Master Plan Report

For the

Griest Addition

August 2023

Prepared by

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and

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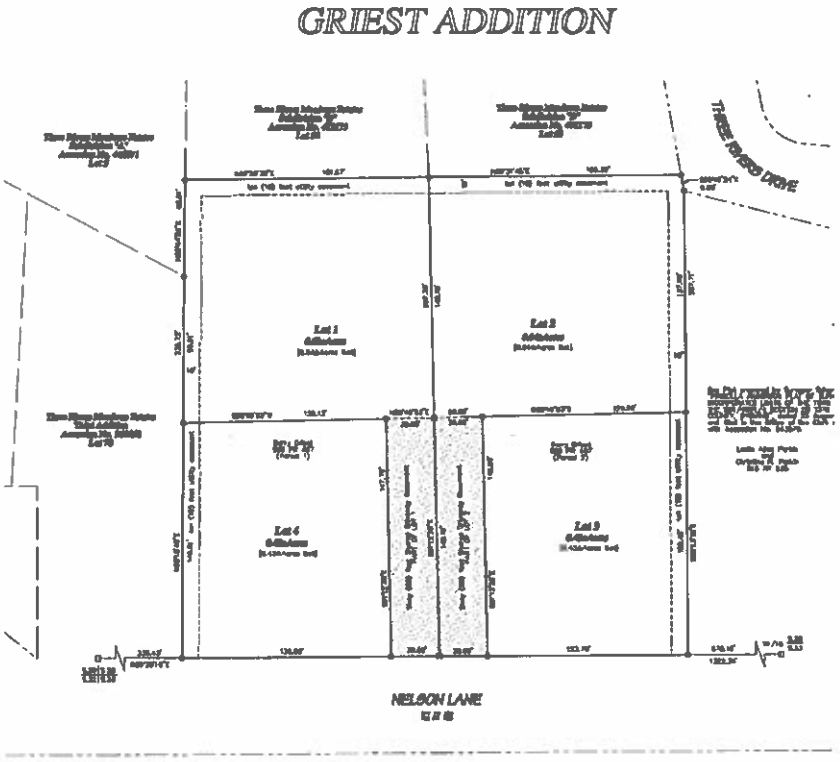
Contents

1.0 Statement of Purpose and Land Uses

The Griest addition Filing encompasses an approximate area of 2.12 acres. The property is located on the north Side of Nelson Lane, approximately 150 feet west of the intersection of Greys River Road and Nelson Lane.

The purpose of this development is to subdivide the existing property into four lots, ranging from 0.43 to 0.54 acres for residential use. A 60' Shared easement allows access to lots 1 and 2 through the shared driveway dividing lots 3 and 4.



2.0 Development Schedule

The project will be constructed in a single phase. This phase will consist of water and sewer installation to the four lots as well as paving on the shared driveway between lots 3 and 4. Water curb stop installation will be completed in this phasing plan and connection and meter pit installation will be completed by future lot owners at the time of construction.

3.0 Lots and Zoning

The Current Zoning for the lot is R-1 Single Family Residential. All lots are proposed to use this existing R-1 Zoning.

4.0 Suitability of Soils

The soils in the proposed Griest Development are classified by the USDA Natural Resources Conservation Service (NRCS) as Hobacker gravelly loam (Hc). This soil profile includes the following:

0-9 inches: gravelly loam

9 to 23 inches: very gravelly loam

23 to 30 inches: very gravelly sandy loam

30 to 60 inches: very gravelly loamy sand

The soil is "somewhat excessively drained" with a depth to water table of more than 80 inches. The soil has low risk of ponding and is in the hydrologic soil group B. The 1976 Soil Survey of Star Valley states this soil has slow runoff and slight erosion hazard. The permeability is between 6 to 20 inches per hour. The report further identifies this soil as being used for urban development.

The Griest development will include water and sewer service extensions. These facilities will be placed from two to seven feet deep and will be in the portion of the soil profile containing up to 30 % coarse fragments greater than three inches. Consequently, all buried water and sewer pipes will require imported bedding and shading. The native soils will be suitable for trench backfill above the shaded pipe. Boulders greater than 12 inches should be excluded from the lower levels of backfill closest to the shading. Screening of this material for bedding is possible, however the remains will not contain adequate "fines" for a suitable trench backfill.

The native Hc soil is classified as A-1 or A-2 under the AASHTO classification system and will be suitable for road subgrade, building foundation and other construction designed to support surface loads. It is non-plastic with low shrink-swell potential and low risk of frost action. The larger course fragments will hinder fine grading operations.

Based on the review of the Hc soil, the native soils are suitable for the proposed development and the urban construction likely to occur on the lot.

5.0 Compatibility with Adjacent Land Uses

The proposed development will be adjacent to land currently zoned R1 Single Family Residential as well. The proposed zoning is consistent with the current uses of land in the surrounding area. Growth in single family residential uses is expected in Alpine and this area where space is available.

6.0 Housing

Alpine is one of the fastest growing areas in Lincoln County due to its proximity to Jackson and the attraction for commuters, as well as the myriad of recreation opportunities available at Alpine. The need for new housing in the Alpine area is evidenced by the recent construction of apartment buildings at Boardwalk and proposed construction of additional apartments in other areas. Snake River Junction was master planned for mixed residential/commercial use, but the area slated for that

development is now an RV park. Five of the lots zoned MRC land within Alpine Meadows are proposed to be employee housing for St. John's Medical Center because of the ongoing housing shortage in the Jackson area.

7.0 Planned Water System

Alpine's water system has grown from a system serving only on the south side of Snake River to a system that serves both sides of the river. The system has two storage tanks on the south side of the river and after acquisition of the North-Star utility system the Town now has a well and tank on the north side of the river. The facilities were combined and linked via a 12" pipeline hung on the WYDOT bridge crossing the Snake River in about 2012. The following descriptions were taken from the 2008 Star Valley Regional Master plan and combined to reflect the current system. Please note these reports are over 12 years old and did not reflect the current peak demand and connection count data that was obtained from the Town.

7.1 Water Users

In 2008 Alpine had 379 residential connections (single family dwellings and apartments) and 34 commercial connections. North-Star Utilities had a handful of residential customers. As of May 2023, the total connections are about 720 with most growth occurring in residential connections. Last year roughly ten new connections were added. Typically, water use is analyzed in terms of equivalent residential units (ERUs) where the water used by each connection is compared to that of an average house. For the purposes of this study, the existing connections were grouped into 2 categories. Table 7.1.1 summarizes the connections.

Table 7.1.1 - Connections and Equivalent Residential Units (ERUs)	Existing Conn. / Units			Existing ERU's per Unit	Total Existing ERU's
Single Family Dwellings	582	/	582	1	582
Apartments	79	/	79	0.67	53
Townhomes	7	/	7	.67	5
Motel/60 Rooms	1	/	1	.25	15
Commercial	51	/	51	1.14	58
Total:	720				713

7.2 Water Use

Although the Alpine water system does have meters on individual connections, water use is estimated from data taken from meters on each system well. Historically, the Town water operator has taken readings every few days at the meters. This data can be used to estimate average and maximum daily demands. Table 7.2.1 summarizes water use as reported by the Town of Alpine in 2020.

TABLE 7.2.1 – 2020 WATER USE SUMMARY

	Alpine Water Use	
	(gpd)	(gpd/ERU)
Average Daily Demand	300,000	430
Maximum Daily Demand	879,000	1,220

At this time, the most current daily and maximum demands are not known on the Alpine system. an estimate by the city water operator was given as roughly 1,300,000 gpd for the maximum daily demand. Judging from previous usage, the maximum daily demand has maintained around 2.9 times the average daily demand. From these estimates we can reason that the average daily demand is roughly 448,000 gpd at current levels. Table 7.2.2 summarizes water use estimates at 2023 levels.

