CHAPTER 3

SYSTEM ANALYSIS

3.1 SYSTEM DESIGN STANDARDS

Standardized performance and design criteria are essential for the efficient evaluation, construction and operation of a water utility. Establishing minimum criteria assures a base level of system reliability and enhances the utility's ability to assess system deficiencies and to plan for future improvements.

The City of Toppenish has established the following performance and design criteria for their water system:

1. Water Quality - The quality of water supplied to the system shall meet or exceed the requirements of the latest edition of the Department of Health (DOH) publication entitled State Board of Health - Drinking Water Regulations.

2. Average Daily Demand - This demand shall be equivalent to the daily consumption per service in a user category averaged for the period 2003-2009, except as otherwise adjusted to account for recent changes in demand trends as discussed in Chapter 2 of this Plan. These average day demand values are presented in Table 2-12.

3. Maximum Daily Demand - This demand shall be the equivalent to the maximum day of consumption per service in a user category, as calculated using the volume of water from the maximum day of production that occurred during the maximum month of consumption as described in Chapter 2 and presented in Table 2-14.

4. Peak Hour Demand - This demand shall be equivalent to the peak hour consumption per service in a user category, as calculated using a conservative estimate of 2 times the maximum day demand as shown in Table 2-14.

5. Storage Requirements - Storage requirements shall be based on providing minimum operational, equalizing, standby, and fire suppression storage for the entire water system as calculated using the DOH Water System Design Manual equations. The specific calculated storage requirements for the City of Toppenish are presented later in this chapter.

6. Flow Rates - Pipelines shall be sized for a maximum allowable water flow velocity of 7 feet per second (fps) for system demands, which equals the maximum instantaneous demand (peak hour flow). Pipeline velocities for fire flow conditions shall be permitted to exceed 7 fps. The basis for pipe size design shall be per computer model analysis.

7. Multiple Sources - The City of Toppenish currently has five primary source wells in service and will apply for new water rights and develop new sources as demand requires.

8. Fire Flow Storage Requirements - Storage requirements for fire flow shall be based on providing 3,000 gallons per minute for a 3-hour duration, which equals 540,000 gallons, as established by the City of Toppenish Fire Department. Additional fire suppression storage and fire flow capacity requirements are discussed later in this Chapter.

9. System Pressures - The City of Toppenish water system currently has only one pressure zone. The minimum service pressure under maximum instantaneous domestic demand conditions shall be 30 pounds per square inch (psi). Under fire flow conditions, the minimum fire hydrant residual pressure shall be 20 psi. Additional information regarding system pressure requirements under specific hydraulic analysis scenarios is presented later in this chapter.

10. Minimum Pipe Sizes - The minimum pipe size allowed within the system shall be 8-inch diameter. Where fire flow requirements exceed 1,000 GPM, the minimum pipeline size shall be determined by hydraulic analysis.

Standards for water main construction in the City of Toppenish are included in Chapter 10 of this Plan.

3.2 WATER QUALITY

A public water utility must supply safe and aesthetically pleasing water to its customers. However, source waters of most water utilities vary in the types and amounts of impurities which have been acquired during their passage through atmosphere, ground surfaces, or underground strata. To assure that all drinking waters maintain a standard level of quality, acceptable limits of contaminants have been established in the WAC Chapter 246-290, Group A Public Water Supplies, effective January 4, 2010 (DOH Pub No. 331-010, Rev. 11-09).

These standards of acceptability establish "maximum contaminant levels" (MCL) for bacteriological, inorganic chemical and physical, and other elements. The Regulations also set forth procedures to be followed if the MCL limits are exceeded.

The City of Toppenish monitors its system's water quality in accordance with the requirements of WAC 246-290-300 and 246-290-310. Follow-up action, if required, is completed in accordance with the requirements of WAC 246-290-320 and the Groundwater Rule (GWR). Bacteriological monitoring is performed at ten (10) locations within the water system in accordance with the City's Coliform Monitoring Plan. Inorganic chemical testing, volatile organic chemical (VOC) testing, synthetic organic chemical (SOC) testing and radiological testing is performed on the City's source wells.

3.2.1 Source Water Sampling and Testing

Inorganic Chemical Monitoring: Water quality monitoring for inorganic chemical and physical parameters is required from each source every three years. Toppenish collects water samples for inorganic chemical and physical testing prior to introduction into the distribution system.

Results of Toppenish's latest source inorganic chemical and physical analysis, summarized in Tables 3-1 and 3-2, show the City to be in compliance with State standards, with the exception of the secondary standard for manganese at Well No. 6 (S06) and Well No. 7 (S07). Highlighted cells in the tables represent samples that exceed the MCL. Copies of the most recent test results for the source wells are provided in Chapter 10 of this Plan.

TABLE 3-1 INORGANIC (PRIMARY SUBSTANCES) CHEMICAL ANALYSIS SUMMARY						
Chemical or Physical Property	MCL (mg/l)	Well No. 3 07/24/2007	Well No. 5 10/09/2007	Well No. 6 10/09/2007	Well No. 7 10/09/2007	Well No. 8 10/09/2007
Antimony (Sb)	0.0060	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Arsenic (As)	0.01	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Barium (Ba)	2.0	0.0070	0.0070	0.0310	0.0490	0.0040
Beryllium (Be)	0.0040	<0.0002	<0.0003	<0.0002	<0.0002	<0.0002
Cadmium (Cd)	0.0050	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Chromium (Cr)	0.05	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047
Copper (Cu)*	1.3	0.0182	<0.0026	<0.0020	<0.0020	<0.0020
Cyanide (HCN)	0.2	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
Fluoride (F)	4.0	1.1300	0.1300	0.57	0.7800	0.1300
Lead (Pb)*	0.015	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Mercury (Hg)	0.0020	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Nickel (Ni)	0.10	<0.0100	<0.0100	<0.0100	<0.0100	<0.0100
Nitrate (as N)	10.0	1.5800	1.4000	<0.0500	<0.0500	0.3800
Nitrite (as N)	1.0	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Selenium (Se)	0.050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Sodium (Na)*	20	9.0500	8.2000	19.2000	24.4000	6.9500
Thallium (Tl)	0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* No DOH Established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.

TABLE 3-2 INORGANIC (SECONDARY SUBSTANCES) CHEMICAL ANALYSIS SUMMARY						
Chemical or Physical Property	MCL (mg/l)	Well No. 3 07/24/2007	Well No. 5 10/09/2007	Well No. 6 10/09/2007	Well No. 7 10/09/2007	Well No. 8 10/09/2007
Chloride (Cl)	250.0	4.6100	4.3800	1.7800	2.2800	1.2200
Fluoride (F)	2.0	1.1300	0.1300	0.57	0.7800	0.1300
Iron (Fe)	0.30	0.0128	0.0172	0.0499	0.0620	0.0213
Manganese (Mn)	0.050	<0.0020	<0.0020	0.0905	0.1120	<0.0020
Silver (Ag)	0.050	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047
Sulfate (SO_4)	250.0	8.4800	8.0400	<0.1000	<0.1000	3.1400
Zinc (Zn)	5.0	<0.0200	<0.0200	<0.0200	<0.0200	<0.0200
Color	15	<4.0000	<4.0000	<4.0000	<4.0000	<4.0000
Hardness	N/A	90.7000	80.6000	38.6000	52.3000	44.8000
Conductivity	700 umhos/cm	222.0000	201.0000	162.0000	207.0000	119.0000

Tables 3-3 through 3-7 present both the latest, and previously conducted inorganic chemical analysis test results for all source wells. The results indicate that water quality in each of the wells has not significantly changed over time.

TABLE 3-3 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 3

Chemical or Physical Property	MCL (mg/l)	01/20/2000	08/05/2003	07/12/2004	07/24/2007
Primary Substances					
Antimony (Sb)	0.006	<0.0050	<0.0050	<0.0050	<0.0050
Arsenic (As)	0.01	<0.0100	<0.0020	<0.0020	<0.0020
Barium (Ba)	2	<0.1000	0.0050	0.0060	0.0070
Beryllium (Be)	0.004	<0.0030	<0.0002	<0.0002	<0.0002
Cadmium (Cd)	0.005	<0.0020	<0.0003	<0.0003	<0.0003
Chromium (Cr)	0.05	<0.0100	<0.0047	<0.0047	<0.0047
Copper (Cu)*	1.3	<0.2000	0.2750	0.0052	0.0182
Cyanide (HCN)	0.2	<0.0500	<0.0100	<0.0100	<0.0100
Fluoride (F)	4	1.3000	4.1900	0.1200	1.1300
Lead (Pb)*	0.015	0.0090	0.0028	0.0019	<0.0005
Mercury (Hg)	0.002	<0.0005	<0.0003	<0.0003	<0.0003
Nickel (Ni)	0.1	<0.0400	<0.0100	<0.0100	<0.0100
Nitrate (as N)	10	2.0000	0.5900	0.8600	1.5800
Nitrite (as N)	1		<0.0700	<0.0700	<0.0500
Selenium (Se)	0.05	<0.0050	<0.0050	<0.0050	<0.0050
Sodium (Na)*	20	8.7000	10.4000	7.3800	9.0500
Thallium (Tl)	0.002	<0.0020	<0.0010	<0.0010	<0.0010
Secondary Substances					
Chloride (Cl)	250	<20.0000	4.0000	4.2800	4.6100
Fluoride (F)	2	1.3000	4.1900	0.1200	1.1300
Iron (Fe)	0.3	<0.1000	0.5840	<0.0097	0.0128
Manganese (Mn)	0.05	<0.0100	0.0133	<0.0020	<0.0020
Silver (Ag)	0.05	<0.0100	<0.0047	<0.0047	<0.0047
Sulfate (SO_4)	250	82.0000	9.1000	9.0400	8.4800
Zinc (Zn)	5	<0.2000	0.4000	0.0200	<0.0200
Color	15	<5.0000	25.0000	<4.0000	<4.0000
Hardness	N/A	91.0000	85.9000	81.5000	90.7000
Conductivity	700 umhos/cm	230.0000	223.0000	210.0000	222.0000

* No DOH Established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.

TABLE 3-4 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 5				
Chemical or Physical Property	MCL (mg/l)	06/11/1997	06/07/2000	10/09/2007
Primary Substances				
Antimony (Sb)	0.006	<0.0050	<0.0050	<0.0050
Arsenic (As)	0.01	<0.0100	<0.0100	<0.0020
Barium (Ba)	2	<0.1000	<0.1000	0.0070
Beryllium (Be)	0.004	<0.0020	<0.0030	<0.0003
Cadmium (Cd)	0.005	<0.0020	<0.0020	<0.0003
Chromium (Cr)	0.05	<0.0100	<0.0100	<0.0047
Copper (Cu)*	1.3	<0.0200	<0.2000	<0.0026
Cyanide (HCN)	0.2	<0.1000	<0.0500	<0.0100
Fluoride (F)	4	0.9000	0.8000	0.1300
Lead (Pb)*	0.015	<0.0020	<0.0020	<0.0005
Mercury (Hg)	0.002	<0.0005	<0.0005	<0.0003
Nickel (Ni)	0.1	<0.0400	<0.0400	<0.0100
Nitrate (as N)	10	2.4000	1.20000	1.4000
Nitrite (as N)	1			<0.0500
Selenium (Se)	0.05	<0.0050	<0.0050	<0.0050
Sodium (Na)*	20	8.0000	7.8000	8.2000
Thallium (Tl)	0.002	<0.0010	<0.0020	<0.0010
Secondary Substances				
Chloride (Cl)	250		<20.0000	4.3800
Fluoride (F)	2	0.9000	0.8000	0.1300
Iron (Fe)	0.3	<0.0500	<0.1000	0.0172
Manganese (Mn)	0.05	<0.0100	<0.0100	<0.0020
Silver (Ag)	0.05	<0.0100	<0.0100	<0.0047
Sulfate (SO_4)	250	<10.0000	<10.0000	8.0400
Zinc (Zn)	5	0.1000	<0.2000	<0.0200
Color	15		<5.0000	<4.0000
Hardness	N/A	90.0000	75.0000	80.6000
Conductivity	700 umhos/cm		200.0000	201.0000

* No DOH Established MCL. Represents EPA established “action levels” for lead and copper and recommended level for sodium.

