

Everything is Awesome (in CO)

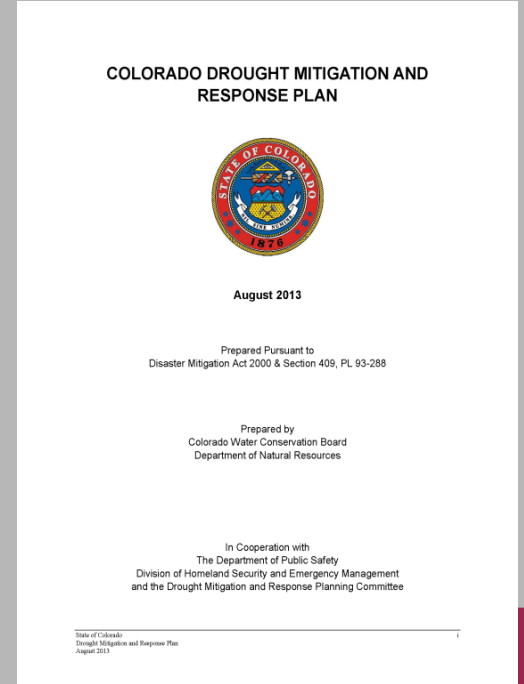
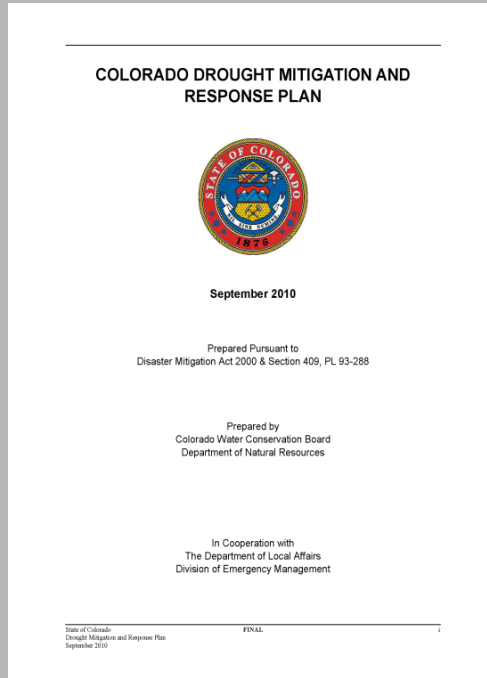
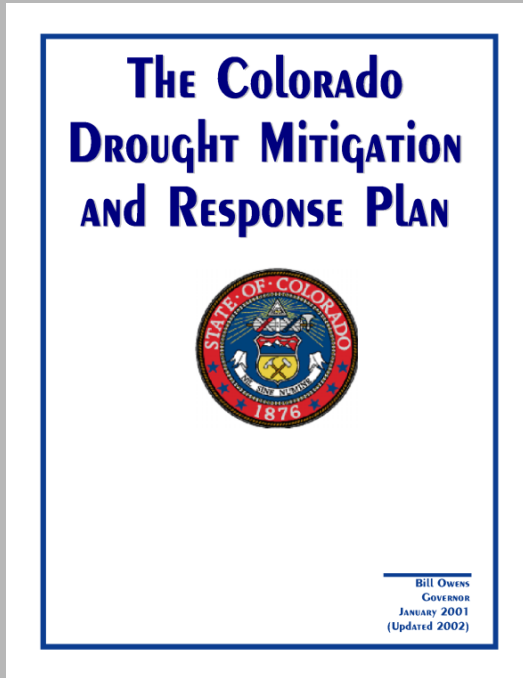
Triggers & Indicators Workshop
September 26, 2016

Taryn Finnessey
Climate Change Risk Management Specialist
Colorado Water Conservation Board

