit	52560000
D	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0
E	General Office	300000	sq. ft	300 sq.ft/person - 25gal/person	9125000
				Total:	**120,721,925**

Phase 2

Parcel	Use	Intensity		Demand/ Unit	Average Yearly Demand (GPY)
A	Retirement Community	1000	Units	130 gal/pers - 1.3 pers/unit	62301850
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	18250000
C	Shopping Center	25000	sq. ft	0.48 gal/sf	4380000
	Business Hotel	240	11	60 gal/room	7884000
	General Office	590000	sq. ft	300 sq.ft/person - 25gal/person	17945833
	Residential Community	900	Units	240 gal / Unit	78840000
D	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0
E	General Office	300000	sq. ft	300 sq.ft/person - 25gal/person	9125000
				Total:	**198,726,683**

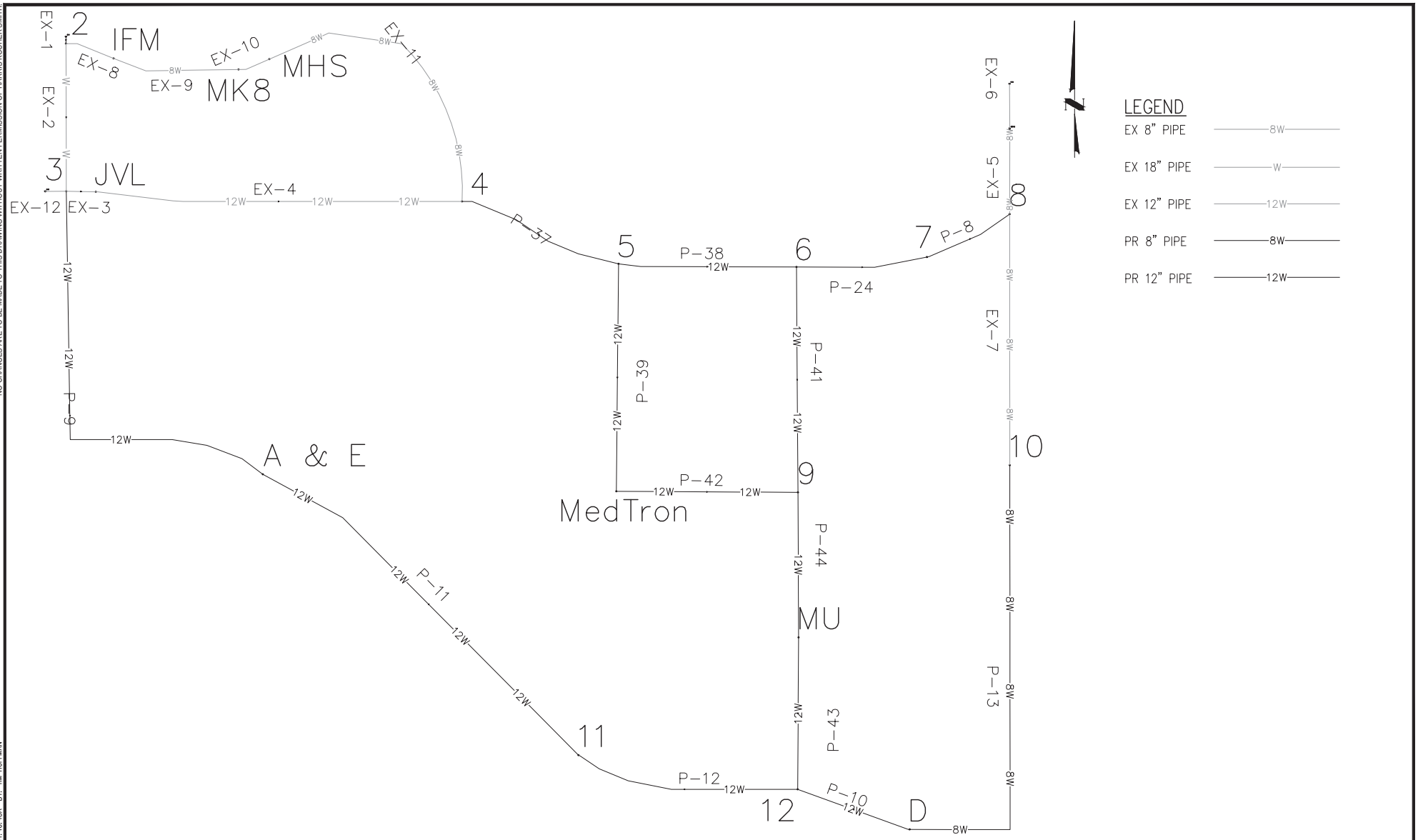
Phase 3

Parcel	Use	Intensity		Demand/ Unit	Average Yearly Demand (GPY)
A	Retirement Community	1326	Units	130 gal/pers - 1.3 pers/unit	81794310
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	18250000
C	Shopping Center	45000	sq. ft	0.48 gal/sf	7884000
	Business Hotel	240	Rooms	60 gal/room	7884000
	General Office	1030000	sq. ft	300 sq.ft/person - 25gal/person	31329167
	Residential Community	900	Units	240 gal / Unit	78840000
D	General Office	0	sq. ft	300 sq.ft/person - 25gal/person	0
E	General Office	330000	sq. ft	300 sq.ft/person - 25gal/person	10037500
				Total:	**236,018,977**

Phase 4

Parcel	Use	Intensity		Demand/ Unit	Average Yearly Demand (GPY)
A	Retirement Community	1326	Units	130 gal/pers - 1.3 pers/unit	81794310
B	Corporate Offices	500000	sq. ft	250 sq.ft/person - 25gal/person	18250000
C	Shopping Center	70000	sq. ft	0.48 gal/sf	12264000
	Business Hotel	240	Rooms	60 gal/room	7884000
	General Office	1310000	sq. ft	300 sq.ft/person - 25gal/person	39845833
	Residential Community	900	Units	240 gal / Unit	78840000
D	General Office	390000	sq. ft	300 sq.ft/person - 25gal/person	11862500
E	General Office	330000	sq. ft	300 sq.ft/person - 25gal/person	10037500
				Total:	**260,778,143**

NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH.



HARRIS KOCHER SMITH
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HarrisKocherSmith.com

BRUE·BAUKOL CAPITAL PARTNERS

REDTAIL RIDGE
PROPOSED WATER NETWORK

ISSUE DATE: 06-19-2019	PROJECT #: 190108
DATE	REVISION COMMENTS
03-03-2020	PER CITY OF LOUISVILLE COMMENTS

DESIGNED BY: TEH
CHECKED BY: TEH
DRAWN BY: TEH

SHEET NO.
1
1 OF 1

FILEPATH: P:\190108\DOCUMENTS\UTILITIES\WATER\APP E WATER LAYOUT.DWG LAYOUT: LAYOUT1
NO XREFs
PLOTTED: THU 02/27/20 11:40:48A BY: TIM HOFFMAN

Scenario: P1 Max
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,624.89	97
MU	5,381.86	321	5,624.80	105
MK8	5,459.71	18	5,625.66	72
MHS	5,456.88	19	5,625.62	73
JVL	5,467.02	7	5,625.88	69
IFM	5,470.66	25	5,625.87	67
D	5,370.00	0	5,624.87	110
A & E	5,432.07	219	5,625.05	83
12	5,377.00	0	5,624.86	107
11	5,396.13	0	5,624.93	99
10	5,367.00	0	5,624.92	112
9	5,386.49	0	5,624.88	103
8	5,370.00	0	5,624.95	110
7	5,380.00	0	5,624.96	106
6	5,393.70	0	5,624.96	100
5	5,412.25	0	5,625.04	92
4	5,430.00	0	5,625.39	85
3	5,470.00	0	5,625.92	67
2	5,475.00	149	5,625.99	65

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Scenario: P1 Max
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	166	1.06	0.001
P-37	960	4	5	12.0	349	0.99	0.000
P-9	2,529	3	A & E	12.0	340	0.97	0.000
EX-1	39	R-1	2	18.0	742	0.94	0.000
EX-8	284	IFM	2	8.0	-132	0.84	0.000
EX-3	166	3	JVL	12.0	286	0.81	0.000
EX-4	2,066	JVL	4	12.0	279	0.79	0.000
EX-9	718	MK8	IFM	8.0	-107	0.68	0.000
EX-2	831	2	3	18.0	461	0.58	0.000
EX-10	185	MHS	MK8	8.0	-89	0.57	0.000
P-39	1,281	5	MedTron	12.0	191	0.54	0.000
P-44	817	MU	9	12.0	-174	0.49	0.000
P-38	1,003	5	6	12.0	158	0.45	0.000
EX-11	1,761	4	MHS	8.0	-70	0.45	0.000
P-43	856	12	MU	12.0	147	0.42	0.000
P-41	1,269	9	6	12.0	-132	0.37	0.000
P-11	2,397	A & E	11	12.0	121	0.34	0.000
P-12	1,276	11	12	12.0	121	0.34	0.000
EX-7	1,414	10	8	8.0	-26	0.17	0.000
P-13	2,618	D	10	8.0	-26	0.17	0.000
P-42	1,023	MedTron	9	12.0	42	0.12	0.000
P-10	671	12	D	12.0	-26	0.07	0.000
P-8	528	7	8	12.0	26	0.07	0.000
P-24	740	6	7	12.0	26	0.07	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P1 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,597.06	85
MU	5,381.86	3,321	5,588.93	90
MK8	5,459.71	18	5,620.09	69
MHS	5,456.88	19	5,619.11	70
JVL	5,467.02	7	5,623.40	68
IFM	5,470.66	25	5,624.14	66
D	5,370.00	0	5,593.82	97
A & E	5,432.07	219	5,609.81	77
12	5,377.00	0	5,593.74	94
11	5,396.13	0	5,599.32	88
10	5,367.00	0	5,596.16	99
9	5,386.49	0	5,594.97	90
8	5,370.00	0	5,597.42	98
7	5,380.00	0	5,597.48	94
6	5,393.70	0	5,597.57	88
5	5,412.25	0	5,600.55	81
4	5,430.00	0	5,610.40	78
3	5,470.00	0	5,624.45	67
2	5,475.00	149	5,625.89	65

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Scenario: P1 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	835	5.33	0.013
P-37	960	4	5	12.0	2,128	6.04	0.010
P-9	2,529	3	A & E	12.0	1,562	4.43	0.006
EX-1	39	R-1	2	18.0	3,072	3.87	0.003
EX-8	284	IFM	2	8.0	-556	3.55	0.006
EX-3	166	3	JVL	12.0	1,640	4.65	0.006
EX-4	2,066	JVL	4	12.0	1,634	4.63	0.006
EX-9	718	MK8	IFM	8.0	-531	3.39	0.006
EX-2	831	2	3	18.0	2,367	2.98	0.002
EX-10	185	MHS	MK8	8.0	-513	3.27	0.005
P-39	1,281	5	MedTron	12.0	1,040	2.95	0.003
P-44	817	MU	9	12.0	-1,783	5.06	0.007
P-38	1,003	5	6	12.0	1,088	3.09	0.003
EX-11	1,761	4	MHS	8.0	-494	3.15	0.005
P-43	856	12	MU	12.0	1,538	4.36	0.006
P-41	1,269	9	6	12.0	-892	2.53	0.002
P-11	2,397	A & E	11	12.0	1,343	3.81	0.004
P-12	1,276	11	12	12.0	1,343	3.81	0.004
EX-7	1,414	10	8	8.0	-196	1.25	0.001
P-13	2,618	D	10	8.0	-196	1.25	0.001
P-42	1,023	MedTron	9	12.0	890	2.53	0.002
P-10	671	12	D	12.0	-196	0.56	0.000
P-8	528	7	8	12.0	196	0.56	0.000
P-24	740	6	7	12.0	196	0.56	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P1 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,610.59	91
MU	5,381.86	321	5,607.22	98
MK8	5,459.71	18	5,622.57	70
MHS	5,456.88	19	5,622.02	71
JVL	5,467.02	7	5,623.80	68
IFM	5,470.66	25	5,624.87	67
D	5,370.00	0	5,605.95	102
A & E	5,432.07	3,219	5,596.42	71
12	5,377.00	0	5,605.84	99
11	5,396.13	0	5,602.57	89
10	5,367.00	0	5,608.93	105
9	5,386.49	0	5,609.70	97
8	5,370.00	0	5,610.55	104
7	5,380.00	0	5,610.63	100
6	5,393.70	0	5,610.75	94
5	5,412.25	0	5,612.31	87
4	5,430.00	0	5,617.31	81
3	5,470.00	0	5,624.33	67
2	5,475.00	149	5,625.89	65

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Scenario: P1 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	870	5.55	0.014
P-37	960	4	5	12.0	1,477	4.19	0.005
P-9	2,529	3	A & E	12.0	2,213	6.28	0.011
EX-1	39	R-1	2	18.0	3,038	3.83	0.003
EX-8	284	IFM	2	8.0	-416	2.66	0.004
EX-3	166	3	JVL	12.0	1,129	3.20	0.003
EX-4	2,066	JVL	4	12.0	1,123	3.18	0.003
EX-9	718	MK8	IFM	8.0	-391	2.50	0.003
EX-2	831	2	3	18.0	2,472	3.12	0.002
EX-10	185	MHS	MK8	8.0	-373	2.38	0.003
P-39	1,281	5	MedTron	12.0	709	2.01	0.001
P-44	817	MU	9	12.0	-1,104	3.13	0.003
P-38	1,003	5	6	12.0	768	2.18	0.002
EX-11	1,761	4	MHS	8.0	-354	2.26	0.003
P-43	856	12	MU	12.0	-783	2.22	0.002
P-41	1,269	9	6	12.0	-544	1.54	0.001
P-11	2,397	A & E	11	12.0	-1,007	2.86	0.003
P-12	1,276	11	12	12.0	-1,007	2.86	0.003
EX-7	1,414	10	8	8.0	-224	1.43	0.001
P-13	2,618	D	10	8.0	-224	1.43	0.001
P-42	1,023	MedTron	9	12.0	560	1.59	0.001
P-10	671	12	D	12.0	-224	0.63	0.000
P-8	528	7	8	12.0	224	0.63	0.000
P-24	740	6	7	12.0	224	0.63	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P1 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	3,149	5,589.51	82
MU	5,381.86	321	5,596.20	93
MK8	5,459.71	18	5,619.51	69
MHS	5,456.88	19	5,618.42	70
JVL	5,467.02	7	5,623.30	68
IFM	5,470.66	25	5,623.97	66
D	5,370.00	0	5,598.65	99
A & E	5,432.07	219	5,612.00	78
12	5,377.00	0	5,598.69	96
11	5,396.13	0	5,603.31	90
10	5,367.00	0	5,597.49	100
9	5,386.49	0	5,594.96	90
8	5,370.00	0	5,596.86	98
7	5,380.00	0	5,596.83	94
6	5,393.70	0	5,596.78	88
5	5,412.25	0	5,597.77	80
4	5,430.00	0	5,608.76	77
3	5,470.00	0	5,624.47	67
2	5,475.00	149	5,625.89	65

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Scenario: P1 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	829	5.29	0.013
P-37	960	4	5	12.0	2,257	6.40	0.011
P-9	2,529	3	A & E	12.0	1,432	4.06	0.005
EX-1	39	R-1	2	18.0	3,079	3.88	0.003
EX-8	284	IFM	2	8.0	-584	3.73	0.007
EX-3	166	3	JVL	12.0	1,742	4.94	0.007
EX-4	2,066	JVL	4	12.0	1,735	4.92	0.007
EX-9	718	MK8	IFM	8.0	-559	3.57	0.006
EX-2	831	2	3	18.0	2,345	2.96	0.002
EX-10	185	MHS	MK8	8.0	-541	3.45	0.006
P-39	1,281	5	MedTron	12.0	1,656	4.70	0.006
P-44	817	MU	9	12.0	758	2.15	0.002
P-38	1,003	5	6	12.0	602	1.71	0.001
EX-11	1,761	4	MHS	8.0	-522	3.33	0.005
P-43	856	12	MU	12.0	1,079	3.06	0.003
P-41	1,269	9	6	12.0	-736	2.09	0.001
P-11	2,397	A & E	11	12.0	1,213	3.44	0.004
P-12	1,276	11	12	12.0	1,213	3.44	0.004
EX-7	1,414	10	8	8.0	134	0.86	0.000
P-13	2,618	D	10	8.0	134	0.86	0.000
P-42	1,023	MedTron	9	12.0	-1,494	4.24	0.005
P-10	671	12	D	12.0	134	0.38	0.000
P-8	528	7	8	12.0	-134	0.38	0.000
P-24	740	6	7	12.0	-134	0.38	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P2 Max
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,623.25	97
MU	5,381.86	564	5,622.84	104
MK8	5,459.71	18	5,625.29	72
MHS	5,456.88	19	5,625.19	73
JVL	5,467.02	7	5,625.70	69
IFM	5,470.66	25	5,625.75	67
D	5,370.00	0	5,622.95	109
A & E	5,432.07	392	5,623.33	83
12	5,377.00	0	5,622.94	106
11	5,396.13	72	5,623.01	98
10	5,367.00	0	5,623.20	111
9	5,386.49	0	5,623.17	102
8	5,370.00	0	5,623.34	110
7	5,380.00	0	5,623.35	105
6	5,393.70	0	5,623.36	99
5	5,412.25	0	5,623.60	91
4	5,430.00	0	5,624.49	84
3	5,470.00	0	5,625.80	67
2	5,475.00	149	5,625.98	65

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Scenario: P2 Max
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	277	1.77	0.002
P-37	960	4	5	12.0	581	1.65	0.001
P-9	2,529	3	A & E	12.0	597	1.69	0.001
EX-1	39	R-1	2	18.0	1,118	1.41	0.000
EX-8	284	IFM	2	8.0	-189	1.20	0.001
EX-3	166	3	JVL	12.0	460	1.31	0.001
EX-4	2,066	JVL	4	12.0	454	1.29	0.001
EX-9	718	MK8	IFM	8.0	-164	1.05	0.001
EX-2	831	2	3	18.0	780	0.98	0.000
EX-10	185	MHS	MK8	8.0	-146	0.93	0.001
P-39	1,281	5	MedTron	12.0	302	0.86	0.000
P-44	817	MU	9	12.0	-372	1.05	0.000
P-38	1,003	5	6	12.0	279	0.79	0.000
EX-11	1,761	4	MHS	8.0	-127	0.81	0.000
P-43	856	12	MU	12.0	192	0.55	0.000
P-41	1,269	9	6	12.0	-219	0.62	0.000
P-11	2,397	A & E	11	12.0	204	0.58	0.000
P-12	1,276	11	12	12.0	133	0.38	0.000
EX-7	1,414	10	8	8.0	-60	0.38	0.000
P-13	2,618	D	10	8.0	-60	0.38	0.000
P-42	1,023	MedTron	9	12.0	152	0.43	0.000
P-10	671	12	D	12.0	-60	0.17	0.000
P-8	528	7	8	12.0	60	0.17	0.000
P-24	740	6	7	12.0	60	0.17	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P2 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,591.31	83
MU	5,381.86	3,564	5,581.52	86
MK8	5,459.71	18	5,618.95	69
MHS	5,456.88	19	5,617.78	70
JVL	5,467.02	7	5,622.78	67
IFM	5,470.66	25	5,623.79	66
D	5,370.00	0	5,586.80	94
A & E	5,432.07	392	5,604.38	75
12	5,377.00	0	5,586.69	91
11	5,396.13	72	5,592.46	85
10	5,367.00	0	5,589.94	96
9	5,386.49	0	5,588.77	88
8	5,370.00	0	5,591.64	96
7	5,380.00	0	5,591.73	92
6	5,393.70	0	5,591.85	86
5	5,412.25	0	5,595.45	79
4	5,430.00	0	5,607.25	77
3	5,470.00	0	5,624.04	67
2	5,475.00	149	5,625.87	65

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Scenario: P2 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	948	6.05	0.017
P-37	960	4	5	12.0	2,346	6.65	0.012
P-9	2,529	3	A & E	12.0	1,831	5.20	0.008
EX-1	39	R-1	2	18.0	3,447	4.35	0.003
EX-8	284	IFM	2	8.0	-609	3.89	0.007
EX-3	166	3	JVL	12.0	1,805	5.12	0.008
EX-4	2,066	JVL	4	12.0	1,799	5.10	0.008
EX-9	718	MK8	IFM	8.0	-584	3.73	0.007
EX-2	831	2	3	18.0	2,688	3.39	0.002
EX-10	185	MHS	MK8	8.0	-566	3.61	0.006
P-39	1,281	5	MedTron	12.0	1,139	3.23	0.003
P-44	817	MU	9	12.0	-1,967	5.58	0.009
P-38	1,003	5	6	12.0	1,206	3.42	0.004
EX-11	1,761	4	MHS	8.0	-547	3.49	0.006
P-43	856	12	MU	12.0	1,597	4.53	0.006
P-41	1,269	9	6	12.0	-977	2.77	0.002
P-11	2,397	A & E	11	12.0	1,439	4.08	0.005
P-12	1,276	11	12	12.0	1,367	3.88	0.005
EX-7	1,414	10	8	8.0	-230	1.47	0.001
P-13	2,618	D	10	8.0	-230	1.47	0.001
P-42	1,023	MedTron	9	12.0	990	2.81	0.002
P-10	671	12	D	12.0	-230	0.65	0.000
P-8	528	7	8	12.0	230	0.65	0.000
P-24	740	6	7	12.0	230	0.65	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P2 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,605.41	89
MU	5,381.86	564	5,600.63	95
MK8	5,459.71	18	5,621.52	70
MHS	5,456.88	19	5,620.80	71
JVL	5,467.02	7	5,623.21	68
IFM	5,470.66	25	5,624.55	67
D	5,370.00	0	5,599.44	99
A & E	5,432.07	3,393	5,590.41	69
12	5,377.00	0	5,599.31	96
11	5,396.13	72	5,595.94	86
10	5,367.00	0	5,603.27	102
9	5,386.49	0	5,604.14	94
8	5,370.00	0	5,605.34	102
7	5,380.00	0	5,605.44	98
6	5,393.70	0	5,605.59	92
5	5,412.25	0	5,607.71	85
4	5,430.00	0	5,614.46	80
3	5,470.00	0	5,623.92	67
2	5,475.00	149	5,625.87	65

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Scenario: P2 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	980	6.26	0.018
P-37	960	4	5	12.0	1,735	4.92	0.007
P-9	2,529	3	A & E	12.0	2,442	6.93	0.013
EX-1	39	R-1	2	18.0	3,415	4.31	0.003
EX-8	284	IFM	2	8.0	-478	3.05	0.005
EX-3	166	3	JVL	12.0	1,326	3.76	0.004
EX-4	2,066	JVL	4	12.0	1,319	3.74	0.004
EX-9	718	MK8	IFM	8.0	-453	2.89	0.004
EX-2	831	2	3	18.0	2,788	3.51	0.002
EX-10	185	MHS	MK8	8.0	-435	2.78	0.004
P-39	1,281	5	MedTron	12.0	829	2.35	0.002
P-44	817	MU	9	12.0	-1,330	3.77	0.004
P-38	1,003	5	6	12.0	906	2.57	0.002
EX-11	1,761	4	MHS	8.0	-416	2.66	0.004
P-43	856	12	MU	12.0	-766	2.17	0.002
P-41	1,269	9	6	12.0	-650	1.84	0.001
P-11	2,397	A & E	11	12.0	-950	2.70	0.002
P-12	1,276	11	12	12.0	-1,022	2.90	0.003
EX-7	1,414	10	8	8.0	-256	1.63	0.001
P-13	2,618	D	10	8.0	-256	1.63	0.001
P-42	1,023	MedTron	9	12.0	680	1.93	0.001
P-10	671	12	D	12.0	-256	0.73	0.000
P-8	528	7	8	12.0	256	0.73	0.000
P-24	740	6	7	12.0	256	0.73	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P2 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	3,149	5,583.57	79
MU	5,381.86	564	5,589.31	90
MK8	5,459.71	18	5,618.33	69
MHS	5,456.88	19	5,617.04	69
JVL	5,467.02	7	5,622.68	67
IFM	5,470.66	25	5,623.61	66
D	5,370.00	0	5,592.05	96
A & E	5,432.07	392	5,606.89	76
12	5,377.00	0	5,592.07	93
11	5,396.13	72	5,596.88	87
10	5,367.00	0	5,591.37	97
9	5,386.49	0	5,588.57	87
8	5,370.00	0	5,591.01	96
7	5,380.00	0	5,590.99	91
6	5,393.70	0	5,590.96	85
5	5,412.25	0	5,592.46	78
4	5,430.00	0	5,605.49	76
3	5,470.00	0	5,624.07	67
2	5,475.00	149	5,625.86	65

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Scenario: P2 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	941	6.01	0.016
P-37	960	4	5	12.0	2,475	7.02	0.014
P-9	2,529	3	A & E	12.0	1,702	4.83	0.007
EX-1	39	R-1	2	18.0	3,454	4.35	0.003
EX-8	284	IFM	2	8.0	-637	4.07	0.008
EX-3	166	3	JVL	12.0	1,906	5.41	0.008
EX-4	2,066	JVL	4	12.0	1,900	5.39	0.008
EX-9	718	MK8	IFM	8.0	-612	3.91	0.007
EX-2	831	2	3	18.0	2,667	3.36	0.002
EX-10	185	MHS	MK8	8.0	-594	3.79	0.007
P-39	1,281	5	MedTron	12.0	1,723	4.89	0.007
P-44	817	MU	9	12.0	574	1.63	0.001
P-38	1,003	5	6	12.0	752	2.13	0.001
EX-11	1,761	4	MHS	8.0	-575	3.67	0.007
P-43	856	12	MU	12.0	1,138	3.23	0.003
P-41	1,269	9	6	12.0	-852	2.42	0.002
P-11	2,397	A & E	11	12.0	1,310	3.72	0.004
P-12	1,276	11	12	12.0	1,238	3.51	0.004
EX-7	1,414	10	8	8.0	100	0.64	0.000
P-13	2,618	D	10	8.0	100	0.64	0.000
P-42	1,023	MedTron	9	12.0	-1,426	4.05	0.005
P-10	671	12	D	12.0	100	0.28	0.000
P-8	528	7	8	12.0	-100	0.28	0.000
P-24	740	6	7	12.0	-100	0.28	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P3 Max
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,622.67	96
MU	5,381.86	654	5,622.13	104
MK8	5,459.71	18	5,625.16	72
MHS	5,456.88	19	5,625.05	73
JVL	5,467.02	7	5,625.63	69
IFM	5,470.66	25	5,625.71	67
D	5,370.00	0	5,622.28	109
A & E	5,432.07	525	5,622.58	82
12	5,377.00	0	5,622.27	106
11	5,396.13	0	5,622.38	98
10	5,367.00	0	5,622.61	111
9	5,386.49	0	5,622.56	102
8	5,370.00	0	5,622.78	109
7	5,380.00	0	5,622.79	105
6	5,393.70	0	5,622.80	99
5	5,412.25	0	5,623.10	91
4	5,430.00	0	5,624.17	84
3	5,470.00	0	5,625.75	67
2	5,475.00	0	5,625.98	65

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Scenario: P3 Max
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	644	1.83	0.001
EX-12	118	R-3	3	8.0	310	1.98	0.002
P-44	817	MU	9	12.0	-428	1.21	0.001
P-9	2,529	3	A & E	12.0	684	1.94	0.001
EX-3	166	3	JVL	12.0	508	1.44	0.001
EX-4	2,066	JVL	4	12.0	501	1.42	0.001
P-43	856	12	MU	12.0	226	0.64	0.000
EX-1	39	R-1	2	18.0	1,086	1.37	0.000
P-11	2,397	A & E	11	12.0	159	0.45	0.000
EX-8	284	IFM	2	8.0	-205	1.31	0.001
P-12	1,276	11	12	12.0	159	0.45	0.000
EX-9	718	MK8	IFM	8.0	-180	1.15	0.001
EX-10	185	MHS	MK8	8.0	-162	1.03	0.001
EX-11	1,761	4	MHS	8.0	-143	0.91	0.000
P-38	1,003	5	6	12.0	312	0.89	0.000
EX-2	831	2	3	18.0	882	1.11	0.000
P-39	1,281	5	MedTron	12.0	332	0.94	0.000
P-42	1,023	MedTron	9	12.0	183	0.52	0.000
P-41	1,269	9	6	12.0	-245	0.70	0.000
EX-7	1,414	10	8	8.0	-67	0.43	0.000
P-13	2,618	D	10	8.0	-67	0.43	0.000
P-8	528	7	8	12.0	67	0.19	0.000
P-24	740	6	7	12.0	67	0.19	0.000
P-10	671	12	D	12.0	-67	0.19	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P3 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,589.76	82
MU	5,381.86	3,654	5,579.50	86
MK8	5,459.71	18	5,618.65	69
MHS	5,456.88	19	5,617.42	69
JVL	5,467.02	7	5,622.60	67
IFM	5,470.66	25	5,623.71	66
D	5,370.00	0	5,585.03	93
A & E	5,432.07	525	5,602.31	74
12	5,377.00	0	5,584.91	90
11	5,396.13	0	5,590.95	84
10	5,367.00	0	5,588.31	96
9	5,386.49	0	5,587.09	87
8	5,370.00	0	5,590.09	95
7	5,380.00	0	5,590.18	91
6	5,393.70	0	5,590.31	85
5	5,412.25	0	5,594.07	79
4	5,430.00	0	5,606.39	76
3	5,470.00	0	5,623.91	67
2	5,475.00	0	5,625.87	65

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Scenario: P3 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	2,401	6.81	0.013
EX-12	118	R-3	3	8.0	982	6.27	0.018
P-44	817	MU	9	12.0	-2,016	5.72	0.009
P-9	2,529	3	A & E	12.0	1,927	5.47	0.009
EX-3	166	3	JVL	12.0	1,847	5.24	0.008
EX-4	2,066	JVL	4	12.0	1,840	5.22	0.008
P-43	856	12	MU	12.0	1,637	4.65	0.006
EX-1	39	R-1	2	18.0	3,415	4.31	0.003
P-11	2,397	A & E	11	12.0	1,402	3.98	0.005
EX-8	284	IFM	2	8.0	-623	3.98	0.008
P-12	1,276	11	12	12.0	1,402	3.98	0.005
EX-9	718	MK8	IFM	8.0	-598	3.82	0.007
EX-10	185	MHS	MK8	8.0	-580	3.70	0.007
EX-11	1,761	4	MHS	8.0	-561	3.58	0.006
P-38	1,003	5	6	12.0	1,236	3.51	0.004
EX-2	831	2	3	18.0	2,792	3.52	0.002
P-39	1,281	5	MedTron	12.0	1,165	3.31	0.003
P-42	1,023	MedTron	9	12.0	1,016	2.88	0.003
P-41	1,269	9	6	12.0	-1,000	2.84	0.003
EX-7	1,414	10	8	8.0	-236	1.50	0.001
P-13	2,618	D	10	8.0	-236	1.50	0.001
P-8	528	7	8	12.0	236	0.67	0.000
P-24	740	6	7	12.0	236	0.67	0.000
P-10	671	12	D	12.0	-236	0.67	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P3 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,603.91	88
MU	5,381.86	654	5,598.71	94
MK8	5,459.71	18	5,621.23	70
MHS	5,456.88	19	5,620.45	71
JVL	5,467.02	7	5,623.02	67
IFM	5,470.66	25	5,624.46	67
D	5,370.00	0	5,597.62	98
A & E	5,432.07	3,525	5,588.16	68
12	5,377.00	0	5,597.48	95
11	5,396.13	0	5,594.24	86
10	5,367.00	0	5,601.65	102
9	5,386.49	0	5,602.53	93
8	5,370.00	0	5,603.83	101
7	5,380.00	0	5,603.94	97
6	5,393.70	0	5,604.10	91
5	5,412.25	0	5,606.38	84
4	5,430.00	0	5,613.63	79
3	5,470.00	0	5,623.78	67
2	5,475.00	0	5,625.87	65

