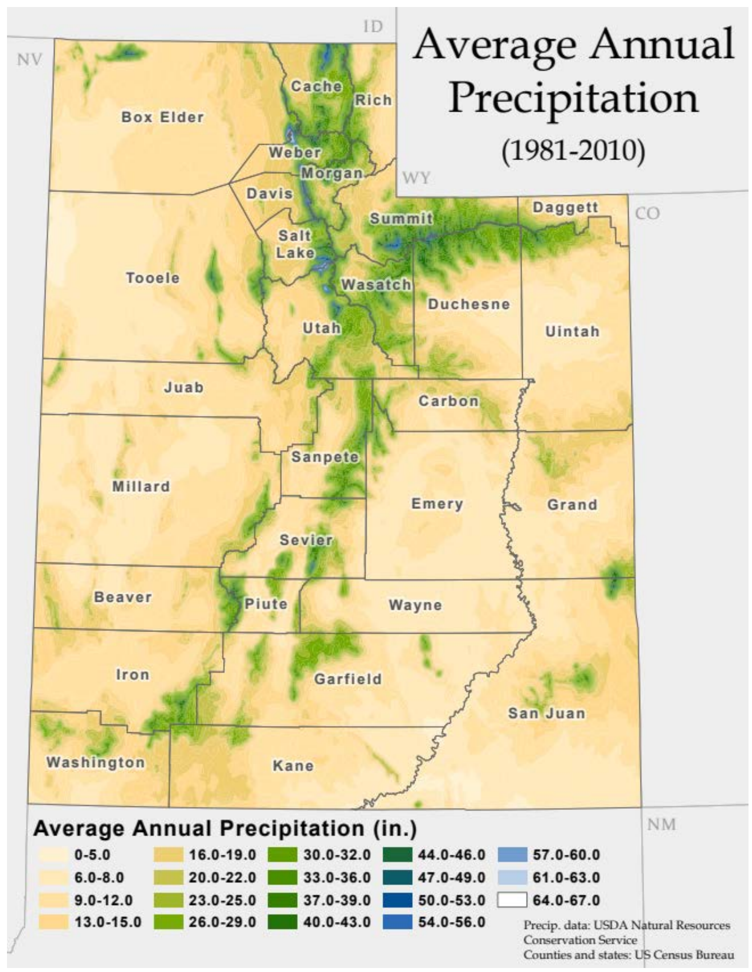
DROUGHT

6.1 Identifying and Profiling Drought Hazards

Drought is a natural occurrence that is manifested everywhere to some degree and is common in the arid West. Utah is a dry landscape; it is among the driest of states in the Nation, receiving on average approximately 13 inches of precipitation per year. See Map 1. Utah has several major watershed basins and several large aquifers. See Maps 2 and 3. Utah's water supply is heavily dependent upon winter snow pack accumulation and capturing the snowmelt in reservoirs. When these factors deviate from historic norms for a prolonged time, impacts in both the social and economic sectors may result.

Because of surface reservoir storage, there may be a lag time between when a drought begins and when its impacts are realized. Generally, if the reservoirs are full before drought conditions are realized, the water supply is sufficient for a season with limited or no water use restrictions. However, as drought conditions persist, the impacts associated with it become much more apparent.

Several factors influence the severity of drought and its impacts, such as winter precipitation, soil moisture and temperature. Less obvious, but just as significant, is vulnerability. How vulnerable is a water supply to drought? There are three main components of vulnerability that go "hand-in-hand" with one another; water storage, water demand and population growth. As the population grows, so does the overall demand for water; and so too must the developed water supply grow or be used in a sustainable manner. Management of drought starts with managing vulnerability through mitigation.



Map 1. Utah Average Annual Precipitation

There is no single definition that fully captures drought. In the most basic sense, drought can be defined as "a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector" (National Drought Mitigation Center). While one sector may be adversely impacted by drought, another may be operating as usual.

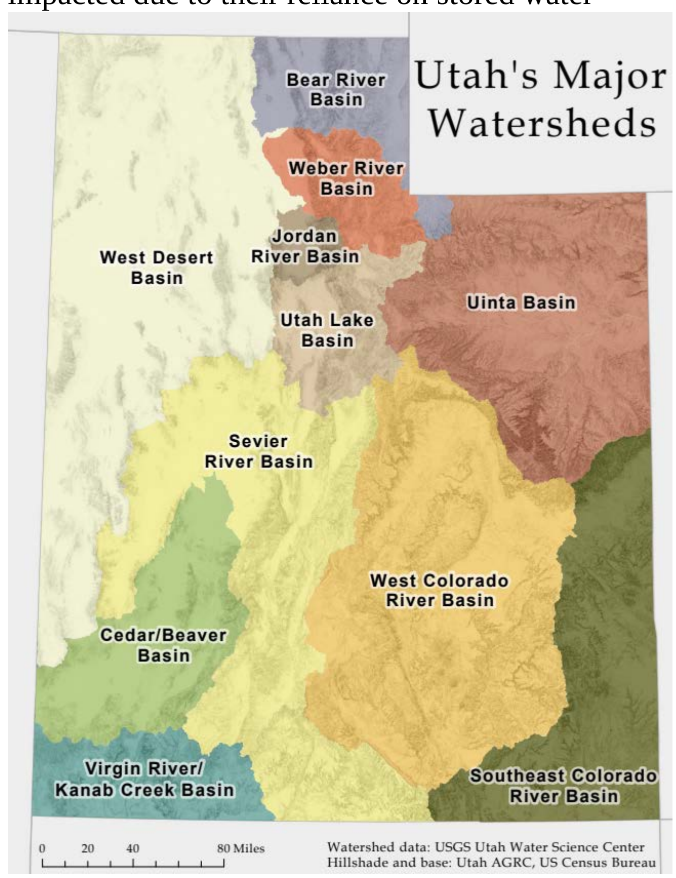
There are four categories that have been developed in order to define drought and its impacts. Although these categories have some unique characteristics, it may make more sense to think of these as "phases" of the same drought. They are listed and described as follows:

Meteorological drought: This is based on meteorological conditions, primarily precipitation. It is characterized by the divergence (degree of dryness) from the long-term average. This is a simple way to describe drought; if precipitation is less than the average or normal then meteorological drought conditions exist.

Agricultural drought: The agricultural sector is typically impacted first by drought. Dry farms are generally the first within the agricultural sector to be impacted by drought, while irrigated farms are not immediately impacted due to their reliance on stored water supplies. The characteristic of this phase or type of drought is a soil water deficiency, which stresses crops and plants, thereby reducing the yield.

Hydrologic drought: This is determined by the overall conditions of the water supply or watershed including snowpack, streamflows, reservoir storage, and soil moisture. Hydrologic drought conditions are also expressed as the deviation from normal or the long-term averages. This approach provides a more applicable description of drought than meteorological drought, specifically for mountainous regions like Utah that depend on winter snow pack and reservoir storage.

Socioeconomic drought: This is the most severe stage of drought. It is realized if dry conditions persist long enough and are severe enough (water supply significantly impacted) to impact sectors beyond the agriculture



Map 2. Utah's Major Watersheds

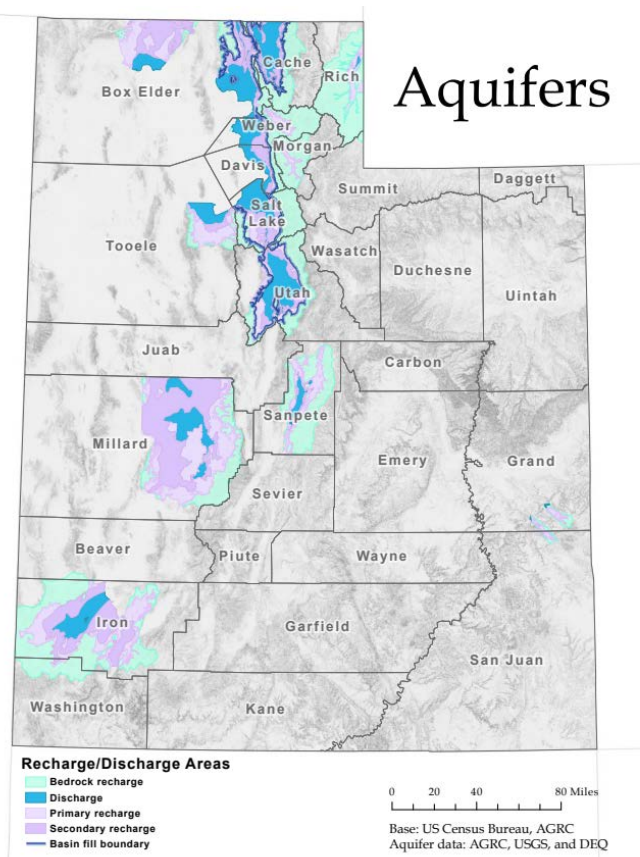
community, such as a community's drinking water supply and social and economic enterprises. Also, there is likely long-term damage to vegetation and other natural environments.

