



EXHIBIT A-3

SYSTEM HYDRAULIC MODEL



FIRE FLOW CERTIFICATION

**Sub-District HB
Blangey Rd., Enzweiler Rd., Gunkel Rd.,
Oneonta Rd., Upper Lick Branch Rd., Pond Creek Rd.,
Poplar Thicket Rd., & Rifle Range Rd.,
Campbell County, KY
April 30, 2024**

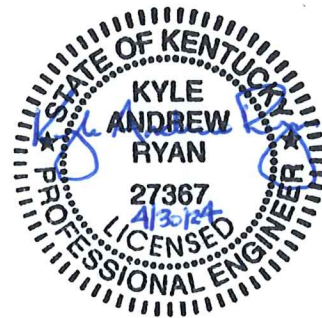
I certify that the proposed improvements meet the 807 KAR 5:066, Section 10b regulation for fire flow protection relating to KRS Chapter 278. I am certifying that “the system can provide a minimum fire flow of 250 gallons per minute; and the water system supporting this flow has the capability of providing this flow for a period of not less than two (2) hours plus consumption at the maximum daily rate”. This certification is based on the information available and is not a guarantee of any precise results.

This certification is based on hydraulic modeling performed using InfoWater, the program available from Innovyze. Supporting documentation and operating conditions are attached and are the basis for this certification.

It should be noted that input data used for modeling is based on available data. Results can change and are dependent on the demand conditions, which can vary at any given time. These values will impact the final results when adjusted. The certification is based on estimated conditions and contains many assumptions based on historical data.

With this certification, the Northern Kentucky Water District will permit the construction of fire hydrants within this project.

Fire flow analyses were made using a hydrant within the project area that would provide a representative result that should simulate the results at other hydrants within the system. Minor variations at different hydrants would still provide a flow rate that meets the minimum standard.





HYDRAULIC AND FLUSHING VELOCITY CERTIFICATION

Sub-District HB
Blangey Rd., Enzweiler Rd., Gunkel Rd.,
Oneonta Rd., Upper Lick Branch Rd., Pond Creek Rd.,
Poplar Thicket Rd., & Rifle Range Rd.,
Campbell County, KY
April 30, 2024

I certify that the proposed improvements are hydraulically capable of meeting the Kentucky Division of Water General Design Criteria for Surface and Ground Water Supplies standard for flushing velocity in the main meeting 2.5 feet per second while maintaining at least 20 psi pressure in accordance with 401 KAR 8:100.

The maximum flow rate that can reliably be supplied to the main and meet 20 psi in the system under maximum hour conditions is:

- Blangey Road
 - 8" main - 850 gpm
 - 2" main - 165 gpm
- Enzweiler Road - 1,500 gpm
- Gunkel Road – 650 gpm
- Oneonta Road – 1,500 gpm
- Upper Lick Branch Road – 1,500 gpm
- Pond Creek Road – 1,500 gpm
- Poplar Thicket Road – 1,200 gpm
- Rifle Range Road – 1,200 gpm

At least 30 psi can be maintained under the peak domestic demand for the 81 customers affected. The peak domestic demand using the D.R. Taylor formula is:

- 33.2 gpm on Blangey Road (11 potential customers)
- 17.3 gpm on Enzweiler Road (3 potential customers)
- 24.5 gpm on Gunkel Road (6 potential customers)
- 38.7 gpm on Oneonta Road (15 potential customers)
- 33.2 gpm on Upper Lick Branch Road (11 potential customers)
- 20.0 gpm on Pond Creek Road (4 potential customers)
- 33.2 gpm on Poplar Thicket Road (11 potential customers)
- 44.7 gpm on Rifle Range Road (20 potential customers)

This certification is based on the information available and is not a guarantee of any precise results. Results are based on hydraulic modeling performed using InfoWater, the program available from Innovyze. Supporting documentation and operating conditions are attached and are the basis for this certification.

It should be noted that input data used for modeling is based on available data. Results can change and are dependent on the demand conditions, which can vary at any given time. These values will impact the final results when adjusted. The certification is based on estimated conditions for maximum hour demand conditions and contains many assumptions based on historical data.

With this certification, the Northern Kentucky Water District will permit the construction of the proposed development.

The assumed Hazen-Williams roughness coefficient for all new pipe was 120, which is suitable for ductile iron or PVC. The water level in the South County Tank, Claryville Tank, and Main Street Tank were one-half full.



