KAW VALLEY ENGINEERING, INC.

WATER SUPPLY & FIRE FLOW

STREETS OF WEST PRYOR

NWQ PRYOR ROAD AND LOWENSTEIN ROAD
LEE'S SUMMIT, MISSOURI

Prepared By:

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KVE Project No. A14D7067-1

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August 6, 2018
A14D7067-1

TO: **Development Services & Public Works**
City of Lee's Summit, Missouri

SUBJECT: **Water Supply and Fire Flow**

PROJECT: **Streets of West Pryor—Lee's Summit, Missouri (KVE A14D7067-1)**
NWQ Pryor Road and Lowenstein Drive

Introduction

This water supply memo is provided to accompany the revised submittal of the Preliminary Development Plan for the Streets of West Pryor development improvements located at NWQ Pryor Road and Lowenstein Drive in Lee's Summit, Missouri. This memo provides the estimated daily water use levels for the development as well as required fire flow rates for the buildings within the development. It also presents the modeling results for fire flows while maintaining minimum pressures, based on the internal pipe network provided.

Water Supply

Water supply for this development is provided from City mains located along the east and south perimeters of the site. The main along Pryor Road is 12-inch. The main along Lowenstein Drive will be upgraded with this project to 12-inch from Pryor Road to Black Twig Lane, and it then continues with the existing 8-inch line from Black Twig lane to the west. Currently, the section between Pryor Road and Black Twig Lane consists of 600 feet of 12-inch on existing Lowenstein Drive west of Pryor Road and then continuing at 6-inch for 1,500 feet to Black Twig Lane.

There are 4 tie-in locations between the City's current mains and the proposed development: (1) at Pryor Road and the north entrance; (2) at Pryor Road and Lowenstein Drive; (3) at Black Twig Lane and Lowenstein Drive and (4) at the western-most intersection of Lowenstein Drive and Lowenstein Court. Fire flow tests were run at existing fire hydrants near the first three locations listed.

Daily Water Usage

The estimated daily water usage demand from properties within this development were calculated based on the City's current engineering requirements. Residential demands were estimated as 125 gallons per day (gpd) per person for 2.78 persons per dwelling average, which equates to 247.5 gpd per equivalent dwelling unit. For commercial property, the EDU rate based on building usage and type from the sewer

code was used as an estimate of the daily water usage. Due to the preliminary and diverse nature of the land use, no more detailed customer estimate was available. Average daily demands were then totaled. The maximum day demand is assumed as 2.1 times the average daily. The peak hour demand is estimated as twice the maximum day rate. Land uses and buildings sizes were based on the revised Preliminary Development Plan proposal resubmitted August 10, 2018.

Detailed calculations are given in Appendix A. The total average daily demand of the development will be 223,072 gpd. The maximum day demand will be 468,451 gpd or 325 gpm (gallons per minute). The peak hour demand is estimated at 651 gpm.

Fire Flow

Fire flow demands were also calculated for the various land uses, as shown on the Table in Appendix A. Flows were calculated in accordance with the City's engineering requirements at the International Fire Code. A minimum of 1,000 gpm for single-family residential at 20 psi residual pressure and 1,5000 gpm at 20 psi residual pressure for other structures was used. Greater values were calculated as necessary for some structures, based on the International Fire Code. This calculation uses the values from Table BG105.1 of the IFC and is based on the square footage of total building (ground floor envelope times number of stories) and construction type. All non-single-family structures will have sprinklers, and therefore the calculated final value for fire flow is 25% of the B105.1 table in the IFC. The highest flow rate required of any structure was 2,000 gpm, which applied to the larger hotel, the senior living complex, and the apartment complex.

The ability of the proposed internal water line network to provide those flows was modeled by Kaw Valley Engineering using EPA Net 2. The internal pipe network and hydrant locations were modeled. The internal pipe network consists of 8-inch lines.

As source flow to the model, the City fire flows for three locations:

- Fire Hydrant # 021-039FH located at the corner of Black Twig Ln and N.W. Lowenstein Dr. (Tie-in point #3 listed above)
- Fire Hydrant # 021-048FH located at 250' north or the corner of N.W. Pryor Rd. and N.W. Summit Woods Xing (Tie-in point #1 listed above)
- Fire Hydrant # 021-057FH located at the corner of N.W. Pryor Rd and N.W. Lowenstein Dr. (Tie-in point #2 listed above)

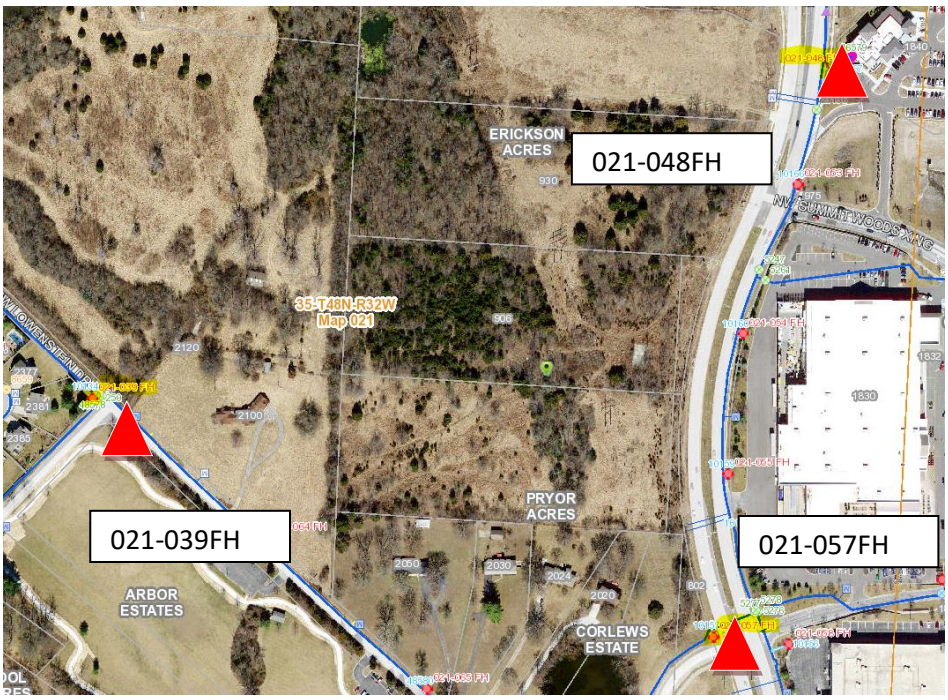


Figure 1: Fire Flow Test Locations

Table 1: Fire Hydrant Flow Results

Fire Hydrant	Elevation (per GIS)	Static	Residual	Flow Rate at Residual	Flow Rate Calc. at 20 Psi
	(ft)	(psi)	(psi)	(gpm)	(gpm)
021-039FH	994	93	56	1700	2454
021-048FH	973	101	68	1850	3004
021-057FH	988	93	61	1700	2654

The corresponding flow rate at a 20 psi residual from each of these locations was also calculated and is shown in the final column. It was calculated based on the equation:

Q at 20 psi / Q at flow test = (Pressure Drop to 20 psi / Pressure drop in flow test) ^0.54

The data above was input as a hypothetical pump into our model with a 3-point curve. Since each flow test represents an independent test, any one of these locations could be used to mimic the source of flow from the City's main. Only one pump was used in any individual fire flow model. Due to the looped

nature of the City's main, additional flow would be available from other source points during a fire event, but a prediction of those additional flows was not possible.

Using Lee's Summit's GIS we choose to model all locations using Fire Hydrant # 021-057FH due to its location to the nearest main water supply point. Proposed water line elevations were based on the proposed grading plan at the time of the submittal. The outer loop of main lines was used in the model to supply water but water demand in these lines was not used with the assumption it was small in comparison to the fire flow. The hydrant fire flow was modeled by using the supplied fire flows and pressures to create a pump curve for the allowable water supply. A pump with the characteristics of this pump curve then was placed at the location of the fire hydrant in the model.

