ENSIGN
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PROJECT:
COBABE RANCH & EDEN CROSSING WATER SYSTEM MASTER PLAN (PWS. NO. 29132)

Weber County, Utah

Project No. 14090

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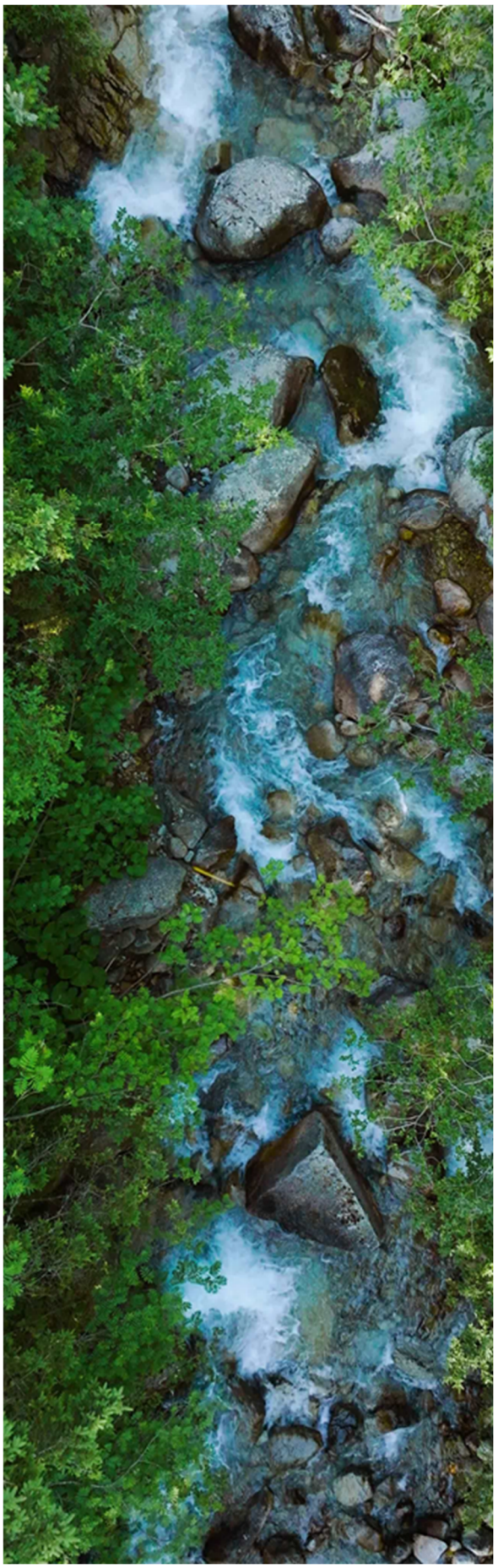

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GLOSSARY OF TECHNICAL TERMS

Average Yearly Demand	Amount of water delivered to consumers by a public water system during a typical year. Demand is typically used in irrigation or drinking water terminology.
Demand	The drinking water flow rate or volume consumed by water system users.
Distribution System	Drinking water system's network of pipes, valves, fitting, and appurtenances.
Drinking Water	Water suitable to be ingested by humans. Sometimes referred to as Culinary or drinking Water.
Fire Flow	Available flowrate of water supply for firefighting with a residual pressure of 20 psi. Typically measured as a rate of flow (gpm) for a specific period of time or duration (hours).
Indoor Use	Hydraulic loading imposed by any sanitary fixture on the system of pipe work to which it discharges inside a building.
Master Plan	Dynamic long-term planning document providing a conceptual layout to guide future growth and development.
Peak Day Demand	Amount of water utilized by a water supplier on the day of highest consumption, generally expressed in gallons per day (gpd) or millions of gallons per day (MGD). Demand is typically used in irrigation or drinking water terminology.
Peak Instantaneous Demand	Calculated or estimated highest demand which can be expected through any water main of the distribution network of a water system at any instant in time, generally expressed in gpm or cfs.
Water Line	Pipe or conduit which contains and conveys water.
Water Right	The right to use water diverted at a specific location on a water source, and putting it to recognized beneficial uses at set locations.

