August 2017

Water Supply and Demand Update

for the Grizzly Flats Community Services District

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Section 1

Introduction

1.1 PURPOSE

This report provides an updated evaluation of water supply and demand for the Grizzly Flats Community Services District (District) system based on recent years' hydrologic data. Current and projected future water demands are compared with the estimated annual safe yield and firm yield water volumes available from North Canyon and Big Canyon Creeks. This report builds on many of the assumptions and data developed in previous reports.

Water supply and demand has been evaluated by different consultants and the results have been documented in a series of reports dating back to 1994. Section 1.3 contains a summary of these reports as well as a summary of the most recent report *Grizzly Flats Community Services District Water Supply and Demand Update* (URS, May 2012).

Evaluation of off-stream reservoir storage is not part of the scope of this report.

1.2 DEFINITIONS

The following definitions are used in this report and were excerpted from the May 2012 URS Report.

Safe Yield: Safe yield is defined as the yield that fully meets demand without deficiency even during the most hydrologically critical season for the historical period of record analyzed.

Firm Yield: Firm yield can be defined in different ways. In this report, firm yield is defined as the water supply that fully meets demand in 95 out of 100 years based on the historical record. In remaining years, demand would exceed supply.

Demand: Demand is the amount of water, usually in acre-feet per month or acre-feet per year that must be supplied from the treated water holding tank to meet the community need. Demand can also be for the entire system, or for an individual residence (dwelling unit (DU)) depending upon the discussion.

Water Year: In this report, evaluations are typically based on the water year, which runs from October 1 through September 30 each year. References to year in this report are to the water year, not calendar year, unless noted otherwise.

1.3 SYSTEM DESCRIPTION

1.3.1 EXISTING SYSTEM

A vicinity map of the Grizzly Flats area showing District facilities is included as Figure 1-1. The following description of the District has been excerpted from the May 2012 URS Report:

> Water for the treatment plant comes from two existing diversions located on North Canyon Creek and Big Canyon Creek. From North Canyon Creek, water is diverted into an 8-inch-diameter buried plastic pipe that follows the old alignment of the Upper Eagle Ditch southeast to the diversion location on Big Canyon Creek. There, water from Big Canyon Creek is also diverted into the pipeline, which increases in size from 8 inches to 10 inches in diameter. The 10-inch-diameter plastic pipe then runs along the old alignment of the Lower Eagle Ditch from Big Canyon Creek to the existing reservoir at the treatment plant. Both pipeline segments flow by gravity. The capacities of the pipelines were estimated in previous investigations by other consultants to be 330 gpm (0.74 cfs) for the 8-inch-diameter pipeline and 800 gpm (1.78 cfs) for the 10-inch-diameter pipeline.
>
> The existing Grizzly Flats water treatment plant utilizes two package filtering units with a combined capacity of approximately 400 gpm. Feed water from the treatment plant reservoir is chlorinated as it enters the plant prior to filtering. Filtered water then goes to a 200,000-gallon treated water holding tank at the treatment plant from which the water is supplied to the distribution system on demand. Treatment plant operation (on or off) is controlled by water levels in the treated water holding tank. According to the District, each filtering unit requires backwashing at a frequency that varied during the year. Backwash frequency is shorter during the higher demand summer months and lower during the winter months. The amount of water used to backwash treatment plant filters is an important consideration in determining yield of the supply system. Previous studies assumed that approximately 7% of the water demand was required for backwashing. However, a recent change in the type of flocculent used at the treatment plant appears to have reduced the backwash water volume required significantly as discussed later in this report.

With the completion of the District's Backwash Tank Replacement Project in 2015/16, the filter backwash water can now be recycled back to the reservoir during periods of severe drought.

The system also includes the following:

- The May 2012 URS Report determined an average backwash volume of 4%. Since there has been very little change in the treatment process since that point, this evaluation assumes the same backwash rate of 4%.

- The existing water treatment plant reservoir has a capacity of 31 acre-feet.

- The system has four (4) water storage tanks that store a total of 600,000 gallons:
    - Clearwell (200,000 gallons)
    - Tyler (200,000 gallons)
    - Winding Way (100,000 gallons)
    - Forest View (100,000 gallons)

In 2008, Wood Rogers (WR) studied possible locations for off-stream reservoirs. These reservoirs are not included here because with the completion of the WSIP project (see section below) and the lining of the existing reservoir, there does not appear to be a need for an off-stream reservoir at this time.

In 2013, the District abandoned a 15 gallon per minute (gpm) well located near the Forest View tank. The well was intended to provide a reliable supply to increase safe and firm yields of the water supply, but it had low production and high treatment costs and was therefore abandoned.

The May 2012 URS Report recommended "a program to systematically replace the North Canyon and Big Canyon pipelines all the way to the treatment plant reservoir" and to "incorporate air relief and blowoff appurtenances." The District obtained grant funding through Prop 84 to install air relief valves along Eagle Ditch by July 2019.

Water System Improvement Project (WSIP)

In 2012, the District completed the Water System Improvement Project (WSIP). The WSIP included the following upgrades:

- Installation of a HDPE liner in the water treatment plant (WTP) reservoir to improve raw water storage.
- Re-compaction of top 3ft of reservoir dam to increase storage capacity (keep reservoir level higher)
- New piping: (1) 1620 ft of 12" parallel plant discharge pipe from the Clearwell to Sciaroni Rd./Winding Way, (2) 950 ft of 8" pipe along Sciaroni Rd. to Grizzly Flat Rd. and (3) 550 ft of 8" pipe along Grizzly Flat Rd. from Evergreen Dr. to Mt Pleasant Dr.
- 6 new fire hydrants

1.3.2 Service Area and Sphere of Influence

The following description of the system has been excerpted from the May 2012 URS Report. The service area and sphere of influence (SOI) has not changed since the previous report.

> The District's service area covers approximately 1,115 acres and includes the Grizzly Park subdivisions and several larger perimeter parcels. The District estimates that approximately 1,225 [corrected] parcels could require water within the service area once build-out of the community is reached in the future.

The El Dorado County Local Agency Formation Commission has also identified the District as the purveyor of choice for a Sphere of Influence around Grizzly Flats covering an area of approximately 9,200 acres. Previous water supply and demand investigations focused on supplying the service area up to the point of build-out, and did not include allowances for water to serve additional development that could occur within the larger Sphere of Influence outside the service area. Projecting to build-out conditions is also beyond the scope of this evaluation.

