Appendix 13

Haymeadow Raw Water irrigation System Basis of Design

MEMORANDUM

TO: Brandon Cohen, Scott Schlosser

FROM: Brendon Langenhuizen, PE & David M. Kotz, PE

DATE: September 13, 2018

RE: **Haymeadow Development Phase A1A and A1B - Raw Water Irrigation System Basis of Design**

This memo presents the design basis for supplying the Haymeadow Development (Haymeadow) with raw water irrigation to both phases of development of Neighborhood A1 and the 15 acres of School Parcel.

Development Phasing

Haymeadow Neighborhood A1 will be constructed in two phases, A1A and A1B. **Attachment A** includes two maps showing the phasing of irrigated areas within Neighborhood A1. **Attachment B** includes four drawings showing the proposed irrigation system design alignments and pressures for Phases A1A and A1B. Raw water line alignments are approximate and may move in the final design to coordinate with other utility alignments.

Phase A1A

Neighborhood A1A will be developed with residential units (including multifamily, townhome, duplex, and single family with an additional dwelling unit (ADU). The A1A irrigation system will be constructed to provide raw water to irrigate lawns, community spaces, and right-of-ways within Neighborhood A1A. Haymeadow will establish irrigation of 15 acres of hay and pasture grass on the School Parcel as part of the Neighborhood A1A construction.

Haymeadow plans to establish a temporary sprinkler irrigation system for hay and pasture grass within the undeveloped portion of Neighborhood A1 (the area to be developed as part of A1B) as well as the Willow Corridor open space. The Willow Corridor open space is situated between the developed areas in Neighborhood A1 and the Willow Corridor found to the east of the Neighborhood A1. The temporary hay and grass irrigation system will allow for continued hay production while providing aesthetic benefit to the A1A development.

The temporary hay field irrigation system will tee off of the raw water distribution system constructed for service to Neighborhood A1A. The temporary hay irrigation sprinkling system is not designed in this memo; however, the irrigation demand was determined in the design of the raw water system for Phase A1A.

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Phase A1B

Phase A1B adds the development of Neighborhood A1B to replace the temporary irrigation system described in Phase A1A. Neighborhood A1B will be developed with residential units (including multifamily, townhome, duplex, and single family with and without ADU), open spaces and right-of-ways. During Phase A1B, Haymeadow plans to install a permanent sprinkler system to irrigating hay, native grasses and trees along the willow corridor open space. Phase A1B was designed with continued irrigation of 15 acres at the School Parcel.

Possible Future Reservoir

Phase A1A and A1B are designed to operate off of Mathews Ditch direct flows. Haymeadow is contemplating a long-term raw water system option to include a reservoir to be located above and east of Neighborhood A1 to provide storage and additional pressures. Design of this reservoir is not part of the scope of this memo; however, the design of the raw water system included considerations for future pressures should the reservoir be constructed.

Irrigation Demands

Peak Month design demands were estimated using the water requirements of the different grasses and the acreage to be irrigated. Peak monthly demands (found to be in July and during a typical dry year) were determined to properly size the raw water distribution system pipe sizes. The dry year peak month demand was calculated to be approximately 0.5 AF/acre for bluegrass and 0.4 AF/acre for hay grass. Phase A1A estimated peak month dry year demand is 35.9 acre feet (AF) per month. Phase A1B estimated peak month dry year demand is 32.4 AF/month, 3.5 AF lower than Phase A1A. The demand decreases due to reduced irrigated acreage from the construction of impervious areas such as roads and houses are constructed in Phase A1B. However, since the crop changes from hay to bluegrass which requires more water per square foot, the demand only drops slightly.

Table 1: Dry Year Peak Month Raw Water Irrigation Demand Phase A1A and A1B

Area	**Phase A1A**			**Phase A1B**		
	Crop	**Irrigable Area**	**Dry Year Peak Month Demand [1]**	**Crop**	**Irrigable Area**	**Dry Year Peak Month Demand [1]**
Neighborhood A1A	Bluegrass (lawns)	10.6 acres	7.0 AF	Bluegrass (lawns)	10.6 acres	7.0 AF
Neighborhood A1B	Hay grass	25.9 acres	14.7 AF	Bluegrass (lawns)	17.3 acres	11.4 AF
Willow Corridor Open Space	Hay grass	10.2 acres	5.8 AF	Hay grass	10.2 acres	5.8 AF
School Parcel	Hay grass	15 acres	8.5 AF	Hay grass	15 acres	8.5 AF
Total	**--**	**61.6 acres**	**35.9 AF**	**--**	**52.4 acres**	**32.4 AF**

Notes: Dry year peak month (July) demand using the modified Blaney-Criddle method. Assumes sprinkler irrigation efficiency of 75%).

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Peak Hourly Flow Rate

The raw water system pipelines must be sized large enough to accommodate the instantaneous demand for irrigation water. Rather than designing the system to accommodate every person irrigating at one time, the system was designed with staggered use of even/odd watering schedules, which would allow each tap to water three days per week based on its address (based on Town of Eagle Phase II watering restrictions). This creates two irrigation zones, which reduces the instantaneous demand through each pipeline by 50%. The system demand also incorporated Town of Eagle watering recommendations to limit residential irrigation to the 17-hour window between 5pm and 10am (Town of Eagle Phase II watering restrictions), and that irrigation demands within each zone (even addresses and odd addresses). Peak hourly demands were estimated at 1.25 of the peak month average day demand.

The peak hourly flow rate demand for Phase A1A and A1B are similar at approximately 540 gallons per minute (gpm) or 1.20 cubic feet per second (cfs). This represents the peak hourly demand for all of Neighborhood A1, the Willow Corridor open space and the School Parcel. Supporting calculation for the peak hourly flow rate are provided in **Attachment C**.

Table 2: Peak Hourly Flow Rate

Dry Year Demand	Phase A1A	Phase A1B
Peak Month Demand	35.9 AF/month	32.4 AF/month
	8.12 AF/week	8.09 AF/week
Peak Month Average Day	1.35 AF/day	1.35 AF/day
	0.441 MGD	0.439 MGD
	432 gpm	430 gpm
Peak Hourly Flow Rate	540 gpm	538 gpm
	1.20 cfs	1.20 cfs

Hydraulic Analysis

SGM developed a WaterCAD based hydraulic model of the proposed raw water system design to model the available pressures, system energy losses, and to optimize the distribution pipeline sizes. The modeled system pressures at different points in the distribution system will guide design of irrigation systems for individual taps. Separate analysis were modeled for Phase A1A and Phase A1B to confirm suitability of the system under both operational conditions. Improved system performance was observed under the final condition in Phase A1B due to looping in the distribution system.

Pipeline Sizing

Pipelines were sized to accommodate peak hourly demands with minimum pressure loss. Modeled pipeline diameters were sequentially increased until observed system pressures

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approached static conditions (~1 psi of drop). System velocities were maintained below 5 ft/s to prevent development of pressure transients.

The pipeline from the proposed Coanda Screen intake structure to the first split is designed with approximately 325 feet of a 10-inch PVC pipe. Phase A1A distribution will require 3,240 feet of 8-inch PVC pipe and 790 feet of 6-inch PVC pipe. Phase A1B will require an additional 3,410 feet of 8-inch PVC, for a total of 6,641 feet of 8-inch line.

Modeled System Pressures

Attachment B (Drawings 1-4) shows the proposed irrigation system design and different modeled system pressures during Phases A1A and A1B. Typically, 20 pounds per square inch (psi) is required to operate a low-pressure head sprinkler system without an additional pump. However, optimal pressures are typically around 40 to 50 psi.

