

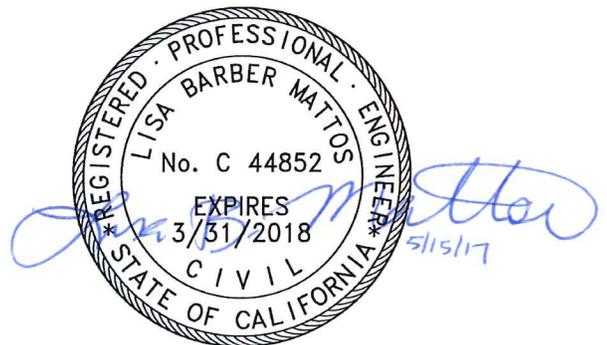
# WATER STUDY

## LINCOLN MEADOWS

City of Lincoln, California  
October, 2015  
Updated May, 2017

Prepared By:

**BAKER-WILLIAMS ENGINEERING GROUP**  
6020 Rutland Drive, Suite #19  
Carmichael, California 95608  
PH: 916-331-4336  
Fax: 916-331-4430



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# Water Study for Lincoln Meadows

## I. Introduction

The Lincoln Meadows project area is located on the northeast corner of the intersection of Virginatown Road and Hungry Hollow Road, in the City of Lincoln (See Figure 1). The project is approximately 40 acres in size and is proposed as a 144 lot single family residential subdivision.

Per the Interim 2015 Urban Water Management Plan, the target number for the Gallons Per Capita Day(GPCD) have been revised to 193 GPCD. With 2.59 residents /unit x 144 units the project would require 71,981 gal/day or 26,273,167 gal/year which equals 80 Acre-Ft/year.

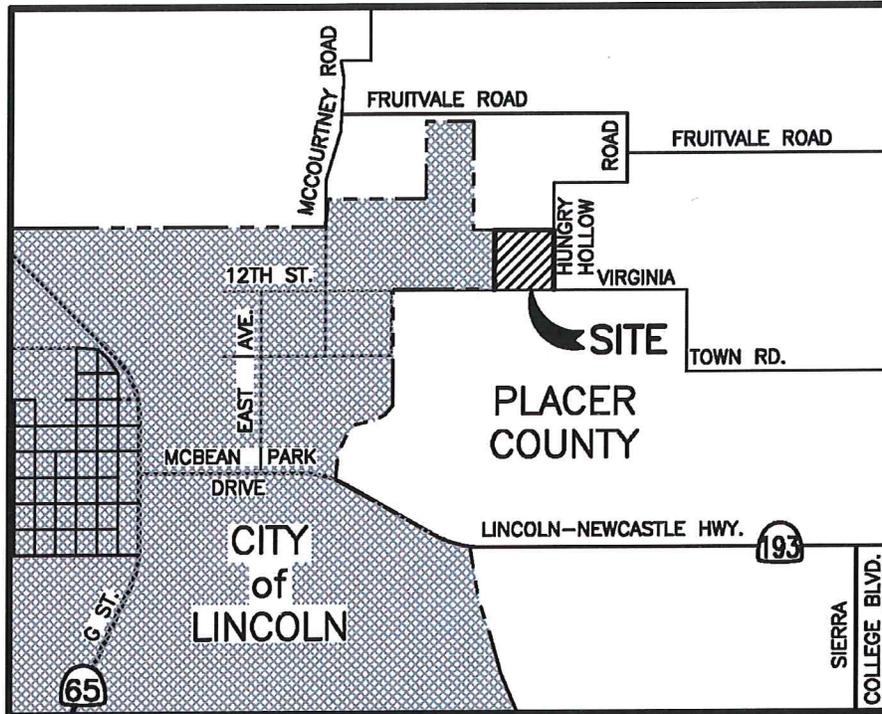


Figure 1 - Vicinity Map

The purpose of the remainder of this report is to analyze the proposed water distribution system capabilities and establish the available system demands to justify the proposed water distribution system pipe sizes for fire flow protection. This study is modeled using CivilCAD software to ensure that the proposed system meets the parameters set forth by the City of Lincoln and the current California Building Code.