To check the fire flow for each building the closest fire hydrant was chosen. This hydrant then had its elevation raised 46' to equal 20 psi loss and emitter changed to open. The fire flow at 20 psi for each building independently can be seen in Table 2. An exhibit showing the test condition for each model run and the nature of the flows is shown in Appendix B.

Table 2: Fire Flow for Streets of West Pryor

Fire Flow for Streets of West Pryor			
NWQ Pryor Road & Lowenstein Drive, Lee's Summit, Missouri			
Lot ID	**Site Use**	**Required Fire Flow (gpm)**	**Available Fire Flow (gpm)**
Residential			
Lots 14-42	Single Family Residential	1000	2260
Lot 7	Apartments w/Club House	2000	2365
Lot 6	Senior Living w/Clubhouse	2000	2477
Commercial			
Lot 1	Restaurant (Sit Down)	1500	2052
Lot 2	Restaurant (Sit Down)	1500	2052
Lot 5	Grocery	1500	2324
Lot 4	Retail	1500	2324
Lot 3	Restaurant w/Drive Thru	1500	2324
Lot 8	Restaurant	1500	2214
Lot 9	Restaurant	1500	2214
Lot 10	Restaurant (2 Tenants)	1500	2052
Lot 11	Hotel (80 Room)	1625	2264
Lot 12	Hotel (105 Rooms)	2000	2264

Conclusion

Fire flow demands can be met for each of the buildings within the development, with additional capacity remaining for maximum day demands. The most limiting scenario is that for Lot 12, with a difference between required and available fire flow of 264 gpm, which is less than the calculated maximum day demand of 325 gpm. However, this result is for the highly simplified and conservative single-pump source version of the model and neglects the additional flow that would be available via looped flows into other source connection points, as well as the distributed nature of the average flow demand throughout the system.

Respectfully Submitted,

William Heatherman, P.E
Project Engineer

Appendices:

Appendix A: Detailed Flow Estimates
Appendix B: Individual EPA NET 2 Model Runs per Building

Appendix A

Detailed Flow Estimates

Water Supply Demand Calculation for Streets of West Pryor
NWQ Pryor Road & Lowenstein Drive, Lee's Summit, Missouri

KVE Project # A14D7067-1
Date: August 1, 2018

Lot ID *	Site Use *	EDU per Unit	Unit of Measure	# of Units	# of EDU	Usage per EDU (gpd) **	Average Daily Demand (gpd)	Ground Floor Area (Envelope) (sf)	# of Stories	Total Fire-Flow Calculation Area (sf)	Type	Table B105.1 Value from IFC (gpm)	Final Value (incl Sprinkler Reduction) (gpm) ****	Minimum Duration (hours)
Residential Demands		***for daily flow calculations:***						***for fire flow calculations:***						
Lot 6	Senior Living w/Clubhouse	1	Apt	165	165	347.5	57,338	81,164	4	324,656	5B	8,000	2,000	4
Lot 7	Apartments w/Club House	1	Apt	250	250	347.5	86,875	68,679	4	274,716	5B	8,000	2,000	4
Lots 14-42	Single Family Residential	1	Lots	29	29	347.5	10,078	Each < 3600 sqf		*SFR (no sprinkler)*		1,000	1,000	2
Commercial Demands (Estimated by Sewer Factors)														
Lot 1	Restaurant (Sit Down)	3.5	1000 sf	6.5	22.8	300.0	6,825	6500	1	6,500	5B	2,250	1,500	2
Lot 2	Restaurant (Sit Down)	3.5	1000 sf	6.5	22.8	300.0	6,825	6500	1	6,500	5B	2,250	1,500	2
Lot 3	Restaurant w/Drive Thru	1.6	1000 sf	5.5	8.8	300.0	2,640	5500	1	5,500	5B	2,000	1,500	2
Lot 4	Retail	0.2	1000 sf	6.5	1.3	300.0	390	6500	1	6,500	5B	2,250	1,500	2
Lot 5	Grocery	0.2	1000 sf	63.1	12.6	300.0	3,787	63119	1	63,119	**2B**	5,250	1,500	4
Lot 7	Retail	0.2	1000 sf	10.0	2.0	300.0	600			*part of Apartment Complex structure, see above*				
Lot 7	Restaurant	1.6	1000 sf	5.0	8.0	300.0	2,400			*part of Apartment Complex structure, see above*				
Lot 8	Restaurant	3.5	1000 sf	7.5	26.3	300.0	7,875	7500	1	7,500	5B	2,250	1,500	2
Lot 9	Restaurant	3.5	1000 sf	7.5	26.3	300.0	7,875	7500	1	7,500	5B	2,250	1,500	2
Lot 10	Restaurant (2 Tenants)	3.5	1000 sf	12.3	43.1	300.0	12,915	12300	1	12,300	5B	3,000	1,500	3
Lot 11	Hotel (80 Room)	0.3	room	80	24.0	300.0	7,200	14,632	4	58,528	5B	6,500	1,625	4
Lot 12	Hotel (105 rooms)	0.3	room	105	31.5	300.0	9,450	22,326	4	89,304	5B	8,000	2,000	4

Maximum Fire-Flow Demand to any stru	**2,000**	**4**

Daily Demands:					
Total Avg Daily (A)	**223,072**	**gpd**	**or**	**155**	**gpm**
Max Day (M=A*2.1) * **	**468,451**	**gpd**	**or**	**325**	**gpm**
Peak Hour (P=2*M)	**936,903**	**gpd**	**or**	**651**	**gpm**

* See Sheet C-4 of Preliminary Development Plan Submittal, revised Submittal August 8, 2018

** For Residential Property, the Usage per Dwelling Unit is estimated as 125 gpd per person, and 2.78 persons per dwelling (average)
For Commercial Property within this subdivision, the usage was estimated based on the sewer flow factors to find equivalent dwelling unit times 300 gpd.