Sub-District HB
 Blangey Rd., Enzweiler Rd., Gunkel Rd.,
 Oneonta Rd., Upper Lick Branch Rd.,
 Pond Creek Rd., Poplar Thicket Rd.. & Rifle Range Rd.
 Campbell County, Kentucky
 Output from InfoWater model - copied to Excel
 August 20th, 2012



Maximum Hour Run for Potential Customers

Blangey Road

Maximum Hour Run, 11 potential Customers = 33.2 GPM				
J224	6.6	572	765.0	83.6
J226	6.6	556	765.4	90.7
J228	6.6	504	765.4	113.3
J230	6.6	530	765.4	102.0
3689	6.6	486	765.4	121.1

Enzweiler Road

Maximum Hour Run, 3 potential Customers = 17.3 GPM				
J232	5.8	810	1006.7	85.2
J234	5.8	837	1006.7	73.5
J236	5.8	837	1006.7	73.5

Gunkel Road

Maximum Hour Run, 6 potential Customers = 24.5 GPM				
J240	6.1	658	1003.5	149.7
J246	6.1	714	1003.5	125.4
J238	6.1	814	1003.5	82.1
J248	6.1	762	1003.5	104.6

Oneonta Road

Maximum Hour Run, 15 potential Customers = 38.7 GPM				
J250	6.5	504	1005.0	217.1
J254	6.5	524	1005.0	208.4
J260	6.5	502	1005.0	218.0
J256	6.5	496	1005.1	220.6
J258	6.5	482	1005.1	226.6
J252	6.5	485	1005.2	225.4

Upper Lick Branch Road

Maximum Hour Run, 11 potential Customers = 33.2 GPM				
J266	8.3	792	1005.2	92.4
J270	8.3	722	1005.2	122.7
J272	8.3	674	1005.2	143.5
J268	8.3	656	1005.2	151.3

Pond Creek Road

Maximum Hour Run, 4 potential Customers = 20 GPM				
J206	6.7	518	1004.9	211.0
J274	6.7	534	1004.9	204.0
J276	6.7	500	1004.9	218.8

Poplar Thicket Road

Maximum Hour Run, 11 potential Customers = 33.2 GPM				
J280	6.6	562	1005.9	192.3
J286	6.6	630	1005.9	162.9
J284	6.6	732	1005.8	118.7
J282	6.6	812	1005.8	84.0
J278	6.6	778	1005.8	98.7

Rifle Range Road

Maximum Hour Run, 20 potential Customers = 44.7 GPM				
J288	8.9	522	1005.6	209.5
J294	8.9	580	1005.6	184.4
J292	8.9	552	1005.6	196.6
J290	8.9	500	1005.7	219.1
J210	8.9	532	1005.8	205.3

Flushing Velocities Under Maximum Hour**Blangey Road**

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J224	6.6	572	744.4	74.7
J226	385.4	556	744.7	81.8
J228	6.6	504	750.8	106.9
J230	6.6	530	747.7	94.3
3689	6.6	486	754.3	116.3

Pipe Information for flushing velocity for new 8" pipe					
Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P395	888	8	405	2.6	120
P399	788	8	399	2.5	120
P401	807	8	392	2.5	120

Blangey Road

Flushing velocity for new 2" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J224	24.0	572	761.4	82.1
J226	6.6	556	765.2	90.6
J228	6.6	504	765.2	113.2
J230	6.6	530	765.2	101.9
3689	6.6	486	765.3	121.0

Pipe Information for flushing velocity for new 2" pipe					
Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P397	209	2	24	2.5	120

Enzweiler Road

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J232	5.8	810	1006.3	85.0
J234	5.8	837	1004.1	72.4
J236	392.0	837	1001.2	71.1

Pipe Information for flushing velocity at 2.5 fps for new 8" pipe					
Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P405	570	8	398	2.5	120
P407	780	8	392	2.5	120

Gunkel Road

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J240	6.1	658	965.1	133.1
J246	6.1	714	961.6	107.3
J238	392.0	814	951.8	59.7
J248	6.1	762	956.9	84.5

Pipe Information for flushing velocity at 2.5 fps for new 8" pipe

Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P415	883	8	404	2.6	120
P417	867	8	398	2.5	100
P419	964	8	392	2.5	100

Oneonta Road

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J250	392.0	504	964.2	199.4
J254	6.5	524	965.7	191.4
J260	6.5	502	972.8	204.0
J256	6.5	496	987.9	213.2
J258	6.5	482	980.1	215.8
J252	6.5	485	995.3	221.1

Pipe Information for flushing velocity at 2.5 fps for new 8" & 12" pipe

Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P423	1744	8	418	2.7	120
P425	386	8	392	2.5	120
P427	1923	8	411	2.6	120
P429	1829	8	405	2.6	120
P431	1857	8	398	2.5	120

Upper Lick Branch Road

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J266	8.3	792	992.9	87.1
J270	8.3	722	988.2	115.3
J272	8.3	674	982.8	133.8
J268	392.0	656	979.0	140.0

Pipe Information for flushing velocity for new 8" pipe

Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P443	1167	8	409	2.6	120
P445	1376	8	400	2.6	120
P447	1021	8	392	2.5	120

