Mark West Creek

Environmental Monitoring Report WY2023

MARCH 25, 2024

Prepared for the Wildlife Conservation Board
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Contents

1. Introduction

In April 2020, Trout Unlimited (TU), California Sea Grant's Russian River Salmon and Steelhead Monitoring Program (CSG) and Sonoma Resource Conservation District (SRCD) were awarded a Wildlife Conservation Board (WCB) grant to enhance streamflow in the Mark West Creek watershed through the implementation of ten streamflow enhancement projects and to monitor key watershed characteristics. This report is the third of four annual reports that describes the results of our annual streamflow and environmental monitoring activities.

One objective of this project is to provide baseline data on streamflow conditions in critical coho salmon and steelhead rearing reaches in order to document potential impacts of low flow on rearing salmonids. Another objective is to demonstrate if and how stream conditions change with the implementation of streamflow enhancement projects. The project overview map (Figure 1) shows the Mark West Creek watershed and the monitored sites, including the wetted habitat survey extent, continuous water quality logger and flow gage locations, and Sonoma Resource Conservation District's potential project sites.

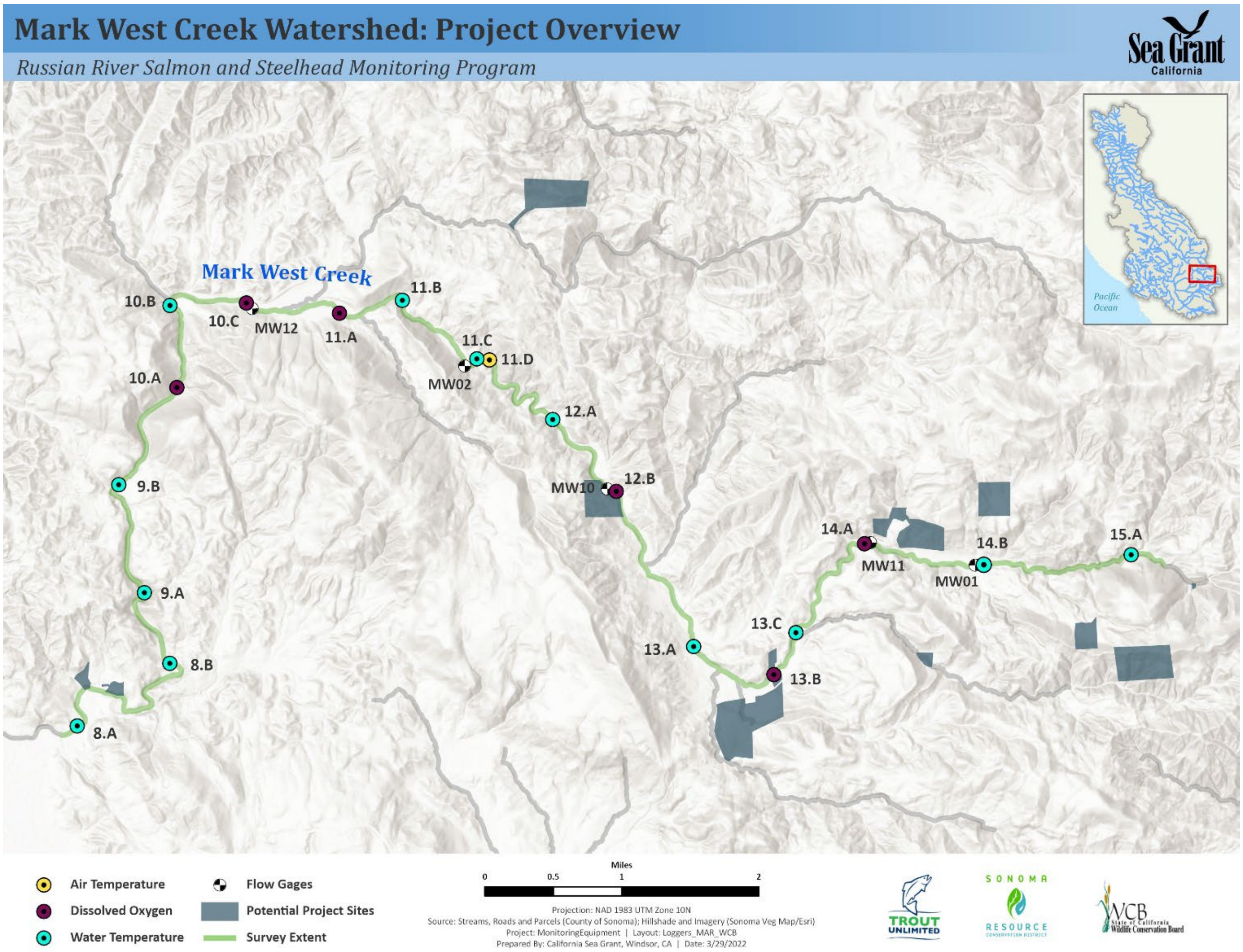


Figure 1. Project overview map, including wetted habitat survey extent, flow gage locations, Sonoma Resource Conservation District's potential project sites and Ca Sea Grant's retired continuous water quality logger locations.

2. Fire

The Mark West Creek watershed has experienced two recent wildfires, the Tubbs Fire and the Glass Fire (Figure 2), that had devastating impacts on the landscape. In October 2017, the Tubbs Fire burned nearly 37,000 acres and over 5,600 structures in Sonoma County (https://wildfiretoday.com/tag/tubbs-fire/), including in portions of the middle and upper Mark West Creek watershed. In September 2020, the Glass Fire burned over 67,000 acres and 1,555 structures in Sonoma and Napa counties (https://abc7news.com/glass-fire-napa-bay-area-wildfire-cal-update/6613102/), including in the upper portion of the Mark West Creek watershed. The Tubbs Fire burned approximately 52% of the area of the Mark West Creek watershed defined as the geographic scope of this project, and the Glass Fire burned approximately 35% of the project focus area within the watershed (Figure 2), resulting in a major cumulative impact. The impacts of the fires on streamflow and habitat conditions are largely unknown, and data collected for this series of reports are among the first to examine post-fire conditions.