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Scenario: P3 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	1,804	5.12	0.008
EX-12	118	R-3	3	8.0	1,013	6.47	0.019
P-44	817	MU	9	12.0	-1,391	3.95	0.005
P-9	2,529	3	A & E	12.0	2,524	7.16	0.014
EX-3	166	3	JVL	12.0	1,377	3.91	0.005
EX-4	2,066	JVL	4	12.0	1,371	3.89	0.005
P-43	856	12	MU	12.0	-738	2.09	0.001
EX-1	39	R-1	2	18.0	3,383	4.27	0.003
P-11	2,397	A & E	11	12.0	-1,000	2.84	0.003
EX-8	284	IFM	2	8.0	-495	3.16	0.005
P-12	1,276	11	12	12.0	-1,000	2.84	0.003
EX-9	718	MK8	IFM	8.0	-470	3.00	0.005
EX-10	185	MHS	MK8	8.0	-452	2.88	0.004
EX-11	1,761	4	MHS	8.0	-433	2.76	0.004
P-38	1,003	5	6	12.0	942	2.67	0.002
EX-2	831	2	3	18.0	2,889	3.64	0.003
P-39	1,281	5	MedTron	12.0	862	2.44	0.002
P-42	1,023	MedTron	9	12.0	712	2.02	0.001
P-41	1,269	9	6	12.0	-679	1.93	0.001
EX-7	1,414	10	8	8.0	-263	1.68	0.002
P-13	2,618	D	10	8.0	-263	1.68	0.002
P-8	528	7	8	12.0	263	0.75	0.000
P-24	740	6	7	12.0	263	0.75	0.000
P-10	671	12	D	12.0	-263	0.75	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P3 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	3,149	5,581.95	79
MU	5,381.86	654	5,587.45	89
MK8	5,459.71	18	5,618.02	68
MHS	5,456.88	19	5,616.67	69
JVL	5,467.02	7	5,622.49	67
IFM	5,470.66	25	5,623.52	66
D	5,370.00	0	5,590.37	95
A & E	5,432.07	525	5,604.94	75
12	5,377.00	0	5,590.39	92
11	5,396.13	0	5,595.44	86
10	5,367.00	0	5,589.76	96
9	5,386.49	0	5,586.83	87
8	5,370.00	0	5,589.43	95
7	5,380.00	0	5,589.41	91
6	5,393.70	0	5,589.38	85
5	5,412.25	0	5,591.02	77
4	5,430.00	0	5,604.60	76
3	5,470.00	0	5,623.94	67
2	5,475.00	0	5,625.87	65

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Scenario: P3 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	2,530	7.18	0.014
EX-12	118	R-3	3	8.0	975	6.22	0.017
P-44	817	MU	9	12.0	524	1.49	0.001
P-9	2,529	3	A & E	12.0	1,798	5.10	0.008
EX-3	166	3	JVL	12.0	1,948	5.53	0.009
EX-4	2,066	JVL	4	12.0	1,941	5.51	0.009
P-43	856	12	MU	12.0	1,178	3.34	0.003
EX-1	39	R-1	2	18.0	3,422	4.31	0.003
P-11	2,397	A & E	11	12.0	1,273	3.61	0.004
EX-8	284	IFM	2	8.0	-651	4.15	0.008
P-12	1,276	11	12	12.0	1,273	3.61	0.004
EX-9	718	MK8	IFM	8.0	-626	4.00	0.008
EX-10	185	MHS	MK8	8.0	-608	3.88	0.007
EX-11	1,761	4	MHS	8.0	-589	3.76	0.007
P-38	1,003	5	6	12.0	789	2.24	0.002
EX-2	831	2	3	18.0	2,771	3.49	0.002
P-39	1,281	5	MedTron	12.0	1,742	4.94	0.007
P-42	1,023	MedTron	9	12.0	-1,407	3.99	0.005
P-41	1,269	9	6	12.0	-884	2.51	0.002
EX-7	1,414	10	8	8.0	95	0.61	0.000
P-13	2,618	D	10	8.0	95	0.61	0.000
P-8	528	7	8	12.0	-95	0.27	0.000
P-24	740	6	7	12.0	-95	0.27	0.000
P-10	671	12	D	12.0	95	0.27	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P4 Max
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,621.93	96
MU	5,381.86	724	5,621.21	104
MK8	5,459.71	18	5,625.00	72
MHS	5,456.88	19	5,624.86	73
JVL	5,467.02	7	5,625.56	69
IFM	5,470.66	25	5,625.66	67
D	5,370.00	73	5,621.36	109
A & E	5,432.07	525	5,621.94	82
12	5,377.00	0	5,621.36	106
11	5,396.13	0	5,621.56	98
10	5,367.00	0	5,621.80	110
9	5,386.49	0	5,621.77	102
8	5,370.00	0	5,622.04	109
7	5,380.00	0	5,622.05	105
6	5,393.70	0	5,622.07	99
5	5,412.25	0	5,622.44	91
4	5,430.00	0	5,623.77	84
3	5,470.00	0	5,625.70	67
2	5,475.00	0	5,625.98	65

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Scenario: P4 Max
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	721	2.05	0.001
EX-12	118	R-3	3	8.0	342	2.19	0.003
P-44	817	MU	9	12.0	-493	1.40	0.001
P-9	2,529	3	A & E	12.0	750	2.13	0.001
EX-3	166	3	JVL	12.0	567	1.61	0.001
EX-4	2,066	JVL	4	12.0	560	1.59	0.001
P-43	856	12	MU	12.0	231	0.66	0.000
EX-1	39	R-1	2	18.0	1,197	1.51	0.000
P-11	2,397	A & E	11	12.0	225	0.64	0.000
EX-8	284	IFM	2	8.0	-223	1.42	0.001
P-12	1,276	11	12	12.0	225	0.64	0.000
EX-9	718	MK8	IFM	8.0	-198	1.26	0.001
EX-10	185	MHS	MK8	8.0	-180	1.15	0.001
EX-11	1,761	4	MHS	8.0	-161	1.03	0.001
P-38	1,003	5	6	12.0	354	1.00	0.000
EX-2	831	2	3	18.0	974	1.23	0.000
P-39	1,281	5	MedTron	12.0	368	1.04	0.000
P-42	1,023	MedTron	9	12.0	218	0.62	0.000
P-41	1,269	9	6	12.0	-274	0.78	0.000
EX-7	1,414	10	8	8.0	-80	0.51	0.000
P-13	2,618	D	10	8.0	-80	0.51	0.000
P-8	528	7	8	12.0	80	0.23	0.000
P-24	740	6	7	12.0	80	0.23	0.000
P-10	671	12	D	12.0	-6	0.02	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P4 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,601.96	87
MU	5,381.86	724	5,596.22	93
MK8	5,459.71	18	5,620.84	70
MHS	5,456.88	19	5,620.00	71
JVL	5,467.02	7	5,622.82	67
IFM	5,470.66	25	5,624.34	66
D	5,370.00	73	5,595.06	97
A & E	5,432.07	3,525	5,586.58	67
12	5,377.00	0	5,594.97	94
11	5,396.13	0	5,592.05	85
10	5,367.00	0	5,599.47	101
9	5,386.49	0	5,600.42	93
8	5,370.00	0	5,601.85	100
7	5,380.00	0	5,601.97	96
6	5,393.70	0	5,602.15	90
5	5,412.25	0	5,604.64	83
4	5,430.00	0	5,612.56	79
3	5,470.00	0	5,623.65	66
2	5,475.00	0	5,625.86	65

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Scenario: P4 Max SL Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	1,892	5.37	0.008
EX-12	118	R-3	3	8.0	1,045	6.67	0.020
P-44	817	MU	9	12.0	-1,466	4.16	0.005
P-9	2,529	3	A & E	12.0	2,579	7.32	0.015
EX-3	166	3	JVL	12.0	1,445	4.10	0.005
EX-4	2,066	JVL	4	12.0	1,438	4.08	0.005
P-43	856	12	MU	12.0	-742	2.11	0.001
EX-1	39	R-1	2	18.0	3,495	4.41	0.004
P-11	2,397	A & E	11	12.0	-945	2.68	0.002
EX-8	284	IFM	2	8.0	-515	3.29	0.005
P-12	1,276	11	12	12.0	-945	2.68	0.002
EX-9	718	MK8	IFM	8.0	-490	3.13	0.005
EX-10	185	MHS	MK8	8.0	-472	3.01	0.005
EX-11	1,761	4	MHS	8.0	-454	2.89	0.004
P-38	1,003	5	6	12.0	989	2.81	0.002
EX-2	831	2	3	18.0	2,979	3.76	0.003
P-39	1,281	5	MedTron	12.0	902	2.56	0.002
P-42	1,023	MedTron	9	12.0	753	2.14	0.001
P-41	1,269	9	6	12.0	-713	2.02	0.001
EX-7	1,414	10	8	8.0	-276	1.76	0.002
P-13	2,618	D	10	8.0	-276	1.76	0.002
P-8	528	7	8	12.0	276	0.78	0.000
P-24	740	6	7	12.0	276	0.78	0.000
P-10	671	12	D	12.0	-203	0.58	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P4 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	149	5,587.50	81
MU	5,381.86	3,724	5,576.59	84
MK8	5,459.71	18	5,618.21	69
MHS	5,456.88	19	5,616.90	69
JVL	5,467.02	7	5,622.39	67
IFM	5,470.66	25	5,623.57	66
D	5,370.00	73	5,582.10	92
A & E	5,432.07	525	5,600.88	73
12	5,377.00	0	5,582.03	89
11	5,396.13	0	5,588.57	83
10	5,367.00	0	5,585.79	95
9	5,386.49	0	5,584.65	86
8	5,370.00	0	5,587.79	94
7	5,380.00	0	5,587.89	90
6	5,393.70	0	5,588.04	84
5	5,412.25	0	5,592.06	78
4	5,430.00	0	5,605.16	76
3	5,470.00	0	5,623.78	67
2	5,475.00	0	5,625.86	65

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Scenario: P4 Max MU Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	2,482	7.04	0.014
EX-12	118	R-3	3	8.0	1,014	6.47	0.019
P-44	817	MU	9	12.0	-2,082	5.91	0.010
P-9	2,529	3	A & E	12.0	1,989	5.64	0.009
EX-3	166	3	JVL	12.0	1,908	5.41	0.008
EX-4	2,066	JVL	4	12.0	1,902	5.40	0.008
P-43	856	12	MU	12.0	1,642	4.66	0.006
EX-1	39	R-1	2	18.0	3,526	4.45	0.004
P-11	2,397	A & E	11	12.0	1,464	4.15	0.005
EX-8	284	IFM	2	8.0	-642	4.10	0.008
P-12	1,276	11	12	12.0	1,464	4.15	0.005
EX-9	718	MK8	IFM	8.0	-617	3.94	0.007
EX-10	185	MHS	MK8	8.0	-599	3.82	0.007
EX-11	1,761	4	MHS	8.0	-580	3.70	0.007
P-38	1,003	5	6	12.0	1,280	3.63	0.004
EX-2	831	2	3	18.0	2,883	3.64	0.003
P-39	1,281	5	MedTron	12.0	1,202	3.41	0.004
P-42	1,023	MedTron	9	12.0	1,052	2.99	0.003
P-41	1,269	9	6	12.0	-1,029	2.92	0.003
EX-7	1,414	10	8	8.0	-251	1.60	0.001
P-13	2,618	D	10	8.0	-251	1.60	0.001
P-8	528	7	8	12.0	251	0.71	0.000
P-24	740	6	7	12.0	251	0.71	0.000
P-10	671	12	D	12.0	-178	0.50	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P4 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	3,149	5,579.57	78
MU	5,381.86	724	5,584.77	88
MK8	5,459.71	18	5,617.56	68
MHS	5,456.88	19	5,616.13	69
JVL	5,467.02	7	5,622.28	67
IFM	5,470.66	25	5,623.38	66
D	5,370.00	73	5,587.69	94
A & E	5,432.07	525	5,603.61	74
12	5,377.00	0	5,587.74	91
11	5,396.13	0	5,593.25	85
10	5,367.00	0	5,587.29	95
9	5,386.49	0	5,584.28	86
8	5,370.00	0	5,587.07	94
7	5,380.00	0	5,587.06	90
6	5,393.70	0	5,587.04	84
5	5,412.25	0	5,588.90	76
4	5,430.00	0	5,603.30	75
3	5,470.00	0	5,623.81	67
2	5,475.00	0	5,625.86	65

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Scenario: P4 Max Office Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
P-37	960	4	5	12.0	2,613	7.41	0.015
EX-12	118	R-3	3	8.0	1,007	6.43	0.018
P-44	817	MU	9	12.0	461	1.31	0.001
P-9	2,529	3	A & E	12.0	1,858	5.27	0.008
EX-3	166	3	JVL	12.0	2,010	5.70	0.009
EX-4	2,066	JVL	4	12.0	2,004	5.68	0.009
P-43	856	12	MU	12.0	1,184	3.36	0.003
EX-1	39	R-1	2	18.0	3,532	4.45	0.004
P-11	2,397	A & E	11	12.0	1,334	3.78	0.004
EX-8	284	IFM	2	8.0	-671	4.28	0.009
P-12	1,276	11	12	12.0	1,334	3.78	0.004
EX-9	718	MK8	IFM	8.0	-646	4.12	0.008
EX-10	185	MHS	MK8	8.0	-628	4.01	0.008
EX-11	1,761	4	MHS	8.0	-609	3.89	0.007
P-38	1,003	5	6	12.0	844	2.40	0.002
EX-2	831	2	3	18.0	2,862	3.61	0.002
P-39	1,281	5	MedTron	12.0	1,768	5.02	0.007
P-42	1,023	MedTron	9	12.0	-1,381	3.92	0.005
P-41	1,269	9	6	12.0	-920	2.61	0.002
EX-7	1,414	10	8	8.0	76	0.49	0.000
P-13	2,618	D	10	8.0	76	0.49	0.000
P-8	528	7	8	12.0	-76	0.22	0.000
P-24	740	6	7	12.0	-76	0.22	0.000
P-10	671	12	D	12.0	149	0.42	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000

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Scenario: P4 Peak Day MU Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	879	5,566.29	72
MU	5,381.86	3,560	5,557.47	76
MK8	5,459.71	19	5,614.30	67
MHS	5,456.88	20	5,612.32	67
JVL	5,467.02	7	5,620.47	66
IFM	5,470.66	27	5,622.38	66
D	5,370.00	339	5,562.60	83
A & E	5,432.07	872	5,586.58	67
12	5,377.00	0	5,562.61	80
11	5,396.13	0	5,570.94	76
10	5,367.00	0	5,566.73	86
9	5,386.49	0	5,564.72	77
8	5,370.00	0	5,568.97	86
7	5,380.00	0	5,569.08	82
6	5,393.70	0	5,569.24	76
5	5,412.25	0	5,574.43	70
4	5,430.00	0	5,594.34	71
3	5,470.00	0	5,622.58	66
2	5,475.00	0	5,625.78	65

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Scenario: P4 Peak Day MU Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	1,281	8.18	0.029
P-37	960	4	5	12.0	3,112	8.83	0.021
P-9	2,529	3	A & E	12.0	2,538	7.20	0.014
EX-8	284	IFM	2	8.0	-797	5.08	0.012
EX-3	166	3	JVL	12.0	2,388	6.78	0.013
EX-4	2,066	JVL	4	12.0	2,381	6.76	0.013
EX-1	39	R-1	2	18.0	4,442	5.60	0.006
EX-9	718	MK8	IFM	8.0	-770	4.91	0.011
EX-2	831	2	3	18.0	3,646	4.60	0.004
EX-10	185	MHS	MK8	8.0	-750	4.79	0.011
P-39	1,281	5	MedTron	12.0	1,643	4.66	0.006
P-44	817	MU	9	12.0	-1,966	5.58	0.009
P-38	1,003	5	6	12.0	1,469	4.17	0.005
EX-11	1,761	4	MHS	8.0	-730	4.66	0.010
P-43	856	12	MU	12.0	1,594	4.52	0.006
P-41	1,269	9	6	12.0	-1,203	3.41	0.004
P-11	2,397	A & E	11	12.0	1,666	4.73	0.007
P-12	1,276	11	12	12.0	1,666	4.73	0.007
EX-7	1,414	10	8	8.0	-267	1.70	0.002
P-13	2,618	D	10	8.0	-267	1.70	0.002
P-42	1,023	MedTron	9	12.0	764	2.17	0.002
P-8	528	7	8	12.0	267	0.76	0.000
P-24	740	6	7	12.0	267	0.76	0.000
P-10	671	12	D	12.0	73	0.21	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000

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Scenario: P4 Peak Day SL Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	879	5,583.09	79
MU	5,381.86	560	5,578.59	85
MK8	5,459.71	19	5,617.28	68
MHS	5,456.88	20	5,615.83	69
JVL	5,467.02	7	5,620.96	67
IFM	5,470.66	27	5,623.24	66
D	5,370.00	339	5,577.03	90
A & E	5,432.07	3,872	5,570.98	60
12	5,377.00	0	5,577.04	87
11	5,396.13	0	5,574.93	77
10	5,367.00	0	5,582.09	93
9	5,386.49	0	5,582.43	85
8	5,370.00	0	5,584.83	93
7	5,380.00	0	5,584.97	89
6	5,393.70	0	5,585.17	83
5	5,412.25	0	5,588.81	76
4	5,430.00	0	5,602.80	75
3	5,470.00	0	5,622.43	66
2	5,475.00	0	5,625.79	65

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Scenario: P4 Peak Day SL Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	1,310	8.36	0.030
P-37	960	4	5	12.0	2,571	7.29	0.015
P-9	2,529	3	A & E	12.0	3,079	8.73	0.020
EX-8	284	IFM	2	8.0	-680	4.34	0.009
EX-3	166	3	JVL	12.0	1,964	5.57	0.009
EX-4	2,066	JVL	4	12.0	1,957	5.55	0.009
EX-1	39	R-1	2	18.0	4,414	5.56	0.006
EX-9	718	MK8	IFM	8.0	-653	4.17	0.008
EX-2	831	2	3	18.0	3,733	4.71	0.004
EX-10	185	MHS	MK8	8.0	-634	4.05	0.008
P-39	1,281	5	MedTron	12.0	1,357	3.85	0.004
P-44	817	MU	9	12.0	-1,395	3.96	0.005
P-38	1,003	5	6	12.0	1,214	3.44	0.004
EX-11	1,761	4	MHS	8.0	-614	3.92	0.007
P-43	856	12	MU	12.0	-835	2.37	0.002
P-41	1,269	9	6	12.0	-917	2.60	0.002
P-11	2,397	A & E	11	12.0	-793	2.25	0.002
P-12	1,276	11	12	12.0	-793	2.25	0.002
EX-7	1,414	10	8	8.0	-297	1.90	0.002
P-13	2,618	D	10	8.0	-297	1.90	0.002
P-42	1,023	MedTron	9	12.0	478	1.36	0.001
P-8	528	7	8	12.0	297	0.84	0.000
P-24	740	6	7	12.0	297	0.84	0.000
P-10	671	12	D	12.0	42	0.12	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000

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Scenario: P4 Peak Day Office Fire
Current Time Step: 0.000Hr
FlexTable: Junction Table

Label	Elevation (ft)	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)
MedTron	5,400.00	3,879	5,557.54	68
MU	5,381.86	560	5,565.48	79
MK8	5,459.71	19	5,613.62	67
MHS	5,456.88	20	5,611.51	67
JVL	5,467.02	7	5,620.35	66
IFM	5,470.66	27	5,622.18	66
D	5,370.00	339	5,568.28	86
A & E	5,432.07	872	5,589.55	68
12	5,377.00	0	5,568.53	83
11	5,396.13	0	5,575.83	78
10	5,367.00	0	5,568.27	87
9	5,386.49	0	5,564.58	77
8	5,370.00	0	5,568.26	86
7	5,380.00	0	5,568.26	81
6	5,393.70	0	5,568.26	76
5	5,412.25	0	5,571.10	69
4	5,430.00	0	5,592.38	70
3	5,470.00	0	5,622.61	66
2	5,475.00	0	5,625.78	65

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Scenario: P4 Peak Day Office Fire
Current Time Step: 0.000Hr
FlexTable: Pipe Table

Label	Length (Scaled) (ft)	Start Node	Stop Node	Diameter (in)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)
EX-12	118	R-3	3	8.0	1,275	8.14	0.029
P-37	960	4	5	12.0	3,226	9.15	0.022
P-9	2,529	3	A & E	12.0	2,425	6.88	0.013
EX-8	284	IFM	2	8.0	-821	5.24	0.013
EX-3	166	3	JVL	12.0	2,478	7.03	0.014
EX-4	2,066	JVL	4	12.0	2,471	7.01	0.014
EX-1	39	R-1	2	18.0	4,448	5.61	0.006
EX-9	718	MK8	IFM	8.0	-795	5.07	0.012
EX-2	831	2	3	18.0	3,627	4.57	0.004
EX-10	185	MHS	MK8	8.0	-775	4.95	0.011
P-39	1,281	5	MedTron	12.0	2,164	6.14	0.011
P-44	817	MU	9	12.0	640	1.82	0.001
P-38	1,003	5	6	12.0	1,062	3.01	0.003
EX-11	1,761	4	MHS	8.0	-755	4.82	0.011
P-43	856	12	MU	12.0	1,200	3.41	0.004
P-41	1,269	9	6	12.0	-1,075	3.05	0.003
P-11	2,397	A & E	11	12.0	1,553	4.40	0.006
P-12	1,276	11	12	12.0	1,553	4.40	0.006
EX-7	1,414	10	8	8.0	13	0.08	0.000
P-13	2,618	D	10	8.0	13	0.08	0.000
P-42	1,023	MedTron	9	12.0	-1,715	4.87	0.007
P-8	528	7	8	12.0	-13	0.04	0.000
P-24	740	6	7	12.0	-13	0.04	0.000
P-10	671	12	D	12.0	352	1.00	0.000
EX-6	252	PRV-5	R-2	8.0	0	0.00	0.000
EX-5	481	8	PRV-5	8.0	0	0.00	0.000

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LOUISVILLE FIRE
PROTECTION DISTRICT
"OUR FAMILY SERVING YOUR FAMILY"
895 W. VIA APPIA LOUISVILLE, CO 80027
HEADQUARTERS: 303.666.6595 | FAX: 303.666.7659
LOUISVILLEFIRE.COM

A TRADITION OF EXCELLENCE SINCE 1887

November 14, 2019

Mark Beal, Director of Construction
Ryan Companies US, Inc.
3900 East Camelback Road Suite 100
Phoenix, Arizona 85018

Subject: Medtronics (Fire Flow)

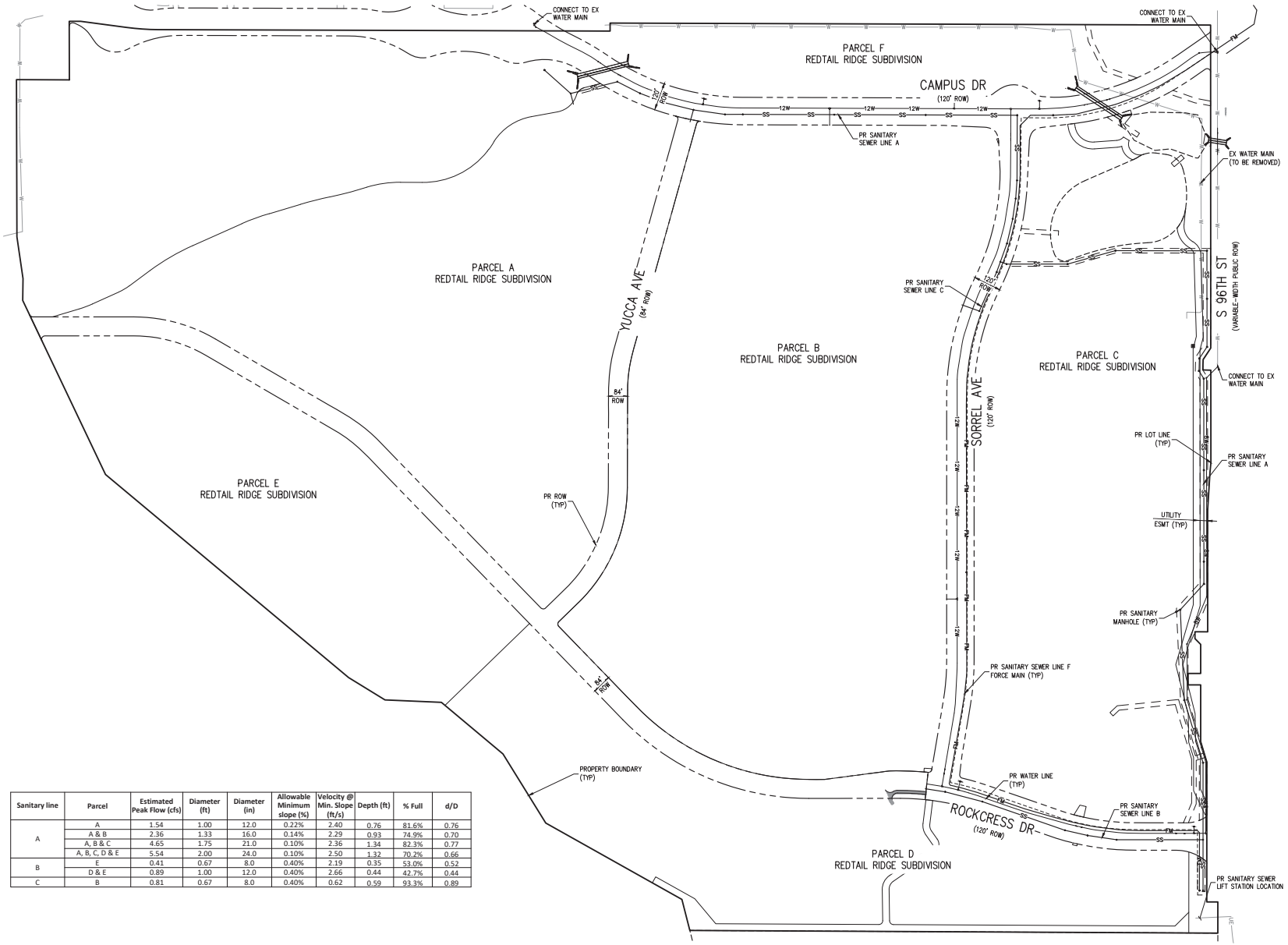
Dear Mr. Beal,

Per our discussion regarding fire flow requirements, it is my interpretation of Appendix B, Table B105.2 that a 75% reduction in fire flow is allowed in sprinkled buildings. With that said, I would like to see only a 50% reduction in fire flows verses the 75% the code allows. Please feel free to call me at 303-666-8809 or email me at cmestas@louisvillefire.com if you would like to discuss this further.

Sincerely,

Chris Mestas
Fire Marshal

APPENDIX F – Filing Utility Plan, Conceptual Utility Layouts



Sanitary line	Parcel	Estimated Peak Flow (cfs)	Diameter (ft)	Diameter (in)	Allowable Minimum slope (%)	Velocity @ Min. Slope (ft/s)	Depth (ft)	% Full	d/D
A	A	1.54	1.00	12.0	0.22%	2.40	0.76	81.6%	0.76
	A & B	2.36	1.33	16.0	0.14%	2.29	0.93	74.9%	0.70
	A, B & C	4.65	1.75	21.0	0.10%	2.36	1.34	82.3%	0.77
	A, B, C, D & E	5.54	2.00	24.0	0.10%	2.50	1.32	70.2%	0.66
B	E	0.41	0.67	8.0	0.40%	2.19	0.35	53.0%	0.52
	D & E	0.89	1.00	12.0	0.40%	2.66	0.44	42.7%	0.44
C	B	0.81	0.67	8.0	0.40%	0.62	0.59	93.3%	0.89

811 Know what's below. Call before you dig.

CALL 3 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

200 0 200 400
SCALE: 1" = 200'

DESIGNED BY: MJS
CHECKED BY: TEH
DRAWN BY: MJS

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

BRUE·BAUKOL CAPITAL PARTNERS

REDTAIL RIDGE
UTILITY FILING PLAN

ISSUE DATE: 03/03/2020	PROJECT #: 190108
DATE	REVISION COMMENTS
03-12-2020	PER CITY OF LOUISVILLE COMMENTS

PRELIMINARY NOT FOR CONSTRUCTION

SHEET NO.
1
1 OF 2

NO CHANGES ARE TO BE MADE TO THE DRAWING WITHOUT WRITTEN PERMISSION FROM HARRIS KOCHER SMITH

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6 XREFs: client logo, e-all, p-base-1, p-base-2, p-legal-1, p-legal-2
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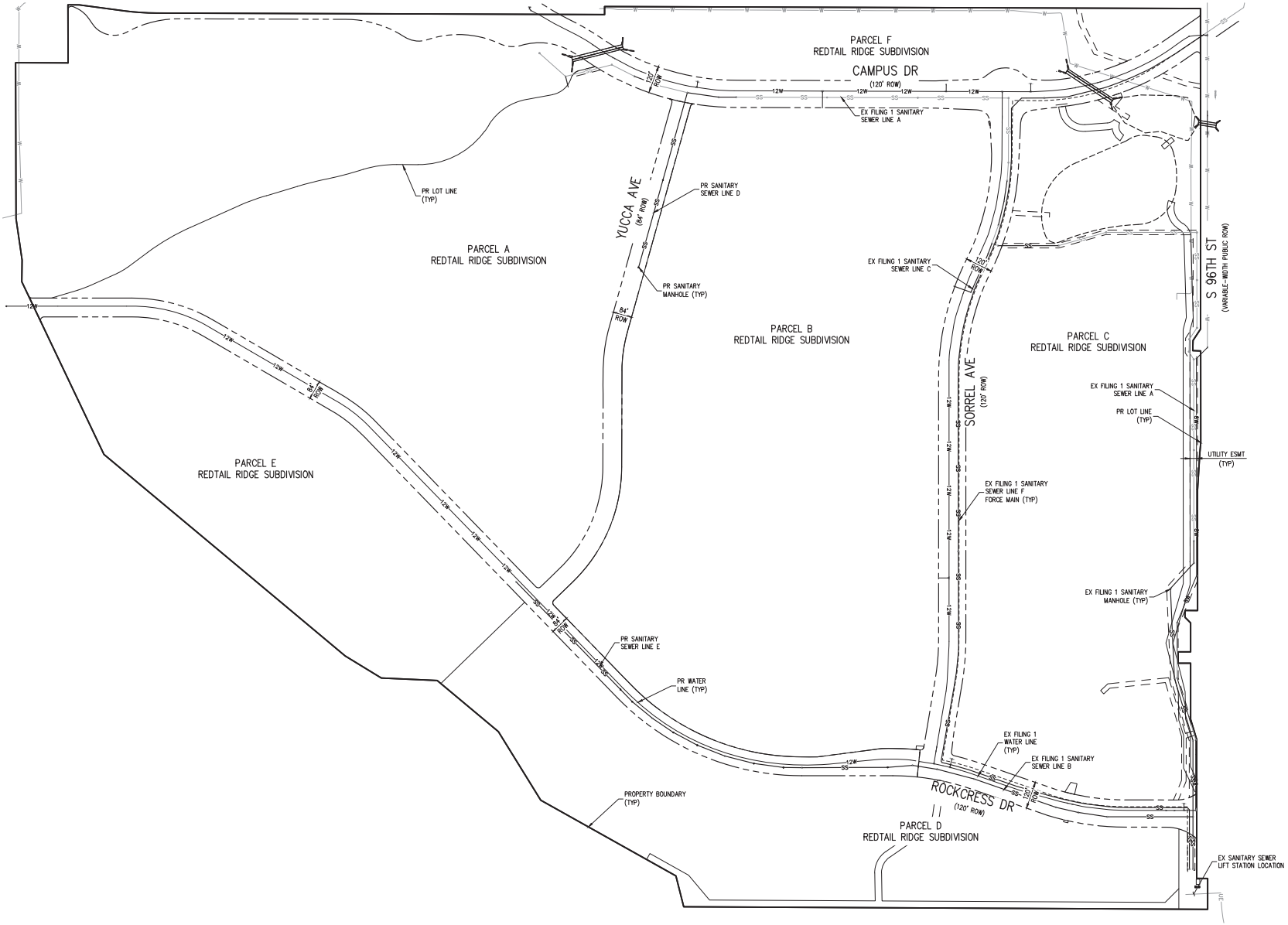

NO CHANGES ARE TO BE MADE TO THIS DRAWING WITHOUT WRITTEN PERMISSION OF HARRIS KOCHER SMITH

FILEPATH: P:\190108\ENGINEERING\EXHIBIT\UTILITY FILING 2\PLAN DWG\ LAYOUT: LAYOUT 2
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PLOTTED: Thu JAN 23 2020 6:18:30 PM BY: EVAN LAKE

Know what's below. Call before you dig.