Profiling Drought Hazards

Droughts typically affect Utah in two ways: 1) results from water shortages within reservoirs affect irrigation and eventually culinary water supplies if the drought lasts more than two years; 2) soil moisture drought causes dry farmers to lose their crops. Public safety threats do not usually become visible in communities until the third year of drought, when culinary water supplies become low.

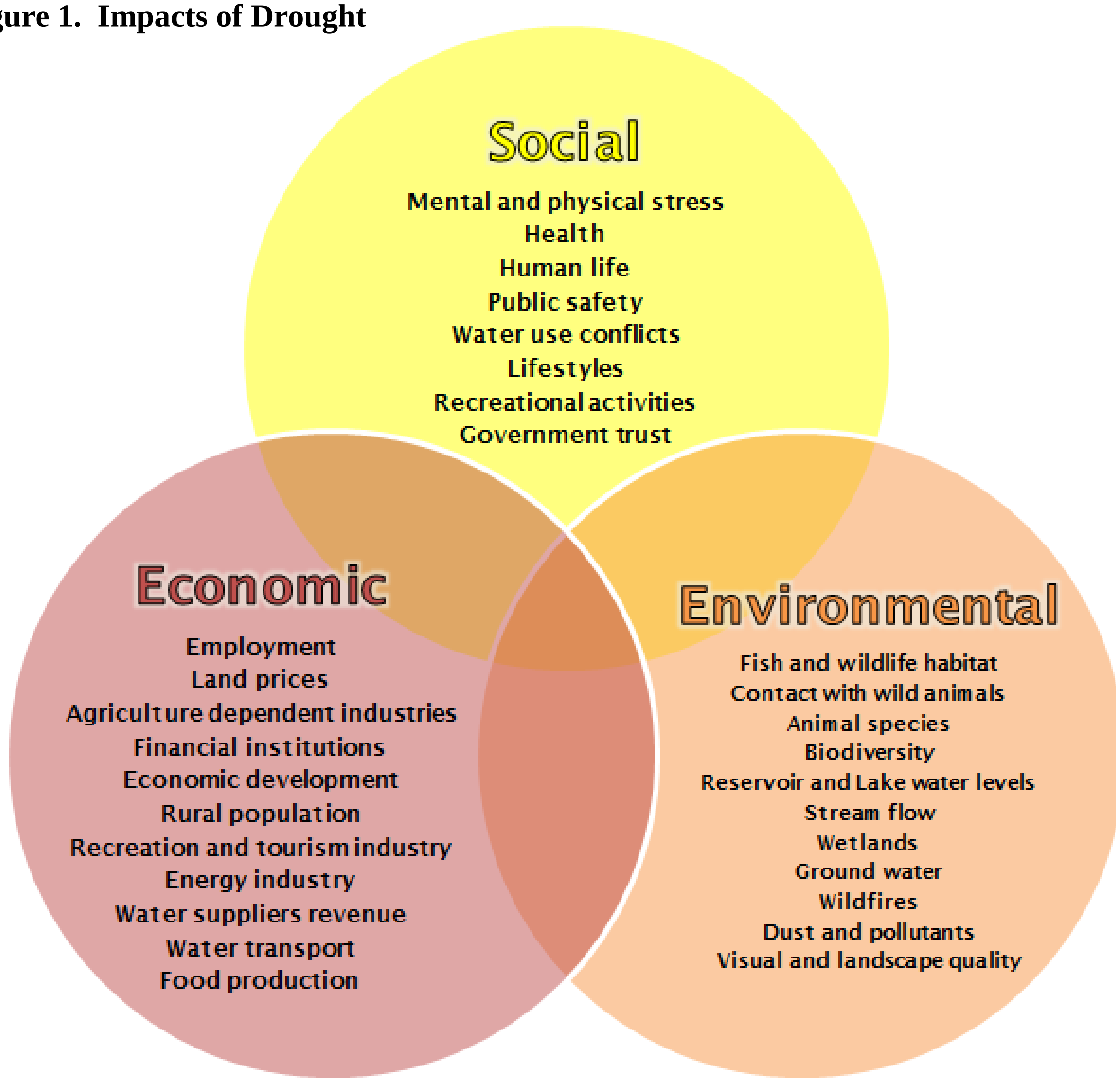
Droughts may affect the availability of drinking water, potentially placing people's livelihoods at risk. Numerous projects throughout the State have placed enough water in storage to insure an adequate supply of drinking water. Yet, prolonged droughts still have a significant effect on agricultural and agribusinesses in areas within the State dependent on irrigation water.

Droughts have significant impact on the natural world. Species over time adapt to the natural world in which they live, becoming depended on constant factors, such as a certain amount of water. The flora and fauna of a given area have an ability to adjust to a certain amount of environmental change, but as drought conditions persist mortality rates across the ecosystem begin to rise. Prolonged droughts place a tremendous burden on wildlife habitat, causing mortality in plant species and heightening the risk of wildfire. As habitat is lost or changed, those animals dependent on it are also lost or must relocate.



Map 3. Utah's Major Aquifers

Figure 1. Impacts of Drought



Drought Indices

There are several indices that are used to measure and describe drought. These indices utilize various climatological, meteorological, and hydrological parameters (i.e. precipitation, temperature, ground water levels, stream flow, and reservoir levels) to develop a relationship between instrumental measurements and drought (Utah Division of Water Resources, 2007). The indices used by entities within Utah are as follows:

Palmer Drought Severity Index. The Palmer Drought Severity Index (PDSI) was developed in the 1960s and is used nationally as a method of measuring the “degree” of wetness and dryness of an area as compared to the historic norm (or previous dry and wet events). The PDSI is standardized to allow for spatial and temporal comparisons and is viewed as a meteorological index due to its reliance upon meteorological variables such as temperature and precipitation. The PDSI is also largely dependent upon and takes into account past climatic trends and the cumulative weather conditions of the previous months in estimating drought intensity.

Palmer Hydrological Drought Index. The Palmer Hydrological Drought Index (PHDI) is a modified PDSI that takes into account hydrological variables and is based on moisture inflow, outflow and storage elements. It does not include past climate trends and is a “real-time” index, which generally responds more slowly than the PDSI due to the lag time associated with hydrological factors. For example, with stream flow, although drought from a meteorological perspective may be occurring, stream flows can remain close to normal due to ground water inflows. If conditions persist then stream flows will decrease. The result is a lag between meteorological and hydrological factors.

Historical Droughts

Droughts are common occurrences in Utah. The Utah Department of Natural Resources, Division of Water Resources (DWRe) listed in their Statewide drought report Water in Utah (2007) that analysis of the Palmer Drought Severity Index (PDSI) data collected in the seven Utah Climate Divisions showed six significant droughts occurring from 1898-1905, 1928-1936, 1946-1964, 1976-1979, 1987-1992, and 1999-2004. For the last SHMP update, a seventh drought was listed that began in 2012.

UDEM conducted a new analysis of the PDSI data based on mostly the same criteria as delineated in the 2007 Water in Utah report. In this new analysis different historical drought years were revealed. The differences from the 2007 Water in Utah report were because the National Climate Data Center (NCDC) revised the PDSI data in 2007 to correct for a time bias that was inherent in the data prior to 1951. For more information about this correction see ftp://ftp.ncdc.noaa.gov/pub/data/cirs/drd/divisional.README.