ABBREVIATIONS AND UNITS

ac	acre [area unit of measurement]
ac-ft	acre-foot (1 acre-foot = 325,851 gallons) [volume unit of measurement]
ERU	equivalent residential unit
ft	foot [length unit of measurement]
ft/s or fps	feet per second [velocity unit of measurement]
gpm	gallons per minute [flow rate unit of measurement]
gpd	gallons per day [flow rate unit of measurement]
HDPE	High-density Polyethylene [material used for various building materials]
IFC	International Fire Code
LOS	Level of Service
psi	pounds per square inch [pressure unit of measurement]
PWS	public water system
OPID	Oquirrh Point Improvement District
UAC	Utah Administrative Code
UDDW	Utah Division of Drinking Water

Section 0: EXECUTIVE SUMMARY

This master plan evaluates the requirements and facilities needed to provide sufficient drinking water and fire flow to the future developments of Cobabe Ranch and Eden Crossing. Water demands are measured based on Equivalent Residential Connections (ERCs). This master plan design is based a full buildout of 413.9 ERCs upon completion of both developments, in addition to a fire flow requirement of 2,000 gallons per minute (gpm) over a 2-hour period.

The system total peak day demand plus fire flow is estimated at 2,229.9 gpm, which includes a peak day demand of 229.9 gpm and a fire flow requirement of 2,000 gpm for two hours.

The system was modeled using EPA Net, and applies steady-state analysis based on Hazen-William's calculations. The design considers a maximum pipe velocity of 10 feet per second during peak demand plus fire flow. Three scenarios were set up in the model including the peak day, peak instantaneous and peak day demand plus fire flow scenarios.

The system will be supplied by three wells. The first (EC 1) is located approximately 1,250 feet east and 1,015 feet north of the southwest corner of Section 34, Township 7N, Range 1 east, and is capable of producing 33 gpm. The second (EC 2) is located approximately 1,440 feet east and 525 feet north of the southwest corner of Section 34, Township 7N, Range 1 east, and is capable of producing 20 gpm. The third (EC 5) is located approximately 100 feet east 600 feet south of the northwest corner of Section 26, Township 7N, Range 1 east, and is capable of producing 250 gpm. Water will be stored in a 500,000-gallon tank, with an average day plus fire storage of approximately 405,550 gallons.

The plan complies with Utah Division of Drinking Water rules in accordance with the Utah Administration Code (UAC R309-105-9), ensuring:

- 20 psi during fire flow
- 30 psi during peak instantaneous demand
- 40 psi during peak day demand