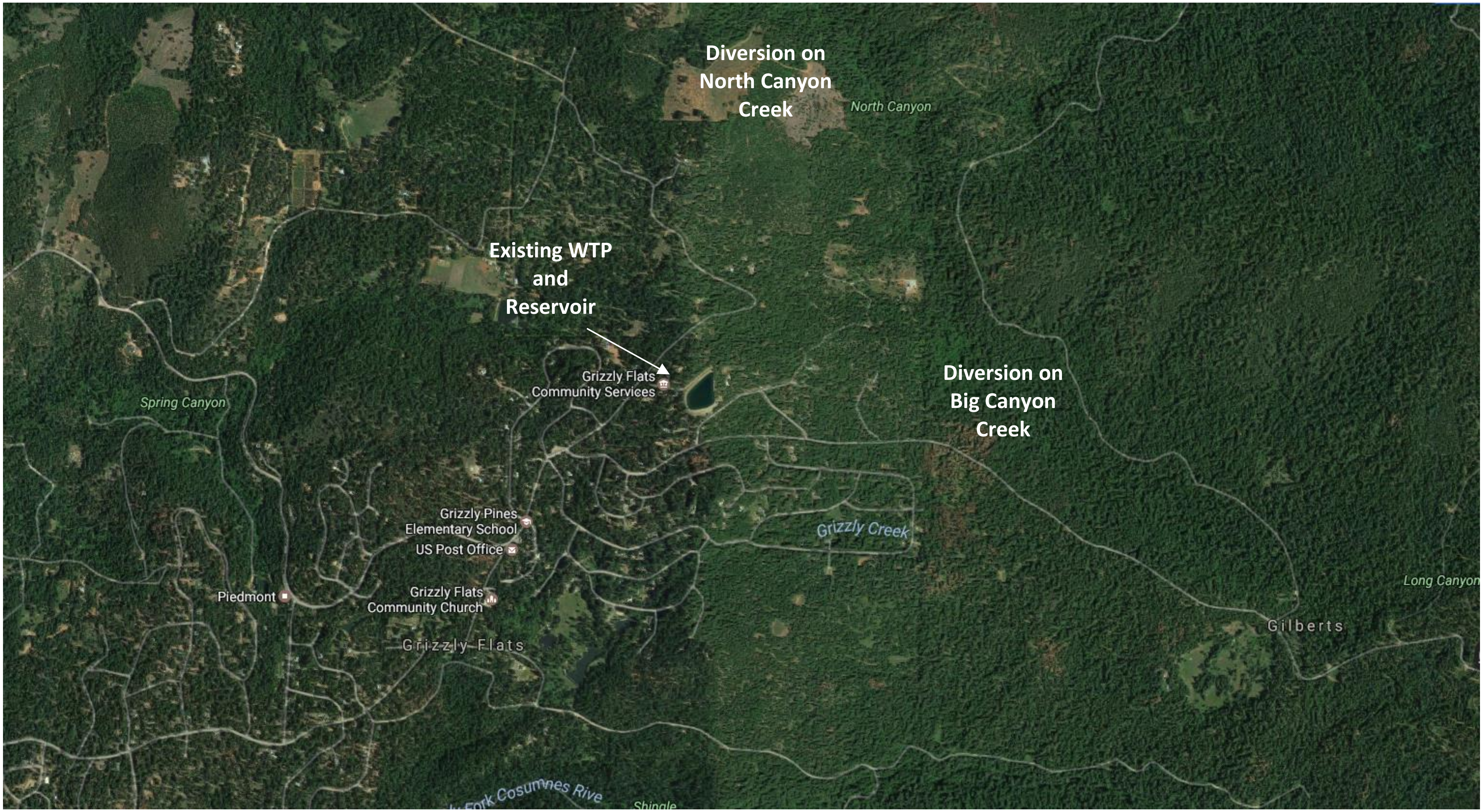

Figure 1-1
Vicinity Map

1.3.3 Drought Plan

The following drought actions are contained within the District's *Drought Plan*, which was developed in 2007 with assistance from Brown & Caldwell.

Approximate stage gage readings have been added to the drought stages to make them easier to use. A figure showing the drought stages is included in Section 2 (Figure 2-1). It is recommended that the Stage 3 drought trigger be changed to 14 acre-feet from the previous 12-acre-feet. This will give the District about 2 months of reliable water supply if conditions are similar to the 2015 drought. This calculation is based on the recommended 0.20 acre-feet/meter.

Addition drought actions that were implemented in response to the recent severe drought are included in the next section.

Policy and Regulation

1. Review and update Drought Plan every 5 years or as needed based on new gage data, new supply, operational changes, or change in expected water demand.
2. Continue water loss management procedures (leak identification)
3. Enforce Prohibition of Wasted Water (see Appendix F) [not included in this report]
4. Continue conservation policies and water-efficient plumbing codes.
5. Review and refine rate stabilization policy relating to drought impacts every 5 years.
6. Understand and comply with legal and regulatory requirements for drought management.

Monitoring

1. Monitor trigger plan quarterly to assess drought status.

    - Check GFCSD storage reservoir levels at the end of June.
    - If storage is less than 22 acre-feet (ac-ft), enter a Stage 1 drought *[approximate staff gage reading = 10.6]*.
    - If the reservoir levels are below 20 ac-ft, enter Stage 2 drought *[approximate staff gage reading = 9.6]*.
    - If the levels at the end of July or August are below 14 ac-ft, go directly into a Stage 3 drought *[approximate staff gage reading = 6.75]*.
    - For every subsequent month, keep the August drought stage through November unless storage levels rise above 14 ac-ft.
    - If the reservoir levels are above 14 ac-ft in August, then reduce the drought stage by one stage each month until no drought is called.

2. Monitor system demands.

Public Outreach

1. Develop and maintain drought awareness and public education materials, tools, and protocol. [The District uses the web site, newsletters, e-mails, and postings in community areas such as the Post Office.]

Resource Management

1. Pursue drought impact avoidance activities. In 2012, the District installed a HDPE liner system in the reservoir to stop leakage. In 2013, the District investigated and then abandoned an existing well to supplement water. The remaining impact avoidance activity would be constructing off-stream storage, which is a multiple year endeavor.

2 Pursue study of underground flows on Big Canyon diversion; investigate the feasibility of the installation of a drought curtain.

3 Maintain interagency coordination annually as shown in Figure 1 [not included in this report]. Figure 1 depicts the type and frequency of interagency coordination activities that will be pursued by the Drought Interagency Coordination Committee (DICC).

4 Confirm and maintain commitment of Drought Advisory Committee (DAC) members as shown in Figure 2 [not included in this report]. Figure 2 depicts the suggested interagency organizational structure.

5 Consider establishing trucking contracts for water hauling (annually). [has not yet been completed]

6 Establish procedure by which residents within GFCSD on wells apply for emergency relief. [procedure has not yet been established]

1.3.4 ADDITIONAL DROUGHT ACTIONS

Additional actions were implemented in response to the severe drought and State Mandate and adopted by resolution in 2014. Most of these actions were rescinded in 2016. The remaining adopted actions are included below.

1. Permanent Water Waste Prohibitions by Water Users

   a. To prevent water waste, each of the following actions are prohibited:

      i. Hosing off sidewalks, driveways, and other hardscapes except as needed for construction purposes;

      ii. Washing automobiles with hoses not equipped with a shut-off nozzle;

iii. Using non-recirculated water in a fountain or other decorative water feature; and

iv. Watering lawns in a manner that causes runoff, or within 48 hours after measurable precipitation.

1.4 SUMMARY OF PREVIOUS REPORTS

A summary of previous reports, excerpted from the May 2012 URS Report, is included in the Appendix.

