Workshop Summary Report

Texas and Oklahoma Climate Extremes:

Learning from the Recent Four-Year Drought and Spring Flooding Events

October 13-14, 2015
Fort Worth, TX

Table of Contents

Executive Summary

In October of 2015, representatives from state and federal agencies representing broad areas of water, public safety, infrastructure and other management participated in the workshop, *Texas and Oklahoma Extremes: Learning from the Recent Four-Year Drought and Spring Flooding Events*. This event was sponsored by NOAA's National Integrated Drought Information System (NIDIS), the Southern Climate Impacts Planning Program (SCIPP), the National Weather Service Southern Region, NOAA's National Centers for Environmental Information (NCEI) and the National Drought Mitigation Center (NDMC). This workshop was a NIDIS Southern Plains Drought Early Warning System (DEWS) activity with the goal of improving disaster reduction and building capacity for better decision-making relating to drought planning and mitigation.

The workshop focused on the successes, challenges, lessons learned, and opportunities for future collaboration related to the recent 2010-2015 drought and spring 2015 flood events. The workshop included presentations and discussions about the shift from extreme drought to floods in 2015 and tactics the participants' agencies used to manage the impacts of those events. Discussions specifically focused on monitoring tools, agency coordination, unexpected impacts, successes and public outreach.

The workshop identified opportunities to improve information and coordination both in near-term actions and long-term planning. In particular, the participants recommended the following:

- Establish a monthly climate webinar starting first with the Texas and Oklahoma agency participants of the workshop, providing localized information to address extreme weather and relevant climate information. These monthly webinars would provide a heads-up of potential threats, allow the two-way exchange of information, and discuss management strategies for preparing for these threats.
- Convene a follow-up workshop focused on translating drought and flood research into useful information for decision-making processes. This workshop would function as a "Train the Trainer" session so that the participants could bring this information back into their own agencies. The hands-on workshop should include examples of how decision support tools can be used for the relevant sector's needs.
- Offer a webinar series to federal, state and local agencies, informing them of current weather conditions and the best tools to address and communicate the issues.
- Organize a follow-up workshop that focuses on public messaging. This would include translating technical information into formats suitable for distribution to the public, including through social media.
- Extend the coordination activities to higher levels including government, municipalities, and state and federal representatives to share current efforts at managing drought and flood events, and to share information among public information officers.

Aside from these broad recommendations, a number of important concepts and issues were raised in the group discussions. These are summarized below to highlight areas where additional information, monitoring, or decision-support tools may benefit managers and opportunities to improve communication between agencies and the public.

Monitoring, Forecasting and Research

- The U.S. Drought Monitor is among the most commonly used drought tools in Texas and Oklahoma.
- Access to real-time data from a network similar to the Oklahoma Mesonet is widely desired among Texas agencies.
- Outside of the individual tools used for specific capacities, many of the tools and resources identified are used by multiple sectors.
- Many of the agencies provide links to these applicable tools as well as offering their own sector-specific tools on their websites.
- Validation of forecasts with real-time observations is important to building confidence in the use of forecasts.
- Numerous suggestions were provided regarding additional tool development. These additional needs may be best categorized as tool improvement, more research/data, and innovative ideas regarding both tools and data.
- Groundwater monitoring is an important management tool, but it needs to become more robust and offer better spatial coverage to reduce uncertainty in decisions.
- Flood inundation maps do not match up well with actual flood impacts. Local and regional coverage needs to be increased to help identify these impacts. Additionally, it was suggested that remotely-sensing data would be beneficial in improving staff safety by reducing the time spent on site in adverse weather conditions.
- The symbols representing both short and long-term drought on the Drought Monitor map were shown to be potentially confusing or unnecessary as users may only be interested in one or the other, and two separate maps were suggested.

Coordination Among Agencies

- Both Oklahoma and Texas agreed that coordination for drought is much more difficult than flooding and needs to be improved.
- Texas created a Drought Preparedness Council which activates the Drought Preparedness Plan, and interacts with multiple agencies. Oklahoma expressed the need to update their state drought contingency plan and adopt a council similar to Texas.
- Interagency state and federal coordination is prevalent within Oklahoma and Texas; however, such coordination can be improved as meetings only convene during an event.
- USACE and FEMA were highlighted as federal agencies that commonly provide service to Texas and Oklahoma.
- Multiple challenges exist among interagency coordination efforts, including the need for transparency, funding, and improved coordination between state and local officials. This includes the communication of specific drought triggers and response strategies used by agencies and partners.
- In addition to receiving federal assistance, both states provide various funding

opportunities to their local agencies relating to planning and response.

- Other non-state agencies and entities that are important to monitoring or managing events include the Red Cross, the media, university extension, and charity/volunteer organizations, along with city and county government.
- During response, it may be difficult to keep track of resources; having a pre-developed list of specific contacts within agencies that are available for consultations during an event will ease this challenge.
- Clear metrics for grant eligibility for drought response are needed, similar to the metrics used for flooding.
- Local partners play an important role in disseminating messages about climate extreme events and the associated risks, such as potential water shortages.
- The lack of documentation of specific local impacts reduces the ability for local officials to effectively respond and access federal funds.

Successes, Challenges and Lessons Learned

- Sustained, long-term drought strains coordination and resources and creates greater impacts than flooding. Because the duration of flooding is shorter, coordination can be easier to maintain.
- Common impacts included water issues and damages which were compounded by a lack of preparedness.
- Lessons learned from drought were more difficult to identify than flood.
- Lessons learned from flooding events included coordination between agencies, the need for educational awareness on floodplains, and the need to plan ahead.
- Some losses may not be covered by insurance or federal aid, such as fences lost in a fire or flood. Replacement of those items must come out-of-pocket from the business, rancher, or farmer.
- There may be benefits to drought or flood, such as control of invasive species, that are not captured in documenting impacts.
- Algae blooms, poor water quality from concentrations of toxins in smaller volumes of water, and infrastructure failure due to expansive soils were among unanticipated impacts from the 2010 to 2015 drought.
- Live reporting of events can lead to misinterpretation of impacts and sensationalism of events. Several agencies hired a public information officer or social media coordinator to minimize sensationalism and improve communication with the media and public.
- In some places the drought eclipsed the previous drought of record (from the 1950's). Follow up studies are needed to address whether existing planning efforts are outdated and need to be updated to incorporate the most recent drought events.
- Proactive mitigation actions need to be implemented well in advance of an event, but it is difficult to get attention and support without a perceived immediate threat.
- Different agencies within a state or agencies of similar function across state lines may use different terminology and metrics for estimating damages and communication.
- Communication was a reoccurring topic throughout this discussion, with responses for impacts, lessons learned, successes, and innovations. Improving communication between state agencies and local communities improved awareness on the local

resources, needs, and capacities.
- Innovations developed during the drought and flood included the review of land use ordinances to conserve water, modifying trigger levels to improve water management rules, and increasing the priority of a sustainable water supply in water management plans.

Public Outreach

- Communication is a key component for building resiliency towards future events.
- Communication varied from agency collaboration to public outreach.
- Social media, especially Twitter, is an important way to both share information and monitor public response during events. Social media can help drive public users to website resources where more detailed information can be provided.
- Clearly defined responsibilities and transparency are important elements of planning, and improves coordination during an event.
- Each agency has unique capabilities and constituencies. By sharing information, especially through social media, a consistent message can reach a wider audience.
- Developing unified public announcements for drought or water conversation that can be shared through each partner is more effective than each agency composing its own messages.
- Continued interaction between state and federal agencies and across state borders is crucial for future preparedness and resiliency improvements.
- The transfer of information among agencies on best practices, success stories, and challenges can enhance the ability of each agency to connect with the public during future events.
- Telling a story relating to the current situations, framing events in historical context, and using terms commonly used by the public improves reception of the messages.
- Keeping information up to date is important to develop trust from users.
- Exercises and scenarios to test communication are valuable in preparing for future events.
- Educational efforts with the public should be undertaken to improve basic understandings of critical messages.
- Relationships between the agencies' public relations and the media should be established and maintained to improve communication.

Introduction

In October of 2015, the workshop, *Texas and Oklahoma Extremes: Learning from the Recent Four-Year Drought and Spring Flooding Events,* was hosted in Fort Worth, TX. The workshop was a collaboration of the National Oceanic Atmospheric Administration (NOAA), the National Integrated Drought Information System (NIDIS), the Southern Climate Impacts Planning Program (SCIPP), and the National Drought Mitigation Center (NDMC). As a NIDIS/Southern Plains Drought and Early Warning System(DEWS) activity with the goal of improving disaster reduction and building capacity for better decision-making relating to drought planning and mitigation, the workshop brought together regional, state, and federal representatives from both Texas and Oklahoma. Discussion focused on the recent 2011-2015 multi-year drought and 2015 spring flooding events, providing participants the opportunity to share experiences and identify the lessons learned, challenges, and opportunities for collaboration regarding future climate extreme events.

This report includes an overview of the workshop goals, presentations, discussions, and workshop outcomes. An overview of the workshop successes is also provided, based on the results of the workshop post-event survey.

Participants

There were 29 participants that attended the event. Below is a summary of the regional organizations, state agencies, and federal agencies represented at the workshop.