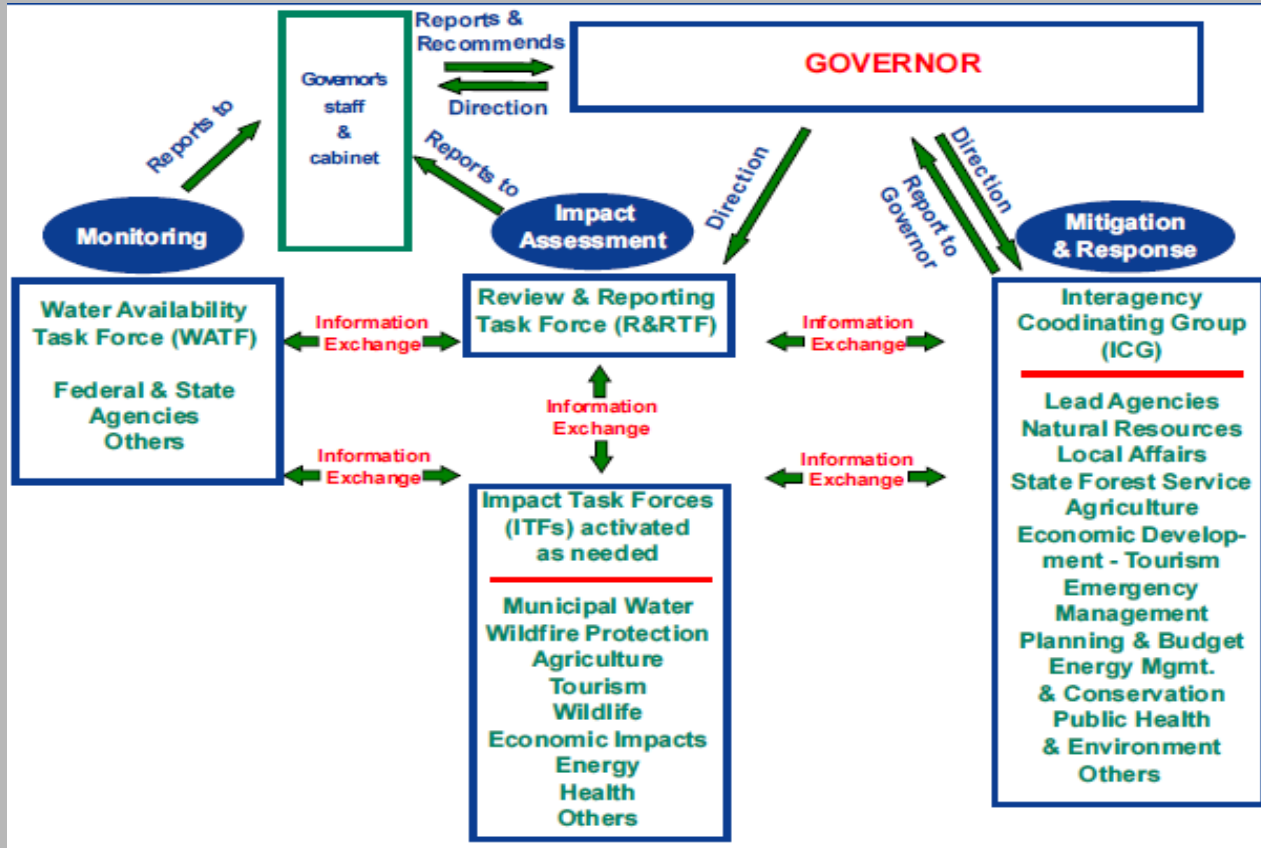
Prepared by Ben Wade, CWCB



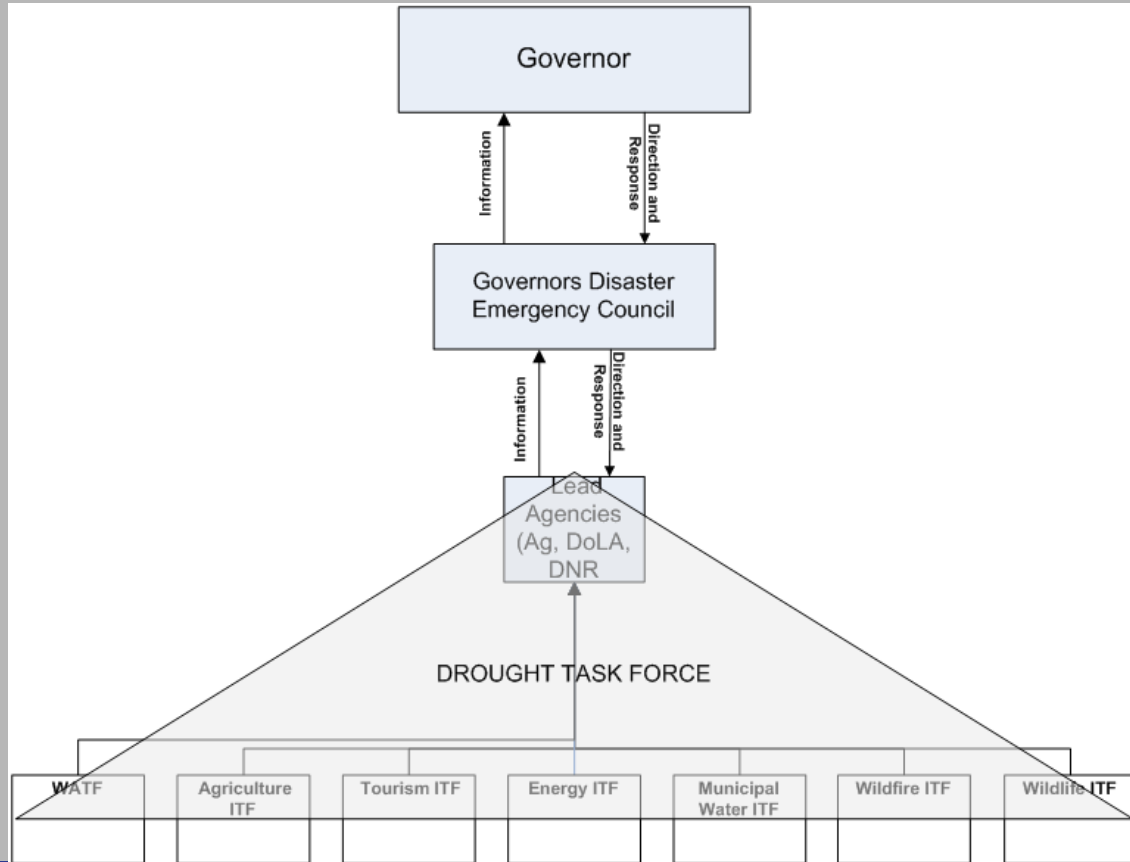
Drought Plan Revisions 2002-2013



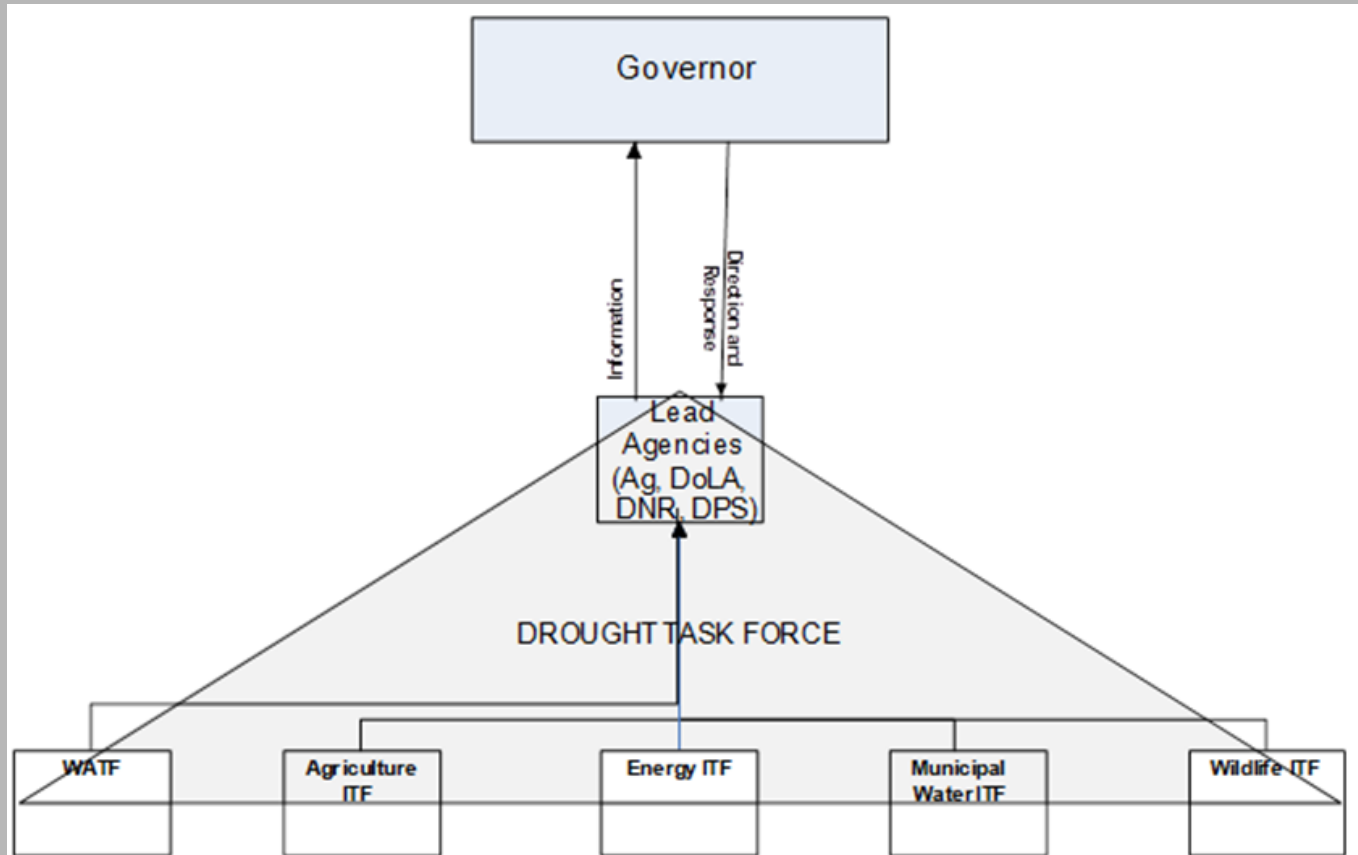
2002 Drought Response Framework

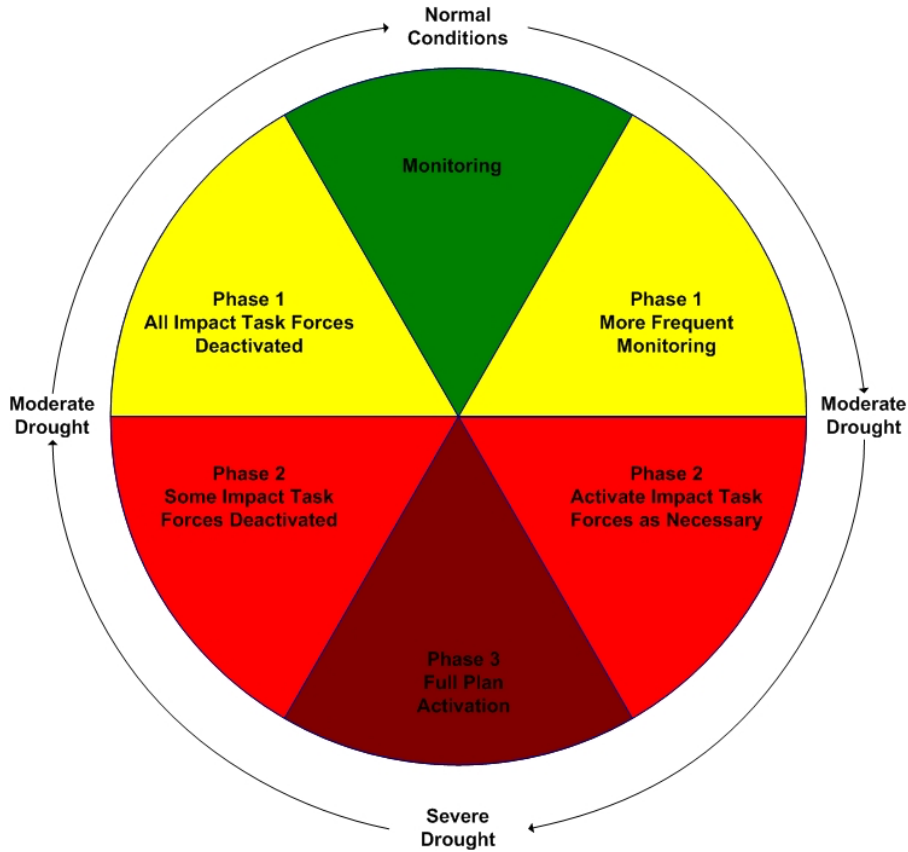


2010 Response Framework



Current Response Framework





Current Implementation Cycle



Severity Indicators: Palmer or SWSI, SPI	Drought Response	Actions to be Considered
-1 to positive indices in all river basins -0.5 to positive SPI (six month)	Normal Conditions Monitoring	1. CWCB/WATF monitors situation on quarterly basis, discusses trends with NWS, State Climatologist, State Engineer, NRCS, and others as appropriate. Data reviewed for drought emergence.
-1.0 to -2.0 in any river basin -0.6 to -1.0 SPI (six month)	Phase 1 More frequent monitoring	1. WATF discusses trend on monthly basis. Water availability information is generated each month. 2. CWCB/WATF provides media with situational information.
Less than -2.0 in any river basin Less than -1.0 SPI (six month)	Phase 2 Impact Task Forces are activated.	1. DNR/DoLA brief the Governor and prepare Governor's Memorandum of potential drought emergency based on recommendations. 2. Governor's Memorandum activates necessary Impact Task Forces. 3. CWCB meets with activated Task Forces' chairs to outline Phase 2 activity. 4. Activated Task Forces make an initial assessment of impact on the affected area. 5. The Review & Reporting Task Force (R&RTF) make periodic reports to the Governor. 6. Task Force chairs interface with media for their area of concern. 7. Lead agencies undertake response actions with their normal programs with available resources. 8. The R&RTF delineates any unmet needs which cannot be handled through normal channels.
Lowest reading at -2.0 to -3.9 in any river basin Less than -1.0 to -1.99 SPI (six month)	Phase 3 Drought Emergency is declared by Proclamation of the Governor.	1. R&RTF briefs Governor and prepares a Governor's Proclamation of drought emergency. 2. Governor's Proclamation activates the ICG. 3. Activated Task Forces continue to assess and report. 4. Unmet needs are passed to the ICG. 5. ICG determines which needs can be met by reallocation of existing resources. Those which cannot are forwarded to the Governor with recommendations. 6. ICG assembles data needed to support a request by the Governor for a Presidential Drought Declaration. 7. Governor requests a Presidential Declaration. 8. If approved, Federal-State Agreement establishes COEM Director as State Coordinating Officer (SCO).
	Late Phase 3 Drought impacts are reduced by increased precipitation.	1. ICG determines all requirements for assistance are being met within ICG channels. 2. ICG briefs Governor and prepares Proclamation to end drought emergency. 3. ICG issues final report and is deactivated.
Lowest reading at -1.6 in any river basin -0.8 SPI (six month)	Return to Phase 2 Return to Phase 1.	1. Impact Task Forces and R&RTF continue assessments. 2. Impact Task Forces and R&RTF issue final report and deactivate.
Lowest reading at -1.0 in any river basin -0.5 SPI (six month)	Return to normal conditions.	1. CWCB/WATF resume normal monitoring.

