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af	Acre-feet
AN	Above normal Sacramento Valley water year type
AWMP	Agricultural Water Management Plan
BMP	Best Management Practice
BN	Below normal Sacramento Valley water year type
C	Critical (dry) Sacramento Valley water year type
CCR	California Code of Regulations
D	Dry Sacramento Valley water year type
DWR	Department of Water Resources
ET	Evapotranspiration
GMP	Groundwater Management Plan
GSP	Groundwater Sustainability Plan
GWS	Groundwater System
SWS	Surface Water System
taf	Thousand acre-feet
Tehama IHM	Tehama Integrated Hydrologic Model
UWMP	Urban Water Management Plan
W	Wet Sacramento Valley water year type
WMP	Water Management Plan

1 DETAILED HISTORICAL WATER BUDGET

1.1 Surface Water System Water Budget Results

1.1.1 Inflows

1.1.1.1 Surface Water Inflow by Water Source Type

Per the GSP Regulations, surface inflows must be reported by water source type. According to the Regulations (23 CCR § 351(ak)):

> *"Water source type" represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.*

Major surface water inflows to the Bowman Subbasin are summarized below according to water source type.

1.1.1.1.1 *Local Supplies*

Local supply inflows to the Bowman Subbasin predominantly include runoff from upgradient small watersheds adjacent to the Subbasin and surface inflows along Cottonwood Creek. A portion of the local supplies are diverted by local water rights users for beneficial use within the Subbasin. There are about 140 riparian diverters in the Subbasin with active water rights. These water rights users divert water primarily from Cottonwood Creek and its tributaries, but there are a few diversions along the Sacramento River. The average annual diversions total approximately 2.4 acre-feet per acre over 940 acres, varying between years depending on water year type and other land use changes over time.

1.1.1.1.2 *Central Valley Project*

Central Valley Project (CVP) inflows to the Bowman Subbasin primarily include surface water diverted from the Sacramento River by the Anderson-Cottonwood Irrigation District (ACID). ACID holds the third oldest water rights on the Sacramento River, and has a total Settlement Contract of more than 100,000 AF per year. While the majority of the ACID service area overlies the Anderson Subbasin, a portion of ACID's CVP supplies are delivered to parcels that overlie the Bowman Subbasin. Surface water is also diverted by small CVP contractors to irrigated land along the Sacramento River.

1.1.1.1.3 *Summary of Surface Inflows*

The annual volume of surface water inflows is summarized by water source type in **Figure 1** and **Table 1**. Between 1990 and 2018, total surface inflows from all sources averaged approximately 81 thousand acre-feet (taf) per year. Of this total, local supplies averaged approximately 63 taf per year, while CVP supplies averaged 18 taf per year.

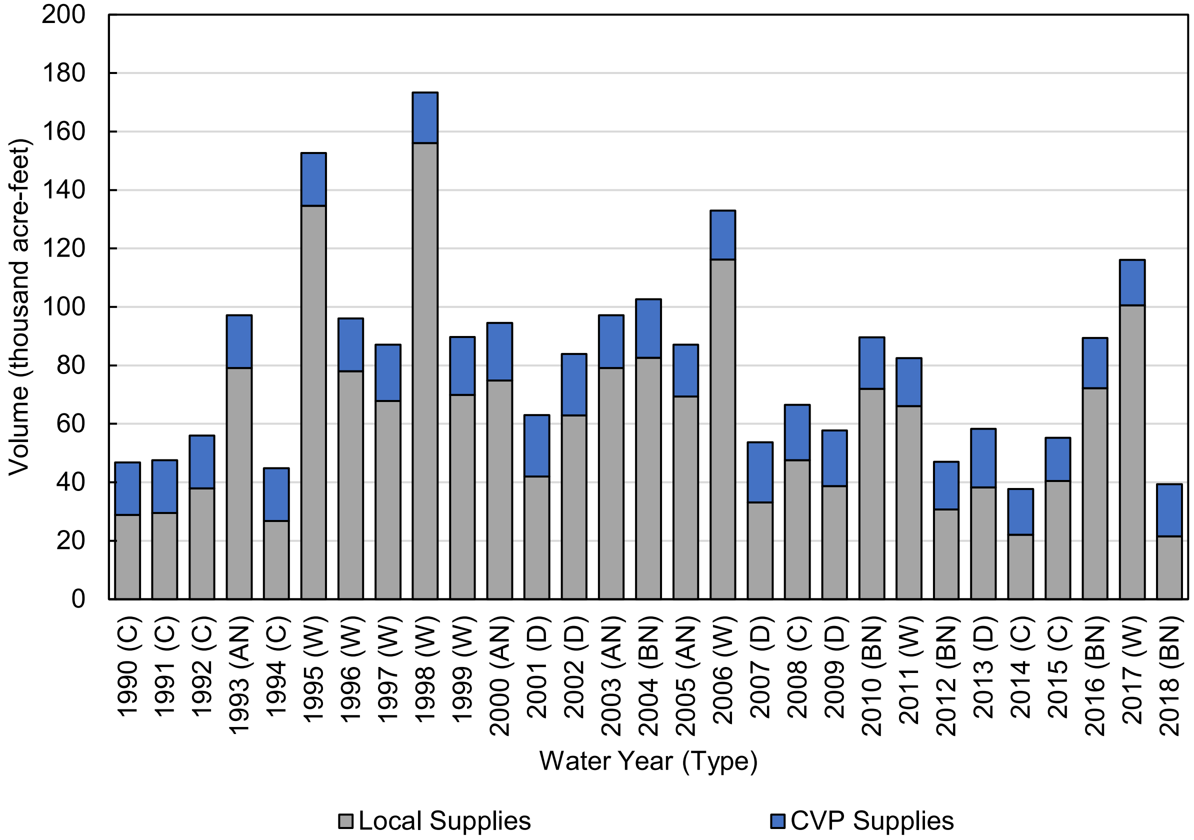

Figure 1. Bowman Subbasin Historical Surface Water Inflows, by Water Source Type

Table 1. Bowman Subbasin Historical Surface Water Inflows, by Water Source Type

Water Year (Type)		CVP Supplies	Local Supplies	Total
1990 (C)		18,000	29,000	47,000
1991 (C)		18,000	29,000	48,000
1992 (C)		18,000	38,000	56,000
1993 (AN)		18,000	79,000	97,000
1994 (C)		18,000	27,000	45,000
1995 (W)		18,000	130,000	150,000
1996 (W)		18,000	78,000	96,000
1997 (W)		19,000	68,000	87,000
1998 (W)		17,000	160,000	170,000
1999 (W)		20,000	70,000	90,000
2000 (AN)		20,000	75,000	95,000
2001 (D)		21,000	42,000	63,000
2002 (D)		21,000	63,000	84,000
2003 (AN)		18,000	79,000	97,000
2004 (BN)		20,000	83,000	100,000
2005 (AN)		18,000	69,000	87,000
2006 (W)		17,000	120,000	130,000
2007 (D)		21,000	33,000	54,000
2008 (C)		19,000	48,000	66,000
2009 (D)		19,000	39,000	58,000
2010 (BN)		18,000	72,000	90,000
2011 (W)		16,000	66,000	83,000
2012 (BN)		16,000	31,000	47,000
2013 (D)		20,000	38,000	58,000
2014 (C)		16,000	22,000	38,000
2015 (C)		15,000	40,000	55,000
2016 (BN)		17,000	72,000	89,000
2017 (W)		16,000	100,000	120,000
2018 (BN)		18,000	22,000	39,000
Average (1990-2018)		18,000	63,000	81,000
1990-2018	W	18,000	99,000	120,000
	AN	18,000	76,000	94,000
	BN	18,000	56,000	74,000
	D	20,000	43,000	63,000
	C	17,000	33,000	51,000

1.1.1.2 Precipitation

Precipitation estimates for the Bowman Subbasin are provided in **Figure 2** and **Table 2**. Total precipitation is highly variable between years in the study area, ranging from approximately 210 taf (20.5 inches) during average critically dry years to 390 taf (38.1 inches) during average wet years.

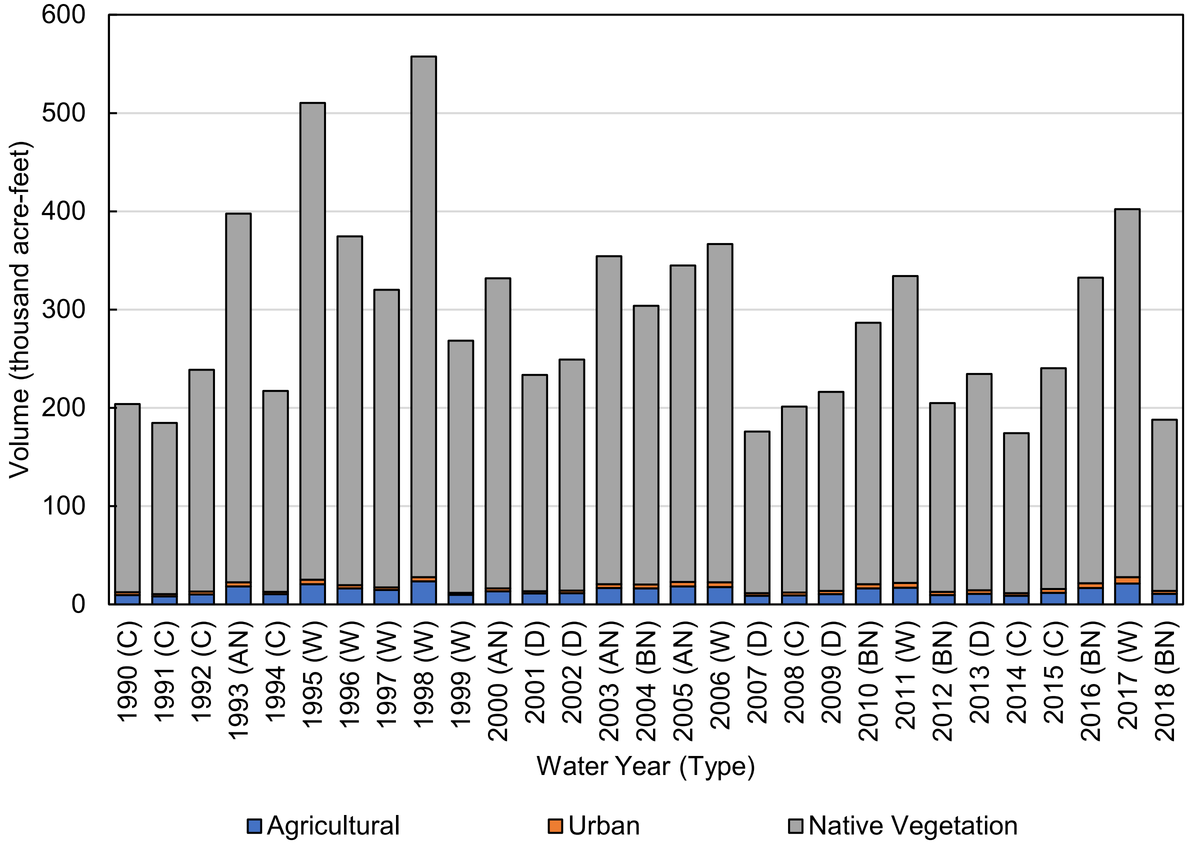

Figure 2. Bowman Subbasin Historical Precipitation, by Water Use Sector

Table 2. Bowman Subbasin Historical Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		9,600	2,800	190,000	200,000
1991 (C)		8,200	2,300	170,000	180,000
1992 (C)		10,000	2,600	230,000	240,000
1993 (AN)		18,000	4,300	370,000	400,000
1994 (C)		11,000	2,200	200,000	220,000
1995 (W)		21,000	4,400	490,000	510,000
1996 (W)		16,000	3,400	350,000	370,000
1997 (W)		15,000	2,500	300,000	320,000
1998 (W)		23,000	4,300	530,000	560,000
1999 (W)		9,900	2,000	260,000	270,000
2000 (AN)		14,000	2,800	320,000	330,000
2001 (D)		11,000	2,200	220,000	230,000
2002 (D)		11,000	2,500	240,000	250,000
2003 (AN)		17,000	4,000	330,000	350,000
2004 (BN)		16,000	3,900	280,000	300,000
2005 (AN)		18,000	4,600	320,000	340,000
2006 (W)		18,000	5,000	340,000	370,000
2007 (D)		8,900	2,500	160,000	180,000
2008 (C)		9,300	2,800	190,000	200,000
2009 (D)		11,000	3,100	200,000	220,000
2010 (BN)		16,000	4,300	270,000	290,000
2011 (W)		17,000	4,900	310,000	330,000
2012 (BN)		9,700	3,100	190,000	200,000
2013 (D)		11,000	3,500	220,000	230,000
2014 (C)		8,800	2,700	160,000	170,000
2015 (C)		12,000	3,700	220,000	240,000
2016 (BN)		17,000	5,000	310,000	330,000
2017 (W)		21,000	6,400	370,000	400,000
2018 (BN)		11,000	3,100	170,000	190,000
Average (1990-2018)		14,000	3,500	270,000	290,000
1990-2018	W	18,000	4,100	370,000	390,000
	AN	17,000	3,900	340,000	360,000
	BN	14,000	3,900	250,000	260,000
	D	11,000	2,800	210,000	220,000
	C	9,800	2,700	200,000	210,000

1.1.1.3 Groundwater Extraction by Water Use Sector

Total groundwater extraction in the Bowman Subbasin represents a combination of groundwater pumping to support agricultural and urban water demands, including rural residential use, and groundwater uptake by crops, urban vegetation, and native vegetation.

Estimates of groundwater pumping by water use sector are provided in **Figure 3** and **Table 3**. Virtually all groundwater pumping in the Bowman Subbasin is used to meet agricultural demand, averaging 6.1 taf per year. Groundwater pumping for urban use is approximately 0.9 taf per year. The total groundwater extraction varies from about 4.9 taf in wet years to 6.5 taf in critically dry years based on variability in surface water supplies, precipitation, and crop water demand.

When groundwater is near the land surface, groundwater uptake can also be a source of supply for vegetation. Estimates of groundwater uptake by vegetation are provided in **Figure 4** and **Table 4**. The majority of groundwater uptake is consumed directly by native vegetation and agricultural crops, totaling 2.6 taf and 0.4 taf per year, on average.

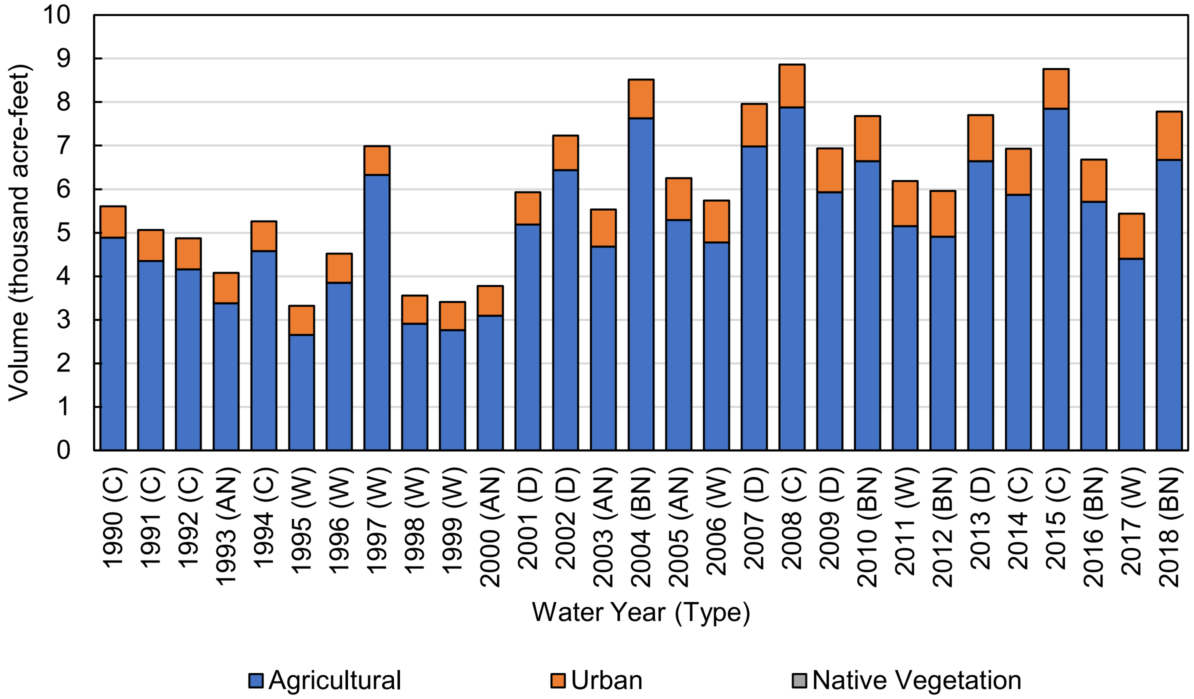

Figure 3. Bowman Subbasin Historical Groundwater Pumping, by Water Use Sector

Table 3. Bowman Subbasin Historical Groundwater Pumping, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		4,900	720	0	5,600
1991 (C)		4,400	710	0	5,100
1992 (C)		4,200	710	0	4,900
1993 (AN)		3,400	700	0	4,100
1994 (C)		4,600	680	0	5,300
1995 (W)		2,700	670	0	3,300
1996 (W)		3,900	670	0	4,500
1997 (W)		6,300	660	0	7,000
1998 (W)		2,900	650	0	3,600
1999 (W)		2,800	650	0	3,400
2000 (AN)		3,100	690	0	3,800
2001 (D)		5,200	740	0	5,900
2002 (D)		6,400	790	0	7,200
2003 (AN)		4,700	850	0	5,500
2004 (BN)		7,600	890	0	8,500
2005 (AN)		5,300	960	0	6,300
2006 (W)		4,800	960	0	5,700
2007 (D)		7,000	980	0	8,000
2008 (C)		7,900	980	0	8,900
2009 (D)		5,900	1,000	0	6,900
2010 (BN)		6,600	1,000	0	7,700
2011 (W)		5,200	1,000	0	6,200
2012 (BN)		4,900	1,100	0	6,000
2013 (D)		6,600	1,100	0	7,700
2014 (C)		5,900	1,100	0	6,900
2015 (C)		7,900	910	0	8,800
2016 (BN)		5,700	970	0	6,700
2017 (W)		4,400	1,000	0	5,400
2018 (BN)		6,700	1,100	0	7,800
Average (1990-2018)		5,200	860	0	6,100
1990-2018	W	4,100	790	0	4,900
	AN	4,100	800	0	4,900
	BN	6,300	1,000	0	7,300
	D	6,200	920	0	7,200
	C	5,700	820	0	6,500

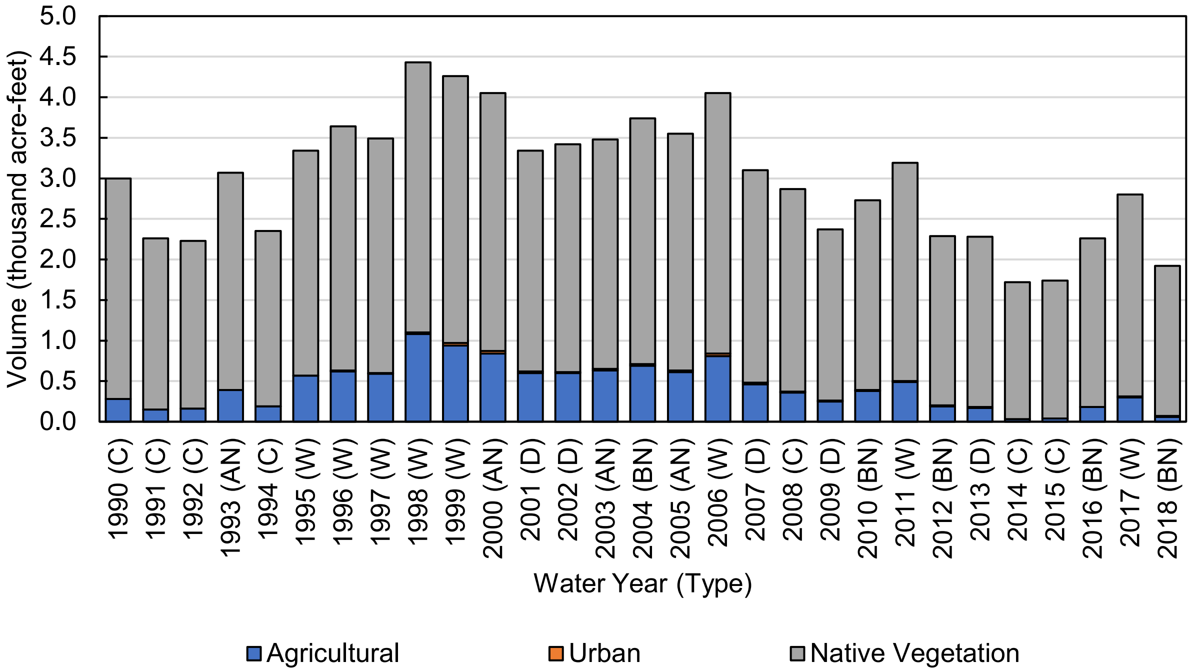

Figure 4. Bowman Subbasin Groundwater Uptake, by Water Use Sector

Table 4. Bowman Subbasin Historical Groundwater Uptake, by Water Use Sector (acre-feet)

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Agricultural</th><th>Urban</th><th>Native Vegetation</th><th>Total</th></tr>
<tr><td colspan="2">1990 (C)</td><td>280</td><td>0</td><td>2,700</td><td>3,000</td></tr>
<tr><td colspan="2">1991 (C)</td><td>150</td><td>0</td><td>2,100</td><td>2,300</td></tr>
<tr><td colspan="2">1992 (C)</td><td>160</td><td>0</td><td>2,100</td><td>2,200</td></tr>
<tr><td colspan="2">1993 (AN)</td><td>390</td><td>0</td><td>2,700</td><td>3,100</td></tr>
<tr><td colspan="2">1994 (C)</td><td>190</td><td>0</td><td>2,200</td><td>2,400</td></tr>
<tr><td colspan="2">1995 (W)</td><td>570</td><td>0</td><td>2,800</td><td>3,300</td></tr>
<tr><td colspan="2">1996 (W)</td><td>620</td><td>10</td><td>3,000</td><td>3,600</td></tr>
<tr><td colspan="2">1997 (W)</td><td>590</td><td>10</td><td>2,900</td><td>3,500</td></tr>
<tr><td colspan="2">1998 (W)</td><td>1,100</td><td>20</td><td>3,300</td><td>4,400</td></tr>
<tr><td colspan="2">1999 (W)</td><td>940</td><td>30</td><td>3,300</td><td>4,300</td></tr>
<tr><td colspan="2">2000 (AN)</td><td>840</td><td>30</td><td>3,200</td><td>4,100</td></tr>
<tr><td colspan="2">2001 (D)</td><td>600</td><td>20</td><td>2,700</td><td>3,300</td></tr>
<tr><td colspan="2">2002 (D)</td><td>600</td><td>10</td><td>2,800</td><td>3,400</td></tr>
<tr><td colspan="2">2003 (AN)</td><td>630</td><td>20</td><td>2,800</td><td>3,500</td></tr>
<tr><td colspan="2">2004 (BN)</td><td>690</td><td>20</td><td>3,000</td><td>3,700</td></tr>
<tr><td colspan="2">2005 (AN)</td><td>610</td><td>20</td><td>2,900</td><td>3,600</td></tr>
<tr><td colspan="2">2006 (W)</td><td>810</td><td>30</td><td>3,200</td><td>4,100</td></tr>
<tr><td colspan="2">2007 (D)</td><td>460</td><td>20</td><td>2,600</td><td>3,100</td></tr>
<tr><td colspan="2">2008 (C)</td><td>360</td><td>10</td><td>2,500</td><td>2,900</td></tr>
<tr><td colspan="2">2009 (D)</td><td>250</td><td>10</td><td>2,100</td><td>2,400</td></tr>
<tr><td colspan="2">2010 (BN)</td><td>380</td><td>10</td><td>2,300</td><td>2,700</td></tr>
<tr><td colspan="2">2011 (W)</td><td>490</td><td>10</td><td>2,700</td><td>3,200</td></tr>
<tr><td colspan="2">2012 (BN)</td><td>190</td><td>10</td><td>2,100</td><td>2,300</td></tr>
<tr><td colspan="2">2013 (D)</td><td>170</td><td>10</td><td>2,100</td><td>2,300</td></tr>
<tr><td colspan="2">2014 (C)</td><td>30</td><td>0</td><td>1,700</td><td>1,700</td></tr>
<tr><td colspan="2">2015 (C)</td><td>40</td><td>0</td><td>1,700</td><td>1,700</td></tr>
<tr><td colspan="2">2016 (BN)</td><td>180</td><td>0</td><td>2,100</td><td>2,300</td></tr>
<tr><td colspan="2">2017 (W)</td><td>300</td><td>10</td><td>2,500</td><td>2,800</td></tr>
<tr><td colspan="2">2018 (BN)</td><td>60</td><td>10</td><td>1,900</td><td>1,900</td></tr>
<tr><td colspan="2">Average (1990-2018)</td><td>440</td><td>10</td><td>2,600</td><td>3,000</td></tr>
<tr><td rowspan="5">1990-2018</td><td>W</td><td>680</td><td>20</td><td>3,000</td><td>3,700</td></tr>
<tr><td>AN</td><td>620</td><td>20</td><td>2,900</td><td>3,500</td></tr>
<tr><td>BN</td><td>300</td><td>10</td><td>2,300</td><td>2,600</td></tr>
<tr><td>D</td><td>420</td><td>10</td><td>2,500</td><td>2,900</td></tr>
<tr><td>C</td><td>170</td><td>0</td><td>2,100</td><td>2,300</td></tr>
</table>

1.1.1.4 Groundwater Discharge to Surface Waterways

Groundwater discharge to surface water represents a gain, or increase of flow, in waterways that traverse or flow along the boundary of the Bowman Subbasin. Groundwater discharge in the Bowman Subbasin is calculated from the Tehama IHM as the net groundwater outflow to water reaches (i.e., groundwater discharge) in excess of groundwater inflows from waterway reaches (i.e., seepage). The total volume of estimated groundwater discharge to surface water is negligible in any given year, therefore set to zero throughout the historical water budget period.

1.1.2 Outflows

1.1.2.1 Evapotranspiration by Water Use Sector

Evapotranspiration (ET) by water use sector is reported in **Figure 5** through **Figure 8**, and **Table 5** through **Table 8**. First, total ET is reported, followed by ET from applied water (ET of water actively applied from surface water deliveries or groundwater pumping), ET of groundwater uptake (ET of shallow water extracted directly by vegetation), and ET from precipitation (ET of water supplied through rainfall).

Total ET varies between years, with the lowest observed in 1991, at approximately 140 taf, and greatest in 2005, at approximately 200 taf. Agricultural ET tends to increase slightly in drier years due to increased climatic demand, while the ET of native vegetation typically decreases due to reduced water supply.

ET of applied water occurs primarily from agricultural land, averaging about 9.3 taf in wet years and about 12 taf in years classified as below normal, dry, or critical. Urban ET of applied water is lower and relatively constant between years, averaging less than 0.3 taf per year. Native vegetation and agricultural crops in the Bowman Subbasin also directly consume shallow groundwater to meet a portion of their consumptive use requirements. ET of groundwater uptake by native vegetation and agricultural crops and totals 2.6 and 0.4 taf per year, on average.

ET of precipitation generally follows the pattern of precipitation, with higher volumes occurring in wet years when more precipitation occurs. Across all water use sectors, ET of precipitation in the Bowman Subbasin averages about 170 taf in wet and above-normal years and 150 taf in dry and critical water years. Much of the total ET of precipitation results from the large acreage of native vegetation in the Bowman Subbasin, though significant volumes result from agricultural areas as well.

Evaporation from rivers, streams, and canals in the Bowman Subbasin is reported in **Figure 9** and **Table 9**. The total volume is relatively small and constant between years, averaging approximately 0.7 taf per year. Evaporation from upgradient small watersheds is minimal, and is also not considered to substantially contribute to the subbasin SWS water budget.

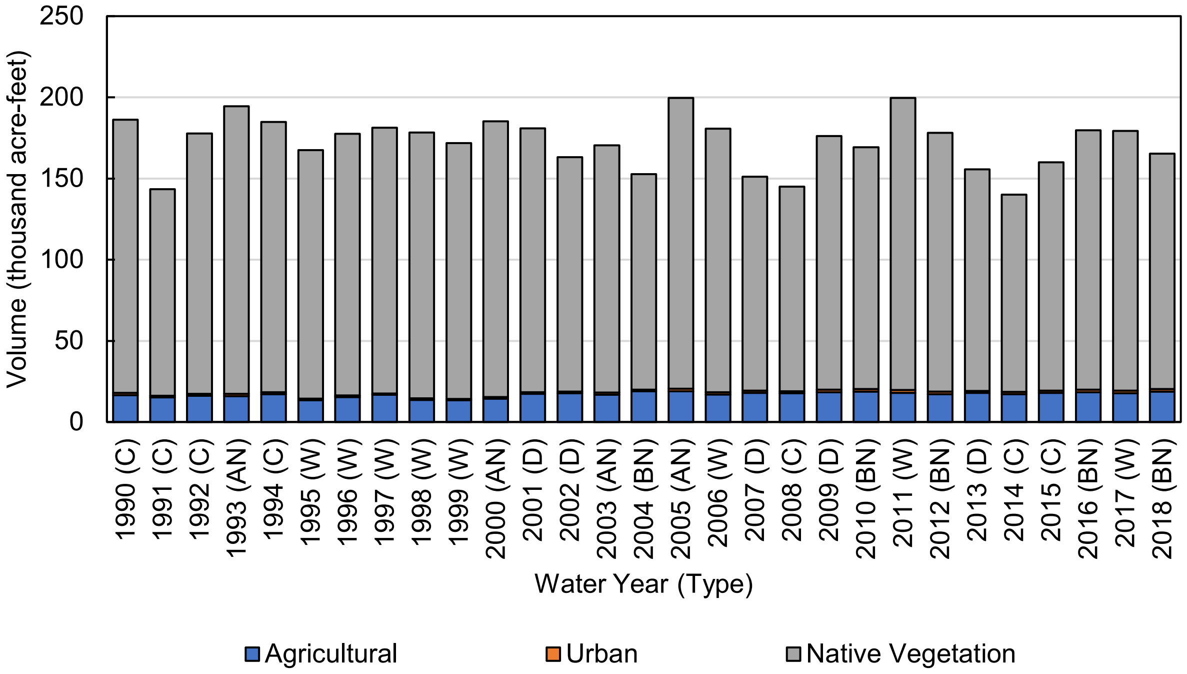

Figure 5. Bowman Subbasin Historical Total Evapotranspiration, (acre-feet)

Table 5. Bowman Subbasin Historical Total Evapotranspiration, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		17,000	1,400	170,000	190,000
1991 (C)		15,000	1,100	130,000	140,000
1992 (C)		16,000	1,200	160,000	180,000
1993 (AN)		16,000	1,300	180,000	190,000
1994 (C)		17,000	1,100	170,000	180,000
1995 (W)		13,000	930	150,000	170,000
1996 (W)		15,000	1,000	160,000	180,000
1997 (W)		17,000	920	160,000	180,000
1998 (W)		14,000	920	160,000	180,000
1999 (W)		13,000	800	160,000	170,000
2000 (AN)		14,000	990	170,000	190,000
2001 (D)		17,000	1,000	160,000	180,000
2002 (D)		18,000	1,000	140,000	160,000
2003 (AN)		17,000	1,300	150,000	170,000
2004 (BN)		19,000	1,100	130,000	150,000
2005 (AN)		19,000	1,700	180,000	200,000
2006 (W)		17,000	1,400	160,000	180,000
2007 (D)		18,000	1,300	130,000	150,000
2008 (C)		18,000	1,200	130,000	150,000
2009 (D)		18,000	1,600	160,000	180,000
2010 (BN)		19,000	1,500	150,000	170,000
2011 (W)		18,000	1,800	180,000	200,000
2012 (BN)		17,000	1,600	160,000	180,000
2013 (D)		18,000	1,400	140,000	160,000
2014 (C)		17,000	1,300	120,000	140,000
2015 (C)		18,000	1,400	140,000	160,000
2016 (BN)		18,000	1,600	160,000	180,000
2017 (W)		18,000	1,600	160,000	180,000
2018 (BN)		19,000	1,600	140,000	170,000
Average (1990-2018)		17,000	1,300	150,000	170,000
1990-2018	W	16,000	1,200	160,000	180,000
	AN	17,000	1,300	170,000	190,000
	BN	18,000	1,500	150,000	170,000
	D	18,000	1,300	150,000	170,000
	C	17,000	1,200	140,000	160,000

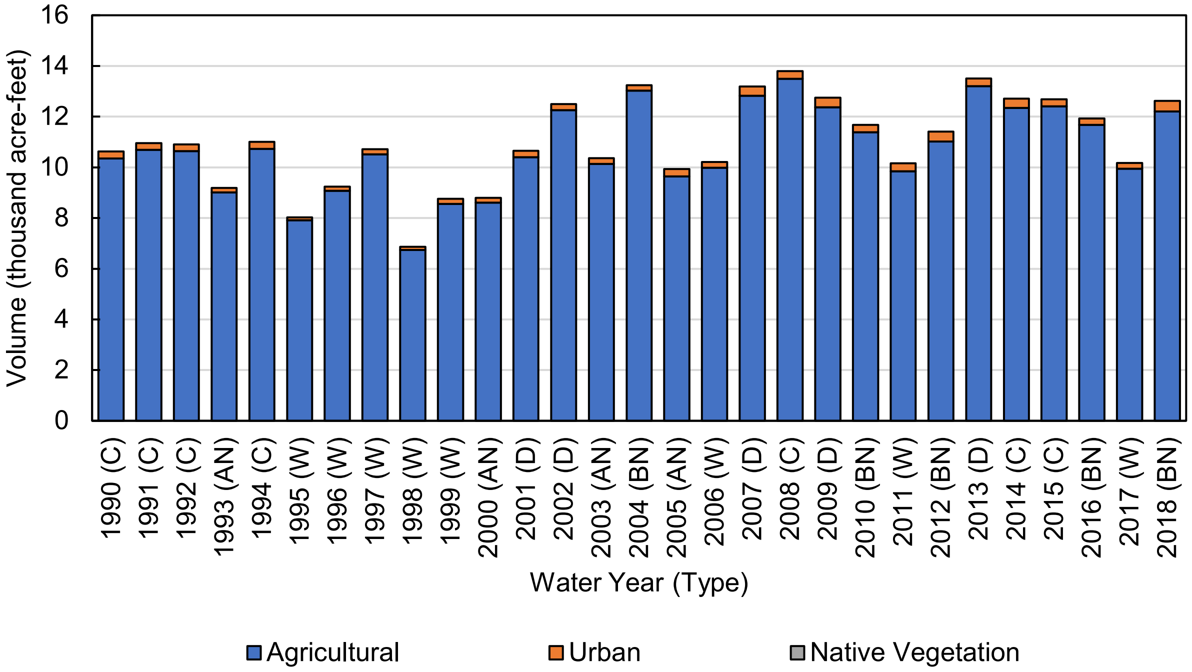

Figure 6. Bowman Subbasin Historical Evapotranspiration of Applied Water, by Water Use Sector

Table 6. Bowman Subbasin Historical Evapotranspiration of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		10,000	280	0	11,000
1991 (C)		11,000	260	0	11,000
1992 (C)		11,000	260	0	11,000
1993 (AN)		9,000	180	0	9,200
1994 (C)		11,000	270	0	11,000
1995 (W)		7,900	120	0	8,000
1996 (W)		9,100	170	0	9,200
1997 (W)		11,000	190	0	11,000
1998 (W)		6,700	120	0	6,900
1999 (W)		8,600	200	0	8,800
2000 (AN)		8,600	190	0	8,800
2001 (D)		10,000	250	0	11,000
2002 (D)		12,000	240	0	13,000
2003 (AN)		10,000	220	0	10,000
2004 (BN)		13,000	210	0	13,000
2005 (AN)		9,600	290	0	9,900
2006 (W)		10,000	230	0	10,000
2007 (D)		13,000	360	0	13,000
2008 (C)		13,000	310	0	14,000
2009 (D)		12,000	380	0	13,000
2010 (BN)		11,000	300	0	12,000
2011 (W)		9,900	310	0	10,000
2012 (BN)		11,000	390	0	11,000
2013 (D)		13,000	310	0	14,000
2014 (C)		12,000	370	0	13,000
2015 (C)		12,000	270	0	13,000
2016 (BN)		12,000	260	0	12,000
2017 (W)		10,000	220	0	10,000
2018 (BN)		12,000	410	0	13,000
Average (1990-2018)		11,000	260	0	11,000
1990-2018	W	9,100	200	0	9,300
	AN	9,400	220	0	9,600
	BN	12,000	310	0	12,000
	D	12,000	310	0	13,000
	C	12,000	290	0	12,000

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total

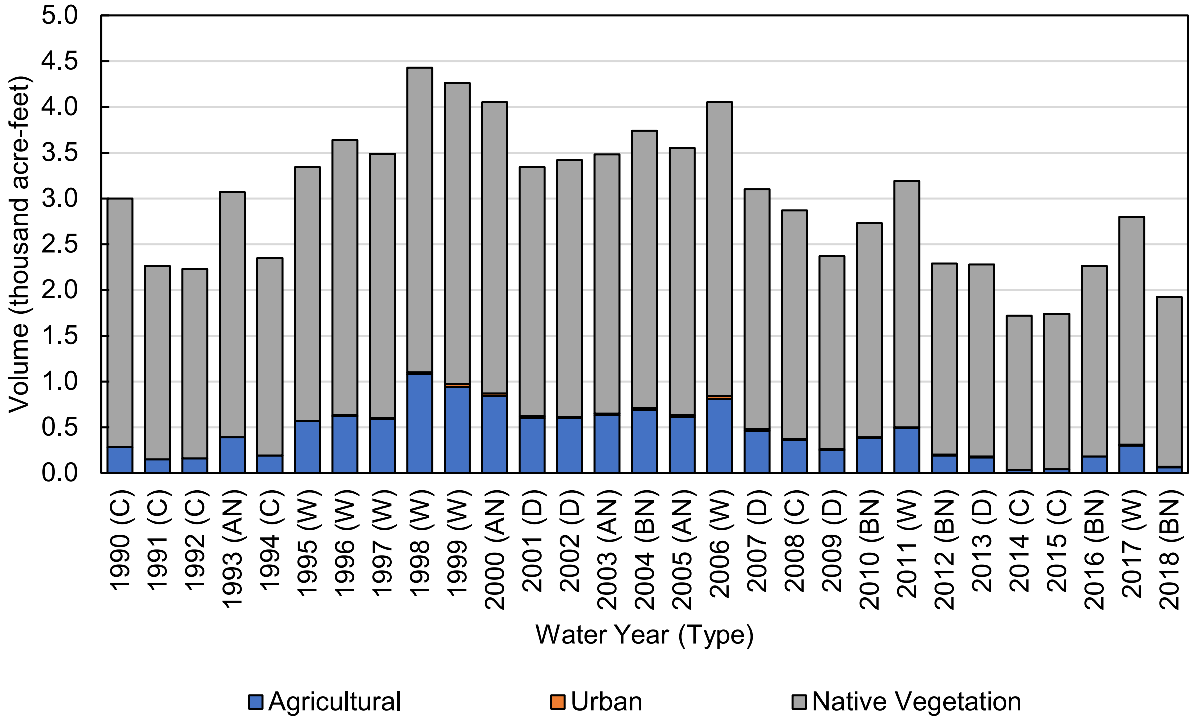

Figure 7. Bowman Subbasin Historical Evapotranspiration of Groundwater Uptake, by Water Use Sector

Table 7. Bowman Subbasin Historical Evapotranspiration of Groundwater Uptake, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		280	0	2,700	3,000
1991 (C)		150	0	2,100	2,300
1992 (C)		160	0	2,100	2,200
1993 (AN)		390	0	2,700	3,100
1994 (C)		190	0	2,200	2,400
1995 (W)		570	0	2,800	3,300
1996 (W)		620	10	3,000	3,600
1997 (W)		590	10	2,900	3,500
1998 (W)		1,100	20	3,300	4,400
1999 (W)		940	30	3,300	4,300
2000 (AN)		840	30	3,200	4,100
2001 (D)		600	20	2,700	3,300
2002 (D)		600	10	2,800	3,400
2003 (AN)		630	20	2,800	3,500
2004 (BN)		690	20	3,000	3,700
2005 (AN)		610	20	2,900	3,600
2006 (W)		810	30	3,200	4,100
2007 (D)		460	20	2,600	3,100
2008 (C)		360	10	2,500	2,900
2009 (D)		250	10	2,100	2,400
2010 (BN)		380	10	2,300	2,700
2011 (W)		490	10	2,700	3,200
2012 (BN)		190	10	2,100	2,300
2013 (D)		170	10	2,100	2,300
2014 (C)		30	0	1,700	1,700
2015 (C)		40	0	1,700	1,700
2016 (BN)		180	0	2,100	2,300
2017 (W)		300	10	2,500	2,800
2018 (BN)		60	10	1,900	1,900
Average (1990-2018)		440	10	2,600	3,000
1990-2018	W	680	20	3,000	3,700
	AN	620	20	2,900	3,500
	BN	300	10	2,300	2,600
	D	420	10	2,500	2,900
	C	170	0	2,100	2,300

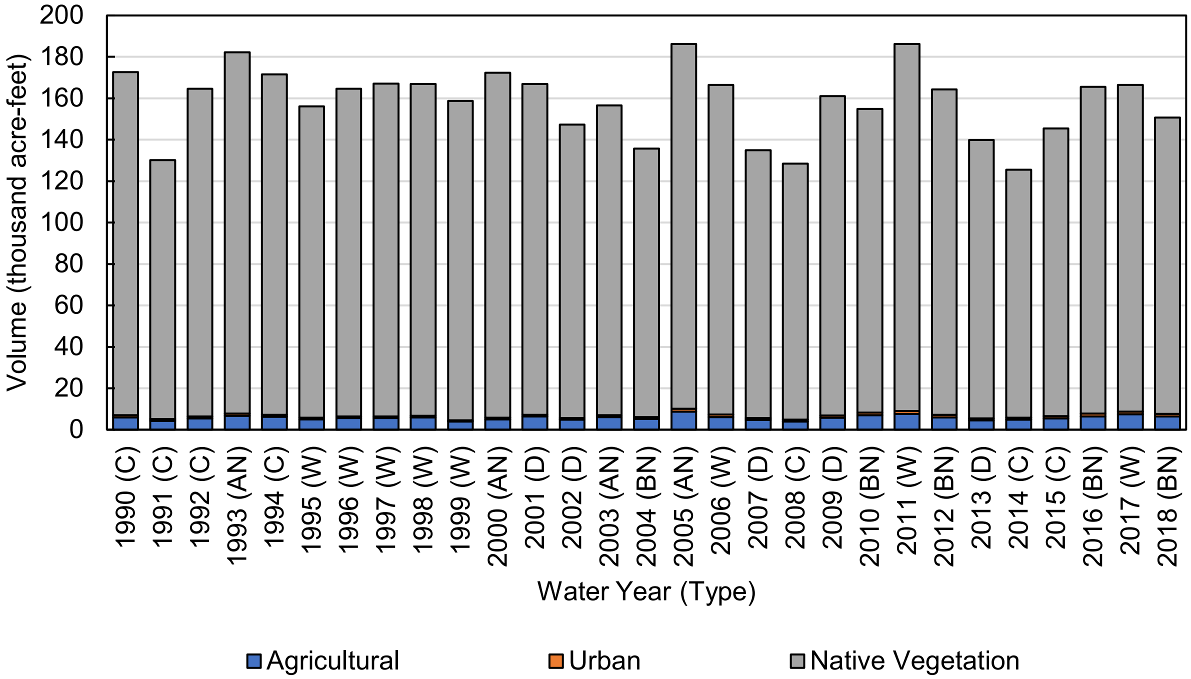

Figure 8. Bowman Subbasin Historical Evapotranspiration of Precipitation, by Water Use Sector

Table 8. Bowman Subbasin Historical Evapotranspiration of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		5,900	1,100	170,000	170,000
1991 (C)		4,300	830	130,000	130,000
1992 (C)		5,400	950	160,000	160,000
1993 (AN)		6,700	1,100	170,000	180,000
1994 (C)		6,300	850	160,000	170,000
1995 (W)		5,000	810	150,000	160,000
1996 (W)		5,600	830	160,000	160,000
1997 (W)		5,600	720	160,000	170,000
1998 (W)		5,900	780	160,000	170,000
1999 (W)		4,000	570	150,000	160,000
2000 (AN)		5,000	770	170,000	170,000
2001 (D)		6,400	750	160,000	170,000
2002 (D)		4,800	770	140,000	150,000
2003 (AN)		6,100	1,000	150,000	160,000
2004 (BN)		5,200	880	130,000	140,000
2005 (AN)		8,700	1,400	180,000	190,000
2006 (W)		6,200	1,200	160,000	170,000
2007 (D)		4,700	920	130,000	130,000
2008 (C)		4,000	860	120,000	130,000
2009 (D)		5,800	1,200	150,000	160,000
2010 (BN)		7,000	1,200	150,000	150,000
2011 (W)		7,600	1,500	180,000	190,000
2012 (BN)		6,000	1,200	160,000	160,000
2013 (D)		4,500	1,000	130,000	140,000
2014 (C)		4,900	940	120,000	130,000
2015 (C)		5,500	1,100	140,000	150,000
2016 (BN)		6,500	1,300	160,000	170,000
2017 (W)		7,400	1,400	160,000	170,000
2018 (BN)		6,500	1,100	140,000	150,000
Average (1990-2018)		5,800	1,000	150,000	160,000
1990-2018	W	5,900	960	160,000	170,000
	AN	6,600	1,100	170,000	170,000
	BN	6,200	1,100	150,000	150,000
	D	5,200	930	140,000	150,000
	C	5,200	950	140,000	150,000

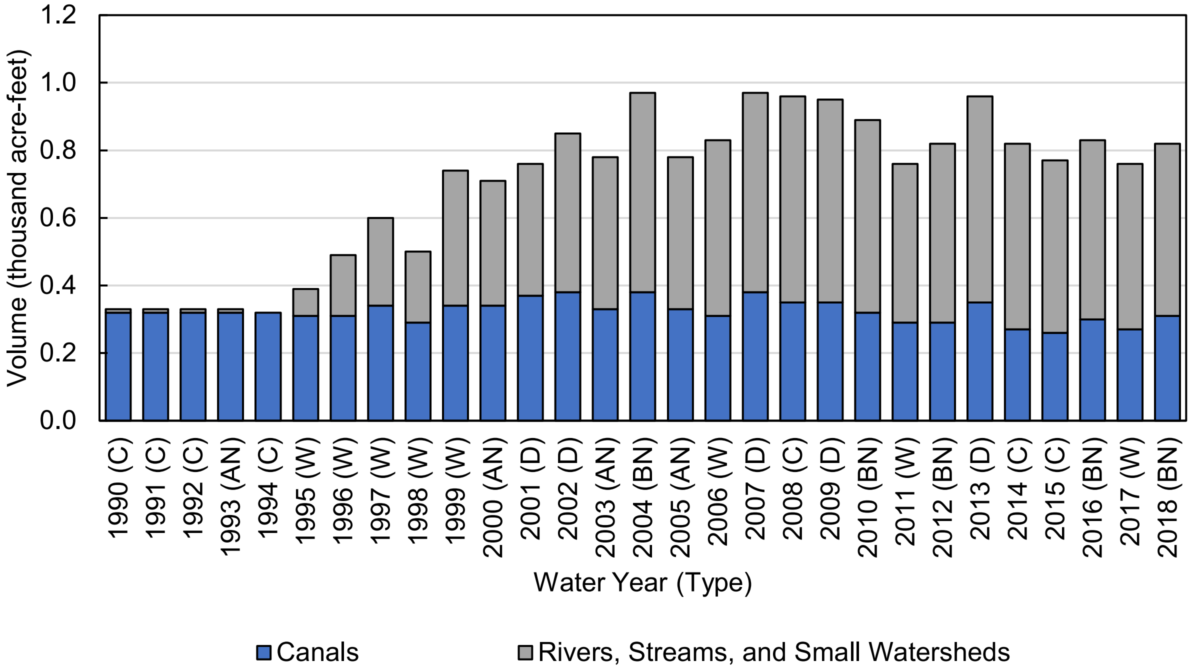

Figure 9. Bowman Subbasin Historical Evaporation of Surface Water Sources

Table 9. Bowman Subbasin Historical Evaporation of Surface Water Sources, by Water Use Sector (acre-feet)

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds[1]	Total
1990 (C)		320	10	330
1991 (C)		320	10	330
1992 (C)		320	10	330
1993 (AN)		320	10	330
1994 (C)		320	0	320
1995 (W)		310	80	390
1996 (W)		310	180	490
1997 (W)		340	260	600
1998 (W)		290	210	500
1999 (W)		340	400	740
2000 (AN)		340	370	710
2001 (D)		370	390	760
2002 (D)		380	470	850
2003 (AN)		330	450	780
2004 (BN)		380	590	970
2005 (AN)		330	450	780
2006 (W)		310	520	830
2007 (D)		380	590	970
2008 (C)		350	610	960
2009 (D)		350	600	950
2010 (BN)		320	570	890
2011 (W)		290	470	760
2012 (BN)		290	530	820
2013 (D)		350	610	960
2014 (C)		270	550	820
2015 (C)		260	510	770
2016 (BN)		300	530	830
2017 (W)		270	490	760
2018 (BN)		310	510	820
Average (1990-2018)		320	380	700
1990-2018	W	310	330	630
	AN	330	320	650
	BN	320	550	870
	D	370	530	900
	C	310	240	550

[1] Includes ET of riparian vegetation along rivers and streams.

1.1.2.2 Surface Water Outflow by Water Source Type

Surface water outflows from the Bowman Subbasin are summarized in **Figure 10** and **Table 10** by water source type. In the Bowman Subbasin, local supply outflows primarily include outflows of runoff, tailwater, and net drainage from land surfaces, in addition to runoff from small watersheds and stream outflows to the Sacramento River. Local supply outflows average approximately 110 taf per year, and range from 50 taf or less in certain dry and critical water years up to 390 taf in 1998. Approximately 1.6 taf of CVP supplies also leave the Subbasin each year in spillage from ACID canals to Cottonwood Creek.

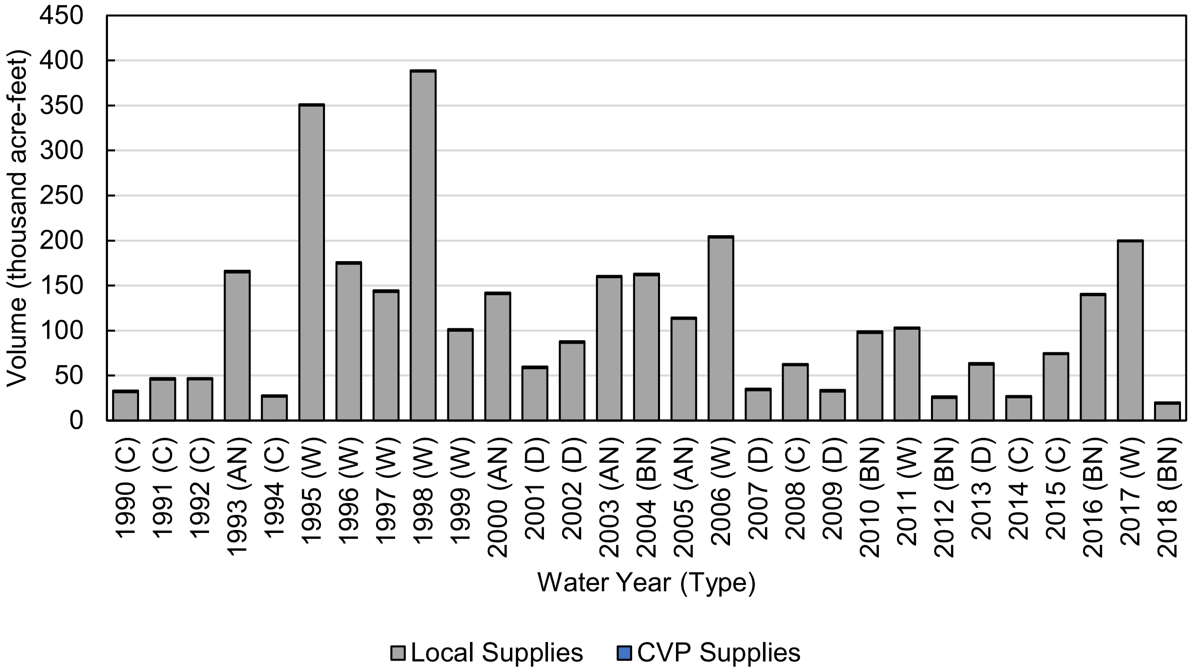

Figure 10. Bowman Subbasin Historical Surface Water Outflows, by Water Source Type

Table 10. Bowman Subbasin Historical Surface Water Outflows, by Water Source Type (acre-feet)

Water Year (Type)		CVP Supplies	Local Supplies	Other (Groundwater Discharge)	Total
1990 (C)		1,600	32,000	0	33,000
1991 (C)		1,600	46,000	0	47,000
1992 (C)		1,600	46,000	0	47,000
1993 (AN)		1,600	160,000	0	170,000
1994 (C)		1,600	26,000	0	28,000
1995 (W)		1,600	350,000	0	350,000
1996 (W)		1,600	170,000	0	180,000
1997 (W)		1,700	140,000	0	140,000
1998 (W)		1,500	390,000	0	390,000
1999 (W)		1,800	100,000	0	100,000
2000 (AN)		1,800	140,000	0	140,000
2001 (D)		1,900	58,000	0	60,000
2002 (D)		1,900	86,000	0	88,000
2003 (AN)		1,600	160,000	0	160,000
2004 (BN)		1,800	160,000	0	160,000
2005 (AN)		1,600	110,000	0	110,000
2006 (W)		1,500	200,000	0	200,000
2007 (D)		1,800	34,000	0	35,000
2008 (C)		1,700	61,000	0	63,000
2009 (D)		1,700	32,000	0	34,000
2010 (BN)		1,600	97,000	0	99,000
2011 (W)		1,500	100,000	0	100,000
2012 (BN)		1,500	25,000	0	27,000
2013 (D)		1,800	62,000	0	64,000
2014 (C)		1,400	26,000	0	27,000
2015 (C)		1,300	74,000	0	75,000
2016 (BN)		1,500	140,000	0	140,000
2017 (W)		1,400	200,000	0	200,000
2018 (BN)		1,600	19,000	0	20,000
Average (1990-2018)		1,600	110,000	0	110,000
1990-2018	W	1,600	210,000	0	210,000
	AN	1,600	140,000	0	150,000
	BN	1,600	88,000	0	90,000
	D	1,800	55,000	0	56,000

Water Year (Type)		CVP Supplies	Local Supplies	Other (Groundwater Discharge)	Total
	C	1,500	44,000	0	46,000

1.1.2.3 Deep Percolation of Applied Water

Estimated deep percolation of applied water (equal to infiltration of applied water in 23 CCR § 354.18(b)(2)) is summarized in **Figure 11** and **Table 11** by water use sector. Deep percolation of applied water is dominated by agricultural irrigation (approximately 8.5 taf per year on average) and varies between years, following the pattern of surface water diversions and deliveries to irrigated lands.

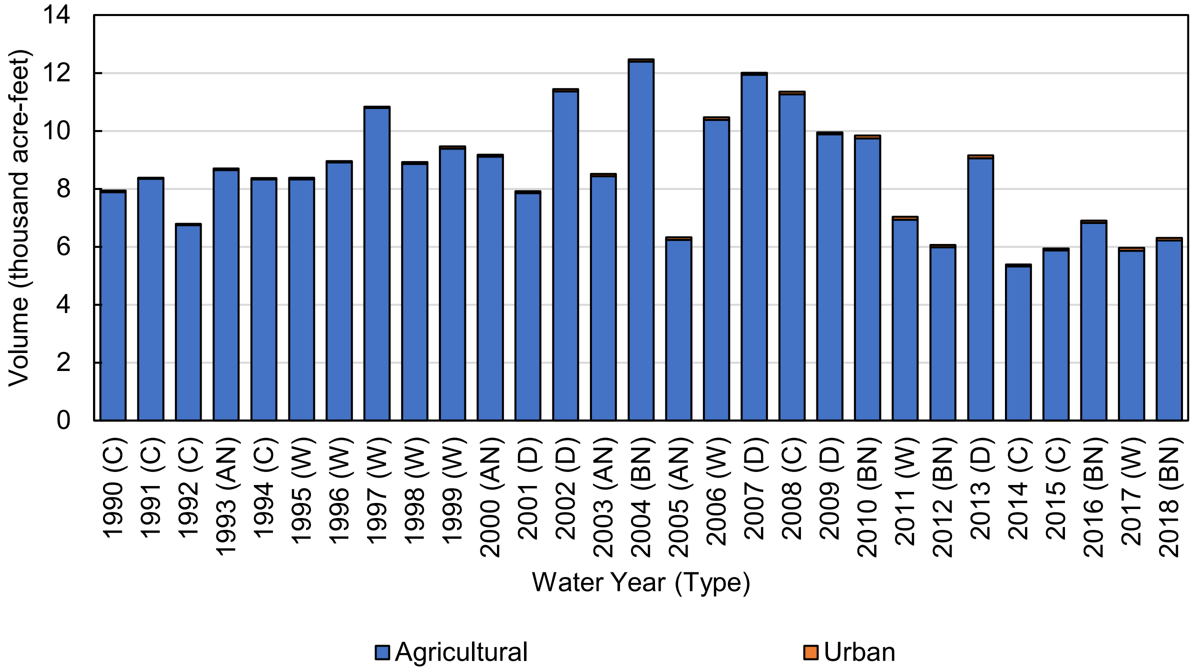

Figure 11. Bowman Subbasin Historical Deep Percolation of Applied Water, by Water Use Sector

Table 11. Bowman Subbasin Historical Deep Percolation of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		7,900	50	0	7,900
1991 (C)		8,400	30	0	8,400
1992 (C)		6,800	40	0	6,800
1993 (AN)		8,700	50	0	8,700
1994 (C)		8,300	40	0	8,400
1995 (W)		8,300	50	0	8,400
1996 (W)		8,900	50	0	9,000
1997 (W)		11,000	50	0	11,000
1998 (W)		8,900	60	0	8,900
1999 (W)		9,400	70	0	9,500
2000 (AN)		9,100	70	0	9,200
2001 (D)		7,900	70	0	7,900
2002 (D)		11,000	70	0	11,000
2003 (AN)		8,400	80	0	8,500
2004 (BN)		12,000	80	0	12,000
2005 (AN)		6,200	90	0	6,300
2006 (W)		10,000	90	0	10,000
2007 (D)		12,000	70	0	12,000
2008 (C)		11,000	80	0	11,000
2009 (D)		9,900	70	0	10,000
2010 (BN)		9,700	100	0	9,800
2011 (W)		6,900	100	0	7,000
2012 (BN)		6,000	70	0	6,100
2013 (D)		9,100	90	0	9,200
2014 (C)		5,300	70	0	5,400
2015 (C)		5,900	70	0	5,900
2016 (BN)		6,800	70	0	6,900
2017 (W)		5,900	100	0	6,000
2018 (BN)		6,200	80	0	6,300
Average (1990-2018)		8,500	70	0	8,600
1990-2018	W	8,700	70	0	8,800
	AN	8,100	70	0	8,200
	BN	8,200	80	0	8,300
	D	10,000	70	0	10,000
	C	7,700	50	0	7,700

1.1.2.4 Deep Percolation of Precipitation

Estimated deep percolation of precipitation (equal to infiltration of precipitation in 23 CCR § 354.18(b)(2)) is provided in and **Table 12** and **Figure 12** by water use sector. Deep percolation of precipitation to the GWS is highly variable from year to year due to variation in the timing and amount of precipitation, ranging from less than 30 taf annually during some dry years to about 100 taf in 1998.

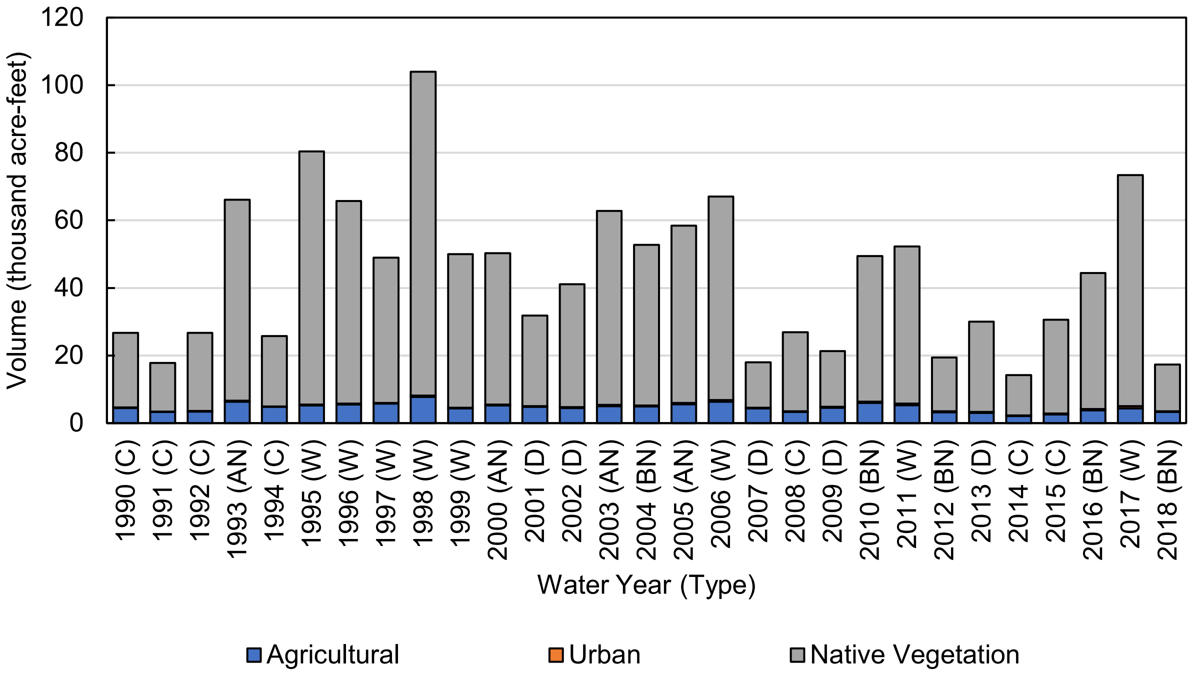

Figure 12. Bowman Subbasin Historical Deep Percolation of Precipitation, by Water Use Sector

Table 12. Bowman Subbasin Historical Deep Percolation of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
1990 (C)		4,500	190	22,000	27,000
1991 (C)		3,300	110	14,000	18,000
1992 (C)		3,400	130	23,000	27,000
1993 (AN)		6,400	280	59,000	66,000
1994 (C)		4,900	120	21,000	26,000
1995 (W)		5,200	330	75,000	80,000
1996 (W)		5,500	260	60,000	66,000
1997 (W)		5,800	200	43,000	49,000
1998 (W)		7,700	400	96,000	100,000
1999 (W)		4,400	210	45,000	50,000
2000 (AN)		5,300	280	45,000	50,000
2001 (D)		4,800	210	27,000	32,000
2002 (D)		4,500	230	36,000	41,000
2003 (AN)		5,000	350	57,000	63,000
2004 (BN)		4,900	360	47,000	53,000
2005 (AN)		5,600	410	52,000	58,000
2006 (W)		6,400	460	60,000	67,000
2007 (D)		4,400	180	13,000	18,000
2008 (C)		3,300	220	23,000	27,000
2009 (D)		4,600	210	16,000	21,000
2010 (BN)		6,000	390	43,000	49,000
2011 (W)		5,300	450	46,000	52,000
2012 (BN)		3,300	220	16,000	19,000
2013 (D)		3,100	280	27,000	30,000
2014 (C)		2,100	180	12,000	14,000
2015 (C)		2,600	290	28,000	31,000
2016 (BN)		3,800	370	40,000	44,000
2017 (W)		4,400	630	68,000	73,000
2018 (BN)		3,300	220	14,000	17,000
Average (1990-2018)		4,600	280	39,000	44,000
1990-2018	W	5,600	370	62,000	68,000
	AN	5,600	330	53,000	59,000
	BN	4,200	310	32,000	37,000
	D	4,300	220	24,000	28,000
	C	3,400	180	20,000	24,000

1.1.2.5 Infiltration of Surface Water

Estimated infiltration of surface water (seepage) by water source is provided in **Figure 13** and **Table 13.** Flows along Cottonwood Creek and runoff from upgradient small watersheds contribute seepage to the Bowman Subbasin, averaging about 31 taf per year. Seepage in the Bowman Subbasin also comes from conveyance of surface water delivered to irrigators in ACID. The total seepage from all canals and diversions is approximately 12 taf per year, on average.

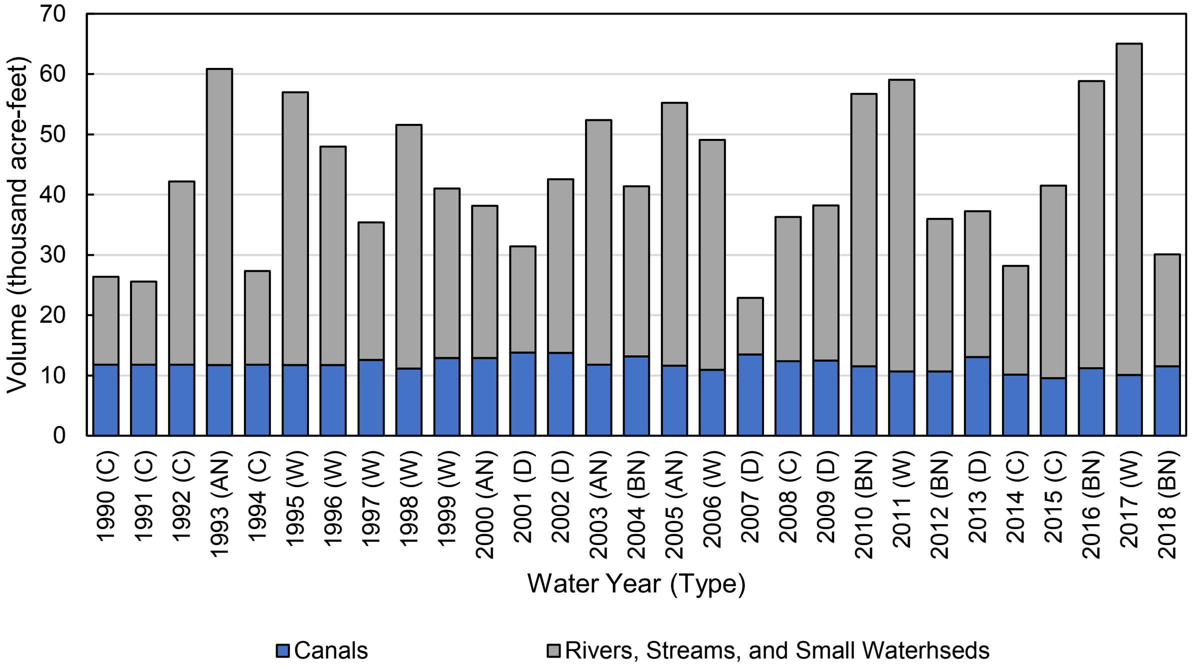

Figure 13. Bowman Subbasin Historical Infiltration of Surface Water, by Water Use Sector

Table 13. Bowman Subbasin Historical Infiltration of Surface Water, by Water Use Sector (acre-feet)

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds	Total
1990 (C)		12,000	15,000	26,000
1991 (C)		12,000	14,000	26,000
1992 (C)		12,000	30,000	42,000
1993 (AN)		12,000	49,000	61,000
1994 (C)		12,000	16,000	27,000
1995 (W)		12,000	45,000	57,000
1996 (W)		12,000	36,000	48,000
1997 (W)		13,000	23,000	35,000
1998 (W)		11,000	40,000	52,000
1999 (W)		13,000	28,000	41,000
2000 (AN)		13,000	25,000	38,000
2001 (D)		14,000	18,000	31,000
2002 (D)		14,000	29,000	43,000
2003 (AN)		12,000	41,000	52,000
2004 (BN)		13,000	28,000	41,000
2005 (AN)		12,000	44,000	55,000
2006 (W)		11,000	38,000	49,000
2007 (D)		14,000	9,400	23,000
2008 (C)		12,000	24,000	36,000
2009 (D)		12,000	26,000	38,000
2010 (BN)		12,000	45,000	57,000
2011 (W)		11,000	48,000	59,000
2012 (BN)		11,000	25,000	36,000
2013 (D)		13,000	24,000	37,000
2014 (C)		10,000	18,000	28,000
2015 (C)		9,500	32,000	42,000
2016 (BN)		11,000	48,000	59,000
2017 (W)		10,000	55,000	65,000
2018 (BN)		12,000	19,000	30,000
Average (1990-2018)		12,000	31,000	43,000
1990-2018	W	11,000	39,000	51,000
	AN	12,000	40,000	52,000
	BN	12,000	33,000	45,000
	D	13,000	21,000	34,000
	C	11,000	21,000	32,000

1.1.3 Change in Root Zone Storage

Estimates of change in root zone storage are provided in **Figure 14** and **Table 14**. Inter-annual changes in storage within the SWS consist primarily of root zone soil moisture storage changes, are relatively small, and tend to average near zero over many years.

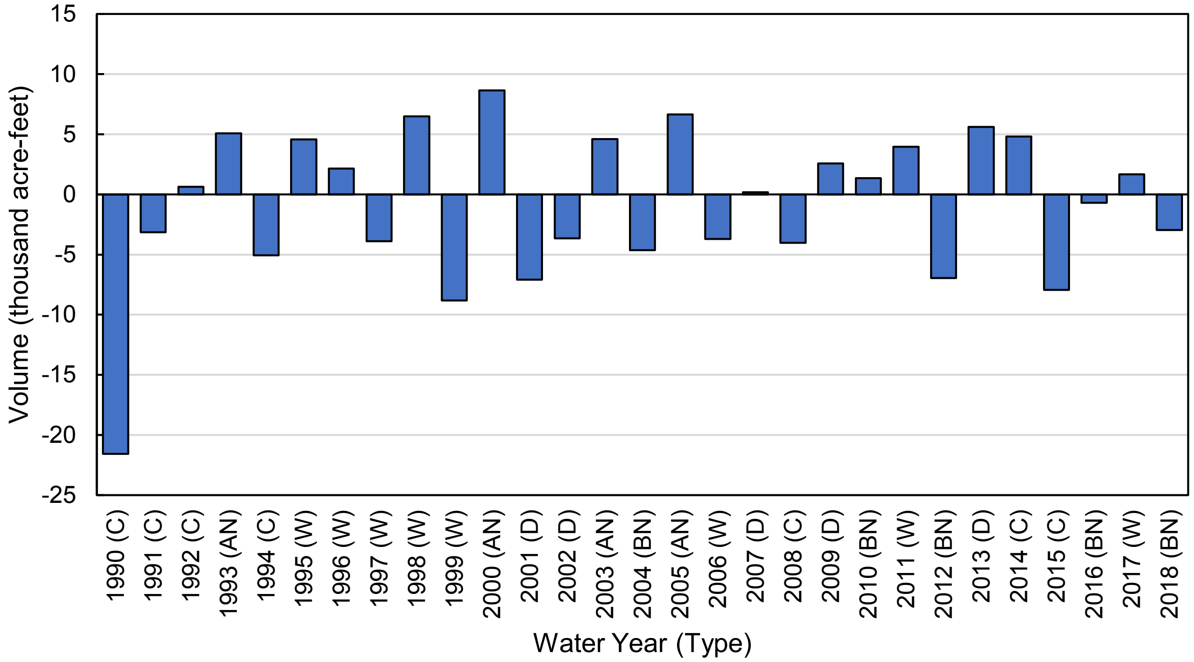

Figure 14. Bowman Subbasin Historical Change in Root Zone Storage

Table 14. Bowman Subbasin Historical Change in Root Zone Storage (acre-feet)

Water Year (Type)		Change in Root Zone Storage
1990 (C)		-22,000
1991 (C)		-3,200
1992 (C)		620
1993 (AN)		5,100
1994 (C)		-5,100
1995 (W)		4,600
1996 (W)		2,100
1997 (W)		-3,900
1998 (W)		6,500
1999 (W)		-8,800
2000 (AN)		8,600
2001 (D)		-7,100
2002 (D)		-3,700
2003 (AN)		4,600
2004 (BN)		-4,600
2005 (AN)		6,700
2006 (W)		-3,700
2007 (D)		170
2008 (C)		-4,000
2009 (D)		2,600
2010 (BN)		1,300
2011 (W)		4,000
2012 (BN)		-7,000
2013 (D)		5,600
2014 (C)		4,800
2015 (C)		-7,900
2016 (BN)		-710
2017 (W)		1,700
2018 (BN)		-3,000
Average (1990-2018)		-870
1990-2018	W	300
	AN	6,300
	BN	-2,800
	D	-480
	C	-5,200

1.1.4 Net Recharge from Surface Water System

Net recharge from the SWS is a useful metric that equates only the impacts of the SWS on recharge and extraction from the GWS, providing valuable insight to the combined effects of land surface processes on the underlying GWS. Net recharge from the SWS is calculated as the total groundwater recharge minus the total groundwater extraction and uptake. When calculated for the historical water budget, average net recharge from the SWS represents the average surplus (when positive) or shortage (when negative) of recharge that has resulted from historical cropping, land use practices, and average hydrologic conditions, when comparing groundwater extractions with deep percolation and infiltration from the SWS to the GWS. Net recharge does not include groundwater discharges to surface water and is not a full accounting of all exchanges occurring between the SWS and GWS. Although net recharge is a useful water balance metric, groundwater sustainability is not defined by the balance of net recharge from the SWS. Other important factors must be considered in the complete assessment of groundwater sustainability, including but not limited to subsurface groundwater flows and groundwater discharge to surface water.

Annual values for net recharge from the SWS over the historical water budget period are presented below for the Bowman Subbasin. **Figure 15** and **Table 15** show the average net recharge from the SWS over 1990-2018 based on the historical water budget results. Historically, the average net recharge in the Bowman Subbasin was approximately 86 taf per year between 1990-2018, indicating net inflows to the GWS from the SWS during the historical water budget period. As illustrated on the cumulative net recharge plot in **Figure 15**, this results in a cumulative net positive recharge (i.e., net discharge from the SWS to the GWS) of about 2,500 taf over the 29-year historical water budget period. Although this means there has historically been more recharge from the SWS to the GWS than extractions and discharges from the GWS to the SWS, this alone does not necessarily mean that groundwater storage is increasing or that the Subbasin groundwater system has been sustainable. The complete Subbasin water budget, including the GWS water budget results, provide an indication of whether total groundwater inflows and outflows are in balance.

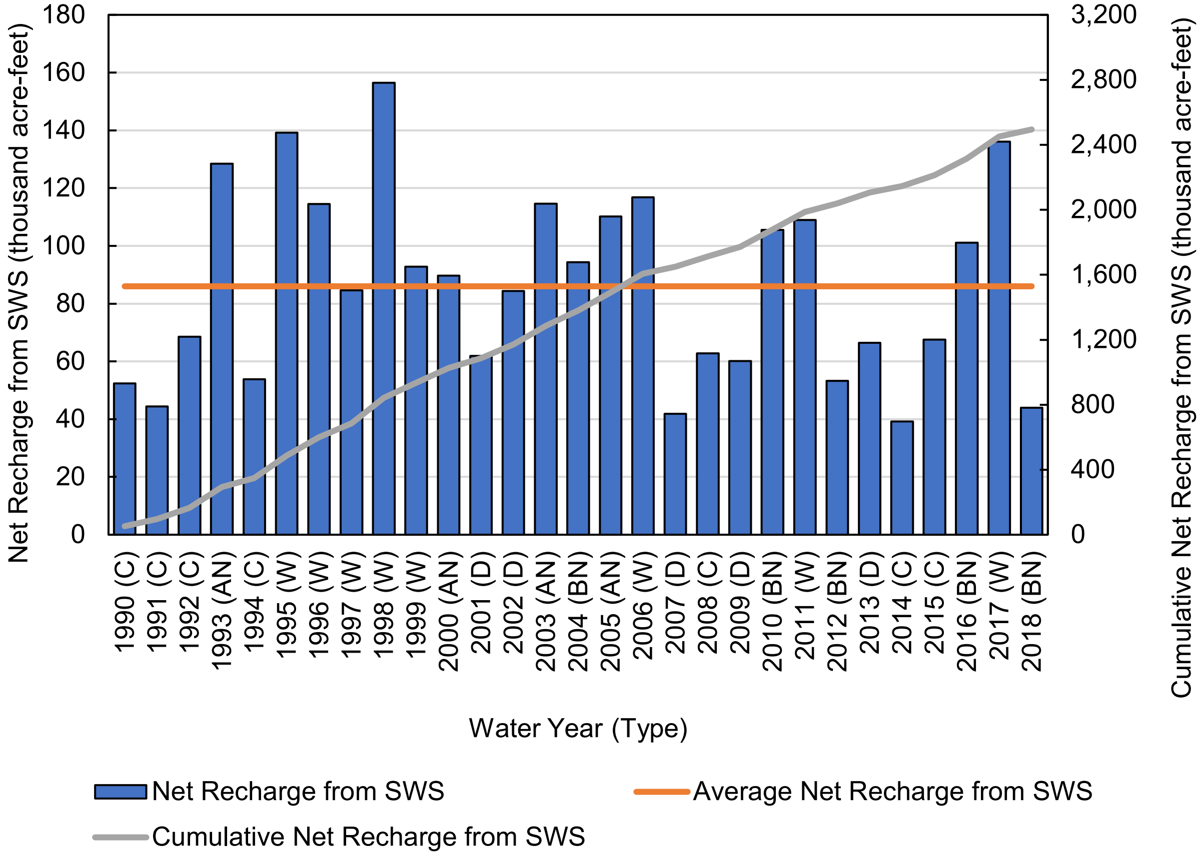

Figure 15. Bowman Subbasin Historical Net Recharge Overview

Table 15. Bowman Subbasin Historical Water Budget: Average Net Recharge from SWS, by Water Year Type (acre-feet)

Year Type	Number of Years	Deep Perc. of Applied Water (a)	Deep Perc. of Precipitation (b)	Infil. of Surface Water (c)	Groundwater Extraction/ Uptake (d)	Net Recharge from SWS (a+b+c-d)
W	8	8,800	68,000	51,000	8,600	120,000
AN	4	8,200	59,000	52,000	8,500	110,000
BN	5	8,300	37,000	45,000	9,900	80,000
D	5	10,000	28,000	34,000	10,000	63,000
C	7	7,700	24,000	32,000	8,800	56,000
Annual Average (1990-2018)	29	8,600	44,000	43,000	9,100	86,000

1.2 Groundwater System Water Budget Results

Historical water budget results for different components of the GWS are presented in the sections below. Inflows and outflows from the GWS that occur through exchanges with the SWS are discussed in the SWS water budget results, although these components are also noted in the sections below relating to the GWS water budget. In contrast to the SWS water budget, many of the GWS water budget components change in flow direction over time representing inflows during some periods and outflows during other periods, depending on Subbasin conditions. The GWS water budget results are presented with net inflows indicated by positive values and net outflows as negative values.

1.2.1 Lateral Subsurface Groundwater Flows

Subsurface groundwater flows to and from the Bowman Subbasin occur between the Red Bluff Subbasin to the south, the Anderson Subbasin to the north, and the South Battle Creek Subbasin to the east. Subsurface groundwater inflows that occur from the upland foothill (small watershed) areas adjoining the Bowman Subbasin are negligible and set at zero throughout the historical period.

1.2.1.1 Lateral Subsurface Flows to/from Adjacent Subbasins

Historical lateral subsurface flows occurring from and to adjacent subbasin are summarized in **Figure 16** and **Table 16**. The total historical net subsurface flows to and from all adjacent subbasins averages about -88 taf per year occurring as outflow from the Bowman Subbasin. Historical subsurface flows across the boundary with the Red Bluff Subbasin average an outflow of nearly -120 taf per year. The magnitude of these subsurface flows does not fluctuate much from year to year, although the subsurface outflows to the Red Bluff Subbasin tend to be somewhat greater during wet years than in dry years. In contrast to the subsurface outflows across the boundary with Red Bluff Subbasin, the flows across the northern boundary with the Anderson Subbasin occur as inflows averaging about 22 taf per year, with little variability by water year type. Subsurface flows across the boundary with the South Battle Creek Subbasin are relatively small. On average the subsurface flows across the South Battle Creek Subbasin boundary occur as net inflows of about 9.4 taf per year.

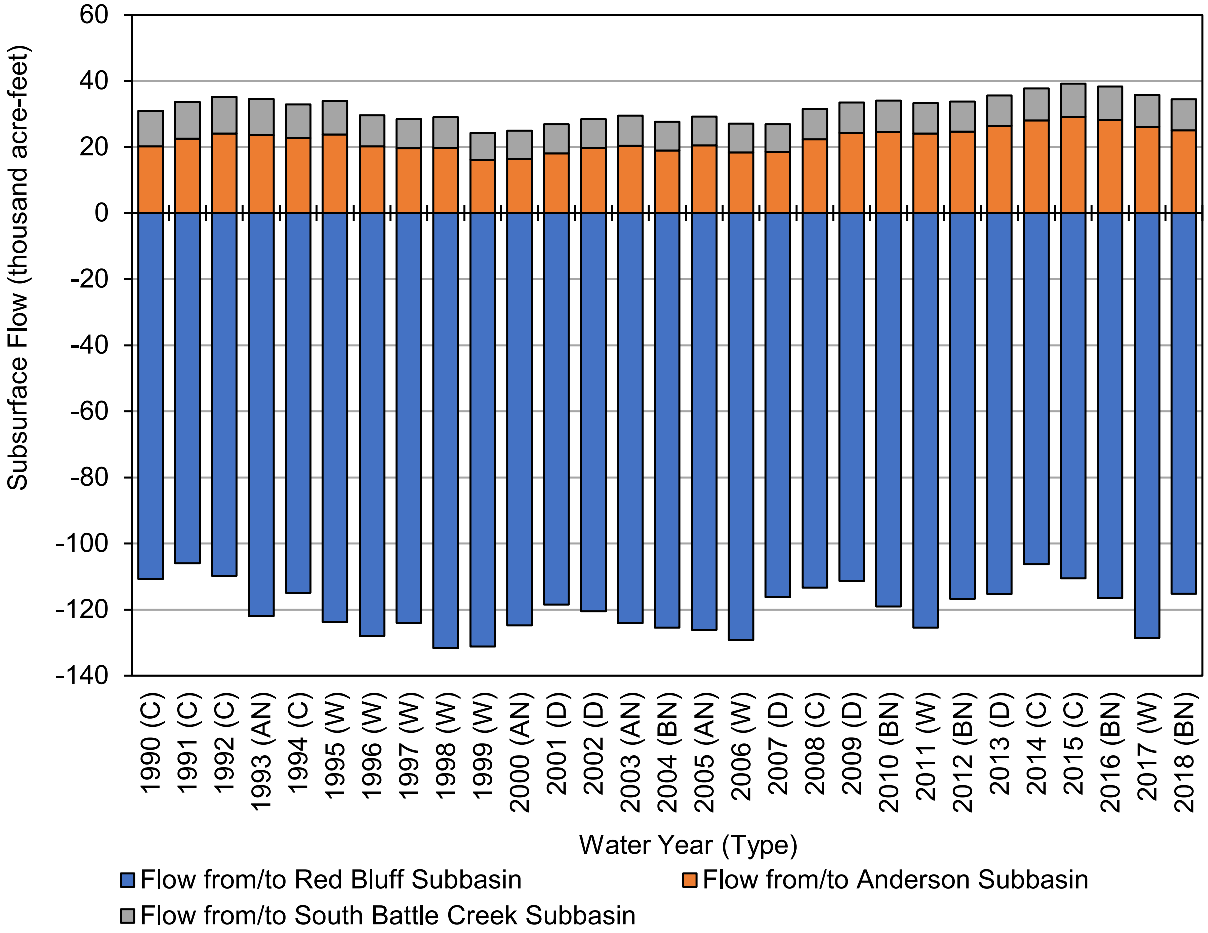

Figure 16. Bowman Subbasin Historical Lateral Subsurface Groundwater Flows to/from Adjacent Subbasins

Table 16. Bowman Subbasin Historical Lateral Subsurface Groundwater Flows Between Adjacent Subbasins (net flows as acre-feet)

Water Year (Type)		Red Bluff	Anderson	South Battle Creek	Total
1990 (C)		-110,000	20,000	11,000	-80,000
1991 (C)		-110,000	23,000	11,000	-72,000
1992 (C)		-110,000	24,000	11,000	-75,000
1993 (AN)		-120,000	24,000	11,000	-87,000
1994 (C)		-110,000	23,000	10,000	-82,000
1995 (W)		-120,000	24,000	10,000	-90,000
1996 (W)		-130,000	20,000	9,400	-98,000
1997 (W)		-120,000	20,000	8,900	-96,000
1998 (W)		-130,000	20,000	9,300	-100,000
1999 (W)		-130,000	16,000	8,100	-110,000
2000 (AN)		-120,000	16,000	8,600	-100,000
2001 (D)		-120,000	18,000	8,700	-92,000
2002 (D)		-120,000	20,000	8,800	-92,000
2003 (AN)		-120,000	20,000	9,100	-95,000
2004 (BN)		-130,000	19,000	8,700	-98,000
2005 (AN)		-130,000	20,000	8,800	-97,000
2006 (W)		-130,000	18,000	8,600	-100,000
2007 (D)		-120,000	19,000	8,300	-89,000
2008 (C)		-110,000	22,000	9,100	-82,000
2009 (D)		-110,000	24,000	9,300	-78,000
2010 (BN)		-120,000	25,000	9,500	-85,000
2011 (W)		-130,000	24,000	9,200	-92,000
2012 (BN)		-120,000	25,000	9,100	-83,000
2013 (D)		-120,000	26,000	9,300	-80,000
2014 (C)		-110,000	28,000	9,600	-69,000
2015 (C)		-110,000	29,000	10,000	-71,000
2016 (BN)		-120,000	28,000	10,000	-78,000
2017 (W)		-130,000	26,000	9,700	-93,000
2018 (BN)		-120,000	25,000	9,400	-81,000
Average (1990-2018)		-120,000	22,000	9,400	-88,000
1990-2018	W	-130,000	21,000	9,200	-98,000
	AN	-120,000	21,000	9,600	-93,000
	BN	-120,000	25,000	9,500	-84,000
	D	-120,000	21,000	8,900	-86,000
	C	-110,000	24,000	10,000	-76,000

Note: positive values represent net inflows to Bowman Subbasin, negative values represent net outflows from Bowman Subbasin.