State Agency Participants:

Electric Reliability Council of Texas
Oklahoma Conservation Commission
Oklahoma Department of Agriculture, Food, and Forestry
Oklahoma Department of Environmental Quality
Oklahoma Water Resources Board
Texas A&M Forest Service
Texas Division of Emergency Management
Texas Parks and Wildlife Department
Texas Sea Grant College Program/Texas A&M
Texas Water Development Board

Regional Organization Participants:

Brazos River Authority
Lower Colorado River Authority
National Drought Mitigation Center (national in scope)
Southern Climate Impacts Planning Program

Federal Agency Participants:

Federal Emergency Management Agency
Gulf Coast Prairie Landscape Conservation Cooperative
National Centers for Environmental Information
National Integrated Drought Information System
National Oceanic and Atmospheric Administration
Natural Resources Conservation Science
National Weather Service-Fort Worth
National Weather Service-Southern Region ROC
University Corporation for Atmospheric Research
U.S. Army Corps of Engineers-Fort Worth
U.S. Department of Agriculture
U.S. Fish and Wildlife Services-Southwest Region

Workshop Purpose

The objectives of the workshop were to:

- Foster dialogue among state agencies and regional partners on various drought and flooding impacts and response topics.
- Initiate discussion on how drought warning, planning, and resiliency can be strengthened on an interagency level and inform federal policy and the Southern Plains Drought Early Warning System (DEWS).
- Provide break-out discussions as a forum for regional organizations, state agencies, and federal agencies to discuss the challenges, successes, and lessons learned from the recent drought and flood events.
- Discuss current examples and future opportunities for collaboration on proactive mitigation activities and response.

Workshop Outcomes

The workshop achieved the following outcomes:

- Learned through conversations among colleagues how agencies have approached and addressed flood and drought extremes in both Texas and Oklahoma.
- Acknowledged services and products that were useful during the recent flooding and drought, in addition to being introduced to new resources that could be developed for future benefit.
- Identified potential opportunities for future collaboration and established relationships with others who could be of future collaborative benefit.
- Provided the foundation for a summary report that will inform a work plan for the Southern Plain DEWS. This work plan will address the challenges, successes, and lessons learned from the recent drought and flood events, areas where collaboration can be improved, and future climate resource needs.

Overview of the Workshop Presentations

Seven presentations were delivered, providing a climate outlook, information on recent climate related research, and a background on NIDIS and the Southern Plains Drought Early Warning System. These presentations are provided on the NIDIS website, www.drought.gov/drought/news/texas-and-oklahoma-climate-extremes-workshop.

Southern Plains Drought Early Warning System (DEWS)

The Southern Plains Drought Early Warning System (DEWS) is an interagency program led by NIDIS. The history and general aspects of NIDIS and the DEWS was provided. The program is designed to meet the NIDIS objective of developing educational resources, interactive systems and tools to promote sound drought-related decision making, drought awareness and drought resiliency. There are nine regional DEWS across the nation, with Texas, Oklahoma, and New Mexico comprising the Southern Plains region.

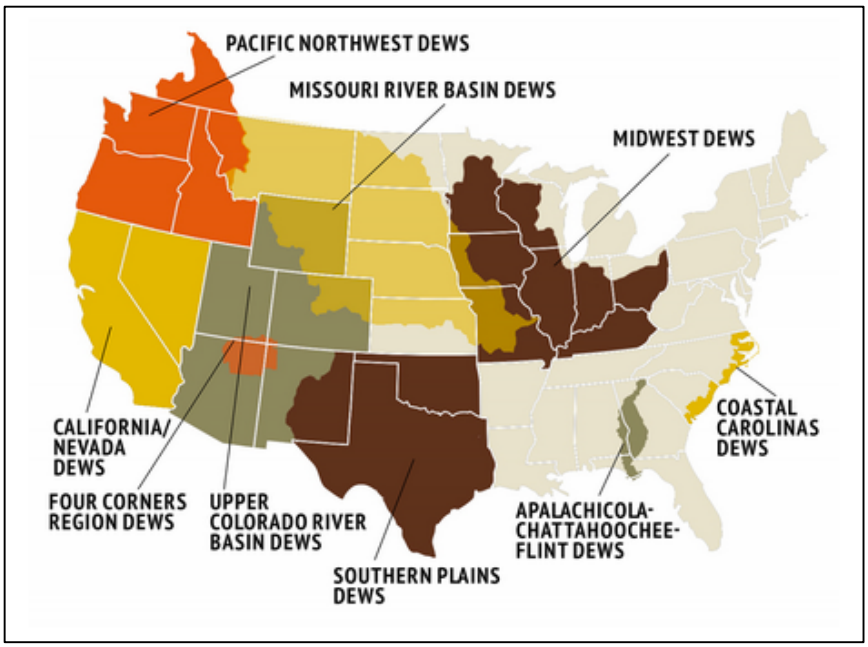

Figure 1: Visual representation of the 9 NIDIS Regional Drought Early Warning Systems (DEWS) across the United States.

Drought Status & Climate Outlook

As an overview of the recent drought conditions, the Texas and Oklahoma historical multi-year drought was summarized. Analyzing monthly drought conditions across each state, the occurrence of various heavy rain and "flash drought" conditions alternated the status of the region during this time. Transitioning into the current drought status, a summary of El Niño and La Niña was given, as well as explanation of the development of what are now strong El Niño conditions over the past year. Out of the two, El Niño is known to shift the storm track further south, increasing the frequency of storm systems across the Southern Plains. Expanding on the current El Niño status, outlooks of both precipitation and temperature for this winter were explained for the Southern Plains. A description of the current seasonal outlook followed as well as trends of past El Niño events covering the risk of extremes, snow anomalies, and precipitation. Taking the most recent drought and heavy rain events into account, historical data showed a link between extreme drought and extreme spring rainfall. These occurrences raise the question of whether extreme drought leads to extreme flood, a topic that is currently under research.

"Dipole Events" – Historical Shifts from Dry to Wet

Based on research conducted by Jordan and Katy Christian and Jeff Basara at the University of Oklahoma, a historical analysis of climate data was performed across the Plains to identify potential dipole events. Defined as an abrupt year-to-year transition from drought to flood, research first consisted of defining thresholds of these events in climate data. Data were then found and analyzed across three regions of the Plains: the Southern, Northern and High Plains. After analyzing the time of occurrence and frequency, the Southern Plains was shown to have an increased frequency of dipole events. Although this trend was found, more research needs to be done on explaining the cause to apply it to future planning.

Southern Plains Drought Early Warning System (DEWS) Activities 2011-15
Activities across the Southern Plains DEWS region were explained from the period of 2011-15, coinciding with the most recent severe drought in Oklahoma and Texas. After explaining the potential causes of drought, the impacts that resulted from this drought were explained, focusing on a multi-hazard context. Additional information regarding required rainfall to end the drought versus the received rainfall was presented. Following, the presentation explained the status of DEWS including a list of tools, resources, and events offered by various organizations.

The Drought Risk Atlas
As a decision support tool for drought climatology, the Drought Risk Atlas (http://droughtatlas.unl.edu) was launched in March 2014. The Atlas includes more than 3,000 stations across the nation recording data of various characteristics of drought, including the use of multiple drought indices. As an online-based tool presented on a user-friendly interface, the data collected are presented at station scales with the goal of allowing decision makers to use the tool to better understand drought within their regions and to aid them in the decision-making or drought planning process. This presentation continued by giving step by step instructions on various ways to use the tool. Additional topics included the methodology, reasoning for the need of the Drought Risk Atlas, specific questions the tool is aiming to solve, and next steps.

Challenges of Seasonal Forecasting
There is often a misconception of the potential accuracy of seasonal forecasts, especially when the public commonly questions daily forecasts. However, there are various atmospheric and coupled forecast system models that are continuing to evolve and are helping to tackle these questions. This problem of accuracy is first addressed by listing multiple tools that aid in the forecast decision. Expanding on one of the tools, seasonal signals, the application to current conditions leads to the further discussion of El Niño and La Niña. Included in this is the explanation of the current El Niño event underway, ranked as one of the three strongest El Niño events on record. This transitioned into the collection of the tools to give an overview of the current model based trends and the latest Climate Prediction Forecast for the winter of 2015/16.

Teleconnections: How Patterns Far Away Can Influence Our Weather
Discussing seasonal signals such as El Niño and La Niña would not be fully understood without explaining the topic of teleconnections. Defined as the connectedness of large-scale weather patterns across the world, weather patterns on the opposite side of the globe can influence what we experience here in the Southern Plains. One of these well-known teleconnections is the El Niño Southern Oscillation (ENSO). Consisting of both El Niño and La Niña, each of these conditions, effects, and potential impacts for this winter were discussed. In addition to ENSO, an overview of multiple other oscillations is explained. Transitioning into drought, the alignment of various phases of these indices has been proven from past droughts to potentially kick start the onset of these conditions. The conclusion of this presentation consisted of the current teleconnections status, as well as projections for the future.

Workshop Discussions Summary

This summary provides an overview of the facilitated results from three small group discussions and one large group discussion conducted during the workshop. The participants were divided into four groups based on their representation of the following sectors: environment, water, infrastructure and agriculture. Each of these groups was asked the same break-out discussion questions under the encouragement of having an open dialogue between colleagues representing Texas and Oklahoma.

Summary of Break-Out Discussion Themes

Small Group Discussion 1*: Monitoring, Forecasting and Research*
Discussion was centered on the tools used during the recent drought and flood events. The dialogue was encouraged around the tools that were used to monitor drought, their performance going into and coming out of drought, any adjustments made to the tools, and if there were any specific tools or data needed to which they did not have access.