2002 Action Plan Summary



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2010 Drought Response Summary Action Table

Severity Indicators and Impacts	Drought Phase and Response Summary	Actions to be Considered
<ul style="list-style-type: none"> -0.5 to positive SPI (six month) D0 Abnormally Dry CMPDI or SWSI: -1.0 to -1.9 SPI: -0.5 to -0.7 	Normal Conditions Regular Monitoring	<ul style="list-style-type: none"> CWCB/WATF monitors situation on monthly basis. Data reviewed for drought emergence and summarized in Governor's Drought Situation Report. Implement long term mitigation actions ITF chairs meet twice yearly
<ul style="list-style-type: none"> -0.6 to -1.0 SPI (six month) D1 Moderate Drought CMPDI or SWSI: -2.0 to -2.9 SPI: -0.8 to -1.2 	<p>Phase 1</p> <p>More close monitoring of conditions for persisting or rapidly worsening drought; Official drought not yet declared</p>	<ul style="list-style-type: none"> ITF chairs alerted of potential for activation, monitoring of potential impacts Assess need for formal ITF and DTF activation DTF Lead Agencies (CDA/DoLA/DNR) notified of need for potential activation
<ul style="list-style-type: none"> Less than -1.0 SPI (six month) D2 Severe Drought CMPDI or SWSI: -3.0 to -3.9 SPI: -1.3 to -1.5 	<p>Phase 2</p> <p>Drought Task Force and Impact Task Forces are activated; Potential Drought Emergency declared</p>	<ul style="list-style-type: none"> Governor's Memorandum activates the Drought Task Force and necessary Impact Task Forces. Department of Agriculture initiates Secretarial Disaster Designation process if appropriate ITF's make an initial damage or impact assessment. ITF's recommend opportunities for mitigation to minimize or limit potential impacts Relevant state agencies undertake response and incident mitigation actions with their normal programs with available resources
<ul style="list-style-type: none"> Less than -1.0 to -1.99 SPI (six month) D3 Extreme Drought to D4 Exceptional Drought CMPDI or SWSI: -3.0 to -5 or less SPI: -1.3 to -2.0 or less 	<p>Phase 3</p> <p>Drought Emergency is declared by Proclamation of the Governor.</p>	<ul style="list-style-type: none"> Governor's Proclamation of drought emergency. Governor's Proclamation activates the GDEC Activated ITFs continue to assess, report, and recommend response measures and incident mitigation. Unmet needs are reported to the DTF Chairs. The GDEC assembles the data to advise the Governor with recommendations to support a request for a Presidential Drought Declaration. Governor requests a Presidential Declaration.



2013 Summary Action Table

Severity Indicators and Impacts (U.S. Drought Monitor, Colorado Modified Palmer Drought Index (CMPDI), SWSI, SPI)	Drought Phase and Response Summary	Actions to be Considered
<p><u>Drought Monitor</u> D0 Abnormally Dry D0 ranges: CMPDI or SWSI¹: +2.0 to -1.9 SPI²: -0.5 to -0.7 Indicator blend Percentile: 21-30</p> <p>Impacts: short-term dryness slowing planting, growth of crops or pastures.</p> <p><u>CMPDI</u> -1 to positive indices in all river basins or modified Palmer climate division</p> <p><u>SPI</u> -0.5 to positive (six month)</p>	<p>Normal Conditions Regular Monitoring</p>	<ul style="list-style-type: none"> • CWCB/WATF monitors situation on monthly basis, discusses trends with National Weather Service (NWS), State Climatologist, State Engineer, Natural Resource Conservation Service (NRCS), and others as appropriate. • Data reviewed for drought emergence and summarized in monthly drought updates. • Implement long-term mitigation actions identified in drought mitigation plan • ITF chairs meet once yearly to monitor progress on long-term drought mitigation and review any lessons from previous drought periods, and review the response plan.
<p><u>Drought Monitor</u> D1 Moderate Drought D1 ranges: CMPDI or SWSI¹: -2.0 to -2.9 SPI²: -0.8 to -1.2 Indicator blend Percentile: 11-20</p> <p>Impacts: Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested</p> <p><u>CMPDI</u> -1.0 to -2.0 in any river basin or modified Palmer climate division</p> <p><u>SPI</u> -0.6 to -1.0 (six month)</p>	<p>Phase 1 More close monitoring of conditions for persisting or rapidly worsening drought; Official drought not yet declared</p>	<ul style="list-style-type: none"> • ITF chairs alerted of potential for activation, monitoring of potential impacts. • Assess need for formal ITF and DTF activation depending on timing, location, or extent of drought conditions, existing water supply, and recommendation of WATF; DTF is comprised of WATF, ITF chairs, and Lead Agencies. • DTF Lead Agencies (CDA/DOLA/DNR/DPS) notified of need for potential activation.

Severity Indicators and Impacts (U.S. Drought Monitor, Colorado Modified Palmer Drought Index (CMPDI), SWSI, SPI)	Drought Phase and Response Summary	Actions to be Considered
<p>Drought Monitor D2 Severe Drought D2 ranges: CMPDI or SWSI¹: -3.0 to -3.9 SPI²: -1.3 to -1.5 Indicator blend Percentile: 6-10</p> <p>Impacts: Crop or pasture losses likely; water shortages common; water restrictions likely to be imposed</p> <p>CMPDI Less than -2.0 in any river basin or modified Palmer climate division</p> <p>SPI Less than -1.0 (six month)</p>	<p>Phase 2 Drought Task Force and Impact Task Forces are activated; Potential Drought Emergency Declared</p>	<ul style="list-style-type: none"> DTF Chairs prepare Governor's Memorandum of potential drought emergency based on recommendations from WATF. Governor's Memorandum activates the Drought Task Force and necessary Impact Task Forces. The DTF Chairs and CWCB meet with activated Impact Task Force chairs to outline Phase 2 activity. Activated ITF's make an initial damage or impact assessment (physical and economic). ITF's recommend opportunities for incident mitigation to minimize or limit potential impacts Periodic reports are made by the ITF chairs to the DTF Chairs. ITF chairs designate their respective department Public Information Officer (PIO) to interface with media for their relative area of concern and develop media messages. Relevant state agencies undertake response and incident mitigation actions with their normal programs with available resources. The DTF conducts a gap analysis identifying any unmet needs that cannot be handled through normal channels.
<p>Drought Monitor D3 Extreme Drought to D4 Exceptional Drought</p> <p>D 3 Ranges CMPDI or SWSI¹: -4.0 to -4.9 SPI²: -1.6 to -1.9 Indicator blend Percentile: 3-5 Impacts: Major crop/pasture losses; widespread water shortages or restrictions very likely to be imposed</p> <p>D4 Ranges: CMPDI or SWSI: -5.0 SPI*: -2.0 or less Indicator blend Percentile: 0-2 Impacts: Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies</p> <p>CMPDI Lowest reading at -2.0 to -3.9 in any river basin or modified Palmer climate division</p> <p>SPI Less than -1.0 to -1.99 SPI (six month)</p>	<p>Phase 3 Drought Emergency is declared by Proclamation of the Governor.</p>	<ul style="list-style-type: none"> Governor's Memorandum updated to activate additional Impact Task Forces as necessary. Activated ITFs continue to assess, report, and recommend response measures and incident mitigation. Unmet needs are reported to the DTF Chairs. DTF Chairs determine the unmet needs that can be met by reallocation of existing resources. Those which cannot be forwarded to the Governor with recommendations to support a request for a Presidential Drought Declaration. Governor may request a Presidential Declaration. If approved, Federal-State Agreement establishes Colorado Office of Emergency Management Director as the State Coordinating Officer (SCO). Work with the Governor's office on long-term recovery operations

2013 Summary Action Table cont'd

Severity Indicators and Impacts (U.S. Drought Monitor, Colorado Modified Palmer Drought Index (CMPDI), SWSI, SPI)	Drought Phase and Response Summary	Actions to be Considered
<p>Lowest reading at -1.6 in any river basin or modified Palmer climate division</p> <p>-0.8 SPI (six month)</p>	Return to Phase 2	<ul style="list-style-type: none"> DTF Chairs determines if all requirements for assistance are being met within the DTF and State agency channels. DTF briefs the Governor and prepares Proclamation to end drought emergency.
<p>D1 Moderate Drought</p> <p>Coming out of drought: some lingering water deficits; pastures or crops not fully recovered</p>	Return to Phase 1	<ul style="list-style-type: none"> Long-term recovery operations continue ITFs continue assessments. ITFs issue final report and conclude formal regular meetings. The DTF issues a final report and is deactivated.
<p>Lowest reading at -1.0 in any river basin</p> <p>-0.5 SPI (six month)</p>	Return to normal conditions	<ul style="list-style-type: none"> CWCB/WATF resume normal monitoring.



