NWS FORM E-5 U.S. DEPARTMENT OF COMMERCE HYDROLOGIC SERVICE AREA:
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE **SAN JOAQUIN VALLEY - HANFORD, CA**

REPORT FOR:

MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS

MONTH: **March** YEAR: 2023

TO: Hydrometeorological Information Center, W/OH12x1
National Weather Service/Office of Hydrology
1325 East-West Highway #7116
Silver Spring, MD 20910

SIGNATURE: Andy Bollenbacher
(In Charge of Hydrologic Service Area)

DATE: April 6th, 2023

When no flooding occurs, include miscellaneous river conditions, such as significant rises, record low stages, ice conditions, snow cover, droughts and hydrologic products issued (WSOM E-41).

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¦ ¦ An **X** inside this box indicates no flooding occurred for the month within this hydrologic service area.
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The month of March from a hydrological perspective will go down as one of, if not the highest impact month on record for the HNX HSA due to numerous atmospheric rivers in rapid succession of each other. The month got off to an active start with a heavy, low elevation snow event that actually had so much snow, that snow load lead to structural failures for communities in the Sierra Nevada and foothills above 3,000 foot elevation. The snow load issues were likely worsened by an already very large snowpack as the Southern Sierra Nevada at the first of March was already at 207% of the April 1st Avg. Since this was a cold system, snow levels briefly got down to around 1,000 feet and hydrological issues were relatively minimal. At higher elevations in the Sierra Nevada, 3-4 feet of snow fell with this system. The San Joaquin Valley also did receive periods of moderate to heavy rain during this early March event (through March 5th), with ASOS stations recording between .2" and .7" through March 5th. A period relatively quiet weather occurred for the next few days, but flows continued to rise for the Merced River at Stevinson from rain earlier in the year. It reached monitor stage of 68 feet on March 8th at 930 UTC. This calm weather did not last long however as an extremely warm, wet, and devastating atmospheric river began to encroach upon the region on March 9th.

For starters, recent snow that was below 5,000 feet in elevation was shallow enough to have melting potential (rain on snow event), while higher elevation snow was deep and cold enough to absorb the snow (which also increases snow load). This Atmospheric River/plume of subtropical moisture had snow levels at around 10,000 feet, which maximized its ability to bring heavy rainfall to the Sierra Nevada and Foothills. Rain started to fall across the region late on the 9th and spread southward across the region on the 10th. The 10th had the heaviest rain for the event, especially in the foothills. Some locations in the foothills saw 4-7" of rain Madera County and northward on the 10th, with the heaviest rain falling in Fresno, Tulare, and Kern County. Tulare County and Kern County both had catastrophic impacts on March 10th due to extremely high snow levels and the heaviest rain falling there. A few stations measured as much over 11" of rain in the Sierra Nevada in Tulare County in just 24 hours, which ended up being nearly a 1-100 year event for those locations per Atlas 14 data. One station, the Peppermint RAWS station, saw about 14" of rain through the entire event, which lasted through the morning hours of the 11th. Needless to say, there was flooding all throughout the district as rivers raged in response to copious rainfall and some snowmelt below 5,000 feet. Flash Flood Emergencies were issued for the Kern River through Kernville and Wofford Heights as the Kern River raged on March 10th. Nearly 45,000 CFS of inflows were

going into Lake Isabella on the afternoon of the 10th which lead to massive flooding in areas just off the Kern River (Fig 4). Another Flash Flood Emergency was issued for the Springville area in Tulare County. Floodwaters inundated numerous buildings and roads. Nearly 45,000 CFS of inflows into Lake Success also occurred during the peak of the event as the Tule River raged on the afternoon of March 10th (Fig 5.) Flooding also became a concern along Yokhol Creek as high flows from that creek go into the St Johns River. This lead to flooding issues around Exeter on the 10th. Major flooding also occurred through Three Rivers as the Kaweah River raged on the afternoon of March 10th. With all of the water that was coming out of Terminus and Shafter Dam, as well as runoff from Kern County, some flooding began to occur in the old Tulare Lake bed at the end of this event in Kings County.

Flooding was also noted up north in Fresno County, and impacts were felt strongly due to the heavy rain especially in Wonder Valley which runs adjacent to Mill Creek. At one point, Mill Creek had nearly 20,000 CFS of uncontrolled flows which lead to flooding in Wonder Valley. Fortunately, Pine Flat was able to manage outflows for the day as reservoir levels were low. However, the combined flows between Hughes and Mills Creek and what CFS was coming out of Pine Flat did lead to between 23,500 and 25,000 CFS to flow into the King's River. Flood fighting task forces were later deployed to the Mendota and Firebaugh area to help reinforce levees there, which ultimately proved to be a success as both locations avoided major floods. Flooding was also noted in the Auberry area which has been clobbered this year with multiple rockslides and mudslides along Highway 168.