Drawings 1 and 2 show the modeled available static and dynamic pressures during Phase A1A while Drawings 3 and 4 show the modeled available static and dynamic pressures during Phase A1B. The pressure in the system drops by as much as 5 psi during peak hourly demand.

During Phase A1A, pressure at the tap during periods of peak demand is expected to range from 21 psi to 34 psi. During Phase A1B, pressure at the tap during periods of peak demand is expected to range from 6 psi at the highest tap to 37 psi.

Irrigation System Concept and Design

The irrigation system will be supplied by the Mathews Ditch, at the point where the Mathews Ditch crosses the Willow Corridor, just to the east of Neighborhood A1. The raw water distribution lines will be gravity fed, using the pressure provided by the elevation of the intake at approximately 6,789.8 feet. A Coanda Screen (sometimes referred to as a wedge wire screen) intake structure will continuously screen ditch water to remove debris and grit and drop the clean water into a small cavity where the pressurized system will begin. Excess water not being used by Neighborhood A1 will simply flow over the screen, providing irrigation water to the Willow Corridor drainage as illustrated in **Figure 1**.

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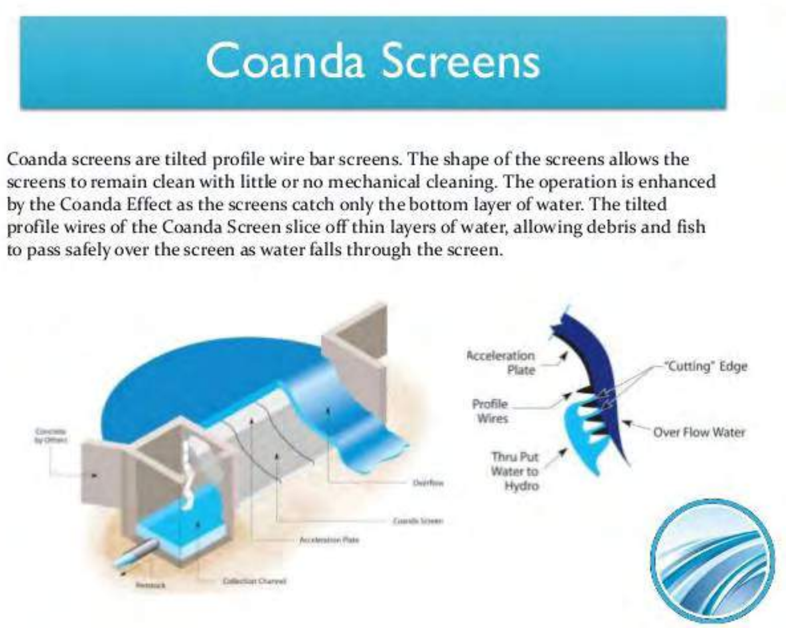
Figure 1: Coanda Screen Illustration



Design of Service Stubs

Individual service stubs will be provided for each tap. A 2-inch line will supply each multifamily unit. A 1-inch line will supply each single family or duplex unit. A 4-inch line will serve the 15 acres on School Parcel.

Each service stub will have a manual gate valve (normally open). Supply to individual systems will be controlled electronically through an operated master valve solenoid (normally closed) that will open only when that particular system is operating such, i.e. odd/even schedules. This analysis considers only the design for wholesale system: from the supply to the manual gage valve. On-lot systems will require detailed design by an irrigation professional and will be subject to design review for quality control, solenoid compatibility and design to a maximum 15 gpm supply limit.

Depending on the location, some of the residences in Neighborhood A1 will have sufficient pressures for irrigation and others may need or desire a pump to increase the pressures. Taps that have pressures below 30 psi and don't want to install a pump may consider installing low pressure sprinkler head such as the Matched Precipitation Rate (MPR) spray heads. Design of irrigation systems at each tap must also consider the possible addition of a reservoir above Neighborhood A1, which would increase the pressure for the irrigation system approximately by 40 psi. Each tap owner will need to make the decision of how to best implement the available pressures for their own irrigation needs and how to adjust the system should a reservoir be constructed. Two general irrigation system options for low delivered pressures are explained below.

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1. **MPR spray head now, and pressure reducing valves in the future.**
   Based on consultation with irrigation representatives at Rainbird and Grand Junction Pipe (GJP), on-lot systems can provide satisfactory service with the current low pressures by using MPR spray heads. For more info on MPR's see the attached product brochures. To manage higher pressures in the future if the reservoir is built, homeowners can maintain system operations by installing individual pressure reducing valves (PRVs).
2. **Install pump to increase pressure now and remove pump in the future.**
   The second option for homeowners who have low pressures now is to install a pump (in-line after the solenoid valve) to boost pressure to the home's system to increase the pressure up to the 40-50 psi required to operate a standard sprinkler head. Pumps of this size typically cost less than $200. To manage higher pressures in the future if the reservoir is built, homeowners can remove the pump.

Attachments

Attachment A: Phasing Maps of Irrigated Area in Neighborhood A1

Attachment B: Haymeadow Irrigation System Model

Attachment C: Irrigation Demand Calculations

Attachment D: Informational Brochures about MPR Heads

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ATTACHMENT A

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118 W. Sixth St., Suite 200
Glenwood Springs, CO 81601
970.945.1004
www.sgm-inc.com

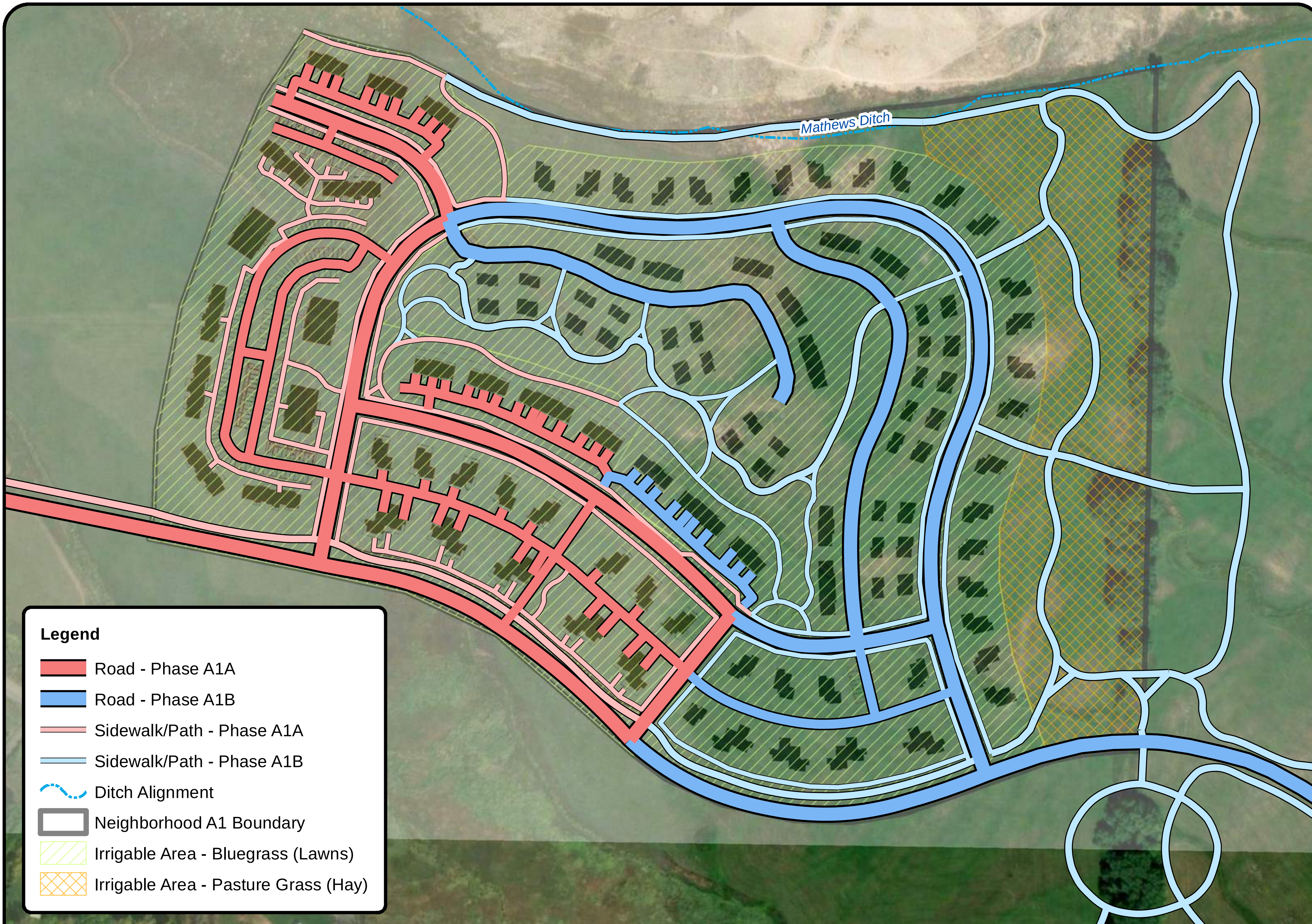
Haymeadow
Irrigation by Development Phase
Phase A1A

