Section 3: Existing and Future Conditions

This section describes the existing and expected future conditions for the Yosemite-Mariposa Region (Y-M Region or Region) that are relevant to water resources management. The information is organized and presented as it relates to the major topic areas of water supply including a water balance, water demands, water-related built infrastructure, water quality, flood protection, environmental resources, and the potential effects of climate change. Important information is provided regarding key water management infrastructure (both constructed and naturally occurring), summarizes and presents important water-related data, introduces some of the major challenges, and offers observations about the current water management system.

A number of original source data, technical reports and other information were reviewed and summarized to provide an overview of conditions throughout this IRWM Plan. An IRWM Plan is a high level representation of many important topics, and as such the reference materials should be reviewed for a more comprehensive discussion of the issues raised throughout the plan.

3.1 Water Demands

Water demand refers to the use of water for a specific purpose. In many cases a particular use will consume the water, such as for agricultural irrigation or residential uses. In other cases, water demands may be non-consumptive, such as for renewable hydroelectric power generation. The analysis of water demands can become complicated when reviewing in terms of the entire hydrologic cycle. The Y-M Region's consumptive water demands are limited mostly to municipal residential and commercial uses, with a limited amount of water used for industry and agriculture. While there are abundant surface water supplies in the Region, most of the water rights are held by agencies outside the Region for municipal and agricultural and ecosystem uses, as described in Section 3.2.2. Groundwater from fractured crystalline rocks comprises the majority of water supplies used in the Region. Current and future demand as well as sources of supply are discussed in greater detail in this section. Some of the potential climate change impacts to water demands are discussed in Section 3.7.

3.1.1 Water Demand Related Issues, Needs, Challenges and Opportunities

This subsection addresses the following key issues, needs, challenges and opportunities related to water demands:

- Balancing local water demand growth with resource availability (especially as related to groundwater) and downstream water export needs
- Water use efficiency programs provide means to efficiently use local supplies

3.1.2 Water Demand Estimates

Estimating the water demands of the Y-M Region is particularly difficult due to the number of small, geographically spread out water systems and highly variable transient water use associated with the recreation economy provided by the Yosemite National Park and other public lands that the Region supports. As a result, water demand estimates have been developed by reviewing select data from several water systems regulated by the California Department of Public Health (CDPH) which are estimated to serve about 9,000 of the 18,000 permanent residents of the Region. These estimates can be updated as additional information becomes available.

3.1.3 Municipal Water Systems

About half of the Region is served by one of approximately twenty community water systems regulated by the CDPH. The majority of these community water systems deliver groundwater while the remaining 9,000 residents use private wells to meet their water demands. CDPH categorizes water systems as follows:

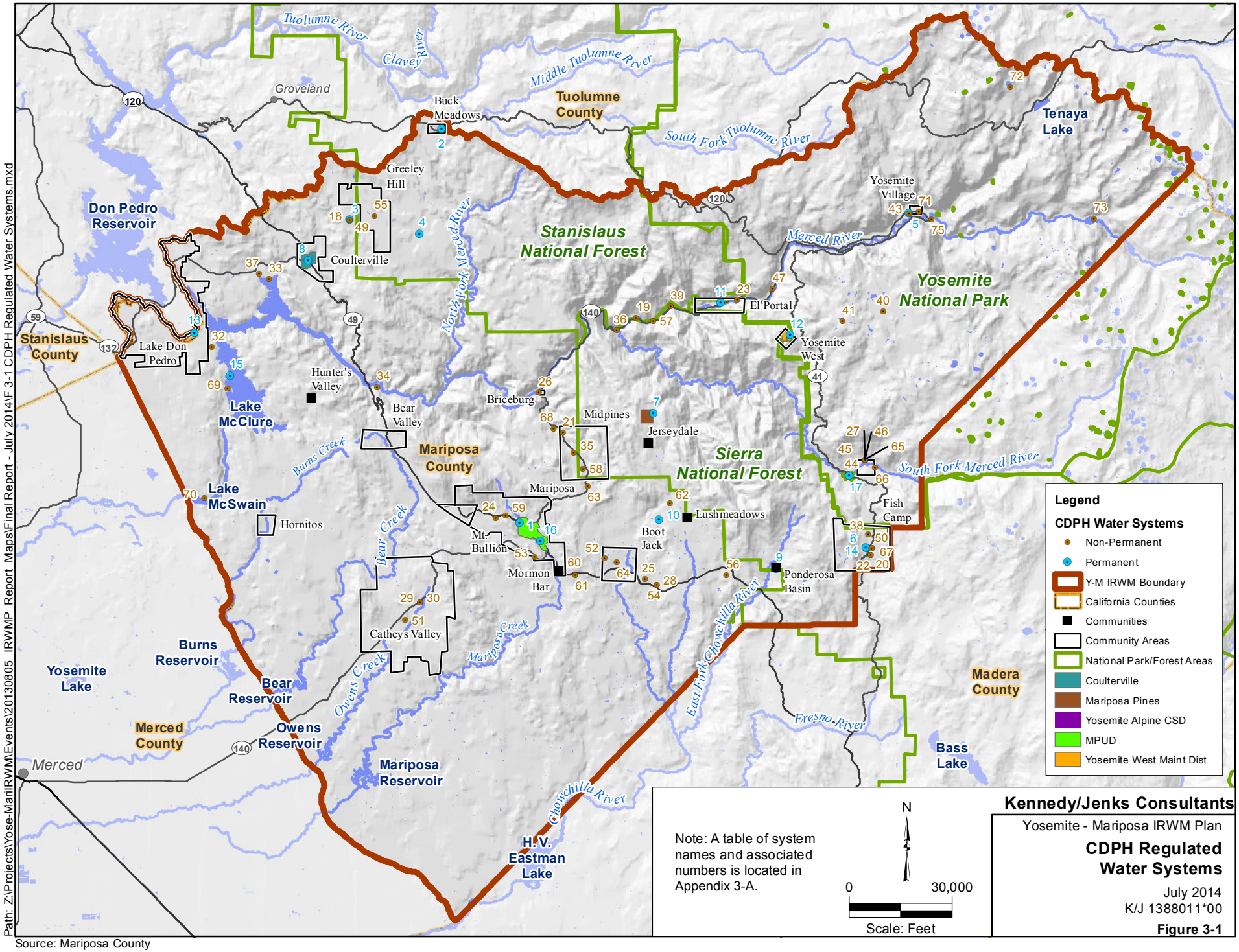
- **Community (C)** Serves at least 15 service connections used by year-round residents or regularly serves 25 year-round residents.
- **Non-Transient Non-Community (NTNC)** Serves at least the same 25 non-residential individuals during 6 months of the year.
- **Transient Non-Community (NC)** Regularly serves at least 25 non-residential individuals (transient) during 60 or more days per year.

Table 3-1 summarizes the larger community water systems that serve residential populations and some key information from these systems. Figure 3-1 shows the locations of these and other CDPH regulated water systems.

Table 3-1: CDPH Regulated Community Water Systems Serving Permanent Residents

Map Number	Water System Name	System Type	Community Served	Primary Water Source (Groundwater/ Surface Water)	Permanent Population Served	Service Connections (as of 2013)
1	CDF & FP - Mt. Bullion	C	Mt. Bullion	Groundwater	110	9
2	Yosemite Ridge Resort	C	Buck Meadows	Groundwater	45	35
3	Yosemite Westlake Mobile Estates	C	Coulterville	Groundwater	40	52
4	Wampum Hill Trailer Village	NC	Greeley Hill	Groundwater	70	35
5	Yosemite NPS-Yosemite Valley	C	Yosemite Village	Groundwater	1,000	235
6	Fish Camp Mutual Water Company	C	Fish Camp	Groundwater	200	76
7	Mariposa Pines Mutual	C	Mid Pines	Groundwater	168	84
8	MPWD-Coulterville CSA 1	C	Coulterville	Groundwater	165	95
9	Ponderosa Basin Mutual Water Co.	C	Ponderosa Basin	Groundwater	665	313
10	Whispering Pines Apartments	C	Midpines	Groundwater	55	26
11	Yosemite NPS - El Portal	C	El Portal	Groundwater	635	235
12	Yosemite West Water System	C	Mariposa	Groundwater	300	143
13	Lake Don Pedro CSD*	C	Lake Don Pedro	Surface Water	3,240	1,417
14	Yosemite Alpine CSD	NC	Fish Camp	Groundwater	50	36
15	McClure Boat Club, Inc.**	C	Lake McClure	Surface Water	48	68
16	Mariposa Public Utility District	C	Mariposa	Surface Water	2,000	678
17	Yosemite National Park – Wawona	C	Wawona	Surface Water	150	150
			Total		**9,076**	**3,692**

Source: CDPH database, 2013
* Lake Don Pedro CSD is listed as part of Tuolumne County by CDPH
** Has an additional 250 transient population



Source: Mariposa County

In addition to the CDPH-regulated community water systems serving permanent residents, there are over fifty other water system serving recreation areas, campgrounds, schools, and industries which are also shown on Figure 3-1. Table 3-2 that follows summarizes the water systems regulated by CDPH. A complete list of water systems with the numbers that correspond to those on Figure 3-1 is provided in Appendix 3-A.

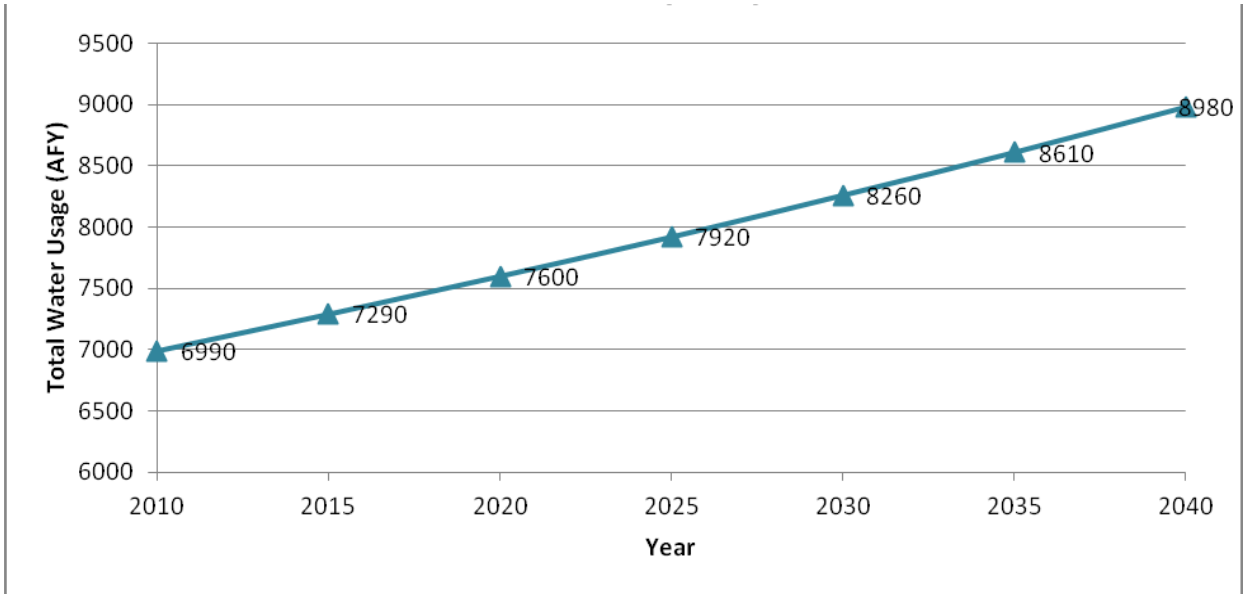
Table 3-2: Summary of Water Systems Regulated by CDPH

Primary Source	Type	Systems	Groundwater Wells[(a)]	Population Served[(b)]	Non-Permanent Population Served[(c)]	Service Connections
Groundwater	Hotel/Motel	6	20	0	726	65
	Industrial/Agricultural	2	3	0	65	14
	Institutional	1	6	110	0	9
	Mobile Home Park	3	5	155	0	122
	Recreation	19	23	1,000	4,143	609
	Residential	13	32	5,478	415	1,121
	School	7	9	0	1,135	15
	Transient	13	21	0	8,888	231
	Ground Water Total	**64**	**119**	**6,743**	**15,372**	**2,186**
Surface Water	Institutional	1	3	135	0	5
	Mobile Home Park	1	0	48	0	68
	Recreation	6	5	0	4,255	17
	Residential	3	4	2,150	0	2,245
	Transient	1	0	0	3,000	2
	Surface Water Total	**12**	**12**	**2,333**	**7,255**	**2,337**

Source: CDPH database
(a) Groundwater wells listed for entities with surface water are a secondary source.
(b) Non-Permanent/Permanent population estimated
(c) Includes transient population

3.1.4 Estimated Municipal and Domestic Water Demands

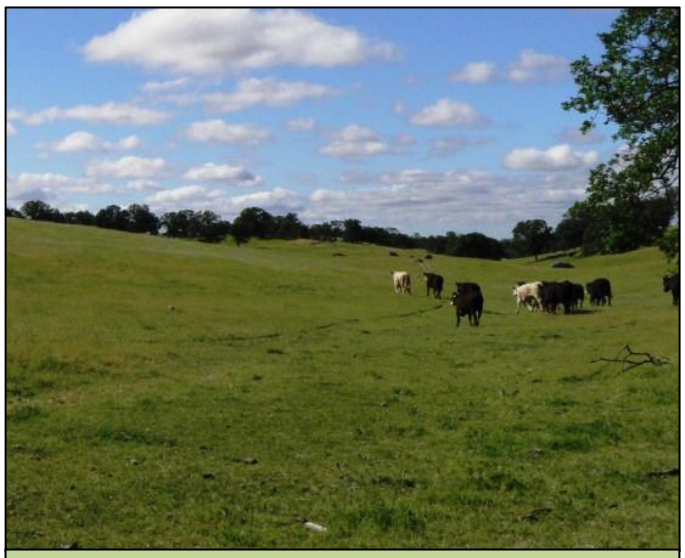
No known prior comprehensive water demand estimate for the Region has been prepared. Using population projections as discussed in Section 2.4 and average per person water demand of 342 gallons per day per capita obtained from data available from several community water systems, the current and future demands were estimated as shown on Figure 3-2. It is assumed that the average water use by a customer in a community water system is comparable to water users with individual water supply wells. The 2010 estimated municipal water demand is approximately 6,990 acre-feet per year (AFY) and is projected to grow to 8,980 AFY by 2040. These projections do not take into account water conservation or other programs that could reduce the average per capita water use. It is difficult to estimate the water demand related to the 4 million (estimated) visitors per year associated with Yosemite National Park as some of the demands of overnight visitors may be included in the local demand while those of day visitors are not. Overnight visitors also include hikers/backpackers that have nominal water use. If it is assumed that each visitor uses an average of about 60 gallons per visit, this could contribute about 746 AFY of additional demand.



Source: Based on data from Department of Finance, Ponderosa Basin Mutual Water Company, and Mariposa Public Utility Data

Figure 3-2: Estimated Existing and Future Mariposa County Residential Water Demand

3.1.5 Agricultural Demands



Rangeland
Credit: Kristen Boysen, Sierra Foothill Conservancy

The Mariposa County Agricultural Crop and Livestock Report indicates that there were about 500 acres of irrigated pasture, 535 acres of miscellaneous field crops and 282 acres of wine grapes and fruits and nuts under cultivation in 2012 with over 400,000 acres of non-irrigated rangeland making up the balance of agricultural lands. Based on a regional reference evapotranspiration from the California Irrigation Management Information System (CIMIS) of 53.1 inches/year, the approximately 1,100 acres of agriculture could add an estimated water demand of about 3,400 AFY. This demand estimate is corroborated by the Department of Water Resources water balance discussed in Section 3.3 which indicates a range of 2,300 to 5,000 AFY of agricultural water demand depending on the annual hydrologic conditions. The majority of the agricultural demands are likely at lower elevations but there are no data available on the proportion of demands that are met by groundwater and surface water diversions.

3.1.6 Water Demands Outside the Region

As noted earlier, the majority of surface water from the Y-M Region leaves the Region for agricultural and municipal uses. The bulk of surface water rights detailed in Section 3.2.2 in the Region are controlled by irrigation districts in the Central Valley. The rights to the majority of the Merced River water resources are allocated to the Merced Irrigation District (Merced ID) from a permit issued by the State Water Resources Control Board (SWRCB). The New Exchequer Dam forming Lake McClure and the McSwain Dam forming Lake McSwain are operated by Merced ID and used for hydroelectricity and the regulation of water to downstream users. Merced ID delivers approximately 320,000 AFY of surface and groundwater per year for irrigating about 100,000 acres of a variety of crops, such as almonds, cotton, tomatoes, wine grapes and hay and corn to support dairy, chicken, and beef livestock.

Big Creek Diversion
Credit: Fish Camp Fire/Rescue Association, Donn Harter

3.1.7 Non-Consumptive Demands – Hydropower Generation

In coordination with the water storage for out of region consumptive uses, there are two hydropower generation projects in the Region; Merced River Hydroelectric Project owned and operated by Merced ID and Merced Falls Hydroelectric Project owned and operated by Pacific Gas and Electric Company (PG&E). Hydropower generation is one of the essential products of the Y-M Region that have resulted in capturing the renewable and natural energy potential of the Merced River. Hydroelectric power generation facilities are a significant user of water in the Y-M Region. However, hydroelectric generation is also “non-consumptive”, in that water used is generally returned to the natural water system downstream of the power production facilities and the quality is not significantly affected. The Merced ID Merced River Project has a flow ranging from 900-2,700 cfs in the dry season and 200-300 cfs in the wet season (USGS, 2013b). The PG&E Merced Falls Project has a flow of about 1,371 cfs (MWH, 2003). This results in a dependable power generation capacity of 103.5 megawatts (MW) and 1.7 MW, respectively.

3.1.8 Total Estimated Water Demands

The total estimated water demands for the region are summarized in the table that follows. It is assumed that agricultural and visitor demands do not change although year-to-year variation can occur based on hydrologic conditions and visitation, which is often tied to economic conditions.

Table 3-3: Summary of Y-M Region Estimated Water Demands

	Estimated Average Demand by Year						
Demand Type	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Residential	6,990	7,290	7,600	7,920	8,260	8,610	8,980
Visitor	746	746	746	746	746	746	746
Agricultural	3,400	3,400	3,400	3,400	3,400	3,400	3,400
Total Estimated Average Demand	13,146	13,451	13,766	14,091	14,436	14,791	15,166

3.2 Water Supply

Surface water resources in the Y-M Region are typically abundant with surface water runoff from the three watersheds providing essential water for local and downstream users. Groundwater sources which are used extensively can be more scarce due to the challenging subsurface geology. This section describes the current and projected water supply conditions and demands of the Y-M Region. A summary of water-supply related climate change vulnerabilities is discussed in Section 3.7.

3.2.1 Water Supply Related Issues, Needs, Challenges and Opportunities

This subsection addresses the following key issues, needs, challenges and opportunities related to water supply management:

- Local surface supplies are limited and there are significant downstream exports
- Groundwater use is not managed and supply reliability is not well understood
- Climate change effects on supply are unknown

3.2.2 Water Rights Background

The ownership, diversion, and storage of water in California is complex and has been an evolving process over the 160 years of California's statehood. The following provides a brief summary of surface water and groundwater regulations that generally apply to the Region as described in the SWRCB Water Transfer Guide from 1999. Legal counsel should be consulted in any water rights determination.

3.2.2.1 Surface Water Rights

Merced River
Credit: Pat Garcia

By law, the State of California SWRCB Division of Water Rights administers water rights law so that water is protected for the use and benefit of all Californians. While surface water cannot be privately owned, rights to use water can be granted to individuals or organizations. A water right is a legally protected right to take possession of water and put it to beneficial use. Under the California Water Code, the SWRCB is responsible for allocating surface water rights and permitting the diversion and use of water throughout the state. Through its Division of Water Rights, the SWRCB issues permits to divert water for new appropriations or to change existing water rights. An important aspect of California water rights is that those granted the oldest rights have priority over those granted more recent (i.e. junior) water rights ("First in time, first in right"). There are two major types of water rights under California State Law: riparian rights and appropriative rights.

Riparian rights are those where water is extracted for use on lands that directly border a water course. A property owner has a riparian right to water that flows through the property. Any owner of a parcel immediately adjacent to a water course has the right to take water for domestic and agricultural use at any time unless specific deed restrictions are stated in the title to the land. The water can only be used on the property and cannot be impounded or stored or exported to another property or sold to another. Any removal of water from a surface water body for delivery

to non-adjacent parcels constitutes appropriative use, which requires a permit from the SWRCB that establishes an appropriative right.

Appropriative rights are those that are permitted or licensed by the SWRCB. Appropriative water rights allow the use of natural flow of the stream provided riparian rights are satisfied. In addition to the diversion of water that is applied directly to beneficial use, appropriative rights may be used for the storage of water. Appropriators can also divert or store water that is "foreign" to the stream system in time or imported into the watershed. Appropriative rights are permitted specifying the actual point of diversion on a waterway and detailed description of the area of use. Appropriative water rights work on a priority system and depend on the time and nature of the water right. However, all appropriative rights are subject to the prevention of waste or unreasonable uses affecting public trust resources, and appropriative rights can be lost if they are not used over a period of years.

- Pre-1914 water rights pre-date statewide permitting authority and are the oldest type of appropriate water rights. Diversion priorities are based on first use of the water and is considered “first come, first served”. Pre-1914 water rights have significantly greater flexibility in terms of points of diversions and places of use than post-1914 water rights.

- Post-1914 appropriative water rights are the modern day administrative system utilized by the State to provide oversight of water rights. Post-1914 rights require licenses or permits to be issued by the SWRCB. The priority for post-1914 water rights is based on the date of the water right application filing with the SWRCB.

State law affords some protections from export of waters from counties that are considered watersheds or “areas of origin”. There are numerous provisions and statements in California code that describe the intentions to protect upstream water users from being “deprived directly or indirectly of the priority right to all the water reasonably required to adequately supply the beneficial needs of the protected area”, however, these provisions are largely unproven and have yet to be fully resolved (SWRCB, 1999).

3.2.2.2 Groundwater Rights

Groundwater is treated differently from surface water in California. Generally, groundwater is shared by landowners who pump water for use on their lands that overlie the groundwater basin or source. Pumped groundwater can be put to reasonable and beneficial use. In water short times they are expected to share the water equitably. Water may be taken to lands that are not owned by the person pumping the water or that does not overlie the groundwater basin provided the overlying landowners are not harmed (SWRCB, 1999).

No state water right permits are required to pump groundwater. Each groundwater user can drill a well and pump groundwater without the need of a water right permit. However, there are often local ordinances that must be obeyed and there are statewide regulations governing well drillers related to recording of the wells they drill. In addition, some groundwater basins, mostly in southern California, have been adjudicated and many groundwater basins have local groundwater management plans adopted under Water Code 10750 et. seq. (also known as AB 3030 for the Assembly bill that enacted these statues) or other laws. There are no adjudicated basins or other known state-issues groundwater restrictions in the Y-M Region.

3.2.2.3 Mariposa County Water Rights and Agreements

There are numerous water users in Mariposa County, although there are only a few significant water rights holders. According to the SWRCB electronic water rights database, there are 290 active appropriative water rights licenses and 103 active filed Statements of Diversion. Statements of Diversion can include both riparian as well as pre-1914 appropriative water rights. In addition, there may be direct riparian users, without storage, throughout the Region who do not make filings with the SWRCB. The following describes, in general terms, the water rights associated with the three major watersheds in the Region.

3.2.2.3.1 Merced River Watershed

The Merced River is by far the largest watershed in the Y-M Region and lies primarily in the Region although the upper south Fork Merced watershed also lies within Madera County. Merced ID is the primary holder of water rights on the Merced River. Merced ID has several water rights, some date back to the 1880s. Even though the agency was incorporated or formed in 1919, they took over the Crocker Huffman Irrigation company that acquired rights from other irrigation companies which ultimately became Merced ID rights. The rights Merced ID took over in 1919 are mostly pre-1914 appropriative. Merced ID water rights include both consumptive, for irrigation and non-consumptive, for hydropower generation. Merced ID also retains a storage license to permit diversions of stored water up to 516,000 AFY in Lake McClure. Merced ID's FERC hydropower license does require certain instream flows to be maintained downstream of Lake McClure (CHM2HILL, 2001).

Neither Mariposa Public Utility District (MPUD) nor Mariposa County have appropriative rights on the Merced River. Applying for a right up stream of Lake McClure (including Merced River tributaries) would require Merced ID (and the SWRCB) participation and probably both agencies approval. MPUD obtains surface water from the Merced River via the Saxon Creek project. MPUD's diversion is provided for through an amendment to Merced ID's water right area of use to include the Mariposa Town Planning Area (map on file with the SWRCB). MPUD's current water rights amendment that includes the Mariposa Town Planning Area could be expanded in the future, but this would require negotiation with Merced ID and the SWRCB.

There are many riparian users on the Merced between the Merced ID impoundments and diversions at Exchequer, McSwain and Crocker Huffman. Monitoring diversions of the many riparian diverters, using regulatory gauging stations can be challenging for downstream appropriative water rights holders such as Merced ID, because the riparian users affect the minimum flow measurements at Exchequer and McSwain used to evaluate permitted minimum bypass flows.

Federal agencies such as the Sierra National Forest, the Stanislaus National Forest, National Park Service, and the Bureau of Land Management have licenses or permits for quantities ranging from 0.1 to 76.5 AFY which are small quantities relative to those of the largest diverter in the Region, Merced ID.

3.2.2.3.2 Lower Mariposa Group of Streams

The Lower Mariposa Group of Streams includes several creeks that flow in a westerly direction and eventually flow outside the western Region boundary. The primary creeks with water rights diversions and impoundments include Mariposa Creek, Bear Creek, and Owens Creek.

Appropriative water rights on Mariposa Creek were held by El Nido Irrigation District until the irrigation district was annexed by Merced ID, in 2005. The rights were transferred to Merced ID in the annexation process. Water rights applications on streams in the Mariposa Creek watershed would require negotiations with SWRCB and Merced ID. MPUD does have appropriative rights on Stockton Creek, a tributary to Mariposa Creek.

Mariposa Reservoir, Owens Creek Reservoir and Bear Creek Reservoirs are Army Corps of Engineers flood control facilities located near the westerly Mariposa County boundary. They are facilities dedicated to reducing flood risk in the lower elevation San Joaquin valley floor and have fixed discharges with no valves. The dams and reservoir areas are on private land. The Army Corps either leases or has easements for the facilities. Closing the discharge to impound water would require permits from SWRCB and negotiation with Merced ID.