TABLE 7.2.2 – 2023 WATER USE ESTIMATES

	Alpine Water Use	
	(gpd)	(gpd/ERU)
Average Daily Demand	448,000	620
Maximum Daily Demand	1,300,000	1,800

From Table 7.2.2 the maximum daily demand in the City of Alpine Water System is given as 1,800 gpd/ERU. The addition of four ERU's would increase the demand by roughly 7,200 gpm at the maximum daily demand, which is equated to roughly 10 GPM. This demand was incorporated into H2O-net and analyzed in Section 7.7.

7.3 Water Sources

The Alpine water system has six water sources: Alpine Well No. 1, Alpine Well No. 2, Alpine Well No. 3, Excel Development No. 1, Flying Saddle Well No. 1, and Flying Saddle Well No. 2.

7.3.1 Alpine Well No. 1

Alpine Well No. 1 is located on Forest Service property just off the Greys River Road southeast of the Town. This well and Well No. 2 are near the proposed development. The well is cased to a total depth of 275 feet. Depth to the first water bearing formation is 60 feet. The well has a 50 hp submersible pump set at 175 feet and produces approximately 350 gpm. A 2006 investigation showed Well No. 1 is capable of a sustained pumping rate of 750 gpm during peak-use periods. To meet this peak rate the well would need to be outfitted with a larger pump and may require a water right appropriation increase. Operation of Well No. 1 is alternated with Well No. 2 to enhance the life of the pumps.

7.3.2 Alpine Well No. 2

Alpine Well No. 2 is located 172 feet east of Well No 1. The well is 243 feet deep and is cased to a depth of 147 feet. At the time of drilling, static water depth was 85 feet. The well has a 50 hp submersible pump set at 156 feet and produces approximately 350 gpm. The 2006 investigation showed Well No. 2 can produce 600 gpm, but sustained pumping could cause air entrainment problems due to water cascading into the well through perforations above the pumping water level. Additionally, the well would need to be outfitted with a larger pump and water right appropriation increase to meet the higher 600-gpm pumping rate.

7.3.3 Alpine District Well No. 3

At the time of the 2008 study, a third well has been drilled and tested. The initial plans were to place this well into service by the end of 2018. Anticipated capacity for Well No. 3 is 500 gpm. Because the well has not been incorporated into the system at the time of this study, it will not be included in source capacity calculations.

7.3.4 Excel Development No. 1

Excel Development No. 1 is located along the southwest edge of Alpine Lakes Subdivision Lot 1 approximately 175 feet southwest of US Highway 26. The well is 142 feet deep. The well is cased to a depth of 42 feet, screened from 42 feet to 102 feet, and cased from 102 feet to 142 feet. At the time of drilling, static water depth was 26 feet. A pump test revealed the well can produce upwards of 2,500 gpm. The well is currently outfitted to produce 500 gpm. To meet a higher peak rate the well would need to be outfitted with a larger pump and may require a water right appropriation increase.

7.3.5 Flying Saddle Well No. 1

Flying Saddle Well No. 1 was constructed as part of the North-Star Utility system but was not fully developed and is currently not in use. The well is located approximately 100 feet south of the Flying Saddle Lodge and south of Highway 89/26. The well is 260 feet deep and is cased to a depth of 120 feet. Static water level reportedly varies between 40 and 80 feet depending on the water depth in Palisades Reservoir. A pump test at drilling showed the well has a production capacity of about 70 gpm.

7.3.6 Flying Saddle Well No. 2

Flying Saddle Well No. 2 was drilled as part of the North-Star Utility system. It is located on Lot 1 of the Flying Saddle Subdivision adjacent to the Flying Saddle Lodge/Restaurant building and approximately 100 feet northwest of Flying Saddle Well No. 1. The well is 160 feet deep and is cased to a depth of 100 feet. The remaining 60 feet of depth are screened. Static water level reportedly varies between 40 and 80 feet depending on the water depth in Palisades Reservoir. The well has a 20 hp submersible pump set at 95 feet and produces approximately 180 gpm.

7.3.7 WATER SOURCE SUMMARY

A summary of the Town's water sources is shown below.

TABLE 7.3.1 – Alpine Water Source Summary

	Existing Capacity (gpm)	Potential Capacity (gpm)
Alpine Well No. 1	350	750
Alpine Well No. 2	350	600
Alpine Well No. 3	0	500
Flying Saddle Well No. 1	70	305
Flying Saddle Well No. 2	180	310
Excel Development No. 1	500	2000
Total	1,450	4,465

The Town of Alpine has municipal water rights for Alpine Wells No. 1, and No. 2 in the amounts of 350 gpm and 375 gpm. A summary of these and acquired water rights from North-Star Utility are shown below (Table 7.4.1).

The WDEQ regulations for water sources are based on water system size and applicable rules are summarized below.

2. *A minimum of two wells (includes springs), or one well and finished water storage equal to twice the maximum daily demand shall be provided. (WDEQ, 2006, p.12-17)*

Alpine has multiple well sources with a combined capacity exceeding twice the maximum daily demand. The Town has an excess source capacity of 330,000 gpd under this rule. This equates to 261 ERU's (based on 1,264 gpd/ERU maximum daily demand).

3. *Where two sources are provided, the sources (and storage) shall be capable of equaling or exceeding the design average daily demand with the largest producing well out of service. (WDEQ, 2006, p. 12-17).*

Capacity with largest source out of service	1,368,000 gpd
+ Storage capacity	1,290,000 gpd
- Average daily demand	300,000 gpd
Excess capacity	2,358,000 gpd

7.4 Water Rights

The Town of Alpine has municipal water rights for Alpine Wells No. 1, and No. 2 in the amounts of 350 gpm and 375 gpm. A summary of these and the Town's other water rights is shown below.

Table 7.4.1 –Alpine Water Rights Summary

Permit	Source	Priority	Amount	Comments
U.W 39163	Alpine Well No. 1	07/20/1977	200 gpm (0.445 cfs)	
U.W. 78067	Alpine Well No. 1	12/27/1985	100 gpm (0.222 cfs)	Enlarged Alpine No. 1
U.W. 98662	Alpine Well No. 1	03/27/1995	50 gpm (0.111 cfs)	Enlarged Alpine No. 1
U.W. 77717	Alpine Well No. 2	06/23/1988	375 gpm (0.836 cfs)	
U.W. 101241	Flying Saddle Well No. 1	12/12/1995	55 gpm (0.12 cfs)	
U.W. 178318	Flying Saddle Well No. 1	09/12/2006	50 gpm (0.11 cfs)	Enlargement
U.W. 182139	Flying Saddle Well No. 1	06/12/2007	200 gpm (0.45 cfs)	Enlargement
U.W. 101242	Flying Saddle Well No. 2	12/12/1995	60 gpm (0.13 cfs)	
U.W 178319	Flying Saddle Well No. 2	09/12/2006	50 gpm (0.11 cfs)	Enlargement
U.W. 182140	Flying Saddle Well No. 2	06/12/2007	200 gpm (0.45 cfs)	Enlargement
U.W. 206257	Excel Development No. 1	09/16/2016	500 gpm (1.11 cfs)	

7.5 WATER STORAGE

The Alpine System after combining with North-Star has three storage tanks. One tank is a 250,000 gallon tank, another is a 500,000 gallon tank and the third is a 540,000 gallon tank.