Date: 9/5/2018	Job No. 2016-277.001	Map by: BRL	
Coordinate System: NAD_1983 StatePlane_Colorado_Central_FIPS_0502_Ft_US		Projection: Transverse Mercator	
Data Sources: SGM, DHM, Eagle County, Haymeadow, NHD, CDSS, ESRI		Page: 1/2	
File: \\sgmfile1\projects\2016\2016-277-Haymeadows\001-WaterIrrigation\H-Dwgs\GIS\MXDs\DevelopmentPhasing.mxd			
The information displayed above is intended for general planning purposes. Refer to legal documentation/data sources for descriptions/locations.			

0 190 380 Feet

1 inch = 250 feet

N W E S



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Haymeadow

Irrigation by Development Phase

Phase A1B

Date:	9/5/2018	Job No.	2016-277.001
Map by:	BRL		
Coordinate System:	NAD_1983 StatePlane_Colorado_Central_FIPS_0502_Ft_US	Projection:	Transverse Mercator
Data Sources:	SGM, DHM, Eagle County, Haymeadow, NHD, CDSS, ESRI	Page:	2/2
File:	\\sgmfile1\projects\2016\2016-277-Haymeadows\001-WaterIrrigation\H-Dwgs\GIS\MXDs\DevelopmentPhasing.mxd		

The information displayed above is intended for general planning purposes. Refer to legal documentation/data sources for descriptions/locations.

0 190 380 Feet

1 inch = 250 feet

N E S W

ATTACHMENT B

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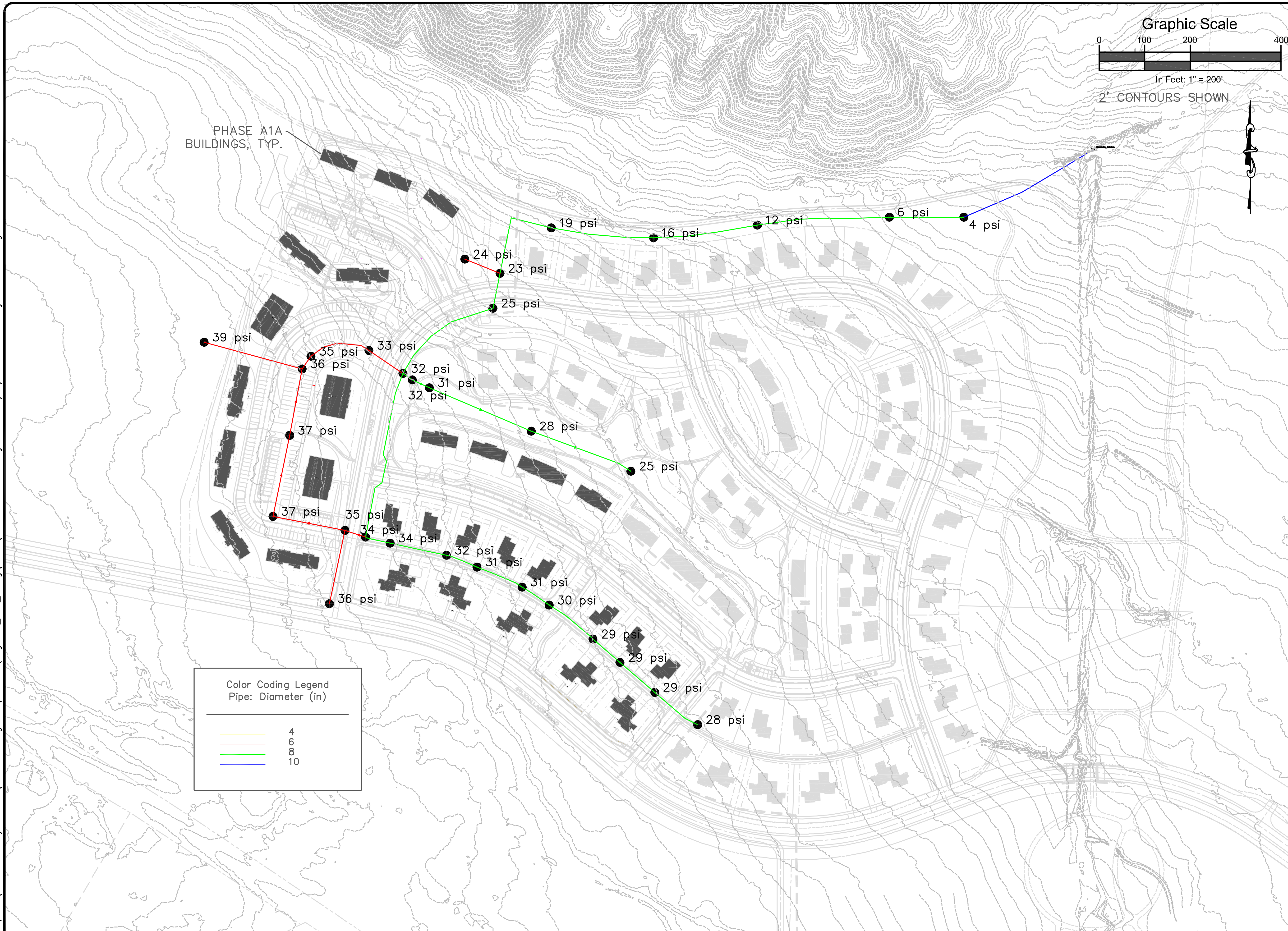

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Haymeadow
Irrigation System Model