1.5 PROJECTED SERVICE AREA GROWTH

Currently, there are 608 metered connections to the system. In 2012, there were 607 and 611 in 2009. District staff reports that on the order of 2 to 5 lots each year might be a typical growth rate. Prior to the downturn in the economy in 2007, the projections of service area buildout were estimated at 1,225 lots in 2050.

Section 2

Water Supply System Safe and Firm Yield Evaluations

2.1 SYSTEM MODEL

The model described in the previous May 2012 URS Report was re-created and used to generate the updated safe and firm yields with recent data following the completion of the WSIP. The following information regarding the set-up of the model was excerpted from the May 2012 URS Report:

> Since the B&A 1998 report was completed, B&A and SH have ceased providing engineering services. Many project files relative to the 1994 and 1998 studies have been lost or discarded. URS discussed the projects with previous consultants and reviewed what limited files remain. Unfortunately, the only definitive information remaining from the previous investigations is what is contained in the text and appendices of the B&A 1994 and B&A 1998 reports. A functional copy of the FORTRAN-based model used by SH to evaluate the performance of the District's system was not found, but some input and output data are memorialized in the reports. URS developed a new Excel-based system model to replace the FORTRAN model and used the published results in the previous reports to calibrate the new model and verify previous findings.

2.2 SUMMARY OF PREVIOUS MODEL RESULTS

Basic information regarding the model set-up has either been summarized or excerpted from the May 2012 URS Report in the following sections.

2.2.1 MODEL COMPONENTS

Hydrologic Data

From the May 2012 URS Report:

> *Creek Runoff*: The District's water supply comes from two diversions located on North Canyon Creek and Big Canyon Creek. Both diversions are ungaged. To estimate creek flows for the B&A 1994 report, SH identified a gage on Sly Park Creek near Pollock Pines, California, that they considered comparable to North Canyon and Big Canyon Creeks based on topographic elevations, average annual rainfall, estimated runoff per square mile, and other factors. The Sly Park Creek gage has daily records spanning the period 1920 to 1992, which included several significant dry and wet periods (note that

SH only used the data from 1925 to 1992 for their evaluations). Table 4 [Table 2-1] provides a comparison of basin characteristics.

Table 2-1
Hydrologic Characteristics of Drainage Basins (a)

Stream	Area (acres)	Average Annual Runoff (acre-feet)	acre-feet/mile^2	Average Precipitation (inches)
Sly Park Creek	15.7	12,326	785	47
North Canyon Creek	1.75	1,365 (b)	780	47
Big Canyon Creek	2.66	2,070 (b)	780	47

(a) Excerpted from the May 2012 URS Report.
(b) Estimated value

SH transposed the Sly Park gaged runoff data to North Canyon Creek and Big Canyon Creek based on the ratio of drainage basin areas. This method is typically used to extrapolate hydrologic data from a gaged basin to ungaged basins with similar hydrologic characteristics.

Influence of Springs: Based on a limited set of data collected by the District in July and August 1998, North Canyon and Big Canyon Creeks appear to have proportionately greater summer flows than predicted from Sly Park Creek (B&A, 1998). The District and SH assumed that the observed difference was associated with the various active springs located within the North Canyon and Big Canyon drainage basins, some of which are located on United States Geological Survey (USGS) maps covering those areas. To account for the apparent, more favorable time distribution of flow during the late summer and early fall due to the springs, SH adjusted the runoff records for each year based on limited District observations made in 1988. That adjustment redistributed some of the annual runoff between seasons to provide a higher spring-related base flow in late summer and fall without changing the annual total runoff.

No description can be found in previous reports that documents how creek flows were adjusted to account for the runoff from springs. However, the B&A 1994 report contains tables for North Canyon and Big Canyon Creeks that document the estimated monthly runoff in acre-feet with the adjustments for the influence of the springs. …. For consistency, URS used the monthly synthesized data from these two tables in its current evaluations of the District's system because it still represents the best available information.

In October 2013, the District installed flow gages to determine flows in North and Big Canyon Creeks. The data from water years 2015, 2016, and through March 2017 were used in the safe and firm yield analyses in this report.

Reservoir Evaporation Data

The values shown in Table 2-2 below were developed by B&A. Previous reports assumed an annual total evaporation of 3 feet distributed by month as shown in the table below. Therefore, the same assumptions were made for the updated model. Further information about this distribution can be found in the May 2012 URS Report.

Table 2-2
Percent Distribution of Annual Evaporation by Month

Month	%	Month	%
October	6.6	April	8.6
November	2.6	May	11.5
December	1.7	June	14.4
January	1.7	July	17.4
February	2.9	August	15.6
March	5.5	September	11.5

Monthly Distribution of Annual Demand

The monthly distribution shown in Table 2-3 below was developed by B&A from monthly treatment plant production data. These values were used in the previous reports from B&A and URS as well as in the current model.

Table 2-3
Percent Distribution of Annual Demand by Month

Month	%	Month	%
October	8.2	April	7.5
November	6.7	May	7.8
December	7.9	June	9.3
January	6.7	July	11.9
February	5.6	August	11.1
March	7.2	September	10.1

Treatment Plant Reservoir Storage Parameters

From the May 2012 URS Report:

> Figure 4 [not included in this report] provides a storage curve for the treatment plant reservoir. This curve was developed from a topographic survey performed in June 1996 by the El Dorado County Surveyor, GIS Division. The treatment plant storage reservoir holds a total of 22.8 acre-feet of water below the present spillway invert. The District holds in reserve approximately 6.14 acre-feet, or 2 million gallons, for emergencies and

> firefighting. This leaves approximately 16.6 acre-feet of storage available to meet treatment plant demand. [see update below]
>
> The supply system is assumed to be at the point of failure (at safe yield) when the demand causes the remaining active storage in the treatment plant reservoir to drop to zero, or just begin to encroach into the reserve storage, in any month during the critical dry year.

Following the reservoir lining and berm compaction as part of the WSIP, the total storage of the reservoir increased from 22.8 to 27.3 acre-feet and active storage of the reservoir increased to 21.2 acre-feet. An updated storage curve for the reservoir is included as Figure 2-1. Figure 2-1 also shows the drought triggers described in Section 1.3.3.

The updated model used 21.8 acre-feet of active storage, which included 600,000 gallons of storage in storage tanks.

Treatment Plant Reservoir Seepage

Since the reservoir was lined as part of the WSIP in 2012, seepage has been eliminated and is therefore not evaluated in this model.

Diversion Efficiency

From the May 2012 URS Report:

> Previous reports assumed that 75 percent (%) of the flows in Big Canyon and North Canyon Creeks would be divertible. The remaining 25% would be unavailable to the system. It includes water remaining in the creek to meet in-stream flow maintenance requirements (15%) and water unavailable for diversion (10%) when creek flows exceed the diversion capacity. URS increased the diversion efficiency to 80% by reducing the unavailable water percentage from 10% to 5%. The reduction is reasonable because the District would be proactive in diverting all available water into the system during the critical summer and fall months each year, particularly in a dry year.

A diversion efficiency of 80% was used in the updated model.