TABLE 3-5 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 6				
Chemical or Physical Property	MCL (mg/l)	06/04/1997	06/07/2000	10/09/2007
Primary Substances				
Antimony (Sb)	0.006	<0.0050	<0.0050	<0.0050
Arsenic (As)	0.01	<0.0100	<0.0100	<0.0020
Barium (Ba)	2	<0.1000	<0.1000	0.0310
Beryllium (Be)	0.004	<0.0020	<0.0030	<0.0002
Cadmium (Cd)	0.005	<0.0020	<0.0020	<0.0003
Chromium (Cr)	0.05	<0.0100	<0.0100	<0.0047
Copper (Cu)*	1.3	<0.0200	<0.2000	<0.0020
Cyanide (HCN)	0.2	<0.1000	<0.0500	<0.0100
Fluoride (F)	4	0.9000	0.9000	0.57
Lead (Pb)*	0.015	<0.0020	<0.0020	<0.0005
Mercury (Hg)	0.002	<0.0005	<0.0005	<0.0003
Nickel (Ni)	0.1	<0.0400	<0.0400	<0.0100
Nitrate (as N)	10	<0.5000	<0.5000	<0.0500
Nitrite (as N)	1		<0.5000	<0.0500
Selenium (Se)	0.05	<0.0050	<0.0050	<0.0050
Sodium (Na)*	20	10.0000	10.0000	19.2000
Thallium (Tl)	0.002	<0.0010	<0.0020	<0.0010
Secondary Substances				
Chloride (Cl)	250		<20.0000	1.7800
Fluoride (F)	2	0.9000	0.9000	0.57
Iron (Fe)	0.3	<0.0500	<0.1000	0.0499
Manganese (Mn)	0.05	0.0280	0.0290	**0.0905**
Silver (Ag)	0.05	<0.0100	<0.0100	<0.0047
Sulfate (SO_4)	250	<10.0000	<10.0000	<0.1000
Zinc (Zn)	5	<0.0500	<0.2000	<0.0200
Color	15		5.0000	<4.0000
Hardness		42.0000	41.0000	38.6000
Conductivity	700 umhos/cm		140.0000	162.0000

* No DOH Established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.

TABLE 3-6 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 7				
Chemical or Physical Property	MCL (mg/l)	06/17/1997	06/07/2000	10/09/2007
Primary Substances				
Antimony (Sb)	0.006	<0.0050	<0.0050	<0.0050
Arsenic (As)	0.01	<0.0100	<0.0100	<0.0020
Barium (Ba)	2	<0.1000	<0.1000	0.0490
Beryllium (Be)	0.004	<0.0020	<0.0030	<0.0002
Cadmium (Cd)	0.005	<0.0020	<0.0020	<0.0003
Chromium (Cr)	0.05	<0.0100	<0.0100	<0.0047
Copper (Cu)*	1.3	<0.0200	<0.2000	<0.0020
Cyanide (HCN)	0.2	<0.1000	<0.0500	<0.0100
Fluoride (F)	4	1.0000	0.7000	0.7800
Lead (Pb)*	0.015	<0.0020	<0.0020	<0.0005
Mercury (Hg)	0.002	<0.0005	<0.0005	<0.0003
Nickel (Ni)	0.1	<0.0400	<0.0400	<0.0100
Nitrate (as N)	10	<0.5000	<0.5000	<0.0500
Nitrite (as N)	1		<0.5000	<0.0500
Selenium (Se)	0.05	<0.0050	<0.0050	<0.0050
Sodium (Na)*	20	23.0000	23.0000	24.4000
Thallium (Tl)	0.002	<0.0010	<0.0020	<0.0010
Secondary Substances				
Chloride (Cl)	250		<20.0000	2.2800
Fluoride (F)	2	1.0000	0.7000	0.7800
Iron (Fe)	0.3	<0.0500	0.1300	0.0620
Manganese (Mn)	0.05	0.1200	0.1200	0.1120
Silver (Ag)	0.05	<0.0100	<0.0100	<0.0047
Sulfate (SO_4)	250	<10.0000	<10.0000	<0.1000
Zinc (Zn)	5	<0.0500	<0.2000	<0.0200
Color	15		<5.0000	<4.0000
Hardness	N/A	54.0000	54.0000	52.3000
Conductivity	700 umhos/cm		220.0000	207.0000
* No DOH Established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.				

TABLE 3-7 INORGANIC CHEMICAL ANALYSIS RESULTS FOR WELL NO. 8			
Chemical or Physical Property	MCL (mg/l)	06/07/2000	10/09/2007
Primary Substances			
Antimony (Sb)	0.006	<0.0050	<0.0050
Arsenic (As)	0.01	<0.0100	<0.0020
Barium (Ba)	2	<0.1000	0.0040
Beryllium (Be)	0.004	<0.0030	<0.0002
Cadmium (Cd)	0.005	<0.0020	<0.0003
Chromium (Cr)	0.05	<0.0100	<0.0047
Copper (Cu)*	1.3	<0.2000	<0.0020
Cyanide (HCN)	0.2	<0.0500	<0.0100
Fluoride (F)	4	0.8000	0.1300
Lead (Pb)*	0.015	<0.0020	<0.0005
Mercury (Hg)	0.002	<0.0005	<0.0003
Nickel (Ni)	0.1	<0.0400	<0.0100
Nitrate (as N)	10	<0.5000	0.3800
Nitrite (as N)	1	<0.5000	<0.0500
Selenium (Se)	0.05	<0.0050	<0.0050
Sodium (Na)*	20	10.0000	6.9500
Thallium (Tl)	0.002	<0.0020	<0.0010
Secondary Substances			
Chloride (Cl)	250	<20.0000	1.2200
Fluoride (F)	2	0.8000	0.1300
Iron (Fe)	0.3	<0.1000	0.0213
Manganese (Mn)	0.05	0.0280	<0.0020
Silver (Ag)	0.05	<0.0100	<0.0047
Sulfate (SO_4)	250	<10.0000	3.1400
Zinc (Zn)	5	<0.2000	<0.0200
Color	15	7.5000	<4.0000
Hardness	N/A	41.0000	44.8000
Conductivity	700 umhos/cm	140.0000	119.0000
* No DOH Established MCL. Represents EPA established "action levels" for lead and copper and recommended level for sodium.			

Nitrate/Nitrite Monitoring: The City of Toppenish conducts annual monitoring for nitrate and nitrite on all City wells. The maximum contaminant level (MCL) for nitrate/nitrate is 10 mg/l. Nitrates that exceed this concentration in drinking water can be a health hazard, especially to infants below six months of age.

Test results for the period 2002 through 2008, summarized in Table 3-8, show the City to be in compliance with State standards. A copy of the nitrate/nitrite analysis test results are provided in Chapter 10 of this Plan.

TABLE 3-8 NITRATE / NITRITE CHEMICAL ANALYSIS RESULTS

	2002	2003	2004	2005	2006	2007	2008
Well No. 3							
Nitrate (NO_3-N)	2.0000	0.5900	0.8600	1.2400	1.5700	1.5800	1.5100
Nitrite (NO_2-N)		<0.0700	<0.0700	<0.0500	<0.0500	<0.0500	<0.0700
Total Nitrate / Nitrite		0.5900	0.8600	1.2400	1.5700	1.5800	1.5100
Well No. 5							
Nitrate (NO_3-N)	1.8000	1.3600	2.1300	1.6000	1.6900	1.4000	0.9300
Nitrite (NO_2-N)		<0.0700	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Total Nitrate / Nitrite		1.3600	2.1300	1.6000	1.6900	1.4000	0.9300
Well No. 6							
Nitrate (NO_3-N)	<0.5000	<0.0700	<0.0500	<0.0500	0.3600	<0.0500	<0.0500
Nitrite (NO_2-N)		<0.0700	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Total Nitrate / Nitrite		<0.5000	<0.5000	<0.5000	0.3600		<0.5000
Well No. 7							
Nitrate (NO_3-N)	<0.5000	<0.0700	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Nitrite (NO_2-N)		<0.0700	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Total Nitrate / Nitrite		<0.5000	<0.5000	<0.5000	<0.5000	<0.5000	<0.5000
Well No. 8							
Nitrate (NO_3-N)	<0.5000	0.3000	0.3600	0.4400	0.4000	0.3800	<0.0500
Nitrite (NO_2-N)		<0.0700	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
Total Nitrate / Nitrite		0.3000	0.3600	0.4400	0.4000	0.3800	<0.5000

Volatile Organic Chemical (VOC) Monitoring: VOC monitoring is required once every three months during the first year of testing. Samples are to be taken following water treatment. If no VOCs are detected during the first year's testing, future monitoring shall be at least every three years. Toppenish conducted VOC testing on its source wells as shown on Table 3-9.

TABLE 3-9 VOC TESTING

Well No. 3	Well No. 5	Well No. 6	Well No. 7	Well No. 8
07/12/2006	04/17/2006	03/30/2009	03/30/2009	03/30/2009
08/06/2003	06/12/2001	08/05/2003	08/06/2003	08/05/2003
06/07/2000				

Test results show the City to be in compliance with State standards. A copy of the VOC analysis test results is provided in Chapter 10 of this Plan.

Synthetic Organic Chemical (SOC) Monitoring: SOC monitoring is required once every three months during the first year of testing. Samples are to be taken following water treatment. If no SOCs are detected during the first year's testing, future monitoring shall be at least once every three years. A copy of the most recent SOC analysis test results for each source well is provided in Chapter 10 of this Plan.

Radionuclide Monitoring: For the City of Toppenish, radionuclide sampling from each source is required once every three years. Toppenish has completed radionuclide testing on its source wells as shown on Table 3-10.

TABLE 3-10 RADIONUCLIDE TESTING

Well No. 3	Well No. 5	Well No. 6	Well No. 7	Well No. 8
12/02/2005	09/27/2005	09/11/2007	12/02/2005	09/11/2007
05/31/2005	04/06/2005	10/18/2005	05/31/2005	03/19/2007
12/11/2003	12/11/2003	04/06/2005	12/11/2003	12/02/2005
		12/11/2003		05/31/2005
				12/11/2003

Test results show the City to be in compliance with State standards. A copy of the radionuclide analysis test results are provided in Chapter 10 of this Plan.

3.2.2 Distribution System Sampling and Testing

Bacteriological: Drinking water samples are required to be collected monthly at various locations throughout the water distribution system for bacteriological analysis in accordance with the City's Coliform Monitoring Plan. The minimum number of samples required to be collected by a water utility is based on the population served. The City of Toppenish is required to sample a minimum of ten (10) locations within the distribution system. The Coliform Monitoring Plan and representative copies of bacteriological analysis results are provided in Chapter 10 of this Plan.

Disinfection Byproducts (DBPs): Toppenish adds chlorine to its drinking water to kill or inactivate harmful organisms that may cause various diseases, and this process is known as disinfection. However, chlorine is a very active substance and it reacts with naturally occurring substances to form DBPs. The most common DBPs formed when chlorine is used are trihalomethanes (THMs) and haloacetic acids (HAAs).

Toppenish currently tests for DBPs in accordance with EPA's Stage 1 Disinfectants and Disinfection Byproducts Rule (Stage 1 DPBR Rule). Collection and analysis of drinking water samples from four (4) locations within the collection system are required periodically (based upon previous results) for DBPs in accordance with the City's Disinfection Byproducts Monitoring Plan. A copy of the Disinfection Byproducts Monitoring Plan is provided in Chapter 10 of this Plan.

In 2006, EPA enacted new rules for disinfection byproducts monitoring, Stage 2 Rule. Under the Stage 2 Rule, water systems will monitor at locations with the highest averages of total trihalomethanes (TTHMs) and haloacetic acids (HAAs). To determine these locations, the Stage 2 Rule will require many systems to complete an Initial Distribution System Evaluation (IDSE). Systems the size of Toppenish are required to complete and submit an IDSE report by July 10, 2010 and to begin routine Stage 2 monitoring by October 1, 2013. Costs for completion of the IDSE report in 2010 will be paid for with budgeted amounts for professional services as described in Chapter 9 of this Plan.

Table 3-11 provides a summary of the 2008 and 2007 DBP monitoring results for trihalomethanes (TTHMs), and Table 3-12 provides a summary of the 2008 and 2007 DBP monitoring results for haloacetic acids (HAAs). Copies of these monitoring results are provided in Chapter 10 of this plan.