1.2.2 Deep Percolation From the SWS

Deep percolation from the SWS includes infiltration of water below the root zone (deep percolation) from precipitation and applied water. These two water budget components are summarized in the SWS water budget as outflows to the SWS and are presented as aggregated deep percolation inflows to the GWS in **Figure 17** and **Table 17**. The average annual deep percolation from the SWS over the historical water budget period is approximately 53 taf per year. Greater volumes of deep percolation occur during wetter years when infiltration of precipitation is higher.

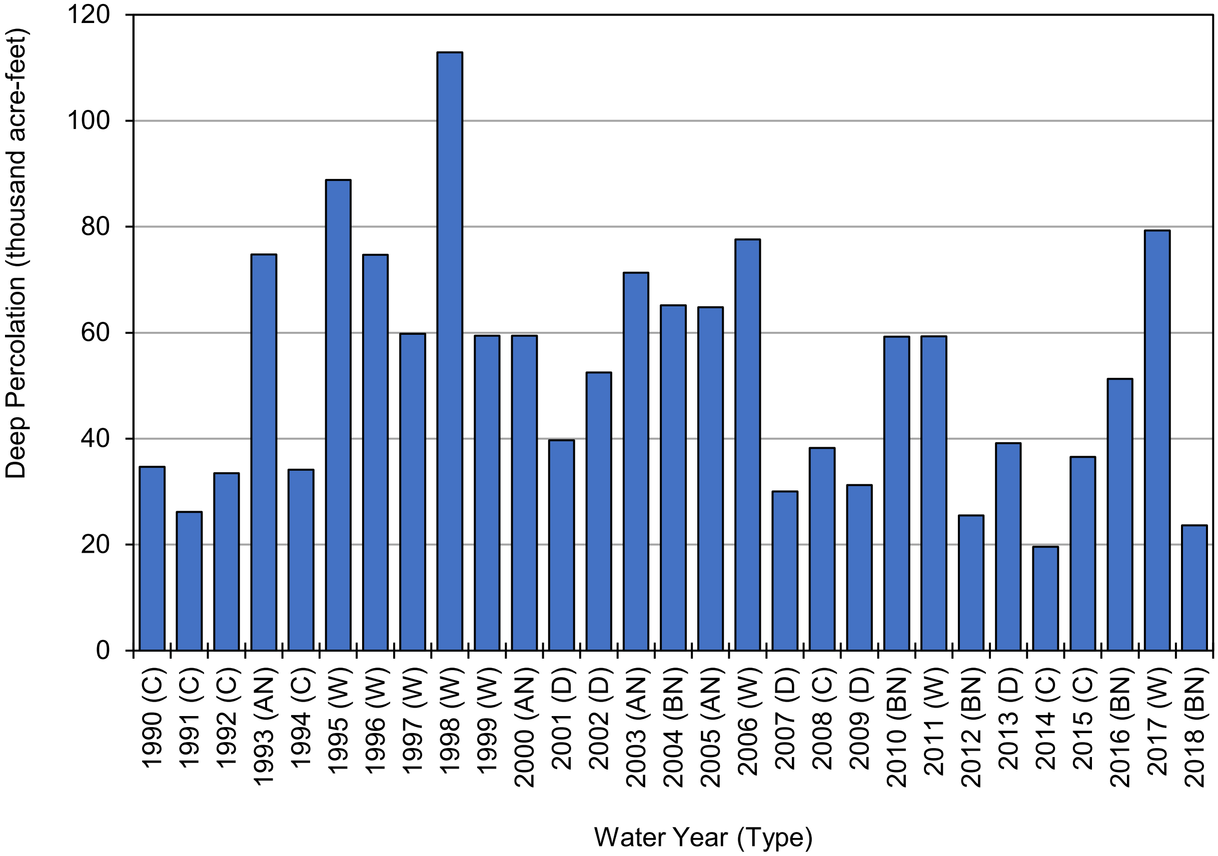

Figure 17. Bowman Subbasin Historical Deep Percolation from the SWS

Table 17. Bowman Subbasin Historical Deep Percolation from the SWS (acre-feet)

Water Year (Type)		Deep Percolation from the SWS
1990 (C)		35,000
1991 (C)		26,000
1992 (C)		33,000
1993 (AN)		75,000
1994 (C)		34,000
1995 (W)		89,000
1996 (W)		75,000
1997 (W)		60,000
1998 (W)		110,000
1999 (W)		59,000
2000 (AN)		59,000
2001 (D)		40,000
2002 (D)		53,000
2003 (AN)		71,000
2004 (BN)		65,000
2005 (AN)		65,000
2006 (W)		78,000
2007 (D)		30,000
2008 (C)		38,000
2009 (D)		31,000
2010 (BN)		59,000
2011 (W)		59,000
2012 (BN)		26,000
2013 (D)		39,000
2014 (C)		20,000
2015 (C)		37,000
2016 (BN)		51,000
2017 (W)		79,000
2018 (BN)		24,000
Average (1990-2018)		53,000
1990-2018	W	76,000
	AN	70,000
	BN	46,000
	D	39,000
	C	32,000

1.2.3 Net Stream Seepage/Groundwater Discharge to Surface Water

The flow of water between the GWS and SWS through seepage of water from streams and canals and groundwater discharging into streams is discussed as part of the SWS water budget. These components are combined for presentation in the GWS water budget as a net volume of stream seepage (**Figure 18** and **Table 18**). Positive total net seepage values represent a net inflow of water from the SWS to the GWS via stream and canal seepage indicating that the overall volume of stream seepage is greater than the volume of any groundwater discharging into surface waterways. Negative net seepage values represent a net outflow of groundwater from the GWS to the SWS through groundwater discharge to surface water. When net seepage is negative, it means that more groundwater is discharging into the surface waterways than is seeping from surface waterways into the GWS.

In the Bowman Subbasin, the historical annual net seepage values are always positive with an average annual net stream seepage value of 43 taf per year indicating net addition of water to the GWS through the exchanges with surface waterways. The annual net stream seepage values tend to be higher in wet years in comparison to dry years corresponding with more groundwater recharge from surface water in wet years and less groundwater recharge in dry years.

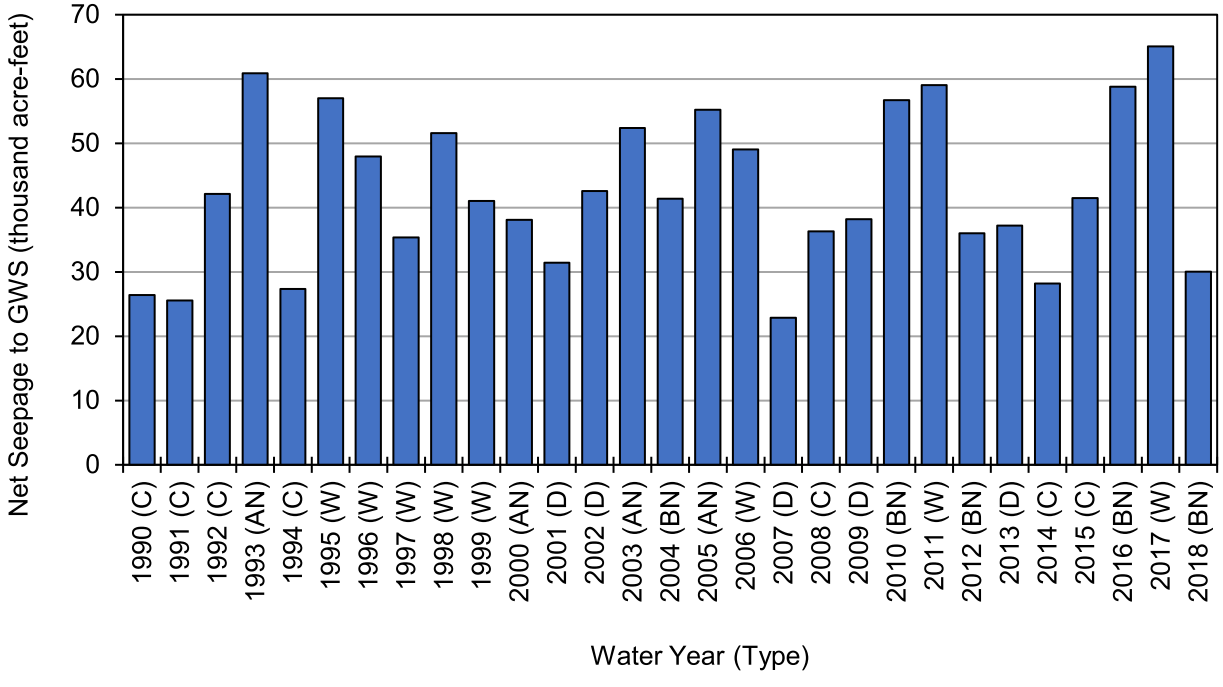

Figure 18. Bowman Subbasin Historical Net Stream Seepage to GWS/Discharge to Surface Water

Table 18. Bowman Subbasin Historical Net Stream Seepage (net flows as acre-feet)

Water Year (Type)		Total Net Seepage from Surface Waterways and Canals
1990 (C)		26,000
1991 (C)		26,000
1992 (C)		42,000
1993 (AN)		61,000
1994 (C)		27,000
1995 (W)		57,000
1996 (W)		48,000
1997 (W)		35,000
1998 (W)		52,000
1999 (W)		41,000
2000 (AN)		38,000
2001 (D)		31,000
2002 (D)		43,000
2003 (AN)		52,000
2004 (BN)		41,000
2005 (AN)		55,000
2006 (W)		49,000
2007 (D)		23,000
2008 (C)		36,000
2009 (D)		38,000
2010 (BN)		57,000
2011 (W)		59,000
2012 (BN)		36,000
2013 (D)		37,000
2014 (C)		28,000
2015 (C)		42,000
2016 (BN)		59,000
2017 (W)		65,000
2018 (BN)		30,000
Average (1990-2018)		43,000
1990-2018	W	51,000
	AN	56,000
	BN	47,000
	D	34,000
	C	32,000

Note: negative values indicate net groundwater discharge to surface water

1.2.4 Groundwater Extraction

Groundwater extractions are exchanges that occur between the GWS and the SWS. Groundwater extraction from the GWS occurs through groundwater pumping to meet water demands for urban and agricultural needs and also through groundwater (root water) uptake by plants directly from shallow groundwater during times and at locations of sufficiently shallow groundwater conditions. Historical groundwater extractions are summarized in **Figure 19** and **Table 19** and also presented and discussed in the SWS water budget sections. Total groundwater extractions over the historical water budget period average about -9.1 taf per year. Overall, groundwater pumping represents a larger fraction of the groundwater extractions than groundwater uptake. Groundwater pumping averaged about -6.1 taf over the historical period and groundwater uptake averaged about -3.0 taf. In wetter periods, groundwater uptake increases and groundwater pumping decreases. Accordingly, during drier periods groundwater pumping increases and water uptake by plants from shallow groundwater decreases in response to the higher water demands for irrigation and other uses and the greater depths to groundwater that also tend to occur during dry periods.

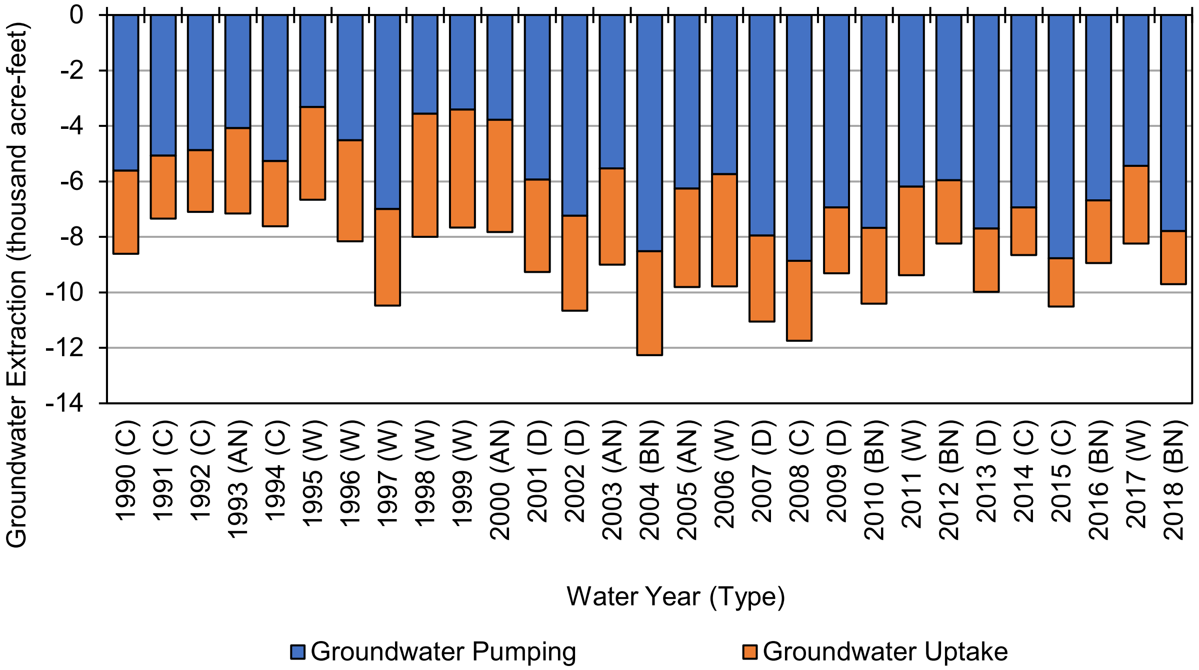

Figure 19. Bowman Subbasin Historical Groundwater Extractions

Table 19. Bowman Subbasin Historical Groundwater Extractions (acre-feet)

Water Year (Type)		Groundwater Pumping	Groundwater (Root Water) Uptake	Total Extractions
1990 (C)		-5,600	-3,000	-8,600
1991 (C)		-5,100	-2,300	-7,300
1992 (C)		-4,900	-2,200	-7,100
1993 (AN)		-4,100	-3,100	-7,200
1994 (C)		-5,300	-2,300	-7,600
1995 (W)		-3,300	-3,300	-6,700
1996 (W)		-4,500	-3,600	-8,200
1997 (W)		-7,000	-3,500	-10,000
1998 (W)		-3,600	-4,400	-8,000
1999 (W)		-3,400	-4,300	-7,700
2000 (AN)		-3,800	-4,000	-7,800
2001 (D)		-5,900	-3,300	-9,300
2002 (D)		-7,200	-3,400	-11,000
2003 (AN)		-5,500	-3,500	-9,000
2004 (BN)		-8,500	-3,700	-12,000
2005 (AN)		-6,300	-3,600	-9,800
2006 (W)		-5,700	-4,000	-9,800
2007 (D)		-8,000	-3,100	-11,000
2008 (C)		-8,900	-2,900	-12,000
2009 (D)		-6,900	-2,400	-9,300
2010 (BN)		-7,700	-2,700	-10,000
2011 (W)		-6,200	-3,200	-9,400
2012 (BN)		-6,000	-2,300	-8,200
2013 (D)		-7,700	-2,300	-10,000
2014 (C)		-6,900	-1,700	-8,700
2015 (C)		-8,800	-1,700	-11,000
2016 (BN)		-6,700	-2,300	-8,900
2017 (W)		-5,400	-2,800	-8,200
2018 (BN)		-7,800	-1,900	-9,700
Average (1990-2018)		-6,100	-3,000	-9,100
1990-2018	W	-4,900	-3,700	-8,500
	AN	-5,300	-3,400	-8,700
	BN	-7,200	-2,500	-9,800
	D	-7,200	-2,900	-10,000
	C	-6,500	-2,300	-8,800

1.2.5 Vertical Subsurface Flows within the Groundwater System

Vertical subsurface flows within the GWS occur between the Upper and Lower Aquifers and represent an internal flow of water within the GWS. These exchanges between the principal aquifers do not directly affect the total volume of groundwater in storage, but do highlight the net vertical movement of water within the GWS. Historical vertical flows between the Upper Aquifer and Lower Aquifer are summarized in **Figure 20** and **Table 20** and show consistent net overall downward flow from the Upper Aquifer to the Lower Aquifer. On average, vertical flows from the Upper Aquifer to the Lower Aquifer total about 84 taf per year over the historical water budget period. There is considerable year-to-year variability in the magnitude of these flows, which appear to correlate with water year conditions, although they are always in the downward direction. The magnitude of downward flows are generally greatest during wet years and decrease during dry periods.

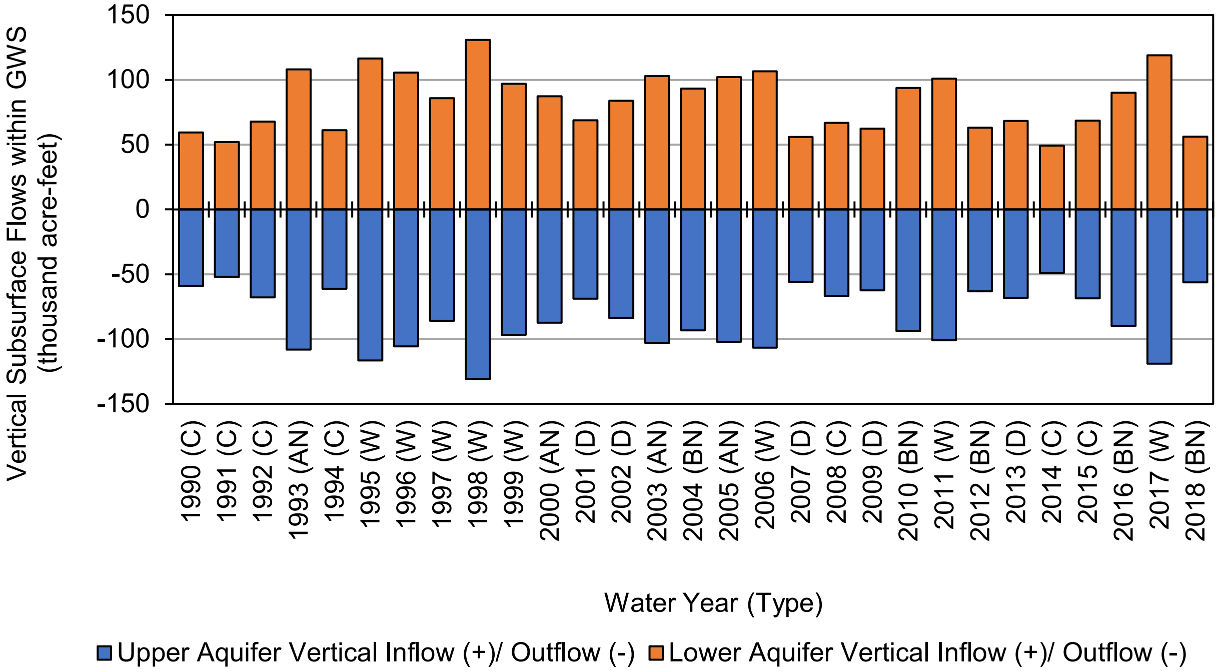

Figure 20. Bowman Subbasin Historical Vertical Subsurface Flow within the GWS

Table 20. Bowman Subbasin Historical Vertical Subsurface Flows within the GWS (acre-feet)

Water Year (Type)		Upper Aquifer to (-) / from (+) Lower Aquifer
1990 (C)		65,000
1991 (C)		59,000
1992 (C)		52,000
1993 (AN)		68,000
1994 (C)		110,000
1995 (W)		61,000
1996 (W)		120,000
1997 (W)		110,000
1998 (W)		86,000
1999 (W)		130,000
2000 (AN)		97,000
2001 (D)		87,000
2002 (D)		69,000
2003 (AN)		84,000
2004 (BN)		100,000
2005 (AN)		93,000
2006 (W)		100,000
2007 (D)		110,000
2008 (C)		56,000
2009 (D)		67,000
2010 (BN)		62,000
2011 (W)		94,000
2012 (BN)		100,000
2013 (D)		63,000
2014 (C)		68,000
2015 (C)		49,000
2016 (BN)		68,000
2017 (W)		90,000
2018 (BN)		120,000
Average (1990-2018)		84,000
1990-2018	W	110,000
	AN	99,000
	BN	79,000
	D	68,000
	C	61,000

1.2.6 Change in Groundwater Storage

Historical change in groundwater storage values for the Bowman Subbasin are summarized in **Figure 21** and **Figure 22,** and **Table 21**. Values for total change in storage in the GWS and cumulative change in storage over the historical water budget period are presented in conjunction with the volumes of groundwater storage change within each of the two principal aquifers present in the Subbasin. Over the 29-year historical period, the average annual change in groundwater storage is about -1.7 taf per year, indicating a decrease in storage every year, on average. The corresponding cumulative total change in storage over the historical period is about -50 taf per year. The annual change in storage numbers reflect the effects of the water year type with increase in storage occurring during wetter years and decreases in storage occurring during dry years. Within the GWS, the year-to-year changes in storage are nearly similar for both the Upper Aquifer and the Lower Aquifer, averaging storage decreases of approximately -0.6 taf and -1.1 taf per year, respectively.

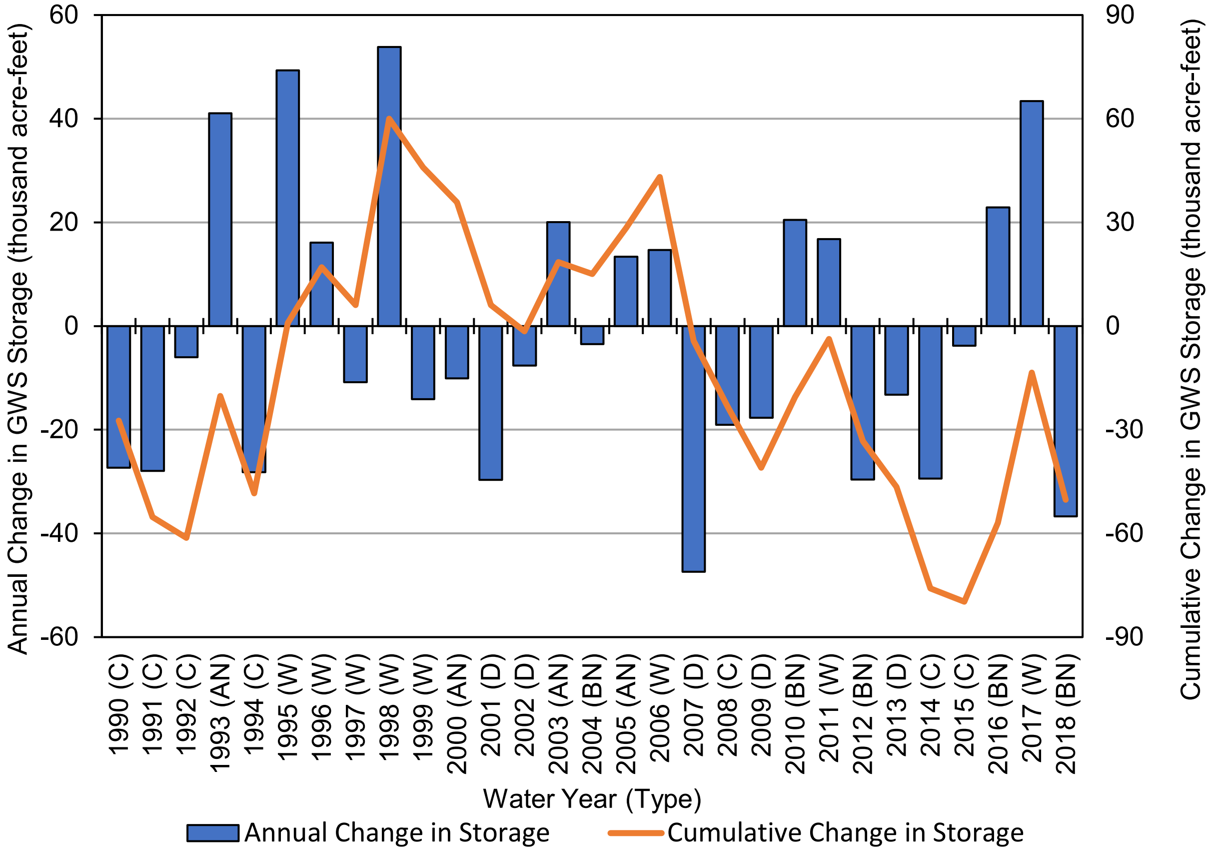

Figure 21. Bowman Subbasin Historical Total Change in Storage within the GWS

Table 21. Bowman Subbasin Historical Change in Groundwater Storage (acre-feet)

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Upper Aquifer</th><th>Lower Aquifer</th><th>Total Annual Change</th><th>Total Cumulative Change</th></tr>
<tr><td colspan="2">1990 (C)</td><td>-9,800</td><td>-18,000</td><td>-27,000</td><td>-27,000</td></tr>
<tr><td colspan="2">1991 (C)</td><td>-9,900</td><td>-18,000</td><td>-28,000</td><td>-55,000</td></tr>
<tr><td colspan="2">1992 (C)</td><td>-1,500</td><td>-4,500</td><td>-6,000</td><td>-61,000</td></tr>
<tr><td colspan="2">1993 (AN)</td><td>17,000</td><td>24,000</td><td>41,000</td><td>-20,000</td></tr>
<tr><td colspan="2">1994 (C)</td><td>-11,000</td><td>-18,000</td><td>-28,000</td><td>-48,000</td></tr>
<tr><td colspan="2">1995 (W)</td><td>19,000</td><td>31,000</td><td>49,000</td><td>910</td></tr>
<tr><td colspan="2">1996 (W)</td><td>4,100</td><td>12,000</td><td>16,000</td><td>17,000</td></tr>
<tr><td colspan="2">1997 (W)</td><td>-4,900</td><td>-5,900</td><td>-11,000</td><td>6,100</td></tr>
<tr><td colspan="2">1998 (W)</td><td>21,000</td><td>33,000</td><td>54,000</td><td>60,000</td></tr>
<tr><td colspan="2">1999 (W)</td><td>-9,600</td><td>-4,500</td><td>-14,000</td><td>46,000</td></tr>
<tr><td colspan="2">2000 (AN)</td><td>-3,000</td><td>-7,100</td><td>-10,000</td><td>36,000</td></tr>
<tr><td colspan="2">2001 (D)</td><td>-11,000</td><td>-19,000</td><td>-30,000</td><td>6,100</td></tr>
<tr><td colspan="2">2002 (D)</td><td>-2,900</td><td>-4,700</td><td>-7,600</td><td>-1,500</td></tr>
<tr><td colspan="2">2003 (AN)</td><td>8,000</td><td>12,000</td><td>20,000</td><td>19,000</td></tr>
<tr><td colspan="2">2004 (BN)</td><td>-2,500</td><td>-960</td><td>-3,500</td><td>15,000</td></tr>
<tr><td colspan="2">2005 (AN)</td><td>4,900</td><td>8,500</td><td>13,000</td><td>28,000</td></tr>
<tr><td colspan="2">2006 (W)</td><td>5,400</td><td>9,300</td><td>15,000</td><td>43,000</td></tr>
<tr><td colspan="2">2007 (D)</td><td>-18,000</td><td>-30,000</td><td>-47,000</td><td>-4,300</td></tr>
<tr><td colspan="2">2008 (C)</td><td>-6,500</td><td>-13,000</td><td>-19,000</td><td>-23,000</td></tr>
<tr><td colspan="2">2009 (D)</td><td>-4,900</td><td>-13,000</td><td>-18,000</td><td>-41,000</td></tr>
<tr><td colspan="2">2010 (BN)</td><td>8,900</td><td>12,000</td><td>21,000</td><td>-20,000</td></tr>
<tr><td colspan="2">2011 (W)</td><td>4,800</td><td>12,000</td><td>17,000</td><td>-3,700</td></tr>
<tr><td colspan="2">2012 (BN)</td><td>-12,000</td><td>-18,000</td><td>-30,000</td><td>-33,000</td></tr>
<tr><td colspan="2">2013 (D)</td><td>-3,800</td><td>-9,400</td><td>-13,000</td><td>-47,000</td></tr>
<tr><td colspan="2">2014 (C)</td><td>-10,000</td><td>-19,000</td><td>-29,000</td><td>-76,000</td></tr>
<tr><td colspan="2">2015 (C)</td><td>-1,000</td><td>-2,800</td><td>-3,800</td><td>-80,000</td></tr>
<tr><td colspan="2">2016 (BN)</td><td>9,800</td><td>13,000</td><td>23,000</td><td>-57,000</td></tr>
<tr><td colspan="2">2017 (W)</td><td>15,000</td><td>29,000</td><td>43,000</td><td>-13,000</td></tr>
<tr><td colspan="2">2018 (BN)</td><td>-14,000</td><td>-23,000</td><td>-37,000</td><td>-50,000</td></tr>
<tr><td colspan="2">Average (1990-2018)</td><td>-620</td><td>-1,100</td><td>-1,700</td><td></td></tr>
<tr><td rowspan="5">1990-2018</td><td>W</td><td>6,800</td><td>14,000</td><td>21,000</td><td></td></tr>
<tr><td>AN</td><td>6,200</td><td>9,400</td><td>16,000</td><td></td></tr>
<tr><td>BN</td><td>-1,800</td><td>-3,400</td><td>-5,300</td><td></td></tr>
<tr><td>D</td><td>-8,000</td><td>-15,000</td><td>-23,000</td><td></td></tr>
<tr><td>C</td><td>-7,100</td><td>-13,000</td><td>-20,000</td><td></td></tr>
</table>

Note: positive values indicate increases in groundwater storage, negative values indicate decreases in groundwater storage.

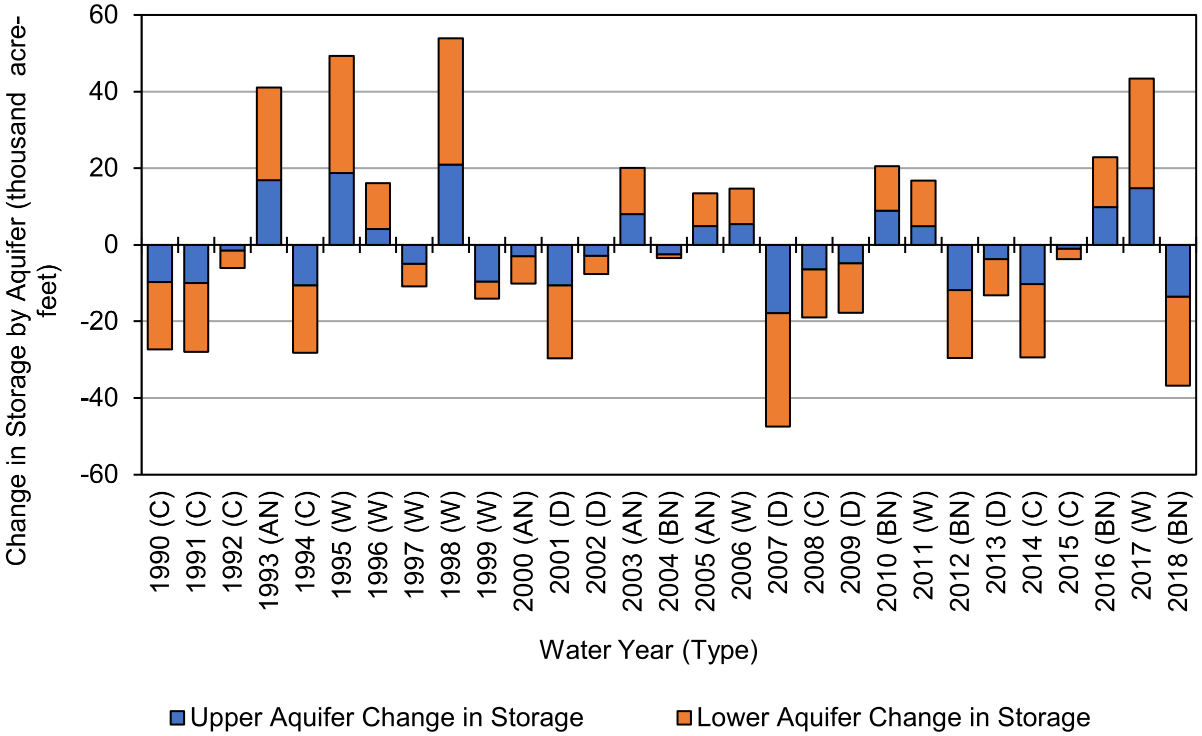

Figure 22. Bowman Subbasin Historical Change in Groundwater Storage by Aquifer

2 DETAILED PROJECTED (CURRENT LAND USE) WATER BUDGET

This section presents the results of the Projected (Current Land Use) scenario. The Current Land Use scenario assumes constant land use conditions based on 2018 conditions.

2.1 Surface Water System Water Budget Results

2.1.1 Inflows

2.1.1.1 Surface Water Inflow by Water Source Type

The projected annual volume of surface water inflows is summarized by water source type in **Figure 23** and **Table 22**. Over the projected (current land use) period, surface water inflows average about 83 taf per year. On average, inflows of local supplies and CVP supplies average about 96 and 17 taf per year, respectively.

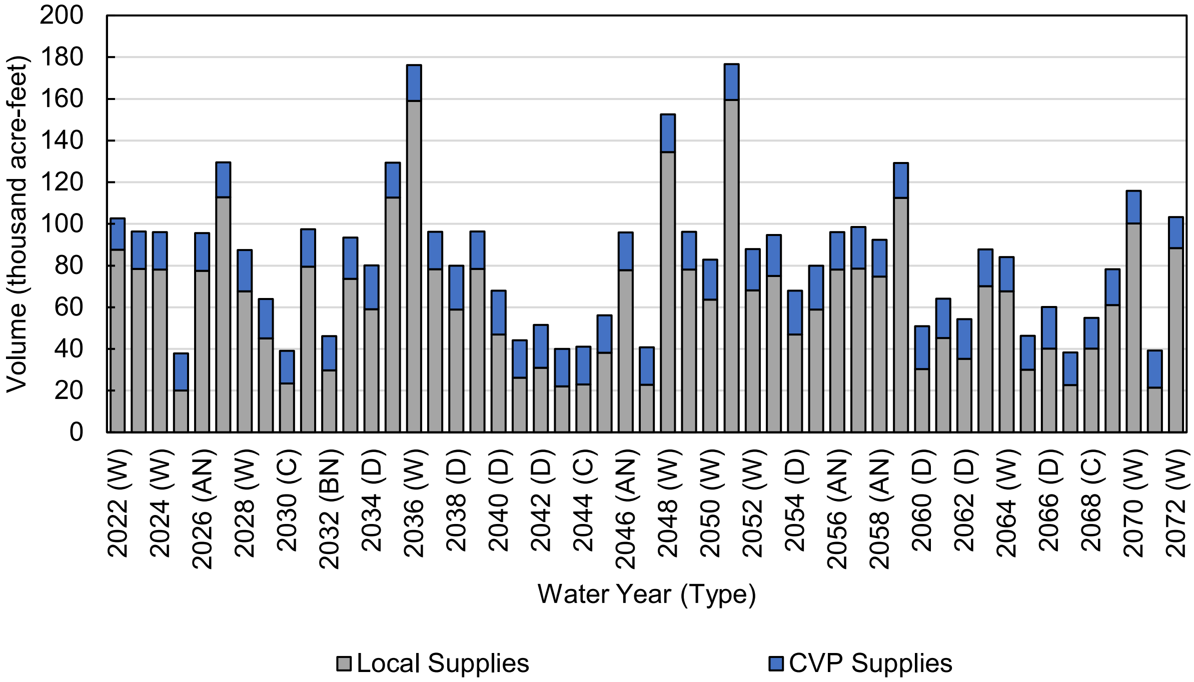

Figure 23. Bowman Subbasin Projected (Current Land Use) Surface Water Inflows, by Water Source Type

Table 22. Bowman Subbasin Projected (Current Land Use) Surface Water Inflows, by Water Source Type (acre-feet)

Water Year (Type)	CVP Supplies	Local Supplies	Total
2022 (W)	15,000	88,000	100,000
2023 (W)	18,000	78,000	96,000
2024 (W)	18,000	78,000	96,000
2025 (BN)	18,000	20,000	38,000
2026 (AN)	18,000	77,000	96,000
2027 (W)	17,000	110,000	130,000
2028 (W)	20,000	68,000	87,000
2029 (C)	19,000	45,000	64,000
2030 (C)	16,000	23,000	39,000
2031 (AN)	18,000	79,000	98,000
2032 (BN)	16,000	30,000	46,000
2033 (AN)	20,000	74,000	93,000
2034 (D)	21,000	59,000	80,000
2035 (W)	17,000	110,000	130,000
2036 (W)	17,000	160,000	180,000
2037 (W)	18,000	78,000	96,000
2038 (D)	21,000	59,000	80,000
2039 (W)	18,000	78,000	96,000
2040 (D)	21,000	47,000	68,000
2041 (C)	18,000	26,000	44,000
2042 (D)	21,000	31,000	52,000
2043 (C)	18,000	22,000	40,000
2044 (C)	18,000	23,000	41,000
2045 (C)	18,000	38,000	56,000
2046 (AN)	18,000	78,000	96,000
2047 (C)	18,000	23,000	41,000
2048 (W)	18,000	130,000	150,000
2049 (W)	18,000	78,000	96,000
2050 (W)	19,000	64,000	83,000
2051 (W)	17,000	160,000	180,000
2052 (W)	20,000	68,000	88,000
2053 (AN)	20,000	75,000	95,000
2054 (D)	21,000	47,000	68,000
2055 (D)	21,000	59,000	80,000

Water Year (Type)		CVP Supplies	Local Supplies	Total
2056 (AN)		18,000	78,000	96,000
2057 (BN)		20,000	79,000	99,000
2058 (AN)		18,000	75,000	92,000
2059 (W)		17,000	110,000	130,000
2060 (D)		21,000	30,000	51,000
2061 (C)		19,000	45,000	64,000
2062 (D)		19,000	35,000	54,000
2063 (BN)		18,000	70,000	88,000
2064 (W)		16,000	68,000	84,000
2065 (BN)		16,000	30,000	46,000
2066 (D)		20,000	40,000	60,000
2067 (C)		16,000	23,000	38,000
2068 (C)		15,000	40,000	55,000
2069 (BN)		17,000	61,000	78,000
2070 (W)		16,000	100,000	120,000
2071 (BN)		18,000	21,000	39,000
2072 (W)		15,000	88,000	100,000
Average (2022-2072)		18,000	64,000	83,000
2022-2072	W	17,000	96,000	110,000
	AN	18,000	77,000	95,000
	BN	18,000	44,000	62,000
	D	21,000	45,000	66,000
	C	17,000	31,000	48,000

2.1.1.2 Precipitation

Precipitation estimates for the Bowman Subbasin are provided in **Figure 24** and **Table 23**. Total precipitation is highly variable between years in the study area, ranging from approximately 210 taf (20.5 inches) during average critically dry years to 390 taf (38.1 inches) during average wet years.

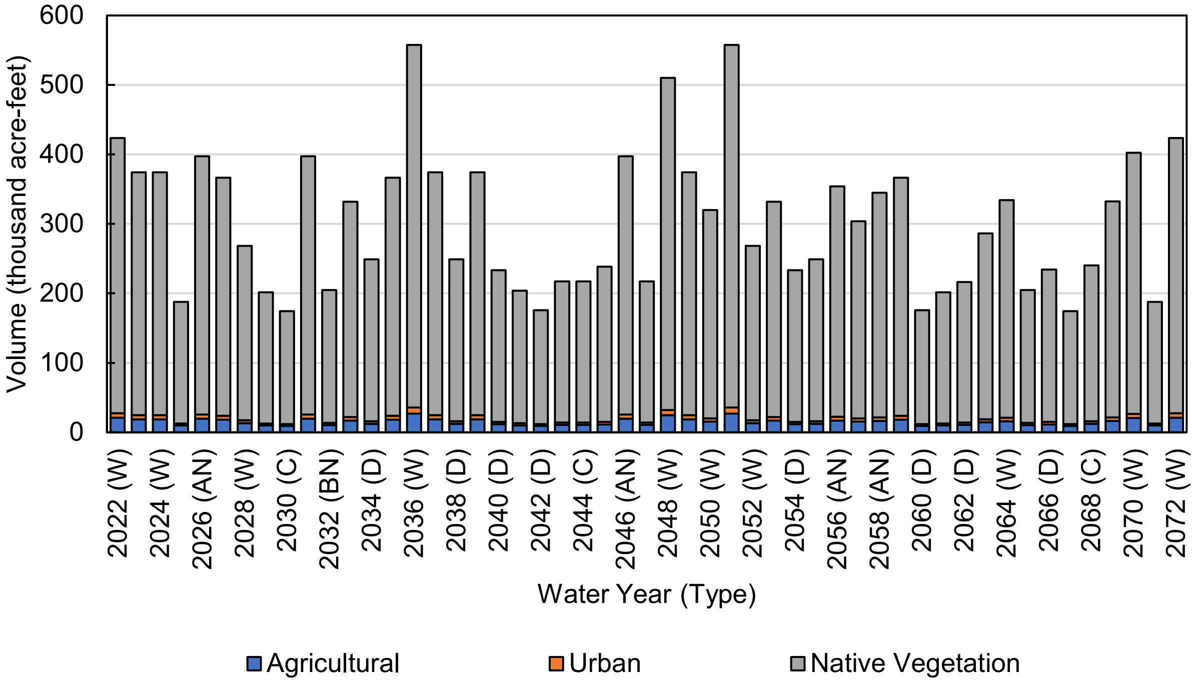

Figure 24. Bowman Subbasin Projected (Current Land Use) Precipitation, by Water Use Sector

Table 23. Bowman Subbasin Projected (Current Land Use) Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	21,000	6,400	400,000	420,000
2023 (W)	19,000	5,700	350,000	370,000
2024 (W)	19,000	5,700	350,000	370,000
2025 (W)	9,800	2,900	180,000	190,000
2026 (BN)	20,000	6,000	370,000	400,000
2027 (AN)	18,000	5,500	340,000	370,000
2028 (W)	13,000	4,000	250,000	270,000
2029 (W)	10,000	3,000	190,000	200,000
2030 (C)	9,200	2,700	160,000	170,000
2031 (C)	20,000	6,000	370,000	400,000
2032 (AN)	10,000	3,100	190,000	200,000
2033 (BN)	17,000	5,100	310,000	330,000
2034 (AN)	12,000	3,700	230,000	250,000
2035 (D)	18,000	5,500	340,000	370,000
2036 (W)	27,000	8,300	520,000	560,000
2037 (W)	19,000	5,700	350,000	370,000
2038 (W)	12,000	3,700	230,000	250,000
2039 (D)	19,000	5,700	350,000	370,000
2040 (W)	12,000	3,500	220,000	230,000
2041 (D)	10,000	3,100	190,000	200,000
2042 (C)	9,100	2,700	160,000	180,000
2043 (D)	11,000	3,300	200,000	220,000
2044 (C)	11,000	3,300	200,000	220,000
2045 (C)	11,000	3,500	220,000	240,000
2046 (C)	20,000	6,000	370,000	400,000
2047 (AN)	11,000	3,300	200,000	220,000
2048 (C)	25,000	7,500	480,000	510,000
2049 (W)	19,000	5,700	350,000	370,000
2050 (W)	15,000	4,800	300,000	320,000
2051 (W)	27,000	8,300	520,000	560,000
2052 (W)	13,000	4,000	250,000	270,000
2053 (W)	17,000	5,100	310,000	330,000
2054 (AN)	12,000	3,500	220,000	230,000
2055 (D)	12,000	3,700	230,000	250,000
2056 (D)	17,000	5,200	330,000	350,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (AN)		16,000	4,600	280,000	300,000
2058 (BN)		17,000	5,100	320,000	340,000
2059 (AN)		18,000	5,500	340,000	370,000
2060 (W)		9,100	2,700	160,000	180,000
2061 (D)		10,000	3,000	190,000	200,000
2062 (C)		11,000	3,200	200,000	220,000
2063 (D)		15,000	4,300	270,000	290,000
2064 (BN)		16,000	4,900	310,000	330,000
2065 (W)		10,000	3,100	190,000	200,000
2066 (BN)		11,000	3,500	220,000	230,000
2067 (D)		9,200	2,700	160,000	170,000
2068 (C)		12,000	3,700	220,000	240,000
2069 (C)		16,000	5,000	310,000	330,000
2070 (BN)		21,000	6,200	380,000	400,000
2071 (W)		9,800	2,900	180,000	190,000
2072 (W)		21,000	6,400	400,000	420,000
Average (2022-2072)		15,000	4,500	280,000	300,000
2022-2072	W	19,000	5,900	370,000	390,000
	AN	18,000	5,500	340,000	370,000
	BN	12,000	3,700	230,000	240,000
	D	11,000	3,300	210,000	220,000
	C	11,000	3,200	190,000	210,000

2.1.1.3 Groundwater Extraction by Water Use Sector

Total groundwater extraction in the Bowman Subbasin represents a combination of groundwater pumping to support agricultural and urban water demands, including rural residential use, and groundwater uptake by crops, urban vegetation, and native vegetation.

Estimates of groundwater pumping by water use sector are provided in **Figure 25** and **Table 24**. Majority of groundwater pumping in the Bowman Subbasin is used to meet agricultural demand, averaging 5.0 taf per year. Groundwater pumping for urban use is approximately 1.2 taf per year. The total groundwater extraction varies from about 5.5 taf in above-normal and wet years to 7.2 taf in critically dry years based on variability in surface water supplies, precipitation, and crop water demand.

When groundwater is near the land surface, groundwater uptake can also be a source of supply for vegetation. Estimates of groundwater uptake by vegetation are provided in **Figure 26** and **Table 25**. The majority of groundwater uptake is consumed directly by native vegetation and agricultural crops, totaling 2.5 taf and 0.3taf per year, on average.

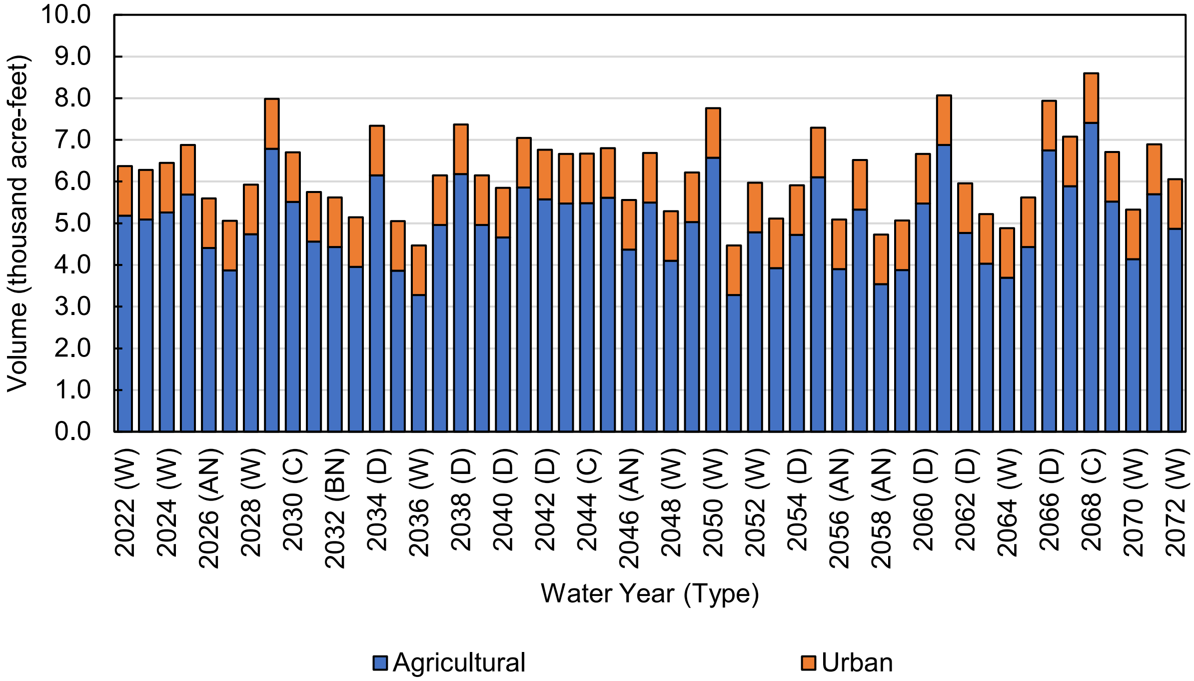

Figure 25. Bowman Subbasin Projected (Current Land Use) Groundwater Pumping, by Water Use Sector

Table 24. Bowman Subbasin Projected (Current Land Use) Groundwater Pumping, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	5,200	1,200	0	6,400
2023 (W)	5,100	1,200	0	6,300
2024 (W)	5,300	1,200	0	6,500
2025 (W)	5,700	1,200	0	6,900
2026 (BN)	4,400	1,200	0	5,600
2027 (AN)	3,900	1,200	0	5,100
2028 (W)	4,700	1,200	0	5,900
2029 (W)	6,800	1,200	0	8,000
2030 (C)	5,500	1,200	0	6,700
2031 (C)	4,600	1,200	0	5,800
2032 (AN)	4,400	1,200	0	5,600
2033 (BN)	4,000	1,200	0	5,100
2034 (AN)	6,200	1,200	0	7,300
2035 (D)	3,900	1,200	0	5,100
2036 (W)	3,300	1,200	0	4,500
2037 (W)	5,000	1,200	0	6,200
2038 (W)	6,200	1,200	0	7,400
2039 (D)	5,000	1,200	0	6,200
2040 (W)	4,700	1,200	0	5,900
2041 (D)	5,900	1,200	0	7,100
2042 (C)	5,600	1,200	0	6,800
2043 (D)	5,500	1,200	0	6,700
2044 (C)	5,500	1,200	0	6,700
2045 (C)	5,600	1,200	0	6,800
2046 (C)	4,400	1,200	0	5,600
2047 (AN)	5,500	1,200	0	6,700
2048 (C)	4,100	1,200	0	5,300
2049 (W)	5,000	1,200	0	6,200
2050 (W)	6,600	1,200	0	7,800
2051 (W)	3,300	1,200	0	4,500
2052 (W)	4,800	1,200	0	6,000
2053 (W)	3,900	1,200	0	5,100
2054 (AN)	4,700	1,200	0	5,900

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Agricultural</th><th>Urban</th><th>Native Vegetation</th><th>Total</th></tr>
<tr><td colspan="2">2055 (D)</td><td>6,100</td><td>1,200</td><td>0</td><td>7,300</td></tr>
<tr><td colspan="2">2056 (D)</td><td>3,900</td><td>1,200</td><td>0</td><td>5,100</td></tr>
<tr><td colspan="2">2057 (AN)</td><td>5,300</td><td>1,200</td><td>0</td><td>6,500</td></tr>
<tr><td colspan="2">2058 (BN)</td><td>3,500</td><td>1,200</td><td>0</td><td>4,700</td></tr>
<tr><td colspan="2">2059 (AN)</td><td>3,900</td><td>1,200</td><td>0</td><td>5,100</td></tr>
<tr><td colspan="2">2060 (W)</td><td>5,500</td><td>1,200</td><td>0</td><td>6,700</td></tr>
<tr><td colspan="2">2061 (D)</td><td>6,900</td><td>1,200</td><td>0</td><td>8,100</td></tr>
<tr><td colspan="2">2062 (C)</td><td>4,800</td><td>1,200</td><td>0</td><td>6,000</td></tr>
<tr><td colspan="2">2063 (D)</td><td>4,000</td><td>1,200</td><td>0</td><td>5,200</td></tr>
<tr><td colspan="2">2064 (BN)</td><td>3,700</td><td>1,200</td><td>0</td><td>4,900</td></tr>
<tr><td colspan="2">2065 (W)</td><td>4,400</td><td>1,200</td><td>0</td><td>5,600</td></tr>
<tr><td colspan="2">2066 (BN)</td><td>6,800</td><td>1,200</td><td>0</td><td>7,900</td></tr>
<tr><td colspan="2">2067 (D)</td><td>5,900</td><td>1,200</td><td>0</td><td>7,100</td></tr>
<tr><td colspan="2">2068 (C)</td><td>7,400</td><td>1,200</td><td>0</td><td>8,600</td></tr>
<tr><td colspan="2">2069 (C)</td><td>5,500</td><td>1,200</td><td>0</td><td>6,700</td></tr>
<tr><td colspan="2">2070 (BN)</td><td>4,100</td><td>1,200</td><td>0</td><td>5,300</td></tr>
<tr><td colspan="2">2071 (W)</td><td>5,700</td><td>1,200</td><td>0</td><td>6,900</td></tr>
<tr><td colspan="2">2072 (W)</td><td>4,900</td><td>1,200</td><td>0</td><td>6,100</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>5,000</td><td>1,200</td><td>0</td><td>6,200</td></tr>
<tr><td rowspan="5">2022-2072</td><td>W</td><td>4,500</td><td>1,200</td><td>0</td><td>5,700</td></tr>
<tr><td>AN</td><td>4,100</td><td>1,200</td><td>0</td><td>5,300</td></tr>
<tr><td>BN</td><td>5,000</td><td>1,200</td><td>0</td><td>6,200</td></tr>
<tr><td>D</td><td>5,600</td><td>1,200</td><td>0</td><td>6,800</td></tr>
<tr><td>C</td><td>6,000</td><td>1,200</td><td>0</td><td>7,200</td></tr>
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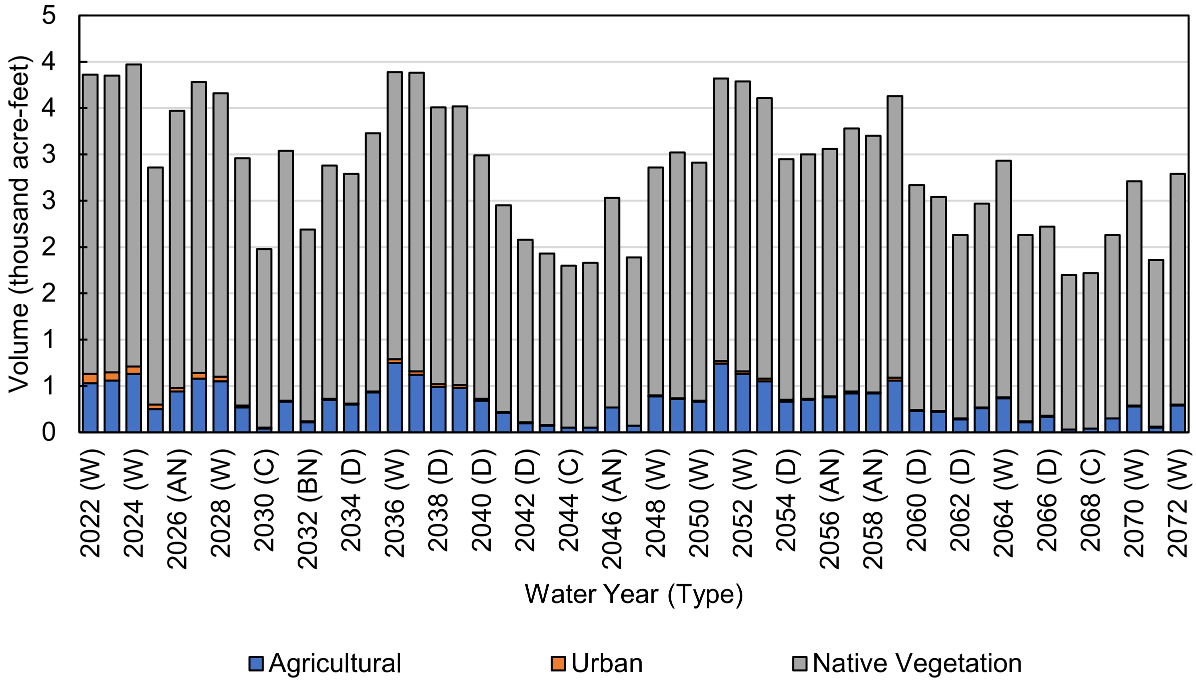

Figure 26. Bowman Subbasin Projected (Current Land Use) Groundwater Uptake, by Water Use Sector

Table 25. Bowman Subbasin Projected (Current Land Use) Groundwater Uptake, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	530	100	3,200	3,900
2023 (W)	560	90	3,200	3,900
2024 (W)	630	80	3,300	4,000
2025 (W)	250	50	2,600	2,900
2026 (BN)	440	40	3,000	3,500
2027 (AN)	580	60	3,100	3,800
2028 (W)	550	50	3,100	3,700
2029 (W)	270	20	2,700	3,000
2030 (C)	40	10	1,900	2,000
2031 (C)	330	10	2,700	3,000
2032 (AN)	110	10	2,100	2,200
2033 (BN)	350	10	2,500	2,900
2034 (AN)	300	10	2,500	2,800
2035 (D)	430	10	2,800	3,200
2036 (W)	750	40	3,100	3,900
2037 (W)	620	40	3,200	3,900
2038 (W)	490	30	3,000	3,500
2039 (D)	480	30	3,000	3,500
2040 (W)	340	20	2,600	3,000
2041 (D)	210	10	2,200	2,500
2042 (C)	100	10	2,000	2,100
2043 (D)	70	10	1,900	1,900
2044 (C)	50	0	1,800	1,800
2045 (C)	50	0	1,800	1,800
2046 (C)	270	0	2,300	2,500
2047 (AN)	70	0	1,800	1,900
2048 (C)	390	10	2,500	2,900
2049 (W)	360	10	2,700	3,000
2050 (W)	330	10	2,600	2,900
2051 (W)	740	30	3,100	3,800
2052 (W)	630	30	3,100	3,800
2053 (W)	550	30	3,000	3,600
2054 (AN)	330	20	2,600	3,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2055 (D)		350	10	2,600	3,000
2056 (D)		380	10	2,700	3,100
2057 (AN)		420	20	2,800	3,300
2058 (BN)		420	10	2,800	3,200
2059 (AN)		560	30	3,000	3,600
2060 (W)		230	10	2,400	2,700
2061 (D)		220	10	2,300	2,500
2062 (C)		140	10	2,000	2,100
2063 (D)		260	10	2,200	2,500
2064 (BN)		370	10	2,600	2,900
2065 (W)		110	10	2,000	2,100
2066 (BN)		170	10	2,000	2,200
2067 (D)		30	0	1,700	1,700
2068 (C)		40	0	1,700	1,700
2069 (C)		150	0	2,000	2,100
2070 (BN)		280	10	2,400	2,700
2071 (W)		50	10	1,800	1,900
2072 (W)		290	10	2,500	2,800
Average (2022-2072)		330	20	2,500	2,900
2022-2072	W	500	40	2,900	3,500
	AN	390	20	2,700	3,100
	BN	190	20	2,200	2,400
	D	270	10	2,400	2,700
	C	110	10	2,000	2,100

2.1.1.4 Groundwater Discharge to Surface Waterways

Groundwater discharge to surface water represents a gain, or increase of flow, in waterways that traverse or flow along the boundary of the Bowman Subbasin. Groundwater discharge in the Bowman Subbasin is calculated from the Tehama IHM as the net groundwater outflow to water reaches (i.e., groundwater discharge) in excess of groundwater inflows from waterway reaches (i.e., seepage). The total volume of estimated groundwater discharge to surface water is negligible in any given year, therefore set to zero throughout the projected water budget period.

2.1.2 Outflows

2.1.2.1 Evapotranspiration by Water Use Sector

Evapotranspiration (ET) by water use sector is reported in **Figure 27** through **Figure 30**, and **Table 26** through **Table 29**. First, total ET is reported, followed by ET from applied water (ET of water actively applied from surface water deliveries or groundwater pumping), ET of groundwater uptake (ET of shallow water extracted directly by vegetation), and ET from precipitation (ET of water supplied through rainfall).

Total ET varies between years, with a projected average of 170 taf per year. Agricultural ET tends to increase slightly in drier years due to increased climatic demand, while the ET of native vegetation typically decreases due to reduced water supply. ET of applied water occurs primarily from agricultural land, averaging about 9.6 taf in above-normal and wet years and about 12 taf in years classified as below normal, dry, or critical. Urban ET of applied water is lower and relatively constant between years, averaging about 0.3 taf per year. Native vegetation and agricultural crops in the Bowman Subbasin also directly consume shallow groundwater to meet a portion of their consumptive use requirements. ET of groundwater uptake by native vegetation and agricultural crops and totals 2.5 and 0.3 taf per year, on average.

ET of precipitation generally follows the pattern of precipitation, with higher volumes occurring in wet years when more precipitation occurs. Across all water use sectors, ET of precipitation in the Bowman Subbasin averages about 170 taf in wet and above-normal years and 150 taf in dry and critical water years. Much of the total ET of precipitation results from the large acreage of native vegetation in the Bowman Subbasin, though significant volumes result from agricultural and urban areas as well.

Evaporation from rivers, streams, and canals in the Bowman Subbasin is reported in **Figure 31** and **Table 30**. The total volume is relatively small and constant between years, averaging less than 0.9 taf per year. Evaporation from upgradient small watersheds is minimal, and is also not considered to substantially contribute to the subbasin SWS water budget.

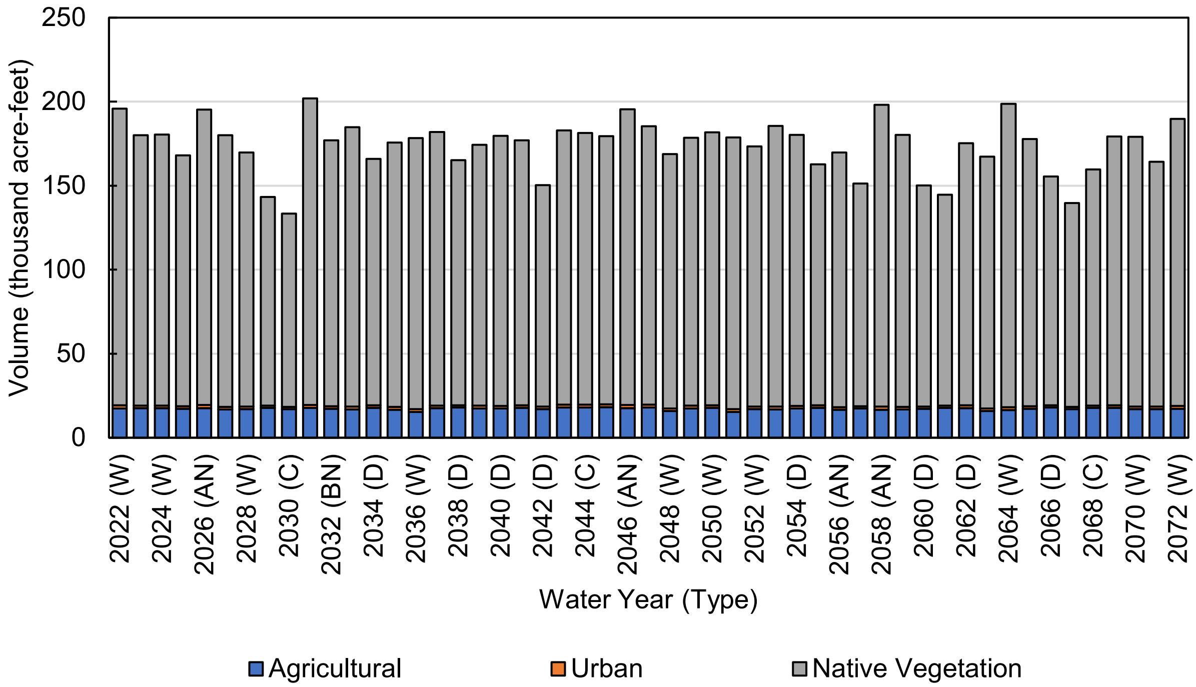

Figure 27. Bowman Subbasin Projected (Current Land Use) Total Evapotranspiration, (acre-feet)

Table 26. Bowman Subbasin Projected (Current Land Use) Total Evapotranspiration, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	17,000	1,800	180,000	200,000
2023 (W)	18,000	1,700	160,000	180,000
2024 (W)	18,000	1,700	160,000	180,000
2025 (BN)	17,000	1,500	150,000	170,000
2026 (AN)	18,000	1,800	180,000	200,000
2027 (W)	17,000	1,600	160,000	180,000
2028 (W)	17,000	1,500	150,000	170,000
2029 (C)	18,000	1,300	120,000	140,000
2030 (C)	17,000	1,300	110,000	130,000
2031 (AN)	18,000	1,900	180,000	200,000
2032 (BN)	17,000	1,600	160,000	180,000
2033 (AN)	17,000	1,700	170,000	180,000
2034 (D)	18,000	1,400	150,000	170,000
2035 (W)	17,000	1,600	160,000	180,000
2036 (W)	15,000	1,700	160,000	180,000
2037 (W)	18,000	1,600	160,000	180,000
2038 (D)	18,000	1,400	150,000	170,000
2039 (W)	17,000	1,600	160,000	170,000
2040 (D)	17,000	1,600	160,000	180,000
2041 (C)	18,000	1,600	160,000	180,000
2042 (D)	17,000	1,400	130,000	150,000
2043 (C)	18,000	1,700	160,000	180,000
2044 (C)	18,000	1,700	160,000	180,000
2045 (C)	18,000	1,600	160,000	180,000
2046 (AN)	18,000	1,800	180,000	200,000
2047 (C)	18,000	1,700	170,000	190,000
2048 (W)	16,000	1,500	150,000	170,000
2049 (W)	17,000	1,600	160,000	180,000
2050 (W)	18,000	1,600	160,000	180,000
2051 (W)	15,000	1,700	160,000	180,000
2052 (W)	17,000	1,500	150,000	170,000
2053 (AN)	17,000	1,700	170,000	190,000
2054 (D)	17,000	1,600	160,000	180,000
2055 (D)	18,000	1,400	140,000	160,000
2056 (AN)	17,000	1,600	150,000	170,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		17,000	1,300	130,000	150,000
2058 (AN)		17,000	1,900	180,000	200,000
2059 (W)		17,000	1,600	160,000	180,000
2060 (D)		17,000	1,400	130,000	150,000
2061 (C)		18,000	1,300	130,000	140,000
2062 (D)		18,000	1,600	160,000	180,000
2063 (BN)		16,000	1,500	150,000	170,000
2064 (W)		16,000	1,800	180,000	200,000
2065 (BN)		17,000	1,600	160,000	180,000
2066 (D)		18,000	1,400	140,000	160,000
2067 (C)		17,000	1,300	120,000	140,000
2068 (C)		18,000	1,400	140,000	160,000
2069 (BN)		18,000	1,600	160,000	180,000
2070 (W)		17,000	1,600	160,000	180,000
2071 (BN)		17,000	1,500	150,000	160,000
2072 (W)		17,000	1,700	170,000	190,000
Average (2022-2072)		17,000	1,600	160,000	170,000
2022 - 2072	W	17,000	1,600	160,000	180,000
	AN	17,000	1,800	170,000	190,000
	BN	17,000	1,500	150,000	170,000
	D	18,000	1,500	150,000	160,000
	C	18,000	1,500	140,000	160,000

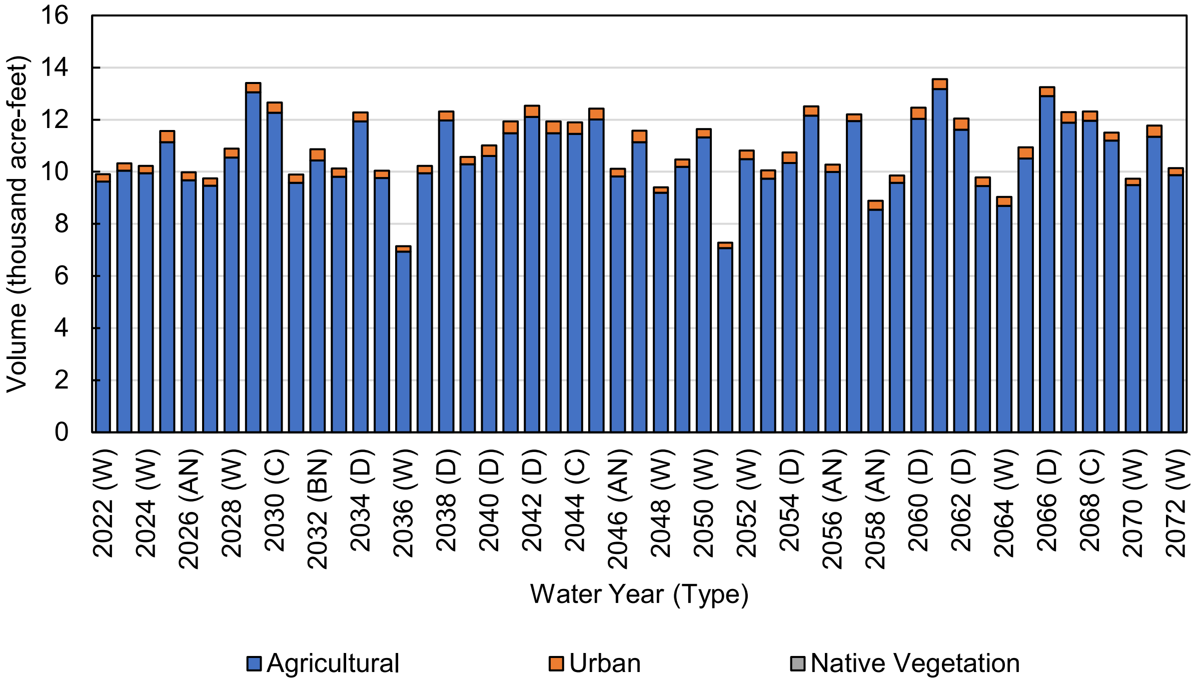

Figure 28. Bowman Subbasin Projected (Current Land Use) Evapotranspiration of Applied Water, by Water Use Sector

Table 27. Bowman Subbasin Projected (Current Land Use) Evapotranspiration of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	9,600	280	0	9,900
2023 (W)	10,000	280	0	10,000
2024 (W)	10,000	280	0	10,000
2025 (BN)	11,000	430	0	12,000
2026 (AN)	9,700	300	0	10,000
2027 (W)	9,500	280	0	9,800
2028 (W)	11,000	340	0	11,000
2029 (C)	13,000	360	0	13,000
2030 (C)	12,000	390	0	13,000
2031 (AN)	9,600	310	0	9,900
2032 (BN)	10,000	430	0	11,000
2033 (AN)	9,800	320	0	10,000
2034 (D)	12,000	350	0	12,000
2035 (W)	9,800	280	0	10,000
2036 (W)	6,900	210	0	7,100
2037 (W)	10,000	280	0	10,000
2038 (D)	12,000	350	0	12,000
2039 (W)	10,000	280	0	11,000
2040 (D)	11,000	400	0	11,000
2041 (C)	11,000	450	0	12,000
2042 (D)	12,000	430	0	13,000
2043 (C)	11,000	450	0	12,000
2044 (C)	11,000	450	0	12,000
2045 (C)	12,000	420	0	12,000
2046 (AN)	9,800	300	0	10,000
2047 (C)	11,000	450	0	12,000
2048 (W)	9,200	210	0	9,400
2049 (W)	10,000	280	0	10,000
2050 (W)	11,000	320	0	12,000
2051 (W)	7,100	210	0	7,300
2052 (W)	10,000	340	0	11,000
2053 (AN)	9,700	320	0	10,000
2054 (D)	10,000	400	0	11,000
2055 (D)	12,000	350	0	13,000
2056 (AN)	10,000	290	0	10,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		12,000	260	0	12,000
2058 (AN)		8,500	350	0	8,900
2059 (W)		9,600	280	0	9,900
2060 (D)		12,000	430	0	12,000
2061 (C)		13,000	370	0	14,000
2062 (D)		12,000	440	0	12,000
2063 (BN)		9,500	330	0	9,800
2064 (W)		8,700	350	0	9,000
2065 (BN)		11,000	430	0	11,000
2066 (D)		13,000	340	0	13,000
2067 (C)		12,000	410	0	12,000
2068 (C)		12,000	350	0	12,000
2069 (BN)		11,000	310	0	12,000
2070 (W)		9,500	250	0	9,700
2071 (BN)		11,000	430	0	12,000
2072 (W)		9,900	270	0	10,000
Average (2022-2072)		11,000	340	0	11,000
2022 - 2072	W	9,600	280	0	9,900
	AN	9,600	310	0	9,900
	BN	11,000	370	0	11,000
	D	12,000	390	0	12,000
	C	12,000	410	0	12,000

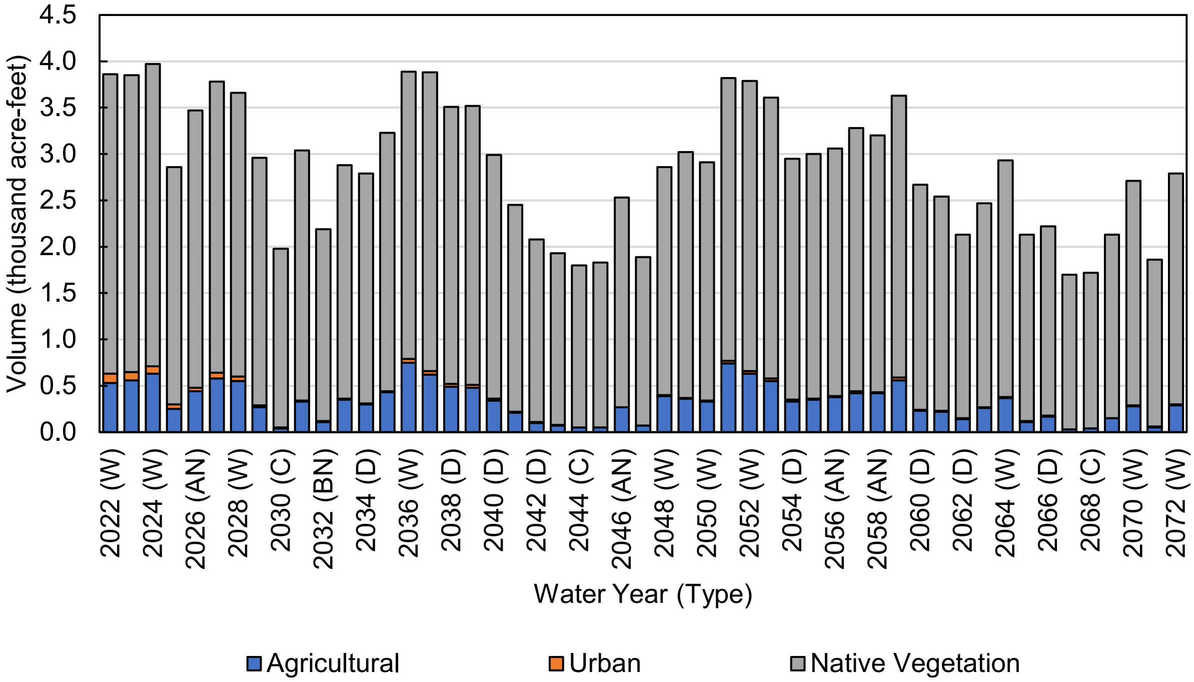

Figure 29. Bowman Subbasin Projected (Current Land Use) Evapotranspiration of Groundwater Uptake, by Water Use Sector

Table 28. Bowman Subbasin Projected (Current Land Use) Evapotranspiration of Groundwater Uptake, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	530	100	3,200	3,900
2023 (W)	560	90	3,200	3,900
2024 (W)	630	80	3,300	4,000
2025 (BN)	250	50	2,600	2,900
2026 (AN)	440	40	3,000	3,500
2027 (W)	580	60	3,100	3,800
2028 (W)	550	50	3,100	3,700
2029 (C)	270	20	2,700	3,000
2030 (C)	40	10	1,900	2,000
2031 (AN)	330	10	2,700	3,000
2032 (BN)	110	10	2,100	2,200
2033 (AN)	350	10	2,500	2,900
2034 (D)	300	10	2,500	2,800
2035 (W)	430	10	2,800	3,200
2036 (W)	750	40	3,100	3,900
2037 (W)	620	40	3,200	3,900
2038 (D)	490	30	3,000	3,500
2039 (W)	480	30	3,000	3,500
2040 (D)	340	20	2,600	3,000
2041 (C)	210	10	2,200	2,500
2042 (D)	100	10	2,000	2,100
2043 (C)	70	10	1,900	1,900
2044 (C)	50	0	1,800	1,800
2045 (C)	50	0	1,800	1,800
2046 (AN)	270	0	2,300	2,500
2047 (C)	70	0	1,800	1,900
2048 (W)	390	10	2,500	2,900
2049 (W)	360	10	2,700	3,000
2050 (W)	330	10	2,600	2,900
2051 (W)	740	30	3,100	3,800
2052 (W)	630	30	3,100	3,800
2053 (AN)	550	30	3,000	3,600
2054 (D)	330	20	2,600	3,000
2055 (D)	350	10	2,600	3,000
2056 (AN)	380	10	2,700	3,100

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		420	20	2,800	3,300
2058 (AN)		420	10	2,800	3,200
2059 (W)		560	30	3,000	3,600
2060 (D)		230	10	2,400	2,700
2061 (C)		220	10	2,300	2,500
2062 (D)		140	10	2,000	2,100
2063 (BN)		260	10	2,200	2,500
2064 (W)		370	10	2,600	2,900
2065 (BN)		110	10	2,000	2,100
2066 (D)		170	10	2,000	2,200
2067 (C)		30	0	1,700	1,700
2068 (C)		40	0	1,700	1,700
2069 (BN)		150	0	2,000	2,100
2070 (W)		280	10	2,400	2,700
2071 (BN)		50	10	1,800	1,900
2072 (W)		290	10	2,500	2,800
Average (2022-2072)		330	20	2,500	2,900
2022 - 2072	W	500	40	2,900	3,500
	AN	390	20	2,700	3,100
	BN	190	20	2,200	2,400
	D	270	10	2,400	2,700
	C	110	10	2,000	2,100

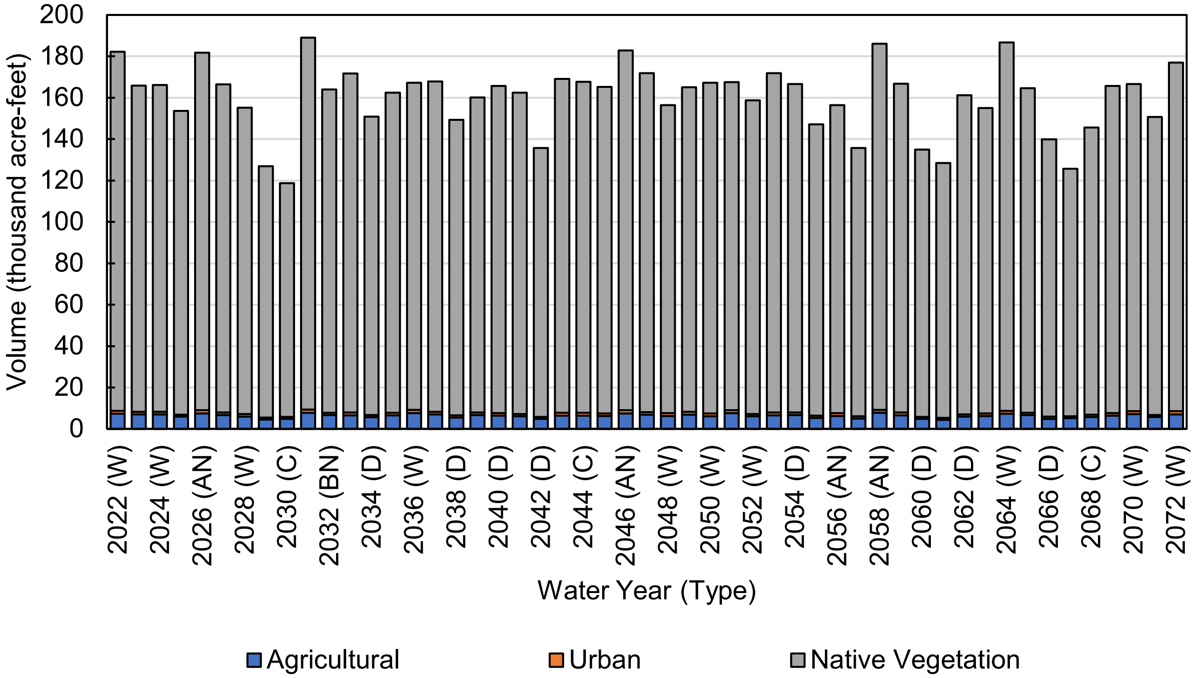

Figure 30. Bowman Subbasin Projected (Current Land Use) Evapotranspiration of Precipitation, by Water Use Sector

Table 29. Bowman Subbasin Projected (Current Land Use) Evapotranspiration of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	7,300	1,400	170,000	180,000
2023 (W)	7,000	1,300	160,000	170,000
2024 (W)	7,000	1,300	160,000	170,000
2025 (BN)	5,900	1,000	150,000	150,000
2026 (AN)	7,600	1,500	170,000	180,000
2027 (W)	6,700	1,300	160,000	170,000
2028 (W)	6,000	1,100	150,000	160,000
2029 (C)	4,500	890	120,000	130,000
2030 (C)	4,800	900	110,000	120,000
2031 (AN)	7,800	1,500	180,000	190,000
2032 (BN)	6,700	1,100	160,000	160,000
2033 (AN)	6,600	1,400	160,000	170,000
2034 (D)	5,600	1,100	140,000	150,000
2035 (W)	6,500	1,300	150,000	160,000
2036 (W)	7,700	1,400	160,000	170,000
2037 (W)	7,000	1,300	160,000	170,000
2038 (D)	5,400	1,100	140,000	150,000
2039 (W)	6,700	1,300	150,000	160,000
2040 (D)	6,500	1,200	160,000	170,000
2041 (C)	6,000	1,100	160,000	160,000
2042 (D)	4,900	960	130,000	140,000
2043 (C)	6,500	1,300	160,000	170,000
2044 (C)	6,500	1,300	160,000	170,000
2045 (C)	6,200	1,200	160,000	170,000
2046 (AN)	7,500	1,500	170,000	180,000
2047 (C)	6,800	1,300	160,000	170,000
2048 (W)	6,200	1,300	150,000	160,000
2049 (W)	6,900	1,300	160,000	170,000
2050 (W)	6,100	1,300	160,000	170,000
2051 (W)	7,600	1,400	160,000	170,000
2052 (W)	6,000	1,100	150,000	160,000
2053 (AN)	6,500	1,400	160,000	170,000
2054 (D)	6,800	1,200	160,000	170,000
2055 (D)	5,300	1,100	140,000	150,000
2056 (AN)	6,300	1,300	150,000	160,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		5,100	1,000	130,000	140,000
2058 (AN)		7,800	1,500	180,000	190,000
2059 (W)		6,600	1,300	160,000	170,000
2060 (D)		4,900	950	130,000	130,000
2061 (C)		4,500	910	120,000	130,000
2062 (D)		5,900	1,200	150,000	160,000
2063 (BN)		6,200	1,200	150,000	160,000
2064 (W)		7,300	1,400	180,000	190,000
2065 (BN)		6,600	1,100	160,000	160,000
2066 (D)		4,900	1,000	130,000	140,000
2067 (C)		5,100	930	120,000	130,000
2068 (C)		5,800	1,100	140,000	150,000
2069 (BN)		6,400	1,300	160,000	170,000
2070 (W)		7,200	1,300	160,000	170,000
2071 (BN)		5,700	1,000	140,000	150,000
2072 (W)		7,100	1,500	170,000	180,000
Average (2022-2072)		6,300	1,200	150,000	160,000
2022 - 2072	W	6,800	1,300	160,000	170,000
	AN	7,200	1,400	170,000	180,000
	BN	6,100	1,100	150,000	160,000
	D	5,600	1,100	140,000	150,000
	C	5,700	1,100	140,000	150,000

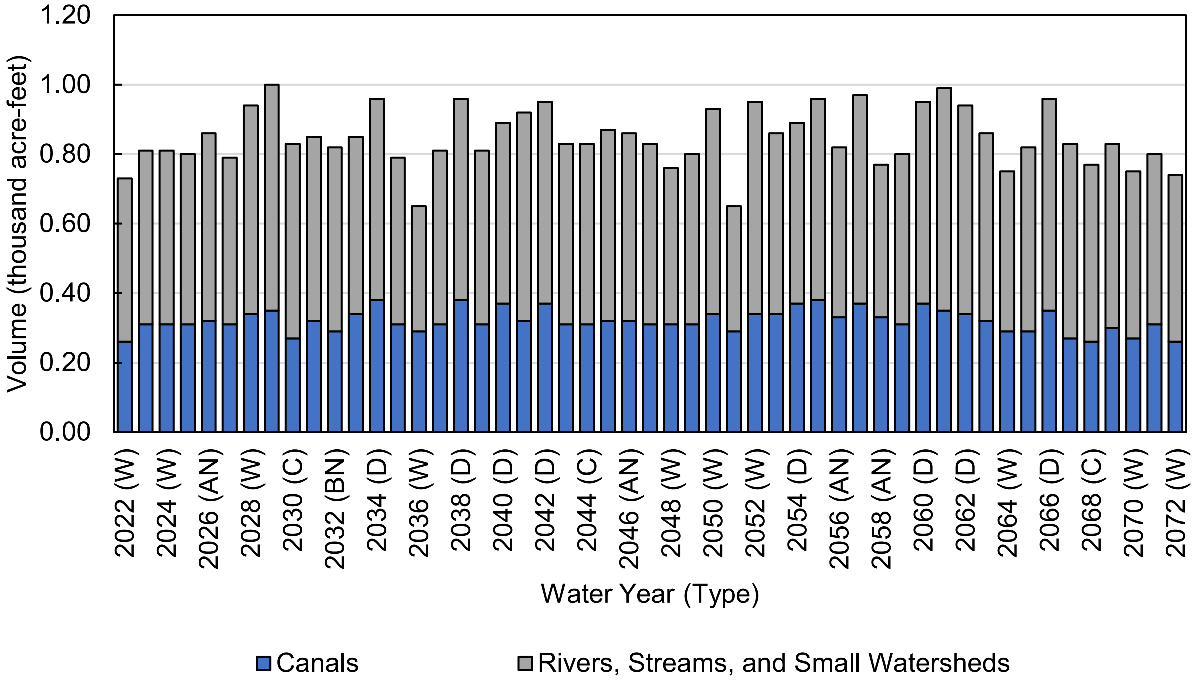

Figure 31. Bowman Subbasin Projected (Current Land Use) Evaporation of Surface Water Sources

Table 30. Bowman Subbasin Projected (Current Land Use) Evaporation of Surface Water Sources, by Water Use Sector (acre-feet)

Water Year (Type)	Canals	Rivers, Streams, and Small Watersheds[1]	Total
2022 (W)	260	470	730
2023 (W)	310	500	810
2024 (W)	310	500	810
2025 (BN)	310	490	800
2026 (AN)	320	540	860
2027 (W)	310	480	790
2028 (W)	340	600	940
2029 (C)	350	650	1,000
2030 (C)	270	560	830
2031 (AN)	320	530	850
2032 (BN)	290	530	820
2033 (AN)	340	510	850
2034 (D)	380	580	960
2035 (W)	310	480	790
2036 (W)	290	360	650
2037 (W)	310	500	810
2038 (D)	380	580	960
2039 (W)	310	500	810
2040 (D)	370	520	890
2041 (C)	320	600	920
2042 (D)	370	580	950
2043 (C)	310	520	830
2044 (C)	310	520	830
2045 (C)	320	550	870
2046 (AN)	320	540	860
2047 (C)	310	520	830
2048 (W)	310	450	760
2049 (W)	310	490	800
2050 (W)	340	590	930
2051 (W)	290	360	650
2052 (W)	340	610	950
2053 (AN)	340	520	860
2054 (D)	370	520	890
2055 (D)	380	580	960
2056 (AN)	330	490	820
2057 (BN)	370	600	970

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds[1]	Total
2058 (AN)		330	440	770
2059 (W)		310	490	800
2060 (D)		370	580	950
2061 (C)		350	640	990
2062 (D)		340	600	940
2063 (BN)		320	540	860
2064 (W)		290	460	750
2065 (BN)		290	530	820
2066 (D)		350	610	960
2067 (C)		270	560	830
2068 (C)		260	510	770
2069 (BN)		300	530	830
2070 (W)		270	480	750
2071 (BN)		310	490	800
2072 (W)		260	480	740
Average (2022-2072)		320	530	850
2022 - 2072	W	300	490	790
	AN	330	510	840
	BN	310	530	840
	D	370	570	940
	C	310	560	870

[1] Includes ET of riparian vegetation along rivers and streams.