CALL 3 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

200 0 200 400
SCALE: 1" = 200'

DESIGNED BY: MJS
CHECKED BY: TEH
DRAWN BY: MJS

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

BRUE·BAUKOL CAPITAL PARTNERS

REDTAIL RIDGE
UTILITY FILING PLAN
FILING NO. 2

ISSUE DATE: 03/03/2020	PROJECT #: 190108
DATE	REVISION COMMENTS
02-12-2020	PER CITY OF LOUISVILLE COMMENTS

PRELIMINARY NOT FOR CONSTRUCTION

SHEET NO.
2
2 OF 2

EXISTING WATER MAIN UTILITY MAP

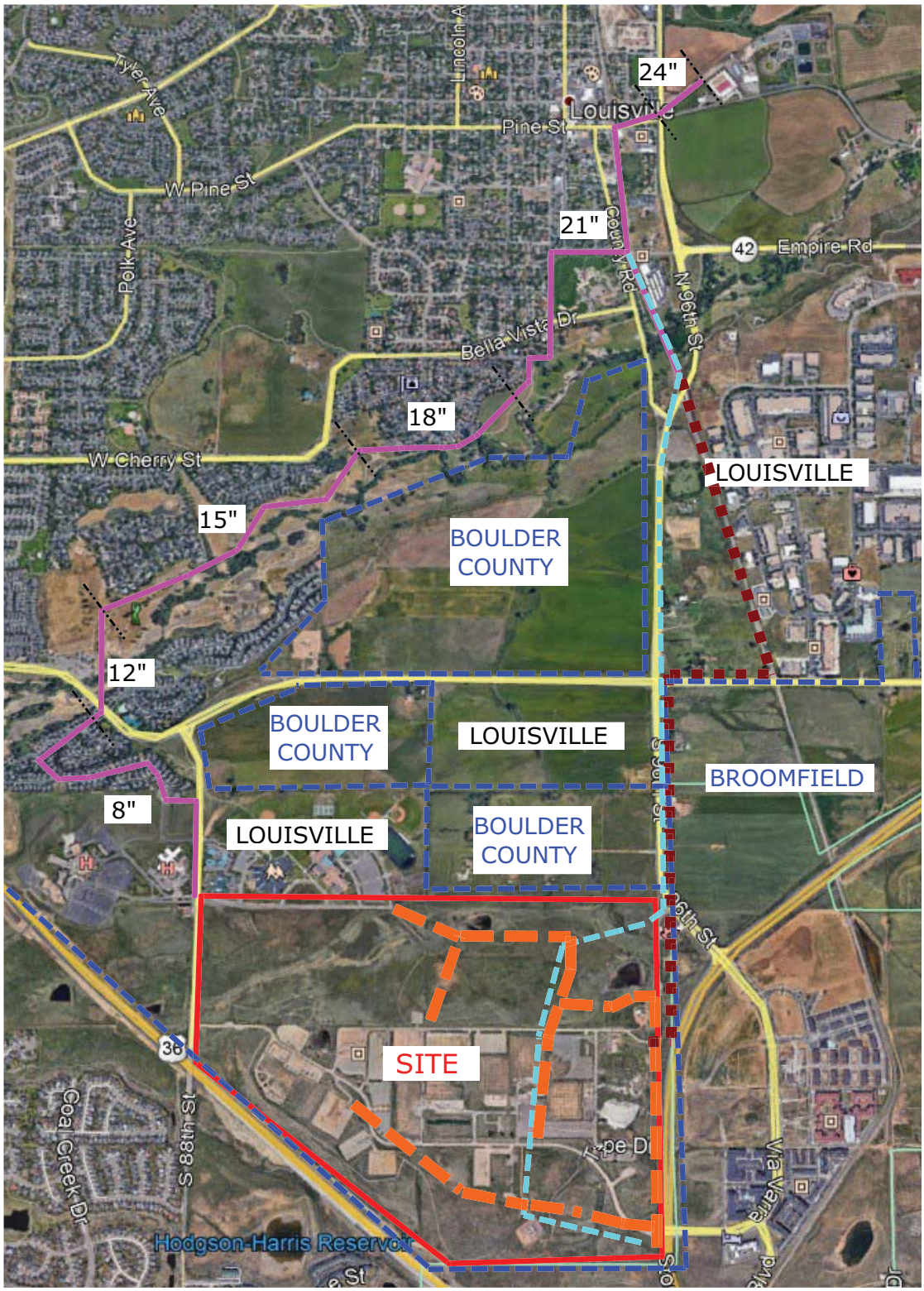
EXISTING WATER MAIN

MUNICIPALITY BOUNDARY

PROPOSED WATER MAIN

PIPE DIAMETER CHANGE

EXISTING SANITARY MAIN UTILITY MAP



EX SANITARY SEWER

MUNICIPALITY BOUNDARY

PROPOSED SANITARY MAIN

PIPE DIAMETER CHANGE

EX SANITARY SEWER FORCE MAIN

PR SANITARY SEWER FORCE MAIN

DRAFT TECHNICAL MEMORANDUM 1

Date: May 5, 2020

To: City of Louisville

From: Patrick Radabaugh, PE, Melinda Brown, PE, Michael Syverson - Dewberry Engineers Inc.

Subject: City of Louisville and Redtail Ridge Development Projected Water Demands

BACKGROUND

The City of Louisville is located in southern Boulder along the Front Range in central Colorado. A general location map for the planning area is shown on **Figure 1**. The City of Louisville was founded in 1878 and incorporated in 1882. During its early days, Louisville was a coal mining town that was composed of many immigrant neighborhoods. The City is named after Louis Nawatny, a landowner during the City's early mining days, who platted a portion of his farmland and named it after himself. The City was a mining town until the closure of the last mine during the 1950s. Since that time, the City has transitioned to a suburban residential community.

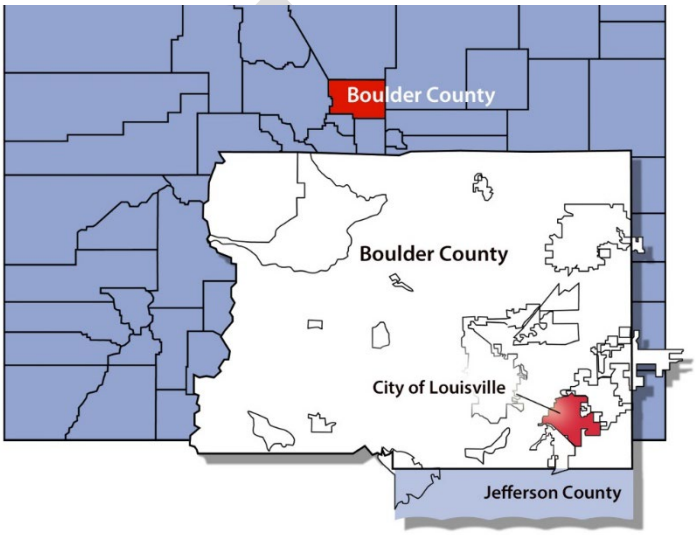


Figure 1 - City of Louisville Location Map

SERVICE AREA AND POPULATION

The service area is the City of Louisville's border. It encompasses 8.6 square miles and in addition to residences and commercial space, contains 26 parks and approximately 1,700 acres open space. **Figure 1** shows the City boundary and the service area. The City's Boundaries are US 36 to the south, the City of Broomfield to the southeast, City of Lafayette to the north, the Davidson Mesa Open Space/Unincorporated Boulder County to the west, and Broomfield County to the east. The City is comprised of primarily residential (single family and multifamily homes) with some industrial, commercial and retail space.

POPULATION

The City of Louisville has a current population of approximately 21,363. The City experienced rapid growth during the 1980s and 1990s, but growth slowed in the 2000s. In 1980, the population was 5,550. By Year 1990, the population had more than doubled to 12,870. By Year 2000, the population grew by approximately 50 percent to 19,051. Since Year 2000, the population of the City of Louisville has slowly grown to over 21,000 residents. Historical population from the US Census Bureau and estimated populations from recent years is given in **Table 1**.

Table 1 - City of Louisville Historical Populations

Year	Population
1980	5,550
1990	12,870
1998	18,177
1999	18,062
2000	19,051
2001	19,088
2002	18,747
2003	18,419
2004	18,574
2005	18,427
2006	18,723
2007	18,989
2008	19,461
2009	19,656
2010	18,376
2011	18,410
2012	19,014
2013	19,499
2014	19,993
2015	20,264
2016	20,719
2017	21,128
2018	21,205
2019	21,363

Notes:

1. Population from Years 2000, 2010 from U.S. Census Bureau.
2. Population from years 1980 and 1990 from www.Citydata.com which sites the US Census Bureau.
3. Population from years 2001-2009, 2011 from PRJCTNS spreadsheet from City of Louisville.
4. Population from years 2012-2019 from https://www.google.com/publicdata/explore?ds=kf7tgg1uo9ude_&met_y=population&idim=sub_county:0846355:0841835&hl=en&dl=en

WATER TREATMENT INFRASTRUCTURE

The City of Louisville secures water rights for its residents and owns and operates two water treatment plants (WTP). The North Water Treatment Plant (NWTP) was constructed in the 1980s and currently has a rated capacity of 8.0 MGD. The Howard Berry Water Treatment Facility (HBWTF), or South Treatment Plant, was constructed in 1993 and has a rated capacity of 5.0 MGD. **Figure 2** shows a map identifying the location of each treatment facility.

DRAFT

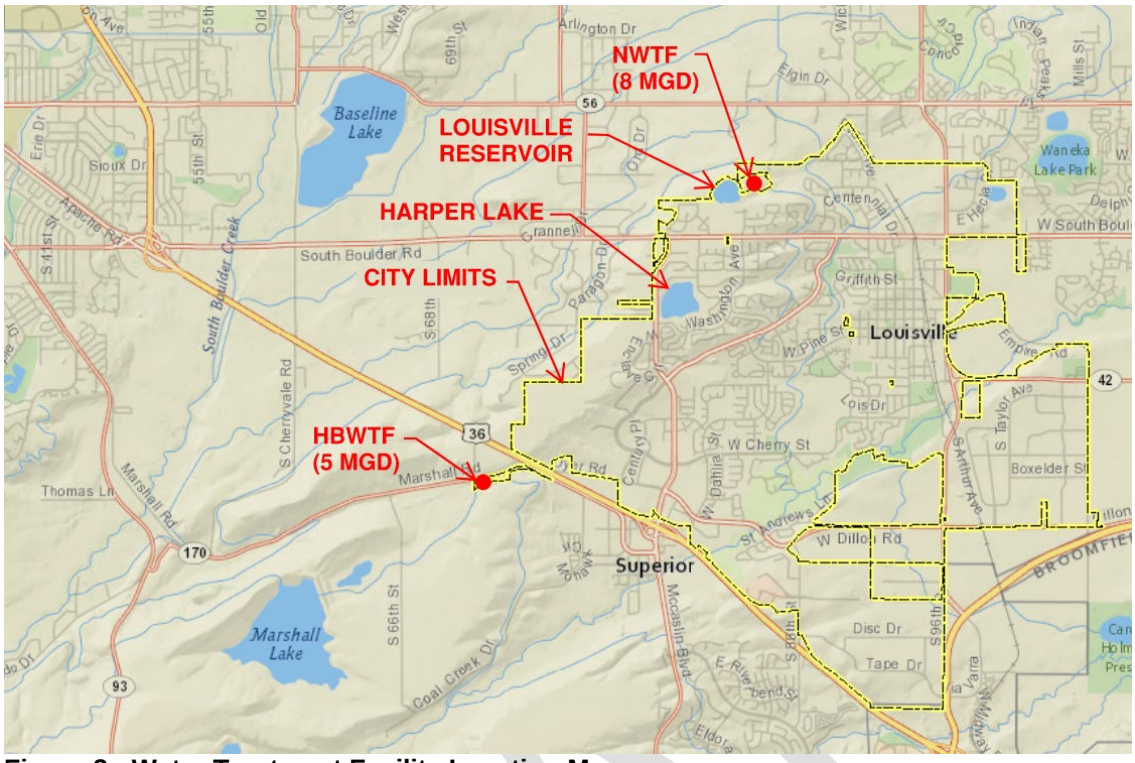


Figure 2 - Water Treatment Facility Location Map

Both facilities are conventional water treatment facilities consisting of coagulation and flocculation, sedimentation, filtration, disinfection, and chemical treatment. **Table 2** provides a summary of the existing infrastructure and process capacities for each plant. A photo of each facility is shown in **Figures 3** and **4**.

Table 2 - Summary of Existing Treatment Processes

Parameter	Number of Units	Max Capacity per Unit
North Treatment Plant		
Rapid Mixers	1	0.82 min detention time at 8 MGD
Flocculation	2	5.8 MGD at max velocity
Sedimentation	2	5.2 MGD at max surface loading rate
Filtration	4	2.5 at max hydraulic loading rate
Disinfection	1	8 MGD
South Treatment Plant		
Rapid Mixers	2	2.07 min detention time at 5 MGD 1.03 min detention time at 10 MGD
Flocculation	1	7.6 MGD at max velocity
Sedimentation	1	5.2 MGD at max surface loading rate
Filtration	2	2.5 MGD, each at max loading rate
Disinfection	1	10 MGD

Figure 3 - Aerial View of the NWTF

Figure 4 - Aerial of the HBWTR

WATER DISTRIBUTION SYSTEM

The City's water distribution system consists of three pressure zones: High Zone, Mid Zone and Low Zone, by which water is delivered from the two treatment plants via a combination of gravity flow and pumping, as shown in **Table 3**. Water from the HBWTF flows to the Mid Zone by gravity, and can also be pumped to the High Zone by a High Zone Pump Station. Water from the NWTP flows into the Low Zone by gravity, and can be pumped to the High Zone from the High Zone Pump Station. Water can flow from the High Zone to the Mid Zone, or from the Mid Zone to the Low Zone, through interconnecting PRVs or from zone valves operated by City staff.

Table 3 - Summary of Existing Water Delivery to Pressure Zones

Zone	HBWTF	NWTP
High Zone	Pumped	Pumped
Mid Zone	Gravity Flow	Pumped to High Zone and Gravity Flow to Mid Zone
Low Zone	Gravity Flow via Mid Zone	Gravity Flow

During higher demand periods, when both water treatment plants are online, the City takes advantage of lower pumping heads to pump water from the HBWTF to the High Zone, minimizing electrical costs. However, during times of lower water demand, the City may only operate one plant, pumping to the High Zone and gravity flowing water to Mid and Low zones. Pumping capacity from the NWTP is limited by high velocities in the transmission line and distribution system. The firm pumping capacity of the HBWTF is based on the largest pump being out of service. Distribution system pumping capacity is shown in **Table 4**.

Table 4 - High Zone Pumping Capacity

WTP	Total Pumping Capacity	Firm Pumping Capacity
HBWTF	6.0	3.5
NWTP	5.0	3.0

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In general, water utilities provide water treatment capacity to meet Maximum Day Demands, while providing storage volume to meet emergency and fire flow needs, as well as, operational volume for daily flow variations. In practice, considerations are made to provide the optimal balance between providing a robust system, controlling capital costs, and managing water quality. The City's distribution system contains 3 storage tanks that store approximately 8.5 million gallons of water, as shown in **Table 5**. A hydraulic profile schematic is shown in **Figure 5** below that depicts flows from each treatment facility and tanks to the associated pressure zones.

Table 5 - Distribution System Storage Volume

Zone	Water Storage Volume (MG)
High Zone	2
Mid Zone	3.5
Low Zone	3
Total Storage	**8.5**

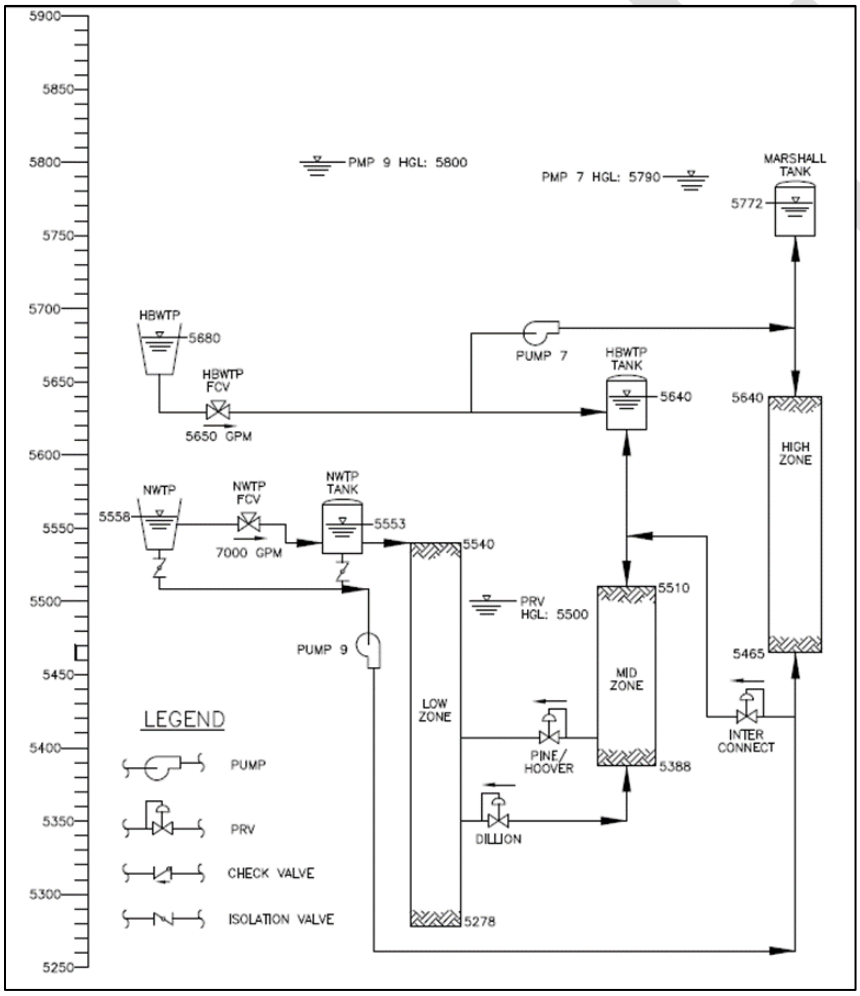

Figure 5 - Existing Distribution System Pressure Zones

PLANNED FUTURE GROWTH

The City of Louisville has planned for growth in the future. New forecasted growth will be infill within the City limits. In the near term, growth contemplated master plan buildout by 2025 in the City; the forecasted growth is expected to come from infill development including the Foundry, Caledonia Place, Delo Lofts and North End Developments. Planned commercial developments are primarily on the south end of town.

POPULATION PROJECTIONS

The current population of the City of Louisville is about 21,163 people per the most recent U.S. Census Bureau website. The town has planned for a population build-out of 23,000 people. Based on available data and trends, the current population growth Population projections for the City of Louisville are given in **Table 6**.

Table 6 - City of Louisville Population Projection

Year	Population	Reference
2019	21,163	U.S. Census Bureau
2020	21,649	Projected Growth at 1.013%
2021	21,938	Projected Growth at 1.013%
2022	22,231	Projected Growth at 1.013%
2023	22,529	Projected Growth at 1.013%
2024	22,830	Projected Growth at 1.013%
2025	23,000	Buildout per Master Plan

Commercial and industrial connections to the City water system typically increase by one tap per year. Growth in commercial/industrial connections is projected to increase between Year 2019 and Year 2030 to a total number of connections of 604 in Year 2030. Projected commercial/industrial connections are provided in **Table 7**.

Table 7 - Projected Commercial Connection Growth

Year	Connections
2019	559
2020	570
2025	576
2030	604

HISTORICAL WATER PRODUCTION SUMMARY

The City of Louisville provided water production and water demand data from 2010 through 2019. The monthly water production data is shown graphically in **Figure 6**. Trends in total production were reviewed from 2010 through 2019. Water production is seasonal with the majority of the City's water being produced the warm weather months. As shown in **Figure 6**, summer production rates are typically about three times the winter water production rates (see analysis later in this technical memorandum). As a result, peak day demands are used to size water treatment plant capacity and water transmission systems.

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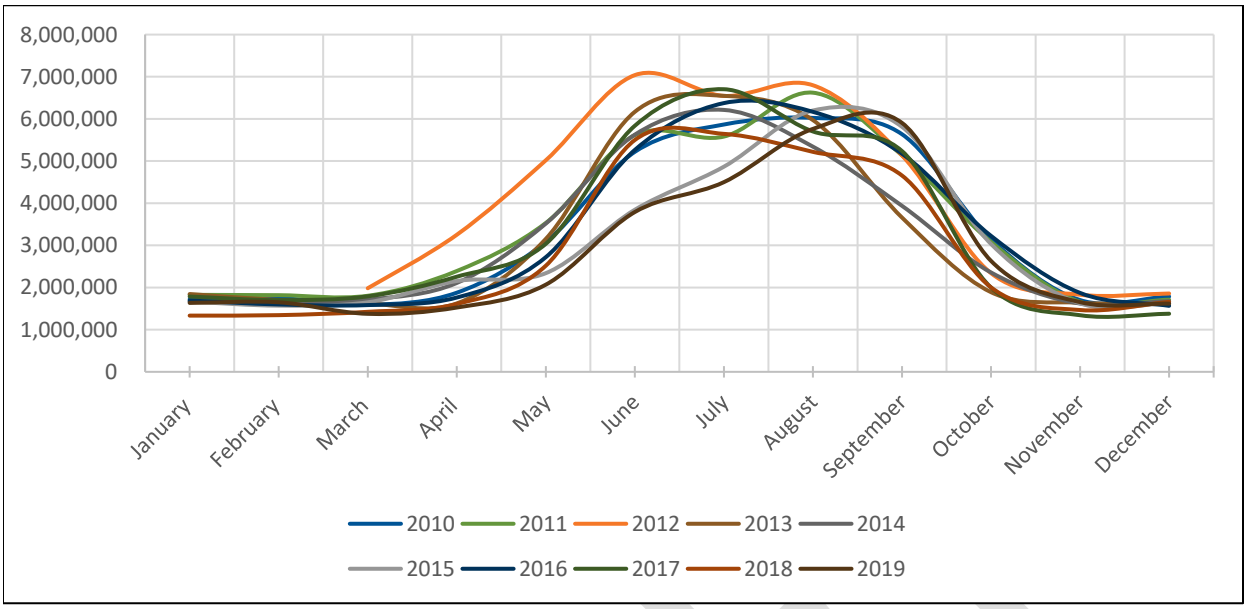

Figure 6 - Total Monthly Average Water Production

Peak water production from 2010 to 2019 was typically observed in the months of July and August. This is typical with communities such as the City of Louisville where winter months, or dry weather months, do not require irrigation which significantly decreases production rates. Dewberry analyzed total water production on an annual and seasonal basis, as shown in **Figure 7**.

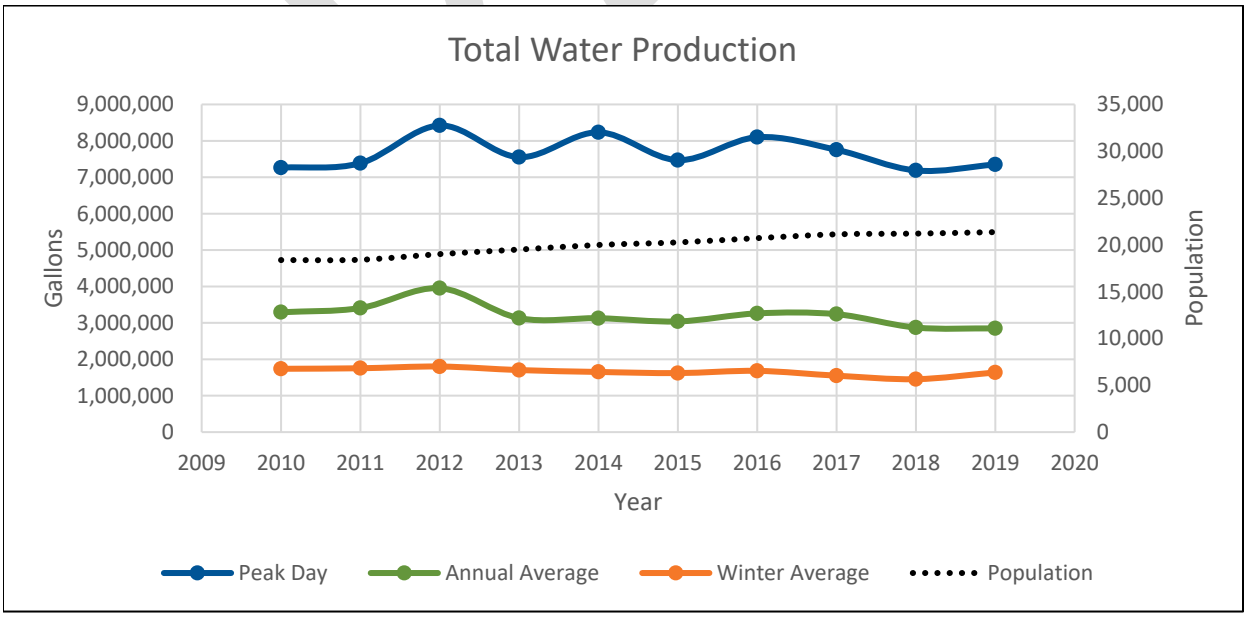

Figure 7 - City of Louisville Historical Water Production

Peak day, annual average, and winter average water production has remained relatively constant from 2010 to 2019. In 2012, the City saw an increase in annual average daily water production. The consistent water production with an increasing population indicates water demand per capita is decreasing over time. It is common practice for water practitioners to use the past five years of data to evaluate treatment plant capacity and typical demand. Analysis of this data was performed using data from 2015 to 2019. **Table 8** lists peak day, average annual day, and seasonal average water production from 2015 to 2019.

Table 8 - Historical Water Production

Parameter	5-year average, MGD
Peak Day Total Production	7.6
Average Summer Day Production	4.7
Average Annual Day Production	3.1
Average Winter Day	1.6

HISTORICAL PER CAPITA WATER DEMAND SUMMARY

Historical water demand was analyzed while considering population and precipitation data. Trends in water use are typically examined over multiple years. **Figure 8** shows a graph of average summer water demand per capita versus population since the mid 1990's.

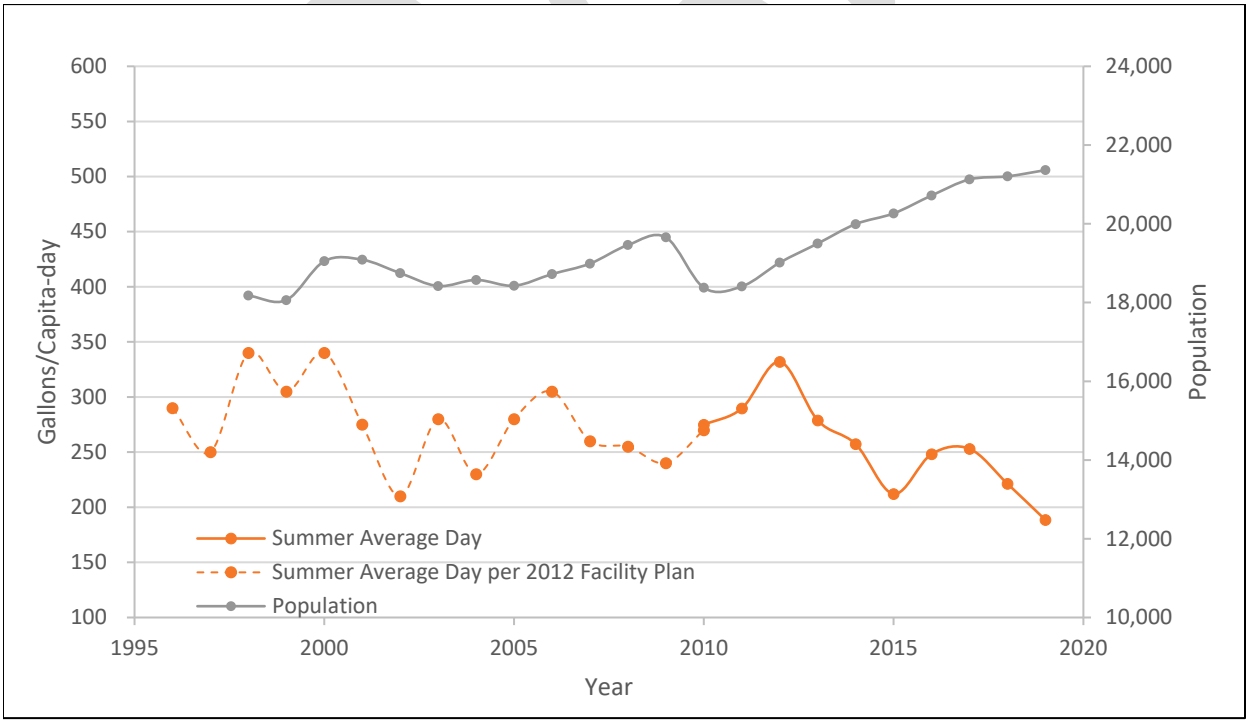

Figure 8 - Average Summer Demand vs Population

Figure 8 shows a decreasing trend in average summer per capita use from 1996 to 2019 with an increasing population. In particular, the average summer day water use has decreased consistently from 2012 to 2019 from 332 gallons per capita per day (gpcpd) to 188 gpcpd, respectively. This observed downward trend is likely due to water conservation efforts put forth by the city. This impact could be a result of residential and commercial spaces upgraded with low flow water fixtures as well as 'smart' household irrigation systems. In addition, The City of Louisville has implemented voluntary water restrictions in the recent years.

The data presented in **Figure 9** reflects a total per capita use for the entire population and annual precipitation. There is a decreasing trend in water use (this information includes irrigation) per capita over time from 2012 to 2019. Annual average water use ranged from 208 gpcpd in 2012 to 133 gpcpd in 2019. Boulder county has seen an average annual precipitation of 22.2 inches, according to the National Oceanic and Atmospheric Administration (NOAA). The high average rainfall shown in 2013 is a result of the historic rainfall event seen in September of 2013 which resulted in disastrous flooding. The annual precipitation data from Year 2012 and Year 2016 (**Figure 9**) suggest 2012 and 2016 may have been in a drought scenario as observed by the increased water demand in 2012 and slight uptick in 2016. Overall, the City has observed a decreasing trend in water consumption over the past decade. **Table 9** lists average water demand per capita from 2010 to 2019 for the City of Louisville.

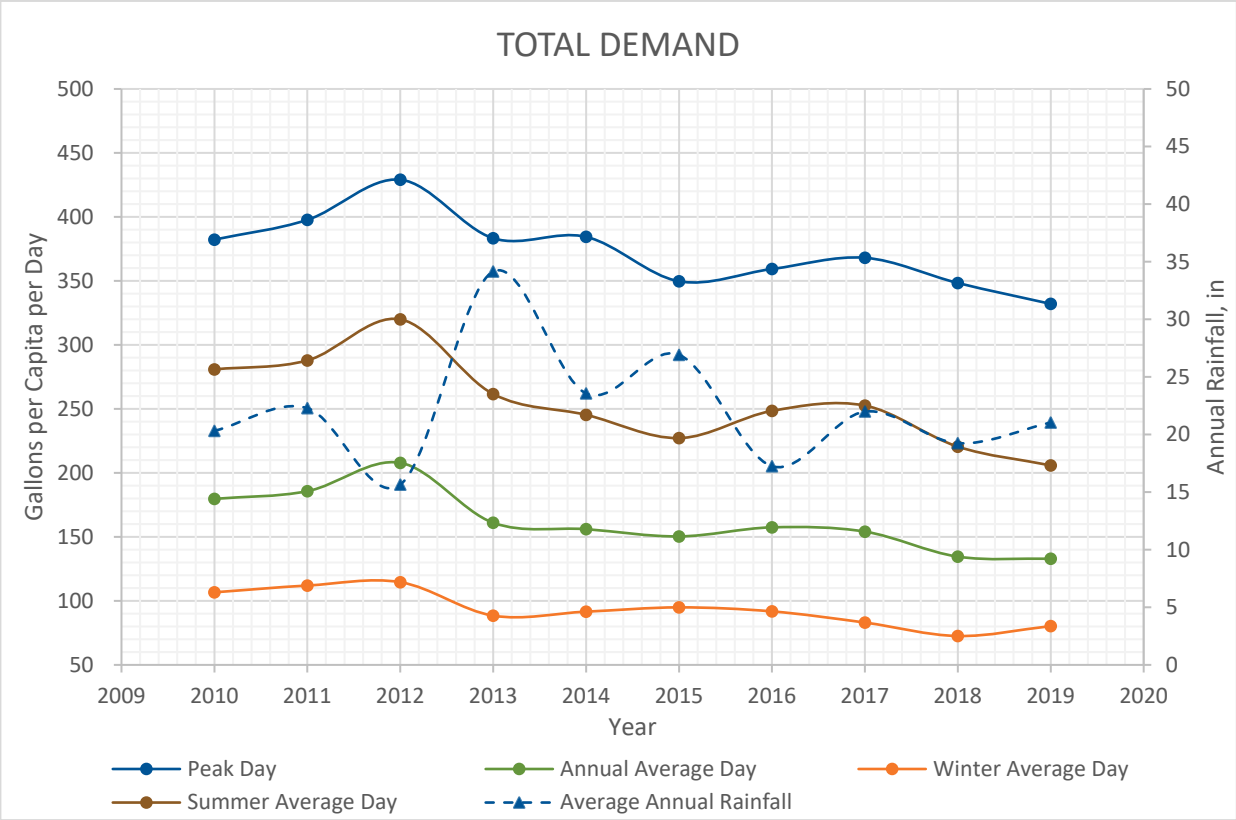

Figure 9 - Historical City of Louisville Total Water Demand per Capita

Table 9 - Historical Water Demand

Parameter	10-year Average, Gallons per Capita per Day
Peak Day Demand	373 (420 historical max)
Summer Average Day Demand	255
Annual Average Day Demand	162
Winter Average Day Demand	94

CITY OF LOUISVILLE PROJECTED WATER DEMANDS

Dewberry was hired to provide an existing capacity evaluation of the water treatment and distribution system, and evaluate the feasibility of incorporating demands from the proposed Redtail Ridge Development. The projections presented below are categorized by future city projections without Redtail Ridge, and projections for Redtail Ridge alone. Irrigation flows for Redtail Ridge are estimated differently than the historical data provided by the City, and historical demand data with irrigation included cannot be used directly. Total projected flows from Redtail Ridge consist of a combination of projections based on historical data and separately estimated irrigation flows. The sections below present the assumptions and methods used for projecting future water demand for the City of Louisville without Redtail Ridge, and Redtail Ridge separately.

