

Clover & Ruby Valley Conservation Districts Joint Meeting February 17, 2016

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United States Department of Agriculture
Natural Resources Conservation Service

Topics

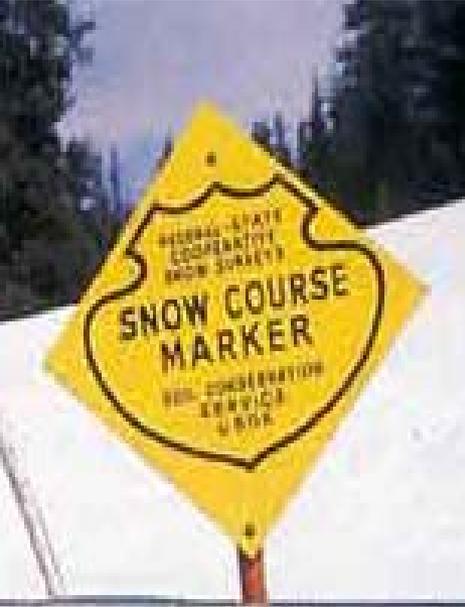
- ⦿ Introduction to snow survey
- ⦿ Hole-in-Mountain SNOTEL
 - Avalanche
 - Future Plan
- ⦿ Current snow and precipitation conditions
- ⦿ Clover Valley – Franklin River Basin Group
- ⦿ New SNOTEL Site – Pros / Cons - Julander
- ⦿ Franklin R near Arthur Streamflow Forecast
 - Status of the stream gage
 - NRCS policy
 - Future possibilities

Snow Water Equivalent (SWE) is a common snowpack measurement. It is the amount of **water** contained within the snowpack. It can be thought of as the depth of **water** that would theoretically result if you melted the entire snowpack instantaneously.

$$\text{Snow Depth (in)} * \text{Density} = \text{SWE (in)}$$



Snow Courses



Permanently marked snow measuring locations.

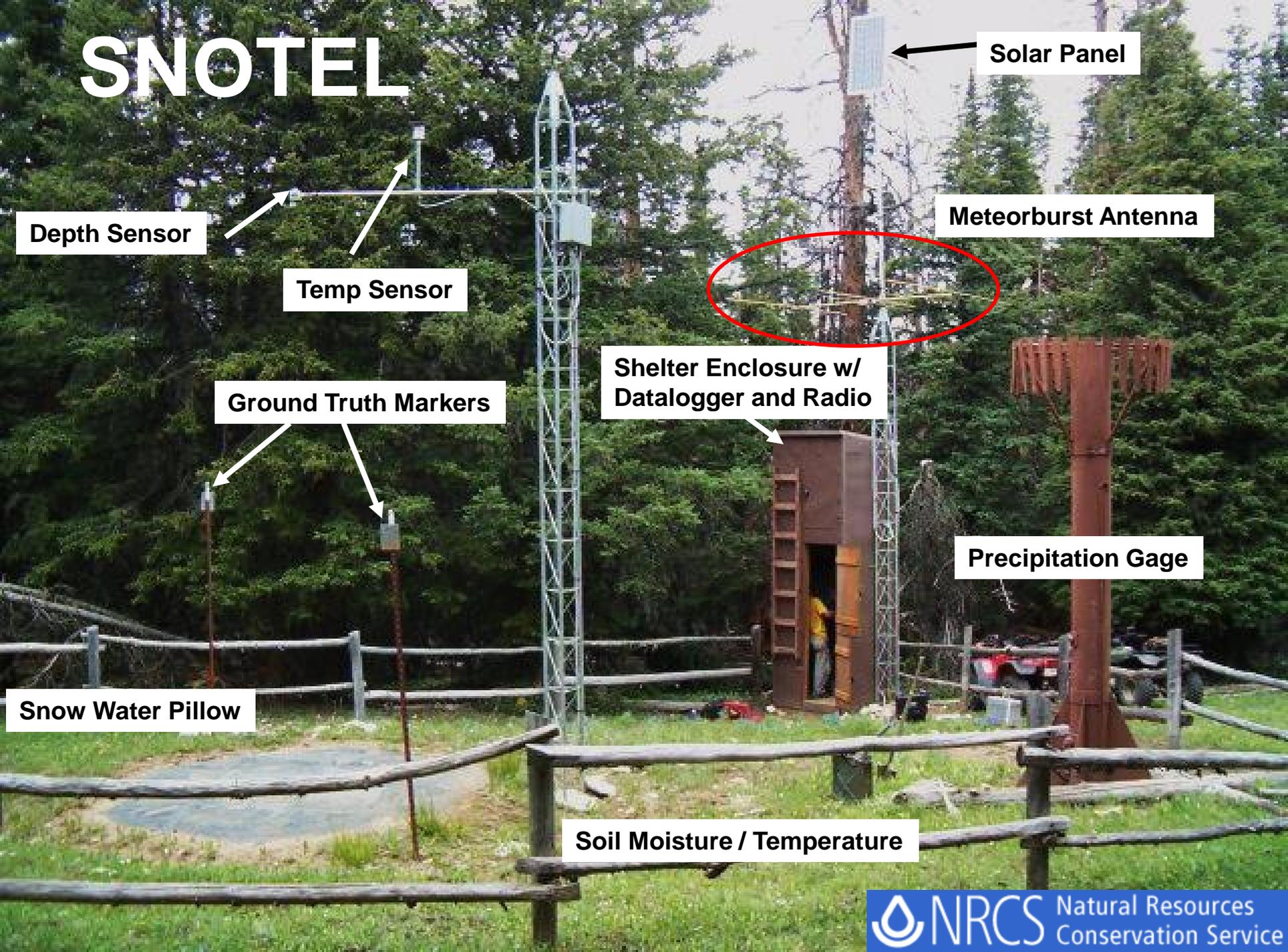
Average of 5-10 points spaced at 50 ft

57 snow courses measured April 1 in NV and eastern Sierra

SNOTEL “Snow Telemetry”