3.2.2.3.3 Chowchilla/Fresno Rivers Watersheds

The Chowchilla River is the primary drainage in the Fresno/Chowchilla watershed in the Region. The Chowchilla River is impounded at the Madera/Mariposa County line at Eastman Lake. Eastman is an Army Corps of Engineers facility and the dam is used to store water for flood control, irrigation, and recreational uses. Water rights are held by the U.S. Bureau of Reclamation, which has incorporated the reservoir into the Central Valley Project (CWD, 2013). Chowchilla Water District also has appropriative water rights on the Chowchilla River as well as contracts with the USBR to receive about 43,000 AFY from Eastman Lake. Water use and appropriations in the Chowchilla watershed would include SWRCB and Madera Irrigation District participation.

Within the Region, Lewis Creek and Miami Creek are in the Upper Fresno River watershed, and no water rights filings were found for Lewis or Miami Creek.

3.2.3 Surface Water Sources

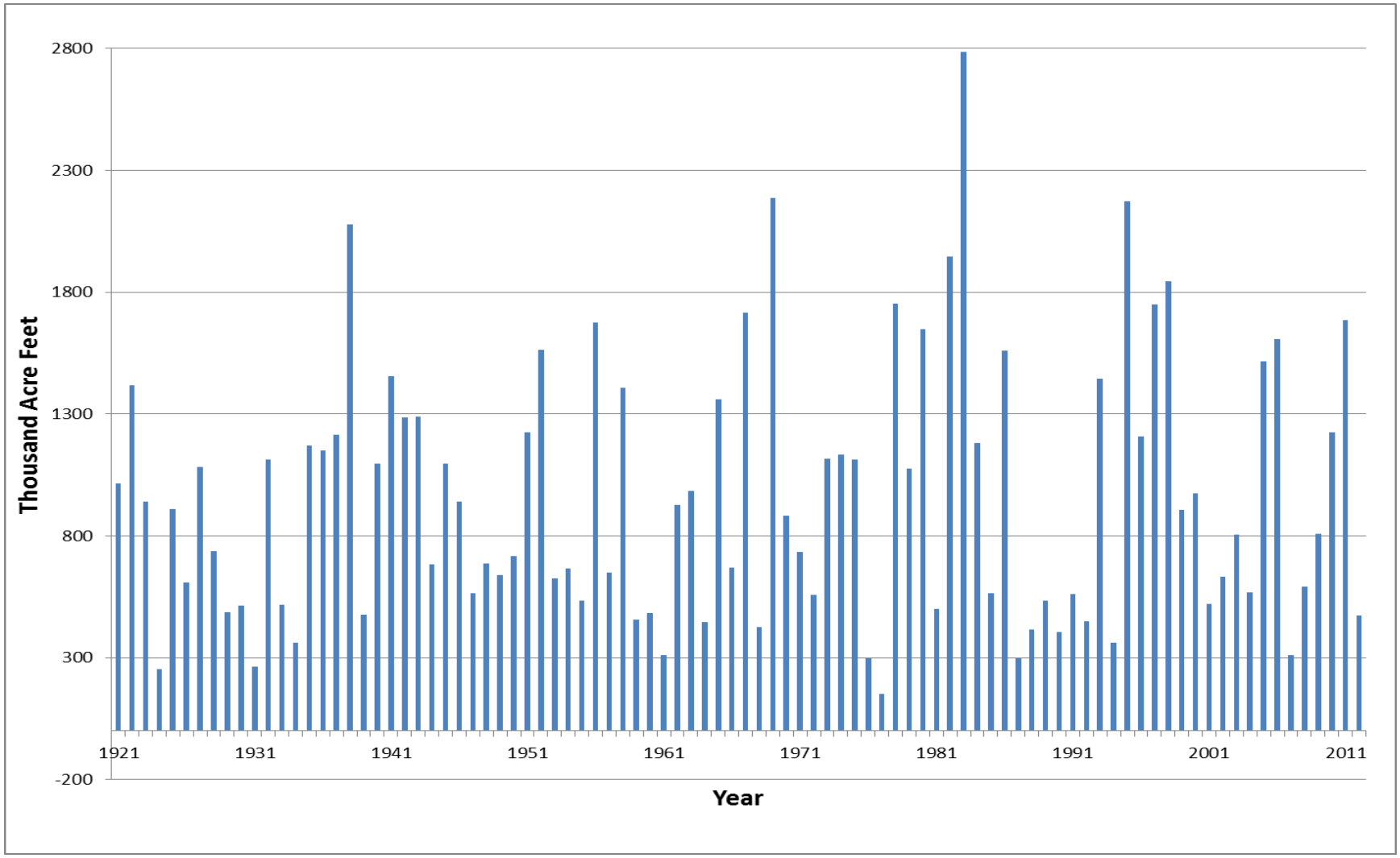
Surface water is the most abundant of the water resources in the Region. As described earlier, the primary surface water supply in the Merced River watershed is the snow pack that accumulates in the various subwatersheds. A significant part of the Upper Merced River watershed is under the control of federal government agencies and are managed by Yosemite National Park, Stanislaus National Forest, Bureau of Land Management (BLM), and Sierra National Forest as shown on Figure 2-5. The Lower Mariposa Group of Streams and the Chowchilla/Fresno River Basins, which are at lower elevations contain watersheds mostly on private lands. Proactive measures by federal agencies have contributed to improved management and maintenance of the overall health of the watershed.

One way to evaluate potentially available surface water supply is to estimate the unimpaired flow for a drainage basin. The unimpaired flow is stream flow that would have occurred had water flow remained unaltered within the watershed. The average annual estimated unimpaired flow for the Merced River from 1921-2003 is 0.96 million acre-feet (MAF) at Lake McClure which, represents a watershed drainage area of about 1,040 square miles (DWR, 2007). The annual flow fluctuates significantly based on precipitation, snow pack conditions and the timing of snowmelt.

In comparison, the Chowchilla River, which has its headwaters in the Y-M Region averaged 70,000 AFY at the Eastman Lake formed by Buchanan Dam, which represents a watershed area of about 235 square miles. There are reservoir inflow estimates for four creeks within the Lower Mariposa Groups of Streams watersheds from the US Army Corps of Engineers' that are used to monitor flood conditions. Four gauged creeks (Burns, Bear, Owens, and Mariposa) in the Lower Mariposa Groups of Streams have a total drainage area of about 279 square miles which is 84 percent of the 331 square miles of the entire watershed. Individual creeks range in drainage area from 26 square miles for the Owens Creek drainage up to 107 square miles for the Mariposa Creek drainage (DWR, 2007).

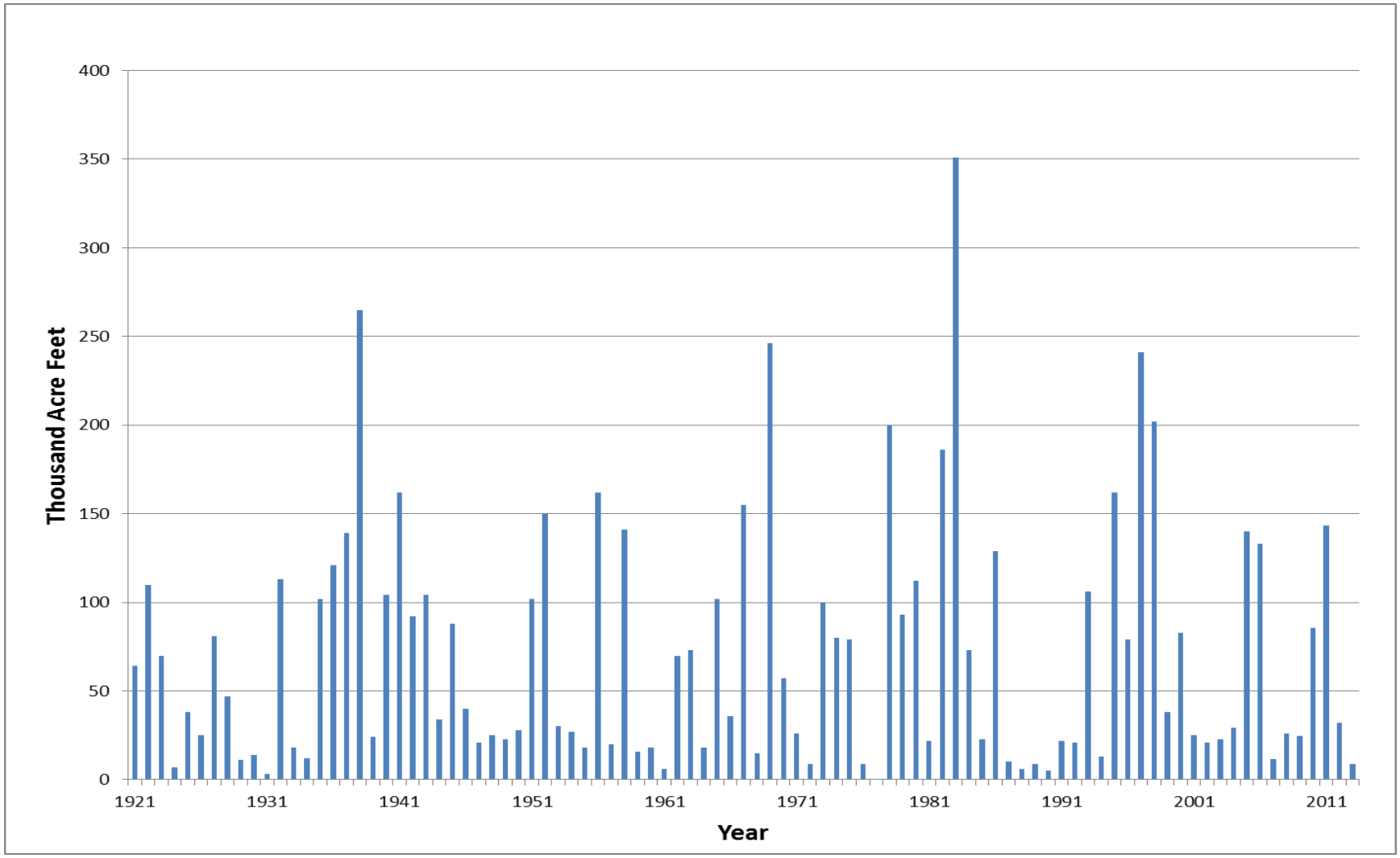
As discussed in section 3.4.1, the larger municipal surface water users include MPUD which draws water from both Stockton Creek a tributary to Mariposa Creek and the Merced River near Saxon Creek. Lake Don Pedro Community Services District (LDPCSD) also draws Merced River water from Lake McClure. As discussed earlier, both MPUD and LDPCSD use Merced River water under contract to Merced ID, the water rights holder. In addition, the Merced River provides water for the NPS Wawona and several other recreational water users.

The Chowchilla River and the Lower Mariposa Groups of Streams are subject to similar seasonal fluctuations in flow as the Merced River. (DWR, 2007). Figure 3-3 shows the annual unimpaired flow for the Merced River Watershed, Figure 3-4 shows the annual unimpaired flow for the Chowchilla River. Figure 3-5 shows the gauged reservoir inflow for the four major creeks in the Lower Mariposa Groups of Streams. It is expected that under climate change conditions these flows may have higher variation causing more prevalent drought/flood cycles.



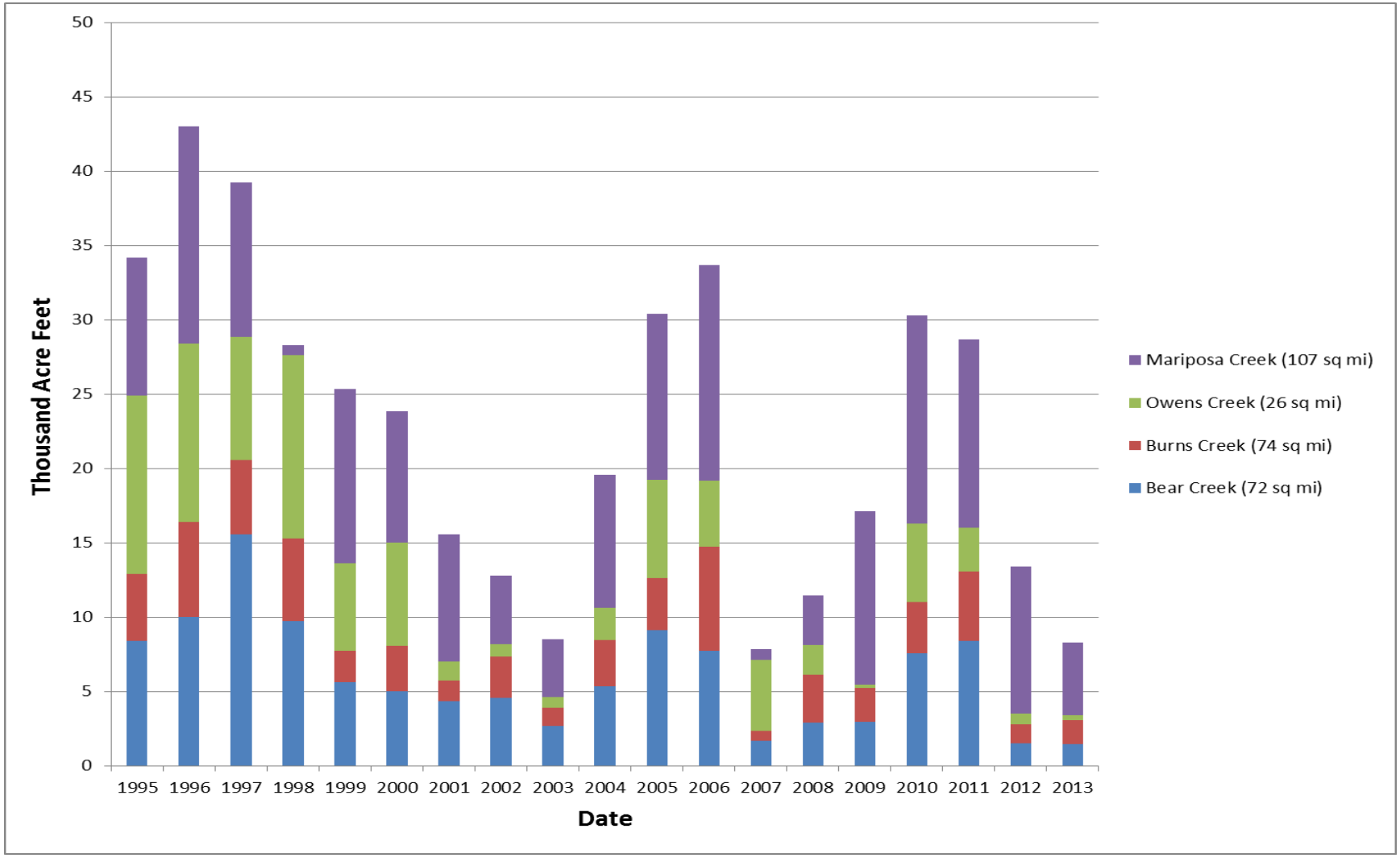
Source: DWR, 2007 and CDEC, 2013

Figure 3-3: Annual Estimated Unimpaired Flow for the Merced River Watershed (1,040 square mile drainage area) at Exchequer Dam (Lake McClure)



Source: DWR, 2007 and CDEC, 2013

Figure 3-4: Annual Estimated Unimpaired Flow for the Chowchilla River at Buchanan Dam (235 square mile drainage area) (Eastman Lake)



Source: CDEC, 2013

Figure 3-5: Annual Reservoir Inflow for Select Mariposa Groups of Streams (279 square mile drainage area)

3.2.4 Groundwater Supply and Extraction

Groundwater is estimated to be the only water source for an estimated 15,000 residents, over 80 percent of the population. As described in Section 2.8.2.2, it is very difficult to predict the reliability of these sources due to the fractured rock geology of the aquifers. Granite masses are encountered beneath the top soil with groundwater being stored in the fissure crack system that developed. The water bearing characteristics of these rock structures are primarily controlled by weathering and structure. Wells drilled in the Region are often unpredictable and encounter highly variable amounts and levels of water. The accepted depth of wells in rock is typically determined by cost, unless depth and quantity of groundwater is known from the surrounding geologic structure.

Typical groundwater statistics cited in the Mariposa County General Plan include:

- In unweathered rock 5 to 15 percent of wells fail annually
- Median yields are less than 8 gallons per minute (gpm) with roughly ten percent reaching a yield greater than 50 gpm
- Groundwater on high on slopes or on top of mountains tends to have more seasonal variation in depth to water and yield

The only DWR recognized contiguous groundwater basin in the Region is the Yosemite Valley Basin. This basin supplies water to the various communities in Yosemite National Park and has much better well yields than other parts of the Region. The Yosemite Valley basin is approximately 7,500 acres with well yields averaging 900 gpm and peaking at 1,200 gpm and has high quality water (DWR, 2003).

Concurrent with the preparation of the IRWM Plan, a focused groundwater study is being prepared for portions of Mariposa County using both existing well logs as well as some field sampling for water levels and water quality. The study is intended to focus on areas where there are relatively high densities of private and community wells where water levels, particularly during dry periods, may decrease to where supplies become limited. The full study is included as Appendix 3-B.

3.2.5 Recycled Water

Recycled water use in the Region is limited to golf course irrigation in Wawona using tertiary wastewater from the National Park Service's (NPS) wastewater treatment plant which produces up to 100 AFY of recycled water and pasture irrigation using secondary wastewater from the Mariposa County Service Area, 1-M, Sewer Zone #1 wastewater treatment plant which produces up to 90 AFY (Kennedy/Jenks 2010, RWQCB 2013). At this time, the other wastewater treatment facilities at Mariposa Public Utility District, at NPS El Portal (which also treats Yosemite Valley wastewater), Coulterville, Yosemite Alpine CSD in Fish Camp, and Yosemite West do not have areas and/or facilities to cost-effectively produce and/or apply recycled water. Wastewater collection and treatment facilities are discussed in Section 3.4.4 in greater detail.

3.2.6 Total Estimated Water Supplies

The total estimated water supplies for the region are summarized in the table that follows. It is assumed that surface water supplies do not change over time although it is acknowledged that annual variation may occur based on hydrologic conditions.

Table 3-4: Summary of Y-M Region Estimated Water Supplies

Supply Type (Acre Feet/Year)	Year						
	2010	2015	2020	2025	2030	2035	2040
Surface Water	1,300	1,300	1,300	1,300	1,300	1,300	1,300
Recycled Water	110	140	170	190	190	190	190
Groundwater	11,736	12,016	12,296,	12,601	12,946	13,301	13,676
Total	15,156	15,471	15,786	16,116	16,466	16,826	17,206

3.3 Regional Water Balance

The hydrologic cycle dictates the generation, conveyance, storage, and use of water throughout the Region. The figure below depicts the hydrologic cycle in terms of a “water balance”, which is useful to improve understanding of the water flows in the system. As the headwaters and an area of origin region, the many watersheds begin within the Y-M Region. Water enters the Region in the form of rainfall or snow, flows through the watersheds through the many streams and rivers. At points along the way, water may be diverted or stored for different uses. At the western downstream extents of the Region, water that has not been used flows into the lower watersheds, where it may be used by others. All of the watersheds are tributaries to the San Joaquin River.

The figure that follow is based on water balances prepared by DWR for Mariposa County, which is contiguous with the Y-M Region, using data from 1999 and 2002 through 2010 as part of the DWR 2013 California Water Plan (CWP) Update. These water balances for single years account for “applied water” or demand such as consumptive water uses such as residential, commercial, agricultural based on the DWRs land use data as well as non-consumptive uses such as environmental releases (accounted for in downstream releases) the vast majority of which leave the Region. Many elements of the water balance are not quantified as the data are not available. A water balance based on data from a single year can provide a useful “snapshot” of water management conditions, but does not depict some important long-term management factors such as changes in groundwater and surface water storage that may be relevant for regions where groundwater and surface water are conjunctively managed.

Given the ten years of available data, years were selected to represent average, dry and wet years. Figure 3-6 presents the information for an average year which was 2009 for the period of record, a dry year which was 2007, and a wet year which was 2006.

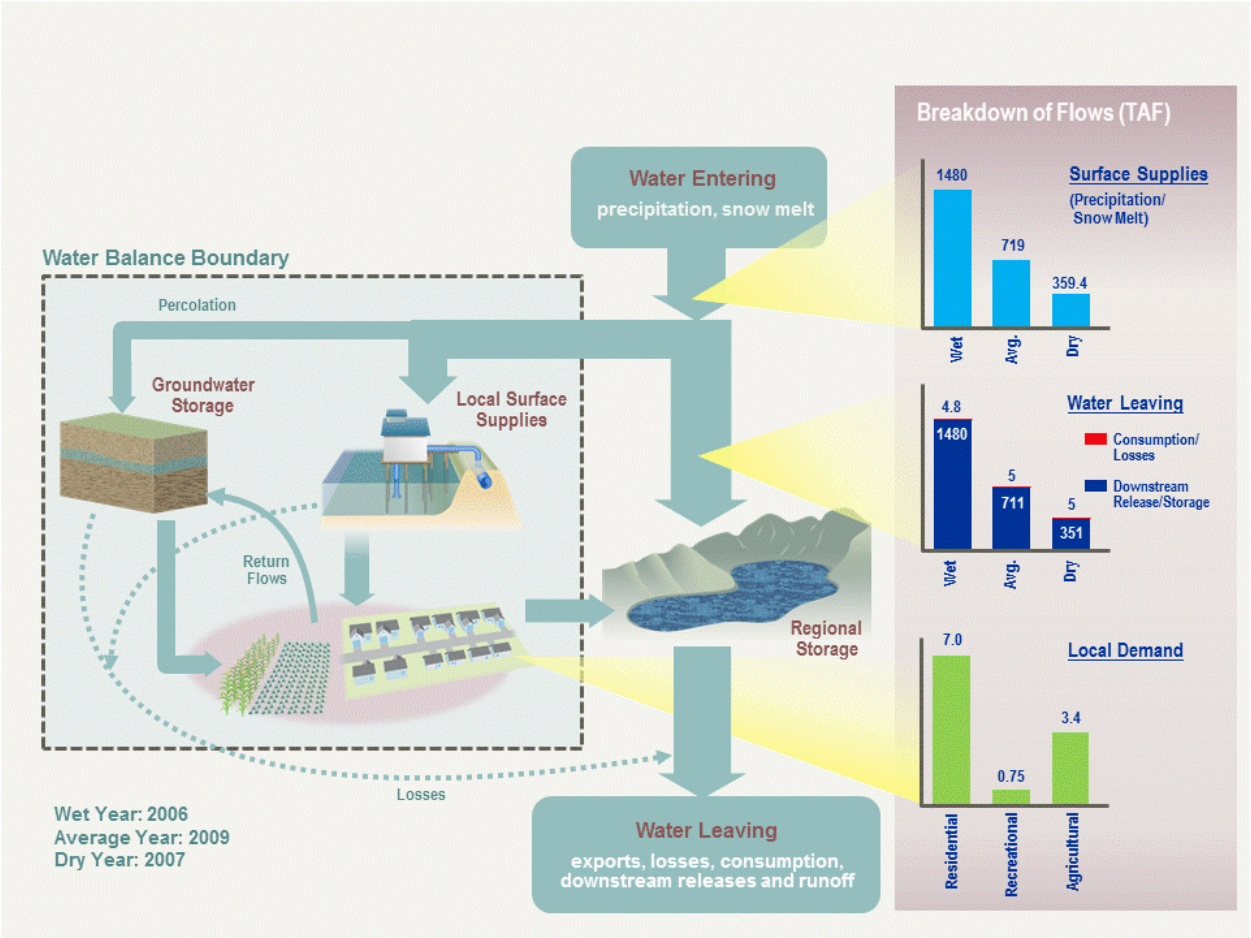


Figure 3-6: Water Balance for Y-M Region

3.4 Water-Related Infrastructure

Water-related infrastructure in the Y-M Region ranges from systems that deliver groundwater and surface water for potable supply as well as the associated water distribution and fire prevention including pipelines, tanks, and pump stations. Large water storage reservoirs provide facilities for hydroelectric power generation and flood control. Wastewater collection and treatment facilities in several communities are also a critical component of the Region's water-related infrastructure. An overview of this range of facilities is described in this section.

3.4.1 Water Infrastructure Related Issues, Needs, Challenges and Opportunities

This subsection addresses the following key issues, needs, challenges and opportunities related to water infrastructure management:

- Aging water supply and distribution infrastructure is not being replaced in a timely manner
- Inadequate water storage and resources for adequate community fire protection
- Compliance with wastewater treatment regulatory standards for community wastewater systems and private septic systems

3.4.2 Drinking Water Infrastructure

As discussed earlier in Section 3.2.1 there are approximately 20 CDPH regulated public water systems that serve primarily groundwater to about 9,000 permanent residents of the Y-M Region as well as 58 other CDPH regulated water systems serving a range of facilities. Table 3-2 provided a summary of the types of agencies, the water source, and population and service connection information. A more detailed table of the individual water systems with identifying numbers associated with Figure 3-1 is found in Appendix 3-A.

Each of these systems has pipelines, pump stations, disinfection and storage facilities. In addition, many agencies only have groundwater wells with disinfection while surface water facilities have more sophisticated treatment facilities, often with groundwater as a back-up. The 2008 draft Local Agency Formation Commission (LAFCO) Water and Wastewater Municipal Service Review Report identifies six special districts or local agencies of the County subject to LAFCO. These six systems represent about 100 miles in distribution pipeline, over 10 water storage tanks, over 10 groundwater wells, and two surface water treatment plants. At this time, data from the other water systems is not available to fully quantify the potable water infrastructure of the Region.

3.4.2.1 Municipal Surface Water Treatment Facilities

Surface water is used on a limited basis for drinking water for permanent residents in the Region by MPUD, LDPCSD, and the National Park Service (NPS) in Wawona. In addition, the following systems serve surface water to visitors and/or recreational facilities.

- Merced ID – McClure Point Recreation Area
- Merced ID – McSwain Recreation Area
- NPS – Glacier Point
- NPS – May Lake Camp
- NPS – Merced Lake Camp
- NPS – Sunrise High Sierra Camp
- NPS – Vernal Falls
- McClure Boat Club

A more detailed description of the MPUD and LDPCSD surface water facilities which combined serve over 5,000 persons follows.