City of Louisville Projected Water Demand

Historical data from the City with irrigation included was used to estimate future water demand for the City of Louisville without Redtail Ridge. The assumptions based on 10-year historical data are the following:

- Winter Average Day flow of 94 gpcpd (10-year average)
- Annual Average Day flow of 162 gpcpd (10-year average)
- Max Month Peaking Factor of 2.08 (maximum observed)
- Peak Day Peaking Factor of 2.59 (maximum observed)

Buildout Projections were estimated using the future population data found in **Table 6**. Annual average day and winter average day projections were developed by multiplying the projected populations by the average per capita water production. Max month and peak day demands were calculated by multiplying the average day demand by the respective peaking factors. Projections for annual average day, max month, and peak day are provided in **Table 10** below.

Table 10 - City of Louisville Water Demand without Redtail Ridge

Parameter	Buildout Water Demand, gallons per day
Winter Average Day	2,152,995
Annual Average Day	3,726,000
Average Day in Max Month	7,768,075
Peak Day	9,650,340

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REDTAIL RIDGE WATER DEMAND

Dewberry used the historical City of Louisville per capita water flow values to estimate the water demand for the Redtail Ridge proposed development without irrigation. Separate flows for irrigation were estimated and described in the section below. Projections for irrigation were developed using estimated irrigated areas with assumptions for annual irrigation requirements. Four phases of development are planned. The timing of these developments is approximately every five years with the assumption that phase 1 occurs in 2025, phase 2 in 2030, phase 3 in 2035 and phase 4 in 2040. Each phase of development includes residential and commercial zoning. Residential is comprised of continuing care retirement communities and commercial is comprised of general office buildings, business hotels, and shopping centers.

Redtail Ridge Non-Irrigated Water Demands

Dewberry developed a range of projections anticipating low, mid, and high-level growth. These projections were developed from several commonly accepted literature sources, historical population and flow and load data in Louisville, and state and county regulations. **Table 11** summarizes our engineering assumptions.

Table 11 - Engineering Assumptions

Commercial or Residential Units	Annual Average Non-Irrigated Water Demand, Gallons per Capita per Day
General Residential, demand per capita[1]	94
Continuing Care Retirement Community, demand per capita	113
Shopping Center, gal/ft^2	0.46
Business Hotel, gal per day person	54
General Office, gal/day-person	24

1 Town of Louisville Historical Data for average winter demand. All other water demands assumed to be 20 percent higher than the wastewater production numbers found in the Wastewater Flow and Load Tech Memo 1.

Table 11 above includes the assumptions for per capita contributions for commercial and residential units. The historical water use of 94 gpcpd is the winter average day use and based on the maximum value in the last 10 years of data provided. This is considered the baseline non-irrigation flow for the development and is assumed to remain constant throughout the year.

Table 12 provides projection assumptions for low, medium, and high flow contributions. These projections assumptions were adjusted based on U.S. Census Bureau Data and typical office space per person in the Denver metropolitan area.

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Table 12 - Flow and Loading per Capita Contribution Assumptions

Commercial or Residential Unit Assumptions	Low	Medium	High
Residents per Unit	2	2.5	3
Retirement Community Residents per Unit	1	1.3	1.6
Hotel Occupants per Unit	1	1.5	2
Office Space sq ft/person	350	300	250

Table 12 above is instrumental for development of low, medium, and high flow and load projections. The assumptions relate to population density. The City of Louisville has an average of 2.45 residents per dwelling per the U.S. Census Bureau. Typical hotel rooms generally have 1 to 2 occupants per night per room. Office space per person assumes a 15-foot-wide by 15-foot-long office with accounting for common space use such as conference room space, hallways, restrooms, stairwells, breakrooms, kitchens, and shipping and receiving areas.

Table 13 provides low, medium, and high flow estimated projections associated with the Redtail Ridge Development. Annual Average non-irrigated flows from Redtail Ridge are estimated to be in the range of 0.6 MGD to 0.9 MGD.

Table 13 - Redtail Ridge Non-Irrigation Water Demand Projections

Flow	Average Annual Day, gpd		
	Low	Medium	High
Phase 1	242,242	303,185	367,784
Phase 2	160,762	198,725	239,384
Phase 3	78,428	94,740	113,293
Phase 4	36,771	41,000	46,920
Total	518,204	637,649	767,381

Note: gpd = gallons per day

Redtail Ridge Irrigated Water Demand Projections

Flows for irrigation demand were estimated using parcel areas provided in the ConocoPhilips Campus General Development Plan, 1st Amendment and common assumptions for irrigated areas. Assumptions for irrigation were developed with consultation from Norris-Design. The following are assumptions for the irrigated flows for Redtail Ridge:

- All irrigation areas receive 25 gallons per square foot per year
- 30% of the total area is irrigated
- 30% of the annual irrigation volume is observed in the max month
- 20% of the annual irrigation volume is observed in the average summer month
- Ratio of peak day irrigation use to max month irrigation use is 1.41.

The peak day to max month ratio was developed using historical data from 2010 to 2019. The City's historical average winter demand is considered to be the baseline non-irrigated flow from Redtail Ridge. Historical irrigation demand was estimated by subtracting the average winter day from both peak day and max month for each year. The ratio used is the highest value from 2010 to 2019. **Table 14** provides projections for the irrigation for each phase of development. Phasing for irrigation demands is unknown and was assumed using the best available information.

Table 14 - Redtail Ridge Irrigation Demand

Flow	Average Irrigation, gpd	Max Month Irrigation, gpd	Peak Day Irrigation, gpd
Phase 1	347,610	521,415	737,371
Phase 2	161,826	242,739	343,275
Phase 3	220,197	330,295	467,094
Phase 4	305,865	458,798	648,818
SUM	1,035,498	1,553,247	2,196,557

Note: gpd = gallons per day

The projected irrigation demands above represent conservative estimates and do not account for the low irrigation landscaping measures intended to be designed for the Redtail Ridge Development. Dewberry's estimate assumes all irrigated landscaping is turf, and requires a considerably higher amount of watering per square foot compared to more water conscious landscaping designs. It should be noted that based on conversations with Norris-Design, the anticipated landscaping design may contain approximately 15 to 20 percent turf. The remaining landscaping is intended to be low water use landscaping consisting of planting areas and native vegetation requiring approximately 5 to10 gallons per square foot per year. This results in landscaping flows that are approximately 45 percent of those shown in **Table 14** above.

TOTAL BUILDOUT WATER DEMAND

The flows presented below represent the total future water demand projections for the City of Louisville with Redtail Ridge. The implications of these projected flows on infrastructure will be presented in Tech Memo 2. Total projections are estimated by phase with a buildout year of 2040 when phase 4 is anticipated to be implemented. **Table 15** provides cumulative total water demand buildout projections for average day in max month and peak day.

Table 15 - City of Louisville with Redtail Ridge Water Projections

Year	Phases	MMF, gpd			PDF, gpd		
		Low	Medium	High	Low	Medium	High
2025	Phase 1	8,531,733	8,592,675	8,657,275	10,629,953	10,690,895	10,755,495
2030	Phases 1-2	8,935,234	9,034,139	9,139,398	11,133,989	11,232,894	11,338,153
2035	Phases 1-3	9,343,957	9,459,174	9,582,986	11,679,511	11,794,728	11,918,540
2040	Phases 1-4	9,839,526	9,958,972	10,088,703	12,365,101	12,484,547	12,614,278

Note: gpd = gallons per day, MMF = average day in the max month flow, PDF = peak day flow

Total buildout max month demands range from 9.9 to 10.2 MGD. Buildout peak day demand projections range from 12.4 to 12.7 MGD. The NWTP and HBWTF have a rated capacity of 8.0 MGD, and 5.0 MGD, respectively. All four phases of development would require approximately 23 percent of the total rated capacity. In the last five years, the City has seen an average peak day demand of 7.3 MGD and average peak day total production of 7.6 MGD. The City currently utilizes approximately 58 percent of its rated capacity to meet peak day demands. The water system and water distribution infrastructure improvements required to meet the Redtail Ridge projections are discussed in Technical Memorandum 2

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Revised Final Report

Redtail Ridge Market Analysis

The Economics of Land Use

Prepared for:
Brue Baukol Capital Partners, LLC

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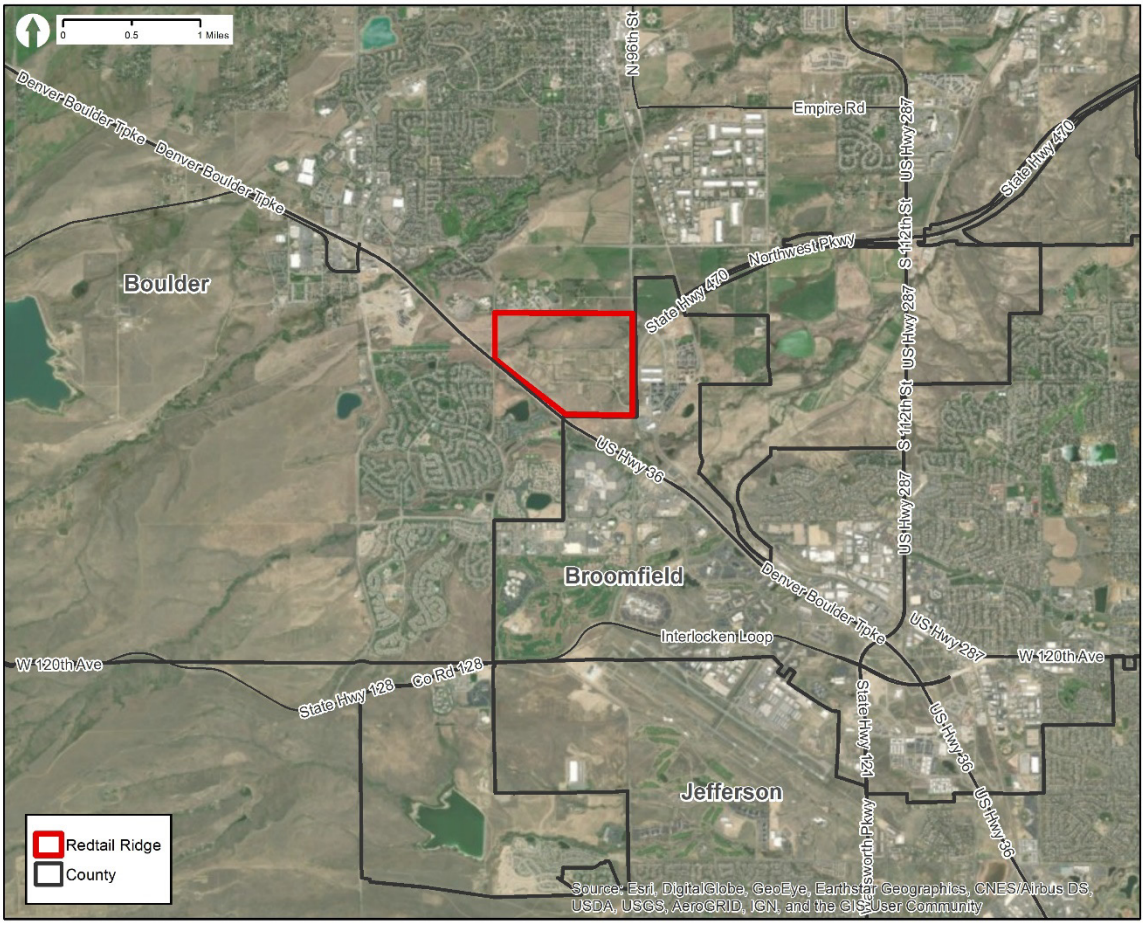
1. Introduction and Summary of Findings

Background

Brue Baukol Capital Partners (Developer) is planning for the development of Redtail Ridge, a project to be built on the 390-acre ConocoPhillips property located at the intersection of US-36 and Northwest Parkway in Louisville, Colorado. The site shown in **Figure 1** represents the Redtail Ridge project area and does not include the full extent of the ConocoPhillips property. ConocoPhillips had previously proposed to build a corporate research campus on the property. Prior to the ConocoPhillips acquisition, the site contained the corporate headquarters and manufacturing facilities of Storage Tek Corporation.

Figure 1. Redtail Ridge



The Developer is planning a corporate business park with additional commercial, hospitality, and senior housing/community uses and extensive open space. A total of 390 acres are located in the City of Louisville for which the Developer is seeking approval of a General Development Plan (GDP). (An additional 40 acres are located in the City and County of Broomfield and 47 acres are located in unincorporated Boulder County.) The proposed GDP contains approximately 260 acres of developable land.

Medtronic, a medical device manufacturer, with a large Boulder County presence, is proposing to build a 500,000 square foot office campus that would be an anchor use for the development. In addition to this anchor tenant, the GDP application includes 2 million square feet of mixed commercial development (including office, research and development, hotel, and retail uses), 900 multifamily residential units, and a continuing care retirement community (CCRC) with up to 1,326 units. Given that the project is expected to take up to 20 years to buildout, the Developer is seeking a rezoning plan that is flexible and market responsive.

Scope of Work

Economic & Planning Systems (EPS) was retained by Brue Baukol to complete a market analysis and development forecasts for commercial uses including office, flex/R&D, hotel, and retail uses. EPS has also evaluated the potential housing demand from the supportable commercial development and estimated the mitigation of this demand resulting from households moving to the CCRC on the site and vacating existing housing units in the market area inventory.

EPS has completed a number of projects in the Louisville area over the last five years and is familiar and knowledgeable with current economic and real estate market conditions. Most recently, EPS was retained by the City of Louisville for a market and feasibility analysis for Parcel O in the Centennial Valley GDP located in the McCaslin Avenue commercial corridor. In that study, EPS analyzed retail market trends and forecasts for the trade area including and surrounding the City of Louisville and evaluated reuse and redevelopment options for the vacant and underutilized large format retail space in Parcel O and elsewhere in the market area. More limited market research was also completed on the hotel, office, and multifamily development sectors as input to redevelopment options. EPS has also completed other retail market and development studies for the Town of Superior and City and County of Broomfield within the trade area of Louisville and the Redtail Ridge property.

Some of the data from these previous studies are of relevance to this market study and are included as previously presented or updated, as cited. However, it is important to note that the location, site conditions, and proposed development plan for the Redtail Ridge property are distinctly different from the major retail nodes in the McCaslin Corridor and elsewhere in the Louisville trade area as further discussed in this study.

The report is presented in six chapters following this Introduction and Summary of Findings as follows:

- **Economic and Demographic Framework –** Building upon the EPS Parcel O Redevelopment Study, this chapter provides updated economic and demographic trends and forecasts affecting development opportunities in Louisville and the surrounding market area including population and households, demographic characteristics, and employment by land use category.
- **Office and R&D Development Potential –** This chapter tracks office and research and development (R&D) development trends and conditions over the 2009 to 2018 time period for the Denver-Boulder metro areas and for the major submarkets in the region. Forecasts for construction are then developed for the 2020 to 2040 time period based on the demand for space derived from employment forecasts, historic trends, and existing land and development capacity. The share of future space demand that can be captured by the project is estimated given the competitive assets of the property and existing and future competition.
- **Hotel Development Potential –** EPS updated the hotel analysis completed for the Parcel O property including the inventory of existing and planned hotel properties in the US-36 subarea and data of existing and historical performance characteristics. The growth in hotel demand was the forecast based on growth in commercial space and households and the historical ratio of hotel rooms to space in the subarea and larger corridor over the 2020 to 2040 time period. The potential market capture for the subject property was then estimated based on its locational attributes and position compared to existing and future competition.
- **Retail Development Potential –** EPS updated the inventory of retail centers and space in the central US-36 Corridor by space category and identified gaps in the existing inventory with the potential for location on the subject property. We also used a retail expenditure model to estimate the demand for the types of goods and stores likely to locate on-site from on-site employees, residents, and the surrounding trade area.
- **Housing Demand –** This chapter summarizes the analysis of housing demand associated with the preliminary development program for Redtail Ridge. The total housing demand is estimated based on the employment generated by the commercial components of the project and existing housing distribution patterns for Louisville employees. A portion of housing demand is also estimated to be reduced by subtracting out the existing housing units in the market area that will potentially be vacated by seniors moving to the 1,326-unit CCRC from the surrounding area.

Proposed Development Program

The GDP application proposes 2.5 million square feet of total commercial development. The preliminary development program includes a 500,000 square foot corporate anchor tenant proposed to be built in Phase 1 by 2022 and an additional 1.75 million square feet of office space anticipated to be built in roughly equal increments of four phases over the life of the project estimated by EPS to extend to 2040.

Table 1. Preliminary Development Program, 2022-2040

Development Program	Unit	Factor	Phase 1 2022	Phase 2 2025	Phase 3 2030	Phase 4 2040	2022-2040 Total	2022-2040 Ann. #
Commercial Space (sq. ft.)								
Corporate Office			500,000	0	0	0	500,000	27,778
Office			300,000	590,000	490,000	370,000	1,750,000	97,222
Hotel			200,000	0	0	0	200,000	11,111
Retail			10,000	15,000	20,000	25,000	70,000	3,889
Total			**1,010,000**	**605,000**	**510,000**	**395,000**	**2,520,000**	**140,000**
Residential Space (units)								
Senior Living	units		505	505	316	0	1,326	74
Residential	units		600	300	0	0	900	50
Total Units	units		**1,105**	**805**	**316**	**0**	**2,226**	**124**
Residential Space (sq. ft.)								
Senior Living	sq. ft.	1,357	685,600	685,600	428,500	0	1,800,000	100,000
Residential	sq. ft.	1,000	600,000	300,000	0	0	900,000	50,000
Total Space (sq. ft.)	sq. ft.		**1,285,600**	**985,600**	**428,500**	**0**	**2,700,000**	**150,000**
Total Space (sq. ft.)			**2,296,000**	**1,591,000**	**939,000**	**395,000**	**5,220,000**	**140,000**

Source: Brue Baukol; Economic & Planning Systems

The Developer's estimated commercial development mix includes 70,000 square feet of retail and 200,000 square feet of hotel development (240 keys) at buildout. The office and business development therefore aims to include a mix of complementary uses to provide amenities to the employers and employees within the project as well as be accessible from the primary entryway at Northwest Parkway and Tape Drive. The allocation of commercial development by land use category may change to respond to changing market conditions and unanticipated development opportunities.

The project is also proposed to contain a continuing care retirement community (CCRC) with up to 1,326 units. A CCRC contains a range of products that allow seniors to age in place. These projects generally contain independent-living housing units, assisted living housing units, and nursing care facilities within the same community. Additionally, the Redtail Ridge development is proposed to include 900 units of residential housing in either attached or multifamily units. The residential components and CCRC expected to be built in the first two phases of development.

Summary of Findings

The major findings from the Redtail Ridge Market Analysis are summarized below.

1. ***The Redtail Ridge development has the potential to attract Boulder based companies that cannot find adequate space to expand in that city.***

   The subject property contains nearly 400 acres at the intersection of US-36 and Northwest Parkway across the highway from FlatIron Mall and Interlocken Business Park. In addition to Interlocken, the US-36 Corridor market area has several business parks including Centennial Valley Business Park, Westmoor Technology Park, and Colorado Technology Center that have captured a significant amount of office and R&D users that have expanded out of Boulder due to the lack of available space. The Redtail Ridge property is well positioned to capture this demand from Boulder-based research and technology companies and the University of Colorado and federal government laboratories.

2. ***The Redtail Ridge development has the potential to become a major office and business location in the US-36 Corridor.***

   Compared to existing competition, the Redtail Ridge development will have superior access and visibility and will be positioned to attract emerging knowledge-based companies and employees seeking a new generation office park containing an active and walkable commercial activity center. The planned development of a 500,000 square foot office building for a major national corporation will be the anchor development for this site and help catalyze additional employment-based uses. The project is forecast to capture an additional 630,000 square feet of office space by 2030 for a total of 1.13 million square feet. Over the 2030 to 2040 time period, the site is forecast to capture an additional 930,000 square feet resulting in total demand for 2 million square feet over the next 20 years.

3. ***The Redtail Ridge property is well positioned to capture a share of the future hotel demand in the US-36 Corridor.***

   Future hotel demand will be driven by on-site employment and by the general growth of transient demand along the US-36 Corridor. Since 2000, the corridor has experienced an increase of 130 rooms per year. Maintaining this level of growth over the next 20 years would support an additional 2,600 hotel rooms in the corridor. The Redtail Ridge site will be a major commercial development at a key highway intersection and is estimated to be able to attract approximately 10 percent share or approximately 260 hotel rooms. Additionally, the site is estimated to be able to attract 155 to 290 hotel rooms by 2040 based on a comparison of hotel development within and surrounding the comparable office and business parks surveyed.

4. ***The development of a major office-based employment center will support the development of complementary retail and restaurant uses.***

   The US-36 Corridor is overbuilt for national tenant larger format anchor stores and other mass merchandisers. Some of the existing big box stores are being converted to non-retail uses due to changes in the national retail market and overbuilding in the corridor. The development of a major employment center with approximately 2.5 million square feet of office-based employment and 240 hotel keys as well as 2,000 housing units will support an increment of restaurant and entertainment and convenience retail space. Based on a retail expenditure analysis of the trade area and on-site residents and seniors, the Redtail Ridge property is estimated to be able to support approximately 63,000 square feet of retail space by buildout.

5. ***The Redtail Ridge development will attract a mix of office uses including flex/R&D.***

   Flex/R&D space is estimated to account for 5 to 10 percent of space or 161,000 to 350,000 square feet based on the historical capture of Boulder R&D spin-off in the Louisville/Lafayette area and the locational advantages of the site on US-36. The U.S. 36 Corridor has historically captured approximately 28 percent of the total flex/R&D development from 2000 to 2018 within the Denver Metro area. The corridor gained 2.7 million square feet since 2000, which consists of 150,000 square feet annually. Flex/R&D buildings have been integrated into existing competitive business parks in the corridor. The development of Redtail Ridge along the corridor with a major office tenant offers opportunity for additional flex/R&D to locate on site.

6. ***The planned CCRC community and residential units will provide a complementary development use that can mitigate a portion of the additional housing demand created by the employment uses on site.***

   Of the 1,126 independent living units within the continuing care retirement community (CCRC), it is estimated approximately 50 percent, or 563 households, will be moving from the surrounding communities within a 15-mile radius. Additionally, Redtail Ridge is proposed to include 900 multifamily housing units, for a total of 1,463 mitigated housing units within the proposed project. To the extent that these housing units are occupied by current area residents, it will free up the existing housing stock and reduce the demand for additional market area housing. At buildout, Redtail Ridge is estimated to generate the demand for 6,189 housing units from on-site employment. The estimated net housing demand on the target market area, accounting for the residential and senior housing units built on site, is 1,938 units or an average of 108 units per year over the estimated 18-year buildout period (**Table 31**).

2. Economic and Demographic Framework

This section provides an overview of the economic and demographic conditions within the City of Louisville and surrounding area. Population, households, employment trends, and employment forecasts are documented to set the context for, and to provide inputs to, the real estate market demand analysis.

Population and Household Trends

The City of Louisville's current population is 21,124 residents, shown below in **Table 2**. From 2010 to 2019, Louisville has gained a total of 2,730 residents at an annual growth rate of 1.5 percent. During this same time period, households in Louisville have increased by 1,138 households, which is an annual growth rate of 1.6 percent. These recent trends follow closely with Boulder County and Denver-Aurora-Lakewood MSAs, which had population growth at an annual rate of 1.4 percent and 1.7 percent respectively as well as household growth at an annual rate of 1.2 percent and 1.6 percent respectively.

The City and County of Broomfield has a current population of 73,431 residents. From 2000 to 2010, Broomfield increased by a total of 16,541 residents at an annual growth rate of 3.6 percent. The growth has slowed down slightly the past 10 years, but Broomfield is still growing at a faster pace than Louisville and Boulder County. From 2010 to 2019, Broomfield gained 17,365 residents at an annual growth rate of 3 percent and 6,761 households at an annual growth rate of 3.1 percent.

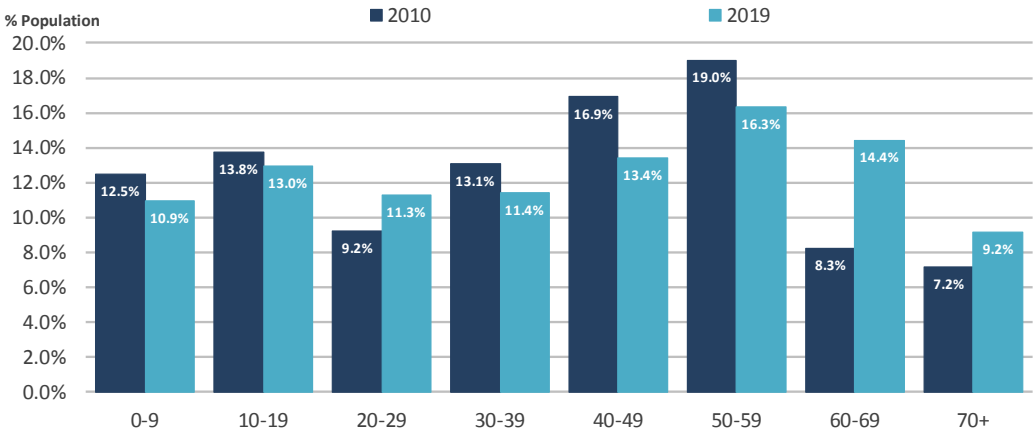
Table 2. Population and Household Trends, 2000-2019

				2000-2010			2010-2019		
Description	2000	2010	2019	Total	Ann. #	Ann. %	Total	Ann. #	Ann. %
Population									
Louisville	19,222	18,394	21,124	-828	-83	-0.4%	2,730	303	1.5%
Lafayette	23,256	24,427	31,018	1,171	117	0.5%	6,591	732	2.7%
Superior	8,984	12,431	13,439	3,447	345	3.3%	1,008	112	0.9%
Broomfield	39,525	56,066	73,431	16,541	1,654	3.6%	17,365	1,929	3.0%
Boulder County	269,713	294,567	333,887	24,854	2,485	0.9%	39,320	4,369	1.4%
Denver-Aurora-Lakewood MSA	2,179,469	2,543,482	2,960,386	364,013	36,401	1.6%	416,904	46,323	1.7%
Households									
Louisville	7,382	7,543	8,681	161	16	0.2%	1,138	126	1.6%
Lafayette	8,808	9,625	11,918	817	82	0.9%	2,293	255	2.4%
Superior	3,373	4,474	4,772	1,101	110	2.9%	298	33	0.7%
Broomfield	14,290	21,471	28,232	7,181	718	4.2%	6,761	751	3.1%
Boulder County	106,495	119,300	132,940	12,805	1,281	1.1%	13,640	1,516	1.2%
Denver-Aurora-Lakewood MSA	852,252	1,004,696	1,161,428	152,444	15,244	1.7%	156,732	17,415	1.6%

Source: ESRI; Economic & Planning Systems

The City of Louisville currently has the majority of residents between ages of 30 and 69, shown below in **Figure 2**. The younger population, 19 years old and younger, have decreased since 2010 by a total of 2 percentage points. While the older age cohorts have increased since 2010, residents ages 60 to 69 have increased by 6.2 percentage points and residents 70 years old and older have increased by 2 percentage points. Louisville has an increasing number of aging residents, which is indicative of a growing demand for senior housing.

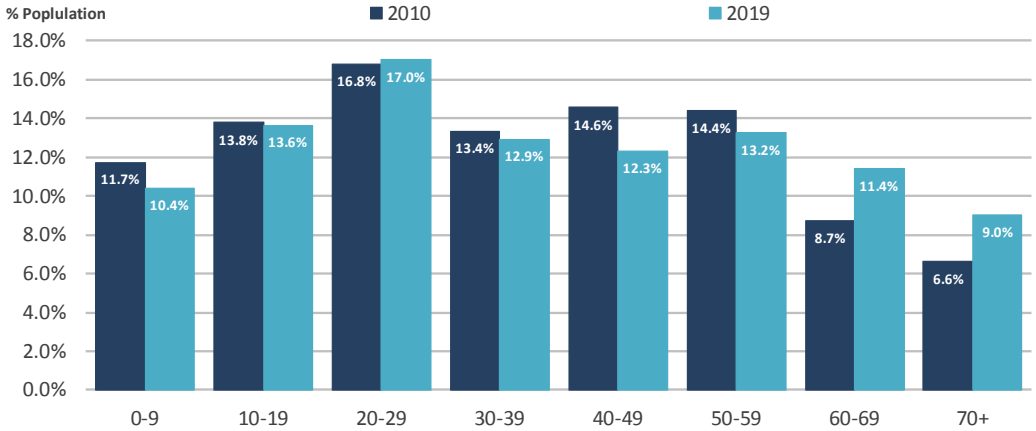
Figure 2. Louisville Age Distribution, 2010-2019



Source: ESRI; Economic & Planning Systems

Similar to Louisville, Boulder County has increasing older age cohorts including residents aged from 60 to 69 increasing 2.7 percentage points since 2010 and residents aged 70 and older increasing by 2.4 percentage points, shown in **Figure 3**.

Figure 3. Boulder County Age Distribution, 2010-2019

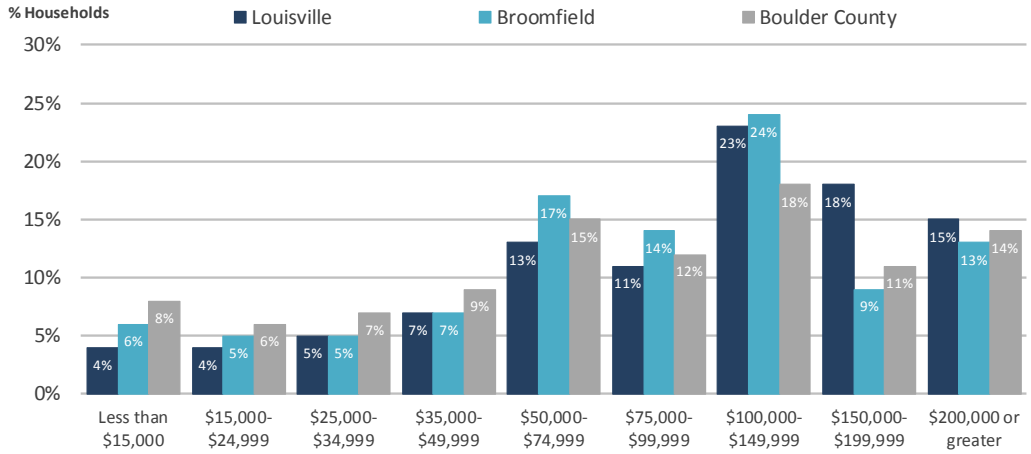


Source: ESRI; Economic & Planning Systems

Households in Louisville have above average incomes for the region. About 56 percent of Louisville households have incomes over $100,000, as shown in **Figure 4**. While in Broomfield 46 percent of households have incomes over $100,000 compared to 43 percent in Boulder County.