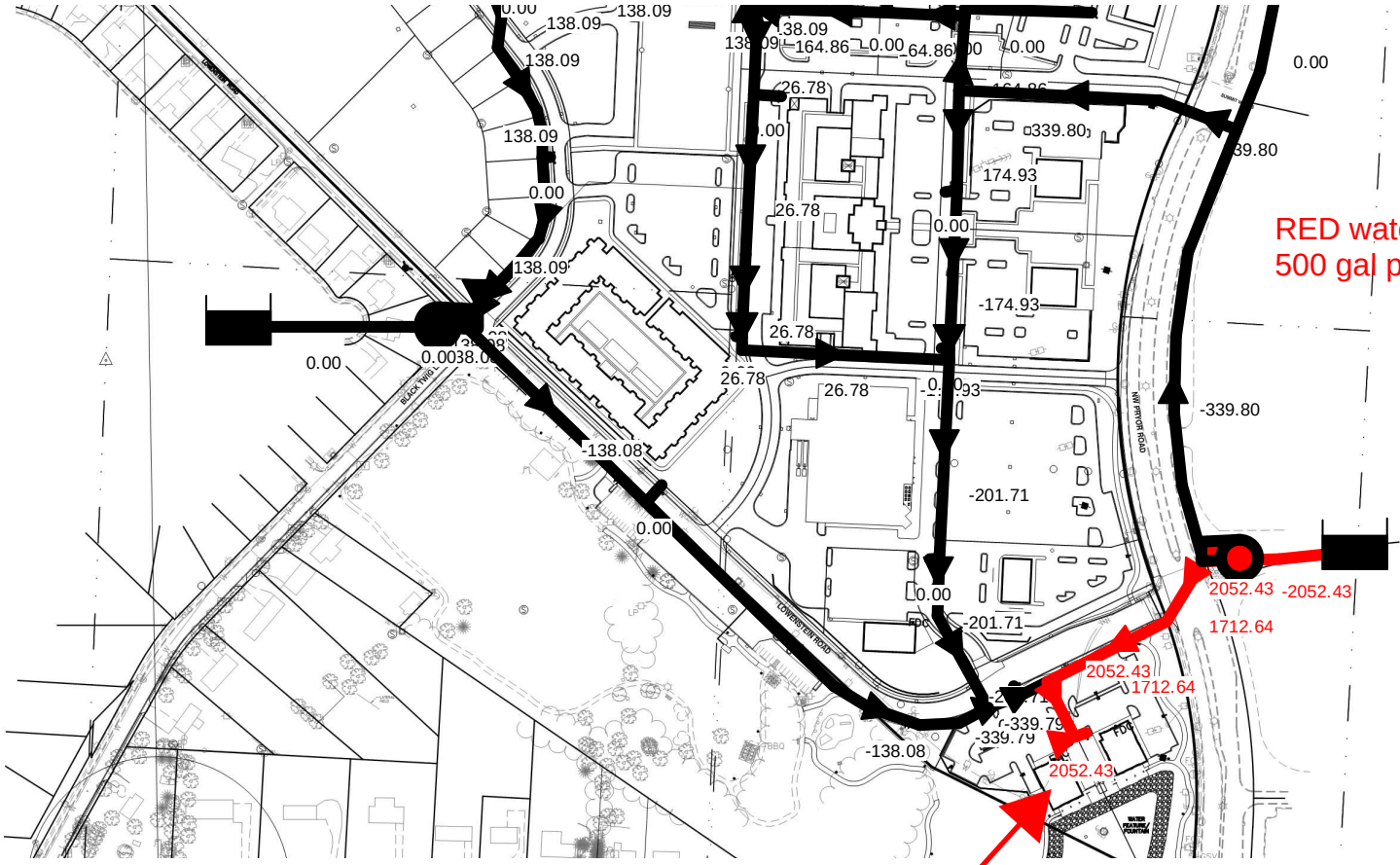
*** Irrigation demands are not calculated separately, but are assumed to be a component of the max-day demand factor.

**** All buildings except single-family residential have automatic sprinklers. Fire-Flow reduced 25%, but not less than 1,500 gpm.