MPUD Surface Water Facilities

MPUD uses water both from Stockton Creek, a tributary to Mariposa Creek which drains to the Lower Mariposa County Group of Streams watershed and the Merced River near Saxon Creek as shown on Figure 3-1. MPUD also has 4 groundwater wells that pump up to 135 gallons per minute (gpm) directly into the water distribution system.

Stockton Creek, one of the primary sources of water for MPUD, is impounded by the Stockton Creek Dam to create a 440 AF reservoir. Source water feed from the Stockton Creek Dam to the Surface Water Treatment Facility (SWTF) flows through a 10-inch diameter 7,000 linear feet raw water pipeline. The estimated maximum flow through the 10" pipeline is 2,000 gpm. However there is approximately 400' of 6" diameter pipe from the valve operating tower in the reservoir pool to the toe of the dam which restricts the flow from the reservoir to approximately 650 gpm. MPUD also uses the pump station on the Merced River (Saxon Creek Pump Station) as a secondary source of up to 2,400 gpm. MPUD holds water rights permits and licenses to Stockton Creek while the use of the Merced River is by contract with Merced ID. Water rights are discussed in Section 3.2.1 in greater detail.

MPUD owns and operates a pump station on the Merced River approximately one mile west of Briceburg. The project title (Saxon Creek Water Project) was derived from the point of diversion being located near the confluence of Saxon Creek and the Merced River. Water is actually pumped from the Merced River. The pump station is equipped with two 1000 hp pumps expandable to include a third pump. Pumping is restricted by water right and BLM land use permits (pumping may not result in a stream flow of less than 50 cfs downstream of the diversion). The current capacity of the pump station is 2400 gpm, expandable (with the third pump installed) to 3200 gpm. Water from the Merced River is transported through a 43,000-foot, 12-inch pipeline which connects to the 10" pipeline at the toe of the Stockton Creek dam. A one million-gallon steel raw water tank is located at the high elevation point in the pipeline. Raw water from the storage tank is then transported by gravity lines to a surface water treatment facility. Alternatively water from the Merced River may be diverted from the 43,000 foot pipeline directly to the Stockton Creek Reservoir. This allows the District to store water from the Merced River during low water runoff years in the spring for use throughout the rest of the year. The flexibility of the water source is especially valuable in critically dry years.

Water Treatment Plant
Credit: MPUD, Mark Rowney

The SWTF was replaced in 2013 with funding from California Proposition 50 grant of $2 million and a State Revolving Fund grant of $3 million. The primary components of the new facility include a clarifier/flocculation tank, Ultrafiltration membrane filters, granular activated carbon reactors, Chlorine disinfection system emergency power generator, replacement of all chemical feed systems and a new operations building. The new SWTF capacity is one million gallons per day. The SWTF is required to meet a 0.1 nephelometric turbidity unit (NTU) standard.

LDP CSD Facilities

The Lake Don Pedro CSD also provides surface water from Lake McClure to its customers with supplemental water from a well. Lake Don Pedro CSD has two intake pumps that draw water down to an elevation of 700 feet. Below that level, a Float Pump Barge is employed, which adjusts to water levels below 700 feet. The water is pumped from Lake McClure into a 1.5 million gallon raw water storage tank which provides a constant flow rate to the water treatment plant. The 2 mgd capacity conventional water treatment plant includes the addition of chemical coagulant followed by a coagulation/flocculation basin and sedimentation of large floc particles. Smaller particles are removed in two multi-media pressure filters that contain anthracite, sand, and garnet media. Following disinfection, the treated water is pumped to a series of distribution system storage tanks for gravity delivery to the customers (Lake Don Pedro CSD, 2013).

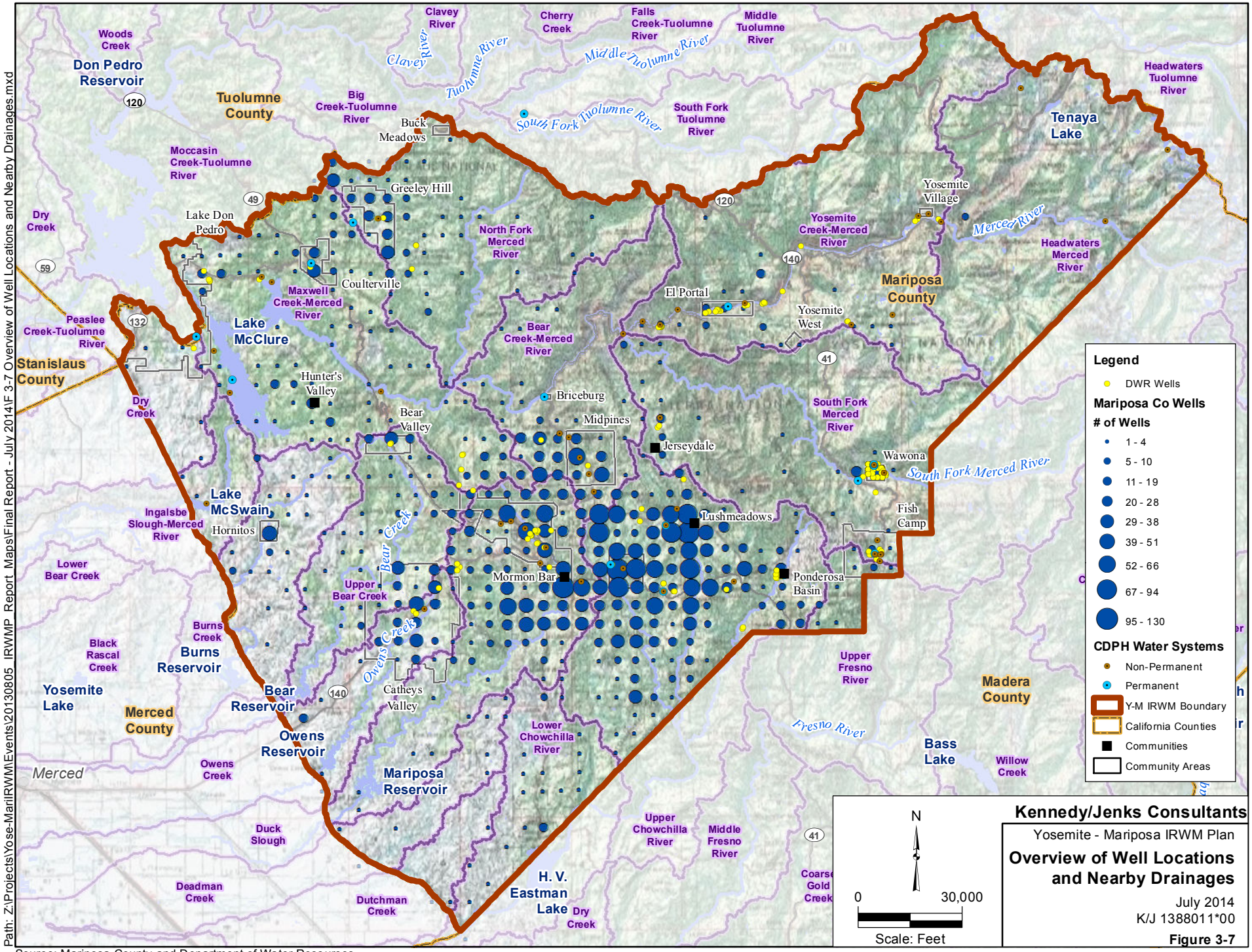
3.4.2.2 Groundwater

The majority of private and community drinking water in the Region is obtained from groundwater. DWR's well log database identifies approximately 6,000 existing, abandoned, and/or deepened wells in Mariposa County. The number of these 6,000 well logs within the township, range, and section of the well location is provided on Figure 3-7. The majority of the wells are located within 12 miles of Mariposa where much of the population of the Region resides.

As discussed earlier, the geology of the Region consists of a hard rock which has the result of small and inconsistent groundwater aquifers. Typical domestic wells can be between 50 and 200 feet deep and produce around ten gallons per minute (gpm). Large yields greater than 50 gpm are rare and usually unsustainable (County of Mariposa, 2006). The topographic location is significant in the productivity of hard rock wells.

As part of this IRWM Plan, a groundwater study was conducted that investigated 10 subareas within the Region. The subareas were derived based on surface watersheds in the areas with the highest well densities (see Figure 3-8). For each subarea, the following evaluations were investigated:

- Pre-development water budget
- Estimation of consumptive use due to groundwater pumping
- Summary of well depths and yields (~3,000 wells) – Not included for Fish Camp



Source: Mariposa County and Department of Water Resources.

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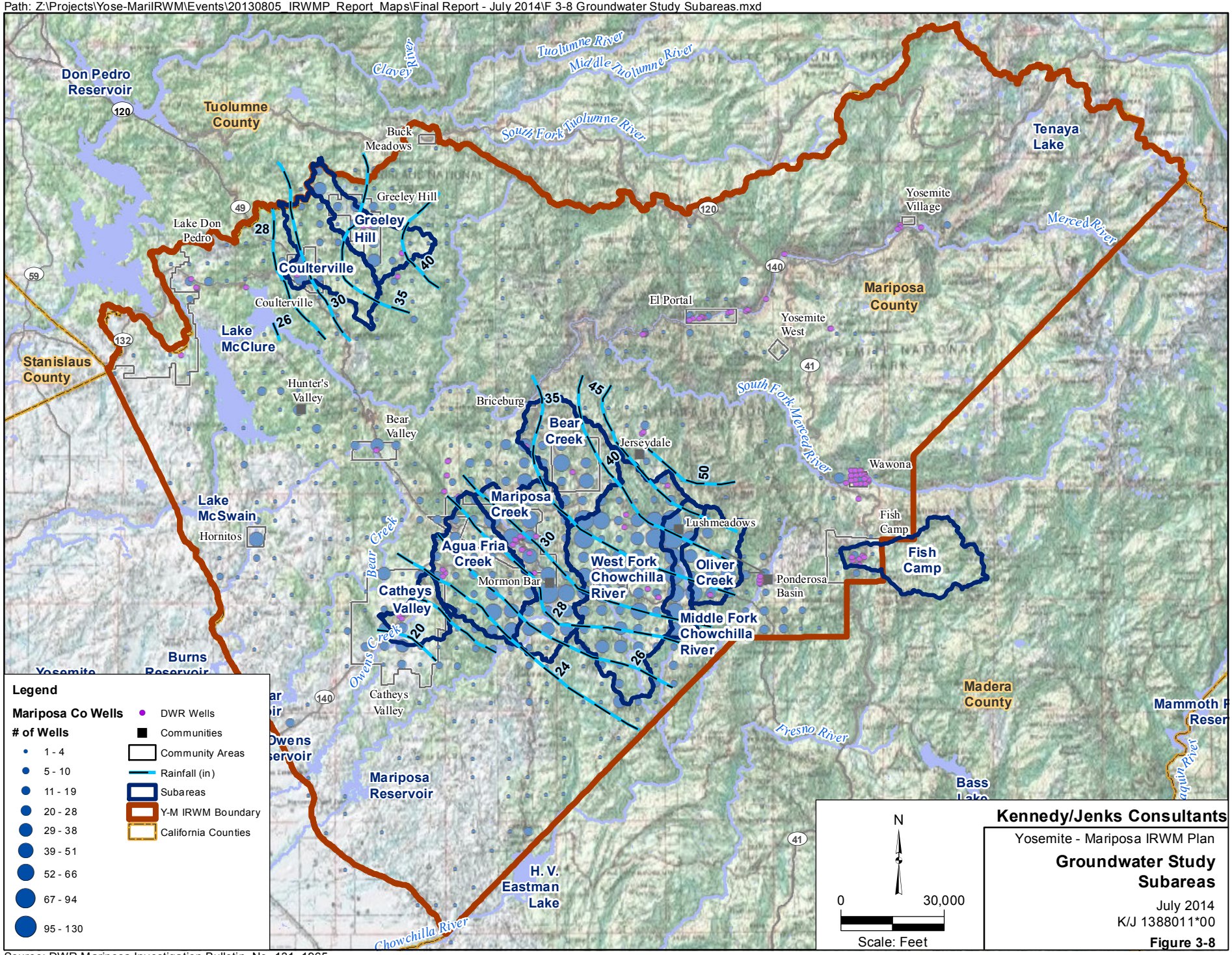


Source: DWR Mariposa Investigation Bulletin, No. 131, 1965.
1. Average precipitation between 1905-1959.

As part of the water budget analysis, isohyetal contours (i.e. lines of equal rainfall) were overlaid to correlate average rainfall over each subarea. In general, precipitation is the source of water for groundwater in each watershed. Under pre-development conditions, this water either was consumed by native plants or evaporated (evapotranspiration), or ran off as streamflow. The groundwater study includes estimates for average natural runoff for each subarea. Estimates for groundwater pumping for each subarea were made including groundwater pumping and estimated consumptive use. In general groundwater recharge appears to be more than groundwater consumption, on an annual basis, based on this high level analysis. The quantity of groundwater available, especially during an extended drought period, could be highly variable within each subarea and would require more detailed study.

Based on the summary of well logs within the Region, more than 80% of the almost 3,000 wells reviewed were less than 400 feet below ground surface (bgs), with approximately 40% of these wells less than 200 feet bgs. Within the Region, the following distribution of well depths was found. The complete groundwater study can be found in Appendix 3-B:

1. **< 200 ft:** 40-55% of wells in all subareas were completed less than 200 ft bgs (1,285 wells).

2. **200-399 ft**: 30-50% of wells in all subareas were between 200-399 ft. bgs (1,327 wells)

3. **400-599 ft**: 9-15% of wells in all subareas were between 400-599 ft. bgs (298 wells)

4. **600-1000 ft**: <10% of wells in all subareas were deeper than 600 ft. bgs (83 wells)

Shallower wells are much more susceptible to falling groundwater levels that could occur either as a result of drought or as a result of higher pumping rates. More recent wells have typically been deeper to provide greater longevity and reliability of the wells.

3.4.3 Water Storage

As shown on Figure 3-1, there are a number of large water storage impoundments that provide a range of function from flood control, private stock ponds, drinking water, and hydroelectric and irrigation storage. The impoundments that have dams with heights in excess of 25 feet requiring regulation by the DWR, Division of Safety of Dams, some of which are shown on Figure 3-1, are summarized in Table 3-5. Smaller creek impoundments are shown on Figure 2-8.

Table 3-5: Dams and Storage Reservoirs

Type	Name	Waterway	Owner	Year Built	Height	Capacity (AF)
Private	McMahon	Maxwell Creek	Carol Menzel	1957	52	520
	Metzger	Dutch Creek	Dennis Seastrom	1956	30	75
	Whispering Oaks	Bear Creek	Whispering Oaks West Home Owners Association	1968	31	69
	Green Valley	Smith Creek	Traian And Alina Micu	1957	33	240
	Hendricks	Horse Creek	Joe Surprenant	1958	33	130
Drinking Water	Stockton Creek	Stockton Creek	MPUD	1950	95	440[(a)]
Hydroelectric/ Irrigation	New Exchequer (Lake McClure)	Merced River	Merced ID	1964	479	1,024,600[(b)]
	Lake McSwain	Merced River	Merced ID	1967	97	9,730
	Merced Falls	Merced River	PG&E	1901	37	579
Flood Control	Bear	Bear Creek	ACOE	1954	92	7,700
	Mariposa	Mariposa Creek	ACOE	1948	88	15,000
	Owens	Owens Creek	ACOE	1949	Not availab le	3,600

Source: DWR, Division of Safety of Dams, 2012;
(a) MPUD.
(b) Includes 350,000 AF of flood storage

Regulated private dams used for stock water or personal water supply include: Whispering Oaks, Hendrick's, McMahon, Green Valley, and Metzger Dams. These dams are typically smaller than public dams with less than 1,000 AF in capacity. The larger dams are discussed in greater detail below.

3.4.3.1 Storage for Fire Protection

Fire can present a significant danger with approximately seventy percent of the communities listed in the Federal Register in 2001 as at high or very high risk from wildfires (County of Mariposa, 2010). With its sparse and distributed population, firefighting water resources in the Region can be extremely limited depending on the location. Fire protection services are provided in the Region by various entities including: California Department of Forestry and Fire Protection (CAL FIRE), Mariposa County Fire Department with many volunteer fire entities such as Fish Camp Fire and Rescue, Mariposa Utility Public District Fire Department and NPS and US Forest Service in the federally managed lands.

In addition to the larger storage facilities listed in Table 3-5 above, Table 3-6 that follows shows the nearest location of water in case of a fire emergency. A Community Wildfire Protection Plan prepared in 2010 indicates that portions of the county have inadequate fire suppression resources and without improvement, additional community systems will become inadequate with future population growth.

Table 3-6: Summary of Available Fire Fighting Water Sources

Community	Nearest Water Source
Bear Valley	Bagby, there is no reliable fire suppression water source in Bear Valley
Bootjack	Privately owned water tank (28,000 gallons), ponds, seasonal water in large creeks and rivers
Cathey's Valley	Bear Creek Reservoir, Owens Reservoir, ponds
Coulterville	Lake McClure, ponds
Fish Camp	Three community water systems and some hydrants, Tenaya Lodge, Tenaya Cottages/Apple Tree Inn, and White Chief, Big Creek
Greeley Hill/ Buck Meadows	Stanislaus National Forest, Buck Meadows Station (60,000 gallons in water tanks), Merced River, ponds
Hornitos	Lake McSwain, Lake McClure
Hunters Valley	Lake McClure, Merced River
Jerseydale/Mariposa Pines	Community water system and hydrants in Mariposa Pines (186,000 gallons with a recharge of 100 gpm), ponds
Lake Don Pedro	Rated hydrants, Lake Don Pedro, Lake McClure
Lushmeadows Mountain Estates	Dawn Lake and Mallard Lake outfitted with dry hydrants
Mariposa [(a)]	Stockton Creek Reservoir, community water system and hydrants (2,000,000 gallons storage tank)
Midpines	No near water sources. More distant water sources are: Merced River, 1M gallon tank on Colorado Road available to service a hydrant system
Mormon Bar/Ben Hur Area	Greenamyers Pond, Hensley Lake, ponds
Mt. Bullion[(a)]	Airport storage and hydrants system
Ponderosa Basin	Hydrants, ponds, swimming pools, seasonal Chowchilla River

Source: Mariposa County, Community Wildfire Protection Plan, 2010
(a) MPUD, 2014

3.4.3.2 Hydroelectric Storage

There are two hydroelectric projects on the Merced River regulated by the Federal Energy Regulatory Commission in the Region including the Merced River Hydroelectric Project and the Merced Falls Project, each of which is described in greater detail below. The storage facilities for these projects serve other purposes including flood control, recreation, and irrigation.

The Merced River Hydroelectric Project is owned by Merced ID and located on the Merced River in Mariposa County. The project occupies approximately 3,153 acres of federal land managed by the Bureau of Land Management. Merced ID was formed in 1919 and established their first hydroelectric dam, Exchequer, in 1926 which originally allowed for the storage of 281,000 AF of water in Lake McClure, and had two generators each with a 15,625 kilowatt capacity. In 1964 the District was granted a license from the Federal Power Commission to expand the irrigation and power facilities on the Merced River which resulted in the construction of the existing New Exchequer Dam in 1964. New Exchequer has a crest elevation of 879 feet with a maximum length of 1,220 feet. This increased Lake McClure's storage to 1,024,600 AF. A second hydroelectric dam was built in 1967 called McSwain Dam to form a regulating reservoir. McSwain Dam was constructed with a crest elevation of 425 feet and a maximum length of 1,620 feet forming Lake McSwain with a capacity of 9,730 AF. Exchequer Dam and McSwain Dam have a combined dependable capacity of 103.5 MW and an annual generation of 385 gigawatt-hours. Merced ID is required to maintain a minimum pool elevation in Lake McClure and Lake McSwain in the dry season for environmental purposes and a maximum pool elevation in the wet season for flood control capacity.

The Merced Falls Project is owned and operated by PG&E and is located on the Merced River on the border of Mariposa and Merced counties downstream from the Merced River Project. This Project is much smaller in scale with a dependable capacity of 1.7 MW and an annual generation of 13.5 gigawatt-hours.

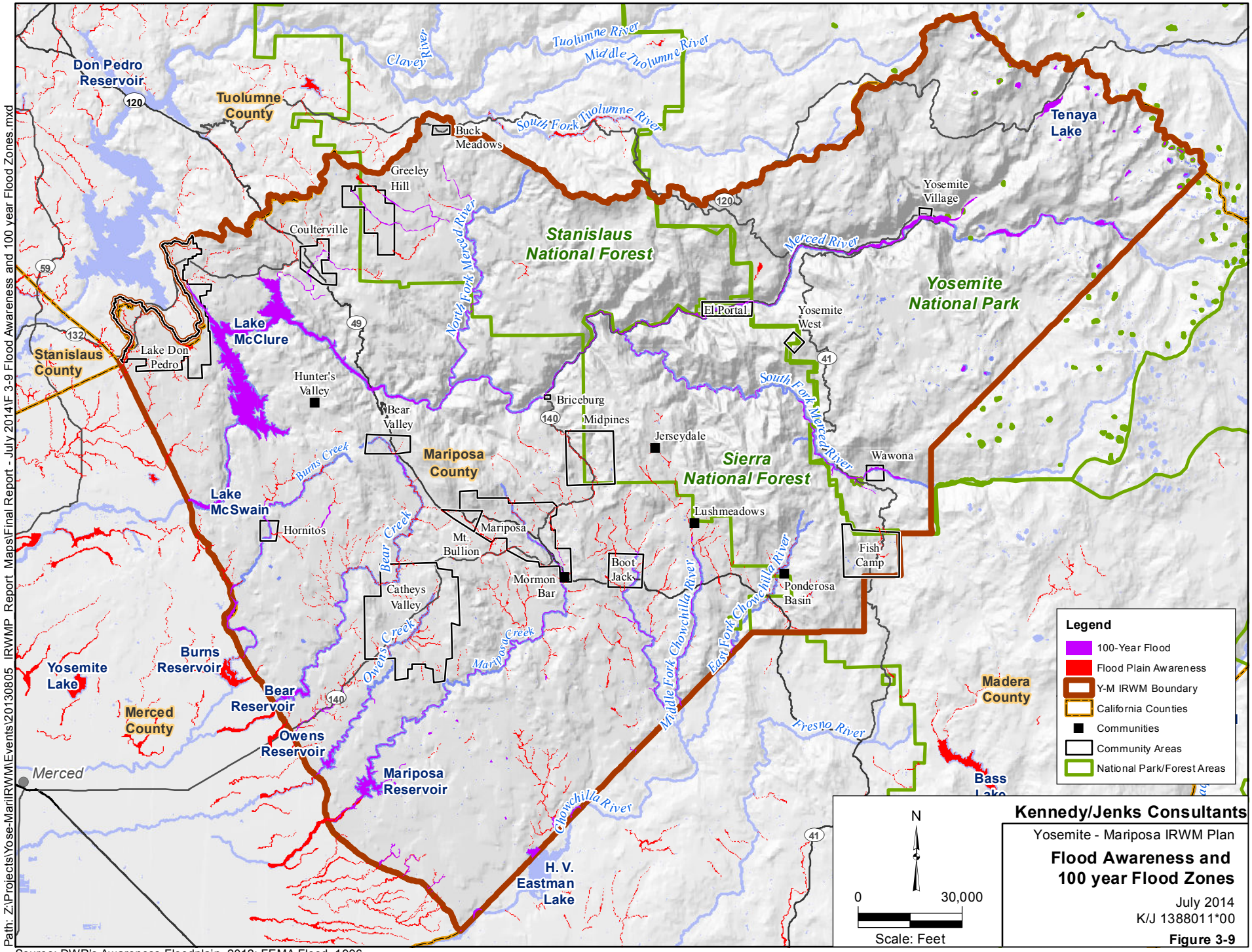
3.4.3.3 Local Flooding and Downstream Flood Management Storage

Catastrophic local flooding occurred in Yosemite Valley in 1997 and as well as to El Portal, Foresta, and Wawona and highways 41, 120 and 140 along the Merced River corridor. Road damage (and associated wastewater pipeline damage) along the Merced River initially closed Yosemite National Park then restricted travel to 1 lane and was not permanently reconstructed until 2000 since the majority of the work occurred during the off season. The resulting economic damage is estimated to have been about $18 million county-wide or about 6.6% of the county economy as well as contributing to the loss of almost 1,000 jobs (UNEP, 2013).

Flooding was the result of an intense 24-hour period of warm tropical rain that also melted snowpack and was estimated to have a return interval of 89-years (i.e. not quite a 100-year flood event). Following that event, the DWR prepared floodplain awareness maps which have been combined with the Federal Emergency Management Agency (FEMA) 100-year flood zone maps that are presented on Figure 3-9.

Much of the flood management infrastructure in the Region is to reduce flood damage downstream in Merced County. In addition to the 350,000 AF of flood storage set aside in Lake McClure, there are several flood control facilities located near the region boundary in the Lower Mariposa Group of Streams watershed. Several of the projects were originally authorized by the Flood Control Act of 1944 as the Merced County Stream Group (MSG) project which is a part of comprehensive flood management for the Sacramento and San Joaquin drainage basins. Bear Reservoir in Mariposa County and Burns Reservoir which is located partially in Mariposa County was part of the original MSG project. Dams on Owens and Mariposa Creeks which are also in Mariposa County were constructed at a later date (Merced IRWM, 2010). The Burns, Bear Creek, Mariposa, and Owens dams are owned and operated by Army Corps of Engineers. These dams are used to regulate and stem large flows during the rainy season (typically the beginning of November until the end of February).

The flood-related vulnerabilities to climate change are discussed in Section 3.7.



Source: DWR's Awareness Floodplain, 2012; FEMA Flood, 1996.