Modernizing Indices

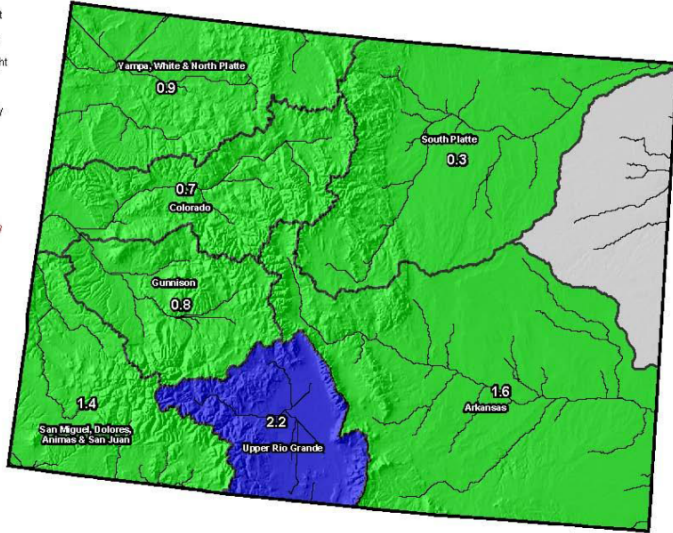
- ★ Surface Water Supply Index (SWSI)
- ★ Palmer Drought Severity Index (PDSI)
- ★ Standard Precipitation Index (SPI)
- ★ USDM
- ★ Forward Looking Indices



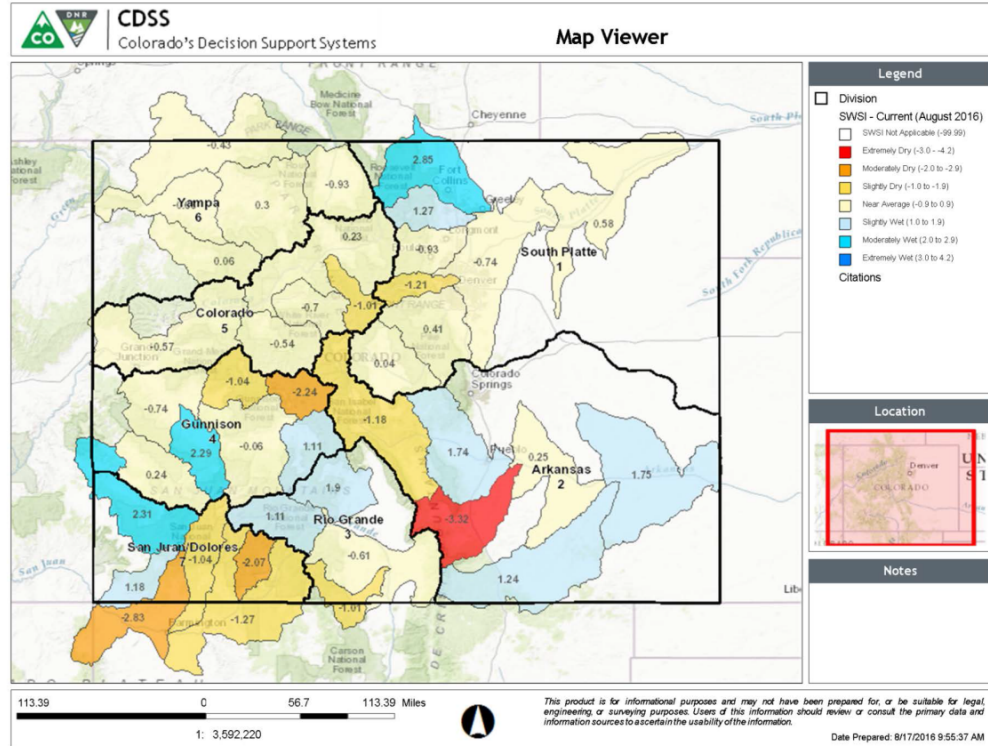
Old SWSI vs New SWSI

Colorado Surface Water Supply Index (SWSI) Map

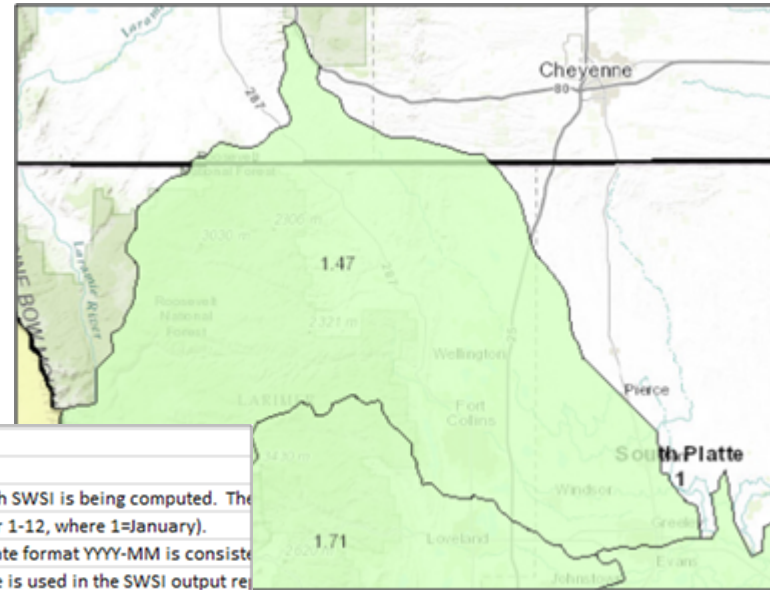
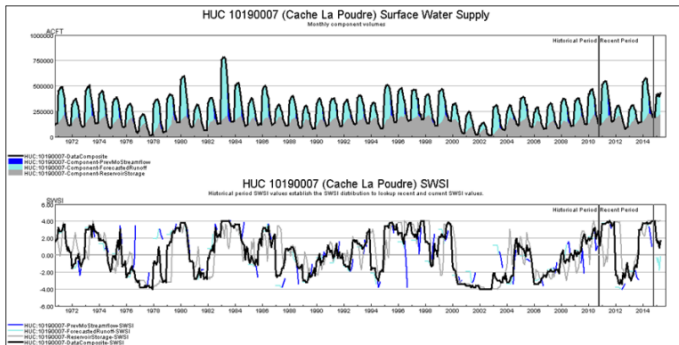
Legend



Current as of February 1, 2009



SWSI Automation Tool (2015)

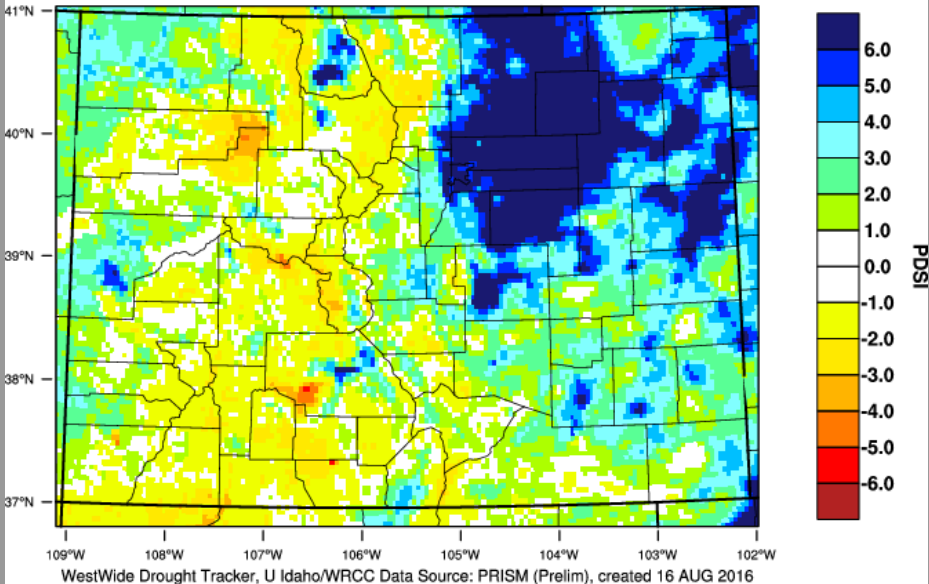


TS Tool Configuration Property Name	Property Value	Property Value (Text)	Property Description
CurrentMonthDate	= 2015-09	2015-09	Current month (as date) for which SWSI is being computed. The
CurrentMonth	= 9	09	Current month (as month number 1-12, where 1=January).
PreviousMonthDate	= 2015-08	2015-08	Previous month (as date). The date format YYYY-MM is consist
PreviousYearMonthDate	= 2014-09	2014-09	Previous year (as date). This date is used in the SWSI output re

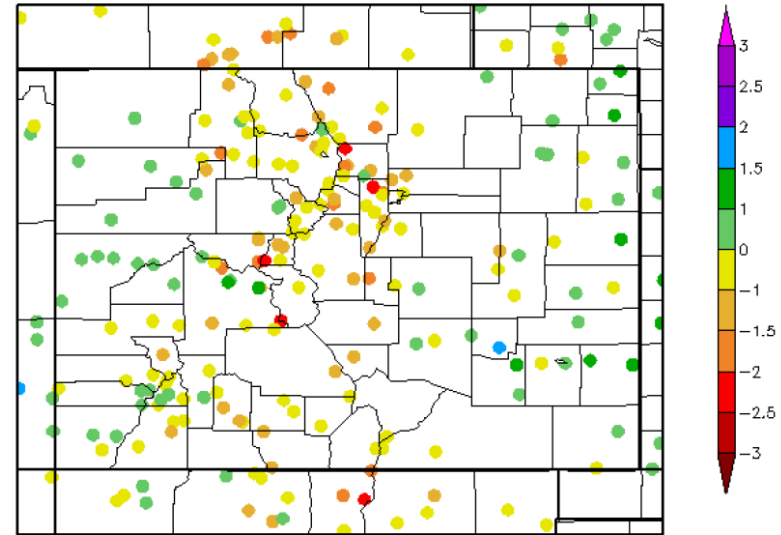
Data Type	ID	Station Name	State	Datstore	Datstore ID	Source	Datstore Data Type
ForecastedNaturalFlow	06707500	SOUTH PLATTE RIVER AT SOUTH PLATTE	CO	NrcsAwdb	CO-06707500	USGS	SRVO
ForecastedNaturalFlow	06710385	BEAR CREEK ABV EVERGREEN	CO	NrcsAwdb	CO-06710385	USGS	SRVO
ForecastedNaturalFlow	06719505	CLEAR CREEK AT GOLDEN	CO	NrcsAwdb	CO-06719505	USGS	SRVO
ForecastedNaturalFlow	06724000	SAINT VRAIN CREEK AT LYONS	CO	NrcsAwdb	CO-06724000	USGS	SRVO
ForecastedNaturalFlow	06727000	BOULDER CREEK NEAR ORODELL	CO	NrcsAwdb	CO-06727000	USGS	SRVO
ForecastedNaturalFlow	06729500	SOUTH BOULDER CK NR ELDERADO SPRINGS, CO	CO	NrcsAwdb	CO-06729500	USGS	SRVO
ForecastedNaturalFlow	06738000	BIG THOMPSON R AT MOUTH, NR DRAKE, CO	CO	NrcsAwdb	CO-06738000	USGS	SRVO
ForecastedNaturalFlow	06752000	CACHE LA POUDE R AT CANYON MOUTH	CO	NrcsAwdb	CO-06752000	USGS	SRVO

PDSI & SPI

Colorado - PDSI
July 2016



Monthly SPI
7/1/2016 - 7/31/2016



Generated 8/11/2016 at HPRCC using provisional data.

