2014-2015 Rain Year in Review

(Rain Year Beginning 7/01/14 and ending 6/30/15)

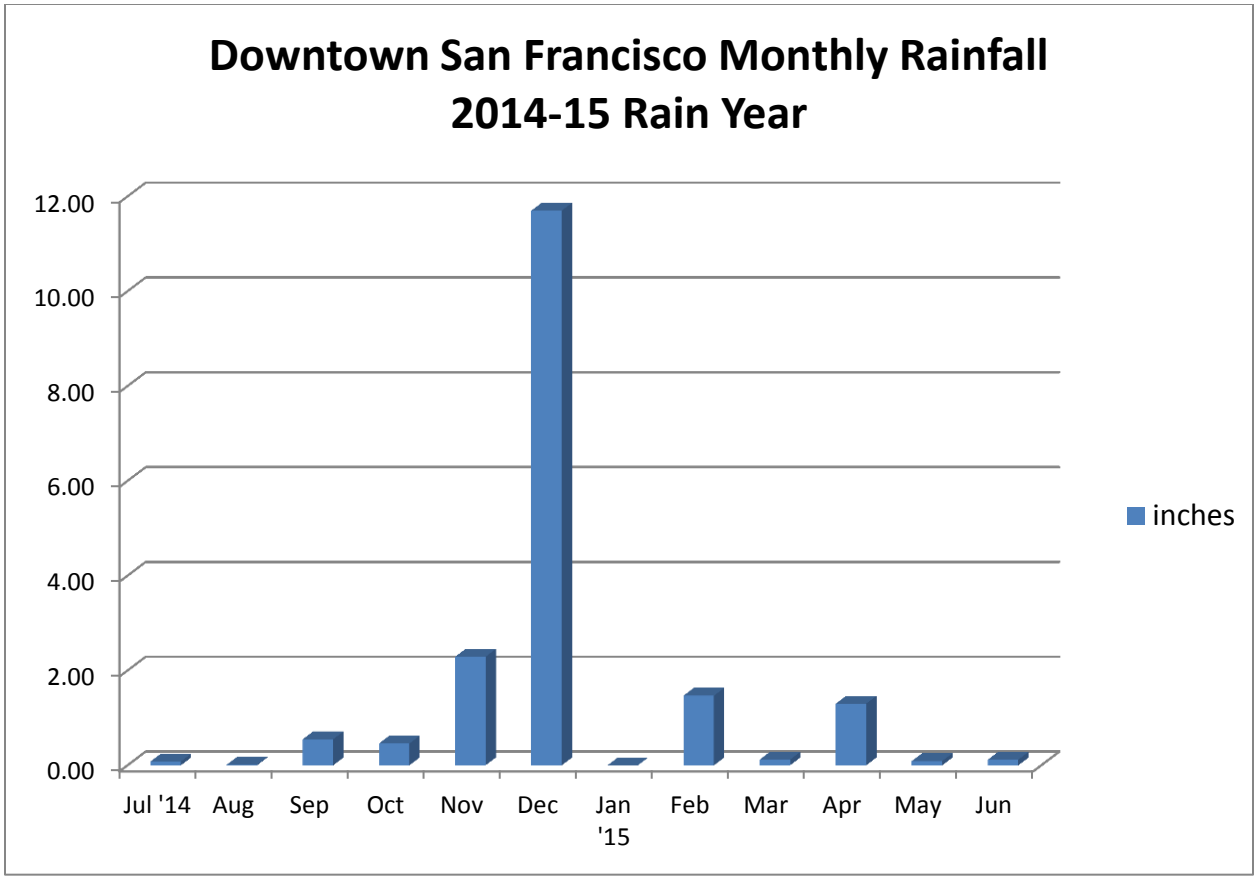
For the San Francisco Bay Area and Monterey Bay Area

The 2014-15 Rain Year was the fourth consecutive dry year for California. Although not as dry as the previous rain year (2013-14), the 2014-15 rain year precipitation totals were below normal at nearly all climate stations across the San Francisco Bay Area and North-Central Coast. A very wet December helped elevate yearly rain totals to somewhat respectable levels, but the remainder of the rain year was mostly dry, including some record-setting dry months. A fourth consecutive year of dry weather resulted in continued drought conditions across the region – drought conditions that were classified as either severe, extreme or exceptional by the time the rain year ended on June 30, 2015.

The 2014-15 rain year was one of extremes, especially during the heart of the rainy season. December 2014 was one of the wettest Decembers on record. San Francisco picked up nearly a foot of rain in December and most of the region saw between 2 and 3 times their normal rainfall for December. December was then followed by the driest January on record. Downtown San Francisco received no rain at all in January, something that had never occurred in 166 years of recorded weather history in San Francisco. Wet conditions returned briefly in early February, but then most of the remainder of February and March were very dry.

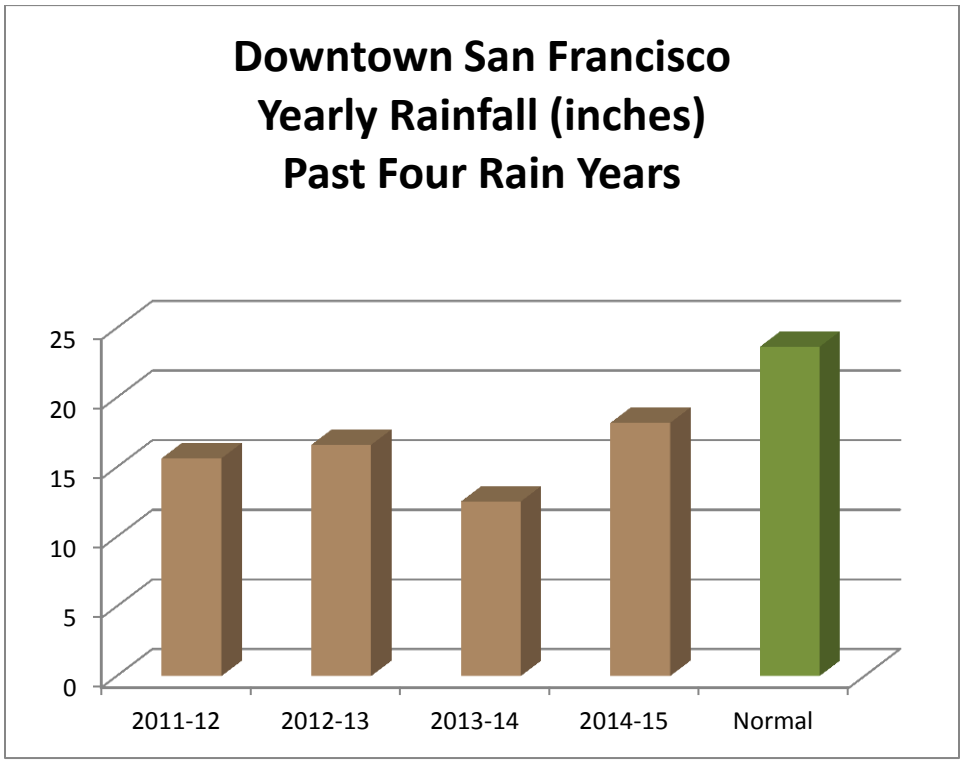
Rainfall totals for the entire rain year mostly fell in the range from 60-90% of normal, including Downtown San Francisco's total of 18.19 inches, which was 77% of normal. Rain totals for the year were above 90 percent of normal at only a few locations, and only two climate stations (Richmond and Moffett Federal Airfield) accumulated enough precipitation during the rain year to meet or exceed their normals.

December's drenching rains contributed significantly to yearly rain totals. In fact, December rainfall alone was at least half of the rain year total at nearly all climate stations, and was as much as two-thirds at some locations**. Downtown San Francisco's 11.70 inches of rain in December represented 64 percent of the City's precipitation total for the entire rain year.**



Monthly rainfall at Downtown San Francisco for the 2014-15 Rain Year. December's 11.70 inches of rain represented 64% of the rain total for the entire year (18.19")

At Downtown San Francisco, rainfall totals during the past four rain years are depicted in the graph below and summarized in the table that follows:

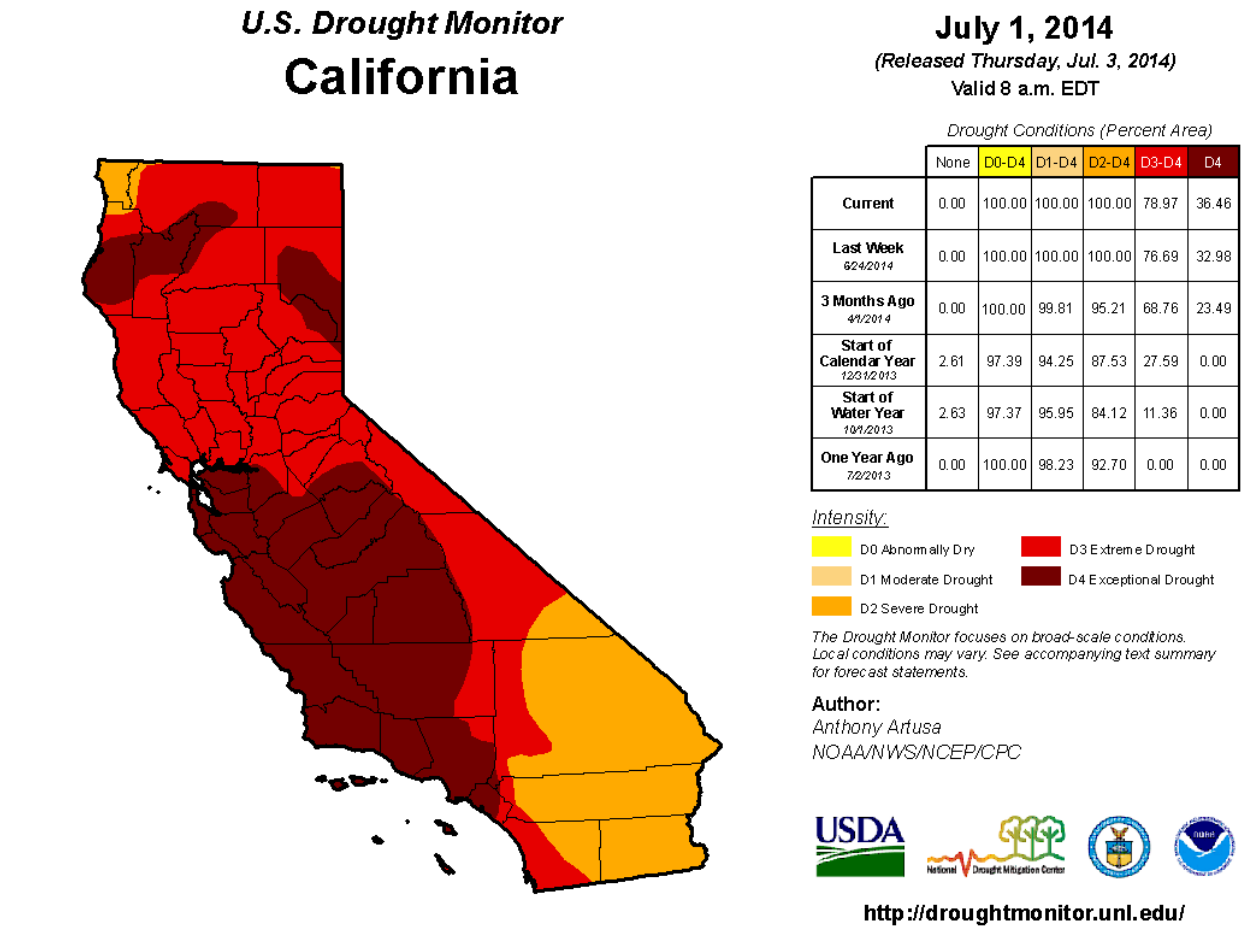


Rainfall totals at downtown San Francisco for the past four rain years, compared to normal.

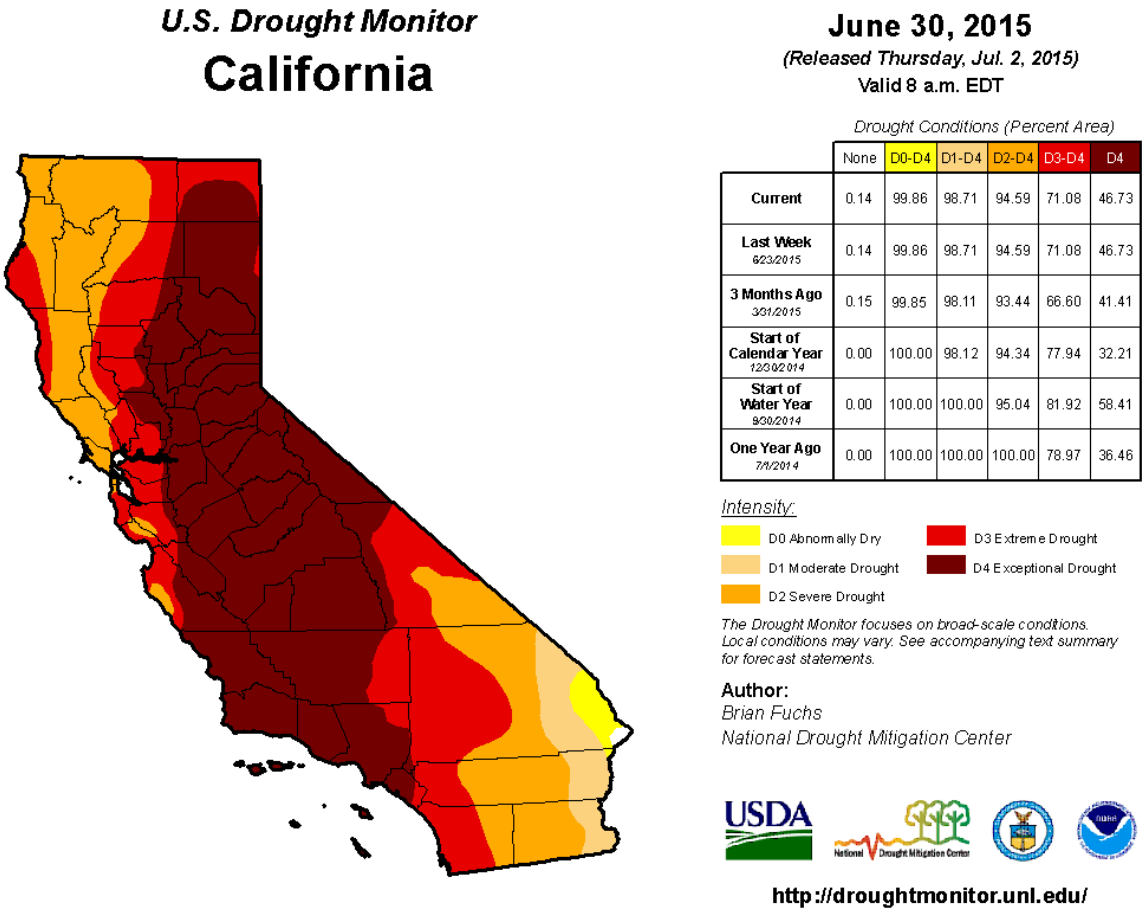
Rain Year	Rain Year Total	Normal	Departure From Normal	Percent of Normal
2011-12	15.64”	23.65”	-8.01”	66%
2012-13	16.61		-7.04	70
2013-14	12.54		-11.11	53
2014-15	18.19		-5.46	77
4-year total	62.98”	94.60”	-31.62”	67%

The combined rainfall deficit for the past four years at downtown San Francisco is 31.62 inches. This deficit is nearly 8 inches more than the average rainfall in San Francisco for an entire year (23.65 inches). For San Francisco to “make up” their accumulated rainfall deficits of the past four years in the upcoming rain year, the City would need to receive more than double their average yearly rainfall (234%).