Small Group Discussion 2*: Coordination Among Agencies*
Turning towards the interaction and coordination among agencies during the drought and flood events, this discussion focused on the level of interaction among state and federal agencies. Of particular interest was the interaction between these agencies, relationships that were new or strengthened as a result of the events, challenges and financial assistance.

Small Group Discussion 3*: Successes, Challenges and Lessons Learned*
This discussion focused on impacts, successes and lessons learned during the drought and flood events. Newly developed innovations to improve drought mitigation and response were also explored.

Large Group Discussion: *Public Outreach*
The final discussion brought all of the participants together to converse about the various ways they handled public outreach during the drought and flooding events. Topics consisted of how messages were sent out to various stakeholders, noting what worked well and what did not regarding communication to the public, and potential improvements for future communication efforts.

Small Group Discussion 1: *Monitoring, Forecasting and Research*

Key Insights:

- The U.S. Drought Monitor is among the most commonly used drought tools in Texas and Oklahoma.
- Access to real-time data from a network such as the Oklahoma Mesonet is widely desired among Texas agencies.
- Outside of the individual tools used for specific capacities, many of the tools and resources identified are used by multiple sectors.
- Many of the agencies provide links to these applicable tools as well as offering their own sector-specific tools on their websites.
- Numerous suggestions were provided regarding additional tool development. These additional needs may be best categorized as tool improvement, more research/data, and innovative ideas regarding both tools and data.

Tools: What tools did you use to monitor the drought and recovery?

There were numerous useful tools identified within each group, with many of these tools revealed as applicable to multiple sectors . Various resources included the use of social media, the Oklahoma Climatological Survey (OCS) and Mesonet (for stakeholders in Oklahoma), the Climate Prediction Center (CPC) Precipitation Forecasts and Drought Outlook, the U.S. Geological Survey (USGS), and various drought indicators. Texas participants concluded that they lack the data and resources of that compared to the Oklahoma Mesonet and would like a similar product. However, multiple constraints, including budget, prevents the plausible consideration of this idea. The preferred channels of social media included Facebook and Twitter. Common information taken from OCS included water data, weather data, and soil moisture data. The accessibility of their website, mobile app and weekly ticker adds to their increased value as a resource. Within the variety of tools utilized from USGS, the most frequently referred data included lake levels and average streamflow conditions. The most commonly used, versatile drought tool amongst the four groups was the U.S. Drought Monitor within the Drought Portal from the NDMC. Additional drought indicator tools included the Standardized Precipitation Index, the Palmer Drought Severity Index map (used for soil moisture status), the wildfire information from the Texas Forest Service, and the Keetch Byram Drought Index used for fire potential assessments.

Additional common resources mentioned throughout the sectors included the tools offered by SCIPP and the 180-day High Priority list sourced by the Texas Commission on Environmental Quality (TCEQ). The SCIPP website provides various tools including historical rainfall charts and temperatures and sends out a monthly Southern Climate Monitor email. The Water Reservoir Data Visualization tool, a new resource that has recently been made available on SCIPP's website, was of interest throughout the sectors. TCEQ's 180-day list shows the current water districts and suppliers in Texas who have less than 180 days of water remaining.

Aside from the evident overlapping of resources amongst the sectors, the individual entities had additional input for their current use of tools. The water group mentioned the use of the Vegetation Drought Response Index (VegDRI) from the NDMC, which provides satellite-based vegetation health/greenness tracking. The Lower Colorado River Authority is interested in seasonal outlooks as well as water quality data, especially with salinity levels and data along the coast. The Oklahoma Water Resources Board (OWRB) utilizes data regarding dam inventory, water wells, rainfall analysis, and reservoirs, in addition to providing the state water plan. For the public, they offer numerous tools on their website, including the majority of the tools mentioned above. Additionally, their drought monitoring publication, the *Oklahoma Water Resources Bulletin*, summarizes the current conditions from the list of tools on the drought portal. Various resources are accessible through the Texas Water Development Board (TWDB) as well, including interactive planning maps displaying municipal water supplies.

The environmental group mentioned the use of groundwater level data along the Colorado River. The agriculture sector mentioned multiple general tools, such as the use of precipitation and snow data, local field personnel, well water levels and water quality, reservoir levels, and state climate offices. River forecast offices develop a weekly tool to display water runoff and pulses down the river. Emergency management personnel noted that although experts in the field provide them with current data and observations, they are not active in relaying that information to local personnel.

Tool Usefulness: How did those tools perform, both going into and coming out of drought? Did you make any adjustments along the way?

Although the results from the tools used to monitor drought and recovery were commonly applicable among the sectors, there was much more sector specific conversation centered around tool performance and adjustments. In general, the groups mentioned the success of social media, which can be a great way to monitor public response during these events, as well as advertising news and changes relevant to their sector. Twitter was especially noted as the preferred social media channel, and can help drive public users to website resources. An example of this success includes the onset of heavy website traffic due to the Corp's release of flood info on Twitter.

The environmental group noted that although the groundwater levels along the Colorado River serves as a good ecological indicator, they lack robustness and need better uniform spatial coverage to help with the certainty of the data.

The water group focused on the positive performance of tools, focusing on many of their most useful resources. These include the USGS streamflow, reservoir supply maps, any CPC forecast/outlook map, SCIPP historical precipitation and temperate maps, and the TCEQ High Priority (180-Day) list.

In general, the agriculture group uses forecasting products such as the CPC seasonal forecasts and drought outlooks, and emphasis was spent on the importance of real-time

weather products. These data were a big decision driver for real-time operations, however, the group noted that one cannot become too dependent on forecasts and need to match it up with observations. Additionally, the group agreed that it was more challenging to use the various tools coming out of the drought.

The infrastructure group also emphasized the importance of real-time information, especially in emergency management situations. TCEQ made an adjustment after they learned from the 2011 drought that they had an inadequate drought contingency plan. Following this realization, they overlaid Palmer indices with a map of reservoir levels. The U.S. Army Corps of Engineers (USACE) mentioned that they have an outdated plan and are trying to develop a similar plan to what TCEQ developed. TCEQ also adopted a template, requiring each entity to determine their specific needs. Additionally, their drought contingency plans adjusted to river levels, allowing the potential for water sharing based on the quantity of water at sites.

Additional Needs: What were the tools or types of data that you wished you would have access to during the event?

The follow-up conversation revealed numerous additional needs to improve the tools, research topics, and data, as well as proposing new tools and ideas. Comments regarding the improvement of current tools included improvements to inundation maps and the Drought Monitor maps. The environmental group indicated that the inundation maps need to improve local and regional coverage so that they can be used to help identify potential flooding impacts and vulnerable assets. Additionally, remote data would be beneficial in improving staff safety by providing data otherwise required by fieldwork in the flood conditions. The Drought Monitor was discussed by the infrastructure group as well as in the large discussion. Currently, symbols for both short and long term drought conditions are displayed on the map. This was agreed to be potentially confusing or unnecessary as a user may only be interested in one or the other, and the suggestion of two different maps were discussed. The Drought Monitor authors are aware of these considerations and are looking into potential improvements.

The water group disclosed their need for more robust data, the issue of funding to get such data, and the shortage of data managers. The agriculture group expressed interest in improved relative humidity, evapotranspiration, and soil moisture data. Transferring these data needs into research topics, OWRB emphasized the need to improve understanding of the water balance in aquifers. The agriculture group indicated a need for correlations between drought indices and runoff/ground/surface water, and how triggers are tied to drought and water plans. Multiple sectors expressed the interest in more studies and data related to groundwater, including available yield determined by aquifers, yield studies at the basin level, and long term uses. Finally, the Federal Emergency Management Agency (FEMA) mentioned the need to research the lake level for drinking water, especially concerning communication with locals, and the point at which it triggers other problems.

Looking beyond current data and tools, the conversation focused heavily on the suggestion of new tools and ideas. As a whole, tools are needed to better help decision-making, such as

more "value added" data, and a website to compile useful climate and weather information in Texas. The environmental group would like to adopt a tool used in Arizona that is focused on spring discharge, for use in certain areas in Oklahoma and Texas. The agriculture group suggested better science translations, such as watershed education to the public. The water group addressed topics including the transparency on instituting water calls, a local product to address drought, a unified public announcement for drought or water conversation, and a water loss and water metering program for municipal water utilities.

Small Group Discussion 2: *Coordination Among Agencies*

Key Insights:

- Both Oklahoma and Texas agreed that coordination for drought is much more difficult than flooding and needs to be improved.
- Texas created a Drought Preparedness Council which activates the Drought Preparedness Plan, and interacts with multiple agencies. Oklahoma expressed the need to update their state drought contingency plan and adopt a council similar to Texas.
- Interagency state and federal coordination is prevalent within Oklahoma and Texas, however, such coordination can be improved as meetings only convene during an event.
- USACE and FEMA were highlighted as federal agencies that commonly provide service to Texas and Oklahoma.
- Multiple challenges exist among interagency coordination efforts, including the need for transparency, funding, and improved coordination between state and local officials.
- In addition to receiving federal assistance, both states provide various funding opportunities to their local agencies relating to planning and response.

State: How did you interact among state agencies during both the flood and drought; did you interact with some agencies in one case but not the other?

The second day of the workshop began by turning the discussion from product application towards coordination among agencies. Overall, both Texas and Oklahoma agreed that coordination was stronger for flooding than drought. Flooding can be easier to plan for, meanwhile drought is much more complex and can leave little time to prepare for and respond to unanticipated impacts. The consensus showed that everyone would like to improve drought coordination.