Boulder County has 30 percent of households making an income below $50,000 annually. In Louisville and Broomfield there are 20 percent and 23 percent of households, respectively, making below $50,000 annually.

Figure 4. Household Income, 2019



Source: ESRI; Economic & Planning Systems

Residential building permit data by housing type and jurisdiction is shown in **Table 3** below. From 2010 to 2018 Louisville has gained over 1,000 housing units or 126 units per year. About 52 percent of these units are single family, which includes attached and detached units. The City and County of Broomfield has gained 7,400 housing units or 925 units per year. Of these new housing units, 54 percent have been multifamily. Lafayette has gained almost 2,500 housing units since 2010 or about 300 units annually. About 56 percent of these are single family and 44 percent multifamily.

In comparison, the 7-county combined Denver-Boulder metro area (comprised of Adams County, Arapahoe County, Boulder County, City and County of Broomfield, City and County of Denver, Douglas County, and Jefferson County), has gained more than 75,000 housing units or about 9,400 housing units per year. About 57 percent of the units built have been multifamily and 43 percent have been single family.

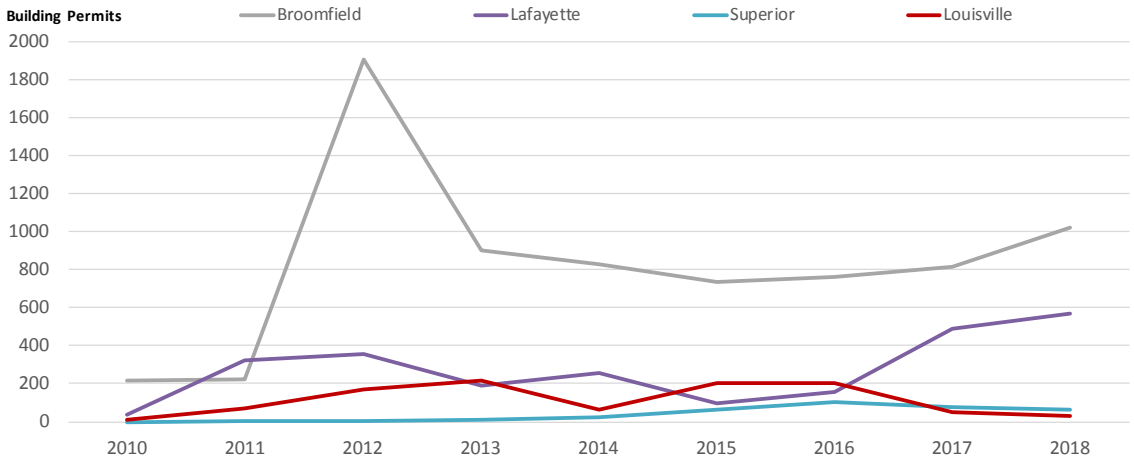
Table 3. Residential Building Permits by Type, 2010-2019

Building Permits	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010-2018 Total	2010-2018 Ann. #
Louisville											
Single Family	13	69	108	81	61	77	46	50	17	522	65
Multifamily	0	0	60	134	0	123	154	0	12	483	60
Total	**13**	**69**	**168**	**215**	**61**	**200**	**200**	**50**	**29**	**1,005**	**126**
Lafayette											
Single Family	35	202	114	190	258	99	154	191	127	1,370	171
Multifamily	0	120	240	0	0	0	0	295	441	1,096	137
Total	**35**	**322**	**354**	**190**	**258**	**99**	**154**	**486**	**568**	**2,466**	**308**
Superior											
Single Family	0	1	1	12	21	63	101	76	64	339	42
Multifamily	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**1**	**1**	**12**	**21**	**63**	**101**	**76**	**64**	**339**	**42**
Broomfield											
Single Family	218	224	179	358	468	451	545	396	587	3,426	428
Multifamily	0	0	1,728	540	360	282	216	418	432	3,976	497
Total	**218**	**224**	**1,907**	**898**	**828**	**733**	**761**	**814**	**1,019**	**7,402**	**925**
7-County Total											
Single Family	1,739	1,841	2,471	3,293	3,982	4,609	4,698	4,838	5,118	32,589	4,074
Multifamily	425	1,447	1,994	1,117	5,609	7,201	7,236	8,671	8,855	42,555	5,319
Total	**2,164**	**3,288**	**4,465**	**4,410**	**9,591**	**11,810**	**11,934**	**13,509**	**13,973**	**75,144**	**9,393**

Source: Home Builders Association of Metro Denver; Economic & Planning Systems

The northwest area housing market is dominated by Broomfield, which comprises about 10 percent of regional housing activity, as shown in **Figure 5**.

Figure 5. Residential Building Permits, 2010-2018



Source: Home Builders Association of Denver Metro; Economic & Planning Systems

Employment Trends

Denver Metro Area

In 2018, the Denver metro area had a total of 1.65 million wage and salary jobs, as shown in **Table 4**. The largest industries include Health Care, Professional and Technical Services, and Retail Trade. From 2000 to 2010 there was a decline in employment of about 32,000 jobs largely due to the impacts of the Great Recession in 2008 to 2010. Job growth increased from 2010 to 2018 by a total of 338,000 jobs or an average of 42,300 jobs per year at a 2.9 percent annual growth rate.

Table 4. Denver Metro Employment by Industry, 2000-2018

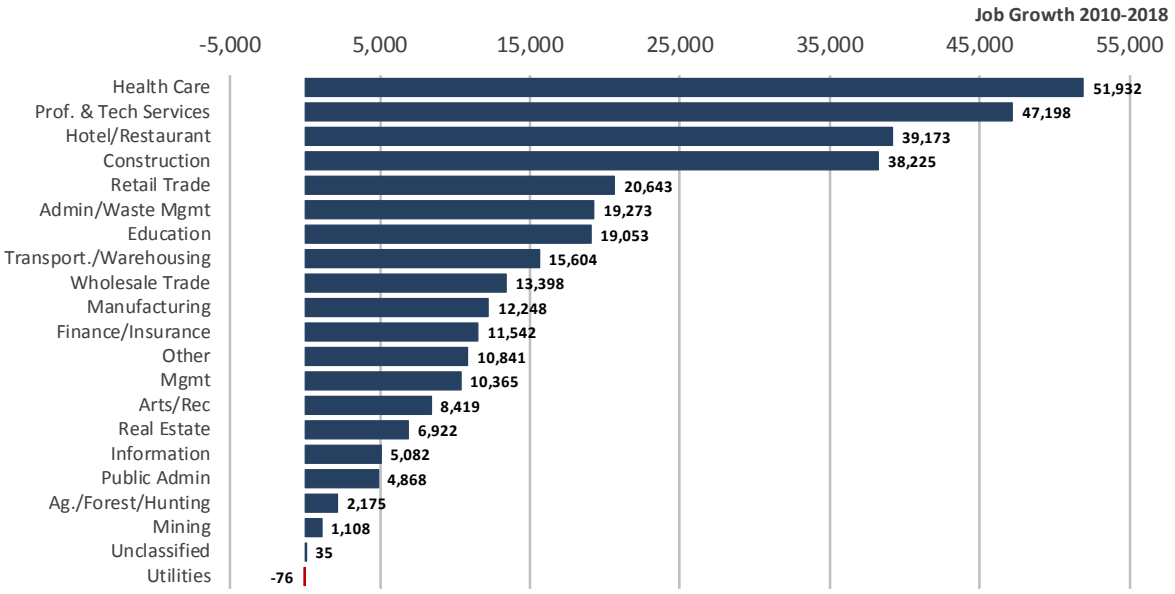
				2000-2010			2010-2018		
Industry	2000	2010	2018	Total	Ann. #	Ann. %	Total	Ann. #	Ann. %
Ag./Forest/Hunting	2,663	1,915	4,090*	-748	-75	-3.2%	2,175	272	9.9%
Mining	5,053	8,916	10,024	3,863	386	5.8%	1,108	139	1.5%
Utilities	5,828	6,048	5,972	220	22	0.4%	-76	-10	-0.2%
Construction	98,182	65,383	103,608	-32,799	-3,280	-4.0%	38,225	4,778	5.9%
Manufacturing	113,699	76,542	88,790	-37,157	-3,716	-3.9%	12,248	1,531	1.9%
Wholesale Trade	74,010	66,103	79,501	-7,907	-791	-1.1%	13,398	1,675	2.3%
Retail Trade	139,712	135,465	156,108	-4,247	-425	-0.3%	20,643	2,580	1.8%
Transport./Warehousing	62,551	50,746	66,350	-11,805	-1,181	-2.1%	15,604	1,951	3.4%
Information	84,673	54,138	59,220	-30,535	-3,054	-4.4%	5,082	635	1.1%
Finance/Insurance	73,624	70,906	82,448	-2,718	-272	-0.4%	11,542	1,443	1.9%
Real Estate	28,717	25,560	32,482	-3,157	-316	-1.2%	6,922	865	3.0%
Prof. & Tech Services	111,265	120,807	168,005	9,542	954	0.8%	47,198	5,900	4.2%
Mgmt	14,650	24,484	34,849	9,834	983	5.3%	10,365	1,296	4.5%
Admin/Waste Mgmt	98,208	85,312	104,585	-12,896	-1,290	-1.4%	19,273	2,409	2.6%
Education	82,284*	110,274	129,327	27,990	2,799	3.0%	19,053	2,382	2.0%
Health Care	109,758	152,447	204,379	42,689	4,269	3.3%	51,932	6,492	3.7%
Arts/Rec	18,944	23,249	31,668	4,305	431	2.1%	8,419	1,052	3.9%
Hotel/Restaurant	107,466	117,852	157,025	10,386	1,039	0.9%	39,173	4,897	3.7%
Other	40,096	40,230	51,071	134	13	0.0%	10,841	1,355	3.0%
Public Admin	68,635	75,790*	80,658*	7,155	716	1.0%	4,868	609	0.8%
Unclassified	6*	85*	120	79	8	30.4%	35	4	4.4%
Total	**1,345,092**	**1,313,339**	**1,651,653**	**-31,753**	**-3,175**	**-0.2%**	**338,314**	**42,289**	**2.9%**

*Nondisclosed Information

Source: Bureau of Labor Statistics QCEW; Economic & Planning Systems

Industries with the most growth over the 2010 to 2018 timeframe include Health Care, Professional and Technological Services, Hotel/Restaurant, and Construction as shown in **Figure 6**.

Figure 6. Denver Metro Employment Growth by Industry, 2010-2018



Source: Bureau of Labor Statistics QCEW; Economic & Planning Systems

Boulder County

As of 2018, Boulder County had 183,466 wage and salary jobs, which is 11 percent of the Denver region's total, as shown in **Table 5**. The largest industries include Professional and Technological Services, Health Care, and Education. From 2000 to 2010 there was a decline in employment of about 27,600 jobs. Employment increased from 2010 to 2018 by a total of 31,350 jobs or an average of 3,900 jobs per year at a growth rate of 2.4 percent annually.

Table 5. Boulder County Employment by Industry, 2000-2018

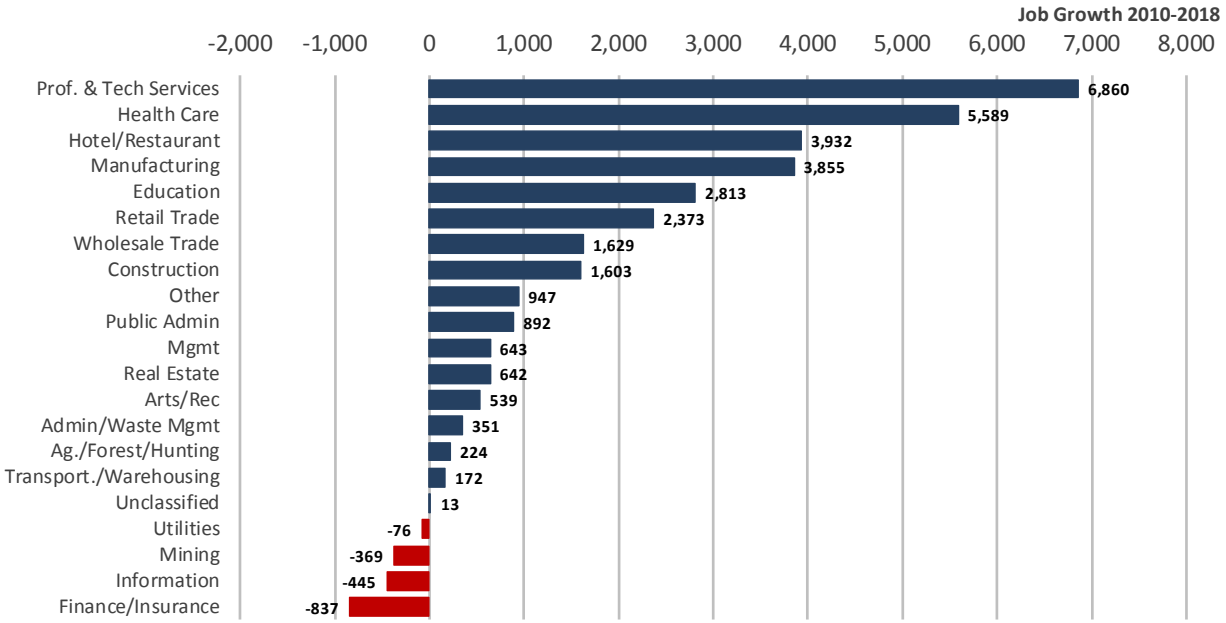
				2000-2010			2010-2018		
Industry	2000	2010	2018	Total	Ann. #	Ann. %	Total	Ann. #	Ann. %
Ag./Forest/Hunting	442	382	606	-60	-6	-1.4%	224	28	5.9%
Mining	228	545	176	317	32	9.1%	-369	-46	-13.2%
Utilities	312	332	256	20	2	0.6%	-76	-10	-3.2%
Construction	8,613	4,086	5,689	-4,527	-453	-7.2%	1,603	200	4.2%
Manufacturing	29,186	15,202	19,057	-13,984	-1,398	-6.3%	3,855	482	2.9%
Wholesale Trade	5,757	4,884	6,513	-873	-87	-1.6%	1,629	204	3.7%
Retail Trade	19,337	15,181	17,554	-4,156	-416	-2.4%	2,373	297	1.8%
Transport./Warehousing	3,532	1,940	2,112	-1,592	-159	-5.8%	172	22	1.1%
Information	15,243	8,696	8,251	-6,547	-655	-5.5%	-445	-56	-0.7%
Finance/Insurance	4,507	4,869	4,032	362	36	0.8%	-837	-105	-2.3%
Real Estate	3,097	2,114	2,756	-983	-98	-3.7%	642	80	3.4%
Prof. & Tech Services	22,119	21,504	28,364	-615	-62	-0.3%	6,860	858	3.5%
Mgmt	1,226	923	1,566	-303	-30	-2.8%	643	80	6.8%
Admin/Waste Mgmt	8,666	5,832	6,183	-2,834	-283	-3.9%	351	44	0.7%
Education	15,591	18,986	21,799	3,395	340	2.0%	2,813	352	1.7%
Health Care	12,735	17,605	23,194	4,870	487	3.3%	5,589	699	3.5%
Arts/Rec	2,200	2,749	3,288	549	55	2.3%	539	67	2.3%
Hotel/Restaurant	15,587	14,259	18,191	-1,328	-133	-0.9%	3,932	492	3.1%
Other	4,704	4,429	5,376	-275	-28	-0.6%	947	118	2.5%
Public Admin	6,636	7,590	8,482	954	95	1.4%	892	112	1.4%
Unclassified	0*	9	22	9	1	---	13	2	11.8%
Total	**179,719**	**152,116**	**183,466**	**-27,603**	**-2,760**	**-1.7%**	**31,350**	**3,919**	**2.4%**

*Nondisclosed Information

Source: Bureau of Labor Statistics QCEW; Economic & Planning Systems

Industries with the most growth since 2010 during this time include Professional and Technological Services, Health Care, Hotel/Restaurant, and Manufacturing, as shown in **Figure 7**. Manufacturing growth over the last eight years is in contrast to the loss of a much greater number of jobs in the 2000 to 2010 time period.

Figure 7. Boulder County Employment Growth by Industry, 2010-2018

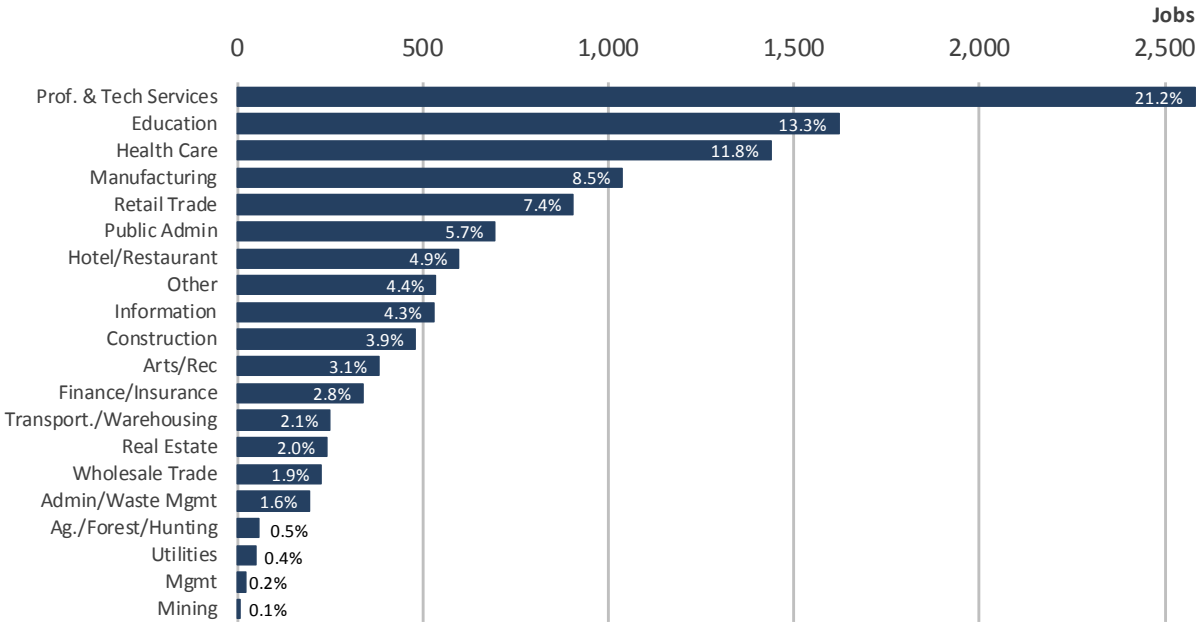


Source: Bureau of Labor Statistics QCEW; Economic & Planning Systems

Louisville

The BLS employment data previously presented is published at the county level and not the city level. ESRI tracks employment at the city level from Census data. Using this data, the largest industry in Louisville is Professional and Technological Services with 2,581 jobs and 21 percent of the total employment, as shown in **Figure 8**. This is followed by Education with 1,621 jobs (13 percent), Health Care with 1,438 jobs (12 percent), and Manufacturing with 1,037 jobs (9 percent).

Figure 8. Louisville Employment by Industry, 2019



Source: ESRI; Economic & Planning Systems

Largest Employers

The largest (non-retail) private sector employers are shown for Boulder and Broomfield counties in **Table 6**. The largest employer in Boulder County (and Louisville) is Medtronic with 2,470 employees, followed by Boulder Community Health with 2,440 employees, and Ball Aerospace & Technologies Corporation with 1,680 employees. Centura Health has 1,280 employees at the Longmont United Hospital and Avista Adventist Hospital, which is located adjacent to the site. The largest employer in Broomfield is Century Link with 2,220 employees. This is followed by Oracle with 1,800 employees and SCL Health Revenue Service Center with 1,200 employees.

Table 6. Boulder County and Broomfield Largest Employers, 2019

Company	Product/Service	Employment
Boulder County		
Medtronic PLC	Medical Devices & Products	2,470
Boulder Community Health	Healthcare	2,440
Ball Aerospace & Technologies Corp.	Aerospace, Tech, & Services	1,680
IBM Corporation	Computer Systems & Services	1,670
Seagate Technology	Computer Hard Drives	1,440
Good Samaritan Medical Center	Healthcare	1,430
Google	Internet Services & Products	1,300
Centura Health[1]	Healthcare	1,280
Sierra Nevada Corporation	Aerospace Systems	750
Kaiser Permanente	Healthcare	750
Total		**15,210**
Broomfield		
CenturyLink	Communication & Internet Systems	2,220
Oracle	Software & Network Computer Systems	1,800
SCL Health Revenue Service Center	Healthcare	1,200
Hunter Douglas Window Fashions	Window Coverings Manufacturing	980
Vail Resorts	International Ski Area Operations	740
Ball Corporation	Aerospace, Containers	610
TSYS	Transaction Processing Services	580
Danone North America	Food Products	570
Broadcom Inc.	Semiconductor Components	500
VMware	Cloud Computing	500
Total		**9,700**

[1] Longmont United Hospital & Avista Adventist Hospital

Source: Metro Denver EDC; Economic & Planning Systems

Commuting Patterns

The Longitudinal Employer-Household Dynamics (LEHD) program provides Census data on resident-based commuting patterns. The City of Louisville has a small portion of residents that live and work in the city—just under 11 percent. These 1,116 residents make up about 8 percent of Louisville's employment base, as shown in **Table 7**. Louisville has 13,399 people who commute into Louisville for work and approximately 9,348 residents commute out of Louisville for work.

Table 7. Inflow and Outflow of Residents and Workers in Louisville, 2017

Description	Total	Percent
Labor Force		
Resident and Employed in Louisville	1,116	10.7%
Resident in Louisville, but work elsewhere	9,348	89.3%
Total Employed Residents in Louisville	**10,464**	**100.0%**
Employment		
Resident and Employed in Louisville	1,116	7.7%
Employed in Louisville, but live elsewhere	13,399	92.3%
Total Employees in Louisville	**14,515**	**100.0%**

Source: LEHD; Economic & Planning Systems

The out-commuting locations of where Louisville residents work is shown in **Table 8** below. About 51 percent of Louisville residents work within Boulder County, which includes about 29 percent in the City of Boulder, and 3 percent in Lafayette. Approximately 13 percent work in Denver and 5 percent work in Broomfield.

Table 8. Where Louisville Residents Work

Work Destination	Jobs	Percent
Boulder County	5,284	50.5%
Denver County	1,347	12.9%
Adams County	807	7.7%
Jefferson County	706	6.7%
Arapahoe County	685	6.5%
Broomfield County	524	5.0%
Douglas County	259	2.5%
Larimer County	192	1.8%
Weld County	183	1.7%
El Paso County	143	1.4%
All Other Locations	334	3.2%
Total	**10,464**	**100.0%**

Source: LEHD; Economic & Planning Systems

The in-commuting locations of the Louisville workforce are shown below in **Table 9**. About 33 percent of Louisville workers live in Boulder County; this includes about 8 percent in Louisville, 6 percent in the City of Boulder, and 6 percent in Lafayette. Approximately 16 percent live in Adams County, 12 percent live in Jefferson County, and 8 percent in Broomfield.

Table 9. Where Louisville Workers Live

Home Destination	Jobs	Percent
Boulder County	4,843	33.4%
Adams County	2,265	15.6%
Jefferson County	1,769	12.2%
Denver County	1,175	8.1%
Broomfield County	1,092	7.5%
Weld County	942	6.5%
Arapahoe County	708	4.9%
Larimer County	480	3.3%
Douglas County	441	3.0%
El Paso County	311	2.1%
All Other Locations	489	3.4%
Total	**14,515**	**100.0%**

Source: LEHD; Economic & Planning Systems

Employment Forecasts

Employment forecasts for the Denver metro area are presented in **Table 10**. The forecasts are based on the DRCOG 2015 to 2040 regional growth model totals. DRCOG prepares employment forecasts in six aggregated industry sectors; Production, Retail, Services, Restaurants, Entertainment, and Education. This forecast was converted to forecasts for the 21 NAICS industries using DRCOG's aggregation scheme which lists the individual industries in the six aggregated sectors.

Total employment is estimated to grow at an annual average of 24,300 jobs from 2015 to 2030 to reach 2.05 million jobs, which is a 1.3 percent annual growth rate. Applying the same growth rates from 2030 to 2040 would add a total of 302,720 jobs or an average of 30,300 jobs per year as shown.

Table 10. Employment Forecast by Industry, 2015-2040

NAICS Industry	2015	2020	2030	2040	2015-2030 Change	2015-2030 Ann. #	2015-2030 Ann. Rate	2030-2040 Change	2030-2040 Ann. #	2030-2040 Ann. Rate
Ag./Forest/Hunting	3,305	3,539	4,057	4,745	752	50	1.4%	688	69	1.6%
Mining	13,369	14,314	16,410	19,193	3,040	203	1.4%	2,783	278	1.6%
Utilities	7,030	7,526	8,628	10,092	1,599	107	1.4%	1,463	146	1.6%
Construction	101,675	108,862	124,796	145,964	23,121	1,541	1.4%	21,167	2,117	1.6%
Manufacturing	99,261	106,277	121,833	142,498	22,572	1,505	1.4%	20,665	2,066	1.6%
Wholesale Trade	87,230	93,395	107,066	125,226	19,836	1,322	1.4%	18,160	1,816	1.6%
Retail Trade	138,603	149,602	174,289	201,791	35,686	2,379	1.5%	27,502	2,750	1.5%
Transport./Warehousing	62,187	66,097	74,669	85,544	12,482	832	1.2%	10,875	1,088	1.4%
Information	58,871	62,572	70,687	80,983	11,816	788	1.2%	10,295	1,030	1.4%
Finance/Insurance	83,989	89,269	100,847	115,535	16,858	1,124	1.2%	14,688	1,469	1.4%
Real Estate	31,717	33,711	38,083	43,630	6,366	424	1.2%	5,547	555	1.4%
Prof. & Tech Services	164,763	175,121	197,833	226,647	33,070	2,205	1.2%	28,814	2,881	1.4%
Mgmt	33,749	35,870	40,522	46,424	6,774	452	1.2%	5,902	590	1.4%
Admin/Waste Mgmt	111,424	118,429	133,788	153,274	22,364	1,491	1.2%	19,486	1,949	1.4%
Education	112,574	118,489	131,268	139,315	18,694	1,246	1.0%	8,047	805	0.6%
Health Care	205,166	218,065	246,346	282,225	41,179	2,745	1.2%	35,880	3,588	1.4%
Arts/Rec	31,916	33,128	35,692	38,927	3,776	252	0.7%	3,235	323	0.9%
Accommodations	201,222	218,577	257,908	301,846	56,686	3,779	1.7%	43,938	4,394	1.6%
Other	51,019	54,227	61,260	70,182	10,240	683	1.2%	8,922	892	1.4%
Public Admin	83,835	89,106	100,662	115,323	16,827	1,122	1.2%	14,661	1,466	1.4%
Unclassified	0	0	0	0	0	0	---	0	0	---
Total	**1,682,905**	**1,796,291**	**2,046,643**	**2,349,363**	**363,738**	**24,249**	**1.3%**	**302,720**	**30,272**	**1.4%**

Source: Denver Regional Council of Governments (DRCOG); Economic & Planning Systems

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3. Office and R&D Development Potential

This chapter begins with a summary of the office and flex/R&D market trends in the Denver metro area by county over the 2000 to 2018 time period. The office and flex/R&D data are also compiled by major business park to illustrate historical market capture. Office demand forecasts are then developed starting with the employment forecasts presented in Chapter 2 and then estimated using the percent of employment office space by sector and applying an average space factor per employee.

Office Supply

The Denver metro area had a total of approximately 193 million square feet of office space in 2018, as shown in **Table 11**. From 2000 to 2018, the region gained a total of 42 million square feet. The City and County of Denver has gained the most office space with a total of 13 million square feet during this time period or 740,000 square feet annually. Denver also holds the largest share of office space in the metro area with 39 percent of the total inventory. Boulder County currently has about 10 percent of the total share of office space with approximately 19 million square feet.

Since 2000, Boulder County has added 4.5 million square feet of office space or 250,000 square feet annually. The City and County of Broomfield currently has almost 7 million square feet or 3.5 percent of the total. Since 2000, Broomfield has gained a total of 2.3 million square feet of office space or 130,000 square feet annually.

Table 11. Office Development Inventory by County, 2000-2018

Denver Metro	2000		2010		2018		2000-2018		
	Inventory *Sq. Ft.*	%Total	Inventory *Sq. Ft.*	%Total	Inventory *Sq. Ft.*	%Total	New *Sq. Ft.*	Ann. # *Sq. Ft.*	%Total
Adams County	6,238,201	4.1%	9,310,622	5.2%	10,098,569	5.2%	3,860,368	214,465	9.2%
Arapahoe County	38,089,131	25.3%	42,494,667	23.9%	44,750,865	23.2%	6,661,734	370,096	15.8%
Boulder County	14,272,702	9.5%	17,368,593	9.8%	18,772,075	9.7%	4,499,373	249,965	10.7%
Broomfield	4,515,190	3.0%	6,274,900	3.5%	6,814,900	3.5%	2,299,710	127,762	5.5%
Denver	61,274,026	40.7%	67,691,256	38.1%	74,632,504	38.7%	13,358,478	742,138	31.7%
Douglas County	6,503,904	4.3%	11,519,124	6.5%	13,098,416	6.8%	6,594,512	366,362	15.7%
Jefferson County	19,827,115	13.2%	23,195,444	13.0%	24,651,402	12.8%	4,824,287	268,016	11.5%
Total	**150,720,269**	**100.0%**	**177,854,606**	**100.0%**	**192,818,731**	**100.0%**	**42,098,462**	**2,338,803**	**100.0%**

Source: CoStar; Economic & Planning Systems

The office inventory in the Denver metro area is shown by major office and business park areas including the US-36 Corridor, South I-25 Corridor, and Downtown Denver. The US-36 Corridor had 16 million square feet of office space in 2018, which consists of 8.5 percent of the Denver metro area total, shown in **Table 12**. Since 2000, the US-36 Corridor has gained 6 million square feet of office space or 345,500 square feet annually, which equates to 15 percent of the total growth. South I-25 Corridor had 37 million square feet office in 2018, which consists of 19 percent of the total.

Since 2000, South I-25 Corridor has gained 8.8 million square feet of office space, or nearly 500,000 square feet annually which equals 21 percent of the total office market. By comparison, Downtown Denver had 38 million square feet of office space in 2018, which consists of 20 percent of the total inventory. Since 2000, Downtown Denver has gained 5.3 million square feet of space or approximately 300,000 square feet annually and a 13 percent market share.