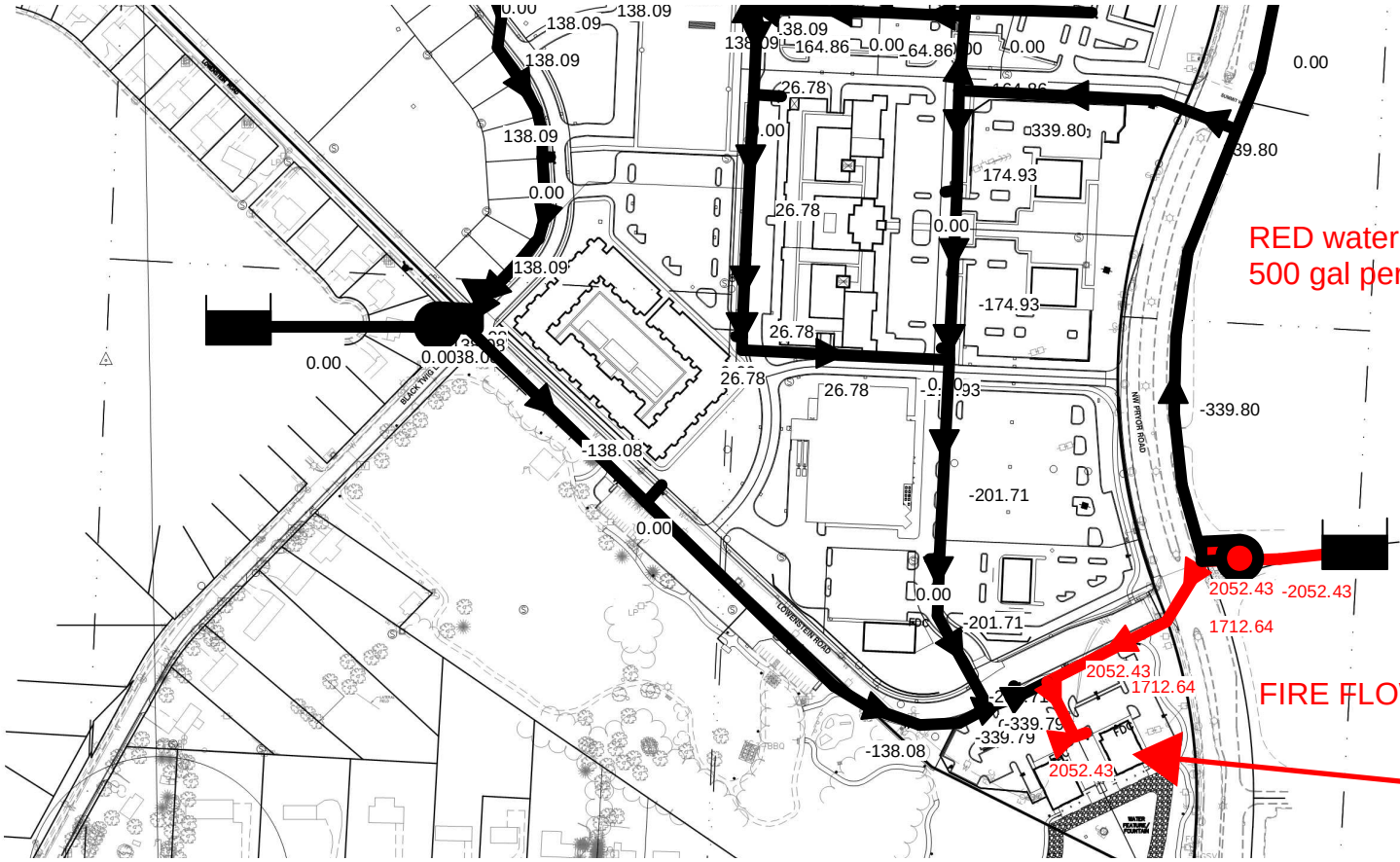
Appendix B

Individual EPA NET 2 Model Runs per Building

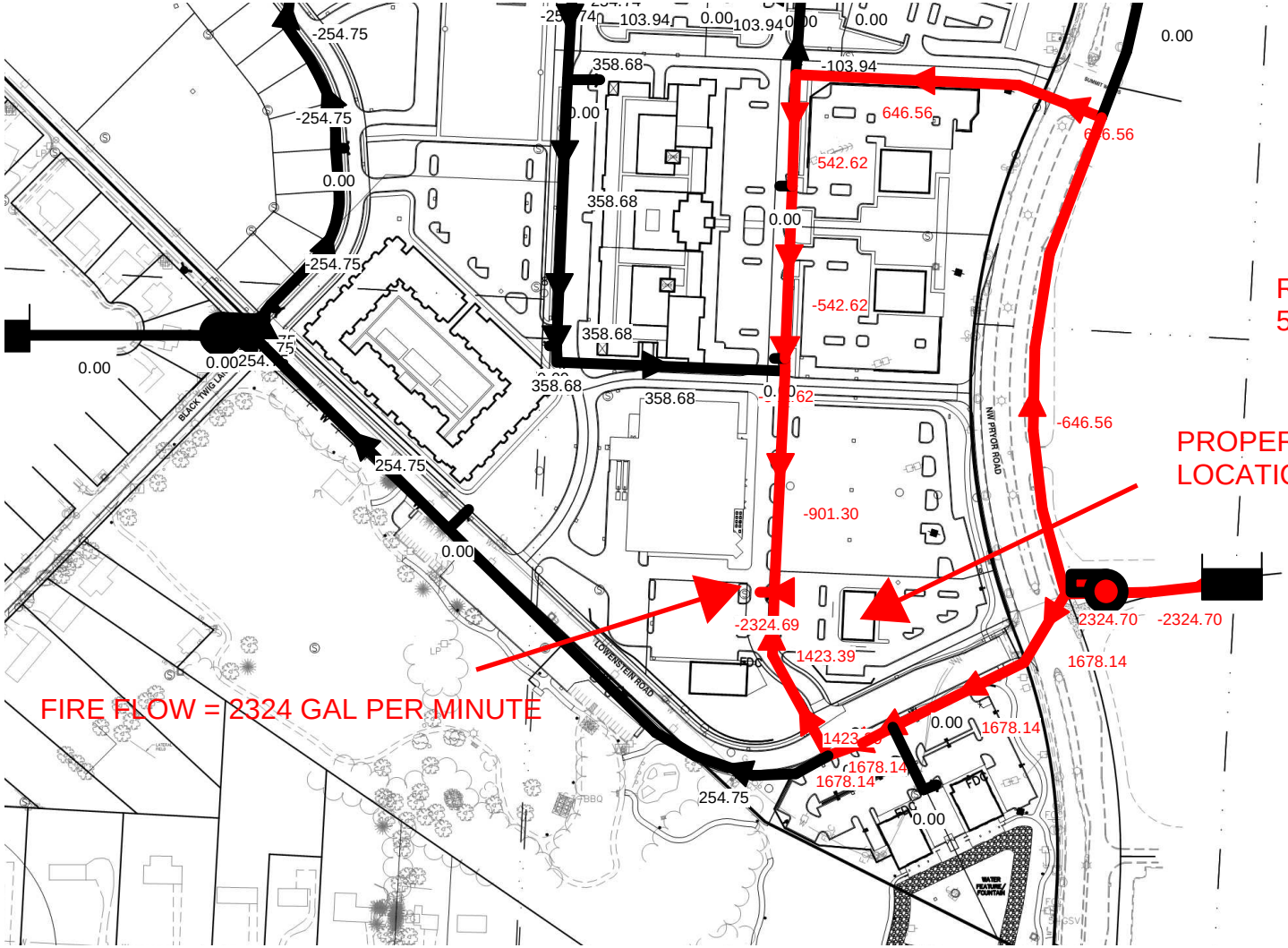
Fire Flow for Restaurant located on Lot 1



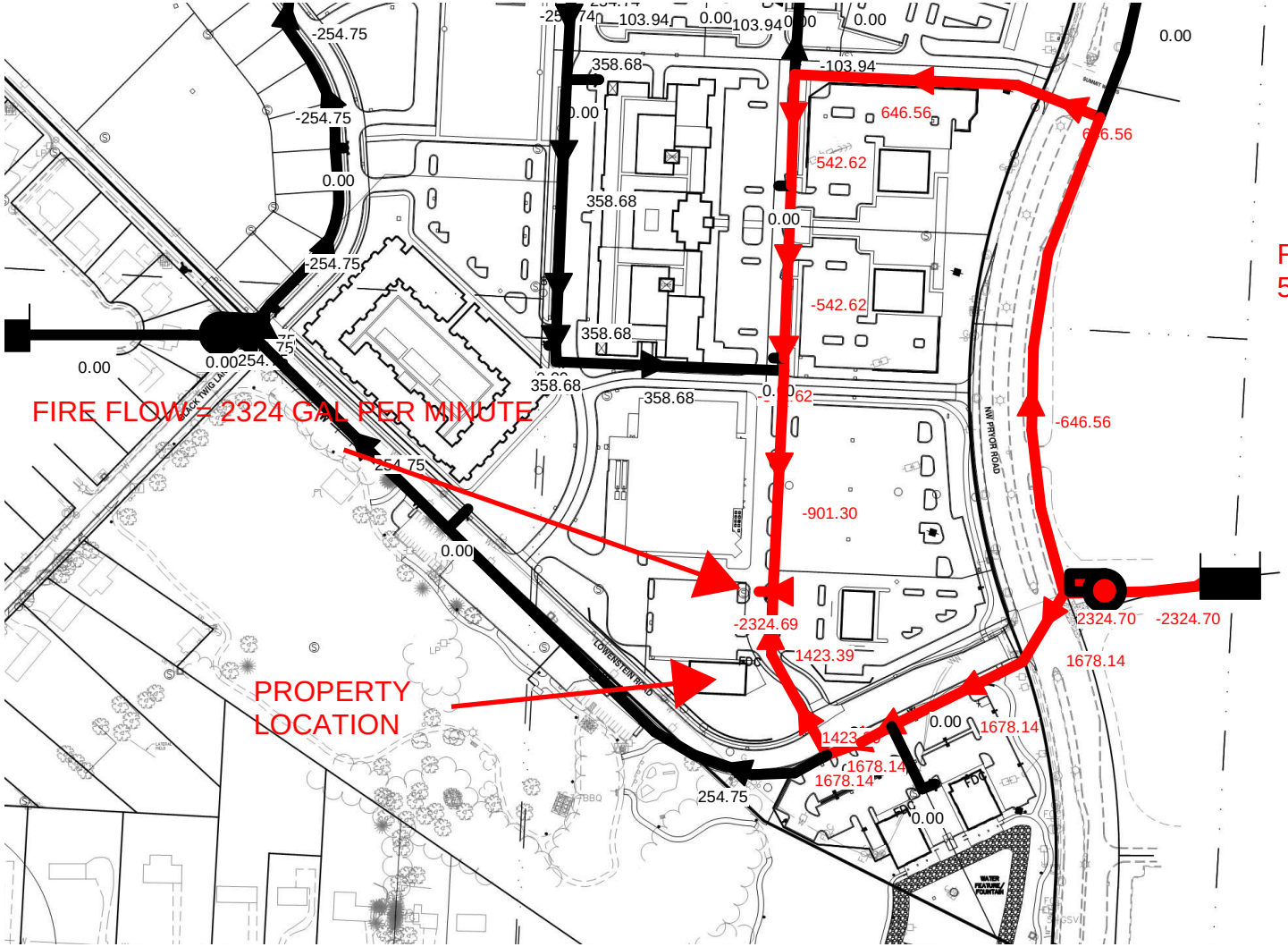
Fire Flow for Restaurant located on Lot 2