2.1.2.2 Surface Water Outflow by Water Source Type

Surface water outflows from the Bowman Subbasin are summarized in **Figure 32** and **Table 31** by water source type. In the Bowman Subbasin, local supply outflows primarily include outflows of runoff, tailwater, and net drainage from land surfaces, in addition to runoff from small watersheds and stream outflows to the Sacramento River. Local supply outflows average approximately 120 taf per year, and range from 50 taf or less in certain dry and critical water years up to 390 taf in some wet years. Approximately 1.6 taf of CVP supplies also leave the Subbasin each year in spillage from ACID canals to Cottonwood Creek.

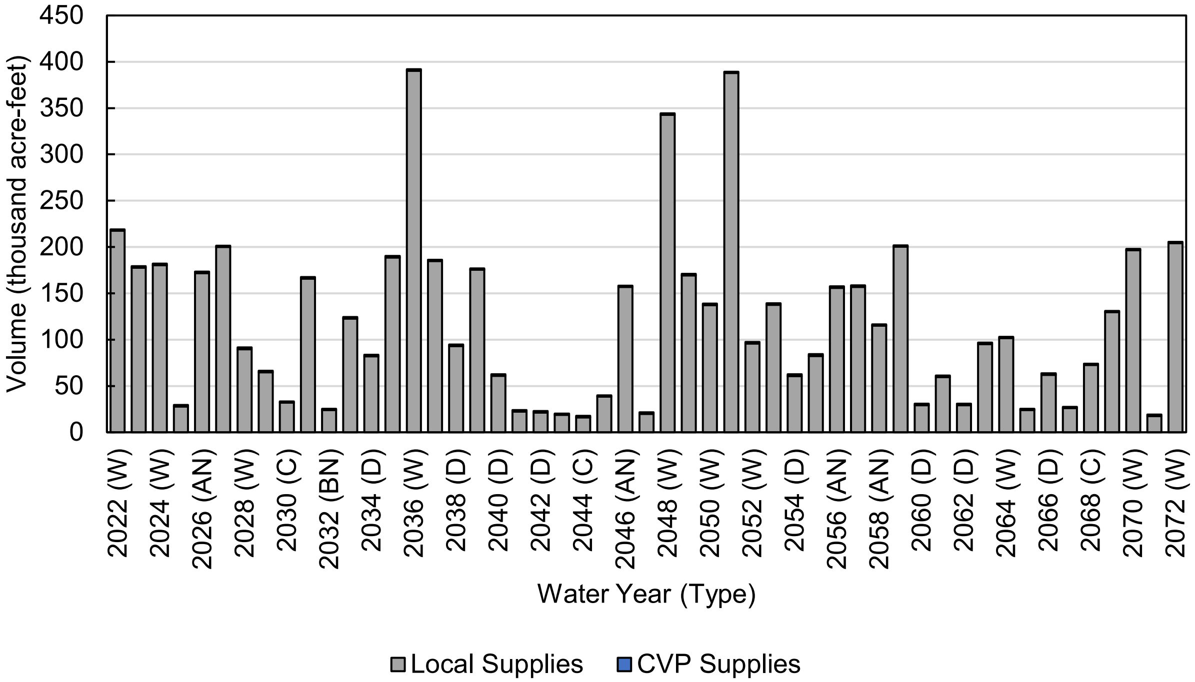

Figure 32. Bowman Subbasin Projected (Current Land Use) Surface Water Outflows, by Water Source Type

Table 31. Bowman Subbasin Projected (Current Land Use) Surface Water Outflows, by Water Source Type (acre-feet)

Water Year (Type)	CVP Supplies	Local Supplies	Other (Groundwater Discharge)	Total
2022 (W)	1,300	220,000	0	220,000
2023 (W)	1,600	180,000	0	180,000
2024 (W)	1,600	180,000	0	180,000
2025 (BN)	1,600	28,000	0	29,000
2026 (AN)	1,600	170,000	0	170,000
2027 (W)	1,500	200,000	0	200,000
2028 (W)	1,800	90,000	0	92,000
2029 (C)	1,700	65,000	0	66,000
2030 (C)	1,400	32,000	0	33,000
2031 (AN)	1,600	170,000	0	170,000
2032 (BN)	1,500	24,000	0	25,000
2033 (AN)	1,800	120,000	0	120,000
2034 (D)	1,900	82,000	0	84,000
2035 (W)	1,500	190,000	0	190,000
2036 (W)	1,500	390,000	0	390,000
2037 (W)	1,600	180,000	0	190,000
2038 (D)	1,900	93,000	0	95,000
2039 (W)	1,600	180,000	0	180,000
2040 (D)	1,900	61,000	0	63,000
2041 (C)	1,600	22,000	0	24,000
2042 (D)	1,800	21,000	0	23,000
2043 (C)	1,600	19,000	0	20,000
2044 (C)	1,600	16,000	0	18,000
2045 (C)	1,600	38,000	0	40,000
2046 (AN)	1,600	160,000	0	160,000
2047 (C)	1,600	20,000	0	22,000
2048 (W)	1,600	340,000	0	340,000
2049 (W)	1,600	170,000	0	170,000
2050 (W)	1,700	140,000	0	140,000
2051 (W)	1,500	390,000	0	390,000
2052 (W)	1,800	96,000	0	97,000
2053 (AN)	1,800	140,000	0	140,000
2054 (D)	1,900	61,000	0	63,000
2055 (D)	1,900	82,000	0	84,000

<table>
<tr><th colspan="2">Water Year (Type)</th><th>CVP Supplies</th><th>Local Supplies</th><th>Other (Groundwater Discharge)</th><th>Total</th></tr>
<tr><td colspan="2">2056 (AN)</td><td>1,600</td><td>160,000</td><td>0</td><td>160,000</td></tr>
<tr><td colspan="2">2057 (BN)</td><td>1,800</td><td>160,000</td><td>0</td><td>160,000</td></tr>
<tr><td colspan="2">2058 (AN)</td><td>1,600</td><td>110,000</td><td>0</td><td>120,000</td></tr>
<tr><td colspan="2">2059 (W)</td><td>1,500</td><td>200,000</td><td>0</td><td>200,000</td></tr>
<tr><td colspan="2">2060 (D)</td><td>1,800</td><td>29,000</td><td>0</td><td>31,000</td></tr>
<tr><td colspan="2">2061 (C)</td><td>1,700</td><td>59,000</td><td>0</td><td>61,000</td></tr>
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<tr><td colspan="2">2063 (BN)</td><td>1,600</td><td>95,000</td><td>0</td><td>97,000</td></tr>
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<tr><td colspan="2">2065 (BN)</td><td>1,500</td><td>24,000</td><td>0</td><td>25,000</td></tr>
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<tr><td colspan="2">2067 (C)</td><td>1,400</td><td>26,000</td><td>0</td><td>27,000</td></tr>
<tr><td colspan="2">2068 (C)</td><td>1,300</td><td>73,000</td><td>0</td><td>74,000</td></tr>
<tr><td colspan="2">2069 (BN)</td><td>1,500</td><td>130,000</td><td>0</td><td>130,000</td></tr>
<tr><td colspan="2">2070 (W)</td><td>1,400</td><td>200,000</td><td>0</td><td>200,000</td></tr>
<tr><td colspan="2">2071 (BN)</td><td>1,600</td><td>18,000</td><td>0</td><td>19,000</td></tr>
<tr><td colspan="2">2072 (W)</td><td>1,300</td><td>200,000</td><td>0</td><td>210,000</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>1,600</td><td>120,000</td><td>0</td><td>120,000</td></tr>
<tr><td rowspan="5">2022 - 2072</td><td>W</td><td>1,600</td><td>200,000</td><td>0</td><td>200,000</td></tr>
<tr><td>AN</td><td>1,700</td><td>150,000</td><td>0</td><td>150,000</td></tr>
<tr><td>BN</td><td>1,600</td><td>68,000</td><td>0</td><td>69,000</td></tr>
<tr><td>D</td><td>1,800</td><td>58,000</td><td>0</td><td>60,000</td></tr>
<tr><td>C</td><td>1,600</td><td>37,000</td><td>0</td><td>39,000</td></tr>
</table>

2.1.2.3 Deep Percolation of Applied Water

Estimated deep percolation of applied water (equal to infiltration of applied water in 23 CCR § 354.18(b)(2)) is summarized in **Figure 33** and **Table 32** by water use sector. Deep percolation of applied water is about 7.3 taf on average, and dominated by agricultural irrigation and varies between years, following the pattern of surface water diversions and deliveries to irrigated lands.

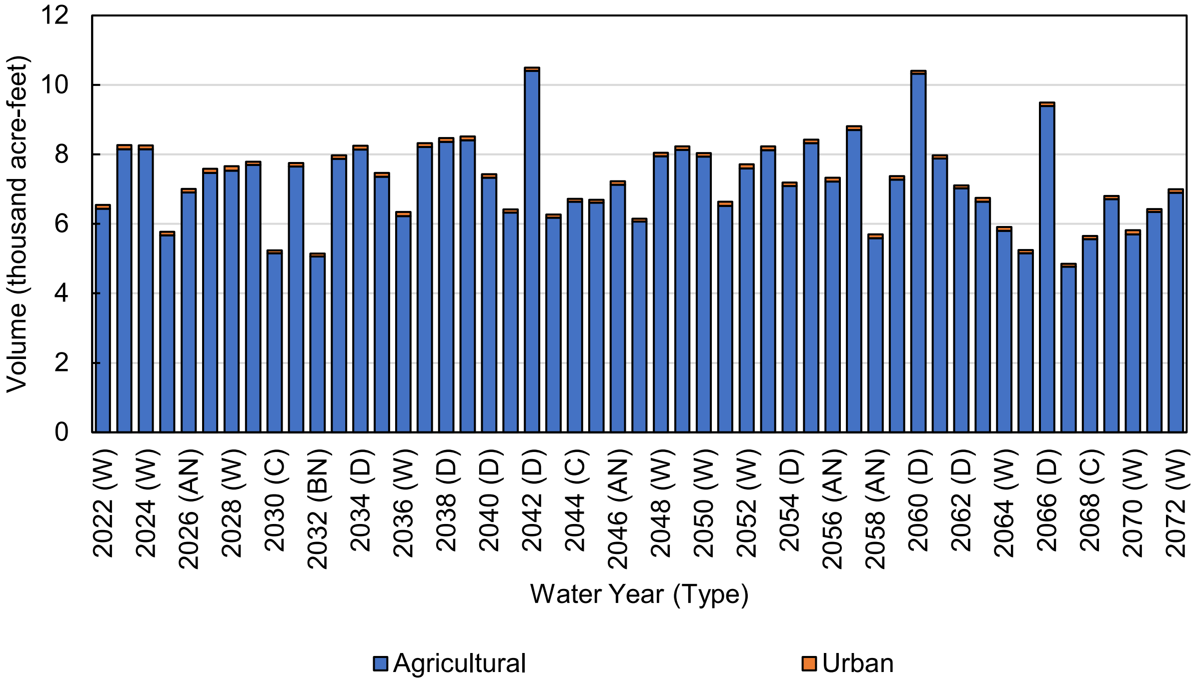


Figure 33. Bowman Subbasin Projected (Current Land Use) Deep Percolation of Applied Water, by Water Use Sector

Table 32. Bowman Subbasin Projected (Current Land Use) Deep Percolation of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	6,400	110	0	6,600
2023 (W)	8,200	120	0	8,300
2024 (W)	8,200	110	0	8,300
2025 (BN)	5,700	100	0	5,800
2026 (AN)	6,900	100	0	7,000
2027 (W)	7,500	120	0	7,600
2028 (W)	7,500	130	0	7,700
2029 (C)	7,700	90	0	7,800
2030 (C)	5,200	80	0	5,200
2031 (AN)	7,700	100	0	7,800
2032 (BN)	5,100	90	0	5,200
2033 (AN)	7,900	100	0	8,000
2034 (D)	8,100	110	0	8,300
2035 (W)	7,400	110	0	7,500
2036 (W)	6,200	120	0	6,300
2037 (W)	8,200	110	0	8,300
2038 (D)	8,400	110	0	8,500
2039 (W)	8,400	110	0	8,500
2040 (D)	7,300	100	0	7,400
2041 (C)	6,300	90	0	6,400
2042 (D)	10,000	90	0	11,000
2043 (C)	6,200	90	0	6,300
2044 (C)	6,600	80	0	6,700
2045 (C)	6,600	80	0	6,700
2046 (AN)	7,100	100	0	7,200
2047 (C)	6,100	80	0	6,200
2048 (W)	8,000	100	0	8,100
2049 (W)	8,100	100	0	8,200
2050 (W)	7,900	100	0	8,000
2051 (W)	6,500	120	0	6,600
2052 (W)	7,600	120	0	7,700
2053 (AN)	8,100	110	0	8,200
2054 (D)	7,100	100	0	7,200
2055 (D)	8,300	110	0	8,400
2056 (AN)	7,200	110	0	7,300

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		8,700	110	0	8,800
2058 (AN)		5,600	110	0	5,700
2059 (W)		7,300	110	0	7,400
2060 (D)		10,000	90	0	10,000
2061 (C)		7,900	90	0	8,000
2062 (D)		7,000	80	0	7,100
2063 (BN)		6,600	110	0	6,800
2064 (W)		5,800	110	0	5,900
2065 (BN)		5,200	90	0	5,300
2066 (D)		9,400	100	0	9,500
2067 (C)		4,800	80	0	4,900
2068 (C)		5,600	90	0	5,700
2069 (BN)		6,700	90	0	6,800
2070 (W)		5,700	120	0	5,800
2071 (BN)		6,300	90	0	6,400
2072 (W)		6,900	100	0	7,000
Average (2022-2072)		7,200	100	0	7,300
2022 - 2072	W	7,300	110	0	7,400
	AN	7,200	100	0	7,300
	BN	6,300	100	0	6,400
	D	8,500	100	0	8,600
	C	6,300	90	0	6,400

2.1.2.4 Deep Percolation of Precipitation

Estimated deep percolation of precipitation (equal to infiltration of precipitation in 23 CCR § 354.18(b)(2)) is provided in and **Figure 34** and **Table 33** by water use sector. Deep percolation of precipitation to the GWS is highly variable from year to year due to variation in the timing and amount of precipitation, ranging from about 23 taf per year during critical dry years to about 67 taf per year during wet years on average.

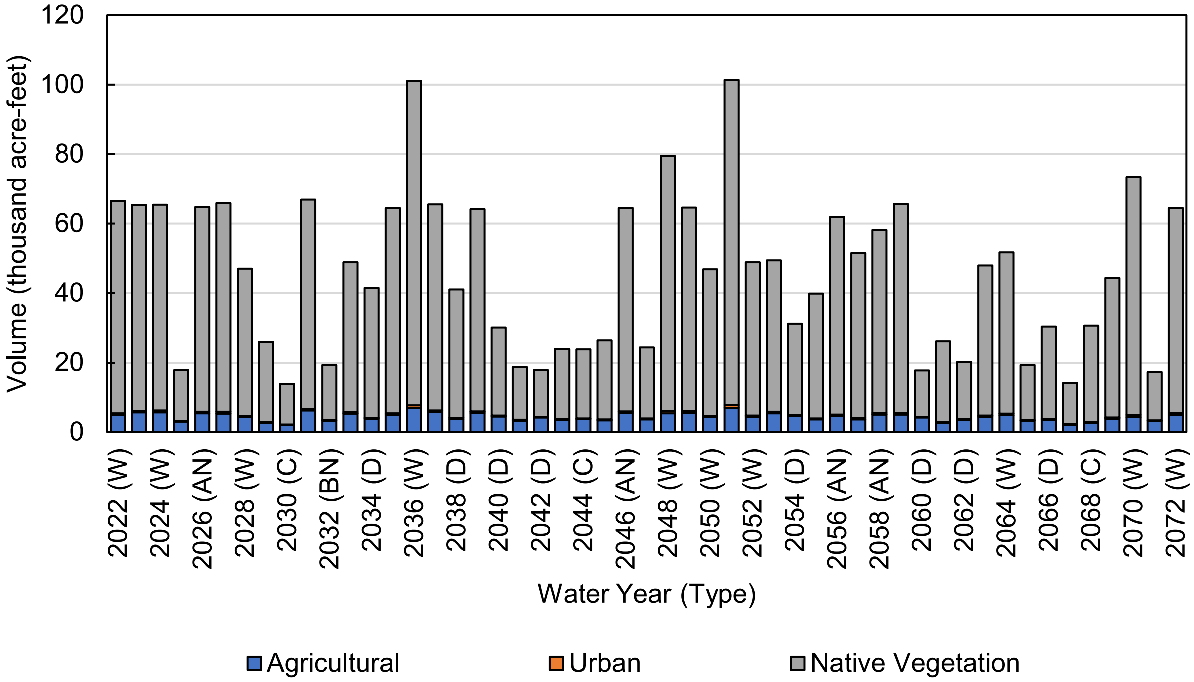


Figure 34. Bowman Subbasin Projected (Current Land Use) Deep Percolation of Precipitation, by Water Use Sector

Table 33. Bowman Subbasin Projected (Current Land Use) Deep Percolation of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	4,900	580	61,000	67,000
2023 (W)	5,700	530	59,000	65,000
2024 (W)	5,700	520	59,000	65,000
2025 (BN)	3,000	240	15,000	18,000
2026 (AN)	5,400	510	59,000	65,000
2027 (W)	5,300	520	60,000	66,000
2028 (W)	4,300	410	42,000	47,000
2029 (C)	2,700	230	23,000	26,000
2030 (C)	2,000	180	12,000	14,000
2031 (AN)	6,200	510	60,000	67,000
2032 (BN)	3,300	220	16,000	19,000
2033 (AN)	5,300	450	43,000	49,000
2034 (D)	3,800	330	37,000	42,000
2035 (W)	4,900	500	59,000	64,000
2036 (W)	6,900	790	93,000	100,000
2037 (W)	5,700	500	59,000	66,000
2038 (D)	3,800	340	37,000	41,000
2039 (W)	5,500	490	58,000	64,000
2040 (D)	4,500	290	25,000	30,000
2041 (C)	3,300	230	15,000	19,000
2042 (D)	4,200	200	13,000	18,000
2043 (C)	3,500	240	20,000	24,000
2044 (C)	3,800	230	20,000	24,000
2045 (C)	3,400	220	23,000	26,000
2046 (AN)	5,500	490	59,000	65,000
2047 (C)	3,700	240	20,000	24,000
2048 (W)	5,400	620	73,000	79,000
2049 (W)	5,500	490	59,000	65,000
2050 (W)	4,300	380	42,000	47,000
2051 (W)	7,000	790	94,000	100,000
2052 (W)	4,400	410	44,000	49,000
2053 (AN)	5,400	450	44,000	49,000
2054 (D)	4,600	300	26,000	31,000
2055 (D)	3,600	330	36,000	40,000
2056 (AN)	4,600	460	57,000	62,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		3,700	430	47,000	52,000
2058 (AN)		5,100	440	53,000	58,000
2059 (W)		5,000	500	60,000	66,000
2060 (D)		4,200	200	13,000	18,000
2061 (C)		2,700	230	23,000	26,000
2062 (D)		3,600	220	16,000	20,000
2063 (BN)		4,400	390	43,000	48,000
2064 (W)		4,900	450	46,000	52,000
2065 (BN)		3,300	220	16,000	19,000
2066 (D)		3,600	280	27,000	30,000
2067 (C)		2,100	180	12,000	14,000
2068 (C)		2,700	290	28,000	31,000
2069 (BN)		3,800	380	40,000	44,000
2070 (W)		4,300	620	68,000	73,000
2071 (BN)		3,200	220	14,000	17,000
2072 (W)		5,000	510	59,000	65,000
Average (2022-2072)		4,400	390	41,000	46,000
2022 - 2072	W	5,300	530	61,000	67,000
	AN	5,400	470	53,000	59,000
	BN	3,500	300	27,000	31,000
	D	4,000	280	26,000	30,000
	C	3,000	230	20,000	23,000

2.1.2.5 Infiltration of Surface Water

Estimated infiltration of surface water (seepage) by water source is provided in **Figure 35** and **Table 34.** Flows along Cottonwood Creek and runoff from upgradient small watersheds contribute seepage to the Bowman Subbasin, averaging about 34 taf per year. Seepage in the Bowman Subbasin also comes from conveyance of surface water delivered to irrigators in ACID. The total seepage from all canals and diversions is approximately 12 taf per year, on average.

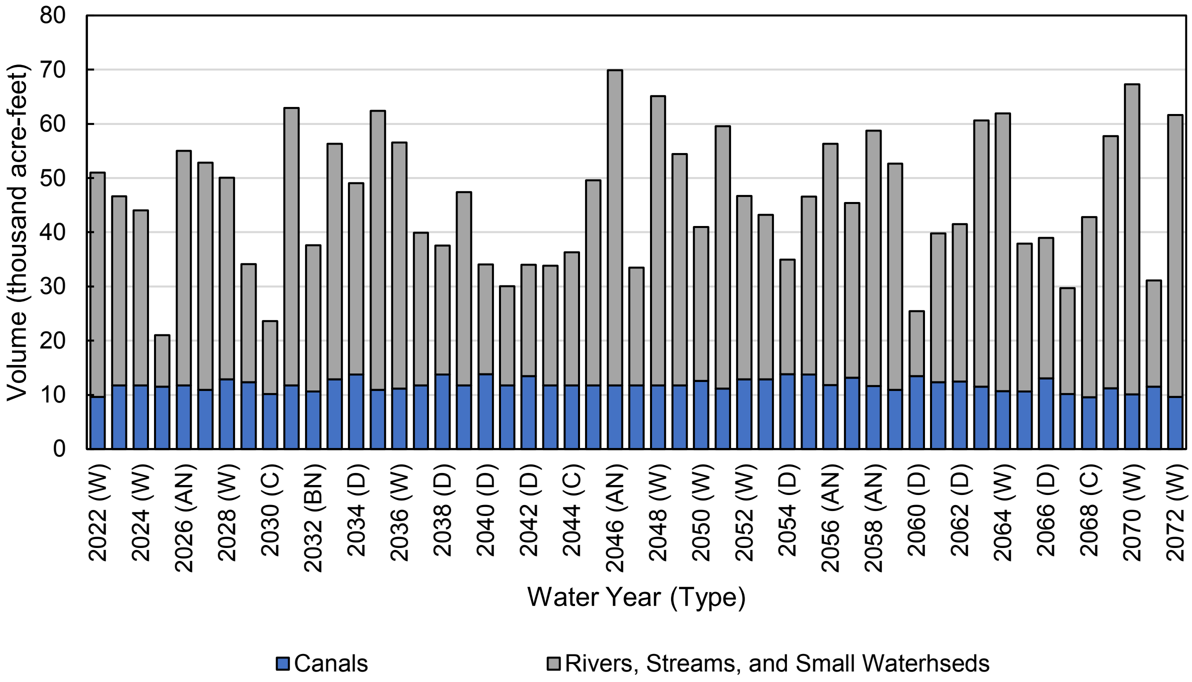


Figure 35. Bowman Subbasin Projected (Current Land Use) Infiltration of Surface Water, by Water Use Sector

Table 34. Bowman Subbasin Projected (Current Land Use) Infiltration of Surface Water, by Water Use Sector (acre-feet)

Water Year (Type)	Canals	Rivers, Streams, and Small Watersheds	Total
2022 (W)	9,600	41,000	51,000
2023 (W)	12,000	35,000	47,000
2024 (W)	12,000	32,000	44,000
2025 (BN)	12,000	9,500	21,000
2026 (AN)	12,000	43,000	55,000
2027 (W)	11,000	42,000	53,000
2028 (W)	13,000	37,000	50,000
2029 (C)	12,000	22,000	34,000
2030 (C)	10,000	14,000	24,000
2031 (AN)	12,000	51,000	63,000
2032 (BN)	11,000	27,000	38,000
2033 (AN)	13,000	43,000	56,000
2034 (D)	14,000	35,000	49,000
2035 (W)	11,000	52,000	62,000
2036 (W)	11,000	45,000	57,000
2037 (W)	12,000	28,000	40,000
2038 (D)	14,000	24,000	38,000
2039 (W)	12,000	36,000	47,000
2040 (D)	14,000	20,000	34,000
2041 (C)	12,000	18,000	30,000
2042 (D)	13,000	21,000	34,000
2043 (C)	12,000	22,000	34,000
2044 (C)	12,000	25,000	36,000
2045 (C)	12,000	38,000	50,000
2046 (AN)	12,000	58,000	70,000
2047 (C)	12,000	22,000	34,000
2048 (W)	12,000	53,000	65,000
2049 (W)	12,000	43,000	54,000
2050 (W)	13,000	28,000	41,000
2051 (W)	11,000	48,000	60,000
2052 (W)	13,000	34,000	47,000
2053 (AN)	13,000	30,000	43,000
2054 (D)	14,000	21,000	35,000
2055 (D)	14,000	33,000	47,000
2056 (AN)	12,000	45,000	56,000

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds	Total
2057 (BN)		13,000	32,000	45,000
2058 (AN)		12,000	47,000	59,000
2059 (W)		11,000	42,000	53,000
2060 (D)		13,000	12,000	25,000
2061 (C)		12,000	27,000	40,000
2062 (D)		12,000	29,000	42,000
2063 (BN)		12,000	49,000	61,000
2064 (W)		11,000	51,000	62,000
2065 (BN)		11,000	27,000	38,000
2066 (D)		13,000	26,000	39,000
2067 (C)		10,000	20,000	30,000
2068 (C)		9,500	33,000	43,000
2069 (BN)		11,000	47,000	58,000
2070 (W)		10,000	57,000	67,000
2071 (BN)		12,000	20,000	31,000
2072 (W)		9,600	52,000	62,000
Average (2022-2072)		12,000	34,000	46,000
2022 - 2072	W	11,000	42,000	53,000
	AN	12,000	45,000	58,000
	BN	11,000	30,000	42,000
	D	13,000	25,000	38,000
	C	11,000	24,000	35,000

2.1.3 Change in Root Zone Storage

Estimates of change in root zone storage are provided in **Figure 36** and **Table 35**. Inter-annual changes in storage within the SWS consist primarily of root zone soil moisture storage changes, are relatively small, and tend to average near zero over many years.

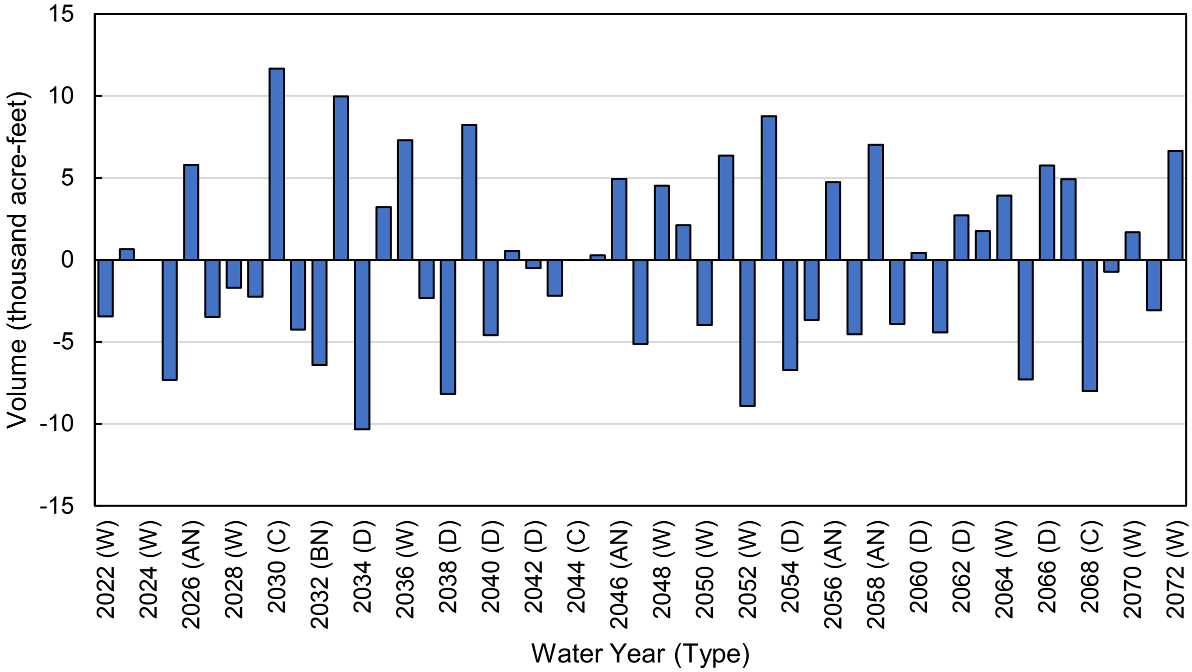


Figure 36. Bowman Subbasin Projected (Current Land Use) Change in Root Zone Storage

Table 35. Bowman Subbasin Projected (Current Land Use) Change in Root Zone Storage (acre-feet)

Water Year (Type)	Change in Root Zone Storage
2022 (W)	-3,500
2023 (W)	640
2024 (W)	0
2025 (BN)	-7,300
2026 (AN)	5,800
2027 (W)	-3,500
2028 (W)	-1,700
2029 (C)	-2,200
2030 (C)	12,000
2031 (AN)	-4,300
2032 (BN)	-6,400
2033 (AN)	10,000
2034 (D)	-10,000
2035 (W)	3,200
2036 (W)	7,300
2037 (W)	-2,300
2038 (D)	-8,200
2039 (W)	8,200
2040 (D)	-4,600
2041 (C)	540
2042 (D)	-510
2043 (C)	-2,200
2044 (C)	-10
2045 (C)	270
2046 (AN)	4,900
2047 (C)	-5,100
2048 (W)	4,500
2049 (W)	2,100
2050 (W)	-4,000
2051 (W)	6,400
2052 (W)	-8,900
2053 (AN)	8,800
2054 (D)	-6,700
2055 (D)	-3,700
2056 (AN)	4,700

Water Year (Type)		Change in Root Zone Storage
2057 (BN)		-4,600
2058 (AN)		7,000
2059 (W)		-3,900
2060 (D)		430
2061 (C)		-4,400
2062 (D)		2,700
2063 (BN)		1,800
2064 (W)		3,900
2065 (BN)		-7,300
2066 (D)		5,800
2067 (C)		4,900
2068 (C)		-8,000
2069 (BN)		-720
2070 (W)		1,700
2071 (BN)		-3,100
2072 (W)		6,700
Average (2022-2072)		-70
2022 - 2072	W	940
	AN	5,300
	BN	-4,000
	D	-2,800
	C	-460

2.1.4 Net Recharge from Surface Water System

Net recharge from the SWS is a useful metric that equates only the impacts of the SWS on recharge and extraction from the GWS, providing valuable insight to the combined effects of land surface processes on the underlying GWS. Net recharge from the SWS is calculated as the total groundwater recharge minus the total groundwater extraction and uptake. When calculated for the projected (current land use) water budget, average net recharge from the SWS represents the average surplus (when positive) or shortage (when negative) of recharge that has resulted from projected cropping, land use practices, and average hydrologic conditions, when comparing groundwater extractions with deep percolation and infiltration from the SWS to the GWS. Net recharge does not include groundwater discharges to surface water and is not a full accounting of all exchanges occurring between the SWS and GWS. Although net recharge is a useful water balance metric, groundwater sustainability is not defined by the balance of net recharge from the SWS. Other important factors must be considered in the complete assessment of groundwater sustainability, including but not limited to subsurface groundwater flows and groundwater discharge to surface water.

Annual values for net recharge from the SWS over the projected (current land use) water budget period are presented below for the Bowman Subbasin. **Figure 37** and **Table 36** show the average net recharge from the SWS over 2022-2072 based on the projected (current land use) water budget results. Under current land use conditions, the average net recharge in the Bowman Subbasin was projected as approximately 90 taf per year between 2022-2072, indicating net inflows to the GWS from the SWS during the projected (current land use) water budget period. As illustrated on the cumulative net recharge plot in **Figure 37**, this results in a cumulative net recharge (i.e., net recharge to the GWS from the SWS) of about 4,600 taf over the 51-year projected (current land use) water budget period. Although this means there is projected to be more recharge from the SWS to the GWS than extractions and discharges from the GWS to the SWS, this alone does not necessarily mean that groundwater storage is increasing or that the Subbasin groundwater system has been sustainable. The complete Subbasin water budget, including the GWS water budget results, provide an indication of whether total groundwater inflows and outflows are in balance.

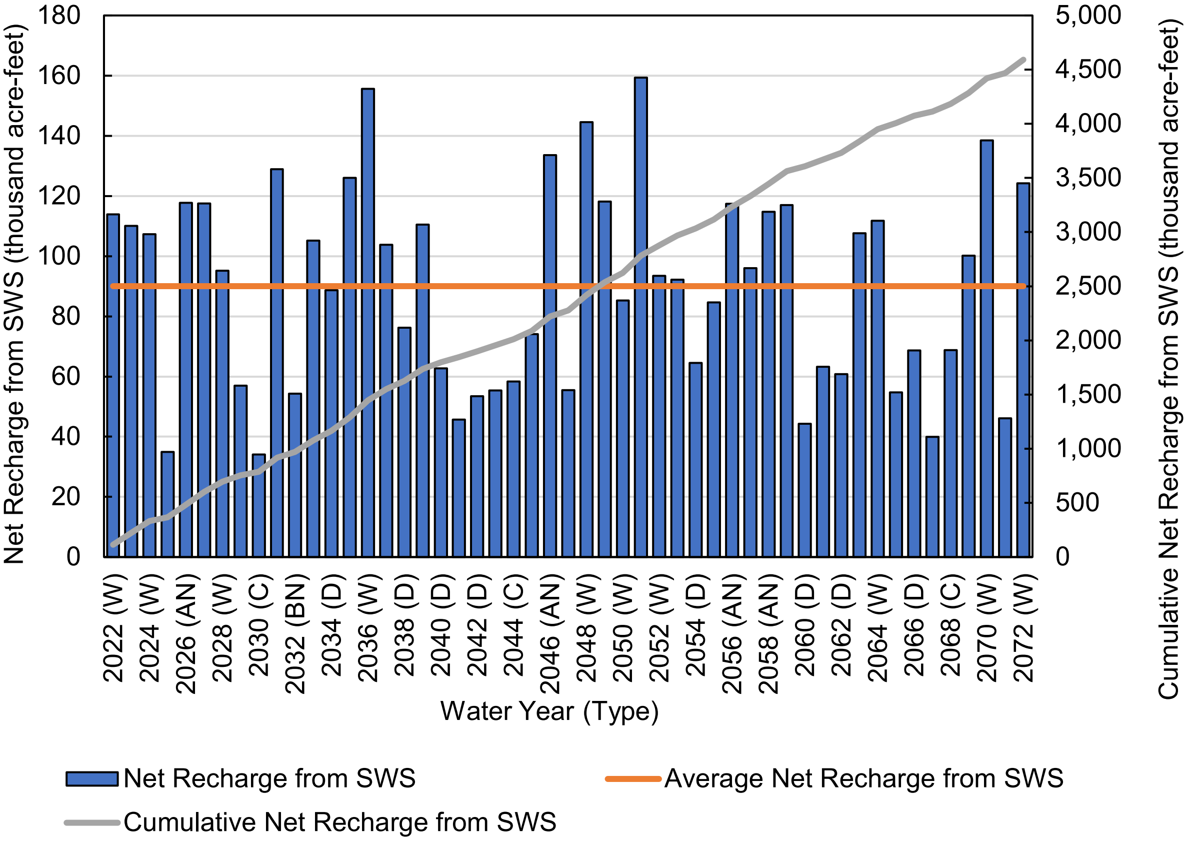


Figure 37. Bowman Subbasin Projected (Current Land Use) Net Recharge Overview

Table 36. Bowman Subbasin Projected (Current Land Use) Water Budget: Average Net Recharge from SWS, by Water Year Type (acre-feet)

Year Type	Number of Years	Deep Perc. of Applied Water (a)	Deep Perc. of Precipitation (b)	Infil. of Surface Water (c)	Groundwater Extraction/ Uptake (d)	Net Recharge from SWS (a+b+c-d)
W	18	7,400	67,000	53,000	9,200	120,000
AN	7	7,300	59,000	58,000	8,400	120,000
BN	7	6,400	31,000	42,000	8,600	71,000
D	9	8,600	30,000	38,000	9,500	67,000
C	10	6,400	23,000	35,000	9,300	55,000
Annual Average (2022 - 2072)	51	7,300	46,000	46,000	9,100	90,000

2.2 Groundwater System Water Budget Results

Projected (current land use) water budget results for different components of the GWS are presented in the sections below. Inflows and outflows from the GWS that occur through exchanges with the SWS are discussed in the SWS water budget results, although these components are also noted in the sections below relating to the GWS water budget. In contrast to the SWS water budget, many of the GWS water budget components change in flow direction over time representing inflows during some periods and outflows during other periods, depending on Subbasin conditions. The GWS water budget results are presented with net inflows indicated by positive values and net outflows as negative values.

2.2.1 Lateral Subsurface Groundwater Flows

Subsurface groundwater flows to and from the Bowman Subbasin occur between the Red Bluff Subbasin to the south, the Anderson Subbasin to the north, and the South Battle Creek Subbasin to the east. Subsurface groundwater inflows that occur from the upland foothill (small watershed) areas adjoining the Bowman Subbasin are negligible and set at zero throughout the historical period.

2.2.1.1 Lateral Subsurface Flows to/from Adjacent Subbasins

Projected (current land use) lateral subsurface flows occurring from and to adjacent subbasin are summarized in **Figure** 38 and **Table 37**. The total Projected (current land use) net subsurface flows to and from all adjacent subbasins averages about -85 taf per year occurring as outflow from the Bowman Subbasin. Projected (current land use) subsurface flows across the boundary with the Red Bluff Subbasin average an outflow of nearly -120 taf per year. The magnitude of these subsurface flows does not fluctuate much from year to year, although the subsurface outflows to the Red Bluff Subbasin tend to be somewhat greater during wet years than in dry years. In contrast to the subsurface outflows across the boundary with Red Bluff Subbasin, the flows across the northern boundary with the Anderson Subbasin occur as inflows averaging about 22 taf per year, with little variability by water year type. Subsurface flows across the boundary with the South Battle Creek Subbasin are relatively small. On average the subsurface flows across the South Battle Creek Subbasin boundary occur as net inflows of about 10 taf per year.

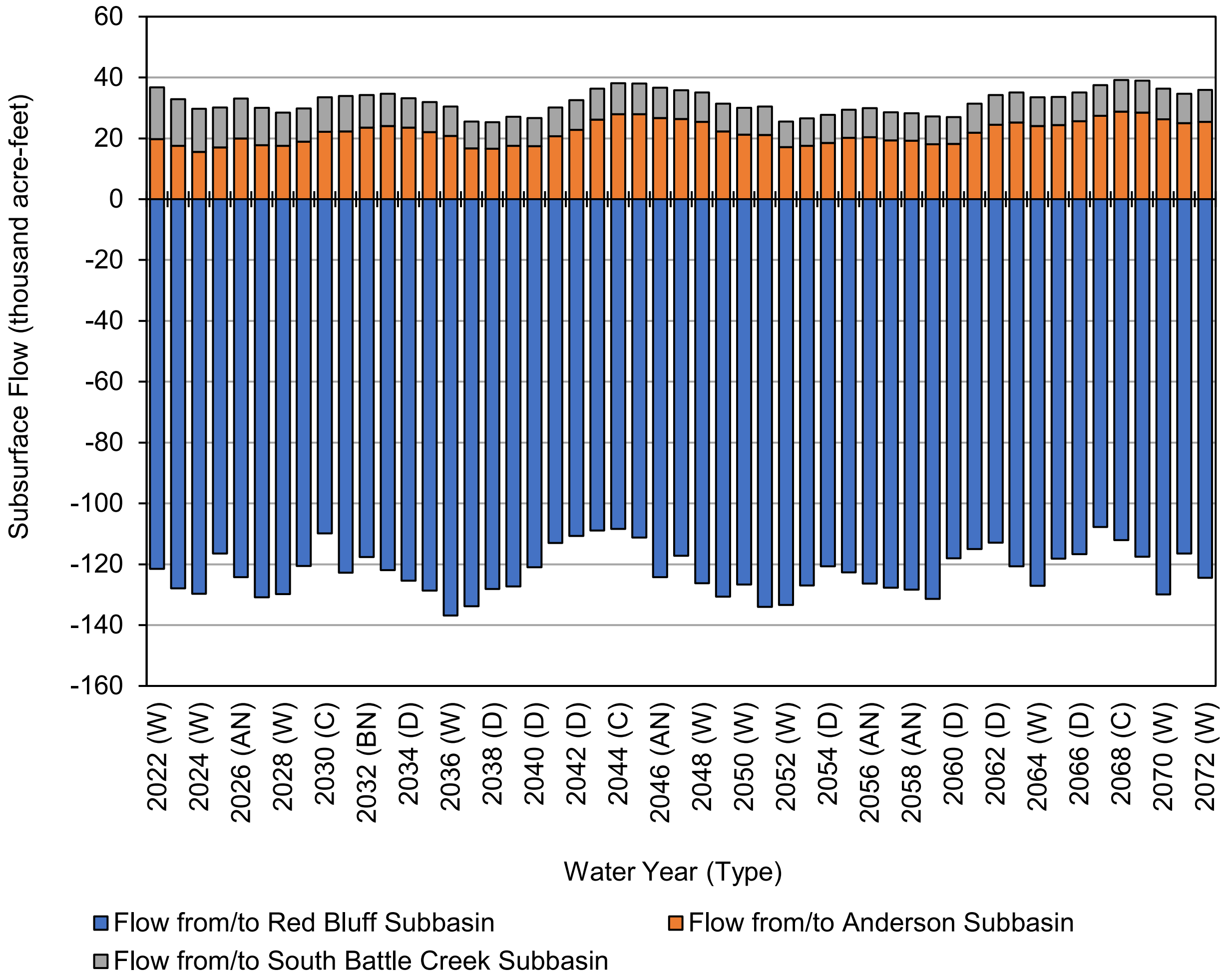


Figure 38. Bowman Subbasin Projected (Current Land Use) Lateral Subsurface Groundwater Flows to/from Adjacent Subbasins

Table 37. Bowman Subbasin Projected (Current Land Use) Lateral Subsurface Groundwater Flows Between Adjacent Subbasins (net flows as acre-feet)

Water Year (Type)	Red Bluff	Anderson	South Battle Creek	Total
2022 (W)	-120,000	20,000	17,000	-85,000
2023 (W)	-130,000	18,000	15,000	-95,000
2024 (W)	-130,000	16,000	14,000	-100,000
2025 (BN)	-120,000	17,000	13,000	-86,000
2026 (AN)	-120,000	20,000	13,000	-91,000
2027 (W)	-130,000	18,000	12,000	-100,000
2028 (W)	-130,000	17,000	11,000	-100,000
2029 (C)	-120,000	19,000	11,000	-91,000
2030 (C)	-110,000	22,000	11,000	-76,000
2031 (AN)	-120,000	22,000	12,000	-89,000
2032 (BN)	-120,000	24,000	11,000	-83,000
2033 (AN)	-120,000	24,000	11,000	-87,000
2034 (D)	-130,000	23,000	9,700	-92,000
2035 (W)	-130,000	22,000	9,900	-97,000
2036 (W)	-140,000	21,000	9,600	-110,000
2037 (W)	-130,000	17,000	8,800	-110,000
2038 (D)	-130,000	17,000	8,700	-100,000
2039 (W)	-130,000	18,000	9,500	-100,000
2040 (D)	-120,000	17,000	9,200	-94,000
2041 (C)	-110,000	21,000	9,400	-83,000
2042 (D)	-110,000	23,000	9,800	-78,000
2043 (C)	-110,000	26,000	10,000	-73,000
2044 (C)	-110,000	28,000	10,000	-70,000
2045 (C)	-110,000	28,000	10,000	-73,000
2046 (AN)	-120,000	27,000	10,000	-88,000
2047 (C)	-120,000	26,000	9,400	-81,000
2048 (W)	-130,000	25,000	9,700	-91,000
2049 (W)	-130,000	22,000	9,100	-99,000
2050 (W)	-130,000	21,000	8,800	-97,000
2051 (W)	-130,000	21,000	9,400	-100,000
2052 (W)	-130,000	17,000	8,500	-110,000
2053 (AN)	-130,000	18,000	9,000	-100,000
2054 (D)	-120,000	18,000	9,300	-93,000
2055 (D)	-120,000	20,000	9,300	-93,000
2056 (AN)	-130,000	20,000	9,600	-96,000
2057 (BN)	-130,000	19,000	9,200	-99,000
2058 (AN)	-130,000	19,000	9,100	-100,000

Water Year (Type)		Red Bluff	Anderson	South Battle Creek	Total
2059 (W)		-130,000	18,000	9,100	-100,000
2060 (D)		-120,000	18,000	8,800	-91,000
2061 (C)		-110,000	22,000	9,600	-84,000
2062 (D)		-110,000	24,000	9,800	-79,000
2063 (BN)		-120,000	25,000	9,800	-86,000
2064 (W)		-130,000	24,000	9,500	-94,000
2065 (BN)		-120,000	24,000	9,300	-85,000
2066 (D)		-120,000	26,000	9,500	-82,000
2067 (C)		-110,000	27,000	10,000	-70,000
2068 (C)		-110,000	29,000	10,000	-73,000
2069 (BN)		-120,000	28,000	11,000	-79,000
2070 (W)		-130,000	26,000	10,000	-94,000
2071 (BN)		-120,000	25,000	9,700	-82,000
2072 (W)		-120,000	25,000	10,000	-88,000
Average (2022-2072)		-120,000	22,000	10,000	-85,000
2022 - 2072	W	-130,000	20,000	11,000	-98,000
	AN	-120,000	21,000	10,000	-93,000
	BN	-120,000	23,000	10,000	-86,000
	D	-120,000	21,000	9,300	-89,000
	C	-110,000	25,000	10,000	-77,000

Note: positive values represent net inflows to Bowman Subbasin, negative values represent net outflows from Bowman Subbasin.

2.2.2 Deep Percolation From the SWS

Deep percolation from the SWS includes infiltration of water below the root zone (deep percolation) from precipitation and applied water. These two water budget components are summarized in the SWS water budget as outflows to the SWS and are presented as aggregated deep percolation inflows to the GWS in **Figure 39** and **Table 38**. The average annual deep percolation from the SWS over the projected (current land use) water budget period is approximately 53 taf per year. Greater volumes of deep percolation occur during wetter years when infiltration of precipitation is higher.

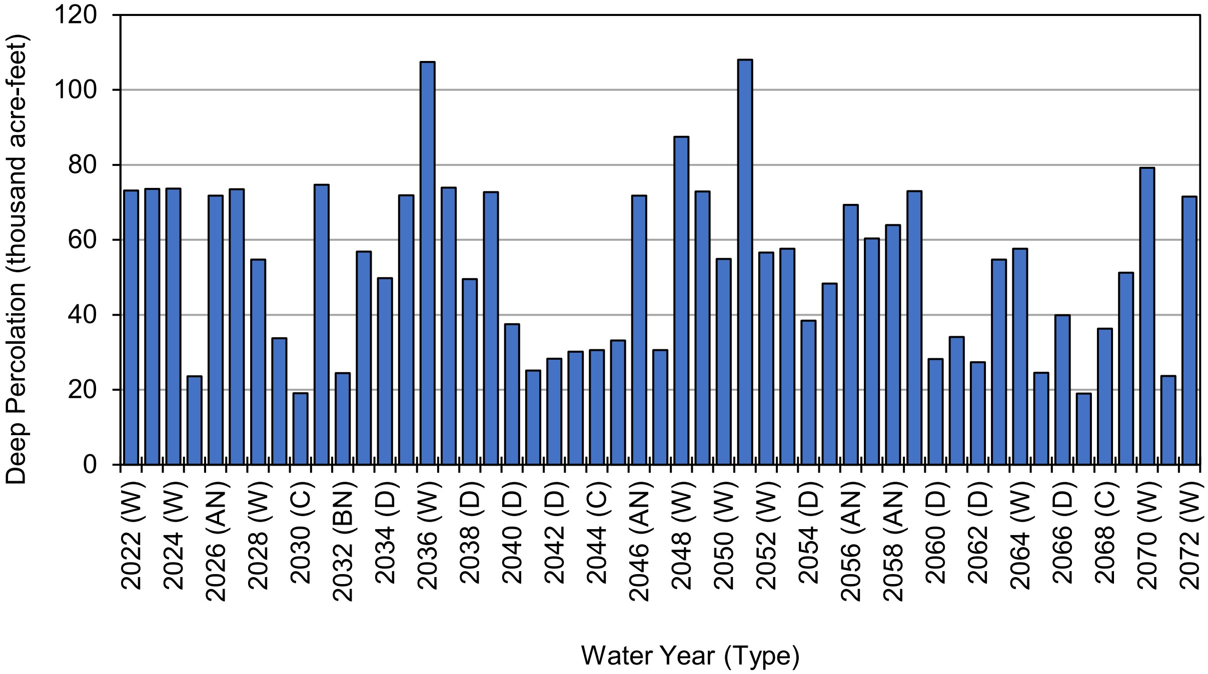


Figure 39. Bowman Subbasin Projected (Current Land Use) Deep Percolation

Table 38. Bowman Subbasin Projected (Current Land Use) Deep Percolation from the SWS (acre-feet)

Water Year (Type)	Deep Percolation from the SWS
2022 (W)	73,000
2023 (W)	74,000
2024 (W)	74,000
2025 (BN)	24,000
2026 (AN)	72,000
2027 (W)	74,000
2028 (W)	55,000
2029 (C)	34,000
2030 (C)	19,000
2031 (AN)	75,000
2032 (BN)	24,000
2033 (AN)	57,000
2034 (D)	50,000
2035 (W)	72,000
2036 (W)	110,000
2037 (W)	74,000
2038 (D)	50,000
2039 (W)	73,000
2040 (D)	38,000
2041 (C)	25,000
2042 (D)	28,000
2043 (C)	30,000
2044 (C)	31,000
2045 (C)	33,000
2046 (AN)	72,000
2047 (C)	31,000
2048 (W)	88,000
2049 (W)	73,000
2050 (W)	55,000
2051 (W)	110,000
2052 (W)	57,000
2053 (AN)	58,000
2054 (D)	38,000
2055 (D)	48,000
2056 (AN)	69,000
2057 (BN)	60,000
2058 (AN)	64,000

Water Year (Type)		Deep Percolation from the SWS
2059 (W)		73,000
2060 (D)		28,000
2061 (C)		34,000
2062 (D)		27,000
2063 (BN)		55,000
2064 (W)		58,000
2065 (BN)		25,000
2066 (D)		40,000
2067 (C)		19,000
2068 (C)		36,000
2069 (BN)		51,000
2070 (W)		79,000
2071 (BN)		24,000
2072 (W)		72,000
Average (2022-2072)		53,000
2022 - 2072	W	74,000
	AN	67,000
	BN	38,000
	D	39,000
	C	29,000

2.2.3 Net Stream Seepage/Groundwater Discharge to Surface Water

The flow of water between the GWS and SWS through seepage of water from streams and canals and groundwater discharging into streams is discussed as part of the SWS water budget. These components are combined for presentation in the GWS water budget as a net volume of stream seepage (**Figure 40** and **Table 39**). Positive total net seepage values represent a net inflow of water from the SWS to the GWS via stream and canal seepage indicating that the overall volume of stream seepage is greater than the volume of any groundwater discharging into surface waterways. Negative net seepage values represent a net outflow of groundwater from the GWS to the SWS through groundwater discharge to surface water. When net seepage is negative, it means that more groundwater is discharging into the surface waterways than is seeping from surface waterways into the GWS.

In the Bowman Subbasin, the projected (current land use) annual net seepage values are always positive with an average annual net stream seepage value of 46 taf per year indicating net addition of water to the GWS through the exchanges with surface waterways. The annual net stream seepage values tend to be higher in wet years in comparison to dry years corresponding with more groundwater recharge from surface water in wet years and less groundwater recharge in dry years.

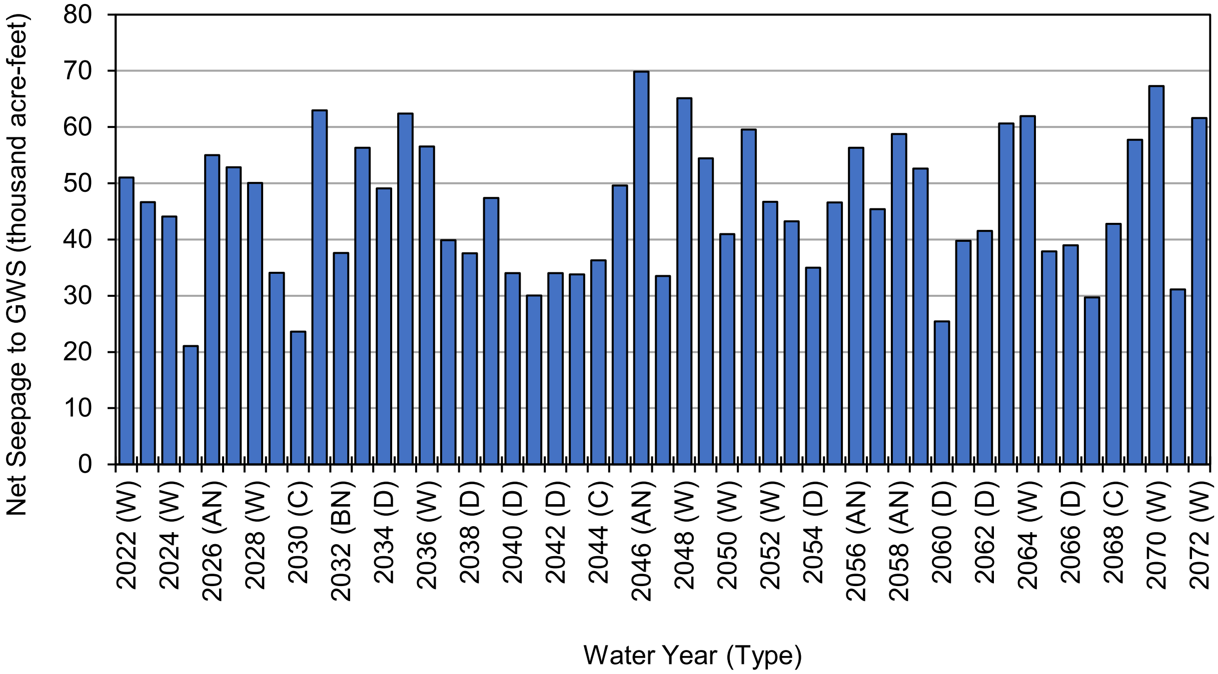


Figure 40. Bowman Subbasin Projected (Current Land Use) Net Stream Seepage to GWS/Discharge to Surface Water

Table 39. Bowman Subbasin Projected (Current Land Use) Net Stream Seepage (net flows as acre-feet)

Water Year (Type)	Total Net Seepage from Surface Waterways and Canals
2022 (W)	51,000
2023 (W)	47,000
2024 (W)	44,000
2025 (BN)	21,000
2026 (AN)	55,000
2027 (W)	53,000
2028 (W)	50,000
2029 (C)	34,000
2030 (C)	24,000
2031 (AN)	63,000
2032 (BN)	38,000
2033 (AN)	56,000
2034 (D)	49,000
2035 (W)	62,000
2036 (W)	57,000
2037 (W)	40,000
2038 (D)	38,000
2039 (W)	47,000
2040 (D)	34,000
2041 (C)	30,000
2042 (D)	34,000
2043 (C)	34,000
2044 (C)	36,000
2045 (C)	50,000
2046 (AN)	70,000
2047 (C)	34,000
2048 (W)	65,000
2049 (W)	54,000
2050 (W)	41,000
2051 (W)	60,000
2052 (W)	47,000
2053 (AN)	43,000
2054 (D)	35,000
2055 (D)	47,000
2056 (AN)	56,000
2057 (BN)	45,000
2058 (AN)	59,000

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Total Net Seepage from Surface Waterways and Canals</th></tr>
<tr><td colspan="2">2059 (W)</td><td>53,000</td></tr>
<tr><td colspan="2">2060 (D)</td><td>25,000</td></tr>
<tr><td colspan="2">2061 (C)</td><td>40,000</td></tr>
<tr><td colspan="2">2062 (D)</td><td>42,000</td></tr>
<tr><td colspan="2">2063 (BN)</td><td>61,000</td></tr>
<tr><td colspan="2">2064 (W)</td><td>62,000</td></tr>
<tr><td colspan="2">2065 (BN)</td><td>38,000</td></tr>
<tr><td colspan="2">2066 (D)</td><td>39,000</td></tr>
<tr><td colspan="2">2067 (C)</td><td>30,000</td></tr>
<tr><td colspan="2">2068 (C)</td><td>43,000</td></tr>
<tr><td colspan="2">2069 (BN)</td><td>58,000</td></tr>
<tr><td colspan="2">2070 (W)</td><td>67,000</td></tr>
<tr><td colspan="2">2071 (BN)</td><td>31,000</td></tr>
<tr><td colspan="2">2072 (W)</td><td>62,000</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>46,000</td></tr>
<tr><td rowspan="5">2022 - 2072</td><td>W</td><td>53,000</td></tr>
<tr><td>AN</td><td>57,000</td></tr>
<tr><td>BN</td><td>42,000</td></tr>
<tr><td>D</td><td>38,000</td></tr>
<tr><td>C</td><td>35,000</td></tr>
</table>

Note: negative values indicate net groundwater discharge to surface water

2.2.4 Groundwater Extraction

Groundwater extractions are exchanges that occur between the GWS and the SWS. Groundwater extraction from the GWS occurs through groundwater pumping to meet water demands for urban and agricultural needs and also through groundwater (root water) uptake by plants directly from shallow groundwater during times and at locations of sufficiently shallow groundwater conditions. Projected (current land use) groundwater extractions are summarized in **Figure 41** and **Table 40** and also presented and discussed in the SWS water budget sections.

Total groundwater extractions over the projected (current land use) water budget period average about -9.1 taf per year. Overall, groundwater pumping represents a larger fraction of the groundwater extractions than groundwater uptake. Groundwater pumping averages about -6.2 taf over the projected (current land use) period and groundwater uptake averages about -2.9 taf. In wetter periods, groundwater uptake increases and groundwater pumping decreases. Accordingly, during drier periods groundwater pumping increases and water uptake by plants from shallow groundwater decreases in response to the higher water demands for irrigation and other uses and the greater depths to groundwater that also tend to occur during dry periods.

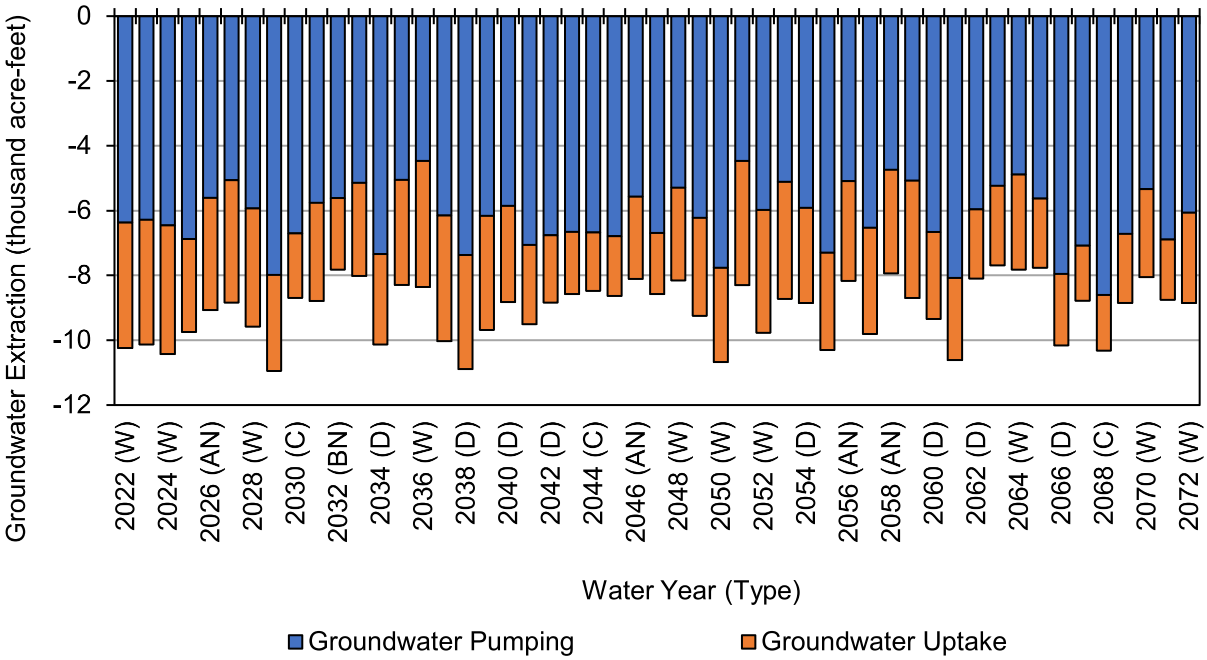


Figure 41. Bowman Subbasin Projected (Current Land Use) Groundwater Extractions

Table 40. Bowman Subbasin Projected (Current Land Use) Groundwater Extractions (acre-feet)

Water Year (Type)	Groundwater Pumping	Groundwater (Root Water) Uptake	Total Extractions
2022 (W)	-6,400	-3,900	-10,000
2023 (W)	-6,300	-3,800	-10,000
2024 (W)	-6,500	-4,000	-10,000
2025 (BN)	-6,900	-2,900	-9,700
2026 (AN)	-5,600	-3,500	-9,100
2027 (W)	-5,100	-3,800	-8,800
2028 (W)	-5,900	-3,700	-9,600
2029 (C)	-8,000	-3,000	-11,000
2030 (C)	-6,700	-2,000	-8,700
2031 (AN)	-5,800	-3,000	-8,800
2032 (BN)	-5,600	-2,200	-7,800
2033 (AN)	-5,100	-2,900	-8,000
2034 (D)	-7,300	-2,800	-10,000
2035 (W)	-5,100	-3,200	-8,300
2036 (W)	-4,500	-3,900	-8,400
2037 (W)	-6,200	-3,900	-10,000
2038 (D)	-7,400	-3,500	-11,000
2039 (W)	-6,200	-3,500	-9,700
2040 (D)	-5,800	-3,000	-8,800
2041 (C)	-7,100	-2,500	-9,500
2042 (D)	-6,800	-2,100	-8,800
2043 (C)	-6,700	-1,900	-8,600
2044 (C)	-6,700	-1,800	-8,500
2045 (C)	-6,800	-1,800	-8,600
2046 (AN)	-5,600	-2,500	-8,100
2047 (C)	-6,700	-1,900	-8,600
2048 (W)	-5,300	-2,900	-8,200
2049 (W)	-6,200	-3,000	-9,200
2050 (W)	-7,800	-2,900	-11,000
2051 (W)	-4,500	-3,800	-8,300
2052 (W)	-6,000	-3,800	-9,800
2053 (AN)	-5,100	-3,600	-8,700
2054 (D)	-5,900	-2,900	-8,900
2055 (D)	-7,300	-3,000	-10,000
2056 (AN)	-5,100	-3,100	-8,200
2057 (BN)	-6,500	-3,300	-9,800

Water Year (Type)		Groundwater Pumping	Groundwater (Root Water) Uptake	Total Extractions
2058 (AN)		-4,700	-3,200	-7,900
2059 (W)		-5,100	-3,600	-8,700
2060 (D)		-6,700	-2,700	-9,300
2061 (C)		-8,100	-2,500	-11,000
2062 (D)		-6,000	-2,100	-8,100
2063 (BN)		-5,200	-2,500	-7,700
2064 (W)		-4,900	-2,900	-7,800
2065 (BN)		-5,600	-2,100	-7,800
2066 (D)		-7,900	-2,200	-10,000
2067 (C)		-7,100	-1,700	-8,800
2068 (C)		-8,600	-1,700	-10,000
2069 (BN)		-6,700	-2,100	-8,900
2070 (W)		-5,300	-2,700	-8,100
2071 (BN)		-6,900	-1,900	-8,700
2072 (W)		-6,100	-2,800	-8,900
Average (2022-2072)		-6,200	-2,900	-9,100
2022 - 2072	W	-5,700	-3,500	-9,200
	AN	-5,300	-3,100	-8,400
	BN	-6,200	-2,400	-8,600
	D	-6,800	-2,700	-9,500
	C	-7,200	-2,100	-9,300

2.2.5 Vertical Subsurface Flows within the Groundwater System

Vertical subsurface flows within the GWS occur between the Upper and Lower Aquifers and represent an internal flow of water within the GWS. These exchanges between the principal aquifers do not directly affect the total volume of groundwater in storage, but do highlight the net vertical movement of water within the GWS. Projected (current land use) vertical flows between the Upper Aquifer and Lower Aquifer are summarized in **Figure 42** and **Table 41** and show consistent net overall downward flow from the Upper Aquifer to the Lower Aquifer. On average, vertical flows from the Upper Aquifer to the Lower Aquifer total about 87 taf per year over the historical water budget period. There is considerable year-to-year variability in the magnitude of these flows, which appear to correlate with water year conditions, although they are always in the downward direction. The magnitude of downward flows are generally greatest during wet years and decrease during dry periods.

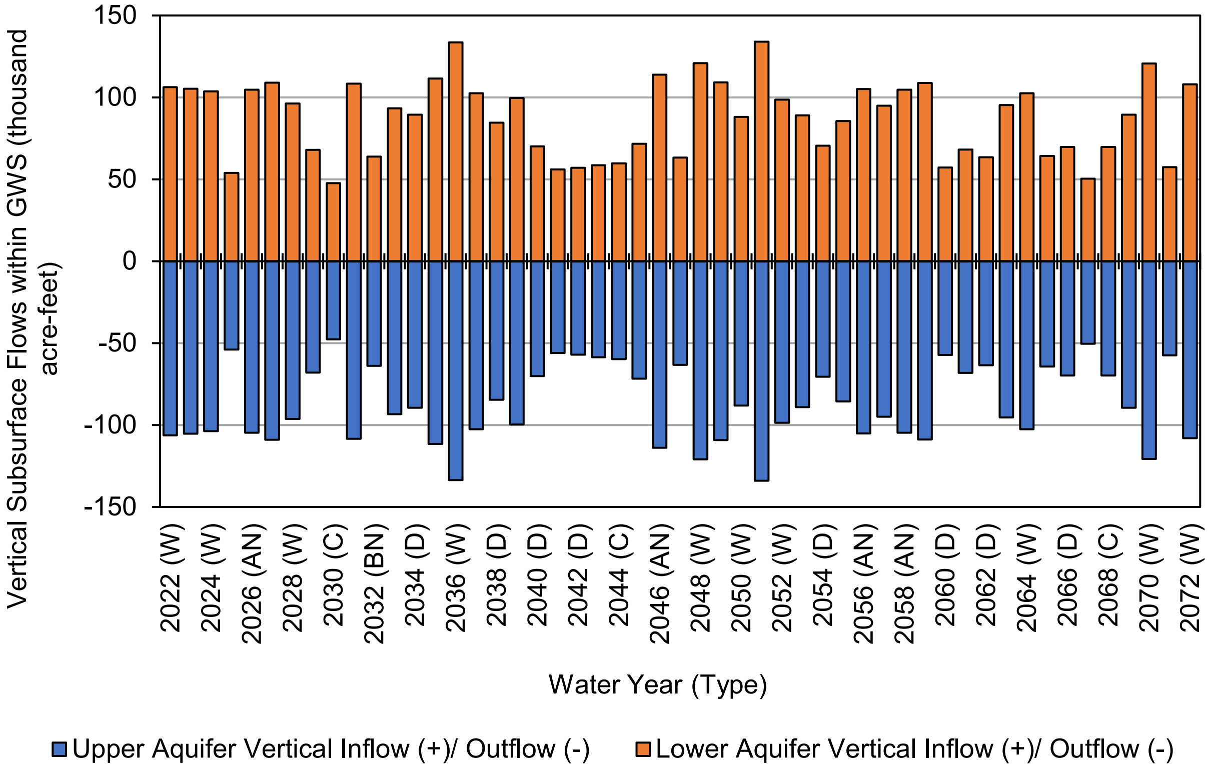


Figure 42. Bowman Subbasin Projected (Current Land Use) Vertical Subsurface Flow within the GWS

Table 41. Bowman Subbasin Projected (Current Land Use) Vertical Subsurface Flows within the GWS (acre-feet)

Water Year (Type)	Upper Aquifer to (-) / from (+) Lower Aquifer
2022 (W)	-110,000
2023 (W)	-110,000
2024 (W)	-100,000
2025 (BN)	-54,000
2026 (AN)	-100,000
2027 (W)	-110,000
2028 (W)	-96,000
2029 (C)	-68,000
2030 (C)	-48,000
2031 (AN)	-110,000
2032 (BN)	-64,000
2033 (AN)	-93,000
2034 (D)	-90,000
2035 (W)	-110,000
2036 (W)	-130,000
2037 (W)	-100,000
2038 (D)	-85,000
2039 (W)	-100,000
2040 (D)	-70,000
2041 (C)	-56,000
2042 (D)	-57,000
2043 (C)	-59,000
2044 (C)	-60,000
2045 (C)	-72,000
2046 (AN)	-110,000
2047 (C)	-63,000
2048 (W)	-120,000
2049 (W)	-110,000
2050 (W)	-88,000
2051 (W)	-130,000
2052 (W)	-99,000
2053 (AN)	-89,000
2054 (D)	-70,000
2055 (D)	-85,000
2056 (AN)	-110,000
2057 (BN)	-95,000
2058 (AN)	-100,000

Water Year (Type)		Upper Aquifer to (-) / from (+) Lower Aquifer
2059 (W)		-110,000
2060 (D)		-57,000
2061 (C)		-68,000
2062 (D)		-63,000
2063 (BN)		-95,000
2064 (W)		-100,000
2065 (BN)		-64,000
2066 (D)		-70,000
2067 (C)		-50,000
2068 (C)		-70,000
2069 (BN)		-89,000
2070 (W)		-120,000
2071 (BN)		-57,000
2072 (W)		-110,000
Average (2022-2072)		-87,000
2022 - 2072	W	-110,000
	AN	-100,000
	BN	-74,000
	D	-72,000
	C	-61,000

2.2.6 Change in Groundwater Storage

Projected (current land use) change in groundwater storage values for the Bowman Subbasin are summarized in **Figure 43** and **Figure 44**, and **Table 42**. Over the projected (current land use) period, the average total annual change in groundwater storage is about -0.2 taf per year, representing a very small decrease in groundwater storage. The corresponding cumulative total change in storage over the projected (current land use) period is about -11 taf. The annual change in storage numbers generally reflect the effects of the water year type with increase in storage occurring during wetter years and decreases in storage occurring during dry years.

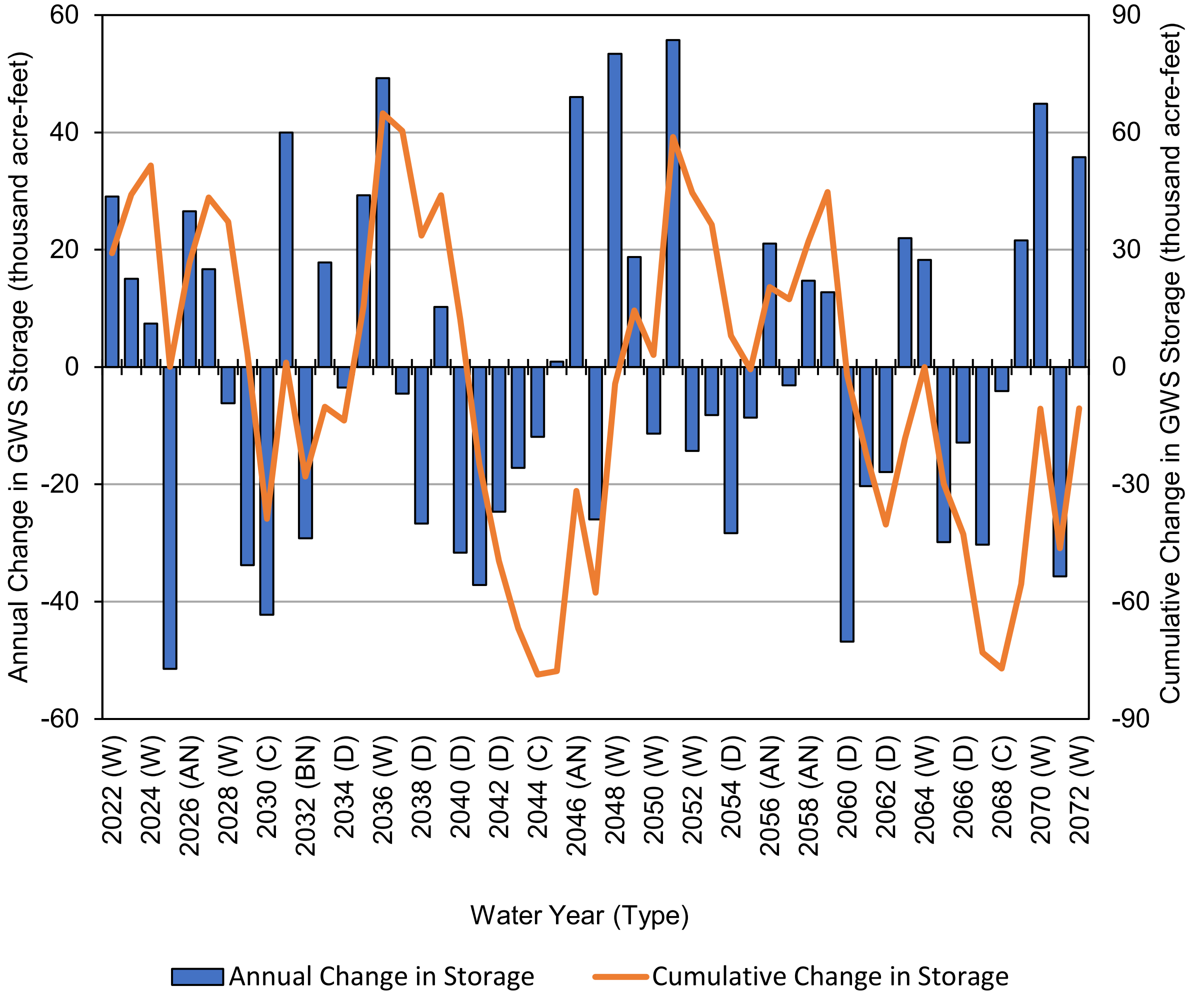


Figure 43. Bowman Subbasin Projected (Current Land Use) Projected (Current Land Use) Total Change in Storage within the GWS

Table 42. Bowman Subbasin Projected (Current Land Use) Change in Groundwater Storage (acre-feet)

Water Year (Type)	Upper Aquifer	Lower Aquifer	Total Annual Change	Total Cumulative Change
2022 (BN)	6,000	23,000	29,000	29,000
2023 (W)	2,000	13,000	15,000	44,000
2024 (W)	-120	7,500	7,400	52,000
2025 (W)	-21,000	-30,000	-51,000	100
2026 (BN)	10,000	16,000	27,000	27,000
2027 (AN)	4,400	12,000	17,000	43,000
2028 (W)	-4,400	-1,800	-6,200	37,000
2029 (W)	-13,000	-20,000	-34,000	3,400
2030 (C)	-14,000	-28,000	-42,000	-39,000
2031 (C)	17,000	23,000	40,000	1,100
2032 (AN)	-12,000	-17,000	-29,000	-28,000
2033 (BN)	8,600	9,200	18,000	-10,000
2034 (AN)	-3,500	3	-3,500	-14,000
2035 (D)	11,000	19,000	29,000	16,000
2036 (W)	18,000	31,000	49,000	65,000
2037 (W)	-3,200	-1,300	-4,500	60,000
2038 (W)	-12,000	-15,000	-27,000	34,000
2039 (D)	6,800	3,500	10,000	44,000
2040 (W)	-11,000	-20,000	-32,000	12,000
2041 (D)	-13,000	-24,000	-37,000	-25,000
2042 (C)	-6,800	-18,000	-25,000	-50,000
2043 (D)	-5,000	-12,000	-17,000	-67,000
2044 (C)	-2,800	-9,100	-12,000	-79,000
2045 (C)	420	490	910	-78,000
2046 (C)	16,000	30,000	46,000	-32,000
2047 (AN)	-10,000	-16,000	-26,000	-58,000
2048 (C)	20,000	33,000	53,000	-4,300
2049 (W)	5,200	14,000	19,000	15,000
2050 (W)	-6,200	-5,200	-11,000	3,100
2051 (W)	21,000	34,000	56,000	59,000
2052 (W)	-9,300	-5,000	-14,000	45,000
2053 (W)	-1,100	-7,100	-8,200	36,000
2054 (AN)	-9,700	-19,000	-28,000	8,000
2055 (D)	-4,000	-4,600	-8,600	-630
2056 (D)	8,500	13,000	21,000	20,000
2057 (AN)	-2,600	-550	-3,100	17,000

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Upper Aquifer</th><th>Lower Aquifer</th><th>Total Annual Change</th><th>Total Cumulative Change</th></tr>
<tr><td colspan="2">2058 (BN)</td><td>5,800</td><td>8,900</td><td>15,000</td><td>32,000</td></tr>
<tr><td colspan="2">2059 (AN)</td><td>3,800</td><td>9,000</td><td>13,000</td><td>45,000</td></tr>
<tr><td colspan="2">2060 (W)</td><td>-17,000</td><td>-30,000</td><td>-47,000</td><td>-2,000</td></tr>
<tr><td colspan="2">2061 (D)</td><td>-7,300</td><td>-13,000</td><td>-20,000</td><td>-22,000</td></tr>
<tr><td colspan="2">2062 (C)</td><td>-5,100</td><td>-13,000</td><td>-18,000</td><td>-40,000</td></tr>
<tr><td colspan="2">2063 (D)</td><td>9,500</td><td>12,000</td><td>22,000</td><td>-18,000</td></tr>
<tr><td colspan="2">2064 (BN)</td><td>5,900</td><td>12,000</td><td>18,000</td><td>-19</td></tr>
<tr><td colspan="2">2065 (W)</td><td>-12,000</td><td>-18,000</td><td>-30,000</td><td>-30,000</td></tr>
<tr><td colspan="2">2066 (BN)</td><td>-3,200</td><td>-9,700</td><td>-13,000</td><td>-43,000</td></tr>
<tr><td colspan="2">2067 (D)</td><td>-11,000</td><td>-19,000</td><td>-30,000</td><td>-73,000</td></tr>
<tr><td colspan="2">2068 (C)</td><td>-1,300</td><td>-2,800</td><td>-4,100</td><td>-77,000</td></tr>
<tr><td colspan="2">2069 (C)</td><td>9,500</td><td>12,000</td><td>22,000</td><td>-56,000</td></tr>
<tr><td colspan="2">2070 (BN)</td><td>15,000</td><td>30,000</td><td>45,000</td><td>-11,000</td></tr>
<tr><td colspan="2">2071 (W)</td><td>-13,000</td><td>-23,000</td><td>-36,000</td><td>-46,000</td></tr>
<tr><td colspan="2">2072 (W)</td><td>14,000</td><td>22,000</td><td>36,000</td><td>-11,000</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>-320</td><td>110</td><td>-210</td><td></td></tr>
<tr><td rowspan="5">2022-2072</td><td>W</td><td>6,100</td><td>14,000</td><td>20,000</td><td></td></tr>
<tr><td>AN</td><td>9,400</td><td>13,000</td><td>23,000</td><td></td></tr>
<tr><td>BN</td><td>-6,000</td><td>-9,100</td><td>-15,000</td><td></td></tr>
<tr><td>D</td><td>-8,100</td><td>-14,000</td><td>-22,000</td><td></td></tr>
<tr><td>C</td><td>-7,800</td><td>-14,000</td><td>-22,000</td><td></td></tr>
</table>

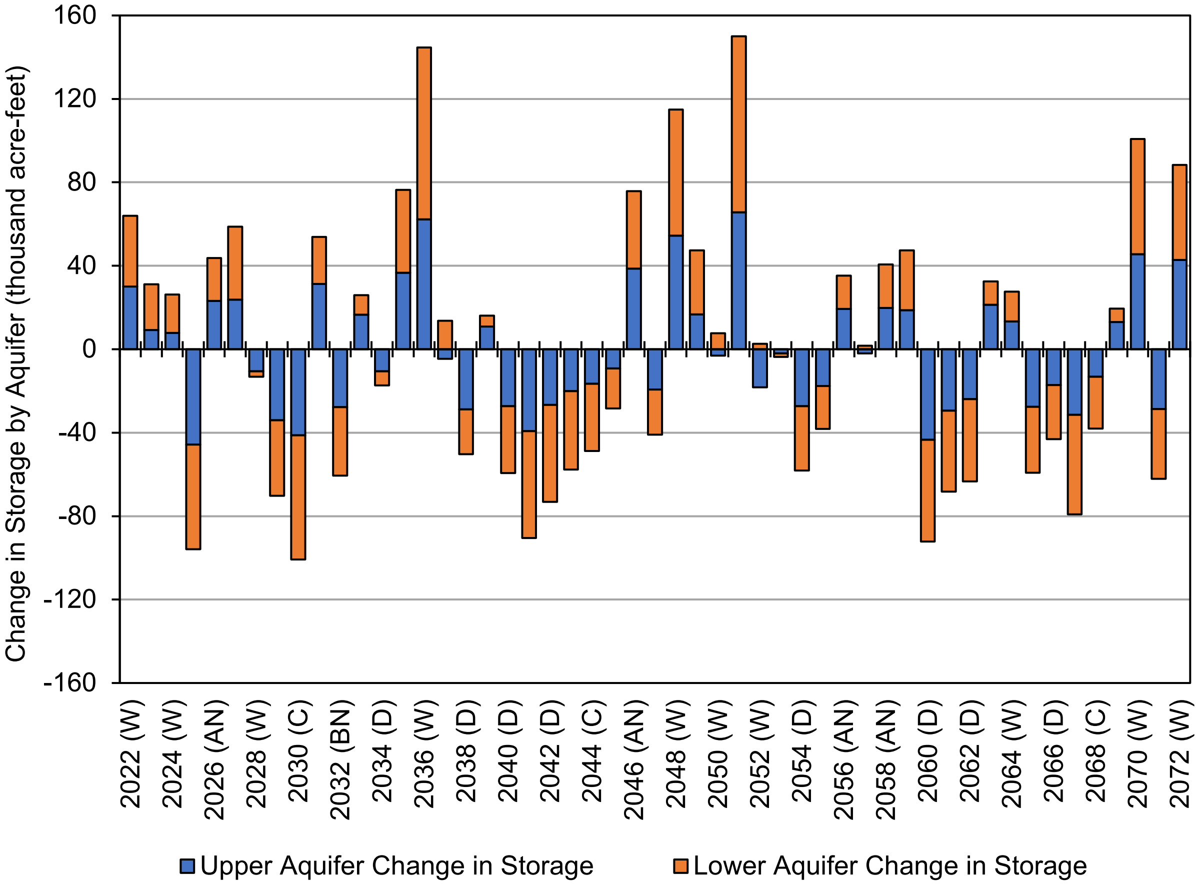


Figure 44. Bowman Subbasin Projected (Current Land Use) Change in Groundwater Storage by Aquifer

3 DETAILED PROJECTED (FUTURE LAND USE) WATER BUDGET

This section presents the results of the Projected (Future Land Use) scenario. The Future Land Use scenario assumes constant land use conditions based on assumed projected development within the Bowman Subbasin.