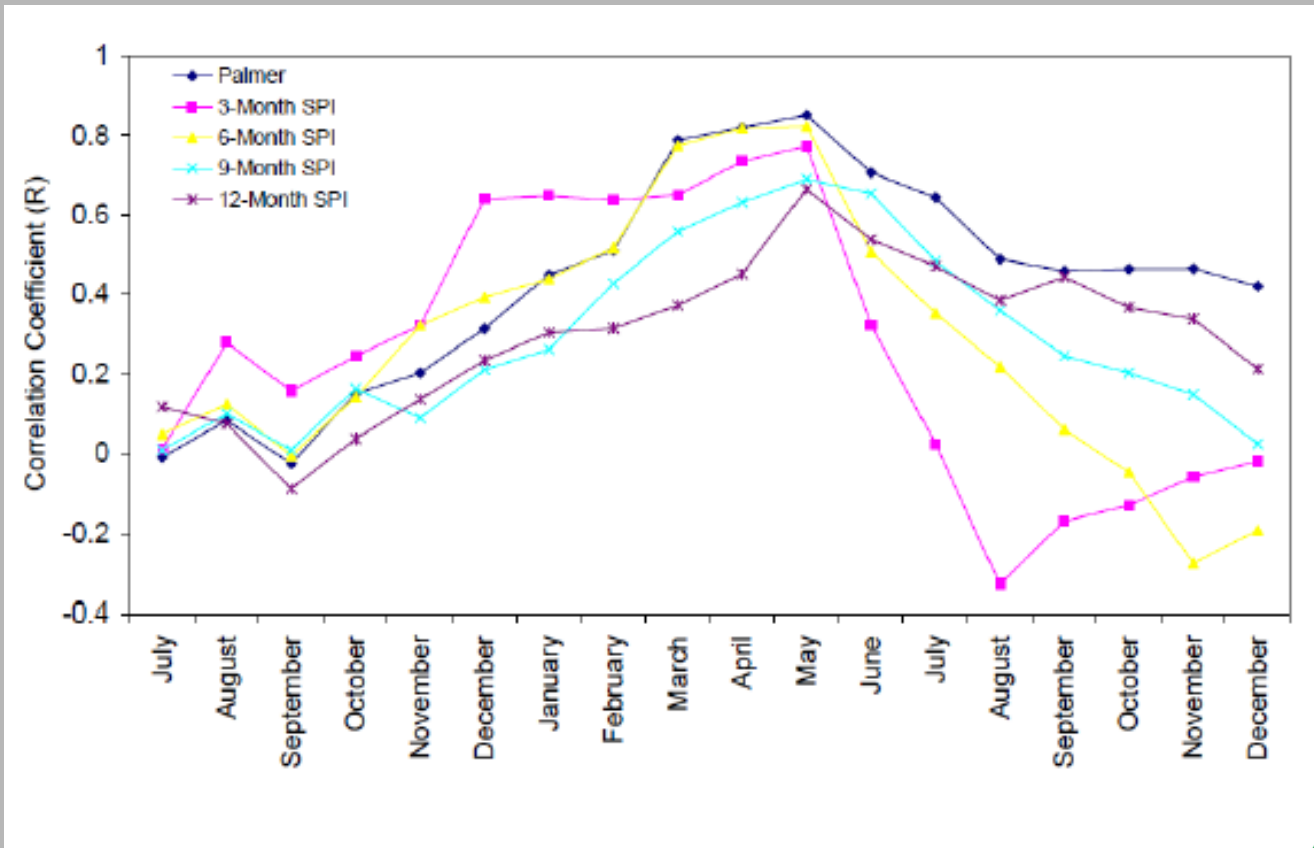
Regional Climate Centers



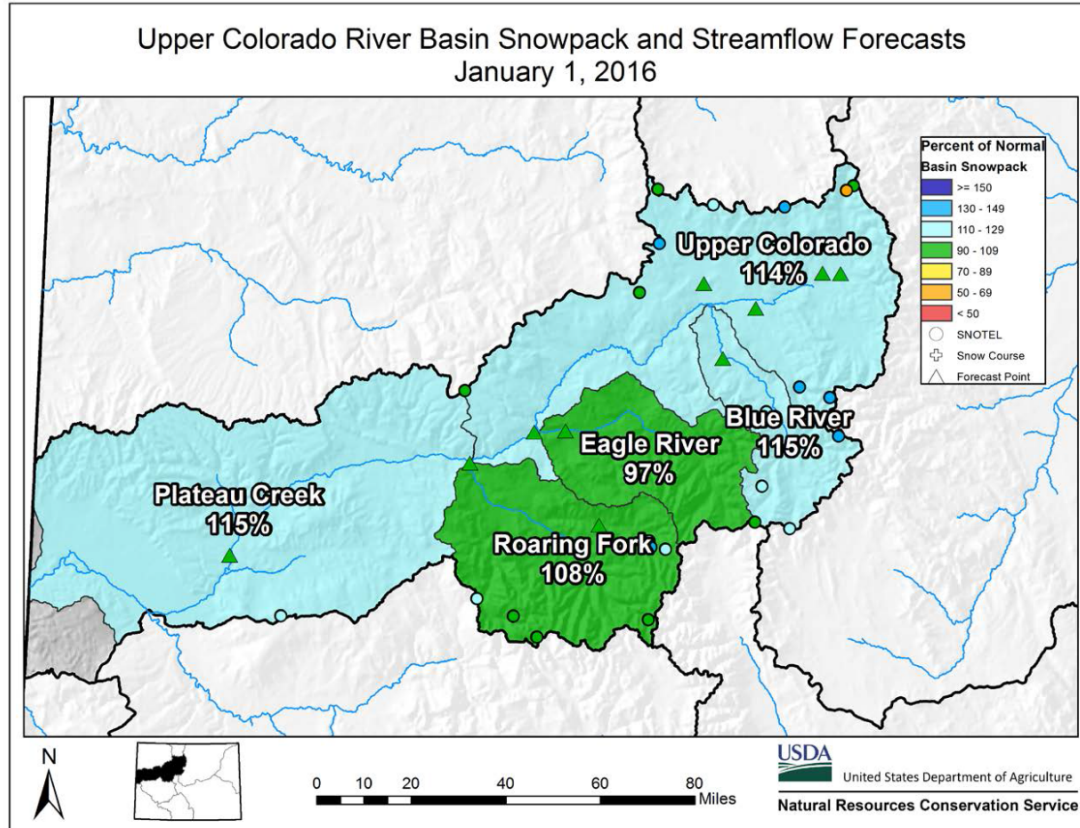
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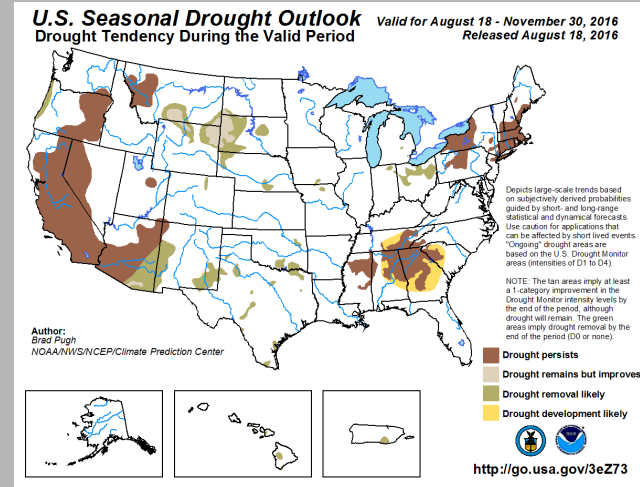
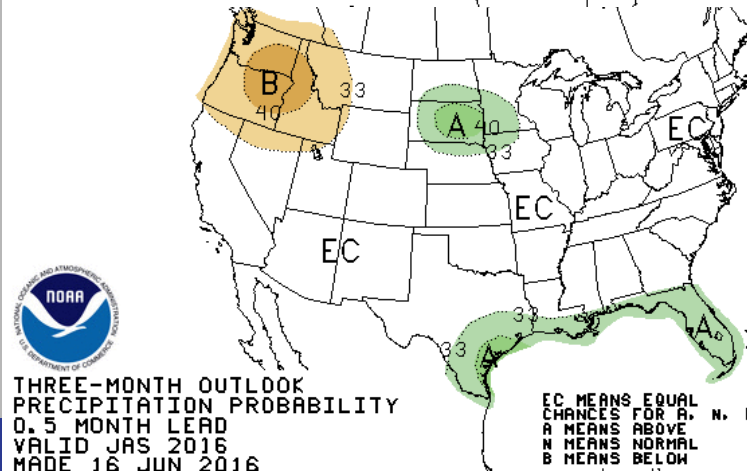
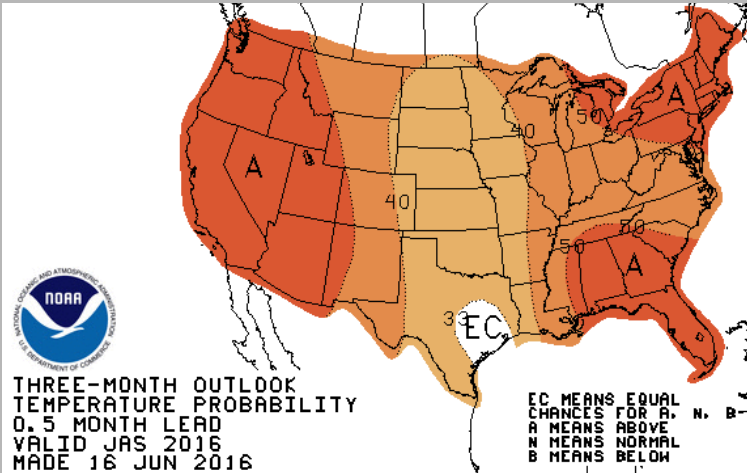
PDSI Proves Its Worth