## II. Background

The project area is relatively flat ground varying in elevation from approximately 217 feet in elevation to 198 feet based on the NAV29 Datum. Water supply to the project is not a major concern as the project will continue the transmission main extension in Virginatown Road in accordance with the master plan.

## III. Land Use and Fire Demand Projections

The proposed project will be a 144 lot (R-1) single family subdivision. For this type of development the maximum day demand is 1,150 gallons/day (0.8 gallons/minute) according to the City of Lincoln Procedures Manual, dated June 2004. For the purpose of this report a conservative demand of 1 gallon/minute was used in the analysis. Table 1

## Water Study for Lincoln Meadows

summarizes the estimated project demands. It is assumed that the future development to the north will provide an additional 158 lots for a total build out of 302 lots.

Demand	Whole Project (gal/day)	Per Lot (gal/day)	Per Lot (gpm)
Maximum Day	347,300	1,150	0.80

**Table 1 - Project Demands**

#### IV. Water System Definition and Level of Service

The water system provided to the project is supplied and maintained by the City of Lincoln. The existing water system consists of an 18" transmission water main in Virginatown Road (Refer to Water Study Diagram in the appendix). The Procedures Manual states that new water distribution systems shall be designed to minimum pressure of 50 pounds per square inch (psi) from the transmission main connection point.

The existing water system is at an approximate elevation of 202 feet. With a design pressure of 50 psi the hydraulic grade line of the system is at an elevation of 315.5 feet. The proposed water system was modeled using CivilCAD analysis program, which uses Hazen-Williams formulas for water distribution systems. Running the model with system demands according to the Procedures Manual is listed as follows: Static System not falling below 40 psi and Fire flow demand of 1,500 gallons/ minute as set forth by the California Building Code (CBC) without falling under 20 psi.

The proposed residential max day demand of 1 gpm was used for each residence on the system, for a total system demand of 144 gpm and 1,148 gpm for each respective model. The 1,500 gpm was placed at the most remote hydrant (node 15), for a worst case scenario analysis. The fire flow is the worst case scenario for this project.

#### V. Project Phasing and Planned Sequence of Subdivisions

While the project is proposed to be broken up in two phases: Phase 1 building 76 lots and Phase 2 building the remaining 72 lots. For the purpose of this report the entire project is being analyzed as completely built. An additional 158 lots are assumed to be developed to the north in the future.

#### VI. Hydraulic Model Results and Conclusions

With the existing system capabilities of supplying the minimum required demands as set forth by the City of Lincoln Procedures Manual, it is determined that the proposed system could supply approximately 302 gpm maximum residential demand without falling below the minimum of 40 psi minimum residual pressure as shown in Appendix A and with the additional fire flow of 1,500 gpm the system did not drop below 20 psi residual pressure as shown in Appendix B. Therefore the proposed system meets the design criteria and is deemed adequate for fire protection.

APPENDIX A

Static Model

# Water Study for Lincoln Meadows

Brandon J. Morland R.C.E. 74735  
 Michael T. Robertson R.C.E. 39875

Kent H. Baker R.C.E. 26487  
 Lisa Barber Mattos R.C.E. 44852

BAKER-WILLIAMS ENGINEERING GROUP  
 6020 Rutland Drive, Suite #19  
 Carmichael, Ca., 95608  
 Telephone (916) 331-4336