Section 1: INTRODUCTION

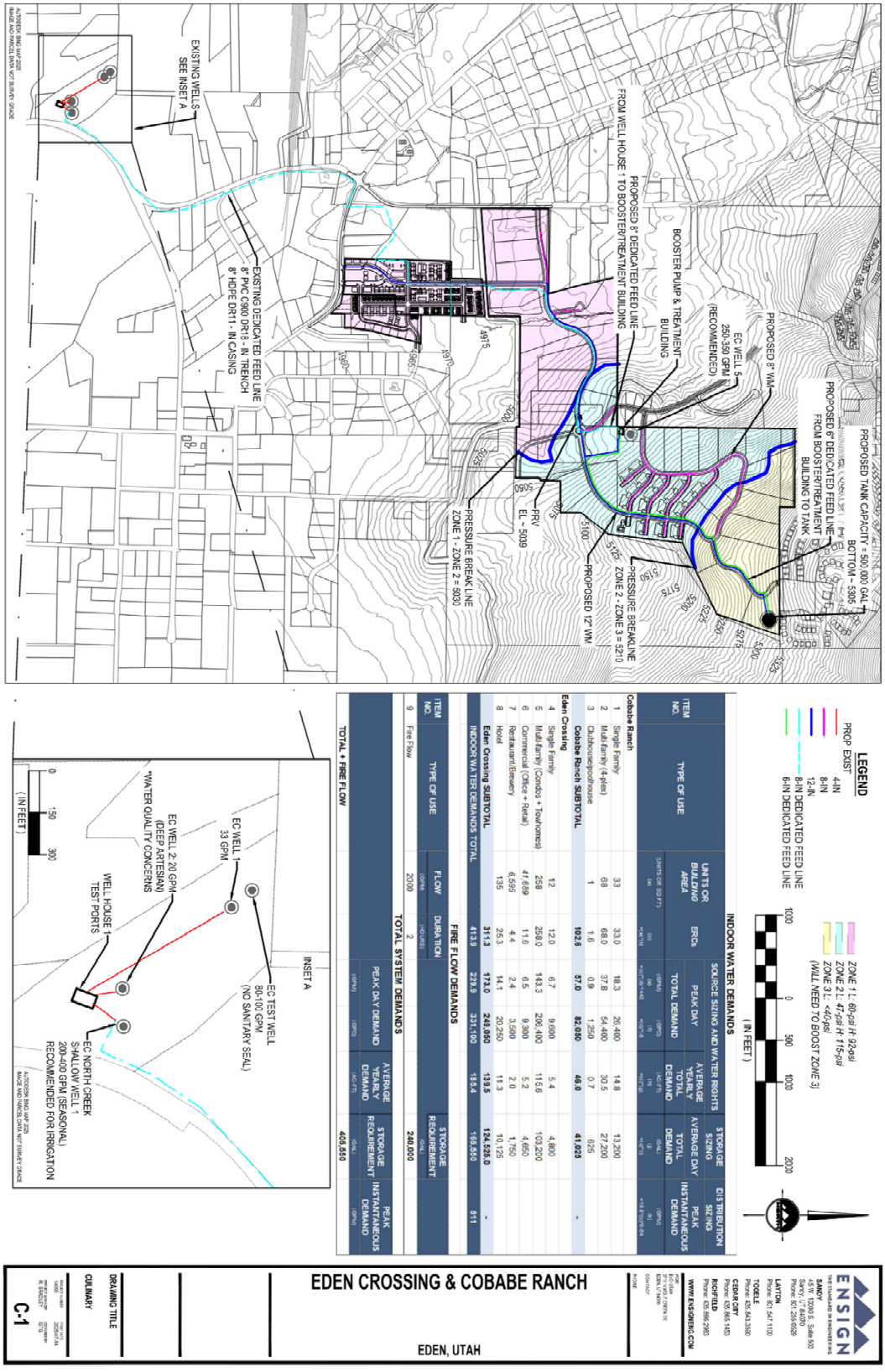
The Cobabe Ranch and Eden Crossing developments include approximately 200-acres and are located north of Eden. They include residential and commercial connections. The land use for the planned subdivision can be seen in Table 1-1 in terms of Equivalent Residential Connections (ERCs).

Table 1-1: Development Land Use Provided

Development Land Use	ERCs	Acres	ERCs/Acre
Single Family	33.0	157.2	0.21
Multi-family (4-plex)	68.0	19.5	3.49
Clubhouse/poolhouse	1.6	1.0	1.56
Cobabe Ranch SUBTOTAL	**102.6**	**177.7**	**5.3**
Single Family	12.0	3.6	3.37
Multi-family (Condos + Towhomes)	258.0	14.1	18.26
Commercial (Office + Retail)	11.6	2.7	4.24
Restaurant/Brewery	4.4	0.9	4.78
Hotel	25.3	2.2	11.57
Eden Crossing SUBTOTAL	**311.3**	**23.5**	**42.2**
Total	**413.9**	**201.2**	**47.5**

The size and schematic location of transmission and distribution water lines, storage tanks, pressure reducing valves (PRV), and booster pumps needed to supply the required quantities of water are described as modeled and shown in Figure 1.

Figure 1:Water System Schematic



1.1 **LEVEL OF SERVICE**

The level of service (LOS) required for the Cobabe Ranch and Eden Crossing facilities is based on the number seen below:

Indoor:

- Peak day demand = 800-gpd per ERC
- Average day demand / equalization storage = 400-gpd per ERC
- Average annual consumptive use = 0.448 ac-ft per ERC

Section 2: WATER DEMAND CRITERIA

Three elements are considered when evaluating a drinking water system for compliance with *Utah Administrative Code (UAC) R309-510 Facility Design and Operation: Minimum Sizing*. These are source, storage, and distribution system. The source, commonly consisting of wells, must have adequate peak day capacity, water quality, and water rights. The storage must meet average day volume capacity for drinking and fire flow volume. The distribution system is evaluated to deliver peak day plus fire flow demands, peak instantaneous demands, and peak day demands with established minimum pressures for each scenario.