<u>Oklahoma</u>

Discussion revealed various interactions among Oklahoma state agencies during the flood and drought events. As a statewide effort, the Oklahoma Emergency Drought Commission and Relief Fund enhanced coordination from it's beginning, organized by the Secretary of

Agriculture, the Oklahoma Conservation Commission (OCC) and OWRB. Under the department of Oklahoma Emergency Management (OEM), there is a drought plan, but it has not been updated since 1997. There was general consensus that this plan needs to be updated.

OEM stated that they are primarily responsible for response. To aid in these efforts, the governor created two different groups, the State Hazard Team and the Emergency Response Team. The state is involved in a bottom-up strategy, relying on local communities to report situations and come to them when they need help. Throughout the drought and flood events, with a heavy emphasis on flooding, OEM has coordinated with various state agencies including OWRB and the Oklahoma Department of Environmental Quality (ODEQ). As a key agency, OWRB was by their side the entire time, providing expertise and potential impacts throughout the situation and during the Emergency Response team meetings. ODEQ was always on hand before and after an event providing help related to debris. OEM also coordinates with their counterpart, the Texas Department of Emergency Management (TDEM). It was noted that although there are multiple connections with state agencies, there lacks documentation. Improvement needs to be made in regards to keeping track of their resources so they can pull from a list when an event arises.

OWRB is dedicated to getting relevant data out to the public. A large portion of their emphasis is placed on water planning, focusing at the state level and best prioritizing funding levels and issues amongst the communities. They also offer the Oklahoma Dam Safety program, providing services such as on-site inspections which benefit Oklahoma dam owners due to required inspections every five years. During the recent drought events, questions arose surrounding water rights and allocation. At times, OWRB facilitated communication between junior and senior water right users to ensure that everyone received an appropriate share of water. As mentioned by their state colleagues, they have an outdated Oklahoma Drought Management Plan (1997). Also included is an Impact Assessment and Response Committee, with its primary duty to, *"monitor and assess the current and potential impacts of impending or ongoing drought…"* Although this is a positive response effort, the committee is only active during drought times and lacks situational awareness.
Finally, the Oklahoma Department of Wildlife Conservation stated that they were severely impacted by the recent floods, receiving support from ODEQ, OWRB, and the Oklahoma Congressional Delegation. Following the initial help, there have been positive, ongoing partnerships with these agencies.

<u>Texas</u>

Texas also heavily relies on state agency collaboration. One of the largest collaborations within the state is the Texas Drought Preparedness Council, established in 1999. Consisting of roughly 20 mandated members, monthly calls and discussions cover pressing issues including current events and how to mitigate and fix them. When appropriate, the Council is actively engaged with various representatives such as those in farming and agriculture. The status of the Drought Council's actions is reported by TCEQ, DEM and the Texas Department of Agriculture. The Drought Council is responsible for the development of

many initiatives including the State of Texas Drought Preparedness Plan, which is activated through the Council during severe drought conditions, the Water Utility Emergency Drink Water Task Force, and the management of the 180-Day High Priority Watch List.

Beyond the Drought Council, there are multiple instances of agencies interacting during extreme weather events. At the state level and as mentioned above, TDEM coordinates across the border with OEM. TCEQ has a contract with 15 regional water authorities, conducting water quality monitoring, assessments and stakeholder outreach in the 23 major river and coastal basins of Texas. TCEQ holds responsibilities over these river authorities including approving their water plans, performing administration processes for suspending/changing environmental flow conditions, and requiring a drought contingency plan, updated every five years. Expanding on regional coordination, the planning of the Texas river authorities is successfully performed at the local level, with positive cooperation on the state side. One example of the various ways the authorities can utilize coordination is that the Brazos River Authority coordinated with the West Gulf River Forecast Office to ensure that water conservation was maximized. Flood response is performed by the river authority regional operation centers and focus consists of preparing for floods. During these times, daily calls occur between NWS, USACE, and USGS. Additional agencies that interact during flood and drought events included the Texas Department of Transportation, the Texas National Guard, the Texas and Southwestern Cattle Raisers Association, the Texas Animal Health Commission and Texas Parks and Wildlife.

Federal: What federal agencies provided sources of information and/or support for operations? Did you establish new or strengthen existing relationships with certain federal agencies during these extreme events?

Multiple federal agencies provide support and information for operations during drought and flooding events. FEMA and USACE were the most frequently mentioned agencies. USACE provided information to agencies such as TDEM and OEM and coordinated with river authorities for water releases during the drought. Additional sources of federal aid and information include the U.S. Forest and Wildlife Services (USFWS) on Endangered Species Act issues, NWS River Forecast Centers, NOAA-Coastal for coastal management, USDA including the National Resource Conservation Service and the Farm Service Agency, the National Park Service, the Bureau of Indian Affairs, and the Bureau of Land Management.

Key relationships within Oklahoma include USACE, FEMA, WS Forecasts and USGS streamflow data. For Texas, their key relationships include the TDEM coordination with the NWS Southern Region Headquarters Regional Operations Center, and the Texas Drought Council. Along with the coordination of state representatives, federal agencies such as FEMA, DC and USGS are occasionally brought into TDEM. The coordination during events between these agencies works well, with the Drought Council and federal partners keeping each other on track.

Other: What other non-state agencies/entities were important in monitoring or managing these events?

Beyond these agencies, there were multiple other non-state agencies and entities that were helpful in monitoring or managing the drought and flood events. Of those that were stated, the Red Cross, the media, university extension, and charity/volunteer organizations were the most frequent. At the emergency management side, the media brings a powerful voice. During times of multiple weather events, the location with the highest media coverage generally correlated to receiving the most charity/volunteer organization support and donations. City/County government was also mentioned as an important entity for water supply, waste water, and water quality. Additional entities mentioned include volunteer fire departments, the Farm Bureau, Cattleman's Association, the Nature Conservancy, Audubon Society and the Indian Health Services.

Challenges: What challenges did you encounter when working with other agencies/entities? Were these challenges addressed? How?

A consensus of challenges included limited resources, funding, the need for standardization and transparency, communication, and coordination. Examples of resources that are currently limited includes a data hub for Texas (similar to the OK Mesonet), drought pages for specific entities, the need for a platform to share data between states, and a lack in funding and transparency for immediate research and response during events.

For flooding, there are metrics that are easy to explain when grant eligibility can occur, however for drought there is less certainty of the timing of needs for both short and long term drought conditions. Also, as mentioned above, challenges can occur when funding from volunteer donations are driven by media coverage. Potential standardization was often mentioned, especially referring to the drought contingency plans between OWRB and TCEQ, and for the water agencies under TCEQ, where otherwise a difference can increase the difficulty in coordinating. The need for transparency was also highly mentioned, urging the need to make people more aware of drought triggers and obtaining the resources needed to respond to these triggers.

Moving to challenges of communication and coordination, drought planning is more developed in Texas than in Oklahoma. There is a need for better understanding and communication between locals and the state of Oklahoma in regards to what they would like to do with potential funds. Another challenge with local and state communication occurs with the lack of documentation of losses due to drought. Currently, local emergency managers report losses from flooding but not drought. The state also admitted that there are coordination challenges with local actions and data, where the state is often left out of local level plans and information sharing. Lack of coordination also raises issues between state agencies, where funding sources are overused in one area or multiple agencies are going to one agency, and can be alleviated by the steering of each other for grants. The Indian Health Service mentioned that integration is needed by Tribal water programs, whom can be segregated and challenging to work with. Additional challenges include times of misinformation during flood and drought events, the retention of information amongst volunteers, the call for more conversations between various agencies, and the compliance of agencies during emergencies.
Various other examples of challenges include the need for more awareness, such as

involving local communities and having them understand their water levels. The Oklahoma agencies of the USFWS have multiple responsibilities that take precedence over other issues and make it hard to engage in wildlife issues at times. Finally, there is a need for systems to move beyond response and become more proactive.

Financial Assistance: What financial or operational assistance programs did you offer or use (state, federal, local, non-governmental, charities)? Were any new programs developed?

The most prominent source of financial assistance throughout the groups was FEMA. The majority of FEMA funds are offered for response, aiding in disaster recovery for events such as flooding, severe storms and fires. Funding examples include the replacement of state park equipment from the fires in 2011, specific funds for different types of water projects, and dam safety programs. It was mentioned that although response funding for drought is greatly appreciated, it would be helpful to have more funds geared toward planning and mitigation. In addition to FEMA, EPA is another federal agency that provides financial assistance within the drought and flood context**,** such as the State Revolving funds for drinking and waste water for public water supplies. An allotted amount of money is also available for research from the South Central Climate Science Center, although their response efforts are not currently service oriented, and participants expressed the need to emphasize the importance of planning. There were also various mentions of federal cost matching that unfortunately at most times are difficult to achieve.

<u>Texas</u>

TWBD partnered with TDEM and TCEQ to form the Emergency Drinking Water Task Force, and with other state partners to develop the Emergency Drinking Water Contingency Annex. As a supplement to the State of Texas Drought Preparedness Plan, attention is focused on the public water systems with 180 days or less of water supply. It was noted several times that a city will more likely be considered for funding if they are included on this list. Other funding sources listed in Texas include the Texas 2604 Grant Program offering equipment to volunteer fire departments, the PL 84-99 USACE program providing financial assistance to repair non-federal levees damaged by floods, and the Texas Senate Bill 1 under which LCRA has finalized funding for an off-channel reservoir.