3.3 Surface Water System Water Budget Results

3.3.1 Inflows

3.3.1.1 Surface Water Inflow by Water Source Type

The projected annual volume of surface water inflows is summarized by water source type in **Figure 45** and **Table 43**. Over the projected (future land use) period, surface water inflows average about 83 taf per year. On average, inflows of local supplies and CVP supplies average about 65 and 18 taf per year, respectively.

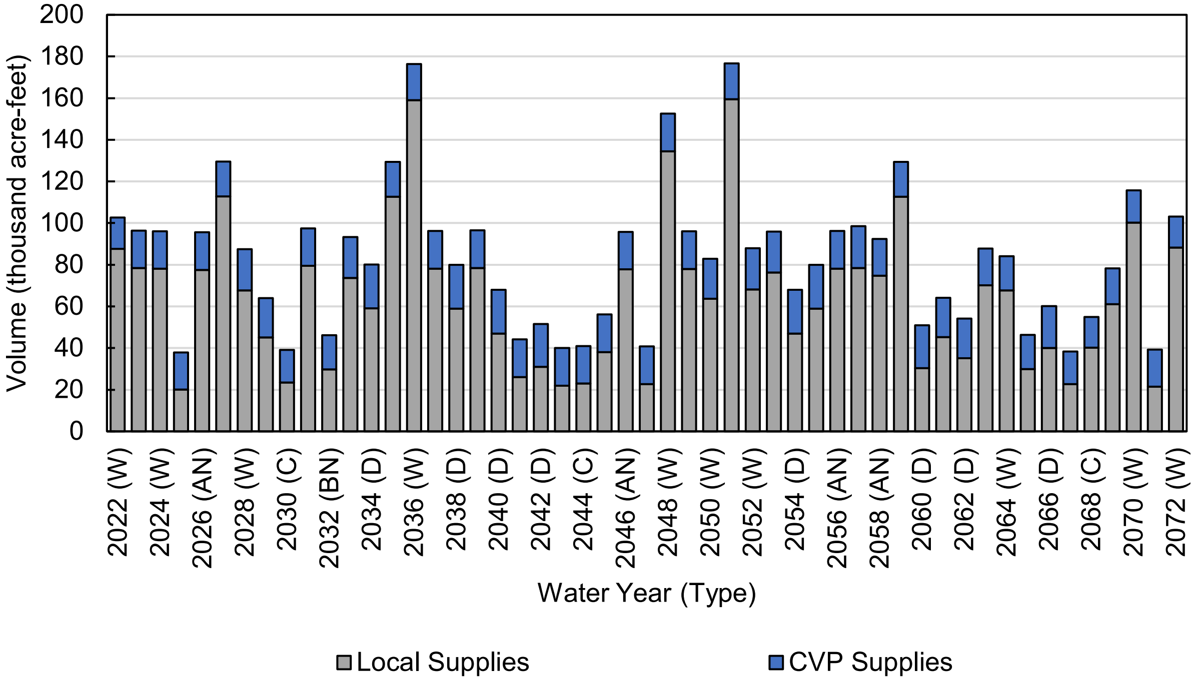


Figure 45. Bowman Subbasin Projected (Future Land Use) Surface Water Inflows, by Water Source Type

Table 43. Bowman Subbasin Projected (Future Land Use) Surface Water Inflows, by Water Source Type (acre-feet)

Water Year (Type)	CVP Supplies	Local Supplies	Total
2022 (W)	15,000	88,000	100,000
2023 (W)	18,000	78,000	96,000
2024 (W)	18,000	78,000	96,000
2025 (BN)	18,000	20,000	38,000
2026 (AN)	18,000	78,000	96,000
2027 (W)	17,000	110,000	130,000
2028 (W)	20,000	68,000	87,000
2029 (C)	19,000	45,000	64,000
2030 (C)	16,000	23,000	39,000
2031 (AN)	18,000	79,000	98,000
2032 (BN)	16,000	30,000	46,000
2033 (AN)	20,000	74,000	93,000
2034 (D)	21,000	59,000	80,000
2035 (W)	17,000	110,000	130,000
2036 (W)	17,000	160,000	180,000
2037 (W)	18,000	78,000	96,000
2038 (D)	21,000	59,000	80,000
2039 (W)	18,000	78,000	97,000
2040 (D)	21,000	47,000	68,000
2041 (C)	18,000	26,000	44,000
2042 (D)	21,000	31,000	52,000
2043 (C)	18,000	22,000	40,000
2044 (C)	18,000	23,000	41,000
2045 (C)	18,000	38,000	56,000
2046 (AN)	18,000	78,000	96,000
2047 (C)	18,000	23,000	41,000
2048 (W)	18,000	130,000	150,000
2049 (W)	18,000	78,000	96,000
2050 (W)	19,000	64,000	83,000
2051 (W)	17,000	160,000	180,000
2052 (W)	20,000	68,000	88,000
2053 (AN)	20,000	76,000	96,000
2054 (D)	21,000	47,000	68,000
2055 (D)	21,000	59,000	80,000

Water Year (Type)		CVP Supplies	Local Supplies	Total
2056 (AN)		18,000	78,000	96,000
2057 (BN)		20,000	78,000	98,000
2058 (AN)		18,000	75,000	92,000
2059 (W)		17,000	110,000	130,000
2060 (D)		21,000	30,000	51,000
2061 (C)		19,000	45,000	64,000
2062 (D)		19,000	35,000	54,000
2063 (BN)		18,000	70,000	88,000
2064 (W)		16,000	68,000	84,000
2065 (BN)		16,000	30,000	46,000
2066 (D)		20,000	40,000	60,000
2067 (C)		16,000	23,000	38,000
2068 (C)		15,000	40,000	55,000
2069 (BN)		17,000	61,000	78,000
2070 (W)		16,000	100,000	120,000
2071 (BN)		18,000	21,000	39,000
2072 (W)		15,000	88,000	100,000
Average (2022-2072)		18,000	65,000	83,000
2022-2072	W	17,000	96,000	110,000
	AN	18,000	77,000	95,000
	BN	18,000	44,000	62,000
	D	21,000	45,000	66,000
	C	17,000	31,000	48,000

3.3.1.2 Precipitation

Precipitation estimates for the Bowman Subbasin are provided in **Figure 46** and **Table 44**. Total precipitation is highly variable between projected years, ranging from approximately 210 taf (20.5 inches) during average critically dry years to 390 taf (38.1 inches) during average wet years.

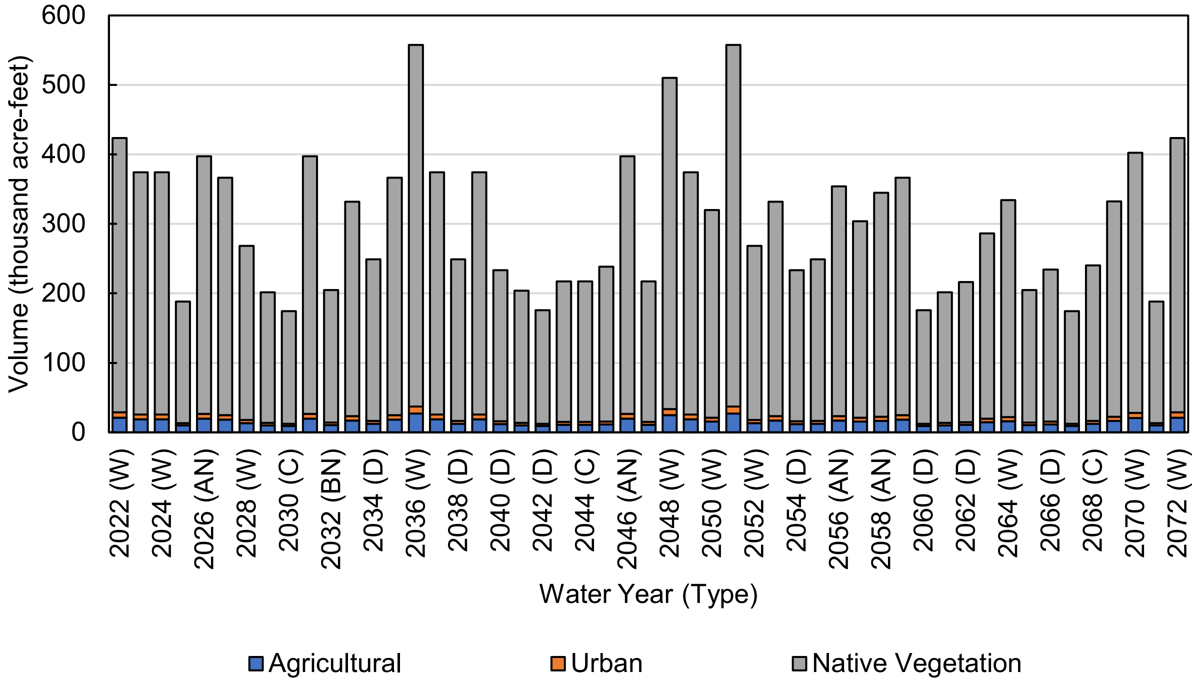


Figure 46. Bowman Subbasin Projected (Future Land Use) Precipitation, by Water Use Sector

Table 44. Bowman Subbasin Projected (Future Land Use) Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	21,000	7,600	390,000	420,000
2023 (W)	19,000	6,800	350,000	370,000
2024 (W)	19,000	6,800	350,000	370,000
2025 (W)	9,800	3,500	170,000	190,000
2026 (BN)	20,000	7,100	370,000	400,000
2027 (AN)	18,000	6,500	340,000	370,000
2028 (W)	13,000	4,800	250,000	270,000
2029 (W)	10,000	3,600	190,000	200,000
2030 (C)	9,200	3,300	160,000	170,000
2031 (C)	20,000	7,100	370,000	400,000
2032 (AN)	10,000	3,700	190,000	200,000
2033 (BN)	17,000	6,100	310,000	330,000
2034 (AN)	12,000	4,400	230,000	250,000
2035 (D)	18,000	6,500	340,000	370,000
2036 (W)	27,000	9,900	520,000	560,000
2037 (W)	19,000	6,800	350,000	370,000
2038 (W)	12,000	4,400	230,000	250,000
2039 (D)	19,000	6,800	350,000	370,000
2040 (W)	12,000	4,200	220,000	230,000
2041 (D)	10,000	3,700	190,000	200,000
2042 (C)	9,100	3,200	160,000	180,000
2043 (D)	11,000	4,000	200,000	220,000
2044 (C)	11,000	4,000	200,000	220,000
2045 (C)	11,000	4,200	220,000	240,000
2046 (C)	20,000	7,100	370,000	400,000
2047 (AN)	11,000	4,000	200,000	220,000
2048 (C)	25,000	9,000	480,000	510,000
2049 (W)	19,000	6,800	350,000	370,000
2050 (W)	15,000	5,700	300,000	320,000
2051 (W)	27,000	9,900	520,000	560,000
2052 (W)	13,000	4,800	250,000	270,000
2053 (W)	17,000	6,100	310,000	330,000
2054 (AN)	12,000	4,200	220,000	230,000
2055 (D)	12,000	4,400	230,000	250,000
2056 (D)	17,000	6,200	330,000	350,000

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2057 (AN)	16,000	5,500	280,000	300,000
2058 (BN)	17,000	6,000	320,000	340,000
2059 (AN)	18,000	6,500	340,000	370,000
2060 (W)	9,100	3,200	160,000	180,000
2061 (D)	10,000	3,600	190,000	200,000
2062 (C)	11,000	3,800	200,000	220,000
2063 (D)	15,000	5,100	270,000	290,000
2064 (BN)	16,000	5,800	310,000	330,000
2065 (W)	10,000	3,700	190,000	200,000
2066 (BN)	11,000	4,200	220,000	230,000
2067 (D)	9,200	3,300	160,000	170,000
2068 (C)	12,000	4,400	220,000	240,000
2069 (C)	16,000	5,900	310,000	330,000
2070 (BN)	21,000	7,400	370,000	400,000
2071 (W)	9,800	3,500	170,000	190,000
2072 (W)	21,000	7,600	390,000	420,000
Average (2022-2072)	15,000	5,400	280,000	300,000
2022-2072 W	19,000	7,000	360,000	390,000
AN	18,000	6,500	340,000	370,000
BN	12,000	4,400	230,000	240,000
D	11,000	4,000	210,000	220,000
C	11,000	3,800	190,000	210,000

3.3.1.3 Groundwater Extraction by Water Use Sector

Total groundwater extraction in the Bowman Subbasin represents a combination of groundwater pumping to support agricultural and urban water demands, including rural residential use, and groundwater uptake by crops, urban vegetation, and native vegetation.

Estimates of groundwater pumping by water use sector are provided in **Figure 47** and **Table 45**. Majority of groundwater pumping in the Bowman Subbasin is used to meet agricultural demand, averaging 5.0 taf per year. Groundwater pumping for urban use is approximately 1.4 taf per year. The total groundwater extraction varies from about 5.5 taf in above-normal years to 7.5 taf in critically dry years based on variability in surface water supplies, precipitation, and crop water demand.

When groundwater is near the land surface, groundwater uptake can also be a source of supply for vegetation. Estimates of groundwater uptake by vegetation are provided in **Figure 48** and **Table 46**. The majority of groundwater uptake is consumed directly by native vegetation and agricultural crops, totaling 2.5 taf and 0.3 taf per year, on average.

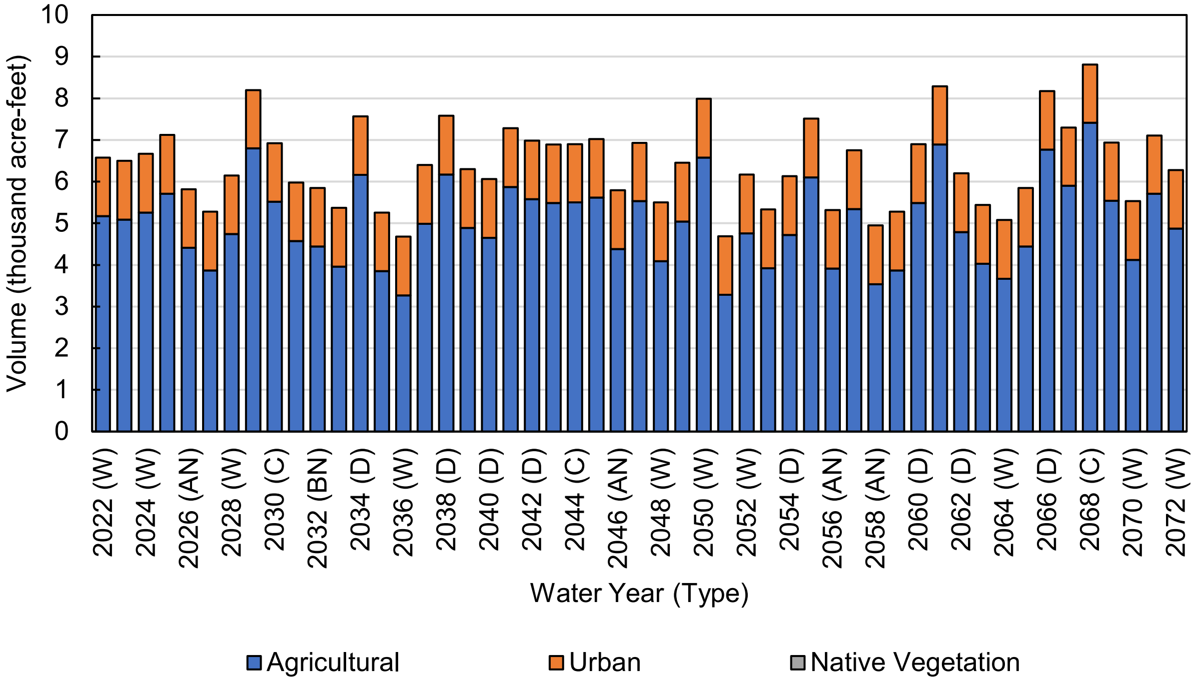


Figure 47. Bowman Subbasin Projected (Future Land Use) Groundwater Pumping, by Water Use Sector

Table 45. Bowman Subbasin Projected (Future Land Use) Groundwater Pumping, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	5,200	1,400	0	6,600
2023 (W)	5,100	1,400	0	6,500
2024 (W)	5,300	1,400	0	6,700
2025 (W)	5,700	1,400	0	7,100
2026 (BN)	4,400	1,400	0	5,800
2027 (AN)	3,900	1,400	0	5,300
2028 (W)	4,700	1,400	0	6,200
2029 (W)	6,800	1,400	0	8,200
2030 (C)	5,500	1,400	0	6,900
2031 (C)	4,600	1,400	0	6,000
2032 (AN)	4,400	1,400	0	5,900
2033 (BN)	4,000	1,400	0	5,400
2034 (AN)	6,200	1,400	0	7,600
2035 (D)	3,900	1,400	0	5,300
2036 (W)	3,300	1,400	0	4,700
2037 (W)	5,000	1,400	0	6,400
2038 (W)	6,200	1,400	0	7,600
2039 (D)	4,900	1,400	0	6,300
2040 (W)	4,700	1,400	0	6,100
2041 (D)	5,900	1,400	0	7,300
2042 (C)	5,600	1,400	0	7,000
2043 (D)	5,500	1,400	0	6,900
2044 (C)	5,500	1,400	0	6,900
2045 (C)	5,600	1,400	0	7,000
2046 (C)	4,400	1,400	0	5,800
2047 (AN)	5,500	1,400	0	6,900
2048 (C)	4,100	1,400	0	5,500
2049 (W)	5,000	1,400	0	6,500
2050 (W)	6,600	1,400	0	8,000
2051 (W)	3,300	1,400	0	4,700
2052 (W)	4,800	1,400	0	6,200
2053 (W)	3,900	1,400	0	5,300
2054 (AN)	4,700	1,400	0	6,100
2055 (D)	6,100	1,400	0	7,500
2056 (D)	3,900	1,400	0	5,300

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (AN)		5,300	1,400	0	6,800
2058 (BN)		3,500	1,400	0	5,000
2059 (AN)		3,900	1,400	0	5,300
2060 (W)		5,500	1,400	0	6,900
2061 (D)		6,900	1,400	0	8,300
2062 (C)		4,800	1,400	0	6,200
2063 (D)		4,000	1,400	0	5,400
2064 (BN)		3,700	1,400	0	5,100
2065 (W)		4,400	1,400	0	5,900
2066 (BN)		6,800	1,400	0	8,200
2067 (D)		5,900	1,400	0	7,300
2068 (C)		7,400	1,400	0	8,800
2069 (C)		5,500	1,400	0	6,900
2070 (BN)		4,100	1,400	0	5,500
2071 (W)		5,700	1,400	0	7,100
2072 (W)		4,900	1,400	0	6,300
Average (2022-2072)		5,000	1,400	0	6,400
2022-2072	W	4,500	1,400	0	5,900
	AN	4,100	1,400	0	5,500
	BN	5,000	1,400	0	6,400
	D	5,600	1,400	0	7,000
	C	6,100	1,400	0	7,500

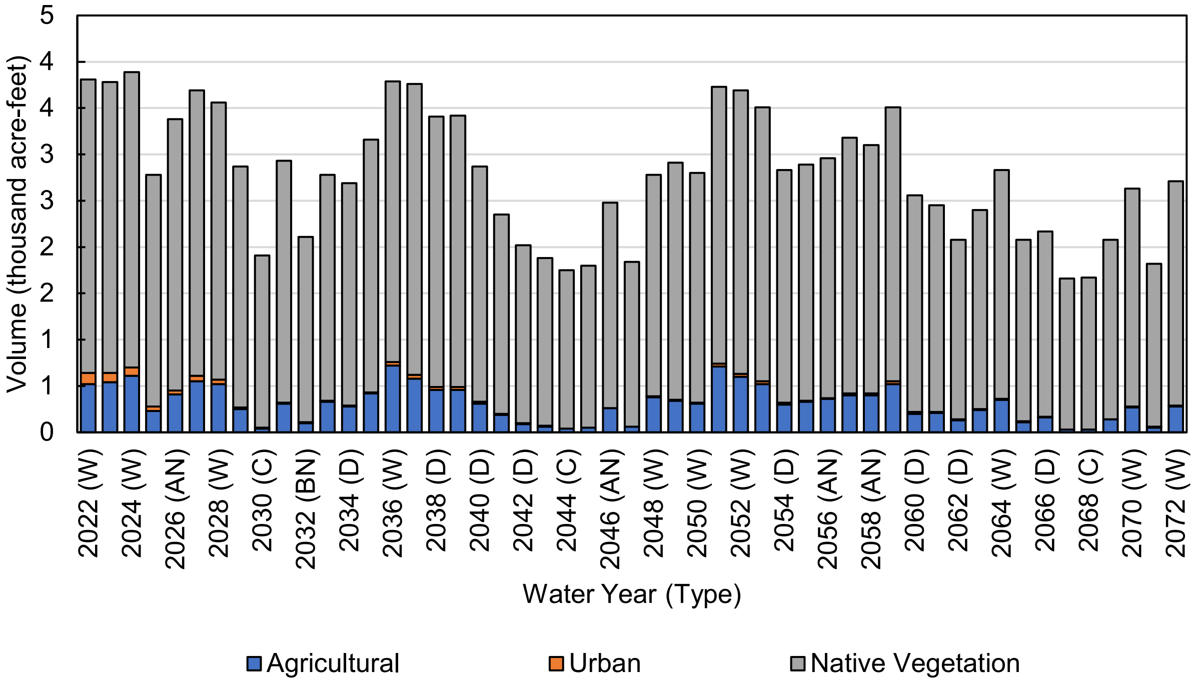


Figure 48. Bowman Subbasin Projected (Future Land Use) Groundwater Uptake, by Water Use Sector

Table 46. Bowman Subbasin Projected (Future Land Use) Groundwater Uptake, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	520	120	3,200	3,800
2023 (W)	540	100	3,100	3,800
2024 (W)	610	90	3,200	3,900
2025 (W)	230	50	2,500	2,800
2026 (BN)	410	40	2,900	3,400
2027 (AN)	550	60	3,100	3,700
2028 (W)	520	50	3,000	3,600
2029 (W)	250	20	2,600	2,900
2030 (C)	40	10	1,900	1,900
2031 (C)	310	10	2,600	2,900
2032 (AN)	100	10	2,000	2,100
2033 (BN)	330	10	2,400	2,800
2034 (AN)	280	10	2,400	2,700
2035 (D)	420	10	2,700	3,200
2036 (W)	720	40	3,000	3,800
2037 (W)	580	40	3,100	3,800
2038 (W)	460	30	2,900	3,400
2039 (D)	460	30	2,900	3,400
2040 (W)	310	20	2,500	2,900
2041 (D)	190	10	2,200	2,400
2042 (C)	90	10	1,900	2,000
2043 (D)	60	10	1,800	1,900
2044 (C)	40	0	1,700	1,800
2045 (C)	50	0	1,800	1,800
2046 (C)	260	0	2,200	2,500
2047 (AN)	60	0	1,800	1,800
2048 (C)	380	10	2,400	2,800
2049 (W)	340	10	2,600	2,900
2050 (W)	310	10	2,500	2,800
2051 (W)	710	30	3,000	3,700
2052 (W)	600	30	3,100	3,700
2053 (W)	520	30	3,000	3,500
2054 (AN)	300	20	2,500	2,800

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2055 (D)		330	10	2,600	2,900
2056 (D)		360	10	2,600	3,000
2057 (AN)		400	20	2,800	3,200
2058 (BN)		400	20	2,700	3,100
2059 (AN)		520	30	3,000	3,500
2060 (W)		200	20	2,300	2,600
2061 (D)		210	10	2,200	2,500
2062 (C)		130	10	1,900	2,100
2063 (D)		240	10	2,200	2,400
2064 (BN)		350	10	2,500	2,800
2065 (W)		110	10	2,000	2,100
2066 (BN)		160	10	2,000	2,200
2067 (D)		30	0	1,600	1,700
2068 (C)		30	0	1,600	1,700
2069 (C)		140	0	1,900	2,100
2070 (BN)		270	10	2,400	2,600
2071 (W)		50	10	1,800	1,800
2072 (W)		280	10	2,400	2,700
Average (2022-2072)		310	20	2,500	2,800
2022-2072	W	480	40	2,800	3,400
	AN	370	20	2,600	3,000
	BN	180	20	2,200	2,400
	D	250	20	2,400	2,600
	C	100	10	1,900	2,000

3.3.1.4 Groundwater Discharge to Surface Waterways

Groundwater discharge to surface water, as described herein, represents a gain, or increase of flow, in waterways that traverse or flow along the boundary of the Bowman Subbasin. Groundwater discharge in the Bowman Subbasin is calculated from the Tehama IHM as the net groundwater outflow to water reaches (i.e., groundwater discharge) in excess of groundwater inflows from waterway reaches (i.e., seepage). The total volume of estimated groundwater discharge to surface water is negligible in any given year, therefore set to zero throughout the projected (current land use) water budget period.

3.3.2 Outflows

3.3.2.1 Evapotranspiration by Water Use Sector

Evapotranspiration (ET) by water use sector is reported in **Figure 49** through **Figure 52,** and **Table 47** through **Table 50**. First, total ET is reported, followed by ET from applied water (ET of water actively applied from surface water deliveries or groundwater pumping), ET of groundwater uptake (ET of shallow water extracted directly by vegetation), and ET from precipitation (ET of water supplied through rainfall).

Total ET varies between years, with a projected average of 170 taf per year. Agricultural ET tends to increase slightly in drier years due to increased climatic demand, while the ET of native vegetation typically decreases due to reduced water supply. ET of applied water occurs primarily from agricultural land, averaging about 10 taf in above-normal and wet years and about 12 taf in years classified as below normal, dry, or critical. Native vegetation and agricultural crops in the Bowman Subbasin also directly consume shallow groundwater to meet a portion of their consumptive use requirements. ET of groundwater uptake by native vegetation and agricultural crops and totals 2.5 and 0.3 taf per year, on average. Urban ET of applied water is consistently very low and negligible.

ET of precipitation generally follows the pattern of precipitation, with higher volumes occurring in wet years when more precipitation occurs. Across all water use sectors, ET of precipitation in the Bowman Subbasin averages about 170 taf in wet and above-normal years and 150 taf in dry and critical water years. Much of the total ET of precipitation results from the large acreage of native vegetation in the Bowman Subbasin, though significant volumes result from agricultural areas as well.

Evaporation from rivers, streams, and canals in the Bowman Subbasin is reported in **Figure 53**Figure 31 and **Table 51**. The total volume is relatively small and constant between years, averaging slightly less than 1.0 taf per year. Evaporation from upgradient small watersheds is minimal, and is also not considered to substantially contribute to the subbasin SWS water budget.

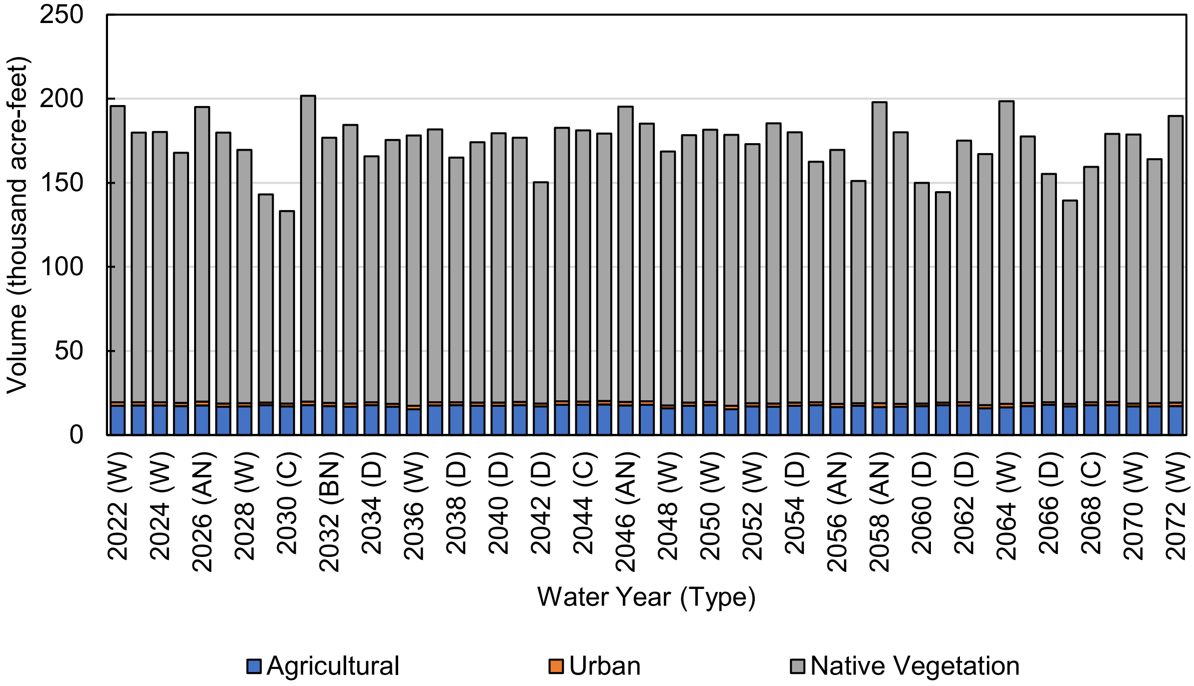


Figure 49. Bowman Subbasin Projected (Future Land Use) Total Evapotranspiration, (acre-feet)

Table 47. Bowman Subbasin Projected (Future Land Use) Total Evapotranspiration, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	17,000	2,100	180,000	200,000
2023 (W)	18,000	2,000	160,000	180,000
2024 (W)	18,000	2,000	160,000	180,000
2025 (BN)	17,000	1,800	150,000	170,000
2026 (AN)	18,000	2,200	180,000	200,000
2027 (W)	17,000	1,900	160,000	180,000
2028 (W)	17,000	1,800	150,000	170,000
2029 (C)	18,000	1,500	120,000	140,000
2030 (C)	17,000	1,600	110,000	130,000
2031 (AN)	18,000	2,200	180,000	200,000
2032 (BN)	17,000	1,900	160,000	180,000
2033 (AN)	17,000	2,000	170,000	180,000
2034 (D)	18,000	1,700	150,000	170,000
2035 (W)	17,000	1,900	160,000	180,000
2036 (W)	15,000	2,000	160,000	180,000
2037 (W)	18,000	1,900	160,000	180,000
2038 (D)	18,000	1,700	150,000	160,000
2039 (W)	17,000	1,900	150,000	170,000
2040 (D)	17,000	1,900	160,000	180,000
2041 (C)	18,000	1,900	160,000	180,000
2042 (D)	17,000	1,700	130,000	150,000
2043 (C)	18,000	2,000	160,000	180,000
2044 (C)	18,000	2,000	160,000	180,000
2045 (C)	18,000	1,900	160,000	180,000
2046 (AN)	18,000	2,200	180,000	200,000
2047 (C)	18,000	2,000	170,000	190,000
2048 (W)	16,000	1,800	150,000	170,000
2049 (W)	17,000	1,900	160,000	180,000
2050 (W)	18,000	1,900	160,000	180,000
2051 (W)	15,000	2,000	160,000	180,000
2052 (W)	17,000	1,800	150,000	170,000
2053 (AN)	17,000	2,000	170,000	190,000
2054 (D)	17,000	1,900	160,000	180,000
2055 (D)	18,000	1,700	140,000	160,000
2056 (AN)	17,000	1,900	150,000	170,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		17,000	1,500	130,000	150,000
2058 (AN)		17,000	2,200	180,000	200,000
2059 (W)		17,000	1,900	160,000	180,000
2060 (D)		17,000	1,700	130,000	150,000
2061 (C)		18,000	1,500	130,000	140,000
2062 (D)		18,000	1,900	160,000	180,000
2063 (BN)		16,000	1,800	150,000	170,000
2064 (W)		16,000	2,100	180,000	200,000
2065 (BN)		17,000	1,900	160,000	180,000
2066 (D)		18,000	1,600	140,000	160,000
2067 (C)		17,000	1,600	120,000	140,000
2068 (C)		18,000	1,700	140,000	160,000
2069 (BN)		18,000	1,900	160,000	180,000
2070 (W)		17,000	1,900	160,000	180,000
2071 (BN)		17,000	1,800	150,000	160,000
2072 (W)		17,000	2,100	170,000	190,000
Average (2022-2072)		17,000	1,900	150,000	170,000
2022 - 2072	W	17,000	1,900	160,000	180,000
	AN	17,000	2,100	170,000	190,000
	BN	17,000	1,800	150,000	170,000
	D	18,000	1,800	150,000	160,000
	C	18,000	1,800	140,000	160,000

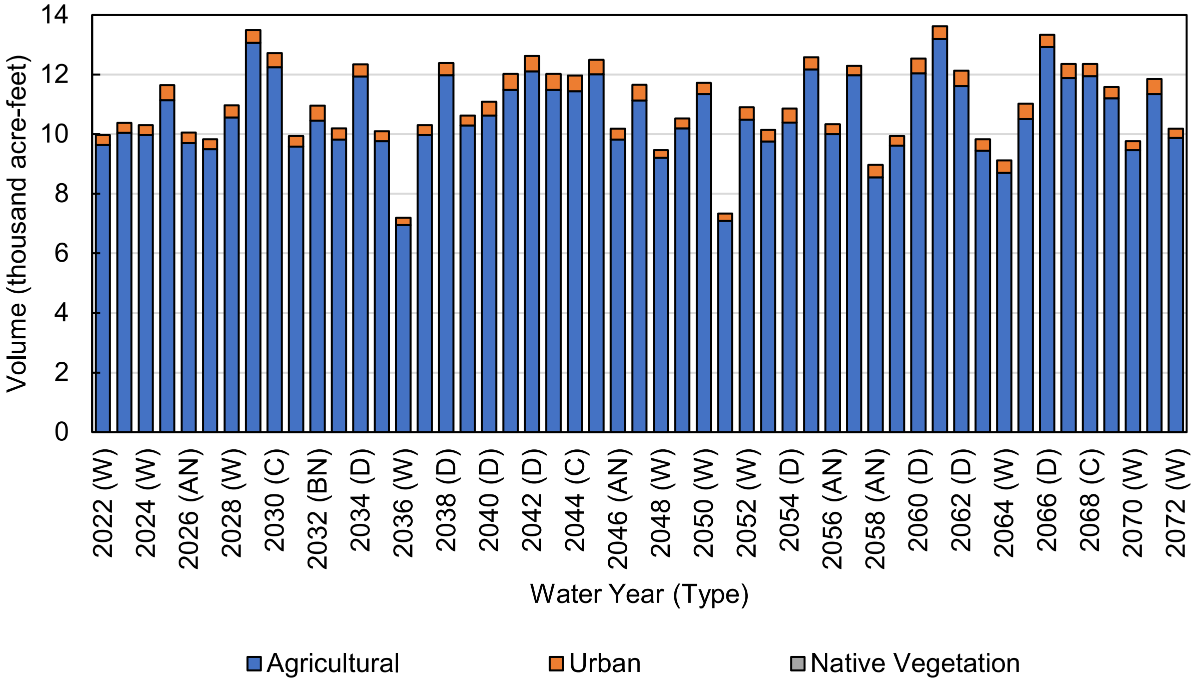


Figure 50. Bowman Subbasin Projected (Future Land Use) Evapotranspiration of Applied Water, by Water Use Sector

Table 48. Bowman Subbasin Projected (Future Land Use) Evapotranspiration of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	9,600	330	0	10,000
2023 (W)	10,000	330	0	10,000
2024 (W)	10,000	330	0	10,000
2025 (BN)	11,000	510	0	12,000
2026 (AN)	9,700	360	0	10,000
2027 (W)	9,500	330	0	9,800
2028 (W)	11,000	410	0	11,000
2029 (C)	13,000	430	0	13,000
2030 (C)	12,000	470	0	13,000
2031 (AN)	9,600	360	0	9,900
2032 (BN)	10,000	510	0	11,000
2033 (AN)	9,800	380	0	10,000
2034 (D)	12,000	410	0	12,000
2035 (W)	9,800	330	0	10,000
2036 (W)	7,000	250	0	7,200
2037 (W)	10,000	330	0	10,000
2038 (D)	12,000	410	0	12,000
2039 (W)	10,000	330	0	11,000
2040 (D)	11,000	470	0	11,000
2041 (C)	11,000	530	0	12,000
2042 (D)	12,000	510	0	13,000
2043 (C)	11,000	530	0	12,000
2044 (C)	11,000	530	0	12,000
2045 (C)	12,000	490	0	13,000
2046 (AN)	9,800	360	0	10,000
2047 (C)	11,000	530	0	12,000
2048 (W)	9,200	250	0	9,500
2049 (W)	10,000	330	0	11,000
2050 (W)	11,000	380	0	12,000
2051 (W)	7,100	250	0	7,300
2052 (W)	10,000	410	0	11,000
2053 (AN)	9,800	380	0	10,000
2054 (D)	10,000	470	0	11,000
2055 (D)	12,000	410	0	13,000
2056 (AN)	10,000	340	0	10,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		12,000	310	0	12,000
2058 (AN)		8,600	420	0	9,000
2059 (W)		9,600	330	0	9,900
2060 (D)		12,000	500	0	13,000
2061 (C)		13,000	430	0	14,000
2062 (D)		12,000	520	0	12,000
2063 (BN)		9,400	390	0	9,800
2064 (W)		8,700	420	0	9,100
2065 (BN)		11,000	510	0	11,000
2066 (D)		13,000	400	0	13,000
2067 (C)		12,000	480	0	12,000
2068 (C)		12,000	410	0	12,000
2069 (BN)		11,000	370	0	12,000
2070 (W)		9,500	300	0	9,800
2071 (BN)		11,000	500	0	12,000
2072 (W)		9,900	320	0	10,000
Average (2022-2072)		11,000	400	0	11,000
2022 - 2072	W	9,600	330	0	9,900
	AN	9,600	370	0	10,000
	BN	11,000	440	0	11,000
	D	12,000	460	0	12,000
	C	12,000	480	0	12,000

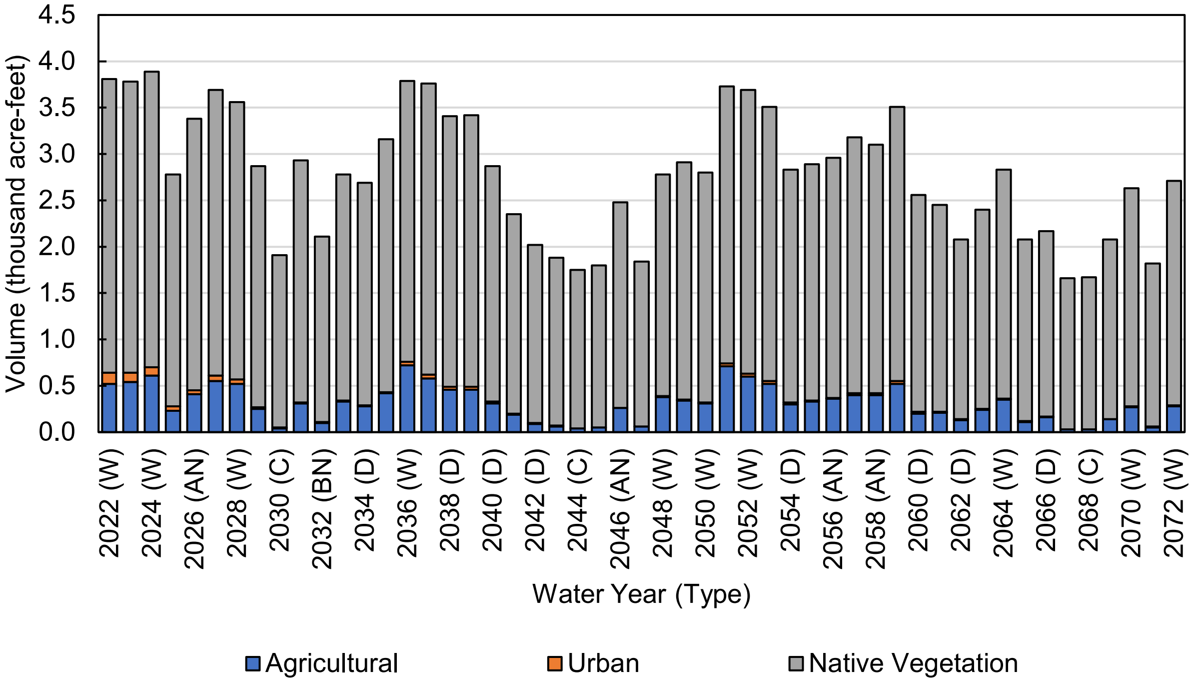


Figure 51. Bowman Subbasin Projected (Future Land Use) Evapotranspiration of Groundwater Uptake, by Water Use Sector

Table 49. Bowman Subbasin Projected (Future Land Use) Evapotranspiration of Groundwater Uptake, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	520	120	3,200	3,800
2023 (W)	540	100	3,100	3,800
2024 (W)	610	90	3,200	3,900
2025 (BN)	230	50	2,500	2,800
2026 (AN)	410	40	2,900	3,400
2027 (W)	550	60	3,100	3,700
2028 (W)	520	50	3,000	3,600
2029 (C)	250	20	2,600	2,900
2030 (C)	40	10	1,900	1,900
2031 (AN)	310	10	2,600	2,900
2032 (BN)	100	10	2,000	2,100
2033 (AN)	330	10	2,400	2,800
2034 (D)	280	10	2,400	2,700
2035 (W)	420	10	2,700	3,200
2036 (W)	720	40	3,000	3,800
2037 (W)	580	40	3,100	3,800
2038 (D)	460	30	2,900	3,400
2039 (W)	460	30	2,900	3,400
2040 (D)	310	20	2,500	2,900
2041 (C)	190	10	2,200	2,400
2042 (D)	90	10	1,900	2,000
2043 (C)	60	10	1,800	1,900
2044 (C)	40	0	1,700	1,800
2045 (C)	50	0	1,800	1,800
2046 (AN)	260	0	2,200	2,500
2047 (C)	60	0	1,800	1,800
2048 (W)	380	10	2,400	2,800
2049 (W)	340	10	2,600	2,900
2050 (W)	310	10	2,500	2,800
2051 (W)	710	30	3,000	3,700
2052 (W)	600	30	3,100	3,700
2053 (AN)	520	30	3,000	3,500
2054 (D)	300	20	2,500	2,800
2055 (D)	330	10	2,600	2,900
2056 (AN)	360	10	2,600	3,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		400	20	2,800	3,200
2058 (AN)		400	20	2,700	3,100
2059 (W)		520	30	3,000	3,500
2060 (D)		200	20	2,300	2,600
2061 (C)		210	10	2,200	2,500
2062 (D)		130	10	1,900	2,100
2063 (BN)		240	10	2,200	2,400
2064 (W)		350	10	2,500	2,800
2065 (BN)		110	10	2,000	2,100
2066 (D)		160	10	2,000	2,200
2067 (C)		30	0	1,600	1,700
2068 (C)		30	0	1,600	1,700
2069 (BN)		140	0	1,900	2,100
2070 (W)		270	10	2,400	2,600
2071 (BN)		50	10	1,800	1,800
2072 (W)		280	10	2,400	2,700
Average (2022-2072)		310	20	2,500	2,800
2022 - 2072	W	480	40	2,800	3,400
	AN	370	20	2,600	3,000
	BN	180	20	2,200	2,400
	D	250	20	2,400	2,600
	C	100	10	1,900	2,000

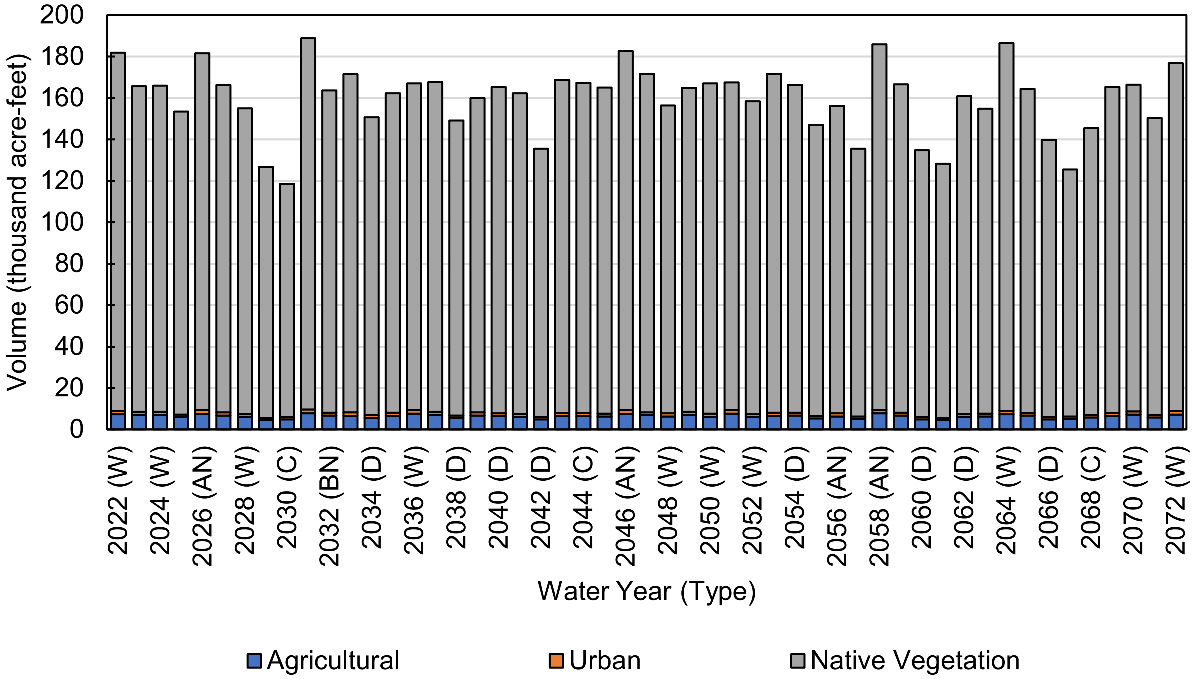


Figure 52. Bowman Subbasin Projected (Future Land Use) Evapotranspiration of Precipitation, by Water Use Sector

Table 50. Bowman Subbasin Projected (Future Land Use) Evapotranspiration of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	7,300	1,700	170,000	180,000
2023 (W)	7,000	1,500	160,000	170,000
2024 (W)	7,000	1,500	160,000	170,000
2025 (BN)	5,900	1,200	150,000	150,000
2026 (AN)	7,600	1,800	170,000	180,000
2027 (W)	6,700	1,500	160,000	170,000
2028 (W)	6,000	1,300	150,000	160,000
2029 (C)	4,500	1,100	120,000	130,000
2030 (C)	4,800	1,100	110,000	120,000
2031 (AN)	7,800	1,800	180,000	190,000
2032 (BN)	6,700	1,300	160,000	160,000
2033 (AN)	6,600	1,600	160,000	170,000
2034 (D)	5,600	1,300	140,000	150,000
2035 (W)	6,600	1,500	150,000	160,000
2036 (W)	7,700	1,700	160,000	170,000
2037 (W)	7,000	1,600	160,000	170,000
2038 (D)	5,400	1,300	140,000	150,000
2039 (W)	6,700	1,600	150,000	160,000
2040 (D)	6,500	1,400	160,000	170,000
2041 (C)	6,000	1,400	150,000	160,000
2042 (D)	4,900	1,200	130,000	140,000
2043 (C)	6,500	1,500	160,000	170,000
2044 (C)	6,500	1,500	160,000	170,000
2045 (C)	6,200	1,500	160,000	170,000
2046 (AN)	7,500	1,800	170,000	180,000
2047 (C)	6,800	1,500	160,000	170,000
2048 (W)	6,200	1,600	150,000	160,000
2049 (W)	6,900	1,600	160,000	160,000
2050 (W)	6,100	1,500	160,000	170,000
2051 (W)	7,600	1,700	160,000	170,000
2052 (W)	6,000	1,400	150,000	160,000
2053 (AN)	6,500	1,600	160,000	170,000
2054 (D)	6,700	1,400	160,000	170,000
2055 (D)	5,300	1,300	140,000	150,000
2056 (AN)	6,300	1,500	150,000	160,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		5,100	1,200	130,000	140,000
2058 (AN)		7,800	1,800	180,000	190,000
2059 (W)		6,600	1,500	160,000	170,000
2060 (D)		4,900	1,100	130,000	130,000
2061 (C)		4,500	1,100	120,000	130,000
2062 (D)		5,900	1,400	150,000	160,000
2063 (BN)		6,200	1,400	150,000	150,000
2064 (W)		7,300	1,700	180,000	190,000
2065 (BN)		6,600	1,300	160,000	160,000
2066 (D)		4,900	1,200	130,000	140,000
2067 (C)		5,100	1,100	120,000	130,000
2068 (C)		5,800	1,300	140,000	150,000
2069 (BN)		6,400	1,600	160,000	170,000
2070 (W)		7,200	1,600	160,000	170,000
2071 (BN)		5,700	1,300	140,000	150,000
2072 (W)		7,100	1,700	170,000	180,000
Average (2022-2072)		6,300	1,500	150,000	160,000
2022 - 2072	W	6,800	1,600	160,000	170,000
	AN	7,200	1,700	170,000	180,000
	BN	6,100	1,300	150,000	160,000
	D	5,600	1,300	140,000	150,000
	C	5,700	1,300	140,000	150,000

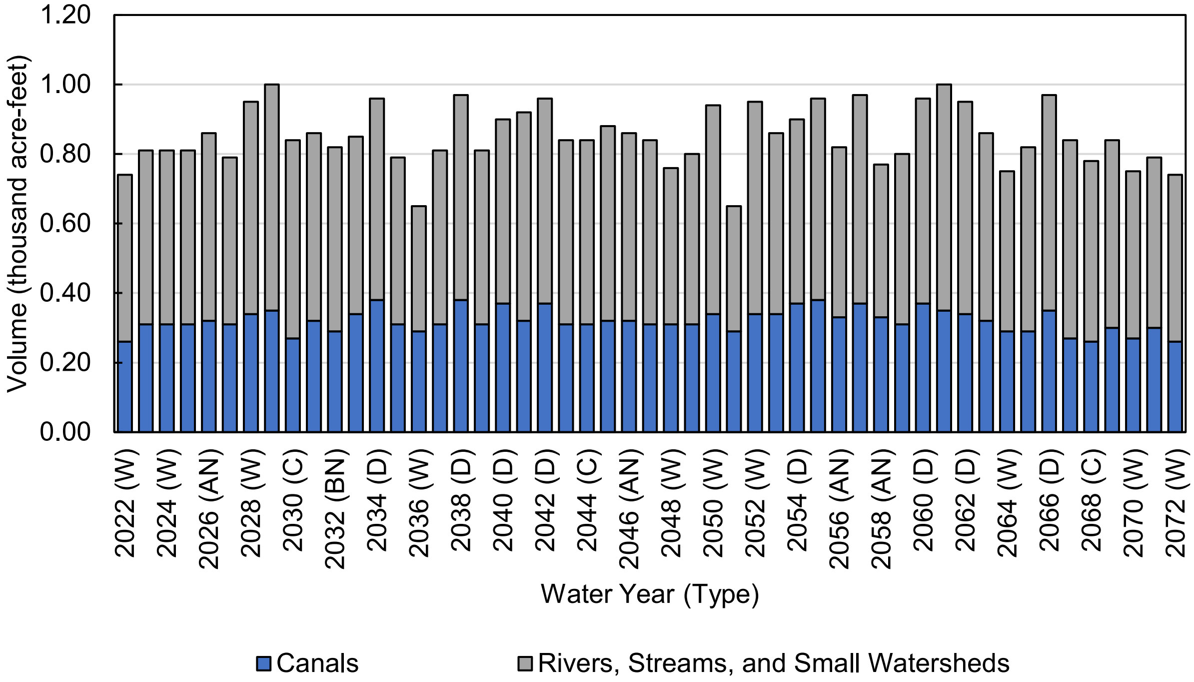


Figure 53. Bowman Subbasin Projected (Future Land Use) Evaporation of Surface Water Sources

Table 51. Bowman Subbasin Projected (Future Land Use) Evaporation of Surface Water Sources, by Water Use Sector (acre-feet)

Water Year (Type)	Canals	Rivers, Streams, and Small Watersheds[1]	Total
2022 (W)	260	480	740
2023 (W)	310	500	810
2024 (W)	310	500	810
2025 (BN)	310	500	810
2026 (AN)	320	540	860
2027 (W)	310	480	790
2028 (W)	340	610	950
2029 (C)	350	650	1,000
2030 (C)	270	570	840
2031 (AN)	320	540	860
2032 (BN)	290	530	820
2033 (AN)	340	510	850
2034 (D)	380	580	960
2035 (W)	310	480	790
2036 (W)	290	360	650
2037 (W)	310	500	810
2038 (D)	380	590	970
2039 (W)	310	500	810
2040 (D)	370	530	900
2041 (C)	320	600	920
2042 (D)	370	590	960
2043 (C)	310	530	840
2044 (C)	310	530	840
2045 (C)	320	560	880
2046 (AN)	320	540	860
2047 (C)	310	530	840
2048 (W)	310	450	760
2049 (W)	310	490	800
2050 (W)	340	600	940
2051 (W)	290	360	650
2052 (W)	340	610	950
2053 (AN)	340	520	860
2054 (D)	370	530	900
2055 (D)	380	580	960
2056 (AN)	330	490	820
2057 (BN)	370	600	970

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds[1]	Total
2058 (AN)		330	440	770
2059 (W)		310	490	800
2060 (D)		370	590	960
2061 (C)		350	650	1,000
2062 (D)		340	610	950
2063 (BN)		320	540	860
2064 (W)		290	460	750
2065 (BN)		290	530	820
2066 (D)		350	620	970
2067 (C)		270	570	840
2068 (C)		260	520	780
2069 (BN)		300	540	840
2070 (W)		270	480	750
2071 (BN)		300	490	790
2072 (W)		260	480	740
Average (2022-2072)		320	530	850
2022 - 2072	W	300	490	790
	AN	330	510	840
	BN	310	530	840
	D	370	580	950
	C	310	570	880

[1] Includes ET of riparian vegetation along rivers and streams.

3.3.2.2 Surface Water Outflow by Water Source Type

Surface water outflows from the Bowman Subbasin are summarized in **Figure 54** and **Table 52** by water source type. In the Bowman Subbasin, local supply outflows primarily include outflows of runoff, tailwater, and net drainage from land surfaces, in addition to runoff from small watersheds and stream outflows to the Sacramento River. Local supply outflows average approximately 120 taf per year, and range from 50 taf or less in certain dry and critical water years up to 390 taf in some wet years. Approximately 1.6 taf of CVP supplies also leave the Subbasin each year in spillage from ACID canals to Cottonwood Creek.

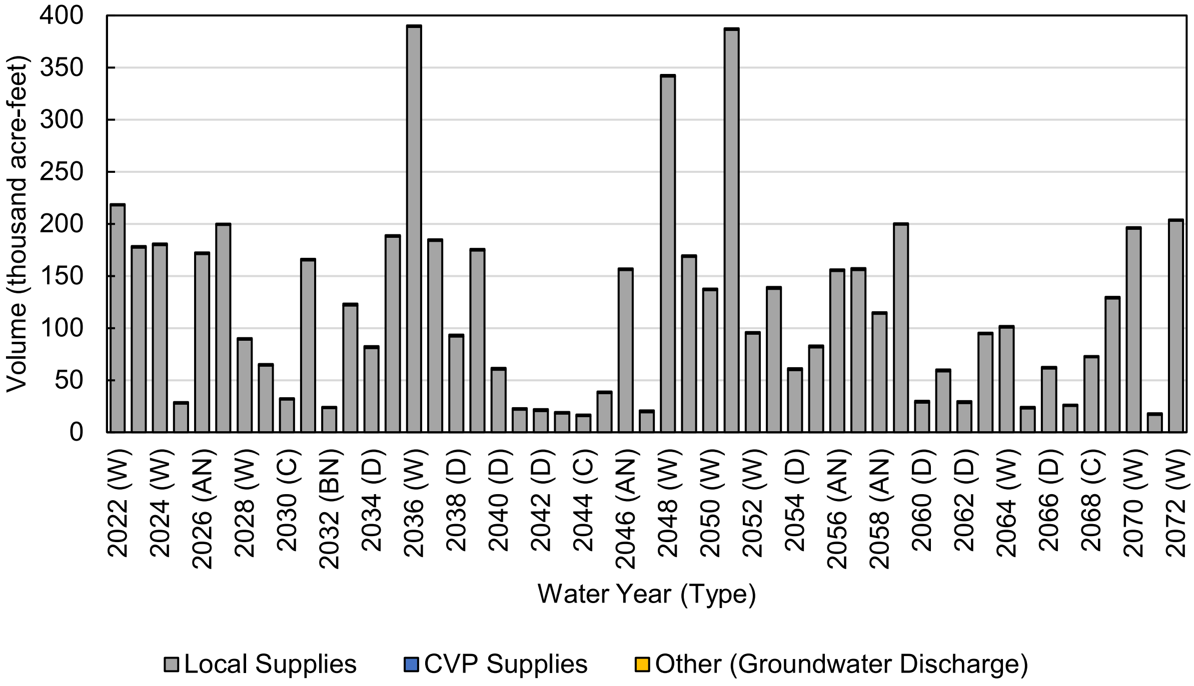


Figure 54. Bowman Subbasin Projected (Future Land Use) Surface Water Outflows, by Water Source Type

Table 52. Bowman Subbasin Projected (Future Land Use) Surface Water Outflows, by Water Source Type (acre-feet)

Water Year (Type)	CVP Supplies	Local Supplies	Other (Groundwater Discharge)	Total
2022 (W)	1,300	220,000	0	220,000
2023 (W)	1,600	180,000	0	180,000
2024 (W)	1,600	180,000	0	180,000
2025 (BN)	1,600	27,000	0	29,000
2026 (AN)	1,600	170,000	0	170,000
2027 (W)	1,500	200,000	0	200,000
2028 (W)	1,800	89,000	0	91,000
2029 (C)	1,700	64,000	0	66,000
2030 (C)	1,400	31,000	0	33,000
2031 (AN)	1,600	160,000	0	170,000
2032 (BN)	1,500	23,000	0	25,000
2033 (AN)	1,800	120,000	0	120,000
2034 (D)	1,900	81,000	0	83,000
2035 (W)	1,500	190,000	0	190,000
2036 (W)	1,500	390,000	0	390,000
2037 (W)	1,600	180,000	0	190,000
2038 (D)	1,900	92,000	0	94,000
2039 (W)	1,600	170,000	0	180,000
2040 (D)	1,900	60,000	0	62,000
2041 (C)	1,600	22,000	0	23,000
2042 (D)	1,800	20,000	0	22,000
2043 (C)	1,600	18,000	0	20,000
2044 (C)	1,600	15,000	0	17,000
2045 (C)	1,600	38,000	0	39,000
2046 (AN)	1,600	160,000	0	160,000
2047 (C)	1,600	19,000	0	21,000
2048 (W)	1,600	340,000	0	340,000
2049 (W)	1,600	170,000	0	170,000
2050 (W)	1,700	140,000	0	140,000
2051 (W)	1,500	390,000	0	390,000
2052 (W)	1,800	95,000	0	96,000
2053 (AN)	1,800	140,000	0	140,000
2054 (D)	1,900	60,000	0	62,000
2055 (D)	1,900	81,000	0	83,000

Water Year (Type)		CVP Supplies	Local Supplies	Other (Groundwater Discharge)	Total
2056 (AN)		1,600	150,000	0	160,000
2057 (BN)		1,800	160,000	0	160,000
2058 (AN)		1,600	110,000	0	120,000
2059 (W)		1,500	200,000	0	200,000
2060 (D)		1,800	28,000	0	30,000
2061 (C)		1,700	59,000	0	60,000
2062 (D)		1,700	28,000	0	30,000
2063 (BN)		1,600	94,000	0	96,000
2064 (W)		1,500	100,000	0	100,000
2065 (BN)		1,500	23,000	0	24,000
2066 (D)		1,800	61,000	0	63,000
2067 (C)		1,400	25,000	0	27,000
2068 (C)		1,300	72,000	0	73,000
2069 (BN)		1,500	130,000	0	130,000
2070 (W)		1,400	200,000	0	200,000
2071 (BN)		1,600	17,000	0	18,000
2072 (W)		1,300	200,000	0	200,000
Average (2022-2072)		1,600	120,000	0	120,000
2022 - 2072	W	1,600	200,000	0	200,000
	AN	1,700	150,000	0	150,000
	BN	1,600	67,000	0	69,000
	D	1,800	57,000	0	59,000
	C	1,600	36,000	0	38,000

3.3.2.3 Deep Percolation of Applied Water

Estimated deep percolation of applied water (equal to infiltration of applied water in 23 CCR § 354.18(b)(2)) is summarized in **Figure 55** and **Table 53** by water use sector. Deep percolation of applied water is about 7.3 taf on average, and dominated by agricultural irrigation and varies between years, following the pattern of surface water diversions and deliveries to irrigated lands.

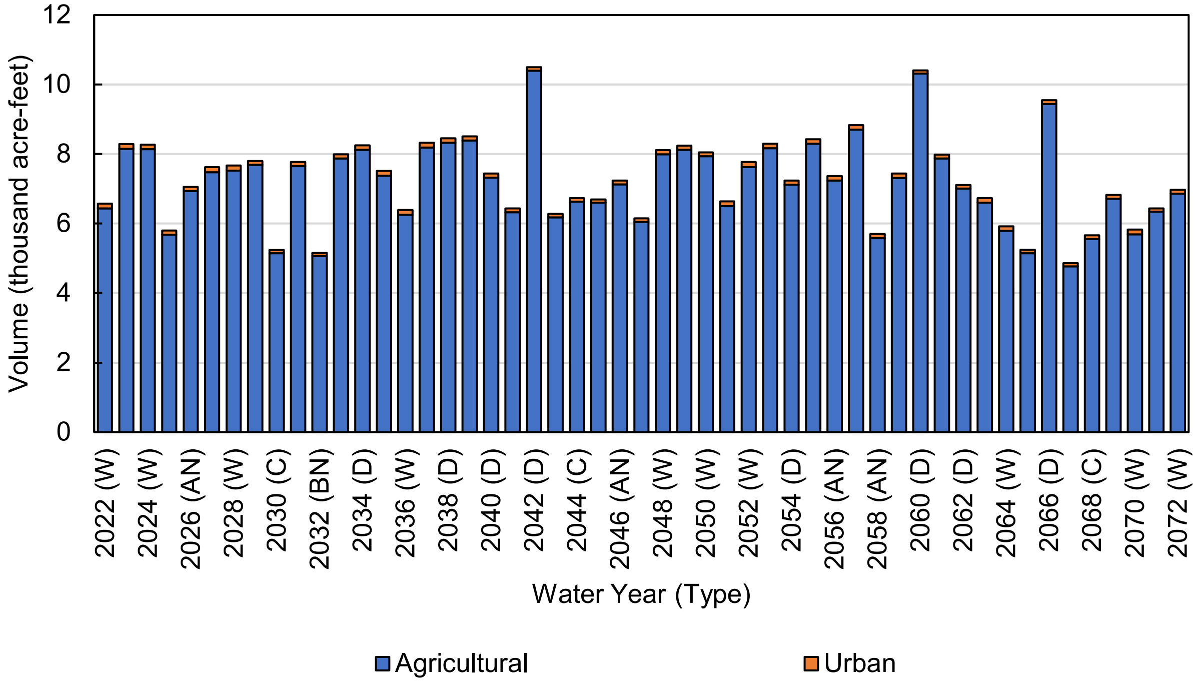


Figure 55. Bowman Subbasin Projected (Future Land Use) Deep Percolation of Applied Water, by Water Use Sector

Table 53. Bowman Subbasin Projected (Future Land Use) Deep Percolation of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	6,400	130	0	6,600
2023 (W)	8,200	140	0	8,300
2024 (W)	8,100	130	0	8,300
2025 (BN)	5,700	120	0	5,800
2026 (AN)	6,900	120	0	7,100
2027 (W)	7,500	140	0	7,600
2028 (W)	7,500	150	0	7,700
2029 (C)	7,700	110	0	7,800
2030 (C)	5,200	90	0	5,200
2031 (AN)	7,700	120	0	7,800
2032 (BN)	5,100	100	0	5,200
2033 (AN)	7,900	120	0	8,000
2034 (D)	8,100	130	0	8,300
2035 (W)	7,400	130	0	7,500
2036 (W)	6,300	140	0	6,400
2037 (W)	8,200	130	0	8,300
2038 (D)	8,300	130	0	8,500
2039 (W)	8,400	120	0	8,500
2040 (D)	7,300	120	0	7,400
2041 (C)	6,300	110	0	6,400
2042 (D)	10,000	100	0	11,000
2043 (C)	6,200	100	0	6,300
2044 (C)	6,600	100	0	6,700
2045 (C)	6,600	90	0	6,700
2046 (AN)	7,100	110	0	7,200
2047 (C)	6,100	100	0	6,200
2048 (W)	8,000	120	0	8,100
2049 (W)	8,100	120	0	8,200
2050 (W)	7,900	110	0	8,100
2051 (W)	6,500	140	0	6,600
2052 (W)	7,600	150	0	7,800
2053 (AN)	8,200	130	0	8,300
2054 (D)	7,100	120	0	7,200
2055 (D)	8,300	130	0	8,400
2056 (AN)	7,200	130	0	7,400

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		8,700	130	0	8,800
2058 (AN)		5,600	120	0	5,700
2059 (W)		7,300	130	0	7,400
2060 (D)		10,000	100	0	10,000
2061 (C)		7,900	110	0	8,000
2062 (D)		7,000	100	0	7,100
2063 (BN)		6,600	130	0	6,700
2064 (W)		5,800	130	0	5,900
2065 (BN)		5,200	100	0	5,300
2066 (D)		9,400	110	0	9,600
2067 (C)		4,800	90	0	4,900
2068 (C)		5,600	110	0	5,700
2069 (BN)		6,700	110	0	6,800
2070 (W)		5,700	140	0	5,800
2071 (BN)		6,300	100	0	6,400
2072 (W)		6,900	110	0	7,000
Average (2022-2072)		7,200	120	0	7,300
2022 - 2072	W	7,300	130	0	7,500
	AN	7,200	120	0	7,400
	BN	6,300	110	0	6,400
	D	8,500	120	0	8,600
	C	6,300	100	0	6,400

3.3.2.4 Deep Percolation of Precipitation

Estimated deep percolation of precipitation (equal to infiltration of precipitation in 23 CCR § 354.18(b)(2)) is provided in and **Figure 56** and **Table 54** by water use sector. Deep percolation of precipitation to the GWS is highly variable from year to year due to variation in the timing and amount of precipitation, ranging from about 23 taf per year during critical dry years to about 67 taf per year during wet years on average.

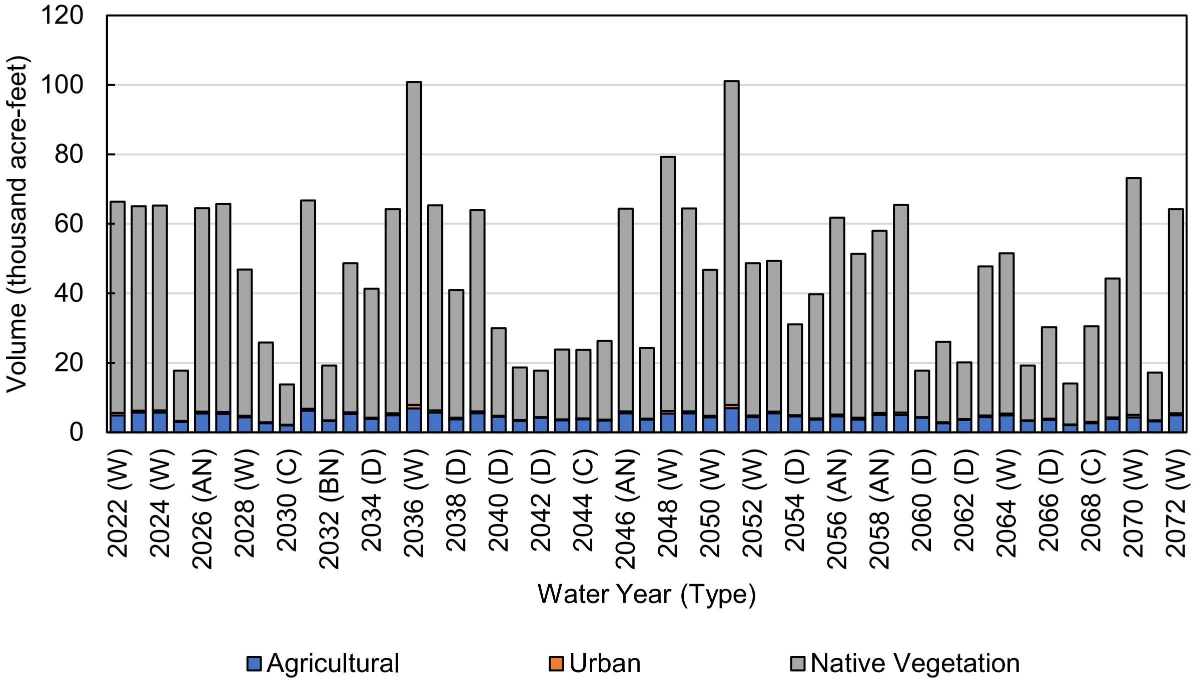


Figure 56. Bowman Subbasin Projected (Future Land Use) Deep Percolation of Precipitation, by Water Use Sector

Table 54. Bowman Subbasin Projected (Future Land Use) Deep Percolation of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	4,900	690	61,000	66,000
2023 (W)	5,600	630	59,000	65,000
2024 (W)	5,700	620	59,000	65,000
2025 (BN)	3,000	280	15,000	18,000
2026 (AN)	5,400	600	59,000	65,000
2027 (W)	5,300	610	60,000	66,000
2028 (W)	4,300	490	42,000	47,000
2029 (C)	2,700	280	23,000	26,000
2030 (C)	2,000	210	12,000	14,000
2031 (AN)	6,200	600	60,000	67,000
2032 (BN)	3,300	260	16,000	19,000
2033 (AN)	5,300	530	43,000	49,000
2034 (D)	3,800	400	37,000	41,000
2035 (W)	5,000	590	59,000	64,000
2036 (W)	6,900	940	93,000	100,000
2037 (W)	5,700	590	59,000	65,000
2038 (D)	3,800	400	37,000	41,000
2039 (W)	5,500	590	58,000	64,000
2040 (D)	4,500	340	25,000	30,000
2041 (C)	3,300	280	15,000	19,000
2042 (D)	4,200	230	13,000	18,000
2043 (C)	3,500	280	20,000	24,000
2044 (C)	3,800	280	20,000	24,000
2045 (C)	3,400	260	23,000	26,000
2046 (AN)	5,500	580	58,000	64,000
2047 (C)	3,700	280	20,000	24,000
2048 (W)	5,400	730	73,000	79,000
2049 (W)	5,500	580	58,000	64,000
2050 (W)	4,300	460	42,000	47,000
2051 (W)	7,000	930	93,000	100,000
2052 (W)	4,400	480	44,000	49,000
2053 (AN)	5,500	540	43,000	49,000
2054 (D)	4,600	350	26,000	31,000
2055 (D)	3,600	390	36,000	40,000
2056 (AN)	4,600	550	57,000	62,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		3,700	510	47,000	51,000
2058 (AN)		5,100	520	52,000	58,000
2059 (W)		5,000	600	60,000	65,000
2060 (D)		4,200	230	13,000	18,000
2061 (C)		2,700	280	23,000	26,000
2062 (D)		3,600	260	16,000	20,000
2063 (BN)		4,400	470	43,000	48,000
2064 (W)		4,900	530	46,000	52,000
2065 (BN)		3,300	260	16,000	19,000
2066 (D)		3,600	340	26,000	30,000
2067 (C)		2,100	210	12,000	14,000
2068 (C)		2,700	350	28,000	31,000
2069 (BN)		3,800	450	40,000	44,000
2070 (W)		4,300	740	68,000	73,000
2071 (BN)		3,200	260	14,000	17,000
2072 (W)		4,900	610	59,000	64,000
Average (2022-2072)		4,400	460	41,000	46,000
2022 - 2072	W	5,300	630	61,000	67,000
	AN	5,400	560	53,000	59,000
	BN	3,500	360	27,000	31,000
	D	4,000	330	26,000	30,000
	C	3,000	270	19,000	23,000

3.3.2.5 Infiltration of Surface Water

Estimated infiltration of surface water (seepage) by water source is provided in **Figure 57** and **Table 55.** Flows along Cottonwood Creek and runoff from upgradient small watersheds contribute seepage to the Bowman Subbasin, averaging about 36 taf per year. Seepage in the Bowman Subbasin also comes from conveyance of surface water delivered to irrigators in ACID. The total seepage from all canals and diversions is approximately 12 taf per year, on average.

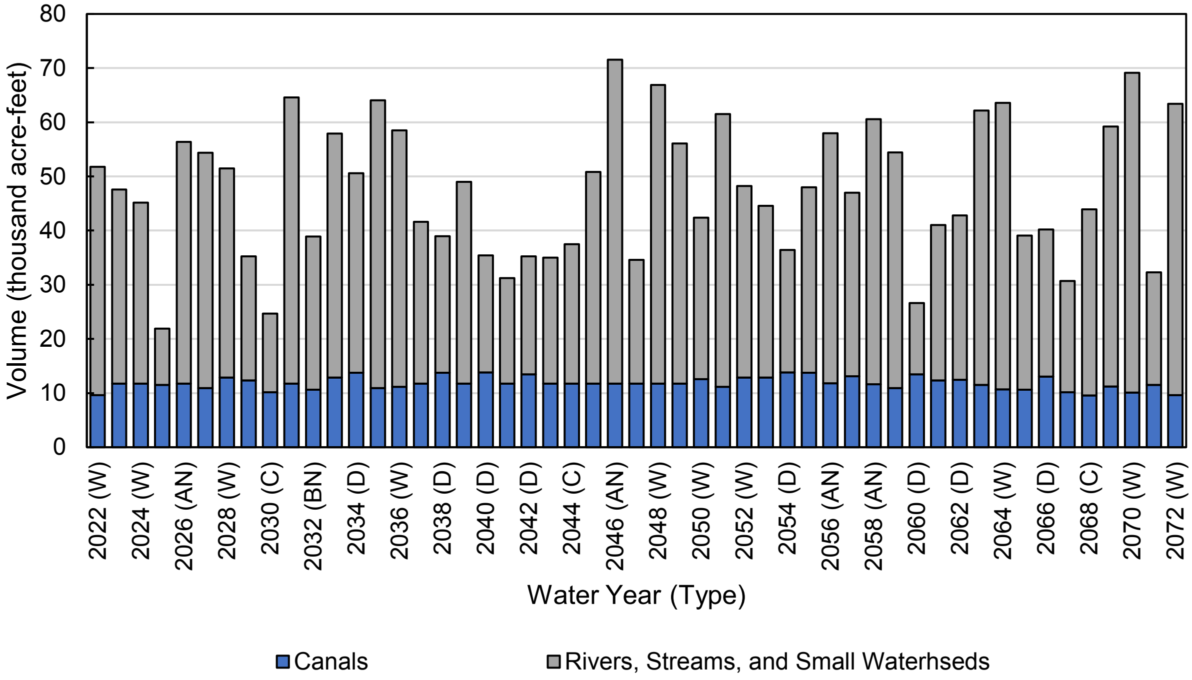


Figure 57. Bowman Subbasin Projected (Future Land Use) Infiltration of Surface Water, by Water Use Sector

Table 55. Bowman Subbasin Projected (Future Land Use) Infiltration of Surface Water, by Water Use Sector (acre-feet)

Water Year (Type)	Canals	Rivers, Streams, and Small Watersheds	Total
2022 (W)	9,600	42,000	52,000
2023 (W)	12,000	36,000	48,000
2024 (W)	12,000	33,000	45,000
2025 (BN)	12,000	10,000	22,000
2026 (AN)	12,000	45,000	56,000
2027 (W)	11,000	43,000	54,000
2028 (W)	13,000	39,000	51,000
2029 (C)	12,000	23,000	35,000
2030 (C)	10,000	15,000	25,000
2031 (AN)	12,000	53,000	65,000
2032 (BN)	11,000	28,000	39,000
2033 (AN)	13,000	45,000	58,000
2034 (D)	14,000	37,000	51,000
2035 (W)	11,000	53,000	64,000
2036 (W)	11,000	47,000	59,000
2037 (W)	12,000	30,000	42,000
2038 (D)	14,000	25,000	39,000
2039 (W)	12,000	37,000	49,000
2040 (D)	14,000	22,000	35,000
2041 (C)	12,000	19,000	31,000
2042 (D)	13,000	22,000	35,000
2043 (C)	12,000	23,000	35,000
2044 (C)	12,000	26,000	37,000
2045 (C)	12,000	39,000	51,000
2046 (AN)	12,000	60,000	72,000
2047 (C)	12,000	23,000	35,000
2048 (W)	12,000	55,000	67,000
2049 (W)	12,000	44,000	56,000
2050 (W)	13,000	30,000	42,000
2051 (W)	11,000	50,000	62,000
2052 (W)	13,000	35,000	48,000
2053 (AN)	13,000	32,000	45,000
2054 (D)	14,000	23,000	36,000
2055 (D)	14,000	34,000	48,000
2056 (AN)	12,000	46,000	58,000

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds	Total
2057 (BN)		13,000	34,000	47,000
2058 (AN)		12,000	49,000	61,000
2059 (W)		11,000	43,000	54,000
2060 (D)		13,000	13,000	27,000
2061 (C)		12,000	29,000	41,000
2062 (D)		12,000	30,000	43,000
2063 (BN)		12,000	51,000	62,000
2064 (W)		11,000	53,000	64,000
2065 (BN)		11,000	28,000	39,000
2066 (D)		13,000	27,000	40,000
2067 (C)		10,000	21,000	31,000
2068 (C)		9,500	34,000	44,000
2069 (BN)		11,000	48,000	59,000
2070 (W)		10,000	59,000	69,000
2071 (BN)		12,000	21,000	32,000
2072 (W)		9,600	54,000	63,000
Average (2022-2072)		12,000	36,000	48,000
2022 - 2072	W	11,000	44,000	55,000
	AN	12,000	47,000	59,000
	BN	11,000	31,000	43,000
	D	13,000	26,000	39,000
	C	11,000	25,000	36,000

3.3.3 Change in Root Zone Storage

Estimates of change in root zone storage are provided in **Figure 58** and **Table 56**. Inter-annual changes in storage within the SWS consist primarily of root zone soil moisture storage changes, are relatively small, and tend to average near zero over many years.