Up in Madera County, there were some hydro issues that occurred on the 10th and 11th due to high releases from the Crane Valley Dam off Bass Lake. Peak flows through Willow Creek were about 2,250 CFS, which activated the Emergency Activation Plan for Crane Valley. Places that normally flood along Willow Creek such as the North Fork were under Evacuation Orders due to the susceptibility of flooding there, especially off of Church Street. A Flood Advisory was initially issued in the early morning hours of March 11th, and got upgraded to a Flash Flood Warning as heavy rain right over Willow Creek created even more flooding compounding the flooding from Crane Valley releases. In Madera County there was also flooding in Oakhurst as the Fresno River and China Creek rose rapidly, with the main impacts in Oakhurst being the Pizza Factory Cooperate Headquarters being flooded off China Creek. Cedar Valley Dam also briefly overtopped on the afternoon of March 10th, but emergency responders were able to deploy sandbags and pumps, and eventually got this earthen dam back within its banks by evening.

Northward in Merced County, flood impacts were less severe as the rainfall amounts were less. That said, Bear Creek at McKee Road did see a significant increase in flows and stage level, with this forecast point reaching monitor stage just after 0300 UTC on March 11th, with a peak of 19.8 feet & 3,674 CFS at 0915 UTC on the same day. Bear Creek exited monitor stage at 0800 UTC on March 12th. For reference, Bear Creek was around 6' stage on the 9th before the heavy rain moved in. In Mariposa County/Yosemite National Park, both Pohono Bridge and Happy Isles didn't see quite a large of a rise as the cold snowpack was able to absorb quite a bit of the rain that fell; neither forecast point reached monitor stage during this event. Other locations across the valley and Coastal Range did see some flooding with about .5" to 1" of rain falling from late on the 9th to early on the 11th, but weren't the same magnitude as what happened in the Sierra Nevada and Foothills, especially in Kern, Tulare, and Fresno Counties. Both the Merced River at Stevinson and the San Joaquin River at Newman were already flowing pretty high leading into the event due to heavy rain from previous months, and did see some rises. Having somewhat longer response times than our other forecast points, it wasn't until 2245 UTC of March 11th that the Merced River at Stevinson eclipsed 70 ft, with a peak of 70.07 feet at 0500 UTC on March 12th. The San Joaquin River at Newman continued to rise throughout the entire event as it has an even longer response time than the Merced River at Stevinson. By midnight of the 12th, 0700 UTC, this forecast point was at

63.67 feet. It reached monitor stage of 63 feet at 0900 UTC on March 11th.

After the main band of precipitation exited the region, southwesterly flow prevailed with cold air aloft. The San Joaquin Valley was well positioned under a diffluent jet stream. Low level moisture was also quite rich due to the heavy rain that had fallen the previous day. Sunshine and favorable shear was able to occur on both March 11th and March 12th, which allowed for discrete supercell formation in the valley once temperatures in the valley reached in the upper 60's to lower 70's. Nearly 1,500 j/kg of ML cape was observed over the area per SPC mesoanalysis on each afternoon. Heavy rain, severe hail, and funnel clouds were observed with the severe weather on each afternoon. A couple of Flash Flood Warnings and tornado warnings were issued during this event. Heavy rainfall rates of about 1" per hour also worsened the ponding of water on roads, especially in Merced, Madera, and Fresno County. On the 13th of March, some cells did form near Los Banos, but didn't quite have the intensity as the previous two days due to warm advection aloft in association with another atmospheric river. This limited CAPE compared to the previous couple of days as the cold air aloft was replaced by a warmer subtropical air mass.

This Atmospheric River had snow levels that were quite high, but not as high as the pervious. Snow levels were estimated to be around 8,000 to 8,500 feet on March 14th. Moderate to heavy rain fell below the snow line and heavy snow above the snowline for this event. Flooding was once again was a concern with this event across the foothills. As the moisture plume pushed through the San Joaquin Valley and foothills through the afternoon. Flash Flooding also became an issue in Mariposa County when a line of cells resembling an NCFR formed over Merced and tracked northeast. Multiple stations recorded instantaneous rainfall rates of 3" to 4" an hour including MCE. In Midpines and Cathey's Valley in Mariposa County, Flash Flooding took out a bridge and also damaged some structures in Midpines in the heavy rain on wet, hydrophobic soil. Bear Creek rose rapidly in Midpines as well, which lead to structural damage to roads and buildings. Bear Creek at McKee Road also saw a sharp response to this heavy rain and runoff, with it cresting at 20.99 feet (4,258 CFS) at 0830 UTC on March 15th. Bear Creek at McKee Road fell though, and went back under monitor stage/17 ft. at 0300 UTC of March 16th. Other hydrological/flooding concerns became apparent again as flows out of Crane Valley once again increased. Willow Creek had peak flows of about 2,500 CFS, which lead more flooding in the North Fork. Once things were all said and done, the Sierra Nevada Foothills saw 3-6 inches of new rain, and the Sierra Nevada got a few feet more snow. Flows continued to rise at the Merced River at Stevinson, and it reached Flood Stage of 71 feet on March 16th at 1800 UTC which triggered a Flood Warning from NWS Hanford.