7.5.1 ALPINE 250,000 GALLON TANK

Alpine's 250,000 gallon reinforced concrete cylindrical storage tank is located south of Town on the hillside. The property that the tank rests on is Forest Service property. The tank was constructed in 1996 and is in good condition. The tank is partially buried to protect it from freezing. The 250,000 gallon tank is at a higher elevation than the 500,000 gallon tank and feeds the upper pressure zone of the system. Water is delivered to this tank from the 500,000 gallon tank by a booster pump through a 6 inch diameter line. The booster pump is located just west of the wells. The line is enlarged to an 8 inch line before dumping into the tank. The booster pump can feed the upper pressure zone and move water to the tank at the same time.

7.5.2 ALPINE 500,000 GALLON TANK

Alpine's 500,000 gallon concrete reinforced cylindrical storage tank is also located on Forest Service property on the hillside east of the 250,000 gallon tank. This partially buried tank was constructed in 1996 and is in good condition. Water is delivered to this tank from the wells through an 8-inch line. Water from this tank is gravity feed into the lower pressure zone of the system through a 10-inch line. Water from the 500,000 gallon tank is also delivered to the 250,000 gallon tank through a 6-inch line that passes through a booster pump.

7.5.3 Former North Star Utility Tank

North Star Utility had one storage tank when acquired by Alpine. The 540,000 gallon cylindrical shaped steel tank is located on the hillside northeast of the Flying Saddle Development on Forest Service property (See Figure 7.7.1). The tank was completed in 2007 and is in good condition. The tank stands completely above ground level and according to the system operator, Richard Sifton, the tank was susceptible to freezing during its first winter of operation in 2007-2008. Measures have been taken to minimize this possibility in the future. Water from the tank is gravity fed to the distribution system.

TABLE 7.5.1 – Water Storage Summary

	Volume (gallons)	Type	Year Constructed
Alpine Tank	250,000	Concrete, Cylindrical	1996
Alpine Tank	500,000	Concrete, Cylindrical	1996
North-Star Tank	540,000	Steel, Cylindrical	2007
Total	1,290,000		

7.5.4 Water Storage Analysis

The WDEQ regulations for storage are based on water system size. As water systems increase in size (based on average daily demand of the system), the required storage per number of gallons served decreases. The WDEQ requirements for storage capacity are listed below followed by brief analyses of the Alpine water system showing compliance.

Rule 1. Water systems serving less than 50,000 gallons on the design average daily demand shall provide clearwell and system storage capacity equal to the average daily demand (WDEQ, 2006, 12-65).

Not applicable.

Rule 2. Water systems serving from 50,000 to 500,000 gallons on the design average daily demand shall provide clearwell and system storage capacity equal to the average daily demand plus fire storage, based on recommendations established by the State Fire Marshall or local fire agency (WDEQ, 2006, 12-65).

The Alpine average daily demand is estimated at 448,000 gallons (2023).

The necessary fire flow for a typical residential building was determined using the National Fire Protection Association 1142, Standard on Water Supplies for Suburban and Rural Fire

Fighting 2007 Edition hereafter referred to as NFPA. The following values for a single-family residence of 4,000 square feet were determined using NFPA:

- Occupancy Hazard Class – Class 7 (Chapter 5.2.5)
- Construction Type – Type V (Chapter 6.3.7)
- Effective Area – For Type V buildings is equal to the total floor area of the largest story plus 50 percent of the total floor area of all other stories or sloped roofs (Annex G.4.1)

A Large Single-Family Residence has an area of 4,000 square feet. standard 8-foot ceilings and a 5/12 sloped roof was assumed for a total volume of 64,000 Cubic Feet. Accordingly, Table G.4.2(b) gives a required fire flow of 1,000 gpm and Table G.6 recommends a fire flow duration of 32 minutes. This results in an equivalent fire flow volume storage of 48,000 gallons. This volume is less than other larger structures within the Town. Therefore, analysis of storage will utilize the fire storage required by the larger structures (180,000 gallons).

The system was modeled in H2O-net as part of the Alpine water system. The H2O-net report predicts fire flow of 5,100 gpm available within the development while maintaining 20 psi throughout the entire system. A water model map and junction report can be found section 7.7 of this report.

The total required storage is 448,000 plus 180,000 or 628,000 gallons. The Alpine tanks have a combined capacity of 1,290,000 gallons. Alpine has an excess capacity of 662,000 gallons. Therefore, the Alpine water system meets the requirements of Rule 2.

Rule 3. Water systems serving in excess of 500,000 gallons on the design average daily demand shall provide clearwell and system storage capacity equal to 25 percent of the design maximum daily demand, plus added fire storage based on recommendations established by the State Fire Marshall or local fire agency (WDEQ, 2006, 12-65).

Not applicable.

Rule 4. Storage need not be provided in well supply system where a minimum of two wells are provided and a maximum hour demand or fire demand, whichever is greater, can be supplied with the largest well out of service (WDEQ, 2006, 12-65).

Not applicable.

Rule 5. If the system only has one source, the finished water storage shall be equal to twice the maximum daily demand (WDEQ, 2006, 12-17).

Not applicable.

7.6 Service Connections

Each unit is anticipated to receive a 5/8"x ¾" meter with 1" service line with dual check backflow prevention.

The default hazard classification as identified in Section 14 (i) (i) (B) of the Water Quality Rules and Regulations Chapter 12 will be followed; however, backflow prevention device will be determined upon development of the lot. If a reduced pressure principle device is required, the device must have certification by one of the following third parties:

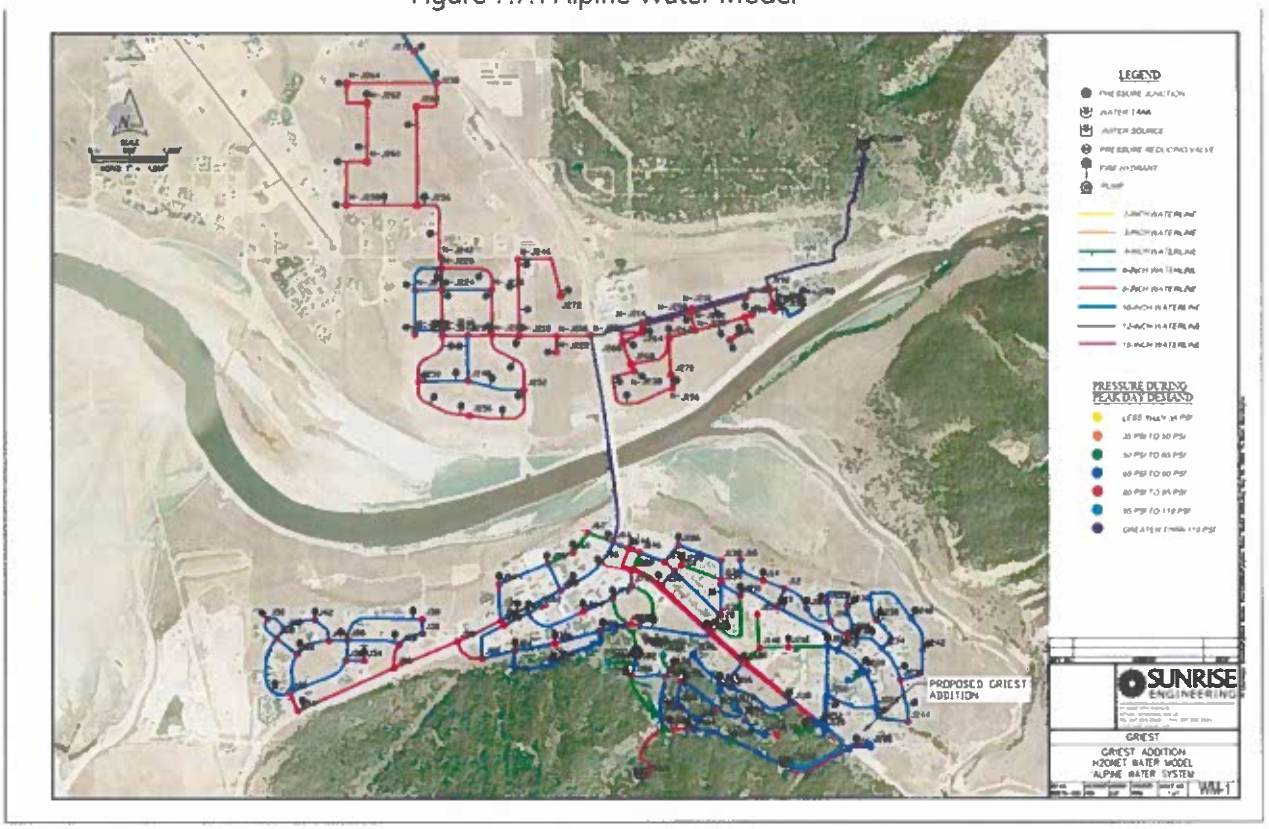
- American Society of Sanitary Engineers (ASSE)
- International Association of Plumbing/Mechanical officials (IAPMO)
- Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California (USC-FCCCHR)