SNOTEL



Depth Sensor

Temp Sensor

Ground Truth Markers

Snow Water Pillow

Soil Moisture / Temperature

Solar Panel

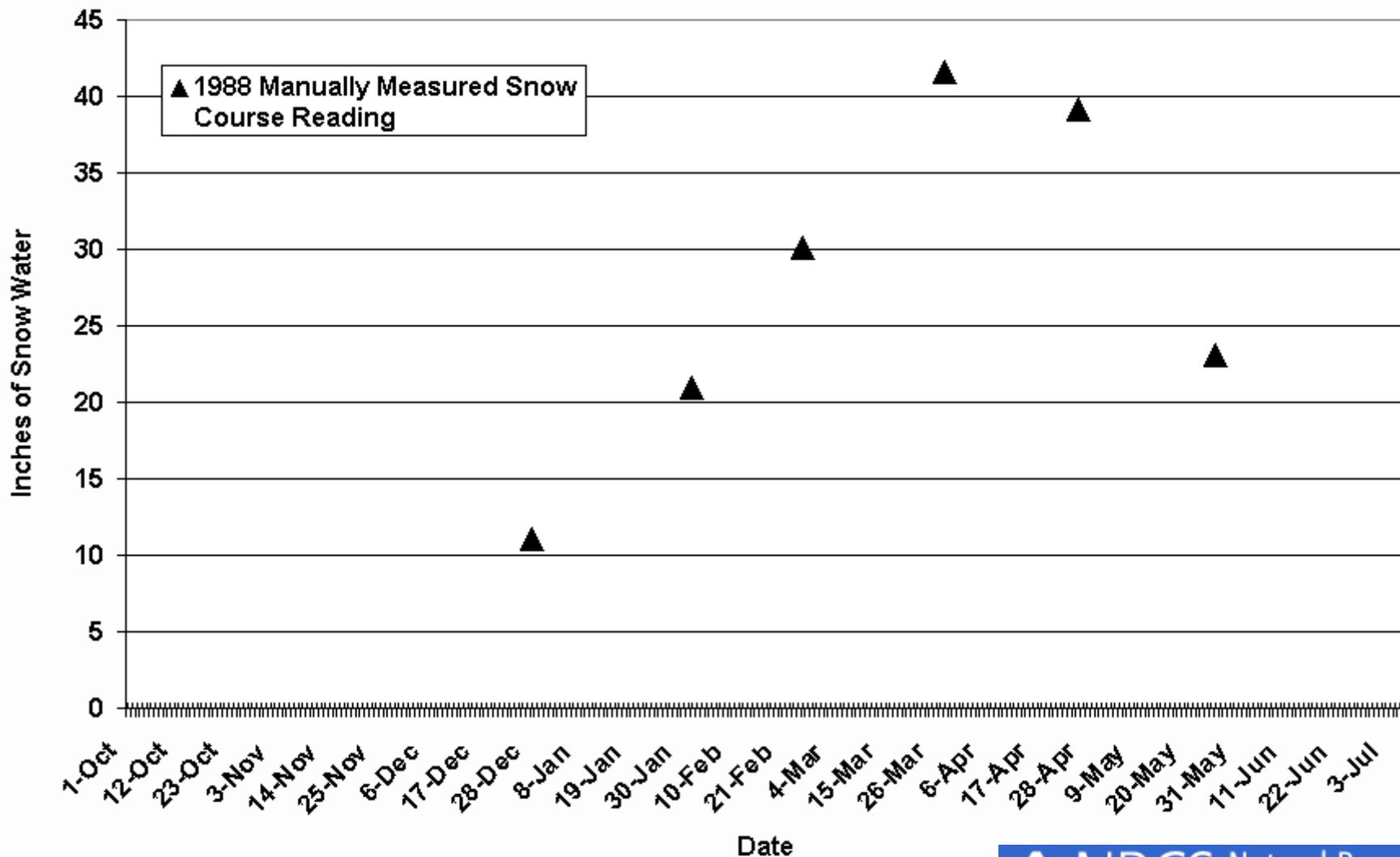
Meteorburst Antenna

Shelter Enclosure w/
Datalogger and Radio

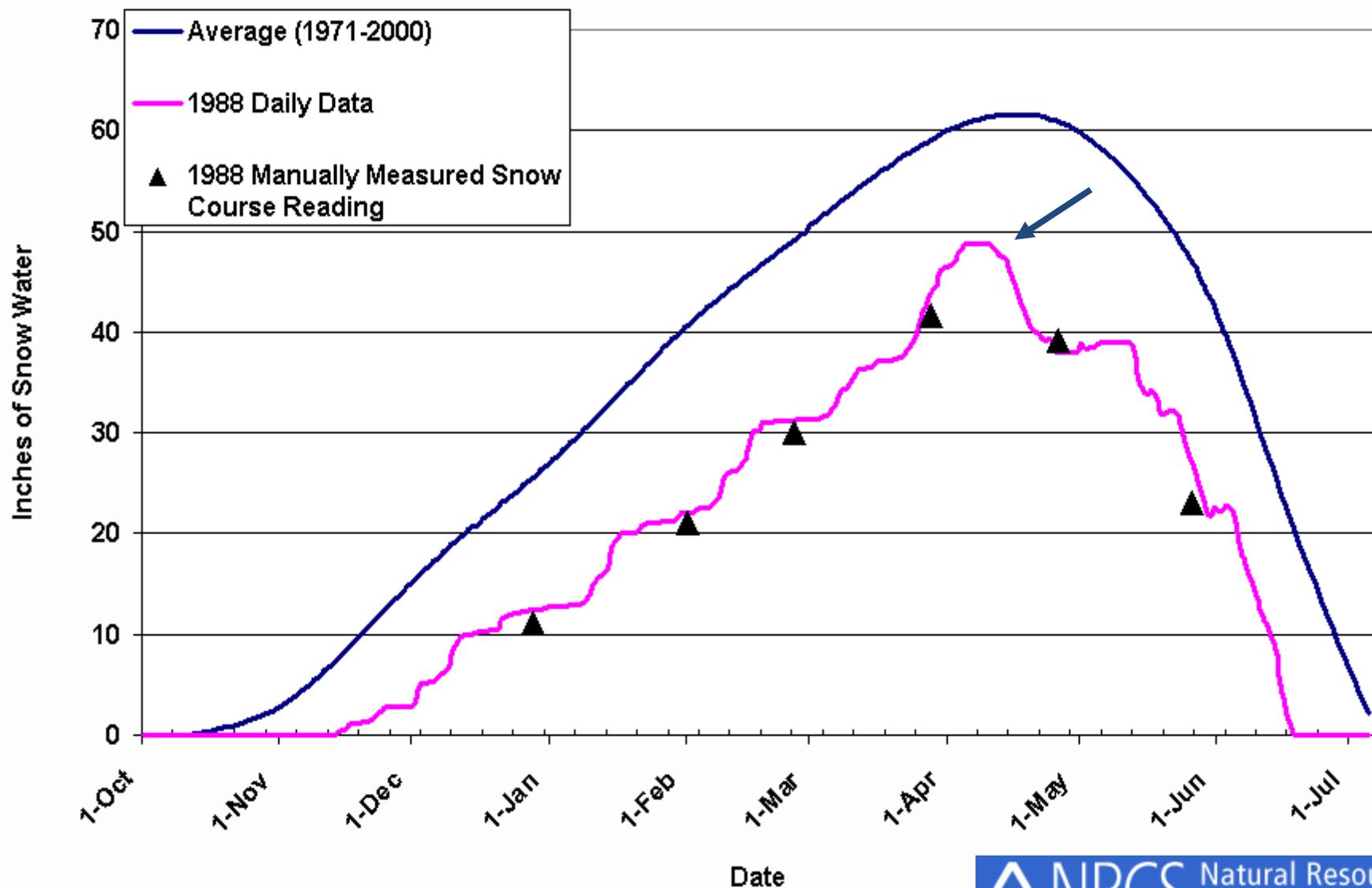
Precipitation Gage

Manual 1st of Month Data

Lost Lake Divide SNOTEL Site, North Fork Clearwater River Basin



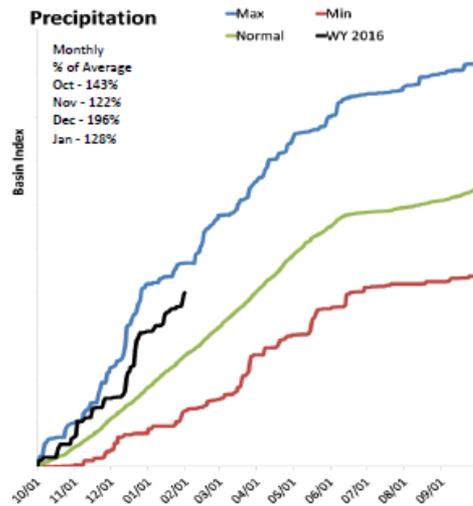
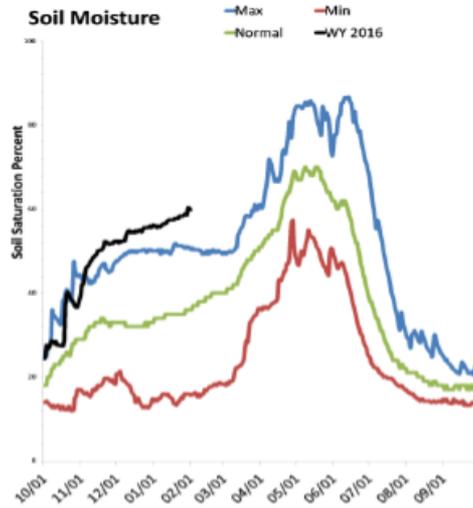
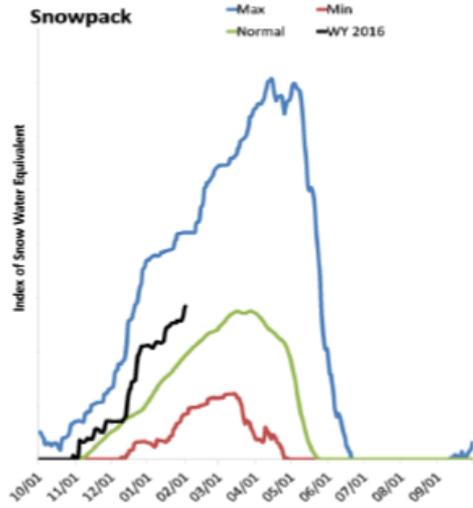
Lost Lake Daily Data vs. Monthly Data



Clover Valley & Franklin River Basin

2/1/2016

Snowpack in the Clover Valley and Franklin River Basin is much above normal at 134% of median, compared to 81% last year. Precipitation in January was above average at 128%, which brings the seasonal accumulation (Oct-Jan) to 149% of average. Soil moisture is 60% compared to 45% last year. The forecast streamflow volume for the Franklin River is 103% of average.



Nevada Water Supply Outlook Report February 1, 2016



Photo - 1/20/2016 Snow Surveyor Logan Jensen stands on the debris pile next to the toppled Hole-in-Mountain SNOTEL shelter

Hole-in-Mountain SNOTEL wiped out by avalanche!

Across Nevada the first half of winter is off to an incredible start. Statewide February 1 snowpack percentages are some of the highest in the West. To date the biggest series of storms this winter occurred between mid-December and Christmas. The snowpack more than doubled its water content during that period in the mountains near Elko. The new snow load proved too much for the slope above Hole-in-Mountain SNOTEL. At 7:00am on December 23, 2015 the site sent out a report indicating 28 inches of new snow in the last 72 hours. The 8:00am reading never arrived because an avalanche descended over 3,000 vertical feet, crossed one-third of a mile of flat ground, and leveled the weather station. The site's 12 foot tall shelter was swept 200 feet away. A similar incident occurred in February 1986 which resulted in moving the SNOTEL site further away from the mountain. For 30 years that move was far enough. This summer we'll try again and are working on permitting to re-install the site outside the debris zone of this avalanche. For the rest of this winter snow surveyors will make monthly visits to the site to manually measure the snow to provide water users in Clover Valley as much information as possible about this summer's water supply.

Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast

Clover Valley & Franklin River Basin	Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
Franklin Ck nr Arthur	APR-JUL	4.8	6.2	7.1	103%	8	9.4	6.9

- 1) 90% and 10% exceedance probabilities are actually 95% and 5%
- 2) Forecasts are for unimpaired flows. Actual flow will be dependent on management of upstream reservoirs and diversions
- 3) Median value used in place of average

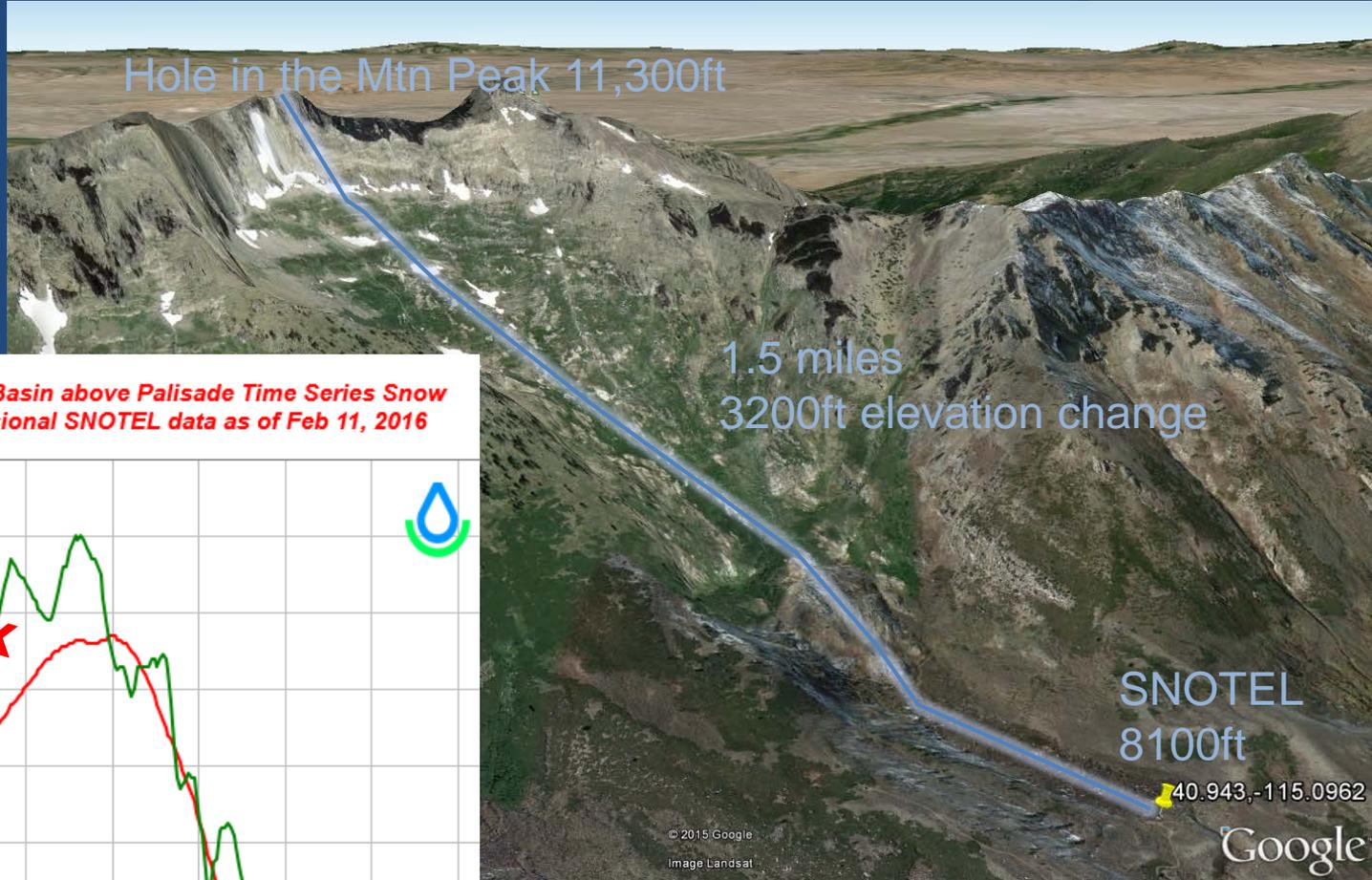
Watershed Snowpack Analysis February 1, 2016	# of Sites	% Median	Last Year % Median
Clover Valley & Franklin River Basin	8	134%	81%
Clover Valley	4	117%	81%
Franklin River	7	136%	79%

Hole-in-Mountain SNOTEL, Nevada hit by Avalanche!