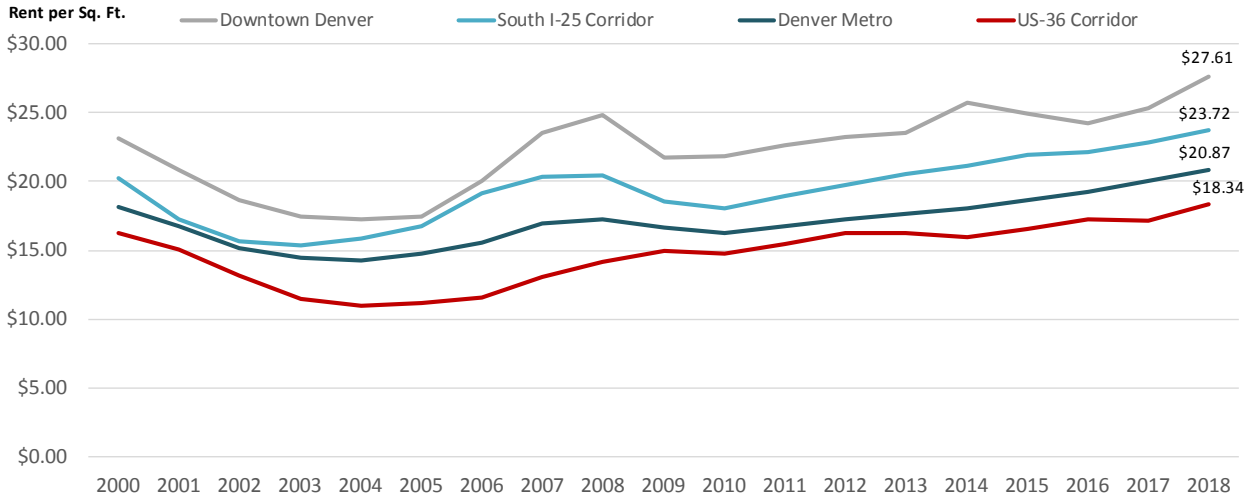
Table 12. Office Development Inventory by Area, 2000-2018

Office Inventory	2000		2010		2018		2000-2018		
	Inventory *Sq. Ft.*	%Total	Inventory *Sq. Ft.*	%Total	Inventory *Sq. Ft.*	%Total	New *Sq. Ft.*	Ann. # *Sq. Ft.*	%Total
US-36 Corridor	10,127,710	6.7%	15,009,742	8.4%	16,347,138	8.5%	6,219,428	345,524	14.8%
South I-25 Corridor	28,393,319	18.8%	33,654,554	18.9%	37,210,747	19.3%	8,817,428	489,857	20.9%
Downtown Denver	32,814,838	21.8%	34,918,800	19.6%	38,132,685	19.8%	5,317,847	295,436	12.6%
Other Areas	79,384,402	52.7%	94,271,510	53.0%	101,128,161	52.4%	21,743,759	1,207,987	51.6%
Denver Metro Total	**150,720,269**	**100.0%**	**177,854,606**	**100.0%**	**192,818,731**	**100.0%**	**42,098,462**	**2,338,803**	**100.0%**

Source: CoStar; Economic & Planning Systems

The average 2018 office rental rate in the Denver metro area is $20.87 per square foot, shown in **Figure 9**. All of the areas follow a similar trend, with US-36 Corridor having the lowest office rental rate at $18.34 and Downtown Denver having the highest rate at $27.61.

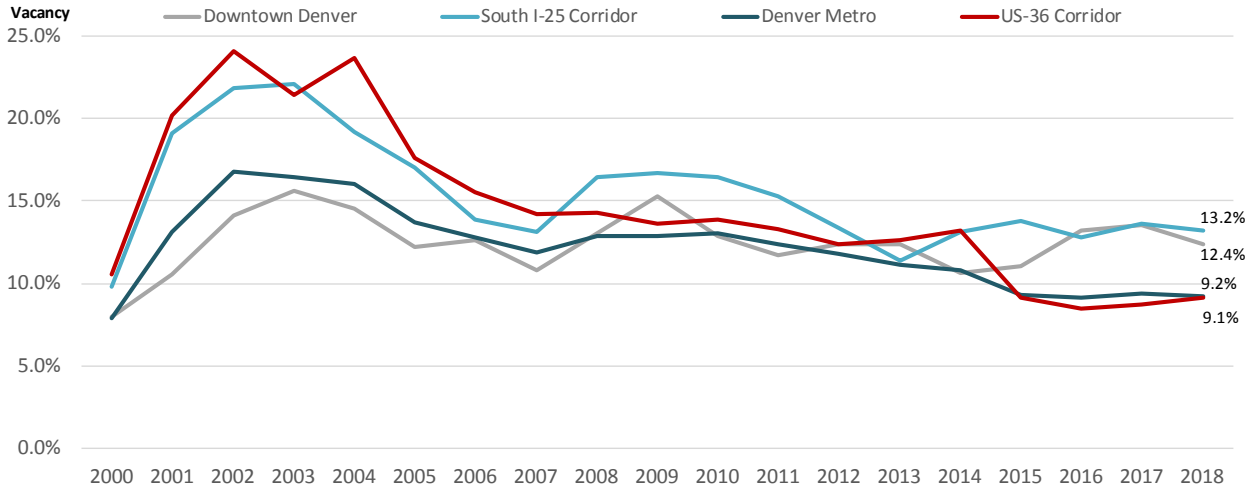
Figure 9. Office Rental Rate, 2000-2018



Source: CoStar; Economic & Planning Systems

The Denver metro area had an office vacancy rate of 9.2 percent in 2018, shown in **Figure 10**. US-36 Corridor had the lowest at 9.1 percent and South I-25 Corridor had the highest at 13.2 percent.

Figure 10. Office Vacancy Rate, 2000-2018



Source: CoStar; Economic & Planning Systems

Flex/R&D Development

In the CoStar inventory, flex/R&D development is a subset of industrial space designed to be versatile to accommodate a variety of uses. It can be used as office, medical, manufacturing, fabrication, processing, assembly of products, quasi-retail, or research and development (R&D) space. To be categorized as flex/R&D development at least half of the rentable building area must be used as office space.

In 2018, the Denver metro area had a total of 46.4 million square feet of flex/R&D space shown in **Table 13**. From 2000 to 2018, the metro area gained a total of 9.5 million square feet, of which 2.5 million square feet or 26 percent was in Boulder County. In 2018, Boulder County had approximately 13 million square feet of flex/R&D space, which represents 28 percent of the Denver metro area total inventory. In 2018, the City and County of Broomfield had a total of 1.1 million square feet. Since 2000, Broomfield has gained about 500,000 square feet of space, or 29,000 square feet annually.

Table 13. Flex/R&D Development Inventory by County, 2000-2018

	2000		2010		2018		2000-2018		
Denver Metro	Sq. Ft.	%Total	Sq. Ft.	%Total	Sq. Ft.	%Total	Total	Ann. #	%Total
Adams County	3,603,976	9.8%	3,883,087	9.0%	4,375,055	9.4%	771,079	42,838	8.1%
Arapahoe County	9,727,217	26.4%	10,992,084	25.4%	11,432,557	24.6%	1,705,340	94,741	17.9%
Boulder County	10,375,595	28.1%	11,897,921	27.5%	12,854,354	27.7%	2,478,759	137,709	26.0%
Broomfield	610,999	1.7%	1,003,886	2.3%	1,137,008	2.4%	526,009	29,223	5.5%
Denver	2,987,916	8.1%	3,551,498	8.2%	3,674,998	7.9%	687,082	38,171	7.2%
Douglas County	1,320,284	3.6%	2,288,833	5.3%	2,640,910	5.7%	1,320,626	73,368	13.8%
Jefferson County	8,258,129	22.4%	9,704,334	22.4%	10,309,225	22.2%	2,051,096	113,950	21.5%
Total	**36,884,116**	**100.0%**	**43,321,643**	**100.0%**	**46,424,107**	**100.0%**	**9,539,991**	**530,000**	**100.0%**

Source: CoStar; Economic & Planning Systems

The flex/R&D inventory in the Denver metro area is tabulated for the same office and business park areas in the US-36 Corridor, South I-25 Corridor, and Downtown Denver. The US-36 Corridor had 5.3 million square feet of flex/R&D space in 2018, which consists of 11 percent of the 7-county metro total, shown in **Table 14**. Since 2000, the US-36 Corridor has gained 2.7 million square feet or 150,000 square feet annually or 29 percent of total development. South I-25 Corridor had 2.9 million square feet in 2018, which represents 6 percent of the total inventory. From 2000 to 2018, this corridor gained almost 300,000 square feet of space, or 16,000 square feet annually.

Table 14. Flex/R&D Development Inventory by Area, 2000-2018

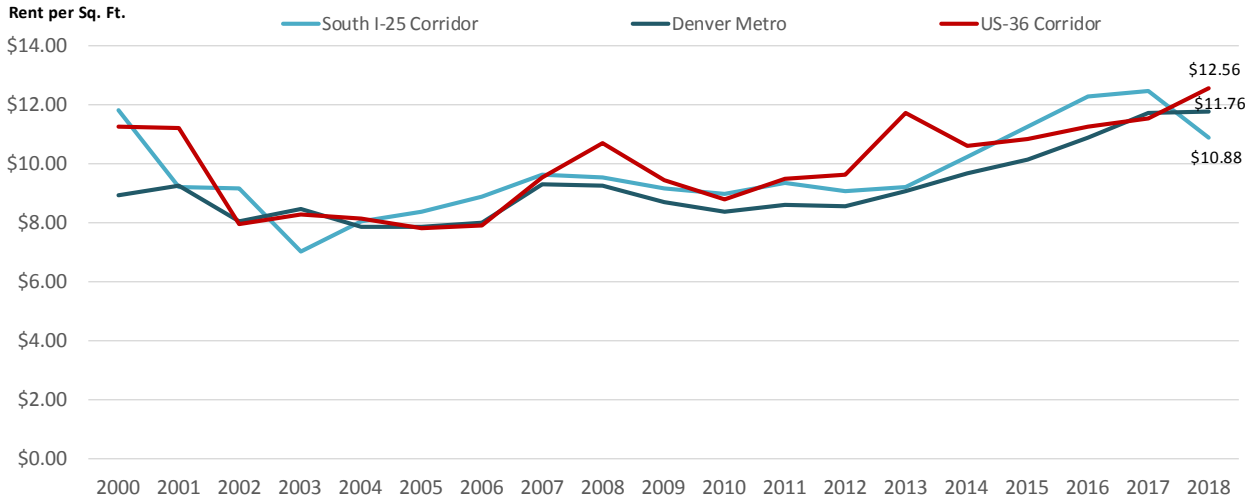
Flex/R&D Inventory	2000		2010		2018		2000-2018		
	Inventory *Sq. Ft.*	%Total	Inventory *Sq. Ft.*	%Total	Inventory *Sq. Ft.*	%Total	New *Sq. Ft.*	Ann. # *Sq. Ft.*	%Total
US-36 Corridor	2,546,308	6.9%	4,265,328	9.8%	5,244,612	11.3%	2,698,304	149,906	28.3%
South I-25 Corridor	2,649,704	7.2%	2,862,655	6.6%	2,933,827	6.3%	284,123	15,785	3.0%
Downtown Denver	47,430	0.1%	47,430	0.1%	47,430	0.1%	0	0	0.0%
Other Areas	31,640,674	85.8%	36,146,230	83.4%	38,198,238	82.3%	6,557,564	364,309	68.7%
Denver Metro Total	**36,884,116**	**100.0%**	**43,321,643**	**100.0%**	**46,424,107**	**100.0%**	**9,539,991**	**530,000**	**100.0%**

Source: CoStar; Economic & Planning Systems

The Colorado Technology Center (CTC) in Louisville is the largest flex/R&D for in the corridor with manufacturing and high tech companies consisting of 2 million square feet of space. From 2016 to 2019, CTC gained a total of 250,000 square feet of flex/R&D space. Many of these companies were initially in Boulder but have moved out of the city due to the lack of available space. Centennial Valley Business Park also has nearly 250,000 square feet of flex/R&D space along with office and manufacturing uses, as shown in **Table 15** on page 30.

The average flex/R&D rental rate in Denver metro area was $11.76 per square foot in 2018, shown in **Figure 11**. The average lease rates by area in 2018 are much more tightly clustered than office rates, with US-36 Corridor having the highest at $12.56 per square foot and South I-25 Corridor having the lowest at $10.88.

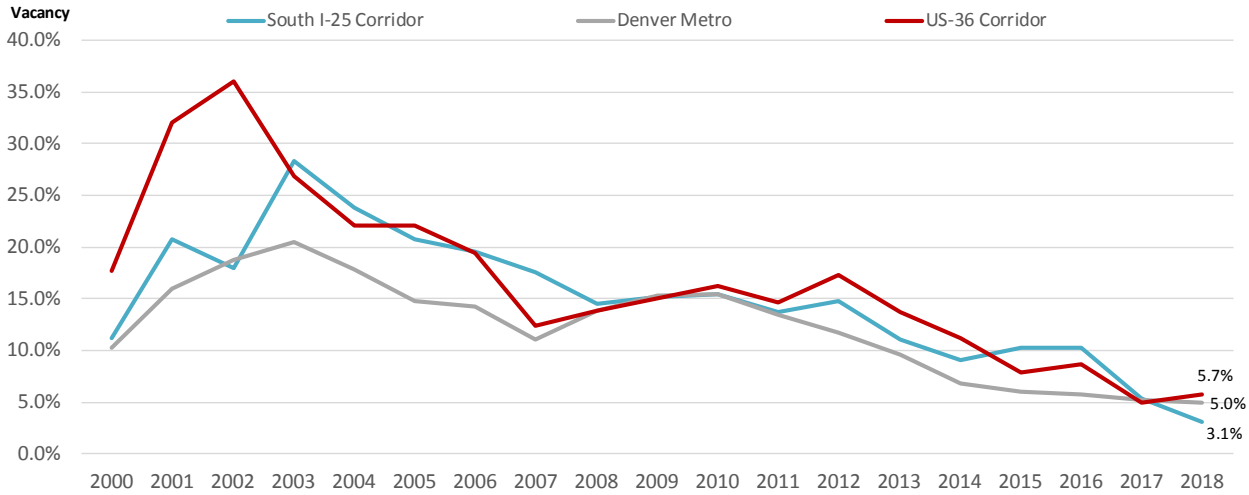
Figure 11. Flex/R&D Rental Rate, 2000-2018



Source: CoStar; Economic & Planning Systems

In 2018, the Denver metro area had a vacancy rate of 5 percent, shown in **Figure 12**. US-36 Corridor had the highest at 5.7 percent and South I-25 Corridor has the lowest vacancy rate at 3.1 percent.

Figure 12. Flex/R&D Vacancy Rate, 2000-2018



Source: CoStar; Economic & Planning Systems

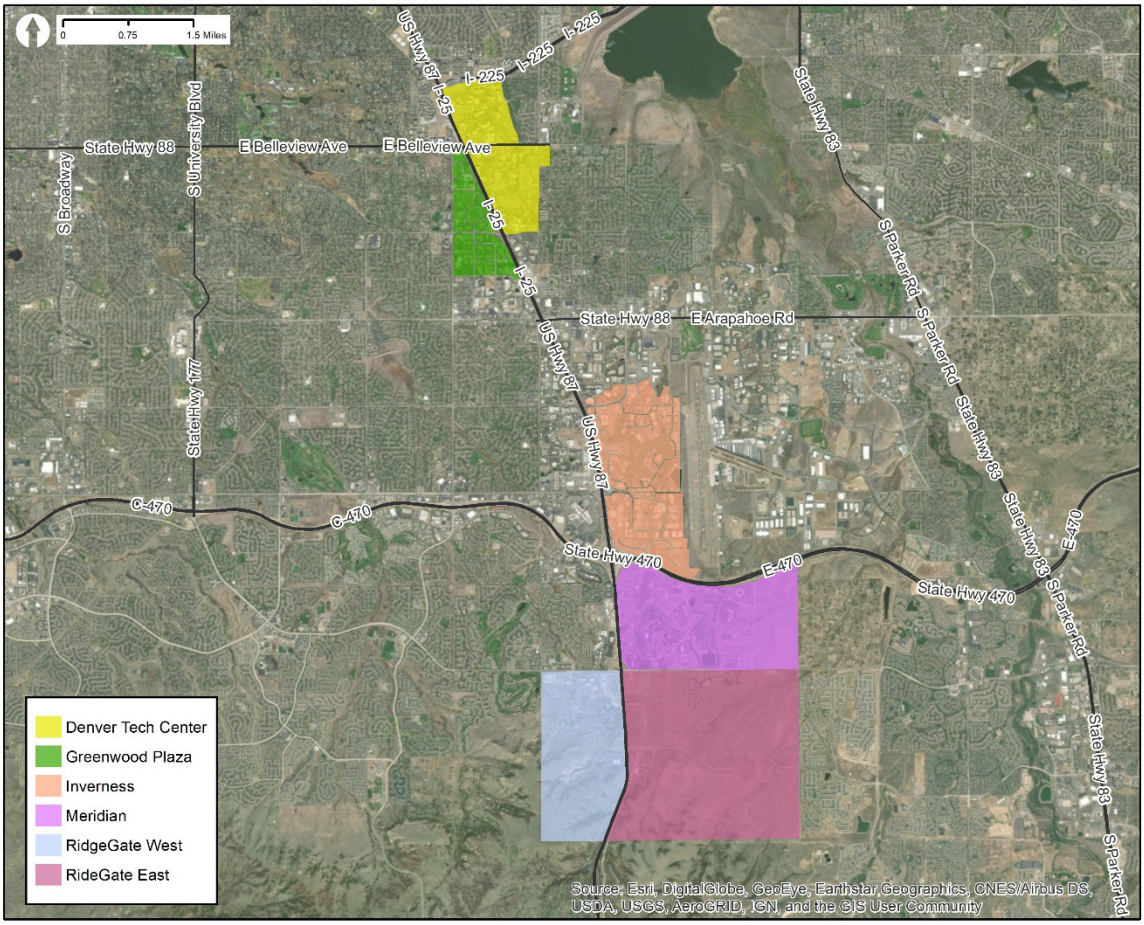
Major Office and Business Parks

The major office and business parks within the Denver metro area are tabulated by corridor or subarea in **Table 15** on page 30 and summarized below.

South I-25 Corridor

The South I-25 Corridor extends approximately eight miles along South I-25 from the Denver Technological Center (DTC) at Belleview Avenue south to RidgeGate in the City of Lone Tree south of Lincoln Avenue. Since DTC began development in 1962, the corridor has been the most significant suburban office concentration in the region. In addition to DTC, the major office and business parks include Greenwood Plaza which opened in 1965, Inverness which opened in 1973, and Meridian which began development in 1983, as shown in **Figure 13**. The most recent development is RidgeGate West which began development in 2004. RidgeGate East, on the east side of I-25, is just now being developed in concert with the Southeast Extension of RTD's Southeast Corridor line.

Figure 13. South I-25 Corridor Business Parks

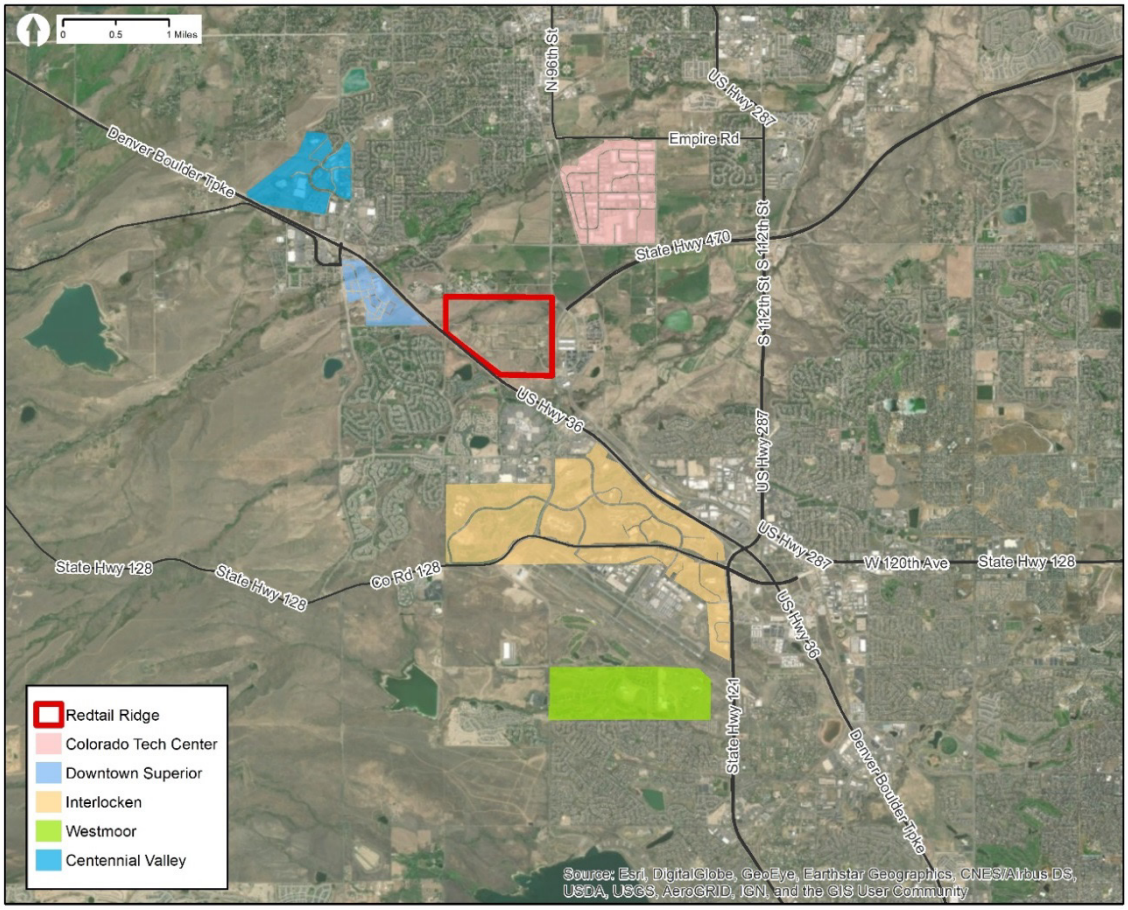


The five major office/business parks currently contain 25.3 million square feet of office development of the approximately 37.2 million total square feet of office space in the corridor. DTC and Inverness are largely built out and are undergoing some infill and redevelopment. The corridor is expected to continue to capture a significant market share as Meridian and especially RidgeGate have extensive additional capacity. The corridor's market position has also been enhanced by the completion of RTD's Southeast Corridor light rail line in 2006, which has spurred additional transit-oriented development (TOD) around the light rail stations both within the listed business parks as well as in new developments including Belleview Station and Arapahoe Station.

US-36 Corridor

The second most significant office and business corridor in the region is the US-36 Corridor extending from Broomfield Arista north to McCaslin Boulevard in Louisville/Superior as shown in **Figure 14**. The largest office/business park is Interlocken which began development in 1986. The 963-acre park currently has 6.3 million square feet of office space and an additional 350,000 square feet of flex/R&D space and 406 hotel rooms. It lacks any significant retail space as it is located next to the FlatIron Mall and adjacent FlatIron retail centers, which together comprise the largest concentration of regional retail space in the northwest metro area. The Storage Tek campus preceded the development of major office and retail development in the corridor. Founded in 1969, Storage Tek built and expanded its headquarters and manufacturing facilities on the Redtail Ridge property on the north side of US-36 across from FlatIron Mall before its acquisition by Sun Microsystems in 2005.

Figure 14. US-36 Corridor Business Parks



Other significant office and business park developments in the US-36 Corridor include Centennial Valley Business Park started in 1996, Westmoor Tech Park started in 1998, and Colorado Tech Center started in 1984. These business parks, as well as Interlocken, have a flex/R&D space component in addition to office uses. The market for these spaces is driven by manufacturing and technology companies moving out of Boulder when they reach a size for which there is inadequate space available, generally exceeding 150,000 square feet.

Downtown Superior is also listed in the inventory of potential office locations. It is a 157-acre mixed use development that is entitled for up to 373,000 square feet of office space and 500 hotel rooms. Although not specifically an office or business park, it can be considered part of the competitive inventory.

At nearly 400 acres, the Redtail Ridge project will provide a significant additional location for office and business park development in the US-36 Corridor. It is larger than both Centennial Valley and Westmoor Tech Park, and has superior highway visibility and access from US-36 and Northwest Parkway. Redtail Ridge will also contain retail, entertainment, and hotel uses providing an environment that is more attractive to companies and employees.

Table 15. Major Business Parks in Denver Metro Area

Description	Year	Size *Acres*	Office *Sq. Ft.*	Flex/R&D *Sq. Ft.*	Industrial *Sq. Ft.*	Retail *Sq. Ft.*	Hotel[1] *Sq. Ft.*	Hotel[1] *Rooms*	Developed[2] *Sq. Ft.*	Undeveloped *Acres*	Undeveloped *Percent*	Major Tenants
Southeast Corridor												
Denver Tech Center	1962	909	9,489,155	0	0	630,296	1,154,984	1,580	11,274,435	0	0.0%	U.S. Bank; WSF, AECOM, Hyatt Regency
Inverness	1973	1,117	4,827,885	1,929,865	376,111	170,179	632,052	683	7,936,092	173	15.5%	Aveanna Healthcare; RMG Engineers; EchoStar
Meridian	1983	1,685	3,749,210	0	0	165,357	316,641	516	4,231,208	557	33.1%	Keysight Tech; Sling; Cognizant Tech Solutions
RidgeGate West	2004	550	1,484,572	0	0	453,488	141,562	227	2,079,622	15	2.7%	Sky Ridge Medical Center; Charles Schwab
RidgeGate East	2030	2,200	0	0	0	0	0	0	0	2,200	100.0%	Lone Tree City Center 12 million sq. ft. commercial
Greenwood Plaza	1965	363	5,744,746	0	0	385,114	281,681	445	6,411,541	17	4.7%	Prometric; Bellco Corporate; AECOM
Total		**6,824**	**25,295,568**	**1,929,865**	**376,111**	**1,804,434**	**2,526,920**	**3,451**	**31,932,898**	**2,962**	**43.4%**	
US-36 Corridor												
Interlocken	1986	963	6,329,600	348,155	96,195	38,750	1,131,465	1,511	7,944,165	162	16.8%	Vail Resorts; Orcale; Level 3 Communications
Westmoor Tech Park	1998	455	2,392,843	40,000	345,000	0	0	0	2,777,843	196	43.1%	Ball Aerospace; Cabela's Corp; Trimble
Centennial Valley	1996	444	687,611	242,348	411,485	138,044	317,333	575	1,796,821	93	20.9%	AntriaBio; Servtech; Westcon Group Inc
Colorado Tech Center	1984	500	278,653	2,193,395	2,323,383	0	0	0	4,795,431	34	6.8%	Lockheed Martin, Sierra Nevada Corporation
Downtown Superior	2018	157	373,000	0	0	444,600	---	500	817,600	140	89.2%	Superior Medical Center
Redtail Ridge	2022	392	2,250,000	0	0	70,000	200,000	240	2,520,000	392	100.0%	Medtronic
Total		**2,911**	**12,311,707**	**2,823,898**	**3,176,063**	**691,394**	**1,648,798**	**2,826**	**20,651,860**	**1,017**	**34.9%**	

[1]Within or adjacent to business park

[2]Includes buildings under construction or proposed

Source: CoStar; County Assessor; Economic & Planning Systems

Office Demand Forecasts

Regional Demand 2020 to 2040

This section presents the estimated demand for office space in the Denver metro area for the 2015 to 2040 time period based on the employment forecasts previously presented in **Table 10**. The percent of employment using office space by NAICS is estimated based on data from the National Association of Realtors, as shown in **Table 16** on the following page. This ranges from 6 percent of Wholesale Trade and 10 percent of Retail Trade employment on the low side to 80 percent of Finance and Insurance and Management on the high side. An average gross space of 275 square feet per employee is then applied to the net employment growth in each sector to estimate the demand for new office space. The employment based office space demand is factored up to total required construction by applying the current office vacancy factor of 9 percent.

Based on these factors, the Denver region is estimated to demand a total of 25.5 million square feet of office space over the 2020 to 2030 time period or an average of 2.5 million square feet per year as shown. This compares to average construction of 2.3 million square feet over the last decade. Total demand is forecast to increase to 31.0 million over the 2030 to 2040 time period or an average of 3.1 million square feet per year.

Table 16. Office Space Demand Forecast, 2015-2040

Industry	Percent in Office Space	Sq. Ft./ Empl.	2020	2030	2040	2020-2030 Change	2020-2030 Ann. #	2020-2030 Ann. Rate	2030-2040 Change	2030-2040 Ann. #	2030-2040 Ann. Rate
Ag./Forest/Hunting	5.0%	275	49,000	56,000	65,000	7,000	700	1.3%	9,000	900	1.5%
Mining	30.0%	275	1,181,000	1,354,000	1,583,000	173,000	17,300	1.4%	229,000	22,900	1.6%
Utilities	25.0%	275	517,000	593,000	694,000	76,000	7,600	1.4%	101,000	10,100	1.6%
Construction	20.0%	275	5,987,000	6,864,000	8,028,000	877,000	87,700	1.4%	1,164,000	116,400	1.6%
Manufacturing	30.0%	275	8,768,000	10,051,000	11,756,000	1,283,000	128,300	1.4%	1,705,000	170,500	1.6%
Wholesale Trade	6.0%	275	1,541,000	1,767,000	2,066,000	226,000	22,600	1.4%	299,000	29,900	1.6%
Retail Trade	10.0%	275	4,114,000	4,793,000	5,549,000	679,000	67,900	1.5%	756,000	75,600	1.5%
Transport./Warehousing	30.0%	275	5,453,000	6,160,000	7,057,000	707,000	70,700	1.2%	897,000	89,700	1.4%
Information	65.0%	275	11,185,000	12,635,000	14,476,000	1,450,000	145,000	1.2%	1,841,000	184,100	1.4%
Finance/Insurance	80.0%	275	19,639,000	22,186,000	25,418,000	2,547,000	254,700	1.2%	3,232,000	323,200	1.4%
Real Estate	60.0%	275	5,562,000	6,284,000	7,199,000	722,000	72,200	1.2%	915,000	91,500	1.4%
Prof. & Tech Services	65.0%	275	31,303,000	35,363,000	40,513,000	4,060,000	406,000	1.2%	5,150,000	515,000	1.4%
Mgmt	80.0%	275	7,891,000	8,915,000	10,213,000	1,024,000	102,400	1.2%	1,298,000	129,800	1.4%
Admin/Waste Mgmt	70.0%	275	22,798,000	25,754,000	29,505,000	2,956,000	295,600	1.2%	3,751,000	375,100	1.4%
Education	40.0%	275	13,034,000	14,439,000	15,325,000	1,405,000	140,500	1.0%	886,000	88,600	0.6%
Health Care	30.0%	275	17,990,000	20,324,000	23,284,000	2,334,000	233,400	1.2%	2,960,000	296,000	1.4%
Arts/Rec	10.0%	275	911,000	982,000	1,070,000	71,000	7,100	0.8%	88,000	8,800	0.9%
Accommodations	10.0%	275	6,011,000	7,092,000	8,301,000	1,081,000	108,100	1.7%	1,209,000	120,900	1.6%
Other	40.0%	275	5,965,000	6,739,000	7,720,000	774,000	77,400	1.2%	981,000	98,100	1.4%
Public Admin	25.0%	275	6,126,000	6,920,000	7,928,000	794,000	79,400	1.2%	1,008,000	100,800	1.4%
Unclassified	0.0%	275	0	0	0	0	0	---	0	0	---
Total Occupied Space	**36.3%**		**176,025,000**	**199,271,000**	**227,750,000**	23,246,000	2,324,600	1.2%	**28,479,000**	**2,847,900**	**1.3%**
Vacancy Rate			9.0%	9.0%	9.0%						
Total Space Demand			**191,867,250**	**217,205,390**	**248,247,500**	**25,338,140**	**2,533,814**	**1.2%**	**31,042,110**	**3,104,211**	**1.3%**

Source: Nat'l Assoc. of Realtors and John Burns Consulting; DRCOG; Economic & Planning Systems

US-36 Office Capture

The US-36 Corridor has captured approximately 345,500 square feet of office space per year over the 2000 to 2018 time period which equates to 15 percent of the Denver region's average office space construction of 2.3 million square feet. From 2000-2010, the corridor captured 19 percent of total construction. Since 2010, the corridor has captured a lower percent of office construction (9 percent) due in large part to the resurgence of Downtown Denver office development, as well as the emergence of new locations such as the River North (RiNo) District north of downtown, and an acceleration of demand in the South I-25 associated with TOD projects located at RTD light rail stations.

Moving forward, the corridor is estimated to achieve the conservative, historical capture rate of 10 percent from the 2010 to 2018 time period which equates to 2.5 million total square feet or 250,000 square feet per year from 2020 to 2030 and 3.1 million total square feet or 310,000 square feet per year from 2030 to 2040, as shown in **Table 17**.

Table 17. Office Demand Capture, 2020-2040

	2020-2030			2030-2040			2020-2040
Description	%Capture	Total	Ann. #	%Capture	Total	Ann. #	Total
Denver Metro		25,338,140	2,533,814		31,042,110	3,104,211	56,380,250
US-36 Corridor	10%	2,533,814	253,381	10%	3,104,211	310,421	5,638,025
Redtail Ridge	25%	633,454	63,345	30%	931,263	93,126	1,564,717
Redtail Ridge Corp.		500,000	--		--	--	500,000
Redtail Ridge Total		**1,133,454**	**113,345**		**931,263**	**93,126**	**2,064,717**

Source: Economic & Planning Systems

Redtail Ridge Potentials

The Redtail Ridge project will provide a sixth major office/business park project in the US-36 Corridor and a distinct alternative to the existing competition. The project is expected to be developed with a greater mix of uses and on-site amenities than present in the existing office/business parks in the corridor, which are predominately low density and largely single use. The project is also located at the intersection of Northwest Parkway and US-36 with superior visibility and exposure to the highway corridor, and close access to the RTD Flatiron Flyer BRT Station.