Backwash Water Volume

In 2015/16, the District completed the Backwash Tank Replacement Project, which allows the filter backwash water to be recycled back to the reservoir during periods of severe drought. Therefore, it was assumed in the model that all backwash water was returned to the reservoir and there was no loss of water.

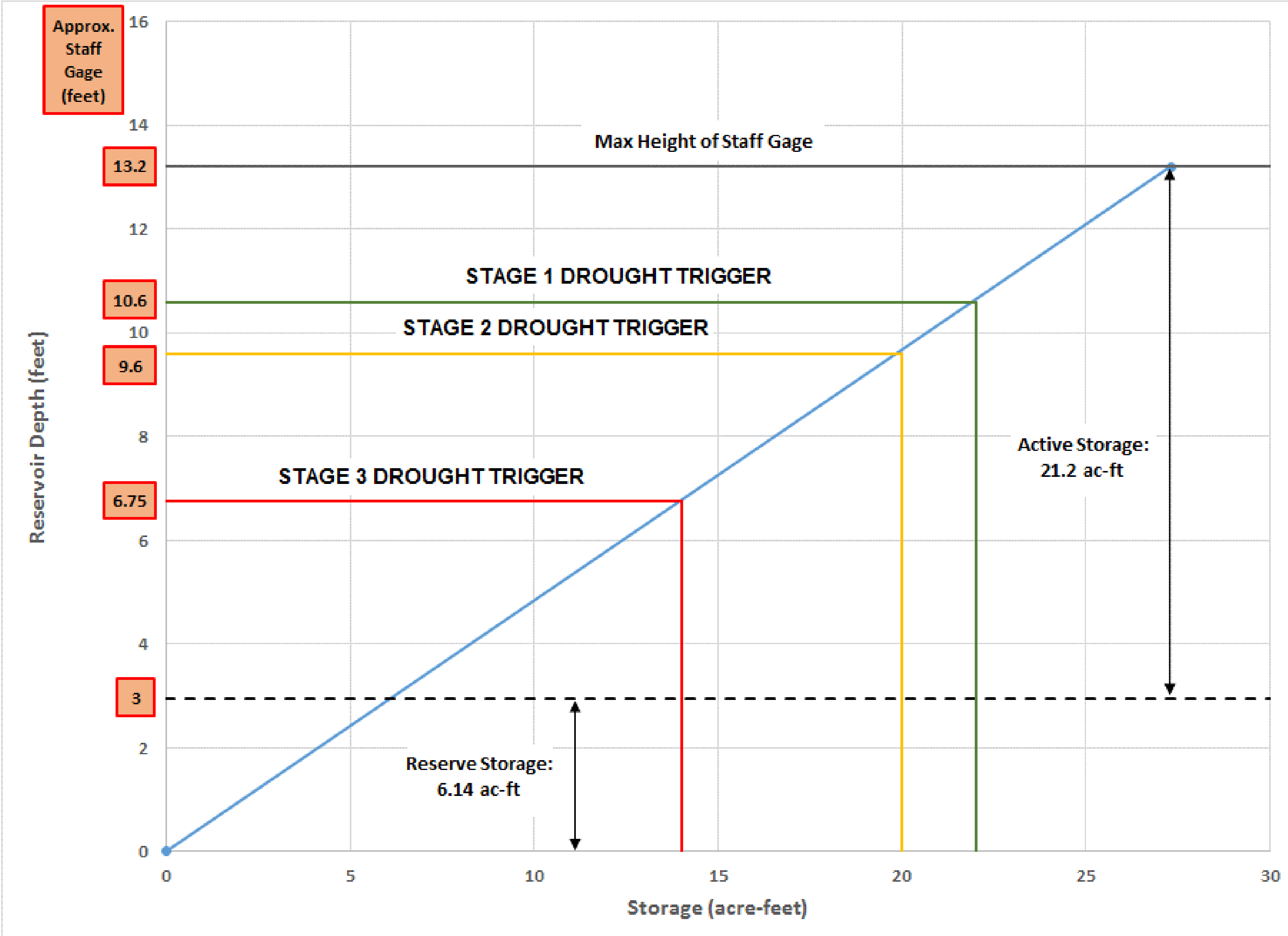

Figure 2-1
Estimated Plant Reservoir Storage Curve and Drought Triggers by Stage

2.2.2 Model Operation to Determine Safe and Firm Yields

The model created for the evaluations in this report followed the same guidelines as the URS model. The description of the general operation of the model has been excerpted from the May 2012 URS Report and is shown below:

> In general, the model operates on a monthly basis as follows:
>
> a. In any month, the total (gross) amount of water available for use is calculated to be the sum of the monthly runoff from North Canyon and Big Canyon Creeks in acre-feet multiplied by the diversion efficiency factor (80%).
>
> b. Water lost to the system is then estimated by calculating an evaporation loss for the treatment plant reservoir and evaporation and seepage losses for the off-stream reservoir if one is included in the case being evaluated.
>
> c. The net amount of water available is then calculated by subtracting the evaporation and seepage losses for the month from the gross amount of water available (item a. above).
>
> d. Monthly demand is calculated by taking the assumed annual total demand and multiplying by the monthly demand percentage.
>
> e. The monthly demand is then adjusted up to account for water needed for treatment plant backwashing. Based on treatment plant backwash flows estimated by the District for the last three years, the additional backwash water volume needed is approximately 4% of the volume of treated water sent to the storage tank to meet system demand. [**<u>Note</u>**: *Since the completion of the WSIP, the District has the ability to keep backwash flows in the system during drought conditions. Therefore, the model assumes no loss of backwash water from the system.*]
>
> f. The surplus or deficit of water for the month is then calculated by subtracting the adjusted demand (demand plus backwash) from the supply available.
>
> g. If supply exceeds demand, the system is considered adequate for the month. If, however, demand exceeds supply, the deficit (supply minus demand) is taken from storage.
>
> h. Demand is increased until the first failure of the supply system is noted. Failure is indicated by the complete depletion of any off-stream storage and the depletion of the active storage in the treatment plant reservoir, leaving only the emergency reserve (approximately 6 acre-feet). The

critical year and month are defined as those when the deficiency first appears over the period of record analyzed.

The same process described above is used to determine the firm yield of the system as well. Firm yield allows for some deficiency to exist between demand and supply in the critical dry years.

The minimum value for safe yield and firm yield occur for the existing system with no additional off-stream storage.

2.3 UPDATES FROM PREVIOUS MODEL

Firm and safe yields were re-calculated with data included from water years (WYs) 2015 and 2016. WY 2015 (October 2014 through September 2015) was a critical year for the District, being the last year of a severe 4-year state-wide drought.

2.4 SAFE YIELD OF THE SYSTEM

Table 2-4 shows the estimated annual safe yield determined using the model described above. The table also shows the controlling critical water year and month that established the safe yield value. Prior to the drought of 2015, previous analyses showed the drought in 1989 as the controlling critical water year. WY 1989 produced a slightly lower safe yield (165 acre-feet). Despite 2015 being a more critical year for water supply, the District's improvements increased storage capacity and therefore the safe yield.