Four years of dry conditions have resulted in exceptional drought conditions across much of California. Below are graphical depictions of drought conditions in California at the beginning of the 2014-15 rain year and at the end of the rain year:

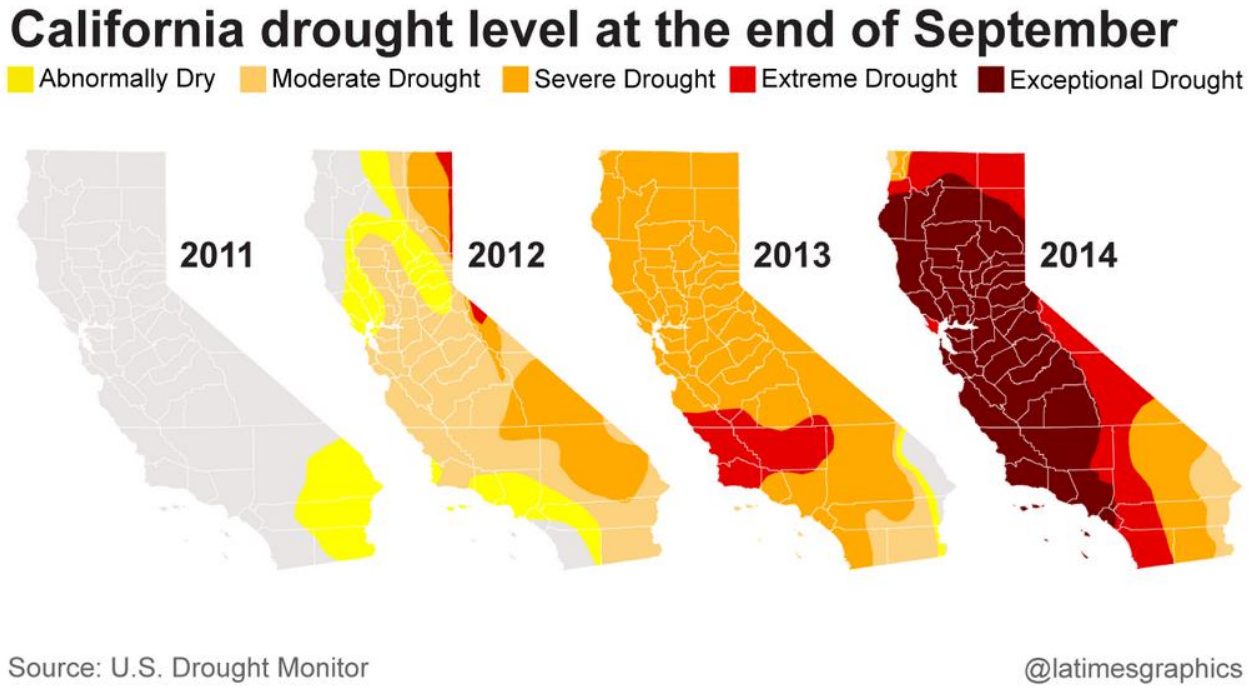


Drought conditions across California at the beginning of the 2014-15 Rain Year.



Drought conditions across California at the end of the 2014-15 Rain Year.

As can be seen from the graphics above, there was enough precipitation during the 2014-15 rain year to ease drought conditions slightly across San Francisco Bay Area and Monterey Bay Area. Even so, as of June 30, 2015, drought intensity ranged from “severe” to “exceptional.”



This graphic shows the progression of drought levels across California over the past four dry years.

2014-15 Rain Year Regional Precipitation Summary:

Location	2013-14 Rainfall	Normal Yearly Rainfall	Percent of Normal
North Bay			
Angwin	31.21	41.30	76
Calistoga	26.63	40.87	65
Cloverdale	35.36	43.13	82
Kentfield	31.89	47.98	66
Muir Woods	28.06	38.26	73
Napa	21.06	27.71	76
Napa Airport	16.77	20.39	82
Occidental	36.97	56.99	65
Petaluma Airport	24.80	26.65	93
Saint Helena	28.75	36.64	78
San Rafael	26.51	35.23	75
Sonoma County Airport	25.35	36.28	70
Sonoma	20.40	31.43	65
San Francisco Peninsula			
Half Moon Bay	16.45	29.00	57
Redwood City	13.88	20.32	68
San Francisco Airport	17.01	20.65	82
San Francisco Downtown	18.19	23.65	77
East Bay			
Antioch	13.42	13.22	102
Berkeley	20.10	26.60	76
Concord	15.80	18.12	87
Concord Airport	14.00	16.46	85
Fremont	14.37	16.68	86
Hayward Airport	13.16	18.04	73
Livermore	13.29	15.23	87
Livermore Airport	13.99	15.71	89
Martinez	16.23	20.23	80
Mount Diablo Junction	20.64	25.04	82
Newark	14.62	15.09	97
Oakland	17.75	23.96	74
Oakland Airport	15.02	20.81	72
Richmond	18.58	24.93	75
South Bay & Santa Cruz County			
Ben Lomond	35.33	50.48	70
Gilroy	15.05	20.54	73
Los Gatos	18.67	23.08	81
Moffett Federal Airfield	14.65	14.68	100
Mount Hamilton	21.64	26.13	83
San Jose	13.74	15.82	87
Santa Cruz	22.66	31.35	72
Watsonville	18.38	23.50	78
Watsonville Airport	17.72	20.27	87

Monterey and San Benito Counties	2013-14 Rainfall	Normal Yearly Rainfall	Percent of Normal
Big Sur Station	34.71	44.88	77
Carmel Valley	13.72	19.36	71
Hollister	10.18	14.19	72
King City	8.99	12.06	75
Monterey	15.93	21.10	75
Monterey Airport	14.92	16.12	93
Pinnacles National Park	11.26	17.24	65
Salinas	12.99	15.45	84
Salinas Airport	9.77	12.83	76

Downtown San Francisco, which has the longest rainfall record (166 years) of any regional climate site, had its 56th driest rain year on record with 18.19 inches (77% of normal).

The following are reviews of monthly precipitation summaries for the San Francisco and Monterey Bay Areas during the 2014-15 rain year:

July 2014

Widely scattered light showers occurred on several days as monsoonal moisture made frequent forays into California. There were also a few days with isolated thunderstorms. One such thunderstorm the developed over far southeast San Benito County on July 20 was likely severe, based on radar information. A summary of the July 20th thunderstorm event can be found here:

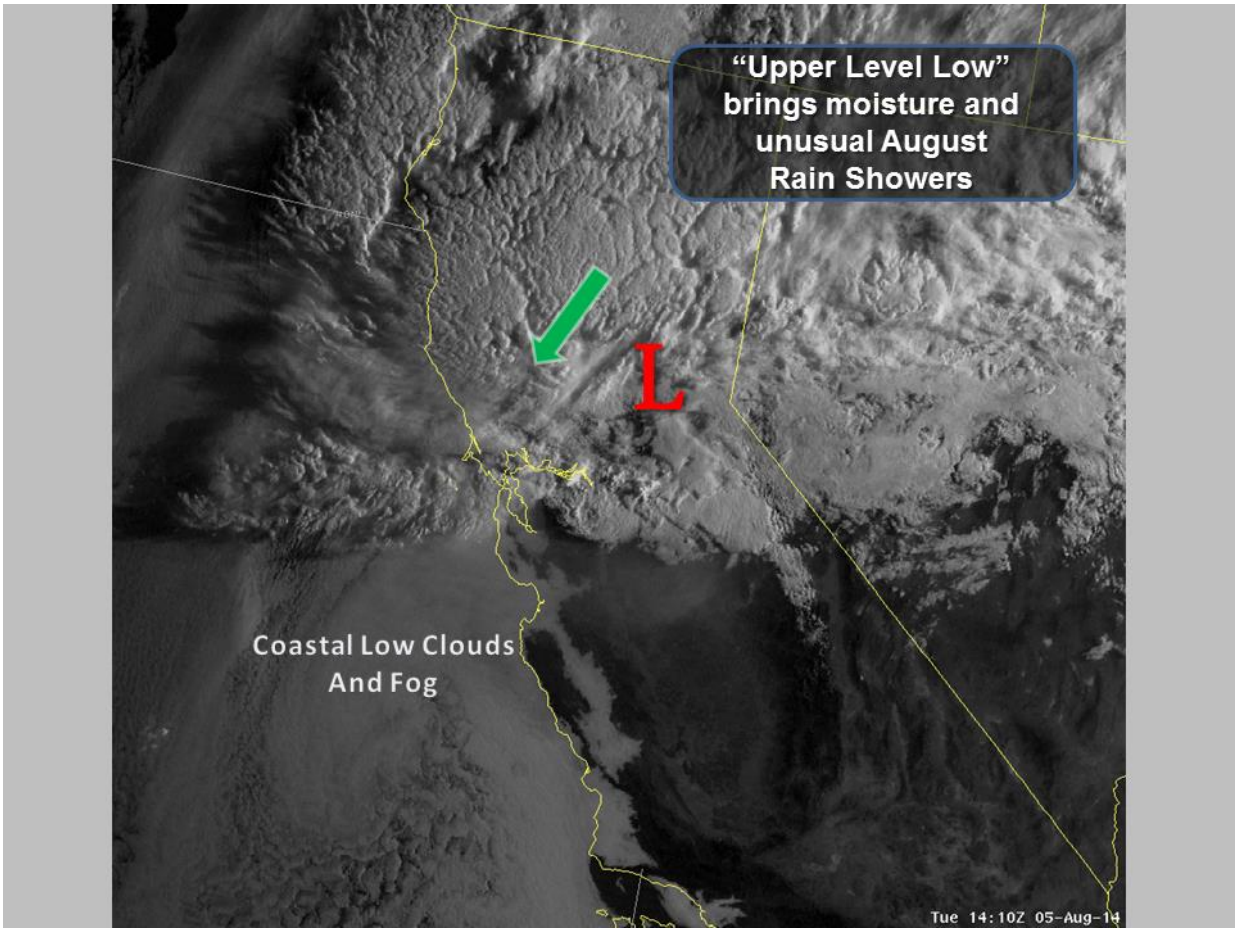
http://www.wrh.noaa.gov/mtr/stormSummary/Hail_7_20_14/hail_7_20_14.php

Although showers or thunderstorms occurred on several days in July 2014, nearly all of the precipitation events produced only isolated light rainfall amounts. Therefore, most climate stations ended the month with little or no measurable rainfall. Some of the locations that did have measurable rainfall picked up several times their normal July rainfall average. The climate station with the greatest July total was Occidental with nearly a quarter of an inch. Santa Cruz had the second greatest total with 0.13.

Downtown San Francisco's total rainfall in July was 0.08 inches, enough to rank July 2014 as the 7th wettest July out of the past 165 years.

August 2014

A deep subtropical moisture plume, which produced a 500-year rain event and flash flooding in the San Gabriel Mountains of Southern California on the afternoon of August 3, was drawn northward by a weak area of low pressure on August 4. This subtropical moisture mostly made its way across the North and East Bay late on Monday the 4th and light rain began to fall late that evening in Pittsburg and also in the Napa Valley. Periods of light rain continued across portions of the North and East Bay through Monday night and into the morning commute hours of Tuesday August 5. Rainfall with this event totaled only a tenth of an inch or less, including 0.07 inches at both the Napa and Concord Airports. This was the first measurable August rain event at both of these locations since 2003.



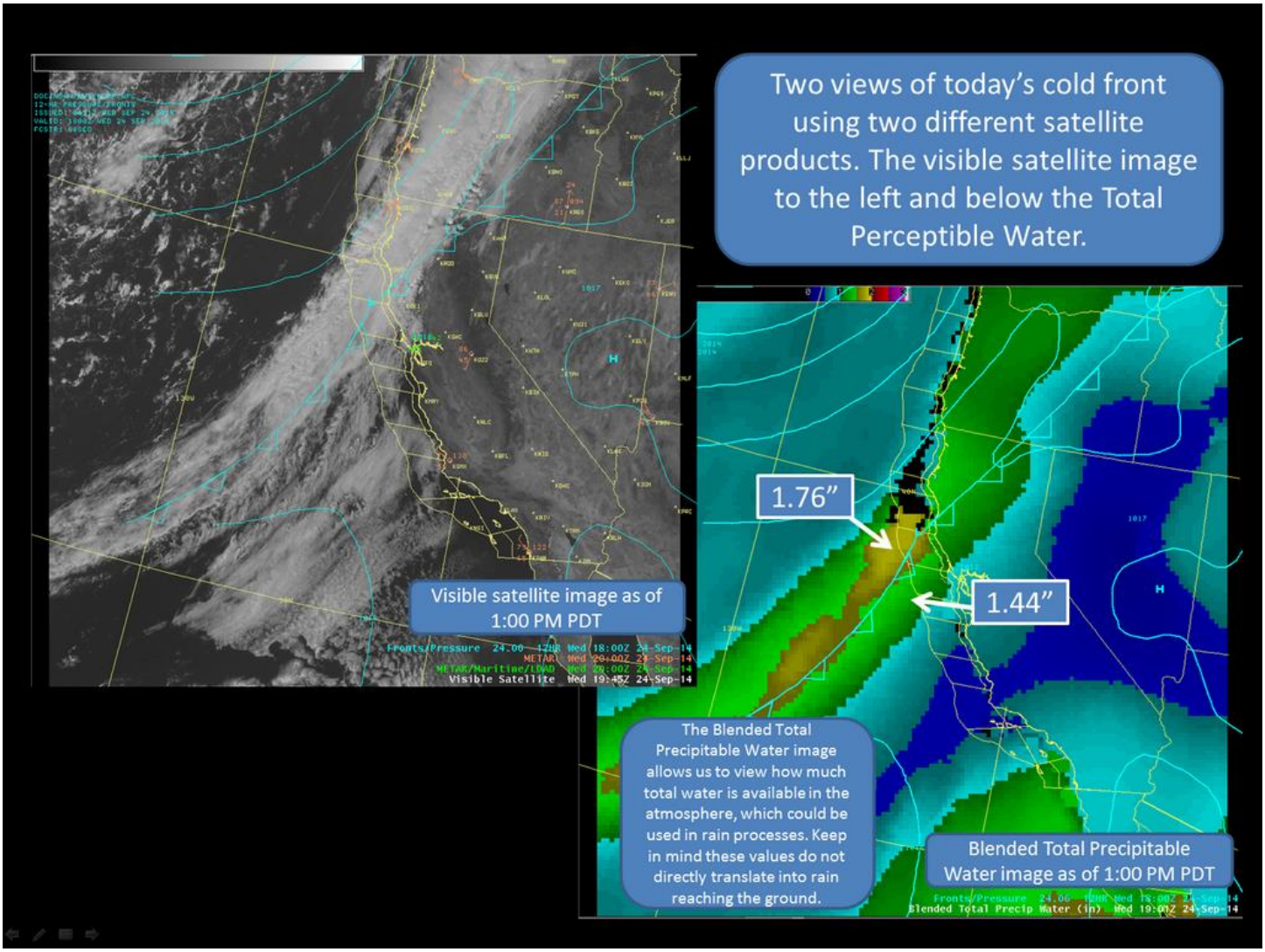
Visible satellite image from 7:10 am on Tuesday August 5, showing widespread cloudiness across northern California associated with subtropical moisture and a weak area of low pressure. Light rain showers were being reported across portions of the North and East Bay at this time.