The criteria used to determine a multi-year drought in the 2018 drought analysis included the following: 1. A drought was considered to have started with two consecutive years of annual average PDSI values less than or equal to -1.0. 2. A drought was terminated with two consecutive years of near or above normal conditions (annual average PDSI value greater than -0.5). However, if another multi-year drought began in the third year following the two consecutive years of greater than -0.5 PDSI than the drought was considered to be ongoing and part of the same drought event.

The analysis was completed for all of Utah’s 7 climate divisions, which include Western, Dixie, North Central, South Central, Northern Mountains, Uinta Basin, and Southeast divisions. See Map 4. Figure 3 shows the results of the analysis and includes the multi-years droughts for each of the seven divisions. The number of years each climate division experienced a multi-year drought during the Utah drought events is displayed in Figure 4.

Table 1. Multi-Year Droughts Comparison

Multi-Year Droughts in 2014 SHMP (based on 2007 Water in Utah report)	Multi-Year Droughts 2018 Analysis (using corrected "time bias" data)
1898 - 1905	1898 - 1905
1928 - 1936	1933 - 1943
1946 - 1964	1950 - 1966
1976 - 1979	1971 - 1977
1987 - 1992	1987 -
1999 - 2004	
2012 -	

Map 4. Utah Climate Divisions

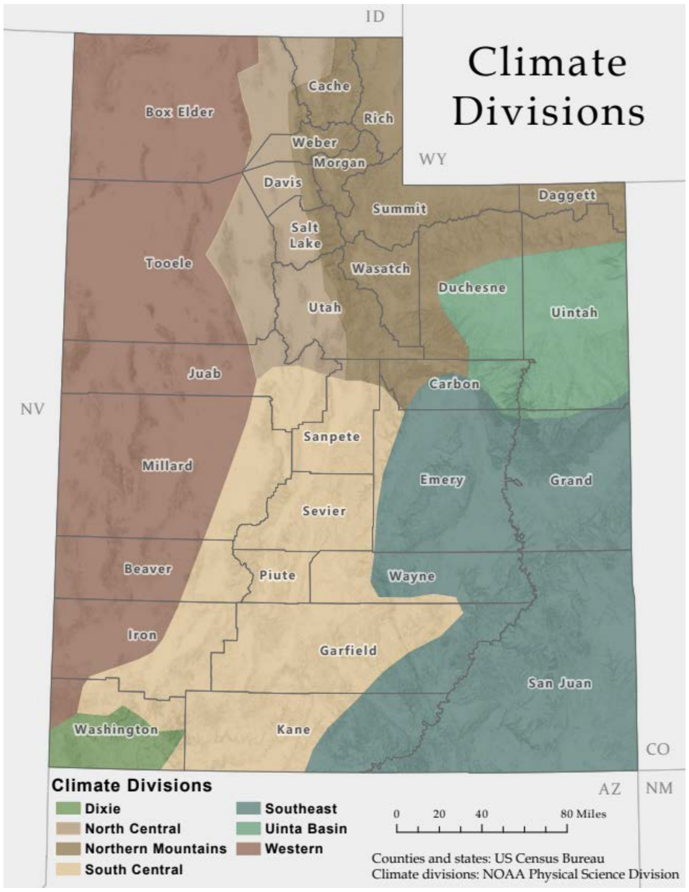


Figure 2. Major Multi-Year Drought Events in Utah by Climate Division*

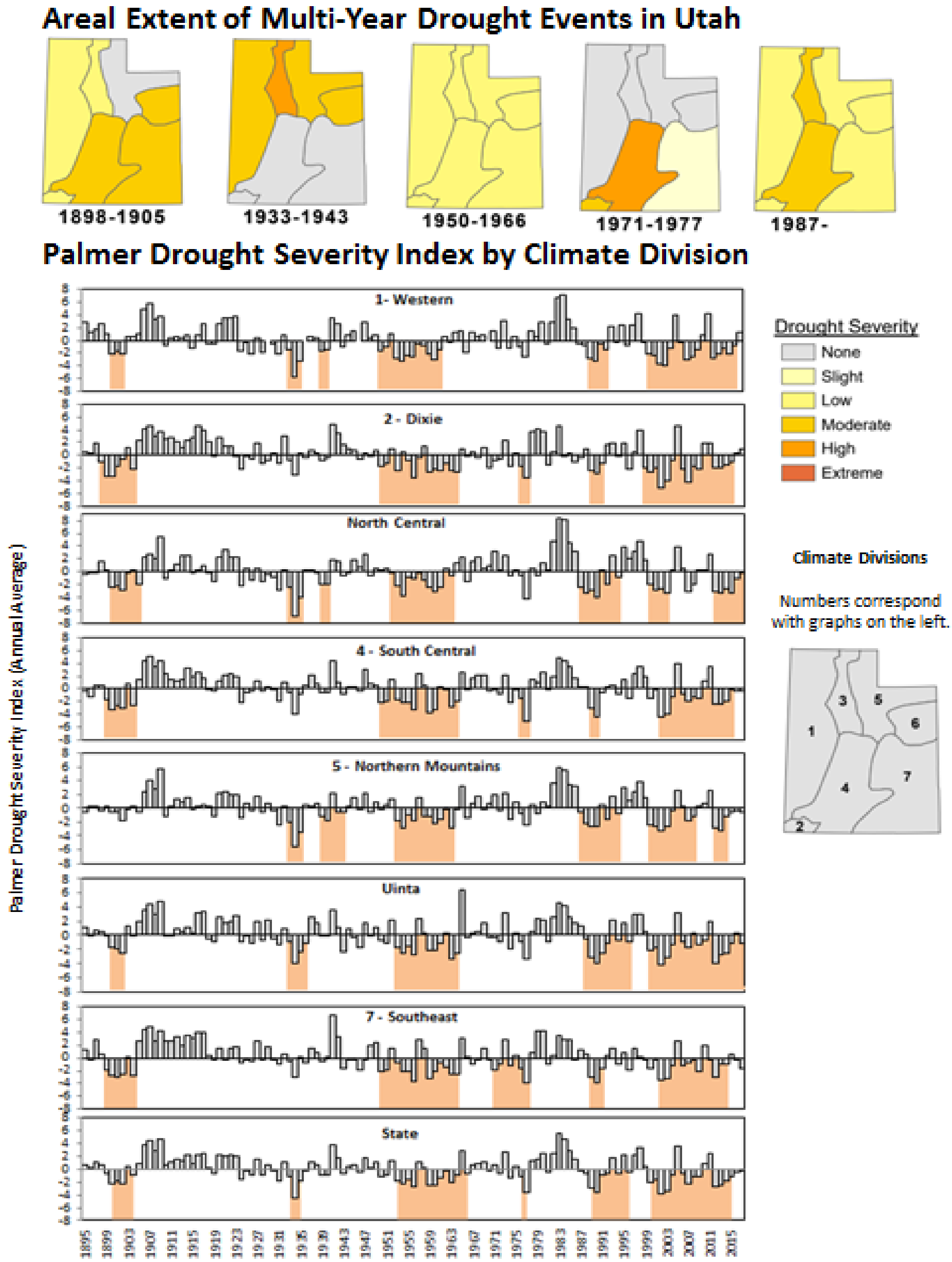


*Figure 3 illustrates PDSI values for each climate region as well as the geographical extent of historical droughts for the years 1895 through 2017. It is important to note that the spatial extent of the occurrences of drought in Utah is not geographically limited to only one particular area.