The continuous rain also exacerbated flooding issues in Tulare County as rain continued there through the 15th. The Tule River became a problem on March 15th as flooding worsened east of Porterville. This was because the dam at Lake Success/Schafer dam was at capacity, so the spillway needed to be activated. Terminus Dam also had very high CFS flowing out of it towards the end of the event on the 15th and the 16th as Lake Kaweah reached capacity. Flows along the St. John's River and Kaweah River increased in response to the outflows out of the Terminus Dam. The spillway was activated at this dam as well due to the dam reaching 119% of capacity. All of this water really started to increase the flooding that had been going on in the Tulare Lake Bed, and massive flooding became even more prominent during this event just south of Corcoran.

A respite in the hyperactive weather pattern occurred between March 16th and March 18th, with the exception of some showers/storms that formed in the Sierra Nevada on the afternoon of the 18th. Some locations got about 2" of rain on the 18th in Madera County near the North Fork and Bass Lake. A more impactful storm system occurred on March 19th; this storm had snow levels of about 6,000 feet. Generally this storm had 1-2 inches of rain in the foothills of the Sierra Nevada below the snow line, with

one to two feet falling above the snowline. A colder system was hot on the heels of the 19th system, bringing with it even more precipitation to the HSA. In between the systems, releases from Friant Dam increased to over 8,500 CFS, so by local policy, a Flood Advisory was issued for the San Joaquin River through about the Mendota area which lasted through at least the end of March. Snow levels with this next system started around 6,000 feet and fell to around 4,000 feet by early on the 22nd of March. With this system, rainfall amounts were similar to the previous; up to ½" of rain in the valley, and 1-3 inches of rain in the foothills below the snowline, with 1-3 feet of snow falling in the Sierra Nevada. The Merced River at Stevinson also briefly dipped out of monitor stage on the 21st of the month at 1915 UTC, but went right back into flood stage just a few days later on March 24th at 1900 UTC. It stayed there almost through the end of the month. Releases from Pine Flat continued to increase towards the end of the month, leading to much higher flows along the King's River than had been seen in years. NWS Hanford issued a Flood Advisory due to the elevated flows on March 24th. Some flooding at the King's River Golf and Country Club was observed towards the end of the month near where the golf carts are located. This Flood Advisory was also kept going through at least the end of the month of March.

The HNX HSA saw a break in the wet, active pattern once again March 23rd through March 27th. The last system that moved over the region occurred on March 28th through March 30th. This was another colder system with snow levels hovering between 4,500 and 5,500 feet. Rainfall amounts of 1-2 inches occurred overnight on the 28th into the 29th in the Sierra Nevada below the snow line, with a few more feet of snow falling in the Sierra Nevada, especially at higher elevations above 7,000 feet through the 30th. On March 31st, dry conditions returned to the HSA, marking a quiescent end of what will be remembered as a devastating and historic March for Central California. The Merced River at Stevinson again briefly went under monitor stage on the 31st of March, however, ended up going back into minor flood stage less than 2 days later.

Needless to say, with the enormous amount of rain and snow that fell over Hanford's HSA through this month lead to a change in the drought monitor. In fact, most of the HSA has been removed from any mention of drought or abnormally dry by the end of March due to the record breaking precipitation (Fig 2). Dam and Reservoir capacities saw major increases through the month due to the heavy rain and runoff. Some of the more notable dams like Pine Flat were releasing 9,500 CFS into the King's River by March 31st. Friant Dam at the end of the month was releasing about 8,500 CFS into the San Joaquin River. During the month of March, Friant had peak releases of 9,050 CFS on March 23rd. Pine Flat was at its peak for the month right on the 31st. A comparison of major reservoir levels from March 1st 2023 to April 1st 2023 can be found at the bottom of this document in Figures 6&7.

The snowpack by the end of the month can be described as nothing less than enormous. In fact, the snowpack in the Southern Sierra Nevada through the end of March was record breaking, well surpassing the 1982-1983 season especially above 8,000 feet elevation. Over 5 feet of snow-water equivalent were present by month's end in the Southern Sierra Snowpack, which is an astronomical 294% of average (Fig 3). By the end of the month, most of the media attention was towards the Tulare Lake Bed, which was estimated to be about 10-15 feet deep in some areas. The looming melt from the huge snowpack and already high flows from Area Rivers continued to be a concern for agriculture impacts in King's County as more flooding in the area becomes increasingly likely going into May and June.