The only other precipitation during August came in the form of drizzle from a deep marine. The majority of climate stations ended the month with no measurable precipitation. However, the August 5th light rain event resulted in some North and East Bay climate stations picking up more than double their normal August rainfall.

September 2014

September 2014 was also notable for a significant precipitation event that occurred from late on the 24th through the 26th, producing widespread rainfall as well as scattered thunderstorms with hail. Rainfall with this system, and another rain event earlier in the month, resulted in monthly rainfall totals that were well above the September average in many locations.

As a robust cold front approached the California coast on September 24, satellite sensors indicated there was significant moisture along the frontal boundary:



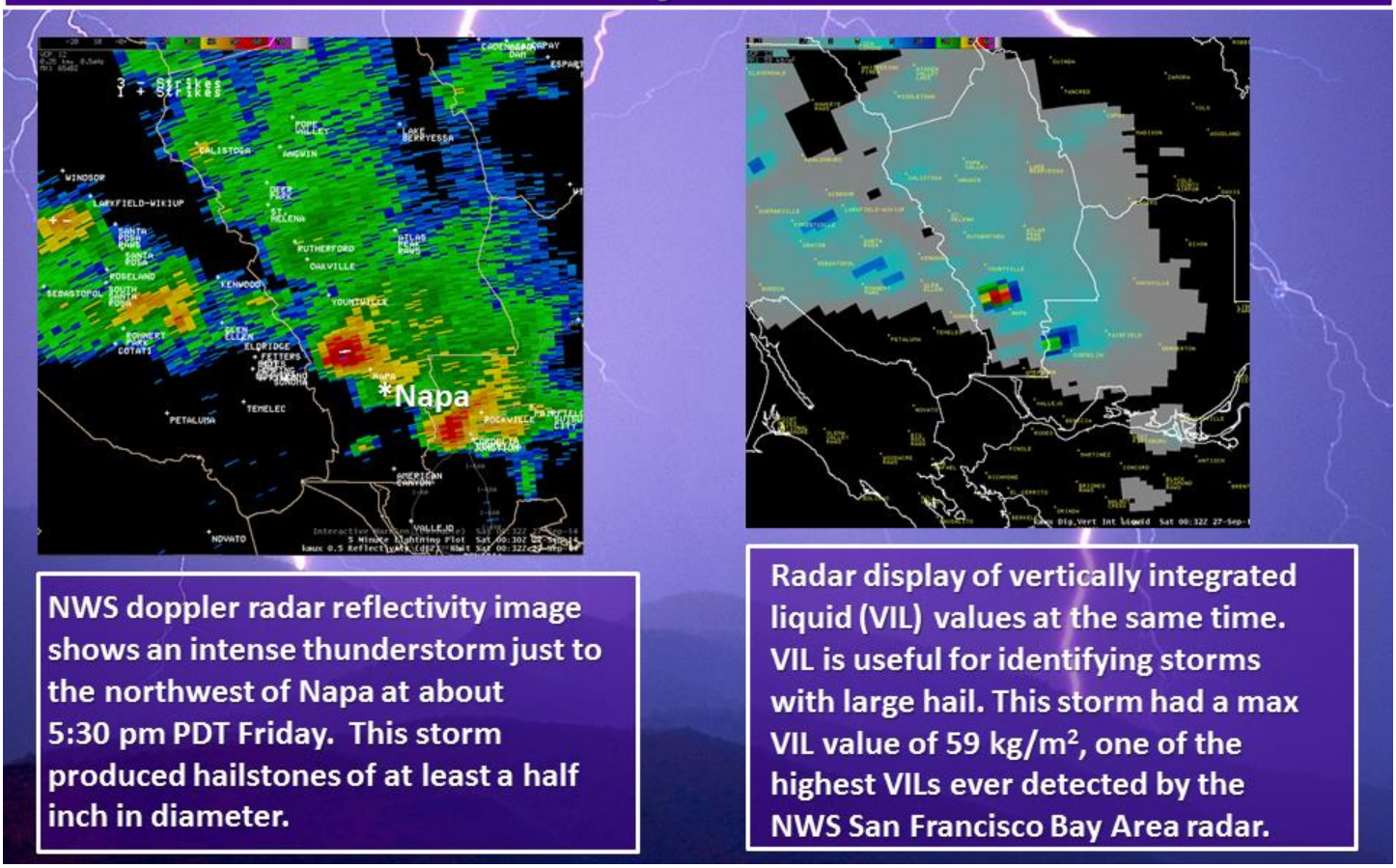
Left: Visible satellite imagery at 1 pm on September 24, showing a cold front moving into northwest California.
Right: Satellite estimates of precipitable water along the cold front.

The front produced a half inch of rain in downtown San Francisco, the highest one-day rain total in San Francisco since 0.74 inches fell back on March 31. Most locations picked up between a quarter and half inch of rain on the 25th. The exceptions: some of the southern interior valleys received less than a tenth of an inch and as much as 0.80 fell across isolated portions of the Santa Cruz Mountains.

A cold upper trough following the front generated significant instability across the region on Friday, September 26. Isolated showers developed early that morning. But it wasn't until mid to late afternoon that widespread shower and thunderstorm activity got underway. Thunderstorm activity initially developed around midafternoon over the mountains of eastern Santa Clara County, over the Santa Cruz Mountains, and also near the city of Santa Cruz. The thunderstorm in Santa Cruz produced small hail. The most intense thunderstorm cell developed just north of Napa late in the afternoon. This storm moved very slowly across the northwest portion of Napa and produced heavy rain and hail that lasted up to 20 minutes. Hail accumulated to a depth of up to six inches along Browns Valley Road. One resident of Napa said, "In the 49 years I've lived here, I've never seen anything like this ever." Another resident in the western part of Napa said "My backyard garden was completely devastated by the hail. We still had ice out in front of our front door two days later." News stories noted that this unusual weather event occurred in Napa just one month after the city was rattled by a 6.0 earthquake. Fortunately for the wine community, most of the hail was confined to urban areas and did not adversely affect most area vineyards.

Footprints in the hail: Hail accumulated up to six inches deep in Northwest Napa on Friday, September 26.

Close-up photo of hailstones that fell in northwest Napa on September 26. Photo credit: Jeni Olsen



Radar data depicting strong thunderstorm on the northwest side of Napa during the late afternoon of Friday, September 26.

Rainfall totals with the September 26 convective event varied considerably, with the most widespread precipitation as well as heaviest rainfall occurring in Sonoma, Napa and Santa Cruz counties where rainfall amounts of between one-third and two-thirds of an inch were common.

September rain totals across the San Francisco Bay Area were above the 30-year average at most climate stations and well above normal at several. Farther to the south, in Monterey and San Benito counties, September rain totals were not nearly so impressive, falling short of normal at the majority of climate stations.

October 2014

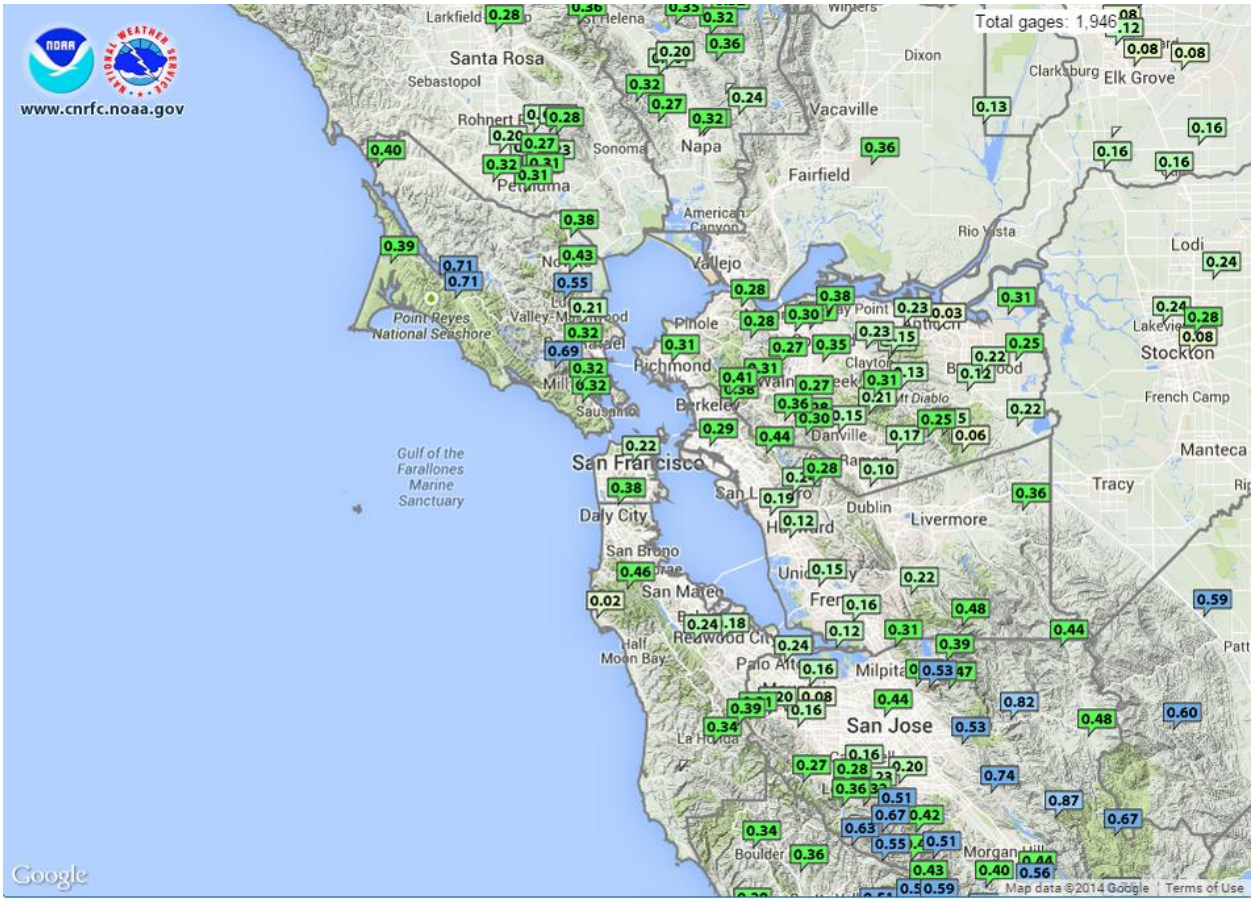
Precipitation totals for October were below normal across the San Francisco Bay Area. However, October was a wetter than normal month at locations near Monterey Bay.

The first half of October was dry. Periodic light rain events began in the middle of the month. The first was October 14-15. Rain amounts were mostly light and generally less than a quarter of an inch. The exception was the North Bay where isolated rainfall totals of between a half inch and an inch were reported. A few days later, on the 17th, more light rain fell, but only in the North Bay.

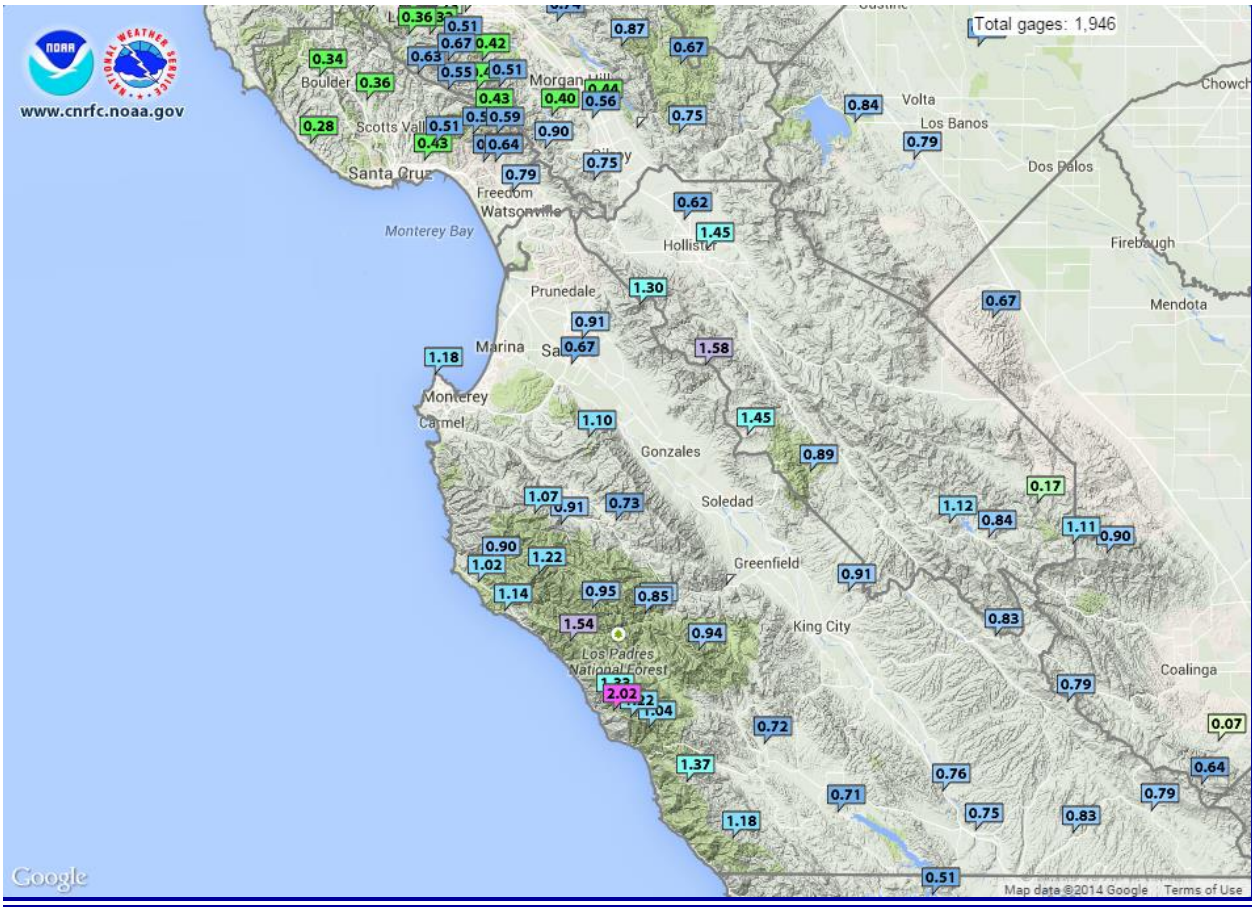
A weak cold front moved through the area on October 20 and generated less than a tenth of an inch of rain in most locations. Isolated spots in the North Bay picked up as much as a third of an inch.