Forward Looking Indices - Short Term



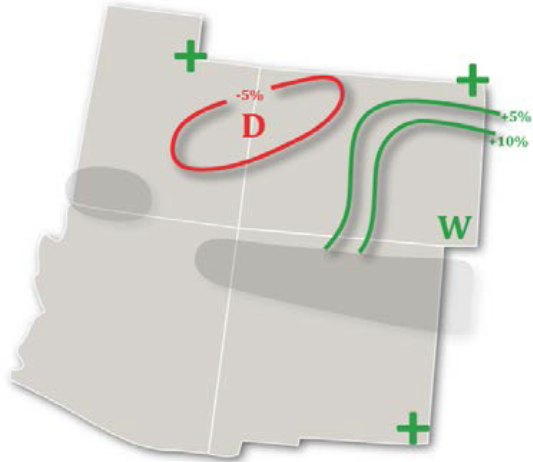
Forward Looking Indices: Long Term Forecasting



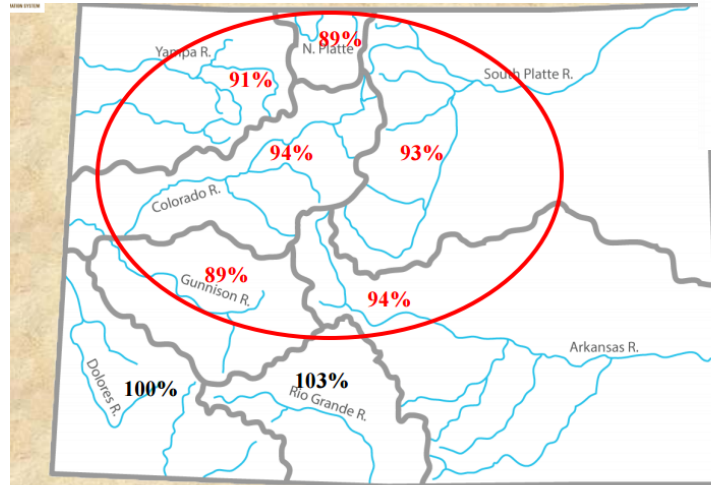
Experimental Long Term Forecasting

Experimental PSD Precipitation Forecast Guidance

APR – JUN 2016 (Issued April 14, 2016) – *Skill Masked*

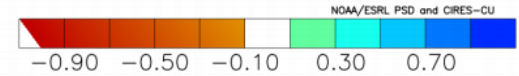
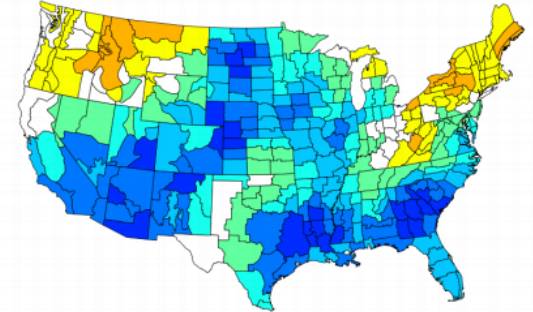


March 1 SWE forecast based on Fall El Niño Composites

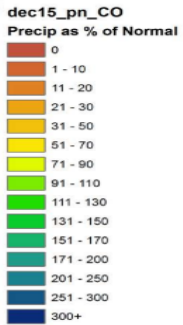
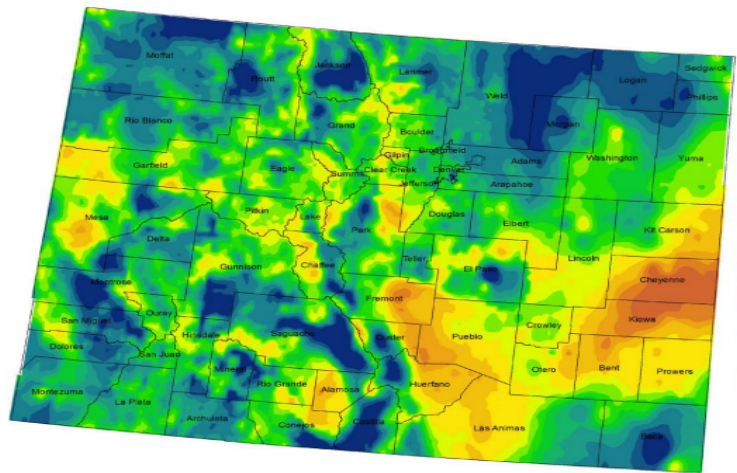


**Median outcome for strong Los Niños since 1968
(after fall seasons: '72, '82, '87, '94, '97)**

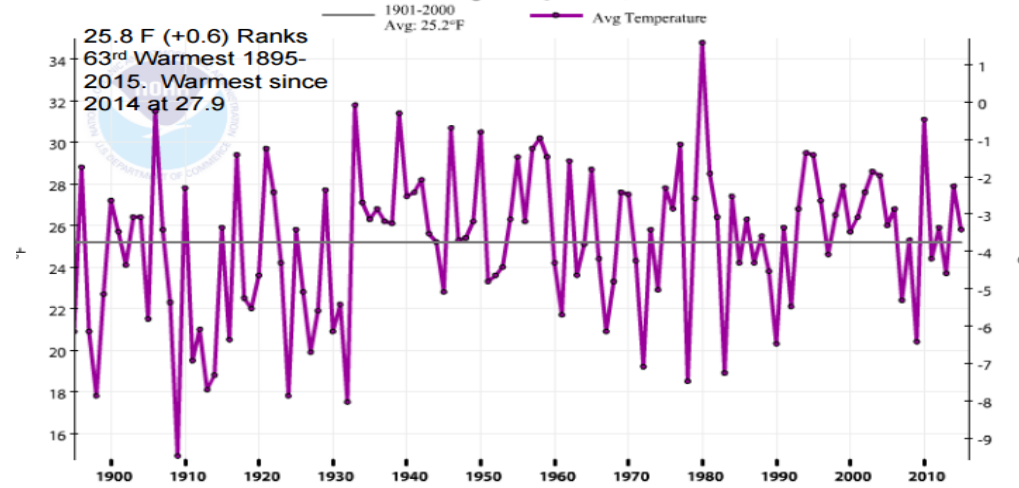
NOAA/NCDC Climate Division Composite Standardized Precipitation Anomalies
Oct to Dec 1957, 1965, 1972, 1982, 1994, 1997, 2009
Versus 1951–2010 Longterm Average



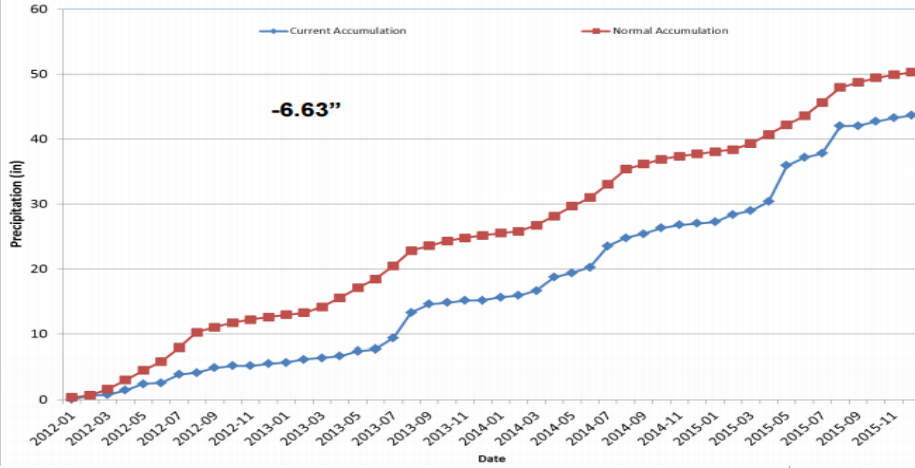
Colorado December 2015 Precipitation as a Percentage of Normal