2.1 WATER DEMAND

Concept plans with generalized land use types were utilized to estimate water demands in the proposed development with a summary shown in Table 2-1.

Table 2-1: Demand Summary

Type of use	Indoor ERUs	Peak Day Demand (GPM)	Storage (gal)	Water Rights (ac-ft)
Residential	371.0	206.1	148,400	166.23
Commercial	42.9	23.8	17,150	19.21
Total	**413.9**	**229.9**	**166,550.0**	**185.4**

2.1.1 Indoor Demand

Each parcel in the developments is equated to ERCs based on the planned use of said parcel. Single-family and multi-family houses each represent 1 ERC per unit (4-plex = 4 ERCs). Non-residential properties such as commercial, or the hotel, are converted into ERCs based on UAC Code R309-510.

Peak day indoor demands are calculated by multiplying the ERCs by 800-gpd. The average day and yearly demand are calculated similarly using 400 gallons per day and 0.448-acre feet (acft) per ERC. Table 2-2 lists the demands for 413.9 indoor ERCs of the planned Cobabe Ranch and Eden Crossing developments with a total indoor peak day of 229.9-gpm, indoor average day of 165,550 gpd, and indoor water rights of 185.44-acft per year. See Table 2-2 for the indoor water demands for the developments.

Table 2-2: Indoor Water Demands

	Indoor Demands							
	Development	Units	ERCs / Unit	ERCs	Peak Day Demand (gpm)	Peak Instant. Demand (gpm)	Storage (gal)	Water Rights (acft)
	Cobabe Ranch							
1.	Single Family	33.0	1	33.0	18.33	43	13,200	14.79
2.	Multi-family (4-plex)	68.0	1	68.0	37.78	68	27,200	30.47
3.	Clubhouse/poolhouse	1.0	1.56	1.6	0.87	6	625	0.70
	Eden Crossing							
4.	Single Family	12.0	1	12.0	6.67	22	4,800	5.38
5.	Multi-family (Condos + Towhomes)	258.0	1	258.0	143.33	160	103,200	115.60
6.	Commercial (Office + Retail)	41,689.0		11.6	6.46	22	4,650	5.21
7.	Restaurant/Brewery	6,595.0		4.4	2.43	12	1,750	1.96
8.	Hotel	135.0	0.1875	25.3	14.06	36	10,125	11.34
	Total			**413.9**	**229.9**	**370.2**	**165,550.0**	**185.4**

2.1.2 Demand Summary

The total indoor demands including average day storage, peak day, peak instantaneous, and annual usage or water rights are shown in Appendix A.

- Peak day demand – 229.9-gpm (331,100 GPD)
- Storage demand – 165,550 gallons
- Annual demand – 185.44 acre-feet

The storage required for these developments is the total of indoor average day demand plus fire flow storage which is based on the system being able to provide 2,000-gpm for 2-hours.

2.1.3 Fire Flow

To meet the fire flow requirements residential developments must be able to deliver a fire flow of 2,000-gpm for two hours at a minimum pressure of 20-psi throughout the development.

2.2 PRESSURE ZONES

The distribution system design criteria were based on the pressures at critical nodes for peak day, peak instantaneous, peak day plus fire flow demands, and the resulting velocity within adjacent pipes.

The elevations across Cobabe Ranch and Eden Crossing range from approximately 5325 to 4970, a vertical difference of 355-feet. To maintain minimum and maximum pressure, the development is divided into 3 pressure zones. Table 2-3 lists the pressure zone and anticipated static pressure.

Table 2-3: Pressure Zone Extents

Pressure Zone Extents					
Pressure Zone	Static Pressure		Elevation		Peak Day Demand (GPM)
	Top	Bottom	Top	Bottom	
1	60	92	5030	4963	177.4
2	47	115	5210	5030	378.6
3	0 (Tank)	40	5325	5210	3.9

NOTE: Pressure Zone Extents describes indoor use drinking water only.