#	Revision	Date	By:
1			

Project Milestone: Preliminary Not For Construction

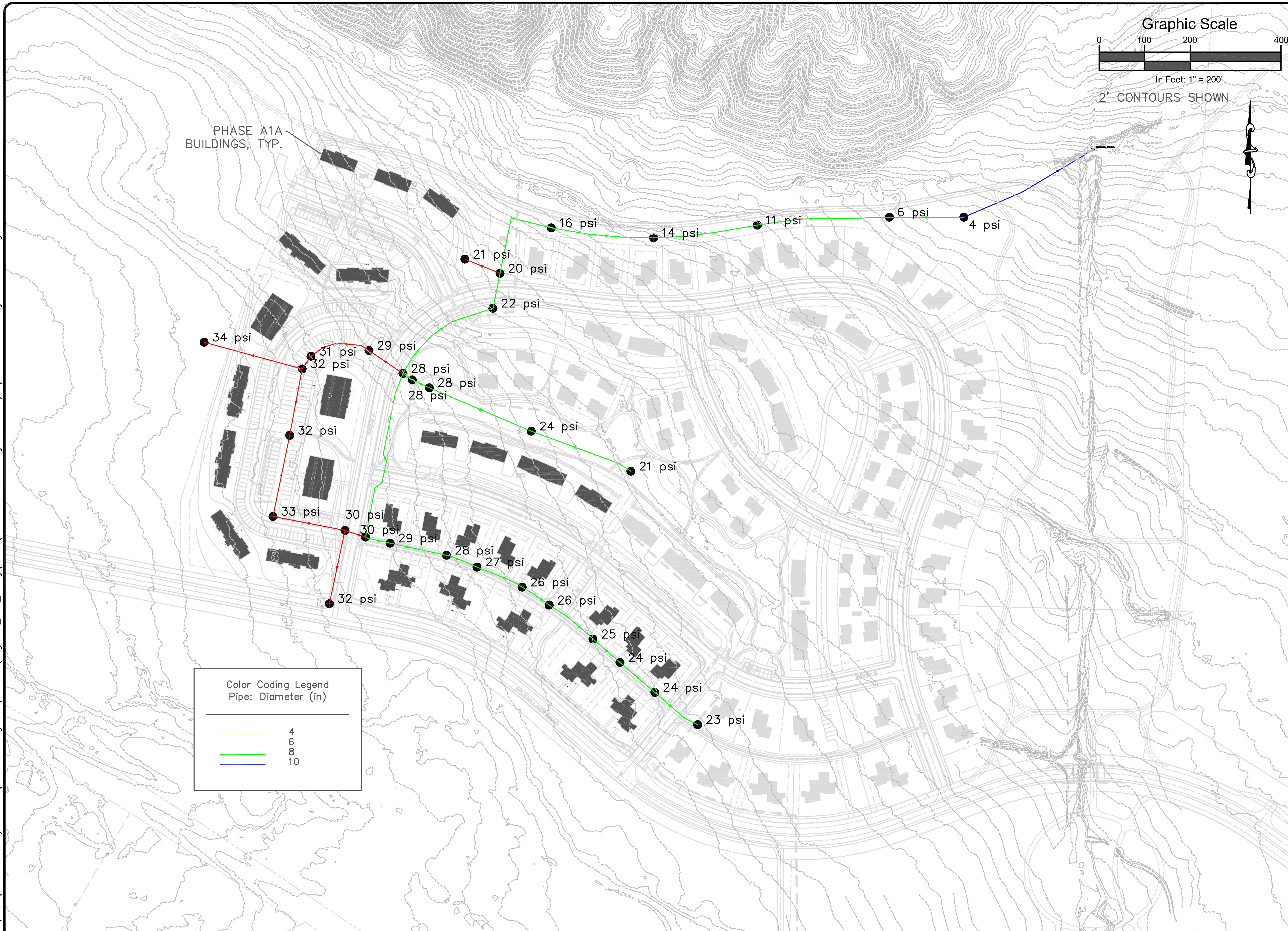
Job No.	2016-277.001
Drawn by:	JJK
Date:	9/10/2018
QC: –	PE: DMK
File:	Non Potable-Ph1

Title:

Phase A1A
(Q = 0 gpm)

Dwg No.
1

Of: 4



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Haymeadow
Irrigation System Model

#	Revision	Date	By:
1			

Project Milestone: Preliminary Not For Construction

Job No.	2016-277.001
Drawn by:	JJK
Date:	9/10/2018
QC: –	PE: DMK
File:	Non Potable-Ph1

Title:

Phase A1A
(Q = 540 gpm)

Dwg No.
2

Of: 4

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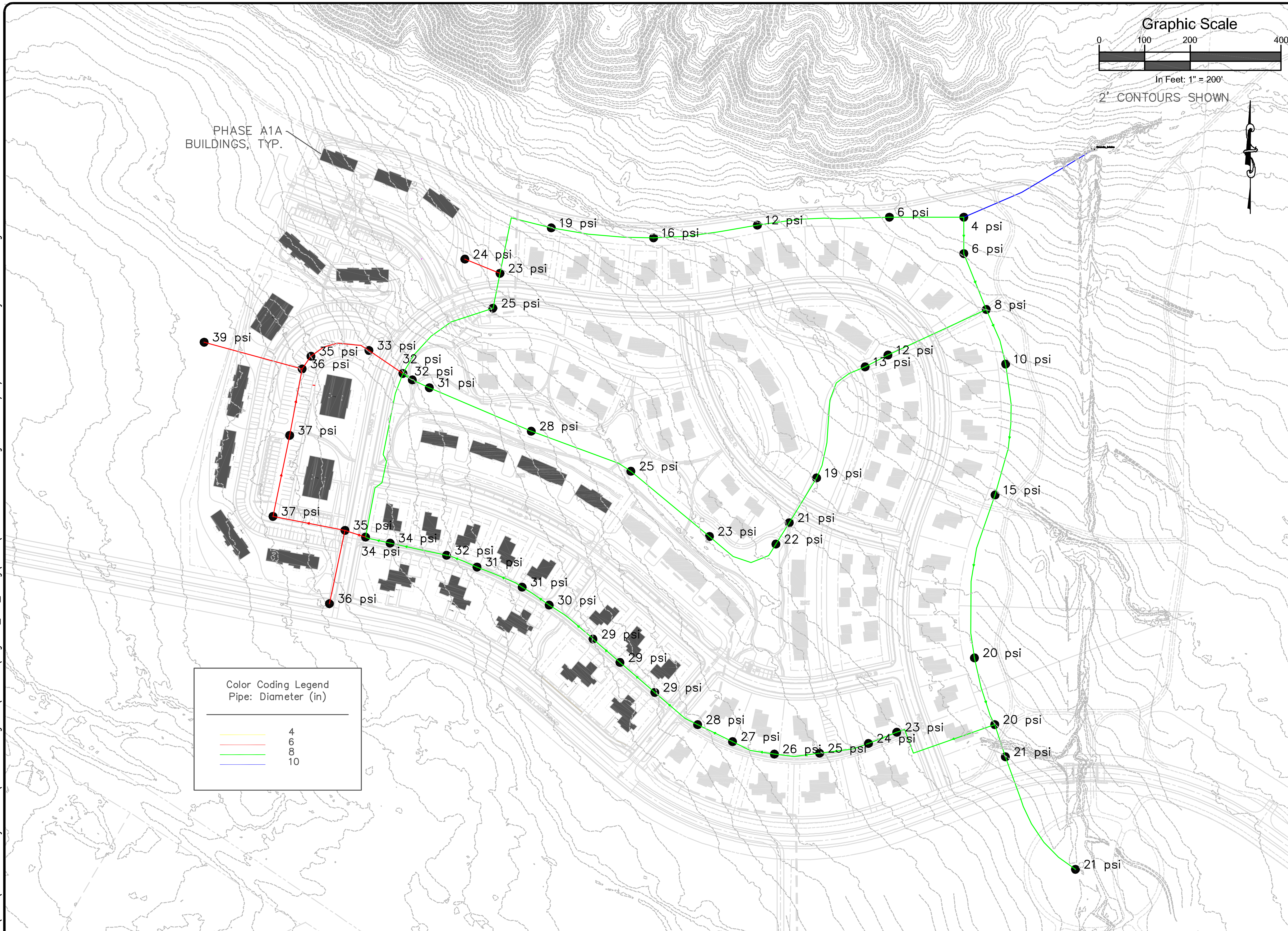