. **Map 5. Average PDSI Value for Major Multi-Year Droughts 1895-2017**

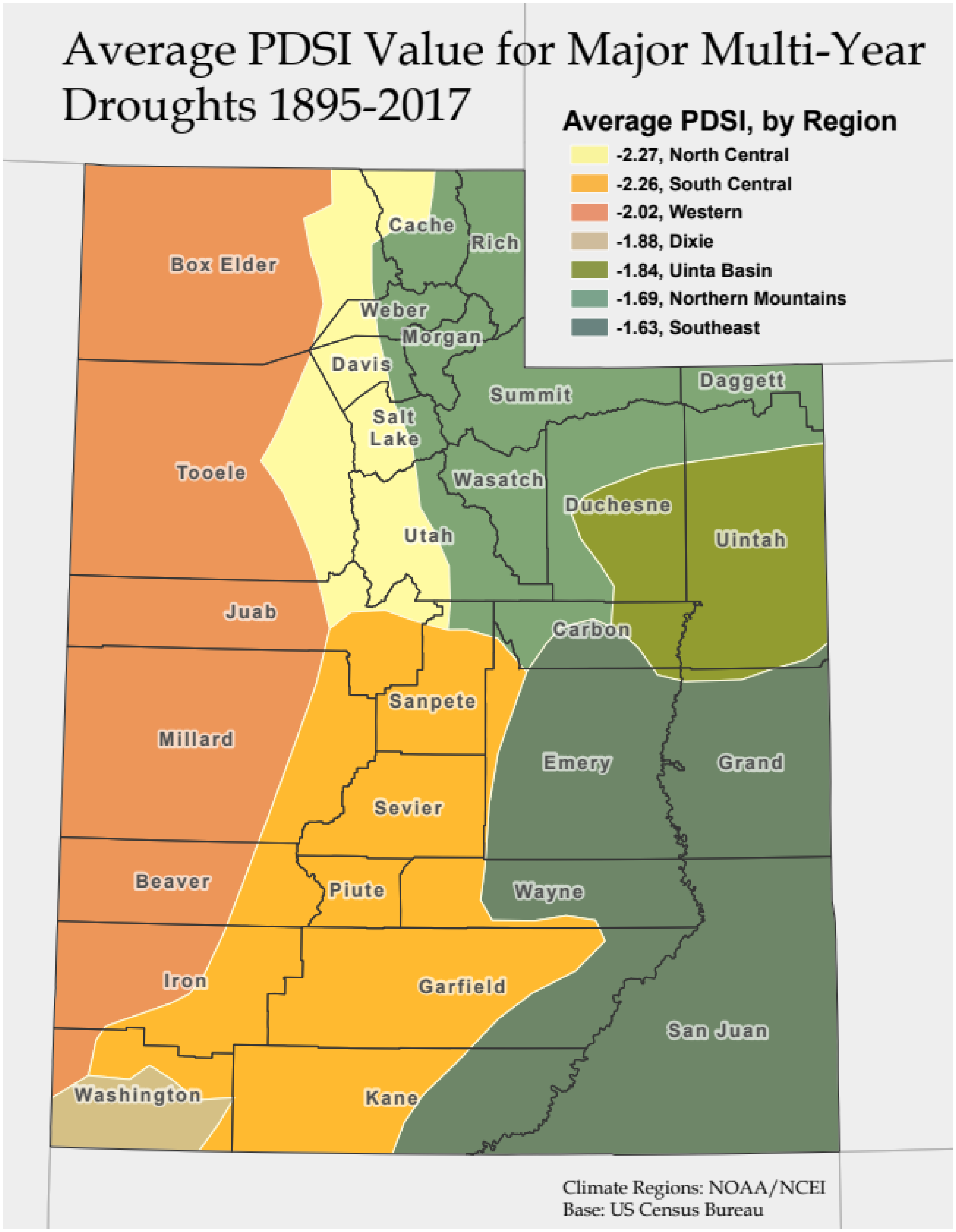
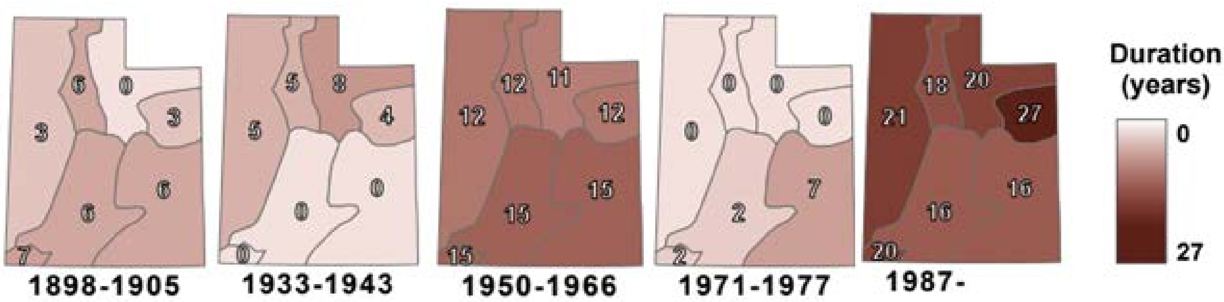
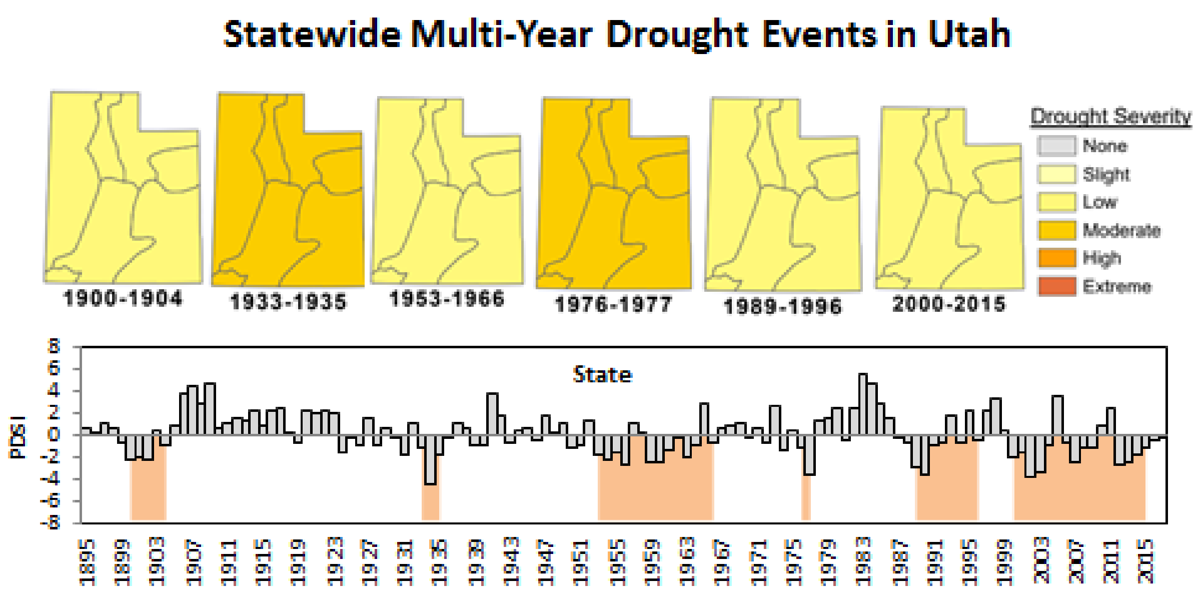


Figure 3. Years of Drought in Multi-Year Drought Events



The data was further analyzed to determine when statewide multi-year droughts occurred in Utah which constitutes when all seven climate divisions are experiencing a multi-year drought at the same time. The analysis yielded a total of 6 statewide multi-year drought events in Utah from 1895 – 2017. The drought events occurred from 1900-1904, 1933-1935, 1953-1966, 1976-1977, 1989-1996, and 2000-2015.

Figure 4. Statewide Multi-Year Drought Events in Utah



The criteria used to determine a multi-year wet spell in the 2018 drought analysis included the following: 1. A wet spell was considered to have started with two consecutive years of annual average PDSI values greater than or equal to 1.0. 2. A wet spell was terminated with two consecutive years of below normal conditions (annual average PDSI value less than -1.0) or the following year was below a PDSI value of -2.0. However, if another multi-year wet spell began in the third year following the two consecutive years of less than -1.0 PDSI than the wet spell was considered to be ongoing and part of the same event.