TABLE 3-11 TTHM DBP MONITORING TEST RESULTS (all values are in µg/L)			
Analyte No.	Analyte Name	08/04/2008	08/27/2007
Location: 713 South Division			
0027	Chloroform	<0.2500	<0.2500
0028	Bromodichloromethane	<0.5000	<0.5000
0029	Dibromochloromethane	<1.5000	<1.5000
0030	Bromoform	<0.6000	<0.6000
0031	Total Trihalomethane	None Detected	None Detected
Location: 509 Buena Way			
0027	Chloroform	<0.2500	0.3000
0028	Bromodichloromethane	<0.5000	0.5000
0029	Dibromochloromethane	<1.5000	0.6000
0030	Bromoform	<6.0000	1.4000
0031	Total Trihalomethane	None detected	<0.6000
Location: 141 Ward Road			
0027	Chloroform	<0.2500	0.8000
0028	Bromodichloromethane	0.5000	0.9000
0029	Dibromochloromethane	0.5000	0.9000
0030	Bromoform	<0.6000	<0.6000
0031	Total Trihalomethane	1.0000	2.6000
Location: 501 Annahat Road			
0027	Chloroform	0.7000	1.5000
0028	Bromodichloromethane	0.7000	1.4000
0029	Dibromochloromethane	0.6000	1.1000
0030	Bromoform	<0.6000	0.3000
0031	Total Trihalomethane	2.0000	4.3000

TABLE 3-12 HAA5-HALO-ACETIC ACIDS DBP MONITORING TEST RESULTS
(all values are in µg/L)

Analyte No.	Analyte Name	08/04/2008	08/27/2007
Location: 713 South Division			
0411	Monochloroacetic Acid	<2.0000	<2.0000
0412	Dichloroacetic Acid	<1.0000	<1.0000
0413	Trichloroacetic Acid	<1.0000	<1.0000
0414	Monobromoacetic Acid	<1.0000	<1.0000
0415	Dibromoacetic Acid	<1.0000	<1.0000
0416	HAA(5)	<15.0000	<15.0000
0417	Bromochloroacetic Acid	<1.0000	<1.0000
Location: 509 Buena Way			
0411	Monochloroacetic Acid	<2.0000	<2.0000
0412	Dichloroacetic Acid	<1.0000	<1.0000
0413	Trichloroacetic Acid	<1.0000	<1.0000
0414	Monobromoacetic Acid	<1.0000	<1.0000
0415	Dibromoacetic Acid	<1.0000	<1.0000
0416	HAA(5)	<15.0000	<15.0000
0417	Bromochloroacetic Acid	<1.0000	<1.0000
Location: 141 Ward Road			
0411	Monochloroacetic Acid	<2.0000	<2.0000
0412	Dichloroacetic Acid	<1.0000	<1.0000
0413	Trichloroacetic Acid	<1.0000	<1.0000
0414	Monobromoacetic Acid	<1.0000	<1.0000
0415	Dibromoacetic Acid	<1.0000	<1.0000
0416	HAA(5)	<15.0000	<15.0000
0417	Bromochloroacetic Acid	<1.0000	<1.0000
Location: 501 Annahat Road			
0411	Monochloroacetic Acid	<2.0000	<2.0000
0412	Dichloroacetic Acid	<1.0000	<1.0000
0413	Trichloroacetic Acid	<1.0000	<1.0000
0414	Monobromoacetic Acid	<1.0000	<1.0000
0415	Dibromoacetic Acid	<1.0000	<1.0000
0416	HAA(5)	<15.0000	<15.0000
0417	Bromochloroacetic Acid	<1.0000	<1.0000

3.2.3 Future Source Water and Distribution System Sampling and Testing

A summary of future source and distribution system monitoring requirement frequencies, dates and sample status, as provided in the City's 2009 Water Quality Monitoring Report (WQMR), is provided below in Table 3-14 and Table 3-15, respectively. A copy of the City's 2009 WQMR is provided in Chapter 10 of this Plan.

TABLE 3-14 FUTURE SOURCE WATER SAMPLING REQUIREMENTS

Sample Type	Frequency	Last Sample	Next Sample	Status
Well No. 3 (S03)				
Inorganic Chemicals (IOC)	Once/3 Years	July 2007	July 2010	Within MCLs
Nitrate/Nitrite	Once/Year	July 2008	July 2009	Within MCLs
Volatile Organic Chemicals (VOCs)	Once/3 Years	July 2006	July 2010	Within MCLs
Synthetic Organic Chemicals (SOCs)	Once/3 Years	December 2001	April 2009[a]	Within MCLs
Radionuclide	Once/3 Years	December 2005	August 2009	Within MCLs
Well No. 5 (S05)				
Inorganic Chemicals (IOC)	Once/3 Years	October 2007	Waiver[b]	Within MCLs
Nitrate/Nitrite	Once/Year	March 2008	March 2009	Within MCLs
Volatile Organic Chemicals (VOCs)	Waiver[c]	April 2006	Waiver[c]	Within MCLs
Synthetic Organic Chemicals (SOCs)	Waiver[c]	June 2001	Waiver[c]	Within MCLs
Radionuclide	Once/3 Years	Sept. 2005	Sept. 2009	Within MCLs
Well No. 6 (S06)				
Inorganic Chemicals (IOC)	Once/3 Years	October 2007	Waiver[b]	Secondary MCL exceeded for Mn
Nitrate/Nitrite	Once/Year	Sept 2008	Sept 2009	Within MCLs
Volatile Organic Chemicals (VOCs)	Once/3 Years	August 2003	March 2009	Within MCLs
Synthetic Organic Chemicals (SOCs)	Once/3 Years	NA	April 2009[a]	NA
Radionuclide	Once/3 Years	Sept. 2007	October 2009	Within MCLs
Well No. 7 (S07)				
Inorganic Chemicals (IOC)	Once/3 Years	October 2007	Waiver[b]	Secondary MCL exceeded for Mn
Nitrate/Nitrite	Once/Year	March 2008	March 2009	Within MCLs
Volatile Organic Chemicals (VOCs)	Once/3 Years	August 2003	March 2009	Within MCLs
Synthetic Organic Chemicals (SOCs)	Once/3 Years	NA	April 2009[a]	NA
Radionuclide	Once/3 Years	December 2005	November 2009	Within MCLs
Well No. 8 (S08)				
Inorganic Chemicals (IOC)	Once/3 Years	October 2007	Waiver[b]	Within MCLs
Nitrate/Nitrite	Once/Year	March 2008	March 2009	Within MCLs
Volatile Organic Chemicals (VOCs)	Once/3 Years	August 2003	March 2009	Within MCLs
Synthetic Organic Chemicals (SOCs)	Once/3 Years	NA	April 2009[a]	NA
Radionuclide	Once/3 Years	Sept. 2007	December 2009	Within MCLs

[a] Insecticide panel waived through December 2010.
[b] Complete IOC not required until after December 2010.
[c] Waived through December 2010.

TABLE 3-15 FUTURE DISTRIBUTION SYSTEM SAMPLING REQUIREMENTS				
Sample Type	Frequency	Last Sample	Next Sample	Status
Coliform Bacteria	10/Month	December 2008	January 2009	Within MCLs
Disinfection Byproducts	Once/Year	August 2008	August 2011	Within MCLs
Lead & Copper	Twenty/3 Years	July 2006	July 2009	No. 13 Exceeded EPA Action Level
Asbestos	Once/9 Years*	July 2009	July 2012	Within MCLs
* Per 40 CFR 141.23(b), one sample during the first three-year compliance period of each nine-year compliance cycle. The next compliance cycle begins January 1, 2011.				

Future sampling requirements are discussed further in Chapter 6 of this Plan. The City's 2009 and future WQMRs should be consulted regarding the dates for future testing.

3.3 SYSTEM DESCRIPTION AND ANALYSIS

The existing City of Toppenish domestic water system consists of a single distribution pressure level, which is served by three water storage reservoirs with a combined total capacity of 1.7 million gallons (MG), only 1.26 MG of which is available above the minimum 20 psi service elevation. The range of static pressures throughout the water distribution system at the normal maximum hydraulic grade line of 898 feet is between 56 and 69 psi (elevation 770 to 740 feet). The location of existing reservoirs and the existing maximum service elevation boundary of 770 feet are shown on Figure 3-1, Water System Map. The City is capable of serving future development up to this elevation, but any proposed future development above 770 feet may require the construction of a new booster pump station and/or reservoir to establish an intermediate pressure zone.

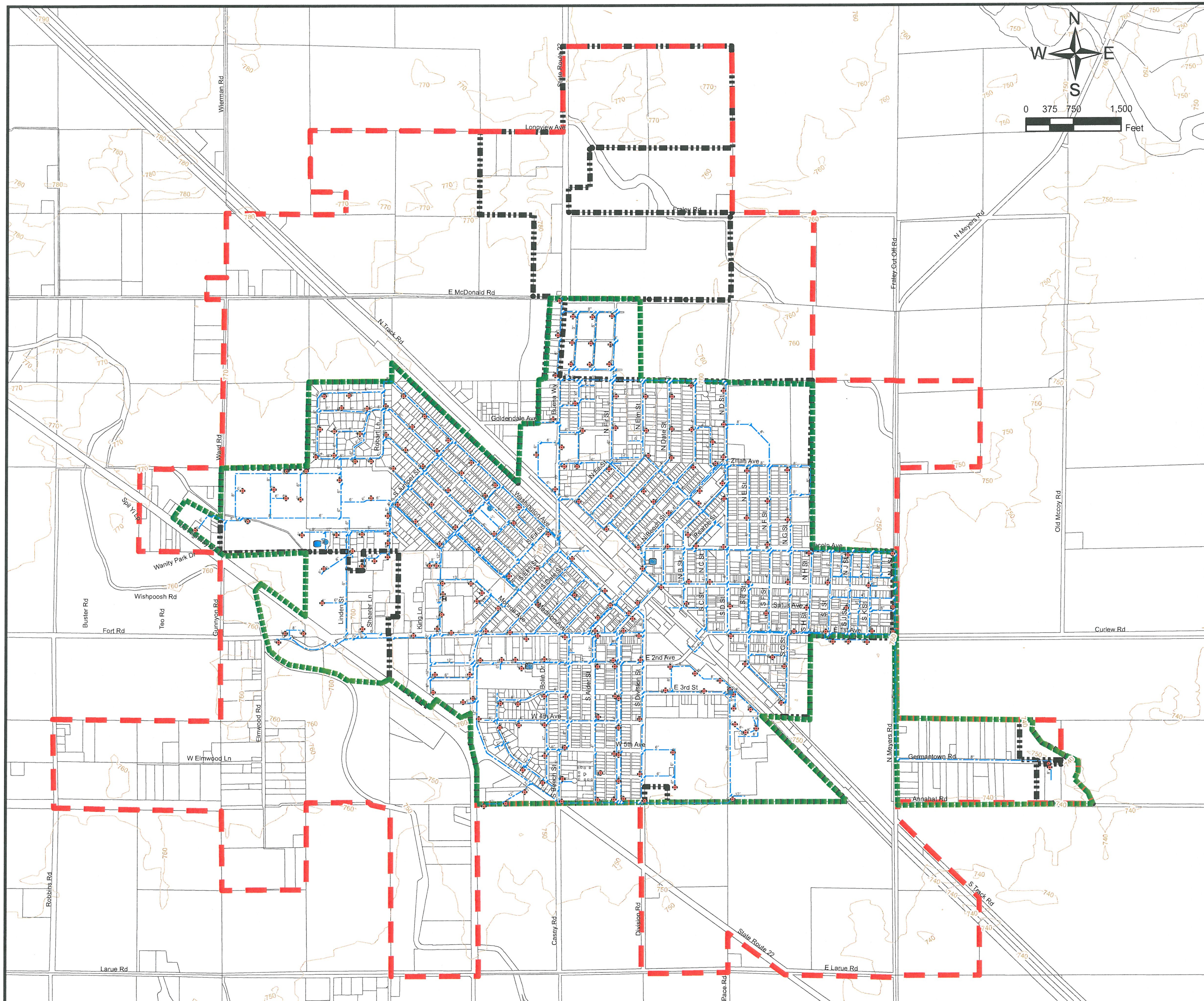
The City is supplied water from five primary source wells. The maximum combined pumping capacity of the five wells is 4,075 GPM or 5.87 million gallons per day. In addition, the City has three source wells currently not in service. The City holds 10-year renewable existing use permits from the Yakama Nation for each of its source wells, with a combined total instantaneous quantity of 4,215 GPM. The City's total existing water rights issued by the Department of Ecology are equal to 2,000 GPM and 3,200 acre-feet per year (1,042.65 MG). Water treatment at each of the source wells includes both disinfection and fluoridation.

The existing transmission and distribution system is looped where possible and consists of mainly four-inch and larger ductile or cast iron pipes. A telemetry system located at the Public Works shop controls the pump operations based on the water levels in the reservoirs. Figure 3-1 and Map A, enclosed in the back pocket of this Plan, show the location of major water system components.