Pressure Zone 3 is the highest in elevation extending from 5210 to the north edge of the development around 5325. This zone will require booster pumps to provide adequate pressure to the occupying lots. The top of Pressure Zone 2 at 5210 is the anticipated starting elevation supported with gravity pressure from the tanks. It extends down the hill to approximately 5030. Pressure Zone 1 encompasses the remainder of the development starting at approximately 5030 and below. A pressure reducing valve (PRV) will be needed between zone 1 and zone 2 to lower the water pressure to an acceptable level.

These pressure zones, storage tanks, PRVs, and booster pump stations allow for each of the nodes to operate within the proper pressures. Demands are distributed for each of the development areas proportional to pressure zones.

2.2.1 Allocation

To effectively meet the pressure requirements for 413.9 ERCs within the district and its various pressure zones, the following system enhancements are recommended:

- Pressure Zone 1: Serves 319.3 ERCs with a total peak day demand of 177.4 gpm.
- Pressure Zone 2: Serves 87.6 ERUs with a total peak day demand of 378.6 gpm.
- Pressure Zone 3: Serves 7 ERUs with a total peak day demand of 3.9 gpm.

For a detailed breakdown of these demand estimations, please refer to Appendix C.

Section 3: HYDRAULIC MODEL

3.1 HYDRAULIC MODEL

The hydraulic modeling for this project was performed using the EPANET hydraulic engine.

System design criteria require that the network maintain a minimum pressure of 20 psi while delivering fire flow plus peak day demand. Additionally, the system must maintain at least 30 psi during peak instantaneous demand and 40 psi during peak day demand. These pressure standards are essential to ensure reliable operation and adequate service levels.

To help meet these criteria, a design guideline was applied to limit pipe velocities to no more than 10 feet per second (fps). Keeping flow velocities below this threshold helps minimize head loss, reduce the risk of pressure surges, and improve the overall longevity of the distribution system.

For a conservative analysis, demands were strategically placed on nodes located either at the farthest points within each pressure zone or at the locations with the highest elevations. This approach ensures that the model evaluates the system under the most challenging conditions.

The following parameters were assumed in the development of the hydraulic model and served as the basis for system analysis and design recommendations:

- A velocity of 10 feet per second (fps) is typically the maximum velocity during a peak day plus fire flow demand event.
- 2,000 gpm fire flow
- Pressures at junction nodes are at approximately 5 ft below ground level.
- The fire flow value indicates the total available flow at a node, it does not indicate actual flow from a hydrant. Fire hydrant flow is dependent on the size, condition, and rating of the equipment.
- Generally, “backbone” water lines are modeled along main corridors (not internal water lines).