Figure 5. Major Multi-Year Wet Periods in Utah by Climate Division*

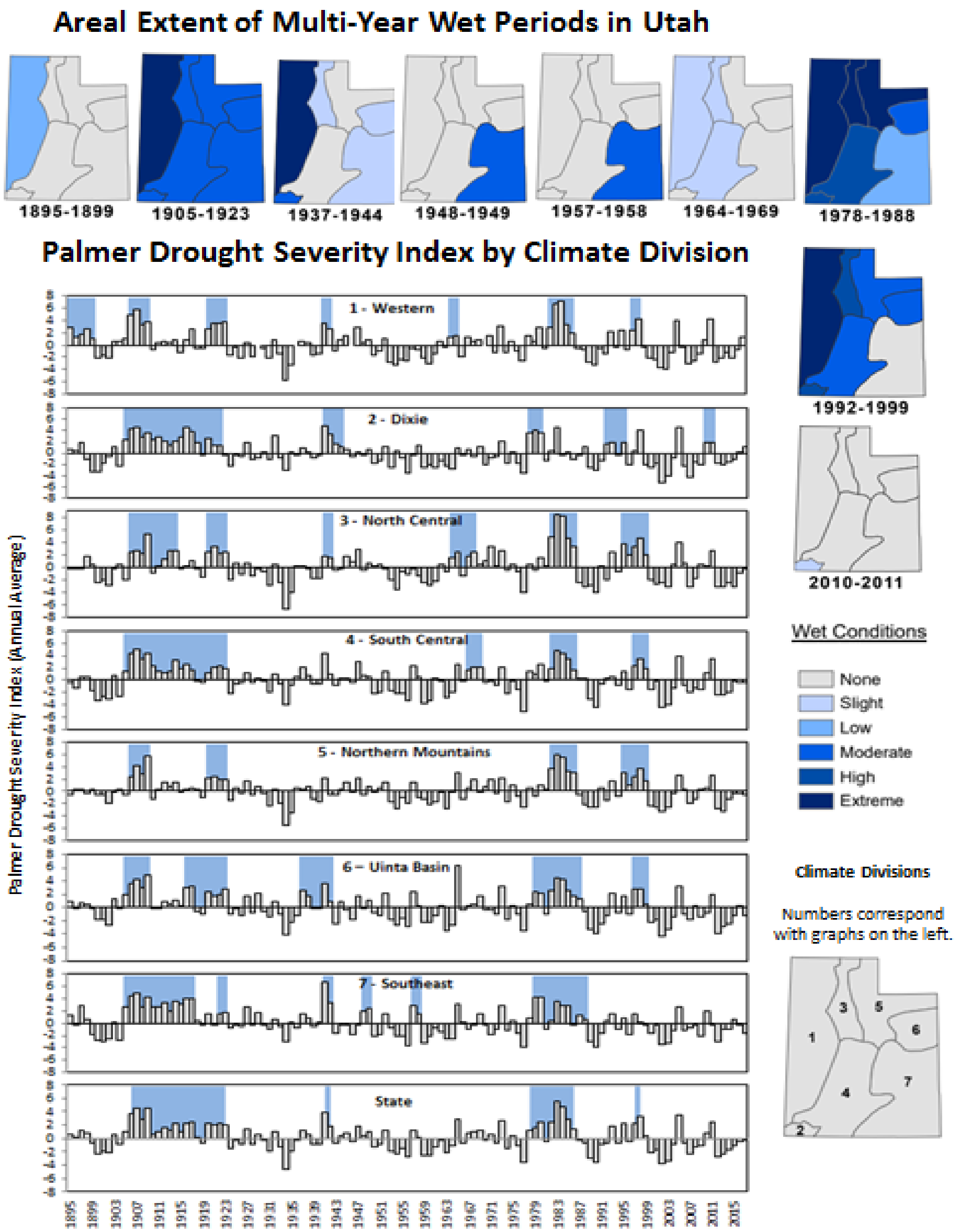
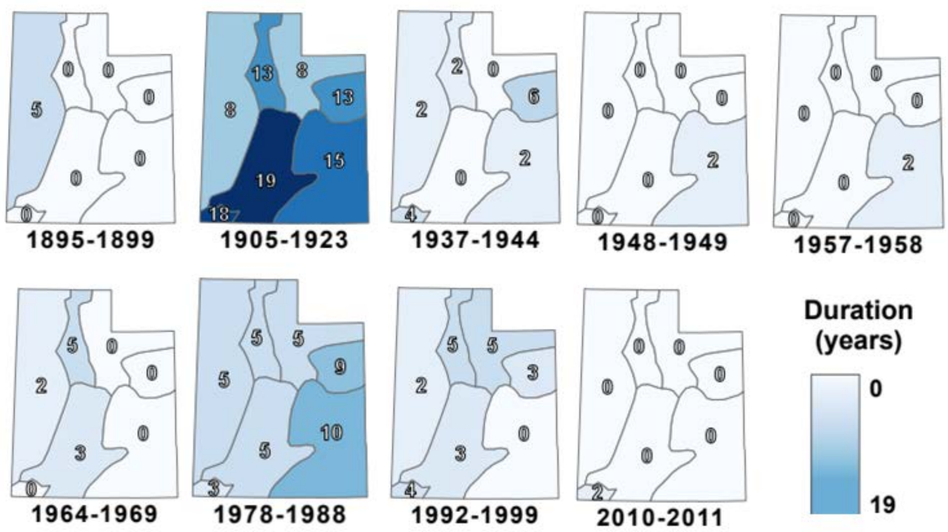


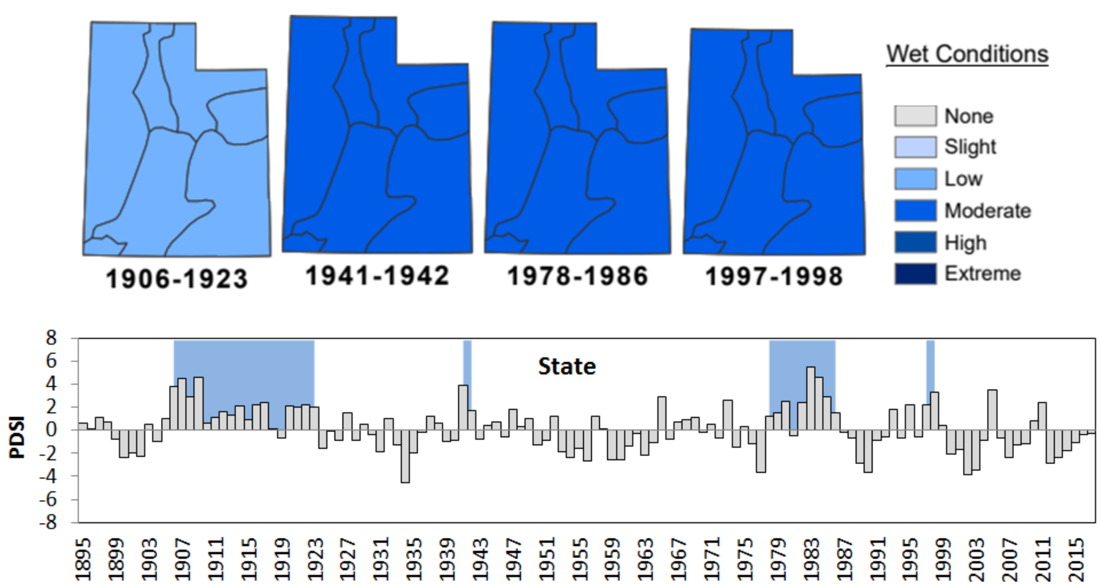
*Figure 6 illustrates PDSI values for each climate region as well as the geographical extent of historical wet periods for the years 1895 through 2017. It is important to note that the spatial extent of the occurrences of wet periods in Utah is not geographically limited to only one particular area.

Figure 6. Years of Wet Periods in Major Multi-Year Wet Period Events



The data was also analyzed to determine when statewide multi-year wet periods occurred in Utah. A major multi-year wet period was determined to occur when all seven climate divisions experienced a multi-year wet period at the same time. The analysis yielded a total of 4 statewide multi-year wet period events in Utah from 1895 – 2017. The wet period events occurred from 1906-1923, 1941-1942, 1978-1986, and 1997-1998.