CITY OF TOPPENISH

Water System Plan Update

WATER SYSTEM MAP



Legend

- Back Flow Preventer
- Fire Hydrant
- Reservoir
- Valve
- Well
- Water Main
- Existing Service Area
- City Limits
- Future Service Area/ Service Area (UGA Boundary)

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5-28-10
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FIGURE 3-1

3.3.1 Water Sources

The City of Toppenish has a total of five active source wells; all are located on City-owned property, as shown on Figure 3-1 and Map A, enclosed in the back of this Plan. The following are descriptions of the City's current well and pump installations:

Well No. 3 (S03): Well No. 3 is located next to Reservoir No. 2 in the City's Swimming Pool Park, near the intersection of Asotin Avenue and South Alder Street, as shown on Figure 3-1. The well was constructed in 1937 to a depth of 188 feet. When last measured in 1994, the static water level within the well was 14 feet 2 inches.

Water is withdrawn from Well No. 3 with a Johnston vertical line-shaft turbine pump (Model No. GD 1203) that was installed in 1994. The pump is powered by a 50 horsepower, 220/440 volt, 3 phase, U.S. Electric Hollowshaft motor. The well originally produced 700 GPM, and in 1970 it pumped 650 GPM. The current well capacity is approximately 495 GPM.

The well and pump are housed in a stucco building that is heated and ventilated. A Water Specialities flow meter, installed in the discharge line, is located in a concrete vault adjacent to the well building. The pump controls, disinfection equipment (a Wallace & Tiernan V-100 automatic gas chlorinator and a Scaletron scale) and fluoridation equipment are located in a second building next to the well and pump building. Information regarding Well No. 3 is summarized on Table 3-16 below.

TABLE 3-16 TOPPENISH WELL NO. 3 INFORMATION	
Date Constructed	1937
Well Depth	188 feet
Casing Depth/Diameter	0 to 187 feet/16-inch
Casing Perforation/Screen Depth	50 to 180 feet
Static Water Level	1994: 14'-2" below ground level
Pump Information Manufacturer Type Model No. Year Installed Stages	 Johnston Line-shaft Turbine GD 1203 1994 6
Motor Information Manufacturer Horsepower RPM Voltage Phase	 U.S. Electric Hollowshaft High Thrust 50 1,800 220 / 440 3
Current Well Capacity	495 GPM

Well No. 5 (S05): Well No. 5 is located in Olney Park near the intersection of Adams Avenue and South Hawthrone Street, as shown on Figure 3-1. The well was drilled in 1952 to a depth of 291 feet and was then rehabilitated in 1954. Water is withdrawn from the well using a Berkely pump, powered by a 75 horsepower, 220/440 volt, 3 phase, 1,800 RPM U.S. Motor. A Sparling flow meter, installed on the discharge pipe, is located under the concrete floor of the well house. The well currently produces 810 GPM. The static water level of this well was measured at 14 feet 4 inches in 1994.

The pump is housed in a concrete block building that is heated and ventilated. The building has a separate chlorine room, which is accessed from the outside and houses a Wallace & Tiernan V-100 automatic gas chlorinator and a Scaletron scale. The chlorine room currently does not have a heater to prevent freezing during the winter months. The fluoride injector is also housed within a separate room in the building. Backup power to the well is supplied by a Manga Max 192 hp diesel engine generator located in the well building adjacent to the well pump. Information regarding Well No. 5 is summarized on Table 3-17 below.

TABLE 3-17 TOPPENISH WELL NO. 5 INFORMATION	
Date Constructed	1952
Well Depth	291 feet
Casing Depth/Diameter	0 to 240 feet/16-inch
Casing Perforation/Screen Depth	50 to 180 feet
Static Water Level	1994: 14'-4" inches below ground level
Pump Information Manufacturer Type Model No. Year Installed Stages	 Berkely Line-shaft Turbine 1004H-5 1999 NA
Motor Information Manufacturer Horsepower RPM Voltage Phase	 U.S. Motor 75 1,800 220 / 440 3
Current Well Capacity	810 GPM

Well No. 6 (S06): Constructed in 1959 to a depth of 863 feet, Well No. 6 is located in Pioneer Park by Reservoir No. 3, as shown on Figure 3-1. Water is withdrawn from the well using a vertical line-shaft turbine pump, powered by a 10 horsepower, 230-460 volt, 3 phase, 1,740 RPM U.S. Motor. When constructed, the well produced 1,000 GPM. However, at that production rate, the well produced a significant amount of sand. The well currently produces 195 GPM. In 1994 this well was under artesian pressure.

The pump is housed in a concrete block building that is heated and ventilated. A Water Specialities flow meter, installed in the discharge line, is located under the concrete floor of the pump house. Within this pump house is a separate chlorine room which houses a Wallace & Tiernan V-100 automatic gas chlorinator and a Scaletron scale. The fluoridation equipment is also housed within a separate room in the pump house. The chlorination and fluoridation equipment located in this building serves both Well No. 6 and nearby Well No. 8. Well No. 6 and Well No. 8 are also both supplied backup power from the same Generac diesel engine generator, which is housed in an outdoor enclosure adjacent to the Well No. 6 building. Information regarding Well No. 6 is summarized on Table 3-18 below.

TABLE 3-18 TOPPENISH WELL NO. 6 INFORMATION	
Date Constructed	1959
Well Depth	863 feet
Casing Depth/Diameter	0 to 783 feet/16-inch 763 to 803 feet/10-inch riser pipe
Casing Perforation/Screen Depth	803 to 863 feet/12-inch well screen
Static Water Level	1994: Artesian
Pump Information Manufacturer Type Model No. Year Installed Stages	 NA Line-shaft Turbine NA 1959 NA
Motor Information Manufacturer Horsepower Voltage Phase	 U.S. Electric 10 230 / 460 3
Current Well Capacity	195 GPM

Well No. 7 (S07): Well No. 7 is located on the west side of Magnolia Street, south of the intersection with Jackson Street, near Reservoir No. 4, as shown on Figure 3-1. The well was drilled in 1973 to a depth of 1,024 feet. Water is withdrawn from the well using an Aurora Vertiline six-stage pump, powered by a 300 horsepower, 460 volt, 3 phase, 1,770 RPM General Electric motor. The well currently produces 2,200 GPM. In 1994 this well was under artesian pressure.

The well and pump are housed in a sheet metal building. A Sparling flow meter, installed in the discharge line, is located in a concrete vault adjacent to the well builidng. Electrical controls for the pump motor, disinfection equipment, fluoride feed equipment, and pump control valve are located in a nearby masonry block building. The disinfection equipment is a Wallace & Tiernan V-100 automatic gas chlorinator, a Scaletron scale, and a Capital Controls Model 1610 gas detector. The well is equipped with an Aptech 387 hp diesel engine generator located outside but adjacent to the electrical control building. Both the pump house and the electrical control building are heated and ventilated. Information regarding Well No. 7 is summarized on Table 3-19 below.

TABLE 3-19 TOPPENISH WELL NO. 7 INFORMATION	
Date Constructed	1973
Well Depth	1,024 feet
Casing Depth/Diameter	0 to 102 feet/30-inch 0 to 303 feet/24-inch 0 to 810 feet/20-inch 810 to 1,022 feet/10-inch
Casing Perforation/Screen Depth	810 to 1,022 feet
Static Water Level	1994: Artesian
Pump Information Manufacturer Type Model No. Year Installed RPM Stages	 Aurora Vertiline Line-shaft Turbine (14RL-M) V75-70649 1973 1,770 6
Motor Information Manufacturer Model No. Horsepower RPM Voltage Phase	 General Electric 5K6287XH16B 300 1775 460 3
Current Well Capacity	2,200 GPM

Well No. 8 (S08): Well No. 8 is located in Pioneer Park by Reservoir No. 3, near Well No. 6, as shown on Figure 3-1. The well was drilled in 1994 to a depth of 250 feet. Water is withdrawn from the well using a Floway 10-stage vertical line-shaft turbine pump, powered by a 40 horsepower, 230-460 volt, 3 phase, 1,775 RPM U.S. Electrical motor. The well currently produces 375 GPM. The static water level of this well was measured at 15 feet 2 inches in 1994.

The pump is housed in a concrete block building that is heated and ventilated. A Water Specialities flow meter, installed in the discharge line, is located under the concrete floor of the nearby Well No. 6 pump house. As discussed previously, Well No. 8 shares both chlorination and fluoridation equipment with Well No. 6. The treatment equipment is located in the Well No. 6 building. Backup power is supplied to Well No. 6 by the Generac diesel engine generator located on the Well No. 6 and Well No. 8 site. Information regarding Well No. 8 is summarized on Table 3-20 below.

TABLE 3-20 TOPPENISH WELL NO. 8 INFORMATION	
Date Constructed	1994
Well Depth	250 feet
Casing Depth/Diameter	0 to 152 feet/20-inch 0- 239 feet/16-inch
Casing Perforation/Screen Depth	138 to 228 feet
Static Water Level	1994: 15'-2" below ground level
Pump Information Manufacturer Type Model No. Year Installed Stages	 Floway 1994 10
Motor Information Manufacturer Horsepower Voltage Phase	 U.S. Electrical High Thrust 40 230 / 460 3
Current Well Capacity	375 GPM

A summary of Toppenish's source wells, including well depth, current static water levels and capacity is provided in Table 3-21 below. The total capacity of all five wells is equal to 4,075 GPM.

TABLE 3-21 TOPPENISH SOURCE WELL INFORMATION SUMMARY

	Well No. 3	Well No. 5	Well No. 6	Well No. 7	Well No. 8
Source No.	S03	S05	S06	S07	S08
Date Drilled	1937	1952/1954	1959	1973	1994
Well Depth	188 feet	291 feet	863 feet	1,024 feet	250 feet
Casing Depth	187 feet	240 feet	863 feet	1,022 feet	239 feet
Static Water Level (1994)	14'-2"	14'-4"	Artesian	Artesian	15'-2"
Current Capacity	495 GPM	810 GPM	195 GPM	2,200 GPM	375 GPM

In addition to the City's five active source wells, Toppenish has three wells not currently in service. Wells No. 1, 2, and 4 are located near the Public Works shop and close to Reservoir No. 1. Well No. 1 was thought to have been constructed in 1907, and Well No. 2 was thought to have been constructed in 1923. Well No. 4 was constructed in 1945 to a depth of 800 feet. None of these three wells are currently active nor have they been used for several years.

3.3.2 Water Treatment

Water supplied from all of Toppenish's source wells is treated through both disinfection and fluoridation. Disinfection of the City's water is accomplished through chlorination of the water as it enters the City's distribution system. Each City well is equipped with a gas chlorinator which injects chlorine into the discharge piping. Information on each chlorinator is included in Section 3.3.1 above, along with the descriptions of each well.

Fluoridation of the City's water is provided as a preventative for tooth decay and is accomplished through the use of upflow saturators and metering pumps. Dry sodium fluoride is added to the water as it enters the City's distribution system using saturators. As fluoride does not dissolve completely in hard water, a water softener is added to the saturator stream flow at Well Nos. 3, 6, and 8 to allow the fluoride to dissolve before the treated water enters the distribution system. Fluoridation is a relatively labor-intensive process, and daily inspection of the equipment in addition to daily laboratory testing, to ensure proper dosage rates are being maintained, is required. Information on each fluoridation system is provided with the descriptions of each well.

3.3.3 Storage Facilities

The City's water storage facilities consist of three active reservoirs and one inactive reservoir (Reservoir No. 1) taken off-line in 1993. The total capacity of the three active reservoirs is approximately 1.7 million gallons. However, the total storage capacity under normal operating conditions is only 1.26 million gallons. This is due to a normal pump-off elevation of approximately 898 feet;also, a minimum of 20 psi must be provided to the highest service elevation of 770 feet, which corresponds to a hydraulic grade line of approximately 816 feet. Reservoir No. 4 is a standpipe, so the bottom 56 feet (400,000 gallons) is not useable and is considered dead storage. Provided below in Table 3-22 is a summary of data for the City's four water storage reservoirs. Further descriptions of each reservoir are provided below Table 3-22.

TABLE 3-22 TOPPENISH RESERVOIR INFORMATION SUMMARY

	Reservoir No. 1 *	Reservoir No. 2	Reservoir No. 3	Reservoir No. 4
Date Constructed	1914	1937	1953	1993
Type	Elevated Tank	Elevated Tank	Elevated Tank	Standpipe
Ground Elevation (feet above msl)	755	757	757	760
Base Elevation (feet above msl)	881	863	863	760
Top Elevation (feet above msl)	902	902	902	902
Overflow Elevation (feet above msl)	900	900	900	900
Height (feet)	21	39	39	142
Height to Overflow (feet)	19	37	37	140
Diameter (feet)	26	32	50	35
Total Capacity (gallons)	75,000	200,000	500,000	1,000,000
Available Capacity (gallons above 20 psi)	75,000	200,000	500,000	600,000
* Reservoir No. 1 was inactivated in 1993.				