Table 2-4
Annual Safe Yield without Off-Stream Storage

Scenario	Estimated Annual Safe Yield	Critical Water Year, Month
Existing system, lined treatment plant reservoir, reservoir active storage of 21.8 acre-feet (a)	170 acre-feet	2015, September

(a) Includes 600,000 gallons of storage tanks.

2.5 FIRM YIELD OF THE SYSTEM

The firm yield is defined as the water supply that fully meets demand in 95 out of 100 years.

Runoff data from water years 1993 through 2014 were unavailable so the "creek flow recurrence interval chart" (used to determine the 95% runoff for the firm yield calculation) was updated with data points from water years 2015 and 2016. It is recommended that the firm yield be updated as more stream flow data becomes available. The updated creek flow recurrence interval chart is included as Figure 2-2.

From Figure 2-2, it can be determined than an annual flow volume of 750 acre-feet would be equaled or exceeded 95% of the time based on available records. The demand that just causes the system to fail with this supply would be a reasonable estimate of the firm yield. Water year 1988 has a runoff of 805 acre-feet for the year, which is the closest value to 750 acre-feet. The runoff from this water year was run through the model for the safe yield calculation. The firm yield with the new data points is estimated as **207 acre-feet/year**.

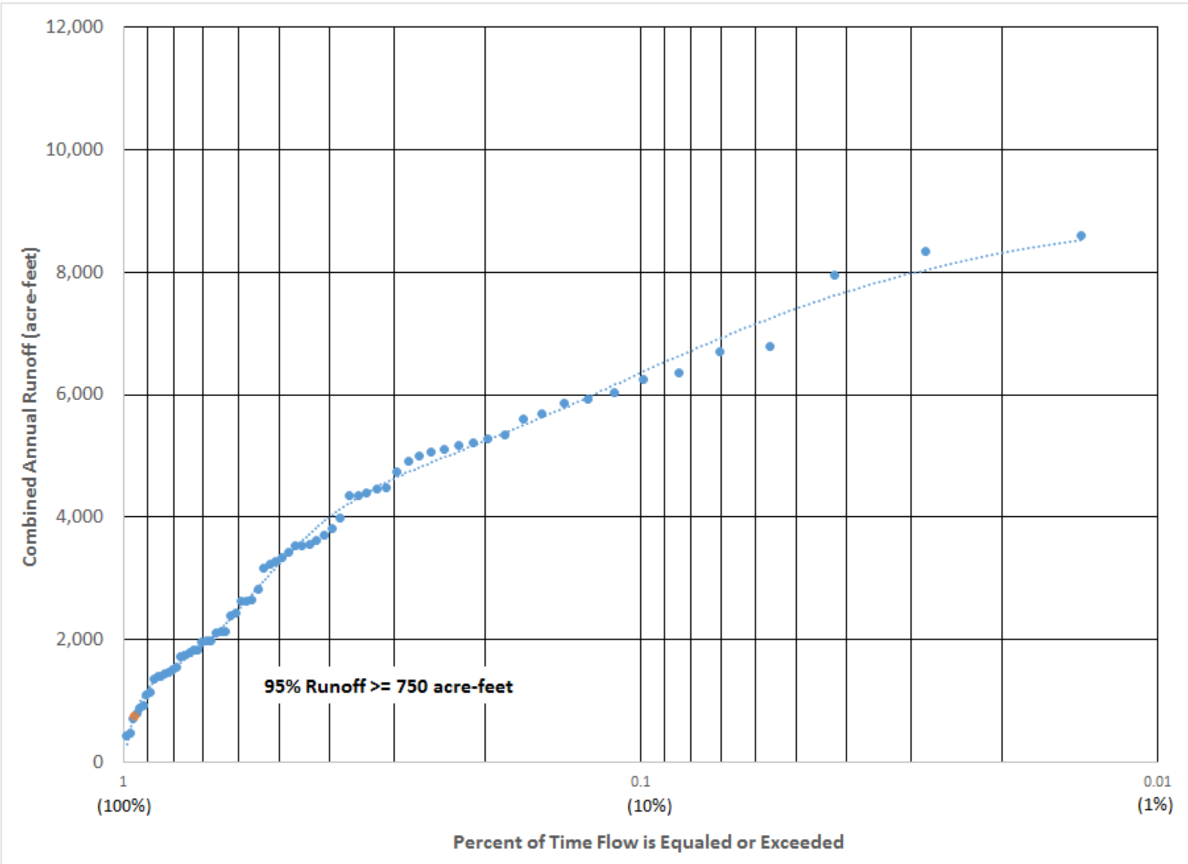

Figure 2-2
Creek Flow Recurrence Interval
(modified from the May 2012 URS Report)

Section 3

System Demand Evaluation

3.1 ESTIMATED DEMAND FROM METERED DATA

Tables 3-1 and 3-2 below show metered water usage by month from 2012 through March 2017 in both cubic feet (ft^3) and acre-feet. Table 3-3 shows the number of active meters by month from 2012 through March 2017. Table 3-4 shows usage per active metered connection (or dwelling unit (DU)) in acre-feet and includes yearly averages. These values were determined by dividing metered usage per month by the number of active meters per month (Table 3-2 divided by Table 3-3).

Table 3-1
Metered Usage from 2012 to 2017 (ft^3)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (ft^3)
2012	231,022	231,992	239,907	184,721	235,999	314,995	380,132	449,921	382,359	337,647	234,222	206,617	3,429,534
2013	253,981	208,620	191,938	215,552	314,289	381,467	426,079	474,536	410,696	294,526	265,627	317,081	3,754,392
2014	240,711	226,181	180,031	247,385	267,116	357,164	440,710	393,459	381,541	291,641	205,633	208,388	3,439,960
2015	245,352	185,468	183,158	231,318	210,467	255,512	330,212	340,108	318,814	263,046	195,694	188,137	2,947,286
2016	221,379	197,267	174,820	215,462	219,110	334,971	420,335	414,238	384,816	259,806	207,618	189,114	3,238,936
2017	213,246	267,425	178,271	---	---	---	---	---	---	---	---	---	---

Table 3-2
Metered Usage from 2012 to 2017 (acre-feet)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (ac-ft)
2012	5.3	5.3	5.5	4.2	5.4	7.2	8.7	10.3	8.8	7.8	5.4	4.7	78.7
2013	5.8	4.8	4.4	4.9	7.2	8.8	9.8	10.9	9.4	6.8	6.1	7.3	86.2
2014	5.5	5.2	4.1	5.7	6.1	8.2	10.1	9.0	8.8	6.7	4.7	4.8	79.0
2015	5.6	4.3	4.2	5.3	4.8	5.9	7.6	7.8	7.3	6.0	4.5	4.3	67.7
2016	5.1	4.5	4.0	4.9	5.0	7.7	9.6	9.5	8.8	6.0	4.8	4.3	74.4
2017	4.9	6.1	4.1	---	---	---	---	---	---	---	---	---	---