Figure 7. Statewide Multi-Year Wet Period Events in Utah



Map 6. Average PDSI Value for Major Multi-Year Wet Periods 1895-2017

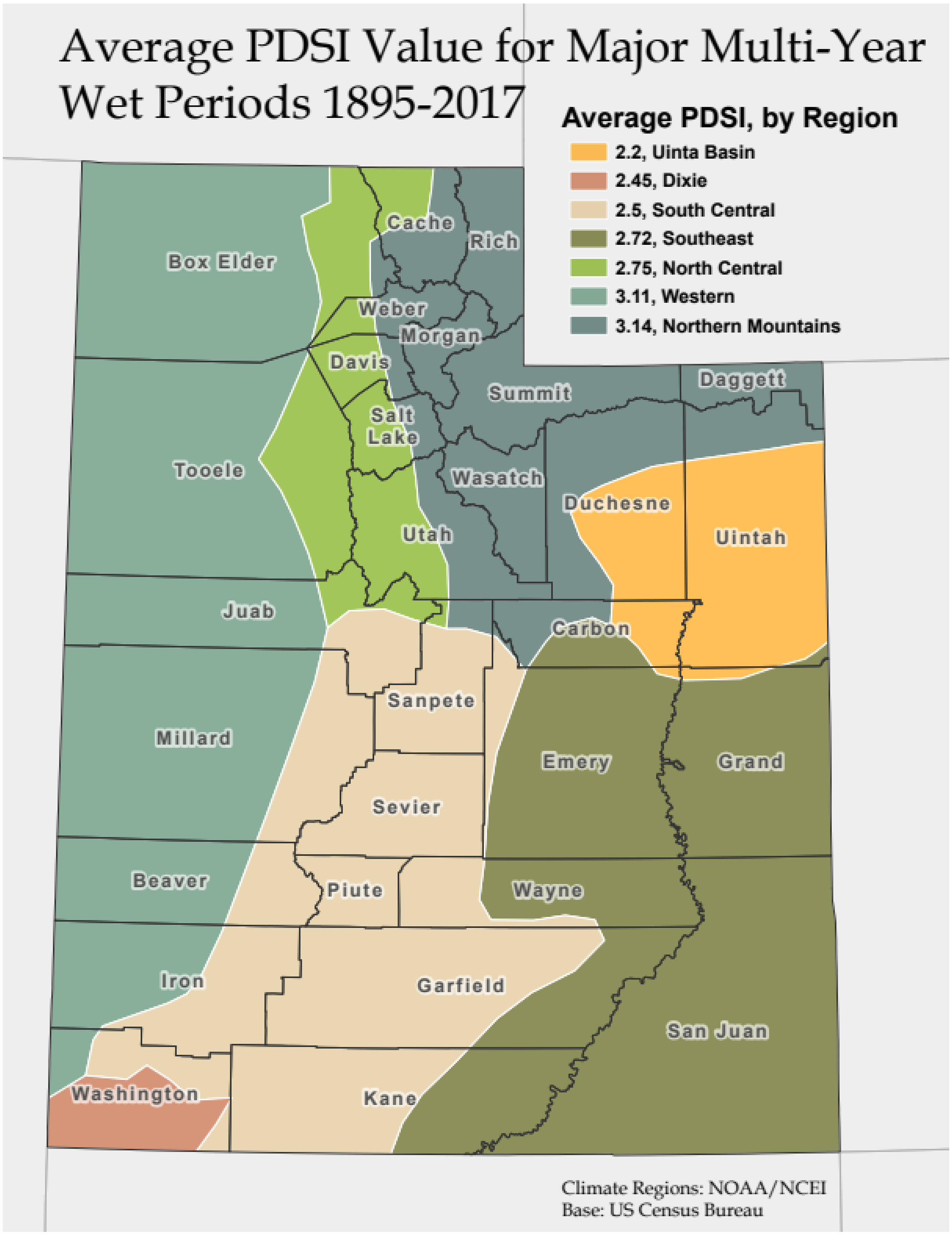
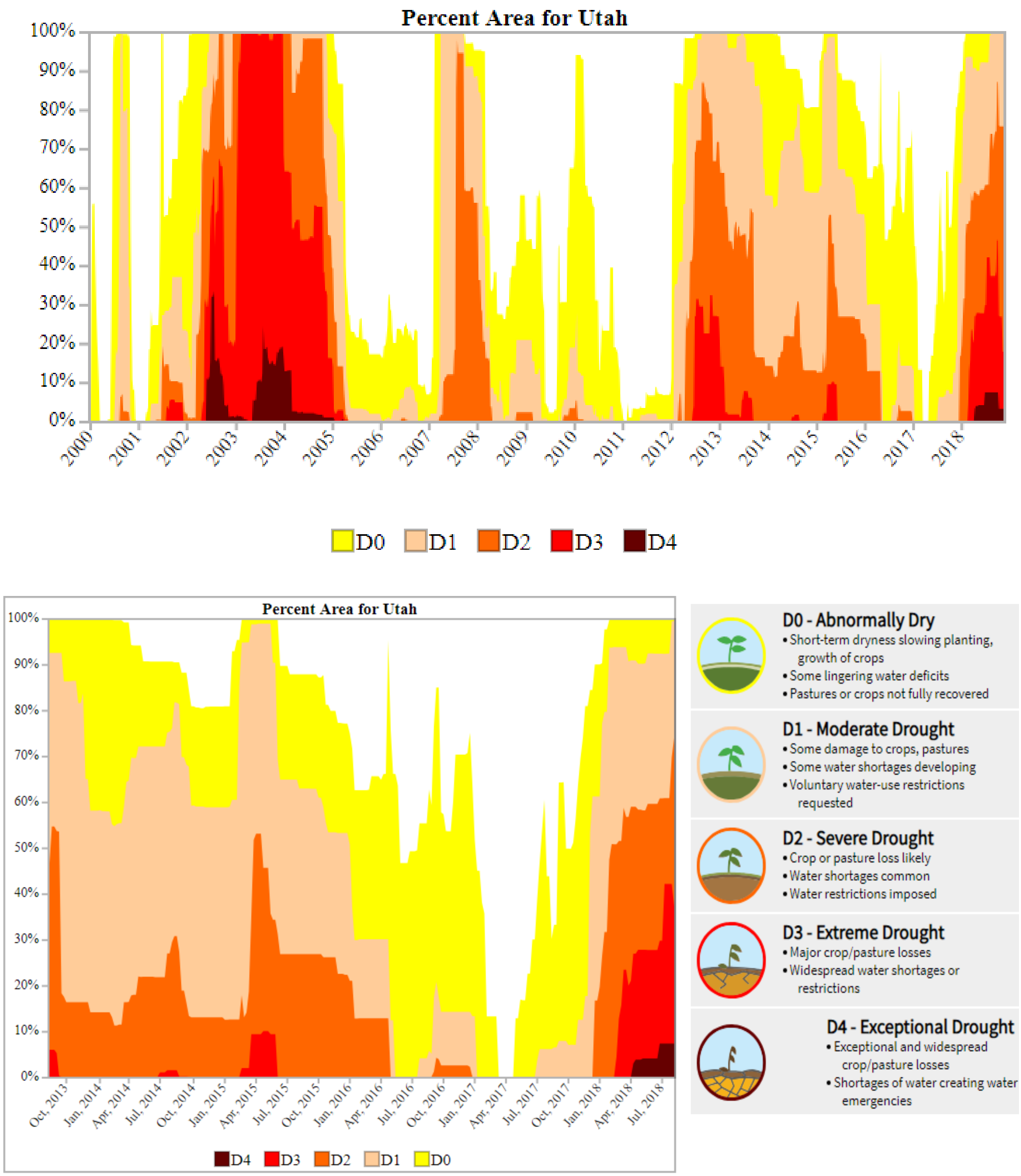


Figure 8. Percent Area of Drought for Utah 2000 – 2018



https://www.drought.gov/drought/states/utah

Sequence of Drought in Utah

Multi Year Droughts in Utah: 1898 – 2018
Adapted from"Drought in Utah: Learning from the Past – Preparing for the Future"

1898 – 1905: Large cattle operations folded, leaving small operations to fight over what was left of adequate grazing lands. The drought forced settlers to uproot their families as lands were drying up and water rights were inadequate.