Reservoir No. 1: Reservoir No. 1 is a 75,000 gallon, steel elevated tank reservoir located near the Public Works shop at the intersection of Buena Way and Washington Avenue as shown on Figure 3-1. The reservoir was originally constructed in 1914 and was closed in August 1993 after being in service for nearly 80 years. At its time of closing, the reservoir leaked in several locations, and it was reported that ice build-up was a problem in some areas of the fill pipe during cold weather. In addition, the reservoir did not have safety ladders equipped with fall protection and was in need of other costly repairs.

Reservoir No. 2: Reservoir No. 2 is located near Well No. 3 in the City's Swimming Pool Park, near the intersection of Asotin Avenue and South Alder Street, as shown on Figure 3-1. Constructed in 1937, Reservoir No. 2 is a steel elevated tank, 32 feet in diameter, with a height of 39 feet and total capacity of about 200,000 gallons.

Reservoir No. 3: Reservoir No. 3 is located in Pioneer Park near Well Nos. 6 and 8, and the City's Fire Station, as shown on Figure 3-1. Constructed in 1953, Reservoir No. 3 is also a steel elevated tank with a 50 foot diameter, and height of 39 feet. The capacity of the reservoir is approximately 500,000 gallons, and the reservoir's overflow elevation is 900 feet above sea level.

Reservoir No. 4: Reservoir No. 4 is located on the west side of Magnolia Street and South Jackson Street, near Well No. 7, as shown on Figure 3-1. Constructed in 1993, Reservoir No. 4 is a 140 foot tall, 35 foot diameter welded steel standpipe. The total capacity of the reservoir is approximately 1.0 million gallons, but the useable capacity above the minimum 20 psi service elevation is only 600,000 gallons as described above. The reservoir's overflow elevation is approximately 900 feet above sea level.

3.3.4 Telemetry Control System

Toppenish's telemetry control system was upgraded in 2004 and exercises supervisory control, data collection, and monitoring of water system operation from a computer located in the Public Works shop. The HMI software used for Toppenish's telemetry system is Wonderware Intouch, with SCADAlarm for annunciating alarms. Data is monitored by Allen Bradley Micrologix PLCs at each site and sent to the telemetry system computer by means of radio communication. The system monitors source production, reservoir level information, and issues commands to start and stop well pumps. The reservoir water levels are sensed by pressure transmitters and source production is measured by flow meters at each of the five source wells.

The source pumps are controlled by the water level in the operator-selected reservoir. The telemetry control settings for turning the various well source pumps on and off, based upon water levels in Reservoir No. 2, are shown in Table 3-23. The reference reservoir base elevation for the levels provided in Table 3-23 is equal to 760 feet above mean sea level, as provided in the telemetry system O&M manual.

TABLE 3-23 EXISTING TELEMETRY CONTROL SETTINGS*

Source Well	Pump On	Pump Off
Well No. 3	132.0 feet	136.0 feet
Well No. 5	128.0 feet	135.0 feet
Well No. 6	134.0 feet	138.0 feet
Well No. 7	120.0 feet	130.0 feet
Well No. 8	134.0 feet	138.0 feet

* Settings are based upon levels in Reservoir No. 2 and reflect normal system operation. The reference reservoir base elevation is equal to 760 feet.

It can be seen from Table 3-23 that based upon the normal operating levels, Well No. 6 and Well No. 8 are the first wells called and the last wells to shut off. The call order of the wells can be adjusted by the operator, based upon system supply and demand requirements. Well No. 7 is typically the last well called and serves the system only in peak demand periods, due to its production of sand, as discussed previously.

Should any equipment fail to respond as ordered (on or off), or a high or low water condition exist in either reservoir, an alarm is sounded at the Public Works shop and through the City's answering service. An automatic telephone dialer (SCADAlarm) is also activated, which then proceeds to contact preprogrammed telephone numbers of key personnel until the alarm is properly acknowledged.

The telemetry control system also monitors source well building temperature and chlorine levels for disinfection, and sends an alarm to notify the operator of these conditions.

3.3.5 Transmission and Distribution Systems

The City's existing transmission and distribution system along with main sizes and valve and fire hydrant locations is shown on Figure 3-1 and Map A, enclosed in the back pocket of this Plan. Most line sizes within the system are four-inches in diameter or larger. The majority of the City's water mains are constructed of either ductile or cast iron and are looped, except where topography or City limit boundaries make it impractical. Table 3-24 and Table 3-25 list the approximate total length and percentage of each type and diameter of pipe in the Toppenish water system, respectively.

TABLE 3-24 TOPPENISH WATER SYSTEM PIPE TYPE SUMMARY

Type of Pipe	Length (feet)	Percent
PVC	1,930	1.0%
Ductile Iron	28,910	15.3%
Asbestos Cement	58,320	30.8%
Cast Iron	99,980	52.9%
TOTAL	189,140	100.0%

TABLE 3-25 TOPPENISH WATER SYSTEM PIPE SIZE SUMMARY

Size of Pipe	Length (feet)	Percent
3-Inch	500	0.3%
4-Inch	36,260	19.2%
6-Inch	54,660	28.9%
8-Inch	64,210	33.9%
10-Inch	12,080	6.4%
12-Inch	21,430	11.3%
TOTAL	189,140	100.0%

3.4 STORAGE ANALYSIS

Reservoir facilities are necessary in a water utility's system in order to provide required storage in three critical areas:

1. Standby Storage - Adequate water reserves need to be maintained to meet the system's average daily demand in the event the largest water supply source is out of service.

2. Fire Suppression Storage - Adequate water reserves need to be maintained to meet the system's highest fire flow requirement with no assistance from existing water supply sources and at a minimum pressure of 20 psi throughout the distribution system. Fire suppression storage may be "nested" within the standby storage volume.

3. Equalizing Storage - Adequate water reserves need to be maintained to meet that portion of the system's maximum instantaneous demand (peak hour) which exceeds the existing water supply source capacity. Equalizing storage must be available to all service connections at a minimum pressure of 30 psi.

Storage facilities also provide a volume of water for supply to the system between source pumping operations. This "operational" volume is established by each utility and is generally based on limiting, as much as practical, the number of pump cycles per hour.

The critical storage components for Toppenish's water system will be addressed in the storage analysis of the following Section.

3.4.1 System Storage Analysis

Standby Storage: The purpose of standby storage is to provide a measure of reliability should sources fail or unusual conditions impose higher demands than anticipated. The Department of Health (DOH) defines standby storage as the volume of stored water available for use during a loss of source capacity, power, or similar short-term emergency at a minimum pressure to all service connections of 20 psi.

For communities with multiple sources of supply such as the City of Toppenish, the Department of Health's (DOH) December 2009 Water System Design Manual recommends the volume of standby storage should be calculated based upon the following equation:

Standby Storage = (2 days) x [(system average demand) or (number of equivalent residential users) x (average day demand per residential user)] - (1440) x (sum of all sources of supply minus the largest source of supply).

At no time, however, shall standby storage be less than 200 gallons times the number of equivalent residential users.

When the above standby storage equation is applied to the existing and projected average day demand (ADD) and ERUs the resulting standby storage requirements are as shown in Table 3-26. Increases in source capacity from recommended future system improvements are included in the calculations for future standby storage requirements.

TABLE 3-26 EXISTING AND FUTURE STANDBY STORAGE REQUIREMENTS

	Existing	2015	2019	2029
System ADD x 2 Days Storage Subtotal	1.388 MGD x 2 Days 2.776 MG	1.717 MGD x 2 Days 3.434 MG	1.844 MGD x 2 Days 3.688 MG	2.129 MGD x 2 Days 4.258 MG
Source Supply - Largest Source* x 1440 minutes Supply Subtotal	1,875 GPM x 1440 min 2.700 MG	2,475 GPM** x 1440 min 3.564 MG	3,875 GPM** x 1440 min 5.580 MG	3,875 GPM** x 1440 min 5.580 MG
Storage Subtotal minus Supply Subtotal	0.076 MG	less than 0	less than 0	less than 0
Equivalent Residential Units (ERUs) x Min. 200 GPD Storage Minimum	2,965 x 200 0.593 MG	3,528 x 200 0.706 MG	3,787 x 200 0.757 MG	4,371 x 200 0.874 MG
Minimum Required Standby Storage	0.593 MG	0.706 MG	0.757 MG	0.874 MG

* Largest source is currently S07 at 2,200 gpm.
** Assumes the construction of Well No. 9 in 2010 with a minimum capacity of 600 gpm and a new source well with a minimum capacity of 1,400 gpm by 2019.

Fire Suppression Storage: To retain their current department classification of Class 5, provided by the Washington Surveying and Rating Bureau, a minimum volume of storage for fire suppression was established by the City of Toppenish Fire Department based upon adopted Uniform Fire Code standards and. The largest required fire flow capacity throughout the City is 3,000 gallons per minute for 3 hours at the Toppenish High School. This required flow is equal to a minimum fire suppression storage volume of 540,000 gallons. The City of Toppenish has chosen to nest fire suppression storage within the standby storage volume.

Equalizing Storage: Equalizing storage must be provided to meet periodic demands placed on the water system which exceed the source pumping capacity. The DOH design method for calculating equalizing storage is 150 times the difference between the system's peak hour (PHD) demand in GPM and the source production rate in GPM. Based on this method, the current and future equalizing storage requirements for Toppenish are as shown in Table 3-27. Increases in source capacity from recommended future system improvements are included in the calculations for future standby storage requirements.

TABLE 3-27 EXISTING AND FUTURE EQUALIZING STORAGE REQUIREMENTS

	Existing	Year 2015	Year 2019	Year 2029
Peak Hour Demand	7,111 GPM	8,448 GPM	9,082 GPM	10,459 GPM
Source Capacity*	- 4,075 GPM	- 4,675 GPM*	- 6,075 GPM*	- 6,075 GPM*
	3,036 GPM	3,773 GPM	3,007 GPM	4,384 GPM
DOH Multiplier	x 150 gal/GPM	x 150 gal/GPM	x 150 gal/GPM	x 150 gal/GPM
Equalizing Storage Total	0.455 MG	0.566 MG	0.451 MG	0.658 MG

* Assumes the construction of Well No. 9 in 2010 with a minimum capacity of 600 gpm and a new source well with a minimum capacity fo 1,400 gpm by 2019.

Operational Storage: Based upon the current set-points and call order for the City of Toppenish wells, as provided in Table 3-23, the normal operating range appears to be approximately six feet, which is equal to about 155,000 gallons. Under this scenario, there is little pump cycling and Well Nos. 3, 6 and 8 operate almost continuously when considering current average day demand.

Adjusting these set-points in the future will reduce the operating level range of the reservoirs while still maintaining a reasonable number of pump on-off cycles. Based upon a calculated future average day demand of 2.129 MGD, reducing the operational storage level range to 3 feet (approx. 78,000 gallons) and calling Well Nos. 3, 5, 6 and 8 at the same time, results in all pumps starting approximately every 4 hours, which is equal to 0.25 starts per hour. This is well below the DOH recommended maximum of six starts per hour.

Total Storage: Table 3-28 summarizes the existing and future storage requirements for the water system. A 10% contingency was added to the total storage capacity to account for distribution system losses. Future standby and equalizing storage volumes assume the installation of recommended system improvements, as discussed above.

TABLE 3-28 EXISTING AND FUTURE STORAGE REQUIREMENTS (all storage values are in million gallons)				
	Existing Requirements	Year 2015 Requirements	Year 2019 Requirements	Year 2029 Requirements
Number of ERUs	2,965	3,528	3,787	4,371
Number of Connections	2,229	2,714	2,897	3,347
Operational Storage	0.155	0.078	0.078	0.078
Equalizing Storage	0.455	0.566	0.451	0.658
Standby Storage	0.593	0.706	0.757	0.874
Fire Suppression Storage*	0.540	0.540	0.540	0.540
Subtotal	1.203	1.350	1.286	1.610
10% Contingency	0.120	0.135	0.129	0.161
Total Storage Required	1.323	1.485	1.415	1.771
Total Storage Available (above 30 psi elev.)	1.134	1.848**	1.848**	1.848**
Total Storage Available (above 20 psi elev.)	1.300	2.300**	2.300**	2.300**
Dead Storage	0.400	1.096**	1.096**	1.096**

* Fire suppression storage is nested in standby storage.
** Assumes the construction of a new 1.7 MG (1.0 MG above 20 psi) standpipe reservoir by 2015.

It can be seen from Table 3-28 that the current available storage capacity above the 20 psi service elevation is adequate to meet the existing requirements, but future improvements will be necessary to provide adequate storage. Figure 3-2, Existing Reservoir Storage Levels, shows a schematic representation of where each of the main storage components discussed above are stored within Toppenish's three reservoirs.