Table 3-3
Total Active Meters

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2012	579	583	582	581	582	581	579	580	582	582	583	582	581
2013	583	583	583	581	581	582	582	579	580	582	585	587	582
2014	587	585	585	584	583	583	585	585	586	588	588	588	586
2015	588	586	587	590	589	589	591	592	592	594	594	597	591
2016	595	594	596	596	598	595	596	596	597	598	599	599	597
2017	599	599	600	---	---	---	---	---	---	---	---	---	---

Table 3-4
Use per Active Metered Connection (acre-feet/month)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yearly Total
2012	0.009	0.009	0.009	0.007	0.009	0.012	0.015	0.018	0.015	0.013	0.009	0.008	0.135
2013	0.010	0.008	0.008	0.009	0.012	0.015	0.017	0.019	0.016	0.012	0.010	0.012	0.148
2014	0.009	0.009	0.007	0.010	0.011	0.014	0.017	0.015	0.015	0.011	0.008	0.008	0.135
2015	0.010	0.007	0.007	0.009	0.008	0.010	0.013	0.013	0.012	0.010	0.008	0.007	0.115
2016	0.009	0.008	0.007	0.008	0.008	0.013	0.016	0.016	0.015	0.010	0.008	0.007	0.125
2017	0.008	0.010	0.007	---	---	---	---	---	---	---	---	---	---
Average	0.009	0.009	0.007	0.009	0.010	0.013	0.016	0.016	0.015	0.011	0.009	0.009	**0.132**

The May 2012 URS Report averaged yearly usages for 2006 through October 2011. The URS report observed that metered usage dropped significantly in 2010 and 2011. The report stated that the drop could be associated with a noticeable increase in part-time residences due to the economic conditions at the time. As of 2017, the District estimated that about 1/3 of metered lots are part-time residents. The report therefore presented two values: an average of total yearly usage from 2006 through October 2011 (0.178 ac-ft/DU/year) and an average of total yearly values from 2006 through 2009, when the values were higher (0.19 ac-ft/DU/year).

The downward trend of water usage observed in 2010 and 2011 has continued through 2017. It may initially have been due to an increase in part-time residences, but the continuing trend was also due to the severe drought experienced state-wide from 2012 to 2016.

3.3 CURRENT DEMAND ESTIMATE

Results of the previous URS analysis and the one completed in this report are included in Table 3-5 below.

Table 3-5
Comparison of Annual Water Usage Factors

	Annual Water Usage (ac-ft/DU/year)
2012-2017 Grizzly Flats Metered Data	0.132
2009-2011 Grizzly Flats Metered Data (a)	0.178
2009-2006 Grizzly Flats Metered Data (a)	0.190
May 2012 URS Report Recommendation (a)	0.25
Previous B&A Usage Estimate (a)	0.42

(a) From May 2012 URS Report

As shown in Table 3-5 and as determined from the District's water meter data, demand values since 2006 have ranged from 0.132 to 0.19 acre-feet/DU/year.

It is recommended that these values be confirmed as more data is collected.

Section 4

Comparisons of Supply and Demand

4.1 PRESENT CONDITIONS FOR EXISTING SYSTEM

Table 4-1 below shows a comparison of the existing number of active meters and the approximate number of meters that could be served based on the safe and firm yields calculated in the previous section. The table also shows the variation in meters potentially served based on the upper and lower water use (demand) values described in Section 3.

Table 4-1
Comparison of Meters Served

Scenario (a)	Current Total Active Meters	Projected Total Meters Supported by Yield (b)	Projected Total Meters Supported by Yield (c)
Safe Yield Criteria (170 ac-ft/year)	608	1,288	895
Firm Yield Criteria (207 ac-ft/year)	608	1,568	1,089

(a) Lined reservoir
(b) Using a demand of 0.132 ac-ft/DU/year.
(c) Using a demand of 0.19 ac-ft/DU/year.

4.2 FUTURE DEMAND GROWTH

Build-out of the Grizzly Flats area assumes that all 1,225 parcels are built out and require water full time. Figure 4-1 shows projected growth (from previous reports), corrected to 1,225 from 1,252 assumed in the URS report. Figure 4-1 also shows actual recent growth from 2009 to 2017. Actual growth is far below projected growth. According to Grizzly Flats CSD staff, in a big development year, between 2 and 5 lots may be developed.

An analysis of off-stream reservoir size is not part of the scope of this report, but should be evaluated when growth and demand increase.

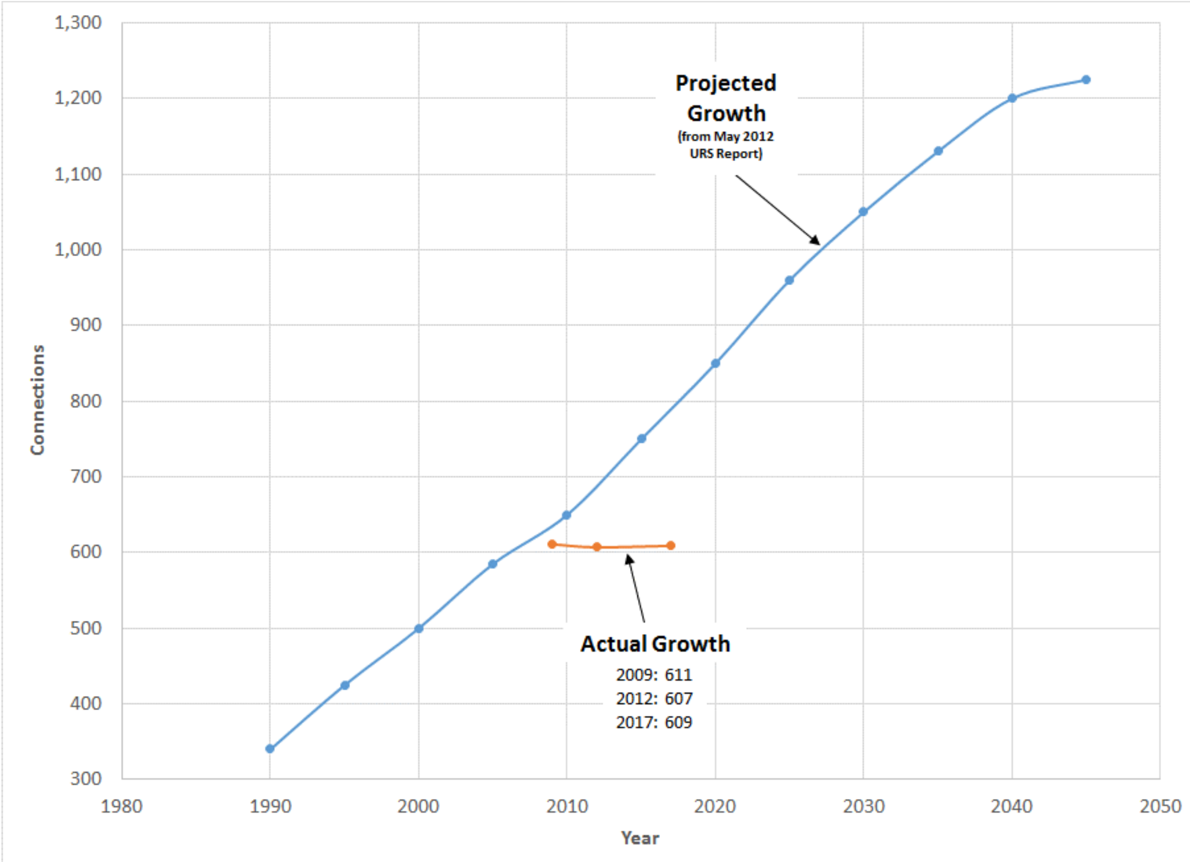

Figure 4-1
Projected Connection Growth
(modified from the May 2012 URS Report to reflect actual build-out of 1,225 parcels instead of 1,252)

Section 5

Findings and Recommendations

5.1 KEY FINDINGS

Table 5-1 below contains a summary of the key findings of this evaluation.