7.7 Water Service Connections to Griest

It is proposed that each of the four lots connect to the 6" pipe with a 1-inch poly service that extends across Nelson Lane. Lot 3 and 4 would place their meters at about the mid-point of the frontage on Nelson Lane. Lot 1 and 2 would place their meters at the outside edges of the shared driveway and extend the service line after the meter down the driveways to the individual lots in separate trenches.

The proposed new connections to Griest were modeled using an AutoCad/GIS based network analysis software. Figure 7.7.1 illustrates the southern portion of the model with the Griest Addition shown in the bottom of the exhibit. J-126 near the subdivision has a pressure of about 71 psi which will be adequate to supply the long service lines running to lots 1 and 2.

Figure 7.7.1 Alpine Water Model



The modeling results (Figure 7.7.2) show that at Node J-126 near the Griest Addition the available fire flow is 5,100 gallons per minute while maintaining 20 psi in the remainder of the system. The model results also show that the 6-inch line will be able to deliver peak day demands at pressures over 70 psi (Figure 7.7.3) to the Griest Development. This relatively high pressure is due to this site's location on the system near a storage tank.

Figure 7.7.2 Fire Flow at J126

	ID	Total Demand (gpm)	Available Flow at Hydrant (gpm)	Critical Node ID	Critical Node Pressure (psi)	Critical Node Head (ft)	Design Flow (gpm)
1	J10	1,016.83	2,951.73	J10	20.00	5,724.16	2,951.73
2	J100	1,016.83	2,220.77	J102	19.12	5,706.12	2,201.54
3	J104	1,016.83	2,280.03	J104	20.00	5,708.16	2,280.03
4	J108	1,016.83	6,122.69	J82	14.84	5,728.25	5,656.16
5	J112	1,016.83	4,567.06	J246	13.01	5,730.03	4,178.88
6	J114	1,016.83	2,137.11	J246	14.79	5,734.14	2,011.15
7	J118	1,016.83	4,248.93	J118	20.00	5,738.16	4,248.93
8	J126	1,016.83	5,089.17	J198	20.87	5,742.15	5,139.99
9	J134	1,016.83	3,887.52	J134	20.00	5,716.16	3,887.52
10	J14	1,016.83	1,906.85	J14	20.00	5,710.16	1,906.85
11	J148	1,016.83	5,207.52	J146	20.00	5,708.16	5,207.52
12	J150	1,016.83	5,035.57	J150	20.00	5,714.16	5,035.57
13	J156	1,016.83	1,946.74	J160	16.47	5,838.01	1,873.72
14	J160	1,016.83	1,791.81	J160	20.00	5,846.16	1,791.81
15	J164	1,016.83	2,116.66	J194	11.31	5,856.10	1,880.01
16	J166	1,016.83	1,650.99	J168	4.38	5,798.11	1,436.35
17	J176	1,016.83	1,716.86	J176	20.00	5,798.16	1,716.86
18	J18	1,016.83	2,495.73	J18	20.00	5,714.16	2,495.73
19	J186	1,016.83	1,672.64	J186	20.00	5,798.16	1,672.64

Figure 7.7.3 Max Day Demand at J126

	ID	Demand (gpm)	Elevation (ft)	Head (ft)	Pressure (psi)
1	J10	16.83	5,678.00	5,854.83	76.62
2	J100	16.83	5,660.00	5,851.42	82.94
3	J102	16.83	5,662.00	5,851.39	82.06
4	J104	16.83	5,662.00	5,852.11	82.38
5	J106	16.83	5,666.00	5,853.72	81.34
6	J108	16.83	5,672.00	5,854.87	79.24
7	J110	16.83	5,672.00	5,854.88	79.24
8	J112	16.83	5,676.00	5,855.64	77.84
9	J114	16.83	5,688.00	5,855.66	72.65
10	J116	16.83	5,690.00	5,855.70	71.80
11	J118	16.83	5,692.00	5,856.56	71.31
12	J12	16.83	5,666.00	5,854.81	81.81
13	J120	16.83	5,694.00	5,858.00	71.06
14	J126	16.83	5,696.00	5,859.92	71.03
15	J128	16.83	5,672.00	5,854.75	79.18
16	J130	16.83	5,672.00	5,854.83	79.22
17	J132	16.83	5,670.00	5,854.69	80.03
18	J134	16.83	5,670.00	5,854.66	80.01
19	J136	16.83	5,670.00	5,854.65	80.01
20	J138	16.83	5,662.00	5,854.63	83.47
21	J14	16.83	5,664.00	5,854.77	82.66
22	J140	16.83	5,674.00	5,855.70	78.73
23	J142	16.83	5,676.00	5,856.24	78.10
24	J144	16.83	5,664.00	5,854.64	82.60

7.8 Summary

The Alpine water system will be able to meet the demands of the new Griest Development both in terms of peak daily demand and required fire demands.

8.0 Planned Wastewater System

The proposed Development will include four single family residences. With an estimated three or four bedrooms per residence.

The wastewater flows will vary depending on the final development. The following are typical flows for single family residences for various sizes.