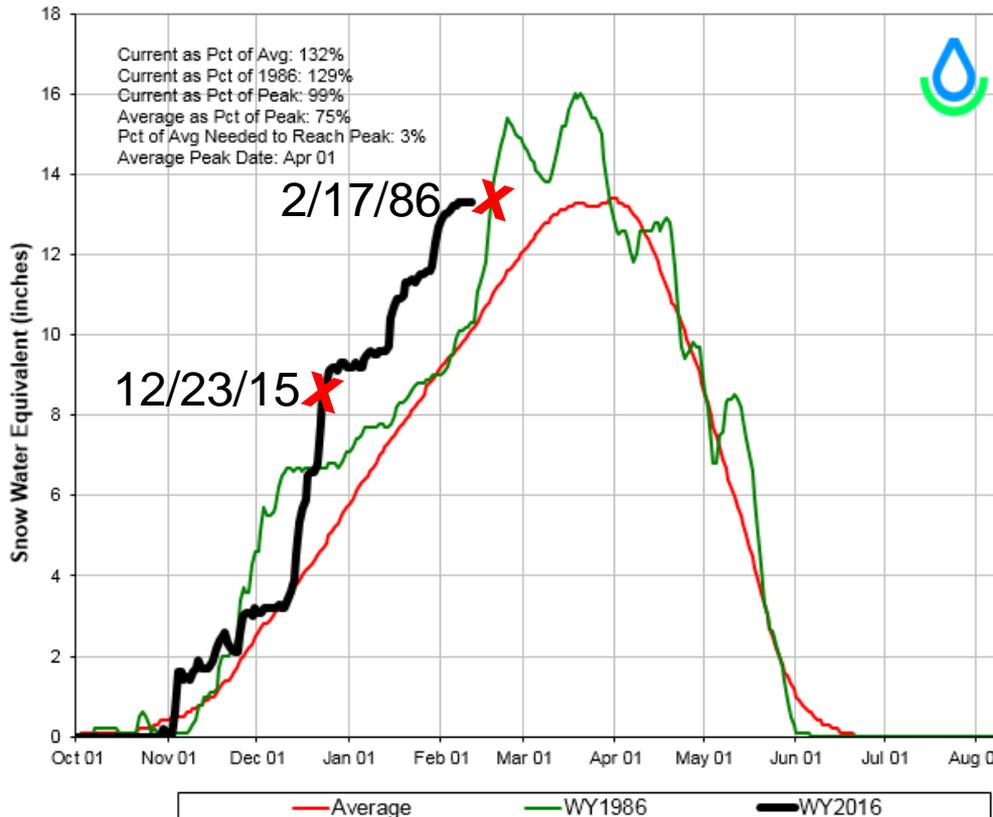
Site stopped reporting
12/23 at 7:00

Site had received 28" in
previous 72 hours

Repeat of 1986 incident



**Upper Humboldt Basin above Palisade Time Series Snow
Based on Provisional SNOTEL data as of Feb 11, 2016**



Summer





Snow pillow,
circular mound of snow is
fence surrounding it

12ft tall shelter toppled over
Slid downhill ~200ft
Weight ~ 1500lbs

Snow pillow & fence appear to be ok, avalanche went over the top on existing snow

No sign of 10ft tall precip gage or 20ft tall tower



Antenna wrapped around aspen



Solar panel bracket

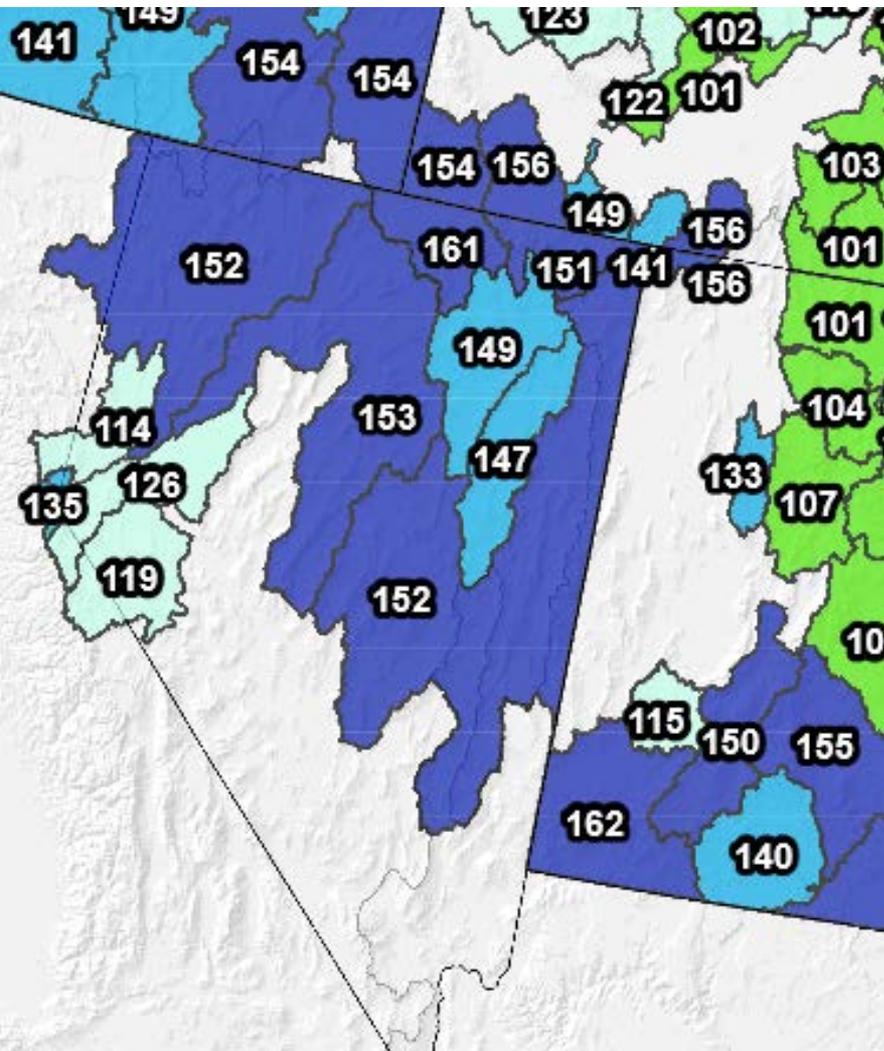
Jan 20th Shelter Retrieval



◎ Future Plans for Hole-in-Mountain

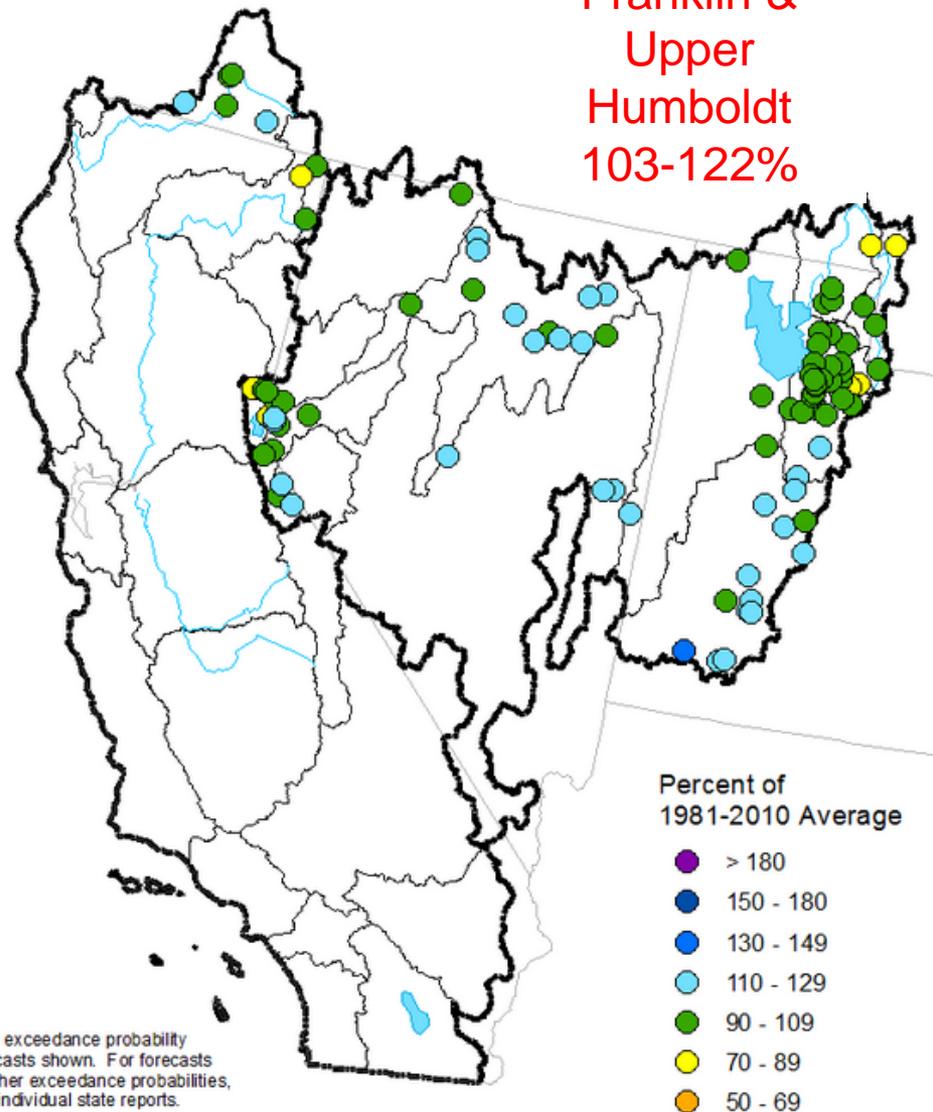
- **This Winter:** Kory and Logan will manually sample snow pillow for Mar 1 and Apr 1, Troy Brosten will estimate the SWE and precipitation for first of month reports. Daily reports will have percentages based on Corral Canyon, Dorsey Basin, Green Mtn, and Lamoille #3 SNOTEL sites.
- **Next Summer:** We are working on permitting to move SNOTEL site a few hundred feet south out of the debris zone of the most recent avalanche.
- **Future years:** Kory and Logan will manually measure previous snow pillow location for a few years so we can relate old site to new site. Once we have a few years we'll calculate new averages for the new location.

February 1, 2016 Snowpack Percent of Median



Great Basin and California Spring and Summer Streamflow Forecasts as of February 1, 2016

Franklin &
Upper
Humboldt
103-122%



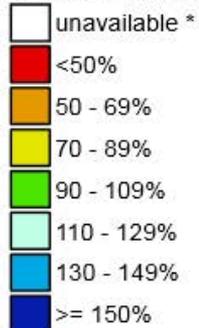
50% exceedance probability forecasts shown. For forecasts at other exceedance probabilities, see individual state reports.