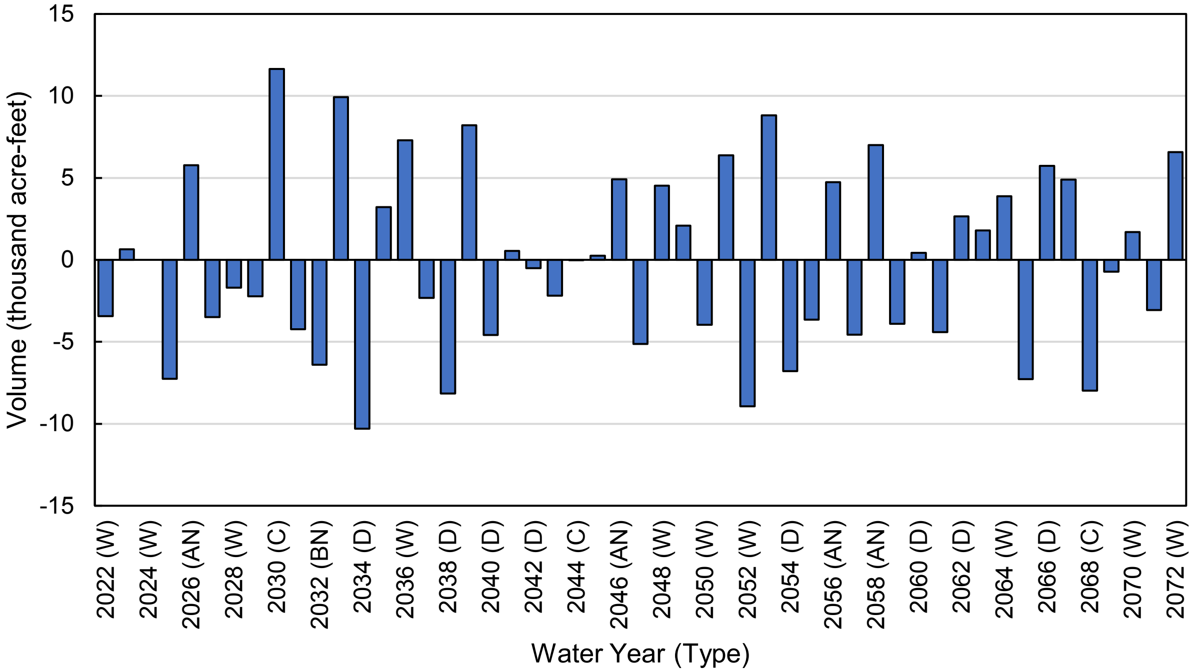


Figure 58. Bowman Subbasin Projected (Future Land Use) Change in Root Zone Storage

Table 56. Bowman Subbasin Projected (Future Land Use) Change in Root Zone Storage (acre-feet)

Water Year (Type)	Change in Root Zone Storage
2022 (W)	-3,400
2023 (W)	640
2024 (W)	0
2025 (BN)	-7,300
2026 (AN)	5,800
2027 (W)	-3,500
2028 (W)	-1,700
2029 (C)	-2,200
2030 (C)	12,000
2031 (AN)	-4,200
2032 (BN)	-6,400
2033 (AN)	9,900
2034 (D)	-10,000
2035 (W)	3,200
2036 (W)	7,300
2037 (W)	-2,300
2038 (D)	-8,200
2039 (W)	8,200
2040 (D)	-4,600
2041 (C)	540
2042 (D)	-500
2043 (C)	-2,200
2044 (C)	-20
2045 (C)	260
2046 (AN)	4,900
2047 (C)	-5,100
2048 (W)	4,500
2049 (W)	2,100
2050 (W)	-4,000
2051 (W)	6,400
2052 (W)	-8,900
2053 (AN)	8,800
2054 (D)	-6,800
2055 (D)	-3,700
2056 (AN)	4,700

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Change in Root Zone Storage</th></tr>
<tr><td colspan="2">2057 (BN)</td><td>-4,600</td></tr>
<tr><td colspan="2">2058 (AN)</td><td>7,000</td></tr>
<tr><td colspan="2">2059 (W)</td><td>-3,900</td></tr>
<tr><td colspan="2">2060 (D)</td><td>420</td></tr>
<tr><td colspan="2">2061 (C)</td><td>-4,400</td></tr>
<tr><td colspan="2">2062 (D)</td><td>2,700</td></tr>
<tr><td colspan="2">2063 (BN)</td><td>1,800</td></tr>
<tr><td colspan="2">2064 (W)</td><td>3,900</td></tr>
<tr><td colspan="2">2065 (BN)</td><td>-7,300</td></tr>
<tr><td colspan="2">2066 (D)</td><td>5,700</td></tr>
<tr><td colspan="2">2067 (C)</td><td>4,900</td></tr>
<tr><td colspan="2">2068 (C)</td><td>-8,000</td></tr>
<tr><td colspan="2">2069 (BN)</td><td>-730</td></tr>
<tr><td colspan="2">2070 (W)</td><td>1,700</td></tr>
<tr><td colspan="2">2071 (BN)</td><td>-3,100</td></tr>
<tr><td colspan="2">2072 (W)</td><td>6,600</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>-70</td></tr>
<tr><td rowspan="5">2022 - 2072</td><td>W</td><td>930</td></tr>
<tr><td>AN</td><td>5,300</td></tr>
<tr><td>BN</td><td>-3,900</td></tr>
<tr><td>D</td><td>-2,800</td></tr>
<tr><td>C</td><td>-460</td></tr>
</table>

3.3.4 Net Recharge from Surface Water System

Net recharge from the SWS is a useful metric that equates only the impacts of the SWS on recharge and extraction from the GWS, providing valuable insight to the combined effects of land surface processes on the underlying GWS. Net recharge from the SWS is calculated as the total groundwater recharge minus the total groundwater extraction and uptake. When calculated for the projected (future land use) water budget, average net recharge from the SWS represents the average surplus (when positive) or shortage (when negative) of recharge that has resulted from projected cropping, land use practices, and average hydrologic conditions, when comparing groundwater extractions with deep percolation and infiltration from the SWS to the GWS. Net recharge does not include groundwater discharges to surface water and is not a full accounting of all exchanges occurring between the SWS and GWS. Although net recharge is a useful water balance metric, groundwater sustainability is not defined by the balance of net recharge from the SWS. Other important factors must be considered in the complete assessment of groundwater sustainability, including but not limited to subsurface groundwater flows and groundwater discharge to surface water.

Annual values for net recharge from the SWS over the projected (future land use) water budget period are presented below for the Bowman Subbasin. **Figure 59** and **Table 57** show the average net recharge from the SWS over 2022-2072 based on the projected (future land use) water budget results. Under future land use conditions, the average net recharge in the Bowman Subbasin was projected as approximately 91 taf per year between 2022-2072, indicating net inflows to the GWS from the SWS during the projected (future land use) water budget period. As illustrated on the cumulative net recharge plot in **Figure 59** this results in a cumulative net recharge of about 4,600 taf over the 51-year projected (future land use) water budget period. Although this means there is projected to be more recharge from the SWS to the GWS than extractions and discharges from the GWS to the SWS, this alone does not necessarily mean that groundwater storage is increasing or that the Subbasin groundwater system has been sustainable. The complete Subbasin water budget, including the GWS water budget results, provide an indication of whether total groundwater inflows and outflows are in balance.

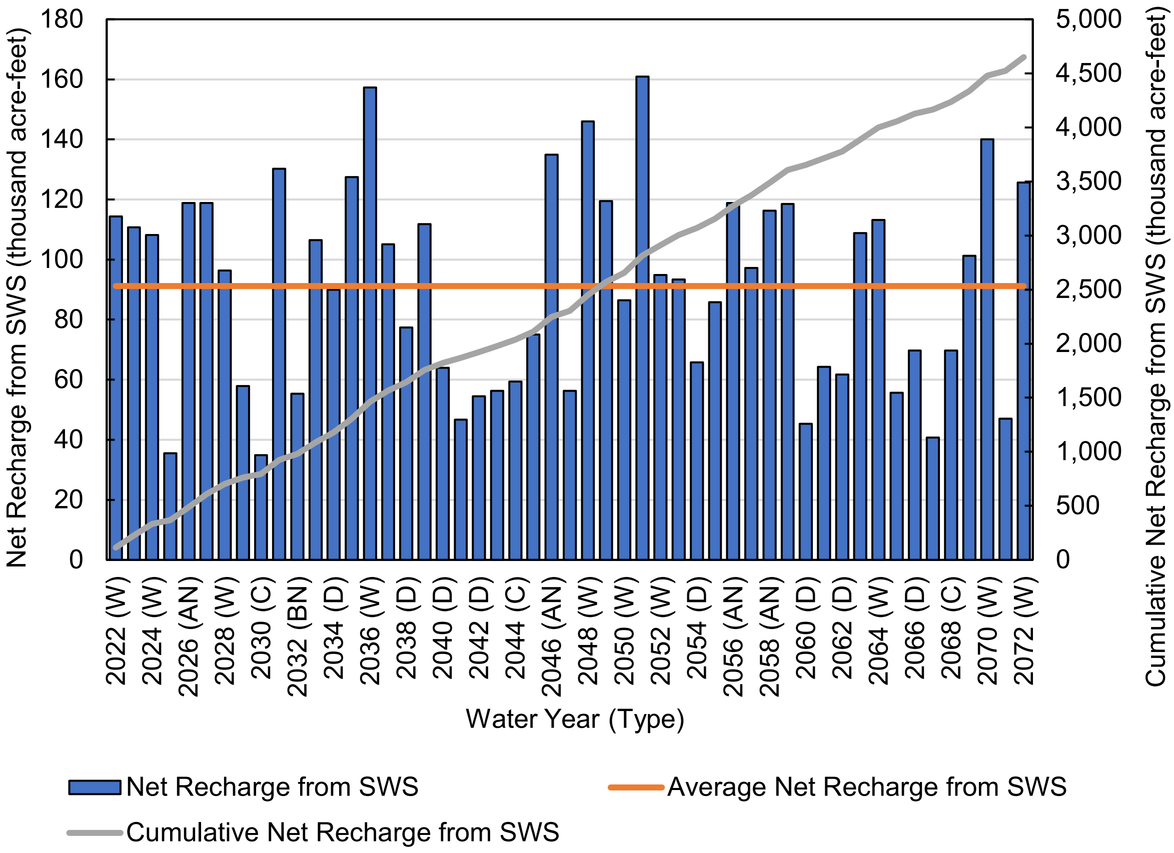


Figure 59. Bowman Subbasin Projected (Future Land Use) Net Recharge Overview

Table 57. Bowman Subbasin Projected (Future Land Use) Water Budget: Average Net Recharge from SWS by Water Year Type (acre-feet)

Year Type	Number of Years	Deep Perc. of Applied Water (a)	Deep Perc. of Precipitation (b)	Infil. of Surface Water (c)	Groundwater Extraction/ Uptake (d)	Net Recharge from SWS (a+b+c-d)
W	18	7,500	67,000	55,000	9,300	120,000
AN	7	7,400	59,000	59,000	8,500	120,000
BN	7	6,400	31,000	43,000	8,800	72,000
D	9	8,600	30,000	39,000	9,600	68,000
C	10	6,400	23,000	36,000	9,500	56,000
Annual Average (2022 - 2072)	51	7,300	46,000	48,000	9,200	91,000

3.4 Groundwater System Water Budget Results

Projected (future land use) water budget results for different components of the GWS are presented in the sections below. Inflows and outflows from the GWS that occur through exchanges with the SWS are discussed in the SWS water budget results, although these components are also noted in the sections below relating to the GWS water budget. In contrast to the SWS water budget, many of the GWS water budget components change in flow direction over time representing inflows during some periods and outflows during other periods, depending on Subbasin conditions. The GWS water budget results are presented with net inflows indicated by positive values and net outflows as negative values.

3.4.1 Lateral Subsurface Groundwater Flows

Subsurface groundwater flows to and from the Bowman Subbasin occur between the Red Bluff Subbasin to the south, the Anderson Subbasin to the north, and the South Battle Creek Subbasin to the east. Subsurface groundwater inflows that occur from the upland foothill (small watershed) areas adjoining the Bowman Subbasin are negligible and set at zero throughout the historical period.

3.4.1.1 Lateral Subsurface Flows to/from Adjacent Subbasins

Projected (future land use) lateral subsurface flows occurring from and to adjacent subbasin are summarized in **Figure 60** and **Table 58**. The total Projected (future land use) net subsurface flows to and from all adjacent subbasins averages about -91 taf per year occurring as outflow from the Bowman Subbasin. Projected (future land use) subsurface flows across the boundary with the Red Bluff Subbasin average an outflow of nearly -130 taf per year. The magnitude of these subsurface flows does not fluctuate much from year to year, although the subsurface outflows to the Red Bluff Subbasin tend to be somewhat greater during wet years than in dry years. In contrast to the subsurface outflows across the boundary with Red Bluff Subbasin, the flows across the northern boundary with the Anderson Subbasin occur as inflows averaging about 23 taf per year, with little variability by water year type. Subsurface flows across the boundary with the South Battle Creek Subbasin are relatively small. On average the subsurface flows across the South Battle Creek Subbasin boundary occur as net inflows of about 11 taf per year.

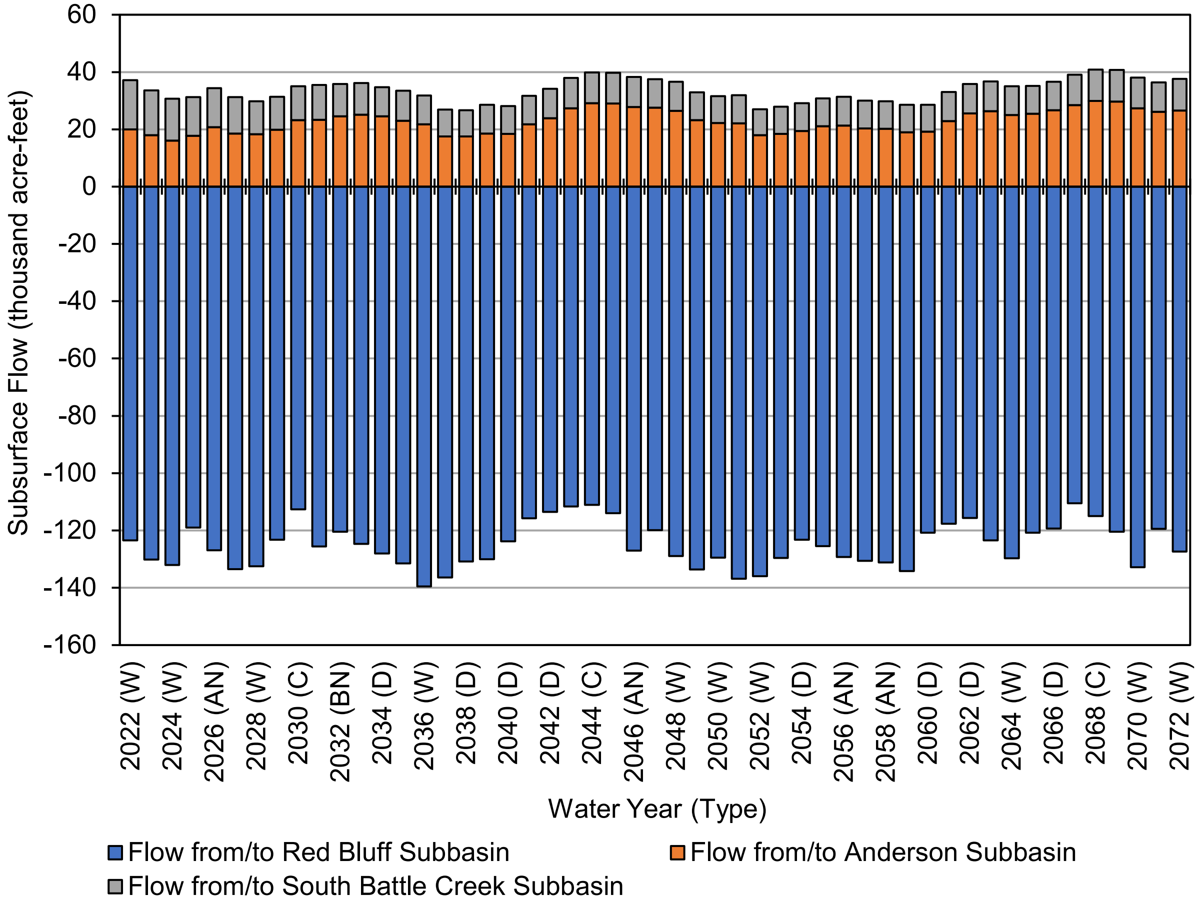


Figure 60. Bowman Subbasin Projected (Future Land Use) Lateral Subsurface Groundwater Flows to/from Adjacent Subbasins

Table 58. Bowman Subbasin Projected (Future Land Use) Lateral Subsurface Groundwater Flows Between Adjacent Subbasins (net flows as acre-feet)

Water Year (Type)	Red Bluff	Anderson	South Battle Creek	Total
2022 (W)	-120,000	20,000	17,000	-86,000
2023 (W)	-130,000	18,000	16,000	-96,000
2024 (W)	-130,000	16,000	15,000	-100,000
2025 (BN)	-120,000	18,000	14,000	-88,000
2026 (AN)	-130,000	21,000	14,000	-93,000
2027 (W)	-130,000	18,000	13,000	-100,000
2028 (W)	-130,000	18,000	11,000	-100,000
2029 (C)	-120,000	20,000	11,000	-92,000
2030 (C)	-110,000	23,000	12,000	-78,000
2031 (AN)	-130,000	23,000	12,000	-90,000
2032 (BN)	-120,000	25,000	11,000	-85,000
2033 (AN)	-120,000	25,000	11,000	-88,000
2034 (D)	-130,000	25,000	10,000	-93,000
2035 (W)	-130,000	23,000	10,000	-98,000
2036 (W)	-140,000	22,000	10,000	-110,000
2037 (W)	-140,000	18,000	9,300	-110,000
2038 (D)	-130,000	17,000	9,200	-100,000
2039 (W)	-130,000	18,000	10,000	-100,000
2040 (D)	-120,000	18,000	9,700	-96,000
2041 (C)	-120,000	22,000	9,900	-84,000
2042 (D)	-110,000	24,000	10,000	-79,000
2043 (C)	-110,000	27,000	11,000	-74,000
2044 (C)	-110,000	29,000	11,000	-71,000
2045 (C)	-110,000	29,000	11,000	-74,000
2046 (AN)	-130,000	28,000	11,000	-89,000
2047 (C)	-120,000	28,000	9,900	-82,000
2048 (W)	-130,000	26,000	10,000	-92,000
2049 (W)	-130,000	23,000	9,600	-100,000
2050 (W)	-130,000	22,000	9,300	-98,000
2051 (W)	-140,000	22,000	9,900	-100,000
2052 (W)	-140,000	18,000	9,000	-110,000
2053 (AN)	-130,000	18,000	9,500	-100,000
2054 (D)	-120,000	19,000	9,700	-94,000
2055 (D)	-130,000	21,000	9,800	-95,000
2056 (AN)	-130,000	21,000	10,000	-98,000
2057 (BN)	-130,000	20,000	9,700	-100,000
2058 (AN)	-130,000	20,000	9,600	-100,000

Water Year (Type)		Red Bluff	Anderson	South Battle Creek	Total
2059 (W)		-130,000	19,000	9,600	-110,000
2060 (D)		-120,000	19,000	9,300	-92,000
2061 (C)		-120,000	23,000	10,000	-85,000
2062 (D)		-120,000	26,000	10,000	-80,000
2063 (BN)		-120,000	26,000	10,000	-87,000
2064 (W)		-130,000	25,000	10,000	-95,000
2065 (BN)		-120,000	25,000	9,800	-86,000
2066 (D)		-120,000	27,000	10,000	-83,000
2067 (C)		-110,000	29,000	11,000	-71,000
2068 (C)		-110,000	30,000	11,000	-74,000
2069 (BN)		-120,000	30,000	11,000	-80,000
2070 (W)		-130,000	27,000	11,000	-95,000
2071 (BN)		-120,000	26,000	10,000	-83,000
2072 (W)		-130,000	27,000	11,000	-90,000
Average (2022-2072)		-130,000	23,000	11,000	-91,000
2022 - 2072	W	-130,000	21,000	11,000	-100,000
	AN	-130,000	22,000	11,000	-94,000
	BN	-120,000	24,000	11,000	-87,000
	D	-120,000	22,000	9,800	-91,000
	C	-120,000	26,000	11,000	-79,000

Note: positive values represent net inflows to Bowman Subbasin, negative values represent net outflows from Bowman Subbasin.

3.4.2 Deep Percolation From the SWS

Deep percolation from the SWS includes infiltration of water below the root zone (deep percolation) from precipitation and applied water. These two water budget components are summarized in the SWS water budget as outflows to the SWS and are presented as aggregated deep percolation inflows to the GWS in **Figure 61** and **Table 59**. The average annual deep percolation from the SWS over the projected (future land use) water budget period is approximately 53 taf per year. Greater volumes of deep percolation occur during wetter years when infiltration of precipitation is higher.

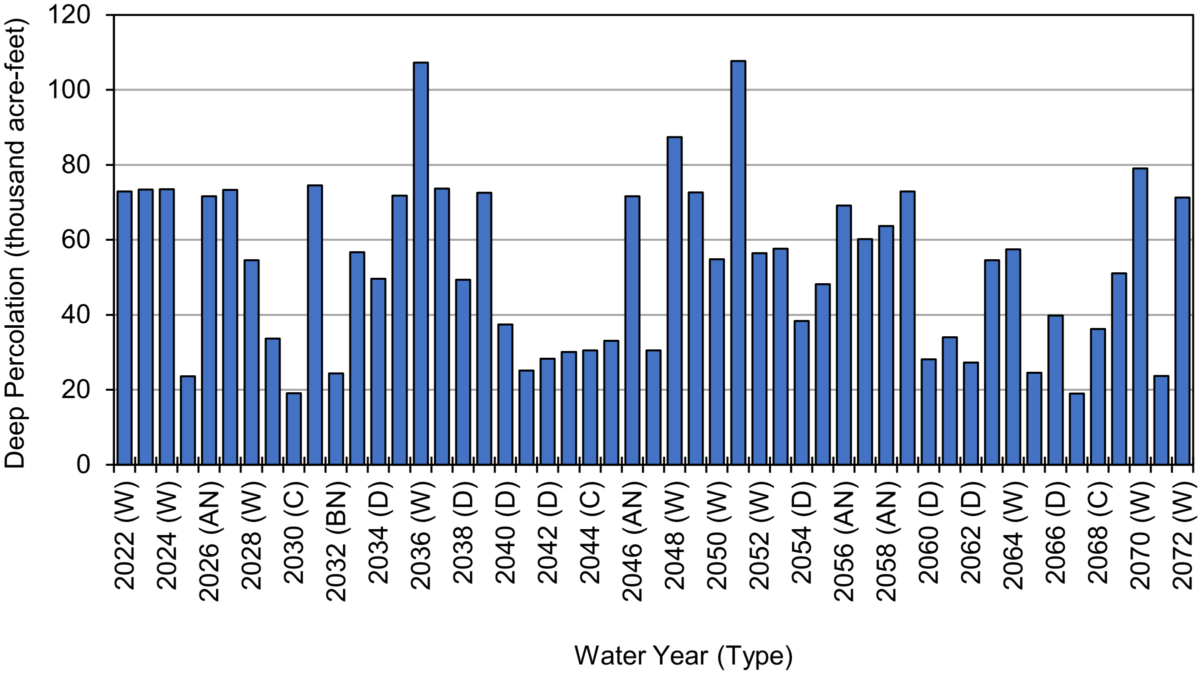


Figure 61. Bowman Subbasin Projected (Future Land Use) Deep Percolation

Table 59. Bowman Subbasin Projected (Future Land Use) Deep Percolation from the SWS (acre-feet)

Water Year (Type)	Deep Percolation from the SWS
2022 (W)	73,000
2023 (W)	73,000
2024 (W)	74,000
2025 (BN)	24,000
2026 (AN)	72,000
2027 (W)	73,000
2028 (W)	55,000
2029 (C)	34,000
2030 (C)	19,000
2031 (AN)	75,000
2032 (BN)	24,000
2033 (AN)	57,000
2034 (D)	50,000
2035 (W)	72,000
2036 (W)	110,000
2037 (W)	74,000
2038 (D)	49,000
2039 (W)	73,000
2040 (D)	37,000
2041 (C)	25,000
2042 (D)	28,000
2043 (C)	30,000
2044 (C)	30,000
2045 (C)	33,000
2046 (AN)	72,000
2047 (C)	30,000
2048 (W)	87,000
2049 (W)	73,000
2050 (W)	55,000
2051 (W)	110,000
2052 (W)	56,000
2053 (AN)	58,000
2054 (D)	38,000
2055 (D)	48,000
2056 (AN)	69,000
2057 (BN)	60,000
2058 (AN)	64,000

Water Year (Type)		Deep Percolation from the SWS
2059 (W)		73,000
2060 (D)		28,000
2061 (C)		34,000
2062 (D)		27,000
2063 (BN)		55,000
2064 (W)		57,000
2065 (BN)		25,000
2066 (D)		40,000
2067 (C)		19,000
2068 (C)		36,000
2069 (BN)		51,000
2070 (W)		79,000
2071 (BN)		24,000
2072 (W)		71,000
Average (2022-2072)		53,000
2022 - 2072	W	74,000
	AN	66,000
	BN	37,000
	D	38,000
	C	29,000

3.4.3 Net Stream Seepage/Groundwater Discharge to Surface Water

The flow of water between the GWS and SWS through seepage of water from streams and canals and groundwater discharging into streams is discussed as part of the SWS water budget. These components are combined for presentation in the GWS water budget as a net volume of stream seepage (**Figure 62** and **Table 60**). Positive total net seepage values represent a net inflow of water from the SWS to the GWS via stream and canal seepage indicating that the overall volume of stream seepage is greater than the volume of any groundwater discharging into surface waterways. Negative net seepage values represent a net outflow of groundwater from the GWS to the SWS through groundwater discharge to surface water. When net seepage is negative, it means that more groundwater is discharging into the surface waterways than is seeping from surface waterways into the GWS.

In the Bowman Subbasin, the projected (future land use) annual net seepage values are always positive with an average annual net stream seepage value of 47 taf per year indicating net addition of water to the GWS through the exchanges with surface waterways. The annual net stream seepage values tend to be higher in wet years in comparison to dry years corresponding with more groundwater recharge from surface water in wet years and less groundwater recharge in dry years.

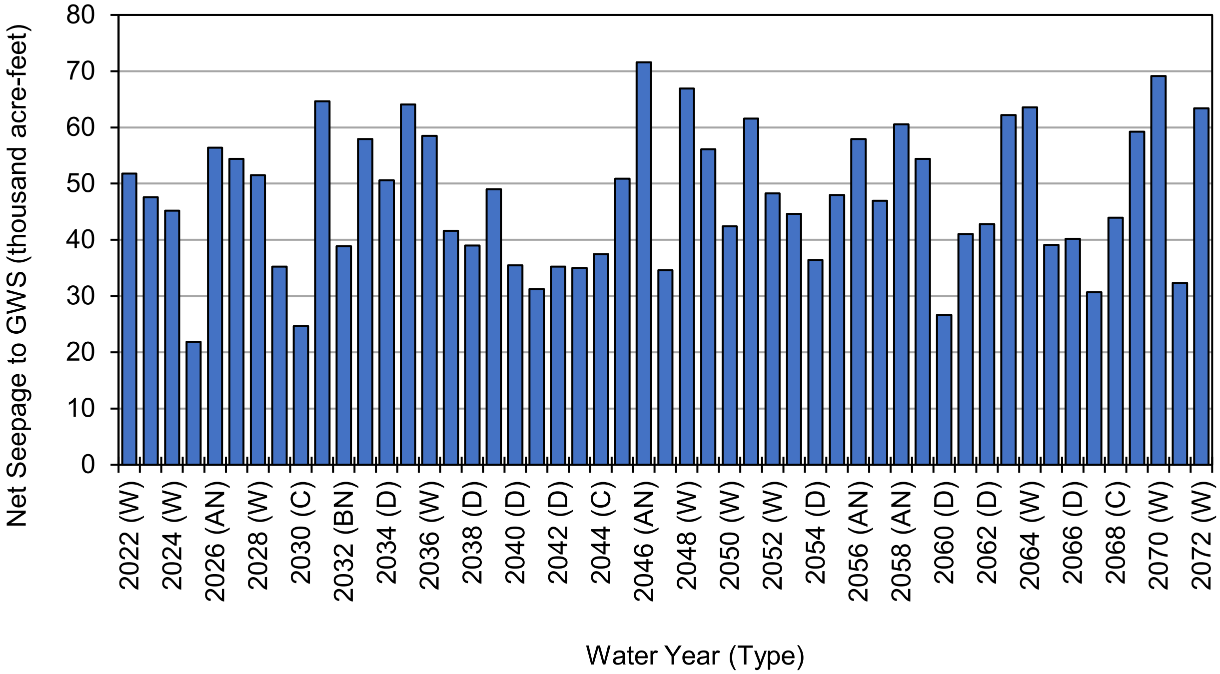


Figure 62. Bowman Subbasin Projected (Future Land Use) Net Stream Seepage to GWS/Discharge to Surface Water

Table 60. Bowman Subbasin Projected (Future Land Use) Net Stream Seepage (net flows as acre-feet)

Water Year (Type)	Total Net Seepage from Surface Waterways and Canals
2022 (W)	52,000
2023 (W)	48,000
2024 (W)	45,000
2025 (BN)	22,000
2026 (AN)	56,000
2027 (W)	54,000
2028 (W)	51,000
2029 (C)	35,000
2030 (C)	25,000
2031 (AN)	65,000
2032 (BN)	39,000
2033 (AN)	58,000
2034 (D)	51,000
2035 (W)	64,000
2036 (W)	59,000
2037 (W)	42,000
2038 (D)	39,000
2039 (W)	49,000
2040 (D)	35,000
2041 (C)	31,000
2042 (D)	35,000
2043 (C)	35,000
2044 (C)	37,000
2045 (C)	51,000
2046 (AN)	72,000
2047 (C)	35,000
2048 (W)	67,000
2049 (W)	56,000
2050 (W)	42,000
2051 (W)	62,000
2052 (W)	48,000
2053 (AN)	45,000
2054 (D)	36,000
2055 (D)	48,000
2056 (AN)	58,000
2057 (BN)	47,000
2058 (AN)	61,000

Water Year (Type)		Total Net Seepage from Surface Waterways and Canals
2059 (W)		54,000
2060 (D)		27,000
2061 (C)		41,000
2062 (D)		43,000
2063 (BN)		62,000
2064 (W)		64,000
2065 (BN)		39,000
2066 (D)		40,000
2067 (C)		31,000
2068 (C)		44,000
2069 (BN)		59,000
2070 (W)		69,000
2071 (BN)		32,000
2072 (W)		63,000
Average (2022-2072)		47,000
2022 - 2072	W	55,000
	AN	59,000
	BN	43,000
	D	39,000
	C	36,000

Note: negative values indicate net groundwater discharge to surface water

3.4.4 Groundwater Extraction

Groundwater extractions are exchanges that occur between the GWS and the SWS. Groundwater extraction from the GWS occurs through groundwater pumping to meet water demands for urban and agricultural needs and also through groundwater (root water) uptake by plants directly from shallow groundwater during times and at locations of sufficiently shallow groundwater conditions. Projected (future land use) groundwater extractions are summarized in **Figure 63** and **Table 61** and also presented and discussed in the SWS water budget sections. Total groundwater extractions over the projected (future land use) water budget period average about -9.2 taf per year. Overall, groundwater pumping represents a larger fraction of the groundwater extractions than groundwater uptake. Groundwater pumping averaged about -6.4 taf over the projected (future land use) period and groundwater uptake averaged about -2.8 taf. In wetter periods, groundwater uptake increases and groundwater pumping decreases. Accordingly, during drier periods groundwater pumping increases and water uptake by plants from shallow groundwater decreases in response to the higher water demands for irrigation and other uses and the greater depths to groundwater that also tend to occur during dry periods.

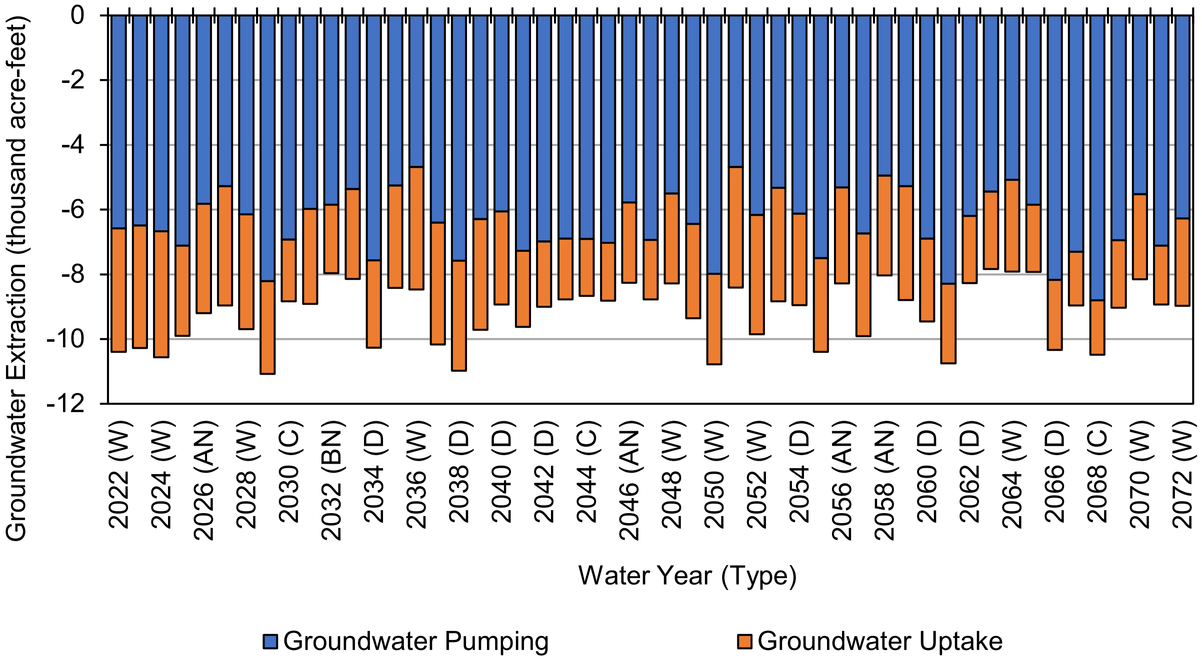


Figure 63. Bowman Subbasin Projected (Future Land Use) Groundwater Extractions

Table 61. Bowman Subbasin Projected (Future Land Use) Groundwater Extractions (acre-feet)

Water Year (Type)	Groundwater Pumping	Groundwater (Root Water) Uptake	Total Extractions
2022 (W)	-6,600	-3,800	-10,000
2023 (W)	-6,500	-3,800	-10,000
2024 (W)	-6,700	-3,900	-11,000
2025 (BN)	-7,100	-2,800	-9,900
2026 (AN)	-5,800	-3,400	-9,200
2027 (W)	-5,300	-3,700	-9,000
2028 (W)	-6,100	-3,600	-9,700
2029 (C)	-8,200	-2,900	-11,000
2030 (C)	-6,900	-1,900	-8,800
2031 (AN)	-6,000	-2,900	-8,900
2032 (BN)	-5,800	-2,100	-8,000
2033 (AN)	-5,400	-2,800	-8,100
2034 (D)	-7,600	-2,700	-10,000
2035 (W)	-5,300	-3,200	-8,400
2036 (W)	-4,700	-3,800	-8,500
2037 (W)	-6,400	-3,800	-10,000
2038 (D)	-7,600	-3,400	-11,000
2039 (W)	-6,300	-3,400	-9,700
2040 (D)	-6,100	-2,900	-8,900
2041 (C)	-7,300	-2,400	-9,600
2042 (D)	-7,000	-2,000	-9,000
2043 (C)	-6,900	-1,900	-8,800
2044 (C)	-6,900	-1,800	-8,700
2045 (C)	-7,000	-1,800	-8,800
2046 (AN)	-5,800	-2,500	-8,300
2047 (C)	-6,900	-1,800	-8,800
2048 (W)	-5,500	-2,800	-8,300
2049 (W)	-6,400	-2,900	-9,400
2050 (W)	-8,000	-2,800	-11,000
2051 (W)	-4,700	-3,700	-8,400
2052 (W)	-6,200	-3,700	-9,900
2053 (AN)	-5,300	-3,500	-8,800
2054 (D)	-6,100	-2,800	-9,000
2055 (D)	-7,500	-2,900	-10,000
2056 (AN)	-5,300	-3,000	-8,300
2057 (BN)	-6,700	-3,200	-9,900

Water Year (Type)		Groundwater Pumping	Groundwater (Root Water) Uptake	Total Extractions
2058 (AN)		-4,900	-3,100	-8,000
2059 (W)		-5,300	-3,500	-8,800
2060 (D)		-6,900	-2,600	-9,500
2061 (C)		-8,300	-2,500	-11,000
2062 (D)		-6,200	-2,100	-8,300
2063 (BN)		-5,400	-2,400	-7,800
2064 (W)		-5,100	-2,800	-7,900
2065 (BN)		-5,900	-2,100	-7,900
2066 (D)		-8,200	-2,200	-10,000
2067 (C)		-7,300	-1,700	-9,000
2068 (C)		-8,800	-1,700	-10,000
2069 (BN)		-6,900	-2,100	-9,000
2070 (W)		-5,500	-2,600	-8,200
2071 (BN)		-7,100	-1,800	-8,900
2072 (W)		-6,300	-2,700	-9,000
Average (2022-2072)		-6,400	-2,800	-9,200
2022 - 2072	W	-5,900	-3,400	-9,300
	AN	-5,500	-3,000	-8,500
	BN	-6,400	-2,300	-8,800
	D	-7,000	-2,600	-9,600
	C	-7,500	-2,000	-9,500

3.4.5 Vertical Subsurface Flows within the Groundwater System

Vertical subsurface flows within the GWS occur between the Upper and Lower Aquifers and represent an internal flow of water within the GWS. These exchanges between the principal aquifers do not directly affect the total volume of groundwater in storage, but do highlight the net vertical movement of water within the GWS. Projected (future land use) vertical flows between the Upper Aquifer and Lower Aquifer are summarized in **Figure 64** and **Table 62** and show consistent net overall downward flow from the Upper Aquifer to the Lower Aquifer. On average, vertical flows from the Upper Aquifer to the Lower Aquifer total about 89 taf per year over the projected (future land use) water budget period. There is considerable year-to-year variability in the magnitude of these flows, which appear to correlate with water year conditions, although they are always in the downward direction. The magnitude of downward flows are generally greatest during wet years and decrease during dry periods.

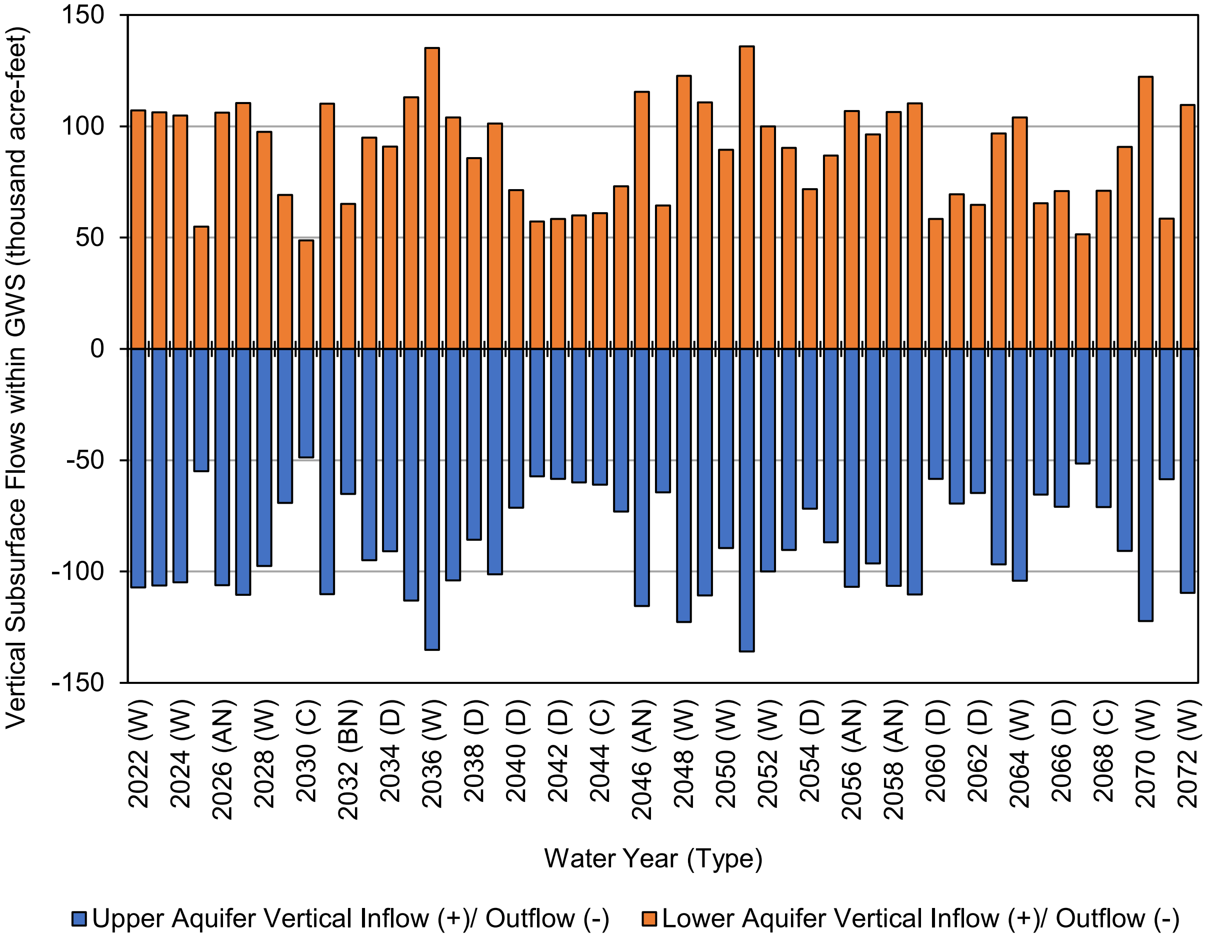


Figure 64. Bowman Subbasin Projected (Future Land Use) Vertical Subsurface Flow within the GWS

Table 62. Bowman Subbasin Projected (Future Land Use) Vertical Subsurface Flows within the GWS (acre-feet)

Water Year (Type)	Upper Aquifer to (-) / from (+) Lower Aquifer
2022 (W)	-110,000
2023 (W)	-110,000
2024 (W)	-100,000
2025 (BN)	-55,000
2026 (AN)	-110,000
2027 (W)	-110,000
2028 (W)	-98,000
2029 (C)	-69,000
2030 (C)	-49,000
2031 (AN)	-110,000
2032 (BN)	-65,000
2033 (AN)	-95,000
2034 (D)	-91,000
2035 (W)	-110,000
2036 (W)	-140,000
2037 (W)	-100,000
2038 (D)	-86,000
2039 (W)	-100,000
2040 (D)	-71,000
2041 (C)	-57,000
2042 (D)	-58,000
2043 (C)	-60,000
2044 (C)	-61,000
2045 (C)	-73,000
2046 (AN)	-120,000
2047 (C)	-64,000
2048 (W)	-120,000
2049 (W)	-110,000
2050 (W)	-89,000
2051 (W)	-140,000
2052 (W)	-100,000
2053 (AN)	-90,000
2054 (D)	-72,000
2055 (D)	-87,000
2056 (AN)	-110,000
2057 (BN)	-96,000
2058 (AN)	-110,000

Water Year (Type)		Upper Aquifer to (-) / from (+) Lower Aquifer
2059 (W)		-110,000
2060 (D)		-58,000
2061 (C)		-69,000
2062 (D)		-65,000
2063 (BN)		-97,000
2064 (W)		-100,000
2065 (BN)		-65,000
2066 (D)		-71,000
2067 (C)		-51,000
2068 (C)		-71,000
2069 (BN)		-91,000
2070 (W)		-120,000
2071 (BN)		-59,000
2072 (W)		-110,000
Average (2022-2072)		-89,000
2022 - 2072	W	-110,000
	AN	-100,000
	BN	-75,000
	D	-73,000
	C	-63,000

3.4.6 Change in Groundwater Storage

Projected (future land use) change in groundwater storage values for the Bowman Subbasin are summarized in **Figure 65** and **Figure 66,** and **Table 63**. Over the projected (future land use) period, the average total annual change in groundwater storage is about -0.3 taf per year, representing a very small decrease in groundwater storage. The corresponding cumulative total change in storage over the projected (future land use) period is about -15 taf. The annual change in storage numbers generally reflect the effects of the water year type with increase in storage occurring during wetter years and decreases in storage occurring during dry years.

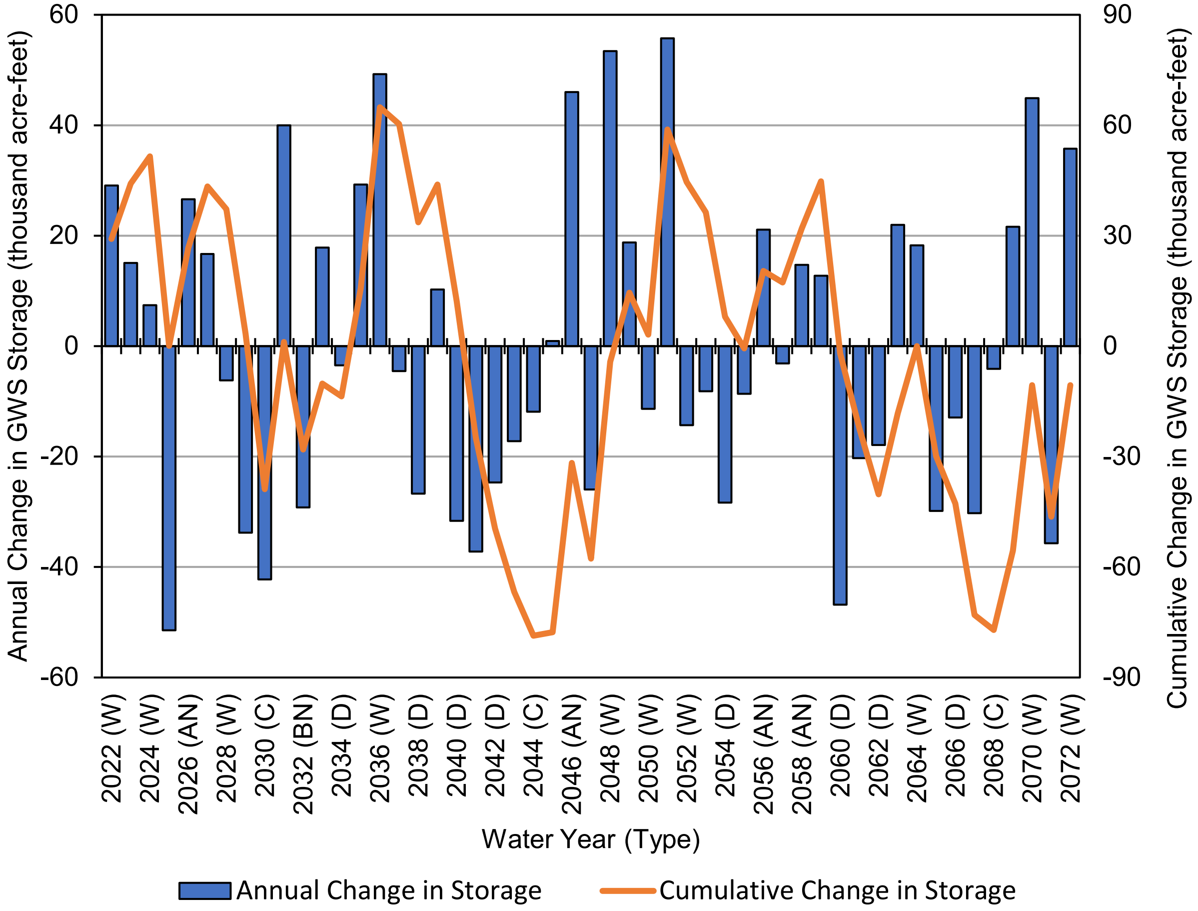


Figure 65. Bowman Subbasin Projected (Future Land Use) Projected (Future Land Use) Total Change in Storage within the GWS

Table 63. Bowman Subbasin Projected (Future Land Use) Change in Groundwater Storage (acre-feet)

Water Year (Type)	Upper Aquifer	Lower Aquifer	Total Annual Change	Total Cumulative Change
2022 (BN)	6,000	23,000	28,000	28,000
2023 (W)	2,000	13,000	14,000	42,000
2024 (W)	-120	7,500	6,800	49,000
2025 (W)	-21,000	-30,000	-52,000	-3,000
2026 (BN)	10,000	16,000	26,000	23,000
2027 (AN)	4,400	12,000	17,000	40,000
2028 (W)	-4,400	-1,800	-6,300	33,000
2029 (W)	-13,000	-20,000	-34,000	-580
2030 (C)	-14,000	-28,000	-43,000	-43,000
2031 (C)	17,000	23,000	40,000	-3,200
2032 (AN)	-12,000	-17,000	-29,000	-32,000
2033 (BN)	8,600	9,200	18,000	-14,000
2034 (AN)	-3,500	3	-3,400	-18,000
2035 (D)	11,000	19,000	29,000	11,000
2036 (W)	18,000	31,000	50,000	61,000
2037 (W)	-3,200	-1,300	-4,400	57,000
2038 (W)	-12,000	-15,000	-27,000	30,000
2039 (D)	6,800	3,500	10,000	40,000
2040 (W)	-11,000	-20,000	-32,000	8,500
2041 (D)	-13,000	-24,000	-37,000	-29,000
2042 (C)	-6,800	-18,000	-25,000	-54,000
2043 (D)	-5,000	-12,000	-17,000	-71,000
2044 (C)	-2,800	-9,100	-12,000	-83,000
2045 (C)	420	490	810	-82,000
2046 (C)	16,000	30,000	46,000	-36,000
2047 (AN)	-10,000	-16,000	-26,000	-62,000
2048 (C)	20,000	33,000	54,000	-8,300
2049 (W)	5,200	14,000	19,000	10,000
2050 (W)	-6,200	-5,200	-11,000	-1,100
2051 (W)	21,000	34,000	56,000	55,000
2052 (W)	-9,300	-5,000	-14,000	41,000
2053 (W)	-1,100	-7,100	-8,300	32,000
2054 (AN)	-9,700	-19,000	-28,000	4,200
2055 (D)	-4,000	-4,600	-8,800	-4,700
2056 (D)	8,500	13,000	21,000	16,000
2057 (AN)	-2,600	-550	-3,300	13,000

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Upper Aquifer</th><th>Lower Aquifer</th><th>Total Annual Change</th><th>Total Cumulative Change</th></tr>
<tr><td colspan="2">2058 (BN)</td><td>5,800</td><td>8,900</td><td>15,000</td><td>28,000</td></tr>
<tr><td colspan="2">2059 (AN)</td><td>3,800</td><td>9,000</td><td>13,000</td><td>41,000</td></tr>
<tr><td colspan="2">2060 (W)</td><td>-17,000</td><td>-30,000</td><td>-47,000</td><td>-6,200</td></tr>
<tr><td colspan="2">2061 (D)</td><td>-7,300</td><td>-13,000</td><td>-20,000</td><td>-27,000</td></tr>
<tr><td colspan="2">2062 (C)</td><td>-5,100</td><td>-13,000</td><td>-18,000</td><td>-45,000</td></tr>
<tr><td colspan="2">2063 (D)</td><td>9,500</td><td>12,000</td><td>22,000</td><td>-23,000</td></tr>
<tr><td colspan="2">2064 (BN)</td><td>5,900</td><td>12,000</td><td>18,000</td><td>-4,100</td></tr>
<tr><td colspan="2">2065 (W)</td><td>-12,000</td><td>-18,000</td><td>-30,000</td><td>-34,000</td></tr>
<tr><td colspan="2">2066 (BN)</td><td>-3,200</td><td>-9,700</td><td>-13,000</td><td>-47,000</td></tr>
<tr><td colspan="2">2067 (D)</td><td>-11,000</td><td>-19,000</td><td>-31,000</td><td>-78,000</td></tr>
<tr><td colspan="2">2068 (C)</td><td>-1,300</td><td>-2,800</td><td>-4,400</td><td>-82,000</td></tr>
<tr><td colspan="2">2069 (C)</td><td>9,500</td><td>12,000</td><td>22,000</td><td>-61,000</td></tr>
<tr><td colspan="2">2070 (BN)</td><td>15,000</td><td>30,000</td><td>45,000</td><td>-15,000</td></tr>
<tr><td colspan="2">2071 (W)</td><td>-13,000</td><td>-23,000</td><td>-36,000</td><td>-51,000</td></tr>
<tr><td colspan="2">2072 (W)</td><td>14,000</td><td>22,000</td><td>36,000</td><td>-15,000</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>-300</td><td>100</td><td>-300</td><td></td></tr>
<tr><td rowspan="5">2022-2072</td><td>W</td><td>6,100</td><td>14,000</td><td>20,000</td><td></td></tr>
<tr><td>AN</td><td>9,400</td><td>13,000</td><td>23,000</td><td></td></tr>
<tr><td>BN</td><td>-6,000</td><td>-9,100</td><td>-15,000</td><td></td></tr>
<tr><td>D</td><td>-8,100</td><td>-14,000</td><td>-22,000</td><td></td></tr>
<tr><td>C</td><td>-7,800</td><td>-14,000</td><td>-22,000</td><td></td></tr>
</table>

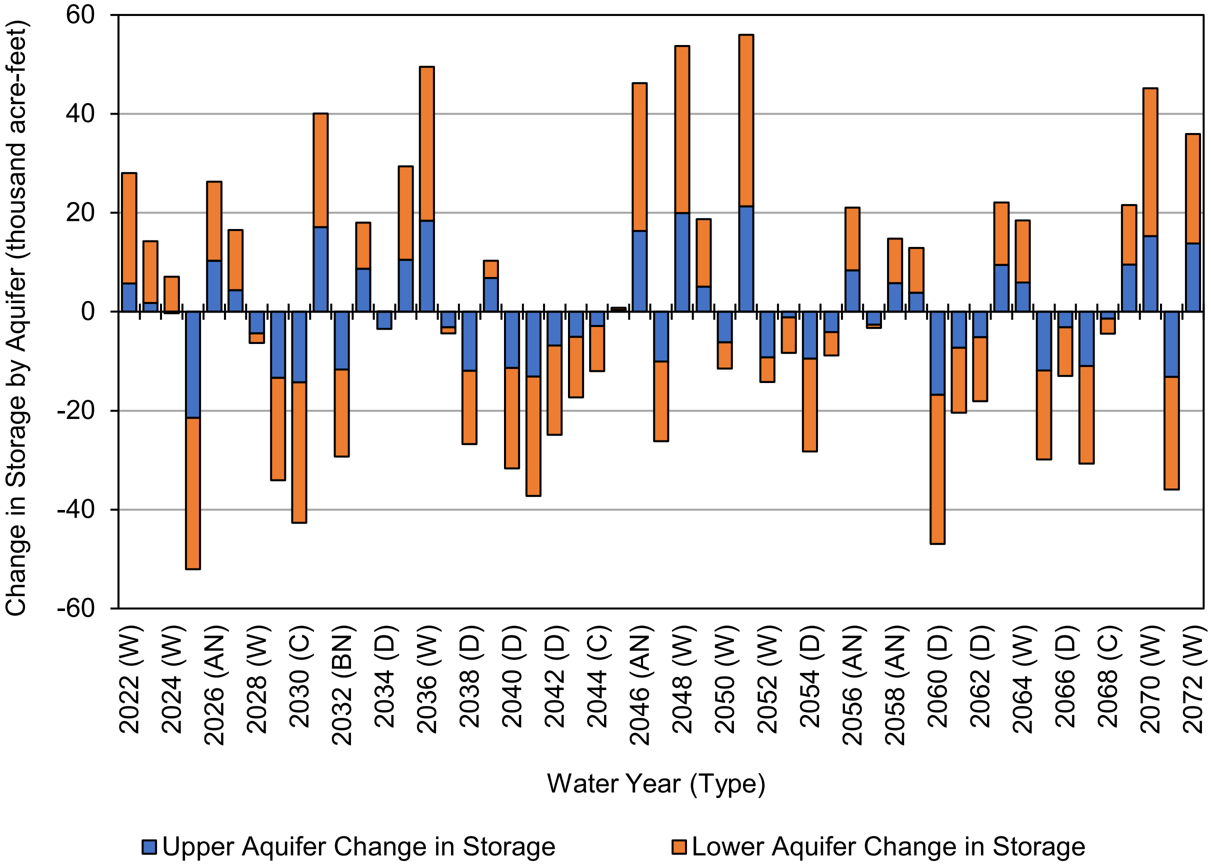


Figure 66. Bowman Subbasin Projected (Future Land Use) Change in Groundwater Storage by Aquifer

4 DETAILED PROJECTED (FUTURE LAND USE WITH CLIMATE CHANGE) WATER BUDGET

This section presents the results of the Projected (Future Land Use with Climate Change) scenario. This scenario assumes constant land use conditions based on assumed projected development within the Bowman Subbasin and the DWR climate change guidance for the 2070 central tendencies.

4.3 Surface Water System Water Budget Results

4.3.1 Inflows

4.3.1.1 Surface Water Inflow by Water Source Type

The projected annual volume of surface water inflows is summarized by water source type in **Figure 67** and **Table 64**. Over the projected (future land use with climate change) period, surface water inflows average about 92 taf per year. On average, inflows of local supplies and CVP supplies average about 74 and 18 taf per year, respectively.

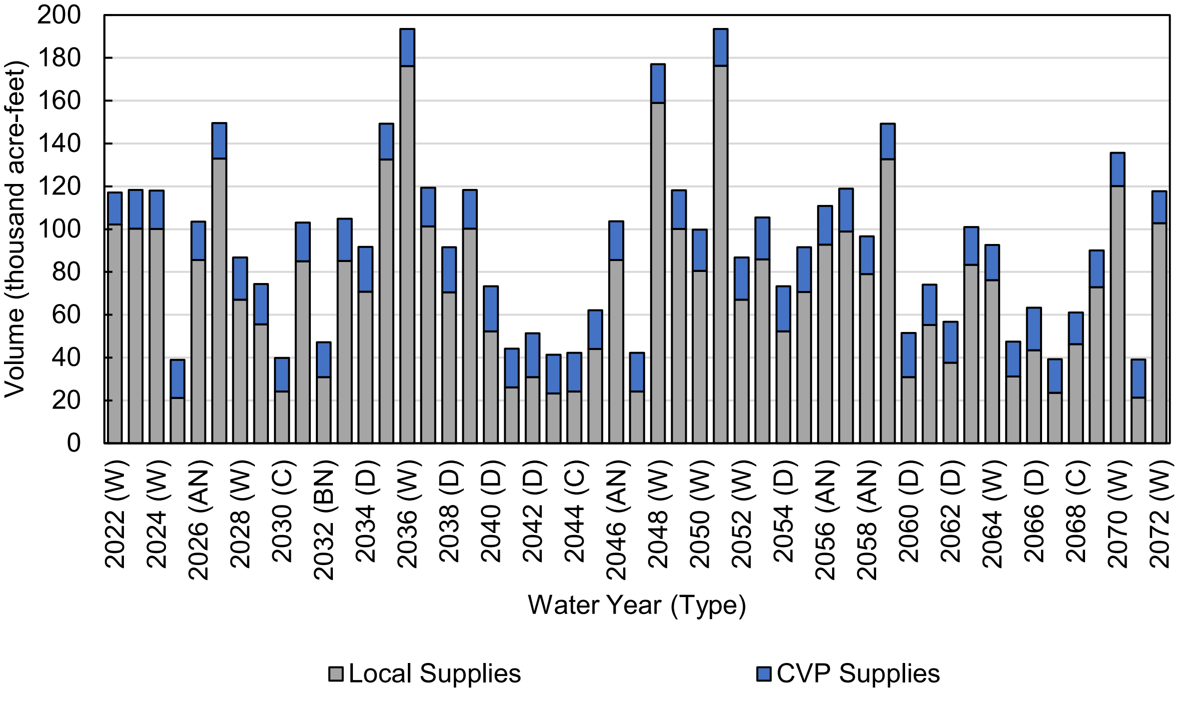


Figure 67. Bowman Subbasin Projected (Future Land Use with Climate Change) Surface Water Inflows, by Water Source Type

Table 64. Bowman Subbasin Projected (Future Land Use with Climate Change) Surface Water Inflows, by Water Source Type (acre-feet)

Water Year (Type)	CVP Supplies	Local Supplies	Total
2022 (W)	15,000	100,000	120,000
2023 (W)	18,000	100,000	120,000
2024 (W)	18,000	100,000	120,000
2025 (BN)	18,000	21,000	39,000
2026 (AN)	18,000	86,000	100,000
2027 (W)	17,000	130,000	150,000
2028 (W)	20,000	67,000	87,000
2029 (C)	19,000	56,000	74,000
2030 (C)	16,000	24,000	40,000
2031 (AN)	18,000	85,000	100,000
2032 (BN)	16,000	31,000	47,000
2033 (AN)	20,000	85,000	100,000
2034 (D)	21,000	71,000	92,000
2035 (W)	17,000	130,000	150,000
2036 (W)	17,000	180,000	190,000
2037 (W)	18,000	100,000	120,000
2038 (D)	21,000	71,000	92,000
2039 (W)	18,000	100,000	120,000
2040 (D)	21,000	52,000	73,000
2041 (C)	18,000	26,000	44,000
2042 (D)	21,000	31,000	51,000
2043 (C)	18,000	23,000	41,000
2044 (C)	18,000	24,000	42,000
2045 (C)	18,000	44,000	62,000
2046 (AN)	18,000	86,000	100,000
2047 (C)	18,000	24,000	42,000
2048 (W)	18,000	160,000	180,000
2049 (W)	18,000	100,000	120,000
2050 (W)	19,000	80,000	100,000
2051 (W)	17,000	180,000	190,000
2052 (W)	20,000	67,000	87,000
2053 (AN)	20,000	86,000	110,000
2054 (D)	21,000	52,000	73,000
2055 (D)	21,000	71,000	92,000

Water Year (Type)		CVP Supplies	Local Supplies	Total
2056 (AN)		18,000	93,000	110,000
2057 (BN)		20,000	99,000	120,000
2058 (AN)		18,000	79,000	97,000
2059 (W)		17,000	130,000	150,000
2060 (D)		21,000	31,000	52,000
2061 (C)		19,000	55,000	74,000
2062 (D)		19,000	38,000	57,000
2063 (BN)		18,000	83,000	100,000
2064 (W)		16,000	76,000	93,000
2065 (BN)		16,000	31,000	47,000
2066 (D)		20,000	43,000	63,000
2067 (C)		16,000	24,000	39,000
2068 (C)		15,000	46,000	61,000
2069 (BN)		17,000	73,000	90,000
2070 (W)		16,000	120,000	140,000
2071 (BN)		18,000	21,000	39,000
2072 (W)		15,000	100,000	120,000
Average (2022-2072)		18,000	74,000	92,000
2022-2072	W	17,000	110,000	130,000
	AN	18,000	86,000	100,000
	BN	18,000	51,000	69,000
	D	21,000	51,000	72,000
	C	17,000	35,000	52,000

4.3.1.2 Precipitation

Precipitation estimates for the Bowman Subbasin are provided in **Figure 68** and **Table 65**. Total precipitation is highly variable between years in the study area, ranging from approximately 220 taf (21.5 inches) during average critically dry years to 420 taf (41.0 inches) during average wet years.

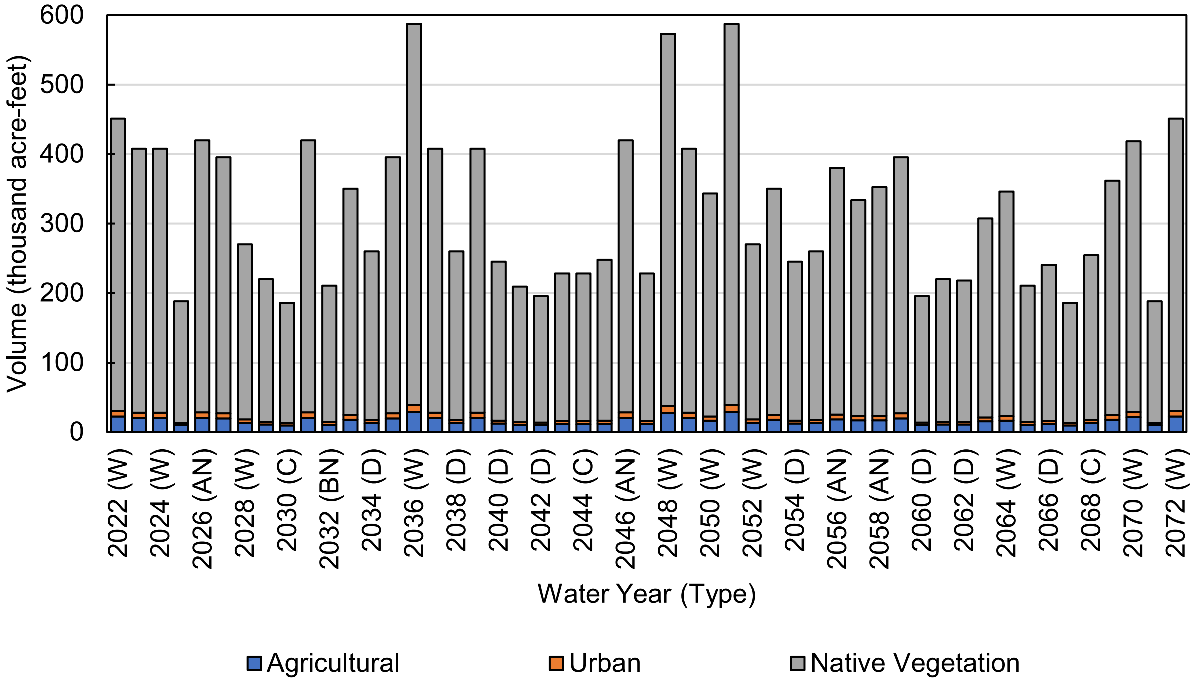


Figure 68. Bowman Subbasin Projected (Future Land Use with Climate Change) Precipitation, by Water Use Sector

Table 65. Bowman Subbasin Projected (Future Land Use with Climate Change) Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	23,000	8,100	420,000	450,000
2023 (W)	20,000	7,400	380,000	410,000
2024 (W)	20,000	7,400	380,000	410,000
2025 (W)	9,800	3,500	180,000	190,000
2026 (BN)	21,000	7,500	390,000	420,000
2027 (AN)	20,000	7,000	370,000	400,000
2028 (W)	13,000	4,800	250,000	270,000
2029 (W)	11,000	3,900	210,000	220,000
2030 (C)	9,800	3,500	170,000	190,000
2031 (C)	21,000	7,500	390,000	420,000
2032 (AN)	11,000	3,800	200,000	210,000
2033 (BN)	18,000	6,500	330,000	350,000
2034 (AN)	13,000	4,600	240,000	260,000
2035 (D)	20,000	7,000	370,000	400,000
2036 (W)	29,000	10,000	550,000	590,000
2037 (W)	20,000	7,400	380,000	410,000
2038 (W)	13,000	4,600	240,000	260,000
2039 (D)	20,000	7,400	380,000	410,000
2040 (W)	12,000	4,400	230,000	250,000
2041 (D)	11,000	3,800	200,000	210,000
2042 (C)	10,000	3,600	180,000	200,000
2043 (D)	12,000	4,200	210,000	230,000
2044 (C)	12,000	4,200	210,000	230,000
2045 (C)	12,000	4,300	230,000	250,000
2046 (C)	21,000	7,500	390,000	420,000
2047 (AN)	12,000	4,200	210,000	230,000
2048 (C)	28,000	10,000	540,000	570,000
2049 (W)	20,000	7,400	380,000	410,000
2050 (W)	17,000	6,100	320,000	340,000
2051 (W)	29,000	10,000	550,000	590,000
2052 (W)	13,000	4,800	250,000	270,000
2053 (W)	18,000	6,500	330,000	350,000
2054 (AN)	12,000	4,400	230,000	250,000
2055 (D)	13,000	4,600	240,000	260,000
2056 (D)	18,000	6,700	360,000	380,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (AN)		17,000	6,000	310,000	330,000
2058 (BN)		17,000	6,200	330,000	350,000
2059 (AN)		20,000	7,000	370,000	400,000
2060 (W)		10,000	3,600	180,000	200,000
2061 (D)		11,000	3,900	210,000	220,000
2062 (C)		11,000	3,900	200,000	220,000
2063 (D)		16,000	5,500	290,000	310,000
2064 (BN)		17,000	6,000	320,000	350,000
2065 (W)		11,000	3,800	200,000	210,000
2066 (BN)		12,000	4,300	220,000	240,000
2067 (D)		9,800	3,500	170,000	190,000
2068 (C)		13,000	4,600	240,000	250,000
2069 (C)		18,000	6,500	340,000	360,000
2070 (BN)		21,000	7,600	390,000	420,000
2071 (W)		9,800	3,500	180,000	190,000
2072 (W)		23,000	8,100	420,000	450,000
Average (2022-2072)		16,000	5,800	300,000	320,000
2022-2072	W	21,000	7,500	390,000	420,000
	AN	19,000	6,900	360,000	380,000
	BN	13,000	4,700	240,000	260,000
	D	12,000	4,200	220,000	240,000
	C	11,000	4,000	210,000	220,000

4.3.1.3 Groundwater Extraction by Water Use Sector

Total groundwater extraction in the Bowman Subbasin represents a combination of groundwater pumping to support agricultural and urban water demands, including rural residential use, and groundwater uptake by crops, urban vegetation, and native vegetation.

Estimates of groundwater pumping by water use sector are provided in **Figure 69** and **Table 66**. Majority of groundwater pumping in the Bowman Subbasin is used to meet agricultural demand, averaging 5.7 taf per year. Groundwater pumping for urban use is approximately 1.4 taf per year. The total groundwater extraction varies from about 6.0 taf in above-normal years to 8.4 taf in critically dry years based on variability in surface water supplies, precipitation, and crop water demand. When groundwater is near the land surface, groundwater uptake can also be a source of supply for vegetation. Estimates of groundwater uptake by vegetation are provided in **Figure 70** and **Table 67**. The majority of groundwater uptake is consumed directly by native vegetation and agricultural crops, totaling 2.5 taf and 0.3 taf per year, on average.

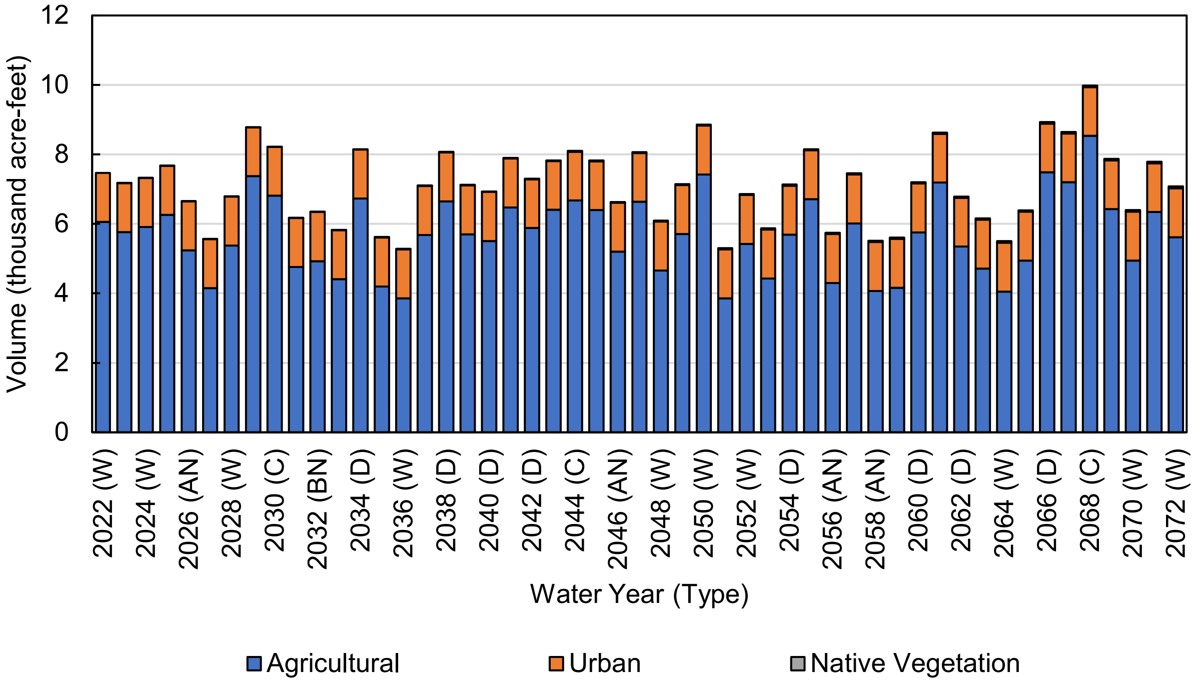


Figure 69. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Pumping, by Water Use Sector

Table 66. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Pumping, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	6,100	1,400	0	7,500
2023 (W)	5,800	1,400	0	7,200
2024 (W)	5,900	1,400	0	7,300
2025 (W)	6,300	1,400	0	7,700
2026 (BN)	5,200	1,400	0	6,700
2027 (AN)	4,200	1,400	0	5,600
2028 (W)	5,400	1,400	0	6,800
2029 (W)	7,400	1,400	0	8,800
2030 (C)	6,800	1,400	0	8,200
2031 (C)	4,800	1,400	0	6,200
2032 (AN)	4,900	1,400	0	6,300
2033 (BN)	4,400	1,400	0	5,800
2034 (AN)	6,700	1,400	0	8,100
2035 (D)	4,200	1,400	0	5,600
2036 (W)	3,900	1,400	0	5,300
2037 (W)	5,700	1,400	0	7,100
2038 (W)	6,700	1,400	0	8,100
2039 (D)	5,700	1,400	0	7,100
2040 (W)	5,500	1,400	0	6,900
2041 (D)	6,500	1,400	0	7,900
2042 (C)	5,900	1,400	0	7,300
2043 (D)	6,400	1,400	0	7,800
2044 (C)	6,700	1,400	0	8,100
2045 (C)	6,400	1,400	0	7,800
2046 (C)	5,200	1,400	0	6,600
2047 (AN)	6,600	1,400	0	8,000
2048 (C)	4,700	1,400	0	6,100
2049 (W)	5,700	1,400	0	7,100
2050 (W)	7,400	1,400	0	8,800
2051 (W)	3,900	1,400	0	5,300
2052 (W)	5,400	1,400	0	6,800
2053 (W)	4,400	1,400	0	5,800
2054 (AN)	5,700	1,400	0	7,100
2055 (D)	6,700	1,400	0	8,100
2056 (D)	4,300	1,400	0	5,700

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Agricultural</th><th>Urban</th><th>Native Vegetation</th><th>Total</th></tr>
<tr><td colspan="2">2057 (AN)</td><td>6,000</td><td>1,400</td><td>0</td><td>7,400</td></tr>
<tr><td colspan="2">2058 (BN)</td><td>4,100</td><td>1,400</td><td>0</td><td>5,500</td></tr>
<tr><td colspan="2">2059 (AN)</td><td>4,200</td><td>1,400</td><td>0</td><td>5,600</td></tr>
<tr><td colspan="2">2060 (W)</td><td>5,800</td><td>1,400</td><td>0</td><td>7,200</td></tr>
<tr><td colspan="2">2061 (D)</td><td>7,200</td><td>1,400</td><td>0</td><td>8,600</td></tr>
<tr><td colspan="2">2062 (C)</td><td>5,400</td><td>1,400</td><td>0</td><td>6,800</td></tr>
<tr><td colspan="2">2063 (D)</td><td>4,700</td><td>1,400</td><td>0</td><td>6,100</td></tr>
<tr><td colspan="2">2064 (BN)</td><td>4,100</td><td>1,400</td><td>0</td><td>5,500</td></tr>
<tr><td colspan="2">2065 (W)</td><td>4,900</td><td>1,400</td><td>0</td><td>6,400</td></tr>
<tr><td colspan="2">2066 (BN)</td><td>7,500</td><td>1,400</td><td>0</td><td>8,900</td></tr>
<tr><td colspan="2">2067 (D)</td><td>7,200</td><td>1,400</td><td>0</td><td>8,600</td></tr>
<tr><td colspan="2">2068 (C)</td><td>8,500</td><td>1,400</td><td>0</td><td>9,900</td></tr>
<tr><td colspan="2">2069 (C)</td><td>6,400</td><td>1,400</td><td>0</td><td>7,800</td></tr>
<tr><td colspan="2">2070 (BN)</td><td>4,900</td><td>1,400</td><td>0</td><td>6,400</td></tr>
<tr><td colspan="2">2071 (W)</td><td>6,300</td><td>1,400</td><td>0</td><td>7,700</td></tr>
<tr><td colspan="2">2072 (W)</td><td>5,600</td><td>1,400</td><td>0</td><td>7,000</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>5,700</td><td>1,400</td><td>0</td><td>7,100</td></tr>
<tr><td rowspan="5">2022-2072</td><td>W</td><td>5,100</td><td>1,400</td><td>0</td><td>6,600</td></tr>
<tr><td>AN</td><td>4,600</td><td>1,400</td><td>0</td><td>6,000</td></tr>
<tr><td>BN</td><td>5,700</td><td>1,400</td><td>0</td><td>7,100</td></tr>
<tr><td>D</td><td>6,200</td><td>1,400</td><td>0</td><td>7,600</td></tr>
<tr><td>C</td><td>7,000</td><td>1,400</td><td>0</td><td>8,400</td></tr>
</table>

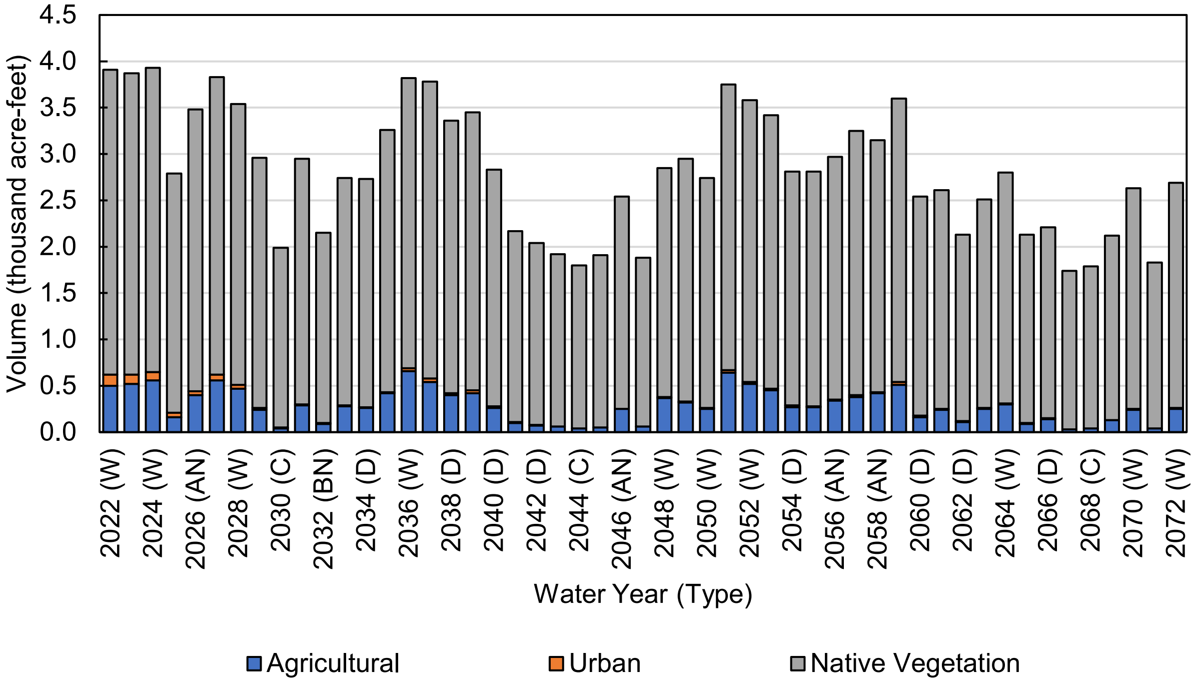


Figure 70. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Uptake, by Water Use Sector

Table 67. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Uptake, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (BN)	500	120	3,300	3,900
2023 (W)	520	100	3,300	3,900
2024 (W)	560	90	3,300	3,900
2025 (W)	160	50	2,600	2,800
2026 (BN)	400	40	3,000	3,500
2027 (AN)	560	60	3,200	3,800
2028 (W)	470	40	3,000	3,500
2029 (W)	240	20	2,700	3,000
2030 (C)	40	10	1,900	2,000
2031 (C)	290	10	2,700	3,000
2032 (AN)	90	10	2,100	2,200
2033 (BN)	280	10	2,500	2,700
2034 (AN)	260	10	2,500	2,700
2035 (D)	420	10	2,800	3,300
2036 (W)	660	30	3,100	3,800
2037 (W)	540	40	3,200	3,800
2038 (W)	400	20	2,900	3,400
2039 (D)	420	30	3,000	3,500
2040 (W)	260	20	2,600	2,800
2041 (D)	100	10	2,100	2,200
2042 (C)	70	10	2,000	2,000
2043 (D)	60	0	1,900	1,900
2044 (C)	40	0	1,800	1,800
2045 (C)	50	0	1,900	1,900
2046 (C)	250	0	2,300	2,500
2047 (AN)	60	0	1,800	1,900
2048 (C)	370	10	2,500	2,900
2049 (W)	320	10	2,600	3,000
2050 (W)	250	10	2,500	2,700
2051 (W)	640	30	3,100	3,800
2052 (W)	520	20	3,000	3,600
2053 (W)	450	20	3,000	3,400
2054 (AN)	270	20	2,500	2,800
2055 (D)	270	10	2,500	2,800
2056 (D)	340	10	2,600	3,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (AN)		380	20	2,900	3,300
2058 (BN)		420	10	2,700	3,200
2059 (AN)		510	30	3,100	3,600
2060 (W)		160	20	2,400	2,500
2061 (D)		240	10	2,400	2,600
2062 (C)		110	10	2,000	2,100
2063 (D)		250	10	2,300	2,500
2064 (BN)		300	10	2,500	2,800
2065 (W)		90	10	2,000	2,100
2066 (BN)		140	10	2,100	2,200
2067 (D)		30	0	1,700	1,700
2068 (C)		40	0	1,800	1,800
2069 (C)		130	0	2,000	2,100
2070 (BN)		240	10	2,400	2,600
2071 (W)		40	0	1,800	1,800
2072 (W)		250	10	2,400	2,700
Average (2022-2072)		280	20	2,500	2,800
2022-2072	W	450	40	2,900	3,400
	AN	350	10	2,700	3,000
	BN	160	10	2,200	2,400
	D	220	10	2,400	2,600
	C	90	10	2,000	2,100

4.3.1.4 Groundwater Discharge to Surface Waterways

Groundwater discharge to surface water, as described herein, represents a gain, or increase of flow, in waterways that traverse or flow along the boundary of the Bowman Subbasin. Groundwater discharge in the Bowman Subbasin is calculated from the Tehama IHM as the net groundwater outflow to water reaches (i.e., groundwater discharge) in excess of groundwater inflows from waterway reaches (i.e., seepage). The total volume of estimated groundwater discharge to surface water is negligible in any given year, therefore set to zero throughout the projected (future land use with climate change) water budget period.

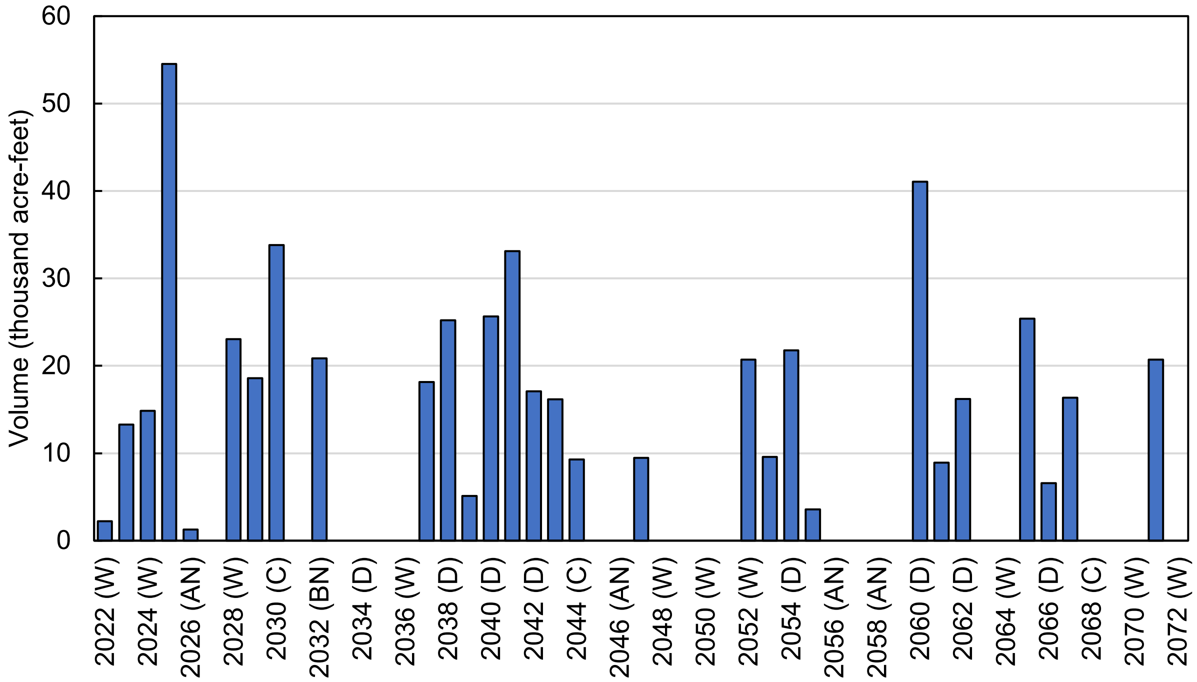


Figure 71. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Discharge to Surface Water

Table 68. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Discharge to Surface Water (acre-feet)

Water Year (Type)	Groundwater Discharge to Surface Water
2022 (BN)	2,200
2023 (W)	13,000
2024 (W)	15,000
2025 (W)	55,000
2026 (BN)	1,300
2027 (AN)	0
2028 (W)	23,000
2029 (W)	19,000
2030 (C)	34,000
2031 (C)	0
2032 (AN)	21,000
2033 (BN)	0
2034 (AN)	0
2035 (D)	0
2036 (W)	0
2037 (W)	18,000
2038 (W)	25,000
2039 (D)	5,100
2040 (W)	26,000
2041 (D)	33,000
2042 (C)	17,000
2043 (D)	16,000
2044 (C)	9,300
2045 (C)	0
2046 (C)	0
2047 (AN)	9,500
2048 (C)	0
2049 (W)	0
2050 (W)	0
2051 (W)	0
2052 (W)	21,000
2053 (W)	9,600
2054 (AN)	22,000
2055 (D)	3,600
2056 (D)	0

Water Year (Type)		Groundwater Discharge to Surface Water
2057 (AN)		0
2058 (BN)		0
2059 (AN)		0
2060 (W)		41,000
2061 (D)		8,900
2062 (C)		16,000
2063 (D)		0
2064 (BN)		0
2065 (W)		25,000
2066 (BN)		6,600
2067 (D)		16,000
2068 (C)		0
2069 (C)		0
2070 (BN)		0
2071 (W)		21,000
2072 (W)		0
Average (2022-2072)		10,000
2022-2072	W	5,400
	AN	1,600
	BN	17,000
	D	17,000
	C	15,000

4.3.2 Outflows

4.3.2.1 Evapotranspiration by Water Use Sector

Evapotranspiration (ET) by water use sector is reported in **Figure 72** through **Figure 75,** and **Table 69** through **Table 72**. First, total ET is reported, followed by ET from applied water (ET of water actively applied from surface water deliveries or groundwater pumping), ET of groundwater uptake (ET of shallow water extracted directly by vegetation), and ET from precipitation (ET of water supplied through rainfall).