Table 3-28 excludes demand from Toppenish's large industrial user (AB Foods), which can have a substantial impact on system storage requirements. Table 3-29 shows existing and future storage requirements including peak demand from AB Foods.

TABLE 3-29 EXISTING AND FUTURE STORAGE REQUIREMENTS (WITH AB FOODS DEMAND) (all storage values are in million gallons)				
	Existing Requirements	Year 2015 Requirements	Year 2019 Requirements	Year 2029 Requirements
Number of ERUs	3,370	3,933	4,192	4,776
Number of Connections	2,230	2,715	2,898	3,348
Operational Storage	0.155	0.078	0.078	0.078
Equalizing Storage	0.566	0.677	0.562	0.768
Standby Storage	0.674	0.787	0.838	0.955
Fire Suppression Storage*	0.540	0.540	0.540	0.540
Subtotal	1.395	1.542	1.478	1.801
10% Contingency	0.140	0.154	0.148	0.180
Total Storage Required	1.535	1.696	1.626	1.981
Total Storage Available (above 30 psi elev.)	1.134	1.848**	1.848**	1.848**
Total Storage Available (above 20 psi elev.)	1.300	2.300**	2.300**	2.300**
Dead Storage	0.400	1.096**	1.096**	1.096**

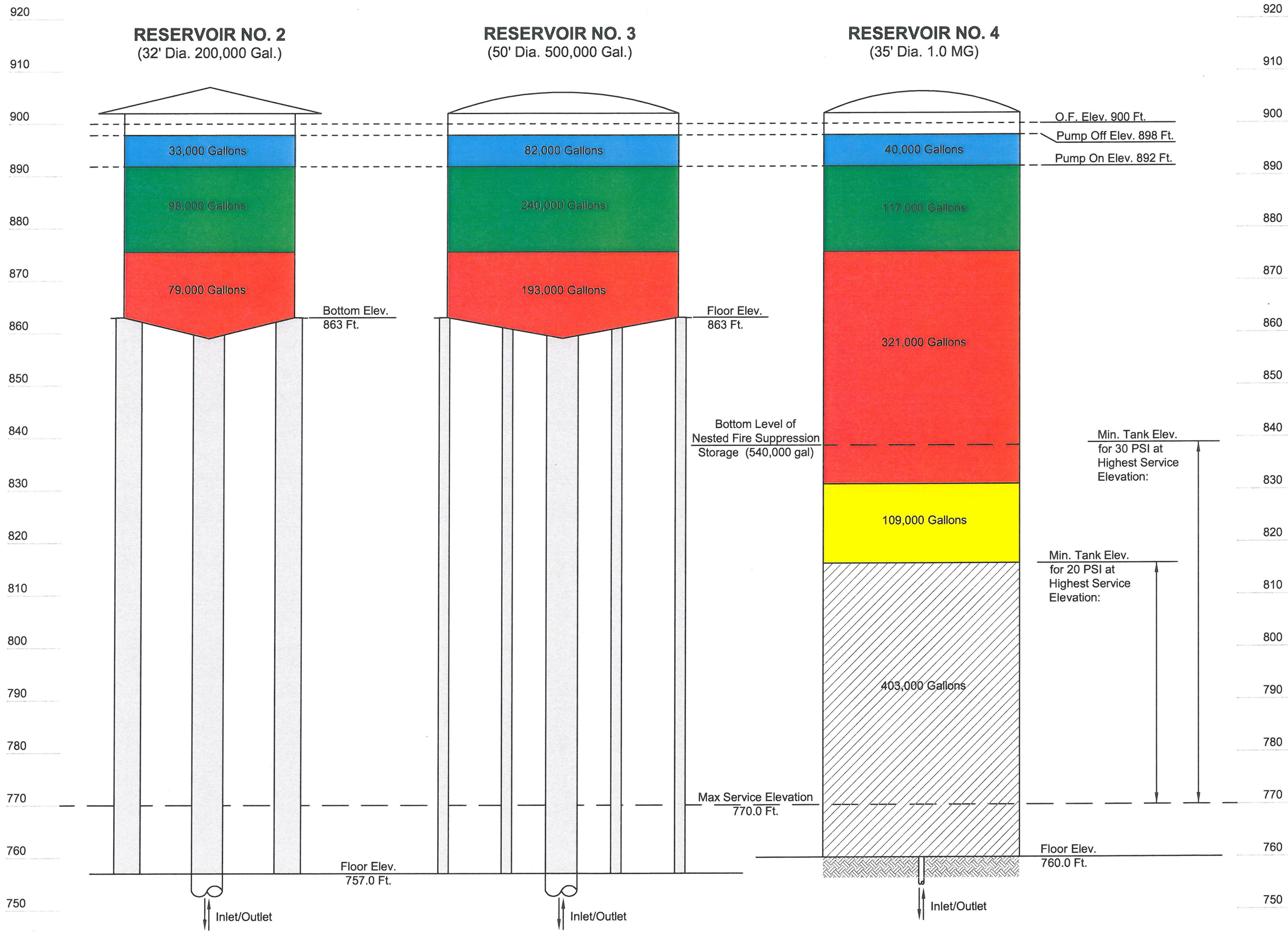
* Fire suppression storage is nested in standby storage.
** Assumes the construction of a new 1.7 MG (1.0 MG above 20 psi) standpipe reservoir by 2015.

As shown in Table 3-29, the existing required storage, including demand from AB Foods, exceeds the available storage capacity by approximately 100,000 gallons. However, with the construction of a new storage reservoir in 2012, as described in Chapter 8 of this Plan, the total available storage will be adequate to serve the projected 20-year demand with AB Foods. Figure 3-3, Year 2015 Reservoir Storage Levels, shows a schematic representation of where each of the main storage components discussed above are stored within Toppenish's current and proposed future reservoirs.

CITY OF TOPPENISH

Water System Plan Update

EXISTING RESERVOIR STORAGE LEVELS



LEGEND

- Operational Storage
- Equalizing Storage
- Standby Storage (Fire Supression Storage Nested)
- Available Storage
- Dead Storage

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FIGURE 3-2

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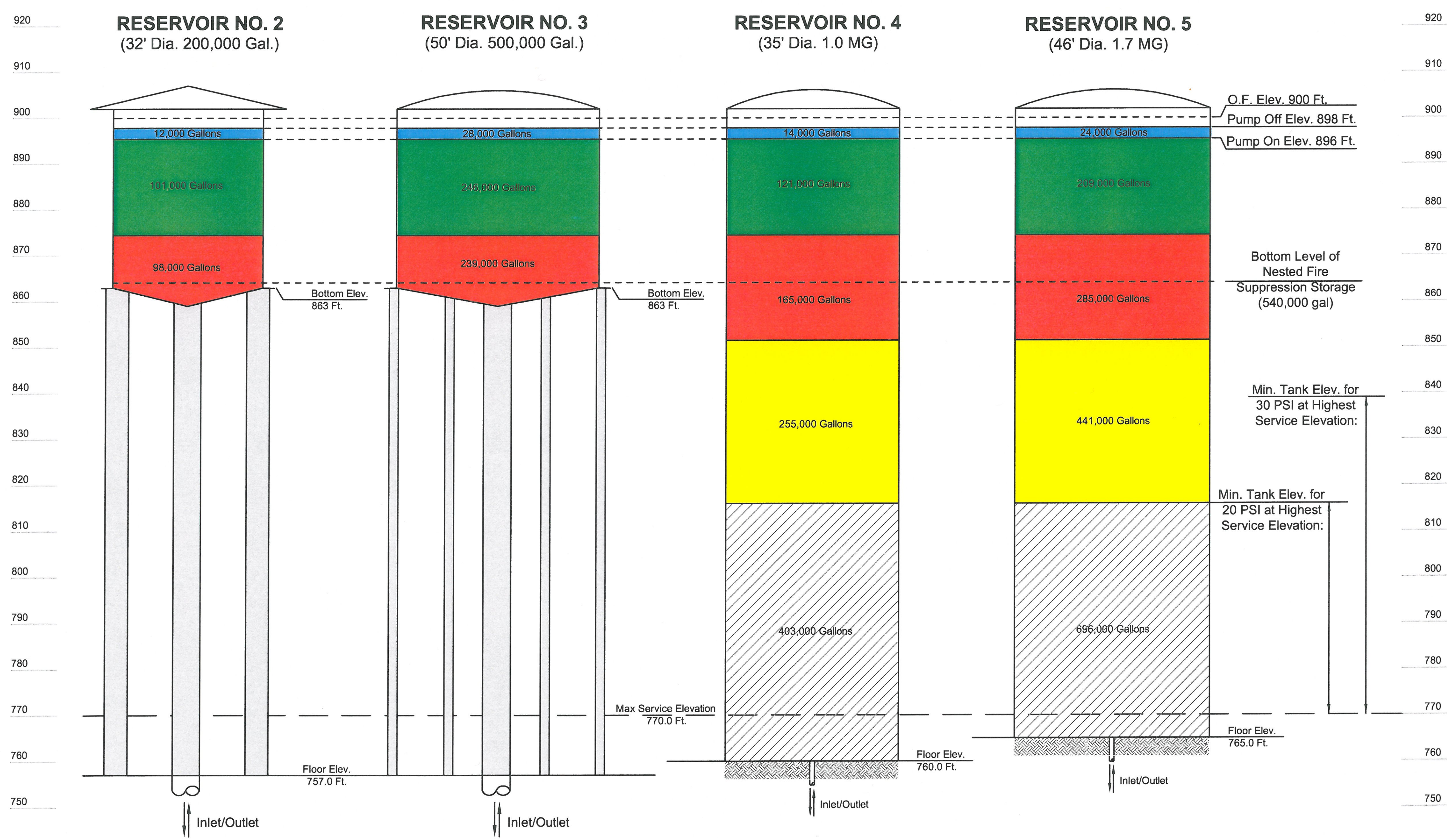
YEAR 2015 RESERVOIR STORAGE LEVELS*



LEGEND

- Operational Storage
- Equalizing Storage
- Standby Storage (Fire Suppression Storage Nested)
- Available Storage
- Dead Storage

* 2015 VOLUMES SHOWN ARE BASED UPON RESERVOIR STORAGE CALCULATIONS INCLUDING PEAK DEMAND FROM AB FOODS

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FIGURE 3-3

3.5 FIRE FLOW

The demand fire flows place upon a water system is typically the most significant element when analyzing the piping network. Every water system which is required to have a Water System Plan must address fire flow. At a minimum, a water utility must comply with fire flow standards established by the Department of Health (DOH). A community may, however, develop its own standards as long as they exceed the DOH minimum requirements.

The City of Toppenish Fire Department has developed a list of minimum fire flow capacities required for many structures throughout the City, which is consistent with their adoption of Uniform Fire Code (UFC) standards and the Class 5 rating provided by the Washington Surveying and Rating Bureau. These fire flow capacities, provided in the 2002 Water System Plan Update and in Chapter 10 of this Plan, were used to develop Figure 3-4, Existing Fire Flow Capacities Map, which shows areas of required minimum fire flow and the actual calculated fire flow capacity at selected locations within those areas. All areas that do not have a specified minimum fire flow range are required to have a minimum fire flow capacity of 1,000 GPM.

A computer hydraulic analysis was used to determine the existing fire flow capacities at the locations shown on Figure 3-4. The hydraulic analysis parameters are discussed later in Section 3.6. As can be seen on Figure 3-4, the greatest fire flow requirements are within the industrially and commercially zoned areas. Some isolated large demands are also required at public schools and churches. It can be seen on Figure 3-4 that several locations throughout the distribution system are deficient in providing the required minimum fire flow capacities. A list of major system deficiencies is provided in Section 3.6.2. Future distribution system improvements will be necessary to increase fire flow capacity in deficient locations. The recommended system improvements are discussed further in Section 3.7.

3.6 HYDRAULIC ANALYSIS

A hydraulic analysis of a water utility system is a method of calculating pressures and flows throughout the distribution network under various conditions of demand at a given instant. Since the advent of personal computers, hydraulic analyses are typically performed by utilizing computer programs which model the piping, reservoirs, pumps and specialty valves of a given water system.