Between the late night hours of Friday, October 24 and the morning of Saturday, October 25, a stronger cold front swept through the area. This system generated between a half and three-quarters of an inch of rain in the coastal mountains. Rain totals were generally less than a quarter of an inch at lower elevations except locally up to a half inch in North Bay coast and valley locations. This system also produced an isolated thunderstorm in northwest Sonoma County early in the afternoon of October 25.

The final rain event of the month began during the late evening hours of Thursday, October 30 when a relatively weak cold front began to spread light rain into the North Bay. Rain pressed south into San Francisco during the morning of October 31. By the time this system reached the Monterey Bay area during the early afternoon hours on Halloween, it intensified and also slowed considerably. Therefore, rainfall totals from Monterey Bay southward were much higher compared to the San Francisco Bay Area. Rain totals in the San Francisco Bay area on Halloween were generally less than a half inch, except locally higher amounts in the hills of Marin and Santa Clara counties. From Monterey Bay southward there were widespread rain totals of between 1 and 2 inches on Halloween except lower amounts along the northern portion of Monterey Bay and in some of the interior valleys.



Graphic showing Halloween rainfall totals in the San Francisco Bay Area.



Graphic showing Halloween rainfall totals in the Monterey Bay Area and Central Coast.

Because the rain events during the second half of October were mostly light, monthly rain totals were below normal at nearly all climate stations across the San Francisco Bay Area, and in some cases well below normal. October rain totals in the Bay Area were mostly between a third and two-thirds of normal, but were as low as 15-20 percent of normal in portions of the East Bay. The Lick Observatory on Mount Hamilton was the only SF Bay Area climate station that managed to pick up more than their average October rainfall.

The heavier rainfall that occurred across the southern portion of the region on Halloween pushed monthly rainfall totals above normal at climate stations near southern Monterey Bay and in the northern Salinas Valley. The Salinas Airport had the most impressive rainfall statistic for October with a monthly total that was nearly twice the norm.

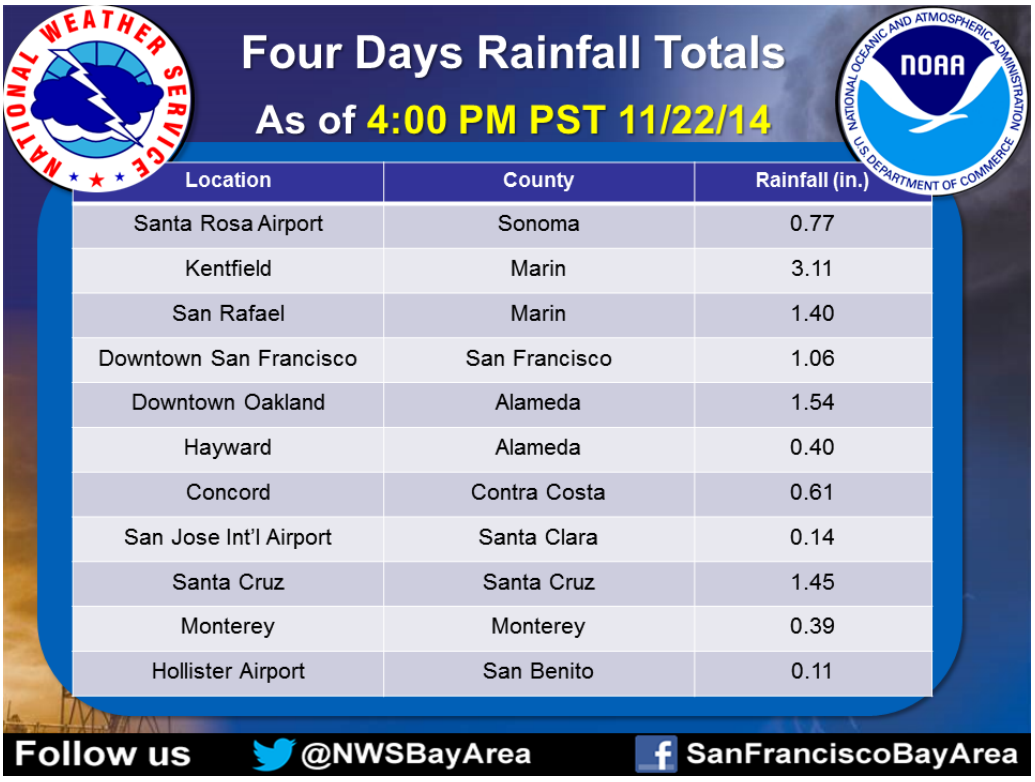
November 2014

Rainfall was scarce during the first half of November, but became more plentiful during the second half. Monthly rain totals were mostly below normal, but some climate stations near Monterey Bay ended the month with above normal rainfall.

A storm system that produced widespread rainfall across the region on Halloween continued to generate scattered showers into Saturday, November 1. A weak weather system generated light amounts of rainfall from late on the evening November 12 through the morning of 13th. Rain totals at lower elevations mostly ranged from a tenth to a third of an inch. Santa Cruz picked up the most rainfall on the 13th with a total of 0.53".

A series of weather systems moved through the region from November 19 through 22. These weather systems generally produced light to moderate amounts of precipitation, but some isolated intense showers and thunderstorms occurred during the late afternoon and early evening hours of Thursday, November 20. The bulk of these showers and thunderstorms occurred over the coastal waters between the Golden Gate and Monterey Bay, and locally inland across southern San Mateo County. Radar showed rotation in some of the more intense showers off the southern San Mateo County coast, prompting issuance of Special Marine Warnings. Rain rates were locally heavy in these showers and isolated thunderstorms. Nearly three quarters of an inch of rain fell in two hours during the late afternoon near La Honda in southern San Mateo County. An isolated heavy shower also developed over Northern San Francisco Bay early that evening; tracking across the Bay Bridge and Yerba Buena Island at about 7 pm. Mike Mibach of KTVU posted a video of water covering the roadway in the Yreba Buena tunnel section of the Bay Bridge. The video can be found here: https://vine.co/v/OJDv2gdFY1D

Rain totals from November 19-22 ranged from less than a tenth of an inch in the interior valleys of Monterey and San Benito counties to as much as 3 inches in the North Bay.



Location	County	Rainfall (in.)
Santa Rosa Airport	Sonoma	0.77
Kentfield	Marin	3.11
San Rafael	Marin	1.40
Downtown San Francisco	San Francisco	1.06
Downtown Oakland	Alameda	1.54
Hayward	Alameda	0.40
Concord	Contra Costa	0.61
San Jose Int'l Airport	Santa Clara	0.14
Santa Cruz	Santa Cruz	1.45
Monterey	Monterey	0.39
Hollister Airport	San Benito	0.11

Four-day rain totals (Nov 19-22) for select locations.

One final storm system brought rain to the region at the end of the month. Rain began in the North Bay by the late afternoon hours of Friday, November 28. Rain then spread across the remainder of the region on Saturday November 29. Rainfall was heaviest in the South Bay on the morning of the 29th. In a departure from the norm, San Jose accumulated more rain on the 29th (0.70") than any other Bay Area city, even more than normally wet spots like Kentfield (0.55").

Showers continued into Sunday November 30 and there were isolated thunderstorms over the coastal waters. Once again, San Jose was wetter than many surrounding areas and for the second consecutive day San Jose picked up more rain than San Francisco.

Three-day rain totals across the San Francisco Bay Area and Santa Cruz County from late on November 28 through November 30 ranged from 0.25-1.25" at lower elevations and from 1.5-3.5" in the hills (highest totals in the Santa Cruz Mountains). Rain totals were significantly lower across Monterey and San Benito Counties, ranging from 0.10-0.50" in most areas, except locally up to 0.80" in the Big Sur area.

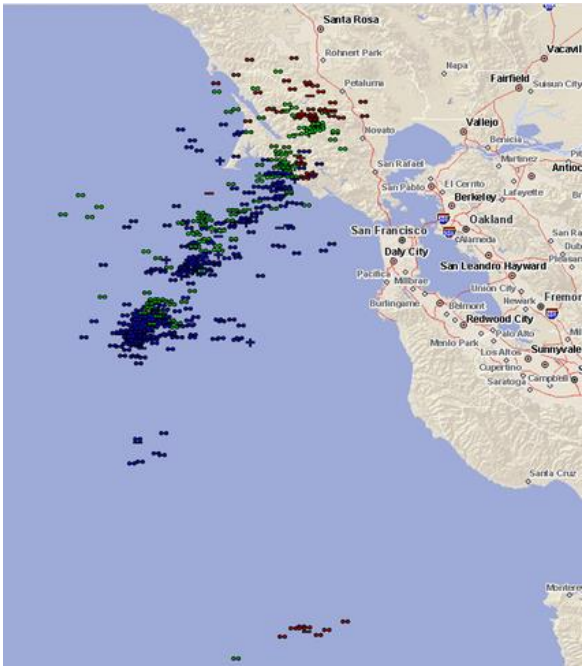
Rain totals for the entire month were below normal at a large majority of climate stations, generally ranging from 50 to 90 percent of normal. Some locations on the San Francisco Peninsula fared the worst, coming in at only slightly more than 40 percent of normal. Climate stations near Monterey Bay generally had a more productive month for rainfall with some locations accumulating totals greater than normal.

December 2014

The first two-thirds of the month were stormy and wet, resulting in rainfall totals that were two to three times the December average. Three climate stations had their wettest December on record, while numerous other locations accumulated enough rainfall to rank December 2014 as one of their wettest.

The first significant storm of December rolled through the area on December 2 and 3. Widespread rain began to move onshore during the early morning hours of Tuesday, December 2. The Tuesday morning commute in the San Francisco Bay Area was made difficult by minor urban flooding and strong winds. Downtown San Francisco picked up over an inch of rain by midday and by 1 pm San Francisco's year to date rain total (starting July 1, 2014) had reached 4.83", a total that was slightly **above** normal. The 1.61 inches of rain that fell in downtown San Francisco on December 2nd was the greatest calendar day rain total in the City since March 14, 2012.

Thunderstorms began to move through the coastal waters during the evening of December 2. By 11:00 pm, a thunderstorm with heavy rain and small hail pushed onshore over Point Reyes. Nearly 300 lightning strikes were detected over the coastal waters and Marin County between 8:00 and 10:00 pm.



Graphic depicting lightning strikes during the evening of Tuesday, December 2. Graphic courtesy of WeatherBug

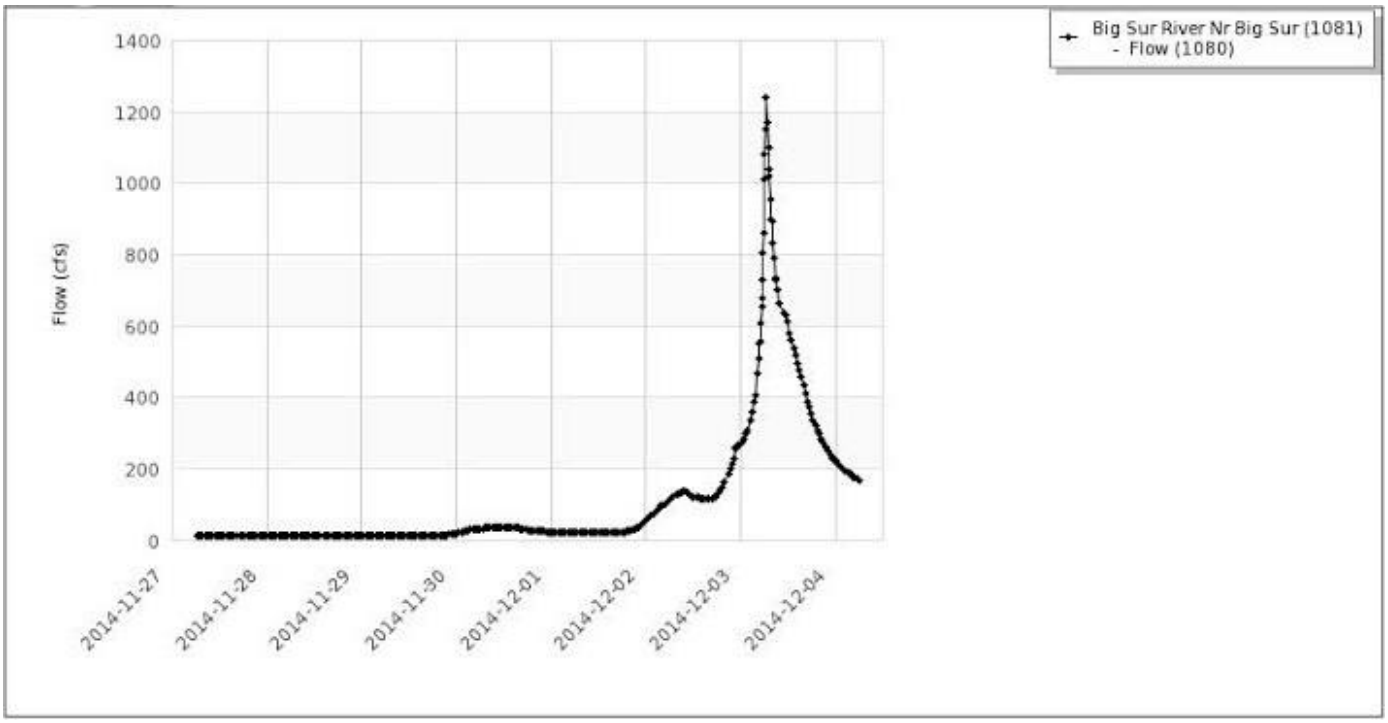
By the early morning hours of Wednesday, December 3, showers and isolated thunderstorms began pushing inland. Roadway flooding occurred in the San Francisco Bay Area during the Wednesday morning commute as strong showers and isolated thunderstorms continued to move through the area.