Fire Flow for Restaurant located on Lot 3



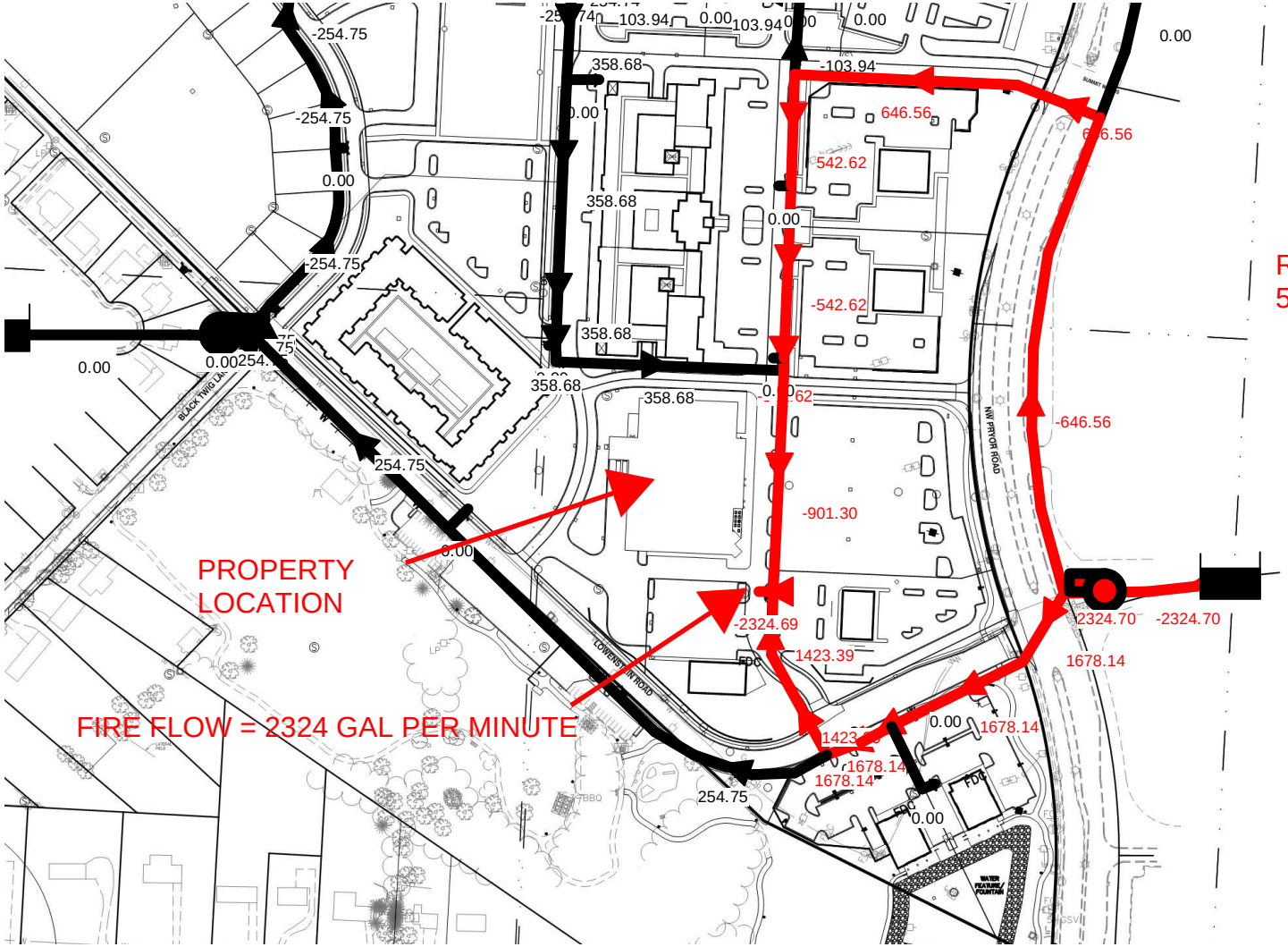
Fire Flow for Retail located on Lot 4



RED water lines have flows greater than 500 gal per minute

Day 1, 12:0

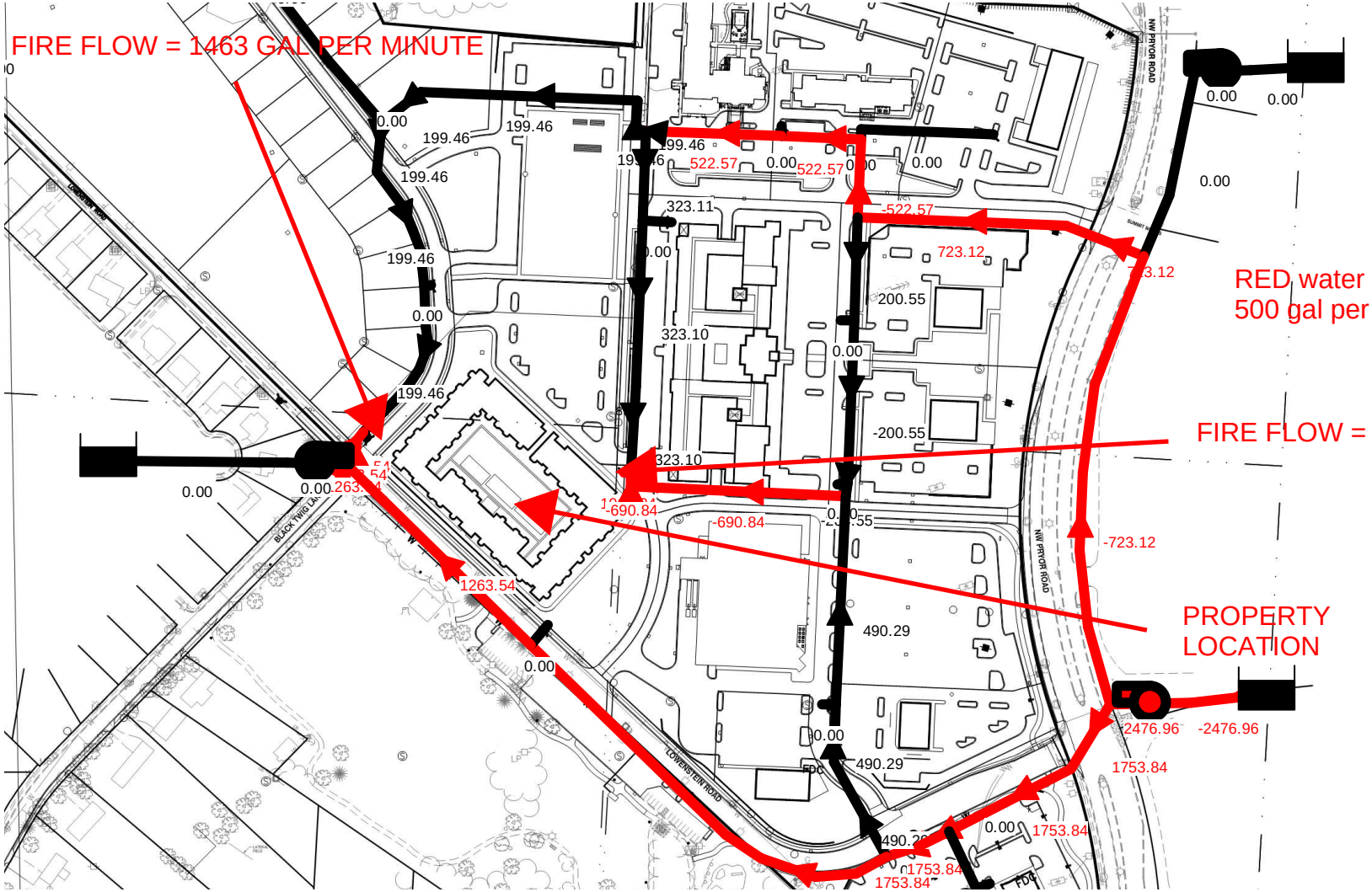
Fire Flow for Grocery located on Lot 5