Key Hydrologic/Flood Products Issued for March 2023

Flood Watches

1226 PM PST Tue Mar 7 2023 (through March 15th at 458 AM!)
For Locations below 4,000 Feet (minus Kern Desert)
546 AM PDT Sun Mar 19 2023
Sierra Nevada Foothills
202 PM PDT Mon Mar 20 2023
For Locations below 4,000 Feet (minus Kern Desert)
956 AM PDT Tue Mar 28 2023
Sierra Nevada Foothills

Flash Flood Warnings

29 Flash Flood Warnings (including the 2 Flash Flood Emergencies) were issued between March 10th and March 12th!
First FFW Issued - 631 AM PST Fri Mar 10 2023
Last FFW Issued - 731 PM PDT Sun Mar 12 2023
Link To all HNX March 2023 FFW's (copy hyperlink in new Chrome tab)

Flash Flood Emergencies

Springville – March 10th 2023
Kernville/Wofford Heights – March 10th 2023

Hydrologic Statements

RVS from SJ River at Newman (updated daily upon hitting monitor stage)
RVS for Merced River at Stevinson until it hit flood stage (updated daily)
RVS for Bear Creek at McKee Road each time it went in and out of monitor stage (updated with each RVF)

Bear Creek at McKee Road -

Date	Time	Monitor Stage (17 ft)
3/1/2023	14:15 UTC	Enters
3/1/2023	17:30 UTC	Exits
3/11/2023	03:15 UTC	Enters
3/12/2023	08:00 UTC	Exits
3/15/2023	05:15 UTC	Enters
3/16/2023	03:00 UTC	Exits

Flood Warnings

11 (Including the Merced River at Stevinson)
List of all March 2023 HNX Flood Warnings (copy hyperlink in new Chrome tab)

Flood Advisories (Rivers & Creeks)

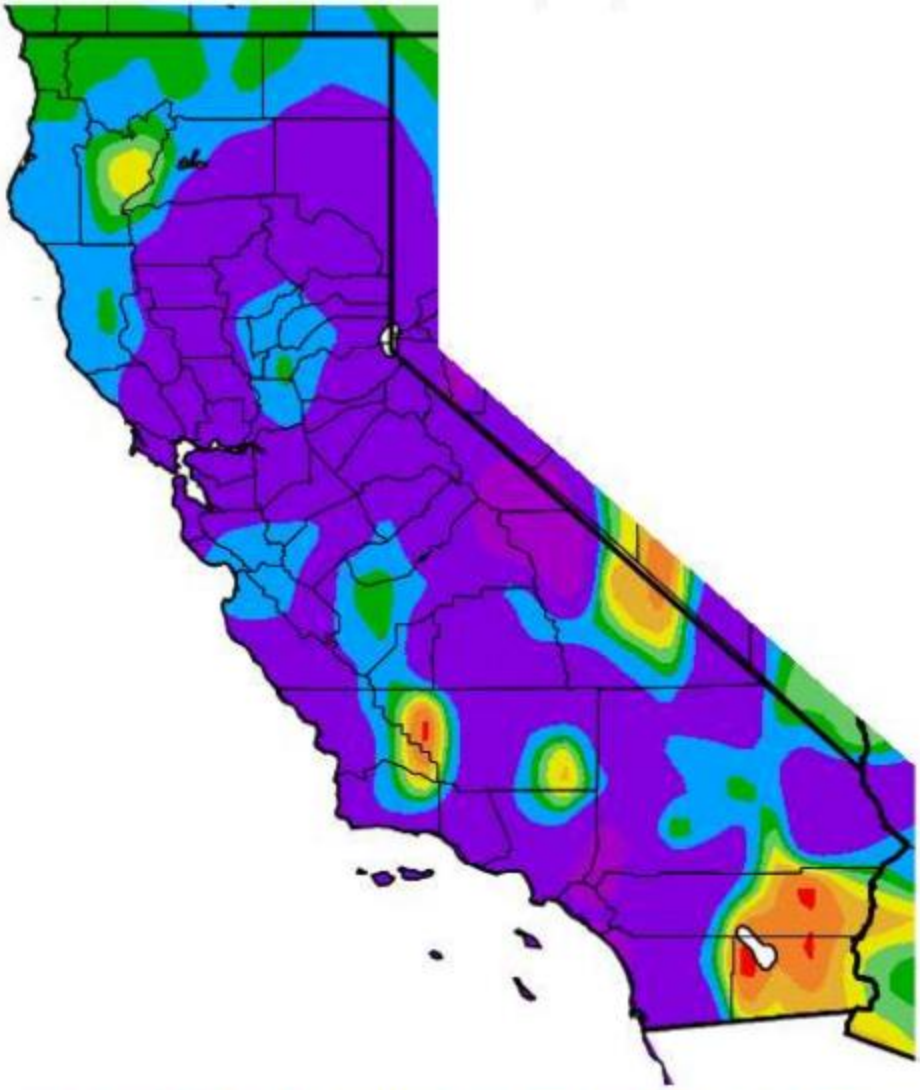
4 (Kings River, San Joaquin River, and Willow Creek - twice)