Northbound 101 off ramp to Stinson Beach in Marin County during the morning of December 3. Photo credit: CHP Marin

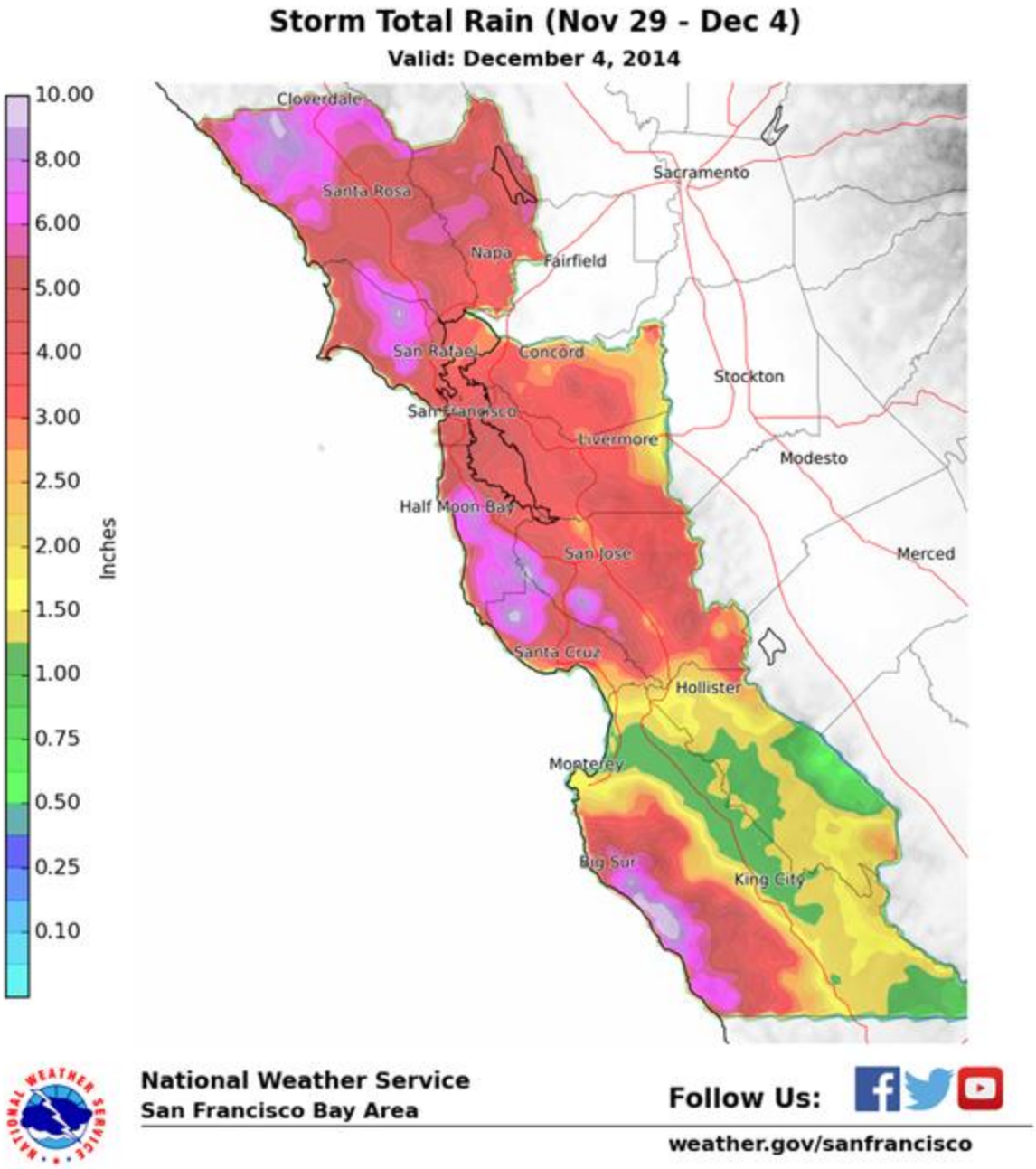
Roadway flooding in Petaluma on December 3. Photo credit: Beth Schlanker, Press-Democrat

At noon on December 3 the San Francisco Airport's 72 hour accumulated rainfall total stood at 3.71 inches, which was more than SFO's rainfall total during the entire 2013 calendar year (3.38").

Heavy rain shifted south into the Santa Lucia Mountains above Big Sur on the afternoon of December 3. At Anderson Peak, 3 inches of rain fell in only 2 hours (between 2:00 and 4:00 pm). Within that two hour window, a burst of very heavy rain dropped nearly an inch of rain in less than 30 minutes. Streams across the area rose rapidly, even with the dry antecedent conditions.



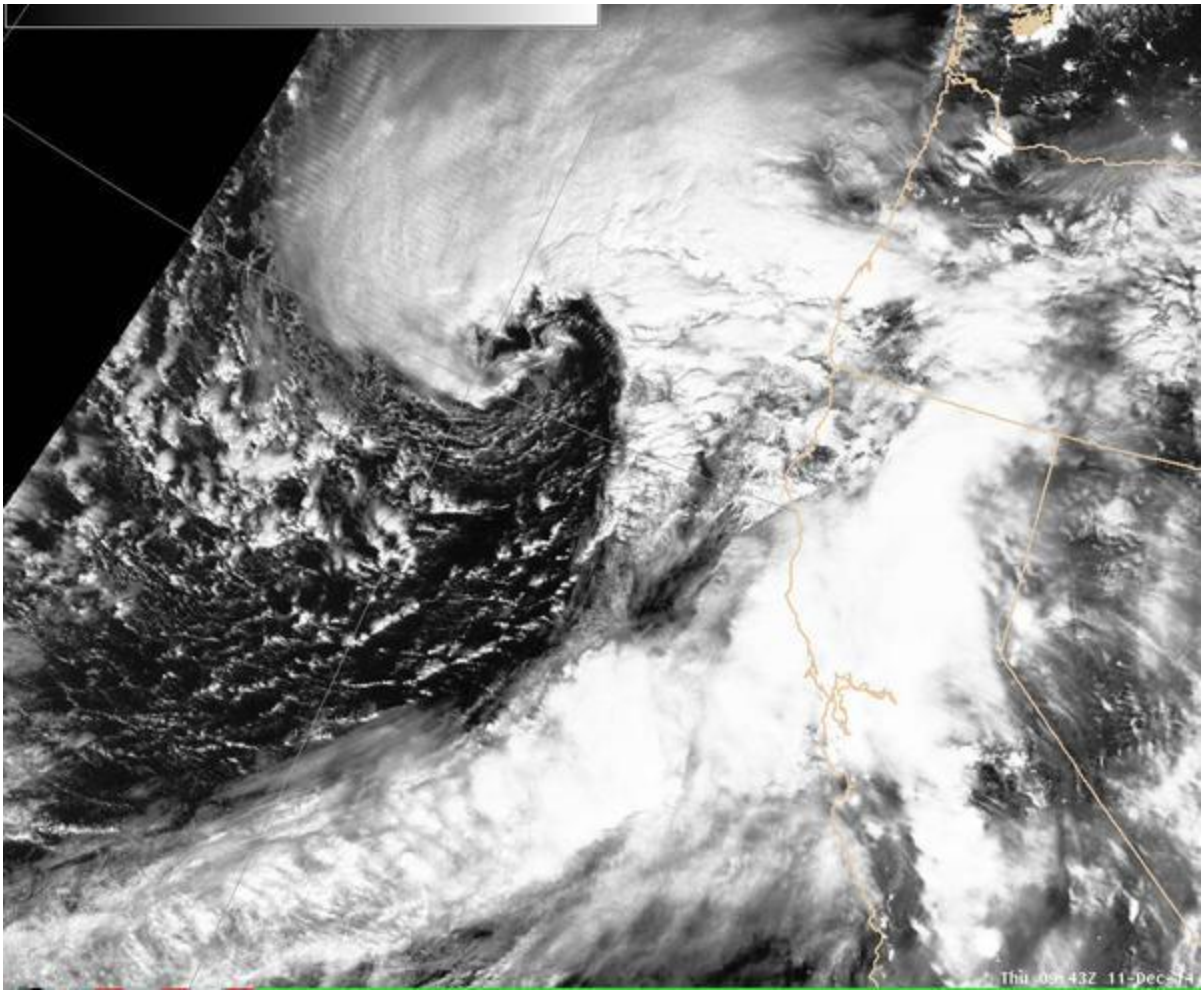
Graph showing a rapid rise in the flow on the Big Sur River during the afternoon of December 3



Graphic depicting rainfall totals from November 29-December 4. The maximum rainfall total during this six day period was 13.16 inches at Mining Ridge in western Monterey County.

Showers continued in Thursday, December 4, but gradually tapered off an ended by afternoon. More scattered showers then developed on Friday, December 5 and became locally heavy by late afternoon and evening with some isolated thunderstorms in the South and East Bay. Showers lingered into the morning hours of Saturday, December 6.

Early in the second week of December a powerful storm developed over the eastern Pacific. This storm entrained a narrow plume of very moist air from the tropics (known as an “atmospheric river”) and moved into California on December 11, producing widespread heavy rainfall and in some cases record one-day rain totals. Flooding occurred in many low lying urban areas and some minor river and creek flooding occurred as well. Although the storm did not quite generate winds of the magnitude expected, locally strong and damaging winds did occur which led to power outages that affected nearly a half million PG&E customers.



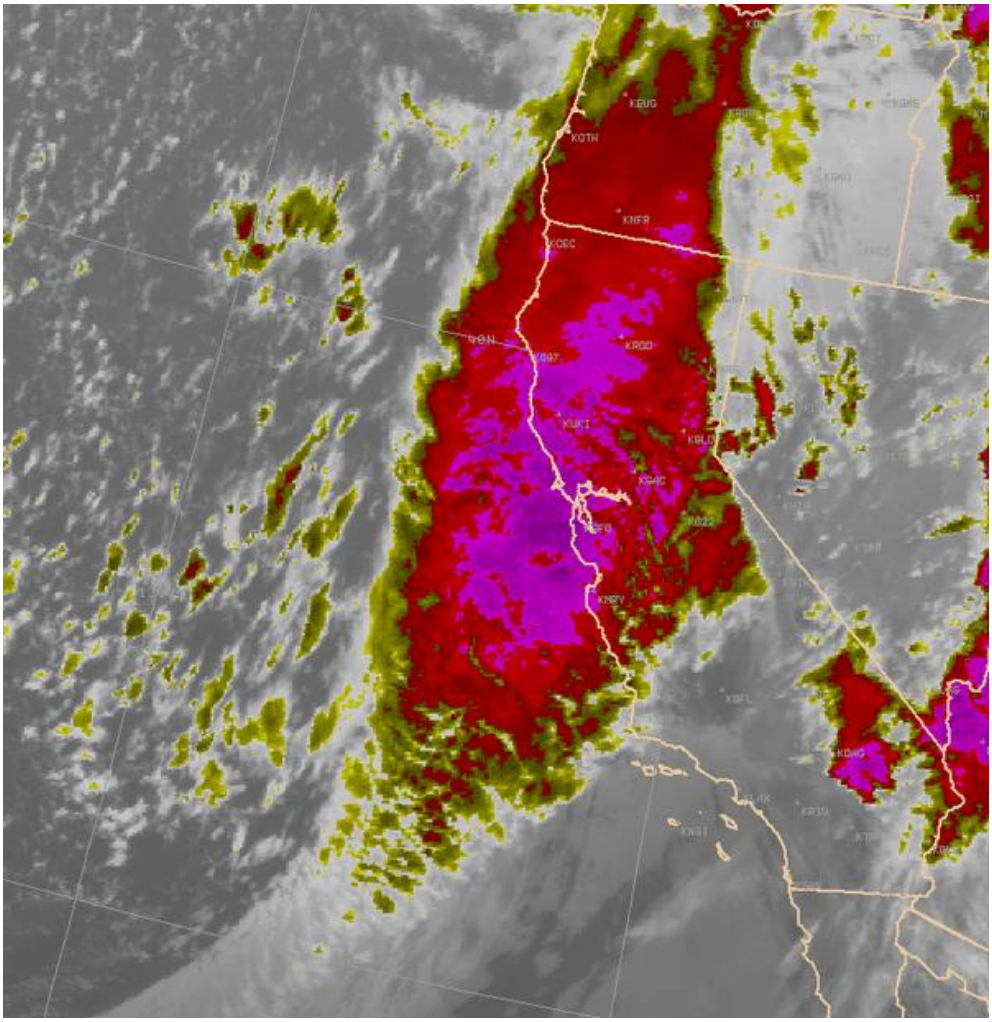
Satellite image of powerful Pacific storm as it began moving into Northern California during the pre-dawn hours of December 11

A more detailed review of the December 11, 2014 storm, including rainfall amounts, peak wind gusts, and storm reports, can be found at the following link:

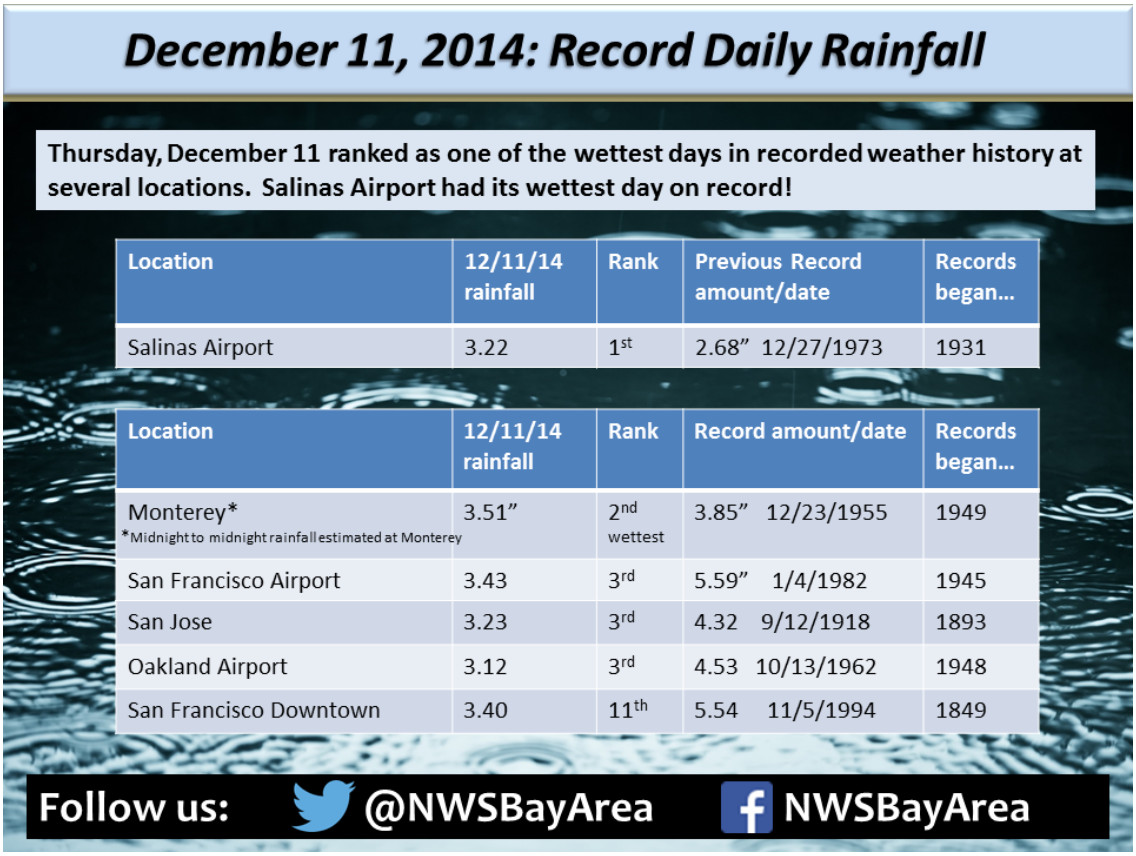
http://www.wrh.noaa.gov/mtr/stormSummary/RainWind_12_11_2014/rain_12_11_14.php

Other notable December 11 storm facts include:

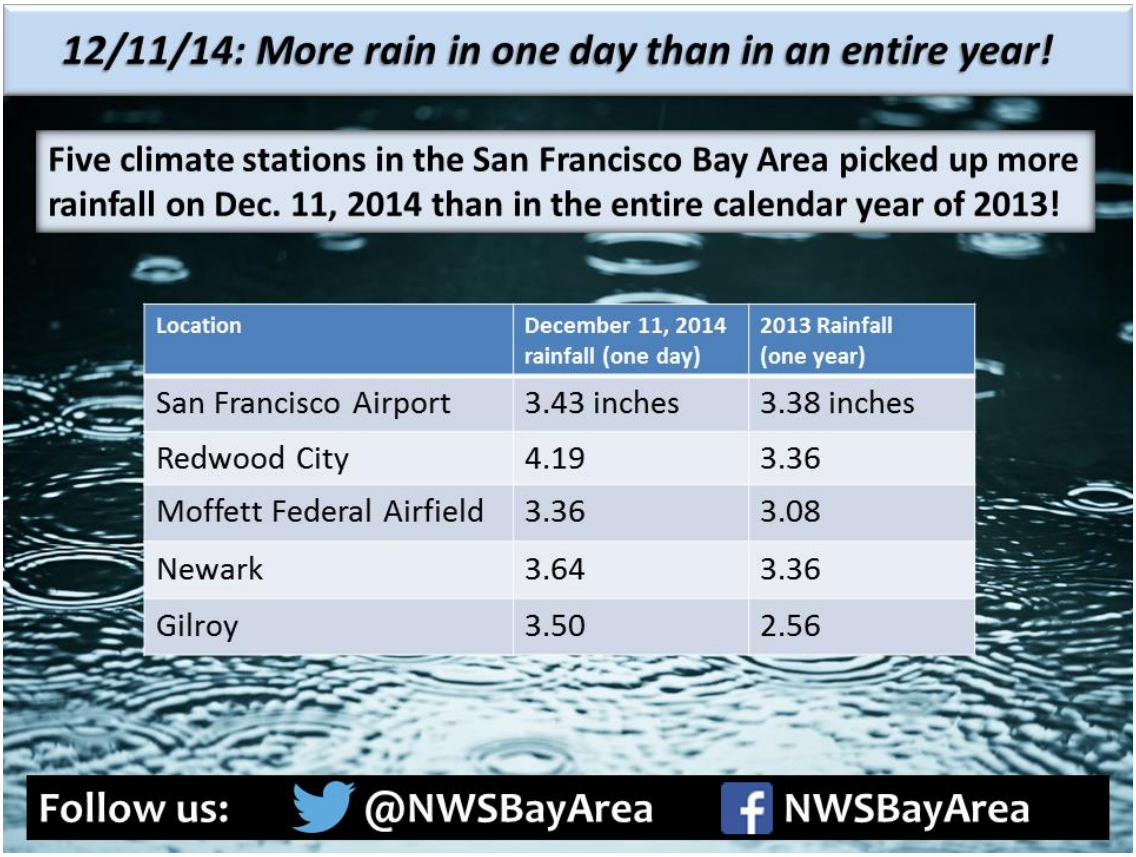
- Salinas Airport picked up 3.22 inches of rain on December 11. This was the greatest calendar day rainfall ever recorded at this location. In addition, climate stations in Monterey, San Jose, San Francisco Airport, and Oakland Airport had calendar day rainfall totals that ranked as one of the top three wettest days. Downtown San Francisco recorded its 11th wettest calendar day rain total. For details, see the graphic on the next page.
- Five climate stations picked up more rainfall on December 11 than they did during all of 2013. (2013 was the driest calendar year on record across the region). For details, see the graphic on the next page.
- Heavy rain on December 11 resulted in minor flooding along the lower Russian River on the following day. The Russian River at Guerneville crested one foot above flood stage during the late afternoon hours of December 12.
- Rockslides/landslides resulted in the closure of highway 1 near Muir Beach and also along the Big Sur Coast from Bixby Bridge to Piedras Blancas.



Infrared satellite image taken at 7:30 pm on the evening of December 11. The frontal system had become nearly stationary at this time, resulting in a prolonged period of moderate to heavy rain.



Graphic showing record (or near record) calendar day rainfall on December 11.



Graphic showing how December 11 rainfall surpassed rain totals for the entire year of 2013 at some climate stations in the San Francisco Bay Area.

Photos from the December 11 storm

Flooding at the Ashby Avenue underpass near I-80 in Berkeley. Photo: Paul Chinn, San Francisco Chronicle

Flooded Safeway parking lot in Healdsburg. Photo: Alvin Jornada, San Francisco Chronicle

Flooding along Rainsville Road and Stony Point Road in Petaluma. Photo: Ramin Rahimian, San Francisco Chronicle

Kayaker in a flooded section of Healdsburg. Photo: The Press Democrat

Flooding along Magnolia Avenue in Petaluma. Photo: Beth Schlanker, Press Democrat

Road bed of Highway 1 washed out near Muir Beach.

Russian River crests one foot above flood stage in Guerneville on December 12. Photo: Paul Chinn, San Francisco Chronicle

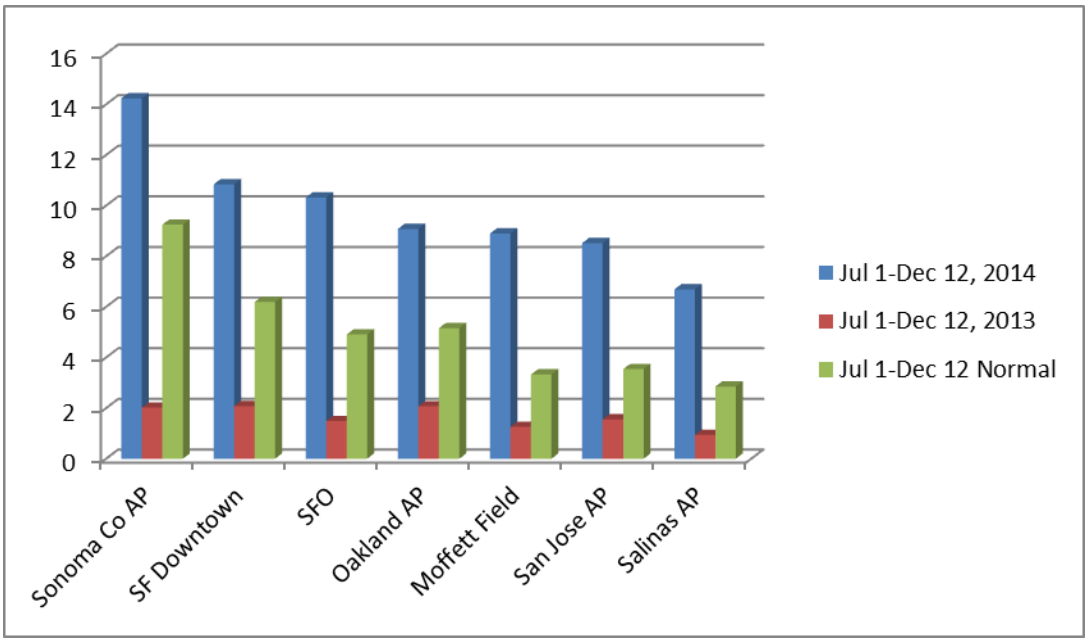
A whirlpool develops near a storm drain in a flooded section of Windsor. Photo: Press Democrat

Flooding on Hartnell Road near Salinas. Photo: Leigh Cooper, The Salinas Californian

Scattered showers continued into Friday, December 12. One shower off Point Reyes produced a waterspout.

Waterspout off Point Reyes on December 12.

As of December 12, year-to-date rainfall totals (for the rain year beginning July 1) were well ahead of totals from a year ago and also well above normal:



Year-to-date rainfall comparison as of December 12

	Jul 1-Dec 12, 2014	2014 PON	Jul 1-Dec 12, 2013	2013 PON	Jul 1-Dec 12 Normal
Sonoma County Airport	14.24	154%	2.02	22%	9.25
San Francisco Downtown	10.84	175%	2.08	34%	6.19
San Francisco Airport	10.32	210%	1.49	30%	4.91
Oakland Airport	9.08	176%	2.07	40%	5.16
Moffett Field	8.90	267%	1.26	38%	3.33
San Jose Airport	8.52	241%	1.56	44%	3.54
Salinas Airport	6.69	235%	0.94	33%	2.85

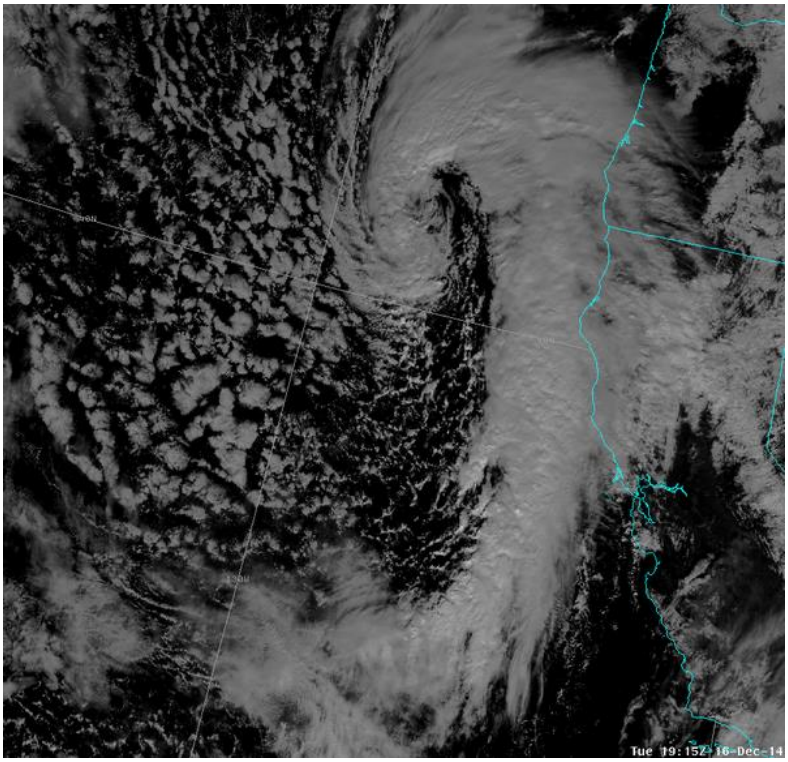
Detail of data presented in the graph above

A very active weather pattern continued through the entire middle third of December. During the afternoon hours of Monday, December 15, a line of intense showers and thunderstorms moved across the Monterey Peninsula. Very heavy rain rates were observed. Pebble Beach and Carmel picked up 0.65” and 0.80” of rain respectively during only one hour that afternoon. These sustained downpours resulted in local flooding on the Monterey Peninsula.

Flooding in Pebble Beach on December 15. Photo: Vern Fisher.

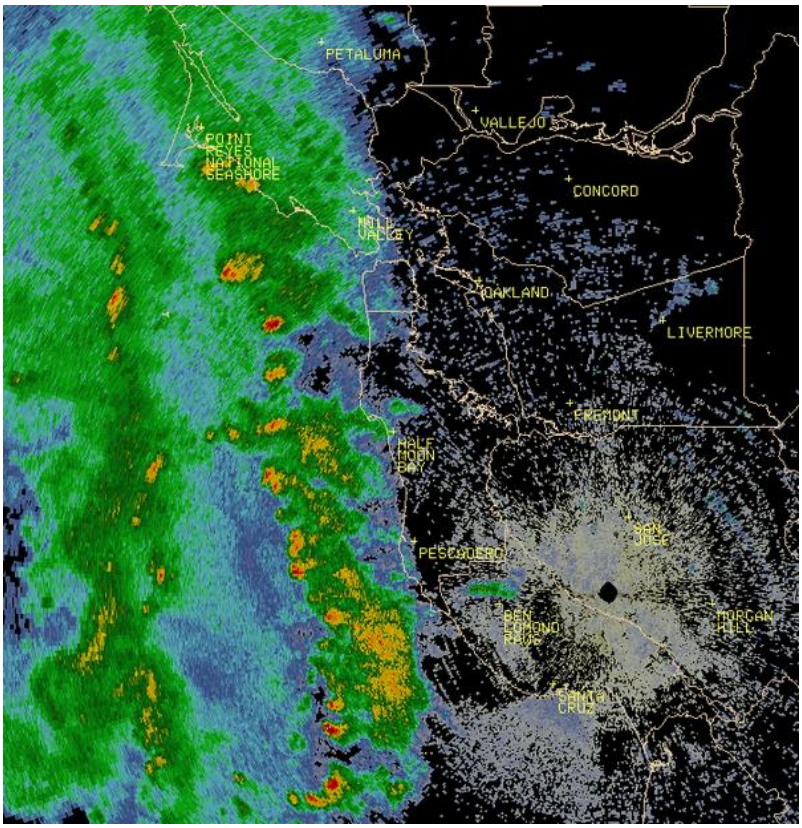
By midafternoon on the 15th heavy rain developed across the North Bay, resulting in flooding on small streams and creeks in Southern Napa County, Southern Sonoma County, and Marin County.