Table 5-1
Summary of Key Findings

Item	Value
Range of Demand Factors	0.132 to 0.19 ac-ft/DU/year
# of Active Meters (2017)	608
Estimated Safe Yield	170 acre-feet
# of meters that can be served using range of use factors and safe yield of 170 acre-feet	895 – 1,288 meters
Estimated Firm Yield	207 acre-feet
# of meters that can be served using range of use factors and firm yield of 207 acre-feet	1,089 – 1,568 meters

The potential number of metered connections determined in this report is higher than those determined in previous reports. This is due to the lower range of water use factors.

It is important to note that the yield estimates have not changed significantly from the 2012 analysis, in spite of the annual flows from North Canyon and Big Canyon Creeks measured at about half of the previous drought levels. In WY 2015 the combined annual flow was 465 acre-ft. During the 1988 drought, the combined annual flows were 805 acre-ft and in the 1961drought the combined flows were 881 acre-ft. However the safe yield calculations increased only slightly to 170 acre-feet. This is because most of the water generated in the watershed is not stored in the reservoir and the 2015 summertime spring flows were only slightly lower than the previous droughts.

In addition, Grizzly Flats has not experienced much growth over the last 10 years (Figure 4-1), which makes water supply planning more difficult. Table 5-1 estimates Grizzly Flats can accommodate at least an additional 287 meters (895 – 608) based on safe yield. Past planning estimates have shown over 600 new meters were possible at build-out (1,225 – 608). We recommend revisiting reservoir expansion planning when this analysis is updated five years from now.

5.2 SENSITIVITY

Variability in data can affect the results. Variables include:

- The beneficial effect of springs in the drainage basin on available runoff, particularly in the late summer months.
- Future environmental limitations on the amount of water that can be diverted to meet higher in-stream flow requirements in excess of those assumed in this and previous evaluation reports.
- The ability of the District to effectively divert all available water needed to meet demand at the diversion sites, and convey the water to the treatment plant.
- The assumed distribution of annual demand by month. A change in the distribution in critical summer months by one or two percent can significantly affect safe yield.

5.3 RECOMMENDATIONS

The following are recommendations for the District based on the evaluations completed in this report:

- As described above, continue to monitor demand to see if the downward trend in demand continues. Update use factor annually, if possible. If the growth rates were to increase back to that of the 1990s where about 20 homes per year were being constructed, start planning for additional reservoir capacity.
- Continue collecting runoff data from Big Canyon and North Canyon Creeks and update firm yield.
- Evaluate the addition of wells or an off-stream reservoir to the system to be able to meet future growth in the system. [from the May 2012 URS Report]

Appendix

Summary of Previous Water Supply and Demand Reports (excerpted from the May 2012 URS Report)

Appendix

Summary of Previous Water Supply and Demand Reports

A summary of previous reports, excerpted from the May 2012 URS Report, is included below.

A BORCALLI & ASSOCIATES, INC. (B&A) REPORT (1994)

B&A prepared the first comprehensive evaluation of water supply and demand for the system in 1994 (B&A, 1994). B&A subcontracted with Sierra Hydrotech (SH) to develop synthesized flow data for Big Canyon and Long Canyon Creeks because no recorded flow data from gages exists for the creeks. The synthesized flow data was extrapolated from gage data recorded for Sly Park Creek, which SH determined to have similar hydrological characteristics to Big Canyon and Long Canyon Creeks. The synthesized data covered water years 1925 through 1992 (note that SH ignored Sly Park Creek data from 1920 to 1924). SH also adjusted the synthesized hydrologic data to incorporate a correction suggested by the District to account for the suspected beneficial effects of springs on creek runoff in the late summer and early fall months. SH developed a model of the supply system that was used to evaluate safe yield for the system using the synthesized hydrologic data. Safe yield was estimated for various combinations of existing conditions at the time (reservoir leakage, evaporation, and the like), planned system improvements (reservoir lining, the addition of wells, and the like), and the addition of off-stream storage reservoirs to accommodate future system growth.

B&A assumed that the demand on the system would be 0.42 acre-feet per dwelling unit (DU) per year for full-time residences. This demand represented the average residence consumption calculated for the east side of the El Dorado Irrigation District (EID) service area using data from 1989 through 1991. It is possible that this demand included some commercial water use. B&A assumed the District served 150 full-time residences and 189 part-time residences at the time based on 1990 connection data. Treatment plant production records provided by the District, the split between part-time and full-time users, and the demand for full-time users (0.42 acre-feet per DU per year) were used to estimate the demand for the part-time residences, which was determined to be 0.113 acre-feet per DU per year.

B&A projected customer growth based on historical growth trends, projecting that build-out would occur in the year 2030 with 1,252 residences. Part-time occupancy was assumed to reduce each year and become zero after the year 2010.

The safe yield of the water supply system was determined to be 126.7 acre-feet. Table 1-1, taken from the 1994 B&A Report, summarizes the supply and demand findings.

As shown on the last two lines in Table 1, water demand was expected to exceed the supply (firm yield) sometime between 1990 and 1995. In order to meet the projected demand growth, B&A evaluated various system modifications that would be required, including, lining and expanding the existing treatment plant reservoir, rehabilitating an existing well, adding new wells, and adding new off-stream storage reservoirs. Modification costs were provided along with a schedule for implementing modifications to keep supply ahead of demand.

Table 1
Supply and Demand Findings, B&A (1994) (a)

	Year						
	1990	**1995**	**2000**	**2005**	**2010**	**2020**	**2030**
Dwelling Units							
Full-Time	150	280	469	706	1,000	1,190	1,252
Part-Time	189	200	181	114	0	0	0
Total	339	480	650	820	1,000	1,190	1,252
Water Demand							
Full-Time Residence Demand (ac-ft/DU/year)	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Full-Time Demand (ac-ft)	63	118	197	297	420	500	526
Part-Time Residence Demand (ac-ft/DU/year)	0.113	0.113	0.113	0.113	0.113	0.113	0.113
Part-Time Demand (ac-ft)	21	23	20	13	0	0	0
Total Demand (ac-ft)	84	141	217	310	420	500	526
Safe Yield (ac-ft)	126.7	126.7	126.7	126.7	126.7	126.7	126.7

(a) Taken from Table 2, B&A (1994); safe yield estimated assuming unlined water treatment plant reservoir with seepage losses and evaporation.