Current Conditions

Nevada/California SNOTEL Current Snow Water Equivalent (SWE) % of Normal

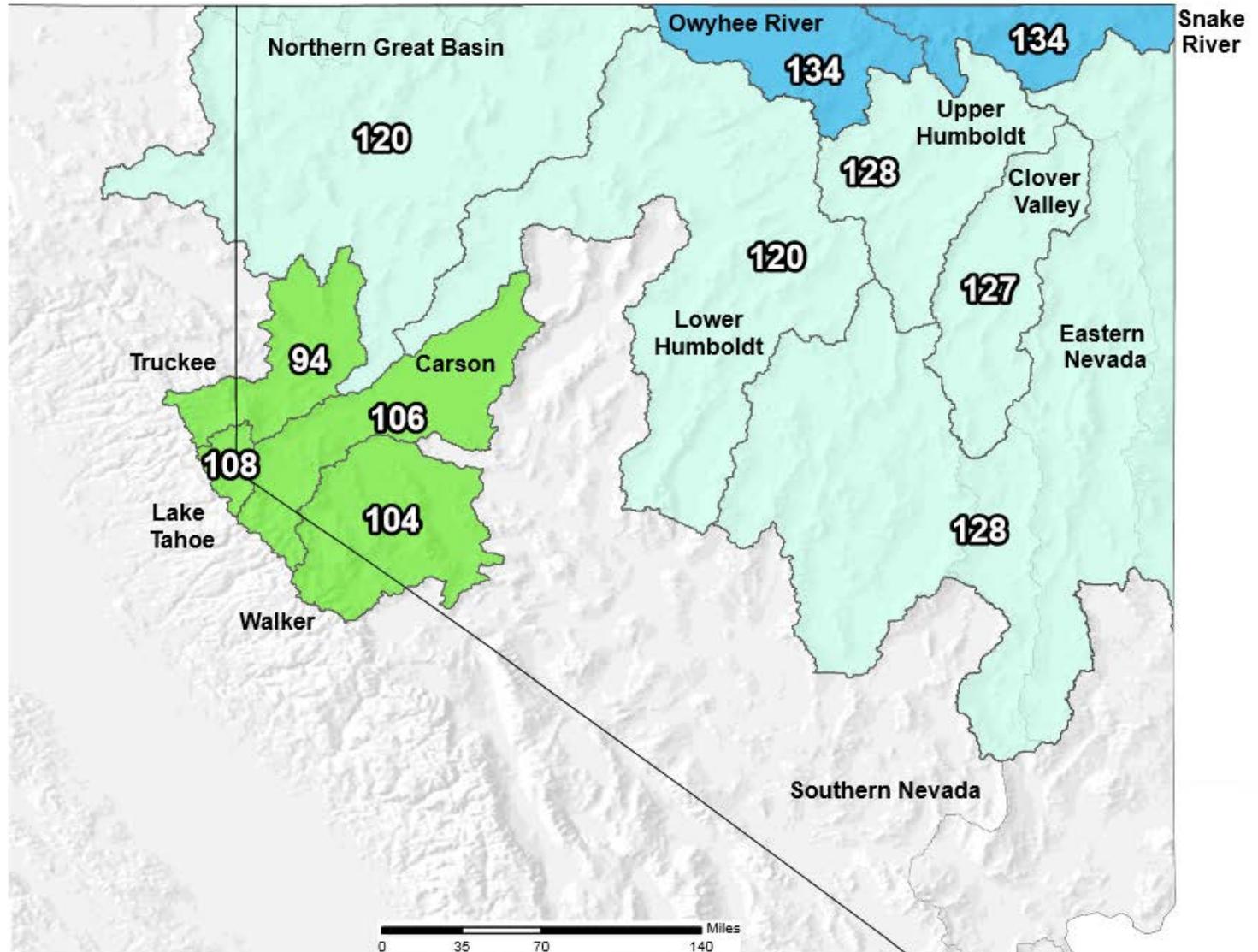
Feb 16, 2016

Current Snow Water Equivalent Basin-wide Percent of 1981-2010 Median

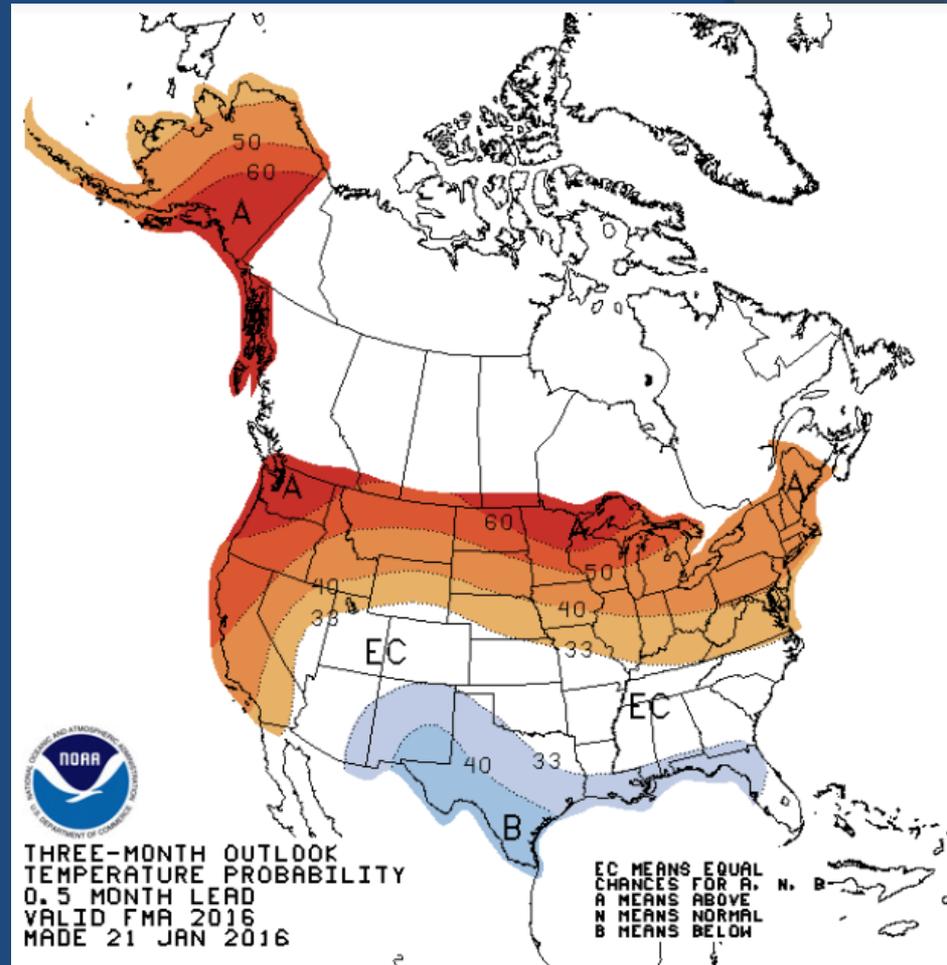
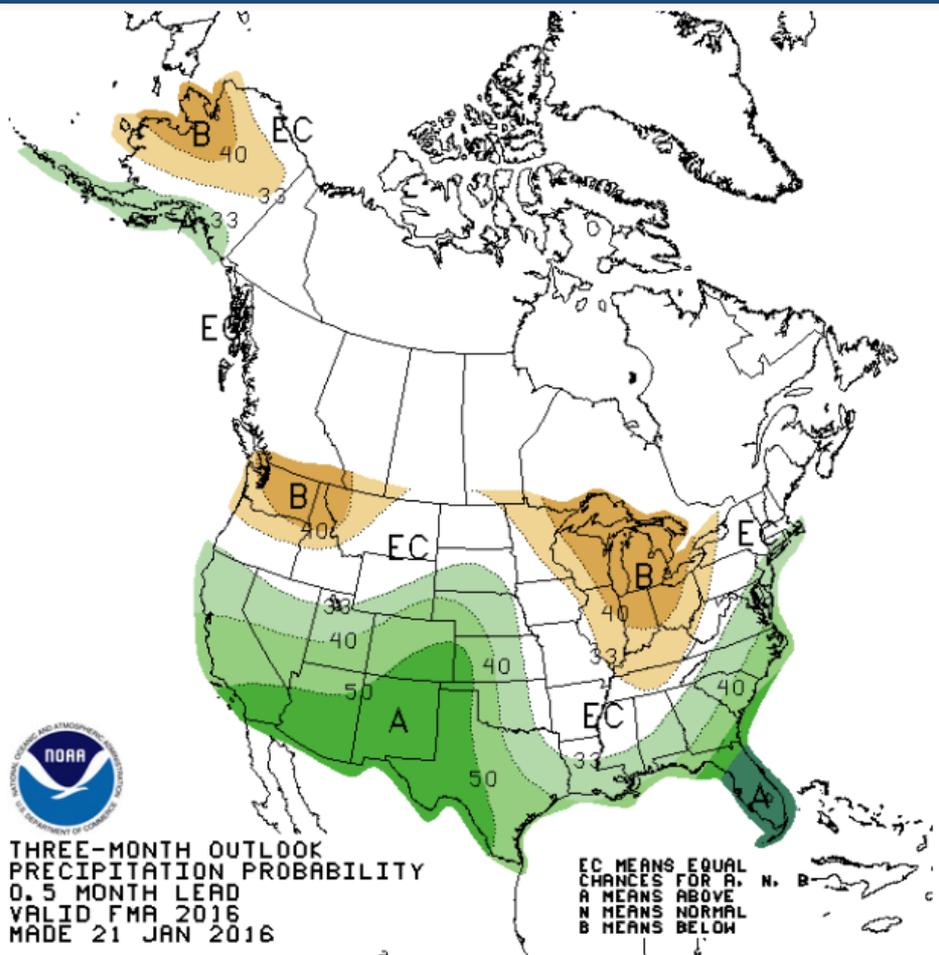


* Data unavailable at time of posting or measurement is not representative at this time of year

Provisional data subject to revision



Feb-Apr 2016 Climate Outlook



○ Clover Valley & Franklin River Basin Group

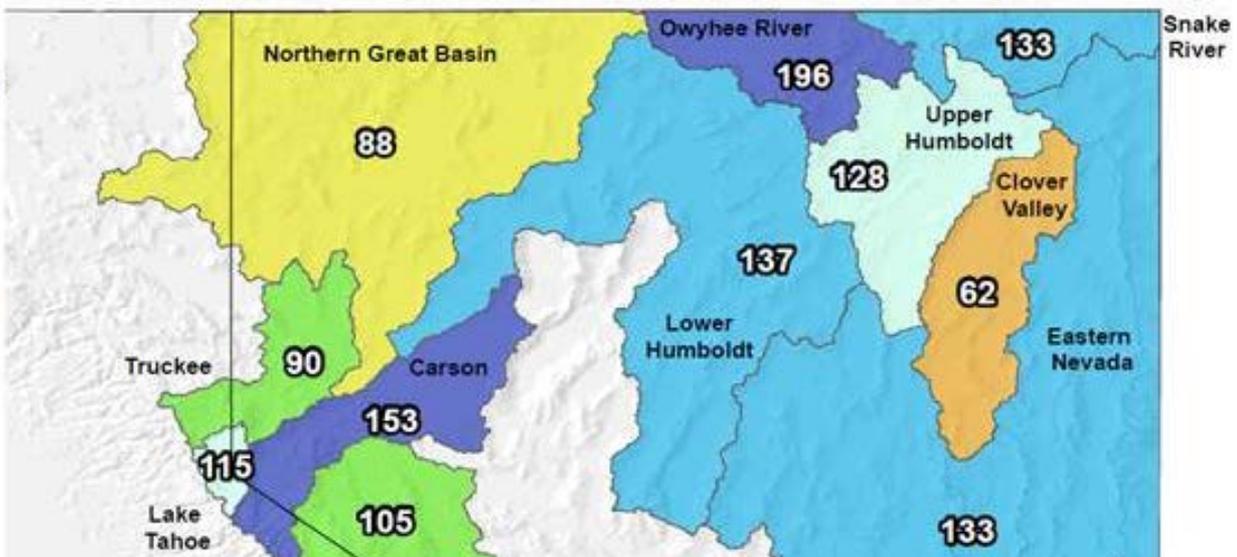
- **History:** Basin groups in Nevada have historically been based on sites strictly inside each basin. This is in contrast to most western snow survey states which use sites near watershed divides in both basins. This doubles the value of a site.
- **The Issue:** Until Dec 2015 the Clover Valley & Franklin River group was based on just Hole in Mountain SNOTEL in daily reports and daily map products. This resulted in a basin % that sometimes stuck out early and late season because the % didn't represent the full elevation band.
- **The Solution:** After careful analysis and to account for a greater elevational spread and more geography the group was changed to add long-term, west side sites in Rubies and East Humboldts. By doing this the basin % is now stronger than it was when it was based on just one site. The group now consists of...