3.4.4 Wastewater Collection and Treatment

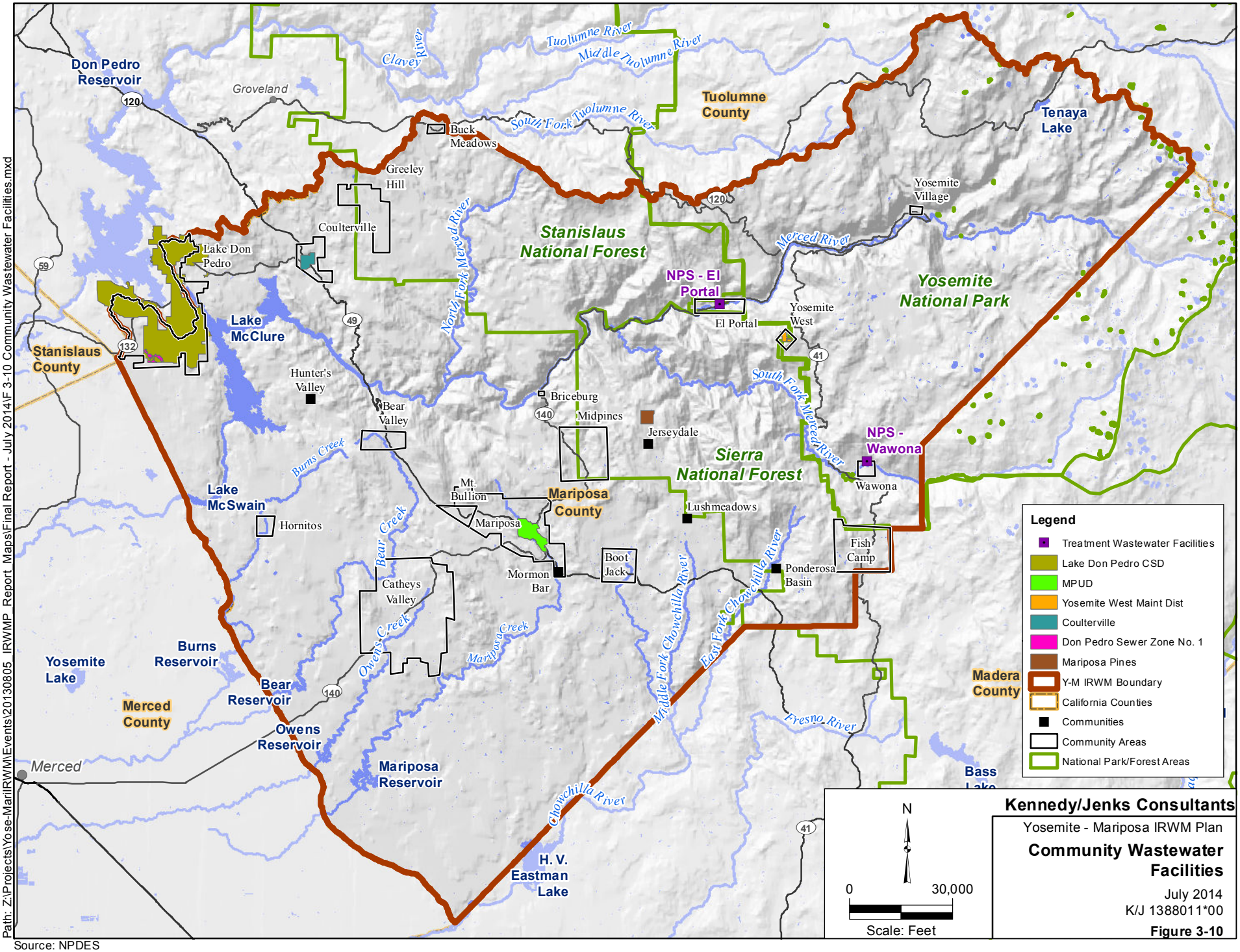
Wastewater treatment and recycled water systems are much like drinking water systems in the Region, in that there are a few centralized wastewater facilities located mainly in community areas. LAFCO has identified five special districts/public agencies that provide wastewater services in the Region which include:

- The Mariposa Public Utility District
- County Service Area 1-M, Coulterville Water and Sewer (CSA1-M/CWS)
- County Service Area 1-M, Sewer Zone No. 1 (CSA1-M/SZ1)
- County Service Area 1-M, Mariposa Pines Wastewater
- Yosemite West Maintenance District

The Regional Water Quality Control Board (RWQCB) also regulates other wastewater collection, treatment, and disposal facilities in Yosemite National Park in El Portal (which also treats wastewater from Yosemite Valley) and Wawona both of which discharge to surface water and on-site systems at Glacier Point and Badger Pass Ski Area. These systems serve approximately 7,500 permanent residents as well as the visitors to these areas and are shown on Figure 3-10.

El Portal Wastewater Treatment Facility
Credit: Kennedy/Jenks Consultants

The larger community wastewater systems are detailed in Table 3-7 that follows. Thirteen other smaller facilities that mostly serve visitors are regulated by the RWQCB and include recreation areas, mobilehome,/RV parks, campgrounds, and hotels/resorts and have estimated flows of 2,500 gallons per day up to 76,000 gallons per day. The remaining 10,500 residents of the Region use individual septic tank/leachfields for wastewater treatment and disposal which are generally suitable for rural and low density residences.



Source: NPDES

Table 3-7: Community Wastewater Systems

Agency	Estimated Connections	Facilities	Effluent Disposal	Capacity (mgd)
Mariposa Public Utility District	700	Collection system, headworks, two oxidation ditches, two secondary clarifiers, and a chlorine contact chamber	Discharge into Mariposa Creek	0.610
County Service Area 1-M, Coulterville Water and Sewer (CSA1-M/CWS)	165	4.3 MG storage reservoir and an aeration basin	Discharge to Maxwell Creek or Land Application – spray field	0.025
County Service Area 1-M, Sewer Zone No. 1 (CSA-M/SZ1) – Lake Don Pedro	3,200 (many of whom are in Tuolumne County)	Collection system, headworks, extended aeration basin, clarifier, chlorine contact basin, lined storage pond, four concrete lined sludge drying beds and decanting structures	Land application	0.080
Mariposa Pines CSA (aka. County Service Area 1-M, Mariposa Pines (CSA1MMP)	23			0.005
Yosemite West Maintenance District	294 (total parcels)	Collection system, aerated pond, inoperable filter, 2000 of leach lines	Groundwater – leach field	0.1
NPS – El Portal	635 (El Portal) 1,000 (Yosemite Valley)	Headworks, two primary clarifiers, aerated flow equalization tank, secondary treatment in three aeration tanks, two secondary clarifiers, tertiary treatment, and UV light disinfection	Discharge into Merced River	1.0
NPS – Wawona	150	Headworks with two grinders, equalization tank, activated sludge treatment system, coagulant and polymer injections, rapid mixing, flocculation, final sedimentation, and sand filtration, chlorine disinfected	South Fork Merced River and Land Application	0.105

Source: EPA, 2013; LAFCO, 2008; RWQCB, 2013.

The largest centralized sanitary collection and treatment system is located in Mariposa and is operated by MPUD. MPUD was formed in 1947 under the Public Utilities Act of 1921. MPUD provides water and wastewater services, as well as, fire protection services. The Coulterville, Mariposa Pines Sewer Zone, and Yosemite West Maintenance District systems are operated by Mariposa County Public Works.

The wastewater treatment plant in Mariposa was constructed in 1984 and has a capacity of 0.610 mgd. The average dry weather flow is about 0.24 MGD. The system contains 73,000 feet of wastewater collection mains, the majority being six to eight inch vitrified clay pipe. This pipe has proved to be a source of infiltration/inflow during the wet season of the year and the District has replaced portions of the collection system with Polyvinyl Chloride (PVC) pipe.

The most recent National Pollution Discharge Elimination System (NPDES) permit adopted by the RWQCB on Dec. 6, 2007 requires the MPUD to provide additional tertiary treatment to the existing secondary treatment facility. Tertiary treatment is typically achieved by providing filtration before treated wastewater is discharged off site.

The wastewater system CSA-1M -Coulterville Water and Sewer became operational in 1979 with the ability to accommodate approximately 76 initial and a total of 102 connections. With minor upgrades, the total number of connections could be increased to around 200.

The CSA-1M/SZ1 encompasses approximately 135 acres of land in the Lake Don Pedro area providing wastewater services to residents and the Lake Don Pedro Golf Course and Resort. The current collection system is composed of approximately 28,300 feet of 4 inch and six-inch sewer mains, with 71 manholes for access and maintenance. There are also seven lift stations in the collection system in addition to the before mentioned wastewater treatment plant. The facilities for treatment include one storage reservoir, an aeration basin, and a clarifier with a spray field utilized for final disposal of the liquids and a drying bed for solids. Since the completion of the new wastewater treatment plant, Mariposa County has not developed a further Capital Improvement Plan (CIP). The new wastewater treatment facility was constructed to address both the needs of existing parcels and perceived future development in the area.

The Yosemite West Maintenance District encompasses approximately 110 acres that includes the subdivision and condominiums for almost 300 connections. There are approximately 31,700 linear feet of 4-inch and 6-inch sewer mains, sixteen manholes for access and maintenance and 2 lift stations. As of 2008, a new wastewater treatment plant including an upper and lower aeration basin with a volume of 480,000 gallons had been constructed. Effluent is disposed of in a drip field. (LAFCO, 2008).

The NPS El Portal and Wawona wastewater treatment plants (WWTP) serve the El Portal/Yosemite Valley and Wawona areas respectively. Both of these WWTP provide tertiary treatment. The El Portal WWTP discharges the treated effluent to percolation ponds adjacent to the Merced River while the Wawona WWTP applies the treated effluent to the adjacent golf course for irrigation; both WWTP have the option of a direct Merced River discharge which are rarely used.

The rural nature of the Y-M Region poses practical limits for expanding community wastewater collection, treatment, and disposal facilities. The wastewater facilities that remain are often constrained by increasing regulations requiring improved treatment processes to improve water quality. The majority of the County's residents use individual septic tanks and leachfields for sanitation and wastewater treatment. County staff reported that while there are periodic reports regarding system failures, mostly with very old systems, the instances of failures are quite infrequent.

3.5 Water Quality Conditions

The water quality of the higher elevation areas of the Y-M Region are generally excellent, as much of the lands are within Yosemite National Park and the activities that may impact water quality are restricted. The lower elevation portions of the Region that are managed by Mariposa County or are under National Forest and/or BLM management also have generally good water quality, although the non-wilderness/wildlands areas of these lands may allow activities such as timber harvest, grazing, and/or mining that could be sources of pollutants that impact water quality. The narrative that follows describes the current water quality regulatory framework provides an overview of surface water and groundwater quality, and identifies activities/natural occurrences such as wildfires that may impact water quality now or in the future.

3.5.1 Water Quality Related Issues, Needs, Challenges and Opportunities

This subsection addresses the following key issues, needs, challenges and opportunities related to water quality management:

- Compliance with surface water and groundwater quality regulations
- Management and restoration of impaired surface water bodies
- Protection of groundwater quality
- Improvement of forest and watershed management actions
- Prevention of catastrophic wildfire and mitigation of resulting water quality impacts

3.5.2 Water Quality Regulatory Framework Overview

There are many tools, whether regulatory, voluntary, or incentive based, currently available for preventing pollution. The USEPA, SWRCB, and RWQCBs have permitting, enforcement, remediation, monitoring, and watershed-based programs to prevent pollution. Pollution can enter a water body from point sources like wastewater treatment plants (WWTP) and/or other industries that directly discharge to the river, and from nonpoint sources over a broad area, such as runoff from a community and/or agricultural farmland or grazing areas located adjacent to stretches of the river reach. The Central Valley RWQCB has recently focused on upgrading WWTP discharge to advanced treatment tertiary standards for all NPDES permittees that discharge to the San Joaquin River (and its tributaries) in an effort to further reduce the water quality impacts of wastewater discharges. Individual WWTPs are discussed more specifically in Section 3.4.

Some nonpoint source contaminants are naturally occurring in local rocks and soil, such as heavy metals, (arsenic, chromium, selenium). Preventing pollution from most point sources relies on a combination of source control and treatment, while preventing nonpoint source pollution generally involves the use of best management practices (BMPs), efficient water management practices, and source control. Nonpoint source pollution is not typically associated with discrete conveyances, in other words, the origin of the pollution cannot always be readily identified.

The Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. SDWA applies to every public water system in the United States. SDWA authorizes the USEPA to set national health based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. Originally, SDWA focused primarily on treatment as the means of providing safe drinking water at the tap and drinking water standards are based on health risk balanced by economic factors. Amendments in 1996 greatly enhanced the existing law by recognizing source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water. Under the SDWA, technical and financial aid is available for certain source water protection activities. In California, the California Department of Public Health regulates drinking water in community water systems.

The Federal Clean Water Act (CWA) contains two strategies for managing water quality including: (1) a technology-based approach that envisions requirements to maintain a minimum level of pollutant management using the best available technology; and (2) a water quality based approach that relies on evaluating the condition of surface waters and setting limitations on the amount of pollution that the water can be exposed to without adversely affecting the beneficial uses of those waters. Oftentimes, limits to water quality are based on the sensitivity of the ecosystem in the receiving water to contaminants, often at trace levels well below drinking water standards. The RWQCB issues NPDES permits for discharges to surface water and waste discharge requirements (WDRs) for discharges to land and regulates the wastewater discharges in the Region. The RWQCB also implements Section 303(d) of the CWA, discussed later, which regulates water quality for ecosystem values.

The federal CWA, as well as the State Porter-Cologne Water Quality Control Act, requires water quality control plans to establish water quality standards, which address beneficial uses of water sources. Specifically, the RWQCB has established and adopted the Water Quality Control Plan for the Sacramento/San Joaquin (Basin Plan). The Basin Plan describes designated beneficial uses to be protected, water quality objectives to protect those uses, and a program of implementation needed for achieving the objectives. Beneficial uses, together with their corresponding water quality objectives, meet federal regulatory criteria for water quality standards. Hence, the Basin Plan serves as regulatory references for meeting both state and federal requirements for surface and groundwater water quality control in the Region.

3.5.3 Surface Water Quality

The surface waters within the Y-M Region support a variety of beneficial uses, including municipal and domestic supply, agriculture water supply, industrial water supply, recreation, commercial and sport fishing, freshwater habitat, migration and spawning of aquatic organisms and wildlife habitat for terrestrial species. Table 3-8 presents the beneficial use designations for major surface water bodies in the Region as identified in the Basin Plan. The Basin Plan does not identify beneficial uses for all water bodies in the Region; however the tributary streams of any specifically identified water body can generally be assumed to have the same beneficial use designations.

Table 3-8: Y-M Region Surface Water Bodies and Beneficial Uses

	Drinking Water	Agricultural Supply	Industrial (Power)	Recreation	Freshwater Habitat	Wildlife Habitat
Chowchilla River Source to Buchanan Reservoir (Eastman Lake)				E	E	E
Merced River	P	E	E	E	E	E
McClure Lake	P	E	E	E	E	E
McSwain Reservoir	P	E	E	E	E	E

E = Existing; P = Potential
Source: Water Quality Control Plan for the Sacramento and San Joaquin Basins, 2010.

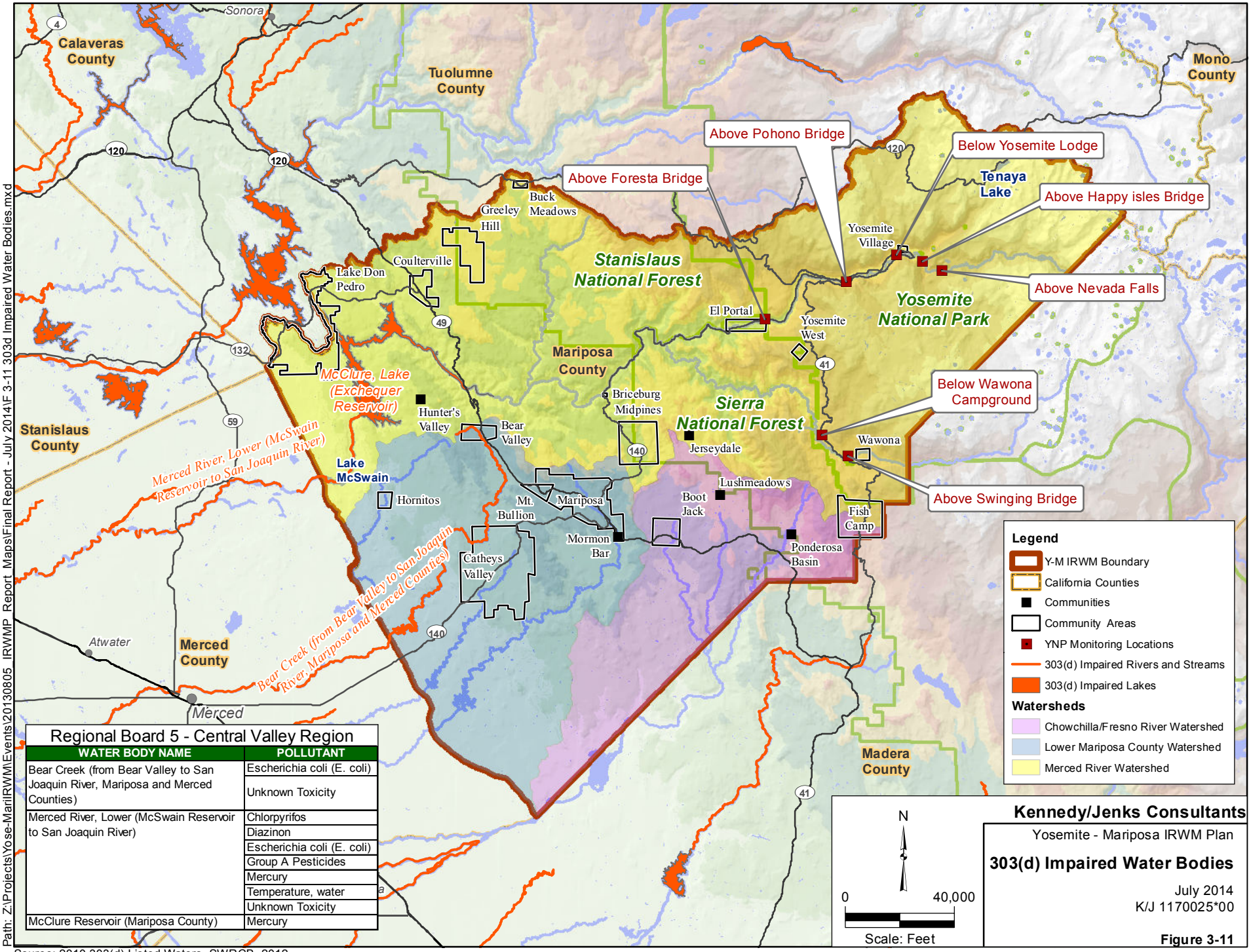
The majority of the surface water quality issues identified within the Region can be linked back to current or historical land use practices. Stakeholders in the Region have expressed concern about the possible negative impacts that increased development may provide to Big Creek, including soil erosion, septic contamination and siltation. (County of Mariposa, 2009) These same concerns are an issue throughout the Region due to the predominant use of septic systems and the steep terrain combined with dirt roads and heavy rainfall. Additional water quality concerns limited to specific drinking water supply diversion points have resulted in production of disinfection byproducts (DBPs) which have required the installation of an upgraded filtration system of the Saxon Creek water diverted by MPUD. DBP formation is usually linked to elevated organic carbon concentrations in source water.

As noted earlier, Section 303(d) requires that the states regulate waters that are not attaining standards (i.e. are impaired) to meet beneficial uses after the technology-based limits are put into place. For waters on this list (and where the USEPA administrator deems they are appropriate) the states are required to determine all the sources of the pollutants that caused the water to be listed, including contributions from point sources and non-point sources. These impaired water bodies within the Y-M Region are listed in Table 3-9 and shown on Figure 3-11. This table identifies pathogens and pesticides as the two major pollutants, although there are a number of other pollutants such as metals, toxicity and mercury. It should be noted that a majority of the impacted reach of the Merced River is outside of the Region. As well, a portion of the Bear Creek stretch listed is outside of the Region. Impacts to these portions may be due to activities within Mariposa County in part as well as due to activities outside of the Region. The agriculturally based pollutants listed including chlorpyrifos, diazinon, and Group A pesticides are generally used for production of orchard and field crops. Because the District has limited acreages of these crop types it is likely that a majority of the pollutant source is outside the Region.

Table 3-9: Impaired Water Bodies

Water Body Name	Est. Affected Area	Unit	Pollutant	Final Listing Decision	Potential Sources
Bear Creek (from Bear Valley to San Joaquin River, Mariposa and Merced Counties)	84	Miles	E. Coli	List on 303(d) list (TMDL required list)	Source Unknown
	84	Miles	Unknown Toxicity	List on 303(d) list (TMDL required list)	Source Unknown
Merced River, Lower (McSwain Reservoir to San Joaquin River)	50	Miles	Chlorpyrifos	Do not delist from 303(d) list (TMDL required list)	Agriculture
	50	Miles	Diazinon	Do not delist from 303(d) list (TMDL required list)	Agriculture
	50	Miles	E. Coli	List on 303(d) list (TMDL required list)	Source Unknown
	50	Miles	Group A Pesticides	List on 303(d) list (TMDL required list)	Agriculture
	50	Miles	Mercury	List on 303(d) list (TMDL required list)	Resource Extraction
	50	Miles	Temperature	List on 303(d) list (TMDL required list)	Source Unknown
	50	Miles	Unknown Toxicity	List on 303(d) list (TMDL required list)	Source Unknown
Lake McClure (Mariposa County)	5605	Acres	Mercury	List on 303(d) list (TMDL required list)	Resource Extraction

Source: USEPA database, 2013



Regional Board 5 - Central Valley Region

WATER BODY NAME	POLLUTANT
Bear Creek (from Bear Valley to San Joaquin River, Mariposa and Merced Counties)	Escherichia coli (E. coli)
	Unknown Toxicity
Merced River, Lower (McSwain Reservoir to San Joaquin River)	Chlorpyrifos
	Diazinon
	Escherichia coli (E. coli)
	Group A Pesticides
	Mercury
	Temperature, water
	Unknown Toxicity
McClure Reservoir (Mariposa County)	Mercury

Source: 2010 303(d) Listed Waters, SWRCB, 2012.

3.5.3.1 Sources of Surface Water Quality Impairments

There are several potential sources of surface water quality impairments, including historic and continued gold mining, historic, current and future wildfire, and inadequately maintained roads. Pathogen sources could come from failing septic systems as well as livestock and wild animals.

Mercury is a significant source of water quality impairment throughout the Y-M Region and is a legacy left by the extensive gold mining that occurred during the mid to late 1800s gold rush period. Mercury was often used in the sluice boxes to concentrate the gold to ease recovery. A more detailed discussion of historic mining follows.

While the 303(d) listing for mercury in the Region is in response to human health concerns from consumption of fish, accumulation of mercury in fish can also impact the health of higher order birds and mammals that feed on fish in the Region. The impact to reproductive health of wildlife, particularly waterfowl, although not currently an area of regulatory attention, is an issue that is being monitored in the San Joaquin and Sacramento Rivers by stakeholder groups such as the San Francisco Estuary Institute and may affect management actions in the future.

Erosion and sedimentation can also present a water quality concern, primarily because of sediment impacts on habitat. Sources of sediment loading in the Region include runoff from cultivated agricultural lands, over-grazing, construction activities, erosion of unpaved roads and trails, silviculture and increased sedimentation from precipitation following wildfires. Reducing undesirable sediment loads can benefit habitat and reduce the risk of flooding. Erosion and sedimentation are a necessary component in healthy geomorphic processes, but they also can reduce the quality of aquatic habitat by covering gravel needed for fish spawning, harming aquatic invertebrates and increasing biochemical oxygen demand through the introduction of organic matter and nutrients to the waterway. Another impact of sediment deposition (even as a result of normal geomorphic processes) can be reduced channel conveyance capacity, especially at lower elevations, and a corresponding increased risk of flooding.

3.5.3.2 Water Quality Sampling Results

Water quality sampling programs are important components of surface water management, because they allow water managers to review water quality data over time to identify trends (both positive and negative). The Upper Merced River Watershed Council (UMRWC) and Yosemite National Park (YNP) have conducted water quality sampling on the Merced River since 2004 and 2003, respectively as described in detail below. In addition, districts such as MPUD and LDPCSD both monitor Merced River water quality as part of their drinking water treatment processes and/or to meet wastewater discharge requirements. The lower Mariposa Group of Streams and the Chowchilla/Fresno River watersheds generally have limited water quality data available.

UMRWC has 17 monitoring locations on the Upper Merced River tributaries that are sampled quarterly by volunteers for temperature, dissolved oxygen, pH, total dissolved solids, and turbidity. YNP has seven stations for which they analyze for both field and laboratory parameters including flow, temperature, dissolved oxygen, nutrients, bacteria, conductivity, minerals, and hydrocarbons on a monthly basis.

Figures 3-12, 3-13 and 3-14 that follow represent a subset of the data from three downstream YNP stations: below Wawona Campground on the South Fork Merced River, on the main stem of Merced River above Pohono Bridge at the downstream end of Yosemite Valley, and above the Foresta Bridge near El Portal as located on Figure 3-11. The Pohono Bridge station is the most upstream followed by the Foresta Bridge location and followed lastly by the Wawona monitoring site on the South Fork of the Merced River which joins the main stem of the Merced River downstream of the other two monitoring sites. These stations capture flow from approximately a third of the Merced River Watershed representing an area with the largest snowpack in the Region.

The parameters shown in the graphs include: flow measured in cubic feet per second (cfs) obtained from a rating curve, E. coli (Escherichia coli) measured in most probable number per 100 milliliters (MPN/100 ml), Total Coliform also measured in MPN/100 ml, and Total Dissolved Nitrogen (TDN) measured in milligrams per liter (mg/l). The testing period was from the 2003-04 water year through the 2012-13 water, however not every parameter was tested each year or at each monthly (approximately) sampling event. When data was not present for a constituent it was represented by a gap in the line on the graph so that the data are more accurately conveyed than interpolating for missing data. The E. coli and Total Coliform values were typically low with occasional spikes precipitated by a lower flow event, however it is difficult to trend due to the data being recorded for E. coli and Total Coliform only in more recent water years.