Office Demand

The project is estimated to capture 25 percent of the corridor demand over the 2020 to 2030 time period, which equates to 633,000 square feet or 63,000 square feet per year. The project is expected to continue to gain market momentum as it matures in the 2030 to 2040 timeframe and as other area office parks become more built out. The project's capture of office demand in the corridor is therefore increased from 25 percent to 30 percent in the second decade of development resulting in a total of over 930,000 square feet of space or 93,000 square feet per year on average from 2030 to 2040. The capture rates for Redtail Ridge are based on the assumption that Parcel C is developed as a mixed use development containing employment, housing, hotels, and complementary retail development that differentiates this site from the existing single purpose business parks.

The development of the 500,000 square foot corporate anchor tenant will provide the site with a major economic development driver and help catalyze the attraction of other office uses. Adding the corporate anchor is a one-time occurrence that is over and above the baseline demand, and results in a total estimated office space development of 1.13 million square feet or 133,000 square feet per year from 2020 to 2030. The total 20-year forecast for the project's office demand capture is estimated at 2.06 million square feet as shown.

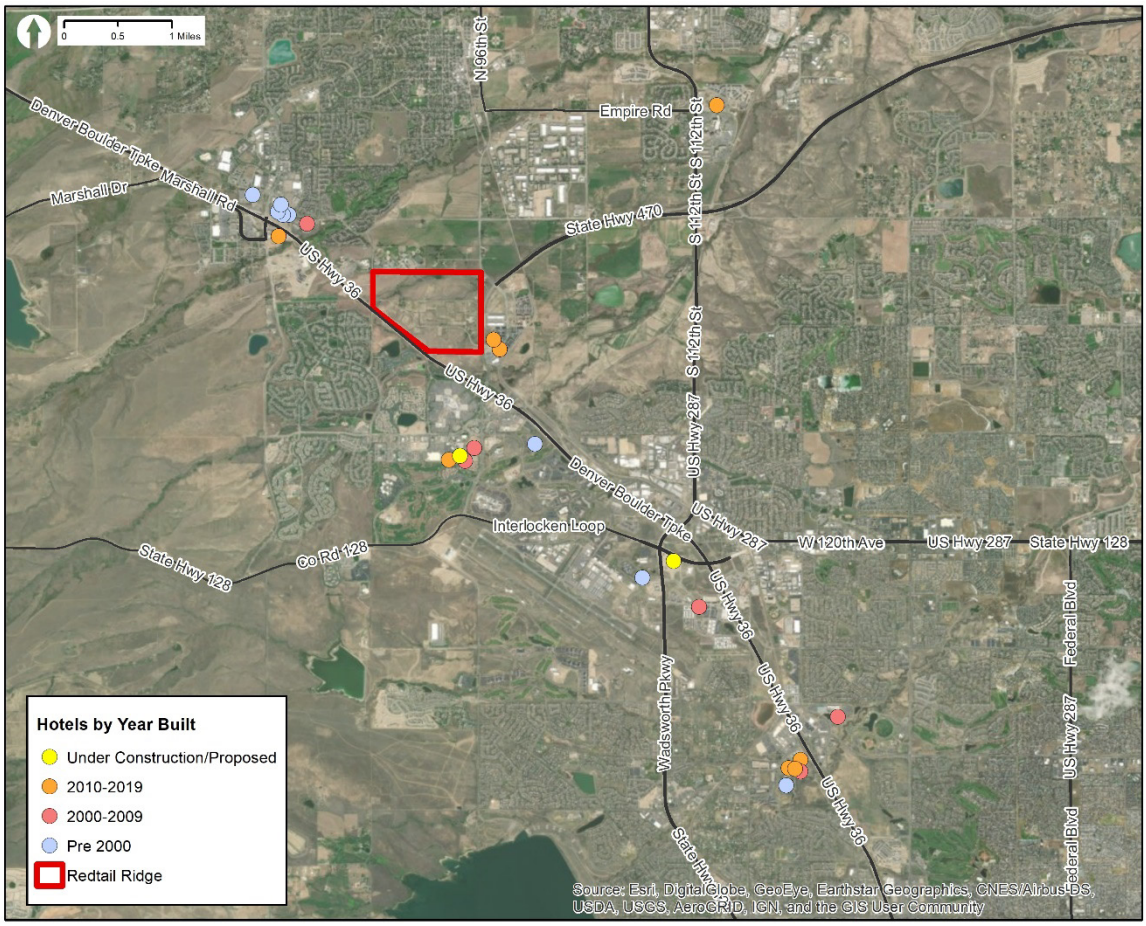
4. Hotel Development Potential

This chapter of the report estimates the potential for hotel development on the subject property. EPS completed an inventory of existing hotels in the US-36 Corridor and obtained data on the growth of room demand and revenue from a STR report on a competitive sample of properties. The amount of hotel development in major competitive office and business parks in the Denver metro area is also estimated as a contributor to hotel demand.

Hotel Conditions and Trends

There are 22 hotels in the US-36 Corridor south of Boulder to Westminster with a total of 3,305 rooms, shown in **Figure 15** and **Table 18**. Additionally, there is a Comfort Suites under construction along Wadsworth Boulevard in Broomfield that will include 104 rooms and a Home2 Suites by Hilton proposed in Broomfield that plans for 107 rooms.

Figure 15. US-36 Corridor Hotel Inventory



The majority of the existing inventory along the corridor was built since 2000 and includes 2,353 rooms. The newest hotel, Element by Westin, was completed in 2019 with 121 rooms located in Downtown Superior. Two properties were added in 2018, a Hampton Inn located in Lafayette and Hyatt Place in Westminster. The closest property to Redtail Ridge is the 123-room Hyatt House located immediately to the east on West Midway Drive in Broomfield that was opened in 2010.

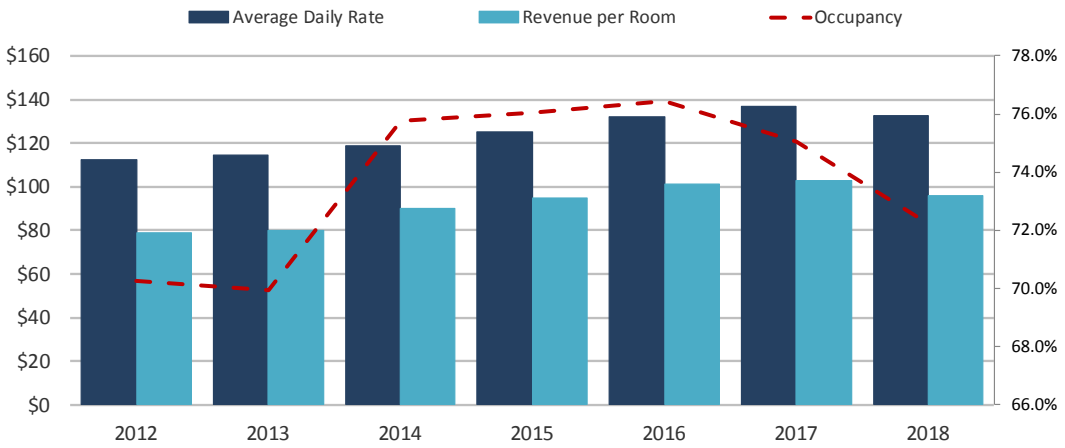
Table 18. US-36 Corridor Hotel Inventory

Hotel	Address	City	Year	Rooms
Element by Westin	1 S Marshall Rd	Superior	2019	121
Hampton Inn and Suites	317 Exempla Cir	Lafayette	2018	84
Hyatt Place	6865 W 103rd Ave	Westminster	2018	137
Holiday Inn Express	11401 Via Varra Blvd	Broomfield	2017	136
Fairfield Inn & Suites	455 Zang St	Broomfield	2017	213
Church Ranch Hotel by Marriott	7000 Church Ranch Blvd	Broomfield	2014	215
Drury Inn	10393 Reed St	Broomfield	2012	180
Hyatt House	13351 W Midway Blvd	Broomfield	2010	123
aLoft	8300 Arista Pl	Broomfield	2009	139
Renaissance Boulder Flatiron Hotel	500 Flatiron Blvd	Broomfield	2002	232
SpringHill Suites	6845 W 103rd Ave	Westminster	2002	164
Residence Inn	845 Coal Creek Cor	Louisville	2000	88
TownePlace Suites	480 FlatIron Blvd	Broomfield	2000	151
Westin Westminster	10600 Westminster Blvd	Broomfield	2000	370
960 W Dillon Rd	960 W Dillon Rd	Louisville	1999	65
Omni Interlocken Hotel	500 Interlocken Blvd	Broomfield	1999	390
La Quinta Inn & Suites	10179 Church Ranch Way	Westminster	1998	59
La Quinta Inn & Suites	902 W Dillon Rd	Louisville	1996	120
Hampton Inn	912 W Dillon Rd	Louisville	1996	80
Courtyard	948 W Dillon Rd	Louisville	1996	154
Quality Inn	1196 W Dillon Rd	Louisville	1995	68
Hilltop Inn GuestHouse & Suites	9009 Jeffco Airport Ave	Broomfield	1989	16
Total				**3,305**

Source: CoStar; Economic & Planning Systems

EPS purchased Smith Travel Research (STR) data on a competitive set of 14 hotel properties in the US-36 Corridor in 2018 for the McCaslin Parcel O Study. The average daily rate (ADR) for this competitive sample was $137 in 2017 up from $112 in 2012. Average daily rates and revenue per room has grown steadily from 2012 to 2017. Rates in 2018 (through September) decreased slightly from 2017 due to the addition of new hotels to the inventory of available rooms. Occupancy rates were at their highest in 2016 at 76.4 percent. Occupancy rates in the area have been strong since 2012 and have remained above rates in 2012 even with the new hotels opening in 2017 and 2018, as shown in **Figure 16**.

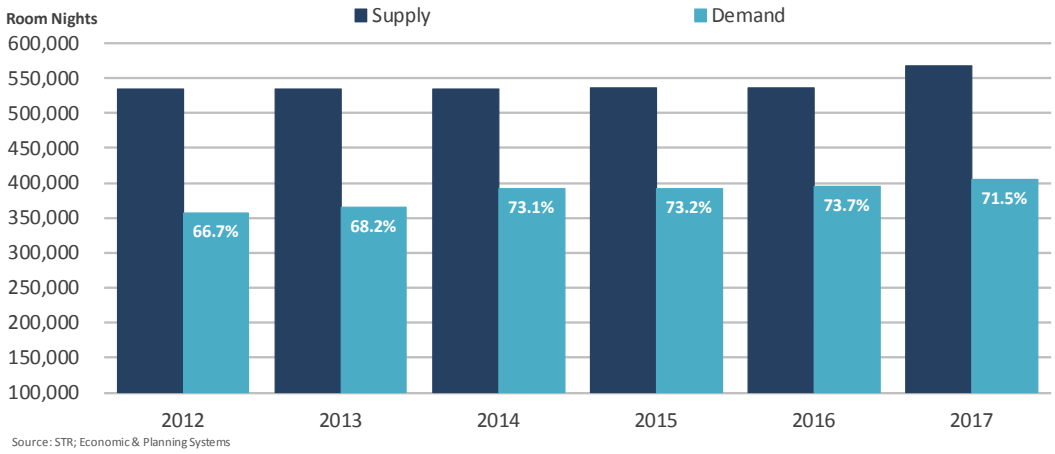
Figure 16. US-36 Corridor Hotel Performance and Occupancy, 2012-2018



Note: 2018 is through September
Source: Economic & Planning Systems

The supply and demand of hotel rooms in the US-36 Corridor along with the demand as a percentage of the total supply is shown in **Figure 17**. The total number of available room nights increased from 535,271 in 2012 to 567,051 in 2017, which represents an annual 1.2 percent increase. Occupied room nights increased by 48,168 from 357,270 to 405,438 over the same time period which was a 2.6 percent annual growth rate. Average occupancy has stayed over 70 percent since 2014—a benchmark of hotel profitability—in spite of the increase in available supply.

Figure 17. US-36 Corridor Supply and Demand of Hotel Rooms, 2012-2017



Transient Room Demand

Based on the inventory in **Table 18**, the corridor added an average of 125 units per year between 2000 to 2010 and 136 units per year from 2010 to 2018. Assuming the continued growth of corridor development, hotel demand would increase by an average of approximately 130 rooms per year over the next 20 years or a total of 2,600 rooms.

Office Park Hotel Space

The amount of hotel space (square footage and number of rooms) located within each major office/business parks inventoried is shown in **Table 19**. Overall, hotels consist of approximately 9 percent of the total development within office and business parks. Denver Tech Center has the largest amount of hotel development with 1,580 hotel rooms, which represents 10 percent of the total development. The South I-25 Corridor has a total of 3,451 hotel rooms and consists of approximately 8 percent of the total development square footage. In the US-36 Corridor, Interlocken has 1,511 hotel rooms and the Centennial Valley area has 575 hotel rooms. These consist of approximately 12 percent of the total development square footage in the corridor.

Table 19. Hotel Space at Major Business Parks

Description	Developed *Sq. Ft.*	Hotel[1] *Sq. Ft.*	Hotel[1] *Rooms*	Hotel *Pct.*	Rooms *per Sq. Ft.*
South I-25 Corridor					
Denver Tech Center	11,274,435	1,154,984	1,580	10.2%	7,136
Inverness	7,936,092	632,052	683	8.0%	11,619
Meridian	4,231,208	316,641	516	7.5%	8,200
RidgeGate West	2,079,622	141,562	227	6.8%	9,161
Greenwood Plaza	6,411,541	281,681	445	4.4%	14,408
Subtotal	**31,932,898**	**2,526,920**	**3,451**	**7.9%**	**9,253**
US-36 Corridor					
Interlocken	7,944,165	1,131,465	1,511	14.2%	5,258
Westmoor Tech Park	2,777,843	0	0	0.0%	---
Centennial Valley	1,796,821	317,333	575	17.7%	3,125
Subtotal	**12,518,829**	**1,448,798**	**2,086**	**11.6%**	**6,001**
Average		**496,965**	**692**	**8.6%**	**8,415**

[1]Within or adjacent to business park

Source: CoStar; Economic & Planning Systems

Hotel Demand

Hotel utilization is based on multiple market segments including business travel, conventions and meetings, and general transient usage by friends and family of residents from the surrounding market area. In addition, drive-by traffic increases utilization with the amount of this transient business at a property highly influenced by highway accessibility and visibility as well as the popularity of the management company flag.

Hotel properties tend to cluster at major highway interchanges including properties at US-36 and McCaslin in Louisville and Superior, and properties at the US-36 and Church Ranch/104th interchange in Westminster. In the US-36 and Northwest Parkway interchange area (including the Interlocken and FlatIron Crossing), there are also four properties but they are less visible and not directly accessible from the highway. Redtail Ridge will effectively add to this node of activity and will prove attractive to hotel flags not already present in the market.

Hotel demand will be driven by multiple factors over the course of the project's development. One demand factor is the amount of growth in on-site employment in office and retail space. The ratio of hotel rooms to total employment space within an office/business park can provide an order of magnitude guideline as to the range of development that might be anticipated to occur. Although there is a considerable variance, the South I-25 and US-36 business parks show an average of one hotel room per 8,000 square feet of total developed space, shown in **Table 19**. Applying this range of hotel rooms to the planned total 2.3 million square feet of commercial space for Redtail Ridge would indicate that the project would be able to capture 155 to 290 hotel rooms over the next 20 years, shown in **Table 20**.

Table 20. Redtail Ridge Hotel Demand

Description	Commercial *Sq. Ft.*	Rooms *per Sq. Ft.*	Demand *Rooms*	Demand *Sq. Ft.*
Low	2,320,000	15,000	155	154,667
High	2,320,000	8,000	290	290,000

Source: Economic & Planning Systems

At an average size of 120 rooms per hotel for a limited service (2-star) hotel, this would represent two to three properties at this location. As discussed above the proportion of hotel space to total project space is only one measure of possible demand. The historic growth of space in the corridor is also a factor, as a significant portion of hotel demand is from transient business, and the site's location and access are superior in this regard. The site is estimated to be able to capture 10 percent of the historical corridor growth, which equates to approximately to 260 hotel keys and is close to the supportable levels based on the comparable properties.

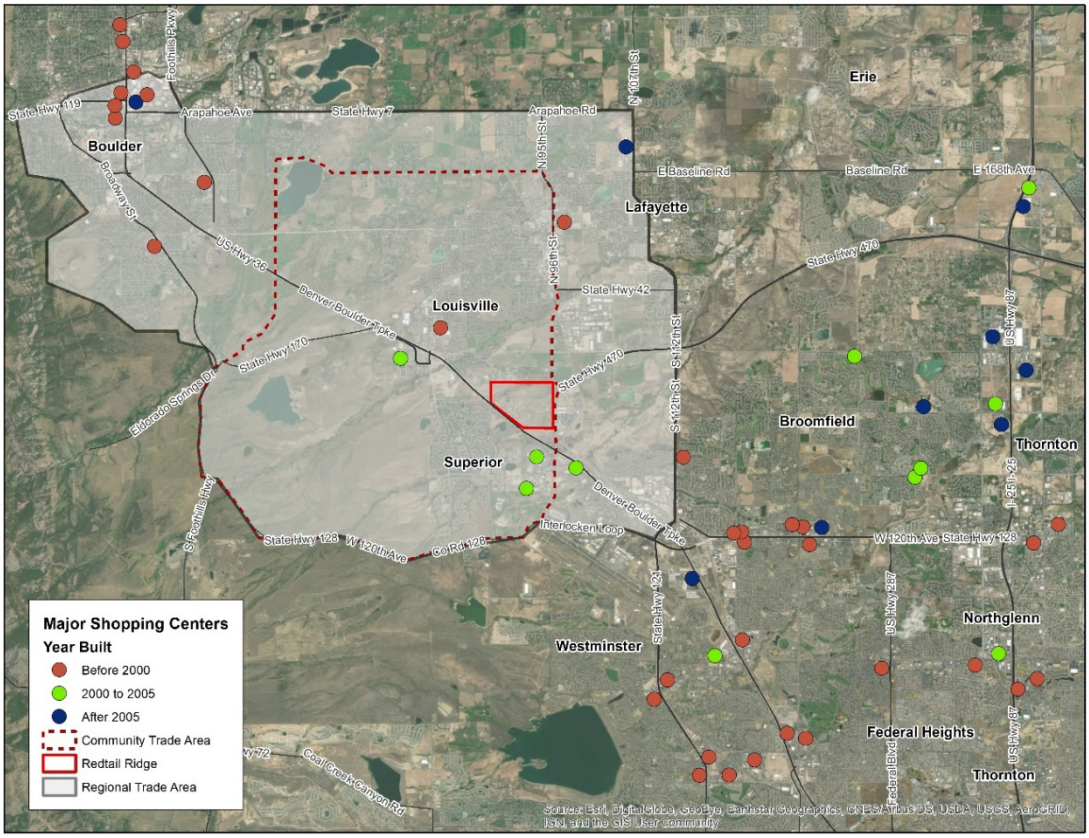
5. Retail Development Potential

This chapter identifies retail development opportunities for the Redtail Ridge development. Regional retail development conditions and trends for the Louisville community and regional trade areas are first summarized as previously reported in the Parcel O Study. This is followed by a review of national trends impacting the retail industry and their impact on future retail development opportunities in the corridor. Retail demand is estimated based on household growth estimates for the trade area and the number of residential and CCRC units on site. Retail expenditure potential is then estimated based on the growth of trade area population and income over the 20-year forecast period.

Retail Trends

Built in 1993, Centennial Valley was the first major retail development located between Boulder and Westminster. Substantial additional retail development occurred from 2000 to 2005 including the Superior Marketplace in Superior and FlatIron Mall and FlatIron Marketplace in Broomfield as shown in **Figure 18**.

Figure 18. North Denver Metro Area Major Retail Centers by Year Built



A new node of community retail uses is developing in Lafayette and Erie at US-287 north of Baseline Road. Regional retail development has followed housing development with a shift to Boulder, and more significantly, a shift eastward to the North I-25 Corridor in Broomfield and Thornton.

Retail Inventory

Since 2005, there has been only minimal retail development within the McCaslin Corridor. The only addition occurred in 2016 with the construction of a small center at the corner of McCaslin Boulevard and West Dillon Road. The Community Trade Area and Regional Trade Area also experienced little growth over this time period; both areas grew at 0.2 percent annually, as shown in **Table 21**. The Community Trade Area attracted 81,000 square feet of new space since 2010, shown in **Table 22**.

Table 21. Retail Inventory Trends

Retail Inventory (Sq. Ft.)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010-2018 Total	2010-2018 Ann. #	2010-2018 Ann. %
Community Trade Area	4,013,824	4,013,824	4,013,824	4,013,824	4,018,274	4,050,565	4,042,910	4,078,546	4,080,843	67,019	8,377	0.2%
Regional Trade Area	9,511,506	9,512,989	9,518,489	9,541,563	9,544,945	9,591,236	9,547,317	9,593,164	9,673,201	161,695	20,212	0.2%

Source: CoStar; Economic & Planning Systems

Table 22. New Retail Construction

New Construction (Sq. Ft.)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010-2018 Total	2010-2018 Ann. Avg.
Community Trade Area	2,796	0	0	0	36,741	0	16,154	25,279	0	80,970	9,526
Regional Trade Area	7,796	13,083	11,567	17,007	53,897	0	16,154	92,313	21,930	14,134	27,500

Source: CoStar; Economic & Planning Systems

Regional Retail Anchor Inventory

As shown in **Table 23**, most of the typical, larger anchor and mass merchandisers active in the Denver metro area are already located within the Regional Trade Area. Most of the major retailers not present were formerly located in the area but left due to low performance (e.g., Ross, Sam's Club, Hobby Lobby) or as part of a chain consolidating or closing (Sports Authority, Great Indoors and Office Depot).

Table 23. Existing Retail Inventory

Retailer	Total Stores		Retailer	Total Stores	
	Community	Regional		Community	Regional
Large Format/Anchor			**Office Supplies**		
Discounter/Supercenter			Office Depot	0	1
Target	1	2	Staples	0	1
Walmart Supercenter	1	2	OfficeMax	1	1
Macy's	1	2			
Kohl's	1	1	**Sporting Goods**		
JC Penney	0	0	Dick's Sporting Goods	1	1
Warehouse Clubs			REI	0	1
Costco	1	1			
Sam's Club	0	0	**Pets**		
Building Materials & Garden			PetSmart	1	1
Home Depot	1	2	Petco	0	1
Lowe's	1	1			
			Arts and Crafts		
Apparel			Hobby Lobby	0	0
TJ Maxx	1	1	Michael's	1	2
Ross	0	0	Jo Ann Fabrics	0	1
Marshalls	0	1			
DSW	1	1	**Books/Music/Toys**		
Old Navy	1	1	Barnes & Noble	0	1
Appliances/Electronics					
Best Buy	0	1			

Source: Economic & Planning Systems

National Trends

The US-36 area has been impacted by national shifts in the retail sector over the last 15 to 20 years including the growth of internet sales, slowing brick and mortar store sales, retail chain consolidations, and demographic shifts and preferences. Collectively, these trends are resulting in store closings and consolidations and reducing the overall demand for new retail space locally and nationally.

- **The Rise of E-Commerce** - Between 2001 and 2017, total online retail purchases (excluding auto related) grew from approximately $29 billion to $427 billion, an 18.3 percent annual growth rate. Online sales accounted for 22 percent of total retail sales growth. During the same period, brick and mortar stores grew at a 2.8 percent annual growth rate, decreasing their share of the total retail market from 98 percent to 87.5 percent.
- **Changing Retail Mix** - These changes in spending patterns are impacting the mix of retail space in aggregate as well as within individual districts, corridors, and centers. The restaurant, bar, and microbrewery segment has grown rapidly, and new food and beverage formats have been introduced (e.g., food halls and market halls, farm to table restaurants, and food trucks). In contrast, the growth of shoppers' goods store space (general merchandise, apparel, furniture, and other shoppers' goods) is flat or declining, as exhibited by numerous store closures by Macy's, JCPenney, Sears, and Kmart.
- **Big Box Reuse** - The loss of anchor stores coupled with an overall decrease of retailers on the market makes re-tenanting vacant big box stores (particularly for retail stores with comparable sales tax revenues) increasingly difficult. Retail developers have had some success filling these vacancies with nontraditional tenants, specifically ones that are fitness or entertainment oriented. Gym franchises such Vasa Fitness, Gold's Gym, and Planet Fitness are also frequently located in former big box stores.
- **Clicks to Bricks –** The news is not all bad for commercial property owners as many e-commerce brands are opening brick and mortar retail spaces to showcase their merchandise and provide an easy portal for delivery and exchanges. While over 700 shopping mall stores have closed in the last two years, many e-commerce retailers (e.g., Warby Parker Eyeglasses, UntuckIt Shirts) are planning to open 850 stores in the next five years. The expected increase in brick and mortar space will still be below historic levels of growth.

These conditions are manifesting themselves within Louisville and the region. The impact of e-commerce and store consolidations are evident in the closure of big box anchors and other mass merchandisers along the US-36 Corridor in Superior (Sports Authority), Louisville (Sam's Club, Kohl's, and Lowe's), and Broomfield (Best Buy, Lord & Taylor, Great Indoors).

The prognosis for national tenant large format and other mass merchandisers as a destination use at the Redtail Ridge site is therefore poor for the 20-year forecast period. The subject property is also not likely to be a viable location for more neighborhood oriented (grocery stores or other convenience goods) retail use given its isolation from nearby residential neighborhoods. Retail development providing dining, entertainment, and other services within a major employment center is, however, an opportunity to be pursued. The employment of approximately 8,400 at buildout, plus 1,740 residential and CCRC independent housing units will generate a portion of the demand for commercial space, as estimated below.

Active and Planned Projects

Planned retail development projects within the approximate 2-mile community trade area include the North End Market—a small infill retail project with approximately 7,400 square feet of space, and Arista—a 200-acre mixed use development with 42,000 square feet of existing and planned retail space.

The Downtown Superior project, which is just outside the trade area on McCaslin, is the most ambitious planned retail project. The 157-acre mixed use project is proposed to include up to 1,400 new housing units, 444,600 square feet of retail, 373,000 square feet of office and 500 hotel rooms. The project to date has mainly built housing. The commercial uses include the Sports Stable, an ice rink and recreation center, a 66,000 square foot medical office building, and a 130-room Element Hotel. The ability to build this much commercial space as planned will be contingent on the ability to attract destination anchor uses to the site as shown in **Figure 19**.

Planned development projects also include projects where outmoded retail space is being redeveloped with other uses. Flatiron Marketplace is a 300,000 square foot power center that is being redeveloped as a mixed-use project with 1,200 apartment units and 12,000 square feet of food and beverage retail. And as previously noted, the GDP for Parcel O on McCaslin Boulevard is proposed to allow for a greater mix of uses as large format retail has been determined to be unlikely as a future use.

Figure 19. Planned Retail and Mixed-Use Developments

Planned Retail and Mixed-Use Developments

North End Market

Blue Star Lane & S. Boulder Rd., Louisville

- 4,000 SF retail
- 3,350 SF restaurant building

Arista

US-36 & Interlocken Loop
Broomfield

- 200 acres
- 42,000 SF retail
- 1,600 residential units
- 90,000 SF (52-bed) University of Colorado Hospital facility

Additionally, Turnpike Shops at Arista is currently under construction with 26,000 square feet of restaurant and retail pad space. A larger retail anchor pad is available for sale.

Downtown Superior

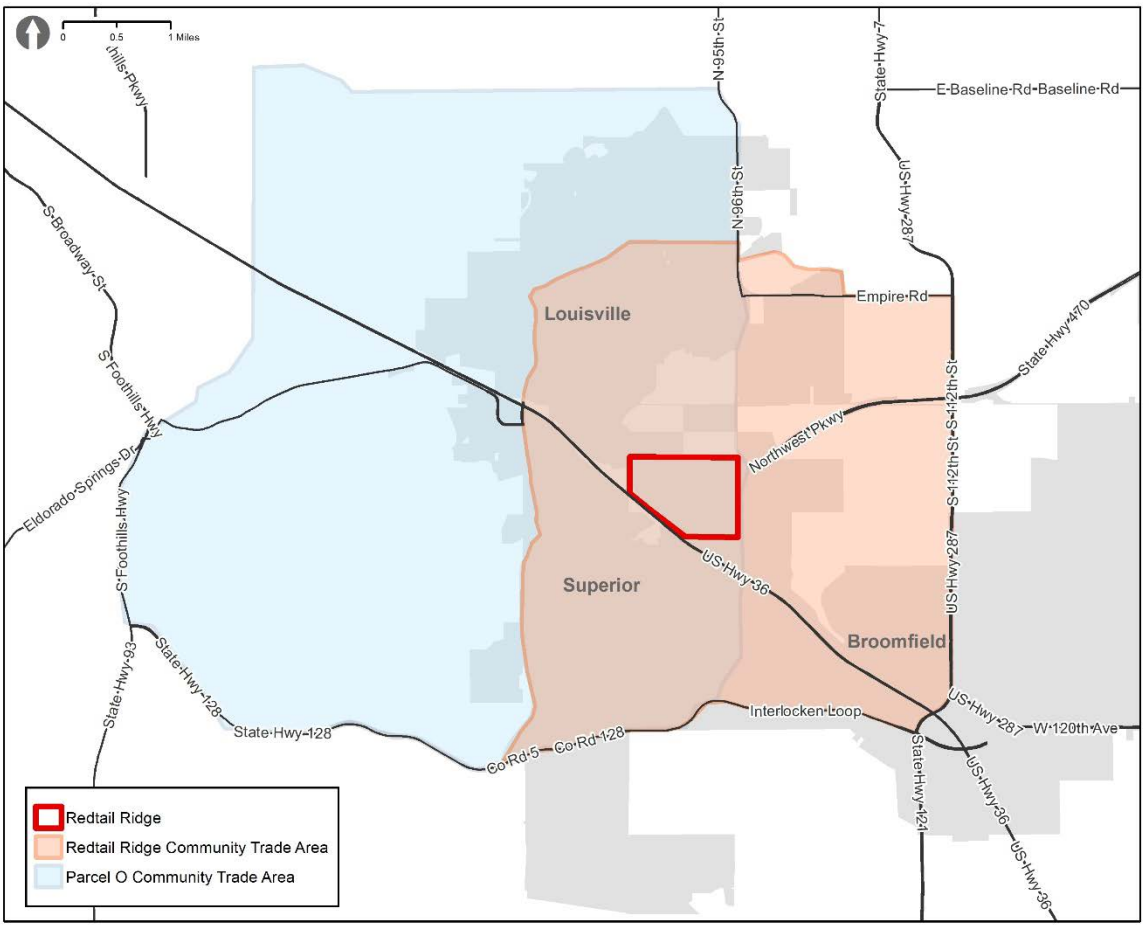
- 157 acres
- 1,400 residential units
- 444,600 SF retail/commercial, including 150,000 SF indoor recreation
- 373,000 SF office
- 500 hotel rooms

There are currently 565 homes, 66,000 square foot medical office building, 130-hotel rooms, and a 165,000 square foot Sports Stable recreation facility.

Trade Area

Retail trade areas were developed to illustrate the consumer shed for retailers in the Louisville Subarea and to estimate existing and future demand for retail from these trade areas. The trade areas used for this analysis represent the primary capture area for retailers providing everyday shopping items (e.g. Safeway) and have roughly a 2-mile radius in size but have been adjusted to align with major roadways. The Parcel O Trade Area is included in this analysis as a comparison to the Redtail Ridge Trade Area, both shown in **Figure 20**.

Figure 20. Trade Area Boundaries



The demographic comparison of Louisville versus the surrounding region is shown in **Table 24**. The population within the Redtail Ridge trade area is 31,699 residents and within the Parcel O trade area is 38,462 residents. Household incomes in Louisville are lower than the Parcel O trade area but higher than the Redtail Ridge trade area. Louisville has the highest median age (42.6) and higher percent of family households than both the trade areas. The Parcel O trade area includes a larger number of households with 15,000 as compared to Redtail Ridge trade area with nearly 13,000 households. Both trade areas have an average household size of 2.5 persons.