Rain totals at our 5 ASOS Stations for March:

Bakersfield 2.98”
Fresno 4.00”
Hanford 3.93”
Madera 3.11”
Merced 4.36”

Fig 1 – Percent of Average Precipitation for March 2023

Percent of Average Precipitation (%)
3/1/2023 – 3/31/2023



2 5 25 50 75 100 125 150 200 400 800

Generated 4/ 1/2023 at WRCC using provisional data.
NOAA Regional Climate Centers

Fig 2 – Drought Status for the state of California

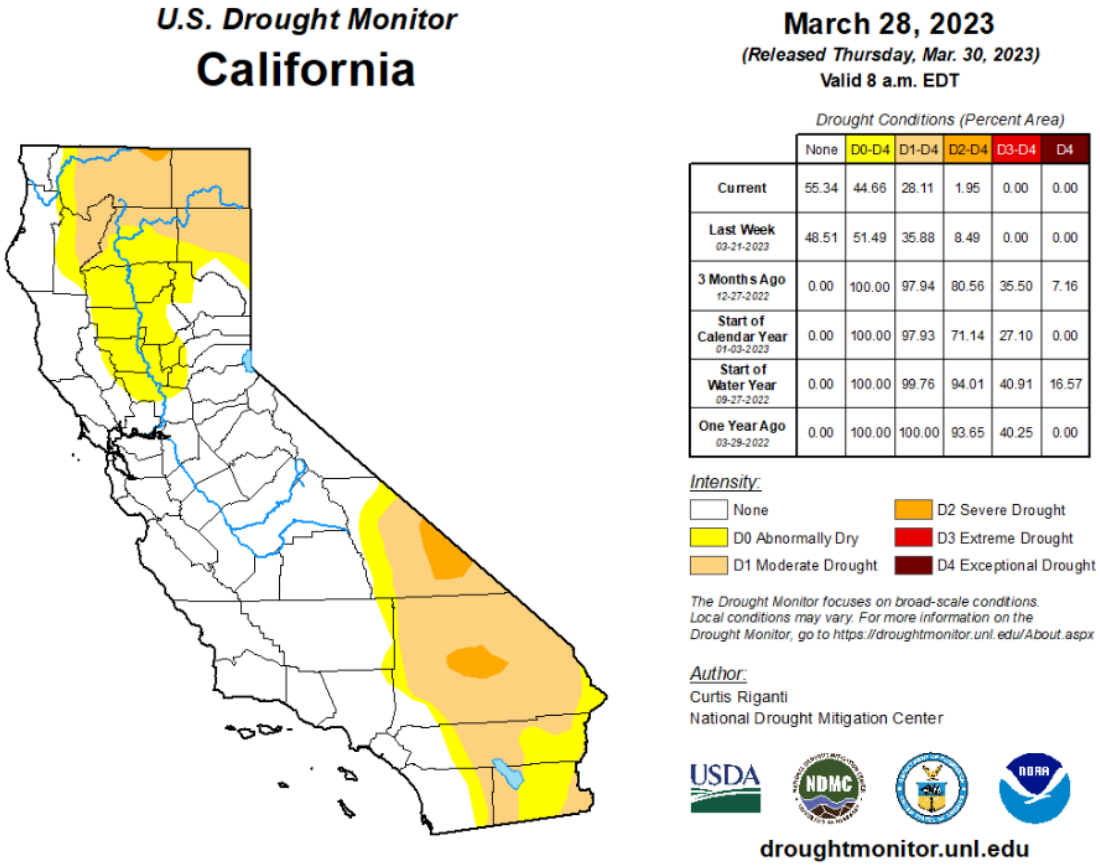


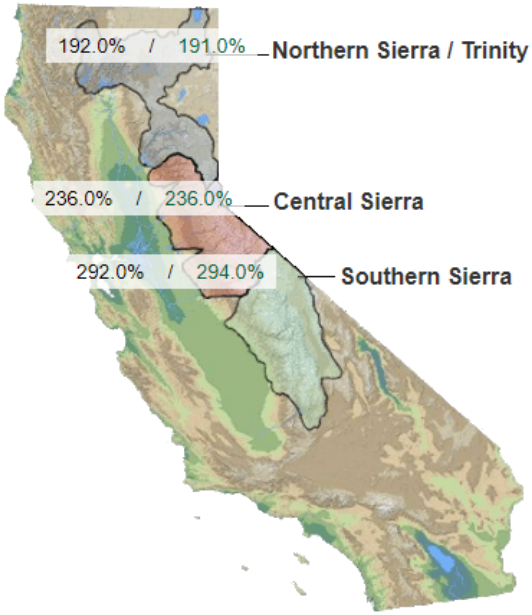
Fig 3 - Snowpack as of March 31st 2023

Snow Water Equivalents (inches)