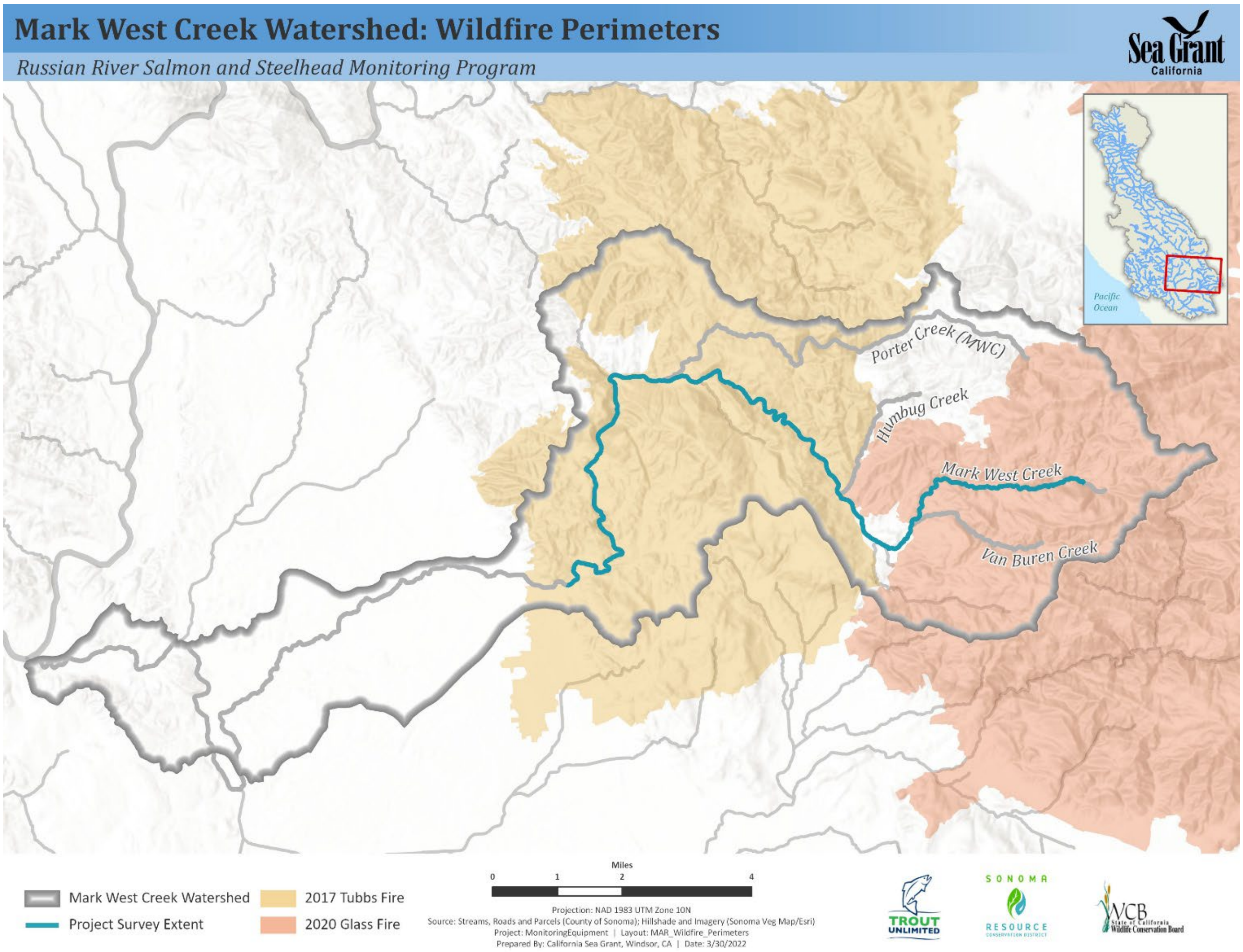


Figure 2. The Tubbs Fire and Glass Fire footprints in relation to the Mark West Creek watershed.

3. Rainfall

Rainfall data were recorded over an 82 water year (WY) period in nearby Healdsburg, CA at National Climatic Data Center (NCDC) Station # 3875 (Healdsburg station, hereafter), median average rainfall at the Healdsburg station is 37.5 inches (Figure 3). Total rainfall in WY2023 was 51.9 inches, 14.4 inches above the long term median, and 20.4 inches higher than the previous year, WY2022 (30.44 inches).

Figure 4 shows total monthly rainfall recorded during in water years 2021 through 2023, with the average monthly rainfall for the 82-year period of record. WY2023 was notably wetter than either WY2022 or WY2021. WY2023 experienced the highest rainfall over the water year in January (18.7 inches), followed by a somewhat dry February. The second-wettest month of the year was March 2023 (14.1 inches). WY2023 also saw the wettest December of the study period. Overall, the rainfall distribution pattern and the total annual rainfall volume in WY2023 was much more supportive to higher summer streamflow than rainfall conditions in WY2022 or WY2021.

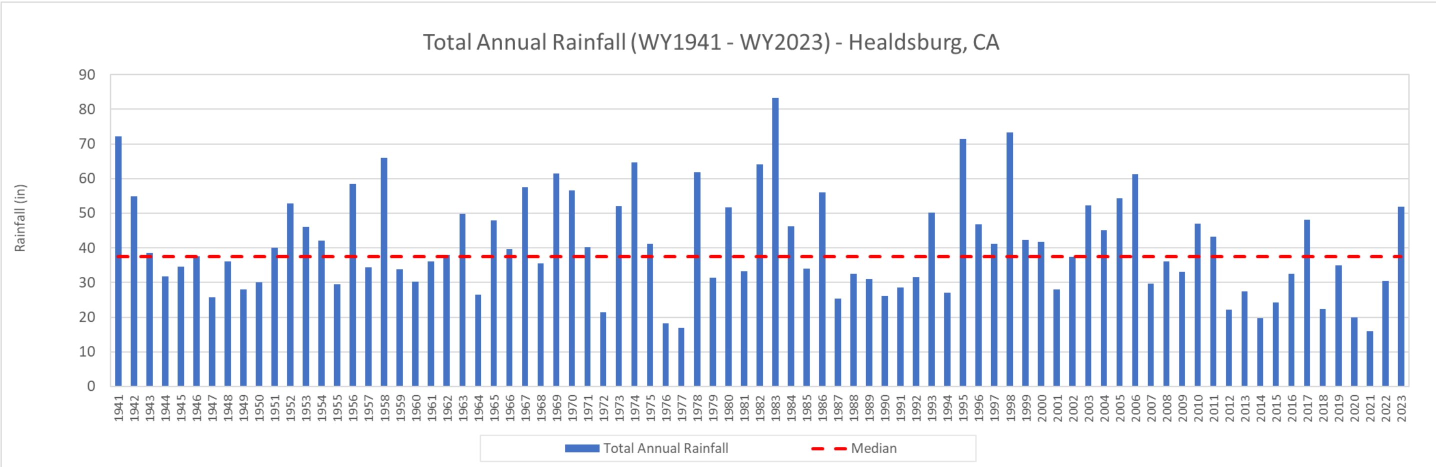


Figure 3. Total and median annual precipitation recorded in Healdsburg, CA (1941-2023) from NCDC station 3875.