1933 – 1943: The "Dust Bowl Years" affected approximately 75% of Utah. Agriculture productivity was decreased to almost half of prior years' production and the number of farms significantly decreased.

1950 – 1966: Multiple areas within Utah were declared disaster areas. Statewide, impacts could have been worse but were lessened due to steps taken to enhance the water supply.

1971 – 1977: Conditions in seven of Utah's counties prompted the Governor to request Federal Disaster Declarations for these counties. By the end of 1977, the State lost $41 million ($170 million in 2018 dollars) due to the drought impacts.

1987 – : This drought produced some of the hottest years and driest years on record. Statewide reservoir capacity plunged below 50% at times and farmers and ranchers struggled to continue operations. However, there were a couple wet years mixed in between for some of the climate divisions, but overall drought conditions prevailed and in 2018 were severe.

For the first time in about ten years Utah's drought conditions reached a threshold that triggered the State's statutory responsibility to convene Utah's Drought Review and Reporting Committee. The committee gathered on Sept. 10, 2018 under the direction of the state's Drought Coordinator, Mike Styler, executive director of the Utah Department of Natural Resources (DNR). On October 15, 2018 Governor Herbert issued an executive order declaring a State of Emergency due to statewide drought conditions.

The Drought Review and Reporting Committee is required to hold this meeting by state code, UCA 53-2a, and Utah's Drought Response, which requires the state to prepare for, respond to and recover from emergencies or disasters with the primary objectives to save lives and protect public health and property. Drought conditions have developed to the degree that several areas within the state are likely to receive severe impacts to various sectors of their economies. (Source:https://naturalresources.utah.gov/dnr-newsfeed/utahs-drought-review-and-reporting-committee-activated).

In 2018, six Utah counties declared drought-related disasters: Box Elder, Carbon, Grand, Emery, San Juan, and Wayne counties.

Drought Recovery

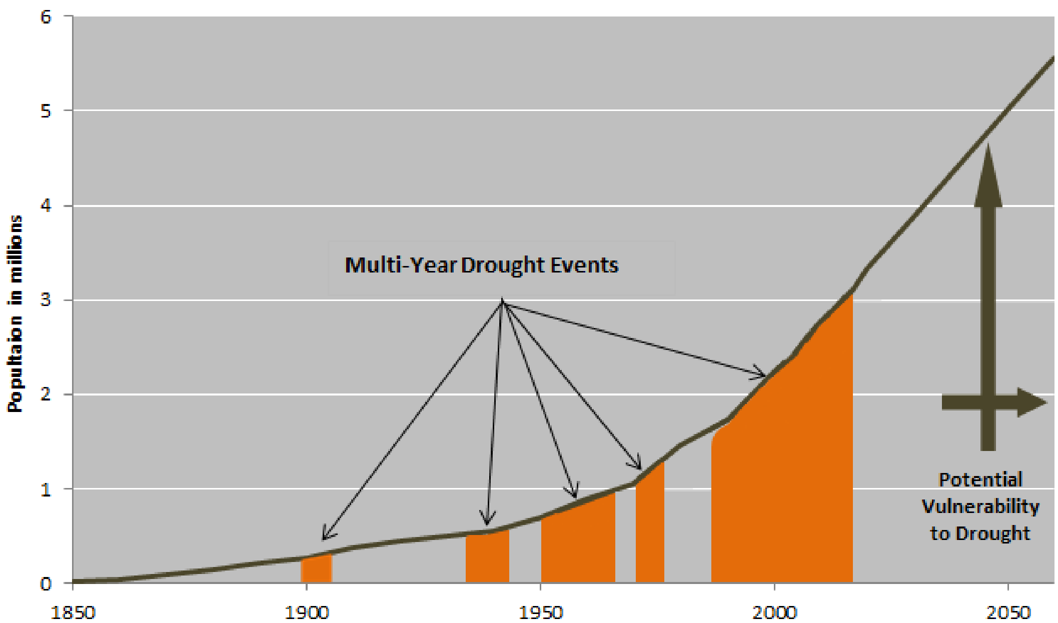
It is human nature to want to return to normal as quickly as possible. Therefore, after a prolonged drought, we look at a return to normal precipitation as the end of the drought. Indicators such as a green pasture or a full reservoir are often erroneously used to determine the end of the drought. The effects of drought linger for several years after a return to normal precipitation. For example, after several years of drought, even though a plant is green it lacks vigor and the overall biomass of the site has been reduced, therefore, land use may be forced to continue at a reduced level for a period following a drought. In addition, soil moisture may be low, inhibiting plant recovery. Springs are slow to recover, and wildlife and livestock births are often reduced.

6.2 Assessment of Local Drought Vulnerability and Potential Losses

It is impossible to exactly predict the onset, duration, and spatial extent of a drought, however, emergency managers do have the ability to prepare for the impacts of drought. The DWRe emphasizes that the combination of limited water availability and a growing population could result in more environmental, agricultural, economical, and societal stresses resulting from drought.

The figure below illustrates Utah's population projections versus drought vulnerability. This chart indicates that population growth within Utah increases the population's potential vulnerability to drought. The DWRe states that innovative water management strategies are necessary in order to sustain the water needs of the population.

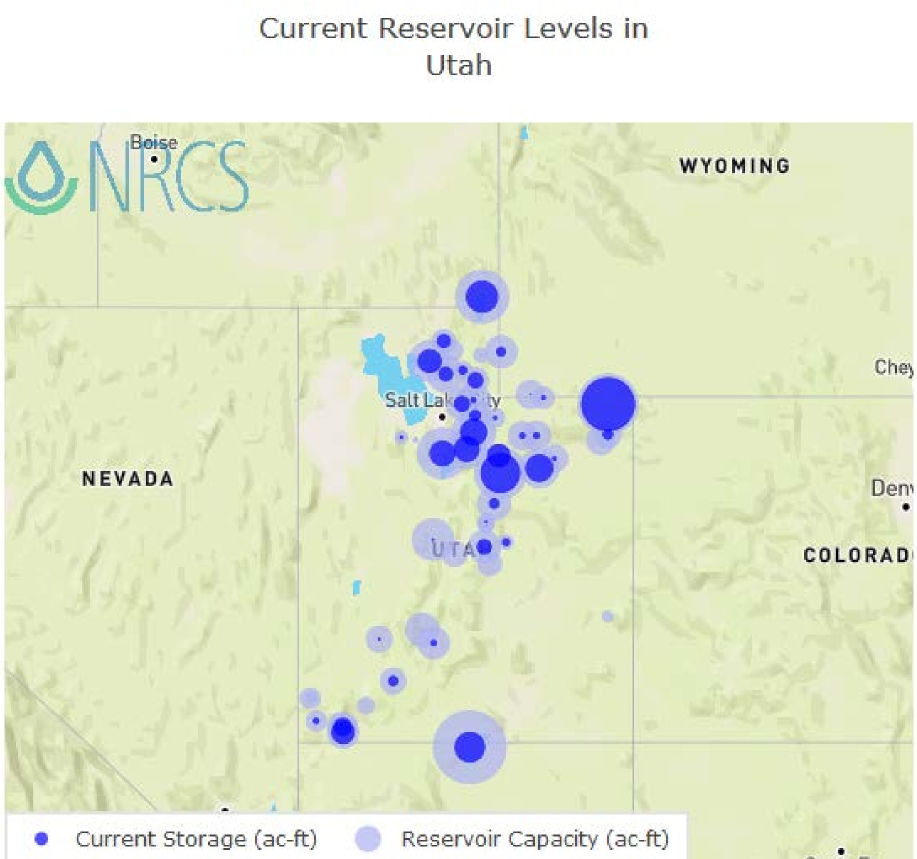
Figure 9. Population Projections and Drought Vulnerability



* Source: Population data obtained from the U.S. Census and Kem C. Gardner Policy Institute, University of Utah. Adapted from Water in Utah, Utah Division of Water Resources. Utah Division of Emergency Management, 2018.