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Haymeadow
Irrigation System Model

#	Revision	Date	By:
1			

Project Milestone: Preliminary Not For Construction

Job No.	2016-277.001
Drawn by:	JJK
Date:	9/10/2018
QC: –	PE: DMK
File:	Non Potable-Ph1

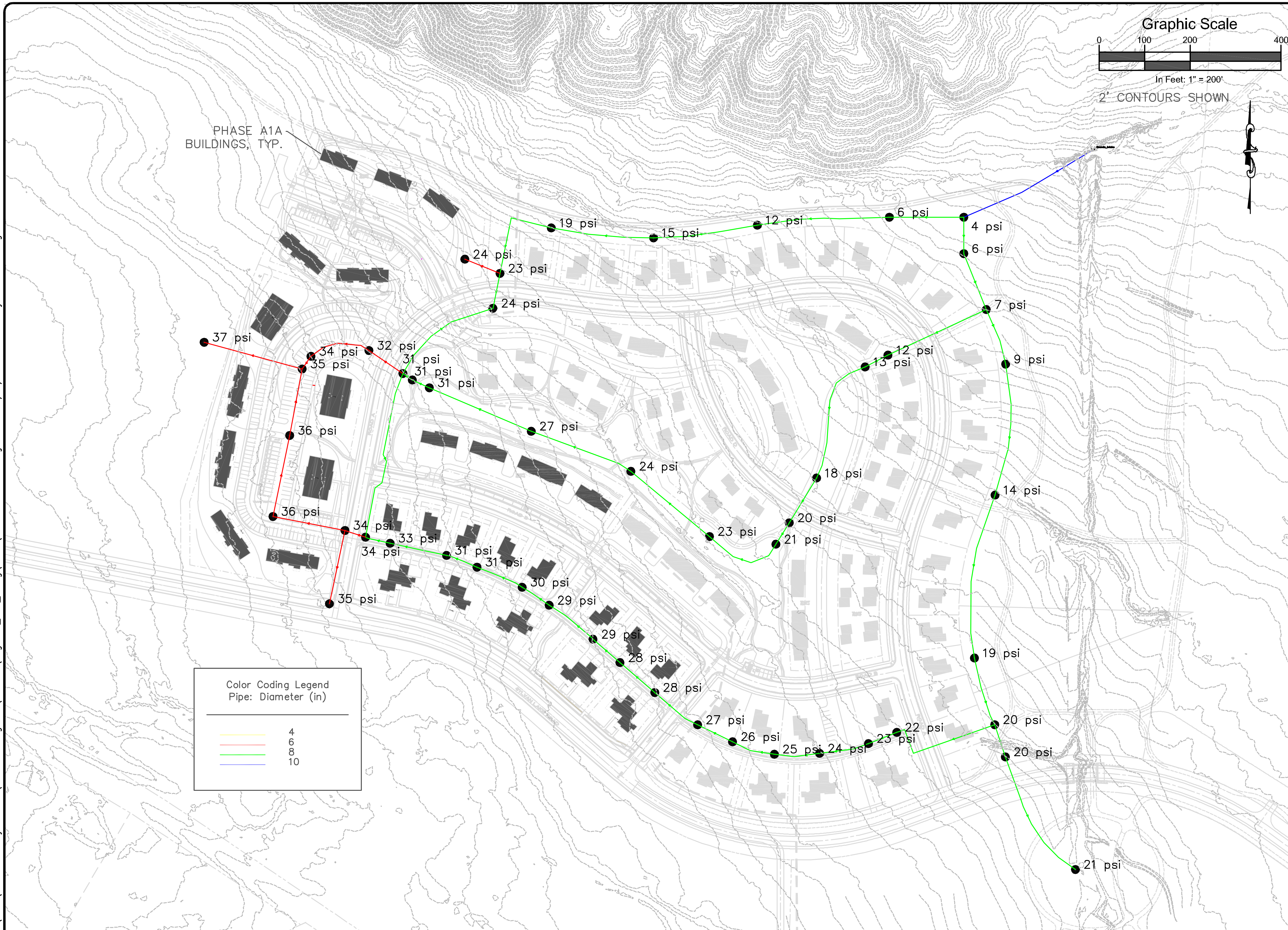
Title:

Phase A1B
(Q = 0 gpm)

Dwg No.

3

Of: 4



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Haymeadow
Irrigation System Model

#	Revision	Date	By:
1			

Project Milestone: Preliminary Not For Construction

Job No.	2016-277.001
Drawn by:	JJK
Date:	9/10/2018
QC: –	PE: DMK
File:	Non Potable-Ph1

Title:

Phase A1B
(Q = 538 gpm)

Dwg No.
4

Of: 4

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ATTACHMENT C

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Phasing Demands and Maximum Flow Rate / Pipeline Sizing Requirements

Phase 1: Table 1

Neighborhood	Irrigable Area (Acres) [1]	Non Potable Demand (AF) [2] – Annual Total (Apr - Oct): Dry Year	Annual Total: Normal Year	Annual Total: Wet Year	Peak Month (July): Dry Year	Peak Month (July): Normal Year	Peak Month (July): Wet Year
Irrigation Water Requirement Bluegrass- Blaney Criddle (feet) [3]		*2.3*	*2.0*	*1.9*	*0.5*	*0.4*	*0.4*
Neighborhood A1A	10.6	32.2	28.6	26.5	7.0	6.1	6.0
Neighborhood A1B	-	-	-	-	-	-	-
Willow Corridor	-	-	-	-	-	-	-
School Parcel	-	-	-	-	-	-	-
Irrigation Water Requirement Pasture Grass (Hay) - Blaney Criddle (feet) [4]		*2.0*	*1.7*	*1.6*	*0.4*	*0.4*	*0.4*
Neighborhood A1A	-	-	-	-	-	-	-
Neighborhood A1B	25.9	68.3	59.9	54.9	14.7	12.6	12.3
Willow Corridor	10.2	26.8	23.6	21.6	5.8	4.9	4.8
School Parcel	15.0	39.6	34.7	31.8	8.5	7.3	7.1
Total	**61.6**	**166.8**	**146.8**	**134.8**	**35.9**	**30.9**	**30.2**

Notes:

1) During Phase 1, Neighborhood A1A has been developed and A1B has not. All irrigable area within Neighborhood A1A (lawns and community spaces) is irrigated bluegrass. Irrigable area is calculated as the total area of the development minus planned impervious areas (homes, roads, paths, sidewalks, parking spaces, etc). Neighborhood A1B has not been developed yet, and so the entire area is irrigated pasture grass. No paths have been built in the Willow Corridor and the entire space is irrigated hay grass. The School parcel is all irrigated hay grass.

2) Total Demand assumes sprinkler irrigation with an efficiency of 75%.
[Total demand] = [Irrigation Water Requirement] x [Irrigable Area] / [Sprinkler Efficiency of 75%]

3) IWR for bluegrass is based on Pochop method: dry year (2.3 AF/acre). GRCC HCU for bluegrass was 2.07 AF/acre.

4) IWR for hay grass is based on the Blaney Criddle method with TR-21 coefficients: dry year (2.0 AF/acre). GRCC HCU was 1.93 AF/acre.