Provided by the California Cooperative Snow Surveys

Data For: **31-Mar-2023**

% Apr 1 Avg. / % Normal for this Date



Change Date : 31-Mar-2023

NORTH	
Data For: 31-Mar-2023	
Number of Stations Reporting	24
Average snow water equivalent	57.0"
Percent of April 1 Average	192%
Percent of normal for this date	191%

CENTRAL	
Data For: 31-Mar-2023	
Number of Stations Reporting	45
Average snow water equivalent	62.3"
Percent of April 1 Average	236%
Percent of normal for this date	236%

SOUTH	
Data For: 31-Mar-2023	
Number of Stations Reporting	27
Average snow water equivalent	62.5"
Percent of April 1 Average	292%
Percent of normal for this date	294%

STATEWIDE SUMMARY	
Data For: 31-Mar-2023	
Number of Stations Reporting	96
Average snow water equivalent	61.0"
Percent of April 1 Average	236%
Percent of normal for this date	236%

Fig 4 - Extreme Flows through the Kern River

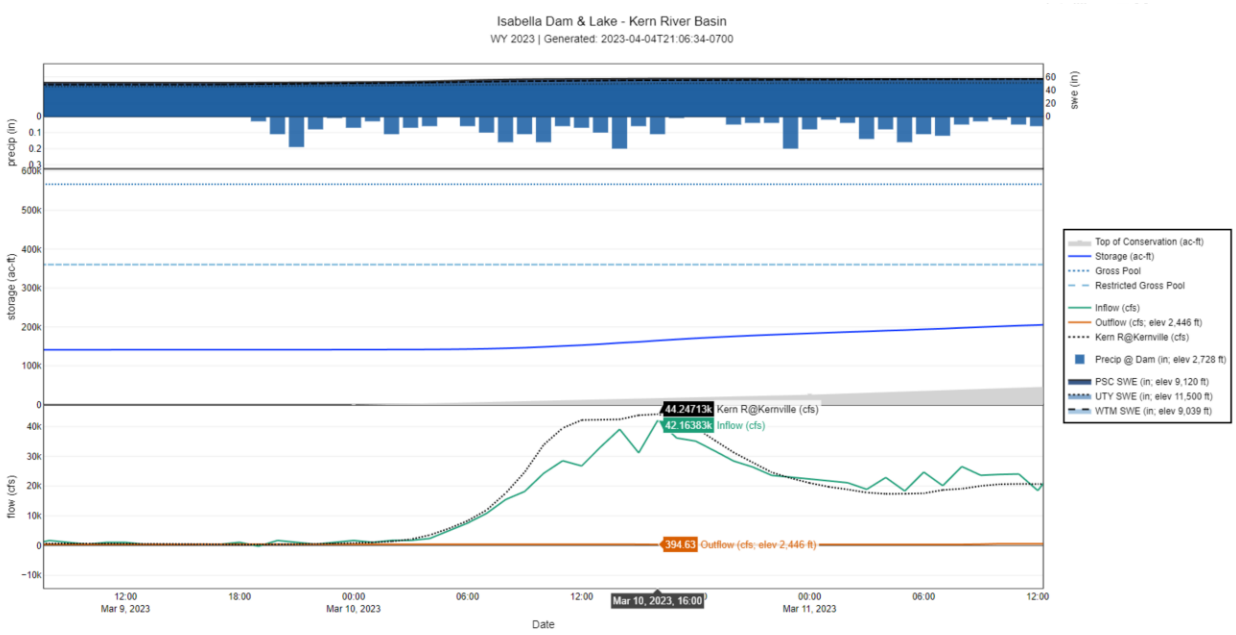


Fig 5 - Extreme Flows through the Tule River