Basin Site Name	Elev (ft)
Corral Canyon	8500
Dorsey Basin	8100
Green Mountain	8000
Hole-in-Mountain	7900
Pole Canyon	7700
Lamoille #3	7700

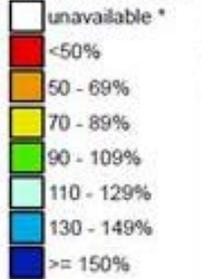
Installed 2013 – no average for ~10yrs

Nevada/California SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Dec 03, 2015

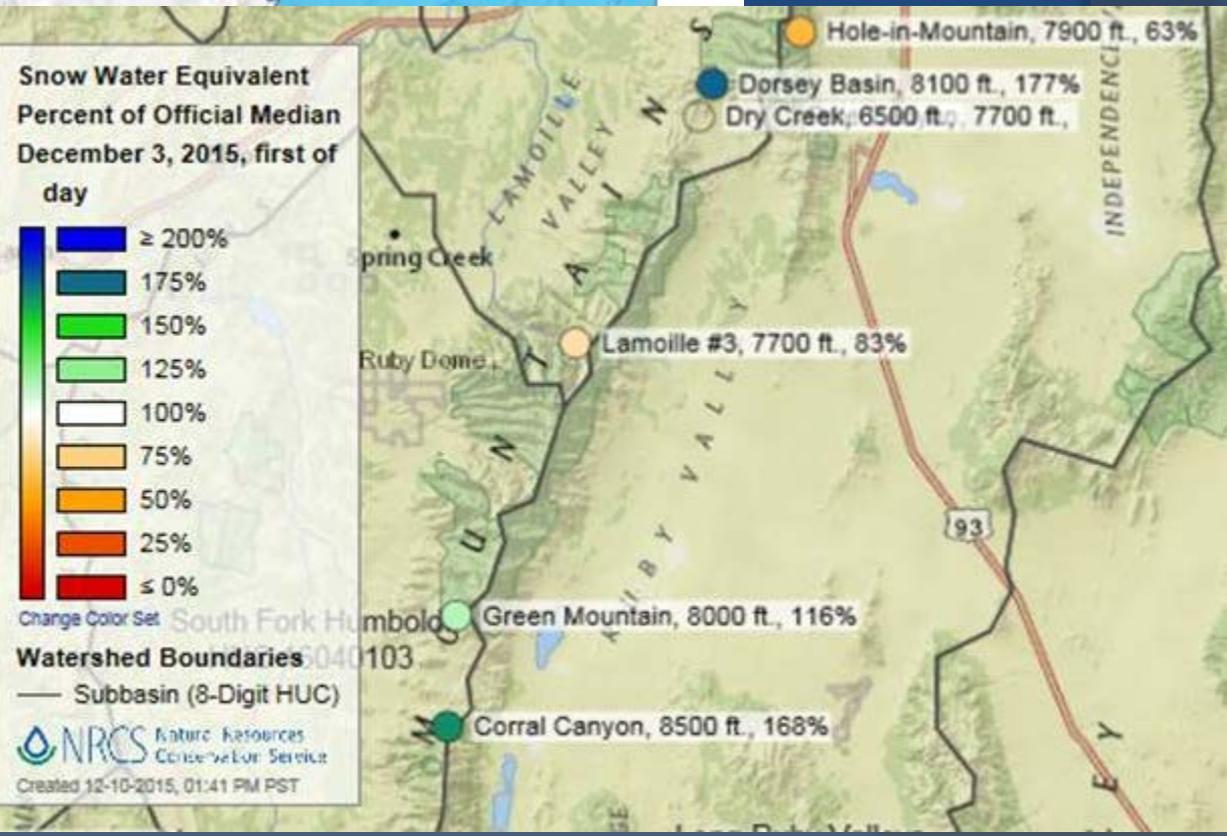


Current Snow Water Equivalent Basin-wide Percent of 1981-2010 Median

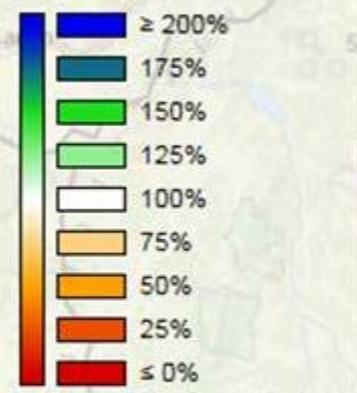


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Provisional data subject to revision



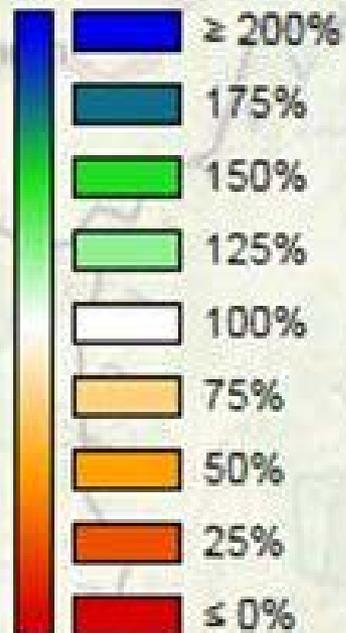
Snow Water Equivalent Percent of Official Median December 3, 2015, first of day



Watershed Boundaries
 — Subbasin (8-Digit HUC)

Normal Year

Snow Water Equivalent
Percent of Official Median
April 1, 2014, first of day



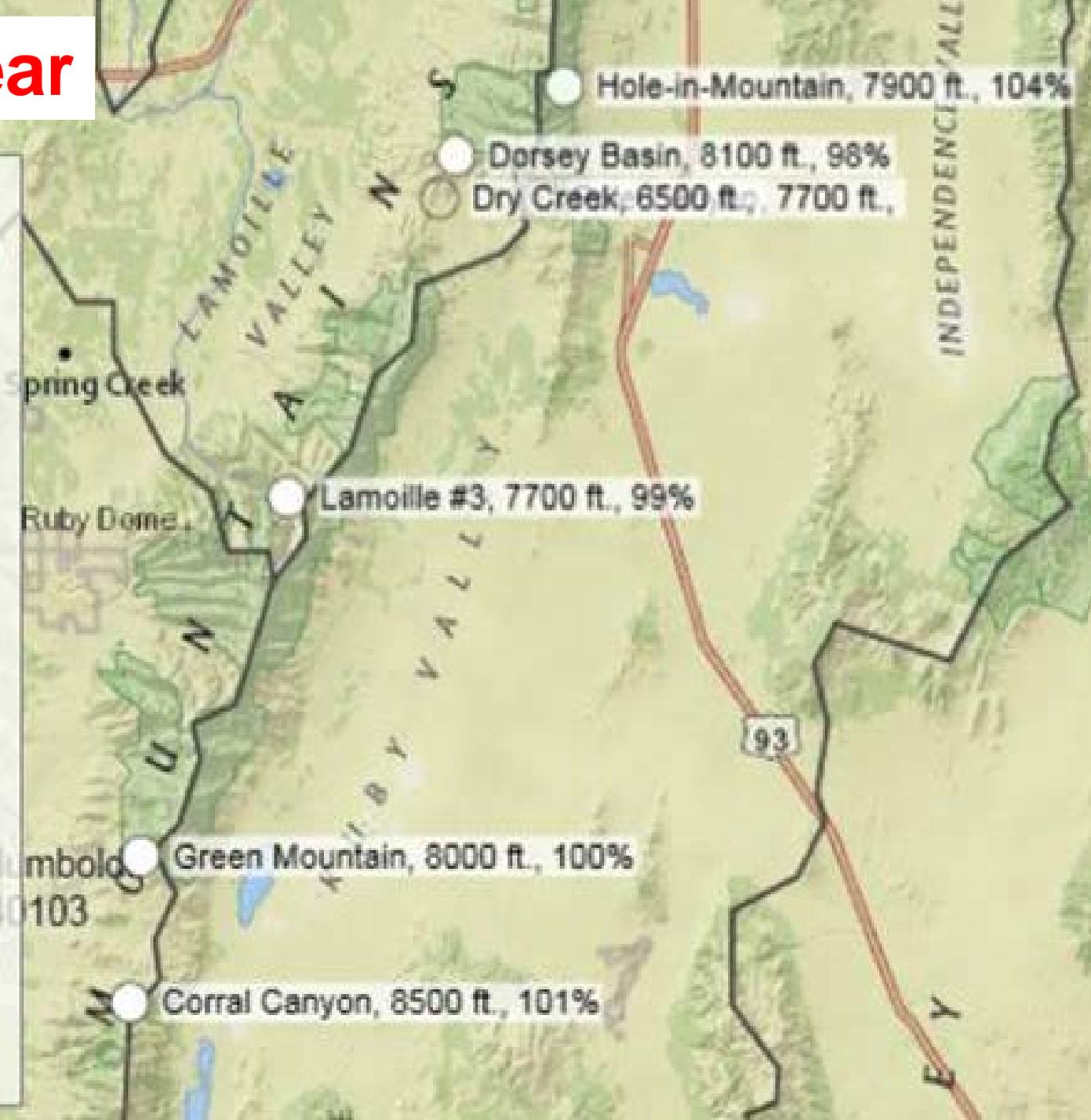
[Change Color Set](#)

Watershed Boundaries

— Subbasin (8-Digit HUC)

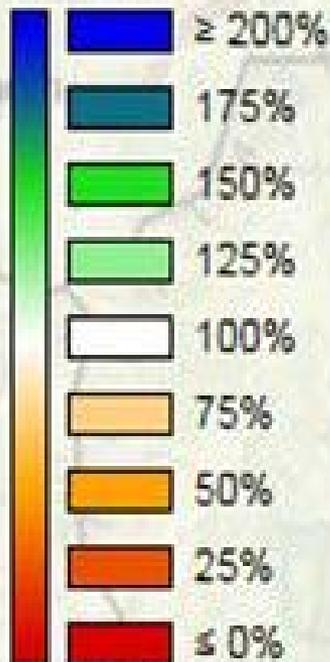
 **NRCS** Nature Resources
Conservation Service

Created 12-10-2015, 01:39 PM PST



Big Year

Snow Water Equivalent
Percent of Official Median
April 5, 2006, first of day



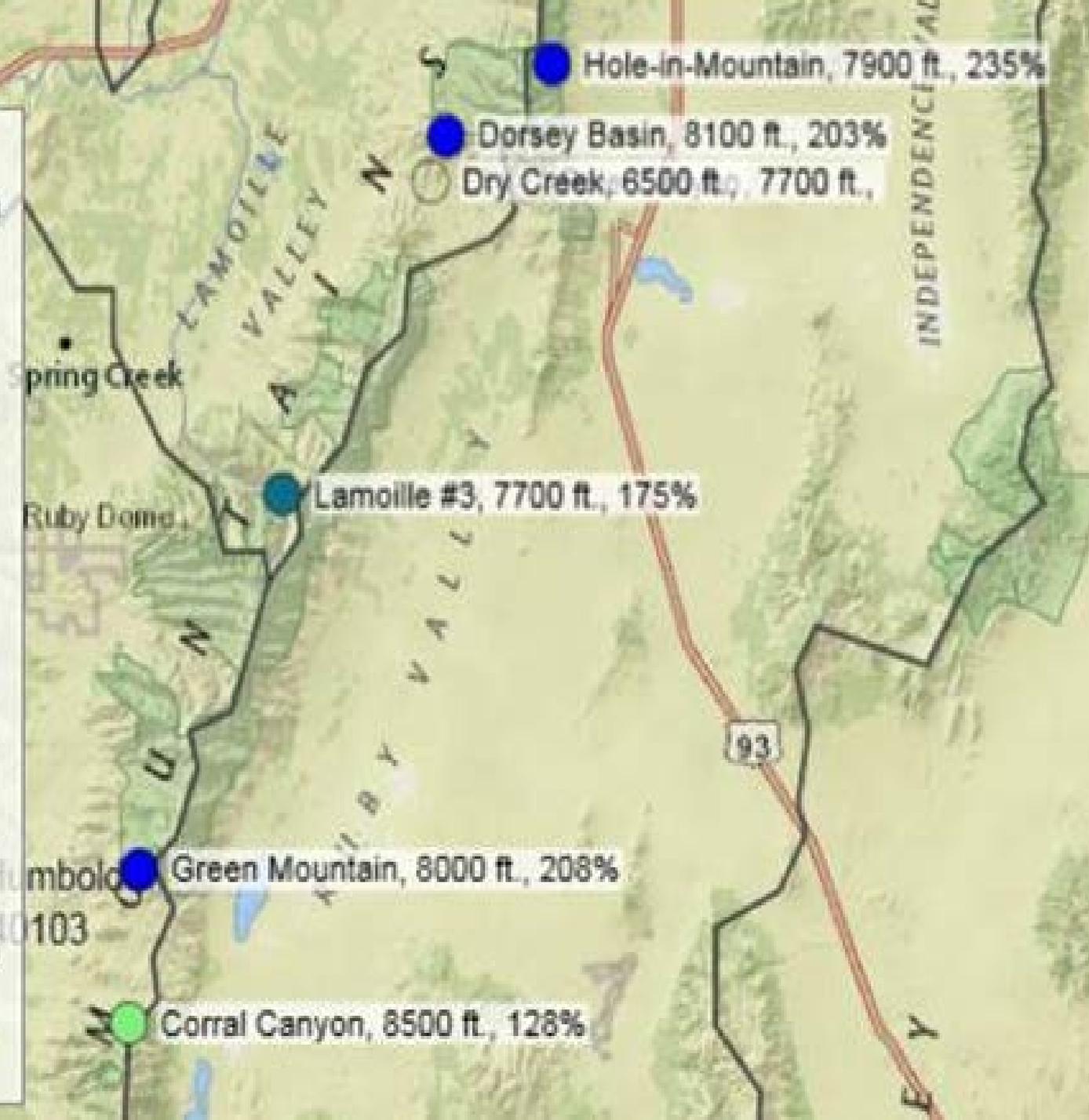
Change Color Set

Watershed Boundaries

— Subbasin (8-Digit HUC)