Phase 1: Table 2

Neighborhood or Development Area	Dry Year Peak Month (July) Demand: Peak Month (AF/month) (1)	Peak Month (AF/ week) (2)	Peak Month Avg Day (AF/day) (3)	Peak Month Avg Day (gal/day) (4)	Average Flow Rate (gpm) (5)	Average Flow Rate (cfs) (6)	Peak Hour Rate: Peak Flow Rate (gpm) (7)	Peak Flow Rate (cfs) (8)
Neighborhood A1A	6.99	1.58	0.26	85,712	84.0	0.19	105.0	0.23
Neighborhood A1B	14.67	3.31	0.55	179,960	176.4	0.39	220.5	0.49
Willow Corridor	5.77	1.30	0.22	70,746	69.4	0.15	86.7	0.19
School Parcel	8.51	1.92	0.32	104,345	102.3	0.23	127.9	0.28
Total	**35.94**	**8.12**	**1.35**	**440,762**	**432.1**	**0.96**	**540.1**	**1.20**

Notes: **3.58**

(1) Dry year peak month (July) demand using the modified Blaney-Criddle method.

(2) Average week demand during peak month. (2) = (1) / [31 days in July] * [7 days per week].

(3) Assumes Phase II watering restrictions: Each tap may water 3 days/week on an even/odd schedule (2 zones).
(3) = (2) / [2 zones] / [3 days of watering per week].
This is equivalent to a peaking factor of 1.17 from 'Peak Month Average Day' to 'Peak Day'.

(4) = (3) * [325,851 gallons / acre-foot]

(5) Assumes Phase II watering restrictions: Watering is allowed after 5pm or before 10am (17 hours available).
(5) = (4) / [17 hours during which watering can occur] / [60 minutes per hour]

(6) = (5) / [448.8 cfs per gpm]

(7) & (8) hourly peaking factor accounts for the peak hour of the day when most users are irrigating.
(7) = (5) * [Peaking factor of 1.25]. (8) = (6) * [Peaking factor of 1.25].

Watering Practices Assumptions (based on Phase II Watering Restrictions)		
Sprinkler irrigation efficiency	75%	irrigation efficiency assumed by GRCC
Days of watering allowed for each account	3	times/week
Even Odd watering schedule:	2	Zones, even and odd
Watering allowed 5:00 pm to 10:00 am:	17	hours when watering can occur
Hourly peaking factor	1.25	peak hourly flow = 1.25 * avg
Number of Residential Units	123	residential units

Phasing Demands and Maximum Flow Rate / Pipeline Sizing Requirements

Phase 2: Table 1

Neighborhood	Irrigable Area (Acres) [1]	Non Potable Demand (AF) [2] Annual Total (Apr - Oct) Dry Year	Normal Year	Wet Year	Peak Month (July) Dry Year	Normal Year	Wet Year
Irrigation Water Requirement Bluegrass- Blaney Criddle (feet)		*2.3*	*2.0*	*1.9*	*0.5*	*0.4*	*0.4*
Neighborhood A1A	10.6	32.2	28.6	26.5	7.0	6.1	6.0
Neighborhood A1B	17.3	52.6	46.8	43.3	11.4	9.9	9.7
Willow Corridor	-	-	-	-	-	-	-
School Parcel	-	-	-	-	-	-	-
Irrigation Water Requirement Pasture Grass (Hay) - Blaney Criddle (feet)		*2.0*	*1.7*	*1.6*	*0.4*	*0.4*	*0.4*
Neighborhood A1A	-	-	-	-	-	-	-
Neighborhood A1B	-	-	-	-	-	-	-
Willow Corridor	9.6	25.2	22.2	20.3	5.4	4.7	4.5
School Parcel	15.0	39.6	34.7	31.8	8.5	7.3	7.1
Total	**52.4**	**149.6**	**132.3**	**122.0**	**32.4**	**28.0**	**27.4**

Notes:

1) During Phase 2, both Neighborhood A1A and A1B have been developed. All irrigable area within Neighborhood A1A and A1B (lawns and community spaces) is irrigated bluegrass. Irrigable area is calculated as the total area of the development minus planned impervious areas (homes, roads, paths, sidewalks, parking spaces, etc). Paths have been built in the Willow Corridor, so the total area of irrigated hay grass in the Willow Corridor is the entire area of the Willow Corridor minus the area of paths. The School parcel is all irrigated hay grass.

2) Total Demand assumes sprinkler irrigation with an efficiency of 75%.

[Total demand] = [Irrigation Water Requirement] x [Irrigable Area] / [Sprinkler Efficiency of 75%]

3) IWR for bluegrass is based on Pochop method: dry year (2.3 AF/acre). GRCC HCU for bluegrass was 2.07 AF/acre.

4) IWR for hay grass is based on the Blaney Criddle method with TR-21 coefficients: dry year (2.0 AF/acre). GRCC HCU was 1.93 AF/acre.

Phase 2: Table 2

	Dry Year Peak Month (July) Demand: Peak Month (AF/month) (1)	Peak Month (AF/ week) (2)	Peak Month Avg Day (AF/day) (3)	Peak Month Avg Day (gal/day) (4)	Average Flow Rate (gpm) (5)	Average Flow Rate (cfs) (6)	Peak Hour Rate: Peak Flow Rate (gpm) (7)	Peak Flow Rate (cfs) (8)
Neighborhood A1A	6.99	1.75	0.29	94,896	93.0	0.21	116.3	0.26
Neighborhood A1B	11.43	2.86	0.48	155,194	152.2	0.34	190.2	0.42
Willow Corridor	5.43	1.36	0.23	73,705	72.3	0.16	90.3	0.20
School Parcel	8.51	2.13	0.35	115,524	113.3	0.25	141.6	0.32
Total	**32.36**	**8.09**	**1.35**	**439,318**	**430.7**	**0.96**	**538.4**	**1.20**

Notes:

(1) Dry year peak month (July) demand using the modified Blaney-Criddle method.

(2) Average week demand during peak month. (2) = (1) / [31 days in July] * [7 days per week].

(3) Assumes Phase II watering restrictions: Each tap may water 3 days/week on an even/odd schedule (2 zones).
(3) = (2) / [2 zones] / [3 days of watering per week].
This is equivalent to a peaking factor of 1.17 from 'Peak Month Average Day' to 'Peak Day'.

(4) = (3) * [325,851 gallons / acre-foot]

(5) Assumes Phase II watering restrictions: Watering is allowed after 5pm or before 10am (17 hours available).
(5) = (4) / [17 hours during which watering can occur] / [60 minutes per hour]

(6) = (5) / [448.8 cfs per gpm]

(7) & (8) hourly peaking factor accounts for the peak hour of the day when most users are irrigating.
(7) = (5) * [Peaking factor of 1.25]. (8) = (6) * [Peaking factor of 1.25].