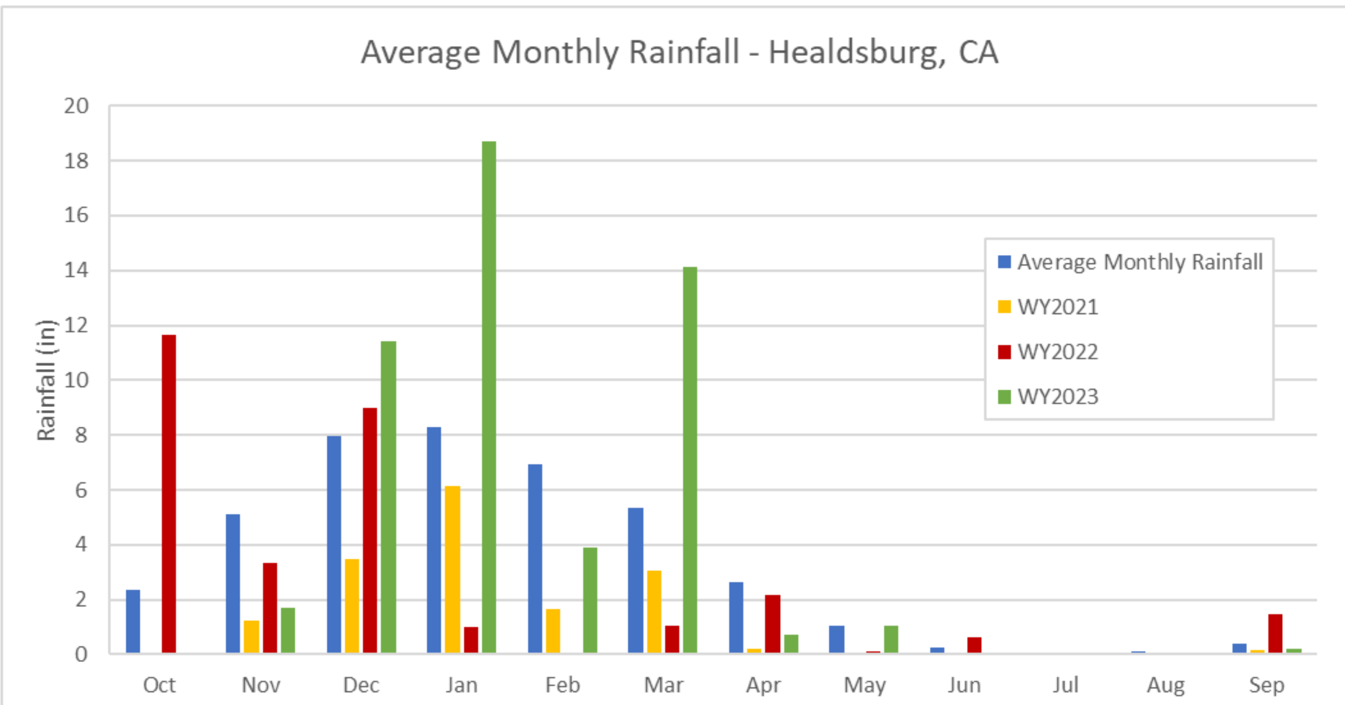
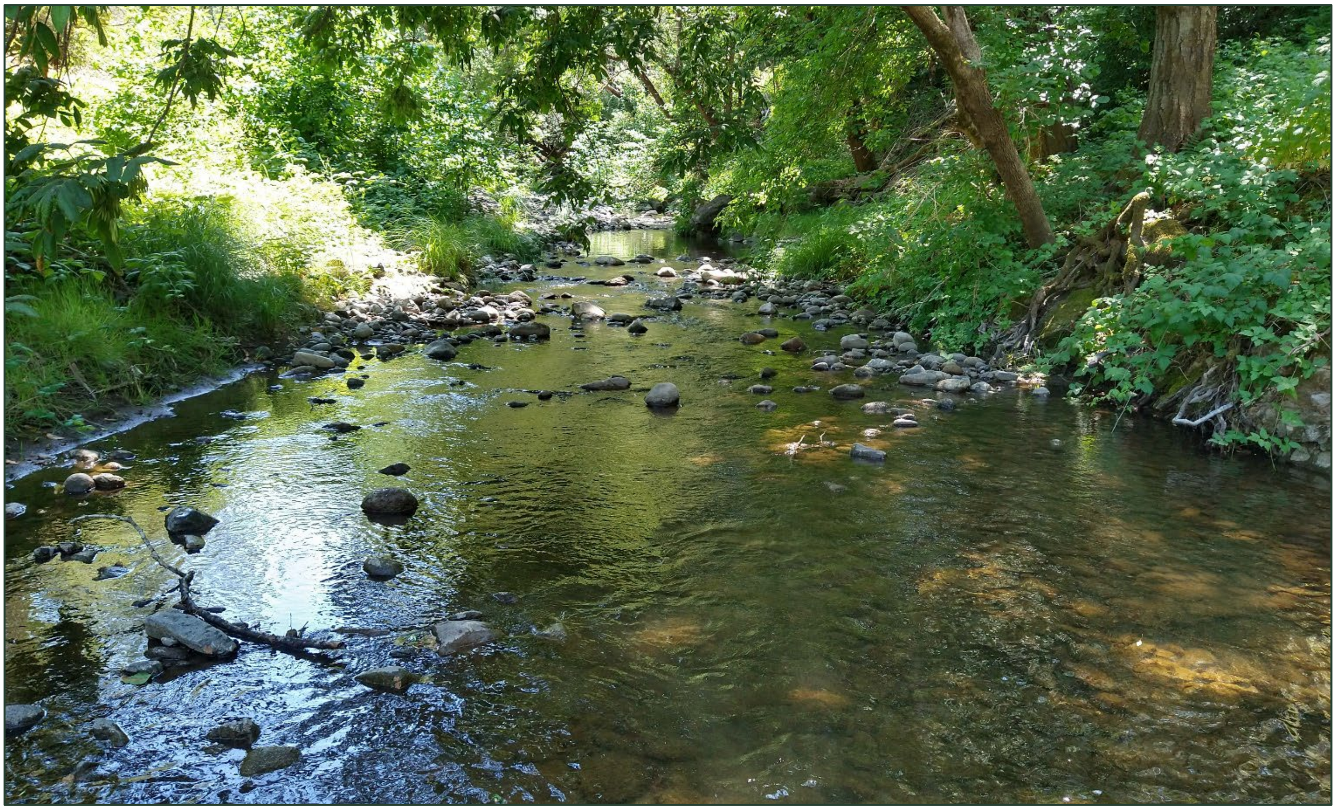


Figure 4. Total monthly precipitation in water years 2021 through 2023 vs monthly average rainfall recorded in Healdsburg, CA from NCDC station 3875.



4. Streamflow

Streamflow was monitored at five sites in Mark West Creek from mid-May through late October in WY2021, and year-round in WY2022 and WY2023 (Figure 1). Low-flow data are presented for the purpose of this report. Adjusted stage data and discrete discharge measurements were used to develop hydrographs for each of the monitored sites for the study period. This section describes stage in WY2023 and streamflow in water years 2021 through 2023 for all gage sites, in order from upstream (MW01) to the farthest downstream (MW12), with the exception of Mark West above Van Buren (MW11), which was not monitored in WY2023.

(MW01) Mark West Creek below Tarwater Road

At site (MW01) Mark West Creek below Tarwater Road, stage began to rise in response to the first storms of the year in December 2022 (Figure 5). The two largest stormy periods of the year occurred in January and March, with stage staying elevated for much of these months. At its highest level, stage rose above 6 feet. Stage began to recede in early April, then then fell through September.

Figure 6 shows streamflow conditions at Mark West Creek below Tarwater Rd in WY2021 through WY2023. Flows in early May 2023 were at the highest of the study period at around 10 ft^3/sec; about 10 times higher then flows in WY2022 at the same time of year. Streamflow in May 2021 was just below 0.5 ft^3/sec and in May 2022 it started around 1.1 ft^3/sec and receded to 0.58 ft^3/sec. Flows in WY2023 reached a baseflow of about 0.5 ft^3/sec in late July 2023, and remained elevated above previous years' base flow until mid-September, when spikes from early fall storms in WY2022 elevated flows. The lower flows in late summer 2022 could be the results of the vegetation regrowth happening in the watershed post fire and an increase in groundwater and surface water diversions to meet increased human water demands. The gage data from WY2022 and

WY2023 shows several potential surface water diversions signals throughout the summer, on the order of 0.02-0.07 ft^3/sec.

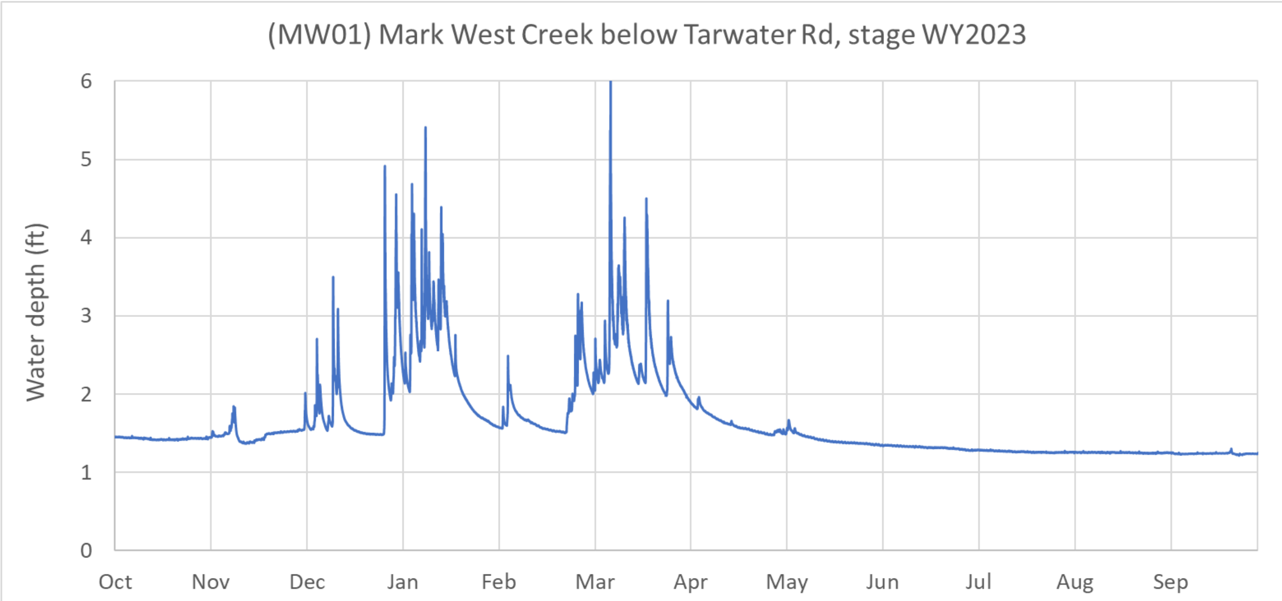


Figure 5. Stage at Mark West Creek below Tarwater Road, WY2023.