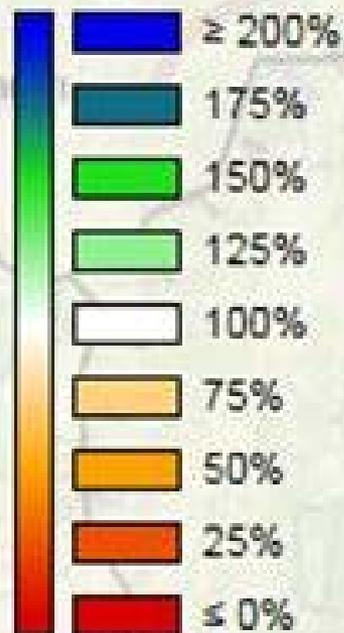
 **NRCS** Nature Resources
Conservation Service

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Low Year

Snow Water Equivalent
Percent of Official Median
February 26, 2007, first of
day



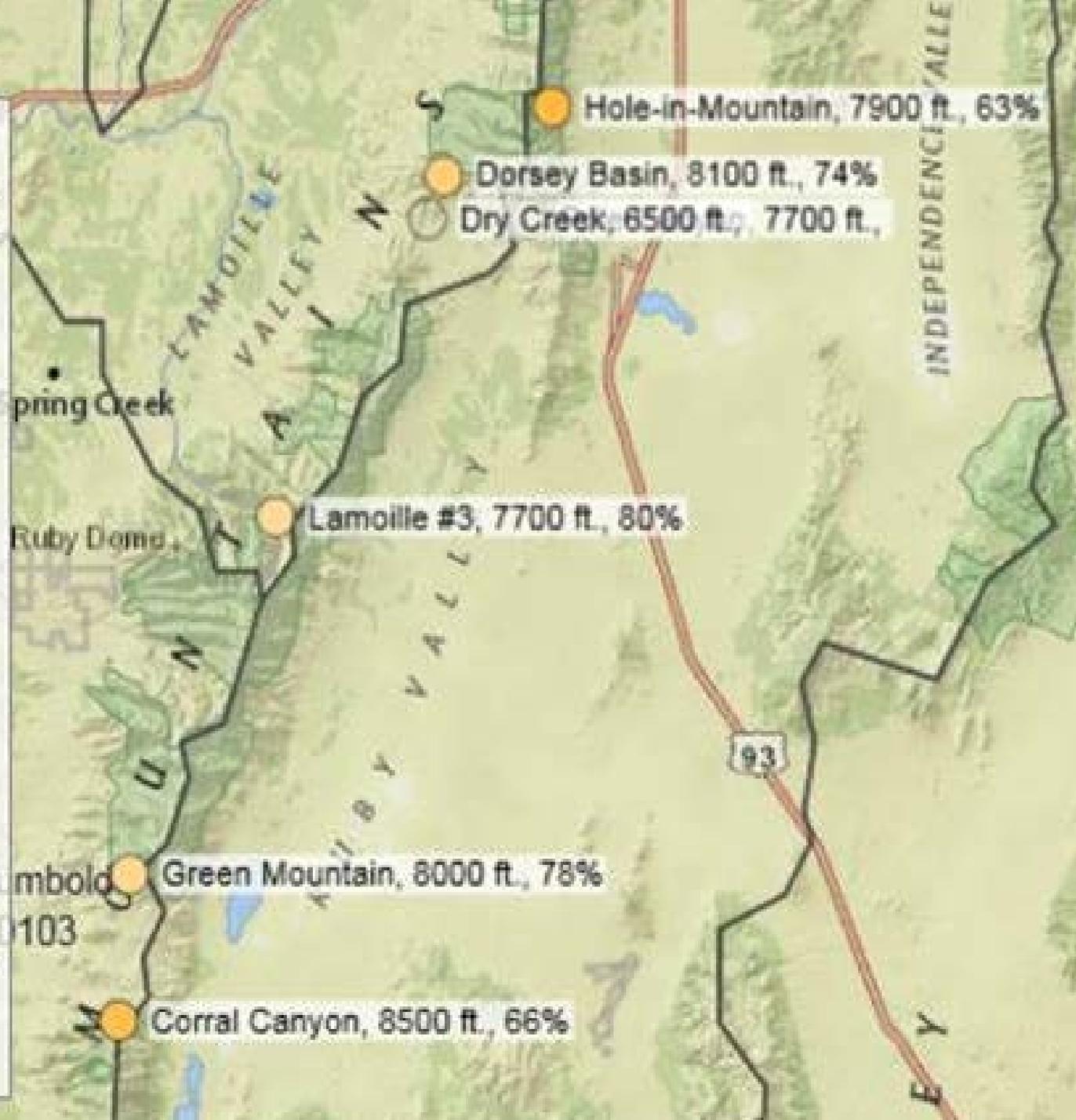
Change Color Set

Watershed Boundaries

— Subbasin (8-Digit HUC)

 NRCS Nature Resources
Conservation Service

Created 12-10-2015, 01:44 PM PST

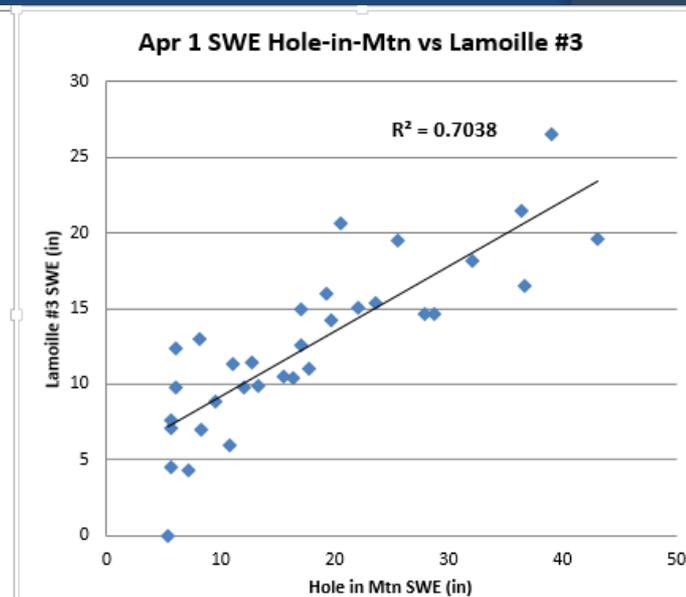
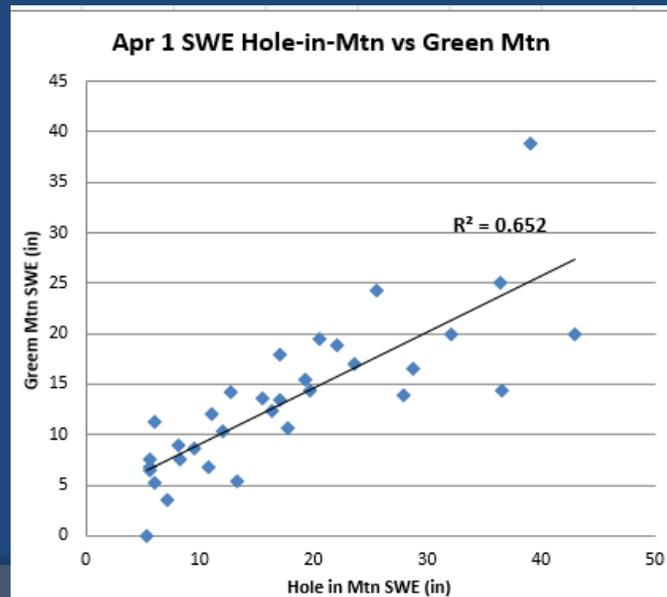
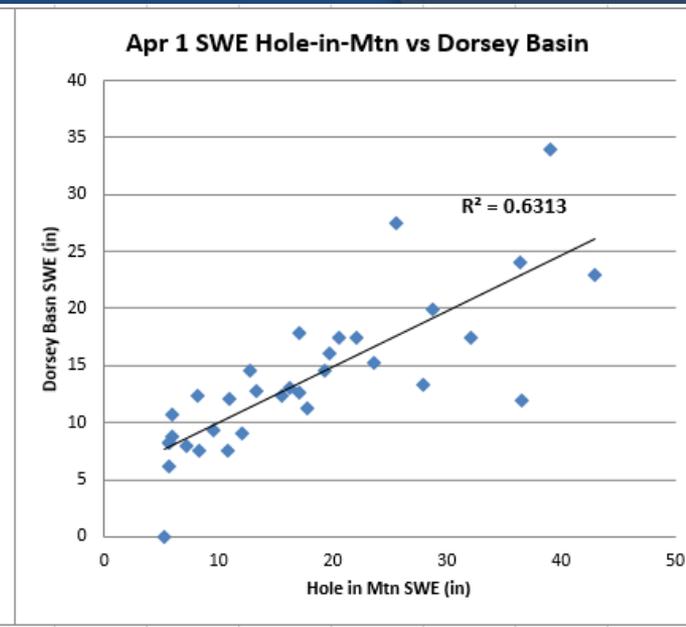
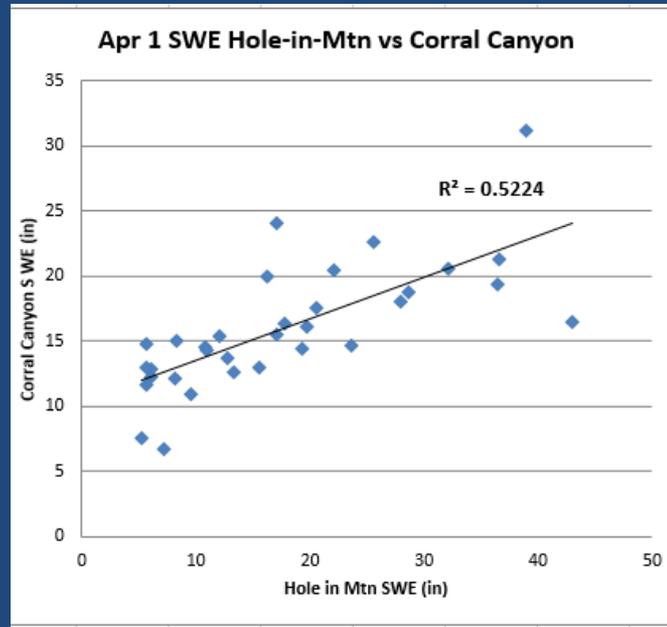


Snowpack Analysis

Snow water analysis for each month Dec-May showed best correlation for the sites with similar elevations.