Watering Practices based on Phase II Watering Restrictions		
Sprinkler irrigation efficiency	75%	
Days of watering allowed for each account	3	times/week
Even Odd watering schedule:	2	Zones, even and odd
Watering allowed 5:00 pm to 10:00 am:	17	hours when watering can occur
Hourly peaking factor	1.25	peak hourly flow = 1.25 * avg
Number of Residential Units	257	residential units

ATTACHMENT D

118 W. 6th St, Ste 200 Glenwood Springs, CO 81601 Phone: 970-945-1004 Fax: 970-945-5948

Plastic MPR Nozzles

Matched Precipitation Rate Nozzles

Features

- Matched precipitation rates across sets and patterns in 5 Series, 8 Series, 10 Series, 12 Series, and 15 Series for even water distribution and design flexibility
- MPR Nozzles are installed by more contractors than all other brands combined
- Quickly identify radius and arc with Top Color-coded™ nozzles even when system is not operating
- Three year trade warranty

Operating Range

- Spacing: 3 to 15 feet (0.9 to 4.6 m)[1]
- Pressure: 15 to 30 psi (1 to 2.1 bar)
- Optimum pressure: 30 psi (2.1 bar)[2]

Models

- 5 Series: Quarter, Half, Full Nozzles
- 5 Series: Bubbler Nozzles
- 8 Series: Quarter, Half, Full Nozzles
- 8 FLT Series: Designed for lower trajectory applications, such as windy areas
- 10 Series Nozzles
- 12 Series Nozzles
- 15 Series: Quarter, Half, Full Nozzles
- 15 Strip Series Nozzles

[1] *These ranges are based on proper pressure at nozzle.*
[2] *Rain Bird recommends using 1800 PRS Spray Bodies to maintain optimum nozzle performance in higher pressure situations.*

Spray Nozzles

Rain Bird® MPR Nozzles, The Industry Standard

MPR Nozzle and Screen

How To Specify

5 F

Pattern
F: Full
H: Half
Q: Quarter

MPR Radius Range
5: 5 feet (1.5 m)
8: 8 feet (2.4 m)
12: 12 feet (3.7 m)
15: 15 feet (4.6 m)

5 Series MPR

5° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm	■ Precip In/h	▲ Precip In/h
5F	15	3	0.29	3.10	3.58
	20	4	0.33	1.99	2.29
	25	4	0.37	2.23	2.57
	30	5	0.41	1.58	1.83
5H	15	3	0.14	3.00	3.46
	20	4	0.16	1.93	2.22
	25	4	0.18	2.17	2.50
	30	5	0.20	1.54	1.78
5Q	15	3	0.07	3.00	3.46
	20	4	0.08	1.93	2.22
	25	4	0.09	2.17	2.50
	30	5	0.10	1.54	1.78

Note: *All MPR nozzles tested on 4" (10.2 cm) pop-ups*
■ *Square spacing based on 50% diameter of throw*
▲ *Triangular spacing based on 50% diameter of throw*

5 Series MPR — METRIC

5° Trajectory

Nozzle	Pressure bar	Radius m	Flow m^3/h	Flow l/m	■ Precip mm/h	▲ Precip mm/h
5F	1.0	1.1	0.06	1.1	79	91
	1.5	1.3	0.08	1.4	51	58
	2.0	1.5	0.09	1.6	57	65
	2.1	1.5	0.09	1.6	40	46
5H	1.0	1.1	0.03	0.5	76	88
	1.5	1.3	0.04	0.7	49	56
	2.0	1.5	0.04	0.7	55	64
	2.1	1.5	0.05	0.9	39	45
5Q	1.0	1.1	0.02	0.4	76	88
	1.5	1.3	0.02	0.4	49	56
	2.0	1.5	0.02	0.4	55	64
	2.1	1.5	0.02	0.4	39	45

Performance data taken in zero wind conditions
Note: *Specify spray body and nozzles separately.*
Note: *Radius reduction over 25% of the normal throw of the nozzle is not recommended*

8 Series MPR

10° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm	■ Precip In/h	▲ Precip In/h
8F	15	5	0.74	2.85	3.29
	20	6	0.86	2.30	2.66
	25	7	0.96	1.89	2.18
	30	8	1.05	1.58	1.82
8H	15	5	0.37	2.85	3.29
	20	6	0.42	2.25	2.59
	25	7	0.47	1.85	2.13
	30	8	0.52	1.56	1.81
8Q	15	5	0.18	2.77	3.20
	20	6	0.21	2.25	2.59
	25	7	0.24	1.89	2.18
	30	8	0.26	1.56	1.81

8 Series MPR METRIC

10° Trajectory

Nozzle	Pressure bar	Radius m	Flow m^3/h	Flow l/m	■ Precip mm/h	▲ Precip mm/h
8F	1.0	1.7	0.16	2.8	72	84
	1.5	2.1	0.20	3.4	58	68
	2.0	2.4	0.23	3.9	48	55
	2.1	2.4	0.24	4.0	40	46
8H	1.0	1.7	0.08	1.4	72	84
	1.5	2.1	0.10	1.7	57	66
	2.0	2.4	0.12	1.9	47	54
	2.1	2.4	0.12	2.0	40	46
8Q	1.0	1.7	0.04	0.7	70	81
	1.5	2.1	0.05	0.8	57	66
	2.0	2.4	0.06	1.0	48	55
	2.1	2.4	0.06	1.0	40	46

10 Series MPR

15° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm	■ Precip In/h	▲ Precip In/h
10F	15	7	1.16	2.28	2.63
	20	8	1.30	1.96	2.26
	25	9	1.44	1.71	1.98
	30	10	1.58	1.52	1.75
10H	15	7	0.58	2.28	2.63
	20	8	0.65	1.96	2.26
	25	9	0.72	1.71	1.98
	30	10	0.79	1.52	1.75
10Q	15	7	0.29	2.28	2.63
	20	8	0.33	1.96	2.26
	25	9	0.36	1.71	1.98
	30	10	0.39	1.52	1.75

10 Series MPR METRIC

15° Trajectory

Nozzle	Pressure bar	Radius m	Flow m^3/h	Flow l/m	■ Precip mm/h	▲ Precip mm/h
10F	1.0	2.1	0.26	4.2	58	67
	1.5	2.4	0.29	4.8	50	58
	2.0	3.0	0.35	6.0	39	45
	2.1	3.1	0.36	6.0	37	43
10H	1.0	2.1	0.13	2.4	58	67
	1.5	2.4	0.14	2.4	50	58
	2.0	3.0	0.18	3.0	39	45
	2.1	3.1	0.18	3.0	37	43
10Q	1.0	2.1	0.06	1.2	58	67
	1.5	2.4	0.07	1.2	50	58
	2.0	3.0	0.09	1.2	39	45
	2.1	3.1	0.09	1.2	37	43

12 Series MPR

30° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm	■ Precip In/h	▲ Precip In/h
12F	15	9	1.80	2.14	2.47
	20	10	2.10	2.02	2.34
	25	11	2.40	1.91	2.21
	30	12	2.60	1.74	2.01
12H	15	9	0.90	2.14	2.47
	20	10	1.05	2.02	2.34
	25	11	1.20	1.91	2.21
	30	12	1.30	1.74	2.01
12Q	15	9	0.45	2.14	2.47
	20	10	0.53	2.02	2.34
	25	11	0.60	1.91	2.21
	30	12	0.65	1.74	2.01

12 Series MPR METRIC

30° Trajectory

Nozzle	Pressure bar	Radius m	Flow m^3/h	Flow l/m	■ Precip mm/h	▲ Precip mm/h
12F	1.0	2.7	0.40	6.8	55	63
	1.5	3.2	0.48	8.3	47	54
	2.0	3.6	0.59	9.7	46	53
	2.1	3.7	0.60	9.8	44	51
12H	1.0	2.7	0.20	3.4	55	63
	1.5	3.2	0.24	4.2	47	54
	2.0	3.6	0.30	4.9	46	53
	2.1	3.7	0.30	4.9	44	51
12Q	1.0	2.7	0.10	1.7	55	63
	1.5	3.2	0.12	2.1	47	54
	2.0	3.6	0.15	2.4	46	53
	2.1	3.7	0.15	2.5	44	51

Note: *All MPR nozzles tested on 4" (10.2 cm) pop-ups*
■ *Square spacing based on 50% diameter of throw*
▲ *Triangular spacing based on 50% diameter of throw*