<u>Oklahoma</u>

OWRB is actively involved with the promotion of water conservation, most recently initiating the 2060 Plan. Bringing private industries together, this plan was funded by EPA and FEMA to introduce a water conservation initiative through the State Water Plan. As the first state in the nation to initiate such a goal, the target is to use no more fresh water in 2060 than the state uses today. Although it is an effective plan, it needs the drive from legislature to get implemented. OWRB offers funding themselves, including general fund proposals and a flood grant planning program. To be considered for funds, applicants must be a part of the 2060 plan, show demand, and express strategies for the use of the potential funds.

The Oklahoma Emergency Drought Commission and Relief Fund consists of participating agencies that provide allocated funds in drought-impacted areas. The Cost-Share Program under OCC provides allocated funds to landowners to improve water quality and soil erosion control. Examples of the use of these funds include new or refurbished water sources and lines, drilling water wells, pipe laying and construction of ponds. As the recent drought continued these funds were altered to address the unexpected impacts and enabled landowners to continue to operate.

Additional funds in Oklahoma consist of a private fund for Oklahoma livestock relief coalition, the 2012 Oklahoma Comprehensive Water Plan with the state and EPA funding 50 years of infrastructure, rural fire department assistance, and state deferral in coordination with the IRS for livestock.

Small Group Discussion 3: *Successes, Challenges and Lessons Learned*

Key Insights:

- Sustained, long-term drought strains coordination and resources and creates greater impacts than flooding. Because the duration of flooding is shorter, coordination can be easier to maintain.
- Common impacts included water issues and damages which were compounded by a lack of preparedness.
- Lessons learned from drought were more difficult to identify than flood.
- Lessons learned from flooding events included coordination between agencies, the need for educational awareness on floodplains, and the need to plan ahead.
- Communication was a reoccurring topic throughout this discussion, with responses for impacts, lessons learned, successes, and innovations. Improving communication between state agencies and local communities improved awareness on the local resources, needs, and capacities.
- Innovations received the most input from the discussion, with many examples of how agencies are moving forward with their efforts after current events.

Impacts: Were there any unexpected impacts and how did you respond to them? What impacts and processes were hard to define or quantify?

Although there were impacts from flooding, the majority of impacts occurred from drought. There were numerous resource and planning impacts, with statewide and sustained long-term drought resulting in a strain on coordination and resources. One of these depleted resources included communities running out of water. Water capacity and conservation issues lead to the issuance of more stringent water quality standards, however, this can limit the water supplies in an already drought-stricken region, such as when wells are shut down due to new arsenic standards. These situations brought awareness to the need for more redundant water sources and regional planning. It was expressed that the lack of required drought contingency plans in Oklahoma does not help when assessing impacts across the state, and it was recently acknowledged that water restriction plans are needed as well.

Expressed by emergency management representatives, assessing impacts is a problem of its own. There is a need to quantify damage especially with dams during flooding and structures that are saved versus lost during fires. There lacks proactive measures that could mitigate these issues, including a cost-benefit analysis and local manager knowledge on assessing damage to in return communicate correctly to the state.

In Texas, during the floods and especially the drought, the cattle industry as well as fencing suffered due to the raging wildfires. This resulted in a financial burden, as currently insurance covers the loss of cattle but does not cover the loss of fencing. In a positive light, the 2015 wet spring and associated flooding caused die-off among some species of invasive timber, such as the Salt Cedar. Unfortunately, this turned dangerous during the summer of 2015 as the dead trees became fuel for the spreading wildfires. The stress on water supplies resulted in the reduction of firm yield levels by the Lower Colorado River Authority as well as the Brazos River Authority.

Another big impact mentioned across the board was due to the time variations between drought and flooding events. Housing and commercial developments occurring during drought years were built within floodplains and did not adequately account for the risk of severe flooding events. In times when extreme flooding occurred, and USACE released water upstream, low flood estimates and limited risk reduction measures revealed they were not prepared for the impacts within the floodplains. In Oklahoma, safe rooms built for severe weather were impacted by the floods in May of 2015, where multiple rooms were filled with water or popped out of the ground. Responses taken from these impacts included stricter regulations for safe room installers (flash flooding and drainage on properties were not previously considered with installations) and the need for more communication at the local level during the installations. During drought and dry spells after flash flooding, algae blooms affected water quality for livestock and recreational activities. Also, water losses due to multiple line breaks occurred during both drought and floods.

Impacts from communication issues were significant. Emergency managers expressed troubles with media communication, ranging from the misinterpretation of impacts to the sensationalism of events. TDEM responded proactively by finding an expert who could explain and verify the reported situation. There is a strong level of coordination between local and state coordinators in Texas, with district coordinators within the local communities serving as the eyes and ears for the state level before they report publicly. However, although proactive solutions can be performed, events may still be improperly portrayed in the media. The issue of live reporting can lead to unexpected impacts of the responses by the public on social media. Issues of how to communicate to the public and control the negative responses arose, along with the discussion that human nature will always present some negative attention and that it's best to manage the situation by providing them with information.

Impacts from drought and flooding events can be difficult to quantify at times. This can especially be true when considering the frequency and intensity of future extreme events. A lot of planning efforts are based on the 1950's drought, however, some areas experienced

their drought of record, raising the question of if these planning parameters are still valid or if they need to be reassessed. In the alternate perspective, areas saw the drought of record followed by the flood of record, increasing the questions of planning for more extreme events and at what thresholds.

Successes and Lessons Learned: What were the successes and lessons learned responding to the drought and flood?

Lessons Learned:
Although impacts of the recent drought and flooding events can portray a negative connotation, the motion behind improving resiliency leads to the next discussion of learning from these experiences. The first topic that many lessons were focused on related to flooding. Numerous agencies acknowledged that although floodplain maps are a good resource to use in planning, they have unfortunately led to the misunderstanding of water staying in-between these lines. Educational tools need to be developed to increase the capacity of generally used terms and concepts relating to floods. TCEQ noticed that people will refer to the map and disregard the actual conditions outside. OEM is one agency that has taken the initiative to identify the need to increase education on mapping, as well as flood insurance policies. Currently in Oklahoma, there are numerous accounts of people opting out of flood insurance without the understanding that flooding can occur in areas outside of the lines depicted on the map. Other lessons learned relating to water include that capacity changes have revealed the reduction of water storage due to the accumulation of silt in lakes. When entities have water capacity issues, they are encouraged to look at the losses first rather than automatically trying to increase capacity or search for new water sources. Additionally, the NWS learned that river flooding needs to be focused on the impacts.

Measures taken to reduce impacts, whether proactively or in response, was another important avenue of lessons learned. In general, this was seen by the enactment of Best Management Practices, as well as the combination of forecasts and observations to provide the most effective response plan. There was an agreement in increasing education and awareness to communities related to recent events. Through experience, it was learned that people generally have a disconnect to an event until it affects them. Therefore, current events upon which people are focused can be used to an advantage when preparing for future impacts. On the management side, it was acknowledged by many that issues need to be proactively addressed, utilizing the drought periods to advance for future floods and vice versa. This is true for sectors such as fixing infrastructure and evaluating flood gauges to make sure the flood stages are in the right categories. OCC learned that land conservation practices need to be done years before a drought starts. It was identified as well that the demand for well drillers commonly exceeds supply and water amounts are not sufficient for filling the ponds.

There were many lessons learned specific to communications. At a state level, both OEM and TDEM agreed upon the lesson that communication and coordination between the two states is key. Weather and extreme events occur in both states, and, therefore, they need to learn from each other and increase awareness of situations that may potentially affect them

both. Alternative lessons on communication include the differences in languages. OEM and OWRB communicate with each other during events, however, they use different estimates of damages and different terminologies. Coordination between these sectors and others moving forward would greatly improve efficiency and response. This can be applied to various other agencies, as well as acknowledging the need to develop relationships and expand efforts to help each other.

Successes:
Success stories entailed conservation incentives, technology, awareness, and improved funds leveraging. As a reoccurring theme amongst these sessions, there were many success stories related to communication. OEM made improvements with inter-agency readiness and coordination regarding flooding, improved their cooperation with USACE, and found public communication effective through social media. Social media was also a success for OWRB, dedicating their own social media person in handling communication and events. TDEM was especially proud of their improved drought communication. Awareness of limitations and involvement with conserving more increased between the community, local and regional levels. This local level knowledge in return opened up a dialogue for better communication with personnel at the state level to learn and understand their various resources, needs, and capacities. New channels and relationships were formed for both Oklahoma and Texas during drought and flood awareness, admitting that the new agencies with which they worked are ones they would not have originally considered.

Success also revolved around the collaborations that OWRB has been able to develop. Relating to ground water studies, USGS provides excellent scientific information. Additionally, USACE provided funds for the development of the Oklahoma State Water Plan. Other successes related to water quality and conservation include the ability for potable water reuse at Big Spring and Wichita Falls, the NRCS Dam Watch program, free water sampling of private wells by ODEQ after the floods, the regionalization of water districts, and the saving of the Wichita Falls water treatment plant during the flooding that followed the drought.

Innovation: Have there been any recent changes made within your agency to improve drought mitigation and response resulting from the recent events?

Multiple measures were taken to learn from previous events and adapt more successfully to future events. Several participants mentioned new ideas related to water demands, such as communities starting to look at land use ordinances to conserve water, tweaking trigger levels at Wichita Falls, creating better water management rules, and including more water supply preservation in water management plans. USFWS-Forth Worth has also taken a proactive stance in water management by identifying the water needed by each species and using this to manage resources within the refuges.