Lincoln Meadows Static Model  
 October 16, 2015

Number of pipes: 24  
 Number of junction nodes: 16

Flow unit of measure: GPM  
 File name: 03012

### Summary of Input Data

#### Pipe Data:

Pipe	Node #1	Node #2	Dia (in)	Length (ft)	H-W Coeff	Minor Fact	Pump Type	FGN Grade
1	0	1	12.0	205.0	130.0	0.0	-	315.50
2	1	2	12.0	255.0	130.0	0.0	-	-
3	2	3	12.0	255.0	130.0	0.0	-	-
4	3	4	12.0	265.0	130.0	0.0	-	-
5	4	5	12.0	245.0	130.0	0.0	-	-
6	5	6	12.0	245.0	130.0	0.0	-	-
7	0	7	8.0	205.0	130.0	0.0	-	315.50
8	7	8	8.0	255.0	130.0	0.0	-	-
9	8	9	8.0	255.0	130.0	0.0	-	-
10	9	10	8.0	265.0	130.0	0.0	-	-
11	10	11	8.0	245.0	130.0	0.0	-	-
12	11	12	8.0	265.0	130.0	0.0	-	-
13	11	5	8.0	510.0	130.0	0.0	-	-
14	13	1	8.0	265.0	130.0	0.0	-	-
15	1	7	8.0	530.0	130.0	0.0	-	-
16	2	8	8.0	535.0	130.0	0.0	-	-
17	3	9	8.0	540.0	130.0	0.0	-	-
18	14	3	8.0	395.0	130.0	0.0	-	-
19	4	10	8.0	545.0	130.0	0.0	-	-
20	4	15	8.0	830.0	130.0	0.0	-	-
21	15	16	8.0	265.0	130.0	0.0	-	-
22	5	15	8.0	305.0	130.0	0.0	-	-
23	16	6	8.0	300.0	130.0	0.0	-	-
24	12	6	8.0	300.0	130.0	0.0	-	-

#### Junction Node Data:

Node #	Demand (GPM)	Elev (ft)	Connecting Pipes
1	10.01	202.00	1, 2, 14, 15
2	7.99	203.00	2, 3, 16
3	14.00	203.00	3, 4, 17, 18
4	11.98	200.00	4, 5, 19, 20
5	15.98	203.00	5, 6, 13, 22
6	54.00	209.00	6, 23, 24
7	10.01	213.00	7, 8, 15
8	10.01	213.00	8, 9, 16
9	11.00	209.00	9, 10, 17
10	10.01	207.00	10, 11, 19
11	10.01	211.00	11, 12, 13
12	51.98	219.00	12, 24
13	7.00	200.00	14
14	6.01	199.00	18
15	24.01	195.00	20, 21, 22
16	51.98	196.00	21, 23

# Water Study for Lincoln Meadows

## Simulation Results

Number of trials: 17  
 Convergence : 0.0038

Pipe	Nodes (Q--->)	Dia (in)	Length (ft)	Flow (GPM)	Vel (fps)	Losses (ft) Head      Minor		Pump Head	Hd Loss /1000 ft	
1	0	1	12.0	205.0	227.41	0.65	0.03	0.00	-	0.16
2	1	2	12.0	255.0	207.28	0.59	0.04	0.00	-	0.14
3	2	3	12.0	255.0	194.39	0.55	0.03	0.00	-	0.12
4	3	4	12.0	265.0	171.37	0.49	0.03	0.00	-	0.10
5	4	5	12.0	245.0	133.38	0.38	0.01	0.00	-	0.06
6	5	6	12.0	245.0	93.03	0.26	0.01	0.00	-	0.03
7	0	7	8.0	205.0	78.58	0.50	0.03	0.00	-	0.16
8	7	8	8.0	255.0	71.69	0.46	0.04	0.00	-	0.14
9	8	9	8.0	255.0	66.58	0.42	0.03	0.00	-	0.12
10	9	10	8.0	265.0	58.58	0.37	0.03	0.00	-	0.10
11	10	11	8.0	245.0	46.17	0.29	0.02	0.00	-	0.06
12	11	12	8.0	265.0	35.93	0.23	0.01	0.00	-	0.04
13	11	5	8.0	510.0	0.23	0.00	0.00	0.00	-	0.00
14	1	13	8.0	265.0	7.00	0.04	0.00	0.00	-	0.00
15	1	7	8.0	530.0	3.12	0.02	0.00	0.00	-	0.00
16	2	8	8.0	535.0	4.90	0.03	0.00	0.00	-	0.00
17	3	9	8.0	540.0	3.00	0.02	0.00	0.00	-	0.00
18	3	14	8.0	395.0	6.01	0.04	0.00	0.00	-	0.00
19	10	4	8.0	545.0	2.40	0.02	0.00	0.00	-	0.00
20	4	15	8.0	830.0	28.41	0.18	0.02	0.00	-	0.02
21	15	16	8.0	265.0	28.99	0.19	0.01	0.00	-	0.03
22	5	15	8.0	305.0	24.60	0.16	0.01	0.00	-	0.02
23	6	16	8.0	300.0	22.99	0.15	0.01	0.00	-	0.02
24	6	12	8.0	300.0	16.05	0.10	0.00	0.00	-	0.01