Table 24. Louisville and Trade Area Demographics, 2019

Description	Louisville	Parcel O Trade Area	Redtail Ridge Trade Area
Population	21,124	38,462	31,699
Households	8,681	15,242	12,920
Avg. Household Size	2.4	2.5	2.5
Percent of Family Households	66.3%	65.1%	62.3%
Avg. Household Income	$135,452	$141,499	$131,513
Median Household Income	$109,154	$112,280	$106,446
Median Age	42.6	38.4	36.0
Education			
Bachelor's	37.4%	39.1%	40.3%
Master's Plus	36.3%	35.5%	31.8%

Source: ESRI Business Analyst; Economic & Planning Systems

Retail Demand

In this section, future retail demand is estimated for the Redtail Ridge trade area and Redtail Ridge property based on household and income growth described in the steps below.

- Total Personal Income (TPI) growth is estimated based on household growth multiplied by average household income.
- Based on the U.S. Census of Retail Trade, the percent spent by retail store category is then estimated.
- The amount of retail space supported by the growth in trade area expenditures is estimated by dividing expenditure potential by average annual sales per square foot estimates for each store category.

Population and household projections were estimated for the City of Louisville and each of the trade areas based on the historical annual growth rates from 2000 to 2019. The Redtail Ridge trade area is estimated to be 16,020 households by 2030 and 19,480 households by 2040, shown in **Table 25**, based on a 2 percent annual growth rate.

Table 25. Population and Household Projection, 2040

Description	2000	2010	2019	2000-2019 Total	2000-2019 Ann. #	2000-2019 Ann. %	2030	2040
Population								
Louisville	19,222	18,394	21,124	1,902	100	0.5%	22,310	23,446
Parcel O Trade Area	30,443	33,865	38,462	8,019	422	1.2%	44,037	49,804
Redtail Ridge Trade Area	23,280	27,152	31,699	8,419	443	1.6%	37,902	44,588
Households								
Louisville	7,382	7,543	8,681	1,299	68	0.9%	9,535	10,384
Parcel O Trade Area	11,603	13,400	15,242	3,639	192	1.4%	17,850	20,606
Redtail Ridge Trade Area	8,911	10,782	12,920	4,009	211	2.0%	16,020	19,480

Source: ESRI Business Analyst; Economic & Planning Systems

The TPI for the Redtail Ridge Trade Area is estimated by multiplying the number of households by the average household income, as shown in **Table 26**. The future growth of the trade area is estimated to be 6,560 units from 2019 to 2040. The Redtail Ridge CCRC units on site is planned to be 1,326 units, of which 85 percent is estimated to be independent living units and 15 percent is estimated to be assisted living facilities with in-house dining. (The TPI is only calculated for the 1,126 independent living units.) The estimated average household income for these units is about $88,000 (based on estimates from Erickson, the proposed developer). There are also 900 multifamily housing units proposed to be built in the project. The average household income is estimated based on an average gross rent for the trade area to be $1,620 each month. Assuming 30 percent of a person's income is spent on rent each month, the estimated average household income for the residential units is $64,800.

Table 26. Redtail Ridge Trade Area Total Personal Income, 2019-2040

Description	2019	2040	2019-2040 Total
Redtail Ridge Trade Area			
Households	12,920	19,480	6,560
Avg. Household Income	$131,513	$131,513	---
Total Personal Income	**$1,699,147,960**	**$2,561,828,263**	**$862,680,303**
Redtail Ridge CCRC			
Independent Units	---	1,126	---
Avg. Household Income	---	$88,000	---
Total Personal Income	---	**$99,088,000**	---
Redtail Ridge Residential			
Housing Units	---	900	---
Avg. Household Income[1]	---	$64,800	---
Total Personal Income	---	**$58,320,000**	---

[1]Based on a median gross rent of $1,620

Source: ESRI Business Analyst; Economic & Planning Systems

The average Colorado household spends 35 percent of its TPI in retail stores. The mix of retail businesses likely to be built in the mixed use district of Redtail Ridge are expected to primarily include convenience goods servicing businesses and residents and a range of eating and drinking establishments. The spending potential of the following store categories is then estimated: Beer, Wine, and Liquor Stores; Health and Personal Care, Miscellaneous Retail, and Eating and Drinking Establishments. The average Colorado household spends about 10 percent of its TPI on these selected retail store categories. The expenditure potential for the select retail goods in the trade area and on-site is estimated to be $99.0 million from 2019 to 2040, as shown in **Table 27**.

Table 27. Redtail Ridge Retail Sales Capture, 2040

Description	Retail Sales ($000s)	Capture %	Capture ($000s)
CCRC			
Beer, Wine, & Liquor Stores	$1,067		$160
Health and Personal Care	$1,650		$248
Miscellaneous Retail	$1,279		$192
Eating and Drinking	$6,034		$905
Subtotal	**$10,030**	15%	**$1,505**
On-site Residential			
Beer, Wine, & Liquor Stores	$628		$157
Health and Personal Care	$971		$243
Miscellaneous Retail	$753		$188
Eating and Drinking	$3,551		$888
Subtotal	**$5,903**	25%	**$1,476**
Redtail Ridge Trade Area			
Beer, Wine, & Liquor Stores	$9,289		$1,393
Health and Personal Care	$14,369		$2,155
Miscellaneous Retail	$11,133		$1,670
Eating and Drinking	$52,534		$7,880
Subtotal Trade Area	**$87,324**	15%	**$13,099**
Trade Area Inflow		20%	**$4,379**
On-site Employment			
Drug Stores	$559		$140
Office Supplies	$672		$168
Other Goods	$360		$90
Personal Care	$714		$178
Personal Services	$288		$72
Eating and Drinking	$3,163		$791
Subtotal	**$5,756**	25%	**$1,439**
Total	**$98,983**		**$21,897**

Source: Economic & Planning Systems

The convenience level retail uses will be supported by three market segments CCRC, other Redtail Ridge residents, Redtail Ridge employees and businesses, and residents from the 2-mile trade area based on the following capture rates.

- **CCRC Residents** – The 1,126 independent living CCRC households are estimated to generate $10.0 million in convenience store and eating and drinking establishment categories. A capture of 15 percent is estimated for retail and restaurants on-site generating $1.5 million in annual sales.
- **Other Redtail Ridge Residents** – The 900 market rate housing units are estimated to generate $5.9 million in retail spending in convenience stores and eating and drinking establishment categories. A capture rate of 25 percent is estimated for the retail and restaurants on site generating $1.5 million in annual sales.
- **Redtail Ridge Trade Area** – The growth of households in the 2-mile community trade area (excluding housing units on-site) over the 2020 to 2040 time period is estimated to generate $87.3 million in annual sales in the applicable retail categories. With an estimated capture of 15 percent of these sales on-site, the trade area would account for $13.1 million in sales.
- **Sales to Employees** – Redtail Ridge has an estimated 8,400 employees working on-site. The estimated spending by workers in the trade area is based on estimated office worker spending data from the International Council of Shopping Centers (ICSC), which surveys spending patterns of office workers nationally. ICSC estimates that an average office worker spends approximately $4,750 annually on retail goods while at or near their place of work. Based on the actual stores anticipated to be located on site, EPS estimates an average worker spends approximately $2,600 annually in the trade area, which is a total of $5.7 million based on a 25 percent capture of selected retail goods and services and a 33 percent capture of eating and drinking establishments. With an estimated on-site capture of 25 percent of the total $5.7 million sales in the trade area, the sales to employees would account for $1.4 million in sales on-site.
- **Sales to Visitors** – Visitors to the subarea are estimated to generate $4.4 million per year or 20 percent of total sales. This percentage of sales to visitors is an approximation of the amount of sales (and associated customers) that are from people who are traveling to the trade area to make retail purchases, which is referred to as trade area inflow. The amount of inflow is not a large portion of the sales meaning that the retailers in Redtail Ridge are mainly serving the residents of the community trade area.

The annual retail sales capture estimates by store category total $21.9 million as shown in **Table 27**. Based on average sales per square foot figures by store category, these sales are estimated to support approximately 66,000 square feet of convenience goods and food and beverage space, as shown in **Table 28**.

Table 28. Redtail Ridge Supportable Retail Square Feet, 2040

Description	Capture ($000s)	Avg. Sales *per Sq. Ft.*	Supportable *Sq. Ft.*
On-site & Trade Area			
Beer, Wine, & Liquor Stores	$1,710	$300	6,000
Health and Personal Care	$3,036	$400	8,000
Miscellaneous Retail	$2,308	$250	9,000
Eating and Drinking	$10,464	$350	30,000
Total	**$17,518**		**53,000**
Trade Area Inflow	**$4,379**	$325	**13,000**
Total	**$21,897**		**66,000**

Source: Economic & Planning Systems

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6. Development Plan and Strategy

This chapter summarizes the market findings by land use category and provides input to the proposed development program. It begins with a summary of current office and business park development trends and applications for the Redtail Ridge property.

Office and Business Park History

Suburban business parks were first developed in the late 1950s, evolving in part as a reaction to deteriorating conditions in urban downtown areas, and also by a desire by business executives to work closer to their suburban homes. These parks are master planned developments in suburban settings with clusters of firms in a campus setting and are generally auto-oriented, single use, and separated from surrounding residential and commercial uses. Two of the first office parks were Research Triangle in North Carolina and Stanford Research Park in the Bay Area. Denver was very much at the forefront of this development trend with the founding of Denver Tech Center in 1962.

In recent years, a number of economic and demographic forces have converged that raise questions about the health and sustainability of the suburban business park going forward. The economic model upon which these business parks were built is changing. Technological advancements and increased productivity mean that most companies do not need as much space as in the past. Also, employees are demanding a different work environment, both internal to the company in the form of more space for collaboration, and external in the form of nearby housing and retail shopping facilitating opportunities to live and work in close proximity. At least in some locations, business parks that began 50 years ago are starting to show their age with buildings declining from Class A and B to Class C properties with higher vacancies and lower rents.

The focus on improving existing suburban business parks and creating a model for new projects was detailed in an Urban Land Institute (ULI) study in 2002 titled *Ten Principles for Reinventing America's Suburban Business Districts*. The report states that existing suburban business districts "encompass a disparate group of isolated uses with little or no integration, a transportation system that is auto oriented and often hostile to pedestrians, and a near total absence of civic identity." It suggests that in response to the social and economic forces identified above, there is a potential to "transform America's more than 200 suburban business districts into more integrated live-work-shop places."

Much of what was recommended in the ULI report is occurring in new and old business parks. Property owners and developers are trying to reinvent the suburban office by adding restaurants, hotels, and other amenities, as well as housing, to compete with the “live, work, play” attraction of the city. Denver’s more mature office and business parks, including DTC, Inverness, and Greenwood Village have added more retail, hotel, and housing than office space over the last 10 years.

The same trends apply to new office and business developments. In some of the most vibrant urban markets (including San Francisco, Boston, Seattle, and Denver), the appeal of the downtown mixed-use environment has grown to the point where real estate values are higher downtown than in the premier suburban business districts, including rents, occupancy rates, and even absorption. A significant portion of the millennial workforce—particularly those employed in technology and other knowledge-based industries—are showing a preference for living and working in downtowns. To compete, employers in suburban locations are seeking activity center locations where they can live and work in close proximity with available transit to minimize dependencies on the auto.

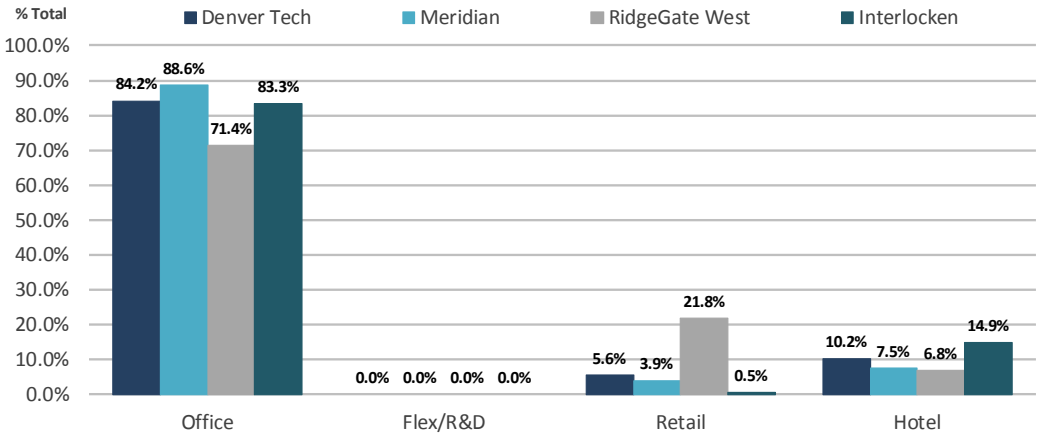
The newer employment-locations in the Southeast Corridor are mixed-use developments, as opposed to single purpose office parks. Belleview Station is a 51-acre master planned development started in 2012. It currently contains over 600,000 square feet of office space in two towers anchored by Fortune 500 companies. The project has also developed a hotel, 700 apartments and 80,000 square feet of retail space. The RidgeGate development in Lone Tree is a larger development with a much more diverse mix of uses than the traditional office/ business park. The 1,700-acre RidgeGate West development, which began in 2004, contains about 550 acres of commercial uses with 1.5 million square feet of office space including the Charles Schwab campus with 4,500 employees. It also contains the Lone Tree Town Center with 450,000 square feet of retail, Sky Ridge Medical Center, the Lone Tree Performing Arts Center, two hotels, and multifamily housing. The 1,800-acre RidgeGate East property, which is just starting to develop east of I-25, will contain a 400-acre city center with 12 million square feet of office, retail and high-density residential development.

Redtail Ridge has an opportunity to develop a similar, more diverse office and business park in the US-36 Corridor and a distinctive option to what is currently available. The land use plan proposes an urban density district with a mix of office, retail, residential, and hotel uses. The 55 acre district will contain the majority of the office space along with the retail, hotel, and market rate housing in the walkable urban format.

Redtail Ridge Development Program

EPS recommendations for the Redtail Ridge development program are based on the market potentials by land use category present above as well as a consideration of the existing development mix in competitive office/business parks. The land use mix for four of the existing established office/business parks are profiled in **Figure 21** below including DTC, Meridian, RidgeGate West, and Interlocken.

Figure 21. Space Allocation by Type in Existing Business Parks



Source: CoStar; Economic & Planning Systems

Office uses are the predominant land use with 71 to 89 percent of total space. Flex/R&D space is not a significant land use in the South I-25 Corridor parks but is found elsewhere in the corridor in lower value locations primarily east in Compark and Dove Valley. The US-36 Corridor flex/R&D space is approximately 4 percent of total space at Interlocken and a considerably higher percentage of space at Centennial Valley and Westmoor. Retail space ranges from less than 1 percent to over 20 percent but these figures are highly variable depending on the proximity of the project to other retail nodes. Hotels range from 4 percent to 10 percent of total space

The Redtail Ridge commercial development by land use category is summarized in **Table 29** below. The site's greatest potential is for office development, which is estimated at 2.25 million square feet by 2040. Based on historic development in the corridor, this is expected to include some flex/R&D space in addition to traditional office space. Business relocations are anticipated from Boulder R&D spin-off businesses to the Louisville/Lafayette area. Retail and hotel uses are expected to be complementary. Retail space is planned at 70,000 square feet or about 3 percent of the total commercial development. Hotel uses are planned at 200,000 square and 240 rooms/keys, which is about 8 percent of the total commercial development. The total commercial development is planned to be 2.52 million square feet by 2020 as shown. This is a fairly similar commercial development program as Meridian.

Table 29. Redtail Ridge Commercial Space Allocation, 2020-2040

Redtail Ridge	Sq. Ft.	%Total
Office	2,250,000	89.3%
Retail	70,000	2.8%
Hotel	200,000	7.9%
Total	**2,520,000**	**100.0%**

Source: Brue Baukol; Economic & Planning Systems

7. Housing Demand

This chapter summarizes the analysis of the expected housing demand associated with the proposed development program for Redtail Ridge. The estimated housing demand on Louisville is estimated based on the employment generated by the commercial components of the project and the percent of Louisville-based employees living in the city. The net housing demand is then reduced by accounting for the existing housing units in the market area that will potentially be vacated by seniors relocating to the CCRC community.

Employment

The number of jobs associated with the proposed commercial development program is estimated based on the average square footage per employee ranging from 300 square feet of gross building space for office, 500 square feet for retail, and 1,000 square feet for hotel. The CCRC employment estimate from Erickson is 600 FTE employees at buildout which is 0.45 employees per unit based on 1,326 units. The project is estimated to generate a total of 8,440 jobs at buildout as shown in **Table 30**. The number of jobs on site would increase incrementally based on the estimated project buildout schedule with 3,115 jobs associated with Phase 1 to be completed in 2022, and an additional 2,225 jobs associated with Phase 2 by 2025, 1,816 jobs in Phase 3, and 1,283 jobs in Phase 4 as shown.

Table 30. Redtail Ridge Employment Estimates, 2022-2040

Employment	Unit	Factor	Phase 1 2022	Phase 2 2025	Phase 3 2030	Phase 4 2040	2022-2040 Total	2022-2040 Ann. #
Corporate Office	sq. ft. per emp.	300	1,667	0	0	0	1,667	93
Office	sq. ft. per emp.	300	1,000	1,967	1,633	1,233	5,833	324
Hotel	sq. ft. per emp.	1,000	200	0	0	0	200	11
Retail	sq. ft. per emp.	500	20	30	40	50	140	8
Senior Housing	per unit- FTE	0.45	229	229	143	0	600	33
Total			**3,115**	**2,225**	**1,816**	**1,283**	**8,440**	**469**

Source: Economic & Planning Systems

Housing Demand

Housing demand is estimated by first converting jobs to employees by adjusting for multiple job holdings, and then applying the number of employees per household. According to U.S. Census data for the combined Denver and Boulder MSAs, there is an average of 1.1 jobs per employee and an average of 1.5 employees per household. Applying these factors to the employment requirements for the project yields an estimated total of 6,189 households by buildout in 2040 as shown in **Table 31**.

Table 31. Redtail Ridge Housing Demand Estimates, 2022-2040

Description	Unit	Factor	Phase 1 2022	Phase 2 2025	Phase 3 2030	Phase 4 2040	2022-2040 Total	2022-2040 Ann. #
Jobs per employee	per employee	1.1	3,427	2,448	1,998	1,412	9,284	516
Household Demand	emp. per unit	1.5	2,284	1,632	1,332	941	6,189	344
Redtail Ridge								
CCRC Units	ILUs	50%	282	281	0	0	563	31
Residential Units			600	300	0	0	900	50
Total			**882**	**581**	**0**	**0**	**1,463**	**81**
Net Housing Demand			**1,403**	**1,051**	**1,332**	**941**	**4,727**	**263**
Market Share								
Boulder & Broomfield[1]	% of units generated	33%	463	347	440	311	1,560	87
Louisville	% of units generated	8%	112	84	107	75	378	21
Total		**41%**	**575**	**431**	**546**	**386**	**1,938**	**108**

Source: Economic & Planning Systems
[1]Excludes City of Louisville

Redtail Ridge will mitigate a portion of the housing demand—6,189 units—created from on-site employment through the development of the independent CCRC units and residential units. Based on other area senior living projects, conservatively, at least one-half of the CCRC residents can be expected to come from the surrounding communities within approximately a 15-mile radius. Residents moving from the existing area housing to Redtail Ridge will reduce the future housing demand created by on-site employment by a commensurate amount given that these residents will be selling or otherwise vacating an existing housing unit within the surrounding area. Half of the independent living units, 563 units, and 900 residential units on-site reduce the housing demand by a total of 1,463 units. To the extent that these housing units are occupied by current area residents, it will free up the existing housing stock and reduce the demand for additional market area housing. These reductions result in a net housing demand of 4,727 units at buildout, as shown in **Table 31**.

The Redtail Ridge project will have access to employees from the larger Denver and Boulder MSAs. The primary area of housing demand is immediately adjacent to the Boulder County cities of Louisville, Superior, Lafayette, and Boulder as well as the City and County of Broomfield. The share of housing demand is estimated at 33 percent in Boulder and Broomfield Counties (excluding Louisville) and 8 percent in Louisville based on existing commuting patterns. Although some of the workforce would come from current residents of the market area, the assumption is that the added employment would create a commensurate increase in area housing units needed. Based on this market share of 41 percent, the estimated net housing demand on the targeted market area is 1,938 units or an average of 108 units per year over the estimated 18-year buildout period.

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Tel 609-924-6622 e-mail rbrprin@aol.com Fax 609-924-1628

MEMORANDUM

TO: Mr. John L. Tansey
Erickson Retirement Communities
703 Maiden Choice Lane
Baltimore, Maryland 21228

FROM: Eric G. Tazelaar

DATE: May 20, 2020

SUBJECT: **Proposed Erickson Retirement Community**
City of Louisville, Boulder County, Colorado

In accordance with your request, we have undertaken a summary evaluation of the secondary economic impacts anticipated to be associated with and considered likely to result from the construction and occupancy of a proposed new CCRC to be located in the City of Louisville in Boulder County, Colorado. You have asked us to consider particularly the revenue expected to be generated for the City through the local consumption (sales/use) tax which is an essential part of the City's operating budget. Louisville is a home-rule city, and as such is empowered to administer its own tax rules, regulations, policies and practices.

The City of Louisville has a current 2020 local budget[1] for governmental (non school) services of $52,849,930, of which $16,081,970 (30.4%) is budgeted to be funded by the collection of a local sales tax on qualified purchases. The sales tax is the most significant revenue source for Louisville, and includes a general Sales/Use tax of 3.0%; an Open Space tax of 0.375%; a Historic Preservation tax of 0.125%; and a Recreation tax of 0.15%. These sales taxes total 3.650% on purchases. While there are specific transactions involving goods and services that are exempt from the sales tax, exemptions are the exception.

Property taxes are the second greatest revenue source for Louisville and account for $5,464,970 or 10.7 percent of the total local budget. The proposed CCRC, with an estimated

[1]Total refers to the comprehensive City-wide budget as opposed to the General Fund budget.

complete value of $396,000,000 could increase **property tax revenues by $314,600**. Sales tax and property tax revenues account for a combined share of 41.1 percent of Louisville's revenue stream.

The construction and occupancy of the proposed CCRC on the subject property in Louisville can be expected to result in primary and secondary impacts during the construction phase as well as in the completed, or operational, phase. These economic impacts include temporary (construction) and permanent employment, expenditure impacts for goods and services, the generation of personal disposable income and the accompanying personal consumption expenditures. Data developed by the U.S. Department of Commerce, Bureau of Labor Statistics (BLS) regarding the relationships and effects resulting from non-residential and residential construction and operations has been incorporated in a methodology[2] for assessing economic impacts for new growth by the Urban Land Institute (ULI) and Center for Urban Policy Research (CUPR). Utilizing the ULI/CUPR input/output model, the proposed development is calculated to have the following impacts during both the construction phase and operational phase. The construction and occupancy of the proposed CCRC would be expected to generate additional ongoing local sales taxes from two primary sources: the residents of the community and the employees of the community.[3]

Construction Phase Impacts

Estimates of the construction stimulus to local economies may be calculated as a derivative of project value. The employment-generating effects of construction may be assessed in order to estimate the effects of private construction expenditures on jobs and materials. The studies by the Bureau of Labor Statistics and the refinement of the BLS data in the input/output models of the Urban Land Institute and the Center for Urban Policy Research yield anticipated construction

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[2]Development Impacts, Urban Land Institute and Center for Urban Policy Research, Economic Impact Analysis, Assessment Handbook.

[3]These two sources represent ongoing revenue sources for the City of Louisville. The construction phase of the project would also generate significant local revenue for the City through various fees and sales taxes on material purchases and spending on convenience goods and services within the City associated with the construction workers during the construction phase.

impacts that are expressed in terms of the number of employee hours per $1,000 value of construction, the percent of on-site employment hours by occupational group and skill level, the value of materials, equipment and supplies per $1,000 of construction cost, and the distribution of equipment and supplies per $1,000 of cost.

The proposed Continuing Care Retirement Community can be expected to directly and indirectly result in 1,086 on-site construction jobs during the construction phase, assuming a one year build-out. The construction will likely take a number of years, but in order to calculate the cumulative local economic impact of the construction phase, the construction schedule has been condensed to one year.

The ULI impact model anticipates the distribution of this employment between on-site and off-site construction; employment in the manufacture of construction products; trade, transportation and services; and other employment. This construction phase employment is expected to generate total payrolls of $168.8 million, a disposable personal income of $141.4 million, and personal expenditures of $130.1 million. The construction of the proposed CCRC development plan can also be expected to result in the purchase of $29.1 million of construction materials from within the region and $87.3 million from outside the region. If the 1,086 "on-site" construction workers each spent $15 per week on consumption expenditures in Louisville during the construction year, additional **sales tax revenue of $30,920** would be anticipated.[4]

Operational Impacts

The economic effects of the "steady state", or completed and occupied development plan, are measured by a derivative of input/output analysis that interprets the effects of the new development on other service providers in the local market area. For the long run, there are direct, indirect and induced effects. In the operational phase, the direct effects consist of permanent jobs created, and spending associated with both the operation of the completed redevelopment plan and spending by its employees and residents. There are also significant induced effects which emerge because households positively impacted by growth have increased wealth to distribute throughout

[4]1,086 workers x $15 per week x 52 weeks equals $847,080 in purchases generating $30,920 in local sales tax.

the economy. This will lead to more sales by businesses and more revenue due to the taxes levied on sales as well as corporate profits. The secondary and tertiary "induced" effects, which are most significant to the macro state economy, are not calculated herein. When completed and occupied, the proposed development is expected to generate, direct on-site employment for 600 full-time equivalent employees (FTE)with net (post-tax) payrolls of $25.3 million. Economic ratios per $1,000 of disposable personal income indicate that the operational (occupied) phase of the new development will generate $23.2 million in annual personal expenditures including expenditures of $9.3 million for shopping and convenience goods and an additional $13.9 million in consumption expenditures. A certain portion of those purchases made by the employees of the CCRC would likely be made in the City of Louisville. If 5.0 percent of the employees annual shopping and convenience good expenditures were to be made in Louisville, with half that amount being subject to the local sales and use tax, the **local employee based sales tax generated would amount to $8,600**.

The level of staffing and associated payroll figures noted above would serve the proposed development of approximately 1,326 total units. The breakdown of the units types would be for approximately 1,126 independent living units and approximately 200 units consisting of a mix of assisted living care, memory care and skilled nursing care. While the staffing and payroll figures reflect the total, 1,326 unit community, the consumption figures noted below are calculated on only the 1,126 independent living units. The occupants of the 200 assisted living, memory care and skilled nursing care units will not be shopping and making expenditures in local establishments.

Economic ratios per $1,000 of disposable personal income indicate that these 1,126 households would be expected to generate $80.2 million in annual personal expenditures including expenditures of $32.3 million for shopping and convenience goods and an additional $47.9 million in consumption expenditures. The vast majority of these expenditures will be made onsite and paid as a function of the monthly charges paid by the residents of the CCRC, but a portion would be expected to be made off site on excursions provided for by Erickson, with a portion of those expenditures made in the City of Louisville. If 5.0 percent of the resident's annual shopping and convenience good expenditures, including restaurant, entertainment and other social based activities, were to be made during off site excursions in Louisville, the **resident based sales tax generated for**

the City of Louisville would amount to $29,500[5]. This would equate to an annual sales tax generation of $26.18 per household, resulting from $720 per year or $60 per month in taxable purchases in the City of Louisville.

The economic impacts expected to result from the completion of the proposed redevelopment plan during the construction and operating phases are summarized on the following table. The economic impacts expected to result from the completion of the proposed redevelopment plan during the construction and operating phases are summarized on the following table.

[5]Assuming annual shopping and convenience goods purchases of $32,329,300 with 5.0 percent Lousiville expenditures ($1,616,500), with one-half taxable ($808,200), the sales tax would total $29,500.

ECONOMIC IMPACT SUMMARY
PROPOSED CONTINUING CARE RETIREMENT COMMUNITY
CITY OF LOUISVILLE, BOULDER COUNTY, COLORADO

I.	**PROJECT**		**Project Value**
	CCRC		$396,000,000
II.	**ECONOMIC IMPACT**		
	A. Construction Phase (temporary)		
	Contract Construction Cost		$277,200,000
	Material Purchases		$116,424,000
	Within Region		$ 29,106,000
	Outside Region		$ 87,318,000
	Employment	Labor Hours	Jobs
	On-Site Construction	2,179,240	1,086
	Off-Site Construction	268,420	134
	Manufacturing	1,910,810	950
	Trade, Trans & Services	1,022,700	512
	Other	348,380	174
	Total	5,711,150	2,856
	Earnings		
	Wages		$168,776,000
	Disposable Personal Income		$141,482,900
	Personal Expenditures		$130,164,300
	Local Expenditures		$ 847,050
	Sales/Use Tax		$ **30,920**
	B. Operation Phase (Permanent)		
	Facility Employees		600
	Annual Payroll		$ 28,765,800
	Disposable Personal Income		$ 25,313,900
	Personal Expenditures		$ 23,288,800
	Shopping Goods		$ 3,982,400
	Convenience Goods		$ 5,403,000
	Consumption Goods		$ 13,903,400
	Sales /Use tax[6]		$ **8,600**
	Households		1,126
	Annual Income		$ 99,088,000
	Disposable Personal Income		$ 87,194,400
	Personal Expenditures		$ 80,221,700
	Shopping Goods		$ 13,717,900
	Convenience Goods		$ 18,611,400
	Consumption Goods		$ 47,892,400
	Louisville Expenditures (5% S + C)		$ 1,616,500
	Sales /Use tax[7]		$ **29,500**

[6]Assumes 5.0 percent of the employees annual shopping and convenience good expenditures are made in Louisville with half that amount being subject to the local sales and use tax.

[7]Assumes 5.0 percent of the resident's annual shopping and convenience expenditures, equal to $1,616,500 are made in Louisville with half that amount subject to the local sales and use tax. The total expenditure of $1,616,500 equates to an average of $120 per CCRC household per month.

Other Fiscal Impacts

In addition to the calculated direct net impact on local governmental services associated with the occupancy of the proposed CCRC, there are other secondary fiscal impacts associated with the project occurring during the construction phase of the development and once the development is completed. Construction phase impacts are considered to be short-term in their duration, and include employment based impacts associated with on-site and off-site construction based employment; trade, transportation and service employment; manufacturing employment that supports the construction of the project. Non-employment construction phase impacts may be income based and exist as a function of the wages and salaries of construction related workers and expenditure impacts which include local material purchases and the expenditure of wages and salaries. The economic impacts associated with the occupancy of the proposed facility are considered to be long term and in the specific case of the proposed CCRC include annual expenditures for campus maintenance, advertising and marketing, insurance and other expenses, utilities, food, food service and food supplies; as well as the secondary economic impact associated with the anticipated payroll of nearly $28.7 million.

In terms of the range of services provided to the community at large, and specifically, to the proposed development, Boulder County is typical of suburban areas where a broad range of services and facilities are provided primarily for the benefit of household residents. The proposed CCRC will, itself, provide an extensive range of on-site services to its residents. The services to be provided by Erickson Living include first response medical service, transportation and paratransit (transportation for those with limited mobility), security, on-site roadway maintenance and street lighting, and social services. Automated fire suppression systems will be installed in all of the buildings and facilities. The self contained nature of the development, coupled with the range of services to be provided limit the dependence upon Boulder County for services. The services to be provided by the City of Louisville and by Boulder County to the planned CCRC are considered to be comparable to those furnished to other low-intensity commercial developments and are quite different from the range of governmental and school services provided to typical residential sub-divisions and individual properties. In many respects, the local services cost generation of a CCRC may be compared to a major hotel or hospital operation. Some would assume a heightened need for

emergency services with a community of persons aged 65 years and older. That assumption is mitigated by several factors. Most significantly, the community is staffed with health care professionals who will serve as the first responders to emergencies. Residents in need of immediate care will pull a chain on their wall or press a button to summon help rather than dialing 911. Further, residents who do have significant health issues may be attended to within the community's assisted living, skilled nursing and memory care units. Residents of those units are already receiving a heightened level of daily medical attention and are less likely to be in need of emergency services than the general population.

The completed CCRC, with an estimated value of $396,000,000 would be estimated to generate annual **property tax revenues of $314,600**. Additionally, the preliminary and very conservative estimates of sale tax revenues would amount to **$69,020** and be comprised of the following:

Construction Employee Sales Tax Revenue	$30,920
CCRC Employees Sales Tax Revenues	$ 8,600
CCRC Resident Sales Tax Revenues	$29,500