B B&A REPORT (1998)

B&A updated its 1994 evaluation of water supply and demand and issued an updated report in 1998 (B&A, 1998). Important modifications B&A made to the previous report included:

- Modifying projected system growth using District growth trends observed since the previous report was completed, and assuming future growth would parallel County growth projections estimated in the January 1994 version of the El Dorado County General Plan. The planning horizon for build-out within the District's system was also extended from 2030 to 2050.

- Modifying the monthly pattern of water use based on an evaluation of monthly treatment plant production data collected since 1994.

- Assuming that a 15 gallon per minute (gpm) well drilled by the District in 1994 near the Forest View tank could be used in critically dry years to meet system demand.

- Incorporating the new area-capacity curve for the treatment plant reservoir developed from a topographic survey performed in June 1996 by the El Dorado County Surveyor, GIS Division.

Using the additional treatment plant data collected since 1994, and assuming the demand for full-time residences remained at 0.42 acre-feet per DU per year, B&A revised the estimated water use for part-time residences from 0.113 acre-feet per DU per year to 0.087 acre-feet per DU per year. The change in the water use pattern, the revised area-capacity curve for the treatment plant reservoir, and the revised part-time residence demand lead to an increase in the safe yield of the supply system from 126.7 acre-feet to 143.5 acre-feet. If the 15 gpm well was added as a source of water in critical dry years, the safe yield would increase to 166.8 acre-feet.

Table 2, taken from the 1998 B&A Report, summarizes the updated water supply and demand findings. From the last two lines of the table, water demand was expected to exceed the supply beginning around the year 2000. In order to meet the projected demand, B&A again evaluated various system modifications and off-stream storage options that could be implemented to meet increasing demand.

Table 2
Supply and Demand Findings, B&A (1998) (a)

	1995	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Dwelling Units												
Full-Time	252	364	493	652	745	850	950	1,050	1,130	1,190	1,230	1,252
Part-Time	180	139	79	0	0	0	0	0	0	0	0	0
Total	432	503	572	652	745	850	950	1,050	1,130	1,190	1,230	1,252
Water Demand												
Full-Time Residence Demand (ac-ft/DU/year)	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Full-Time Demand (ac-ft)	106	153	207	274	313	357	399	441	475	500	517	526
Part-Time Residence Demand (ac-ft/DU/year)	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087
Part-Time Demand (ac-ft)	16	12	7	0	0	0	0	0	0	0	0	0
Total Demand (ac-ft)	122	165	214	274	313	357	399	441	475	500	517	526
Safe Yield (ac-ft)	166.8	166.8	166.8	166.8	166.8	166.8	166.8	166.8	166.8	166.8	166.8	166.8

(b) Taken from Table 3, B&A (1998); safe yield estimated assuming unlined water treatment plant reservoir and 15 gpm well available in critical dry years.

C WOOD RODGERS, INC. (WR) REPORT (2008)

In 2008, WR, formally B&A, prepared an evaluation for two new alternative off-stream reservoir sites identified as Spring Flats and Lincoln Hill. Results of the evaluation are presented in a report titled "Reconnaissance Study Off-Stream Storage Reservoir Sites, Lincoln Hill and Spring Flat" (WR, 2008). The Spring Flat site is too small to accommodate anything but a small reservoir with insufficient capacity, but the Lincoln Hill site can accommodate a reservoir with an active storage volume of 400 acre-feet or more and could be considered by the District as an alternative to meet projected future growth within the District.

D URS CORPORATION AMERICAS (URS) REPORT (AUGUST 2009)

In March 2009, URS entered into an agreement with the District to provide engineering services to update the B&A 1998 water supply and demand evaluation. Results of the study were provided in a Draft Water Supply and Demand Update Report dated August 2009 (URS, 2009).

Previous B&A reports assumed that the water demand would be 0.42 acre-feet per DU per year for full-time residences (equivalent to approximately 375 gallons per residence per day). This demand was considered high for the Grizzly Flats community that lacked significant commercial water use. To address this issue URS evaluated water treatment plant production data and metered water use data from the District's billing system to refine the monthly and annual system demand estimates. The El Dorado County Water Agency also prepared an estimate of water use per DU for a selected residential area of Pollock Pines, California, without commercial use for comparison with the demands being estimated from the District's use data. The demand for Pollock Pines was estimated to be 0.25 acre-feet per DU per year. In the URS 2009 report, the District's water use data and Pollock Pines data was averaged and the demand was estimated to be approximately 0.23 acre-feet per DU per year for full time residences. This demand is down significantly from 0.42 acre-feet per DU per year used in previous reports.

Some influence from part-time residences on system demand was incorporated by favoring the Pollock Pines data in the evaluation.

Another significant change included in the August 2009 report was an increase in assumed diversion efficiency from the creeks. Previous reports assumed that 75 percent (%) of the flows in Big Canyon and North Canyon Creeks would be divertible. The remaining 25% would be unavailable to the system. It includes water remaining in the creek to meet in-stream flow maintenance requirements (15%) and water unavailable for diversion (10%) when creek flows exceed the diversion capacity. URS increased the diversion efficiency to 80% by reducing the unavailable water percentage from 10% to 5%. The reduction is reasonable because the District would be proactive in diverting all available water into the system during the more critical summer and fall months each year. To further support the reduction, the District should also continue to be proactive in addressing suspected root intrusions or air accumulation in the gravity pipeline (air binding) whenever such conditions are suspected.

With the higher diversion efficiency, the safe yield was found to be 145 acre-feet with an unlined treatment plant reservoir and 162 acre-feet with a lined treatment plant reservoir. At the time of the study, District record showed that 611 meters were being served. Table 3 summarizes the water supply and demand findings relative to the conditions existing at the time the draft report was prepared.

Table 3
Supply and Demand Findings, URS (2009)

	Active Meters	Demand (ac-ft/DU/year)	Total Demand (ac-ft/year)	Safe Yield (ac-ft)
Existing System, Unlined Treatment Plant Reservoir	611	0.23	140.5	145
Existing System, Lined Treatment Plant Reservoir	611	0.23	140.5	162

(a) Taken from Table 10, URS (2009); Safe yield determined excluding 15 gpm well.

As in previous studies, the system demand with an unlined treatment plant reservoir remained close to the safe yield of the system.

The August 2009 Water Supply Demand Update Report remained in draft form. In August 2011, the District requested that URS update the draft report. This report is the update to the August 2009 draft report and supersedes that report.

E GRIZZLY FLATS COMMUNITY SERVICES DISTRICT WATER SUPPLY AND DEMAND UPDATE (URS, MAY 2012)

A summary of the findings from the May 2012 URS Report are included in Table 4 below.

Table 4
Supply and Demand Findings, URS (2012)

	Active Meters	Demand (ac-ft/DU/year)	Safe Yield (ac-ft)	Firm Yield (ac-ft)
Existing System, Unlined Treatment Plant Reservoir	611	0.25	149	166
Existing System, Line Treatment Plant Reservoir	611	0.25	165	184

(a) Taken from May 2012 URS Report; safe yield determined excluding 15 gpm well.