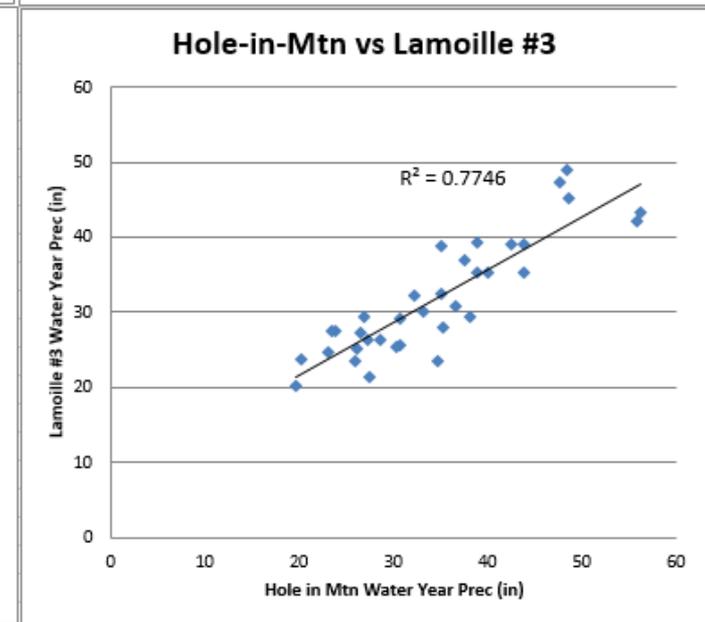
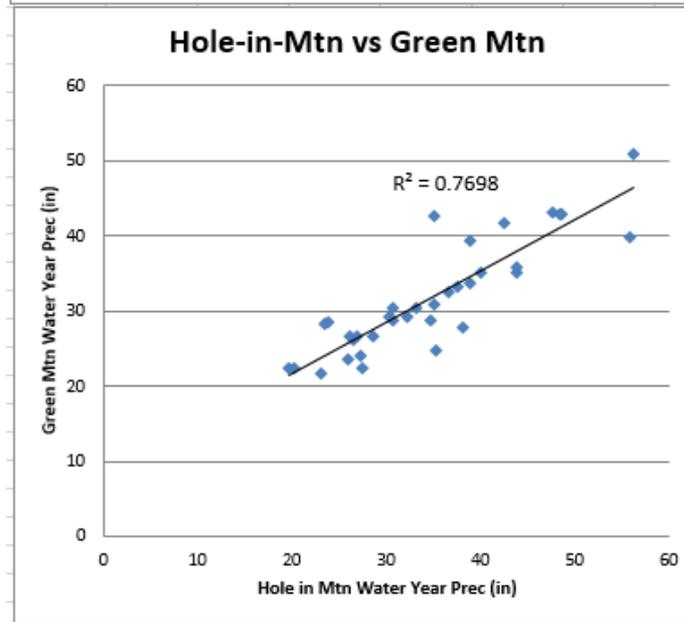
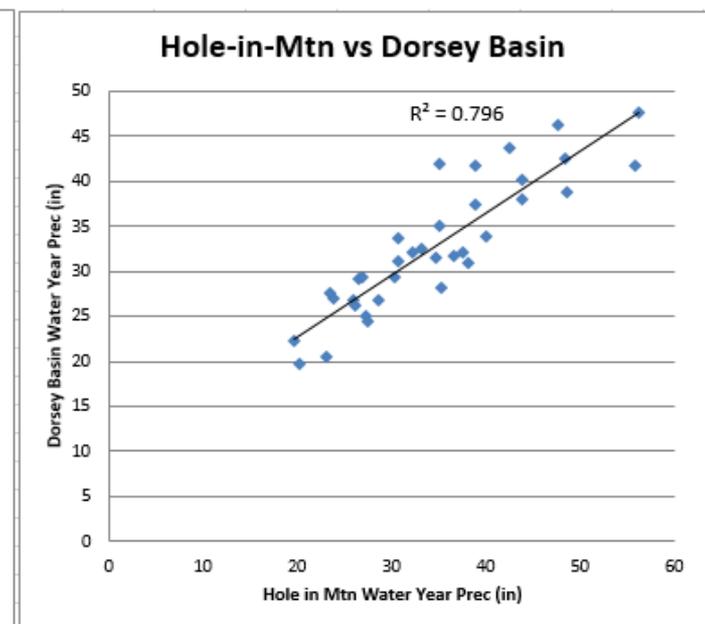
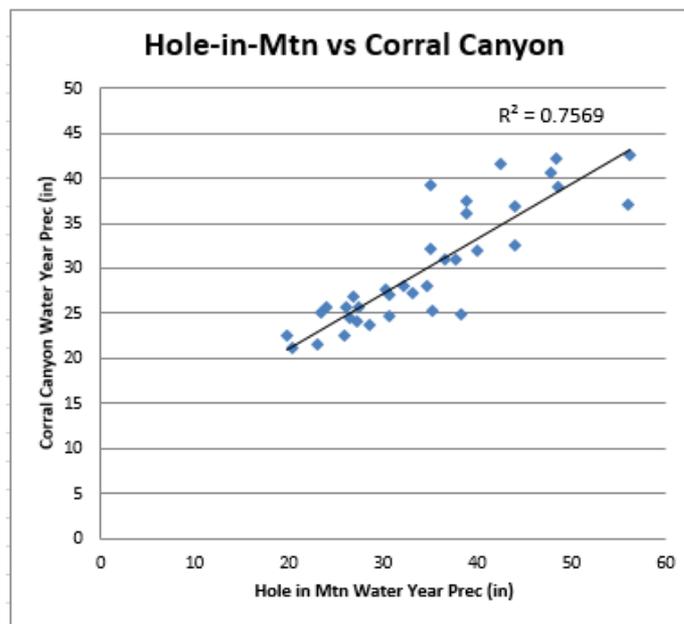
$R^2 = 0.6$ for Dorsey, 0.7 for Green, and 0.7 for Lamoille all are within 200 ft elevation. $R^2 = 0.5$ for Corral Canyon which is 600ft higher.

This is expected as snow accumulation starts, peaks and melts out differently based on things like elevations and aspect.



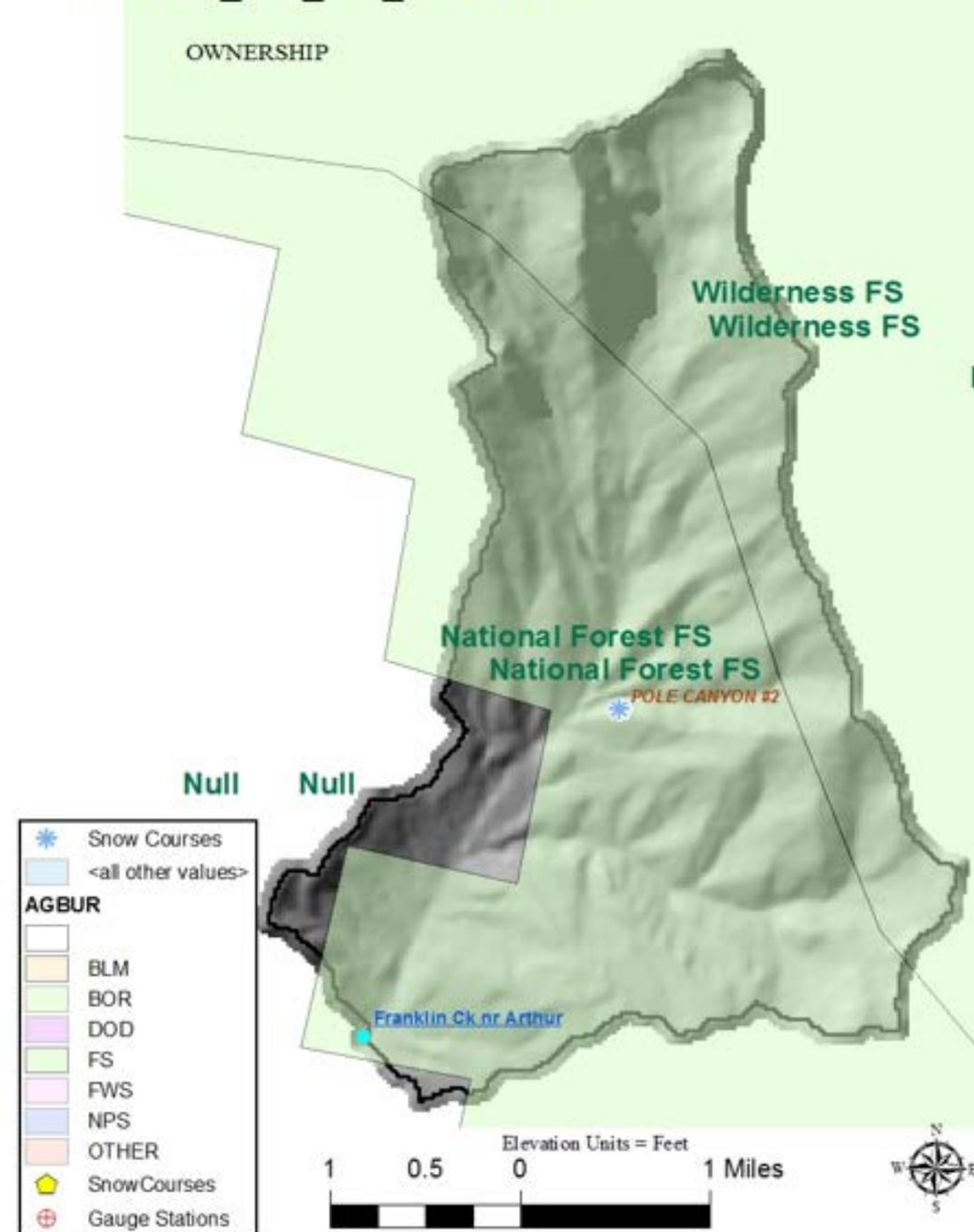
Precipitation Analysis

Good statistical relationship ($R^2 = 0.75-0.80$) between Hole in Mountain and other SNOTELs for annual precipitation



Franklin R near Arthur Streamflow Forecast

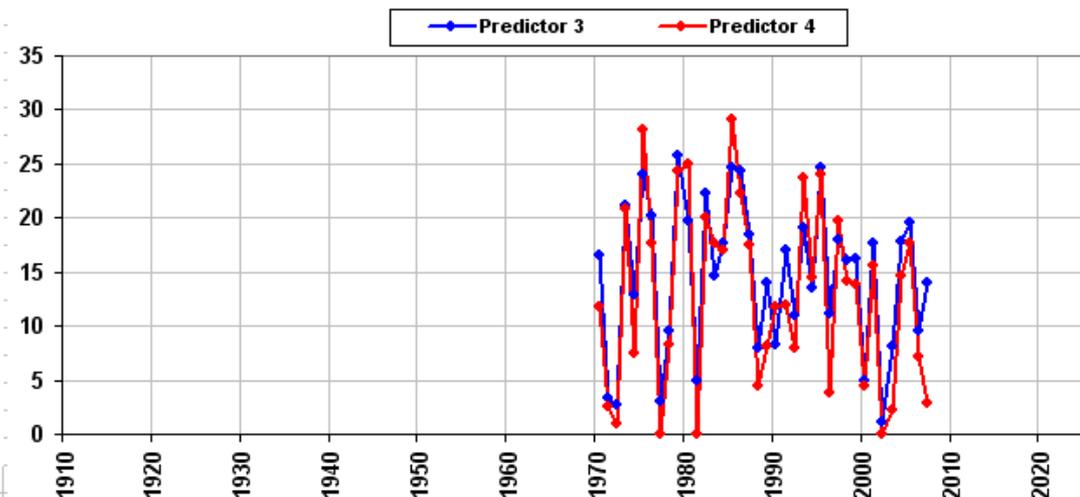
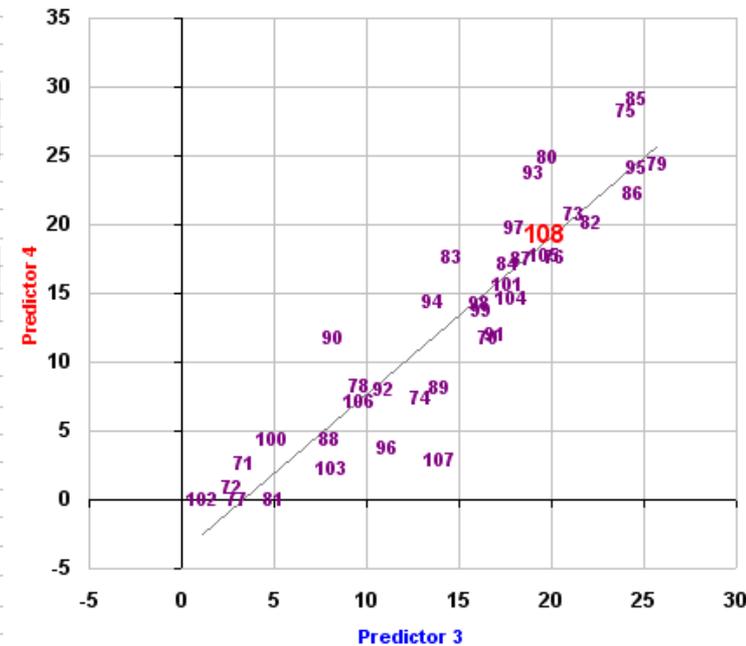
FRANKLIN_CK_NR_ARTHUR



How are streamflow forecasts made?