Very active weather resumed the following day on Tuesday, December 16. By late morning a line of heavy showers had developed over the coastal waters.



Visible satellite image taken at 11:15 am on Tuesday, December 16, showing a line of heavy showers offshore, approaching the northern and central California coast.

By 3 pm that afternoon, this line of showers began to push inland and several lightning strikes were detected offshore.



KMUX radar image at 3 pm on the afternoon of December 16, showing a line of intense showers and isolated thunderstorms beginning to move inland.

By early evening on the 16th a thunderstorm was reported near San Francisco, along with heavy rain and small hail. Radar indicated that some of the intense showers and thunderstorms over the coastal waters exhibited severe characteristics. Thirteen special marine warnings were issued for the coastal waters between Point Reyes and Point Piedras Blancas between 4 pm and 9 pm on the 16th. In addition, a severe thunderstorm warning was issued for the Watsonville and Moss Landing areas of Santa Cruz County that evening.

Rain continued off and on through December 17 and 18, albeit less widespread and intense compared to the previous two days.

The December 18 update of the Drought Monitor showed slight improvement for Northern California due to heavy rains over the preceding week. Most of the San Francisco Bay Area and much of the Monterey Bay Area were reduced from the D4 "exceptional" drought category to D3 "extreme" category. In early January, the climate.gov web site posted an article entitled "It Poured in California in December. Can We Stop Talking About the Drought?" This article explained why copious rainfall in December resulted in only marginal drought relief.

A cold front swept into the North Bay during the early morning hours of Friday, December 19, and by mid-morning rain totals across portions of the North Bay were already approaching 2 inches. Kentfield's rainfall total on the 19th was 2.63 inches and San Francisco's 1.24". Rain totals were much lower to the south of San Francisco. This was to be the final significant rain event of the month.

A strong cold front moved in from the north on Christmas Eve. This cold front produced a brief burst of heavy rain in San Francisco during the early afternoon hours of the 24th, but less than a tenth of an inch of rain fell in the City and no location picked up more than a quarter of an inch.

Stormy weather during the first three weeks of December, including several periods of heavy rain, resulted in monthly rainfall totals that were well above normal. In fact, most climate stations received from two to three times their normal rainfall during December. A few locations accumulated more than 300% of average December rainfall, including Petaluma, Livermore, Newark, Moffett Field, Monterey Airport, and Salinas. December 2014 turned out to be the wettest December on record for three climate stations, including Petaluma Airport which has a 100-year rainfall climate record. Several other climate stations had one of their wettest Decembers on record. At nearly every location, the wettest December prior to this year was in 1955. Downtown San Francisco, which has the longest rainfall period of record at 165 years, registered its 5th wettest December. See tables below for details:

December 2014: Wettest December on Record

Location	Dec 2014 Rain Total	Average Dec Rain	Previous Record and Year	Years of Records
Petaluma Airport	15.60 inches	4.94	15.48 in 1955	100
Newark	9.48	2.56	7.93 in 1955	72
Salinas	7.45	2.44	5.92 in 1996	56

December 2014: One of the Wettest on Record					
Location	**Dec 2014 Rain Total**	**Rank**	**Average Dec Rain**	**Record Dec Rain & Year**	**Years of Records**
Mount Diablo Junction	11.78 inches	2nd	4.39	15.38 in 1955	63
Monterey	9.73	2nd	3.41	9.79 in 1955	79
Moffett Federal Airfield	8.53	2nd	2.56	9.55 in 1955	66
Livermore	8.23	2nd	2.58	10.15 in 1955	111
San Jose	7.76	2nd	2.61	9.26 in 1955	120
Sonoma	13.50	3rd	6.21	16.87 in 1955	75
Mount Hamilton	10.92	3rd	4.15	21.55 in 1955	66
Martinez	10.74	3rd	3.71	12.90 in 1955	88
Redwood City	10.73	3rd	3.84	14.16 in 1955	95
San Francisco Airport	10.66	3rd	4.03	12.30 in 1955	70
Oakland Museum	10.49	3rd	4.48	11.87 in 2002	43
Oakland Airport	8.86	3rd	3.66	11.29 in 1955	53
San Rafael	17.17	4th	7.59	22.65 in 1955	68
Richmond	11.36	4th	4.61	15.40 in 2002	65
Half Moon Bay	10.80	4th	5.28	13.81 in 1955	74
Saint Helena	17.08	5th	7.12	24.32 in 1955	108
Napa	11.97	5th	5.23	16.13 in 1955	117
Berkeley	12.02	5th	5.04	15.04 in 1955	116
San Francisco Downtown	11.70	5th	4.56	15.16 in 1866	165
Salinas Airport	6.01	5th	1.93	8.96 in 1955	84
Gilroy	8.67	6th	3.70	10.26 in 1906	70
Kentfield	19.80	7th	9.91	32.87 in 1955	110
Angwin	17.37	7th	8.09	30.44 in 1955	72
Watsonville	10.14	7th	4.25	14.61 in 1944	101
King City	4.83	7th	1.98	7.69 in 1955	105
Pinnacles National Park	5.91	8th	2.78	9.84 in 1955	76

December 2014 was the **3rd wettest December** on record for **California Climate Division #4** and the wettest December since 1955 for this climate division. (California Climate Division #4 is defined in the temperature section that follows).

California Climate Divisions

On December 31st, with the first six months of the rain year complete, year-to-date rainfall totals were running well ahead of normal across the region. December 31st year-to-date rain totals ranged from a low of about 125 percent of normal at some North Bay locations such as Occidental and Calistoga to more than 200 percent of normal at San Jose, Moffett Field, Newark, Salinas, and Monterey Airport.

January 2015

January 2015 was the driest January on record across the San Francisco Bay Area and Monterey Bay Area. Most climate stations received no measurable rainfall during January - a remarkable occurrence considering that January is typically one of the wettest months of the year. The previous driest January at most climate stations occurred the previous January (2014).

Downtown San Francisco was one of many climate stations with no measurable rain in January. Until this year, a January with no measurable rain had never occurred in San Francisco since rainfall records began there in 1849 (166 years).

There were only two light precipitation events during January. The first occurred on Friday, January 16 when a weak weather system moved across Northern California. Light rain fell as far south as San Francisco and Berkeley, but nearly all measurable rain was confined to the North Bay. Up to a third of an inch fell on the Sonoma County coast and locally in the North Bay Mountains, otherwise amounts were generally less than a tenth of an inch.

The second light rain event occurred on Tuesday, January 27, when an upper low off the southern California coast lifted to the northeast and across south-central California. Light rain that morning was primarily confined to southern Monterey County and southern San Benito County, although sprinkles were observed as far north as San Jose. Rainfall totals on the 27th were generally under a quarter of an inch.

Other than these two light rain events, January was a completely dry month. An upper level ridge of high pressure persisted along the west coast for nearly the entire month, effectively preventing Pacific weather systems from making their way into California.

Rain totals for January 2014 were exceptionally low. The majority of climate stations received no measurable rainfall during January and those locations that did measure picked up less than 5 percent of their January normal.

February 2015

After an exceptionally dry January, February got off to a promising start when an “atmospheric river” developed across the Eastern Pacific. By February 3 a plume of very moist air (atmospheric river) extended from near the Hawaiian Islands northeast towards the west coast. Weather prediction models indicated that this atmospheric river would deliver heavy amounts of precipitation to the San Francisco Bay Area from Friday, February 6 through Sunday, February 8. Flash flood watches were issued for the North Bay counties.

Rain began to spread into the North Bay by 10 pm on the evening of Thursday, February 5. Rain was heaviest in the North Bay during the overnight hours. Significant rain then spread south across the remainder of the San Francisco Bay Area on Friday, and rain became heavy in the Santa Cruz Mountains late that day. By 6 pm that evening, rain rates of up to 0.75 inches/hour were being observed in the Santa Cruz Mountains.

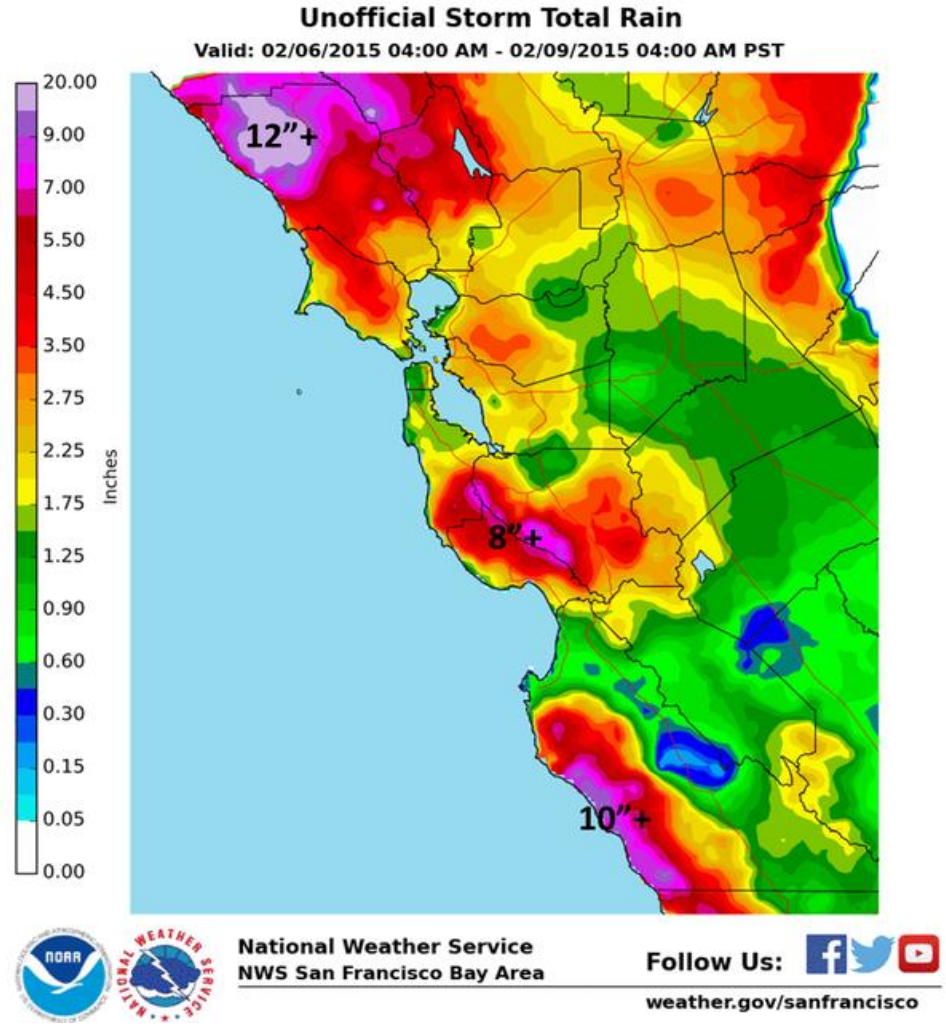
Rainfall totals through Friday night varied considerably across the region, with the coastal mountains picking up significantly more precipitation compared to lower elevation locations. More than ten inches of rain fell at Venado in northwest Sonoma County from late on the 5th through late on the 6th. Localized amounts of more than 6 inches were reported in the Santa Cruz and Santa Lucia Mountain ranges. In contrast, locations near sea level from Monterey south received only a quarter of an inch of rain, or less. Rainfall totals for other locations near sea level included:

Santa Rosa Airport: 2.62”
San Rafael: 2.00”
Concord Airport: 1.38”
San Jose Airport: 1.26”
Napa Airport: 1.17”
Oakland Museum: 1.01”
San Francisco Downtown: 0.75”
Santa Cruz: 0.75”

There were several reports of roadway flooding across the San Francisco Bay Area on February 6. Flooding was mostly confined to low lying urban areas and no significant river flooding occurred with this storm.

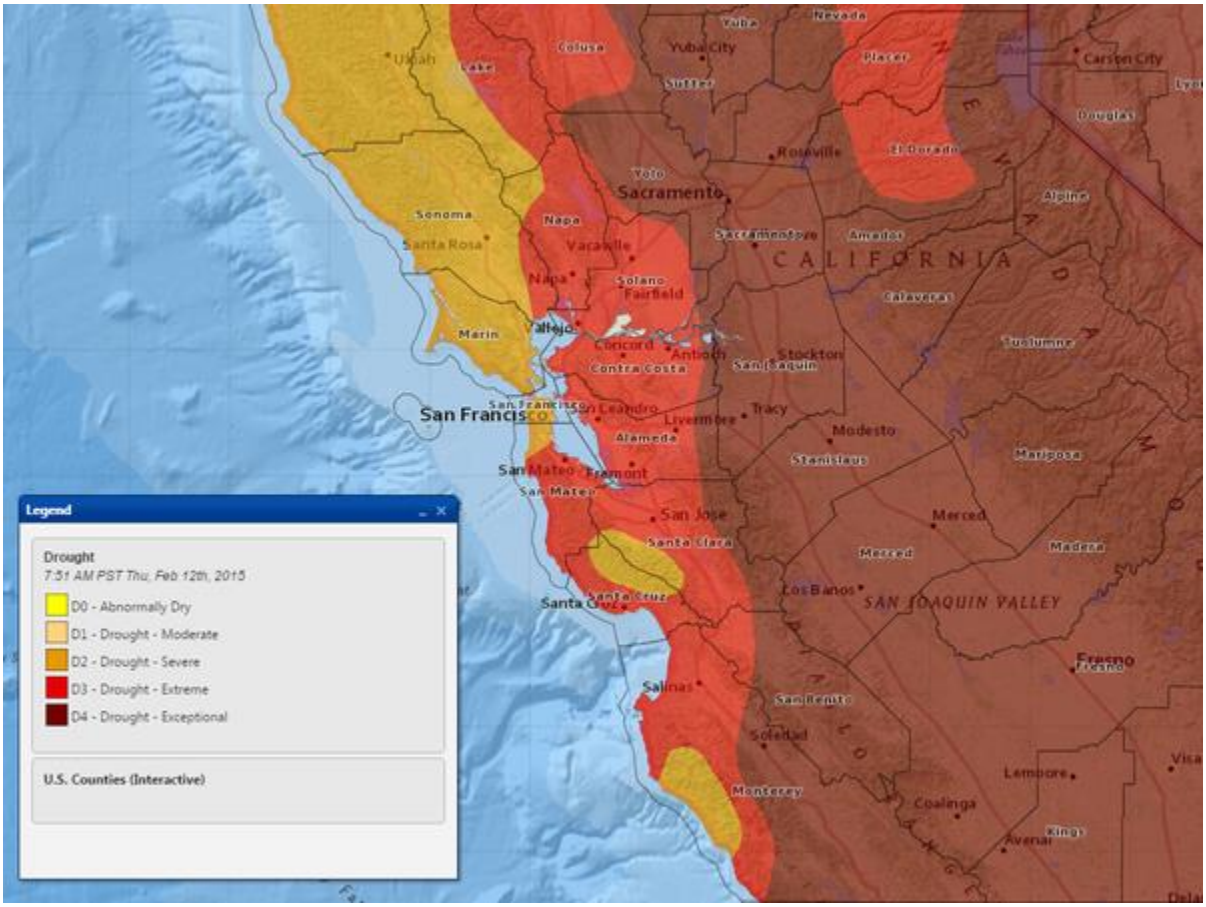
There was a period of relatively dry weather on Saturday, February 7, before another frontal system approached the coast around sunrise on Sunday, February 8, producing a second round of precipitation. The airmass with this second impulse on the 8th was somewhat unstable. An isolated thunderstorm developed in the Santa Cruz Mountains around midday, and thunder was heard in the East Bay near Walnut Creek that afternoon.