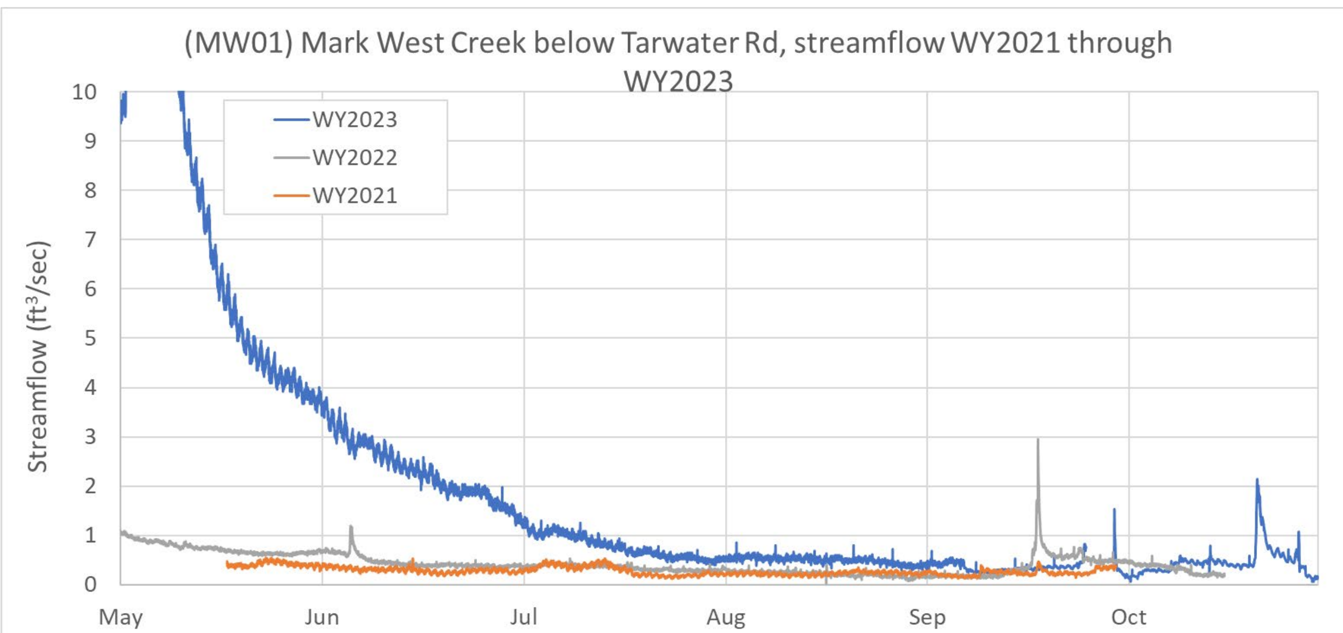


Figure 6. Streamflow at Mark West Creek below Tarwater Road, WY2021 through WY2023.

(MW10) Mark West Creek below Humbug Creek

At site (MW10) Mark West Creek below Humbug Creek, stage began to rise in response to the first storms of the year in December 2022 (Figure 9). The two largest stormy periods of the year occurred in January and

March, with stage staying elevated for much of these months. At its highest level, stage rose to nearly 10 feet. Stage began to recede in early April, then then fell through September.

Figure 10 shows streamflow conditions at Mark West Creek below Humbug Creek from WY2021 through WY2023. Streamflow in May 2023 rose and fell around 18 ft^3/sec, responding to spring storms. Streamflow in May 2021 started around 1.15 ft^3/sec (at the time of the gage installation) and receded to 0.2 ft^3/sec, and in May 2022 started around 1.9 ft^3/sec and receded to 0.74 ft^3/sec. Flows remained elevated well above WY2021 and 2022 flows during May and June 2023. In July 2023, flows receded to levels similar to those seen in WY2022, and remained at a baseflow of about 0.3 to 0.5 ft^3/sec through the remainder of the season.

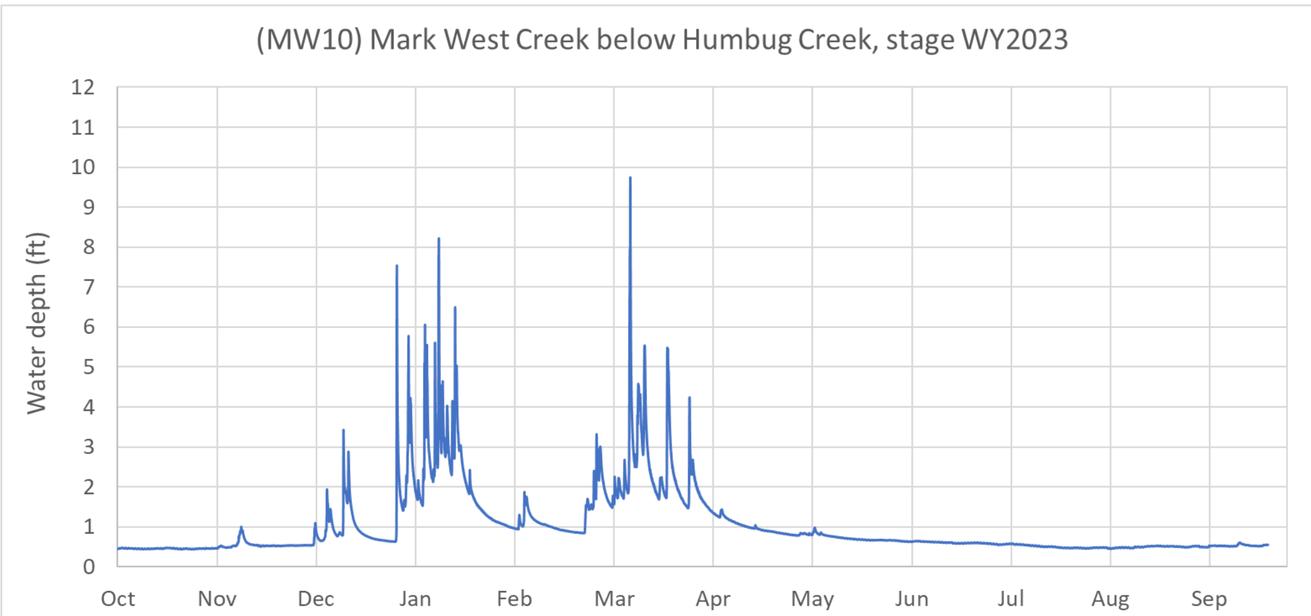


Figure 7. Stage at Mark West Creek below Humbug Creek, WY2023.