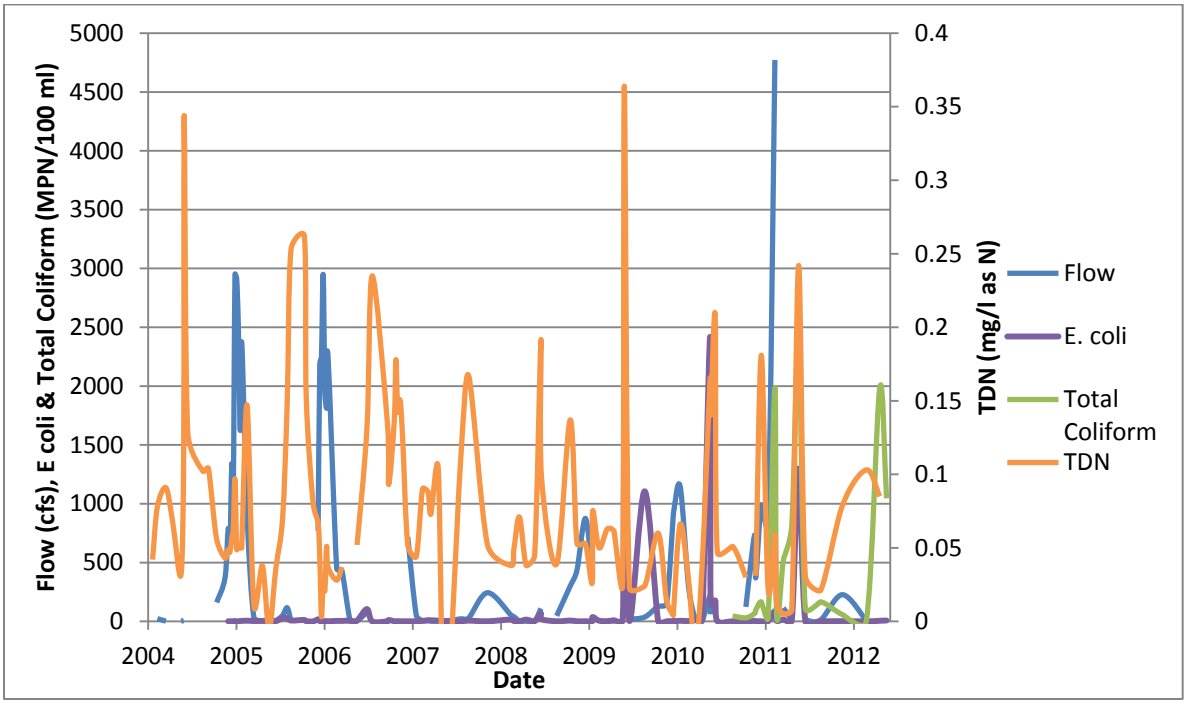


Figure 3-12: Water Quality Below Wawona Campground on S. Fork Merced River

Source: Yosemite National Park Water Quality Monitoring Program

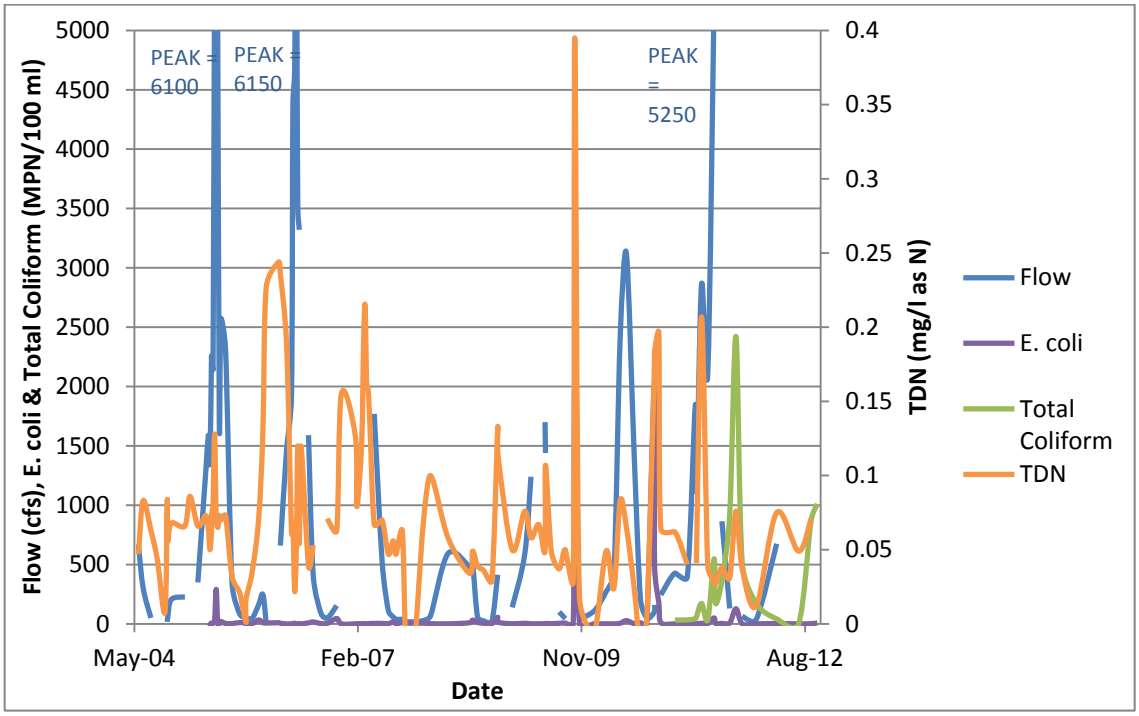


Figure 3-13: Water Quality Above Pohono Bridge on Main Stem Merced River

Source: Yosemite National Park Water Quality Monitoring Program

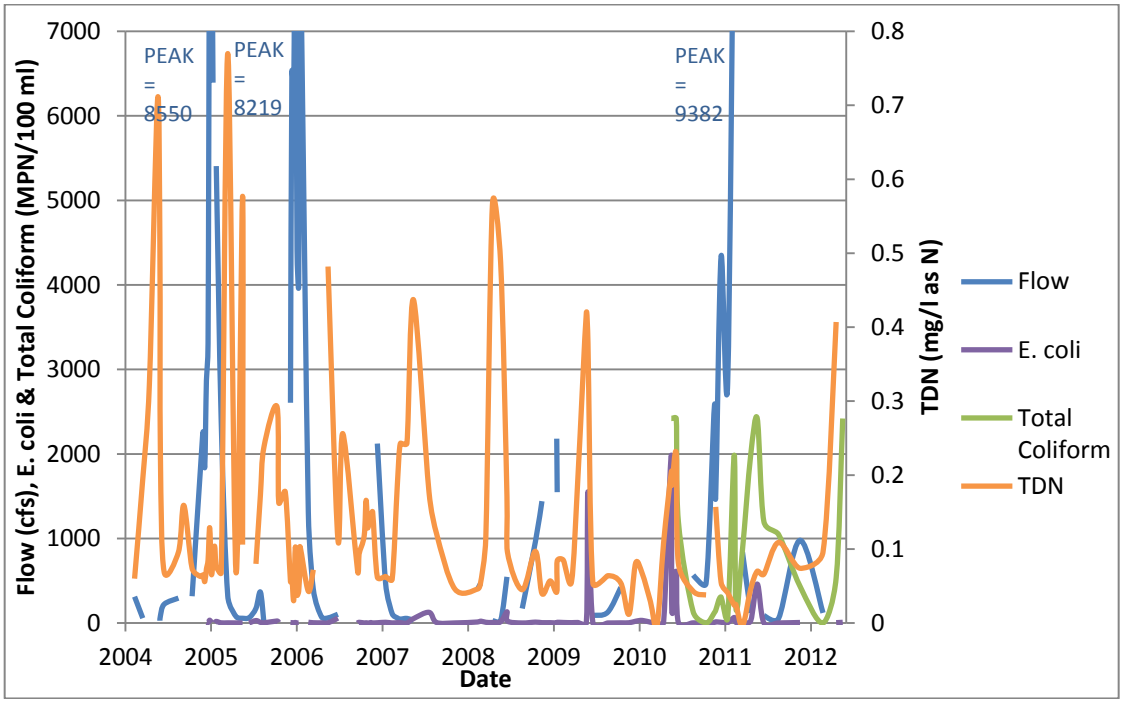


Figure 3-14: Water Quality Above Forest Bridge on Main Stem Merced River

Source: Yosemite National Park Water Quality Monitoring Program

3.5.3.3 Historic Mining

The US Geological Survey maintains the Mineral Resources Data System that is a compilation of mining related data utilizing multiple documents and sources. The data for Mariposa County are derived from information maintained by the USGS and its predecessor agencies as early as the 1900s through the 1980s. The database is separated into occurrences (i.e. claims), prospects, past producers, producers, plants and unknown mine types for a range of minerals. As mercury is the contaminant associated with water quality impairments, the data associated with gold mining which historically used mercury for processing, were used. The database indicates that there may have been almost 1,300 locations including claims, with gold mining and one location associated with mercury mining. Figure 3-15 that follows identifies where gold has been produced and/or processed as well as the mercury mine. The mines are scattered throughout the lower portions of the Region with the majority occurring in the Merced River and Mariposa Group of Streams watersheds. Because mercury has discharged from the mines through runoff which flows downstream, mercury impairment has been identified in Lake McClure and Bear Creek as well as further downstream into the San Joaquin River.

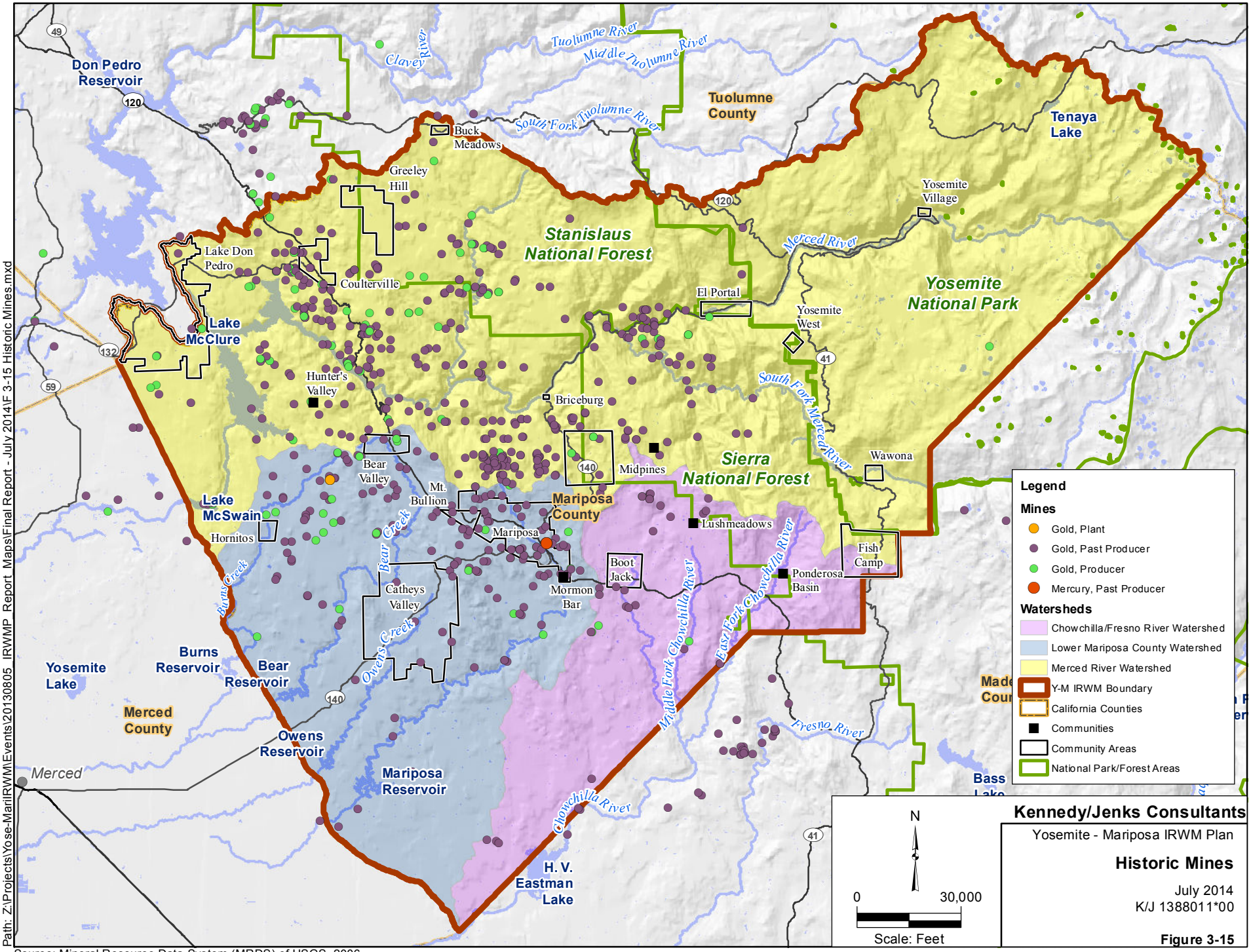
3.5.3.4 Wildfire and Forest Management

Another potential significant contributor to water quality impacts are wildfires that have historically occurred in the Region. As described in previous sections, the majority of the Region is covered by the Sierra National Forest, Stanislaus National Forest, BLM-managed lands and Yosemite National Park. Altogether, approximately 56% of the Region is federally managed lands, (County of Mariposa, 2010) fires in the upper watersheds have the potential to travel downhill and impact both public and private lands. This results in coordination of forest and wildland management becoming a significant issue for water quality management. This is particularly the case, since wildfires that cross institutional boundaries occur with some frequency. In addition, various areas in the Region have been altered significantly in part as a result of changes to historic fuel and fire management philosophies within different institutions. These changes have direct implications for water quality in the Region, which are discussed in the following sections. A detailed discussion on wildfire and forest management is provided in Section 4 Land Use.

Wildfire
Credit: Burt Stalter, Sierra National Forest, Bass Lake Ranger District

3.5.3.4.1 Historic and Existing Forest Conditions and Fire Susceptibility

Wildfires are prevalent in the Region and are the number one natural disaster threatening residents. The Mediterranean climate with its dry summer season combined with mixed chaparral, grass and oak lands, as well as ponderosa pine and mixed conifer forests found within the Region are highly susceptible to wildland fire. The fire risk is especially high when there is hazardous fuel buildup coupled with dry years, which occur with some regularity. Increased fuels also generally lead to more intense burns.



Source: Mineral Resource Data System (MRDS) of USGS, 2006.

Significant fuel buildup has occurred in many areas of the Region as a result of various historic factors, including over a century of fire suppression in forests and wildlands. Prior to European settlement, the Region's forests were significantly less dense, with around 50-100 trees per acre than they are today. Natural wildfires played an important role in determining the density and composition of the forests. The fire regime was characterized by frequent small and low intensity fires ignited by lightning strikes, which was reflected in forest management techniques of Native Americans. Upon arrival of settlers, the natural fire regime was disrupted and with it the natural influence of wildland fires on the structure of the forest.

Starting in the mining period and into the early decades of the twentieth century, forests were extensively logged and clear cut without proactive revegetation or post-management to maintain previous natural conditions. These activities resulted in a high accumulation of fuels on the ground and less robust forests as the diverse native plant community became replaced by fast-establishing shrubs and invasive species, and dense stands of trees of a uniform age.

Compounding the effects of clear-cutting came increased fire suppression. With the formation and increased public visitation of national parks and other natural protected areas, forest management has become increasingly dominated by fire suppression in an effort to protect human interests, including property and recreational values. This has often occurred despite the benefits of more frequent low intensity fires that reduce fuel accumulation and enhance natural propagation of native species, as well as to maintain low density stands. As a result, existing forests have developed significantly different from the natural forests from pre-European settlement. Forest stands have reached densities of 400 to 500 trees per acre, which is often publicly perceived as healthy and natural because that is what is familiar to most members of the public.

Despite growing knowledge of more appropriate fuel and forest management, which may include regular prescribed burns, these management strategies can often stand in conflict with public interests and have to be carefully weighed by federal land managers. Controlled burns are often undesirable from a public perspective due to aesthetic impacts in highly visited natural areas, such as Yosemite National Park, including visual and air quality impacts. Air quality impacts are a particular concern in the Y-M Region, as Mariposa County (and neighboring Counties in the Central Valley) are currently designated as a nonattainment area for ozone requiring specific actions to meet air quality standards (EPA, 2013a). Other environmental concerns associated with prescribed burns may result in conflicting interests with forest managers and environmentalists, and equally important to consider are the practical hazards and risks of conducting burns in forest systems susceptible to high-intensity stand-replacement fires. (Franklin, G., 2013; County of Mariposa, 2010; YWPHI, 2007; Conard, S.G. and Weise, D.R., 1998)

In addition to above-mentioned management activities conducted on public lands, inadequate private land management which comprises over 45 percent of the Region is increasingly contributing to more prevalent and devastating wildfire risks in the Region. The Region is experiencing continuous population growth within the Wildland Urban Interface (WUI). In these areas, proactive management of fuels and maintenance of defensible space is imperative and legally mandated for mitigating wildfire risks. However, the majority of new residents moving to the Region relocate from urban areas and are often unaware of the high wildfire danger throughout the County and the necessity to actively manage fuels. In addition, a large part of the population includes senior, low income, and disabled residents that can find it difficult to keep up with brush and tree clearing. Private landowners are faced with managing large lots, which pose added challenges, often requiring significant time and financial investment. As a result, effective mitigation measures are not always consistently or adequately implemented on private lands (MCFSC, 2013; County of Mariposa, 2010; YWPHI, 2007).

In combination, these factors have resulted in forests changing from wildfire-adapted systems to lands more prone to catastrophic wildfires. Management objectives are now increasingly a matter of preventing a devastating fire storm.

3.5.3.4.2 Wild Fires

In the Sierra Nevada mountains and foothills, fires have occurred on average every seven years up to 5,000 feet in elevation. Since the mid-1940s stand replacing fires, which until that time were extremely rare, have become increasingly common as a result of the accumulation of heavy fuel loads in the area. In addition, wildland fires burning over 5,000 acres have occurred at least once annually since 1983.

As far back as the 1800s, fires have caused devastation to communities in the Region including several occurrences where the entire Town of Mariposa burned down. In the past twenty years, every community has been threatened by major wildland fires at least once (County of Mariposa, 2010) and approximately seventy percent of the communities in the Region are listed in the Federal Register in 2001 as at high or very high risk from wildfires. These listed communities include Bootjack, Coulterville, El Portal, Fish Camp, Foresta, Greeley Hill, Hunter Valley, Jerseydale, Lushmeadows Mountain Estates, Mariposa, Midpines, Mormon Bar/Ben Hur, Wawona, and Yosemite Valley (County of Mariposa, 2010).

In the last approximately 50 years, there have been nearly 80 wildfires greater than 500 acres within Mariposa County, the most recent of which burned a total of over 257,000 acres. A list of these fires is presented in the Table 3-10, and Figure 3-15 shows a map of historical fires in the Region.

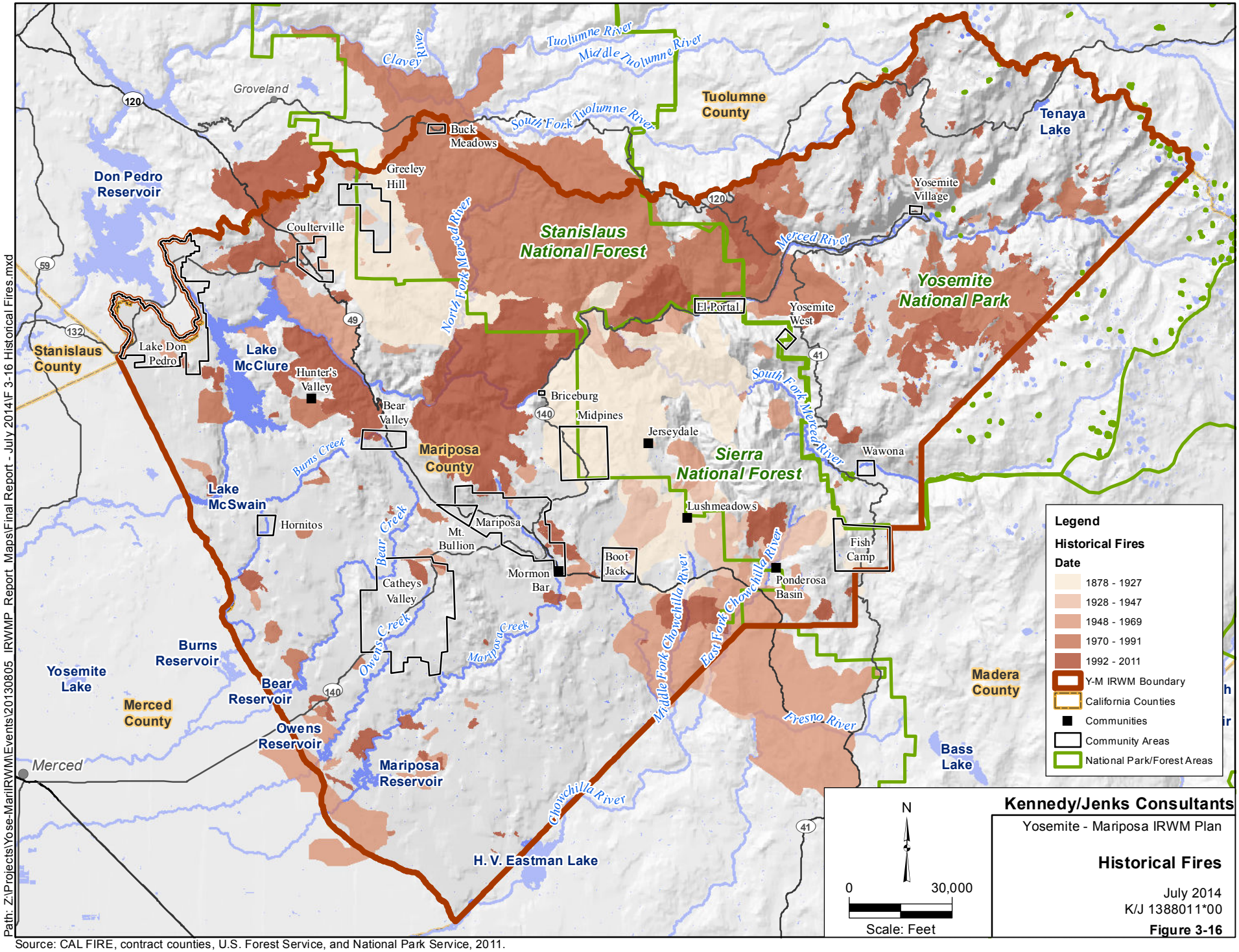
The 2013 Rim Fire burned a total of 257,314 acres of which approximately 6,000 acres encroached into the Y-M Region. Caused by an illegal campfire that got out of control, the destruction was significant and full containment was attained only after one month. Eleven (11) homes, 3 commercial properties, and 98 outbuildings were destroyed. Total costs were preliminarily estimated at nearly $126 million (InciWeb, 2013). The fire burned through expanses of ponderosa pine and other conifers, burning young tree plantations planted after previous wildfires as well as some of the last remaining old growth in the Stanislaus Forest (LA Times, 2013). The portion of the Rim Fire in the Region is within the top 15 fires by acreage in the Region since 1961.

Given the dense vegetation in many parts of the Region, the probability for future fires is high, especially if extended dry years occur.

Table 3-10: Mariposa County Historic Fires of the Last 50 Years

Year	Fire Name	Acreage Burned
1961	HARLOW	43,331
1962	BOWERS	7,738
1966	IRON MT.	1,101
1968	CANYON	1,690
	EAGLE	1,075
	ENGINEERS ROAD	8,074
	MERCED FALLS	669
1970	WILLIAMS	1,702
1972	TRUMBULL	582
1974	BAKER	717
	HORSESHOE BEND	577
	LIGHTNING #2	814
	STARR KING	3,906
1975	THREE BUTTES	589
	(blank)	532
1978	HOOVER	628
1980	(blank)	1,963
1981	BASKET	624
	CONCOURS	2,233
	GRANITE SPRINGS	711
1983	LIGHTNING #7	705
	OLD TOLL	521
1984	(blank)	738
1985	BRICEBURG	982
	BRICEBURG	982
	LOST BEAR	1,018
1986	CASCADE CREEK	2,069
	COULTERVILLE	711
	GLACIER POINT	686
1987	CALF	4,929
	CAMPGROUND	1,207
	HAMM	33,144
	HASLOE	6,524
	LARSON	48,087
	LOST BEAR	1,999
	MERCED FALLS	1,723
1988	ALASKA	1,877
	CLEARHOUSE	2,500
	ECHO	1,424
	HORIZON	674
	QUARTZITE	613
	WALKER	2,650
1990	A-ROCK	17,758
	SAVAGE	1,942
	STEAMBOAT	6,102
1991	ILL	3,102
1992	HORNITOS	654
1994	HUNTER	669
	(blank)	3,252
1995	SOUTH TURNER	610
1996	COTTON	826
	STUMPFIELD	3,710
1999	COULTERVILLE	543
	DARK	866
	LOST BEAR	2,144
	LOST VALLEY	889
	MERCED FIRE	713
2000	GRANITE	2,592
	HUNTER	8,206
2001	BRICEBERG	718
	CREEK FIRE	22,190
	HOOVER	7,231
2003	WHISKEY	1,041
2004	MEADOW WFU	5,031
	OLD HWY/MPUD 149	1,335
2005	LA PALOMA	751
	(blank)	545
2007	JACK WF	1,106
2008	HWY 140	1,566
	OLIVER	2,806
	SILVER KNOB	570
	TELEGRAPH	34,084
2009	BIG MEADOW	7,553
	GROUSE	3,040
2011	AVALANCHE	1,068
	MOTOR	5,230
	TAMARACK	1,014
2013	RIM	257,314[(a)]

Source: Community Wildfire Protection Plan, 2010
(a)About 6,000 acres in Mariposa County



Source: CAL FIRE, contract counties, U.S. Forest Service, and National Park Service, 2011.

Path: Z:\Projects\Yose-Mari\RWM\Events\20130805_IRWMP_Report_Maps\Final Report - July 2014\F 3-16 Historical Fires.mxd

3.5.3.4.3 Wildfire Impacts in the Watershed

Watershed hydrology dynamics can be considerably affected by wildfires through accelerated erosion and sedimentation. Among the most destructive impacts of wildfires are the increased post-fire flood peak flows which can exacerbate erosion on the steep slopes that are characteristic of the Region. The impacts of wildfire disturbances and ensuing hydrologic impacts are particularly relevant in the forested watersheds of the Region and are critical to consider in forest management.