Planners have taken many steps including the consideration of reusing water to meet future water needs, adopting new concepts such as maintaining and/or decreasing per capita water use, and considering projected population growth and associated future water needs to address questions related to the shortage of water supplies.

Communication, outreach and collaboration changes have aided in advancement and increased transparency as well. NWS mentioned the potential collaboration with USDA to come up with a national campaign to better promote water conservation. TWDB has extended their Weekly Drought Update to both legislature and TWDB mailing lists. OWRB provides information on water use to the public, planners, and the water community in hopes of empowering the planning process by better-educating discussions on future water use. LCRA has incorporated flyover pictures of lakes such as Lake Travis into their social media content, as well as website content showing inflows, outflows, and releases.

Within the agencies, it was recognized that there is a need for more information and new studies. OWRB has increased groundwater studies, identifying the linkage between surface and ground water, and investigating aquifer yields. They've additionally started to monitor groundwater quality. USFWS-Forth Worth is currently performing a robust vulnerability assessment of infrastructure to flooding.

Currently, there are multiple agencies that have addressed the need to promote advanced drought and flood planning and mitigation. For funding, there is a shift from response to mitigation, where the Oklahoma Drought Commission funded multiagency efforts, such as pipelines, ponds, and other infrastructure enhancements before the next drought. It was also discussed that one idea to incentivize practice planning would be to require the development of a plan before receiving funds. OCC has implemented a plan to develop farm-scale demonstration projects of no-till farming. The Brazos River Authority is now projecting the levels of all 11 reservoirs out in advance. TDEM has started doing "High Impact, Low Probability" exercises to better prepare mindsets for future impacts. The state has also updated their water contingency plan after 2011 to incorporate drought. Communication was also improved by bringing in experts in the field to better explain situations and control the language, performing briefings, and overviewing the situation at large during activation. TCEQ altered contingency plans to incorporate individual stages due to a lesson from floods revealing that this was more beneficial in planning and response efforts. Other new preparedness measures include the development of a water loss audit program benefiting the infrastructure sector and promoting better awareness, pre-positioning fire equipment, and table top demos for watersheds.

Lastly, there was a trend in localized shifts throughout the sectors. Texas has divided their water management into 16 regional districts across the state. Across the border, although OWRB wanted to decentralize, locals wanted them to remain in control. There has also been an improvement in facilitating projects at the grass root, local, and regional levels, including locals making decisions based on transparent data and research from the state. Another example of this is the monitoring and regionalizing of water management at the grass-roots level.

Large Group Discussion: *Public Outreach*

Key Insights:

- Communication is a key component for building resiliency towards future events.
- Communication varied from agency collaboration to public outreach.
- Social media, especially Twitter, is an important way to both share information and monitor public response during events. Social media can help drive public users to website resources where more detailed information can be provided.
- Oklahoma reemphasized their need for an updated drought plan and formulation of a drought council.
- Clearly defined responsibilities and transparency are important elements of planning and improves coordination during an event.

How did you get your messages out to the public, media and other stakeholders?
The final discussion revolved around the topic of public outreach. As seen from the small group results, communication is a key component for building resiliency towards future events. Multiple participants recognized the need for collaboration between agencies when handling extreme weather events. During recent floods, OWRB noticed a connection between emergency management and floodplain management with community response, however, there are some areas that could have been pre-identified. Additionally for OWRB, during flooding events, there are emergency action plans for all high-hazard dams in the state, with the requirement that plans are no more than five years old. During flooding events, OEM brought OWRB into direct response activities, promoting agencies to work together. OEM and TDEM initiated communication after an ice storm forced road closures in OK, inadvertently stranding motorists in Texas. This event closed the gap between the two states and allowed them to work things out and handle situations better moving forward.

Outwards to reaching the community, emergency managers are the lead on public outreach, while the Oklahoma Department of Transportation (ODOT) works to put messages out on road closures while using the media outreach network. One very helpful tool for reaching the public has been the Oklahoma Emergency App, providing various helpful tools such as an emergency map and live twitter feeds from state liaisons. For TDEM, their approach alters from Oklahoma as they move away from the direct involvement through apps and rely on officials at the county level. Calls and requests are made at this level, with TDEM providing assistance and documenting events once they've been contacted. The Texas Forest Service has an information management center, centralized at one location and working virtually during the actual moments.

As mentioned by OEM and OWRB above, there are various successful social media efforts being used to reach the public. Other examples include NWS posting road closure information from state transportation department websites and working with the Texas Department of Public Safety and the Texas Department of Transportation to post weather information on highways, as well as OWRB highlighting that the media is key for educating

the public and informing them of the backstory for current flooding situations.

What worked well and what did not in communicating with the public?

When discussing current efforts of public outreach, it was beneficial for stakeholders to hear from others about what worked well and what did not during these events. It was largely agreed upon that communication content and language are very important when trying to connect with the public. This may consist of educating and telling a backstory regarding current situations, considering the language being used, making sure information is continually flowing and speaking in a manner where there is common ground such as rephrasing the word "climate change" to something more familiar, or framing historical climate context in terms of events to which they can relate. Putting on events is another way to apply these techniques while connecting information to the public. OCC brought in six Dust Bowl survivors to speak about their experiences. LCRA had a "Meteorologist Day," where local television meteorologists were invited for a day to learn more about climate, resulting in multiple positive news stories.

There were multiple pathways identified to help information flow, the most common being social media and websites. For social media, Facebook and especially Twitter highly are valued. Correlating to the first small group session where it was largely agreed upon that Twitter was an important tool, it was mentioned again how it can be used to push information to the public in small bits to keep them interested in topics such as drought awareness and long-term climate info. Additionally, it can be used as an aid to drive audiences to websites for more detailed information. Once on the website, it is important to keep materials updated to ensure trust from the user and utilize the page to expose information such as the drought survival toolkit and links to more regional websites.

Regarding broader communication contacts, it is important to build relationships between the agencies' public relations and the media, maintaining these relationships by sending them press releases and keeping them engaged during less active times. Engaging conversation with local political figures, and coordinating pre-disaster exercises with the Red Cross were other successful efforts.

How could communication be improved in the future?

Overall, it was recognized that agencies should maintain or create a plan in place, creating transparency by allowing everyone to understand the roles and timing of when each takes place. During the workshop, Oklahoma and Texas representatives shared information, recognized their differences, and formed new adaptable ideas of how to work together in the future. Agencies in Oklahoma agreed that moving forward, their drought management plan needs to be updated, as well as forming a drought council similar to the Texas Drought Council. Texas agencies expressed the importance of their Drought Council and the communication that takes place between legislature and officials, however, they raised the question of whether communication and information are being received effectively during flooding events. Performed at the local level, the state is in coordination with local emergency management offices and local forecast offices. Solidifying communication between these levels and making sure information is free flowing can be done by doing

things such as top-down exercises, as seen by the river authorities. Inspired by the tools used in Oklahoma, Texas agencies expressed interest in achieving a data portal similar to the Oklahoma Mesonet, as well as using more social media.

Continuing the discussion between agencies and across state borders was another popular comment, favoring future workshops similar to this one. This would provide the platform for agencies to come together again, working together and learning from each other while moving forward. Another way to continue interaction between agencies includes getting involved with local and federal level organizational efforts. The Red Cross provides the Coordinated Assistance Network, aiding the discussion of what to do before a disaster happens at a local level. At the federal level, Food and Agriculture Council meetings occur quarterly in each state within the USDA regions and discuss various agency updates. Information transfer was another big topic among various sectors, calling for more table top exercises. Additionally, the need for upfront communication before a disaster was mentioned for USFWS-Forth Worth.

Potential Post Workshop Follow-Up Activities

Concluding the workshop, the open-ended conversation led to many useful, tangible ideas in the creation of various workshop ideas to continue interagency collaborations and increase of knowledge.

The group expressed interest in a monthly climate webinar providing localized information, where members of SCIPP, NOAA and NWS will team up to address current extreme weather and relevant climate information to the group. The open platform concept will then encourage the interaction between agencies, discussing issues they are currently facing, providing a heads up of threats, allowing two-way information, and brainstorming ideas of how to address them. It is critical to continue the relationship between Oklahoma and Texas by having both states involved with the webinar series. This is because they share similar events and experiences, and would be able to bounce back ideas. It was acknowledged that trust is a big component of allowing agencies to express themselves and interact with each other. The suggestion was to start with the current group of individuals because trust was built during this workshop.

The members of this workshop would also like a follow-up workshop geared towards translating drought and flood research into useable information that can be used to aid in their various decision-making processes. Suggesting a, “Train the Trainers” workshop, it would be beneficial for these participants to learn what information is most important and how to relay it back to their larger groups. Although the knowledge of accessible tools and the importance of using them are understood, the skills are lacking of how to use the tools in a meaningful way. A hands-on workshop working with decision support tools can reveal research needs and how to cater the science data for each sector’s needs. It would be helpful in areas such as the drought monitor, where the formulation of trigger questions can help identify the local meanings for Texas and Oklahoma. Tethering off of the idea of local information, a less demanding option could consist of a webinar informing agencies of

current weather information at the local level, the best tools to address the problem and what information they need to communicate the issue.

Proceeding the success of this workshop in helping agencies expand their capacity for utilizing tools and information for decision making, a workshop was proposed to focus on public messaging. Spending time on how to best communicate the information to the public, potential aspects of this workshop consist of addressing how to communicate the use of tools for people who don't work with them on a regular basis, how to translate research in a way that can easily be consumed by their target audience, and to help users to know how they can use the tools to make a decision. Potential breakout sessions with users can reveal how existing tools can be used to help their decisions and how it can be applied to their needs. Another question was raised regarding the intention of the Drought Monitor information and if there is an implied set of actions that it wants stakeholders to take. Conversing with agencies can clear up whether they are expected to provide the information with the intent of guiding users of what to do with it, or if it is only intended for them to provide the data and let users go about their needs as they wish.