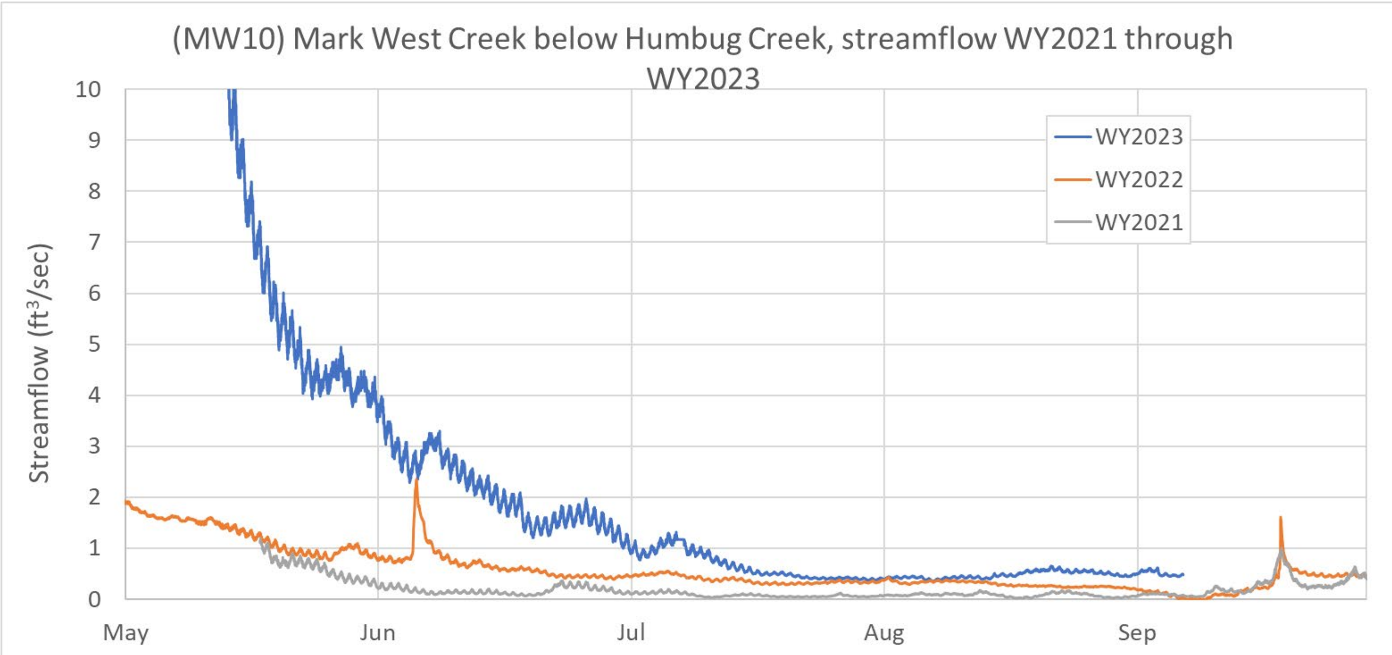


Figure 8. Streamflow at Mark West Creek below Humbug Creek, WY2021 through WY2023.

(MW02) Mark West Creek above Porter Creek

Similar to upstream sites, stage began to rise at Mark West Creek above Porter Creek (MW02) in response to the first storms of the year in December 2022 (11). The two largest stormy periods of the year occurred in January and March, with stage staying elevated for much of these months. At its highest level, stage rose to above 10 feet. Stage began to recede in early April, then then fell through September.

Figure 12 shows streamflow conditions at Mark West Creek above Porter Creek in WY2021 through WY2023. Streamflow in May 2023 rose and fell around 6.5ft^3/sec, rising above 10 ft^3/sec in May storms. By comparison, treamflow in May 2021 was approximately 0.22 ft^3/sec and 3.1 ft^3/sec in May 2022. Streamflow was higher in WY2023 than in WY2021 and WY2022 through the entire summer. Streamflow in WY2032 remained elevated in May and June, before slowly receding to a baseflow of about 0.5 ft^3/sec in mid-July. The gage data show dips in streamflow potentially caused by surface water pumping in mid-July and early August, at a rate of 0.26 ft^3/sec, and throughout the summer at a rate of 0.1 ft^3/sec.

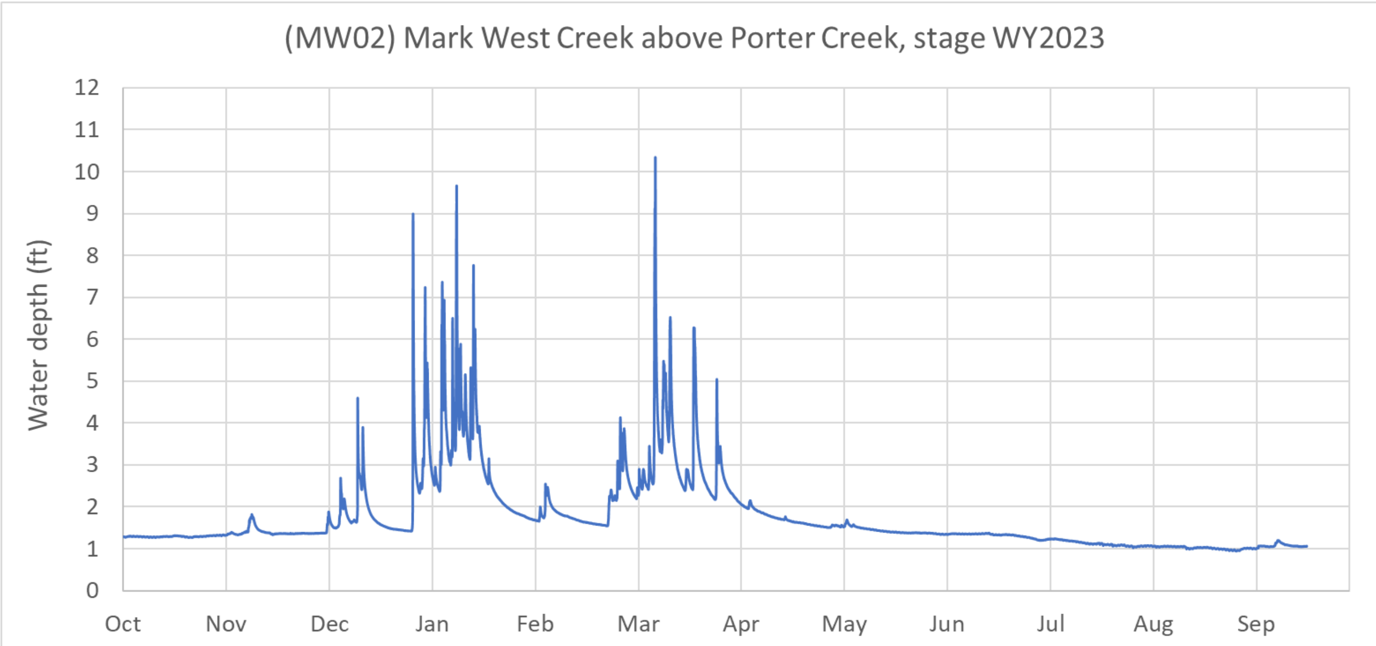


Figure 9. Stage at Mark West Creek above Porter Creek, WY2023.

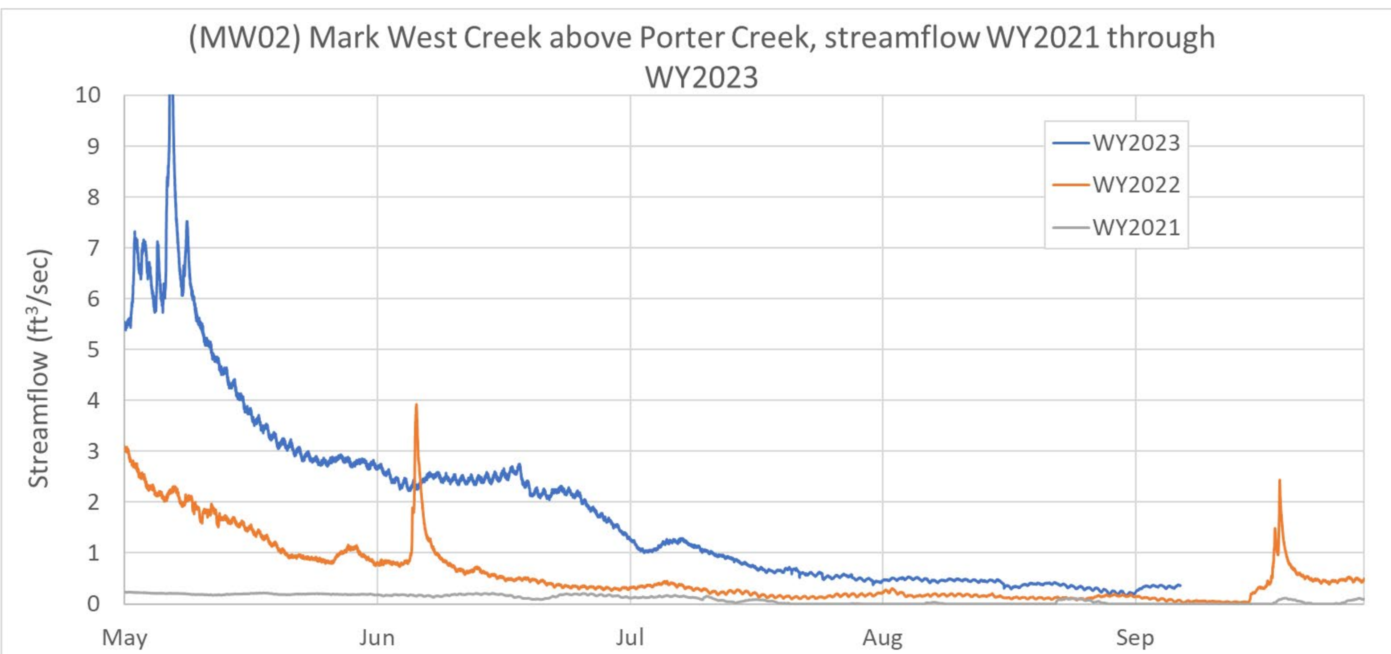


Figure 10. Streamflow at Mark West Creek above Porter Creek, WY2021 through WY2023.