RED water lines have flows greater than 500 gal per minute

Day 1, 12:0

Fire Flow for Senior Living located on Lot 6

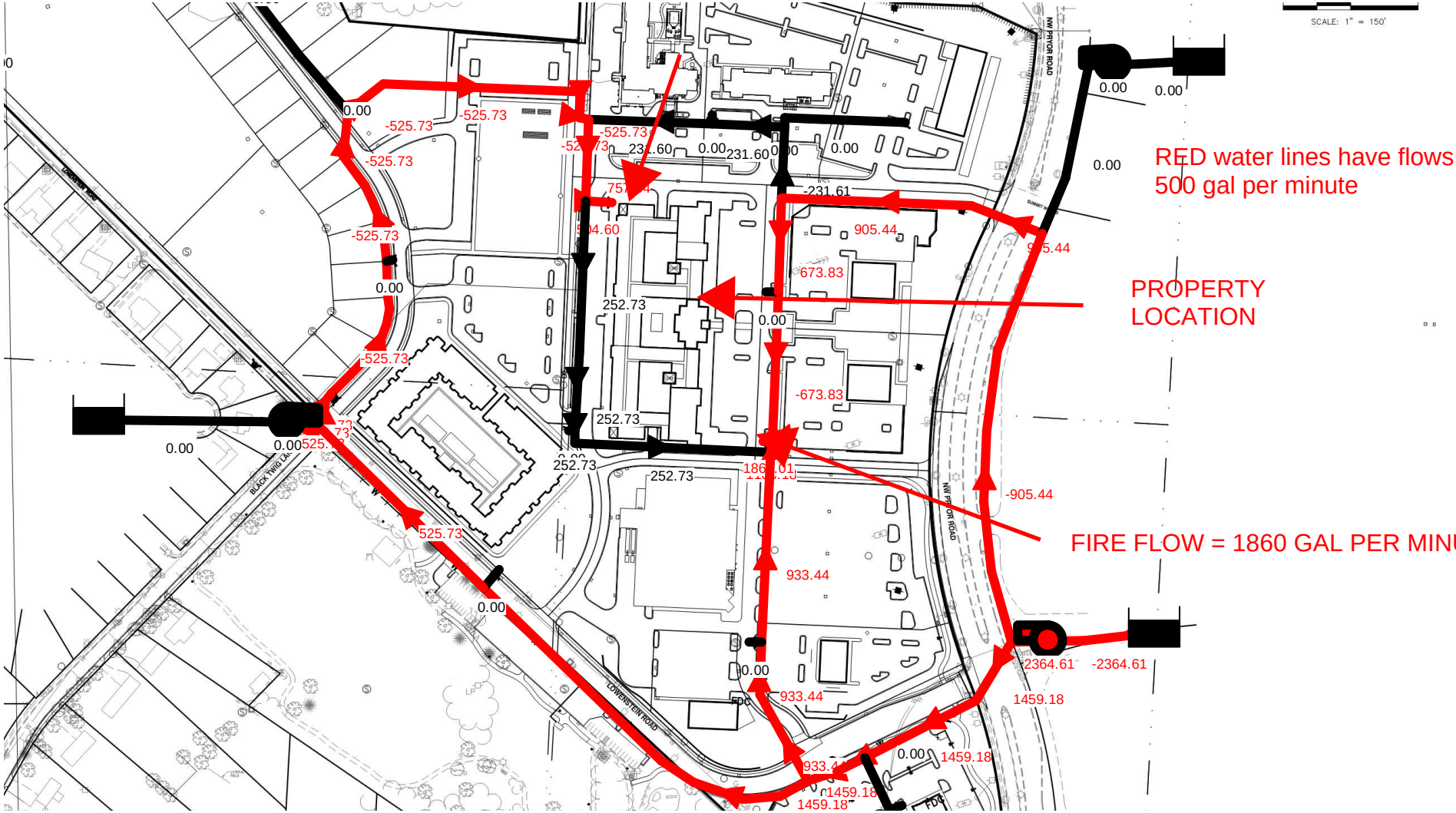


TOTAL COMBINED FIRE FLOW = 2477 GAL PER MINUTE

EPANET 2--Fire Flow for Streets of West Pryor-Lee's Summit, Missouri -- A14D7067-1