The coastal mountains picked up from 2 to 4 inches of rain on the 8th. Lower elevation locations accumulated 0.5 to 1.5 inches, except less than a half inch near southern Monterey Bay and across interior sections of Monterey and San Benito Counties. Storm total rainfall for both systems (Feb 6-8) is depicted in the graphic below. Note how orographic enhancement resulted in rain totals in the coastal mountain ranges that were more than 10 times greater as that of many lower elevation locations and more than 20 times greater than some interior valley locations.



The Thursday, February 12 update of the Drought Monitor showed the effects of the February 6-8 rain events. Improvement was noted, but primarily in the coastal ranges. The following areas were re-classified from D3 (extreme drought) to D2 (severe drought):

- Most of Sonoma County as well as northwest Napa County
- San Francisco
- Much of the Santa Cruz Mountains
- Much of the Santa Lucia Mountains



February 12 update of the Drought Monitor, showing improved conditions across portions of the North Bay, the northern San Francisco Peninsula, the Santa Cruz Mountains, and the Santa Lucia Mountains.

The persistent ridge that dominated California's weather during most of January redeveloped by the second week of February and produced dry weather through the third week of Feburary.

A cool upper trough dropping in from the north on Sunday, February 22, generated no rainfall over the San Francisco Bay Area. But the system then picked up some moisture off the Pacific and managed to produce widely scattered showers over Monterey and San Benito Counties that afternoon and evening, and an isolated thunderstorm near Fort Hunter Liggett in southern Monterey County. Rainfall amounts were mostly less than a tenth of an inch, except in Parkfield in extreme southeast Monterey County where 0.43" fell.

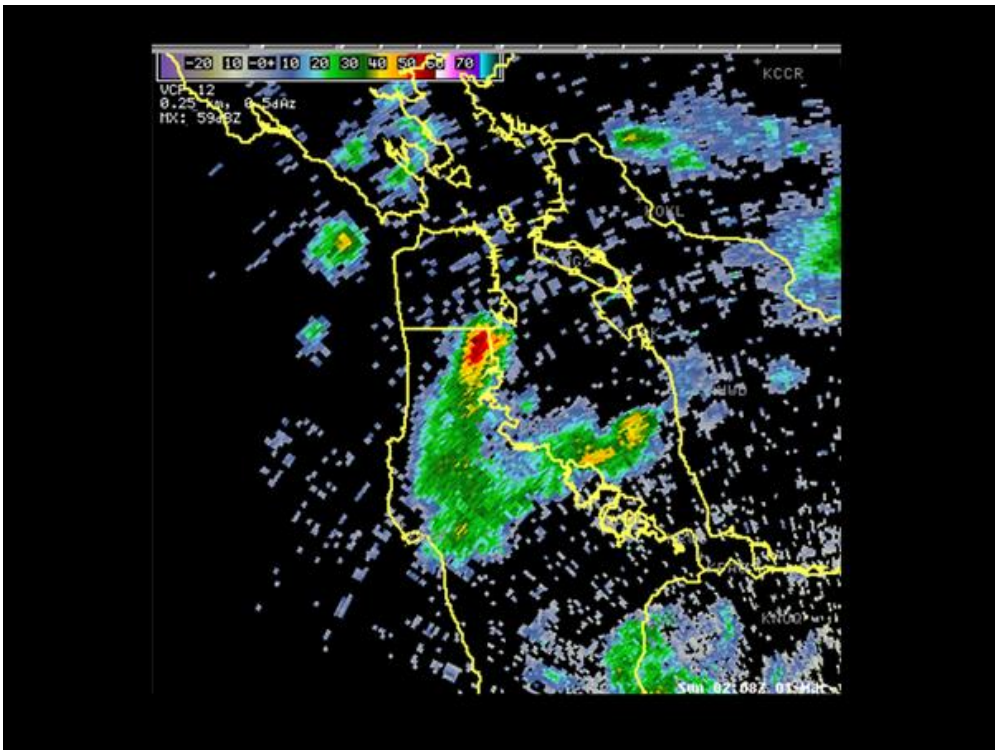
Another weather system dropped south along the west coast on Friday, February 27, triggering scattered showers near the southern portion of Monterey Bay that evening. Showers became more widespread by the morning of Saturday, February 28. Thunder was heard at the NWS Forecast Office in Monterey at 6 am.

Showers developing over Monterey Bay on the morning of February 28. Photo: Ryan Smithies

By early afternoon on February 28 a thunderstorm developed over Rohnert Park in Sonoma County, between Santa Rosa and Petaluma. This thunderstorm produced numerous lightning strikes. Isolated afternoon thunderstorms also developed over the Santa Clara Valley between southeastern San Jose and Morgan Hill, as well as the adjoining hills to the east of the valley. These storms produced small hail, enough to cover the ground in some locations.

Hail covers the ground in the Meadowlands neighborhood in south San Jose on the afternoon of February 28. Photo: Steve Baker

Shortly after 6 pm on the evening of February 28 a thunderstorm developed just to the south of San Francisco.



Radar image showing a thunderstorm over extreme northern San Mateo County shortly after 6 pm on February 28

An eyewitness reported that this storm produced a funnel cloud over northern San Mateo County. Several spectacular photographs of this storm were taken right around sunset.

Storm clouds from Bernal Heights in San Francisco on the evening of February 28. Photo: Jacob DeFlitch

Lightning from Daly City on the evening of February 28. Photo: Antonio Maffei

Thunderstorm as seen from the Mission District of San Francisco on the evening of February 28. Photo: Marcus Muench

Rainfall from the February 27-28 storm system was spotty and mostly light. Monterey picked up a half inch of rain and Carmel Valley accumulated 0.88”. Most other locations received less than a quarter of an inch.

Because February had only one significant precipitation event (Feb. 6-8), rainfall totals for the month were below normal across the entire region. Rain totals at the majority of climate stations were from about half to

three-quarters of normal, but ranged from a low of 25 percent of normal at the Salinas Airport up to 93 percent of normal in Palo Alto.

March 2015

Rainfall was scarce during March. The majority of climate stations accumulated less than 10 percent of their average March rainfall.

In contrast to the dry conditions that prevailed during most of March, the month began cool and showery. On Sunday, March 1 an upper low centered over the Central California Coast produced numerous showers and isolated thunderstorms, mainly over Monterey and San Benito Counties.

Thunderstorm just to the south of Salinas during the evening of Sunday, March 1. Photo: Miguel Santiago

Unsettled weather continued into Monday, March 2. A line of showers and isolated thunderstorms over southern Monterey Bay moved inland across northern Monterey County. Thunder was heard in Castroville and pea sized hail fell at the National Weather Service Forecast Office in Monterey. By early afternoon lightning was observed between Milpitas and Fremont, while portions of San Jose experienced heavy rain and small hail. Nearly all of the precipitation that fell during the first two days of March was confined to areas from San Jose southward. Big Sur picked up over a half inch of rain on March 1 and 2, while areas from San Francisco and Oakland northward had no measurable precipitation.

Rainfall totals for March were well below normal across the entire region. Most climate stations across the San Francisco Bay Area received less than 10 percent of their average March rainfall. Locations near Monterey Bay fared a bit better compared to the San Francisco Bay Area, with slightly higher percent-of-normal rainfall values for March. Only one location, Watsonville, managed to accumulate more than 20 percent of its average monthly rain total.

Petaluma's 0.08" rain total for March tied for the driest March on record at that location:

Driest March on Record				
Location	**Normal March Rainfall (inches)**	**March 2015 Rainfall**	**Previous Driest March and Year**	**Length of Climate Record (yrs)**
Petaluma Airport	3.79	0.08 (tie)	0.08 in 1988	101

Seven other climate stations experienced their second driest March on record:

Second Driest March on Record				
Location	**Normal March Rainfall (inches)**	**March 2015 Rainfall**	**Driest March and Year**	**Length of Climate Record (yrs)**
Angwin	5.66	0.21	0.05 in 1988	73
Napa	3.87	0.10	0.02 in 1923	118
Oakland Airport	3.08	0.09	0.04 in 1956	54
Oakland Museum	3.39	0.05	0.03 in 1988	44
Occidental	7.42	0.38	0.33 in 1994	71
Redwood City	3.13	0.05	0.00 in 1934	96
San Francisco Airport	2.96	0.06	0.05 in 1988	71

Five more climate stations had their 3rd driest March, including Calistoga, Cloverdale, Sonoma, Half Moon Bay, and Gilroy.

Downtown San Francisco, with 166 years of precipitation data, experienced its 4th driest March.

April 2015

A few precipitation events produced moderate amounts of rainfall in April. Although some locations accumulated more than their average April precipitation, the majority of climate stations ended the month with rain totals below their historical average.

A weak weather system moved ashore during the morning of Sunday, April 5, producing light amounts of rain. Rainfall amounts at lower elevations were less than a quarter of an inch. Up to a third of an inch fell at some higher elevation locations in the San Francisco Bay Area.

A more robust weather system moved through the area on April 6 and 7:

- Monday, April 6, 8:30 pm: Rain begins in the North Bay as a strong cold front approaches.
- Tuesday, April 7, late morning: Several lightning strikes detected offshore.
- Early morning hours of Tuesday: Several higher elevation locations report winds gusts of more than 40 mph.
- Late afternoon Tuesday: Small hail reported in Pleasant Hill and Sonoma.

Rainfall totals with the April 6-7 storm system were as follows:

- Lower Elevations: Generally from 0.25-0.75" except up to 1.5" in the North Bay Valleys and locally along the Santa Cruz and Monterey County Coasts.
- Higher Elevations: from 0.5-1.75" except locally up to 2 inches in the Santa Cruz Mountains.

Only one other widespread rainfall event occurred during April. A fast-moving weather system spread light to moderate rain across the region from the evening of Friday, April 24 through the pre-dawn hours of Saturday, April 25. Rainfall amounts at lower elevations generally ranged from a quarter to a half inch. Higher elevations picked up between 0.5 and 1.5" except local amounts of more than 2 inches in the Santa Lucia Mountains of Monterey County.

Rain totals for the month ranged from less than 40 percent of normal at Half Moon Bay and Hollister to more than 130 percent of normal in the southern Napa Valley. But most locations ended the month with rain totals that were relatively close to normal.

May 2015

There were only two notable precipitation events during May, both of them convective in nature. Four climate stations across the region managed to accumulate above normal monthly rainfall totals from these two events. All other locations ended the month with below normal precipitation, and some North and East Bay locations received no measurable rain at all.

The first May precipitation event was on Thursday, May 7 and the second one week later on Thursday, May 14. Both events consisted of scattered precipitation, with rainfall amounts varying considerably across the region.

May 7 and 14 were not the only days in which rain occurred during the month. However, the bulk of May's precipitation fell during these two events. Very light precipitation also occurred at various times between May 20 and 26. But most of the precipitation during the final third of the month was in the form of drizzle falling from a deep and persistent marine layer, and typically only amounted to a few hundredths at any one time. All of Downtown San Francisco's May precipitation (0.09") came in the form of very light rain or drizzle during this period of time. In addition, there were some isolated light rain showers in Santa Cruz and Monterey Counties on May 20 and 21, which also resulted in localized light amounts of precipitation.

Because most of May's rainfall was convective in nature, precipitation totals for May ran the gamut from zero across much of the North Bay to more than twice normal in Hollister. Only four locations accumulated more than their normal May rainfall (Hollister, Palo Alto, Moffett Field and Livermore). Rain totals at all other climate stations were below normal. In general, the southern portion of the region fared rather well, while the northern portion came up well short of 30-year averages. By the end of May drought conditions remained unchanged, with drought classification as of May 26 ranging from "severe" to "exceptional" across the region.

June 2015

An upper level low pressure trough gradually deepened along the west coast during the first five days of June. Local light rain and drizzle occurred on the morning of June 1, but it took until the early morning hours of Thursday June 4th before showers and thunderstorms developed. Isolated showers and thunderstorms continued into June 5. Precipitation during the first five days of June was mostly light and fell primarily over the North Bay and also across southern San Benito County and southeastern Monterey County.

An upper low off the southern California coast began to lift to the north during the early morning hours of Tuesday, June 9. Thunderstorms initially developed off the southern California during the early morning hours of June 9 when more than 500 lightning strikes were detected between 4-5 am. By mid-morning, thunderstorms were detected off the Central California Coast. Precipitation began to move onshore across southern Monterey County by early that afternoon.

As the low continued to track northward that night, showers spread into the San Francisco Bay Area. Widespread shower activity developed across the San Francisco Bay Area by sunrise on the morning of

Wednesday, June 10. Isolated thunderstorms also developed that same afternoon over southern Monterey and San Benito Counties.

As much as a half inch or rain fell across portions of the East Bay on June 10, and some North Bay locations picked up as much as a quarter inch. Most locations outside of the North and East Bay received less than a quarter of an inch. San Francisco and San Jose both picked up about a tenth of an inch.

June is typically a dry month in which most climate stations average less than a quarter of an inch of rain. Thus, whenever rain of any significance does fall, rain totals can greatly exceed average rainfall. Such was the case in June 2015 when some East Bay locations picked up more than three times their normal June rainfall. These East Bay sites were Antioch, Concord and Livermore. At the other extreme, five climate stations received no measurable rain during the month of June. These dry locations were Gilroy, Los Gatos, Watsonville, Hollister, and Pinnacles National Park.

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