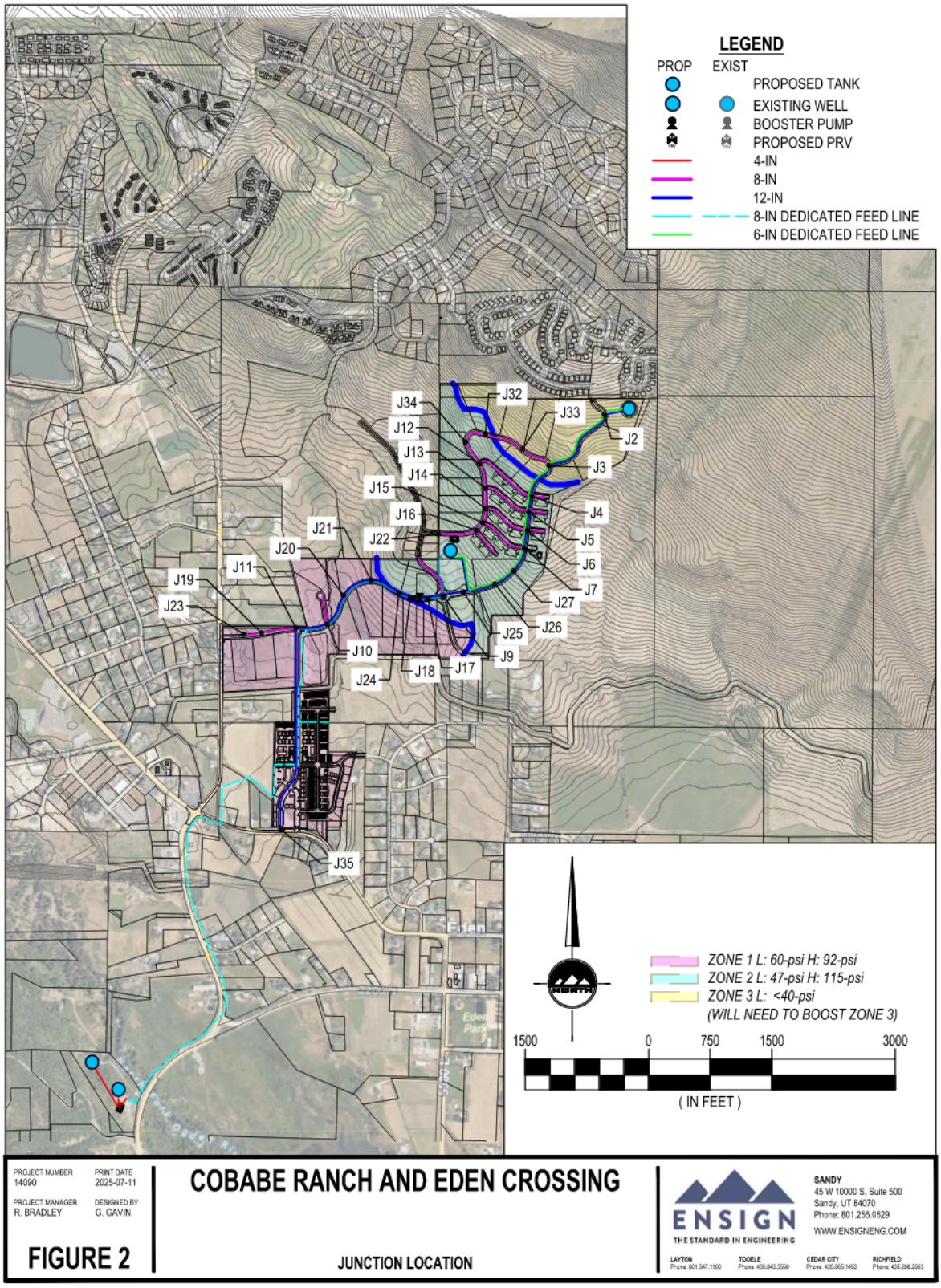
Table 3-1 shows the state requirements for distribution.

Table 3-1: State Requirements for the Distribution System

Demand Type	Minimum state requirements	Proposed pressure goals for Cobabe Ranch and Eden Crossing
Peak Day Pressure	40 psi	50 psi
Peak Instantaneous Pressure	30 psi	40 psi
Fire Flow + Peak Day Pressure	20 psi	30 psi
Fire Flow Required	2,000-gpm	N/A

Figure 2 shows the junction locations.

Figure 2: Junction Locations



3.2 MODEL RESULTS

After the location of the tank was determined, the pipe sizes were analyzed to determine the anticipated pressures and fire flow to each node given different demand scenarios. See Table 3-2, Table 3-3, and Table 3-34 for these results.

Table 3-2: Peak Day Demand Pressure Results

Peak Day Junction Results			
Node ID	**Elevation**	**Demand (GPM)**	**Peak Day Pressure (PSI)**
Pressure Zone 1			
Junc 35	4960	185.0	93.88
Junc 10	4982.99	1.1	84.13
Junc 19	4985.04	0.6	83.22
Junc 20	4986.99	1.7	82.43
Junc 11	4987.04	0.6	82.35
Junc 23	4992.99	0.6	79.77
Junc 21	5011.88	1.1	71.68
Junc 24	5025	1.7	66.03
Pressure Zone 2			
Junc 17	5039	0.0	115.79
Junc 18	5039	1.1	60
Junc 9	5040.83	0.0	115
Junc 25	5045.2	1.1	113.12
Junc 26	5071.05	1.1	101.96
Junc 22	5075.02	0.0	100.3
Junc 16	5095.7	4.4	91.34
Junc 27	5103.91	0.6	87.75
Junc 15	5107.47	2.8	86.24
Junc 28	5119.44	2.2	81.05
Junc 14	5123.79	2.8	79.18
Junc 7	5130	2.8	76.47
Junc 29	5137.46	2.2	73.25
Junc 13	5145.61	2.8	69.73
Junc 6	5147.55	4.4	68.88
Junc 30	5154.67	2.2	65.81
Junc 12	5160.22	2.8	63.42
Junc 5	5165.93	4.4	60.93
Junc 34	5174.24	1.1	57.35
Junc 31	5177.76	2.2	55.82
Junc 4	5184.16	4.4	53.05
Junc 32	5198.6	1.1	46.8
Pressure Zone 3			
Junc 33	5225	0.0	35.38
Junc 3	5229.59	0.0	33.4
Junc 2	5300	0.0	3.02