Fire Flow for Apartments located on Lot 7

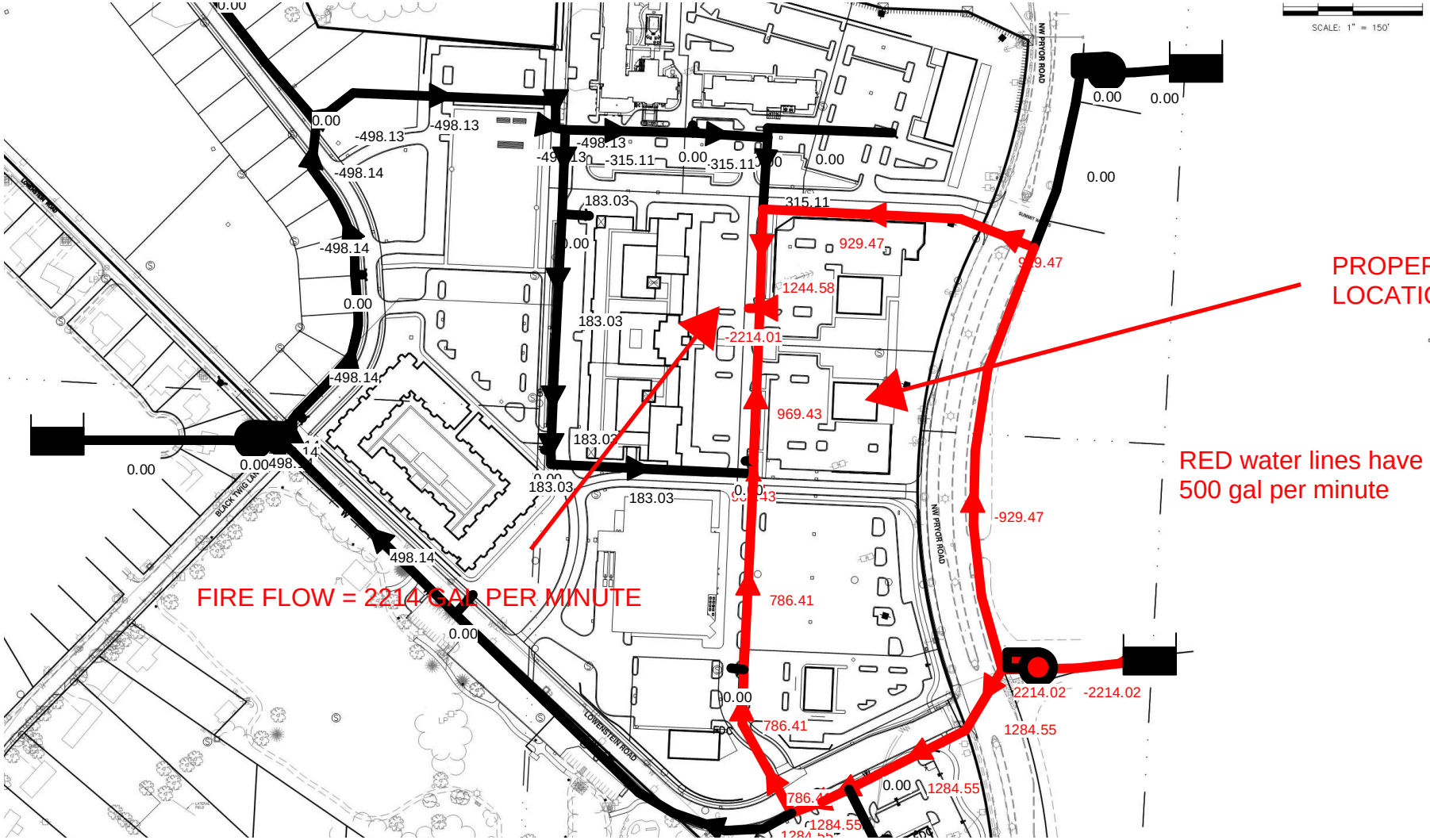
FIRE FLOW = 505 GAL PER MINUTE



TOTAL COMBINED FIRE FLOW = 2365 GAL PER MINUTE

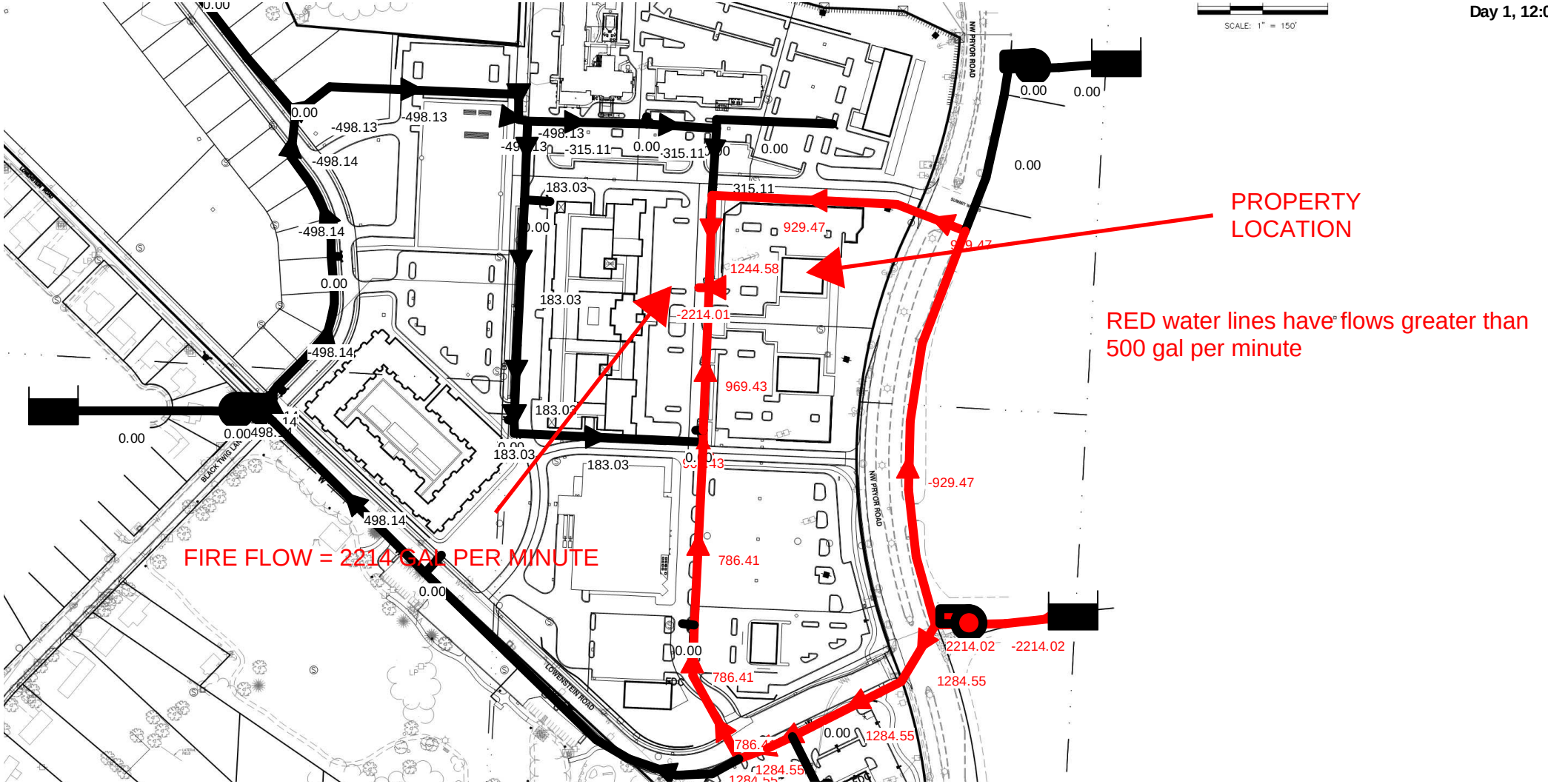
EPANET 2--Fire Flow for Streets of West Pryor-Lee's Summit, Missouri -- A14D7067-1

Fire Flow for Restaurant located on Lot 8



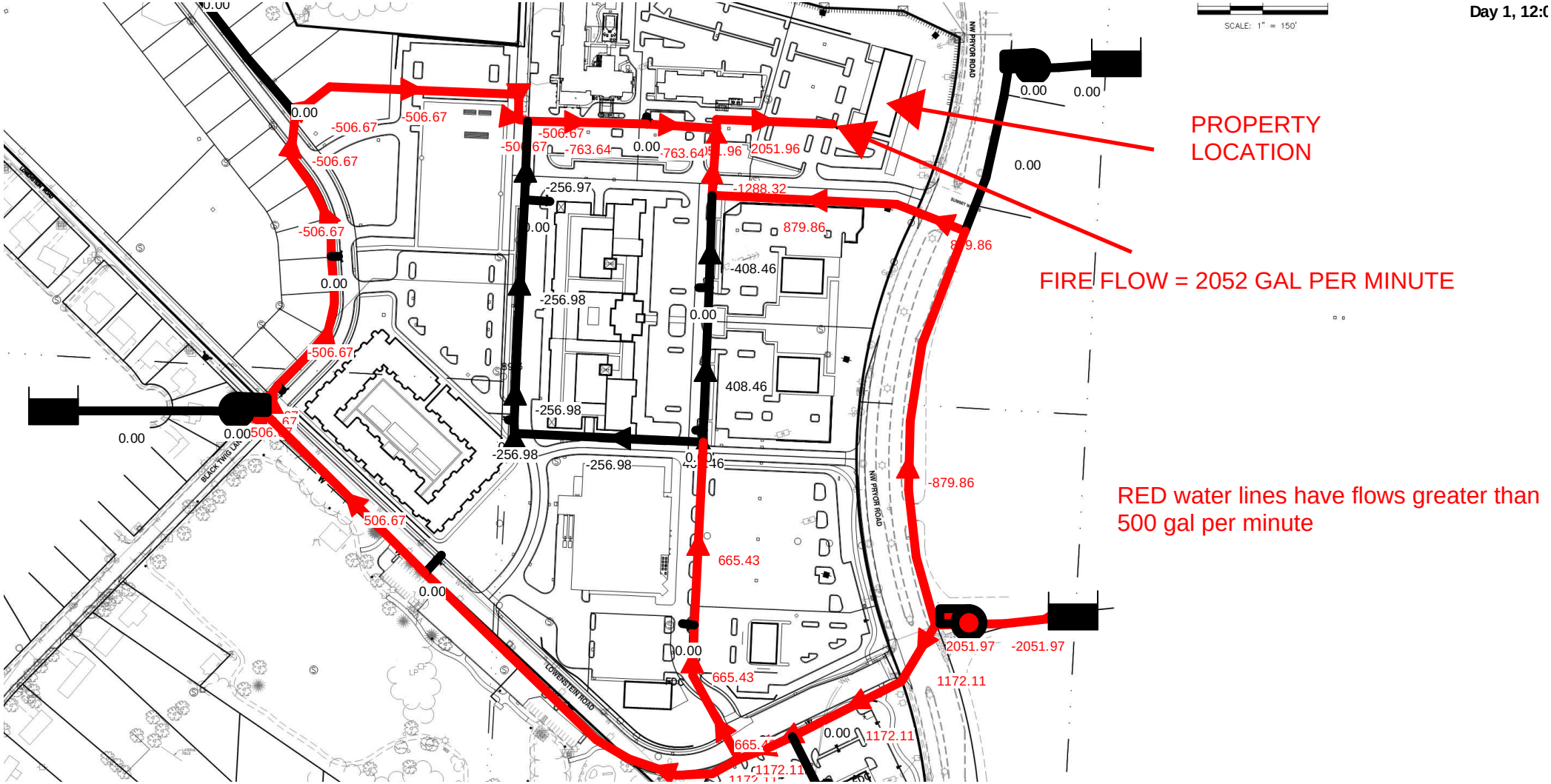
EPANET 2--Fire Flow for Streets of West Pryor-Lee's Summit, Missouri -- A14D7067-1