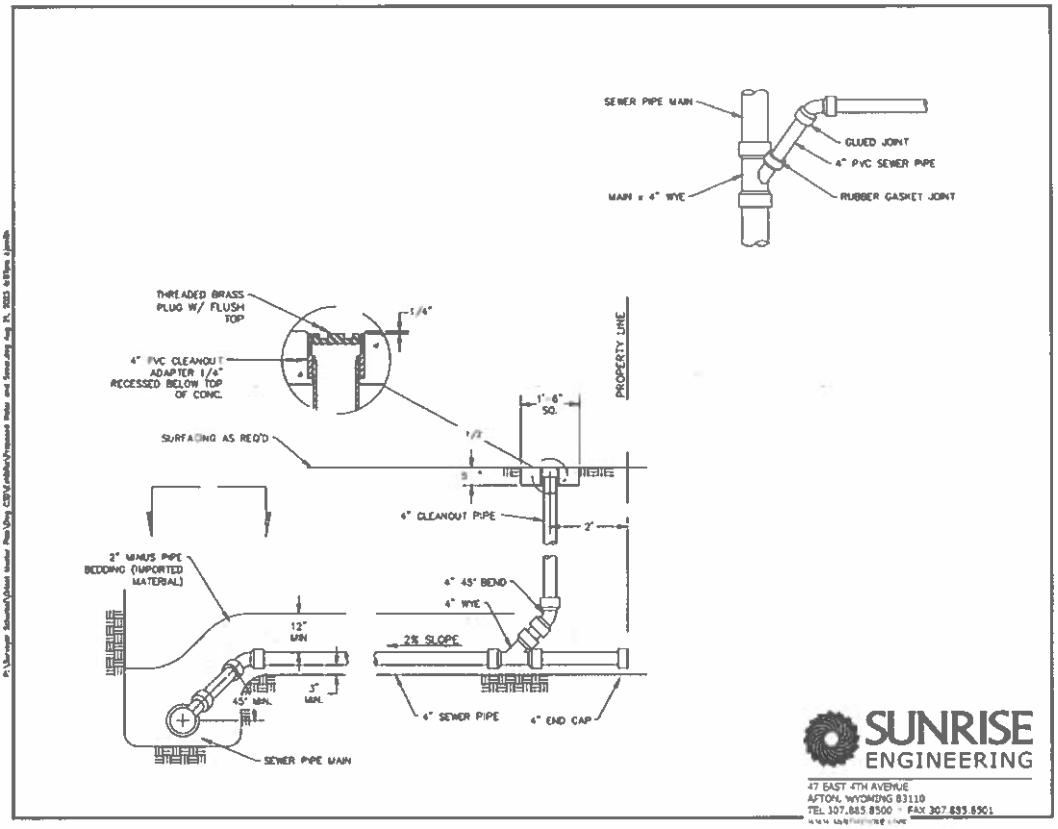
Table 8.0. Wastewater Flow Rates

# of Bedrooms	Peak Flow Rate (GPD)
2	280
3	390
4	470
5	550
6	630

The addition of four new single family residences with an anticipated four bedrooms per residence will increase the daily flows by 1880 GPD. The peak flow for these flows can be calculated as two times the average flow (12-hours) at 5.25 gpm. This flow rate is well below the 480 gpm capacity of the minimum 8" sewer line. These flows will add to other downstream flows from the neighboring users but it is anticipated that the Town of alpine will have no difficulties with these additional flows.

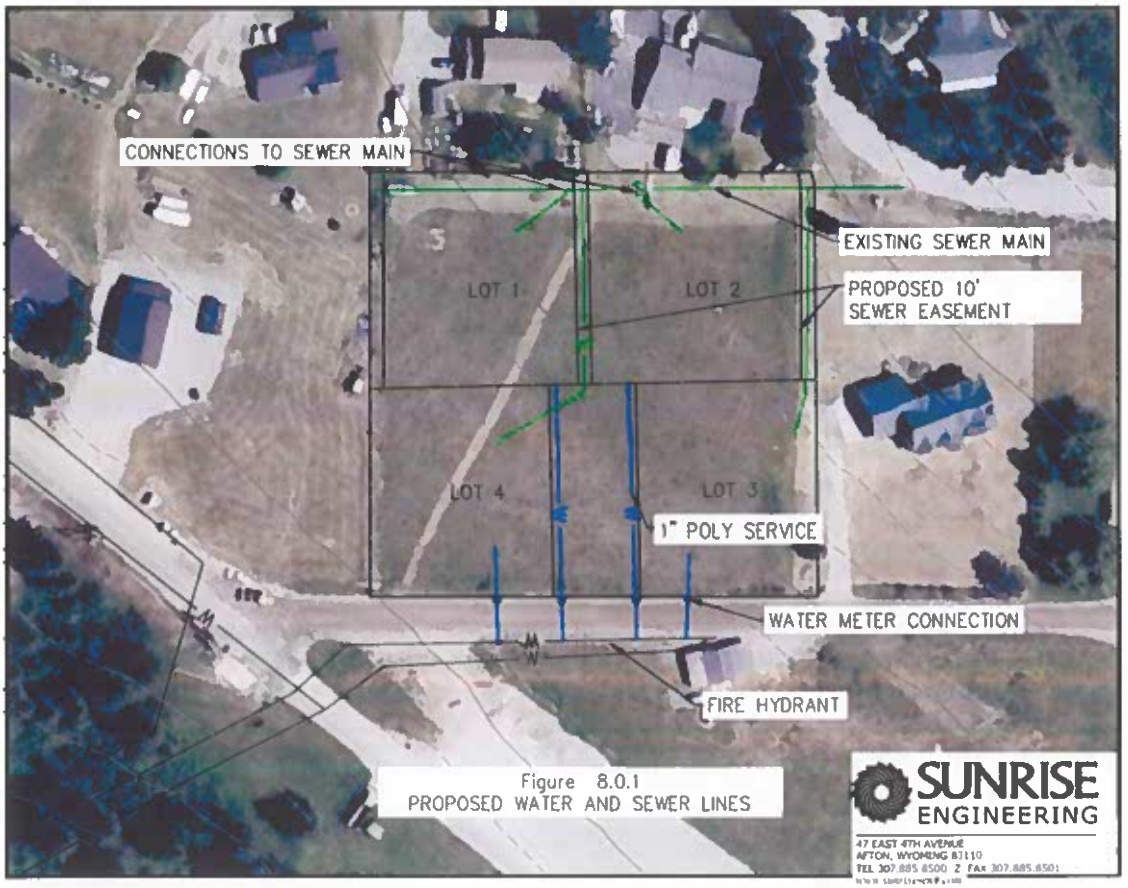
The flows will ultimately reach the Town of Alpine WWTP on the south side of the Snake River. All sewers are proposed to be 4" connections to the existing sewer line. Standard Sewer connection details are shown in figure 8.0.1. Lot owners will be responsible for proper installation and materials for sewer connections as approved by the Town of Alpine.

Figure 8.0.1 Sewer Connection Details



The proposed addition will not require a sewer line extension. At present, an existing 8" sewer approximately 9 feet deep is located along the north side of the property. The location of the sewer appears to have it touching lots 1 and 2. It would appear both of these lots could connect simply with a new service saddle on the existing mainline. Lots 3 and 4 must traverse lots 1 and 2 in order to reach the existing sewer. Two 10 foot utility easements on the edges of lots 1 and 2 provide a potential route to the sewer for lots 3 and 4. A third route could be provided with an easement between lots 1 and 2.

Figure 8.0.1 Final Sewer Extension (Green) and Final Water (Blue)