Table 3-3: Peak Instantaneous Demand Pressure Results

Peak Instantaneous Junction Results			
Node ID	Elevation	Demand (GPM)	Peak Inst. Pressure (PSI)
Pressure Zone 1			
Junc 35	4960	253	93.6
Junc 10	4982.99	2.6	84.02
Junc 19	4985.04	1.3	83.08
Junc 20	4986.99	3.9	82.34
Junc 11	4987.04	1.3	82.22
Junc 23	4992.99	1.3	79.64
Junc 21	5011.88	2.6	71.62
Junc 24	5025	3.9	66
Pressure Zone 2			
Junc 17	5039	0	115.41
Junc 18	5039	2.6	60
Junc 9	5040.83	0	114.62
Junc 25	5045.2	2.6	112.76
Junc 26	5071.05	2.6	101.63
Junc 22	5075.02	0	100.03
Junc 16	5095.7	8	91.07
Junc 27	5103.91	1.3	87.44
Junc 15	5107.47	7.9	85.97
Junc 28	5119.44	4	80.77
Junc 14	5123.79	7.9	78.91
Junc 7	5130	7.9	76.19
Junc 29	5137.46	4	72.99
Junc 13	5145.61	7.9	69.48
Junc 6	5147.55	8	68.62
Junc 30	5154.67	4	65.56
Junc 12	5160.22	3.9	63.18
Junc 5	5165.93	8	60.68
Junc 34	5174.24	2.6	57.13
Junc 31	5177.76	8	55.59
Junc 4	5184.16	8	52.82
Junc 32	5198.6	2.6	46.59
Pressure Zone 3			
Junc 33	5225	0	35.19
Junc 3	5229.59	0	33.23
Junc 2	5300	0	3

Table 3-4: Peak Day + Fireflow Pressure Results

Peak Day + Fireflow Junction Results			
Node ID	Elevation	Demand (GPM)	Fireflow Pressure (PSI)
Fireflow Scenarios			
Junc 35	4960	2185	61.18
Junc 23	4992.99	2001.3	35.49
Junc 32	5198.6	2002.6	26.32
Junc 31	5177.76	2010.6	38.83
Junc 22	5075.02	2000	54.37
Junc 18	5039	2002.6	60

Section 4: PROPOSED SYSTEM

4.1 SOURCE AND WATER SUPPLY

Drinking water supply for the system is estimated to be provided by three new wells. Well EC 1 is expected to produce 33 gallons per minute (gpm), well EC 2 is expected to produce 20 gpm, and well EC 5 is expected to produce a minimum of 250 gpm. Wells 1 and 2 are located near each other and will be conveyed through an existing 8-inch PVC supply line to a booster and filtration station located near well EC 5. Well EC 5 will also pass through this booster and filtration system and from there the water will be conveyed to the storage tank via a dedicated 6" PVC feed line. The new storage tank will have an active storage capacity of 500,000 gallons.

4.2 BOOSTER PUMP STATION

The main booster pump station is planned to be located near the north end of the lot that contains well EC 5. Two separate filtration and booster skids will be used. One system will serve the approximately 53 gpm coming from EC 1 (33 gpm) and EC 2 (20 gpm) with the other serving the approximately 250 gpm from EC 5. From the booster station this flow will be combined and conveyed to the storage tank. A secondary, smaller booster station will be needed near the storage tank to provide adequate pressure to the 7 lots in pressure zone 3.