Summary of inflows (+) and outflows (-):

Pipe #	Flow (GPM)
1	227.40+
7	78.57+

Net system demand: 306 GPM

Maximum-Minimum Summary:

Pipe #	Vel (fps)	Pipe #	HL/1000 ft	Node #	Press (psi)
1	0.65	7	0.16	15	52.15
2	0.59	1	0.16	16	51.72
3	0.55	8	0.14	14	50.44
17	0.02	16	0.00	7	44.40
19	0.02	15	0.00	8	44.39
13	0.00	13	0.00	12	41.75

NOTE: 'HL/1000 ft' does NOT include Minor Losses; and Pipes with zero flow are not included under Minimum 'Vel (fps)'.

APPENDIX B

Fire Flow Model  
1500 gpm at Node 15

# Water Study for Lincoln Meadows

Brandon J. Morland R.C.E 74735  
 Michael T. Robertson R.C.E.39875

Kent H. Baker R.C.E.26487  
 Lisa Barber Mattos R.C.E.44852

BAKER-WILLIAMS ENGINEERING GROUP  
 6020 Rutland Drive, Suite #19  
 Carmichael, Ca., 95608  
 Telephone (916) 331-4336

Lincoln Meadows 1000gpm Fire Flow at Node 15  
 October 16, 2015

Number of pipes: 24  
 Number of junction nodes: 16

Flow unit of measure: GPM  
 File name: 03012

### Summary of Input Data

#### Pipe Data:

Pipe	Node #1	Node #2	Dia (in)	Length (ft)	H-W Coeff	Minor Fact	Pump Type	FGN Grade
1	0	1	12.0	205.0	130.0	0.0	-	315.50
2	1	2	12.0	255.0	130.0	0.0	-	-
3	2	3	12.0	255.0	130.0	0.0	-	-
4	3	4	12.0	265.0	130.0	0.0	-	-
5	4	5	12.0	245.0	130.0	0.0	-	-
6	5	6	12.0	245.0	130.0	0.0	-	-
7	0	7	8.0	205.0	130.0	0.0	-	315.50
8	7	8	8.0	255.0	130.0	0.0	-	-
9	8	9	8.0	255.0	130.0	0.0	-	-
10	9	10	8.0	265.0	130.0	0.0	-	-
11	10	11	8.0	245.0	130.0	0.0	-	-
12	11	12	8.0	265.0	130.0	0.0	-	-
13	11	5	8.0	510.0	130.0	0.0	-	-
14	13	1	8.0	265.0	130.0	0.0	-	-
15	1	7	8.0	530.0	130.0	0.0	-	-
16	2	8	8.0	535.0	130.0	0.0	-	-
17	3	9	8.0	540.0	130.0	0.0	-	-
18	14	3	8.0	395.0	130.0	0.0	-	-
19	4	10	8.0	545.0	130.0	0.0	-	-
20	4	15	8.0	830.0	130.0	0.0	-	-
21	15	16	8.0	265.0	130.0	0.0	-	-
22	5	15	8.0	305.0	130.0	0.0	-	-
23	16	6	8.0	300.0	130.0	0.0	-	-
24	12	6	8.0	300.0	130.0	0.0	-	-