Vegetation generally provides valuable protection from soil erosion for various reasons. It intercepts rainfall and reduces its impact, increases water infiltration into soils and can reduce runoff velocities. Additionally, vegetation can filter out sediment and hold the soil together with its root systems. The removal of vegetation from fires therefore contributes significantly to altered hydrology and increased erosion rates. Soils often develop a hydrophobic layer, which reduces water infiltration rates and moisture storage capacity, thereby further contributing to increased runoff and erosion rates. Reduced rain infiltration rates following fires result in increased overland flows, peak flows and sediment yield in the watershed. The hydrophobic soil layers prevent nutrients from infiltrating the soil, resulting in more nutrients running off with the sediments. Post-fire floods, mud flows and debris flows often ensue when winter rains soak the previously burned hill slopes. The effects can produce significant water quality impairments, can affect stream physical conditions, aquatic habitat and pose risks to human health and safety (Forrest, L.C. and Harding, M.V., 1994; Neary, et al., 2003).

The removal of vegetation by intense fires also impacts the abundance and diversity of native plant species. Invasive plant species generally re-establish more quickly after fires, which lead to crowding out of native species. Regrowth of trees is also typically slow, resulting in a higher abundance of shrubs moving in that contribute to fuels accumulation again. Invasive species and fuels accumulation in turn lead to larger, more frequent, high-intensity burns which contribute to water quality impairments and overall degradation of the Region's watersheds.

The impacts and threats from post-fire damages are a serious issue that were recently assessed after the Rim fire. USGS assessed the potential for debris flows to help land and emergency managers prioritize mitigation treatments. One of the major efforts is establishing stream gauge and water quality monitoring to document the quantity and quality of water entering the downstream Lake Don Pedro and to model post-fire streamflow changes. Ongoing work will be performed using the hydrologic models developed that incorporate data on soil properties, burn severity and expected rates of vegetation recovery, to help improve understanding of runoff and stream flows in subsequent years (USGS, 2013a).

3.5.3.4.4 Overview of Fuel and Fire Management

There is a high level of collaboration and partnerships among numerous agencies, organizations and individuals to actively manage fuels and fires on private and federal lands in the Region. A more detailed discussion is provided in Section 4.

Assistance for private property owners is provided through various organizations, which include the Mariposa County Fire Safe Council, the Mariposa County Resource Conservation District and the California Department of Forestry and Fire Protection (CAL FIRE). The Mariposa County Fire Safe Council, a non-profit community partnership, implements various fire prevention and fuel reduction projects, as well as education and outreach events to increase fire safety in the County. The Mariposa County Resource Conservation District provides resources to preserve the natural resources in Mariposa County and supports increased interagency efforts. The District also actively participates in Mariposa County Fire Safe Council events. CAL FIRE provides important services for fire protection and stewardship on privately-owned wildlands, including critical fire and emergency response to Mariposa County. The US Department of Agriculture Natural Resources Conservation Services (NRCS) also provides technical and financial assistance to private landowners to conserve natural resources.

Forest Thinning
Credit: Fish Camp Fire/Rescue Association, Donn Harter

Community Wildfire Protection Plans (CWPPs) are also valuable resources that help guide the management of forests and rangelands for hazardous fuel reduction and fire resilience and facilitates acquisition of grant funding for related projects. The Council was a major participant in the development of the Mariposa Countywide Community Wildfire Protection Plan. The communities of Yosemite West and Foresta have also developed individual CWPPs with assistance from the National Park Service.

Fuels and fire management on federal lands is led by the US Forest Service, BLM, and National Park Service. Fire management in Yosemite National Park has taken on a very progressive approach with highly monitored prescribed burns that can be a model for other areas in the Region.

3.5.4 Groundwater Quality

Groundwater within the Region generally is obtained from fractured bedrock formations. These basins are susceptible to contamination from surface infiltration and thus have variable water quality. In addition to fractured bedrock formations, there is one recognized groundwater basin in the Region, Yosemite Valley Basin, which has exceptionally high quality groundwater (DWR, 2003). Other than the Yosemite Valley Basin, the lack of contiguous basins combined with the many, dispersed individual groundwater users in the Region has resulted in limited study of groundwater quality in the Region.

The Region's wells each serve between 2 and 3 people on average (County of Mariposa, 2006), and sampling is not mandatory for all wells, which makes identification of contaminated wells more problematic. The exception is in areas where contamination is brought to the attention of local health authorities. Based on conversations with the Mariposa County Environmental Health Department, the most common contaminants have been from agricultural uses such as historic turkey and chicken farming, leaking underground storage tanks, and septic systems, and are often evidenced in aging drinking water wells.

While most of the agriculture in the County is associated with rangeland and grazing cattle, there were previously some turkey ranches and chicken farms within the Region. Concentrated animals with improper manure management can be associated with high nitrates that can impact shallow groundwater (typically shallower than 75 feet deep) in a fairly localized area. Grazing cattle, in moderation and when managed properly, typically do not impact water quality, and can improve habitat, especially in vernal pools. Other potential sources of nitrates are septic systems, particularly if they are associated with small lots. To date, about 10 wells have been identified with nitrates in excess of drinking water standards in the County (Mariposa County Environmental Health, 2014).

Mariposa County Environmental Health Department now requires testing for nitrates in groundwater for new homes and/or subdivisions, particularly in areas of historic high nitrates. The presence of nitrates in groundwater can require construction of deeper wells that are sealed in the shallower groundwater to both prevent a migration path for nitrates as well as to provide drinking water from a deeper, unimpaired zone. (Mariposa County Environmental Health, 2014).

Septic tanks can also be the source of bacteriological contamination. Many septic systems were installed prior to the requirement of a soil investigation and health study to demonstrate long term feasibility of the septic system prior to its installation; thus, the areas of most concern are generally associated with older residences where septic systems were installed prior to the passing of these regulations. Septic system contamination leads to bacteriological contamination within groundwater wells that can become problematic for domestic use of local groundwater. In a few isolated cases, bacteriological contamination in older drinking water wells has occurred which are likely the result of poor sanitary seals that allow surface contaminants to enter the well and/or intersection of a fracture zone that is an immediate conduit for surface contaminants and/or septic tank effluent to the well.

Other sources of groundwater contamination within the Region are leaking underground storage tanks (LUSTs). The GEOTRACKER on-line database has identified twelve open LUST sites that are currently under the RWQCB oversight. Of these cases, most are petroleum tanks while one is a clandestine lab waste site and another is an airplane crash site. The twelve cases are categorized as follows: five cases are undergoing remediation, five cases are undergoing site assessment, one is eligible for closure, and one is undergoing verification monitoring. In addition, there are over 80 sites that have been cleaned up and the case is closed.

Comprehensive information regarding groundwater in Mariposa County is generally lacking and specific issues as to water quality, quantity, and recharge capabilities require further investigation. Water quality samples of 64 private wells throughout the Region were collected as part of the groundwater study conducted for this IRWM Plan. The constituents that were analyzed for include:

- Major Cations and Anions
- pH, Fluoride, Electrical Conductivity, and Total Dissolved Solids
- Metals
- Asbestos
- Alpha Activity and Stable Isotopes of Water

Overall the water quality of the wells sampled was good. Three wells exceeded a Primary Maximum Contaminant Level (MCL) for arsenic, with values ranging from 10 to 21 ppb, compared to an MCL of 10 ppb. Most wells however were below 2 ppb. Although approximately 2/3 of the wells were non-detect for manganese, eight wells exceeded the Secondary MCL, with concentrations ranging from 0.36 to 0.84 ppm, compared to an MCL of 0.05 ppm. In addition to arsenic and manganese, one well exceeded the Secondary MCL for iron, with a value of

1.5 mg/l, compared to an MCL of 0.3 mg/l. The other water quality concern noted was an area of low pH groundwater in the Lush Meadows-Bootjack area.

3.5.5 Other Water Quality Impacts

Illegal marijuana cultivation is a continued issue in Mariposa County that can have negative impacts on water quality within the Region. There are a variety of activities that can occur during illegal marijuana cultivation that threaten or damage riparian and aquatic habitat, including:

- grading, terracing, dam, and road construction without permits, leading to the filling of streams through erosion and sediment deposition;
- deforestation and habitat fragmentation;
- illegal use of rodenticides, fungicides, herbicides and insecticides;
- use of soil amendments and fertilizers in situations where run off to surface waters may occur;
- discarding of trash and haphazard management of human waste;
- substandard storage of hazardous materials such as diesel and gasoline; and
- unauthorized diversion of water from streams.

These activities impair beneficial uses of the water, from municipal drinking water to swimming, and from agriculture to preserving habitat for endangered fish and wildlife (RWQCB, 2013). Impacts from marijuana cultivation can affect both surface water and groundwater quality within the Region and Mariposa County Sheriff's department estimates that up to 30 wilderness marijuana gardens are removed annually with associated water supply and water quality issues. In some areas, Federal agencies are able to use volunteers to supplement local responders to assist in clean up and restoration of these sites.

3.6 Ecological Processes and Environmental Resources

Watershed health is also a major concern for stakeholders and has a significant effect on this Region, as well as the neighboring Merced IRWM Region. The lakes, creeks, meadows and other water features that form the Region provide key habitat for many of California's most important aquatic and terrestrial species, including many fish and wildlife species. Anadromous fish once migrated into the Region, using its waterways for spawning as far upstream as the waterfalls that did not allow further fish passage; fish passage is now limited to reaches below downstream dams. Over 50 special status species are found in the Region today, many of which are federally or state listed species. Protection and restoration of these species is an important aspect of this IRWM program.

3.6.1 Environmental Resource Related Issues, Needs, Challenges and Opportunities

This subsection addresses the following key issues, needs, challenges and opportunities related to environmental resources management:

- Protection and restoration of anadromous fisheries, threatened, endangered and sensitive aquatic and terrestrial species
- Restoration of functional wildlife habitat
- Management of the spread of invasive aquatic and terrestrial invasive species

3.6.2 Aquatic Ecosystems and Fisheries

There are many valuable aquatic ecosystems in the Region including high elevation lakes, streams and rivers that traverse the Region as well as forested riparian areas and meadows at a range of elevations. These ecosystems, much of which occurs within federally managed lands, provide habitat for both native and non-native introduced species. These aquatic ecosystems are also a focal point for Native American cultural resources. The largest water feature in the Y-M Region, the upper Merced River, was designated a Wild and Scenic river system, by Congress in 1987. This designation which originated in 1968 preserves selected rivers with remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values. The goal is to counterbalance dams and other construction in order to preserve these selected rivers/portions of rivers in their free-flowing condition to protect water quality and wildlife habitat for the benefit of future generations. The Upper Merced River and associated 81 miles of tributaries is the only Wild and Scenic river in the Y-M Region. The designation preserves the Upper Merced River's free-flowing condition and resulting unique values for present and future generations.

Kayaker on Lake Tenaya
Credit: Melissa Odell

Some of the more valuable aquatic ecosystems in the Region support sensitive species such as foothill yellow-legged frogs, Yosemite Toad, and western pond turtles. This is particularly true in the upper North Fork Merced River watershed including the Smith, Bean, Bull, Moore and Jordan Creek areas. Most of these streams support small, possibly interconnected populations of these two sensitive species and is the largest area within the Region in which they occur (YSS, 2011). Amphibian inventories from the early 1900s were resurveyed in the last 20 years; the results indicate changes in the relative abundance in the survey area of the five key amphibian species and an associated aquatic species, the western pond turtle. This species, like the foothill yellow-legged frog, exists in multiple locations within the survey area, but populations are generally small and skewed toward older individuals with limited apparent recruitment of young individuals into those populations (YSS, 2011).

Across the remainder of the Region, small population of foothill yellow-legged frog and western pond turtle are highly isolated, lacking other populations in close proximity for breeding and genetic exchange (YSS, 2012). Within Yosemite National Park, the NPS is preparing an Aquatic Resources Management Plan to improve habitats for both the foothill yellow-legged frog and the Yosemite toad. Similarly, the Sierra and Stanislaus National Forests conducted a Yosemite Toad Adaptive Management Project from 2005-2010 which evaluated impacts of public lands grazing and toad breeding pools in high elevation mountain meadows. The survey portion conducted from 2006-2008 found that cattle select for higher forage quality diets in drier meadows and that toads are more prevalent in wetter meadows, indicating that grazing and Yosemite Toad can coexist within the same environment (Tate, K. and Roche, L.; USFS, 2012 and 2013).

In addition, many of the rivers in the Region historically supported anadromous fisheries of steelhead and Chinook salmon; some runs were reported up to the headwaters in Yosemite Valley until the 1950s although access to high elevations was likely limited in distribution by large

geologic features (waterfalls, very steep gradients). All of the anadromous fisheries in the Region are now disconnected from the downstream San Joaquin River because of the construction of water storage and/or flood control dams on all of the major tributaries flowing out of the Region. Currently there are reported to be 11 species of fish in the upper Merced River which is well studied because of its proximity in Yosemite National Park. At lower elevations (<4,000 feet), the native fish community was comprised of few species and included hardhead, Sacramento pikeminnow, California roach, Sacramento sucker, resident rainbow trout, and riffle sculpin. Beginning in the early 1900s, trout were extensively stocked to provide recreational opportunities. Currently there are few streams without fish, typically headwater, intermittent and seasonal streams (YSS, 2012). Fishery studies of the lower Mariposa Group of streams and upper Fresno/Chowchilla Rivers are not readily available.

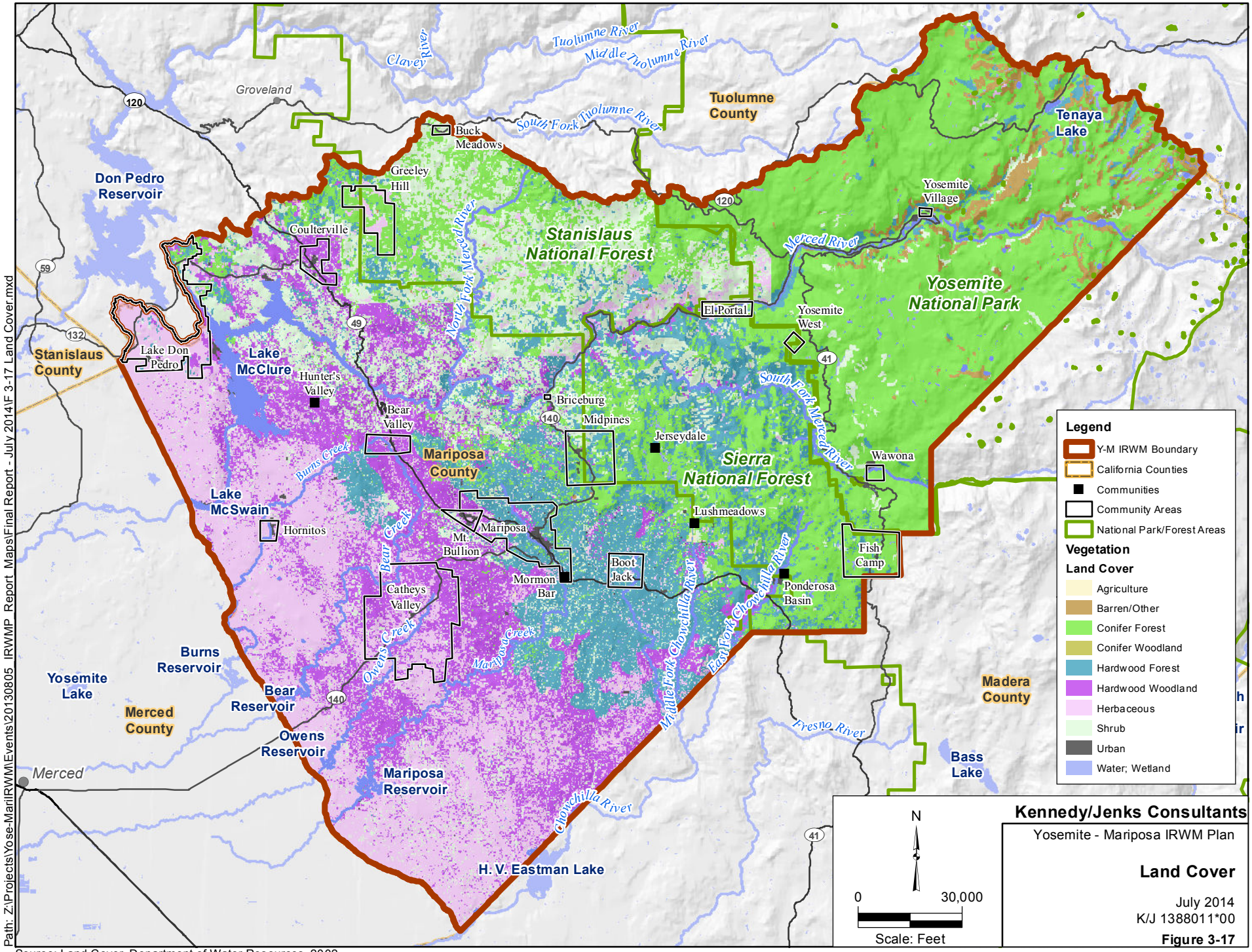
3.6.2.1 Aquatic Invasive Species

Invasive species are a concern for the Y-M Region because of their negative effect on native ecosystems. One example is the invasive bullfrog, a non-native competitor, having the potential to severely impact foothill yellow-legged frog and western pond turtle populations. These adult bullfrogs can prey on all terrestrial life stages of the foothill frog and early life stages of the turtle effectively reducing native populations. Perennial ponds within this area have been a source for breeding populations of the bullfrog. In addition, species of non-native trout such as rainbow, brook, brown, cutthroat, and golden as well as small mouth bass, and blue gill can also prey on amphibians and invertebrates thus impacting populations of several native species (NPS, 2014b). Invasive terrestrial species such as yellow star thistle can also negatively impact aquatic native species as discussed in Section 3.6.3.

In addition, non-native plants such as Arundo donax which have a high evapotranspiration rate in riparian areas can result in water losses that reduce habitat suitability for aquatic native species as well. Mariposa County Department of Agriculture uses Integrated Pest Management techniques in cooperation with other agencies to remove Arundo, star thistle and other non-native species in the County. (County of Mariposa, 2012d)

3.6.3 Terrestrial Ecosystems

The Y-M Region contains a wide variety of terrestrial ecosystems consisting mainly of forested and range land over a several thousand foot elevation band. This large elevation span represents an important movement corridor for migrating species such as mule deer and other large mammals. Providing unconstrained movement between elevations will be important for climate change adaptation for many species (CDFW, 2013). Meadows and other riparian areas are interspersed in the Region and, while limited in acreage, provide valuable resources including water storage and habitat for native animals and plants; many of the plants are important to Native American tribes for ceremony, basket making, and medicines. There are approximately 700,000 acres of forested or range lands with a range of vegetation out of the 930,000 acres in the Region as shown on Figure 3-17 that follows.



Source: Land Cover, Department of Water Resources, 2002.

Mariposa County also has approximately 6,500 acres of lower elevation vernal pools which are ephemeral wetland ecosystems that provide habitat to some localized special status species and are therefore a focus for conservation organizations. Mariposa County is unique to the Central Valley in that comparative aerial photo surveys of vernal pools from 1976 – 2005 indicate no loss of the 6,500 acres of vernal pool during this period, while the remainder of the Central Valley saw losses of about 135,000 acres or about 13 percent of the total area (Holland, R.F., 2009). In addition, studies by The Nature Conservancy and others indicate that moderate, well-managed cattle grazing are not damaging to vernal pools, and in fact, can benefit the habitat by removing non-native invasive species (Marty, J.T. 2004 and 2006; Robins, J.D. and Vollmar, J.E., 2002).

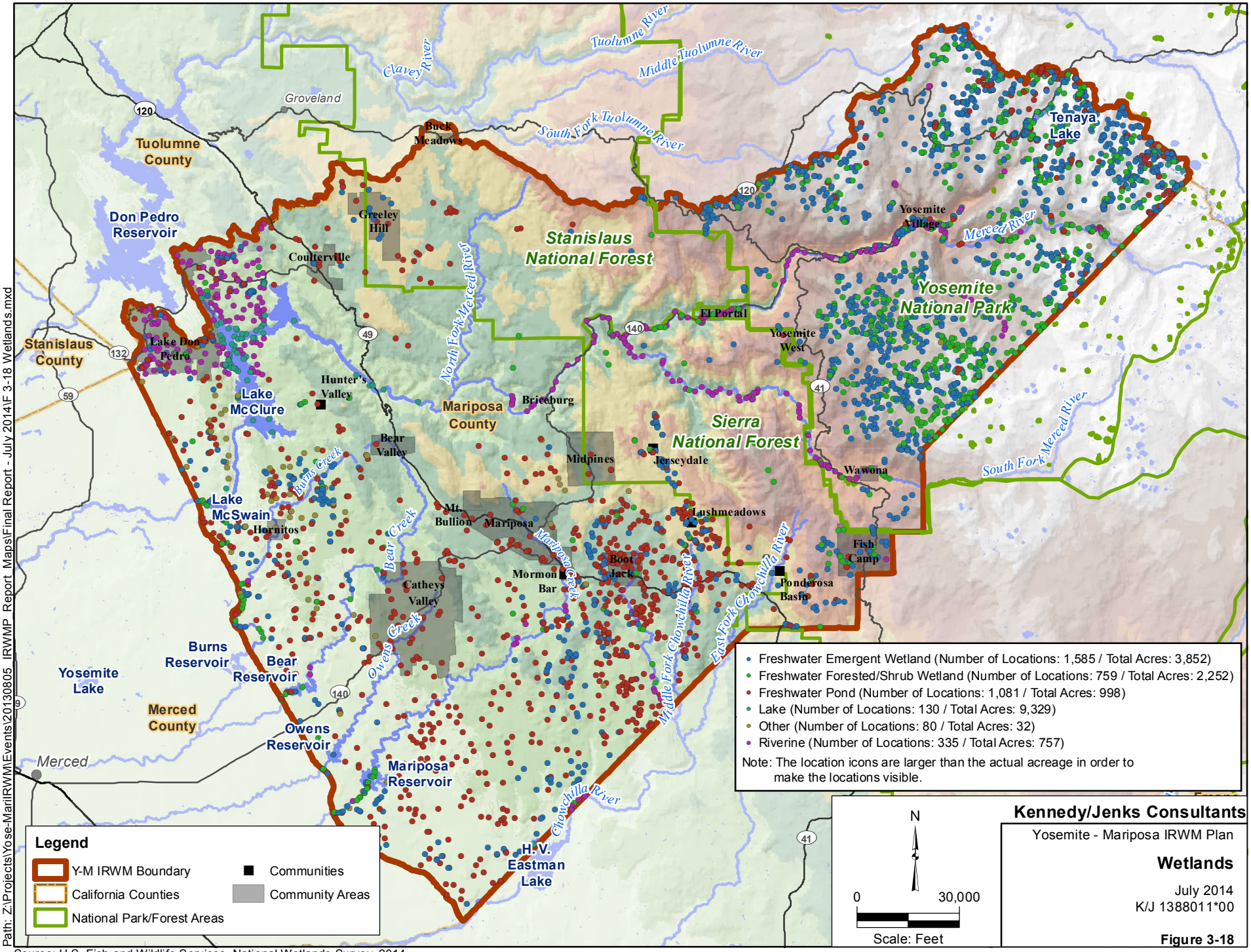
The U.S. Fish & Wildlife Service created an inventory of wetland, riparian, deep water and related aquatic habitats in priority areas to promote the understanding and conservation of resources. This inventory is shown in Figure 3-18 with dots depicting each wetland area and shows almost 6,000 acres of wetland areas, not including lakes, in almost 4,000 various locations throughout the Region. It should be noted that the dots on Figure 3-18 are much larger than the actual wetland acreages in order to make them visible on the map.

Mariposa County Wildflower - Shooting Star
Credit: Pat Garcia

As discussed earlier, wildfire and forest fuel management are integrally linked to the health of terrestrial ecosystems as non-native plants often out compete native plants in the post-fire regime. In addition, for some key terrestrial wildlife species in the Sierra, such as the Pacific fisher and the California spotted owl, habitat needs include large areas that have large trees, dead trees, and other characteristics of mature forests. The habitat requirements of these higher level carnivores are complex as they require environments to sustain prey as well as nests/dens. Monitoring is a key element of management of these species. In the Sierra National Forest, for example, these and similar species are used to assess management decisions because if these higher level species are well supported, then it stands to reason lower level species also benefit (USFS, 2013b). Opportunities to improve the terrestrial ecosystem within the Region include restoration of vegetation density to a more historic regime, reintroducing fire to maintain important terrestrial habitat elements, and reducing densities of aquatic and terrestrial invasive species.

3.6.3.1 Terrestrial Invasive Species

Across the western United States, aggressive, non-native plants have permanently taken over millions of acres of formerly productive agricultural and wildlands to the detriment of ecosystems and the economies that depend on them. A major concern is the noxious weeds within the Region that vary from absent to almost total degradation of terrestrial habitat. Sources have estimated that almost 60% of the Region contains some type of noxious weed infestation. Examples of the more threatening noxious weed species known to occur in the landscape include yellow-star thistle (*Centaurea solstitialis*), Italian thistle (*Carduus pycnocephalus*), tocalote (*Centaurea melitensis*), diffuse knapweed (*Centaurea diffusa*), medusahead (*Taeniatherum caput-medusae*), Klamath weed (*Hypericum perforatum*), barbed goatgrass



Source: U.S. Fish and Wildlife Services, National Wetlands Survey, 2014.

(*Aegilops triuncialis*), Arundo (*Arundo donax*), Tree of Heaven (*Ailanthus altissima*), Armenian or Himalayan Blackberry (*Rubus armeniacus*),puncturevine (Tribulus terrestris), and bull thistle (*Cirsium vulgare*). Wildlife habitat, native plant species, rangeland health, ecosystem integrity and fire regimes are all adversely affected by annual expansion of invasive noxious weed species in the landscape.

There have been several movements in the Region to eradicate or at least reduce the amount of harmful invasive plant life. The yellow-star thistle has collectively received a great amount of attention. Two major areas of the Merced River Canyon, El Portal and Briceburg, have significant infestations. Treatments have been ongoing for several years, including hand pulling and applying herbicides with boom trucks on steep slopes. Burning, hand pulling, herbicide spraying and even targeted grazing can be used alone or in combination to control or eradicate noxious weeds from wildlands. The Mariposa County Department of Agriculture actively manages several programs to treat and reduce invasive species including thistles and Arundo (County of Mariposa, 2012d).

Another method of fighting invasive species is to educate people about the impacts so that they will be motivated to take action. The principles of Integrated Weed Management is one such example. The idea is to combine education and prevention with the appropriate control tools for each particular weed and location. Preventative measures have proved more cost effective than treatment when an invasive is widespread.