9.0 Points of Access and Traffic Volumes

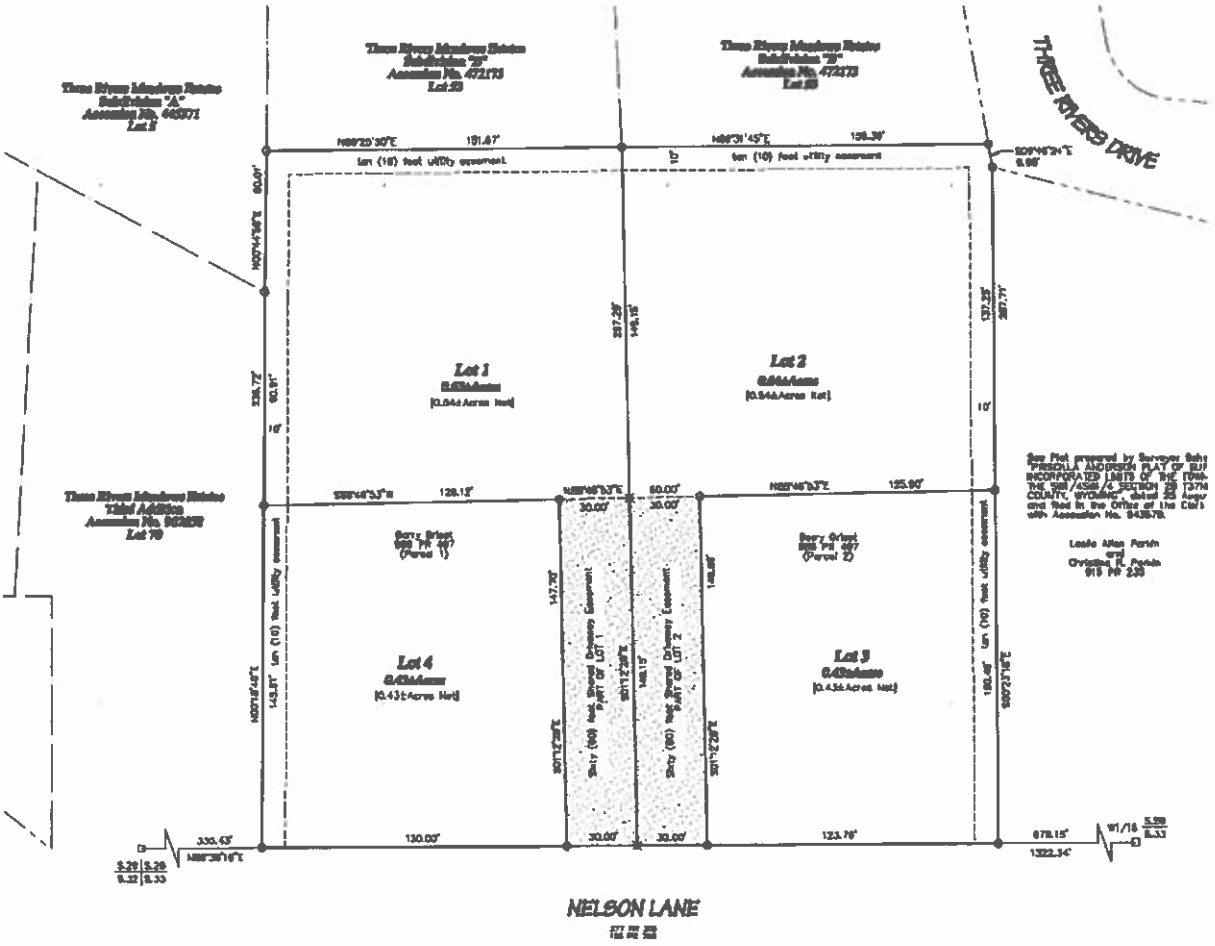
This review of traffic impacts caused by the proposed development of the Griest addition is based in part on data from the Wyoming Department of Transportation. It is intended to quantify daily trips from the development and the magnitude of those trips compared to existing traffic counts and roadway capacity guidelines. The road of primary interest is Greys River Road.

9.1 Background

The Griest Development is located in the southeast portion of Alpine.. It is located Southeast of the intersection of US 89 and Greys River Road just east of the intersection of Nelson Lane and Greys River Road. This 2.12 acre area is proposed to develop four lots as single family residences. Figures 9.1.1 and 9.1.2 outline the area and illustrate the lot layout. Nelson Lane is on the south and Greys River Road is on the southwest side.

Figure 9.1.1 Site Photo with area outlined and major roads

Figure 9.1.2 Lot Layouts



9.2 Current Traffic Counts

WYDOT Maintains Traffic Counts for US 89 South of Etna, which is the closest traffic count site on HWY 89 to the project location. Average monthly traffic levels were received from the WYDOT database for January traffic level and July levels for 2022. In January the Monthly average was 4657 while in July it reached 7966. The peak hour PM traffic recorded for January was 543 and the peak hour traffic for July was 860. Peak Hour AM was lower at 349 and 655 for January and July respectively. We can see from these traffic trends that the traffic count is nearly doubled in the summer with the maximum peak hour values happening in the afternoon.

9.3 Projected Griest Development Traffic

The development will be built out in a single phase. It is anticipated to be completed in a single year. Residences are anticipated to be built immediately following completion taking one to two years to complete. Table 9.3.1 contains an estimate of occupied units. Depending on market conditions, residences could be constructed at a faster or slower pace.

Table 9.3.1 Projected Occupied Units

Projected Additional Occupied Dwelling Units	
2022	0
2024	2
2026	4
2028	4

Table 9.3.2 shows the 2022 WYDOT Traffic Count Data For US HWY 89 South of Afton. The annual data

Table 9.3.2 WYDOT 2019 Traffic Count Data For US HWY 89 South of Etna

WYDOT Traffic Count Data HWY 89 South of Etna		
	Jan-22	Jul-22
Average Daily Traffic		
MADT	4657	7966
AM Peak Hour	349	655
PM Peak Hour	543	860

The traffic out of the development and onto HWY 89 is projected to include four AM trips and six PM trips for residences and is projected to increase traffic on HWY 89 according to the following Table 9.3.3.

Table 9.3.3 Projected Griest Development Traffic

Projected Additional Traffic Onto HWY 89				
Estimated Total Trips Generated By Development	AM Trips/Day PM Trips/Day	4 *Per Dwelling Unit* 6 *Per Dwelling Unit*		
		Total Projected Trips (Cars +Trucks)		
	Year	Jan	July	
	2022	0	0	
	2024	10	20	
	2026	20	40	
Projected % Increase over 2019	2022	0.0%	0.0%	
	2024	0.2%	0.3%	
	2026	0.4%	0.5%	

9.4 Capacity, Sight Distance, Stopping Distance and Access Spacing

9.4.1 HWY 89:

The Development at buildout will increase traffic on HWY 89 over present levels by adding about 0.5% more trips over 2022 levels. Fill in on existing lots and developments within the surrounding area will also add traffic volume, diluting the effect the Development may have.

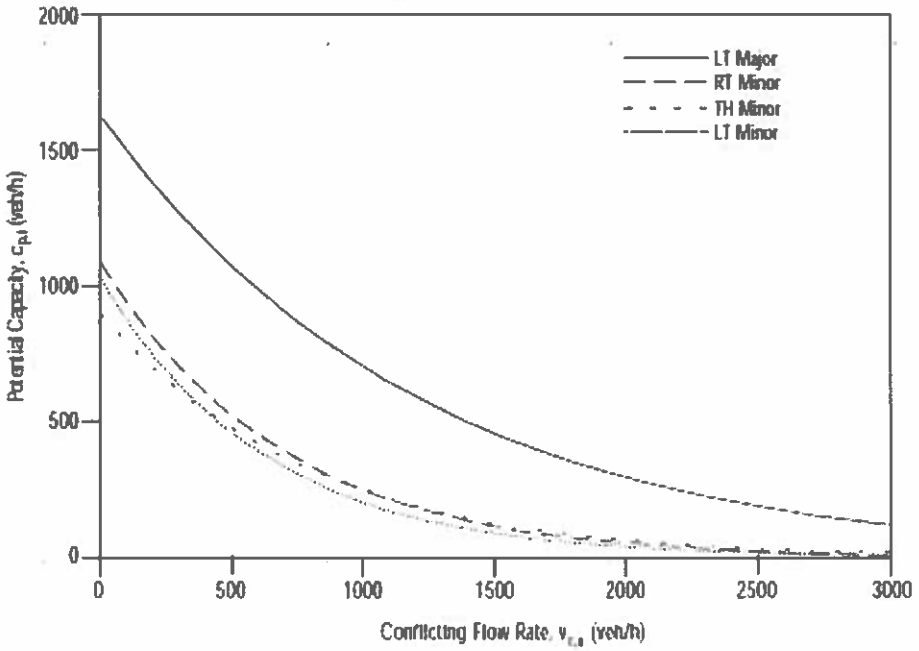
The following "Table 3-1 ADT Volumes below which MUTCD Signal Warrants Cannot be Met" is taken from the WYDOT Traffic Studies Manual. The values in the table indicate there will be no need for signalization or additional traffic measures at the intersections the Development will use to enter HWY 89.