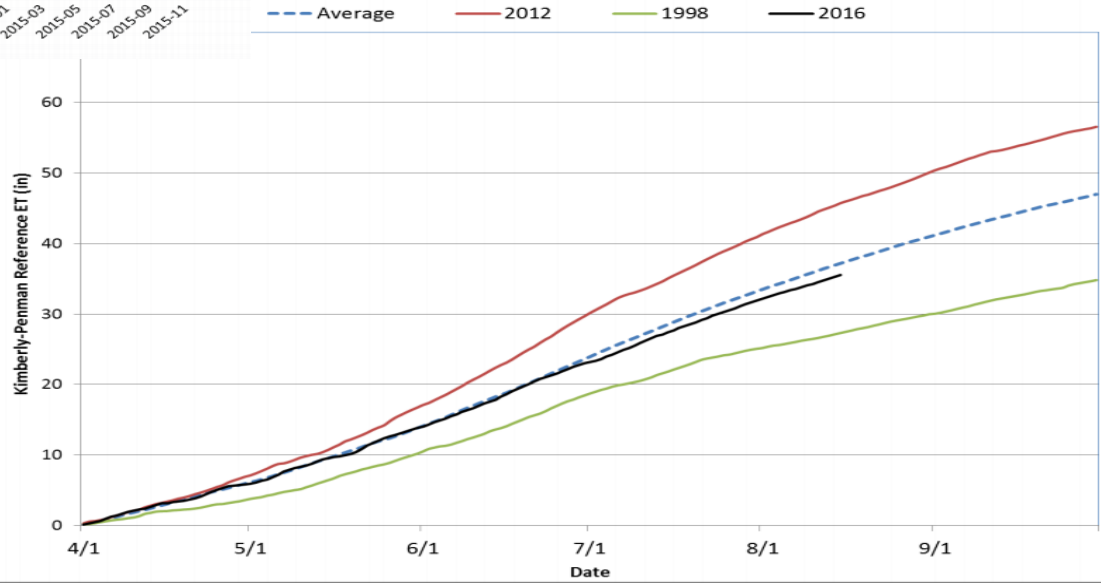
Colorado, Average Temperature, December



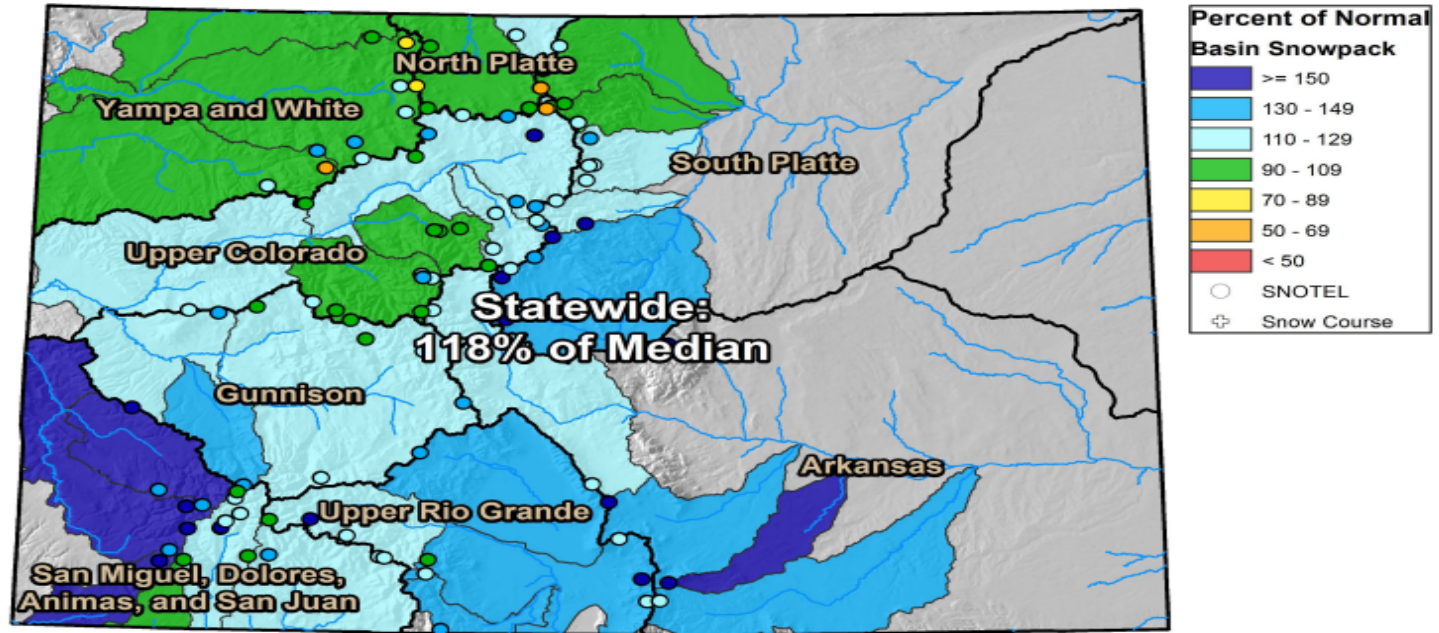
Pueblo Memorial AP Precipitation Accumulation



Montrose Kimberly-Penman Reference ET (1993 - 2016)



Colorado Snowpack Summary January 1, 2016



0 25 50 100 150 200 Miles

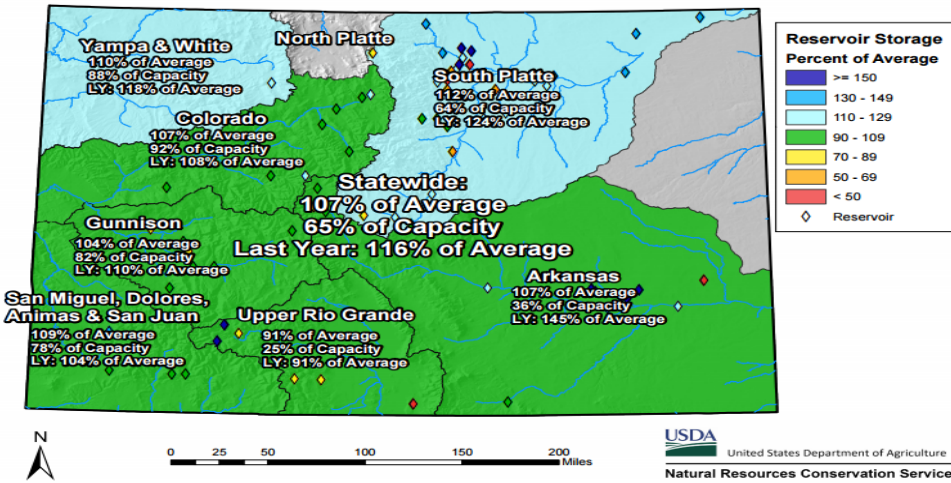


United States Department of Agriculture

Natural Resources Conservation Service

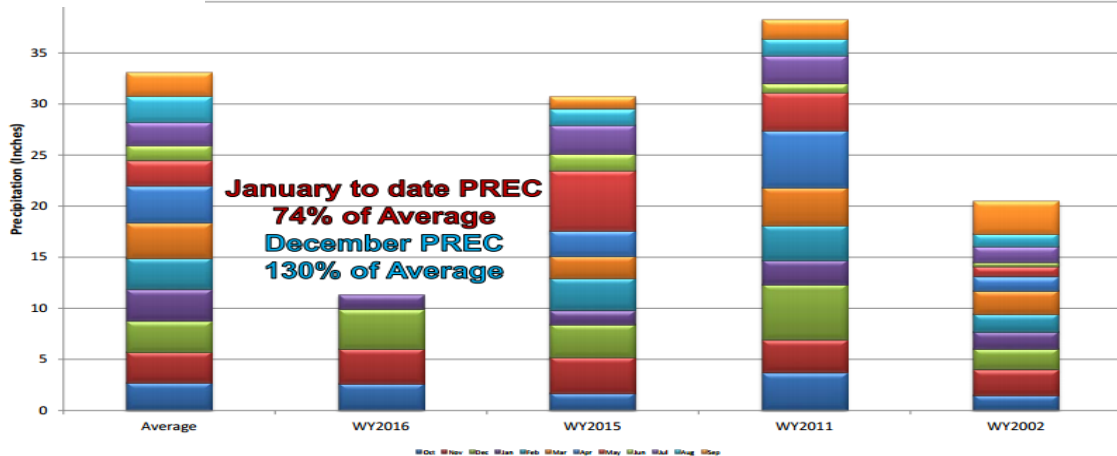
Colorado Monthly Reservoir Storage Summary