Total ET varies between years, with a projected average of 180 taf per year. Agricultural ET tends to increase slightly in drier years due to increased climatic demand, while the ET of native vegetation typically decreases due to reduced water supply. ET of applied water occurs primarily from agricultural land, averaging about 11 taf in wet years and about 14 taf in years classified as critical. Native vegetation and agricultural crops in the Bowman Subbasin also directly consume shallow groundwater to meet a portion of their consumptive use requirements. ET of groundwater uptake by native vegetation and agricultural crops and totals 2.5 and 0.3 taf per year, on average. Urban ET of applied water is consistently very low and negligible.

ET of precipitation generally follows the pattern of precipitation, with higher volumes occurring in wet years when more precipitation occurs. Across all water use sectors, ET of precipitation in the Bowman Subbasin averages about 170 taf in wet and above-normal years and 150 taf in dry and critical water years. Much of the total ET of precipitation results from the large acreage of native vegetation in the Bowman Subbasin, though significant volumes result from agricultural and urban areas as well.

Evaporation from rivers, streams, and canals in the Bowman Subbasin is reported in **Figure 76** and **Table 73**. The total volume is relatively small and constant between years, averaging less than 1 taf per year. Evaporation from upgradient small watersheds is minimal, and is also not considered to substantially contribute to the subbasin SWS water budget.

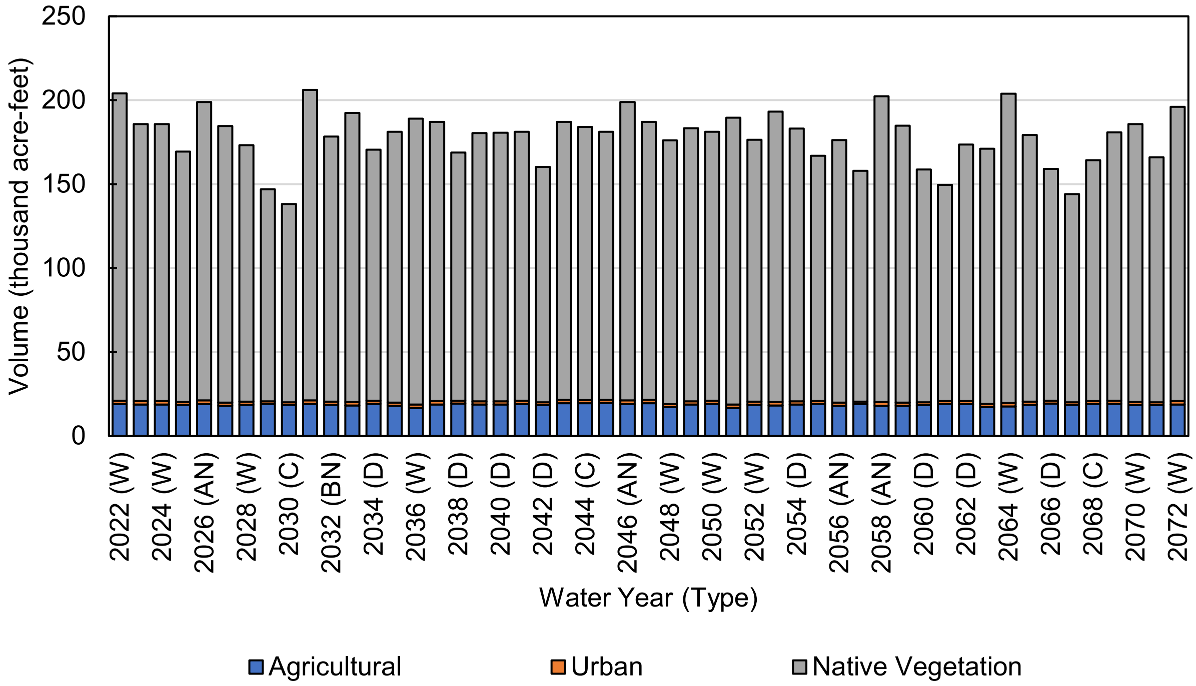


Figure 72. Bowman Subbasin Projected (Future Land Use with Climate Change) Total Evapotranspiration, (acre-feet)

Table 69. Bowman Subbasin Projected (Future Land Use with Climate Change) Total Evapotranspiration, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	19,000	2,200	180,000	200,000
2023 (W)	19,000	2,000	160,000	190,000
2024 (W)	19,000	2,000	160,000	190,000
2025 (BN)	19,000	1,800	150,000	170,000
2026 (AN)	19,000	2,200	180,000	200,000
2027 (W)	18,000	2,000	160,000	180,000
2028 (W)	19,000	1,800	150,000	170,000
2029 (C)	19,000	1,600	130,000	150,000
2030 (C)	19,000	1,600	120,000	140,000
2031 (AN)	19,000	2,200	180,000	210,000
2032 (BN)	19,000	1,900	160,000	180,000
2033 (AN)	18,000	2,100	170,000	190,000
2034 (D)	19,000	1,700	150,000	170,000
2035 (W)	18,000	1,900	160,000	180,000
2036 (W)	17,000	2,100	170,000	190,000
2037 (W)	19,000	2,000	170,000	190,000
2038 (D)	19,000	1,700	150,000	170,000
2039 (W)	19,000	2,000	160,000	180,000
2040 (D)	19,000	1,900	160,000	180,000
2041 (C)	19,000	2,000	160,000	180,000
2042 (D)	18,000	1,800	140,000	160,000
2043 (C)	20,000	2,100	170,000	190,000
2044 (C)	19,000	2,000	160,000	180,000
2045 (C)	20,000	1,900	160,000	180,000
2046 (AN)	19,000	2,200	180,000	200,000
2047 (C)	20,000	2,000	170,000	190,000
2048 (W)	17,000	1,900	160,000	180,000
2049 (W)	19,000	2,000	160,000	180,000
2050 (W)	19,000	1,900	160,000	180,000
2051 (W)	17,000	2,100	170,000	190,000
2052 (W)	19,000	1,800	160,000	180,000
2053 (AN)	18,000	2,100	170,000	190,000
2054 (D)	19,000	1,900	160,000	180,000
2055 (D)	19,000	1,700	150,000	170,000
2056 (AN)	18,000	1,900	160,000	180,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		19,000	1,600	140,000	160,000
2058 (AN)		18,000	2,200	180,000	200,000
2059 (W)		18,000	1,900	160,000	180,000
2060 (D)		18,000	1,700	140,000	160,000
2061 (C)		19,000	1,600	130,000	150,000
2062 (D)		19,000	1,900	150,000	170,000
2063 (BN)		17,000	1,900	150,000	170,000
2064 (W)		18,000	2,200	180,000	200,000
2065 (BN)		19,000	1,900	160,000	180,000
2066 (D)		19,000	1,600	140,000	160,000
2067 (C)		19,000	1,600	120,000	140,000
2068 (C)		19,000	1,700	140,000	160,000
2069 (BN)		19,000	1,900	160,000	180,000
2070 (W)		18,000	2,000	170,000	190,000
2071 (BN)		18,000	1,800	150,000	170,000
2072 (W)		19,000	2,100	180,000	200,000
Average (2022-2072)		19,000	1,900	160,000	180,000
2022 - 2072	W	18,000	2,000	170,000	190,000
	AN	18,000	2,100	170,000	200,000
	BN	18,000	1,800	150,000	170,000
	D	19,000	1,800	150,000	170,000
	C	19,000	1,800	150,000	170,000

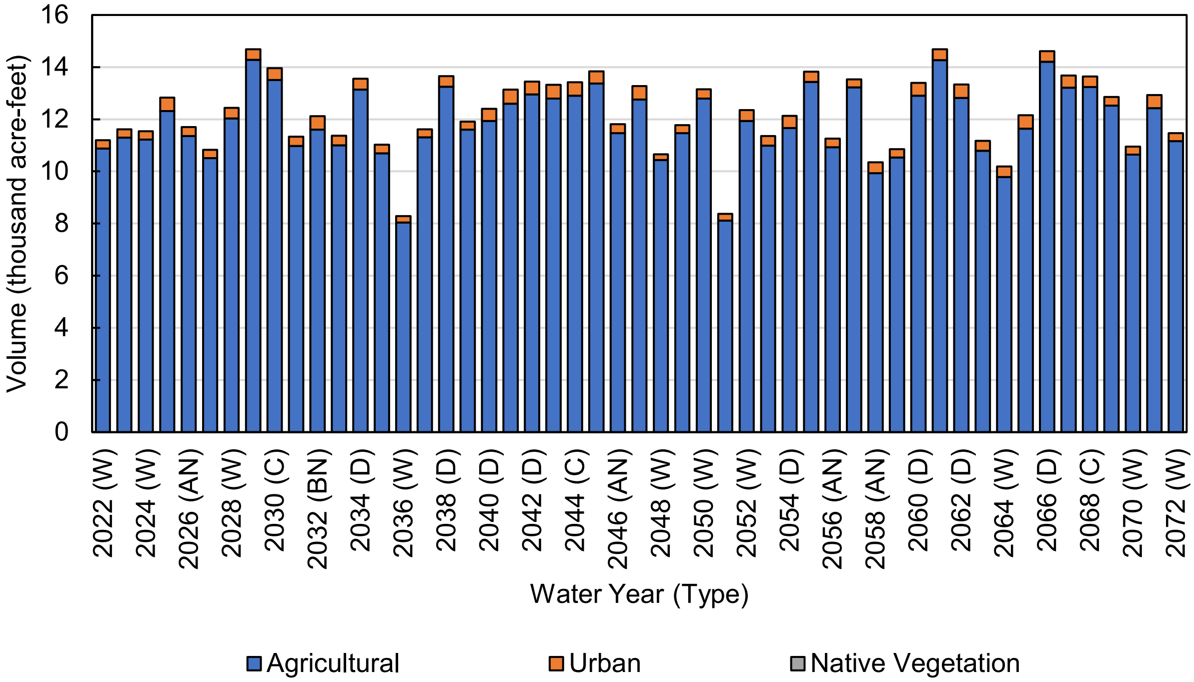


Figure 73. Bowman Subbasin Projected (Future Land Use with Climate Change) Evapotranspiration of Applied Water, by Water Use Sector

Table 70. Bowman Subbasin Projected (Future Land Use with Climate Change) Evapotranspiration of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	11,000	320	0	11,000
2023 (W)	11,000	320	0	12,000
2024 (W)	11,000	320	0	12,000
2025 (BN)	12,000	510	0	13,000
2026 (AN)	11,000	340	0	12,000
2027 (W)	11,000	320	0	11,000
2028 (W)	12,000	410	0	12,000
2029 (C)	14,000	410	0	15,000
2030 (C)	14,000	450	0	14,000
2031 (AN)	11,000	350	0	11,000
2032 (BN)	12,000	520	0	12,000
2033 (AN)	11,000	370	0	11,000
2034 (D)	13,000	410	0	14,000
2035 (W)	11,000	320	0	11,000
2036 (W)	8,000	250	0	8,300
2037 (W)	11,000	310	0	12,000
2038 (D)	13,000	400	0	14,000
2039 (W)	12,000	310	0	12,000
2040 (D)	12,000	460	0	12,000
2041 (C)	13,000	540	0	13,000
2042 (D)	13,000	490	0	13,000
2043 (C)	13,000	520	0	13,000
2044 (C)	13,000	510	0	13,000
2045 (C)	13,000	470	0	14,000
2046 (AN)	11,000	340	0	12,000
2047 (C)	13,000	510	0	13,000
2048 (W)	10,000	230	0	11,000
2049 (W)	11,000	310	0	12,000
2050 (W)	13,000	360	0	13,000
2051 (W)	8,100	250	0	8,400
2052 (W)	12,000	410	0	12,000
2053 (AN)	11,000	370	0	11,000
2054 (D)	12,000	460	0	12,000
2055 (D)	13,000	400	0	14,000
2056 (AN)	11,000	330	0	11,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		13,000	300	0	14,000
2058 (AN)		9,900	420	0	10,000
2059 (W)		11,000	320	0	11,000
2060 (D)		13,000	490	0	13,000
2061 (C)		14,000	420	0	15,000
2062 (D)		13,000	510	0	13,000
2063 (BN)		11,000	380	0	11,000
2064 (W)		9,800	410	0	10,000
2065 (BN)		12,000	520	0	12,000
2066 (D)		14,000	400	0	15,000
2067 (C)		13,000	470	0	14,000
2068 (C)		13,000	400	0	14,000
2069 (BN)		13,000	340	0	13,000
2070 (W)		11,000	300	0	11,000
2071 (BN)		12,000	510	0	13,000
2072 (W)		11,000	310	0	11,000
Average (2022-2072)		12,000	390	0	12,000
2022 - 2072	W	11,000	320	0	11,000
	AN	11,000	360	0	11,000
	BN	12,000	440	0	13,000
	D	13,000	450	0	13,000
	C	13,000	470	0	14,000

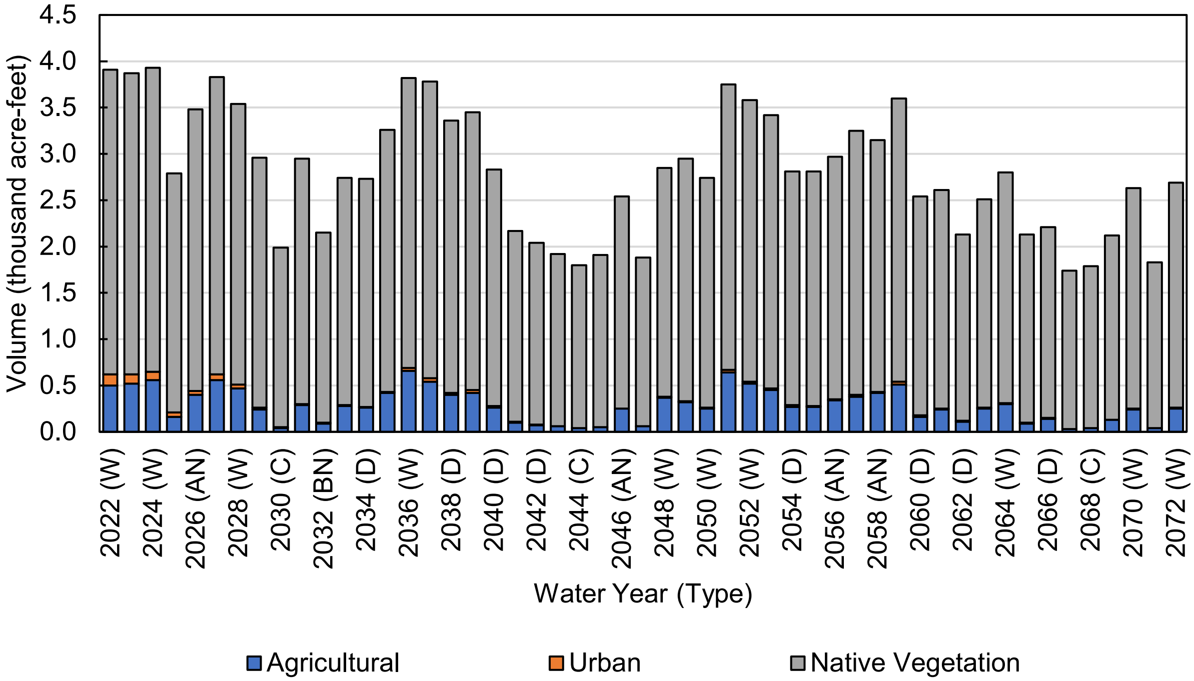


Figure 74. Bowman Subbasin Projected (Future Land Use with Climate Change) Evapotranspiration of Groundwater Uptake, by Water Use Sector

Table 71. Bowman Subbasin Projected (Future Land Use with Climate Change) Evapotranspiration of Groundwater Uptake, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	500	120	3,300	3,900
2023 (W)	520	100	3,300	3,900
2024 (W)	560	90	3,300	3,900
2025 (BN)	160	50	2,600	2,800
2026 (AN)	400	40	3,000	3,500
2027 (W)	560	60	3,200	3,800
2028 (W)	470	40	3,000	3,500
2029 (C)	240	20	2,700	3,000
2030 (C)	40	10	1,900	2,000
2031 (AN)	290	10	2,700	3,000
2032 (BN)	90	10	2,100	2,200
2033 (AN)	280	10	2,500	2,700
2034 (D)	260	10	2,500	2,700
2035 (W)	420	10	2,800	3,300
2036 (W)	660	30	3,100	3,800
2037 (W)	540	40	3,200	3,800
2038 (D)	400	20	2,900	3,400
2039 (W)	420	30	3,000	3,500
2040 (D)	260	20	2,600	2,800
2041 (C)	100	10	2,100	2,200
2042 (D)	70	10	2,000	2,000
2043 (C)	60	0	1,900	1,900
2044 (C)	40	0	1,800	1,800
2045 (C)	50	0	1,900	1,900
2046 (AN)	250	0	2,300	2,500
2047 (C)	60	0	1,800	1,900
2048 (W)	370	10	2,500	2,900
2049 (W)	320	10	2,600	3,000
2050 (W)	250	10	2,500	2,700
2051 (W)	640	30	3,100	3,800
2052 (W)	520	20	3,000	3,600
2053 (AN)	450	20	3,000	3,400
2054 (D)	270	20	2,500	2,800
2055 (D)	270	10	2,500	2,800
2056 (AN)	340	10	2,600	3,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		380	20	2,900	3,300
2058 (AN)		420	10	2,700	3,200
2059 (W)		510	30	3,100	3,600
2060 (D)		160	20	2,400	2,500
2061 (C)		240	10	2,400	2,600
2062 (D)		110	10	2,000	2,100
2063 (BN)		250	10	2,300	2,500
2064 (W)		300	10	2,500	2,800
2065 (BN)		90	10	2,000	2,100
2066 (D)		140	10	2,100	2,200
2067 (C)		30	0	1,700	1,700
2068 (C)		40	0	1,800	1,800
2069 (BN)		130	0	2,000	2,100
2070 (W)		240	10	2,400	2,600
2071 (BN)		40	0	1,800	1,800
2072 (W)		250	10	2,400	2,700
Average (2022-2072)		280	20	2,500	2,800
2022 - 2072	W	450	40	2,900	3,400
	AN	350	10	2,700	3,000
	BN	160	10	2,200	2,400
	D	220	10	2,400	2,600
	C	90	10	2,000	2,100

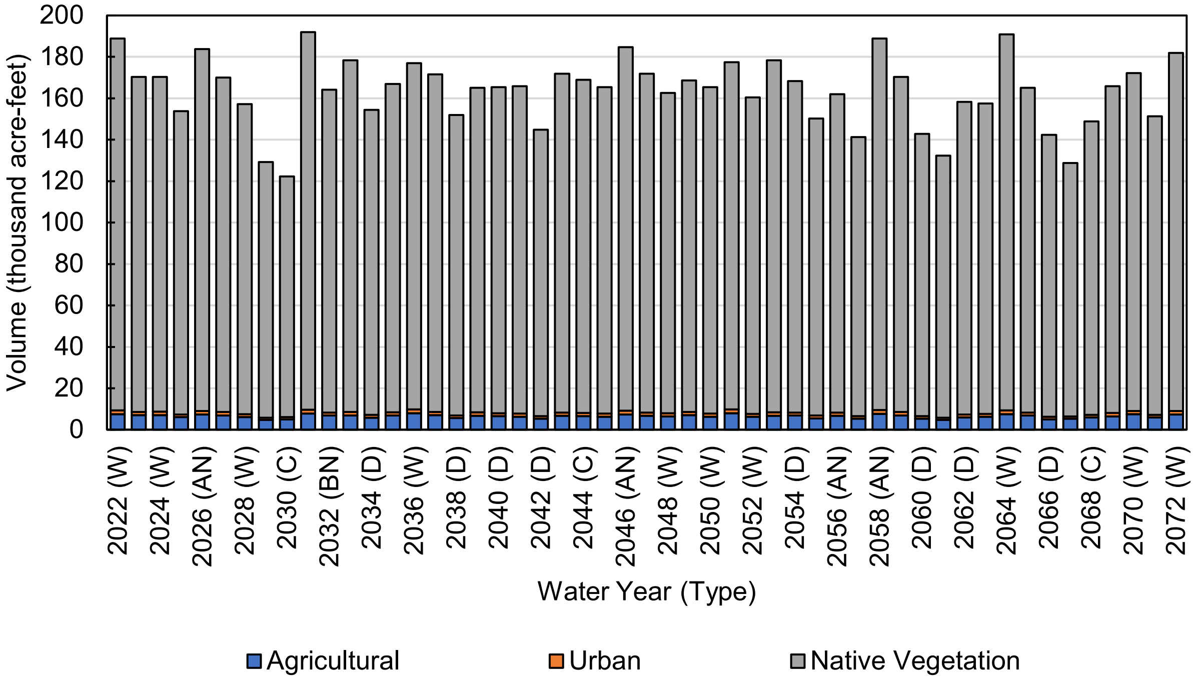


Figure 75. Bowman Subbasin Projected (Future Land Use with Climate Change) Evapotranspiration of Precipitation, by Water Use Sector

Table 72. Bowman Subbasin Projected (Future Land Use with Climate Change) Evapotranspiration of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	7,500	1,800	180,000	190,000
2023 (W)	7,000	1,600	160,000	170,000
2024 (W)	7,100	1,600	160,000	170,000
2025 (BN)	6,000	1,300	150,000	150,000
2026 (AN)	7,300	1,800	170,000	180,000
2027 (W)	6,900	1,600	160,000	170,000
2028 (W)	6,100	1,400	150,000	160,000
2029 (C)	4,700	1,100	120,000	130,000
2030 (C)	5,000	1,100	120,000	120,000
2031 (AN)	7,800	1,900	180,000	190,000
2032 (BN)	6,900	1,400	160,000	160,000
2033 (AN)	6,900	1,700	170,000	180,000
2034 (D)	5,800	1,300	150,000	150,000
2035 (W)	6,800	1,600	160,000	170,000
2036 (W)	8,000	1,800	170,000	180,000
2037 (W)	7,000	1,600	160,000	170,000
2038 (D)	5,600	1,300	150,000	150,000
2039 (W)	6,800	1,600	160,000	170,000
2040 (D)	6,500	1,400	160,000	170,000
2041 (C)	6,300	1,400	160,000	170,000
2042 (D)	5,400	1,300	140,000	140,000
2043 (C)	6,700	1,500	160,000	170,000
2044 (C)	6,500	1,500	160,000	170,000
2045 (C)	6,300	1,500	160,000	170,000
2046 (AN)	7,300	1,800	180,000	180,000
2047 (C)	6,700	1,500	160,000	170,000
2048 (W)	6,400	1,600	150,000	160,000
2049 (W)	7,000	1,600	160,000	170,000
2050 (W)	6,200	1,500	160,000	170,000
2051 (W)	7,900	1,800	170,000	180,000
2052 (W)	6,200	1,400	150,000	160,000
2053 (AN)	6,800	1,700	170,000	180,000
2054 (D)	6,800	1,400	160,000	170,000
2055 (D)	5,500	1,300	140,000	150,000
2056 (AN)	6,700	1,600	150,000	160,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		5,300	1,300	130,000	140,000
2058 (AN)		7,700	1,800	180,000	190,000
2059 (W)		6,900	1,600	160,000	170,000
2060 (D)		5,400	1,200	140,000	140,000
2061 (C)		4,700	1,100	130,000	130,000
2062 (D)		6,000	1,400	150,000	160,000
2063 (BN)		6,200	1,500	150,000	160,000
2064 (W)		7,500	1,800	180,000	190,000
2065 (BN)		6,800	1,400	160,000	170,000
2066 (D)		5,100	1,200	140,000	140,000
2067 (C)		5,300	1,200	120,000	130,000
2068 (C)		5,900	1,300	140,000	150,000
2069 (BN)		6,500	1,600	160,000	170,000
2070 (W)		7,400	1,600	160,000	170,000
2071 (BN)		5,900	1,300	140,000	150,000
2072 (W)		7,300	1,800	170,000	180,000
Average (2022-2072)		6,500	1,500	160,000	160,000
2022 - 2072	W	7,000	1,600	160,000	170,000
	AN	7,200	1,800	170,000	180,000
	BN	6,200	1,400	150,000	160,000
	D	5,800	1,300	150,000	150,000
	C	5,800	1,300	140,000	150,000

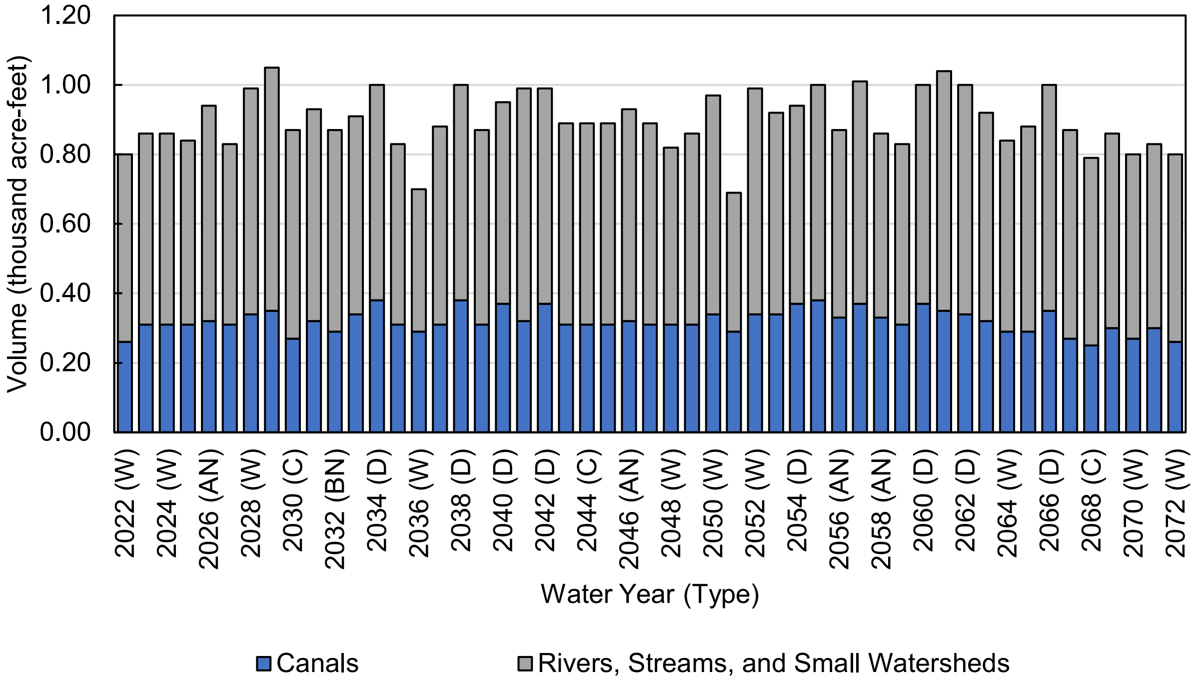


Figure 76. Bowman Subbasin Projected (Future Land Use with Climate Change) Evaporation of Surface Water Sources

Table 73. Bowman Subbasin Projected (Future Land Use with Climate Change) Evaporation of Surface Water Sources, by Water Use Sector (acre-feet)

Water Year (Type)	Canals	Rivers, Streams, and Small Watersheds[1]	Total
2022 (W)	260	540	800
2023 (W)	310	550	860
2024 (W)	310	550	860
2025 (BN)	310	530	840
2026 (AN)	320	620	940
2027 (W)	310	520	830
2028 (W)	340	650	990
2029 (C)	350	700	1,100
2030 (C)	270	600	870
2031 (AN)	320	610	930
2032 (BN)	290	580	870
2033 (AN)	340	570	910
2034 (D)	380	620	1,000
2035 (W)	310	520	830
2036 (W)	290	410	700
2037 (W)	310	570	880
2038 (D)	380	620	1,000
2039 (W)	310	560	870
2040 (D)	370	580	950
2041 (C)	320	670	990
2042 (D)	370	620	990
2043 (C)	310	580	890
2044 (C)	310	580	890
2045 (C)	310	580	890
2046 (AN)	320	610	930
2047 (C)	310	580	890
2048 (W)	310	510	820
2049 (W)	310	550	860
2050 (W)	340	630	970
2051 (W)	290	400	690
2052 (W)	340	650	990
2053 (AN)	340	580	920
2054 (D)	370	570	940
2055 (D)	380	620	1,000
2056 (AN)	330	540	870
2057 (BN)	370	640	1,000

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds[1]	Total
2058 (AN)		330	530	860
2059 (W)		310	520	830
2060 (D)		370	630	1,000
2061 (C)		350	690	1,000
2062 (D)		340	660	1,000
2063 (BN)		320	600	920
2064 (W)		290	550	840
2065 (BN)		290	590	880
2066 (D)		350	650	1,000
2067 (C)		270	600	870
2068 (C)		250	540	790
2069 (BN)		300	560	860
2070 (W)		270	530	800
2071 (BN)		300	530	830
2072 (W)		260	540	800
Average (2022-2072)		320	580	900
2022 - 2072	W	300	540	850
	AN	330	580	910
	BN	310	580	890
	D	370	620	990
	C	310	610	920

[1] Includes ET of riparian vegetation along rivers and streams.

4.3.2.2 Surface Water Outflow by Water Source Type

Surface water outflows from the Bowman Subbasin are summarized in **Figure 77** and **Table 74** by water source type. In the Bowman Subbasin, local supply outflows primarily include outflows of runoff, tailwater, and net drainage from land surfaces, in addition to runoff from small watersheds and stream outflows to the Sacramento River. Local supply outflows average approximately 140 taf per year, and range from 50 taf or less in certain dry and critical water years up to 430 taf in some wet years. Approximately 1.6 taf of CVP supplies also leave the Subbasin each year in spillage from ACID canals to Cottonwood Creek.

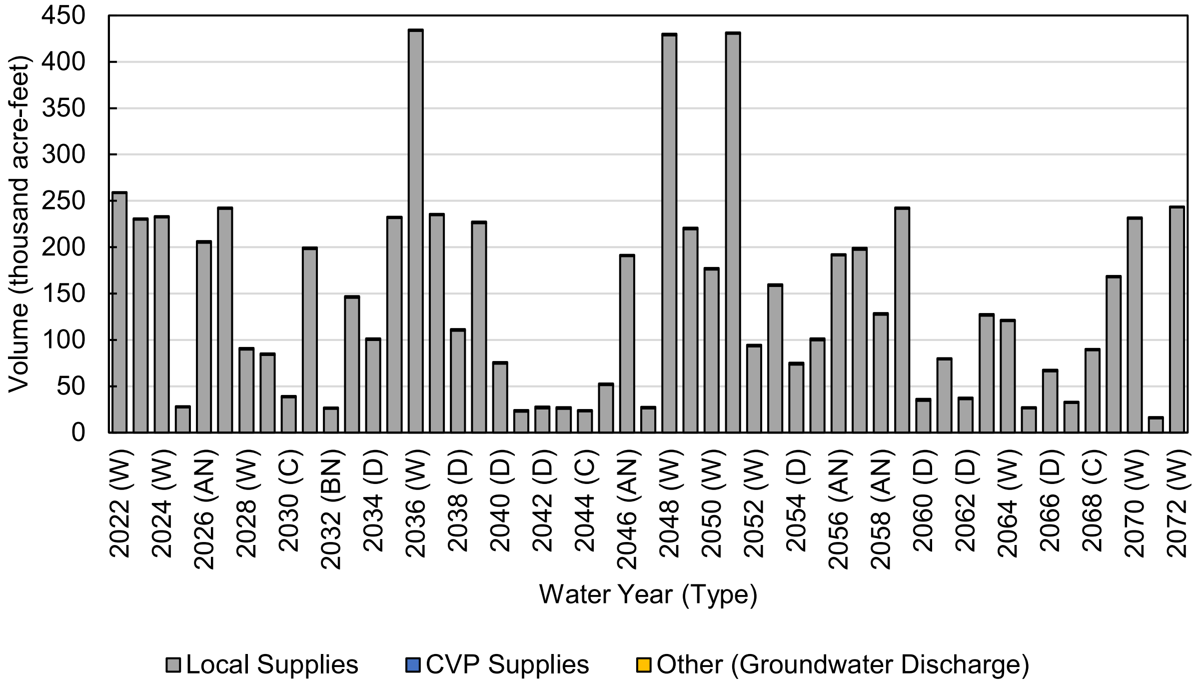


Figure 77. Bowman Subbasin Projected (Future Land Use with Climate Change) Surface Water Outflows, by Water Source Type

Table 74. Bowman Subbasin Projected (Future Land Use with Climate Change) Surface Water Outflows, by Water Source Type (acre-feet)

Water Year (Type)	CVP Supplies	Local Supplies	Other (Groundwater Discharge)	Total
2022 (W)	1,300	260,000	0	260,000
2023 (W)	1,600	230,000	0	230,000
2024 (W)	1,600	230,000	0	230,000
2025 (BN)	1,600	27,000	0	29,000
2026 (AN)	1,600	210,000	0	210,000
2027 (W)	1,500	240,000	0	240,000
2028 (W)	1,800	89,000	0	91,000
2029 (C)	1,700	84,000	0	86,000
2030 (C)	1,400	38,000	0	39,000
2031 (AN)	1,600	200,000	0	200,000
2032 (BN)	1,500	26,000	0	27,000
2033 (AN)	1,800	150,000	0	150,000
2034 (D)	1,900	100,000	0	100,000
2035 (W)	1,500	230,000	0	230,000
2036 (W)	1,500	430,000	0	430,000
2037 (W)	1,600	230,000	0	240,000
2038 (D)	1,900	110,000	0	110,000
2039 (W)	1,600	230,000	0	230,000
2040 (D)	1,900	74,000	0	76,000
2041 (C)	1,600	23,000	0	24,000
2042 (D)	1,800	26,000	0	28,000
2043 (C)	1,600	26,000	0	27,000
2044 (C)	1,600	23,000	0	24,000
2045 (C)	1,600	51,000	0	53,000
2046 (AN)	1,600	190,000	0	190,000
2047 (C)	1,600	26,000	0	28,000
2048 (W)	1,600	430,000	0	430,000
2049 (W)	1,600	220,000	0	220,000
2050 (W)	1,700	180,000	0	180,000
2051 (W)	1,500	430,000	0	430,000
2052 (W)	1,800	93,000	0	95,000
2053 (AN)	1,800	160,000	0	160,000
2054 (D)	1,900	73,000	0	75,000
2055 (D)	1,900	100,000	0	100,000

Water Year (Type)		CVP Supplies	Local Supplies	Other (Groundwater Discharge)	Total
2056 (AN)		1,600	190,000	0	190,000
2057 (BN)		1,800	200,000	0	200,000
2058 (AN)		1,600	130,000	0	130,000
2059 (W)		1,500	240,000	0	240,000
2060 (D)		1,800	34,000	0	36,000
2061 (C)		1,700	79,000	0	80,000
2062 (D)		1,700	36,000	0	38,000
2063 (BN)		1,600	130,000	0	130,000
2064 (W)		1,500	120,000	0	120,000
2065 (BN)		1,500	26,000	0	28,000
2066 (D)		1,800	66,000	0	68,000
2067 (C)		1,400	32,000	0	33,000
2068 (C)		1,300	89,000	0	90,000
2069 (BN)		1,500	170,000	0	170,000
2070 (W)		1,400	230,000	0	230,000
2071 (BN)		1,600	15,000	0	17,000
2072 (W)		1,300	240,000	0	240,000
Average (2022-2072)		1,600	140,000	0	140,000
2022 - 2072	W	1,600	240,000	0	240,000
	AN	1,700	170,000	0	180,000
	BN	1,600	84,000	0	85,000
	D	1,800	69,000	0	71,000
	C	1,600	47,000	0	49,000

4.3.2.3 Deep Percolation of Applied Water

Estimated deep percolation of applied water (equal to infiltration of applied water in 23 CCR § 354.18(b)(2)) is summarized in **Figure 78** and **Table 75** by water use sector. Deep percolation of applied water is about 7.1 taf on average, and dominated by agricultural irrigation and varies between years, following the pattern of surface water diversions and deliveries to irrigated lands.

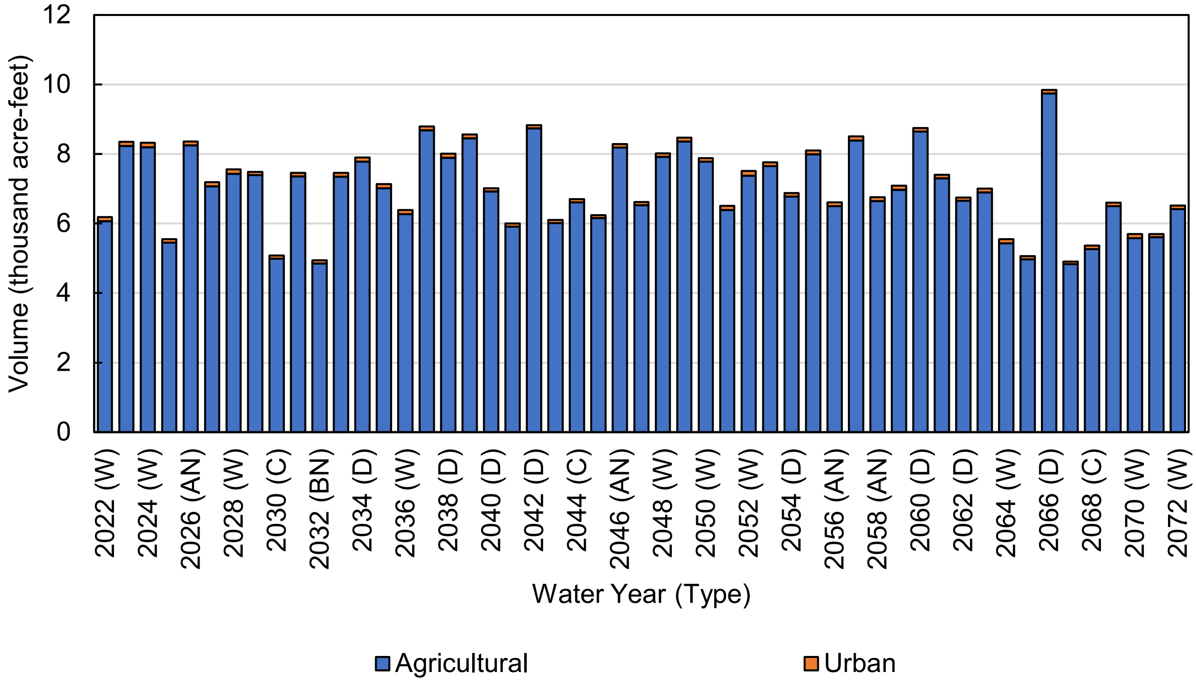


Figure 78. Bowman Subbasin Projected (Future Land Use with Climate Change) Deep Percolation of Applied Water, by Water Use Sector

Table 75. Bowman Subbasin Projected (Future Land Use with Climate Change) Deep Percolation of Applied Water, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	6,100	120	0	6,200
2023 (W)	8,200	120	0	8,400
2024 (W)	8,200	120	0	8,300
2025 (BN)	5,500	100	0	5,600
2026 (AN)	8,300	110	0	8,400
2027 (W)	7,100	120	0	7,200
2028 (W)	7,400	130	0	7,600
2029 (C)	7,400	100	0	7,500
2030 (C)	5,000	90	0	5,100
2031 (AN)	7,400	100	0	7,500
2032 (BN)	4,900	90	0	4,900
2033 (AN)	7,400	110	0	7,500
2034 (D)	7,800	120	0	7,900
2035 (W)	7,000	120	0	7,100
2036 (W)	6,300	120	0	6,400
2037 (W)	8,700	110	0	8,800
2038 (D)	7,900	120	0	8,000
2039 (W)	8,500	110	0	8,600
2040 (D)	6,900	100	0	7,000
2041 (C)	5,900	90	0	6,000
2042 (D)	8,700	90	0	8,800
2043 (C)	6,000	90	0	6,100
2044 (C)	6,600	90	0	6,700
2045 (C)	6,200	80	0	6,200
2046 (AN)	8,200	100	0	8,300
2047 (C)	6,500	90	0	6,600
2048 (W)	7,900	100	0	8,000
2049 (W)	8,400	110	0	8,500
2050 (W)	7,800	100	0	7,900
2051 (W)	6,400	120	0	6,500
2052 (W)	7,400	130	0	7,500
2053 (AN)	7,700	110	0	7,800
2054 (D)	6,800	100	0	6,900
2055 (D)	8,000	110	0	8,100
2056 (AN)	6,500	110	0	6,600

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		8,400	120	0	8,500
2058 (AN)		6,700	110	0	6,800
2059 (W)		7,000	120	0	7,100
2060 (D)		8,700	100	0	8,800
2061 (C)		7,300	100	0	7,400
2062 (D)		6,700	90	0	6,800
2063 (BN)		6,900	110	0	7,000
2064 (W)		5,400	120	0	5,600
2065 (BN)		5,000	90	0	5,100
2066 (D)		9,700	100	0	9,800
2067 (C)		4,800	80	0	4,900
2068 (C)		5,300	100	0	5,400
2069 (BN)		6,500	100	0	6,600
2070 (W)		5,600	120	0	5,700
2071 (BN)		5,600	90	0	5,700
2072 (W)		6,400	100	0	6,500
Average (2022-2072)		7,000	110	0	7,100
2022 - 2072	W	7,200	120	0	7,300
	AN	7,400	110	0	7,500
	BN	6,100	100	0	6,200
	D	7,900	100	0	8,000
	C	6,100	90	0	6,200

4.3.2.4 Deep Percolation of Precipitation

Estimated deep percolation of precipitation (equal to infiltration of precipitation in 23 CCR § 354.18(b)(2)) is provided in and **Figure 79** and **Table 76** by water use sector. Deep percolation of precipitation to the GWS is highly variable from year to year due to variation in the timing and amount of precipitation, ranging from about 22 taf per year during critical dry years to about 63 taf per year during wet years on average.

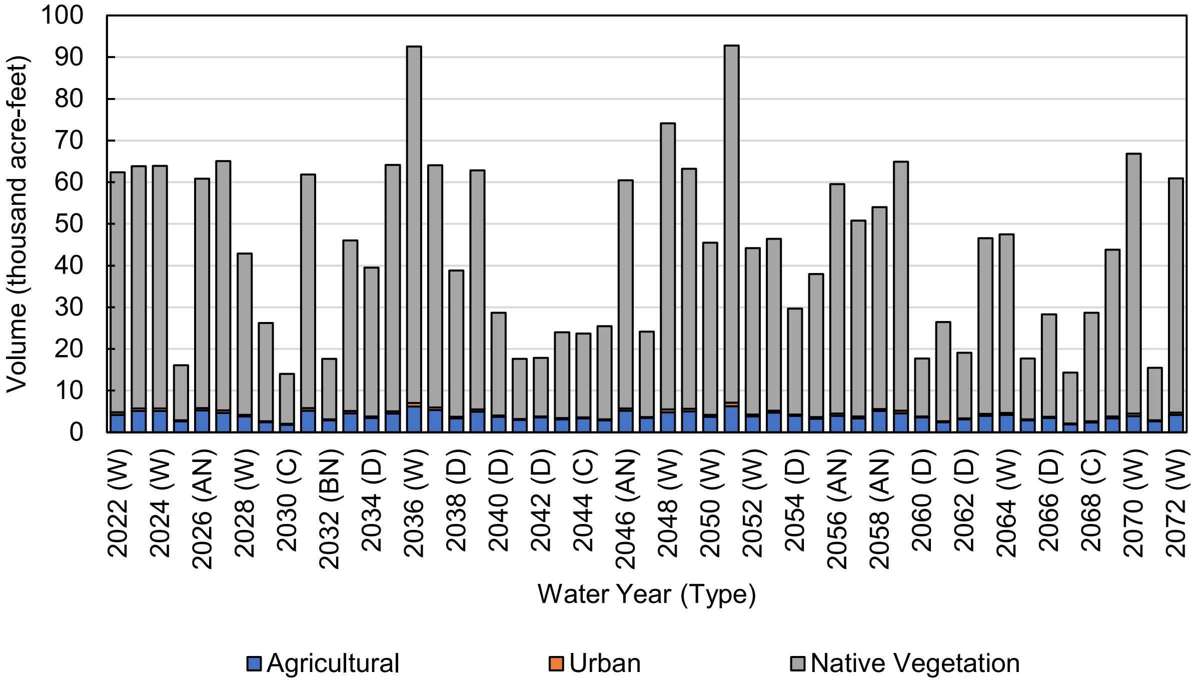


Figure 79. Bowman Subbasin Projected (Future Land Use with Climate Change) Deep Percolation of Precipitation, by Water Use Sector

Table 76. Bowman Subbasin Projected (Future Land Use with Climate Change) Deep Percolation of Precipitation, by Water Use Sector (acre-feet)

Water Year (Type)	Agricultural	Urban	Native Vegetation	Total
2022 (W)	4,200	640	58,000	62,000
2023 (W)	5,100	610	58,000	64,000
2024 (W)	5,200	610	58,000	64,000
2025 (BN)	2,700	250	13,000	16,000
2026 (AN)	5,300	550	55,000	61,000
2027 (W)	4,700	600	60,000	65,000
2028 (W)	3,800	440	39,000	43,000
2029 (C)	2,400	260	24,000	26,000
2030 (C)	1,900	210	12,000	14,000
2031 (AN)	5,200	550	56,000	62,000
2032 (BN)	2,900	230	15,000	18,000
2033 (AN)	4,600	510	41,000	46,000
2034 (D)	3,500	380	36,000	40,000
2035 (W)	4,500	580	59,000	64,000
2036 (W)	6,200	840	85,000	93,000
2037 (W)	5,400	580	58,000	64,000
2038 (D)	3,400	380	35,000	39,000
2039 (W)	4,900	580	57,000	63,000
2040 (D)	3,800	310	25,000	29,000
2041 (C)	3,000	250	14,000	18,000
2042 (D)	3,600	240	14,000	18,000
2043 (C)	3,100	270	21,000	24,000
2044 (C)	3,300	270	20,000	24,000
2045 (C)	2,900	250	22,000	25,000
2046 (AN)	5,200	530	55,000	60,000
2047 (C)	3,400	270	21,000	24,000
2048 (W)	4,800	680	69,000	74,000
2049 (W)	5,100	570	58,000	63,000
2050 (W)	3,800	430	41,000	45,000
2051 (W)	6,300	840	86,000	93,000
2052 (W)	3,800	440	40,000	44,000
2053 (AN)	4,700	510	41,000	46,000
2054 (D)	4,000	320	25,000	30,000
2055 (D)	3,300	370	34,000	38,000
2056 (AN)	4,000	530	55,000	60,000

Water Year (Type)		Agricultural	Urban	Native Vegetation	Total
2057 (BN)		3,400	490	47,000	51,000
2058 (AN)		5,100	470	48,000	54,000
2059 (W)		4,600	580	60,000	65,000
2060 (D)		3,600	240	14,000	18,000
2061 (C)		2,400	270	24,000	26,000
2062 (D)		3,100	240	16,000	19,000
2063 (BN)		4,000	440	42,000	47,000
2064 (W)		4,200	490	43,000	47,000
2065 (BN)		2,900	230	15,000	18,000
2066 (D)		3,500	310	25,000	28,000
2067 (C)		1,900	210	12,000	14,000
2068 (C)		2,300	320	26,000	29,000
2069 (BN)		3,400	440	40,000	44,000
2070 (W)		3,900	660	62,000	67,000
2071 (BN)		2,700	230	13,000	15,000
2072 (W)		4,200	570	56,000	61,000
Average (2022-2072)		3,900	430	39,000	44,000
2022 - 2072	W	4,700	600	58,000	63,000
	AN	4,900	520	50,000	56,000
	BN	3,100	330	26,000	30,000
	D	3,500	310	25,000	29,000
	C	2,700	260	20,000	22,000

4.3.2.5 Infiltration of Surface Water

Estimated infiltration of surface water (seepage) by water source is provided in **Figure 80** and **Table 77**. Flows along Cottonwood Creek and runoff from upgradient small watersheds contribute seepage to the Bowman Subbasin, averaging about 37 taf per year. Seepage in the Bowman Subbasin also comes from conveyance of surface water delivered to irrigators in ACID. The total seepage from all canals and diversions is approximately 12 taf per year, on average.

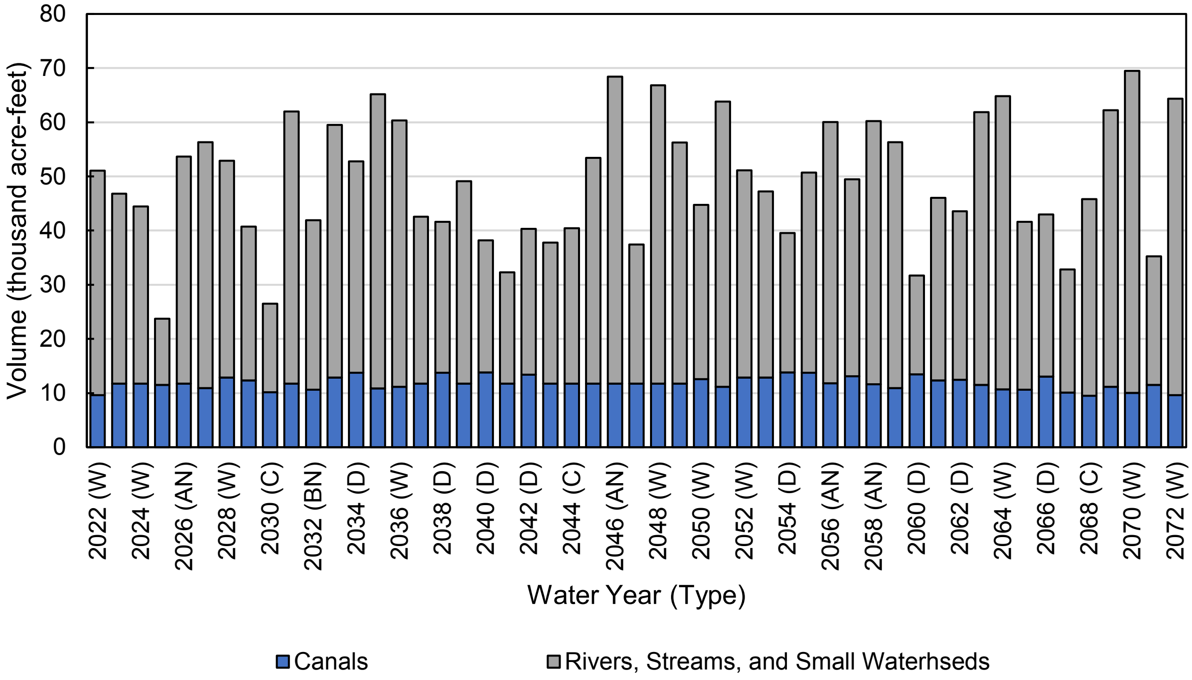


Figure 80. Bowman Subbasin Projected (Future Land Use with Climate Change) Infiltration of Surface Water, by Water Use Sector

Table 77. Bowman Subbasin Projected (Future Land Use with Climate Change) Infiltration of Surface Water, by Water Use Sector (acre-feet)

Water Year (Type)	Canals	Rivers, Streams, and Small Watersheds	Total
2022 (W)	9,600	41,000	51,000
2023 (W)	12,000	35,000	47,000
2024 (W)	12,000	33,000	44,000
2025 (BN)	12,000	12,000	24,000
2026 (AN)	12,000	42,000	54,000
2027 (W)	11,000	45,000	56,000
2028 (W)	13,000	40,000	53,000
2029 (C)	12,000	28,000	41,000
2030 (C)	10,000	16,000	27,000
2031 (AN)	12,000	50,000	62,000
2032 (BN)	11,000	31,000	42,000
2033 (AN)	13,000	47,000	60,000
2034 (D)	14,000	39,000	53,000
2035 (W)	11,000	54,000	65,000
2036 (W)	11,000	49,000	60,000
2037 (W)	12,000	31,000	43,000
2038 (D)	14,000	28,000	42,000
2039 (W)	12,000	37,000	49,000
2040 (D)	14,000	24,000	38,000
2041 (C)	12,000	21,000	32,000
2042 (D)	13,000	27,000	40,000
2043 (C)	12,000	26,000	38,000
2044 (C)	12,000	29,000	40,000
2045 (C)	12,000	42,000	53,000
2046 (AN)	12,000	57,000	68,000
2047 (C)	12,000	26,000	37,000
2048 (W)	12,000	55,000	67,000
2049 (W)	12,000	45,000	56,000
2050 (W)	13,000	32,000	45,000
2051 (W)	11,000	53,000	64,000
2052 (W)	13,000	38,000	51,000
2053 (AN)	13,000	34,000	47,000
2054 (D)	14,000	26,000	40,000
2055 (D)	14,000	37,000	51,000
2056 (AN)	12,000	48,000	60,000

Water Year (Type)		Canals	Rivers, Streams, and Small Watersheds	Total
2057 (BN)		13,000	36,000	49,000
2058 (AN)		12,000	49,000	60,000
2059 (W)		11,000	45,000	56,000
2060 (D)		13,000	18,000	32,000
2061 (C)		12,000	34,000	46,000
2062 (D)		12,000	31,000	44,000
2063 (BN)		12,000	50,000	62,000
2064 (W)		11,000	54,000	65,000
2065 (BN)		11,000	31,000	42,000
2066 (D)		13,000	30,000	43,000
2067 (C)		10,000	23,000	33,000
2068 (C)		9,500	36,000	46,000
2069 (BN)		11,000	51,000	62,000
2070 (W)		10,000	59,000	70,000
2071 (BN)		12,000	24,000	35,000
2072 (W)		9,600	55,000	64,000
Average (2022-2072)		12,000	37,000	49,000
2022 - 2072	W	11,000	45,000	56,000
	AN	12,000	47,000	59,000
	BN	11,000	34,000	45,000
	D	13,000	29,000	42,000
	C	11,000	28,000	39,000

4.3.3 Change in Root Zone Storage

Estimates of change in root zone storage are provided in **Figure 81** and **Table 78**. Inter-annual changes in storage within the SWS consist primarily of root zone soil moisture storage changes, are relatively small, and tend to average near zero over many years.

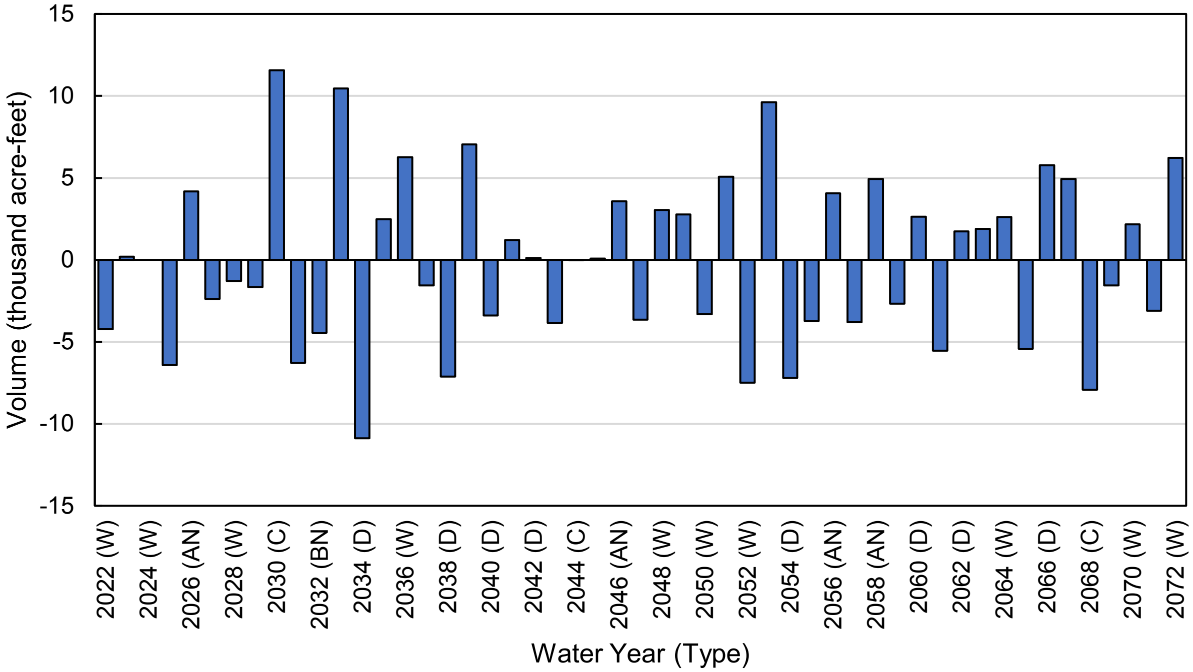


Figure 81. Bowman Subbasin Projected (Future Land Use with Climate Change) Change in Root Zone Storage

Table 78. Bowman Subbasin Projected (Future Land Use with Climate Change) Change in Root Zone Storage (acre-feet)

Water Year (Type)	Change in Root Zone Storage
2022 (W)	-4,200
2023 (W)	190
2024 (W)	0
2025 (BN)	-6,400
2026 (AN)	4,200
2027 (W)	-2,400
2028 (W)	-1,300
2029 (C)	-1,700
2030 (C)	12,000
2031 (AN)	-6,300
2032 (BN)	-4,500
2033 (AN)	10,000
2034 (D)	-11,000
2035 (W)	2,500
2036 (W)	6,300
2037 (W)	-1,600
2038 (D)	-7,100
2039 (W)	7,100
2040 (D)	-3,400
2041 (C)	1,200
2042 (D)	110
2043 (C)	-3,900
2044 (C)	-10
2045 (C)	80
2046 (AN)	3,600
2047 (C)	-3,600
2048 (W)	3,100
2049 (W)	2,800
2050 (W)	-3,300
2051 (W)	5,100
2052 (W)	-7,500
2053 (AN)	9,600
2054 (D)	-7,200
2055 (D)	-3,700
2056 (AN)	4,100

Water Year (Type)		Change in Root Zone Storage
2057 (BN)		-3,800
2058 (AN)		4,900
2059 (W)		-2,700
2060 (D)		2,600
2061 (C)		-5,600
2062 (D)		1,700
2063 (BN)		1,900
2064 (W)		2,600
2065 (BN)		-5,400
2066 (D)		5,800
2067 (C)		4,900
2068 (C)		-7,900
2069 (BN)		-1,600
2070 (W)		2,200
2071 (BN)		-3,100
2072 (W)		6,200
Average (2022-2072)		-80
2022 - 2072	W	830
	AN	4,400
	BN	-3,300
	D	-2,500
	C	-480

4.3.4 Net Recharge from Surface Water System

Net recharge from the SWS is a useful metric that equates only the impacts of the SWS on recharge and extraction from the GWS, providing valuable insight to the combined effects of land surface processes on the underlying GWS. Net recharge from the SWS is calculated as the total groundwater recharge minus the total groundwater extraction and uptake. When calculated for the projected (future land use with climate change) water budget, average net recharge from the SWS represents the average surplus (when positive) or shortage (when negative) of recharge that has resulted from projected cropping, land use practices, and average hydrologic conditions, when comparing groundwater extractions with deep percolation and infiltration from the SWS to the GWS. Net recharge does not include groundwater discharges to surface water and is not a full accounting of all exchanges occurring between the SWS and GWS. Although net recharge is a useful water balance metric, groundwater sustainability is not defined by the balance of net recharge from the SWS. Other important factors must be considered in the complete assessment of groundwater sustainability, including but not limited to subsurface groundwater flows and groundwater discharge to surface water.

Annual values for net recharge from the SWS over the projected (future land use with climate change) water budget period are presented below for the Bowman Subbasin. **Figure 82** and **Table 79** show the average net recharge from the SWS over 2022-2072 based on the projected (future land use with climate change) water budget results. Under future land use with climate change conditions, the average net recharge in the Bowman Subbasin was projected as approximately 90 taf per year between 2022-2072, indicating net inflows to the GWS from the SWS during the projected (future land use with climate change) water budget period. As illustrated on the cumulative net recharge plot in **Figure 82**, this results in a cumulative net recharge of about 4,600 taf over the 51-year projected (future land use) water budget period. Although this means there is projected to be more recharge from the SWS to the GWS than extractions and discharges from the GWS to the SWS, this alone does not necessarily mean that groundwater storage is increasing or that the Subbasin groundwater system has been sustainable. The complete Subbasin water budget, including the GWS water budget results, provide an indication of whether total groundwater inflows and outflows are in balance.

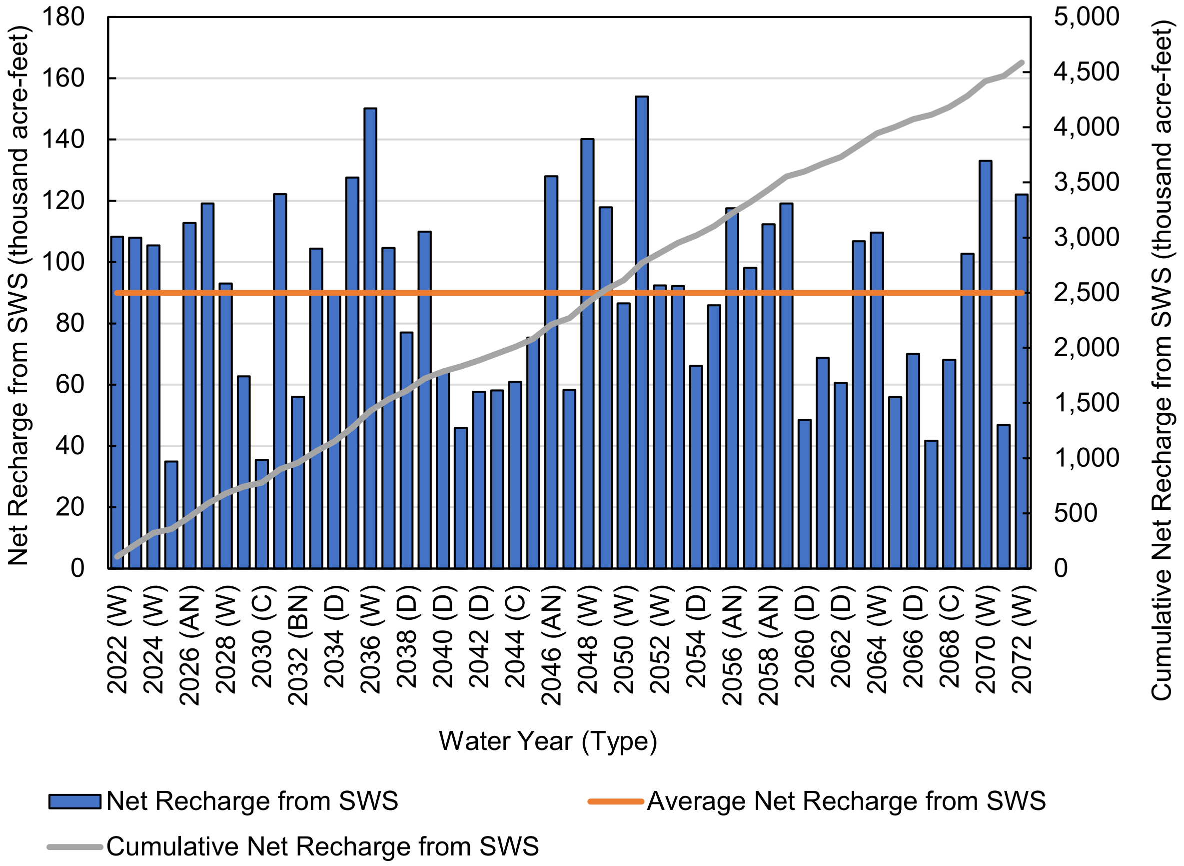


Figure 82. Bowman Subbasin Projected (Future Land Use with Climate Change) Net Recharge Overview

Table 79. Bowman Subbasin Projected (Future Land Use with Climate Change) Water Budget: Average Net Recharge from SWS, by Water Year Type (acre-feet)

Year Type	Number of Years	Deep Perc. of Applied Water (a)	Deep Perc. of Precipitation (b)	Infil. of Surface Water (c)	Groundwater Extraction/ Uptake (d)	Net Recharge from SWS (a+b+c-d)
W	18	7,300	63,000	56,000	9,900	120,000
AN	7	7,500	56,000	59,000	9,100	110,000
BN	7	6,200	30,000	45,000	9,500	72,000
D	9	8,000	29,000	42,000	10,000	69,000
C	10	6,200	22,000	39,000	10,000	58,000
Annual Average (2022 - 2072)	51	7,100	44,000	49,000	9,900	90,000

4.4 Groundwater System Water Budget Results

Projected (future land use with climate change) water budget results for different components of the GWS are presented in the sections below. Inflows and outflows from the GWS that occur through exchanges with the SWS are discussed in the SWS water budget results, although these components are also noted in the sections below relating to the GWS water budget. In contrast to the SWS water budget, many of the GWS water budget components change in flow direction over time representing inflows during some periods and outflows during other periods, depending on Subbasin conditions. The GWS water budget results are presented with net inflows indicated by positive values and net outflows as negative values.

4.4.1 Lateral Subsurface Groundwater Flows

Subsurface groundwater flows to and from the Bowman Subbasin occur between the Red Bluff Subbasin to the south, the Anderson Subbasin to the north, and the South Battle Creek Subbasin to the east. Subsurface groundwater inflows that occur from the upland foothill (small watershed) areas adjoining the Bowman Subbasin are negligible and set at zero throughout the historical period.

4.4.1.1 Lateral Subsurface Flows to/from Adjacent Subbasins

Projected (future land use with climate change) lateral subsurface flows occurring from and to adjacent subbasin are summarized in **Figure 83** and **Table 80**. The total Projected (future land use with climate change) net subsurface flows to and from all adjacent subbasins averages about -90 taf per year occurring as outflow from the Bowman Subbasin. Projected (future land use with climate change) subsurface flows across the boundary with the Red Bluff Subbasin average an outflow of nearly -130 taf per year. The magnitude of these subsurface flows does not fluctuate much from year to year, although the subsurface outflows to the Red Bluff Subbasin tend to be somewhat greater during wet years than in dry years. In contrast to the subsurface outflows across the boundary with Red Bluff Subbasin, the flows across the northern boundary with the Anderson Subbasin occur as inflows averaging about 24 taf per year, with little variability by water year type. Subsurface flows across the boundary with the South Battle Creek Subbasin are relatively small. On average the subsurface flows across the South Battle Creek Subbasin boundary occur as net inflows of about 11 taf per year.

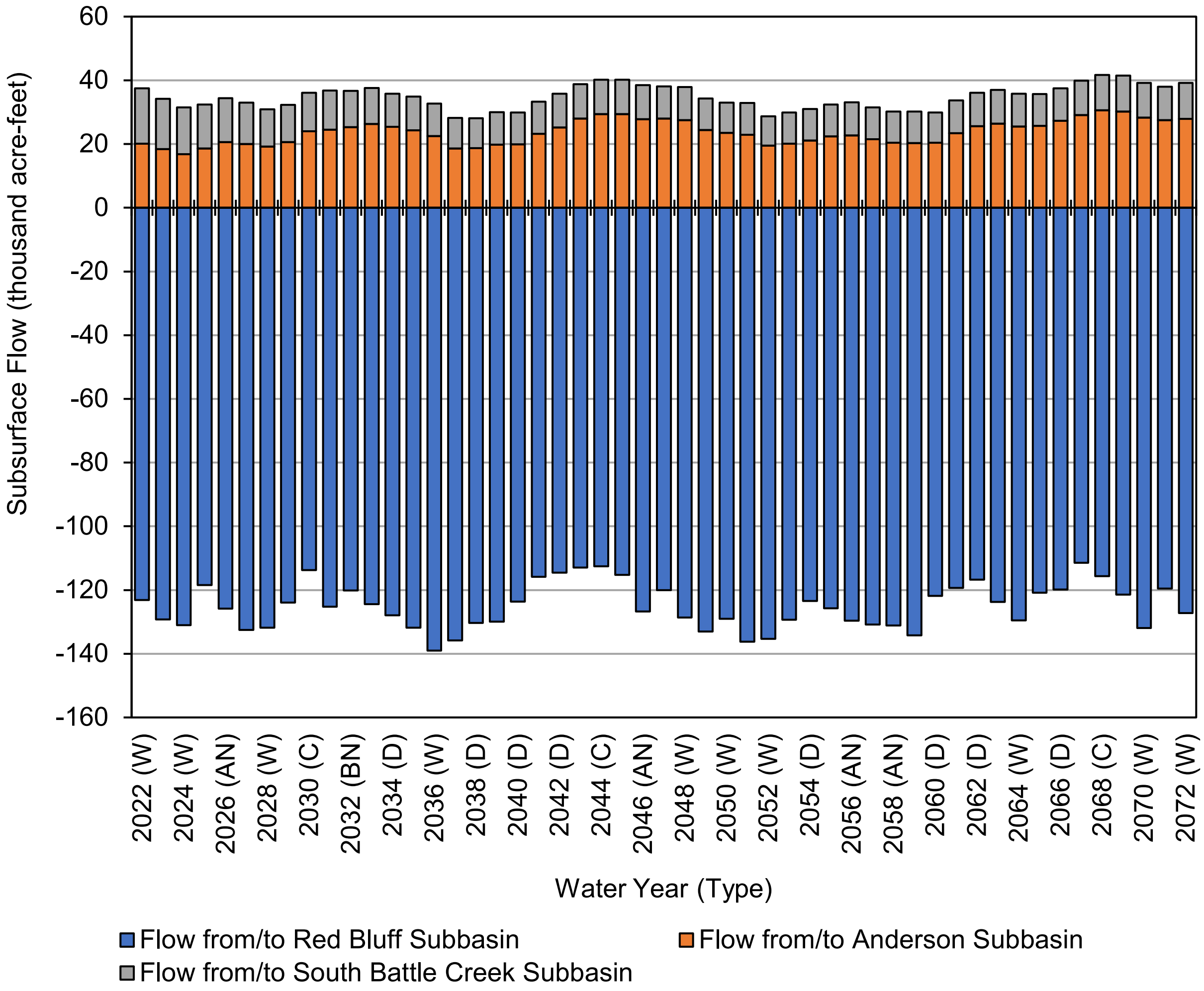


Figure 83. Bowman Subbasin Projected (Future Land Use with Climate Change) Lateral Subsurface Groundwater Flows to/from Adjacent Subbasins

Table 80. Bowman Subbasin Projected (Future Land Use with Climate Change) Lateral Subsurface Groundwater Flows Between Adjacent Subbasins (net flows as acre-feet)

Water Year (Type)	Red Bluff	Anderson	South Battle Creek	Total
2022 (W)	-120,000	20,000	17,000	-86,000
2023 (W)	-130,000	18,000	16,000	-95,000
2024 (W)	-130,000	17,000	15,000	-99,000
2025 (BN)	-120,000	19,000	14,000	-86,000
2026 (AN)	-130,000	21,000	14,000	-91,000
2027 (W)	-130,000	20,000	13,000	-99,000
2028 (W)	-130,000	19,000	12,000	-100,000
2029 (C)	-120,000	21,000	12,000	-92,000
2030 (C)	-110,000	24,000	12,000	-78,000
2031 (AN)	-130,000	24,000	12,000	-88,000
2032 (BN)	-120,000	25,000	11,000	-83,000
2033 (AN)	-120,000	26,000	11,000	-87,000
2034 (D)	-130,000	25,000	10,000	-92,000
2035 (W)	-130,000	24,000	11,000	-97,000
2036 (W)	-140,000	23,000	10,000	-110,000
2037 (W)	-140,000	19,000	9,600	-110,000
2038 (D)	-130,000	19,000	9,400	-100,000
2039 (W)	-130,000	20,000	10,000	-100,000
2040 (D)	-120,000	20,000	10,000	-94,000
2041 (C)	-120,000	23,000	10,000	-83,000
2042 (D)	-110,000	25,000	11,000	-79,000
2043 (C)	-110,000	28,000	11,000	-74,000
2044 (C)	-110,000	29,000	11,000	-72,000
2045 (C)	-120,000	29,000	11,000	-75,000
2046 (AN)	-130,000	28,000	11,000	-88,000
2047 (C)	-120,000	28,000	10,000	-82,000
2048 (W)	-130,000	28,000	10,000	-91,000
2049 (W)	-130,000	24,000	9,800	-99,000
2050 (W)	-130,000	23,000	9,500	-96,000
2051 (W)	-140,000	23,000	10,000	-100,000
2052 (W)	-140,000	20,000	9,200	-110,000
2053 (AN)	-130,000	20,000	9,800	-99,000
2054 (D)	-120,000	21,000	10,000	-92,000
2055 (D)	-130,000	22,000	9,900	-93,000
2056 (AN)	-130,000	23,000	10,000	-97,000
2057 (BN)	-130,000	22,000	10,000	-99,000
2058 (AN)	-130,000	20,000	9,800	-100,000

Water Year (Type)		Red Bluff	Anderson	South Battle Creek	Total
2059 (W)		-130,000	20,000	9,800	-100,000
2060 (D)		-120,000	20,000	9,500	-92,000
2061 (C)		-120,000	23,000	10,000	-86,000
2062 (D)		-120,000	26,000	10,000	-81,000
2063 (BN)		-120,000	26,000	11,000	-87,000
2064 (W)		-130,000	26,000	10,000	-94,000
2065 (BN)		-120,000	26,000	10,000	-85,000
2066 (D)		-120,000	27,000	10,000	-82,000
2067 (C)		-110,000	29,000	11,000	-72,000
2068 (C)		-120,000	31,000	11,000	-74,000
2069 (BN)		-120,000	30,000	11,000	-80,000
2070 (W)		-130,000	28,000	11,000	-93,000
2071 (BN)		-120,000	27,000	11,000	-82,000
2072 (W)		-130,000	28,000	11,000	-88,000
Average (2022-2072)		-130,000	24,000	11,000	-90,000
2022 - 2072	W	-130,000	22,000	11,000	-98,000
	AN	-130,000	23,000	11,000	-93,000
	BN	-120,000	25,000	11,000	-86,000
	D	-120,000	23,000	10,000	-90,000
	C	-120,000	27,000	11,000	-79,000

Note: positive values represent net inflows to Bowman Subbasin, negative values represent net outflows from Bowman Subbasin.

4.4.2 Deep Percolation From the SWS

Deep percolation from the SWS includes infiltration of water below the root zone (deep percolation) from precipitation and applied water. These two water budget components are summarized in the SWS water budget as outflows to the SWS and are presented as aggregated deep percolation inflows to the GWS in **Figure 84** and **Table 81**. The average annual deep percolation from the SWS over the projected (future land use with climate change) water budget period is approximately 51 taf per year. Greater volumes of deep percolation occur during wetter years when infiltration of precipitation is higher.

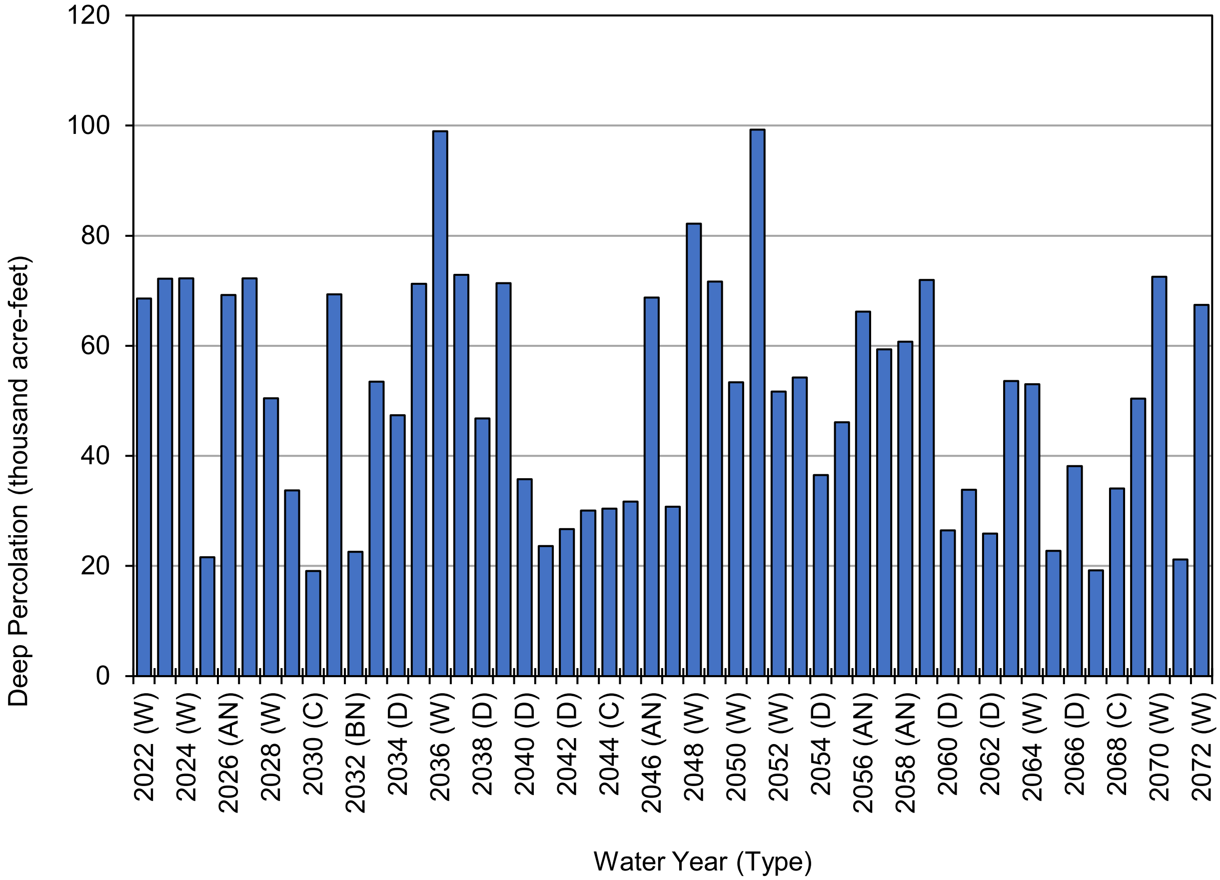


Figure 84. Bowman Subbasin Projected (Future Land Use with Climate Change) Deep Percolation

Table 81. Bowman Subbasin Projected (Future Land Use with Climate Change) Deep Percolation from the SWS (acre-feet)

Water Year (Type)	Deep Percolation from the SWS
2022 (W)	69,000
2023 (W)	72,000
2024 (W)	72,000
2025 (BN)	22,000
2026 (AN)	69,000
2027 (W)	72,000
2028 (W)	50,000
2029 (C)	34,000
2030 (C)	19,000
2031 (AN)	69,000
2032 (BN)	23,000
2033 (AN)	53,000
2034 (D)	47,000
2035 (W)	71,000
2036 (W)	99,000
2037 (W)	73,000
2038 (D)	47,000
2039 (W)	71,000
2040 (D)	36,000
2041 (C)	24,000
2042 (D)	27,000
2043 (C)	30,000
2044 (C)	30,000
2045 (C)	32,000
2046 (AN)	69,000
2047 (C)	31,000
2048 (W)	82,000
2049 (W)	72,000
2050 (W)	53,000
2051 (W)	99,000
2052 (W)	52,000
2053 (AN)	54,000
2054 (D)	37,000
2055 (D)	46,000
2056 (AN)	66,000
2057 (BN)	59,000
2058 (AN)	61,000

Water Year (Type)		Deep Percolation from the SWS
2059 (W)		72,000
2060 (D)		26,000
2061 (C)		34,000
2062 (D)		26,000
2063 (BN)		54,000
2064 (W)		53,000
2065 (BN)		23,000
2066 (D)		38,000
2067 (C)		19,000
2068 (C)		34,000
2069 (BN)		50,000
2070 (W)		73,000
2071 (BN)		21,000
2072 (W)		67,000
Average (2022-2072)		51,000
2022 - 2072	W	71,000
	AN	63,000
	BN	36,000
	D	37,000
	C	29,000

4.4.3 Net Stream Seepage/Groundwater Discharge to Surface Water

The flow of water between the GWS and SWS through seepage of water from streams and canals and groundwater discharging into streams is discussed as part of the SWS water budget. These components are combined for presentation in the GWS water budget as a net volume of stream seepage (**Figure 85** and **Table 82**). Positive total net seepage values represent a net inflow of water from the SWS to the GWS via stream and canal seepage indicating that the overall volume of stream seepage is greater than the volume of any groundwater discharging into surface waterways. Negative net seepage values represent a net outflow of groundwater from the GWS to the SWS through groundwater discharge to surface water. When net seepage is negative, it means that more groundwater is discharging into the surface waterways than is seeping from surface waterways into the GWS.

In the Bowman Subbasin, the projected (future land use) annual net seepage values are always positive with an average annual net stream seepage value of 49 taf per year indicating net addition of water to the GWS through the exchanges with surface waterways. The annual net stream seepage values tend to be higher in wet years in comparison to dry years corresponding with more groundwater recharge from surface water in wet years and less groundwater recharge in dry years.

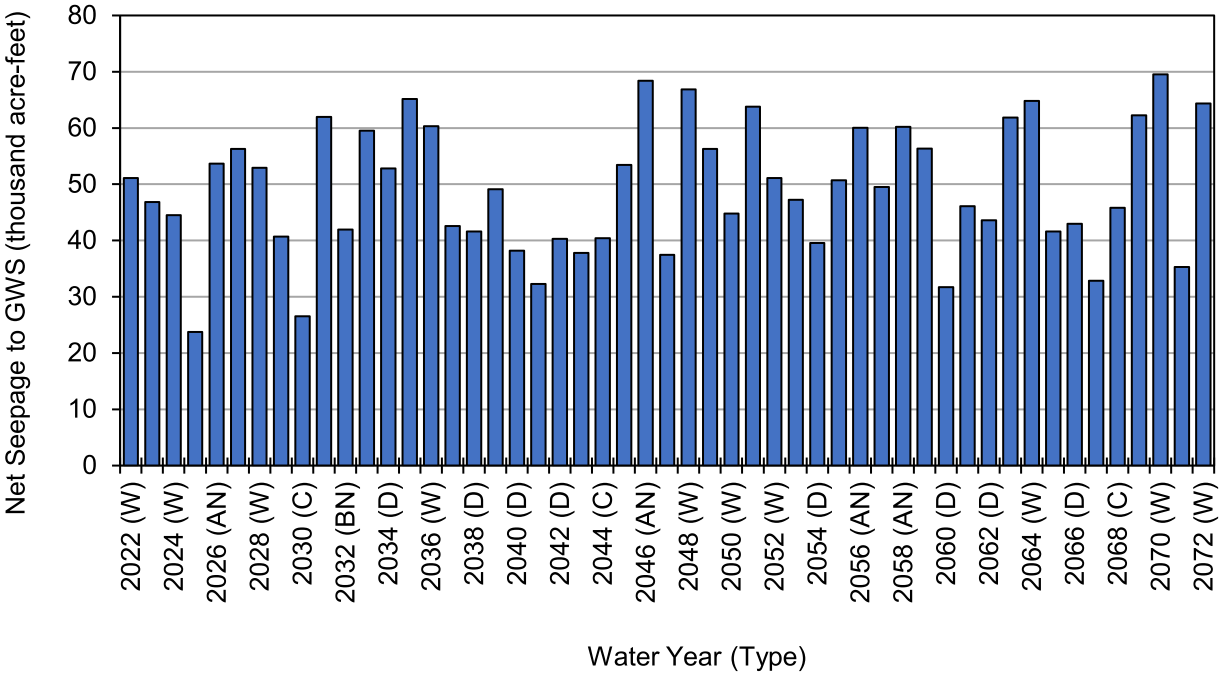


Figure 85. Bowman Subbasin Projected (Future Land Use with Climate Change) Net Stream Seepage to GWS/Discharge to Surface Water

Table 82. Bowman Subbasin Projected (Future Land Use with Climate Change) Net Stream Seepage (net flows as acre-feet)

Water Year (Type)	Total Net Seepage from Surface Waterways and Canals
2022 (W)	51,000
2023 (W)	47,000
2024 (W)	44,000
2025 (BN)	24,000
2026 (AN)	54,000
2027 (W)	56,000
2028 (W)	53,000
2029 (C)	41,000
2030 (C)	27,000
2031 (AN)	62,000
2032 (BN)	42,000
2033 (AN)	60,000
2034 (D)	53,000
2035 (W)	65,000
2036 (W)	60,000
2037 (W)	43,000
2038 (D)	42,000
2039 (W)	49,000
2040 (D)	38,000
2041 (C)	32,000
2042 (D)	40,000
2043 (C)	38,000
2044 (C)	40,000
2045 (C)	53,000
2046 (AN)	68,000
2047 (C)	37,000
2048 (W)	67,000
2049 (W)	56,000
2050 (W)	45,000
2051 (W)	64,000
2052 (W)	51,000
2053 (AN)	47,000
2054 (D)	40,000
2055 (D)	51,000
2056 (AN)	60,000
2057 (BN)	49,000
2058 (AN)	60,000

Water Year (Type)		Total Net Seepage from Surface Waterways and Canals
2059 (W)		56,000
2060 (D)		32,000
2061 (C)		46,000
2062 (D)		44,000
2063 (BN)		62,000
2064 (W)		65,000
2065 (BN)		42,000
2066 (D)		43,000
2067 (C)		33,000
2068 (C)		46,000
2069 (BN)		62,000
2070 (W)		70,000
2071 (BN)		35,000
2072 (W)		64,000
Average (2022-2072)		49,000
2022 - 2072	W	56,000
	AN	59,000
	BN	45,000
	D	42,000
	C	39,000

Note: negative values indicate net groundwater discharge to surface water

4.4.4 Groundwater Extraction

Groundwater extractions are exchanges that occur between the GWS and the SWS. Groundwater extraction from the GWS occurs through groundwater pumping to meet water demands for urban and agricultural needs and also through groundwater (root water) uptake by plants directly from shallow groundwater during times and at locations of sufficiently shallow groundwater conditions. Projected (future land use with climate change) groundwater extractions are summarized in **Figure 86** and **Table 83** and also presented and discussed in the SWS water budget sections. Total groundwater extractions over the projected (future land use with climate change) water budget period average about -9.9 taf per year. Overall, groundwater pumping represents a larger fraction of the groundwater extractions than groundwater uptake. Groundwater pumping averaged about -7.1 taf over the projected (future land use with climate change) period and groundwater uptake averaged about -2.8 taf. In wetter periods, groundwater uptake increases and groundwater pumping decreases. Accordingly, during drier periods groundwater pumping increases and water uptake by plants from shallow groundwater decreases in response to the higher water demands for irrigation and other uses and the greater depths to groundwater that also tend to occur during dry periods.