- Various parameters (Snow, Precip, El Niño/La Niña, etc...) are compared to streamflow. The parameters with the best correlation are kept in the equation.
- For data to correlate the two data sets must overlap.
- Correlation relationships can change over time because of landscape changes (fire, vegetation, climate change, etc...). Forecast equations are updated periodically to account for this.
- Without new streamflow data it's impossible to know how good a forecast performed.

Cross-Correlation		
X-Variable		
Predictor 3		
Transformation:	None	
Y-Variable		
Predictor 4		
Transformation:	None	
Slope	1.1425	
Intercept	-3.72558	
R	0.921	
R2	0.848	
	X	Y
Original	19.6	19.2
Estimated	20.0662	18.6674
O - E	-0.46618	0.53261



NRCS Streamflow Forecasting Policy

The USDA NRCS National Water and Climate Center (NWCC) containing the Snow Survey and Water Supply Forecasting Program mission is to provide water supply forecast to help conserve water and provide guidance for water management. For the many decades, the science of forecasting water supplies relies on the statistical relationship between the stream gage or water measurement and the climate and snow measurements. The stronger the relationship, the more accurate the forecast can be. The NRCS NWCC strives to provide the best information available, which includes the data to support the forecasts and updating the statistical models on a regular basis. **To provide a forecast, the data from stream gages, SNOTEL and snow courses and climate stations need to have a long term monthly record of a minimum of 10 years.** These long term stations are valuable to determine how the forecast can accurately predict all the possible average, dry and wet years.

It is the policy of the NWCC to discontinue forecasts that have had the stream gages discontinued or removed after 5 years. This policy allows us to make sure the information provided is of the best quality. While the forecasts can be continued in the form that they had when the stream gage was removed, there is no way to update the statistical relationship and over time this relationship will change and deteriorate. In addition, we cannot verify that the forecast provided accurate and valuable information without the streamflow data to verify it.

Sites used in the Franklin R forecast are:

Elko wb Airport precipitation

Trout Creek lower SC

Trout creek upper AM

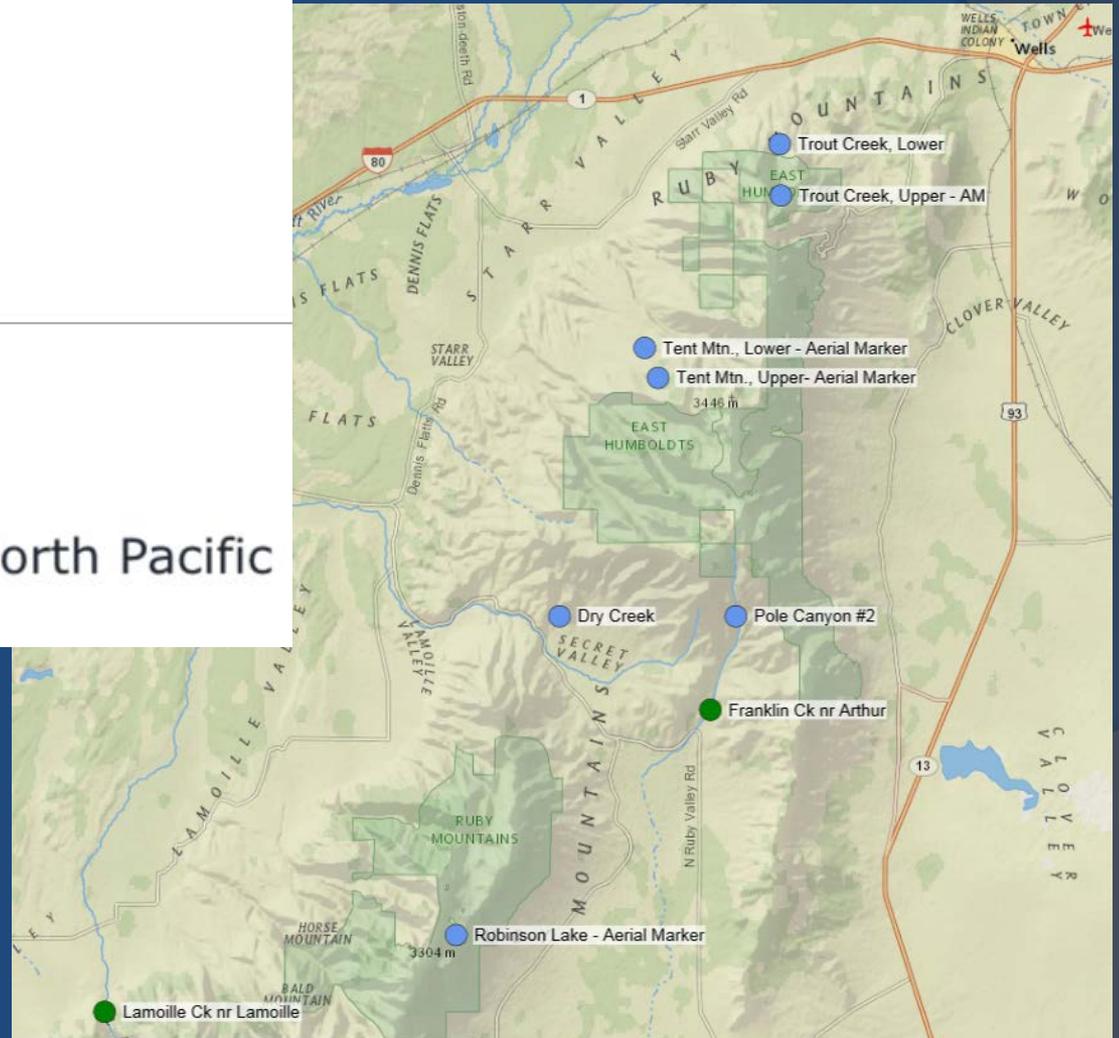
Hole in Mountain SC

Tent mountain upper AM

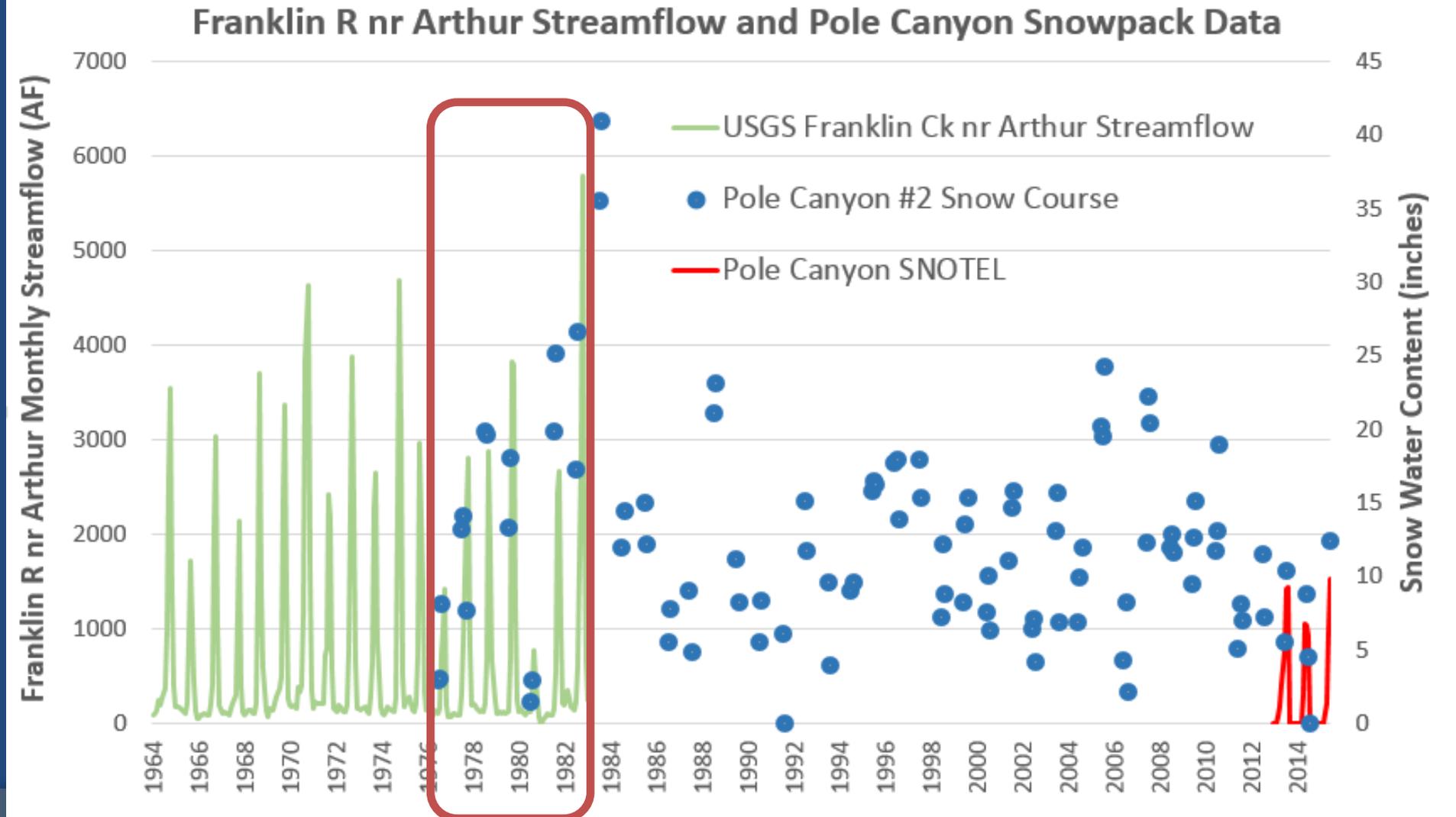
Lamoille Ck streamflow

TNI climate index

EP-NP Index (east Pacific-North Pacific climate index.)



Franklin River forecast is based on 7 years (not 10 years) of overlap.
Forecast verification has happened in 33 years (max is supposed to be 5 years)



Stream Gaging Future Possibilities

- **Hire USGS:** Cost to gage Apr-July period = \$7,200 without matching funds.
 - Includes: 15 minute data recorded by automated equipment, real-time data available on internet every hour, development of stage discharge relationship, maintaining automated equipment, manual verification every 6 weeks, data stored in national database.
 - Matching Funds are not available for FY16 but may be in future years. See additional information from USGS about this.
- **Hire Consultant:** Cost to identify permanent monitoring location and manually measure flow 5 times from April – July = \$7,877
- **Do Nothing:** Without additional streamflow data the NRCS policy would mean the loss of this streamflow forecast. NRCS would continue to provide snow and precipitation percentages and a qualitative relationship could be assumed.