End of August 2016



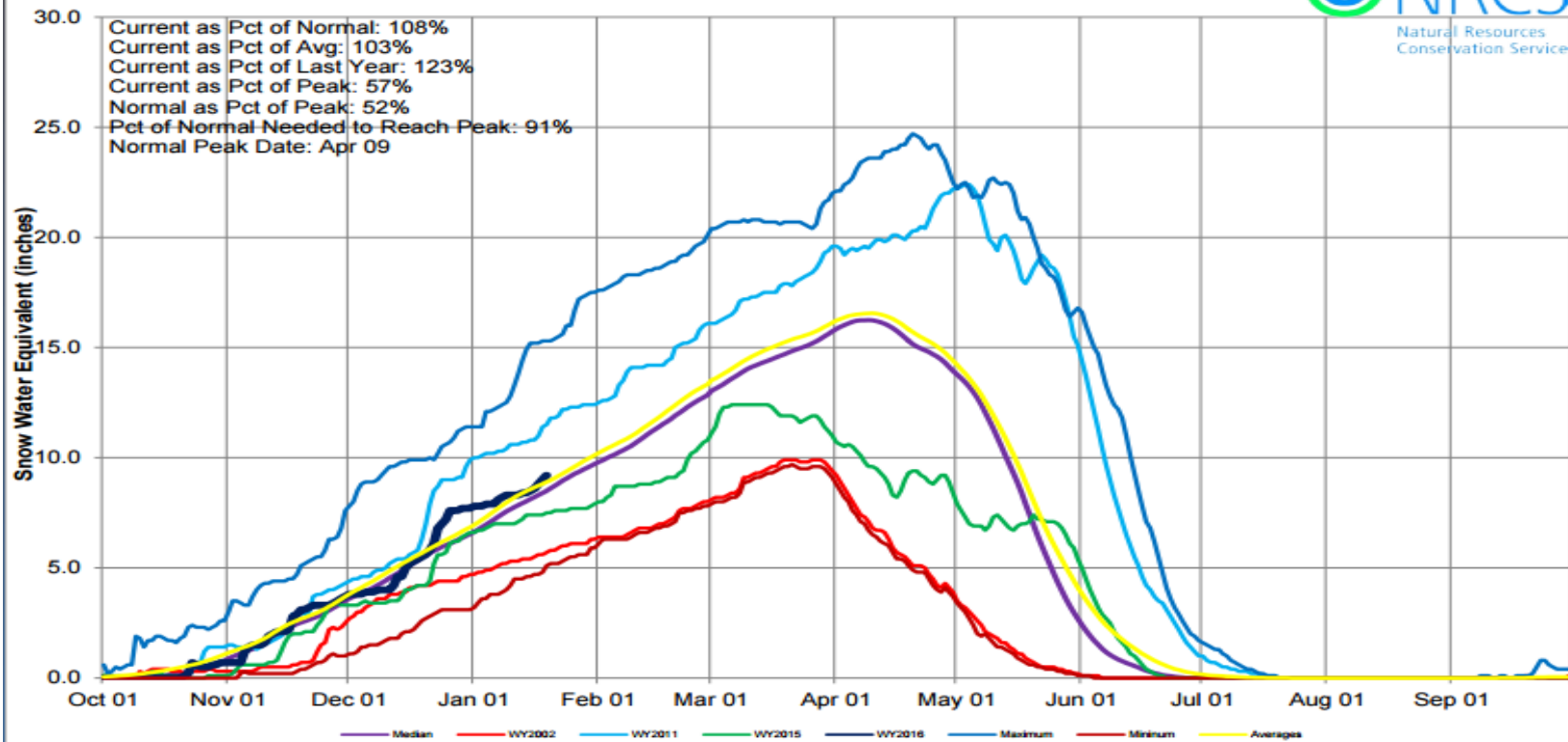
Colorado Statewide High/Low Monthly Precipitation Summary

Based on Provisional SNOTEL data as of Jan 19, 2016



Colorado Statewide High/Low Snowpack Summary

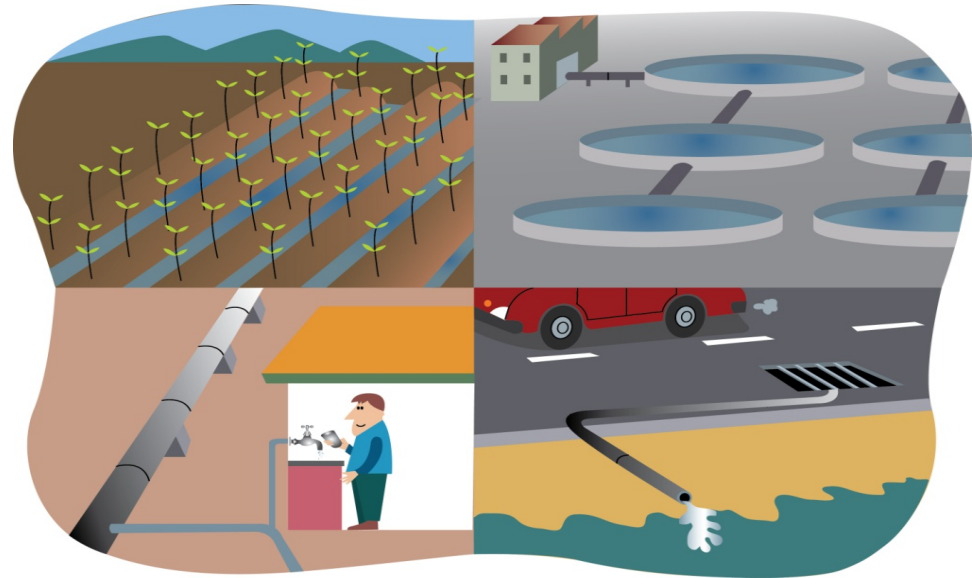
Based on Provisional SNOTEL data as of Jan 19, 2016



Reports from:

- ✓ Water providers
- ✓ Impact Task Forces
- ✓ The Gov's Water Policy Advisor
- ✓ Other Federal Partners

During times of drought it is not uncommon for media to attend



Vulnerability Assessment Tool

★ Added to 2013 revision following 2010

Impacts

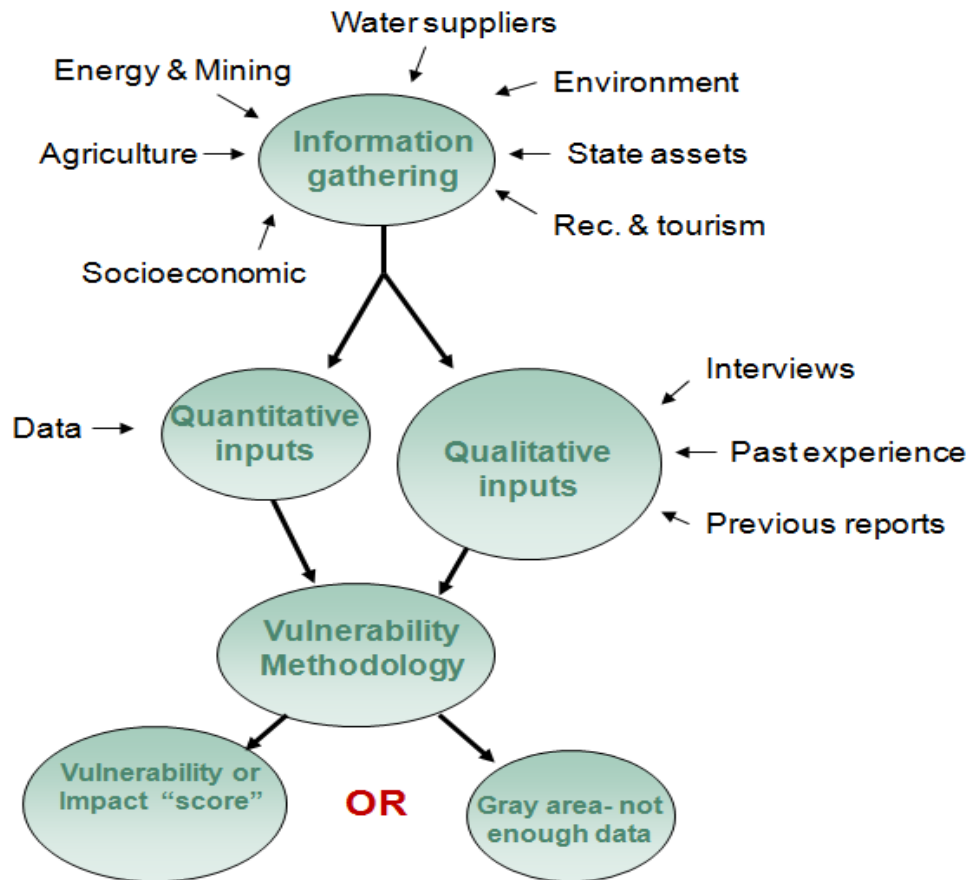
★ Vulnerability to Sectors

★ Vulnerability to State Assets

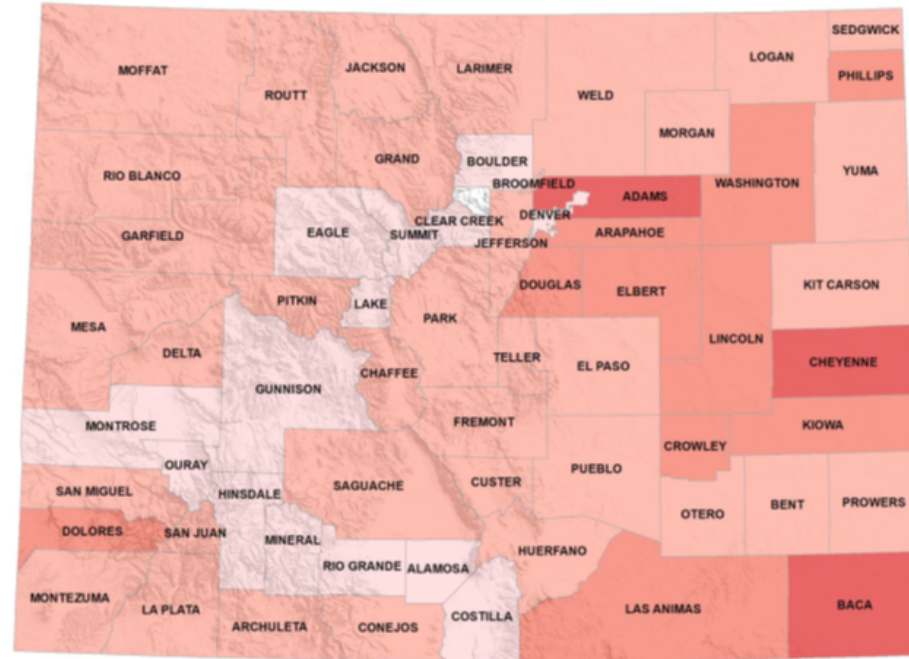


Methodological Framework

- Research sectors, publications, previous drought studies
- Quantitative data
 - What we have
 - What we need
- Qualitative
 - Interviews
 - Past experiences
 - Specific knowledge of the area
- Methodology
- Vulnerability "score" OR framework for future data collection



Agricultural Vulnerability Score



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Questions?



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