Table 3-1 ADT Volumes below which MUTCD Signal Warrants Cannot be Met

	Number of Lanes for Moving Traffic on Each Approach		Vehicles Per Hour on Major Street (Total of Both Approaches)		Equivalent ADT		Vehicles Per Hour on Higher Volume Minor Street Approach (One Direction Only)		Equivalent ADT	
	Major St.	Minor St	100%	70%	100%	70%	100%	70%	100%	70%
Warrant 1 Condition A	1	1	500	350	4,000	2,800	150	105	2,400	1,680
	2 or more	1	600	420	4,800	3,360	150	105	2,400	1,680
	2 or more	2 or more	600	420	4,800	3,360	200	140	3,200	2,240
	1	2 or more	500	350	4,000	2,800	200	140	3,200	2,240
Warrant 1 Condition B	1	1	750	525	6,000	4,200	75	53	1,200	848
	2 or more	1	900	630	7,200	5,040	75	53	1,200	848
	2 or more	2 or more	900	630	7,200	5,040	100	70	1,600	1,120
	1	2 or more	750	525	6,000	4,200	100	70	1,600	1,120
Combination of Warrants 1A & 1B	1	1	600	420	4,800	3,360	120	84	1,920	1,344
	2 or more	1	720	504	5,760	4,032	120	84	1,920	1,344
	2 or more	2 or more	720	504	5,760	4,032	160	112	2,560	1,792
	1	2 or more	600	420	4,800	3,360	160	112	2,560	1,792

The following graph Exhibit 17-7 from the Highway Capacity Manual indicates the number of minor street turn movements that can be accomplished when turning onto a two-lane major street (HWY 89). As shown by the exhibit, even with much higher traffic volumes on HWY 89 there is still ample capacity for the traffic volumes generated by the proposed development at the HWY 89 access.

EXHIBIT 17-7. POTENTIAL CAPACITY FOR FOUR-LANE STREETS



9.4.2 Development Entrance/Exit:

The north-south shared driveway in the development services lots 1 and 2 from Nelson Lane. This single access driveway, if blocked, is a bottleneck from the perspective of emergency ingress and egress to these two lots. Lots 3 and 4 have individual driveways which will not cause any issues with circulation.

9.4.2.1 Sight Distance

The intersection of Nelson lane and Greys River Road occurs in a current 25 MPH zone. This intersection will be controlled with a stop sign on Nelson Lane. The sections of Greys River Road before and after the intersection are level with no obstructions in both directions.

The sight distances are over 1,000 feet and compare favorably with the WYDOT traffic studies manual Table 6-2 which calls for 240 feet for a crossover or right turn maneuver and 280 feet for a left turn maneuver.

9.4.2.2 Stopping Sight Distance

The stopping sight distance recommended by the WYDOT Traffic Studies Manual for this 25 mph section of roadway is 155 feet (WYDOT Table 6-3). This section of the roadway offers good visibility in terms of vertical curvature. During dry conditions stopping sight distance meets Table 6-3 at either location.

9.4.2.3 Access Spacing

The WYDOT access manual designates rural minor collectors as having a designated spacing depending on the type of access. Greys River Road is an existing access to Nelson lane and it proposed to be used as a principle access point.

9.5 Conclusions

In summary, the proposed project will not require a new access to Greys River Road, rather it will use the existing Nelson Lane designed to serve the properties in this area. It will increase traffic on Greys River Road and HWY 89, however all lots along Nelson Lane and all other roads will do the same as they are developed. No further improvements are recommended at this time.

10.0 Vehicular Circulation Plan

Vehicles within the development will exit the subdivision directly onto Nelson Lane. Nelson Lane is accessed only by greys River Road on the west end. A turnaround is available on the east end for larger and emergency vehicles to reverse direction. Access to the nearest Highway, US highway 89 is facilitated by greys river road travelling northwest. Access to the Bridger Teton National Forest is facilitated by Greys River Road travelling southeast.

11.0 Planned Storm Water Management

As described in the soils report the soils within the Development tend to be well drained offering the ability to manage storm water on-site.

The existing site is currently open rangeland and largely uncultivated containing grasses and sagebrush. The ground slopes northeast. The overall elevation change over the site is approximately 5 feet.

11.1 Design

The Town of Alpine requires that "water be managed without damage to surrounding properties". A common design standard is the 10-year, 24-hour storm. Storm runoff calculations were performed using the SCS Method using the Urban Hydrology for Small Watersheds (TR-55) manual created by the United States Department of Agriculture (USDA). The USDA-NRCS soil classification of the site is Hydrogeologic Soil Group "A" which is a well draining soil and results in a lower curve number. Precipitation/Frequency Data was found based on the National Oceanic and Atmospheric

Administration (NOAA) Atlas 2 Volume II for Wyoming. Table 11.1.1 below shows the estimated precipitation values for a given frequency and duration for the project site.

Table 11.1.1: Precipitation Values (in) for Given Frequency and Duration

Duration (min)	Return Interval					
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5	0.12	0.21	0.23	0.29	0.33	0.36
10	0.19	0.32	0.36	0.45	0.52	0.55
15	0.24	0.41	0.46	0.57	0.66	0.70
30	0.34	0.57	0.63	0.79	0.91	0.97
60	0.42	0.72	0.80	1.00	1.15	1.23
120	0.49	0.79	0.90	1.10	1.26	1.37
180	0.55	0.85	0.99	1.19	1.36	1.50
360	0.70	1.00	1.20	1.40	1.60	1.80
720	0.85	1.20	1.40	1.70	2.00	2.20
1440	1.00	1.40	1.60	2.00	2.40	2.60

When evaluating a site for stormwater management, the expected runoff was identified to help in determining how much stormwater will need to be retained on site. We analyzed the site Pre-Development as well as Post-Development based on the proposed site plan accounting for building footprint and parking areas. The results can be found in the following sections.

11.2 Pre-Development

After evaluating the existing grade, the site was analyzed as one basin. The total site area that will contribute to stormwater runoff is 2.12 acres. The anticipated runoff during the 10-year, 24-hour storm in the pre-developed state is expected to be a runoff volume of 24-cubic feet using the SCS Method as presented in the TR-55 Manual. A summary of the runoff can be seen below in Table 11.2.1. According to the TR-55 Manual, the site mostly resembles upland range (grass understory that is not grazed with some sagebrush cover) and has a curve number of 58. The shape of the site plane with about twenty feet of fall or less causes the runoff to sheet flow to the northeast across site rather than to concentrate at any one point.

Table 11.2.1 Pre-Development Runoff

Griest Addtion PRE-DEVELOPMENT TOTAL					
Storm Event (24-Hour)	Sr (Retention)	P (in)[A]	Qd (in)	Qd (ft)	Storage Volume (ft^3)
100-year	7.24	2.60	0.158	0.013	1217
50-year	7.24	2.40	0.111	0.009	851
25-year	7.24	2.00	0.039	0.003	301

10-year	7.24	1.60	0.003	0.000	24
5-year	7.24	1.40	0.000	0.000	2
2-year	7.24	1.00	0.030	0.002	228

11.3 Post-Development

The slopes in each individual lot will flow toward the northeast corner of each lot. Drainage swales will be used to split the flows equally between the four lots. Grading on the future homes and construction will channel flow away from the house toward the northeast corner of the lot. Drainage areas for homes was assumed using a large home footprint of 4000 square feet per home and 1000 square feet for the driveway totaling 5000 square feet per lot. A 24' Paved Driveway will run through the 60' shared easement and will add to the imperviousness of the lots. Precipitation for each lot will be detained in detention swales in the northeast corner of the lot.