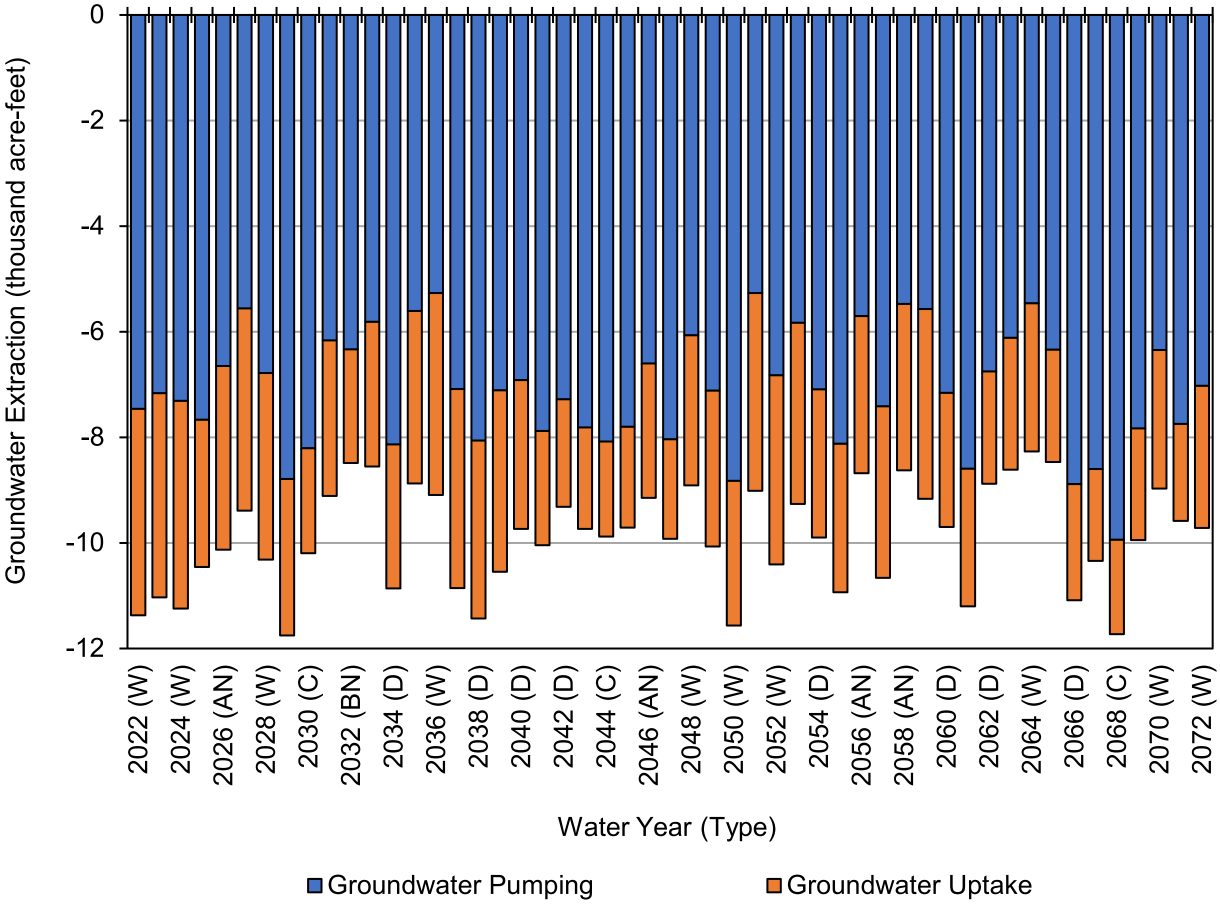


Figure 86. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Extractions

Table 83. Bowman Subbasin Projected (Future Land Use with Climate Change) Groundwater Extractions (acre-feet)

Water Year (Type)	Groundwater Pumping	Groundwater (Root Water) Uptake	Total Extractions
2022 (W)	-7,500	-3,900	-11,000
2023 (W)	-7,200	-3,900	-11,000
2024 (W)	-7,300	-3,900	-11,000
2025 (BN)	-7,700	-2,800	-10,000
2026 (AN)	-6,600	-3,500	-10,000
2027 (W)	-5,600	-3,800	-9,400
2028 (W)	-6,800	-3,500	-10,000
2029 (C)	-8,800	-3,000	-12,000
2030 (C)	-8,200	-2,000	-10,000
2031 (AN)	-6,200	-2,900	-9,100
2032 (BN)	-6,300	-2,200	-8,500
2033 (AN)	-5,800	-2,700	-8,600
2034 (D)	-8,100	-2,700	-11,000
2035 (W)	-5,600	-3,300	-8,900
2036 (W)	-5,300	-3,800	-9,100
2037 (W)	-7,100	-3,800	-11,000
2038 (D)	-8,100	-3,400	-11,000
2039 (W)	-7,100	-3,400	-11,000
2040 (D)	-6,900	-2,800	-9,700
2041 (C)	-7,900	-2,200	-10,000
2042 (D)	-7,300	-2,000	-9,300
2043 (C)	-7,800	-1,900	-9,700
2044 (C)	-8,100	-1,800	-9,900
2045 (C)	-7,800	-1,900	-9,700
2046 (AN)	-6,600	-2,500	-9,100
2047 (C)	-8,000	-1,900	-9,900
2048 (W)	-6,100	-2,800	-8,900
2049 (W)	-7,100	-2,900	-10,000
2050 (W)	-8,800	-2,700	-12,000
2051 (W)	-5,300	-3,700	-9,000
2052 (W)	-6,800	-3,600	-10,000
2053 (AN)	-5,800	-3,400	-9,300
2054 (D)	-7,100	-2,800	-9,900
2055 (D)	-8,100	-2,800	-11,000
2056 (AN)	-5,700	-3,000	-8,700
2057 (BN)	-7,400	-3,300	-11,000

Water Year (Type)		Groundwater Pumping	Groundwater (Root Water) Uptake	Total Extractions
2058 (AN)		-5,500	-3,100	-8,600
2059 (W)		-5,600	-3,600	-9,200
2060 (D)		-7,200	-2,500	-9,700
2061 (C)		-8,600	-2,600	-11,000
2062 (D)		-6,800	-2,100	-8,900
2063 (BN)		-6,100	-2,500	-8,600
2064 (W)		-5,500	-2,800	-8,300
2065 (BN)		-6,300	-2,100	-8,500
2066 (D)		-8,900	-2,200	-11,000
2067 (C)		-8,600	-1,700	-10,000
2068 (C)		-9,900	-1,800	-12,000
2069 (BN)		-7,800	-2,100	-9,900
2070 (W)		-6,300	-2,600	-9,000
2071 (BN)		-7,700	-1,800	-9,600
2072 (W)		-7,000	-2,700	-9,700
Average (2022-2072)		-7,100	-2,800	-9,900
2022 - 2072	W	-6,500	-3,400	-9,900
	AN	-6,000	-3,000	-9,100
	BN	-7,100	-2,400	-9,500
	D	-7,600	-2,600	-10,000
	C	-8,400	-2,100	-10,000

4.4.5 Vertical Subsurface Flows within the Groundwater System

Vertical subsurface flows within the GWS occur between the Upper and Lower Aquifers and represent an internal flow of water within the GWS. These exchanges between the principal aquifers do not directly affect the total volume of groundwater in storage, but do highlight the net vertical movement of water within the GWS. Projected (future land use with climate change) vertical flows between the Upper Aquifer and Lower Aquifer are summarized in **Figure 87** and **Table 84** and show consistent net overall downward flow from the Upper Aquifer to the Lower Aquifer. On average, vertical flows from the Upper Aquifer to the Lower Aquifer total about 88 taf per year over the projected (future land use with climate change) water budget period. There is considerable year-to-year variability in the magnitude of these flows, which appear to correlate with water year conditions, although they are always in the downward direction. The magnitude of downward flows are generally greatest during wet years and decrease during dry periods.

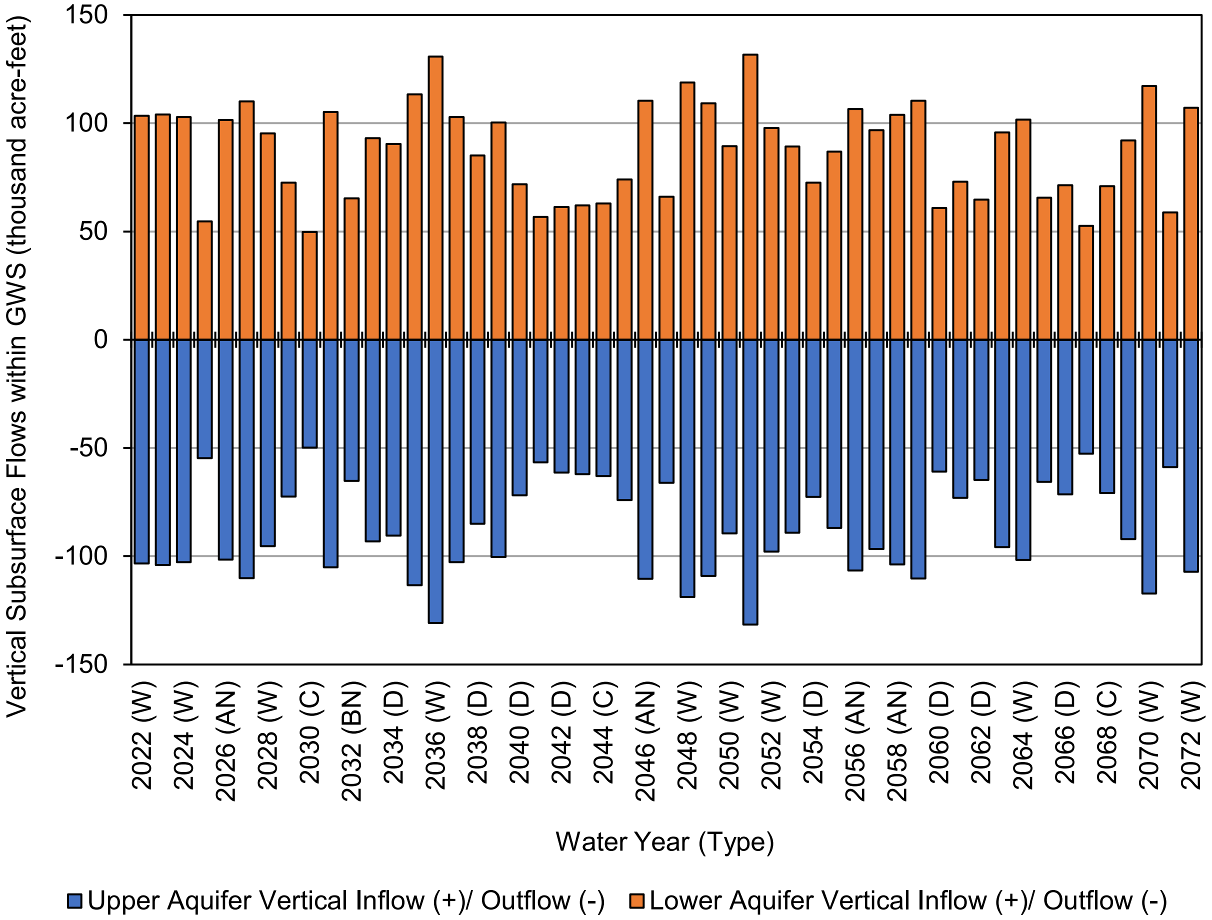


Figure 87. Bowman Subbasin Projected (Future Land Use with Climate Change) Vertical Subsurface Flow within the GWS

Table 84. Bowman Subbasin Projected (Future Land Use with Climate Change) Vertical Subsurface Flows within the GWS (acre-feet)

Water Year (Type)	Upper Aquifer to (-) / from (+) Lower Aquifer
2022 (W)	-100,000
2023 (W)	-100,000
2024 (W)	-100,000
2025 (BN)	-55,000
2026 (AN)	-100,000
2027 (W)	-110,000
2028 (W)	-95,000
2029 (C)	-73,000
2030 (C)	-50,000
2031 (AN)	-110,000
2032 (BN)	-65,000
2033 (AN)	-93,000
2034 (D)	-90,000
2035 (W)	-110,000
2036 (W)	-130,000
2037 (W)	-100,000
2038 (D)	-85,000
2039 (W)	-100,000
2040 (D)	-72,000
2041 (C)	-57,000
2042 (D)	-61,000
2043 (C)	-62,000
2044 (C)	-63,000
2045 (C)	-74,000
2046 (AN)	-110,000
2047 (C)	-66,000
2048 (W)	-120,000
2049 (W)	-110,000
2050 (W)	-89,000
2051 (W)	-130,000
2052 (W)	-98,000
2053 (AN)	-89,000
2054 (D)	-73,000
2055 (D)	-87,000
2056 (AN)	-110,000
2057 (BN)	-97,000
2058 (AN)	-100,000

<table>
<tr><th colspan="2">Water Year (Type)</th><th>Upper Aquifer to (-) / from (+) Lower Aquifer</th></tr>
<tr><td colspan="2">2059 (W)</td><td>-110,000</td></tr>
<tr><td colspan="2">2060 (D)</td><td>-61,000</td></tr>
<tr><td colspan="2">2061 (C)</td><td>-73,000</td></tr>
<tr><td colspan="2">2062 (D)</td><td>-65,000</td></tr>
<tr><td colspan="2">2063 (BN)</td><td>-96,000</td></tr>
<tr><td colspan="2">2064 (W)</td><td>-100,000</td></tr>
<tr><td colspan="2">2065 (BN)</td><td>-66,000</td></tr>
<tr><td colspan="2">2066 (D)</td><td>-71,000</td></tr>
<tr><td colspan="2">2067 (C)</td><td>-53,000</td></tr>
<tr><td colspan="2">2068 (C)</td><td>-71,000</td></tr>
<tr><td colspan="2">2069 (BN)</td><td>-92,000</td></tr>
<tr><td colspan="2">2070 (W)</td><td>-120,000</td></tr>
<tr><td colspan="2">2071 (BN)</td><td>-59,000</td></tr>
<tr><td colspan="2">2072 (W)</td><td>-110,000</td></tr>
<tr><td colspan="2">Average (2022-2072)</td><td>-88,000</td></tr>
<tr><td rowspan="5">2022 - 2072</td><td>W</td><td>-110,000</td></tr>
<tr><td>AN</td><td>-100,000</td></tr>
<tr><td>BN</td><td>-76,000</td></tr>
<tr><td>D</td><td>-74,000</td></tr>
<tr><td>C</td><td>-64,000</td></tr>
</table>

4.4.6 Change in Groundwater Storage

Projected (future land use with climate change) change in groundwater storage values for the Bowman Subbasin are summarized in **Figure 88** and **Figure 89,** and **Table 85**. Over the projected (future land use with climate change) period, the average total annual change in groundwater storage is about -0.5 taf per year, representing a very small decrease in groundwater storage. The corresponding cumulative total change in storage over the projected (future land use) period is about -27 taf. The annual change in storage numbers generally reflect the effects of the water year type with increase in storage occurring during wetter years and decreases in storage occurring during dry years.

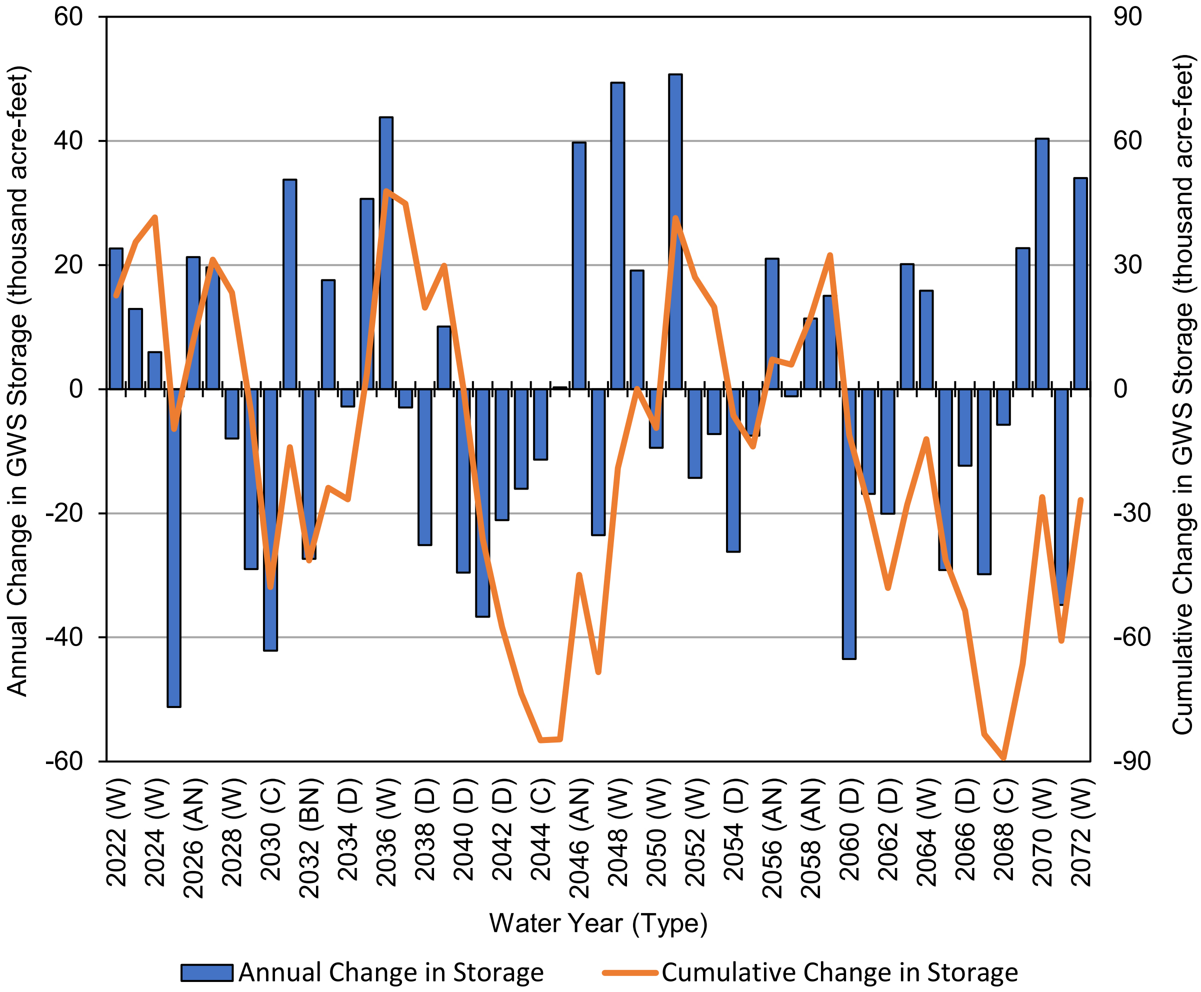


Figure 88. Bowman Subbasin Projected (Future Land Use with Climate Change) Projected (Future Land Use with Climate Change) Total Change in Storage within the GWS

Table 85. Bowman Subbasin Projected (Future Land Use with Climate Change) Change in Groundwater Storage (acre-feet)

Water Year (Type)	Upper Aquifer	Lower Aquifer	Total Annual Change	Total Cumulative Change
2022 (BN)	3,900	19,000	23,000	23,000
2023 (W)	1,700	11,000	13,000	36,000
2024 (W)	-370	6,300	6,000	42,000
2025 (W)	-21,000	-30,000	-51,000	-9,700
2026 (BN)	8,600	13,000	21,000	12,000
2027 (AN)	5,700	14,000	20,000	31,000
2028 (W)	-5,100	-2,900	-8,000	23,000
2029 (W)	-11,000	-18,000	-29,000	-5,700
2030 (C)	-14,000	-28,000	-42,000	-48,000
2031 (C)	15,000	19,000	34,000	-14,000
2032 (AN)	-11,000	-16,000	-27,000	-41,000
2033 (BN)	9,000	8,500	18,000	-24,000
2034 (AN)	-3,300	520	-2,800	-27,000
2035 (D)	11,000	20,000	31,000	4,000
2036 (W)	16,000	28,000	44,000	48,000
2037 (W)	-2,100	-850	-3,000	45,000
2038 (W)	-11,000	-14,000	-25,000	20,000
2039 (D)	6,500	3,600	10,000	30,000
2040 (W)	-11,000	-19,000	-30,000	280
2041 (D)	-13,000	-24,000	-37,000	-36,000
2042 (C)	-5,800	-15,000	-21,000	-57,000
2043 (D)	-4,900	-11,000	-16,000	-74,000
2044 (C)	-2,800	-8,500	-11,000	-85,000
2045 (C)	160	140	290	-85,000
2046 (C)	15,000	25,000	40,000	-45,000
2047 (AN)	-9,300	-14,000	-24,000	-68,000
2048 (C)	19,000	31,000	49,000	-19,000
2049 (W)	5,600	14,000	19,000	47
2050 (W)	-5,400	-4,000	-9,400	-9,400
2051 (W)	19,000	32,000	51,000	41,000
2052 (W)	-9,000	-5,300	-14,000	27,000
2053 (W)	-470	-6,800	-7,200	20,000
2054 (AN)	-9,200	-17,000	-26,000	-6,400
2055 (D)	-3,600	-3,900	-7,500	-14,000
2056 (D)	8,000	13,000	21,000	7,100
2057 (AN)	-1,600	390	-1,200	6,000

Water Year (Type)		Upper Aquifer	Lower Aquifer	Total Annual Change	Total Cumulative Change
2058 (BN)		4,300	7,100	11,000	17,000
2059 (AN)		4,900	10,000	15,000	32,000
2060 (W)		-16,000	-28,000	-43,000	-11,000
2061 (D)		-6,100	-11,000	-17,000	-28,000
2062 (C)		-6,100	-14,000	-20,000	-48,000
2063 (D)		8,600	12,000	20,000	-28,000
2064 (BN)		5,100	11,000	16,000	-12,000
2065 (W)		-12,000	-18,000	-29,000	-41,000
2066 (BN)		-2,800	-9,500	-12,000	-54,000
2067 (D)		-11,000	-19,000	-30,000	-83,000
2068 (C)		-2,100	-3,600	-5,800	-89,000
2069 (C)		10,000	13,000	23,000	-66,000
2070 (BN)		14,000	26,000	40,000	-26,000
2071 (W)		-13,000	-22,000	-35,000	-61,000
2072 (W)		13,000	21,000	34,000	-27,000
Average (2022-2072)		-400	-120	-530	
2022-2072	W	5,700	13,000	19,000	
	AN	8,400	11,000	20,000	
	BN	-5,700	-8,700	-14,000	
	D	-7,600	-13,000	-21,000	
	C	-7,400	-14,000	-21,000	

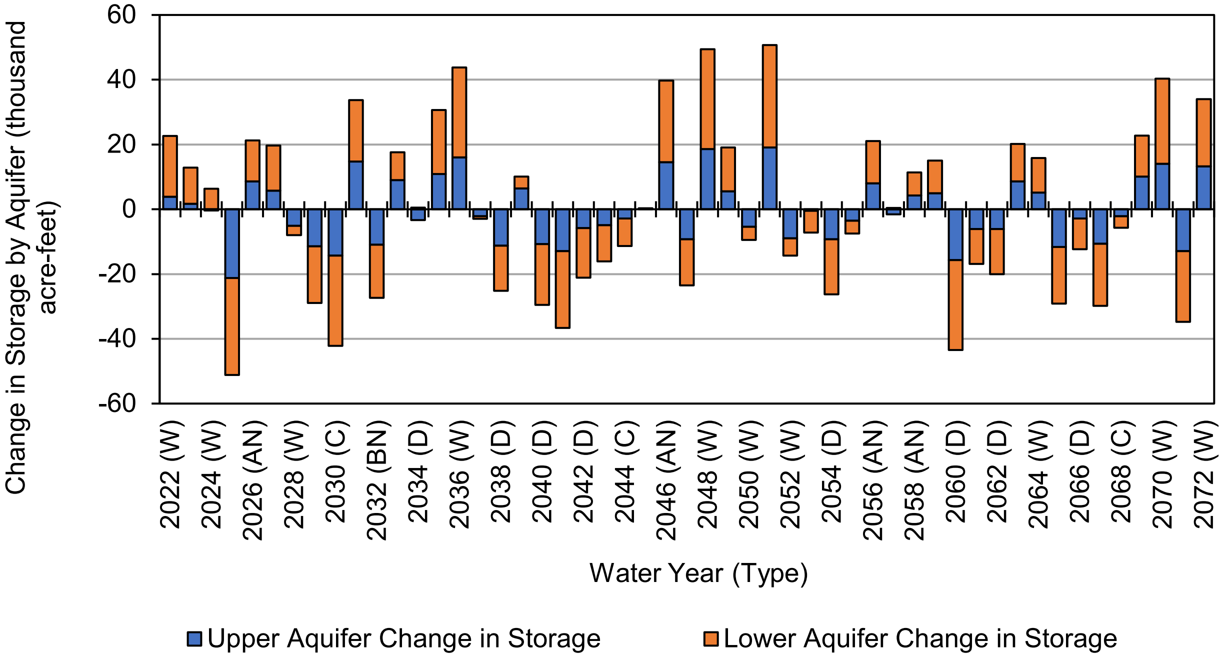


Figure 89. Bowman Subbasin Projected (Future Land Use with Climate Change) Change in Groundwater Storage by Aquifer

Appendix 3-A

DMS Summary

Introduction

The Tehama County Flood Control and Water Conservation District retained LSCE to provide a Data Management System (DMS). The DMS is a SGMA requirement as well as good business practice. The DMS is an asset, that like a physical asset should be maintained to properly perform. The DMS was created to manage data related to monitoring, analysis, and reporting on groundwater conditions and related information and meet the requirements of the GSP Regulations, including § 352.4, § 352.6, and § 354.4. GSP Regulations state that “Each Agency shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin.”

The Tehama County DMS has five key attributes:

1) Flexibility for importing data from various software platforms and systems,
2) Sufficient capacity to store existing (qualified) historical data and additional future data,
3) Ability to export data to numerous software formats (i.e., ESRI, Tableau),
4) Capability to grow and evolve as part of a larger DMS in the future, and
5) Capability to provide an interactive graphical platform.

This DMS incorporates both the database (data stored within related digital tables) for data storage accompanied by an interface to manipulate, query, and manage that data. Web components can be coupled with this system to allow for online viewing of data in the form of maps and graphs. The DMS has functionality to enable importing of data from and exporting data to other commercially available software programs for data visualization or to an enterprise level database for multi-user needs or both. This DMS consists of a Microsoft database, and visualization is possible with an ESRI webhosted map and webhosted Tableau graphics. The Tehama County DMS User Manual provides additional information about the DMS structure, data import and export procedures, quality control processes, and data analysis queries.

Data Types and GSP Indicators

Public agencies collect and maintain data applicable to GSP development and implementation, including DWR, United States Geological Survey (USGS), State Water Resources Control Board (SWRCB) comprising data from GeoTracker, GAMA, and Division of Drinking Water (DDW), NASA Jet Propulsion Laboratory (JPL), and National Oceanic and Atmospheric Administration (NOAA). The Tehama County Flood Control and Conservation District also conducts groundwater monitoring. These monitoring programs and available data are continually evolving to expand and merge to create a more useful and powerful network of information. Data collection methods and sources will likely change in the future.

The DMS contains a variety of data types, including well location and construction details, groundwater level and quality, land subsidence elevation, stream flow, and septic and well permits. The table below identifies the five applicable sustainability indicators and data maintained in the DMS for monitoring each.

Table 1. Sustainability Indicators and Applicable Monitoring Data

Sustainability Indicator	Ground-water Levels	Ground-water Quality	InSAR Subsidence	Stream Stage and Flow
Chronic Lowering of Groundwater Levels	✓			
Reduction of Groundwater Storage	✓			
Degraded Water Quality		✓		
Land Subsidence			✓	
Depletion of Interconnected Surface Water	✓			✓

DMS Database Structure

The database has a similar structure to common datasets developed by the USGS, SWRCB, and DWR. All data in the DMS are identified by data source. Each site or station is uniquely identified by a Site ID depending on the data source the Site ID could be the State Well Number (SWN), Station ID, or site-specific name. To ensure user flexibility, the DMS was designed using the Microsoft Access 2007-2016 software platform and the *.accdb* database format. The figure below illustrates different relationships that exist in the database. There are three main tables, several smaller tables, and many “lookup tables.” The three main tables are:
T_Well = well information
T_WL = water level information related to wells
T_WQ = water level information related to wells

While the Tehama County Flood Control and Conservation District GSA values transparency, several components of the DMS contain confidential information and such information will not be made publicly available. Well owner and contact information, certain well construction information and permit information will be treated in a confidential manner. Other types of information may also be considered confidential and access to such information will be restricted accordingly. Content of the DMS (structure, data, queries, and relationships between tables) is expected to evolve over time to increase the utility and functionality of the DMS.

Table Relationships, part one of two

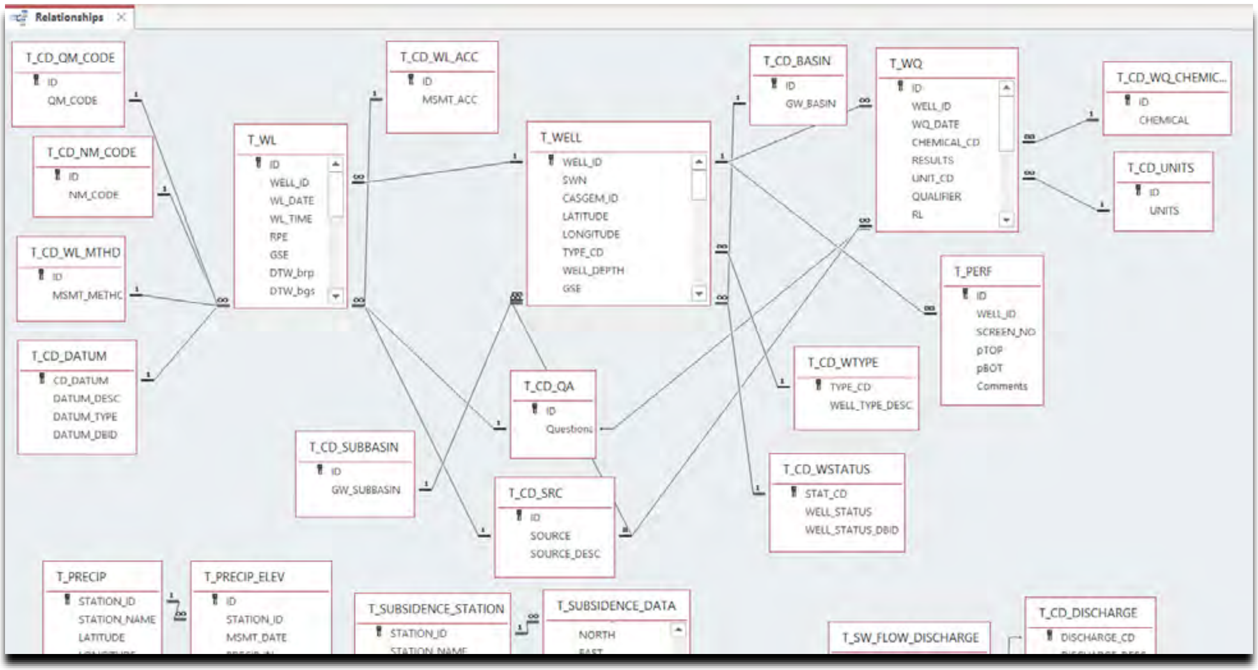
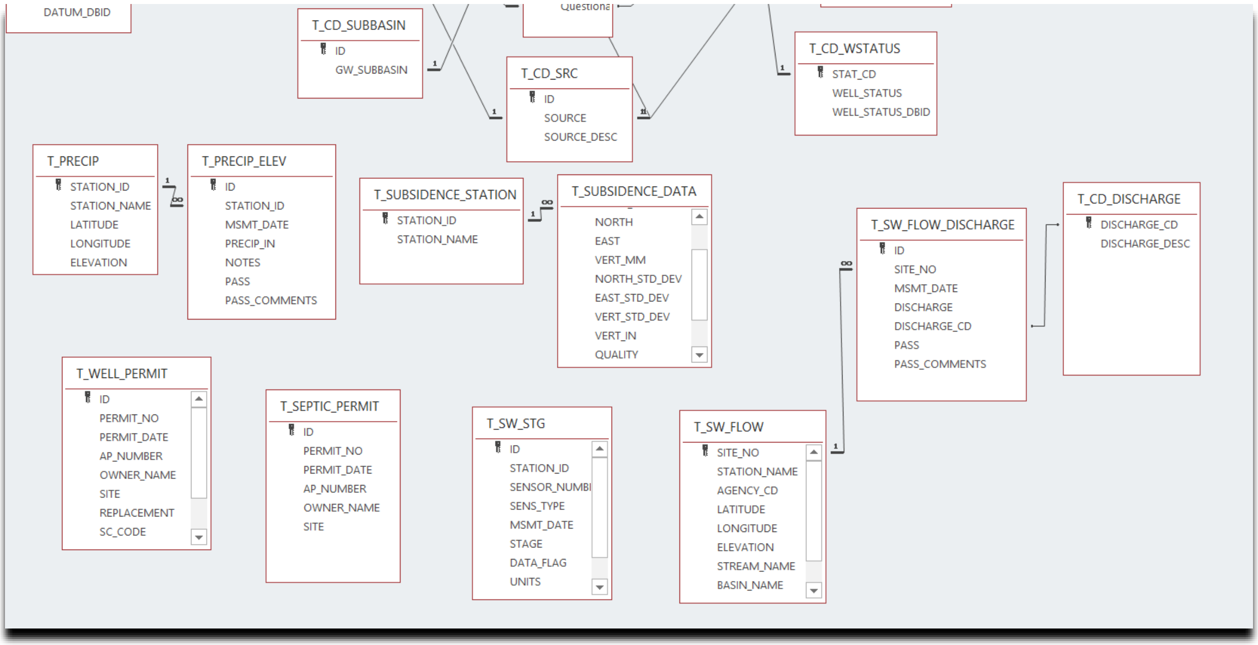


Table Relationships, part two of two



Database Schema and Data Fields

Proper creation of tables and table relationships, also known as schema, will avoid errors in query results and improve database efficiency. All tables in the DMS have a unique primary key (a special key (field) used to uniquely identify records) that serves as the common link between tables. The primary key maintains structural integrity of the relational database, prohibits duplicate entries in a field that requires unique information, and it is a useful field for linking tables with a defined relationship. Tables may also have foreign keys (a key or field used to establish a relationship between two tables) to help association with other tables and their fields. The process of creating proper table construction and relationship definitions makes inconsistent data more obvious and helps with quality control. All tables are normalized to at least the 3rd normal form. Normalization is a database design technique, to modify existing tables and their schema to minimize data redundancy and dependency.

Data standardization is important to avoid mixing definitions, units or other references that make data non-equivalent. Examples include elevation data that is referenced by a datum. There are generally two different vertical datums commonly used in reporting elevations: NGVD29 and NAVD88. NGVD29 is the older vertical datum that is referenced on USGS Quadrangles, and in California it is basically equivalent to mean sea level. Equating the NAVD88 datum to the NGVD29 datum varies by location. The datum in this DMS is all NAVD88. Water quality parameters are also standardized for example nitrate as nitrogen versus nitrate as nitrate, and should have consistent concentration units (e.g., mg/l, ug/l).

Use of List of Values tables. These can help in data standardization and keep track of the allowable values for each table filed (column). These can be referenced by other data tables. For example, T_LOV_WQ_AN which contains list of analytes. These are “lookup tables.”

T_LOV_WQ_AN		
T_WQ_AN_DBID	WQ_AN_CD	AN_DESC
2	Cl	Chloride mg/L
3	EC	Electrical Conductivity umhos/cm
4	Perc	Perchlorate ug/L
1	TDS	Total Dissolved Solids mg/L

The well site is uniquely identified by a “Well ID”, usually corresponding to the DWR-assigned State Well Number (SWN), USGS Site ID, or local Source Name. It is important to ensure this field is unique as State Well Numbers are not the unique identification that they were intended to be.

Quality Assurance and Quality Control

The DMS users should follow quality assurance and quality control processes to identify inconsistencies with data and common problems that occur through data entry. The most important component of quality control in the DMS is the preparation and review of data before entry in the DMS. These data are technical and should be scrutinized for inconsistencies and completely described before data entry. Tools have been established in the DMS for troubleshooting and error checking. Automatic reports (described in the user manual) have been constructed for presenting data in graphical and tabular format. These reports can be reviewed by a technical person with a conceptual understanding of the data to identify any questionable data or functional problems of the DMS (should they arise).

Additional quality assurance and quality control queries have been established to identify conflicting or inconsistent records or information (e.g., inconsistent units of measure for a water quality parameter, multiple reference point elevations for a well or groundwater pumping during water level collection). Despite efforts to minimize inaccurate data in the DMS inaccurate data does exists and is corrected on an ongoing basis.

It is important to remove redundancy in data. This can occur when two sources of information provide identical or similar data for the same well. The well records with redundant data need to be identified and flagged. Then the duplicated data (water level/quality entry) need to be examined and appropriate steps taken to remove the redundancy. One well ID should be used for each physical well. Nested wells (multiple wells within the same casing) should be uniquely identified.

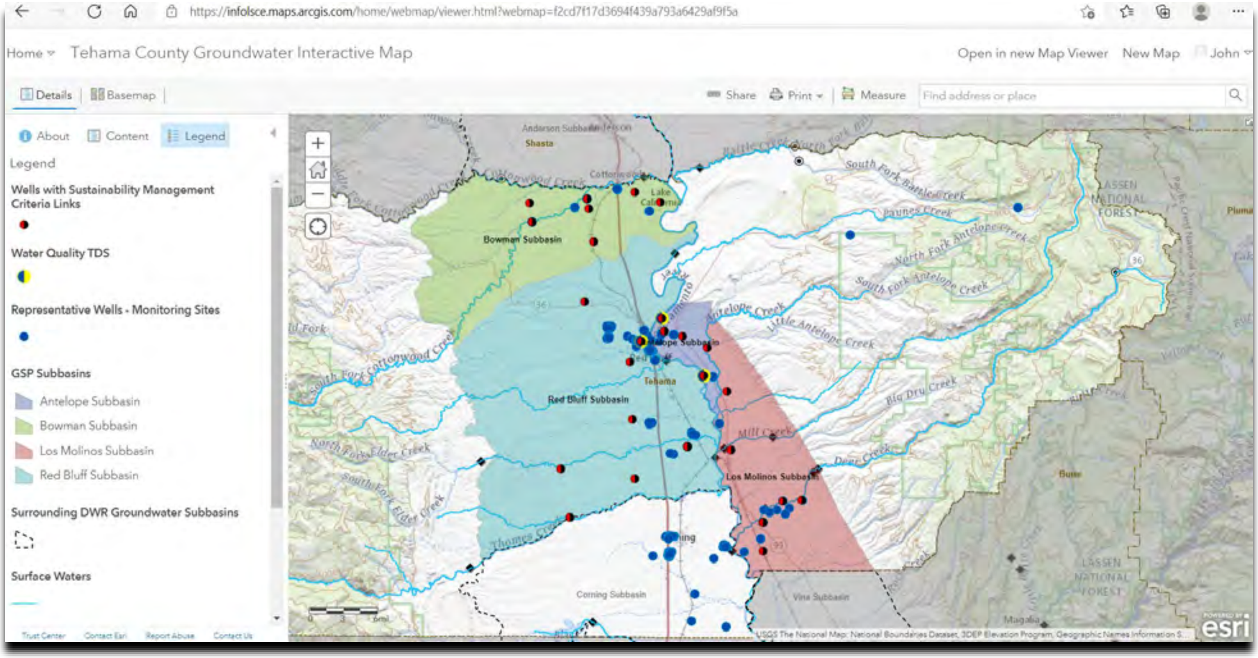
Groundwater level data may contain measuring point discrepancies and/or changes over time. These differences may arise when a well gets modified, re-surveyed or the measuring point changes. There might also be errors in the reference point elevations, in which case the reporting agency should be notified to resolve the error. Other differences in reference point elevations should be considered when making interpretations of water level changes and should, therefore, be rectified. Differences in elevation datum (between the older NGVD29 and more recent NAVD88) should be carefully observed and considered in order to interpret groundwater elevations. Lastly, significant subsidence over time may make the reference point elevation no longer representative.

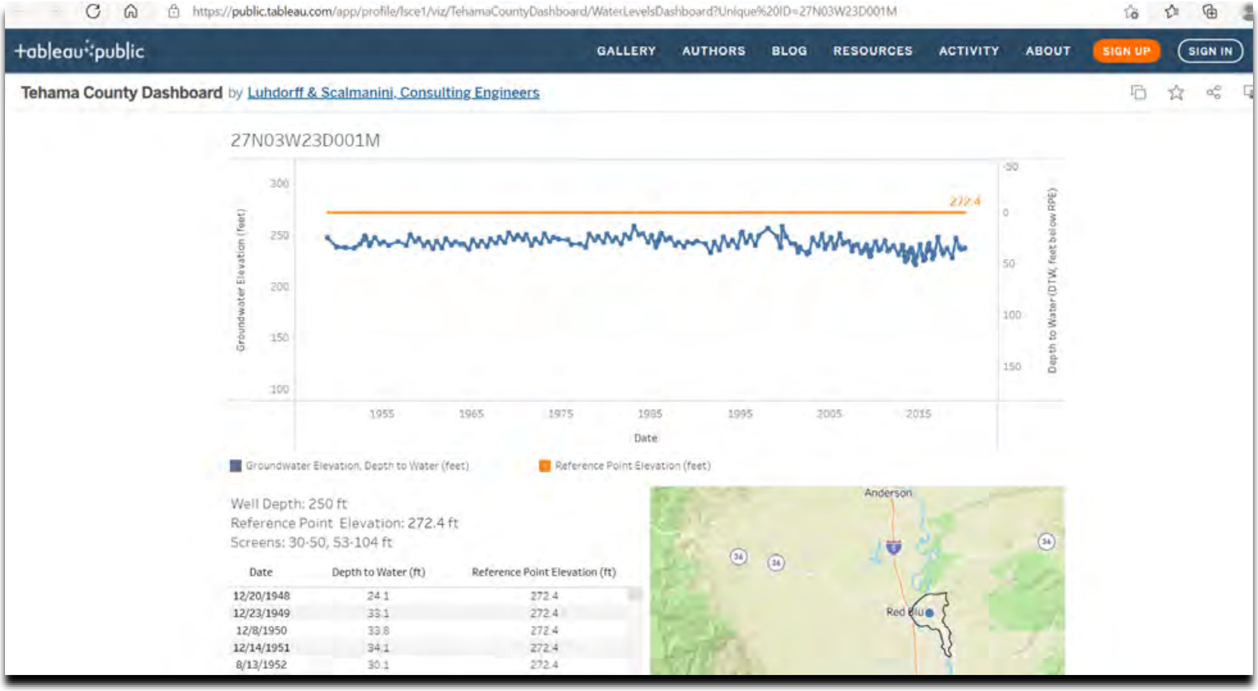
Numeric entries, such as *Depth to Water* field and *water quality value fields* should contain only numeric values. No text, spacing, or punctuation is allowed in numeric data. Data in fields should be consistent and logical. The use of numerical flags, like 999 or -9999 should be avoided as a separate field can perform this function. Also, these comment type numbers can bias mathematical functions, like mean or median. The correct data type and field standards for each table in the DMS are maintained in an Excel spreadsheet and are listed below.

Online Visualization

The data within the database is also presented in front-end software, an interactive ESRI web interface, and graphically in Tableau. Both programs allow users to view and interact with data from a DMS without specific knowledge of DMS software and structure. Below is a figure illustrating an example of an interactive web map in which, after clicking on a site location, site information is presented such as groundwater levels or water sample results for Total Dissolved Solids.

Interactive ESRI Map and Tableau Graph Examples





Well Depth: 250 ft
Reference Point Elevation: 272.4 ft
Screens: 30-50, 53-104 ft

Date	Depth to Water (ft)	Reference Point Elevation (ft)
12/20/1948	24.1	272.4
12/23/1949	33.1	272.4
12/8/1950	33.8	272.4
12/14/1951	34.1	272.4
8/13/1952	30.1	272.4

Reporting

DWR Submittals

Data submittals to DWR, as part of regular reporting, will include data contained in the DMS and be contained in forms (Excel files) provided by DWR through the SGMA Portal[1]. The DMS has the capability to conduct queries for extracting the appropriate reporting data in a format compatible for submittal in accordance with DWR reporting requirements.

Annual CASGEM Reporting

After the submittal of the GSP, the Subbasin will no longer need to update the CASGEM site with data and will instead report groundwater level monitoring data for Representative Monitoring Sites through uploads to the SGMA Monitoring Network Module[2].

GSP Annual Report

GSP Regulation §356.2 requires GSAs to submit GSP annual reports covering the previous water year (October 1 to September 30) every April 1 after submitting the GSP. GSP Regulations require that GSP annual reports include the following content:

- Executive Summary and location map §356.2(a).
- Groundwater elevation data, including groundwater contours and hydrographs for each principal aquifer §356.2(b).
- Total water use including groundwater extraction (general location and volume) for the preceding water year and surface water supply used or available for use (including the volume and sources) for the preceding water year §356.2(b).
- Change in groundwater storage for each principal aquifer §356.2(b).
- A graph illustrating cumulative change in groundwater storage, water year type, annual change in groundwater storage §356.2(b).
- Progress on Plan Implementation including achieving interim milestones, and implementation of projects and management actions §356.2(c).

There is no required template for GSP annual reports, although DWR provides a spreadsheet-based template, that it refers to as an elements guide, intended to accompany each annual report and provide a cross-reference between the content required by the GSP Regulations and the location of the required content in that annual report. Additionally, DWR has released spreadsheet-based templates to use for submitting and uploading data on groundwater extraction, groundwater extraction methods, surface water supply, and total water use required as part of GSP annual reports.

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[1] https://sgma.water.ca.gov/portal/

[2] https://sgma.water.ca.gov/SgmaWell/

GSP Five-Year Report

SGMA and the GSP Regulations require GSAs in medium-priority and high-priority basins to conduct a periodic review and assessment of GSPs at least every five years and whenever a GSP is amended. The Five-Year Report will be due by April 1 of every fifth year starting in 2027. The Five-Year Report includes a more comprehensive evaluation compared to the annual report and it will include elements of the annual reports, GSP implementation progress, and progress toward meeting the Subbasin sustainability goal. DWR has not yet released any guidance documents related to the preparation of the GSP Five-Year Report. The content of the Five-Year Report will follow any forthcoming guidance documentation or template provided by DWR.

Appendix 3-B

Groundwater Level Hydrographs, Measurable Objectives (MO) and Minimum Thresholds (MT) of Groundwater Level Sustainability Indicator Wells

Appendix 3B

Groundwater Level Hydrographs, Measurable Objectives (MO) and Minimum Thresholds (MT) of Groundwater Level Sustainability Indicator Wells

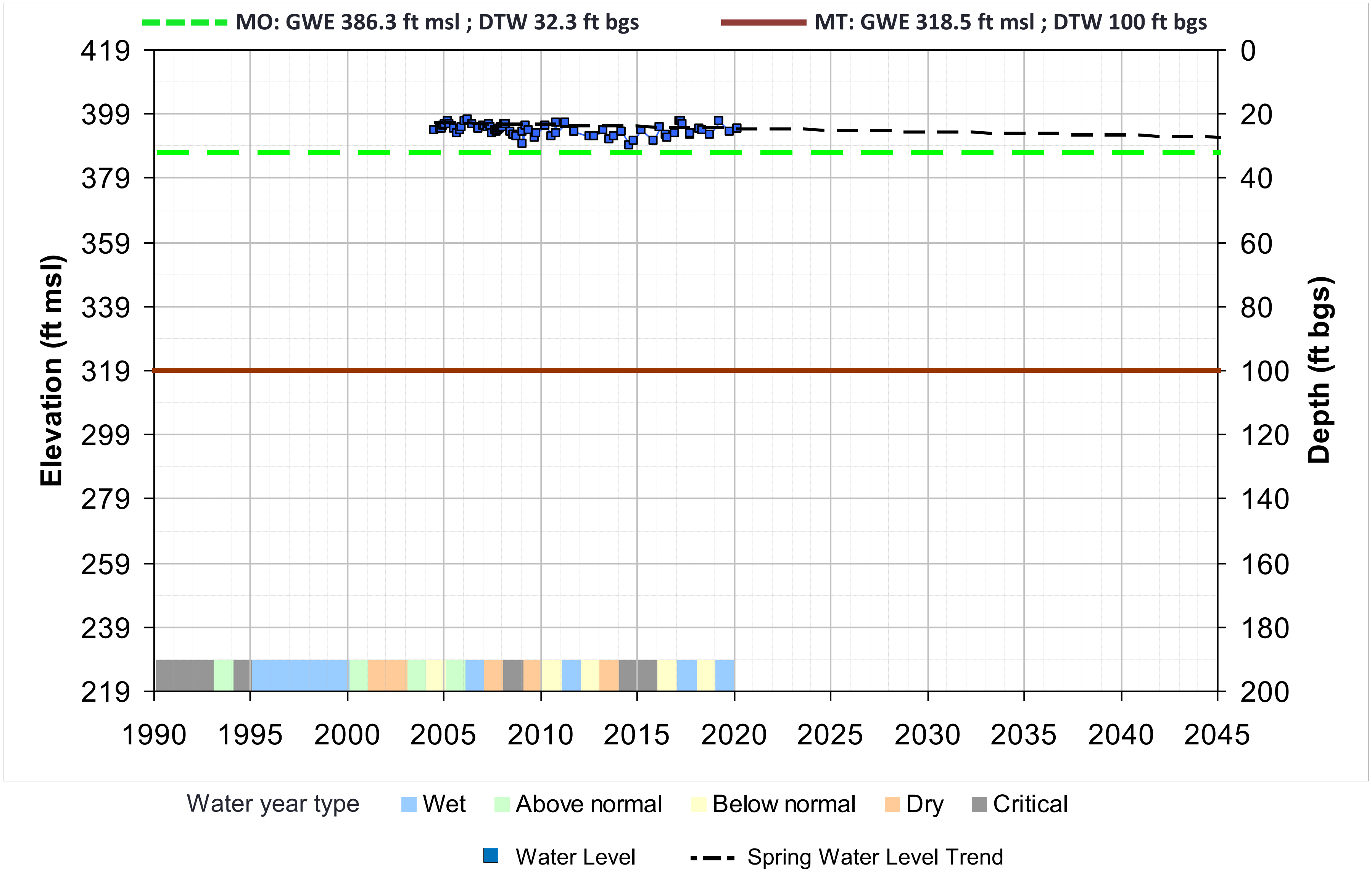
Bowman Subbasin

Bow-1U SWN: 29N03W18M001M

MO = Spring 2042 DTW + 5 ft

Well Depth (ft): 234; Screens (ft bgs): N/A

Aquifer: Upper; Well Type: Irrigation

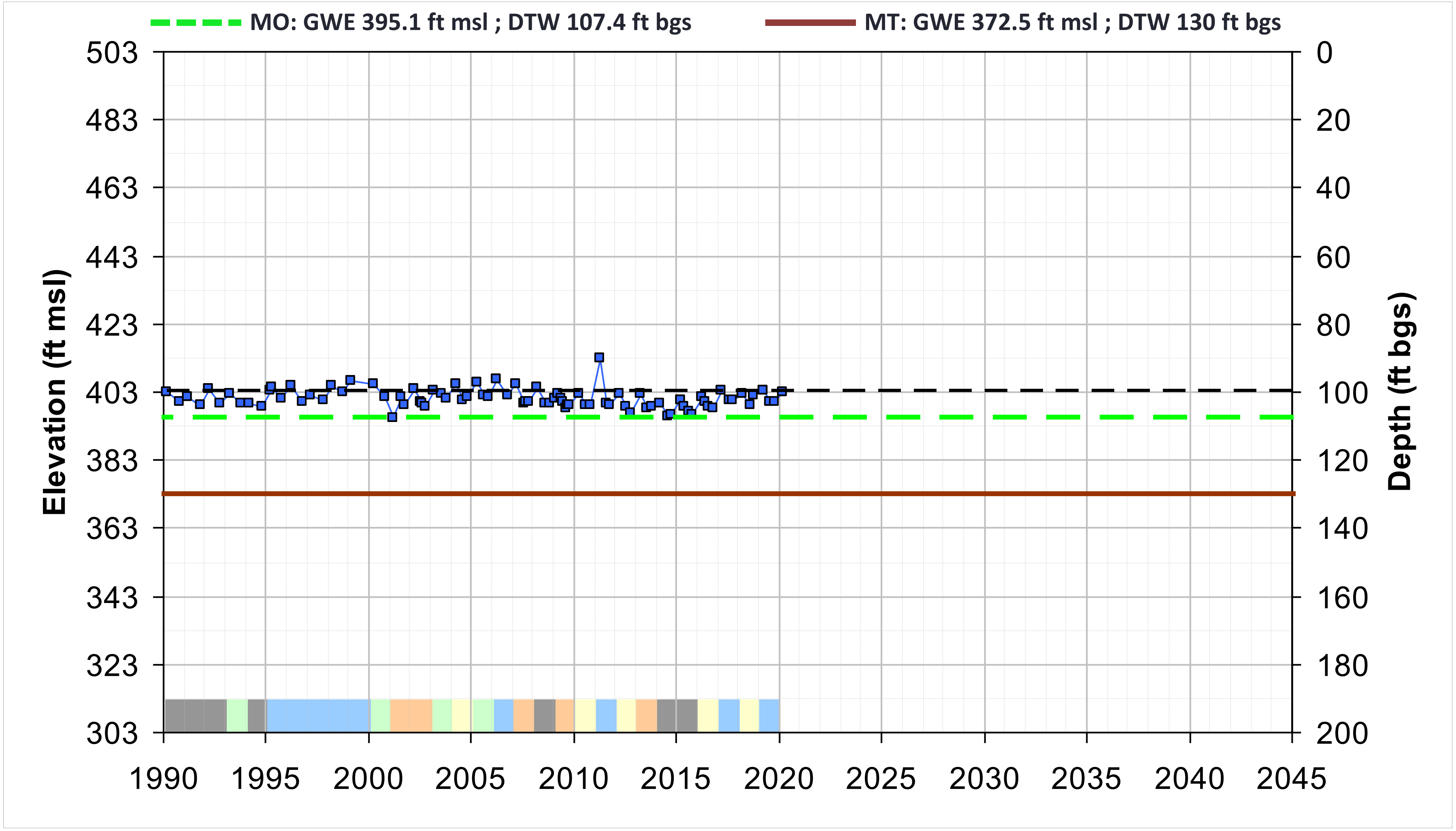


Bow-2U SWN: 29N04W28D001M

MO = Spring 2015 DTW + 5 ft

Well Depth (ft): 134; Screens (ft bgs): 114 - 134

Aquifer: Upper; Well Type: Domestic



Water year type 🟦 Wet 🟩 Above normal 🟨 Below normal 🟧 Dry ⬛ Critical

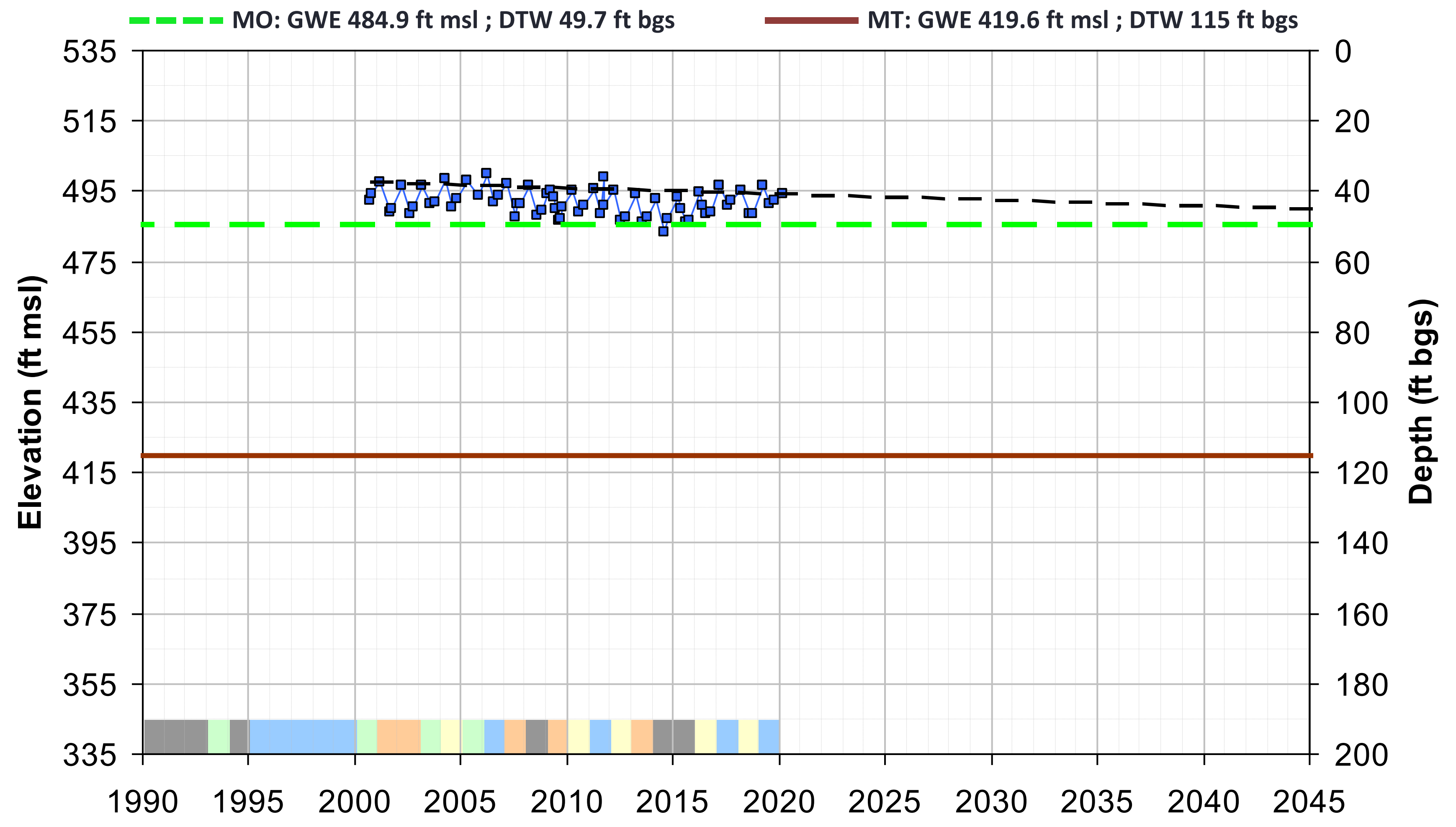
■ Water Level - - - Spring Water Level Trend

Bow-3U SWN: 29N05W33A004M

MO = Spring 2042 DTW + 5 ft

Well Depth (ft): 210; Screens (ft bgs): 110 - 210

Aquifer: Upper; Well Type: Monitoring



Water year type 🟦 Wet 🟩 Above normal 🟨 Below normal 🟧 Dry ⬛ Critical

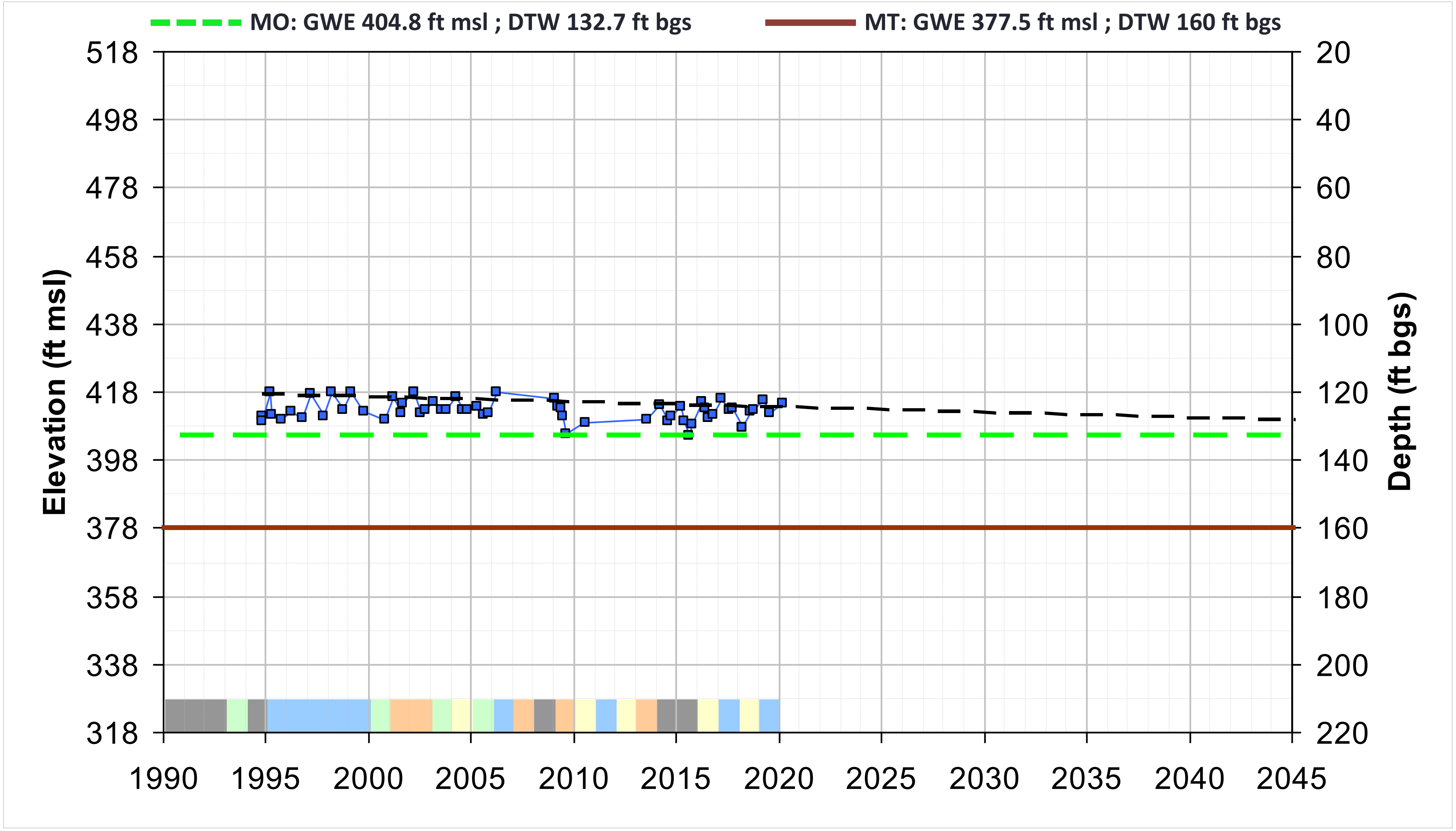
■ Water Level - - Spring Water Level Trend

Bow-4U SWN: 28N04W04P001M

MO = Spring 2042 DTW + 5 ft

Well Depth (ft): 270; Screens (ft bgs): 200 - 270

Aquifer: Upper; Well Type: Domestic



Water year type 🟦 Wet 🟩 Above normal 🟨 Below normal 🟧 Dry ⬛ Critical

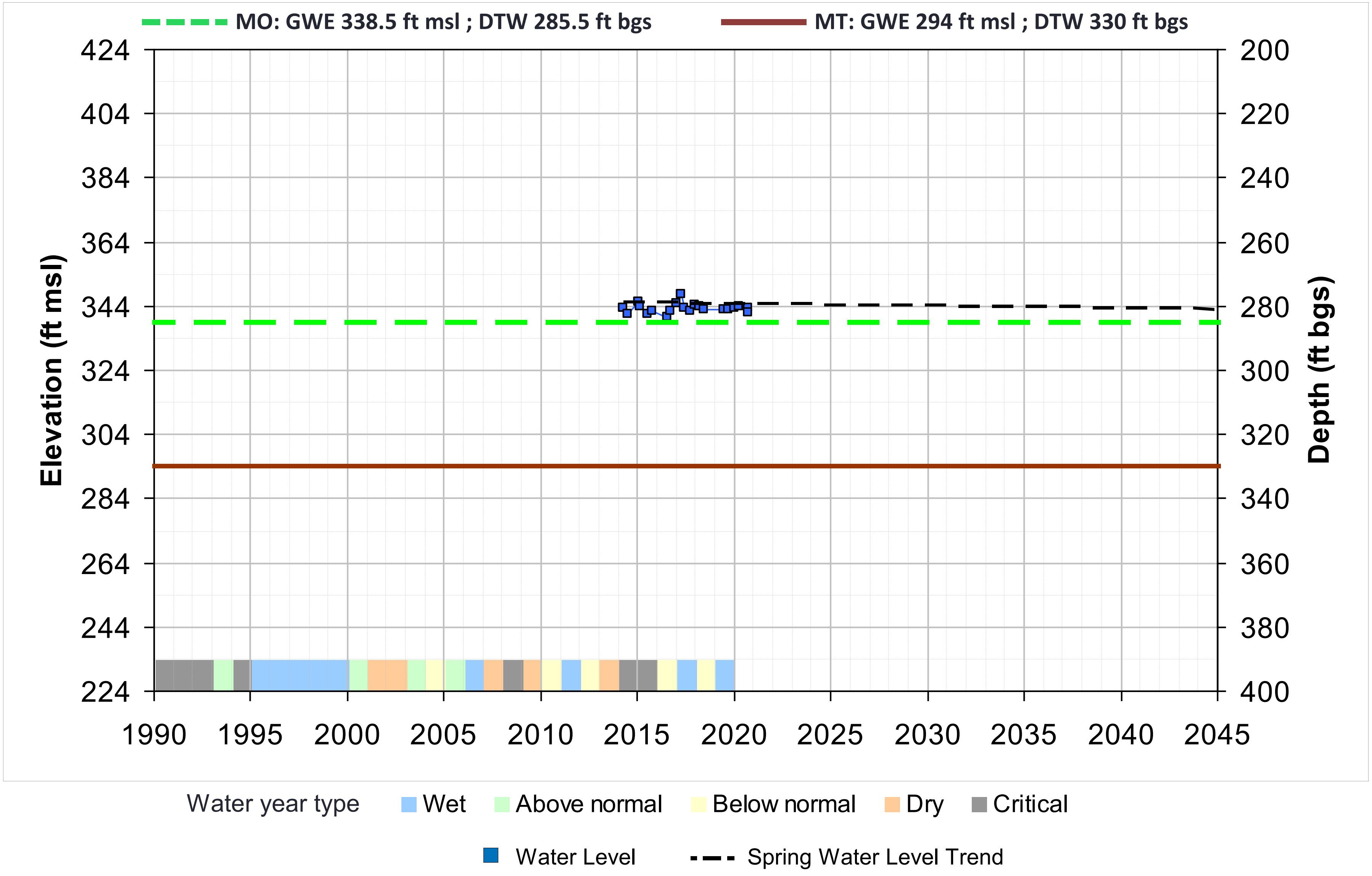
■ Water Level - - - Spring Water Level Trend

Bow-5L SWN: 29N03W21

MO = Spring 2042 DTW + 5 ft

Well Depth (ft): 760; Screens (ft bgs): 390 - 750

Aquifer: Lower; Well Type: Municipal

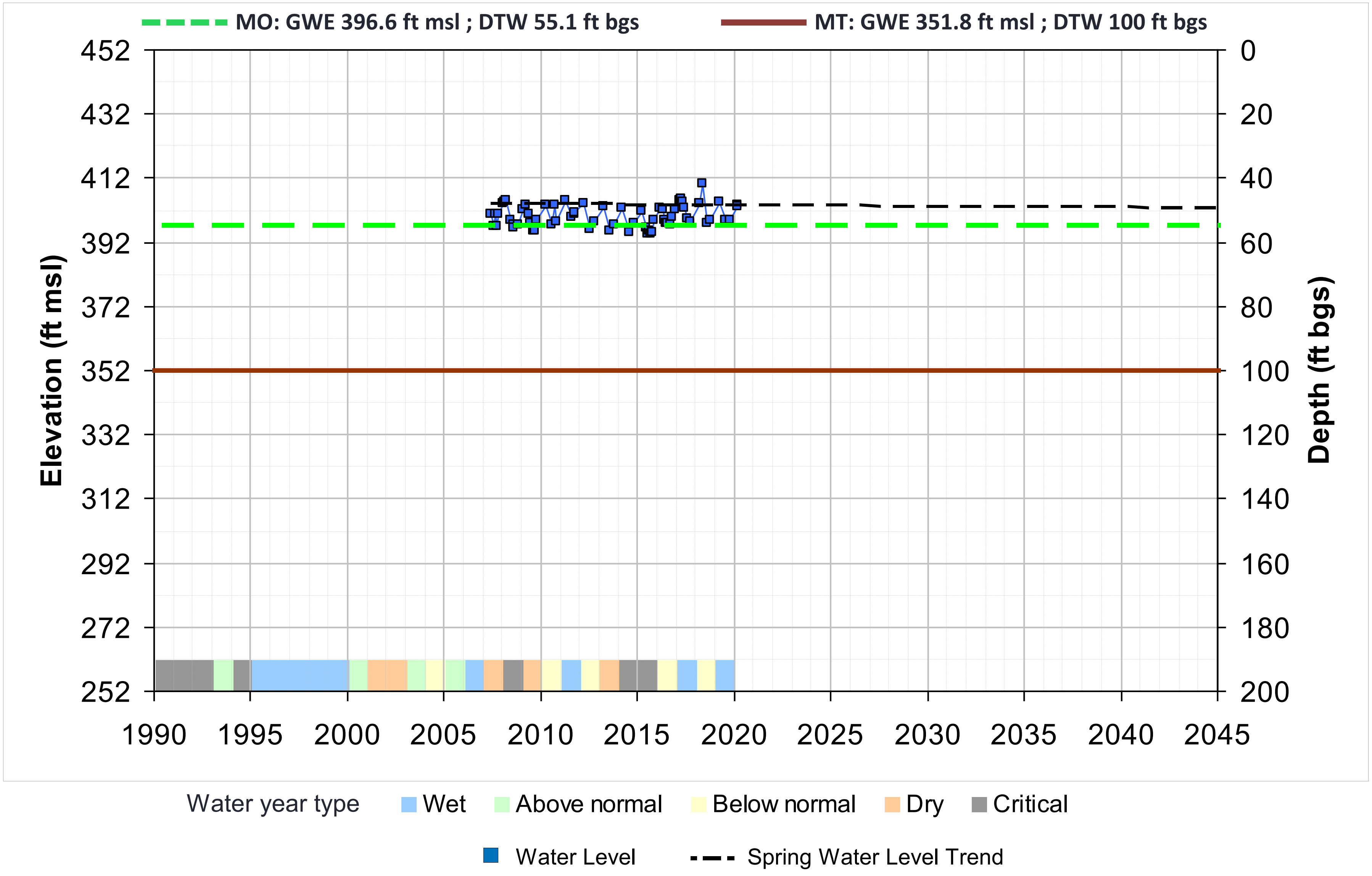


Bow-6L SWN: 29N04W20A002M

MO = Spring 2042 DTW + 5 ft

Well Depth (ft): 451; Screens (ft bgs): 360 - 430

Aquifer: Lower; Well Type: Monitoring

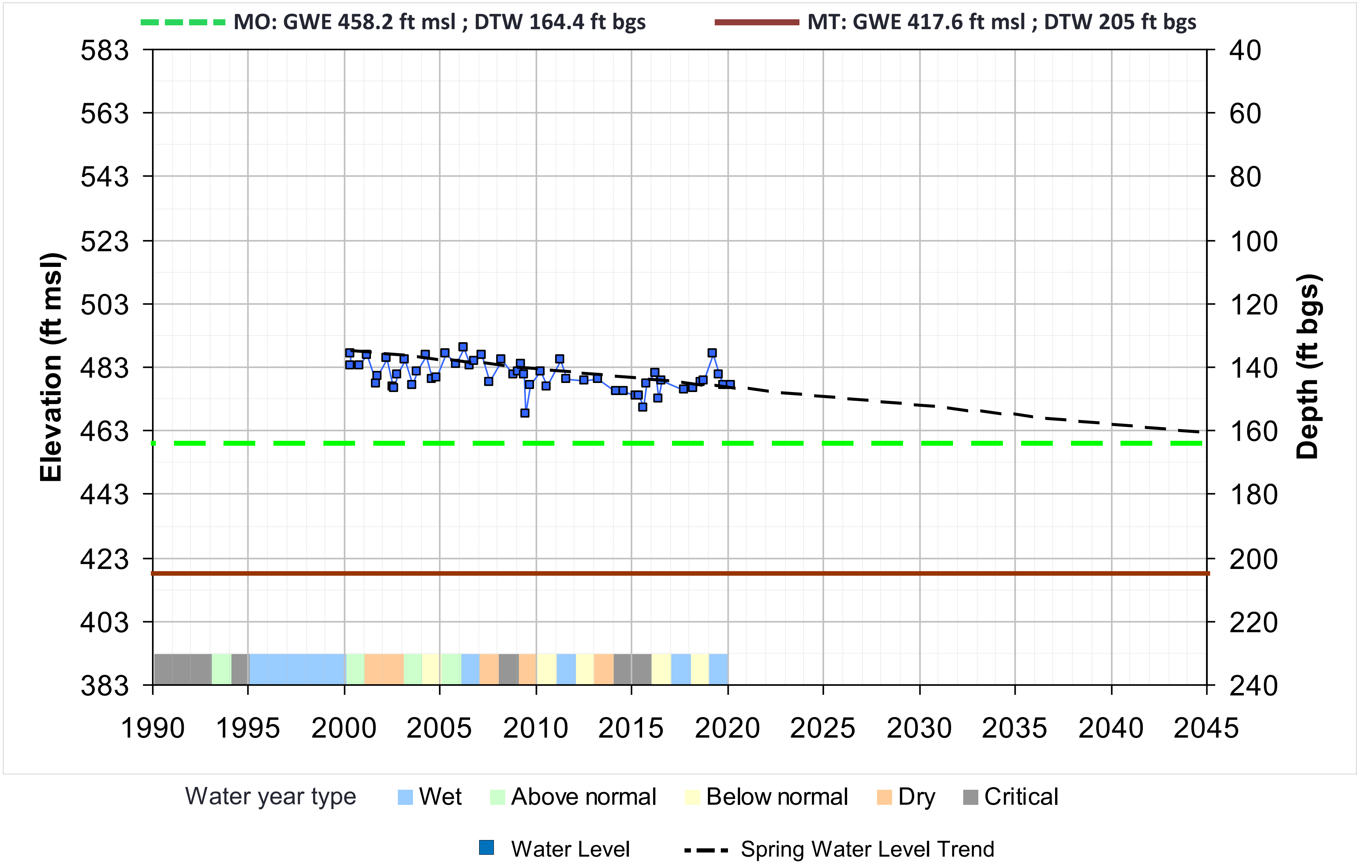


Bow-7L SWN: 29N05W21H001M

MO = Spring 2042 DTW + 5 ft

Well Depth (ft): 280; Screens (ft bgs): 250 - 280

Aquifer: Lower; Well Type: Domestic



Appendix 3-C

InSAR Subsidence Time Series Graphics

Bowman Subbasin

Sustainable Groundwater Management Act

Groundwater Sustainability Plan Appendix 3-C InSAR Subsidence Timeseries Data

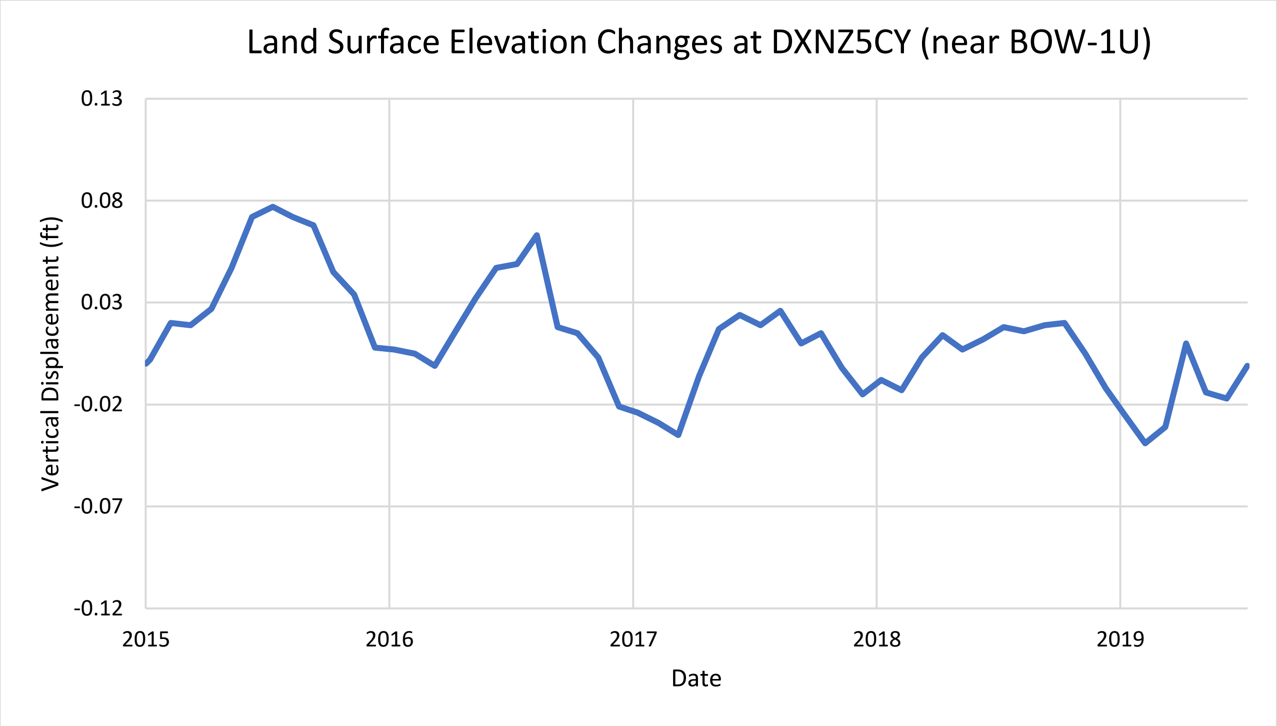
January 2022

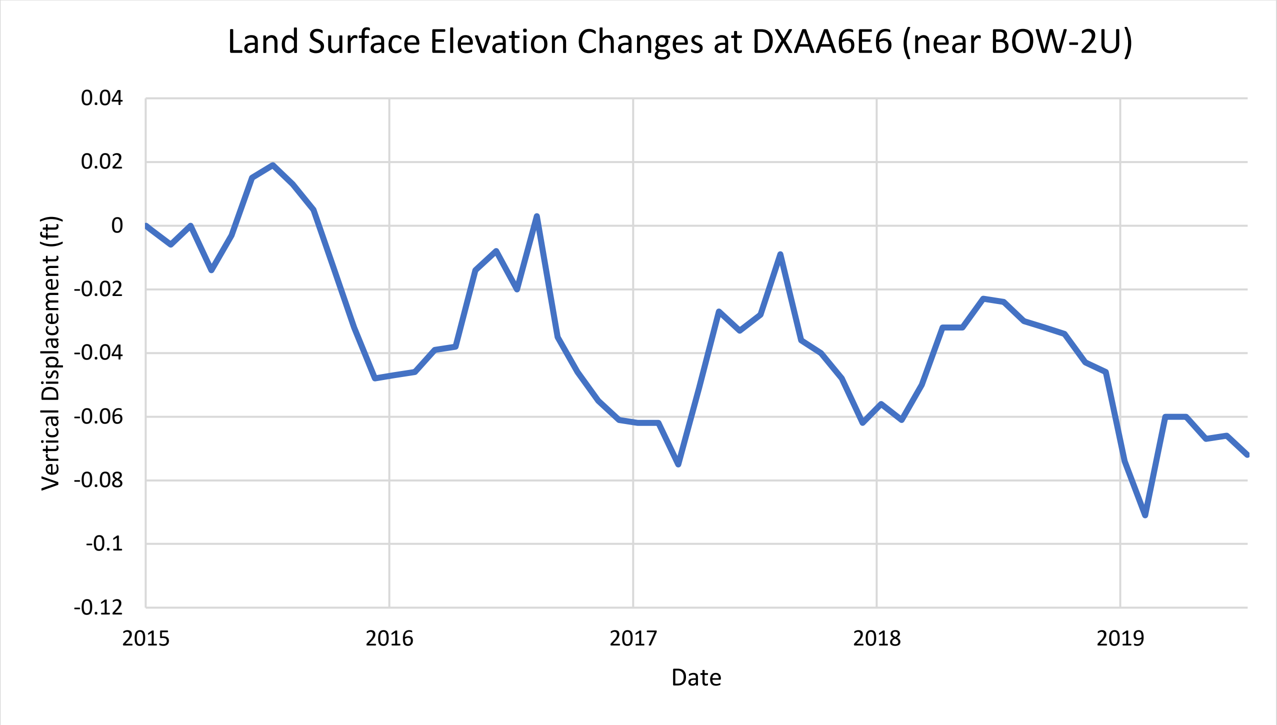
Prepared For:

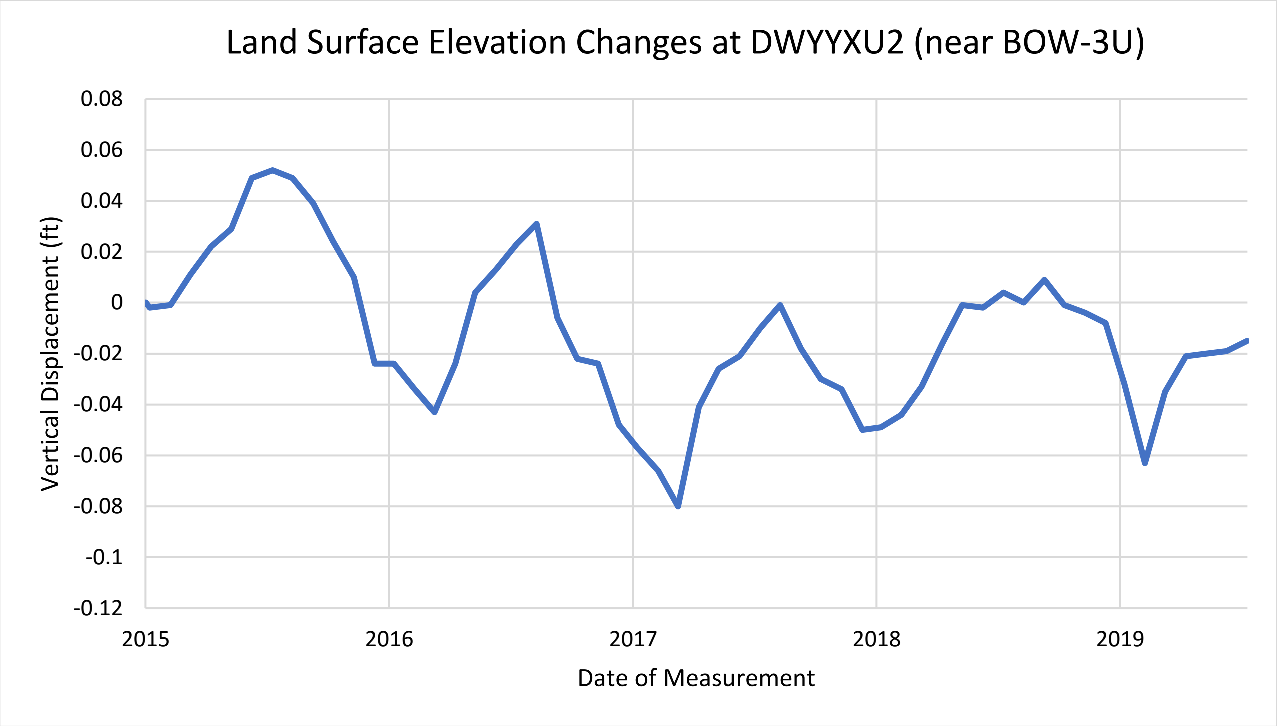
Tehama County Flood Control and Water Conservation District