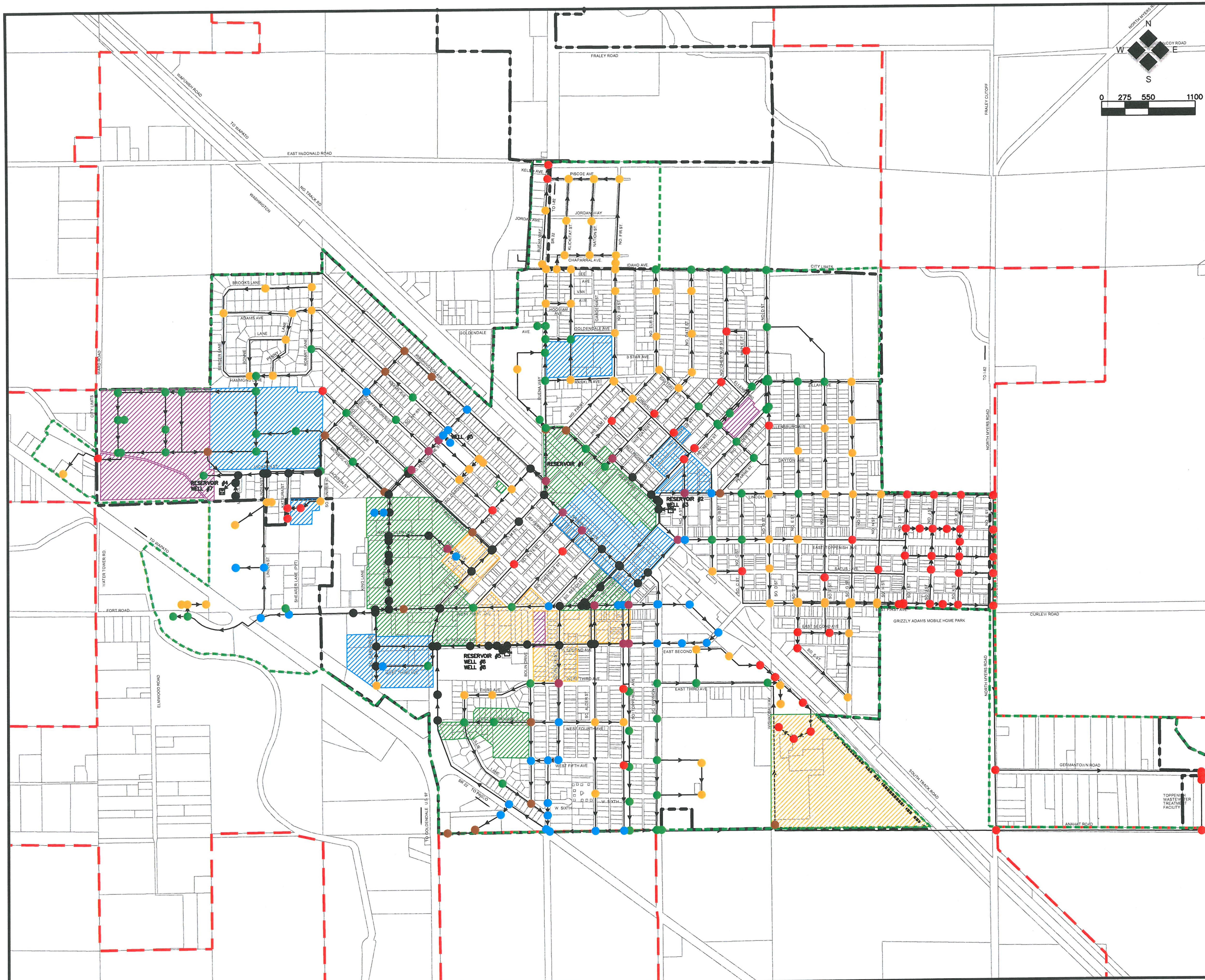
Numerous computer programs have been developed for performing network analyses. The program utilized for the modeling and analysis of the City of Toppenish water system is called WaterCAD (Version 8), distributed by Bentley Systems, Inc. WaterCAD can perform instantaneous and extended period simulations of complete distribution networks including reservoirs, source pumps, booster pumps, pressure reducing valves, pressure sustaining valves, check valves, flow control valves, pressure switches, and up to 1,000 pipes and 1,000 nodes (pipe junctions).

The program utilizes KYPIPEZ computational algorithms to solve the pressure networks. All water system components are entered into the computer, supply rates and user demands are input, and reservoir water levels are established. Once this base information has been loaded, various options such as increasing system demand, lowering reservoir levels, shutting off source pumps, adding system improvements, and simulating fire flow conditions can be analyzed for their impact on the system.

3.6.1 Assumptions

In order to analyze the water system at a given moment in time, it is necessary to assume certain existing conditions and to program the status of key system components. The following general assumptions have been made for the hydraulic analysis of the City of Toppenish water system:

- Roughness coefficients for most 8-inch or larger pipes were assumed to be 120. Pipes 6- inch or smaller were assumed to have coefficients of 110. Known old or poor condition pipes were assumed at C=100.
- Nominal pipe diameters were input for inside pipe diameters.
- Node elevations are based on available contour elevations.



CITY OF TOPPENISH

Water System Plan Update

EXISTING FIRE FLOW CAPACITIES MAP

LEGEND

- EXISTING SERVICE AREA
- CITY LIMITS
- FUTURE SERVICE AREA/SERVICE AREA (UGA BOUNDARY)

FIRE FLOW RANGE	FIRE DEPT. REQUESTED FLOW CAPACITIES
>1000 GPM	MINIMUM 1000 GPM
1000-1500 GPM	
1500-2000 GPM	
2000-2500 GPM	
2500-3000 GPM	
3000-3500 GPM	
>3500 GPM	

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FIGURE 3-4

Table 3-30 identifies the specific parameters used in the hydraulic analysis performed for existing and future peak hour demand (PHD) and for existing and future fire flow capacities at 20 psi residual pressure during maximum day demand (MDD) conditions. The PHD hydraulic analysis assumes that all source wells are operating and that the operating and equalizing storage volume has been depleted from all tanks. The fire flow analysis, during MDD, assumes that the starting elevation in all tanks is with fire suppression, operating and equalizing storage depleted. Initial elevations for the hydraulic analysis are calculated from the current and future reservoir pump-off elevations. The pump-off elevations can be operator-adjusted based upon current system demand, but the elevations used represent normal operating conditions. Lower or higher initial water level elevations could affect the calculated results provided in this Plan.

TABLE 3-30 HYDRAULIC ANALYSIS PARAMETERS

	Hydraulic Analysis Scenario			
Water System Feature	Existing Peak Hour Demand[a] (7,111 GPM)	Existing Fire Flow w/MDD[b] (3,554 GPM)	Year 2029 Peak Hour Demand[ac] (11,197 GPM)	Year 2015 Fire Flow w/MDD[bc] (4,592 GPM)
Reservoir No. 2 Levels				
Maximum Elevation	898 Ft.	898 Ft.	898 Ft.	898 Ft.
Initial Elevation	876 Ft.	839 Ft.[d]	877 Ft.	866 Ft.
Minimum Elevation	816 Ft.	816 Ft.	816 Ft.	816 Ft.
Bottom Elevation	863 Ft.	863 Ft.	863 Ft.	863 Ft.
Base/Ground Elevation	757 Ft.	757 Ft.	757 Ft.	757 Ft.
Reservoir No. 3 Levels				
Maximum Elevation	898 Ft.	898 Ft.	898 Ft.	898 Ft.
Initial Elevation	876 Ft.	839 Ft.[d]	877 Ft.	866 Ft.
Minimum Elevation	816 Ft.	816 Ft.	816 Ft.	816 Ft.
Bottom Elevation	863 Ft.	863 Ft.	863 Ft.	863 Ft.
Base/Ground Elevation	757 Ft.	757 Ft.	757 Ft.	757 Ft.
Reservoir No. 4 Levels				
Maximum Elevation	898 Ft.	898 Ft.	898 Ft.	898 Ft.
Initial Elevation	876 Ft.	839 Ft.	877 Ft.	866 Ft.
Minimum Elevation	816 Ft.	816 Ft.	816 Ft.	816 Ft.
Base/Ground Elevation	760 Ft.	760 Ft.	760 Ft.	760 Ft.
Future Reservoir No. 5 Levels				
Maximum Elevation	NA	NA	898 Ft.	898 Ft.
Initial Elevation	NA	NA	877 Ft.	866 Ft.
Minimum Elevation	NA	NA	816 Ft.	816 Ft.
Base/Ground Elevation	NA	NA	765 Ft.	765 Ft.
Source Well Status				
Well No. 3	495 GPM	495 GPM	495 GPM	495 GPM
Well No. 5	810 GPM	810 GPM	810 GPM	810 GPM
Well No. 6 & 8	570 GPM	570 GPM	570 GPM	570 GPM
Well No. 7	2,200 GPM	2,200 GPM	2,200 GPM	2,200 GPM
Future Well No. 9	NA	NA	600 GPM	600 GPM
Future Well	NA	NA	1,400 GPM	NA
Total Supply	4,075 GPM	4,075 GPM	4,675 GPM	4,675 GPM

[a] Operational and equalizing storage depleted.
[b] Operational, equalizing and fire suppression storage depleted.
[c] Includes peak demand from AB Foods.
[d] Initial elevation is below elevated tank floor elevation to match water surface elevation of Reservoir No. 4.

3.6.2 Analysis Scenarios

The existing water system was first analyzed considering a current PHD of 7,111 GPM, which was the total calculated peak hourly flow (excluding demand from AB Foods) on July 29, 2009. All nodes providing domestic service within the system did so with a minimum residual pressure of 30 psi or greater with all source pumps in operation. Pipe velocities remained below the 7 feet per second (FPS) design parameter.

A copy of the computer printout of this scenario and all other hydraulic analysis results discussed in this section are provided in Chapter 10 of this Plan. Map B in the back of this Plan shows the computer model with the pipe and node numbers for identification.

A future PHD analysis was run on the system using the PHD for the year 2029 of 11,197 GPM, which included peak demand from AB Foods. This analysis scenario assumes that all recommended system improvements are in place. This scenario was conducted using the year 2029, equalizing storage volume depleted at the beginning of the analysis. All service pressures were greater than 30 psi and pipe velocities were below 7 fps with all source pumps in operation.

Fire flows were considered at all hydrant locations throughout the pipe network while assuming an existing system consumptive demand of 3,554 GPM (excluding demand from AB Foods), which was the MDD on July 29, 2009. The computer hydraulic model was used to calculate the maximum flow attainable at designated hydrant nodes while providing a residual, positive pressure of 20 psi. Operating, equalizing and fire suppression storage was depleted at the start of the fire flow analysis. The resulting fire flow capacities are as shown on Figure 3-4, along with the system's desired fire flow capacities as previously discussed in Section 3.5. Many locations were calculated to be deficient in meeting the specified fire flow capacities, as shown on Figure 3-4.

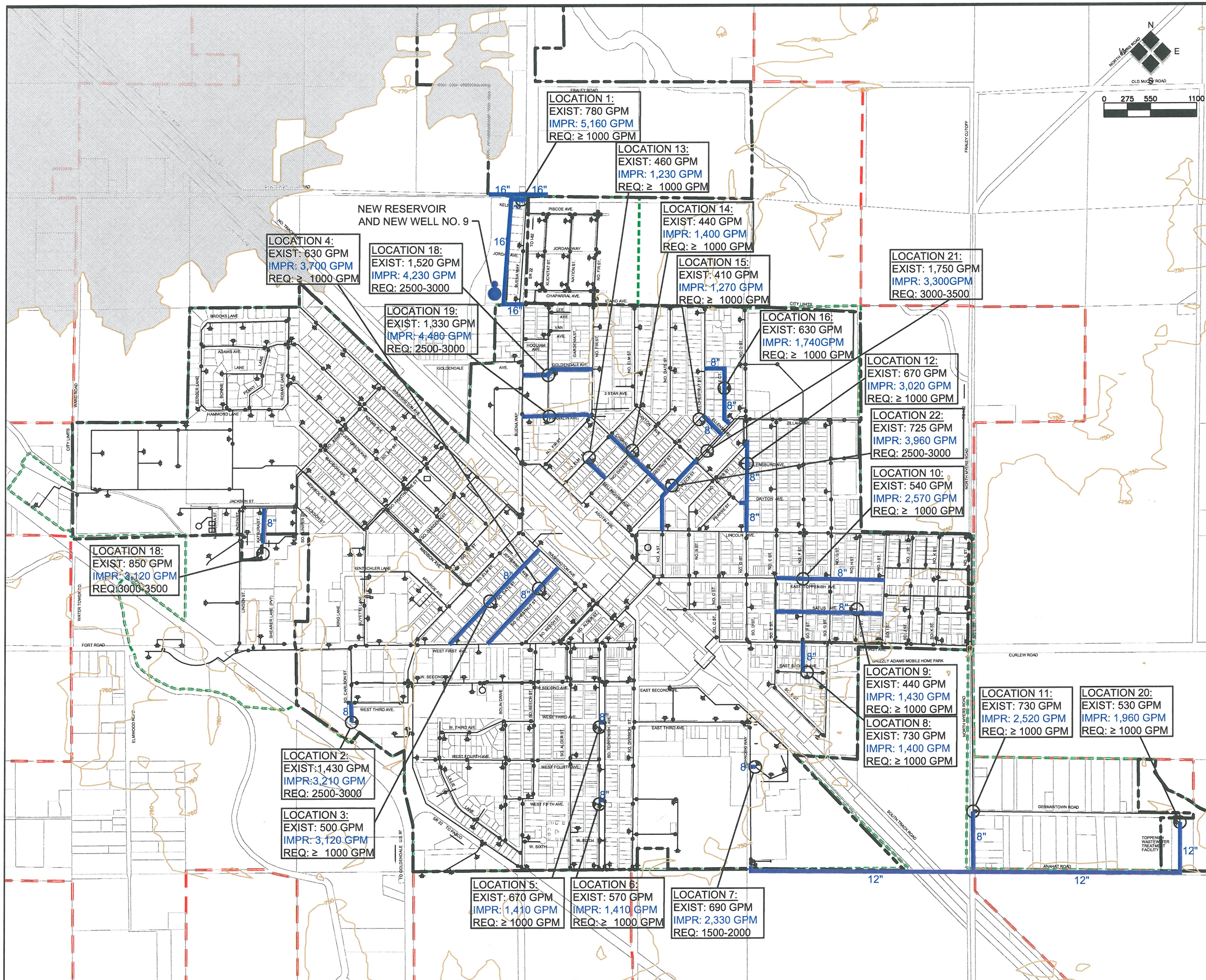
A future fire flow analysis was performed on the system assuming a year 2015 MDD value of 4,592 GPM, which included demand from AB Foods. The future fire flow analysis was used to determine the improved fire flow capacities at selected deficiency locations with various major system improvements in place. Again, fire flows were the maximum attainable while providing a residual, positive pressure of 20 psi at all hydrant nodes.