Table 11.3.1 provides the total area of the drainage basin, area of the various features and the corresponding curve numbers.

Table 11.2.1: Drainage Basin Summary

AREA #	DESCRIPTION	SF	ACRES	CN
1	Homes & Driveways	20,000.00	0.46	98
2	Lawn	68,791.20	1.58	60
3	24' Paved Easement	3,556.00	0.08	75
	TOTAL	92,347.20	2.12	69

Table 11.3.2 shows the estimated runoff post development conditions.

Table 11.3.2: Post Development Lot Runoff

Griest Addtion POST-DEVELOPMENT TOTAL					
Storm Event (24-Hour)	Sr (Retention)	P (in)*	Qd (in)	Qd (ft)	Runoff Volume (ft^3)
100-year	4.53	2.60	0.46	0.04	3,544
50-year	4.53	2.40	0.37	0.03	2,848
25-year	4.53	2.00	0.21	0.02	1,635
10-year	**4.53**	**1.60**	**0.09**	**0.01**	**708**
5-year	4.53	1.40	0.05	0.00	373
2-year	4.53	1.00	0.00	0.00	14

*From NOAA Atlas 2

Comparing the 10-year volumes between Tables 11.3.1 and 11.3.2 shows that one can expect about 684 cubic feet of runoff difference as the lot is developed. The hydrograph shows this water will arrive at the points of concentration at a peak rate of about 61.80 gallons per minute or 0.14 cfs. The site design will direct the flows to multiple retention basins located on the northeastern corners of the lots. In total there will be about four detention/infiltration areas. Consequently, each of the swales will receive about 1/4 of the flow or 15.45 gpm.

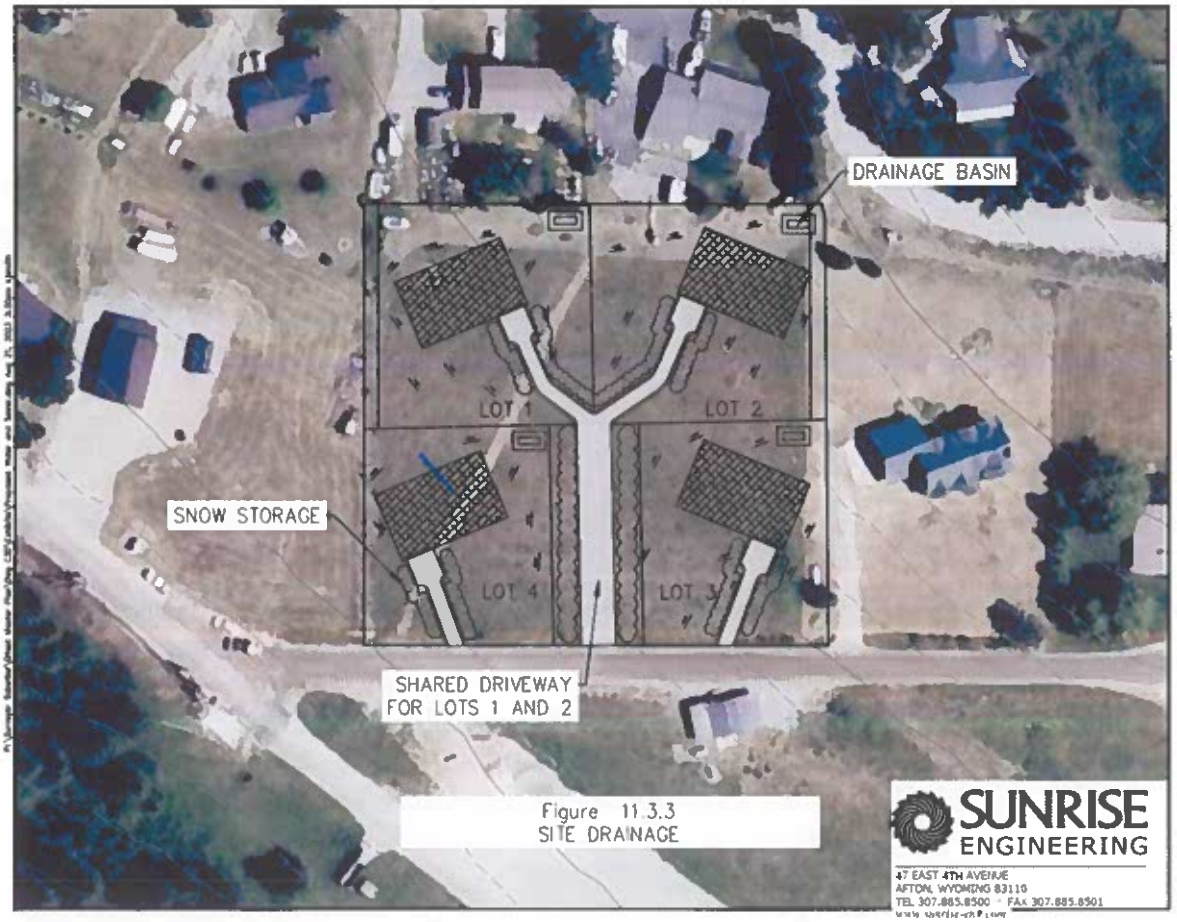


FIGURE 11.3.3 SITE DRAINAGE

This volume of stormwater will be managed by the retention basins as shown on Figure 11.3.3. The depth of the basins in conjunction with infiltration will dispose of all storm water reaching the swale. The retention basins will have a grassy bottom and sides with a 4:1 slope to a depth of 12 to 20

inches. Installations in these soils infiltrate more than 20 inches per hour. With a total area needed of about 300 square feet of infiltration area, these basins will be able to meet peak flows by infiltrating up to 62 gpm per basin. This can be managed on each of the four lots by a 75 square foot retention basin. This could be accomplished by a 5 foot by 15 foot retention basin on each lot.

The perimeter and sides of the constructed retention basin can be graded as lawn or grasses and shrubs. Flow from the road, each driveway and roof areas will be directed to the detention areas. In addition, on the perimeter of the duplexes grassy areas will serve to buffer runoff and capture flows. The bottom of the swales can also be vegetated; however, care should be taken to ensure the soil in the bottom is granular and well drained similar to the native sub-surface soil. Importation of a clayey soil could create undesirable results with the storm water not being able to infiltrate in a rapid manner. It has been shown at other sites within this type of alluvium that the soil is capable of rapidly absorbing water at an initial rate of one inch per minute slowing to 20 inches per hour

This absorption rate over the period of the storm will allow the basins to absorb the volume of water over the 24 hour period.

11.4 Snow Storage

Snow Storage will be provided as shown on the Site Drainage Plan. The lot sizes will provide plenty of space for snow storage.

11.5 Conclusion

Based on the above calculations, the site will be able to manage the 10-yr, 24-hour stormwater provided about 300 square feet of drainage basins with native material in the bottom are provided. These swales should be about 12 to 20 inches deep over the bottom with side slopes of about 4:1.

12.0 Landscaping Plan

Anticipated landscaping for this development will include grassy areas as well as low water demand landscaping such as gravel ground treatments and shrubs. In addition, the drainage swale areas and areas between the buildings is proposed for landscaping and trees.

13.0 Planned Easements

The water and sewer lines will be in the shared driveway easement running the length of lots 3 and 4 underneath the paved driveway. There are no proposed easements through this development for access to or extension of the Town of Alpine community trail system.

14.0 Planned Covenants and Deed Restrictions

A draft of the planned covenants is in process. A copy will be delivered under separate cover.