(MW12) Mark West Creek below Porter Creek

For available time periods, stage at (MW12) Mark West Creek below Porter Creek (Figure 13) is similar to stage patterns at upstream sites. Due to technical difficulties, there is a gap in data at MW12 from late November through early June. Stage receded from early June through August, before rebounding slightly in the fall of 2023.

Available data show that treamflow at Mark West Creek above Porter Creek (MW12) was likely higher than at other years through May 2023, and remained elevated above WY2022 and 2021 through the dry season. Streamflow in May 2021 was approximately 0.45 ft^3/sec (at the time of installation) and in May 2022 started around 5 ft^3/sec and receded to 1.48 ft^3/sec. Flows were at about 4.5 ft^3/sec in early June 2023, and reached a baseflow of about 0.3 ft^3/sec in late July 2023. Streamflow was higher in WY2022 than WY2021 through mid-August. By mid-August 2022, streamflow reached a very low baseflow of approximately 0.02-0.01 ft^3/sec.

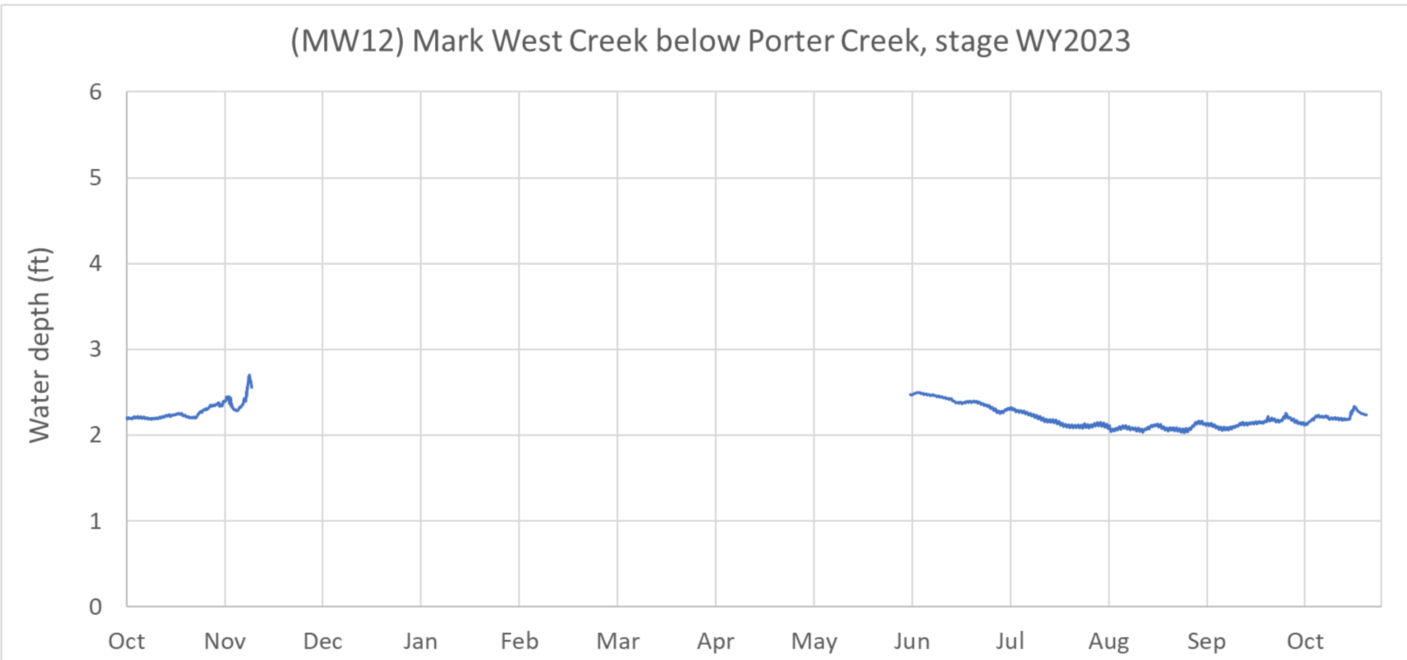


Figure 11. Stage at Mark West Creek below Porter Creek, WY2023.

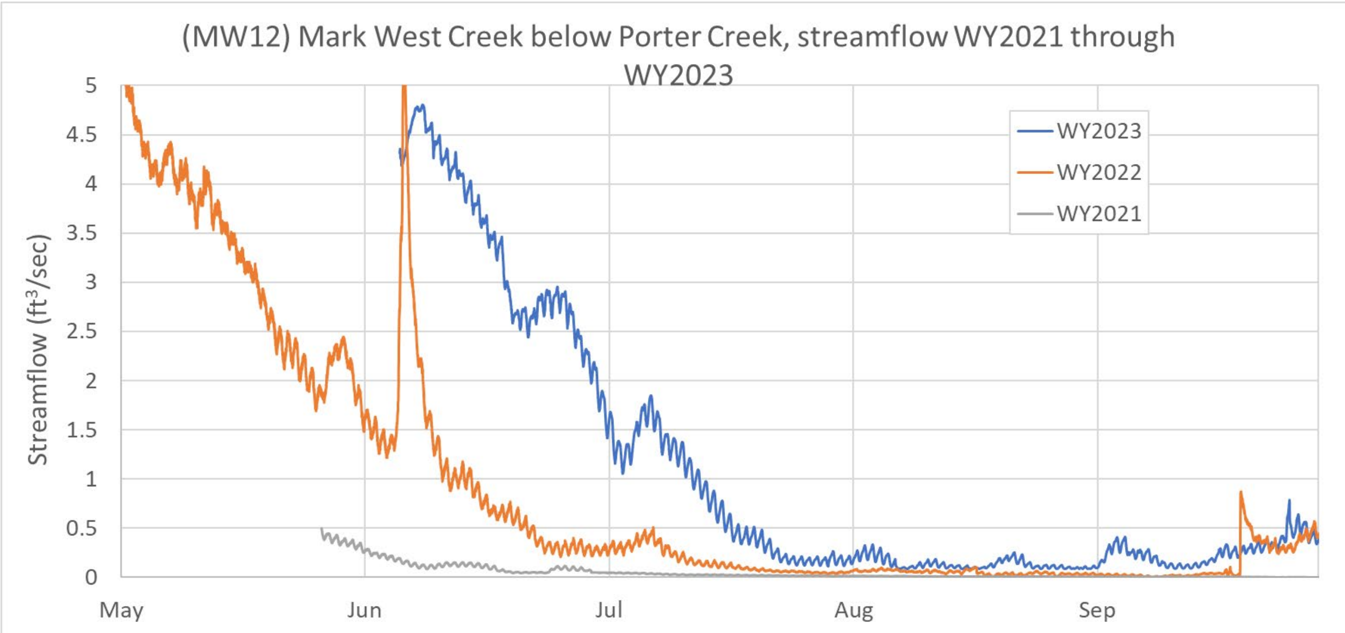


Figure 12. Streamflow at Mark West Creek below Porter Creek, WY2021 through WY2023.