Another idea consisted of having a workshop focusing on the communication aspect of hazard preparation and the perception from different levels of authority. An extended invitation to public information officers could allow for lecture sessions of what information they have and what they need, as well as facilitating questions with the various agencies. The final workshop idea included meeting with higher level coordination among government, municipalities, state and federal representatives, recognizing what their current efforts are and how to build off of that.

Besides the actions of organizing various workshops, there were focus questions that were offered for the consideration of data. The recommendation was given to speak with various state climatologists to ensure data can be more uniform across state boundaries.

Overview of the Workshop Survey Results

The participants of the workshop were provided with the opportunity to offer feedback by answering a survey handed out at the end of the second day. The survey consisted of both ranked and open-ended questions. A total of 19 surveys were returned for consideration. Summaries of the results are provided below while the ranked portions of this survey are reviewed in more detail in Appendix B at the end of this summary report.

Overall, the majority of the results were shown to be very positive. First off, 79% of the participants were very pleased with the meeting. Multiple comments mentioned that the event was informative, useful, and clearly identified areas that need improvement. Additionally, it was expressed that having both Oklahoma and Texas representatives present was critical to its success. Similarly, the majority of the participants, at 68%, said they would attend a similar event. Out of the remaining responses, 32% would maybe attend another event. Considering the usefulness of the various sessions of the group, each topic was averaged amongst the 19 individual ratings. All of the topics received either a

"Good" or "Excellent" rating, with the highest rated topics including the *Drought Status & Climate Outlook* presentation, the second and third small group discussions, and the large group discussion. A compilation of the comments revealed that the small group discussions were most useful for participants, allowing for agencies to work together, learn from colleagues and exchange information.

When asked what were the three most important ideas, resources or information taken away from the workshop, the most occurring topic was communication and collaboration. Multiple comments also revealed that it was an excellent opportunity to network and build relationships. Additional topics, in the order of frequency, include adaptable practices, new resources, and information. Future workshop considerations included emphasizing new research, the briefing of data and tools, and resilience.

The next rating on the general aspects of the meeting was also compiled from an average of results. The majority of these topics received a "Good" rating, with only one "Excellent" rating for the knowledge of the speakers. When asked for recommendations and improvements, responses revolved around establishing small group discussion protocols and considering more agencies to participate.

Concluding the survey results, comments revealed that the majority of participants enjoyed the workshop and felt that it was very helpful and on topic for their agencies. The limited focus of the states made the discussions more relevant and interest was expressed for another workshop in the near future.

Conclusion

The workshop, *Texas and Oklahoma Extremes: Learning from the Recent Four-Year Drought and Spring Flooding Events*, provided a platform to bring representatives from each state together to meet, learn, discuss, and network ideas based on recent drought and flooding events in the region. During multiple discussions at this event, participants were asked to consider a broad range of topics, including tools and interagency performance, identify challenges and lessons learned, acknowledge successes and innovations, and apply these newfound ideas to potential future improvements. Interactions between participants from various sectors allowed others to be introduced to new ideas and experiences. Common themes raised during the workshop proved that although the majority of participants may be formulating newfound relationships, common experiences exist through the experience of extreme events. Of these themes, one of the most reoccurring topics was communication. This coincides nicely with the purpose of this workshop, as communication was a large component of the goals and aimed for participants to collaborate with each other. The workshop outcomes, as well as the survey results, revealed that this opportunity was extremely beneficial for agencies to advance and improve their efforts. The collaboration amongst others within states and across borders was highly valued and follow-up workshops and continued collaboration was extremely encouraged by the attendees.

Appendix A: Texas and Oklahoma Climate Extremes Workshop Agenda

Texas and Oklahoma Climate Extremes Workshop

Learning from the Recent Four-year Drought and Spring Flooding Events

Fort Worth Federal Building, Texas Conference Room

819 Taylor Street, Fort Worth, Texas

October 13-14, 2015

Day 1: October 13

12:30 Registration

1:00 Welcome & Overview

1:15 Drought Status & Climate Outlook

1:30 "Dipole events" – Historical Shifts From Dry to Wet

1:45 Southern Plains Drought Early Warning System (DEWS)

2:10 Break

Monitoring, Forecasting and Research

2:30 Small Group Discussion: Monitoring, Forecasting and Research
- **Tools**: What tools did you use to monitor the drought and recovery?
- **Tool Usefulness:** How did those tools perform, both going into and coming out of drought? Did you make any adjustments did you make along the way?
- **Additional Needs:** Were there tools or type of data that you wished you would have access to during the event?

3:30 Summarize Key Findings from Small Group Discussion

4:00 The Drought Risk Atlas

4:20 Challenges of Seasonal Forecasting

4:40 Teleconnections: How Patterns Far Away Can Influence Our Weather

5:00 Adjourn for the evening

An informal social event will be scheduled for the evening.

Day 2 October 14

8:30 Recap from Day 1 Discussion

Engaging Preparedness Communities

8:45 Small-Group Discussion: Coordination Among Agencies
- **State:** How did you interact among state agencies during both the drought and flood; did you interact with some agencies in one case but not the other? Why?
- **Federal:** What federal agencies provided sources of information and/or support for operations? Did you establish new or strengthen existing relationships with certain federal agencies during these extreme events?
- **Other:** What other non-state agencies/entities were important in monitoring or managing these events?
- **Challenges:** What challenges did you encounter when working with other agencies / entities? Were these challenges addressed? How?
- **Financial Assistance:** What financial or operational assistance programs did you offer or use (state, federal, local, non-governmental, charities)? Were any new programs developed?

9:45 Summarize Key Findings from Small Group Discussion

10:15 Break

10:40 Coordination Among Texas Agencies

10:50 Coordination Among Oklahoma Agencies

11:00 Small-Group Discussion: Impacts, Successes, Challenges and Lessons Learned
- **Impacts:** Were there any unexpected impacts and how did you respond to them? What impacts and processes were hard to define or quantify?
- **Successes & Lessons Learned:** What were the successes and lessons learned responding to the drought and flood?
- **Innovation:** Have there been any recent changes made within your agency to improve drought mitigation and response resulting from the recent events?

12:15 Working Lunch
- Summarize Key Findings from Small Group Discussion

Education and Public Awareness

1:15 Large-Group Discussion: Public Outreach
- How did you get your messages out to the public, media, and other stakeholders?
- What worked well and what did not in communicating with the public?
- How could communication be improved in the future?

2:45 Next Steps & Recommendations

3:00 Adjourn

Appendix B: Survey Results

A graphical summary of the four tabled survey questions is displayed below. Although not shown, open-ended questions were documented and fully considered for future events.

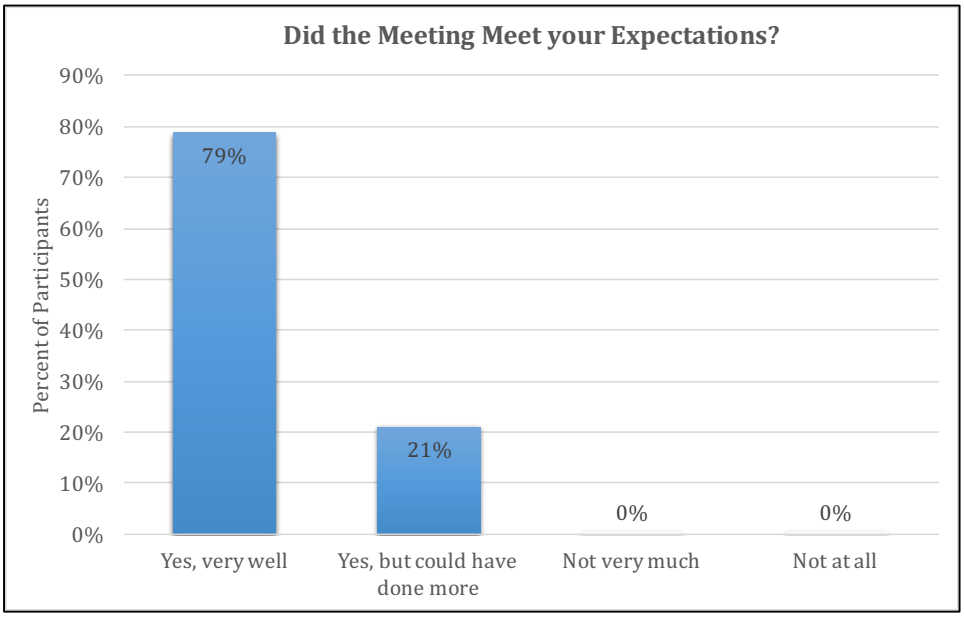

Figure 2: The rating of meeting expectations, based on percent of participants.