Prepared By:

Luhdorff & Scalmanini, Consulting Engineers


Land Surface Elevation Changes at DXNZ5CY (near BOW-1U)
Vertical Displacement (ft)
0.13
0.08
0.03
-0.02
-0.07
-0.12
2015
2016
2017
2018
2019
Date


Land Surface Elevation Changes at DXAA6E6 (near BOW-2U)
Vertical Displacement (ft)
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
2015
2016
2017
2018
2019
Date


Land Surface Elevation Changes at DWYYXU2 (near BOW-3U)
Vertical Displacement (ft)
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0.06
0.04
0.02
0
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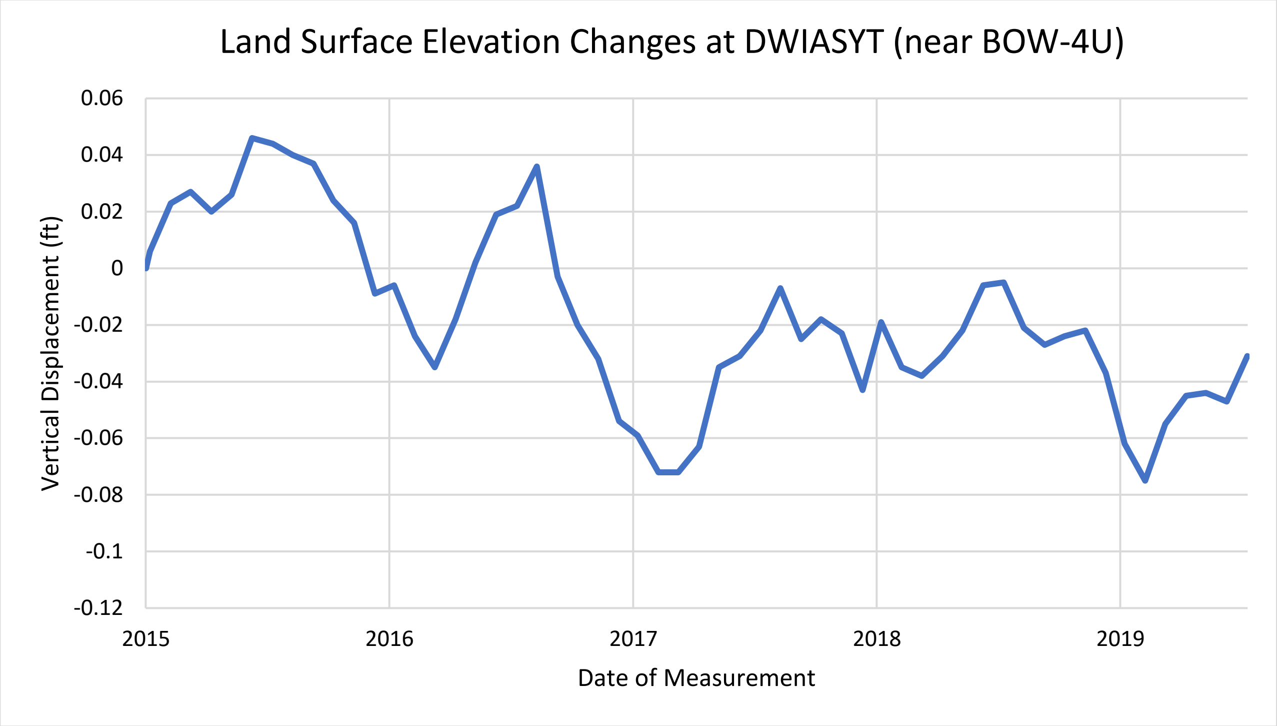
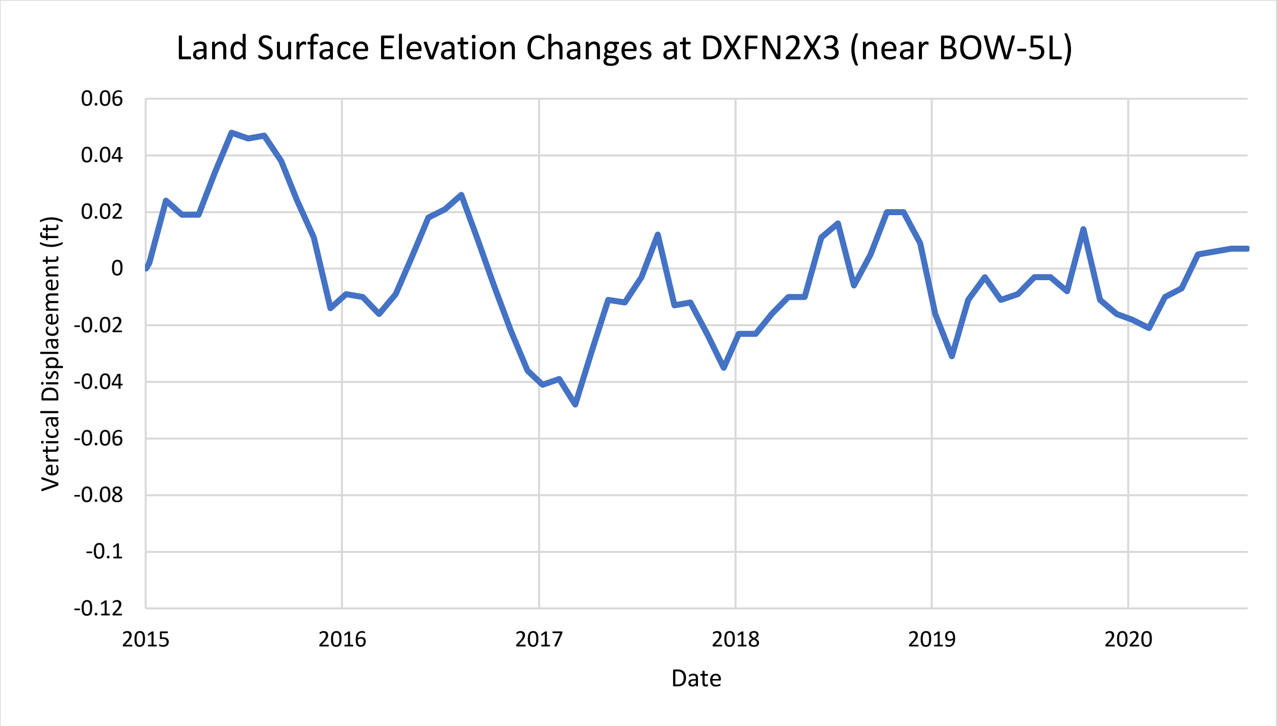
-0.04
-0.06
-0.08
-0.1
-0.12
2015
2016
2017
2018
2019
Date of Measurement


Land Surface Elevation Changes at DWIASYT (near BOW-4U)
Vertical Displacement (ft)
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
2015
2016
2017
2018
2019
Date of Measurement


Land Surface Elevation Changes at DXFN2X3 (near BOW-5L)
Vertical Displacement (ft)
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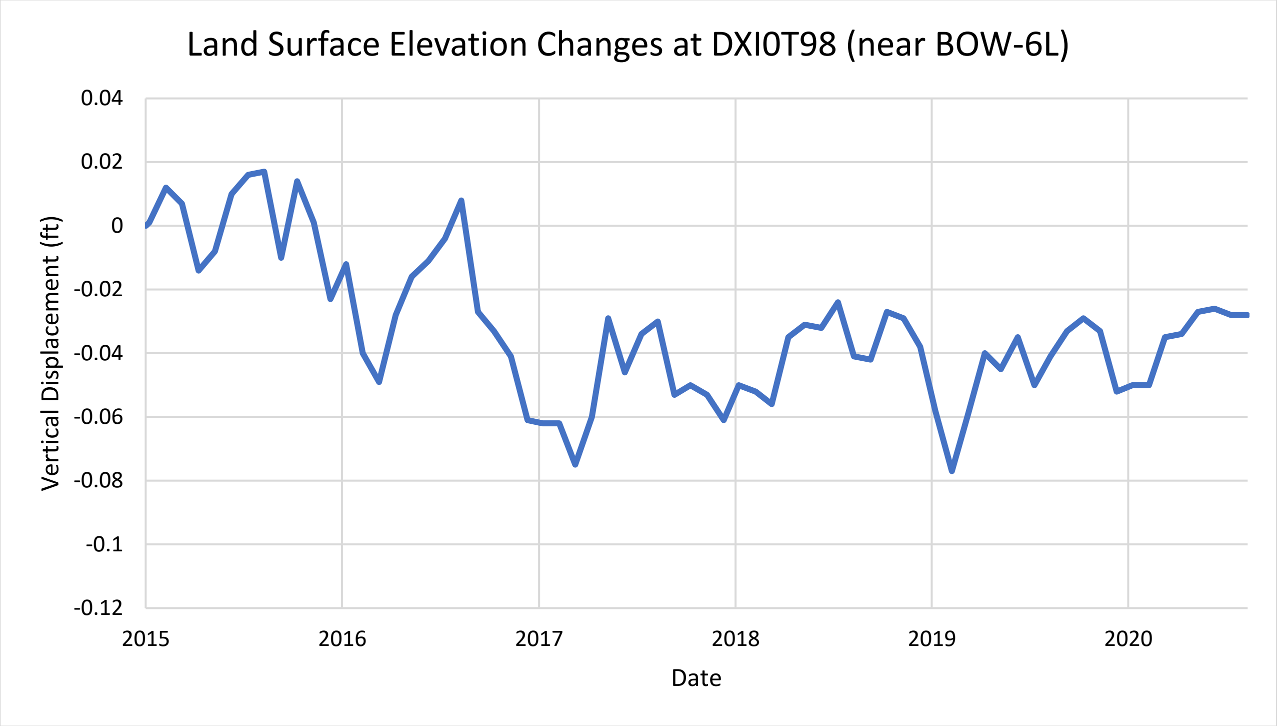
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
2015
2016
2017
2018
2019
2020
Date


Land Surface Elevation Changes at DXI0T98 (near BOW-6L)
Vertical Displacement (ft)
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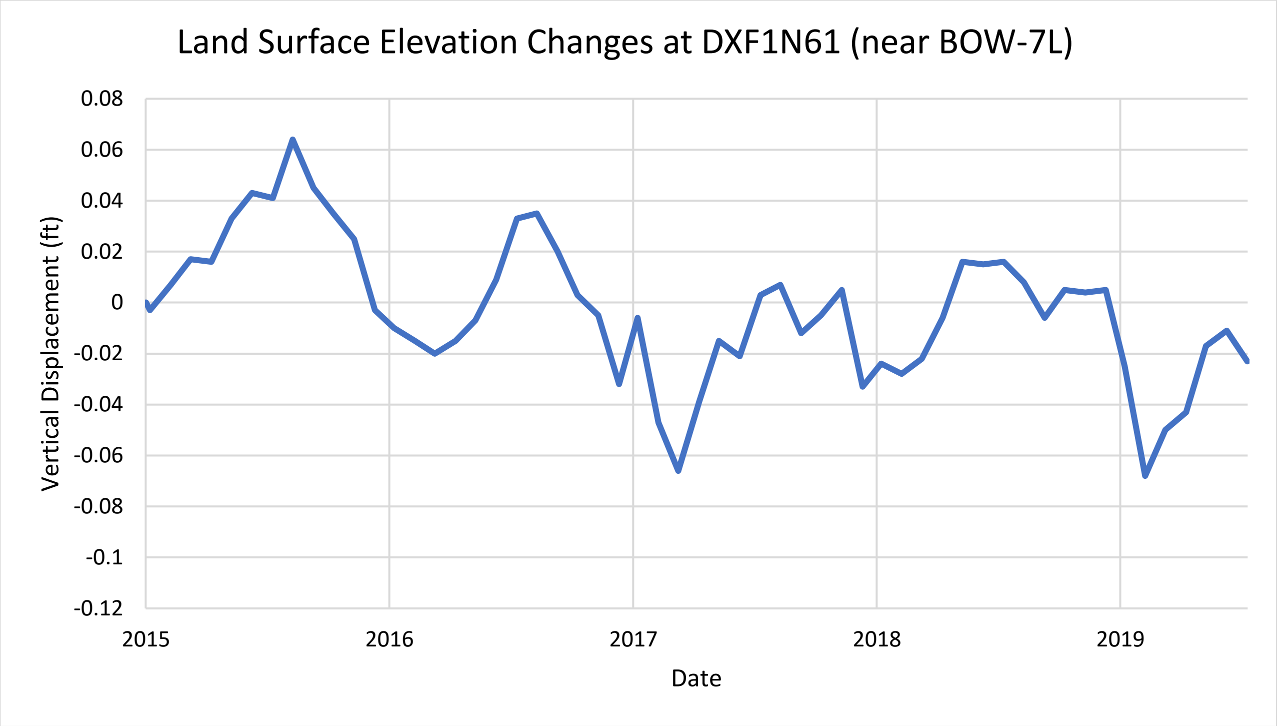
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
2015
2016
2017
2018
2019
2020
Date


Land Surface Elevation Changes at DXF1N61 (near BOW-7L)
Vertical Displacement (ft)
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
2015
2016
2017
2018
2019
Date

Appendix 3-D

Baseline Water Quality Sampling Documentation

Bowman Subbasin

Sustainable Groundwater Management Act

Groundwater Sustainability Plan Appendix 3-D Water Quality Sampling Results

January 2022

Prepared For:

Tehama County Flood Control and Water Conservation District

Prepared By:

Luhdorff & Scalmanini, Consulting Engineers

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LIST OF TABLES

1 WATER QUALITY SAMPLING

1.1 Summary

This appendix outlines the methodology and results of a Tehama County FCWCD examination of groundwater quality within the Bowman Subbasin in Tehama County, California. Groundwater samples were collected from three wells in the Bowman Subbasin and analyzed for TDS. TDS results were below the California recommended secondary MCL (500 mg/L) in all samples.

1.2 Introduction

Recent groundwater quality data has been identified as a data gap within the Bowman Subbasin. To fill this data gap, water quality samples were collected from wells within the Subbasin. These data support the development and implementation of the Bowman Subbasin GSP to comply with SGMA and achieve sustainable groundwater management by 2042.

The sampled wells are part of the representative monitoring network for groundwater quality for management under the GSP. The primary purpose of testing these samples is to provide a baseline for water quality within the Subbasin for comparison with future repeated sampling events, which are necessary to track temporal trends in groundwater quality. These data will be used to calculate interim milestones to reach MOs at each well over the projected period.

1.3 Methods

On August 19, August 27, and September 13, 2021, three wells were sampled for groundwater quality. All wells are part of a groundwater elevation network monitored by the Tehama County FCWCD/DWR for the Subbasin’s California Statewide Groundwater Elevation Monitoring (CASGEM) Program. Field sampling was conducted by LSCE coordinated with both DWR and Tehama County FCWCD. Sampled wells consisted of agricultural wells, domestic wells, and monitoring wells. To ensure the samples are representative of the water quality, a large volume of water was purged from agricultural and domestic wells prior to sampling and samples were collected at the closest point of distribution from the well. Standard purge volume of three well casings were targeted however, flow meters were not installed on all wells. Wells without flow meters were purged for a time calculated using the pump rate listed on the well completion report to achieve three casing volumes. For monitor wells, passive Hydrasleeve samplers were installed and allowed to equilibrate in the well for a minimum of one week. Samples were collected in laboratory supplied plastic bottles and placed on ice before delivery to Basic Labs in Chico, CA. Samples were analyzed for TDS by method SM 2540C. To ensure the validity of laboratory results, sample duplicates were collected from 10% of wells and analyzed by Basic Labs.

Groundwater quality data were compared to published California Code of Regulations, Title 22, Secondary Drinking Water Standards.

Prior to sampling, property owners were contacted to secure permission for LSCE to access and sample the wells. Some owners were unable to be contacted to secure access agreements. LSCE will continue to attempt to reach property owners where samples could not be collected and, if access is denied, identify a suitable replacement well for future WQ sampling events.

1.4 Results and Conclusion

Samples collected from the RMS wells had TDS detections ranging from 134 mg/L in sample Bow-1 to 161 in sample Bow-4 (**Table 1**). All the collected samples are below the California Recommended Secondary MCL for TDS (**Table 1**).

Lab results indicate that there are no widespread water quality concerns relating to TDS within the Subbasin. These samples represent a baseline condition for the start of the GSP implementation period and will be used to compare future results to evaluate if water quality is changing over the GSP implementation period.

Table 1. Bowman Water Quality Sampling Results

Well Name	State Well Number (SWN)	Date Sampled	TDS (mg/L)	Secondary Maximum Contaminant Levels	
				Recommended (TDS mg/L)	Upper Secondary MCL (TDS mg/L)
Bow-1U	29N03W18M001M	08/19/2021	134	500	1,000
Bow-2U[1]	29N04W28D001M	TBD	TBD	500	1,000
Bow-3U	29N05W33A004M	09/13/2021	175	500	1,000
Bow-4U	28N04W04P001M	08/19/2021	161	500	1,000

1. Access has yet to be secured

Appendix 4-A

Projects and Management Actions Matrix

Appendix 4-A.

Overview of Projects and Management Actions

Introduction

Projects and management actions (PMAs) are included in the Groundwater Sustainability Plans (GSPs) for the Antelope, Bowman, Los Molinos, and Red Bluff Subbasins to achieve and maintain sustainable groundwater conditions in each Subbasin. In accordance with 23 CCR §354.44(a), these PMAs will support ongoing sustainability and adapt to potential future changes in conditions in each Subbasin. PMAs are categorized and presented in this appendix as follows:

- **Projects and Management Actions Developed for Implementation** are PMAs that the GSA or other project proponents are planning to implement or are currently implementing in the Subbasins. These PMAs have been developed to achieve and maintain groundwater sustainability while supporting other local goals.
- **Portfolio of Other Potential Projects and Management Actions** are PMAs that could be implemented, as needed, to achieve and maintain long-term sustainable groundwater management across the Subbasins. These potential PMAs would be further evaluated and selected for implementation depending on funding, interest among stakeholders, and whether Subbasin conditions have changed such that additional PMAs would be necessary to maintain groundwater sustainability. These PMAs may have been studied by the project proponent or in earlier regional water planning documents, but most project design, cost estimates, and planning work have yet to be completed, and would only be initiated if the project is eventually triggered for implementation as a result of continued monitoring of groundwater conditions.

The compilation of PMAS presented in this appendix are designed to support the long-term sustainability of groundwater resources in the Subbasins. The information currently available for each of these PMAs is provided in Tables 1 through 6 below. These tables summarize the following information:

- Table 1. Brief Description of all Projects and Management Actions
- Table 2. Project Type, Proponent, and Location for all Projects and Management Actions.
- Table 3. Implementation Criteria, Notice Process, Permitting and Regulatory Process, and Timeline for all Projects and Management Actions.
- Table 4. Anticipated Benefits of all Projects and Management Actions.
- Table 5. Benefit Evaluation and Water Source for all Projects and Management Actions.
- Table 6. Legal Authority Requirements, Estimated Cost, and Potential Funding Sources for all Projects and Management Actions.

The fields in these tables have been designed to meet the requirements for PMAs as described in the California Code of Regulations (CCR); when applicable, a reference to a specific location in the GSP regulations is provided as the first row of each table.

Table 1. Brief Description of all Projects and Management Actions.

	23 CCR § 354.44		**23 CCR §354.44(a)**
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
Projects and Management Actions Developed for Implementation			
All	Grower Education	Northern Sacramento Valley Mobile Irrigation Lab	Grower education on topics that support groundwater sustainability is proposed for all areas of Tehama County. Grower education would be accomplished through onsite irrigation system evaluations, workshop education, and irrigation water management and scheduling assistance. This project will continue and expand the irrigation evaluation service that has been in place for ten years. In 2002, Tehama County Resource Conservation District began the operation of a Mobile Irrigation Lab (MIL) in Tehama County with funding from the California Department of Water Resources and the Bureau of Reclamation. Since then, the program has expanded to include other funding sources and the areas serviced by the Butte, Glenn and Western Shasta Resource Conservation Districts (RCDs), and it could be expanded to service the entire Northern Sacramento Valley Integrated Regional Water Management Plan (NSVIRWMP) area.
All	Multi-Benefit Recharge	Multi-Agency / Jurisdictions	The Nature Conservancy (TNC) has prepared guidance to assist GSAs in planning on-farm, multi-benefit groundwater recharge programs. A multi-benefit recharge program will provide groundwater recharge through normal farming operations while also providing critical wetland habitat for shorebirds migrating along the Pacific Flyway. Fields with soil and cropping conditions conducive to groundwater recharge will be flooded and maintained with shallow depths. Water will be sourced from existing water rights contracts, depending on availability. The GSA may also consider financial compensation for participating offsetting field preparation, irrigation, and water costs.
Bowman	Cottonwood Creek Invasives Control Follow Up	Tehama County Resource Conservation District	The objective of this project is to permanently control known invasive plant species occurrences within portions of Cottonwood Creek's South Fork located in Tehama County. Through the control of these plants, the threat of their spreading into the Sacramento River's main stem is reduced as is their impacts on those portions of the Creek's riparian zone that now contain infestations. Project work entails the removal of giant reed (Arundo donax), salt cedar (Tamarisk), black locust, tree-of-heaven, pampas grass, and scotch broom. Herbicide and manual removal methods will be employed. It is anticipated that initial project work which has already been funded will begin in September 2012 and will continue for a total of five years. Due to the growth characteristics of Arundo donax and Tamarisk, in particular, follow up treatments would be required in order to attain control of infested sites and to treat missed areas of infestation. It is anticipated that three follow up treatments will be required over a five year period in order to assure control. Once formerly infested sites are free of infestations, native plants need to be reestablished in

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
			order to expedite the development of the Creek's riparian corridor and to prevent erosion of creek banks where plants have been removed.
Bowman	Cottonwood Creek Riparian Habitat Restoration	Tehama County Resource Conservation District	This project would implement riparian restoration activities in the Cottonwood Creek Watershed. This project would enhance existing riparian habitat (fill in fragmented areas), implement riparian fencing, and/or obtain conservation easements to protect riparian resources.
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 1	Deer Creek Watershed Conservancy	The overall Lower Deer Creek Project, as described in the 2011 feasibility study, is anticipated to include five (5) phases along Deer Creek from the Sacramento River to approximately River mile 8. This project includes the first phase that will result in a complete project that locally achieves the dual purposes of the Lower Deer Creek Restoration and Flood Management project to implement actions that lead to improved ecosystem health and reliable flood protection. The first phase of the Lower Deer Creek Project covers planning for floodplain habitat, improvements to fish passage and aquatic habitat, widening floodplains and enhancing natural flood channels, and enhancing fish passage at the Stanford Vina Irrigation Dam. Since there are five phases to the overall project, it is anticipated the USACE and State Regulatory Agencies will require one California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) document to support permitting. Anticipated permitting requirements include a 404 permit from the US Army Corps of Engineers (USACE), and a Central Valley Flood Protection Board (CVFPB) encroachment permit. USACE 408 authorization is also expected to address all phases of the project.
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 3	Deer Creek Watershed Conservancy	This project covers Phase 3 of the Lower Deer Creek Levee Improvements and Habitat Restoration project, which will include the final design and construction of a new 4,620 linear foot (LF) levee. The new levee will be setback (566 LF at the largest point). The existing Deer Creek Project Levee 2 will be removed. The Levee setback will create approximately 40 acres of new floodway with floodway and migration easements, which will be contoured and improved to greatly assist fish passage (e.g. salmonids). The new floodway would be incorporated into the current DWR floodway maintenance program.
Los Molinos	Deer Creek Instream Flow Planning and Design Project	Trout Unlimited	This project would improve conjunctive use management at Deer Creek Irrigation District (DCID) by designing improved groundwater systems at Sheep Camp Ditch and Cone-Kimball Ditch and exploring opportunities to increase total water use efficiency within DCID and the Stanford-Vina Ranch Irrigation Company (SVRIC), including tailwater recovery and seasonal groundwater recharge.

	23 CCR § 354.44		**23 CCR §354.44(a)**
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
Los Molinos	DCID Diversion Automation Project	Trout Unlimited	This project would improve the efficiency of water delivery within DCID by automating the main diversion and north main and south main ditch flow rates and provide real-time monitoring of spills.
Red Bluff	El Camino Restoration Project	El Camino Irrigation District	This project would identify and fix the most inefficient pumps in the El Camino Irrigation District system. Other improvements would include: replacement of concrete pipe with more durable PVC pipe, replacement of hub gates, and installation of flowmeters on each discharge pipe from every pump
Red Bluff	Expanded Use of CVP Contract Supplies in Proberta Water District and Thomes Creek Water District	Proberta Water District, Thomes Creek Water District	This project would incentivize expanded use of Central Valley Project (CVP) contract supply by irrigators in Proberta Water District (PWD) and Thomes Creek Water District (TCWD), with the goal of using the full contract supply available to each district. By encouraging irrigators to use more surface water, this project would offset groundwater demand and provide in-lieu recharge benefits to Red Bluff Subbasin
Red Bluff	Elder Creek Non-Native Invasive Species Plant Control	Tehama County Resource Conservation District	This project would identify and remove non-native invasive species (NIS) plants in the Elder Creek watershed, with a focus on Arundo donax and Tamarisk. Additional coordination and permitting work would be required of the USACE levee systems on Elder Creek.
Red Bluff	Tehama West Non-Native Invasive Species Plant Control	Tehama County Resource Conservation District	This project would identify and remove NIS plants in the Tehama County westside watersheds (excluding Elder Creek), with a focus on Arundo donax and Tamarisk.
Red Bluff	Thomes Creek and Elder Creek Diversion for Direct or In-Lieu Groundwater Recharge	Multi-Agency / Jurisdictions	Thomes and Elder Creek originate to the west of the Red Bluff Subbasin and flow eastward into the Red Bluff Subbasin. During periods of flow in the winter and spring, a portion of these flows could be diverted for either (1) off-stream storage and subsequent use for irrigation or (2) direct groundwater recharge through Flood-MAR, dedicated recharge basins, or modified stream beds.
Portfolio of Other Potential Projects and Management Actions			
All	Direct Groundwater Recharge of Stormwater and Flood Water – Groundwater Recharge of Stormwater through Unlined Canals, Natural Drainages, Recharge Basins, and ASR Wells	Multi-Agency / Jurisdictions	Supply groundwater recharge with excess surface water in wet years for use in dry years. Recharge may be done in conveyance structures such as unlined canal and laterals, natural drainages such as creek beds, recharge basins, agricultural fields, and aquifer storage and recovery (ASR) wells. Areas identified for recharge should have suitable recharge surficial geology, low enough water levels to support recharge, and access to surface water.

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
All	Direct Groundwater Recharge of Stormwater and Flood Water – Off-Stream Temporary Storage of Flood Water on Private Lands	Multi-Agency / Jurisdictions	Divert floodwater for off-stream temporary storage on private lands, providing direct recharge and potentially in-lieu recharge.
All	Stormwater Management Improvements	Multi-Agency / Jurisdictions	Improve stormwater management facilities to enhance groundwater recharge of stormwater. Maintain stormwater pumps and ensure stormwater holding basins are of adequate size for retention.
All	Stormwater Management Improvements – Watershed Restoration to Reduce Runoff	Multi-Agency / Jurisdictions	Restore watersheds burned in wildfires and restore unused grazing land to reduce runoff and improve recharge.
All	Levee Setback and Stream Channel Restoration	Multi-Agency / Jurisdictions	Restore stream channel and levee setback to increase groundwater recharge, provide wildlife habitat, lower water temperatures in the Sacramento River, and improve the overall riparian ecosystem.
All	Recycled Water Program	Multi-Agency / Jurisdictions	Facilitate use recycled water of suitable quality (e.g., treated wastewater) for groundwater recharge and for urban or agricultural irrigation.
All	Recycled Water Program – Treated Wastewater Recycling to Support Wetlands	Multi-Agency / Jurisdictions	Construct and operate wetlands as a discharge site for treated wastewater (e.g., the Rio Alto Water District Wastewater Treatment Plant & Constructed Wetlands Project). Creation of constructed wetlands would enhance the surrounding community by increasing natural habitat for waterfowl and wildlife, while offering educational and recreational opportunities for local schools and community residents through the development of walking trails and informational kiosks.
All	Recycled Water Program – Wastewater Treatment Facility Construction to Supply Recycled Water for Irrigation	Multi-Agency / Jurisdictions	Enhance wastewater treatment facilities to supply tertiary-treated Title-22 effluent for use as irrigation water.
All	Inter-Basin Surface Water Transfers or Exchanges – Increase Inter-Basin Surface Water Transfers or Exchanges to Promote Surface Water Use	Multi-Agency / Jurisdictions	Promote inter-basin surface water transfers or exchanges and potentially subsidize surface water costs so that it is less expensive than groundwater.

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
All	Inter-Basin Surface Water Transfers or Exchanges – Surface Water Imports from Other Tehama County Subbasins	Multi-Agency / Jurisdictions	Import underutilized surface water and other supplies from other subbasins in Tehama County, and use for direct recharge or in lieu of groundwater pumping. Potential opportunities include: 1. Treated wastewater from the City of Red Bluff 2. Trout Unlimited Groundwater substitution transfers 3. Groundwater substitution transfers.
All	Invasive Plant Removal from Creeks and Irrigation Conveyance Canals	Multi-Agency / Jurisdictions	Remove invasive plants from creeks and irrigation conveyance canals (e.g., Arundo donax, tamarisk, Himalayan blackberry). Many small tributaries in the watersheds of Tehama County have decreased conveyance, high levels of siltation, and diminished flood-carrying capacity due to invasive vegetation overgrowth. Debris-clearing is a challenge due to environmental permitting restrictions. Plant removal would reduce conveyance issues, reduce evapotranspiration (ET), and allow for more water in the shallow groundwater area, restoring conditions for GDEs and native riparian species.
All	Water Supply Reservoir Construction, Renovation, or Conversion	Multi-Agency / Jurisdictions	Construct, renovate, or convert flood control facilities to a water supply reservoir.
All	Enhanced Boundary Flow Measurement	Multi-Agency / Jurisdictions	Enhance measurement of boundary outflows resulting from precipitation runoff and irrigation return flows, which are believed to be a substantial component of the water budget. These outflows can vary substantially from year to year based on precipitation and (in critically dry years) surface water availability.
All	Well Metering	Multi-Agency / Jurisdictions	Meter larger agricultural wells to better assess the total volume of groundwater pumped in the Subbasin. Data will help to better manage continued sustainability of the Subbasin within its sustainable yield.
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Residential Water Use Efficiency Improvements	Multi-Agency / Jurisdictions	Offer incentives for urban, residential, and commercial projects that improve water use efficiency, such as high efficiency appliance rebates and incentives for lawn removal, low-water landscape installation, rain barrels, graywater reuse, etc.
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Municipal Water System Efficiency Improvements	Multi-Agency / Jurisdictions	Evaluate municipal water system operation and reduce losses to reduce municipal groundwater pumping demand.

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Irrigation Efficiency Improvements	Multi-Agency / Jurisdictions	Assist growers with conversion to efficient and dual-source irrigation systems. Related efforts may include soil mapping to customize irrigation timing and duration and grower education to encourage soil management to improve moisture retention.
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Surface Water Conveyance and Irrigation Infrastructure Improvements for Dual-Source Systems	Multi-Agency / Jurisdictions	Irrigation system improvements needed to utilize surface water for drip irrigation of orchards. Typical system components required for a dual source system are a surface water irrigation “turnout” or point of delivery to the field, a pipeline or ditch to convey water from the turnout to a pump station, a pump or pumps for pressurization, and filtration. Improvements in the Subbasin may include installation of regulating reservoirs, filters or treatment (for algae), and pressurize systems for drip irrigation. SCADA improvements and install VFDs on pumps to improve and maintain delivery pressures.
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Assistance for Capital Improvements	Multi-Agency / Jurisdictions	Assist growers with capital improvements to irrigation infrastructure, from use of groundwater to use of surface water or dual-source systems.
All	Water Market for Surface Water and Groundwater Exchange	Multi-Agency / Jurisdictions	Create a water market for exchanging surface water and groundwater, allowing for flexibility in water use to meet irrigation demands in the Subbasin while remaining within the overall sustainable yield.
All	Demand Management – Conversion to Less Water Intensive Crops	Multi-Agency / Jurisdictions	Promote conversion of agricultural lands to less water intensive crops to reduce water use while continuing to promote agriculture land use. Would be considered if other planned PMAs are insufficient to maintain sustainability.
All	Demand Management – Pumping Fees	Multi-Agency / Jurisdictions	Implement tiered fee structure for groundwater extractions to incentivize reduced groundwater use. Would be considered if other planned PMAs are insufficient to maintain sustainability.
All	Demand Management – Groundwater Extraction Allocation Program	Multi-Agency / Jurisdictions	Curtail and/or restrict groundwater extractions through a groundwater extraction allocation program. Would be considered if other planned PMAs are insufficient to maintain sustainability.
All	Demand Management – Land Fallowing Program	Multi-Agency / Jurisdictions	Curtail and/or restrict groundwater extractions through a land fallowing program. Would be considered if other planned PMAs are insufficient to maintain sustainability.
All	Demand Management – County Water Use Ordinance and Conservation Efforts	Multi-Agency / Jurisdictions	Coordinate with counties to develop policies that align with sustainable groundwater management goals. Possible ordinances include regulations and limits for groundwater use, export, and illegal diversion of surface water. Counties could create additional

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
			guidelines during the well permitting process to reduce nearby competition between wells (i.e. well spacing or suggestions regarding total well depth, depth of well perforations, and location of a new well relation to existing wells). Efforts could be designed to be protective of domestic wells. Would be considered if other planned PMAs are insufficient to maintain sustainability.
All	Demand Management – Management and Restrictions of Land Use Changes	Multi-Agency / Jurisdictions	Coordinate with counties to restrict land use changes that increase water demand in the Subbasin. Management would primarily focus on development of new agricultural land, and to restrict growth in areas with no surface water supply. Would be considered if other planned PMAs are insufficient to maintain sustainability.
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Surface Water	Multi-Agency / Jurisdictions	Incentivize use of surface water for irrigation when available to allow groundwater levels to recover in between drought years when surface water is not available.
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Recycled Water	Multi-Agency / Jurisdictions	Provide incentives for use of recycled water of suitable quality (e.g., treated wastewater) for groundwater recharge and for urban or agricultural irrigation to decrease groundwater demand.
All	Tehama County Domestic Well Tracking and Outreach Program – Provide Information and Resources for Protection of Domestic Wells	Multi-Agency / Jurisdictions	Provide domestic well owners with resources and funding for well testing, inspection, and replacement. Target well owners in locations where domestic wells are known to go dry or have water quality impacts.
All	Tehama County Domestic Well Tracking and Outreach Program – Tehama County Dry Domestic Well Tracking System	Multi-Agency / Jurisdictions	Create county-wide system to track dry domestic wells. Information will allow Tehama County to better manage assistance to domestic well owners when water levels drop and wells go dry, identify if wells need to be replaced, and provide information on well replacement
All	Well Deepening or Replacement Program	Multi-Agency / Jurisdictions	Create program to deepen or replace shallow wells and/or wells that go dry. Fewer shallow domestic and irrigation wells allows for deeper acceptable water levels in some parts of Subbasin.
All	Review of County Well Permitting Ordinances	Multi-Agency / Jurisdictions	Review existing ordinances and assess if additional well permitting requirements are warranted. Follow updated DWR well construction recommendations (Bulletin 74), as

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
			needed. Improve the well permitting and installation program to help protect water quality, allow for better screening, and avoid interference or impacts on neighboring wells.
All	Coordination and Development of Public Data Portals	Multi-Agency / Jurisdictions	Continue coordination with member units and other water purveyors to develop shared public data portals. Coordination would determine the types of data and data formats available, and establish standard methods for receiving, storing, and sharing data with the public, DWR, other agencies.
All	Coordination and Development of Public Data Portals – Ongoing Coordination and Information Sharing	Multi-Agency / Jurisdictions	Continue coordination and information sharing among agencies in Tehama County and with agencies in neighboring subbasins. Coordination would include holding regular public meetings, attending meetings in neighboring subbasin, coordination with land use planning entities, and fostering relationships with relevant agencies and organizations.
All	Coordination and Development of Public Data Portals – Data Sharing for Monitoring Contaminant Plumes	Multi-Agency / Jurisdictions	Continue and improve sharing of contaminant data across organizations, including data to track and monitor contaminant plumes.
All	Tehama County Well Inventory and Registration Program – Well Registration Program	Multi-Agency / Jurisdictions	Create well registration program to collect well locations, screening information, and pumping data for use in GSP updates.
All	Tehama County Well Inventory and Registration Program – Tehama County Well Inventory	Multi-Agency / Jurisdictions	Create county-wide well inventory to compile all available information on active wells in Tehama County and improve understanding of well distribution, construction, and hydrogeology. Inventory will potentially be useful for filling monitoring data gaps.
All	Maintain and Expand Groundwater Level Monitoring Network	Multi-Agency / Jurisdictions	Maintain existing monitoring network to improve the understanding of aquifer conditions and dynamics and to monitor groundwater conditions related to sustainable management criteria.
All	Maintain and Expand Groundwater Level Monitoring Network – Maintain Coordination with Other Monitoring Entities	Multi-Agency / Jurisdictions	Maintain existing coordination with other monitoring entities to support the use of identified monitoring locations as part of the monitoring network and to share relevant collected data.
All	Maintain and Expand Groundwater Level	Multi-Agency / Jurisdictions	Identify existing wells that may be incorporated into the groundwater level monitoring network. Wells may be used to fill data gaps and improve understanding of aquifer

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
	Monitoring Network – Identify Existing Wells for Incorporation into the Groundwater Level Monitoring Network		conditions and dynamics, and groundwater conditions related to GDEs and surface water depletions.
All	Maintain and Expand Groundwater Level Monitoring Network – Identify New Wells for Incorporation into the Groundwater Level Monitoring Network	Multi-Agency / Jurisdictions	Identify new monitoring sites that may be added to the groundwater level monitoring network. Wells may be used to fill data gaps and improve understanding of aquifer conditions and dynamics, and groundwater conditions related to GDEs and surface water depletions.
All	One-Time Groundwater Quality Snapshot and Evaluation – One-Time Groundwater Quality Snapshot	Multi-Agency / Jurisdictions	Conduct a one-time sampling of groundwater quality parameters over a wide range of wells in Tehama County. Data will improve understanding of groundwater quality conditions and provide a basis for refinement of monitoring networks.
All	One-Time Groundwater Quality Snapshot and Evaluation – Evaluation of Groundwater Quality Monitoring Options	Multi-Agency / Jurisdictions	Evaluate groundwater quality monitoring options, potentially informed by the one-time groundwater quality snapshot. Consider options to better characterize widespread groundwater quality conditions and address localized groundwater quality concerns.
All	Install Additional Agroclimate Stations	Multi-Agency / Jurisdictions	Install additional stations that monitor agriculture-related weather and climate parameters. Improved data will inform agricultural water use practices and potentially enhance water conservation. Data can also improve the accuracy of the Tehama Integrated Hydrologic Model (Tehama IHM).
All	Expanded Subbasin Monitoring and Aquifer Testing – Aquifer Testing	Multi-Agency / Jurisdictions	Aquifer testing will improve the understanding of aquifer conditions, particularly the level of confinement, connectivity between depths, connectivity with surface water bodies, and the understanding of hydraulic properties needed for simulation within the Tehama IHM and an estimation of recharge entering the Subbasin.
All	Expanded Subbasin Monitoring and Aquifer Testing – Identify Locations Vulnerable to Damage from Subsidence	Multi-Agency / Jurisdictions	Identify locations in the Subbasin that are potentially vulnerable to damage from subsidence, should subsidence become considered more of a threat in the future .

	23 CCR § 354.44		23 CCR §354.44(a)
Subbasin	**Project/ Management Action Name – Component**	**Proponent**	**Brief Project Description**
All	Expanded Subbasin Monitoring and Aquifer Testing – Groundwater Subbasin LIDAR	Multi-Agency / Jurisdictions	Collect LIDAR (Light Detection and Ranging) data across the Subbasin to supports monitoring all sustainability indicators.
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze the Relationship between Groundwater Levels and GDE Health	Multi-Agency / Jurisdictions	Analyze the relationship between groundwater levels and GDE health to improve the understanding of how GDEs are affected by conditions in the groundwater aquifer accessed by pumping.
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze Water Supplies Accessed by Potential GDEs	Multi-Agency / Jurisdictions	Analyze the water supplies accessed by potential GDEs, potentially using a combination of surface water data, shallow groundwater level data, and remote sensing data related to vegetative cover.
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Evaluate the Need for Additional Groundwater - Surface Water Interaction Studies or Monitoring	Multi-Agency / Jurisdictions	Evaluate the need for additional studies or monitoring of groundwater-surface water interactions. Additional information would improve the understanding of how GDEs relate to the groundwater aquifer accessed by pumping, and may allow for refinement of how GDEs and their water supply needs are monitored.

Table 2. Project Type, Proponent, and Location for all Projects and Management Actions.

	23 CCR § 354.44			
Subbasin	**Project/ Management Action Name**	**Project Proponent**	**Project Type**	**Project Location**
Projects and Management Actions Developed for Implementation				
All	Grower Education	Northern Sacramento Valley Mobile Irrigation Lab	Management Action	Subbasin-wide
All	Multi-Benefit Recharge	Multi-Agency / Jurisdictions	Direct Groundwater Recharge	Lands suitable for spreading and recharge
Bowman	Cottonwood Creek Invasives Control Follow Up	Tehama County Resource Conservation District	Groundwater Demand Reduction	Cottonwood Creek
Bowman	Cottonwood Creek Riparian Habitat Restoration	Tehama County Resource Conservation District	Groundwater Demand Reduction	Cottonwood Creek
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 1	Deer Creek Watershed Conservancy	Direct Groundwater Recharge	Deer Creek
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 3	Deer Creek Watershed Conservancy	Direct Groundwater Recharge	Deer Creek
Los Molinos	Deer Creek Instream Flow Planning and Design Project	Trout Unlimited	Surface Water Conveyance Improvements	Deer Creek
Los Molinos	DCID Diversion Automation Project	Trout Unlimited	Surface Water Conveyance Improvements	Deer Creek Irrigation District
Red Bluff	El Camino Restoration Project	El Camino Irrigation District	System Modernization	El Camino Irrigation District
Red Bluff	Expanded Use of CVP Contract Supplies in Proberta Water District and Thomes Creek Water District	Proberta Water District, Thomes Creek Water District	In-lieu Groundwater Recharge	Proberta Water District, Thomes Creek Water District
Red Bluff	Elder Creek Non-Native Invasive Species Plant Control	Tehama County Resource Conservation District	Surface Water Conveyance Improvements	Elder Creek

	23 CCR § 354.44			
Subbasin	**Project/ Management Action Name**	**Project Proponent**	**Project Type**	**Project Location**
Red Bluff	Tehama West Non-Native Invasive Species Plant Control	Tehama County Resource Conservation District	Surface Water Conveyance Improvements	Tehama West watersheds
Red Bluff	Thomes Creek and Elder Creek Diversion for Direct or In-Lieu Groundwater Recharge	Multi-Agency / Jurisdictions	Direct or In-Lieu Groundwater Recharge	Lands adjacent to creeks suitable for recharge
Portfolio of Other Potential Projects and Management Actions				
All	Direct Groundwater Recharge of Stormwater and Flood Water – Groundwater Recharge of Stormwater through Unlined Canals, Natural Drainages, Recharge Basins, and ASR Wells	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Direct Groundwater Recharge of Stormwater and Flood Water – Off-Stream Temporary Storage of Flood Water on Private Lands	Multi-Agency / Jurisdictions	Project	Lands adjacent to channels that convey flood water
All	Stormwater Management Improvements	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Stormwater Management Improvements – Watershed Restoration to Reduce Runoff	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Levee Setback and Stream Channel Restoration	Multi-Agency / Jurisdictions	Project	Stream channels
All	Recycled Water Program	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Recycled Water Program – Treated Wastewater Recycling to Support Wetlands	Multi-Agency / Jurisdictions	Project	Rio Alto Water District
All	Recycled Water Program – Wastewater Treatment Facility Construction to Supply Recycled Water for Irrigation	Multi-Agency / Jurisdictions	Project	Wastewater treatment facilities
All	Inter-Basin Surface Water Transfers or Exchanges – Increase Inter-Basin Surface Water Transfers or Exchanges to Promote Surface Water Use	Multi-Agency / Jurisdictions	Project	Subbasin-wide

	23 CCR § 354.44			
Subbasin	**Project/ Management Action Name**	**Project Proponent**	**Project Type**	**Project Location**
All	Inter-Basin Surface Water Transfers or Exchanges – Surface Water Imports from Other Tehama County Subbasins	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Invasive Plant Removal from Creeks and Irrigation Conveyance Canals	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Water Supply Reservoir Construction, Renovation, or Conversion	Multi-Agency / Jurisdictions	Project	TBD
All	Enhanced Boundary Flow Measurement	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Well Metering	Multi-Agency / Jurisdictions	Project	Subbasin-wide
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Residential Water Use Efficiency Improvements	Multi-Agency / Jurisdictions	Management Action	Residential areas
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Municipal Water System Efficiency Improvements	Multi-Agency / Jurisdictions	Management Action	Municipal service areas
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Irrigation Efficiency Improvements	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Surface Water Conveyance and Irrigation Infrastructure Improvements for Dual-Source Systems	Multi-Agency / Jurisdictions	Management Action	Surface Water Supplier Service Areas
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Assistance for Capital Improvements	Multi-Agency / Jurisdictions	Management Action	Lands with access to surface water
All	Water Market for Surface Water and Groundwater Exchange	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Demand Management – Conversion to Less Water Intensive Crops	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide

	23 CCR § 354.44			
Subbasin	**Project/ Management Action Name**	**Project Proponent**	**Project Type**	**Project Location**
All	Demand Management – Pumping Fees	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Demand Management – Groundwater Extraction Allocation Program	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Demand Management – Land Fallowing Program	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Demand Management – County Water Use Ordinance and Conservation Efforts	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Demand Management – Management and Restrictions of Land Use Changes	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Surface Water	Multi-Agency / Jurisdictions	Management Action	Surface Water Supplier Service Areas
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Recycled Water	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Tehama County Domestic Well Tracking and Outreach Program – Provide Information and Resources for Protection of Domestic Wells	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Tehama County Domestic Well Tracking and Outreach Program – Tehama County Dry Domestic Well Tracking System	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Well Deepening or Replacement Program	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Review of County Well Permitting Ordinances	Multi-Agency / Jurisdictions	Management Action	Subbasin-wide
All	Coordination and Development of Public Data Portals	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Coordination and Development of Public Data Portals – Ongoing Coordination and Information Sharing	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide

	23 CCR § 354.44			
Subbasin	**Project/ Management Action Name**	**Project Proponent**	**Project Type**	**Project Location**
All	Coordination and Development of Public Data Portals – Data Sharing for Monitoring Contaminant Plumes	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Tehama County Well Inventory and Registration Program – Well Registration Program	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Tehama County Well Inventory and Registration Program – Tehama County Well Inventory	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Maintain and Expand Groundwater Level Monitoring Network	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Maintain and Expand Groundwater Level Monitoring Network – Maintain Coordination with Other Monitoring Entities	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Maintain and Expand Groundwater Level Monitoring Network – Identify Existing Wells for Incorporation into the Groundwater Level Monitoring Network	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Maintain and Expand Groundwater Level Monitoring Network – Identify New Wells for Incorporation into the Groundwater Level Monitoring Network	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	One-Time Groundwater Quality Snapshot and Evaluation – One-Time Groundwater Quality Snapshot	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	One-Time Groundwater Quality Snapshot and Evaluation – Evaluation of Groundwater Quality Monitoring Options	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Install Additional Agroclimate Stations	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Expanded Subbasin Monitoring and Aquifer Testing – Aquifer Testing	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide

	23 CCR § 354.44			
Subbasin	**Project/ Management Action Name**	**Project Proponent**	**Project Type**	**Project Location**
All	Expanded Subbasin Monitoring and Aquifer Testing – Identify Locations Vulnerable to Damage from Subsidence	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Expanded Subbasin Monitoring and Aquifer Testing – Groundwater Subbasin LIDAR	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Subbasin-wide
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze the Relationship between Groundwater Levels and GDE Health	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Stream channels near GDEs
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze Water Supplies Accessed by Potential GDEs	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Stream channels near GDEs
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Evaluate the Need for Additional Groundwater - Surface Water Interaction Studies or Monitoring	Multi-Agency / Jurisdictions	Other (Monitoring/Studies)	Stream channels near GDEs

Table 3. Implementation Criteria, Notice Process, Permitting and Regulatory Process, and Timeline for all Projects and Management Actions.

	23 CCR § 354.44	23 CCR §354.44(b)(1)(A)	23 CCR §354.44(b)(1)(B)	23 CCR §354.44(b)(3)	23 CCR §354.44(b)(4)		
Subbasin	**Project/Management Action Name**	**Implementation and Termination Timing/ Criteria for Implementation**	**Public and/or Inter-Agency Notice Process**	**Required Permitting and Regulatory Process or Status of Permitting**	**Current Status**	**Anticipated Start Date (Year)**	**Anticipated Completion Date (Year)**
Projects and Management Actions Developed for Implementation							
All	Grower Education	Currently in implementation / construction phase	See Note 2	None anticipated	Ongoing	Ongoing	Ongoing
All	Multi-Benefit Recharge	See Note 1	See Note 2	See Note 3	Planned	See Note 4	See Note 4
Bowman	Cottonwood Creek Invasives Control Follow Up	Currently in implementation / construction, maintenance, monitoring phase	See Note 2	See Note 3	Ongoing	Ongoing	Not indicated
Bowman	Cottonwood Creek Riparian Habitat Restoration	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 1	Currently in Environmental Documentation & CEQA, Permitting, Implementation / Construction	See Note 2	CEQA and NEPA process, 404 permit, CVFPB encroachment permit, USACE 408 authorization that addresses all phases of the project.	Ongoing	Ongoing	Not indicated
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 3	Currently in implementation/construction phase	See Note 2	Same as phase 1, above	Ongoing	Ongoing	Not indicated
Los Molinos	Deer Creek Instream Flow Planning and Design Project	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4
Los Molinos	DCID Diversion Automation Project	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4
Red Bluff	El Camino Restoration Project	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(1)(A)	23 CCR §354.44(b)(1)(B)	23 CCR §354.44(b)(3)	23 CCR §354.44(b)(4)		
Subbasin	**Project/Management Action Name**	**Implementation and Termination Timing/ Criteria for Implementation**	**Public and/or Inter-Agency Notice Process**	**Required Permitting and Regulatory Process or Status of Permitting**	**Current Status**	**Anticipated Start Date (Year)**	**Anticipated Completion Date (Year)**
Red Bluff	Expanded Use of CVP Contract Supplies in Proberta Water District and Thomes Creek Water District	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4
Red Bluff	Elder Creek Non-Native Invasive Species Plant Control	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4
Red Bluff	Tehama West Non-Native Invasive Species Plant Control	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4
Red Bluff	Thomes Creek and Elder Creek Diversion for Direct or In-Lieu Groundwater Recharge	See Note 1	See Note 2	See Note 3	Potential	See Note 4	See Note 4
Portfolio of Other Potential Projects and Management Actions							
All	Direct Groundwater Recharge of Stormwater and Flood Water – Groundwater Recharge of Stormwater through Unlined Canals, Natural Drainages, Recharge Basins, and ASR Wells	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Direct Groundwater Recharge of Stormwater and Flood Water – Off-Stream Temporary Storage of Flood Water on Private Lands	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Stormwater Management Improvements	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Stormwater Management Improvements – Watershed Restoration to Reduce Runoff	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Levee Setback and Stream Channel Restoration	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Recycled Water Program	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(1)(A)	23 CCR §354.44(b)(1)(B)	23 CCR §354.44(b)(3)	23 CCR §354.44(b)(4)		
Subbasin	**Project/Management Action Name**	**Implementation and Termination Timing/ Criteria for Implementation**	**Public and/or Inter-Agency Notice Process**	**Required Permitting and Regulatory Process or Status of Permitting**	**Current Status**	**Anticipated Start Date (Year)**	**Anticipated Completion Date (Year)**
All	Recycled Water Program – Treated Wastewater Recycling to Support Wetlands	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Recycled Water Program – Wastewater Treatment Facility Construction to Supply Recycled Water for Irrigation	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Inter-Basin Surface Water Transfers or Exchanges – Increase Inter-Basin Surface Water Transfers or Exchanges to Promote Surface Water Use	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Inter-Basin Surface Water Transfers or Exchanges – Surface Water Imports from Other Tehama County Subbasins	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Invasive Plant Removal from Creeks and Irrigation Conveyance Canals	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Water Supply Reservoir Construction, Renovation, or Conversion	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Enhanced Boundary Flow Measurement	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Well Metering	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Residential Water Use Efficiency Improvements	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Municipal Water System Efficiency Improvements	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Irrigation Efficiency Improvements	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(1)(A)	23 CCR §354.44(b)(1)(B)	23 CCR §354.44(b)(3)	23 CCR §354.44(b)(4)		
Subbasin	**Project/Management Action Name**	**Implementation and Termination Timing/ Criteria for Implementation**	**Public and/or Inter-Agency Notice Process**	**Required Permitting and Regulatory Process or Status of Permitting**	**Current Status**	**Anticipated Start Date (Year)**	**Anticipated Completion Date (Year)**
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Surface Water Conveyance and Irrigation Infrastructure Improvements for Dual-Source Systems	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Assistance for Capital Improvements	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Water Market for Surface Water and Groundwater Exchange	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Demand Management – Conversion to Less Water Intensive Crops	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Demand Management – Pumping Fees	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Demand Management – Groundwater Extraction Allocation Program	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Demand Management – Land Fallowing Program	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Demand Management – County Water Use Ordinance and Conservation Efforts	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Demand Management – Management and Restrictions of Land Use Changes	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Surface Water	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Recycled Water	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Tehama County Domestic Well Tracking and Outreach Program –	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(1)(A)	23 CCR §354.44(b)(1)(B)	23 CCR §354.44(b)(3)	23 CCR §354.44(b)(4)		
Subbasin	**Project/Management Action Name**	**Implementation and Termination Timing/ Criteria for Implementation**	**Public and/or Inter-Agency Notice Process**	**Required Permitting and Regulatory Process or Status of Permitting**	**Current Status**	**Anticipated Start Date (Year)**	**Anticipated Completion Date (Year)**
	Provide Information and Resources for Protection of Domestic Wells						
All	Tehama County Domestic Well Tracking and Outreach Program – Tehama County Dry Domestic Well Tracking System	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Well Deepening or Replacement Program	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Review of County Well Permitting Ordinances	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Coordination and Development of Public Data Portals	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Coordination and Development of Public Data Portals – Ongoing Coordination and Information Sharing	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Coordination and Development of Public Data Portals – Data Sharing for Monitoring Contaminant Plumes	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Tehama County Well Inventory and Registration Program – Well Registration Program	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Tehama County Well Inventory and Registration Program – Tehama County Well Inventory	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Maintain and Expand Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Maintain and Expand Groundwater Level Monitoring Network – Maintain Coordination with Other Monitoring Entities	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(1)(A)	23 CCR §354.44(b)(1)(B)	23 CCR §354.44(b)(3)	23 CCR §354.44(b)(4)		
Subbasin	**Project/Management Action Name**	**Implementation and Termination Timing/ Criteria for Implementation**	**Public and/or Inter-Agency Notice Process**	**Required Permitting and Regulatory Process or Status of Permitting**	**Current Status**	**Anticipated Start Date (Year)**	**Anticipated Completion Date (Year)**
All	Maintain and Expand Groundwater Level Monitoring Network – Identify Existing Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Maintain and Expand Groundwater Level Monitoring Network – Identify New Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	One-Time Groundwater Quality Snapshot and Evaluation – One-Time Groundwater Quality Snapshot	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	One-Time Groundwater Quality Snapshot and Evaluation – Evaluation of Groundwater Quality Monitoring Options	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Install Additional Agroclimate Stations	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Expanded Subbasin Monitoring and Aquifer Testing – Aquifer Testing	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Expanded Subbasin Monitoring and Aquifer Testing – Identify Locations Vulnerable to Damage from Subsidence	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Expanded Subbasin Monitoring and Aquifer Testing – Groundwater Subbasin LIDAR	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze the Relationship between Groundwater Levels and GDE Health	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(1)(A)	23 CCR §354.44(b)(1)(B)	23 CCR §354.44(b)(3)	23 CCR §354.44(b)(4)		
Subbasin	**Project/Management Action Name**	**Implementation and Termination Timing/ Criteria for Implementation**	**Public and/or Inter-Agency Notice Process**	**Required Permitting and Regulatory Process or Status of Permitting**	**Current Status**	**Anticipated Start Date (Year)**	**Anticipated Completion Date (Year)**
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze Water Supplies Accessed by Potential GDEs	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Evaluate the Need for Additional Groundwater - Surface Water Interaction Studies or Monitoring	See Note 1	See Note 2	See Note 3	Concept	See Note 4	See Note 4

Notes:

1. This PMA is currently in the early planning or conceptual stage. Thus the implementation and termination dates have yet to be determined. Criteria for implementation may, among other factors, be linked to the sustainability indicators and will be provided in GSP annual reports and five-year updates when known.
2. Public and/or Inter-Agency Noticing will be facilitated through GSA board meetings, GSA and/or cooperating agency website(s), GSA and/or cooperating agency newsletters, inter-basin coordination meetings, agency governing body public meetings, GSP annual reports and five-year updates, public scoping meetings and environmental/regulatory permitting notification.
3. Required permitting and regulatory review will be project-specific and initiated through consultation with applicable governing agencies. Governing agencies for which consultation will be initiated may include, but are not limited to: DWR, SWRCB, CDFW, Flood Board, Regional Water Boards, USFWS, NMFS, LAFCO, Tehama County, and CARB.
4. This PMA is currently in the early planning or conceptual stage. Thus, the start and completion dates for this activity have yet to be determined and will be provided in GSP annual reports and five-year updates when known.

Table 4. Anticipated Benefits of all Projects and Management Actions.

	23 CCR § 354.44	**23 CCR §354.44(b)(5)**			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
Projects and Management Actions Developed for Implementation					
All	Grower Education	Groundwater levels, groundwater storage, depletions of interconnected surface water, water quality		See Note 2	See Note 4
All	Multi-Benefit Recharge	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Wildlife habitat	See Note 2	See Note 4
Bowman	Cottonwood Creek Invasives Control Follow Up	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Increased native vegetation / habitat; decreased sediment trapping	See Note 2	See Note 4
Bowman	Cottonwood Creek Riparian Habitat Restoration	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Increased native vegetation / habitat; decreased sediment trapping	See Note 2	See Note 3
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 1	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 4
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 3	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Fish passage; riparian habitat	See Note 2	See Note 4
Los Molinos	Deer Creek Instream Flow Planning and Design Project	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
Los Molinos	DCID Diversion Automation Project	Groundwater levels, groundwater storage, and		See Note 2	See Note 3

	23 CCR § 354.44	23 CCR §354.44(b)(5)			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
		depletions of interconnected surface water			
Red Bluff	El Camino Restoration Project	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
Red Bluff	Expanded Use of CVP Contract Supplies in Proberta Water District and Thomes Creek Water District	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
Red Bluff	Elder Creek Non-Native Invasive Species Plant Control	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Increased native vegetation / habitat; decreased sediment trapping	See Note 2	See Note 3
Red Bluff	Tehama West Non-Native Invasive Species Plant Control	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Increased native vegetation / habitat; decreased sediment trapping	See Note 2	See Note 3
Red Bluff	Thomes Creek and Elder Creek Diversion for Direct or In-Lieu Groundwater Recharge	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
Portfolio of Other Potential Projects and Management Actions					
All	Direct Groundwater Recharge of Stormwater and Flood Water – Groundwater Recharge of Stormwater through Unlined Canals, Natural Drainages, Recharge Basins, and ASR Wells	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Direct Groundwater Recharge of Stormwater and Flood Water – Off-	Groundwater levels, groundwater storage, and		See Note 2	See Note 3

	23 CCR § 354.44	**23 CCR §354.44(b)(5)**			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
	Stream Temporary Storage of Flood Water on Private Lands	depletions of interconnected surface water			
All	Stormwater Management Improvements	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Stormwater Management Improvements – Watershed Restoration to Reduce Runoff	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Reduced runoff and erosion	See Note 2	See Note 3
All	Levee Setback and Stream Channel Restoration	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Wildlife habitat creation	See Note 2	See Note 3
All	Recycled Water Program	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Recycled Water Program – Treated Wastewater Recycling to Support Wetlands	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Wetland habitat creation; recreation; Sacramento River water quality improvement	See Note 2	See Note 3
All	Recycled Water Program – Wastewater Treatment Facility Construction to Supply Recycled Water for Irrigation	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Inter-Basin Surface Water Transfers or Exchanges – Increase Inter-Basin Surface Water Transfers or Exchanges to Promote Surface Water Use	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3

	23 CCR § 354.44	23 CCR §354.44(b)(5)			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
All	Inter-Basin Surface Water Transfers or Exchanges – Surface Water Imports from Other Tehama County Subbasins	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Invasive Plant Removal from Creeks and Irrigation Conveyance Canals	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Increased native vegetation / habitat; decreased sediment trapping	See Note 2	See Note 3
All	Water Supply Reservoir Construction, Renovation, or Conversion	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Enhanced Boundary Flow Measurement	See Note 1		See Note 2	See Note 3
All	Well Metering	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Residential Water Use Efficiency Improvements	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Municipal Water System Efficiency Improvements	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Irrigation Efficiency Improvements	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Assistance and Incentives for On-Farm Irrigation Infrastructure	Groundwater levels, groundwater storage, and		See Note 2	See Note 3

	23 CCR § 354.44	**23 CCR §354.44(b)(5)**			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
	Improvements – Surface Water Conveyance and Irrigation Infrastructure Improvements for Dual-Source Systems	depletions of interconnected surface water			
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Assistance for Capital Improvements	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Water Market for Surface Water and Groundwater Exchange	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Demand Management – Conversion to Less Water Intensive Crops	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Demand Management – Pumping Fees	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Demand Management – Groundwater Extraction Allocation Program	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Demand Management – Land Fallowing Program	Groundwater levels, groundwater storage, and depletions of interconnected surface water	Potential for multi-benefits on temporarily idled lands, depending on program design	See Note 2	See Note 3
All	Demand Management – County Water Use Ordinance and Conservation Efforts	Groundwater levels, groundwater storage, and		See Note 2	See Note 3

	23 CCR § 354.44	**23 CCR §354.44(b)(5)**			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
		depletions of interconnected surface water			
All	Demand Management – Management and Restrictions of Land Use Changes	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Surface Water	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Recycled Water	Groundwater levels, groundwater storage, and depletions of interconnected surface water		See Note 2	See Note 3
All	Tehama County Domestic Well Tracking and Outreach Program – Provide Information and Resources for Protection of Domestic Wells	Water quality		See Note 2	See Note 3
All	Tehama County Domestic Well Tracking and Outreach Program – Tehama County Dry Domestic Well Tracking System	See Note 1		See Note 2	See Note 3
All	Well Deepening or Replacement Program	See Note 1		See Note 2	See Note 3
All	Review of County Well Permitting Ordinances	Groundwater levels, groundwater storage, depletions of interconnected surface water, water quality		See Note 2	See Note 3
All	Coordination and Development of Public Data Portals	See Note 1		See Note 2	See Note 3

	23 CCR § 354.44	23 CCR §354.44(b)(5)			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
All	Coordination and Development of Public Data Portals – Ongoing Coordination and Information Sharing	See Note 1		See Note 2	See Note 3
All	Coordination and Development of Public Data Portals – Data Sharing for Monitoring Contaminant Plumes	See Note 1		See Note 2	See Note 3
All	Tehama County Well Inventory and Registration Program – Well Registration Program	See Note 1		See Note 2	See Note 3
All	Tehama County Well Inventory and Registration Program – Tehama County Well Inventory	See Note 1		See Note 2	See Note 3
All	Maintain and Expand Groundwater Level Monitoring Network	See Note 1		See Note 2	See Note 3
All	Maintain and Expand Groundwater Level Monitoring Network – Maintain Coordination with Other Monitoring Entities	See Note 1		See Note 2	See Note 3
All	Maintain and Expand Groundwater Level Monitoring Network – Identify Existing Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1		See Note 2	See Note 3
All	Maintain and Expand Groundwater Level Monitoring Network – Identify New Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1		See Note 2	See Note 3
All	One-Time Groundwater Quality Snapshot and Evaluation – One-Time Groundwater Quality Snapshot	See Note 1		See Note 2	See Note 3

	23 CCR § 354.44	**23 CCR §354.44(b)(5)**			
Subbasin	**Project/Management Action Name**	**Sustainability Indicators Expected to Benefit**	**Specific Multi-Benefits Expected**	**Serves Disadvantaged Community (If so, which one?)**	**Expected Yield**
All	One-Time Groundwater Quality Snapshot and Evaluation – Evaluation of Groundwater Quality Monitoring Options	See Note 1		See Note 2	See Note 3
All	Install Additional Agroclimate Stations	See Note 1		See Note 2	See Note 3
All	Expanded Subbasin Monitoring and Aquifer Testing – Aquifer Testing	See Note 1		See Note 2	See Note 3
All	Expanded Subbasin Monitoring and Aquifer Testing – Identify Locations Vulnerable to Damage from Subsidence	See Note 1		See Note 2	See Note 3
All	Expanded Subbasin Monitoring and Aquifer Testing – Groundwater Subbasin LIDAR	See Note 1		See Note 2	See Note 3
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze the Relationship between Groundwater Levels and GDE Health	See Note 1		See Note 2	See Note 3
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze Water Supplies Accessed by Potential GDEs	See Note 1		See Note 2	See Note 3
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Evaluate the Need for Additional Groundwater - Surface Water Interaction Studies or Monitoring	See Note 1		See Note 2	See Note 3

Notes

1. Coordination, data sharing, and additional monitoring are beneficial to GSP implementation and tracking progress toward the Subbasin sustainability goal. However, there are no anticipated direct benefits to specific sustainability indicators.

2. The majority of areas, especially population centers, within the Subbasins are classified as either Severely Disadvantaged Communities, Disadvantaged Communities, or Economically Distressed Areas (based on 2018 census block groups, tracts, and places).
3. This PMA is currently in the early planning or conceptual stage. Thus the expected yield of this PMA has yet to be determined and will be reported in GSP annual reports and five-year updates when known. Benefits are generally expected to accrue in all years beginning the first year of implementation for most PMAs.
4. All available information is provided in the corresponding Subbasin GSP chapter.

Table 5. Benefit Evaluation and Water Source for all Projects and Management Actions.

	23 CCR § 354.44	23 CCR §354.44(b)(5)	23 CCR §354.44(b)(6)	
Subbasin	**Project/Management Action Name**	**Benefit Evaluation Methodology**	**Water Source**	**Water Source Reliability**
Projects and Management Actions Developed for Implementation				
All	Grower Education	See Note 1	See Note 2	See Note 2
All	Multi-Benefit Recharge	See Note 1	See Note 3	See Note 3
Bowman	Cottonwood Creek Invasives Control Follow Up	See Note 1	See Note 2	See Note 2
Bowman	Cottonwood Creek Riparian Habitat Restoration	See Note 1	See Note 2	See Note 2
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 1	See Note 1	See Note 2	See Note 2
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 3	See Note 1	See Note 2	See Note 2
Los Molinos	Deer Creek Instream Flow Planning and Design Project	See Note 1	See Note 2	See Note 2
Los Molinos	DCID Diversion Automation Project	See Note 1	See Note 2	See Note 2
Red Bluff	El Camino Restoration Project	See Note 1	See Note 2	See Note 2
Red Bluff	Expanded Use of CVP Contract Supplies in Proberta Water District and Thomes Creek Water District	See Note 1	See Note 3	See Note 3
Red Bluff	Elder Creek Non-Native Invasive Species Plant Control	See Note 1	See Note 2	See Note 2
Red Bluff	Tehama West Non-Native Invasive Species Plant Control	See Note 1	See Note 2	See Note 2
Red Bluff	Thomes Creek and Elder Creek Diversion for Direct or In-Lieu Groundwater Recharge	See Note 1	See Note 3	See Note 3
Portfolio of Other Potential Projects and Management Actions				
All	Direct Groundwater Recharge of Stormwater and Flood Water – Groundwater Recharge of Stormwater through Unlined Canals, Natural Drainages, Recharge Basins, and ASR Wells	See Note 1	See Note 3	See Note 3
All	Direct Groundwater Recharge of Stormwater and Flood Water – Off-Stream Temporary Storage of Flood Water on Private Lands	See Note 1	See Note 3	See Note 3
All	Stormwater Management Improvements	See Note 1	See Note 2	See Note 2

	23 CCR § 354.44	**23 CCR §354.44(b)(5)**	**23 CCR §354.44(b)(6)**	
Subbasin	**Project/Management Action Name**	**Benefit Evaluation Methodology**	**Water Source**	**Water Source Reliability**
All	Stormwater Management Improvements – Watershed Restoration to Reduce Runoff	See Note 1	See Note 2	See Note 2
All	Levee Setback and Stream Channel Restoration	See Note 1	See Note 2	See Note 2
All	Recycled Water Program	See Note 1	See Note 3	See Note 3
All	Recycled Water Program – Treated Wastewater Recycling to Support Wetlands	See Note 1	See Note 3	See Note 3
All	Recycled Water Program – Wastewater Treatment Facility Construction to Supply Recycled Water for Irrigation	See Note 1	See Note 3	See Note 3
All	Inter-Basin Surface Water Transfers or Exchanges – Increase Inter-Basin Surface Water Transfers or Exchanges to Promote Surface Water Use	See Note 1	See Note 3	See Note 3
All	Inter-Basin Surface Water Transfers or Exchanges – Surface Water Imports from Other Tehama County Subbasins	See Note 1	See Note 3	See Note 3
All	Invasive Plant Removal from Creeks and Irrigation Conveyance Canals	See Note 1	See Note 2	See Note 2
All	Water Supply Reservoir Construction, Renovation, or Conversion	See Note 1	See Note 2	See Note 2
All	Enhanced Boundary Flow Measurement	See Note 1	See Note 2	See Note 2
All	Well Metering	See Note 1	See Note 2	See Note 2
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Residential Water Use Efficiency Improvements	See Note 1	See Note 2	See Note 2
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Municipal Water System Efficiency Improvements	See Note 1	See Note 2	See Note 2
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Irrigation Efficiency Improvements	See Note 1	See Note 2	See Note 2
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Surface Water	See Note 1	See Note 2	See Note 2

	23 CCR § 354.44	23 CCR §354.44(b)(5)	23 CCR §354.44(b)(6)	
Subbasin	**Project/Management Action Name**	**Benefit Evaluation Methodology**	**Water Source**	**Water Source Reliability**
	Conveyance and Irrigation Infrastructure Improvements for Dual-Source Systems			
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Assistance for Capital Improvements	See Note 1	See Note 2	See Note 2
All	Water Market for Surface Water and Groundwater Exchange	See Note 1	See Note 2	See Note 2
All	Demand Management – Conversion to Less Water Intensive Crops	See Note 1	See Note 2	See Note 2
All	Demand Management – Pumping Fees	See Note 1	See Note 2	See Note 2
All	Demand Management – Groundwater Extraction Allocation Program	See Note 1	See Note 2	See Note 2
All	Demand Management – Land Fallowing Program	See Note 1	See Note 2	See Note 2
All	Demand Management – County Water Use Ordinance and Conservation Efforts	See Note 1	See Note 2	See Note 2
All	Demand Management – Management and Restrictions of Land Use Changes	See Note 1	See Note 2	See Note 2
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Surface Water	See Note 1	See Note 2	See Note 2
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Recycled Water	See Note 1	See Note 3	See Note 3
All	Tehama County Domestic Well Tracking and Outreach Program – Provide Information and Resources for Protection of Domestic Wells	See Note 1	See Note 2	See Note 2
All	Tehama County Domestic Well Tracking and Outreach Program – Tehama County Dry Domestic Well Tracking System	See Note 1	See Note 2	See Note 2
All	Well Deepening or Replacement Program	See Note 1	See Note 2	See Note 2
All	Review of County Well Permitting Ordinances	See Note 1	See Note 2	See Note 2
All	Coordination and Development of Public Data Portals	See Note 1	See Note 2	See Note 2

	23 CCR § 354.44	23 CCR §354.44(b)(5)	23 CCR §354.44(b)(6)	
Subbasin	**Project/Management Action Name**	**Benefit Evaluation Methodology**	**Water Source**	**Water Source Reliability**
All	Coordination and Development of Public Data Portals – Ongoing Coordination and Information Sharing	See Note 1	See Note 2	See Note 2
All	Coordination and Development of Public Data Portals – Data Sharing for Monitoring Contaminant Plumes	See Note 1	See Note 2	See Note 2
All	Tehama County Well Inventory and Registration Program – Well Registration Program	See Note 1	See Note 2	See Note 2
All	Tehama County Well Inventory and Registration Program – Tehama County Well Inventory	See Note 1	See Note 2	See Note 2
All	Maintain and Expand Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 2
All	Maintain and Expand Groundwater Level Monitoring Network – Maintain Coordination with Other Monitoring Entities	See Note 1	See Note 2	See Note 2
All	Maintain and Expand Groundwater Level Monitoring Network – Identify Existing Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 2
All	Maintain and Expand Groundwater Level Monitoring Network – Identify New Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 2
All	One-Time Groundwater Quality Snapshot and Evaluation – One-Time Groundwater Quality Snapshot	See Note 1	See Note 2	See Note 2
All	One-Time Groundwater Quality Snapshot and Evaluation – Evaluation of Groundwater Quality Monitoring Options	See Note 1	See Note 2	See Note 2
All	Install Additional Agroclimate Stations	See Note 1	See Note 2	See Note 2
All	Expanded Subbasin Monitoring and Aquifer Testing – Aquifer Testing	See Note 1	See Note 2	See Note 2
All	Expanded Subbasin Monitoring and Aquifer Testing – Identify Locations Vulnerable to Damage from Subsidence	See Note 1	See Note 2	See Note 2
All	Expanded Subbasin Monitoring and Aquifer Testing – Groundwater Subbasin LIDAR	See Note 1	See Note 2	See Note 2

	23 CCR § 354.44	23 CCR §354.44(b)(5)	23 CCR §354.44(b)(6)	
Subbasin	**Project/Management Action Name**	**Benefit Evaluation Methodology**	**Water Source**	**Water Source Reliability**
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze the Relationship between Groundwater Levels and GDE Health	See Note 1	See Note 2	See Note 2
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze Water Supplies Accessed by Potential GDEs	See Note 1	See Note 2	See Note 2
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Evaluate the Need for Additional Groundwater - Surface Water Interaction Studies or Monitoring	See Note 1	See Note 2	See Note 2

Notes:

1. Evaluation of benefits may be quantified through with-project monitoring. With-project monitoring would be compared to without-project data as a means of quantifying the PMA benefit. With-project monitoring may include, but is not limited to; flow measurement consistent with state regulations, consumptive use analysis, reductions in GW use, well monitoring, determination of infiltration rates, water balance analysis, as-built drawings and stream gaging.
2. This PMA does not rely on a particular water source from outside the Subbasin, but may be useful for managing existing water resources.
3. The water source and reliability is described in the corresponding Subbasin GSP chapter.

Table 6. Legal Authority Requirements, Estimated Cost, and Potential Funding Sources for all Projects and Management Actions.

	23 CCR § 354.44	**23 CCR §354.44(b)(7)**	**23 CCR §354.44(b)(8)**	
Subbasin	**Project/Management Action Name**	**Legal Authority Required**	**Estimated Cost**	**Potential Funding Sources**
Projects and Management Actions Developed for Implementation				
All	Grower Education	See Note 1	See Note 3	See Note 4
All	Multi-Benefit Recharge	See Note 1	See Note 3	See Note 4
Bowman	Cottonwood Creek Invasives Control Follow Up	See Note 1	See Note 3	See Note 4
Bowman	Cottonwood Creek Riparian Habitat Restoration	See Note 1	See Note 2	See Note 4
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 1	See Note 1	See Note 3	See Note 4
Los Molinos	Lower Deer Creek Levee Improvements & Habitat Restoration Phase 3	See Note 1	See Note 3	See Note 4
Los Molinos	Deer Creek Instream Flow Planning and Design Project	See Note 1	See Note 2	See Note 4
Los Molinos	DCID Diversion Automation Project	See Note 1	See Note 2	See Note 4
Red Bluff	El Camino Restoration Project	See Note 1	See Note 2	See Note 4
Red Bluff	Expanded Use of CVP Contract Supplies in Proberta Water District and Thomes Creek Water District	See Note 1	See Note 2	See Note 4
Red Bluff	Elder Creek Non-Native Invasive Species Plant Control	See Note 1	See Note 2	See Note 4
Red Bluff	Tehama West Non-Native Invasive Species Plant Control	See Note 1	See Note 2	See Note 4
Red Bluff	Thomes Creek and Elder Creek Diversion for Direct or In-Lieu Groundwater Recharge	See Note 1	See Note 2	See Note 4
Portfolio of Other Potential Projects and Management Actions				
All	Direct Groundwater Recharge of Stormwater and Flood Water – Groundwater Recharge of Stormwater through Unlined Canals, Natural Drainages, Recharge Basins, and ASR Wells	See Note 1	See Note 2	See Note 4
All	Direct Groundwater Recharge of Stormwater and Flood Water – Off-Stream Temporary Storage of Flood Water on Private Lands	See Note 1	See Note 2	See Note 4
All	Stormwater Management Improvements	See Note 1	See Note 2	See Note 4
All	Stormwater Management Improvements – Watershed Restoration to Reduce Runoff	See Note 1	See Note 2	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(7)	23 CCR §354.44(b)(8)	
Subbasin	**Project/Management Action Name**	**Legal Authority Required**	**Estimated Cost**	**Potential Funding Sources**
All	Levee Setback and Stream Channel Restoration	See Note 1	See Note 2	See Note 4
All	Recycled Water Program	See Note 1	See Note 2	See Note 4
All	Recycled Water Program – Treated Wastewater Recycling to Support Wetlands	See Note 1	See Note 2	See Note 4
All	Recycled Water Program – Wastewater Treatment Facility Construction to Supply Recycled Water for Irrigation	See Note 1	See Note 2	See Note 4
All	Inter-Basin Surface Water Transfers or Exchanges – Increase Inter-Basin Surface Water Transfers or Exchanges to Promote Surface Water Use	See Note 1	See Note 2	See Note 4
All	Inter-Basin Surface Water Transfers or Exchanges – Surface Water Imports from Other Tehama County Subbasins	See Note 1	See Note 2	See Note 4
All	Invasive Plant Removal from Creeks and Irrigation Conveyance Canals	See Note 1	See Note 2	See Note 4
All	Water Supply Reservoir Construction, Renovation, or Conversion	See Note 1	See Note 2	See Note 4
All	Enhanced Boundary Flow Measurement	See Note 1	See Note 2	See Note 4
All	Well Metering	See Note 1	See Note 2	See Note 4
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Residential Water Use Efficiency Improvements	See Note 1	See Note 2	See Note 4
All	Incentivize Residential and Municipal Water Use Efficiency Improvements – Municipal Water System Efficiency Improvements	See Note 1	See Note 2	See Note 4
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Irrigation Efficiency Improvements	See Note 1	See Note 2	See Note 4
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Surface Water Conveyance and Irrigation Infrastructure Improvements for Dual-Source Systems	See Note 1	See Note 2	See Note 4
All	Assistance and Incentives for On-Farm Irrigation Infrastructure Improvements – Assistance for Capital Improvements	See Note 1	See Note 2	See Note 4
All	Water Market for Surface Water and Groundwater Exchange	See Note 1	See Note 2	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(7)	23 CCR §354.44(b)(8)	
Subbasin	**Project/Management Action Name**	**Legal Authority Required**	**Estimated Cost**	**Potential Funding Sources**
All	Demand Management – Conversion to Less Water Intensive Crops	See Note 1	See Note 2	See Note 4
All	Demand Management – Pumping Fees	See Note 1	See Note 2	See Note 4
All	Demand Management – Groundwater Extraction Allocation Program	See Note 1	See Note 2	See Note 4
All	Demand Management – Land Fallowing Program	See Note 1	See Note 2	See Note 4
All	Demand Management – County Water Use Ordinance and Conservation Efforts	See Note 1	See Note 2	See Note 4
All	Demand Management – Management and Restrictions of Land Use Changes	See Note 1	See Note 2	See Note 4
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Surface Water	See Note 1	See Note 2	See Note 4
All	Incentivize Use of Available Surface Water and Recycled Water – Incentivize Use of Recycled Water	See Note 1	See Note 2	See Note 4
All	Tehama County Domestic Well Tracking and Outreach Program – Provide Information and Resources for Protection of Domestic Wells	See Note 1	See Note 2	See Note 4
All	Tehama County Domestic Well Tracking and Outreach Program – Tehama County Dry Domestic Well Tracking System	See Note 1	See Note 2	See Note 4
All	Well Deepening or Replacement Program	See Note 1	See Note 2	See Note 4
All	Review of County Well Permitting Ordinances	See Note 1	See Note 2	See Note 4
All	Coordination and Development of Public Data Portals	See Note 1	See Note 2	See Note 4
All	Coordination and Development of Public Data Portals – Ongoing Coordination and Information Sharing	See Note 1	See Note 2	See Note 4
All	Coordination and Development of Public Data Portals – Data Sharing for Monitoring Contaminant Plumes	See Note 1	See Note 2	See Note 4
All	Tehama County Well Inventory and Registration Program – Well Registration Program	See Note 1	See Note 2	See Note 4
All	Tehama County Well Inventory and Registration Program – Tehama County Well Inventory	See Note 1	See Note 2	See Note 4
All	Maintain and Expand Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 4

	23 CCR § 354.44	23 CCR §354.44(b)(7)	23 CCR §354.44(b)(8)	
Subbasin	**Project/Management Action Name**	**Legal Authority Required**	**Estimated Cost**	**Potential Funding Sources**
All	Maintain and Expand Groundwater Level Monitoring Network – Maintain Coordination with Other Monitoring Entities	See Note 1	See Note 2	See Note 4
All	Maintain and Expand Groundwater Level Monitoring Network – Identify Existing Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 4
All	Maintain and Expand Groundwater Level Monitoring Network – Identify New Wells for Incorporation into the Groundwater Level Monitoring Network	See Note 1	See Note 2	See Note 4
All	One-Time Groundwater Quality Snapshot and Evaluation – One-Time Groundwater Quality Snapshot	See Note 1	See Note 2	See Note 4
All	One-Time Groundwater Quality Snapshot and Evaluation – Evaluation of Groundwater Quality Monitoring Options	See Note 1	See Note 2	See Note 4
All	Install Additional Agroclimate Stations	See Note 1	See Note 2	See Note 4
All	Expanded Subbasin Monitoring and Aquifer Testing – Aquifer Testing	See Note 1	See Note 2	See Note 4
All	Expanded Subbasin Monitoring and Aquifer Testing – Identify Locations Vulnerable to Damage from Subsidence	See Note 1	See Note 2	See Note 4
All	Expanded Subbasin Monitoring and Aquifer Testing – Groundwater Subbasin LIDAR	See Note 1	See Note 2	See Note 4
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze the Relationship between Groundwater Levels and GDE Health	See Note 1	See Note 2	See Note 4
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Analyze Water Supplies Accessed by Potential GDEs	See Note 1	See Note 2	See Note 4
All	Additional Studies of GDEs and Groundwater - Surface Water Interactions – Evaluate the Need for Additional Groundwater - Surface Water Interaction Studies or Monitoring	See Note 1	See Note 2	See Note 4

Notes:

1. GSAs, Districts and individual proponents have the authority to plan and implement projects, including surveys, studies, and other monitoring efforts.
2. This PMA is currently in the early planning or conceptual stage. Thus the anticipated costs of this PMA have yet to be determined and will be reported in GSP annual reports and five-year updates when known.

3. Available information on estimated costs is provided in the corresponding Subbasin GSP chapter.
4. Potential funding sources are being evaluated as PMA planning continues; they include, but are not limited to, the following: grants, loans, bonds, assessment fees, and cost-sharing programs. Potential funding sources will be reported in GSP annual reports and five-year updates when known.