Noxious terrestrial weed species have contributed to the degradation of terrestrial habitat used by the western pond turtle and, to a lesser extent, the foothill yellow-legged frog. Dense stands of yellow-star thistle along Jordan Creek and North Fork Merced River may inhibit very small hatchling turtles from reaching stream habitat as they emerge from nests (YSS, 2011)

3.6.4 Endangered and Special Status Species

This subsection presents a sampling of wildlife and plant species that occur or have been known to historically occur in the Region. The species listed in Table 3-11 below have special status designations of endangered, threatened or special status. Some species, while not federally or state listed, have been identified as a ranked species on the heritage global, heritage state, or rare plant lists. A more extensive table can be found in Appendix 3-C including information in addition to the common name and status in Table 3-11 on scientific name, other status, common habitats, as well as an explanation of the Heritage and Rare Plant ranking systems.

Larval California Tiger Salamander
Credit: Kristen Boysen, Sierra Foothill Conservancy

Table 3-11: Special Status Species

#	Common Name	Federal List	California List	Heritage Global Rank	Heritage State Rank	Rare Plant Rank
	Amphibians					
1	California Tiger Salamander	Threatened	Threatened	G2G3	S2S3	-
2	Mount Lyell Salamander	None	None	G3	S3	-
3	Yosemite Toad	Proposed Threatened	None	G2	S2	-
4	Foothill Yellow-legged Frog	None	None	G3	S2S3	-
5	Limestone Salamander	None	Threatened	G1	S1	-
6	Sierra Nevada yellow-legged Frog	Proposed Endangered	Threatened	G1	S1	-
	Arachnids					
7	Crane Flat Harvestman	None	None	G1	S1	-
	Birds					
8	Great Gray Owl	None	Endangered	G5	S1	-
9	Northern Goshawk	None	None	G5	S3	-
10	Willow Flycatcher	None	Endangered	G5	S1S2	-
11	Prairie Falcon	None	None	G5	S3	-
12	Black-backed Woodpecker	None	None	G5	SNR	-
13	Least Bell's Vireo	Endangered	Endangered	G5T2	S2	-
14	Double-crested Cormorant	None	None	G5	S3	-
	Bryophytes					
15	Elongate Copper Moss	None	None	G4	S2	2B.2
16	Norris' Beard Moss	None	None	G3G4	S3S4	2B.2
17	Shevock's Copper Moss	None	None	G1	S1	1B.2
18	Slender Silver Moss	None	None	G4G5	S2	2B.2
19	Bolander's Bruchia	None	None	G3	S3?	2B.2
20	Koch's Cord Moss	None	None	G1	S1	1B.3
	Crustaceans					
21	Wengerors' Cave Amphipod	None	None	G1	S1	-
	Dicots					
22	Hoover's Calycadenia	None	None	G3	S3	1B.3
23	Merced Clarkia	None	Endangered	G1	S1	1B.1
24	Mariposa Daisy	None	None	GH	SH	1A
25	Big-scale Balsamroot	None	None	G2	S2	1B.2
26	Mariposa Pussypaws	Threatened	None	G1	S1	1B.1
27	Parry's Horkelia	None	None	G2	S2.2	1B.2
28	Yosemite Ivesia	None	None	G3	S3.2	4.2
29	Congdon's Lomatium	None	None	G2	S2.2	1B.2
30	Yosemite Popcornflower	None	None	G4T2Q	S2.2	1B.2
31	Mariposa Cryptantha	None	None	G3	S3	1B.3
32	Slender-stemmed Monkeyflower	None	None	G2	S2	1B.2
33	Succulent Owl's-clover	Threatened	Endangered	G4?T2	S2	1B.2
34	Fell-fields Claytonia	None	None	G4G5	S2S3	2B.3
35	Congdon's Lewisia	None	Rare	G2	S2	1B.3
36	Yosemite Lewisia	None	None	G2	S2.2	1B.2
37	Yellow-lip Pansy Monkeyflower	None	None	G2G3	S2S3	1B.2
38	Congdon's Woolly Sunflower	None	Rare	G2	S2.2	1B.2
39	Mono Hot Springs Evening-primrose	None	None	G3T2	S2	1B.2
40	Slender-stalked Monkeyflower	None	None	G2G3	S2S3	1B.2
41	Tulare Rockcress	None	None	G2	S2	1B.3
42	Small's Southern Clarkia	None	None	G2	S2	1B.2
43	Yosemite Woolly Sunflower	None	None	G2	S2.3	1B.3
44	Short-leaved Hulsea	None	None	G3	S3	1B.2
45	Mariposa Lupine	None	Threatened	G2T1	S1	1B.2

#	Common Name	Federal List	California List	Heritage Global Rank	Heritage State Rank	Rare Plant Rank
	Dicots (cont'd)					
46	Bolander's Clover	None	None	G2G3	S2S3	1B.2
47	Mariposa Clarkia	None	None	G4G5T2T3	S2S3	1B.2
48	Beaked Clarkia	None	None	G2G3	S2S3	1B.3
49	Madera Leptosiphon	None	None	G1?	S1?	1B.2
50	Slender Lupine	None	None	G2	S2	1B.3
51	Shaggyhair Lupine	None	None	G2	S2.2	1B.2
52	Merced Phacelia	None	None	G5TH	SH	3.2
	Ferns					
53	Moosewort	None	None	G3?	S1	2B.1
54	Paradox Moonwort	None	None	G3G4	S1	2B.1
	Forest					
55	Big Tree Forest	None	None	G3	S3.2	-
	Inland Waters					
56	Central Valley Drainage Hardhead/Squawfish Stream	None	None	GNR	SNR	-
	Insects					
57	Wawona Riffle Beetle	None	None	G1G3	S1S2	-
58	Boharts' Blue Butterfly	None	None	G3G4T1	S1	-
59	Sierra Pygmy Grasshopper	None	None	G1G2	S1S2	-
60	Valley Elderberry Longhorn Beetle	Threatened	None	G3T2	S2	-
61	Leech's Skyline Diving Beetle	None	None	G1?	S1?	-
	Mammals					
62	Long-eared Myotis	None	None	G5	S4?	-
63	American Badger	None	None	G5	S4	-
64	Yuma Myotis	None	None	G5	S4?	-
65	Gray-headed Pika	None	None	G5T2T4	S2S4	-
66	Sierra Nevada Mountain Beaver	None	None	G5T3T4	S2S3	-
67	Spotted Bat	None	None	G4	S2S3	-
68	Sierra Nevada Red Fox	None	Threatened	G5T1T2	S1	-
69	Townsend's Big-eared Bat	None	Candidate Threatened	G3G4	S2S3	-
70	Silver-haired Bat	None	None	G5	S3S4	-
71	Western Red Bat	None	None	G5	S3?	-
72	Fisher - West Coast DPS	Candidate	Candidate Threatened	G5T2T3Q	S2S3	-
73	Pallid Bat	None	None	G5	S3	-
74	Western Mastiff Bat	None	None	G5T4	S3?	-
75	California Wolverine	Proposed Threatened	Threatened	G4	S1	-
76	Sierra Marten	None	None	G5T3T4	S3S4	-
77	Western Small-footed Myotis	None	None	G5	S2S3	-
78	Fringed Myotis	None	None	G4	S4	-
79	Hoary Bat	None	None	G5	S4?	-
80	Long-legged Myotis	None	None	G5	S4?	-
81	Mount Lyell Shrew	None	None	G2G3	S2S3	-
82	Merced Kangaroo Rat	None	None	G3G4T2T3	S2S3	-
	Mollusks					
83	Merced Canyon Shoulderband	None	None	G1	S1	-
84	Yosemite Mariposa Sideband	None	None	G1	S1	-
85	Trinity Spot	None	None	G1G3	S1S3	-
	Monocots					
86	Sanford's Arrowhead	None	None	G3	S3	1B.2
87	Tompkins' Sedge	None	Rare	G3	S3.3	4.3
88	Yosemite Bog Orchid	None	None	G2	S2.2	1B.2
89	Brownish Beaked-rush	None	None	G5	S1	2B.2
90	Northern Clustered Sedge	None	None	G5	S2	2B.2

#	Common Name	Federal List	California List	Heritage Global Rank	Heritage State Rank	Rare Plant Rank
			Monocots (cont'd)			
91	Bolander's woodreed	None	None	G2	S2	1B.2
92	Pilot Ridge Fawn Lily	None	None	G1	S1	1B.2
93	Slender-leaved Pondweed	None	None	G5T5	S3	2B.2
94	Mountain Bent Grass	None	None	G4Q	S2	2B.3
95	Pleasant Valley Mariposa-lily	None	None	G4T2	S2	1B.2
96	Stinkbells	None	None	G3	S3.2	4.2
97	Robbins' Pondweed	None	None	G5	S3	2B.3
98	White beaked-rush	None	None	G5	S2	2B.2
99	Yosemite Onion	None	Rare	G3	S3	1B.3
100	Nuttall's Ribbon-leaved Pondweed	None	None	G5	S2S3	2B.2
			Reptiles			
101	Western Pond Turtle	None	None	G3G4	S3	-

Source: California Natural Diversity Database (CNDDB) program managed by the California Department of Fish and Wildlife, April 2014.

3.7 Vulnerability to Climate Change

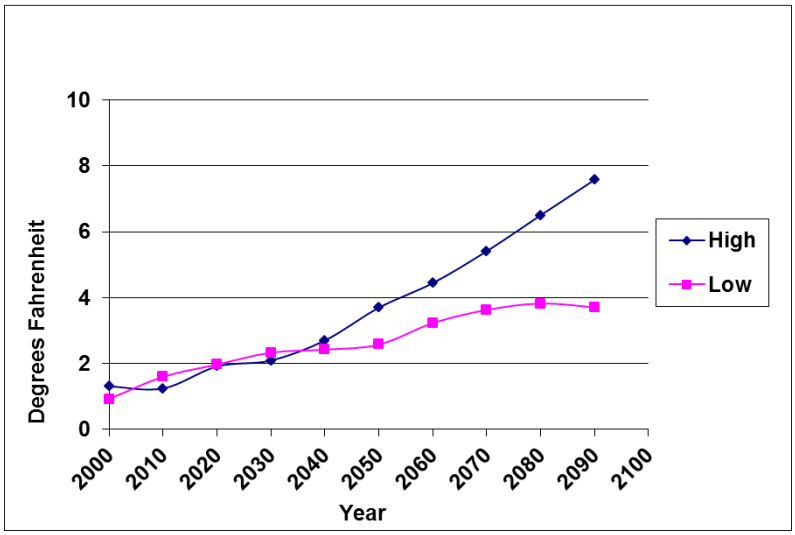
This section provides a discussion of the projected climate change impacts in the Region as well as a summary of the key vulnerabilities of the Region to climate change and potential future actions to mitigate the vulnerabilities to Climate Change. The more detailed Climate Change Vulnerability Checklist is found in Appendix 3-D.

3.7.1 Projected Climate Change Impacts

Climate change has the potential to have significant impacts on the Yosemite-Mariposa Region. The U.S. Bureau of Reclamation (Reclamation), State of California (CalAdapt.org), and others continue to study climate change and its potential impacts on water and other resources in the western states. Reclamation has completed a Global Climate Model, which includes modeling and hydrologic modeling steps and released the results for several western U.S. rivers including the San Joaquin River. Cal-Adapt.org has used four general circulation models (GCM) of climate with 2 emissions scenarios for each model to project 15 parameters for the state of California. Cal-Adapt.org provides projected wildfire risk, increase in temperature, decrease in snow water equivalent as well as other metrics for analysis of climate change impacts.

Climate change is expected to have various impacts on the Region including: 1) changing hydrology due to a shift from snow to rain precipitation, 2) higher fire risk due to warmer, drier conditions over the year, and associated impacts on water quality and flooding, 3) longer and drier conditions over the year, and associated impacts on water quality and flooding, 4) longer and more severe multi-year droughts, 5) more evapotranspiration and thus less runoff from mountain headwaters due to longer annual growing seasons at higher elevations, 6) greater summer water demand from all categories of users and 7) habitats and species shifts.

Cal-adapt projects that temperature for the Yosemite-Mariposa Region will increase by 4-8 degrees Fahrenheit over the next 90 years as shown on Figure 3-19. The projected increases to temperature will likely result in a higher portion of rain over snow in the winter and earlier melting of the snowpack. Increased temperatures could lead to increased fishery stress, increased invasive species infestations, and increased wildfire risk, which is shown in Figure 3-20 (High Emissions Scenario). Additionally, increasing temperatures without an increase in precipitation could result in increased applied water requirements for crops, landscaping and instream ecosystems.



Note: Cal-adapt.org. Based on average of 4 Climate Models for 2 Emission Scenarios (High, Low) using Base Period, 1951-1990. Location projected near City of Mariposa.

Figure 3-19: Projected Annual Temperature Increases

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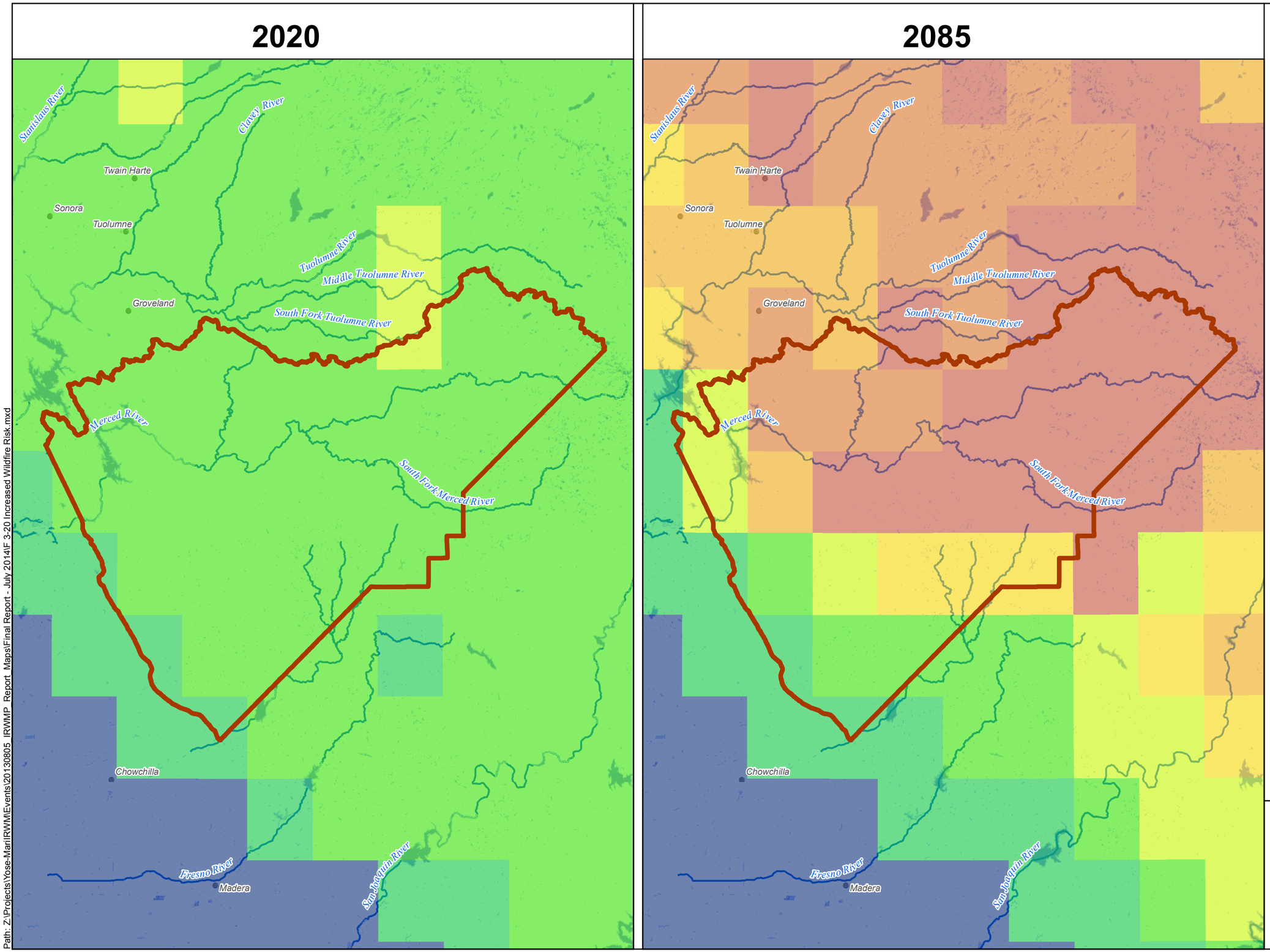

Legend

- Y-M IRWM Boundary
- River/Stream
- Waterbodies

Projected Increase in Area Burned (Base Period 1961-1990)

- 0.25
- 0.5
- 0.75
- 1
- 1.25
- 1.5
- 1.75
- 2
- 2.25
- >2.25

Source:
Fire Risk Data. PCM1; B1. UC Merced Climate Application Lab, 2008

N

0 5 10
Miles

Kennedy/Jenks Consultants

Yosemite - Mariposa IRWM Plan

Climate Change
Increase in Fire Risk
Medium-High Emissions Scenario

July 2014
K/J 1388011*00

Figure 3-20

Path: Z:\Projects\Yose-Mari\IRWM\Events\20130805_IRWMP_Report_Maps\Final Report - July 2014\F 3-20 Increased Wildfire Risk.mxd

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3.7.2 Summary of Climate Change Vulnerability Checklist

The Climate Change Vulnerability Checklist encompasses seven major topic areas that include:

1. Water Demand
2. Water Supply
3. Water Quality
4. Sea Level Rise
5. Flooding
6. Ecosystem and Habitat Vulnerability
7. Hydropower

All of these areas are likely to be of concern for the Region excluding sea level rise and flooding. The region's foothill location is a higher elevation than would be affected by sea level rise. Changes in flow regimes due to climate change may affect flooding for areas downstream of the major rim dams in the San Joaquin Valley, but is not anticipated to be a regional challenge in the steeply sloped, mountainous Yosemite-Mariposa Region, although certain areas may be subject to localized flooding impacts. The completed checklist can be found in Appendix 3-D, while a summary of these topic areas follows.

Based on the vulnerabilities, future efforts of the Region with regard to Climate Change will likely focus on reducing wildfire risk through reducing fuel load; increased restoration efforts which has water supply, water quality, and ecosystem benefits; improving water demand estimates for municipal, commercial, and agricultural uses, especially those using groundwater; and improving understanding of water quality risks associated with wildfire.

3.7.2.1 Water Demand

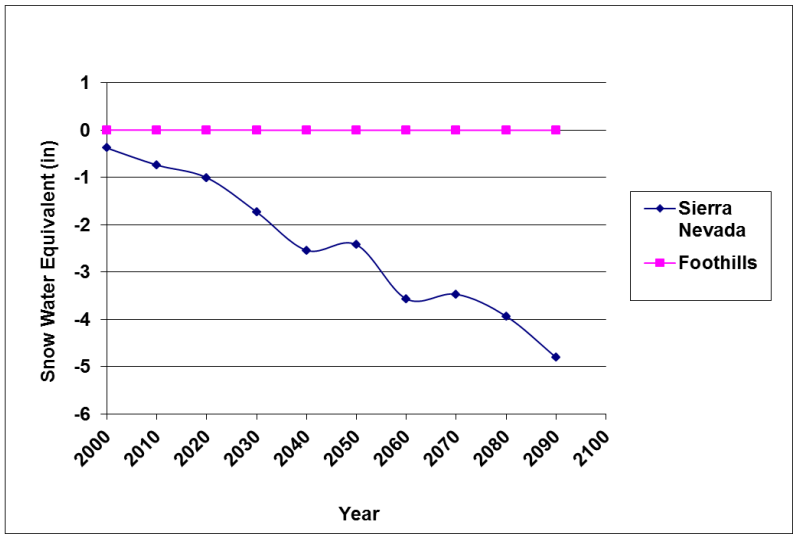
Demand in the Region varies by season for two major reasons: (1) increase in agricultural production in the summer and (2) increase in summer tourism. Agricultural water use, mostly from dry farming, within the Region could account for up to 25% of the total water use (although minimal irrigated agriculture occurs). Additionally, the Region has a significant tourism industry, which contributes to a higher summertime domestic water use. If agriculture becomes a larger industry within the Region, especially if it is focused on the growth of permanent crops such as vineyards or fruit and nut trees, this could harden the water demand requiring an increased reliance on groundwater, which could be problematic in those subareas with many other users. Likewise, the tourism industry is an important part of the Y-M Region's economy and measures should be taken to ensure supplies are available to meet peak summertime tourist-related demands. Overall, it is possible that water demands may increase as a result of climate change due to higher temperatures and prolonged droughts.

Agriculture has a variety of water demand management options including fallowing fields of annual crops and changing the crop itself to one that may be less water intensive, yet economically viable. Additionally, in some cases, farmers may be able to switch their water source from surface water to groundwater. Additional water demand management options include mandates and incentives to reduce water use by homes and businesses. An example of an incentive to reduce water use would be installation of water meters on homes and businesses with implementation of metered rates or low flow shower and toilet rebate programs.

3.7.2.2 Water Supply

Groundwater is the primary source of water within the Region while the Merced River and other local waterways provide water to limited portions of the Region. The Merced River watershed is fed primarily by snowmelt. The carryover storage and available water supply from the major

reservoirs could be affected by changing snowfall and snowmelt patterns which may also change, as noted earlier, coniferous forest species composition and density. Figure 3-21 shows the projected change in average snow water equivalent based on the high emissions scenario projections (CalAdapt.org). Although a direct correlation between snow water equivalent and how it will affect the watershed is not available, a continued decrease in snow production, or poor forest conditions within the watershed could alter groundwater recharge, and therefore, the reliability of water supply within the Region.



Source: Caladapt.org, 2014. Based on average of 4 Climate Models for the High Emission Scenario using Base Period, 1951-1990. Location projected near City of Mariposa (Foothills) and Half Dome in Yosemite Valley National Park (Sierra Nevada).

Figure 3-21: Average Projected Change in Snow Water Equivalent with Climate Change

The Region relies on both surface water and groundwater for agricultural and M&I water supplies. Approximately 80% of the Region relies on groundwater for its supplies with approximately 9,000 persons relying on private wells. The groundwater in the Region may be subject to decreasing reliability related to the extent and duration of longer drought periods that may occur due to climate change. There are limited data available to quantify the sustainable groundwater supplies and therefore to assess the resiliency of these supplies after drought events. A better understanding of groundwater supplies will be important to continued resiliency against climate change, as water supply management becomes a more important issue in the Region.

3.7.2.3 Water Quality

Increased threat of wildfire and resultant threat to water quality from sediment runoff of the burned landscape containing nutrients, are a significant climate change vulnerability in the Region, although current water quality monitoring may not be sufficient to identify trends. Water quality of the reservoirs in the upper watershed that are directly located in forested areas and where erosion from peak runoff is enhanced by mountainous topography will likely be impacted the greatest by wildfires. Additional potential impacts may include increased algal blooms and increased bacterial activity in waterways. Adaptation strategies include watershed management to reduce wildfire risks. The Region already has many forest management projects through the USFS, NPS as well as local entities; however, continued forest management will be important for mitigating the future effects of climate change.

3.7.2.4 Flooding

Localized flooding and large scale flood protection are potential climate change vulnerabilities. Local flood control facilities have historically provided adequate levels of flood protection in most areas, although there are areas of localized flooding. Areas within the Region susceptible to local flooding include Mariposa, El Portal, Coulterville, Wawona and Hornitos. Efforts to mitigate future flood impacts include removal of nonessential infrastructure from high flood risk areas. The largest reservoir in the Region, Lake McClure was constructed in part to provide flood protection for the flat, low-lying urban and agricultural areas in the San Joaquin Valley below the Region that would see significant peak flood flows from the Merced River.

3.7.2.5 Ecosystem and Habitat Vulnerability

The Region contains a portion of the California Sierra Nevada Mountains, which have been identified by the Endangered Species Coalition as one of the top 10 habitats vulnerable to climate change. Studies show that ecosystems at high elevations are greatly impacted by climate change effects. Species that have been identified to be particularly sensitive to temperature changes resulting from climate change include the American Pika, native amphibians and the alpine chipmunk, which is endemic to the Sierra Nevada and found throughout Yosemite National Park.

Another concern is the lengthening of growing season at higher elevations, where transpiration by forest vegetation is currently limited by cold winter temperatures. Warmer winters allow longer growing seasons and thus more annual water use in the forest. Predictions of how this will affect recruitment, disease, mortality and fire remain uncertain due to a lack of information.

Continued research and understanding of ecosystem and habitat vulnerabilities and management will aid the Region in understanding what adaptation strategies will best protect the Region's ecosystem and habitat from the effects of climate change. Yosemite National Park has an ongoing Natural Resource Condition Assessment (http://www.nature.nps.gov/water/nrca/) which when completed will provide a comprehensive view of the vulnerability of various resources within that portion of the Region to climate change.

In addition, various studies of specific resources have also been completed or are in progress. For example, the Sierra Nevada Network Inventory and Monitoring Program provides regional assessments of climate impacts on resources such as birds, forests, lakes, rivers, wetlands and snowpack (Westerling, A.L., 2006). A common feature in these assessments is the response of ecosystems and resources to a shift from snow to rain as the climate warms (Rice, R. and Bales, R., 2013).

3.7.2.6 Hydropower

There are 2 hydroelectric facility licenses within the Region, with capacities of 103.5 and 1.7 megawatts. These facilities are a major source of power for the Region and users in the Central Valley. Since the Region is highly affected by changes in snowpack and resulting changes in flow regimes, hydropower production will be affected by climate change requiring changes to the timing and availability of water releases through changes in water storage operations. Changes in these water releases could impact the overall reliability of hydropower in the Region and availability of municipal supplies that are associated with hydropower storage facilities.

3.7.2.7 Prioritized Climate Change Vulnerabilities and Adaptation Strategies

The climate change vulnerabilities were prioritized according to their relative linkage to the Plan objectives. Note that not all climate change vulnerabilities or objectives were included.