4.3 DISTRIBUTION MAIN AND WATER LINES

The backbone distribution water lines will be 8 to 12-inch line sizes as required by velocities within the pipes and the ability to provide the necessary pressures at peak day plus fire flow demand conditions. These distribution main lines follow the main rights-of-way of the concept plan for the delivery of water from the storage tanks and booster pump stations to the vicinity of each development.

APPENDIX A SYSTEM WATER DEMAND CALCULATIONS

INDOOR WATER DEMANDS

ITEM NO.	TYPE OF USE	UNITS OR *BUILDING AREA* (UNITS OR *SQ FT*) (a)	% of ERC (b)	ERCs (c) =(a)*(b)	SOURCE SIZING AND WATER RIGHTS					STORAGE SIZING		DISTRIBUTION SIZING
					PEAK DAY			AVERAGE YEARLY		AVERAGE DAY		PEAK INSTANTANEOUS DEMAND
					UNIT DEMAND	TOTAL DEMAND		UNIT DEMAND	TOTAL DEMAND	UNIT DEMAND	TOTAL DEMAND	
					(GPD/ERC) (d)	(GPM) (e) =(c)*(d)/1440	(GPD) (f) =(c)*(d)	(GAL/ERC) (g)	(AC-FT) (h) =(c)*(g)	(GAL/ERC) (i)	(GAL) (j) =(c)*(i)	(GPM) (k) =10.8*(c)^0.64
	Cobabe Ranch											
1	Single Family	33	100.00%	33.0	800	18.3	26,400	146,000	14.79	400	13,200	43
2	Multi-family (4-plex)	68	100.00%	68.0	800	37.8	54,400	146,000	30.47	400	27,200	68
3	Clubhouse/poolhouse	1	100.00%	1.6	800	0.9	1,250	146,000	0.70	400	625	6
	Cobabe Ranch SUBTOTAL			**102.6**		**57.0**	**82,050**		**45.95**		**41,025**	**117**
	Eden Crossing											
4	Single Family	12	100.00%	12.0	800	6.7	9,600	146,000	5.38	400	4,800	22
5	Multi-family (Condos + Towhomes)	258	100.00%	258.0	800	143.3	206,400	146,000	115.60	400	103,200	160
6	Commercial (Office + Retail)	*41,689*		11.6	800	6.5	9,300	146,000	5.21	400	4,650	22
7	Restaurant/Brewery	*6,595*		4.4	800	2.4	3,500	146,000	1.96	400	1,750	12
8	Hotel	135	18.75%	25.3	800	14.1	20,250	146,000	11.34	400	10,125	36
	Eden Crossing SUBTOTAL			**311.3**		**173.0**	**249,050**		**139.49**		**124,525**	**253**
	INDOOR WATER DEMANDS TOTAL			**413.9**		**229.9**	**331,100**		**185.44**		**165,550**	**511**

NOTES:

1) Cobabe Ranch SF & MF ERCs estimated by counting parcels shown in "Cobabe Line Work" CAD file: Z:\sandy\Sandy 14000\14090\Municipal\Received\Gardner
2) Eden Crossing ERCs from Cody Storey email May 6 2025
3) 35 gpd/seat in restaurant: Assuming 100 seats
4) 1 employee/350sq ft for commercial = 120 employees
5) 15 GPD/employee/day for commercial = 1800 gpd
6) 15 restrooms for commercial (500gpd/restroom) = 7500 gpd
7) Clubhouse/poolhouse assumed as "Swimming pool & bathhouse": 10 GPD/person. Assumed limit 75 ppl. 1 public bathroom 500 GPD

FIRE FLOW DEMANDS

ITEM NO.	TYPE OF USE	FLOW (GPM)	DURATION (HOURS)	STORAGE REQUIREMENT (GAL)
9	Fire Flow	2000	2	240,000

TOTAL SYSTEM DEMANDS

		PEAK DAY DEMAND (GPM)	PEAK DAY DEMAND (GPD)	AVERAGE YEARLY DEMAND (AC-FT)	STORAGE REQUIREMENT (GAL)	PEAK INSTANTANEOUS DEMAND (GPM)
	TOTAL + FIRE FLOW				**405,550**	