Fire Flow for Restaurant located on Lot 9



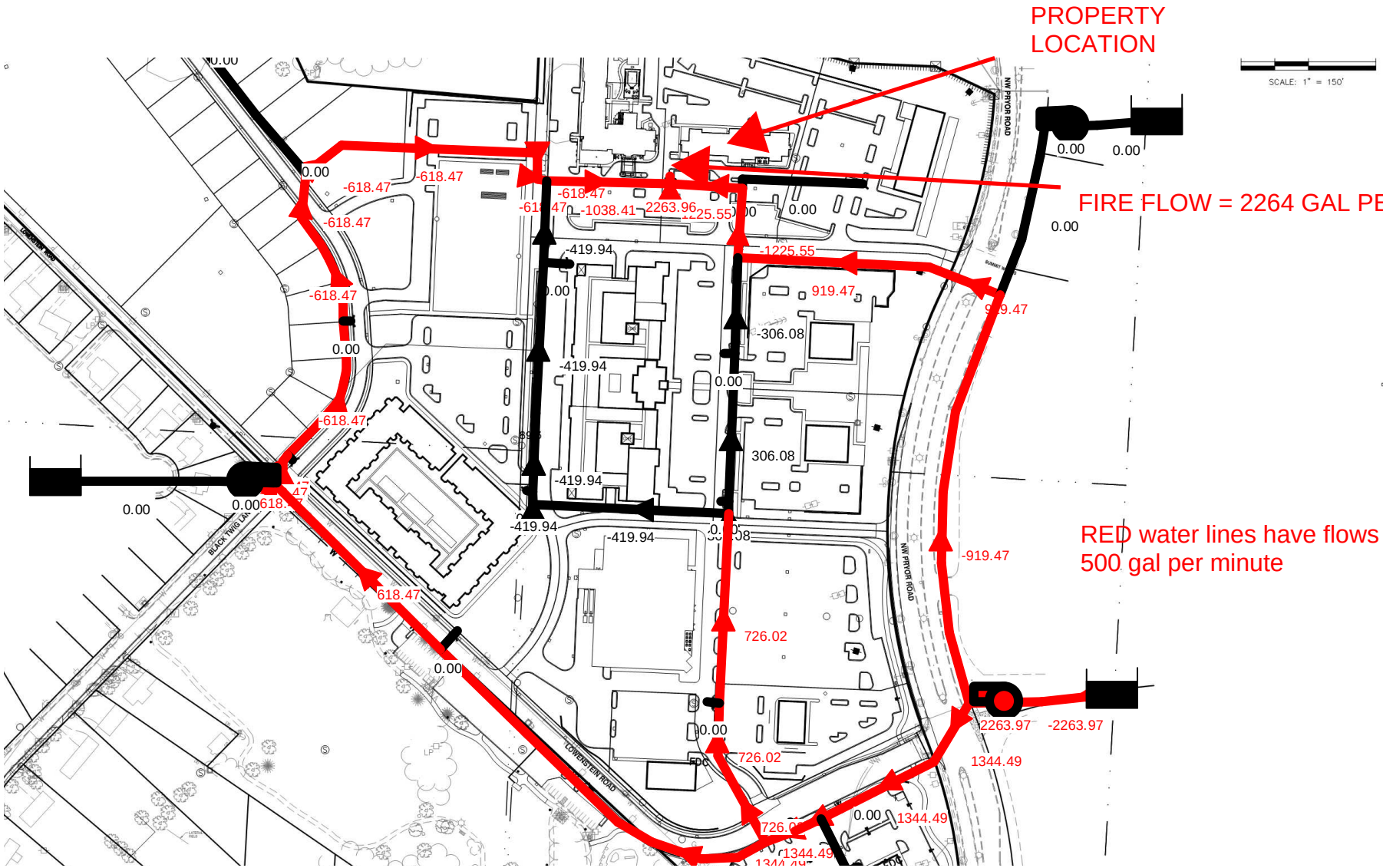
EPANET 2--Fire Flow for Streets of West Pryor-Lee's Summit, Missouri -- A14D7067-1

Fire Flow for Restaurant located on Lot 10



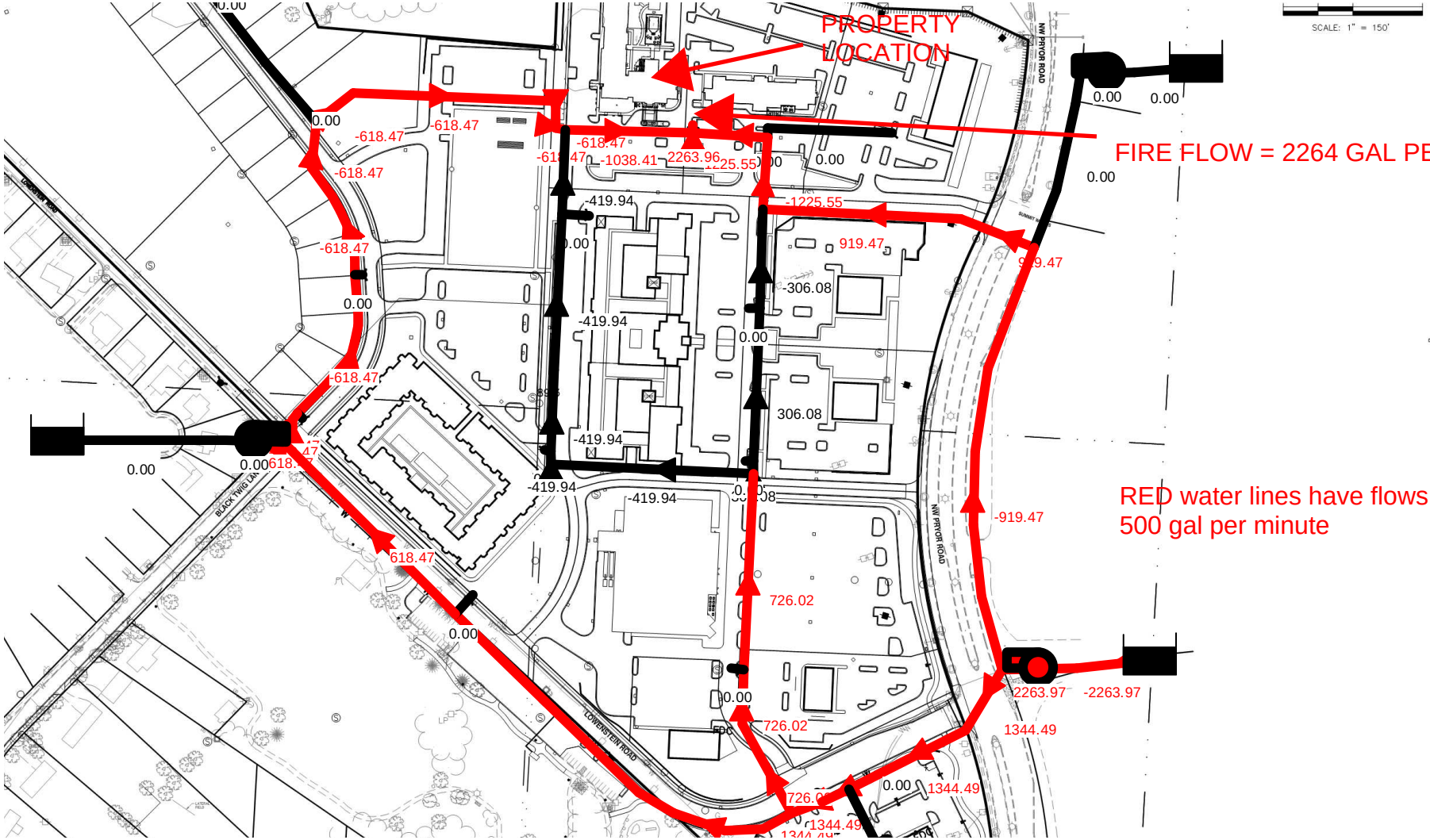
EPANET 2--Fire Flow for Streets of West Pryor-Lee's Summit, Missouri -- A14D7067-1

Fire Flow for Hotel with 90 rooms located on Lot 11



EPANET 2--Fire Flow for Streets of West Pryor-Lee's Summit, Missouri -- A14D7067-1

Fire Flow for Hotel with 130 rooms located on Lot 12



Day 1, 12:0

EPANET 2--Fire Flow for Streets of West Pryor-Lee's Summit, Missouri -- A14D7067-1

Fire Flow for Single Family Residential located on Lots 14-42