Table 3-12: Prioritized Climate Change Vulnerabilities

Climate Change Vulnerability Area /Subtopic		Associated Objectives	Priority
1. Water Demand	1.2 Water use varies more than 50% seasonally in parts of the Region.		Medium
	1.4 Groundwater supplies in parts of the region lack resiliency after drought events.	A, B	High
	1.5 Water use curtailment measures are effective and can harden demand.	C	Medium
2. Water Supply	2.1 A portion of the water supply in the Region comes from snowmelt.	A	High
	2.4 The Region may have difficulty storing carryover supply surpluses from year to year.	A	High
	2.5 The Region faced a drought which it failed to meet local water demands.	A	High
3. Water Quality	3.1 Increased wildfires are a threat in the Region.	S	High
	3.5 Part of the Region observes water quality shifts during rain events that impact treatment facility operation.	I, K, S	High
5. Flooding	5.5 Wildfires are a concern in parts of the Region.	S	High
6. Ecosystem and Habitat Vulnerability	6.1 The Region includes inland aquatic habitats vulnerable to erosion and sedimentation issues.	I, K	High
	6.3 Climate-sensitive fauna or flora populations live in the Region.	M	High
	6.4 Endangered and threatened species exist in the Region.	M	High
	6.5 The Region relies on aquatic or water-dependent habitats for recreation.	P	High
	6.8 The Region includes the California Sierra Nevada Mountains which has ecosystems vulnerable to climate change.	L, M, N	High
	6.9 The Region includes areas if fragmented aquatic and wetland wildlife habitat.	N	High

The Y-M IRWM Plan objectives and strategies contain a number of considerations that will facilitate the Region's preparedness and ability to adapt to climate change in the future. The objectives and/or strategies shown in Table 3-13 are each associated with adaptation to the following climate change factors:

- Changes in the amount, intensity, timing, quality and variability of runoff and recharge.
- Reducing emissions which includes consideration of the energy embedded in water use, and ultimately reducing GHG emissions.

Table 3-13: Potential Climate Change Adaptation Strategies

Summary of Objective		Description
C.	Promote Water Use Efficiency (WUE) practices throughout the Region and educate 80% of households and businesses.	Reducing water use will facilitate improved local water supply reliability
D.	Identify, manage and conserve forest, wetland, and range lands for enhancement of water supply.	Improved management of forests, wetland and range lands can improve base flows to meet critical ecological and other water supply needs, especially during dry periods.
L.	Improve watershed health by preventing the establishment of or, reducing/eliminating aquatic and terrestrial invasive species.	Several terrestrial invasive species consume significant water which, when removed, can make additional supply available to meet ecological and water supply needs during dry periods.
M.	Protect special status and sensitive species and preserve and restore 10,000 acres.	Climate change is expected to affect species in the Region negatively and may have a larger effect on species that are already special status; therefore improving existing habitat for these species will improve their ability to adapt to climate change.
R.	Develop opportunities/data management system so that current scientific data can be made available to make informed, collaborative choices regarding water resources and land use management.	Improved understanding of existing conditions will help provide scientists and water resource managers the tools to make informed decisions regarding water resources needs, under climate change, in the Region.
S.	Facilitate and coordinate fuel management policies and strategies.	Improved fuel management policies will help mitigate increased fire risk due to climate change.
V.	Mitigate impacts of climate change by implementing cost-effective renewable energy production.	The Region already produces hydroelectric power; meeting this objective increases renewable energy production from the Region.
W.	Mitigate flood risk associated with climate change by cooperating with Local Hazard Mitigation Planning flood risk updates and public education..	Mitigation of flood risk within the Region will decrease the negative impacts of increased flooding due to climate change.

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Section 4: Relation to Local Water and Land Use Planning

Water resources and land use planning in the Yosemite-Mariposa (Y-M) Region are inherently linked due to the connection between the uses of land (i.e., for rural residences, forestry, agricultural, and other activities) and the ways in which water is conveyed and used (i.e., for both consumptive and non-consumptive uses within and outside the Region). Land use changes that occur without proper planning or collaboration can significantly impact water resources/quality and the availability and reliability of supply for urban, agricultural, and ecosystem benefits. Collaboration between water managers and land use managers can help mitigate land use decisions to avoid detriment to water resources. Historical events such as water storage, and hydroelectric generation projects in the Region have significantly altered the natural hydrology of water systems. These changes to the water systems have provided considerable human benefit, but in some cases have also resulted in adverse environmental consequences. Efforts have been undertaken to reduce the impacts, such as, establishing a Wild and Scenic protected corridor on the Merced River.

Recognizing that collaboration between land and water use managers is an important linkage; IRWM Plans are required to describe the relationships and interactions between local water planning, local land use planning, and regional planning efforts fostered by the Yosemite-Mariposa Regional Water Advisory Council (RWAC).This section identifies some of those points of collaboration and highlights opportunities for improved communication and action in the future. It is broadly understood that water resources can be better protected, managed, and restored when water managers provide early input to, and ongoing coordination with, entities responsible for making land use decisions and implementing land use changes. Although many land use planning documents set appropriate goals related to water resources management, active implementation of land use policies that benefit water resources may require more interaction and collaboration between water managers, land use planners, and the elected officials that set policies.

Numerous plans and studies related to water resources and land use management in the Y-M Region have been reviewed to support the development of this IRWM Plan. The Y-M IRWM Plan contains information from local planning efforts that have occurred throughout the Region, and is consistent with and supports locally-led planning and implementation of integrated water management. The reference list provides additional information about the planning documents used in development of the Y-M IRWM Plan.

4.1 Relation to Local Water Planning

The Y-M IRWM Plan in no way replaces or supersedes local planning, but is intended to incorporate, strengthen, and provide tools for local planning efforts. This Plan will support local water management organizations in making local decisions and taking local actions that help accomplish a shared vision for the whole Region. This section contains a description of how the Y-M IRWM Plan incorporates its water management planning and implementation activities with local resource management planning activities.

4.1.1 Local Water Supply Planning

Local water supply planning responsibilities in the Y-M Region are generally carried out by the county and local agencies providing water/wastewater services. Residents in the Y-M Region live in small communities or in rural settings. Much of the Region consists of unincorporated public lands managed by the NPS, BLM, and USFS. Water systems are made up of numerous small, geographically dispersed systems with about half of the residents served by community water systems with the remaining residents on private wells. Approximately twenty community water systems serve a large portion of the permanent residents and there are over fifty non-residential community water systems, serving uses such as recreation areas and campgrounds. Similarly there are only a few centralized wastewater facilities, mainly located in community areas. None of the water systems in the Y-M Region are Urban Water Suppliers (i.e., have over 3,000 customers or deliver more than 3,000 acre-feet per year of potable water), therefore formal water planning is limited.

4.1.2 Incorporation of Water Planning

The Y-M IRWM Plan incorporates elements of local resource management planning documents, including watershed and forestry management plans, emergency response plans, and the General Plan. Many of these planning documents (included in the Technical Analysis Appendix 3-C) focus on improving natural resources with consideration of water resources in the Y-M Region. There only a few water resources planning documents that provide the basis for understanding the water supply and demand conditions, water quality, and water-related infrastructure in the Region. This information also has been used to develop the Region Description (Section 2) and Resource Management Strategies (Section 6). The water management documents used in preparation of the IRWM Plan are listed in the references.

The water management needs, challenges, and conflicts identified and addressed in the Y-M IRWM Plan (see Section 3) were developed through consideration of local water planning activities and stakeholder input. Most of the IRWM Plan goals and objectives detailed in Section 5 relate to improving water planning such as:

- Objective B, improve understanding of groundwater usage, private groundwater wells provide water supply to the majority of the County residents:
- Objective D, identify, manage, and conserve lands for water supply enhancement;
- Objective Q to review ordinances and planning related to water management; and
- Objective W, mitigate flood risk by cooperating with Local Hazard Mitigation Planning activities.

Resource Management Strategies (Section 6) and Project Review and Prioritization (Section 7) for the Y-M IRWM Plan were subsequently developed from the Challenges and Opportunities and Objectives. Furthermore, the Coordination discussion in the Section 9 – Plan Implementation Framework addresses how local water management issues and potential climate change adaptation strategies could be better coordinated at a regional level. In this way, local water planning is woven through the Y-M IRWM Plan in a multi-layered approach.

4.1.3 Climate Change

Climate change is a growing concern of water managers and could likely increase the variability of seasonal runoff and affect water quality, among other factors. Policies and programs to address GHG emission reductions and climate change impacts have been incorporated into Catheys Valley Community Plan Policies and Implementation Measures. 32 energy efficiency mandates have been addressed by the Housing Element of the General Plan (County of Mariposa, 2013a). Mariposa County completed a baseline GHG inventory in 2014 which identified community transportation as the largest contributor, at 55 percent of total GHG, which is consistent with the rural nature of the Region. Climate change impacts have also been considered in the process of developing this Plan and are presented in the Climate Change Vulnerability Checklist, which is available as an appendix to Section 3. This information may provide valuable insight for resource management and planning throughout the Region.

4.2 Relation to Local Land Use Planning

Land use decisions and planning often have a direct influence on water management actions. State policies often attempt to link land use decisions and water management decisions, such as Senate Bill 221 (SB 221) and Senate Bill 610 (SB 610) which require evaluation of water supplies and demands for developments over 500 dwelling units or for developments with similar water demands. However, the Region's low urban development does not meet these policy thresholds, so that integration of land use and water resource management often remains a challenge to be managed by local policies. This section considers the current land use management structure, characterizes the current relationship between land use planners and water managers, and identifies additional opportunities for collaboration between the RWAC and land use planners.

4.2.1 Land Use Management Agencies

There are several entities responsible for land management in the Y-M Region. Land use and water supply planning within the Y-M Region are typically managed by separate agencies. The Region encompasses the entirety of Mariposa County, which does not have any incorporated cities. As such, land use planning in the Region's communities falls under the jurisdiction of Mariposa County. In addition, over half of the Region is public lands managed by federal agencies including the National Park Service, Stanislaus National Forest, Sierra National Forest, and the US Bureau of Land Management. These agencies seek local input in their planning, including updates of forests, wild and scenic rivers, the General Plan and other planning documents as described in Section 4.2.6.

As mentioned above, several planning efforts improve collaboration between and integration of water resource management and land use planning. There are often opportunities during the development of public documents for water managers to provide input to planning managers. Local land use planning efforts that include water supply, distribution and usage planning include the Mariposa County General Plan, Mariposa County Codes and the Local Agency Formation Commission (LAFCO) sphere of influence and municipal service reviews. In addition, activities such as the California Environmental Quality Act (CEQA) document review and commitments provide opportunities to consider water service and availability during land use decision-making of individual developments.

4.2.2 Mariposa County General Plan

Although water resources are not typically discussed as a separate 'element' in the general plan, they play an important role in the land use decisions that are made under the guidance of general plans. General plan development, implementation and updates provide a forum for coordination and collaboration between land use planning agencies and water managers. One challenge for land use planning is that comprehensive General Plan updates are not always prepared on a consistent basis and can take a long time to complete.

The Mariposa County Planning Agency prepares the General Plan for the administration of specific plans, zoning and subdivision ordinances. The planning agency is comprised of the County Board of Supervisors, Planning Commission, Planning Department, Planning Director and various Planning Advisory Committees. This Agency is separate from LAFCO.

In the process of the General Plan development, the Planning Agency consults with various local agencies and County departments to ensure consistency of the General Plan with ongoing programs and projects. Additionally, the County Planning Agency promotes public interest in and input to the General Plan. Public participation is also encouraged for reviewing County Code Amendments and reviewing discretionary projects subject to CEQA.

The General Plan provides a long-range vision and policy direction for the County, serving as a land use regulation tool. The Plan includes seven mandatory elements: Circulation, Conservation, Housing, Land Use, Noise, Open Space and Safety. The Plan also includes six optional elements of local interest: Agriculture, Arts and Culture, Economic Development, Historic and Cultural Resources, Local Recreation and Regional Tourism.

Importantly, the County General Plan also includes various water-specific policies and provisions that enhance efficient use and protection of local water resources and other natural resources. For the Residential Land Use and Circulation, Infrastructure and Services Elements, provisions and policies state:

- New subdivision lots must be served by a Health Department – approved potable water supply
- A disclosure statement is required if a property is to be served in the future by a well
- "New projects and subdivisions should be served by basic water and wastewater infrastructure"
- "New parcels must have approved areas for onsite or community system sewage disposal"

Water resources are also discussed in depth within the Conservation and Open Space Element. The goal is to "Protect and manage the use of Mariposa County's limited water resources," which is to be accomplished by the following policies:

- "Conserve water to accommodate County growth and sustainable agriculture" (Policy 11-2a)
- "Preserve surface and sub-surface water quality" (Policy 11-2b)
- "Preserve the existing or potential sources of a sustainable water supply" (Policy 11-2c)

Of high importance and relevance to this IRWM Plan is also the goal to "Conserve the natural and scenic resources, and open space lands to protect and enhance the County's quality of life and character ensuring a viable economy." In order to reach this goal, the County is required to "Collaborate with other public and private agencies for conservation management plans and programs." This collaboration with the County, which should involve federal, State and other public and private agencies, is also a crucial component of this IRWM Plan (County of Mariposa, 2013b; County of Mariposa, 2006).

Generally, the policies and provisions set forth in the County General Plan are implemented through County ordinances and standards. Numerous County Code requirements consider local water and other natural resources, including ordinances related to Health and Safety, Water and Sewers, Subdivisions, Zoning, Mining, and other land use regulations. Among these ordinances, are requirements related to waste and hazardous substances disposal and storage, controlled burns and clearing of brush and vegetation, water supply, well and sewer regulations, construction ordinances, and mining regulations (County of Mariposa, 2013a). These County ordinances provide valuable tools to protect and improve the health of the Region's watersheds and natural resources.

4.2.3 Local Agency Formation Commission

LAFCOs are similar to regional planning bodies in that they promote orderly growth and development, as well as, logical formation and determination of local agency boundaries. However they are prohibited from directly regulating land use, property development, and subdivision requirements. LAFCO responsibilities in Mariposa County include the formation of new special districts, and boundary changes for districts, which may lead to the creation of new services or increase the level of existing services. LAFCO activities encourage public participation and enhance agency collaboration. For example, LAFCO municipal service reviews (MSR), which are required to update an existing agency Sphere of Influence, help identify opportunities for greater coordination and cooperation between providers (County of Mariposa, 2013a). It should be noted that LAFCO does not apply to private water providers, of which there are over 50 in the County.

4.2.4 CEQA

The development review process for projects subject to CEQA enhances agency collaboration and integration of water and land use planning. Among the multiple elements analyzed for impacts are hydrology and water quality, land use/planning, and utilities and service systems, which together include water supply, water quality, flood hazard, and wastewater treatment capacity considerations. Comments during this process may come from diverse agencies including the California Department of Public Health, the State Water Resources Control Board, California Department of Fish and Wildlife, US Army Corps of Engineers, National Park Service, BLM, National Forest Service, County Health Department, Mariposa County Public Works Department, and County Building Department as well as other local agencies and private citizens. This process thereby provides opportunities for enhanced collaboration and coordination between water and land use management (County of Mariposa, 2013a).

4.2.5 Agricultural Land Use and the Williamson Act

The agricultural and ranching sectors in the Region have benefited widely from participation in the Williamson Act, which enables local governments to enter into restrictive contracts with private landowners of agricultural lands to preserve agriculture in exchange for reduced taxes. It is a non-mandated state program administered by counties and cities to preserve agricultural land and discourage the premature conversion of agricultural land to urban uses. Mariposa County's 20-year rolling contracts significantly restrict land uses and development.

As of 2010, within Mariposa County, 208,586 acres are under the Williamson Act contract, which is 48% of all county lands in private ownership (County of Mariposa, 2013b). Until recently, the state offered financial support to the Williamson Act by providing subvention payments to county governments to help offset county property tax losses. Recent state budget cuts have eliminated state funding for the Williamson Act, resulting in the need for county governments to either fund the program at the county level or allow Williamson Act contracts to expire. While some counties chose not to renew their contracts as a result of non-payment by the State, Mariposa County has maintained the program based on strong local policies supporting agriculture and in the hopes that State funding will resume as the economy improves.

4.2.6 Public Land Use and Management

Public lands make up approximately 53% of the total Y-M Region, and are managed by the National Park Service, US Forest Service (USFS) Stanislaus National Forest, USFS Sierra National Forest, and the US Bureau of Land Management (BLM). More specifically, USFS-managed lands comprise 174,040 acres, NPS-managed lands comprise about 242,485 acres and BLM-managed lands comprise 76,397 acres (BLM, 2011).

Each agency has a unique set of land use and resource management directives and objectives, but all are interested in balancing water resources management with land use objectives. Stanislaus National Forest goals, objectives and management practices, for example, include protection and improvement of water quality and watershed conditions through implementation of the Stanislaus National Forest Plan – Forest Plan Direction, the Merced River Wild and Scenic River Management Plan and the Forest Service Manual. Currently, there is limited comprehensive coordination between these public land use managers and the RWAC or local water managers, as no formalized forums for collaboration are in place.

In addition, many of the broad Federal resource plan documents are over 20 years old such as the BLM South Fork Merced River Implementation Plan and the Yosemite National Park General Management Plan. Broad plans have been replaced with more topic or geographic specific plans such as the Yosemite Valley Plan, Invasive Species Management Plans, and Forest Roads analyses. A pilot effort to update the Forest Plan is underway in the Sierra National Forest which follows the completion of the Bio-regional assessment and other assessments that document current forest ecological, air, soil, water resources, and quality, at-risk species as well as social, cultural and economic conditions.

4.2.7 Fuels and Fire Management

Given the large proportion of undeveloped forest lands within the Y-M Region, forest and wildland management is an issue of high priority. As discussed in Section 3, wildfires are prevalent in the Region and their frequency and intensity have direct implications on water resources and water quality. As a result, the management of fuels and fire is a critical factor in integrated water resource management.

The following sections provide a discussion on fuels and fire management on privately and publicly owned lands as well as potential future developments in wildfire management.

4.2.7.1 Fuels and Fire Management on Private Lands

Various efforts exist to provide assistance to private property owners for managing fuels, such as in the form of financial, technical and educational assistance.

Active participation by the citizens is considered to be an essential factor in reducing the risk of wildfires. There is a large influx of new residents to the Y-M Region, generally coming from more urbanized areas and are therefore often unaware of the wildfire risk in the Region. Wildfire education to increase public understanding of living in the fire-adapted ecosystem is a high priority in the Region and is needed on an ongoing basis for highest effectiveness.

Mariposa County Fire Safe Council

The Mariposa County Fire Safe Council, is a 501(c)3 non-profit, non-governmental and non-regulatory community partnership of Mariposa County residents, property owners, businesses, organizations, and agencies. The Council was formed in 1998 as a grassroots community effort to increase awareness for the dangers of wildfire in the wildland urban interface (WUI) and mobilize Mariposa County residents to make their homes and communities fire safe. In efforts to reduce the vulnerability to wildfire threats, the Council provides valuable resources to residents through education and outreach events, and implements various fire prevention and fuel reduction projects, such as chipping services. The Council depends on grant funding to implement their projects (MCFSC, 2013).

Mariposa County Resource Conservation District

The Mariposa County Resource Conservation District (MCRCD) provides technical, financial and educational resources to assist communities in preserving the natural resources of Mariposa County. The MCRCD supports increased interagency efforts and develops cooperative alliances with other agencies and community organizations, including a partnership with the Natural Resources Conservation Service. Among MCRCD activities is participation in Fire Safe Council events (MCRCD, 2012)

Community Wildfire Protection Plans

Community Wildfire Protection Plans (CWPPs), which are encouraged under the Healthy Forest Restoration Act of 2003, are also valuable resources that help guide the management of forests and rangelands on private property to protect human life and reduce property loss and facilitate acquisition of grant funding for hazardous fire management projects.

The Mariposa Countywide CWPP was developed in a collaborative effort between fire districts, local government, community-based organizations and federal land management agencies. The Mariposa County Fire Safe Council was among the major participants in its development. A major component of the plan is the management of forests and rangelands for hazardous fuel reduction and fire resilience. Overall, it provides an essential resource for understanding wildfire risk and prioritizing measures to reduce potential wildfire risk and associated losses in the Region. In addition, the CWPP enhances the County's ability to acquire grant funding for projects related to wildfire management and protection (County of Mariposa, 2010).

The purpose of the Mariposa Countywide CWPP is as follows:

- Protect human life and property from wildland fires
- Restore fire-adapted ecosystems
- Increase public understanding of living in a fire-adapted ecosystem
- Instill a sense of personal responsibility for taking preventative actions regarding wildland fire
- Increase communities' ability to prepare for and respond to wildland fires
- Improve the landscape's fire resilience while protecting other social and ecological values.

The goals of the plan are to: (1) coordinate hazardous fuel reduction treatments across boundaries because wildland fires do not pay attention to political boundaries; (2) promote a better understanding of living in a fire-adapted environment; and (3) promote personal responsibility for taking preventative action.

The communities of Yosemite West and Foresta have developed their own CWPPs with assistance from the National Park Service. Both communities are susceptible to a large-scale, stand-replacing wildfire and pose direct fire threats to Yosemite National Park. The Yosemite West and Foresta CWPPs provide prioritized courses of actions to mitigate impacts of wildfires to those communities and implement effective management measures to reduce wildfire threats.

<u>California Department of Forestry and Fire Protection</u>

The California Department of Forestry and Fire Protection (CAL FIRE) provides important services for fire protection and stewardship on privately-owned wildlands. It provides critical fire response to numerous counties in the state, including Mariposa County. Among the valuable services provided through CAL FIRE is the administration of cost-share assistance programs, such as under the California Forest Improvement Plan and Proposition 40. These programs help reduce wildland fuel loads and improve the overall health of private forest lands with grant funding of up to 75 percent and in special instances, up to 90 percent. CAL FIRE also provides education on fire prevention, fire safety and natural resource protection through exhibits, printed materials, school programs and other media (CAL FIRE, 2013).

CAL FIRE also assesses annual fire prevention fees that are imposed on rural residents living in State Responsibility Areas (SRA). These areas lie outside of incorporated city boundaries and not on federally owned land, where the State is financially responsible for prevention and suppression of wildfires. A fee of $150 is assessed per habitable structure (BOE, 2013).

4.2.7.2 Fuels and Fire Management on Public Lands

Fuels and fire management on federal lands is led by the US Forest Service, BLM, and National Park Service. As mentioned in Section 3, fire suppression has been a major component of forest management in the Region and has contributed to fuels buildup and modified fire regimes. Forest management on federally owned properties is often influenced by public opinion, which may limit implementation of more progressive management techniques. However, high intensity, disastrous fires in past years is causing a shift in fire management towards enhanced fuels reduction and restoration of fire dependent ecosystems.

The US Forest Service, BLM and National Park Service are cooperating with other federal agencies in a comprehensive strategy for managing wildland fires. This National Cohesive Wildland Fire Management Strategy focuses on ecosystem restoration, community preparedness and wildfire response. Management techniques under this strategy include prescribed fires and forest thinning, increasing community resilience to fires and enhancing preparedness of response teams (Forests and Rangelands, 2013).

US Forest Service

The US Forest Service recognizes the large role that natural fire plays in the health of natural ecosystems and the importance of research and technology for improved fire management. The US Forest Service manages prescribed fires and conducts thinning of overgrown sites. The US Forest Service also provides assistance for enhancing community resilience to fires, which may include grants to develop community wildfire protection plans (USFS, 2013a).

Bureau of Land Management

BLM works collaboratively with other agencies and local communities to protect people and property from wildfires. In efforts to address hazardous fuels accumulation and threats of increasingly disastrous fires, BLM uses suppression crews to reduce hazardous fuels and restore fire dependent ecosystems on public lands. During times of high fire risk, BLM may issue fire restrictions that prohibit open fires on public lands, such as was issued in June 2013 for Mariposa County (BLM, 2013a; BLM 2013b).

National Park Service

The National Park Service has taken a very proactive approach in the management of fuels and fire in Yosemite National Park. Highly monitored and extensively studied prescribed burns are a major component of forest management in this national Park. Fuels are reduced by burning unwanted understory, which can enhance the re-establishment of native vegetation and reduce risks of high intensity fires. This approach aligns with management techniques of pre-European settlement and has shown a high level of success in Yosemite National Park.

Studies indicate that this progressive method of managing understory may also have positive result in increased groundwater storage of affected watersheds, which provides another critical link to water resources management (Franklin, G. 2013).

4.2.7.3 Future Fuels and Fire Management

Wildfire trends in the Y-M Region have shown increased frequency and intensity in fires in recent years. Climate change impacts, which include overall warmer and drier conditions, will

likely impact fire regimes and increase susceptibility to disastrous fires in the Region. Efforts to prevent wildfires including fuel management as well as public education and participation, will therefore become increasingly important.

Wildfire threats have implications for water quality and water supply in the Region. As a result, effective integrated resource management is critical. An approach that may come under more consideration in the future may be the concept of community forests to increasingly integrate private and public land management and enhance the community role in forest management and land use decision making.

4.2.8 Potential Areas of Improved Land and Water Resources Planning Collaboration

A strong relationship between land use planning and water resources planning is essential to optimizing resource management in the Y-M Region. It is therefore important to understand where improvements may be needed. The IRWM process provides a collaborative forum between land use management agencies and water suppliers that focuses on developing a common understanding of regional water supply and growth capacity. However, specific, local land use decisions are often not based on the broader regional water supply context. Conversely, water agencies may not have an understanding of long-term development plans, which hinders their ability to ensure a reliable and sustainable supply.

When updating the General Plan, land use planners may wish to consider implementing policies that consider water resources, such as conservation and supply reliability in the future and including drought conditions, before approving new development and take into account long-term water infrastructure planning and water utility capacity when reviewing new development.

With the high priority on forest and fire management in the Y-M Region, improved coordination between forest managers, County representatives, and water managers may provide additional benefits to the Region's resources management.

The RWAC and land use managers are considering ways in which to improve collaboration on a variety of topics and areas of focus, such as flood plain management, flood control planning, groundwater management, treatment and conveyance facilities, stormwater management, water conservation efforts, watershed management, recreational area management, land use changes, general plan updates, water supply for emergency planning, and habitat management.

Much of the collaboration and coordination in the past occurred through the development and implementation of formal documents, such as the General Plans, flood insurance studies, watershed assessments, watershed sanitary surveys, and stormwater management programs. However, there is limited formal consultation between planning agencies and the public and water interests during the preparation of these documents and when entitlement decisions about land use are under consideration by land use managers. The IRWM Plan may be another forum to improve education on these land use decisions.

The RWAC is encouraged to consult and collaborate with land use managers in the planning and development of projects that address water resources-related objectives. Section 9, Plan Implementation Framework, provides additional discussion about opportunities for improved collaboration going forward as projects are developed and implemented.