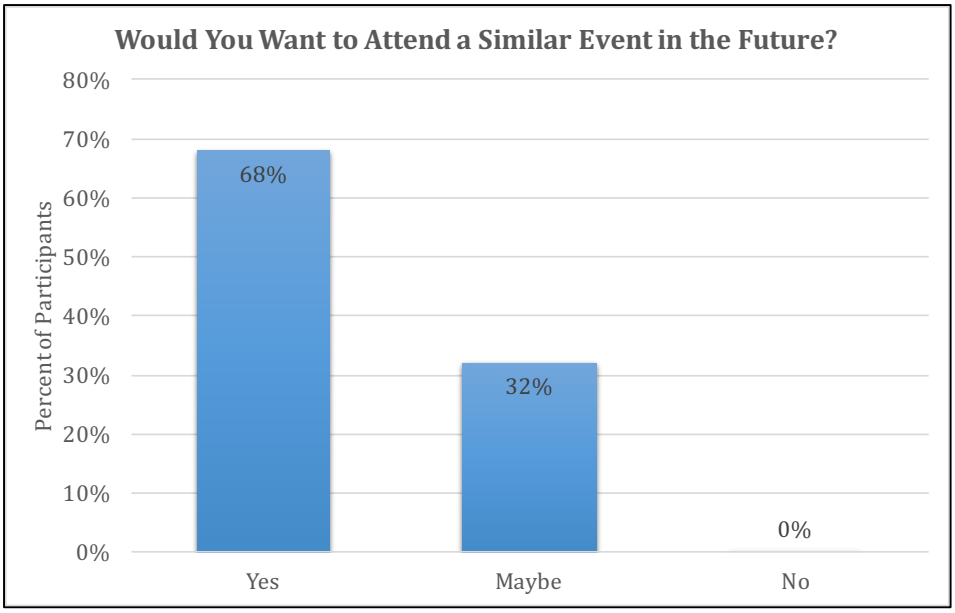

Figure 3: The potential for attending a future similar event, based on percent of participants.

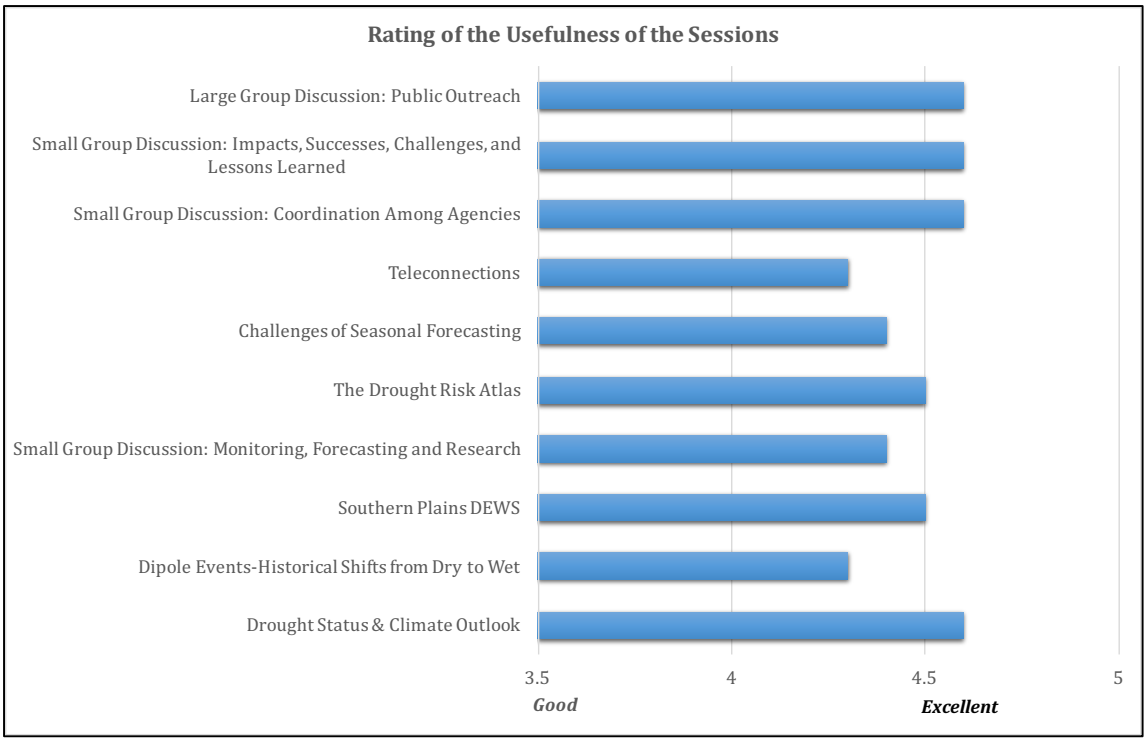

Figure 4: The various rankings of the usefulness of the sessions. Based on the numerical average of all participants and assigned as a categorical ranking, the results were rounded to the nearest whole number.

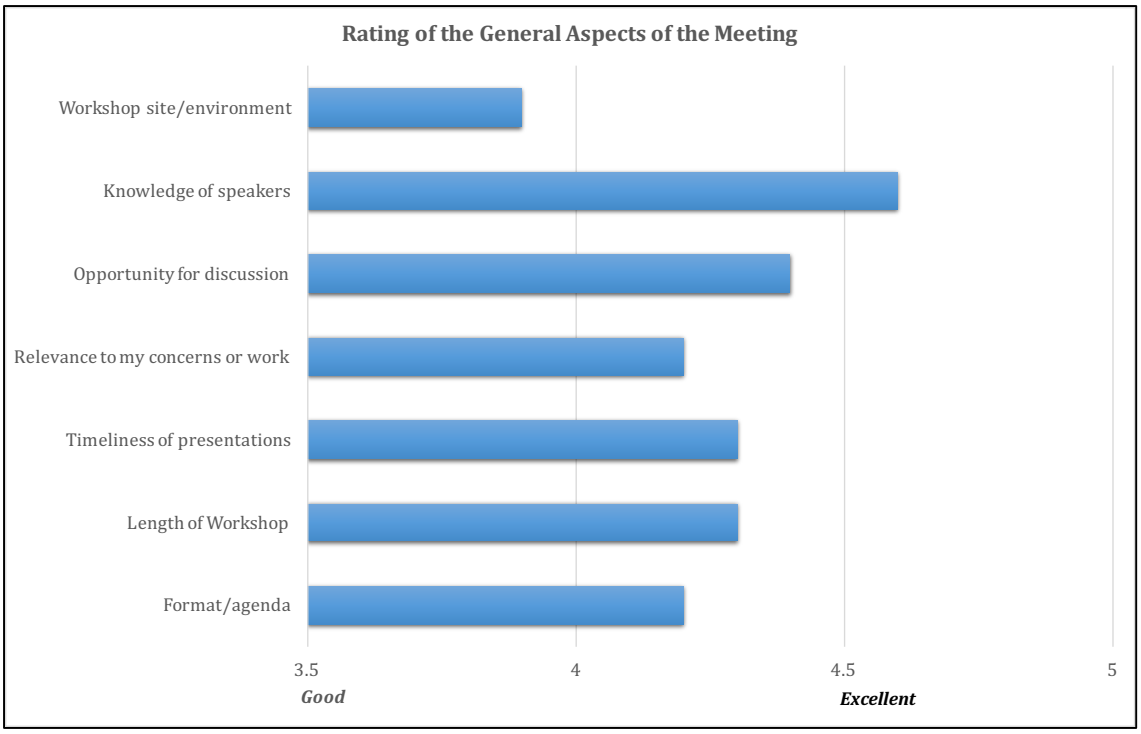

Figure 5: The various rankings of the general aspects of the meeting. Based on the numerical average of participants and assigned as a categorical ranking, the results were rounded to the nearest whole number.

Appendix C: Participant List

Participant	**Organization**
Aaron Abel	Brazos River Authority
Bill Bartush	Gulf Coast Prairie Landscape Conservation Cooperative
Courtney Black	NIDIS
Loree Boyanton	Oklahoma Department of Environmental Quality
David Brown	NOAA
Stuart Carlton	Texas Sea Grant College Program/Texas A&M
Kay Coffey	Oklahoma Department of Environmental Quality
Chris Coleman	Electric Reliability Council of Texas
Rhea Cooper	Texas A&M Forest Service
Jerry Cotter	U.S. Army Corps of Engineers
Julie Cunningham	Oklahoma Water Resources Board
Nelun Fernando	Texas Water Development Board
Rafael J. Guerrero	USDA/NRCS/CENTRAL
Teena Gunter	Oklahoma Department of Agriculture, Food and Forestry
Andrew Hautzinger	U.S. Fish and Wildlife Service
Sam Marie Hermitte	Texas Water Development Board
Chris Higgins	Brazos River Authority
Brian Hoeth	NWS Southern Region ROC
Michelle Huckabee	Texas Division of Emergency Management
Daniel Huckaby	NWS Fort Worth
Brian Jackson	UCAR-JOSS
Leah Kos	Southern Climate Impacts Planning Program
Trey Lam	Oklahoma Conservation Commission
Cindy Loeffler	Texas Parks and Wildlife Department
Richard McDaniel	Oklahoma Department of Environmental Quality
Helena Mosser	U.S. Army Corps of Engineers
Victor Murphy	NOAA/NWS
Alessandro Parola	U.S. Army Corps of Engineers
David Pointon	FEMA Region 6
Sara Pope	USDA Southern Plains Climate Hub
Darlene Prochaska	U.S. Army Corps of Engineers
Matt Rollins	Oklahoma Water Resources Board
Bob Rose	Lower Colorado River Authority
Patricia Schaffer	FEMA Region 6
Mark Shafer	Southern Climate Impacts Planning Program
Yohanes Sugeng	Oklahoma Water Resource Board
Mark Svoboda	National Drought Mitigation Center
Annie Vest	Oklahoma Department of Emergency Management
Don Wilhelm	U.S. Fish and Wildlife Service