Figures 15a through 15c shows summer streamflow conditions at all gages sites plotted together for each water year. Figure 15a shows streamflow from May through September in WY2021, at all sites in the Mark West Creek watershed. In May, streamflow was very low at all sites (below 1.2 ft^3/sec). Out of all the gage sites, (MW02) Mark West Creek above Porter Creek had the lowest streamflow. Flow slowly decreased and became intermittent at this site, as well as at (MW12) Mark West Creek below Porter Creek. Other sites remained connected at a low summer baseflow. By September, flows began to rebound and the stream reconnected by late October due to the storm.

Figure 15b shows streamflow from May through September in WY2022, at all sites in the Mark West Creek watershed. In May, streamflow was higher at all sites than the previous year, and streamflow increased from the most upstream gage site to the farthest downstream site (as you would expect with the increase in drainage area), with the exception of MW11 which had higher flow than the downstream sites. This streamflow patterned shifted in mid-June and by late summer, (MW02) Mark West Creek above Porter Creek had the lowest streamflow. Flows at all sites rebounded with the mid-September rain event.

Figure 15c shows streamflow from May through September in WY2023, at all sites in the Mark West Creek watershed. In May, streamflow was at the highest levels of the study period. In June 2023, flows were highest at MW12, the most distal portion of the watershed, similar between MW01 and MW10, and lowest at MW02. This streamflow patterned shifted in mid-July, when sites reached baseflow; in late summer MW01 was the highest, MW10 and MW02 were slightly lower and the furthest upstream site, MW12, had the lowest flows.

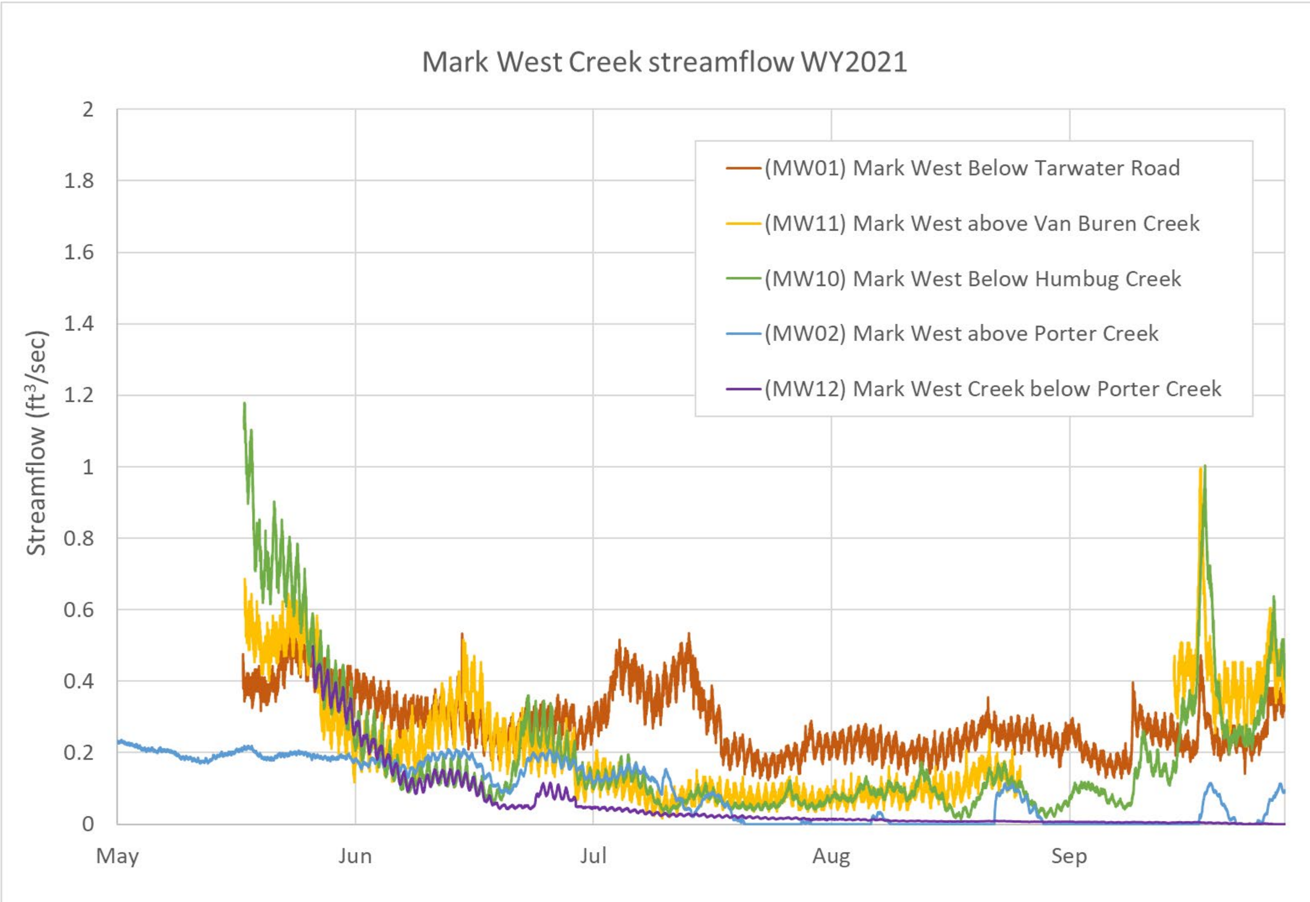


Figure 13a. Streamflow at all Mark West Creek sites, WY2021.

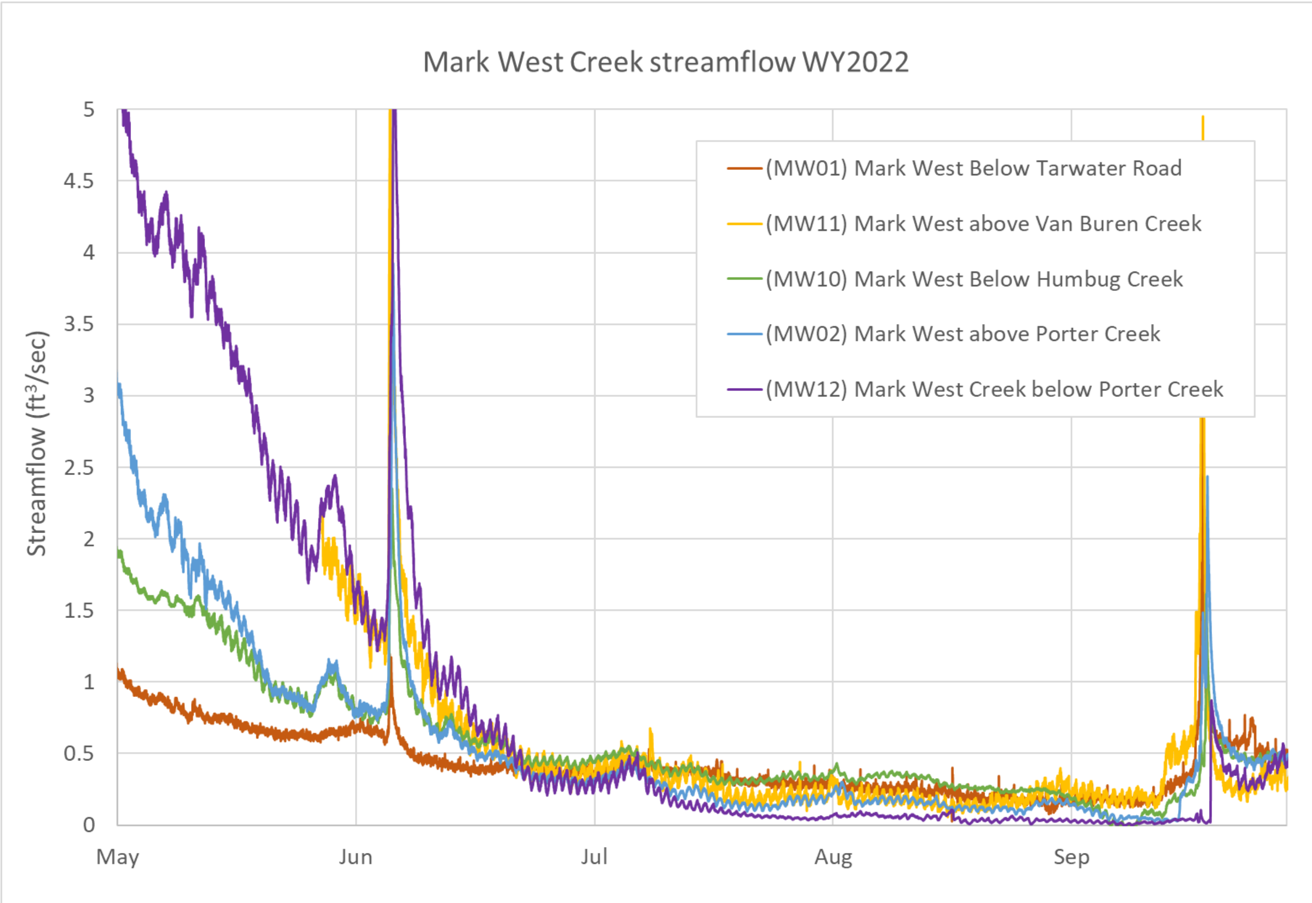


Figure 14b. Streamflow at all Mark West Creek sites, WY2022.