Performance data taken in zero wind conditions
Note: *Specify spray body and nozzles separately.*
Note: *Radius reduction over 25% of the normal throw of the nozzle is not recommended*

15 Series MPR

30° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm	■ Precip In/h	▲ Precip In/h
15F	15	11	2.60	2.07	2.39
	20	12	3.00	2.01	2.32
	25	14	3.30	1.62	1.87
	30	15	3.70	1.58	1.83
15H	15	11	1.30	2.07	2.39
	20	12	1.50	2.01	2.32
	25	14	1.65	1.62	1.87
	30	15	1.85	1.58	1.83
15Q	15	11	0.65	2.07	2.39
	20	12	0.75	2.01	2.32
	25	14	0.82	1.62	1.87
	30	15	0.92	1.58	1.83

Note: *All MPR nozzles tested on 4" (10.2 cm) pop-ups*
■ *Square spacing based on 50% diameter of throw*
▲ *Triangular spacing based on 50% diameter of throw*

15 Series MPR — METRIC

30° Trajectory

Nozzle	Pressure bar	Radius m	Flow m^3/h	Flow l/m	■ Precip mm/h	▲ Precip mm/h
15F	1.0	3.4	0.60	9.8	52	60
	1.5	3.9	0.72	11.8	47	55
	2.0	4.5	0.84	13.7	41	48
	2.1	4.6	0.84	14.0	40	46
15H	1.0	3.4	0.30	4.9	52	60
	1.5	3.9	0.36	5.9	47	55
	2.0	4.5	0.42	6.8	41	48
	2.1	4.6	0.42	7.0	40	46
15Q	1.0	3.4	0.15	2.5	52	60
	1.5	3.9	0.18	2.9	47	55
	2.0	4.5	0.21	3.4	41	48
	2.1	4.6	0.21	3.5	40	46

Performance data taken in zero wind conditions
Note: *Specify spray body and nozzles separately.*
Note: *Radius reduction over 25% of the normal throw of the nozzle is not recommended*

5 Series MPR Stream Bubbler Nozzles

0° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm
5F-B	15	5	1.50
	20	5	1.50
	25	5	1.50
	30	5	1.50
5H-B	15	5	1.00
	20	5	1.00
	25	5	1.00
	30	5	1.00
5Q-B	15	5	0.50
	20	5	0.50
	25	5	0.50
	30	5	0.50
5CST-B	15	5	0.50
	20	5	0.50
	25	5	0.50
	30	5	0.50

5 Series MPR Stream Bubbler Nozzles — METRIC

0° Trajectory

Nozzle	Pressure bar	Radius m	Flow m^3/h	Flow l/m
5F-B	1.0	1.5	0.35	5.7
	1.5	1.5	0.35	5.7
	2.0	1.5	0.35	5.7
	2.1	1.5	0.35	5.7
5H-B	1.0	1.5	0.23	3.8
	1.5	1.5	0.23	3.8
	2.0	1.5	0.23	3.8
	2.1	1.5	0.23	3.8
5Q-B	1.0	1.5	0.12	1.9
	1.5	1.5	0.12	1.9
	2.0	1.5	0.12	1.9
	2.1	1.5	0.12	1.9
5CST-B	1.0	1.5	0.12	1.9
	1.5	1.5	0.12	1.9
	2.0	1.5	0.12	1.9
	2.1	1.5	0.12	1.9

Note: *Indicates adjusted radius at psi shown*
Note: *Flow at adjusted radius of 5 feet (1.5 m)*

15 Strip Series

30° Trajectory

Nozzle	Pressure psi	W x L ft.	Flow gpm
15EST	15	4 x 13	0.45
	20	4 x 14	0.50
	25	4 x 14	0.56
	30	4 x 15	0.61
15CST	15	4 x 26	0.89
	20	4 x28	1.00
	25	4x 28	1.11
	30	4 x 30	1.21
15RCS	15	3 x 11	0.35
	20	3 x 12	0.40
	25	4 x 14	0.45
	30	4 x 15	0.49
15LCS	15	3 x 11	0.35
	20	3 x 12	0.40
	25	4 x 14	0.45
	30	4 x 15	0.49
15SST	15	4 x 26	0.89
	20	4 x 28	1.00
	25	4 x 28	1.11
	30	4 x 30	1.21
9SST	15	9 x 15	1.34
	20	9 x 16	1.47
	25	9 x 18	1.60
	30	9 x 18	1.73

***W** = Width of coverage pattern* ***L** = Length of coverage pattern*

***Note:** Specify spray body and nozzles separately.*

***Note:** Radius reduction over 25% of the normal throw of the nozzle is not recommended*

15 Strip Series — METRIC

30° Trajectory

Nozzle	Pressure bar	W x L m	Flow m³/h	Flow l/m
15EST	1.0	1.2 x 4.0	0.10	1.7
	1.5	1.2 x 4.3	0.11	2.0
	2.0	1.2 x 4.3	0.13	2.3
	2.1	1.2 x 4.6	0.14	2.3
15CST	1.0	1.2 x 7.9	0.20	3.4
	1.5	1.2 x 8.5	0.23	4.0
	2.0	1.2 x 8.5	0.25	4.5
	2.1	1.2 x 9.2	0.27	4.6
15RCS	1.0	0.8 x 3.2	0.08	1.3
	1.5	1.0 x 3.9	0.09	1.6
	2.0	1.2 x 4.5	0.11	1.8
	2.1	1.2 x 4.6	0.11	1.9
15LCS	1.0	0.8 x 3.2	0.08	1.3
	1.5	1.0 x 3.9	0.09	1.6
	2.0	1.2 x 4.5	0.11	1.8
	2.1	1.2 x 4.6	0.11	1.9
15SST	1.0	1.2 x 7.9	0.20	3.4
	1.5	1.2 x 8.5	0.23	4.0
	2.0	1.2 x 8.5	0.25	4.5
	2.1	1.2 x 9.2	0.27	4.6
9SST	1.0	2.7 x 4.6	0.30	5.1
	1.5	2.7 x 4.9	0.33	5.8
	2.0	2.7 x 5.5	0.36	6.5
	2.1	2.7 x 5.5	0.39	6.5

Performance data taken in zero wind conditions

8 FLT Series MPR

5° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow gpm	■ Precip In/h	▲ Precip In/h
8H-FLT	15	6	0.56	3.36	3.88
	20	7	0.65	2.91	3.36
	25	7	0.72	2.60	3.01
	30	8	0.79	2.38	2.75
8Q-FLT	15	6	0.28	3.32	3.83
	20	7	0.32	2.87	3.32
	25	7	0.36	2.57	2.97
	30	8	0.39	2.35	2.71

***Note:** All MPR nozzles tested on 4" (10.2 cm) pop-ups*

■ *Square spacing based on 50% diameter of throw*

▲ *Triangular spacing based on 50% diameter of throw*

8 FLT Series MPR — METRIC

5° Trajectory

Nozzle	Pressure bar	Radius m	Flow m³/h	Flow l/m	■ Precip mm/h	▲ Precip mm/h
8H-FLT	1.0	1.7	0.12	2.1	87	101
	1.5	2.1	0.15	2.6	71	82
	2.0	2.4	0.18	2.9	62	71
	2.1	2.4	0.18	3.0	60	70
8Q-FLT	1.0	1.7	0.06	1.1	86	100
	1.5	2.1	0.07	1.3	71	81
	2.0	2.4	0.09	1.4	61	71
	2.1	2.4	0.09	1.5	60	69

Performance data taken in zero wind conditions

***Note:** Specify spray body and nozzles separately.*

***Note:** Radius reduction over 25% of the normal throw of the nozzle is not recommended*