Recommended future improvements will increase fire flow capacities in some areas as shown on Figure 3-5, Fire Flow Capacity Improvements Map. A summary of the improvements in fire flow capacities at these locations, as a result of the proposed water system improvements, is presented in Table 3-31. The deficiency location in Table 3-31 corresponds to the location identified on Figure 3-5.

CITY OF TOPPENISH

Water System Plan Update

FIRE FLOW CAPACITIES IMPROVEMENT MAP



LEGEND

- EXISTING SERVICE AREA
- CITY LIMITS
- FUTURE SERVICE AREA/SERVICE AREA (UGA BOUNDARY)
- AREA ABOVE CURRENT MAXIMUM WATER SERVICE ELEVATION OF 770 FT
- WATER LINE
- PRIVATE LINE
- VALVE
- HYDRANT
- IMPROVEMENTS

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FIGURE 3-5

TABLE 3-31 EXISTING FIRE FLOW DEFICIENCIES				
Deficiency Location No.	Junction Node No.	Existing Fire Flow (GPM)	Required Fire Flow (GPM)	Improved Fire Flow (GPM)
1	J-248	780	≥ 1,000	5,160
2	J-117	1,430	2,500-3,000	3,210
3	J-221	500	≥ 1,000	3,120
4	J-222	630	≥ 1,000	3,700
5	J-187	670	≥ 1,000	1,410
6	J-189	570	≥ 1,000	1,410
7	J-373	690	1,500-2,000	2,330
8	J-347	730	≥ 1,000	1,400
9	J-333	440	≥ 1,000	1,430
10	J-386	540	≥ 1,000	2,570
11	J-154	730	≥ 1,000	2,520
12	J-315	670	≥ 1,000	3,020
13	J-306	460	≥ 1,000	1,230
14	J-302	440	≥ 1,000	1,400
15	J-300	410	≥ 1,000	1,270
16	J-287	630	≥ 1,000	1,740
17	J-48	850	3,000-3,500	3,120
18	J-276	1,520	2,500-3,000	4,230
19	J-247	1,330	2,500-3,000	4,480
20	J-157	530	≥ 1,000	1,960
21	J-296	1,750	3,000-3,500	3,290
22	J-311	720	2,500-3,000	3,960

3.6.3 Model Calibration

System pressure readings have been taken at many hydrant locations throughout the City and most all of the pressure readings were within five psi of the model pressures. Where practical, adjustments were made to node elevation or roughness coefficient to calibrate the modeled system pressures.

Fire flow tests throughout the distribution system were also recently performed by the Toppenish Fire Department. The results of the flow tests were also used to calibrate the system model, taking into consideration that the Fire Department flow tests were likely not done at a starting reservoir level equal to fire suppression storage being depleted.

3.7 SUMMARY OF SYSTEM DEFICIENCIES

The following is a listing and brief description of deficiencies which have been identified in the present water system. The items have been grouped within three system categories (supply, storage, and distribution) and are generally placed in order of their importance. The deficiencies may be operational in nature (which have been identified by the City's Water Department personnel), maintenance related, inadequate present or future capacities, and/or system hydraulics problems.

Supply

1. **Protective Covenants** – The City owns all of its well sites, but has no recorded protective covenants, establishing the required 100-foot sanitary protective radius around each well. Protective covenants are required at all of Toppenish's source wells and will be developed as part of the recommended system improvements to protect the City's drinking water sources.

2. **Water Rights** – A city's water rights status is crucial in determining the amount of possible future growth. Currently, Toppenish has adequate combined annual certificated (3,200 acre-feet) water rights and permitted instantaneous (4,215 GPM) withdrawal quantities from the Yakama Nation, but future demand projections show that additional permitted quantities will be necessary. Also, the City's current permits expire in 2015 and will have to be renewed.

3. **Source Well Capacity** – As discussed previously in Chapter 2 and this Chapter, the projected future MDD will exceed the current source capacity. This becomes especially critical if the City's largest source of supply (Well No. 7 at 2,200 gpm) is out of service. Increasing future source capacity will be essential to improve system reliability and minimize required storage and will be possible through rehabilitation of existing sources with diminished capacity and drilling new sources of supply.

   Of the existing sources, Well No. 8 is experiencing sand production problems, which adds excessive wear to pump components and limits its current pumping capacity. Also, Well No. 5 has experienced some diminished capacity in recent years, which contributes to the City's source of supply deficiency.

4. **Source Reliability** – A reliable electrical and control system is critical in order to have a reliable source of supply to the system. Well No. 7, the City's largest source of supply at 2,200 gpm, has recently had some electrical issues. Though generally this well is the last called, not having it operational when needed can lead to excessive operation of the City's other sources of supply during peak demand periods.

5. **Source Meters** – Accurate source meters are necessary to provide precise data for tracking current production and for projection of future demand needs. Source meters need to be calibrated routinely, depending on meter type, and it is unknown when the City's source meters were last calibrated. Also, Well No. 5 has been reported to have an inaccurate flow meter, mostly due to its close proximity to the well discharge pipe and isolation valves.

6. **Source Monitoring** – The last static water levels for most of the City's source wells were recorded in 1994. Most of the wells do not have a means of monitoring static and dynamic water levels and/or shut-in pressures to anticipate potential supply issues.

Storage

7. **Existing Reservoirs** – The City last cleaned and inspected their storage reservoirs in 2003. Also, it is unknown when the reservoirs were last coated. Given the age and unknown condition of the existing reservoirs, it is likely that they will need to be rehabilitated and recoated in the next six years.

8. **Future Storage Capacity** – As shown previously in the system storage analysis, the City of Toppenish currently has adequate storage capacity with its three reservoirs, but additional storage capacity will be required by the year 2015. The need for additional storage is mostly due to the high peak demands and resulting high volume of equalizing storage that is required

for the City. Installing additional sources of supply reduces this need, but future storage will still be necessary, based on projected system demands.

Distribution

9. **Fire Flow Capacity** – Several locations within the City were identified in Section 3.6 as having insufficient fire flow capacities. Fire flow deficiencies are mainly located in areas where there are inadequate pipe sizes or insufficient looping of the pipelines. Many of these locations were also identified in the 2002 Water System Plan Update, but only improvements near the new high-school have been made.

10. **Water Main Upsizing & Replacement** – A significant amount of the City's distribution system is made up of undersized and aging cast iron and asbestos cement pipes that are nearing the end of their useful life. The condition of each of these pipes is not fully known, but many are suspected to be corroded or leaking.

11. **Service Meters** – The City began a service meter replacement program in 2007, to upgrade to new radio-read style meters. There are approximately 200 service meters remaining that are of the older style and have to be manually read.

3.8 SELECTION AND JUSTIFICATION OF PROPOSED IMPROVEMENT PROJECTS

The following discussion identifies recommended system improvements proposed to eliminate or reduce deficiencies described in the previous section. References to prioritized improvements specified in Section 8.2 of this Report are provided. Further description of the water system improvements is provided in Chapter 8 of the Plan.

Protective Covenants – Protective well covenants will be produced for source wells owned by the City of Toppenish that currently do not have a protective covenant, which provides the necessary 100-foot sanitary protective radius around the wells. **[Improvement No. 5]**

Source Well Capacity – The City will need to provide an additional source of supply to meet future maximum day demand (MDD), as discussed previously in this Chapter. The City has obtained a public works trust fund loan and has been granted a permit by the Yakama Nation for construction of Well No. 9, with a capacity of 600 GPM. This improvement will reduce required storage volumes and meet MDD beyond 2015. However, based upon projected future demand, an additional source of supply with a minimum capacity of 1,400 GPM will be required by 2019, as discussed in Section 2.5.4 of the Plan. **[Improvement No. 1]**

Well No. 8 currently has sand production issues and Well No. 5 has recently had a slight reduction in source capacity. Well No. 8 will be inspected, rehabilitated and the well pump replaced to eliminate the production of sand, which leads to excessive maintenance costs, and improve its current capacity. Well No. 5 will also be inspected and rehabilitated to improve its current capacity and hopefully return it to its historical capacity of 950 GPM. Increased capacity from both of these improvements will help meet future demand. **[Improvement Nos. 2 & 9]**

Source Reliability – Well No. 7 is currently the City's largest source of supply and recently has had some electrical issues. The electrical problems will be investigated and improvements made as necessary to improve the reliability of this source. **[Improvement No. 3]**

Source Meters – To improve the accuracy of water production data, the city will begin a routine source meter calibration program in 2011. Also, the Well No. 5 source meter will be relocated outside of the existing building to improve accuracy.

Source Monitoring – Well No. 8 is the only source well where the city monitors static and dynamic water levels. A level transducer will be installed in the other source wells when they are rehabilitated or inspected in the future to track static and drawdown water levels, allowing the city to anticipate or troubleshoot future well capacity issues.

Storage – Total system storage capacity is currently not deficient, but is anticipated to be deficient by the year 2015, as shown previously in the system storage analysis. Construction of a new 1.7 MG (1.0 MG effective) capacity standpipe reservoir in 2013 will provide adequate storage to meet the projected 20-year demand. The new reservoir is planned to be constructed on City owned property, near new Well No. 9, which will provide additional storage on the north side of the City, increasing system reliability. **[Improvement No. 7]**

The existing water storage reservoirs have not been cleaned or inspected since 2003. The City plans to inspect two of their three storage reservoirs in 2010 and the third the following year. As discussed above, it is likely that the reservoirs will have to be rehabilitated and recoated by the year 2015. Routine inspection and maintenance of the reservoirs is necessary to extend the lifetime of these critical system components. **[Improvement No. 4]**

Fire Flow Capacity – Certain areas within the City were identified as being deficient in fire flow capacity, as described in Section 3.6 and shown on Figure 3-3. Water main upsizing and/or looping improvements are necessary to increase fire flow capacities at these locations to the required levels. Figure 3-4 shows the improved fire flow capacity as a result of the identified water main improvements. **[Improvement Nos. 6 and 10 through 25]**

Water Main Upsizing & Replacement – As described in the previous section, a large portion of the City's distribution system is made up of undersized and aging pipes. These water mains need to be replaced to improve system flow capacity and potentially reduce distribution system leakage. Some of these water mains will be replaced with the above recommended fire flow improvement projects, but the remaining water mains will be prioritized for replacement in the future. The City plans to implement a leak detection program, starting in 2011, to further investigate the condition of existing pipes and prioritize them for replacement.

Service Meters – The City began replacing old service meters with new radio-read meters in 2007. Meters that are known to be inoperable or that are leaking are prioritized for replacement. Upgrading service meters to radio-read meters reduces the time to record meter data and improves meter data accuracy. The City will complete this improvement with the replacement of approximately 200 service meters in 2010.