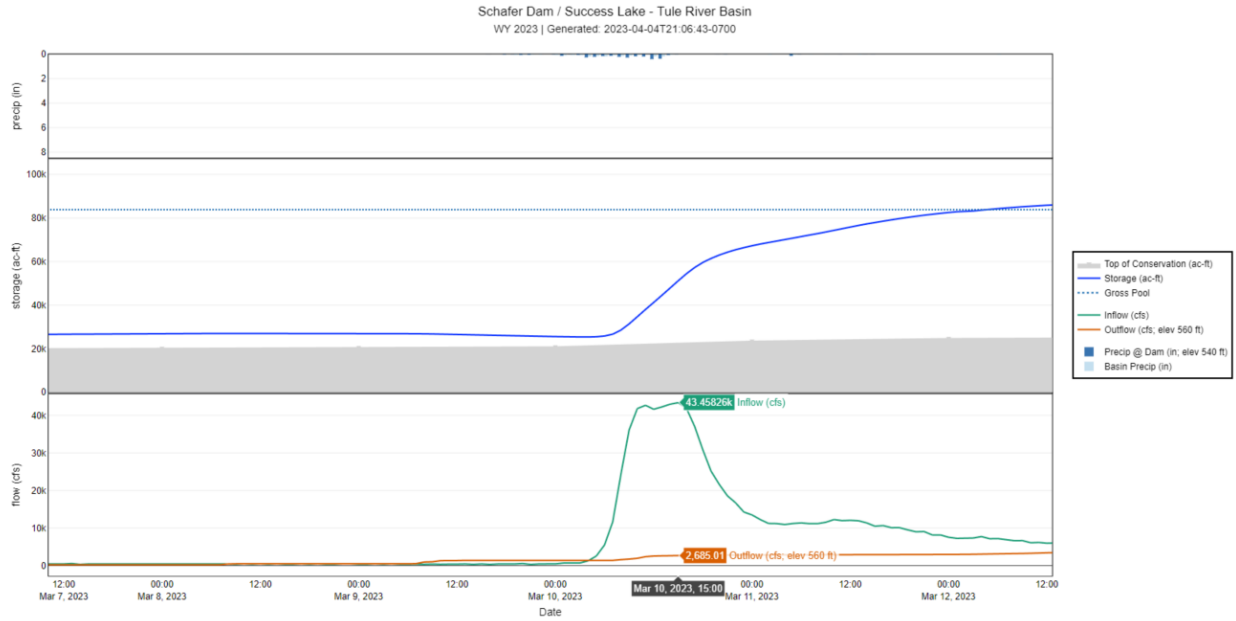


Figure 6 – Major Reservoir Levels on March 1st 2023

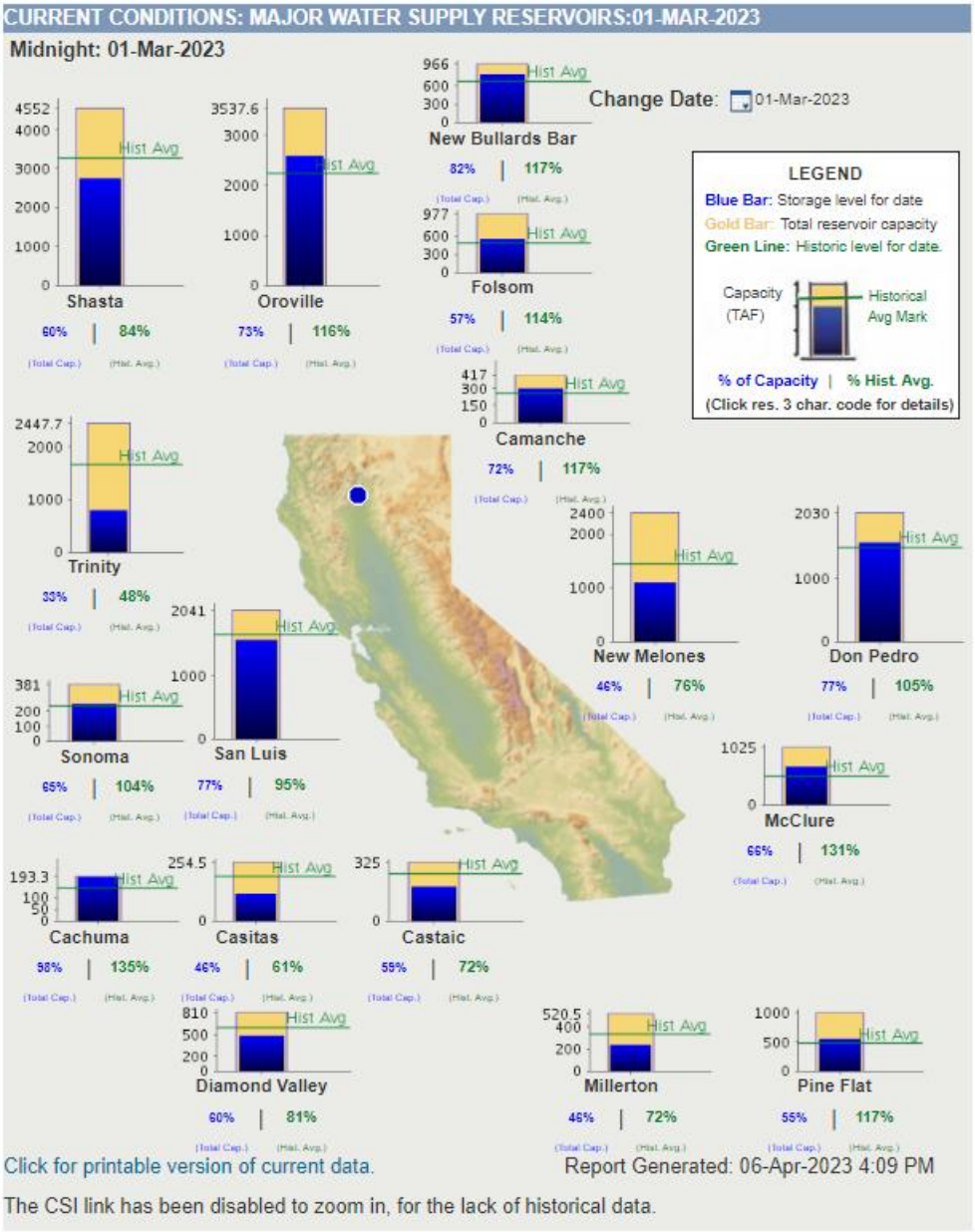
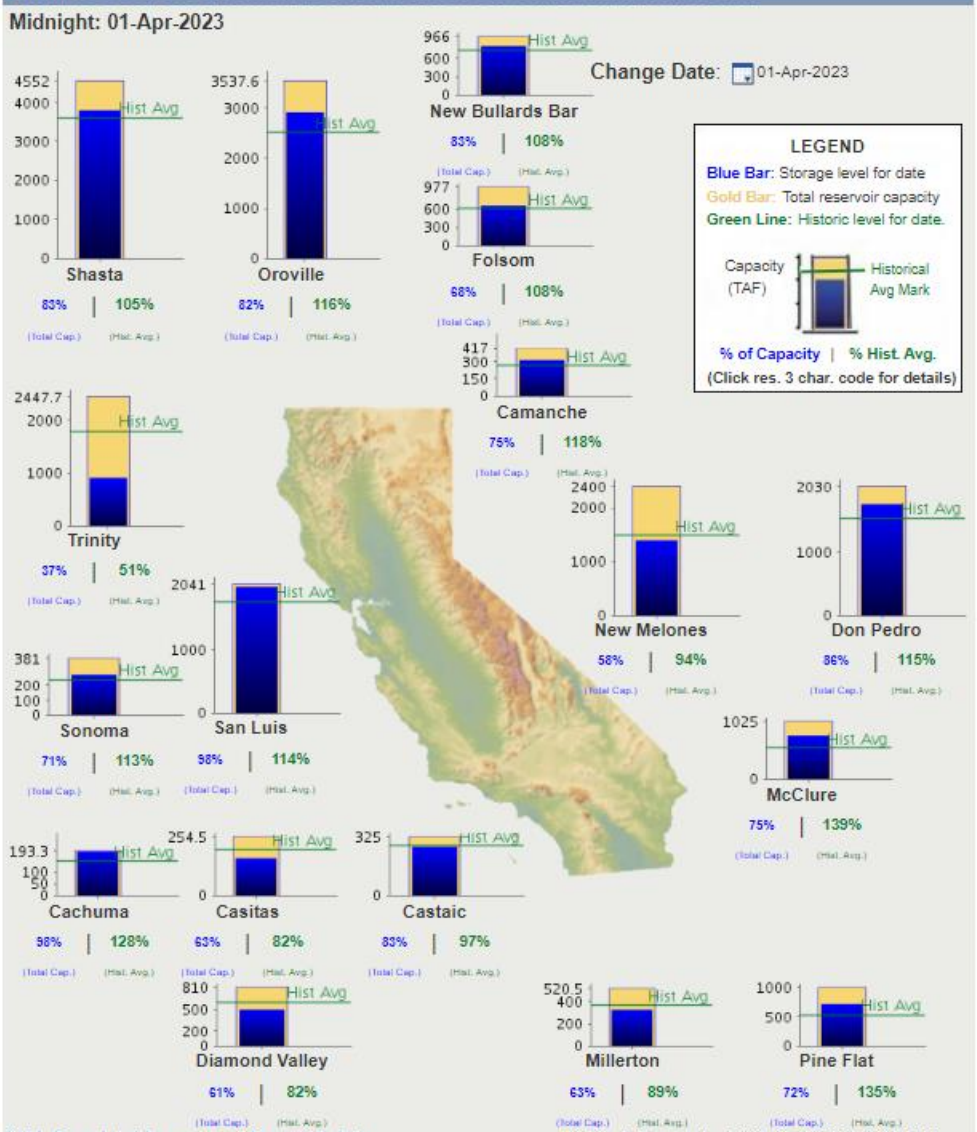


Figure 7 – Major Reservoir Levels on April 1st 2023

CURRENT CONDITIONS: MAJOR WATER SUPPLY RESERVOIRS:01-APR-2023



Click for printable version of current data.

Report Generated: 06-Apr-2023 4:06 PM

The CSI link has been disabled to zoom in, for the lack of historical data.