Pond Creek Road

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J206	6.7	518	979.9	200.2
J274	6.7	534	975.5	191.3
J276	392.0	500	973.9	205.3

Pipe Information for flushing velocity for new 8" pipe

Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P449	1144	8	399	2.5	120
P451	441	8	392	2.5	120

Poplar Thicket Road

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J280	6.6	562	1002.4	190.8
J286	6.6	630	997.0	159.0
J284	6.6	732	991.6	112.5
J282	6.6	812	987.0	75.8
J278	392.0	778	982.9	88.8

Pipe Information for flushing velocity for new 8" pipe					
Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P455	1321	8	412	2.6	120
P457	1088	8	392	2.5	120
P459	1187	8	399	2.5	120
P461	1368	8	405	2.6	120

Rifle Range Road

Flushing velocity for new 8" pipe (under max hour)				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J288	392.0	522	949.2	185.1
J294	8.9	580	960.2	164.7
J292	8.9	552	969.5	180.9
J290	8.9	500	979.1	207.6
J210	8.9	532	988.3	197.7

Pipe Information for flushing velocity for new 8" pipe					
Pipe ID	Length, ft	Diam, inch	Flow, gpm	Velocity, fps	Roughness
P463	2163	8	419	2.7	120
P465	2366	8	410	2.6	120
P467	2398	8	401	2.6	120
P469	2929	8	392	2.5	120

Maximum Available Flow Under Maximum Hour**Blangey Road (8" Main)**

Maximum Hour Run, Maximum Available Flow				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J224	6.6	572	645.3	31.8
J226	850.0	556	645.7	38.9
J228	6.6	504	671.2	72.5
J230	6.6	530	658.5	55.7
3689	6.6	486	685.7	86.5

Blangey Road (2" Main)

Maximum Hour Run, Maximum Available Flow				
ID	Demand, gpm	Elevation, ft	Grade, ft	Pressure, psi
J224	165.0	572	626.2	23.5
J226	6.6	556	760.6	88.7
J228	6.6	504	762.0	111.8
J230	6.6	530	761.3	100.2
3689	6.6	486	762.8	119.9

Enzweiler Road

Maximum Hour Run, Maximum Available Flow				
J232	5.8	810	1003.9	84.0
J234	5.8	837	978.1	61.1
J236	1500.0	837	943.1	46.0

Gunkel Road

Maximum Hour Run, Maximum Available Flow				
J240	6.1	658	917.8	112.6
J246	6.1	714	909.1	84.5
J238	650.0	814	884.4	30.5
J248	6.1	762	897.3	58.6

Oneonta Road

Maximum Hour Run, Maximum Available Flow				
J250	1500.0	504	573.8	30.2
J254	6.5	524	591.1	29.1
J260	6.5	502	675.1	75.0
J256	6.5	496	847.0	152.1
J258	6.5	482	758.5	119.8
J252	6.5	485	927.8	191.8
8757*	4.8	876	938.1	26.9

* Area of Minimum Pressure

Upper Lick Branch Road

Maximum Hour Run, Maximum Available Flow				
J266	8.3	792	890.0	42.5
J270	8.3	722	836.5	49.6
J272	8.3	674	774.1	43.4
J268	1500.0	656	728.3	31.3

Pond Creek Road

Maximum Hour Run, Maximum Available Flow				
J206	6.7	518	731.7	92.6
J274	6.7	534	679.9	63.2
J276	1500.0	500	660.1	69.4

Poplar Thicket Road

Maximum Hour Run, Maximum Available Flow				
J280	6.6	562	984.8	183.2
J286	6.6	630	944.4	136.2
J284	6.6	732	902.9	74.1
J282	6.6	812	867.3	24.0
J278	1200.0	778	835.0	24.7

Rifle Range Road

Maximum Hour Run, Maximum Available Flow				
J288	1200.0	522	584.6	27.1
J294	8.9	580	671.6	39.7
J292	8.9	552	743.8	83.1
J290	8.9	500	816.0	136.9
J210	8.9	532	882.9	152.0

<u>Pipe ID</u>	<u>From Node</u>	<u>To Node</u>
P395	3689	J228
P397	J226	J224
P399	J228	J230
P401	J230	J226
P405	J232	J234
P407	J234	J236
P415	J240	J246
P417	J246	J248
P419	J248	J238
P425	J254	J250
P429	J258	J260
P431	J260	J254
P423	J252	J256
P427	J256	J258
P443	J266	J270
P445	J270	J272
P447	J272	J268
P449	J206	J274
P451	J274	J276
P455	J280	J286
P461	J286	J284
P459	J284	J282
P457	J282	J278
P467	J292	J294
P469	J294	J288
P465	J290	J292
P463	J210	J290