#### Junction Node Data:

Node #	Demand (GPM)	Elev (ft)	Connecting Pipes
1	10.01	202.00	1, 2, 14, 15
2	7.99	203.00	2, 3, 16
3	14.00	203.00	3, 4, 17, 18
4	11.98	200.00	4, 5, 19, 20
5	15.98	203.00	5, 6, 13, 22
6	54.00	209.00	6, 23, 24
7	10.01	213.00	7, 8, 15
8	10.01	213.00	8, 9, 16
9	11.00	209.00	9, 10, 17
10	10.01	207.00	10, 11, 19
11	10.01	211.00	11, 12, 13
12	51.98	219.00	12, 24
13	7.00	200.00	14
14	6.01	199.00	18
15	1524.01	195.00	20, 21, 22
16	51.98	196.00	21, 23

# Water Study for Lincoln Meadows

## Simulation Results

Number of trials: 9  
 Convergence : 0.0043

Pipe	Nodes (Q--->)	Dia (in)	Length (ft)	Flow (GPM)	Vel (fps)	Losses (ft) Head      Minor		Pump Head	Hd Loss /1000 ft	
1	0	1	12.0	205.0	1343.38	3.81	0.90	0.00	-	4.38
2	1	2	12.0	255.0	1323.29	3.75	1.09	0.00	-	4.26
3	2	3	12.0	255.0	1310.88	3.72	1.07	0.00	-	4.19
4	3	4	12.0	265.0	1308.68	3.71	1.11	0.00	-	4.17
5	4	5	12.0	245.0	965.52	2.74	0.58	0.00	-	2.38
6	5	6	12.0	245.0	413.12	1.17	0.12	0.00	-	0.49
7	0	7	8.0	205.0	462.60	2.95	0.90	0.00	-	4.38
8	7	8	8.0	255.0	455.67	2.91	1.09	0.00	-	4.26
9	8	9	8.0	255.0	450.08	2.87	1.06	0.00	-	4.16
10	9	10	8.0	265.0	421.27	2.69	0.98	0.00	-	3.68
11	10	11	8.0	245.0	312.90	2.00	0.52	0.00	-	2.12
12	11	12	8.0	265.0	178.34	1.14	0.20	0.00	-	0.75
13	11	5	8.0	510.0	124.54	0.79	0.20	0.00	-	0.39
14	1	13	8.0	265.0	7.00	0.04	0.00	0.00	-	0.00
15	1	7	8.0	530.0	3.08	0.02	0.00	0.00	-	0.00
16	2	8	8.0	535.0	4.42	0.03	0.00	0.00	-	0.00
17	9	3	8.0	540.0	17.81	0.11	0.01	0.00	-	0.01
18	3	14	8.0	395.0	6.01	0.04	0.00	0.00	-	0.00
19	10	4	8.0	545.0	98.37	0.63	0.14	0.00	-	0.25
20	4	15	8.0	830.0	429.54	2.74	3.17	0.00	-	3.82
21	16	15	8.0	265.0	433.51	2.77	1.03	0.00	-	3.89
22	5	15	8.0	305.0	660.97	4.22	2.59	0.00	-	8.49
23	6	16	8.0	300.0	485.49	3.10	1.44	0.00	-	4.79
24	12	6	8.0	300.0	126.37	0.81	0.12	0.00	-	0.40

Summary of inflows (+) and outflows (-):

Pipe #	Flow (GPM)
1	1343.38+
7	462.60+

Net system demand: 1806 GPM

Maximum-Minimum Summary:

Pipe #	Vel (fps)	Pipe #	HL/1000 ft	Node #	Press (psi)
22	4.22	22	8.49	13	49.66
1	3.81	23	4.79	14	49.16
2	3.75	7	4.38	16	49.05
18	0.04	18	0.00	8	43.56
16	0.03	16	0.00	11	43.31
15	0.02	15	0.00	12	39.76

NOTE: 'HL/1000 ft' does NOT include Minor Losses; and Pipes with zero flow are not included under Minimum 'Vel (fps)'.

APPENDIX C

Exhibits