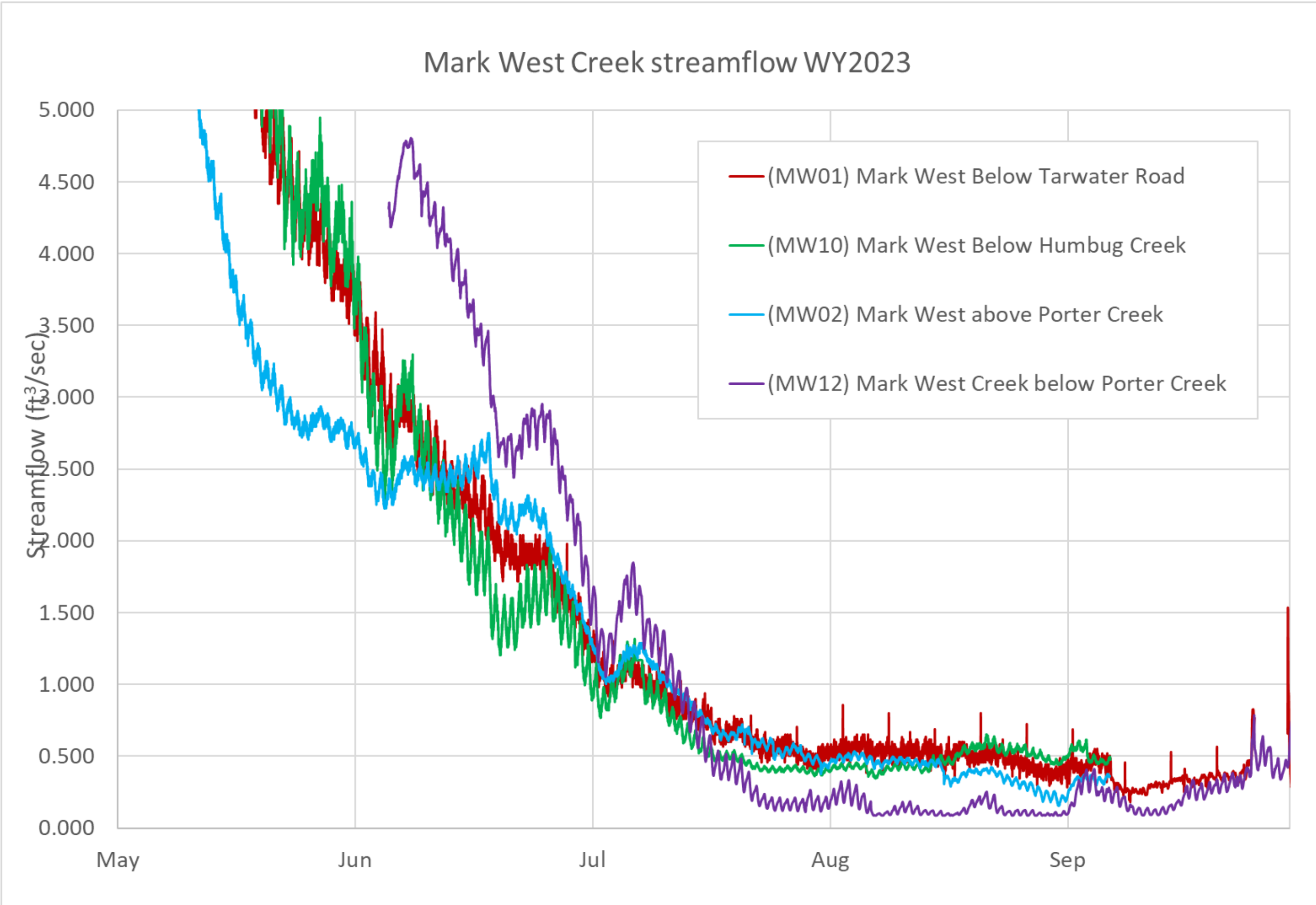


Figure 15c. Streamflow at all Mark West Creek sites, WY2023.

5. Discussion

In 2021, the Russian River watershed, like much of the western region of the United States, experienced exceptional drought conditions on the heels of the severe drought of 2020 (https://droughtmonitor.unl.edu/Maps/MapArchive.aspx). WY 2021 was the second driest year in state record (California Department of Water Resources 2021) and the driest on record at the Healdsburg station. Overall, streams in the greater Russian River basin were drier than in 2015, when the driest in-stream conditions were previously documented at the peak of the recent historic drought .

The 2022 water year was wetter than 2021 and characterized by severe drought in the Russian River region (https://droughtmonitor.unl.edu/Maps/MapArchive.aspx). Rain fall in WY2022 was 7.1 inches below median average, and 14.5 inches higher than WY2021. Streamflow conditions in Mark West Creek in May 2022 were in general approximately 10 times higher than were the previous year.

WY2023 was a well-above average water year, with rainfall 14.4 inches higher than the median, and the highest rainfall on record at the Healdsburg station since 2006. The wettest months were January and March, and while April and May were not notably wet, streamflow was able to persist at elevated levels through the dry season, as compared to WY2021 and WY2022.

While WY2022 was a wetter year than WY2021, streamflow conditions recorded at TU's gage network in Mark West Creek reached similar levels in late summer 2022 as in 2021. This data represents the second year of post-fire data available for the watershed and it is possible it is showing the impacts of vegetation regrowth and human water development in the watershed post fire. Late summer conditions represent a time when evapotranspiration rates are highest, and it's possible that near stream vegetation could be negatively affecting streamflow. Low canopy, near stream vegetation management is recommended to reduce water demand while maintaining the upper canopy, which provides the shade needed to maintain cool water temperatures. Human water demands have also likely increased from WY2021 due to landowners' rebuilding and replanting. Both vegatation and human water demands may have been reduced by 2023. Storage and forbearance projects to reduce both surface and groundwater demands would likely improve late-summer flow.

Late-summer low flows were observed at the five streamflow gaging stations in the Mark West Creek watershed, with streamflow at all sites below 1 ft^3/sec by mid-July. During baseflow, streamflow generally increased from the most downstream gage site to the farthest upstream site (as you would expect with the increase in drainage area). In general, seasonal reduction in flows late in the dry season may be exacerbated by human water demands (both surface and groundwater pumping) as well as an increased evapotranspiration rate from vegetation regrowth post fire.

The primary take-away from the first three years of monitoring is that Mark West Creek provides valuable and relatively rare flow refugia for rearing juvenile coho salmon and steelhead in the Russian River basin, even under severe to exceptional drought conditions, though water quality conditions are in need of improvement. The relationship between streamflow and water quality is not yet clear, but appears to be different than that observed in nearby study streams, such as Green Valley Creek, where surface flow connectivity and increases in streamflow of as little as ≤0.1 ft^3/s have been shown to correspond with improvements in water quality (California Sea Grant 2020). A fourth year of data collection in a wetter water year may yield more conclusive data in regard to the ability of water quality impairment to be remediated through additional summer streamflow.

6. References

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