Utah Monthly Water Supply Reports generated by the NRCS and CBRFC help water users in Utah manage water storage. Water supply reports can vary and extremes are not unusual in any given year or month. (*http://www.nrcs.usda.gov/wps/portal/nrcs/main/ut/snow/waterproducts/*)

Map Reservoir Levels in Utah as of December 2018



Source: https://www.wcc.nrcs.usda.gov/ftpref/states/ut/iCharts/dev/RESC/resMapUT.html

The DWRe makes several recommendations pertaining to the management of drought. They suggest that mitigating the drought prior to its onset can be less expensive than responding after the drought has begun.

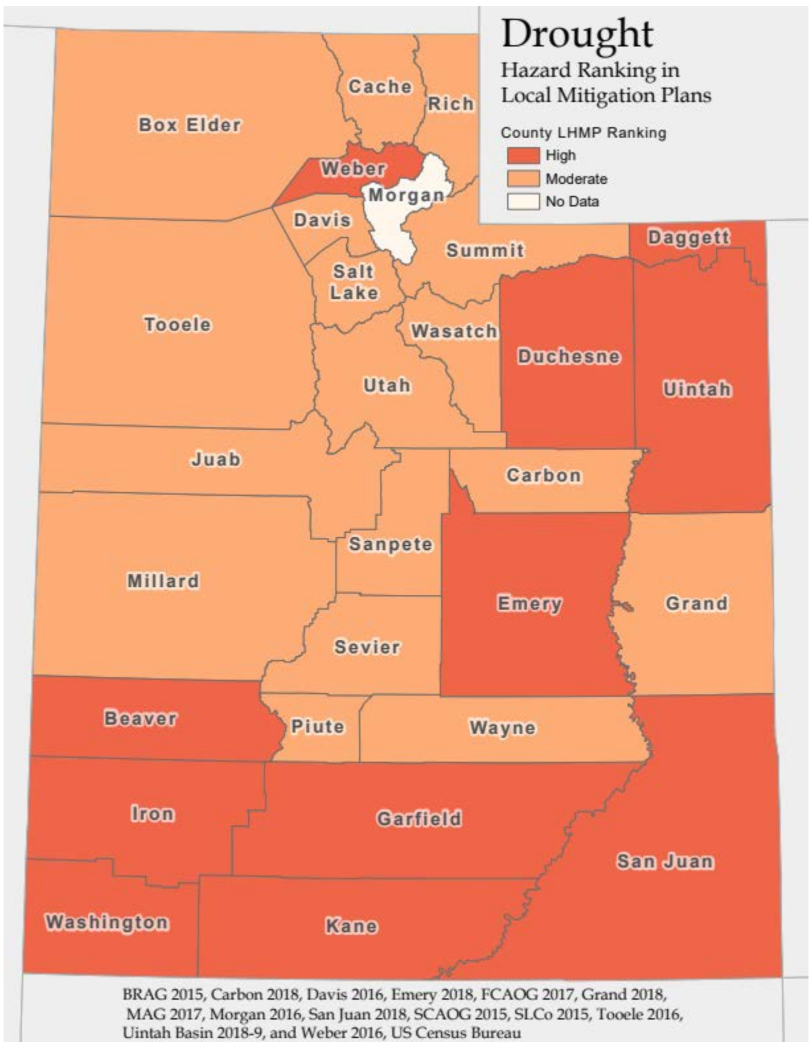
In order to do this, strategies such as water redistribution, conjunctive management, water systems interconnections, water development projects, water reuse, demand management (alternative landscaping and incentive pricing), water metering, leak detection projects, and weather modification projects are recommended.

Vulnerability Based on LHMPs

Each LHMP was reviewed to gather data on how each jurisdiction viewed their vulnerability to drought. The frequency of drought and severity of drought as reported in the LHMPs were gathered to determine a hazard ranking for drought. The hazard ranking is calculated from a combination of severity (categorized from 0-4) and probability/frequency (categorized from 0-4). The numbers were then combined to allow for a ranking from 0-8 to be scored. A map was also created that shows the hazard ranking of drought for each county as reported in the LHMPs.

The results of the LHMP analysis on drought show that the southern and eastern counties of Utah, as well as Weber County rank themselves as the most at risk to drought, while most of the rest of the state is at moderate risk.

Figure 10. Drought Hazard Rankings from LHMPs



Due to the unpredictability of drought, it is difficult to identify the areas most threatened by drought and to provide loss estimate values. Reports about damages have only been sporadically given. However, historical drought records demonstrate that agriculture and tourism are typically the economic sectors most impacted by drought.

The Governor's Office of Planning and Budget (GOPB) compiled drought loss numbers from 2002 for the 2003 Economic Report to the Governor. The Economic Report to the Governor suggested that the drought (in 2002) reduced employment by 0.4%. During 2002, job change was –1.0%. Without the drought, job change might have been –0.6%, 0.4% higher than what actually occurred.

During the 2002 drought it is estimated that the agricultural sector lost $150 million ($208.9 million in 2017 dollars). Ranchers were forced to sell their livestock for very low prices, and many ranchers were unable to make a profit from their sales. In addition, it is reported that this drought led to increased unemployment with the loss of 6,110 jobs and $120 million ($167 million dollars in 2017) in income (Utah Division of Water Resources, 2007). It is expected that future droughts will similarly impact the agricultural sector, possibly creating even greater losses in the severity and extent of the drought if it increases in magnitude.

Best estimates in 2003 were that livestock sales went down $100 million ($136.7 million in 2017 dollars) due to the drought; hay sales went down $50 million ($68.3 million in 2017 dollars); and, because of drought related fires, tourism sales went down $50 million ($68.3 million in 2017 dollars).

Some estimates put drought related impacts for just 2017-2018 in the tens of millions of dollars (Utah's Drought Bad, But Could Get Worse Without a Wet Winter, slchamber.com; Deseret News, Sept. 10, 2018).

In 2018, a report came out by the Drought Review and Reporting Committee entitled, "Report of the Economic Impacts Task Force." The report lists some of the effects that the current drought has had in Utah over the past year. Some of the findings include:

- For the 2017-2018 ski season, snowfall was down 26 percent across the Rocky Mountain region. In addition, Utah experienced higher-than-average tem-peratures. Utah skier visits were down 9.6 percent year-over-year (YoY) and ski/snowboard spending fell an estimated $109 million YoY.

- 92 percent of Utah is currently classified as experiencing some level of drought, with the southeastern quarter of the state in extreme drought conditions. As a result, livestock animal unit months (AUMs) on federal land have been temporarily reduced in multiple parts of the state. In addition, first year commuter permits have increased, signaling permittees' need to seek live-stock forage outside the state, mainly in Idaho and Wyoming.

- Wildfires have consumed part or all of 29 federal grazing allotments, which produce an estimated 29,497 AUMs annually. The loss of these AUMs will result in the loss of nearly $3 million annually in economic benefits for rural Utah until livestock are able to resume grazing in recovered areas.

- Around fifteen ranchers have already applied for emergency livestock watering assistance for roughly 10,000 head of livestock.

- Some producers have called for consultation concerning an increase in pinkeye in their cattle.

- Some ranchers are selling off animals early to lessen the burden of having to provide feed, which in the case of emergency sales can result in livestock being sold at 60 percent of normal value.

- Reduced snowmelt in drought years diminishes streamflows, reduces aquifer recharge, lowers water tables, and results in increased pumping, which depletes aquifers and can dry up wells.

- The Department of Agriculture anticipates seeing a greater concentration and wider distribution of insects in pastures, other forage, and crops.

Table 2 lists the agriculture statistics for Utah's counties from the 2012 Agriculture Census, which is the most current agriculture census data available to date. The counties with the most farms include: Utah, Box Elder, Uintah, Cache, and Weber counties. The counties with the most farm acreage are San Juan, Box Elder, Duchesne, Millard, and Iron counties. The top 5 counties with the highest market value of products sold are Beaver, Utah, Millard, Box Elder, and Sanpete counties. The counties with the highest estimated market value of land and buildings include: Rich, Iron, Grand, Beaver, and Wasatch counties.

Table 3 displays the per capita loss of market value of products sold for each county in Utah. Beaver, Rich, Millard, Piute, and Wayne counties have the highest per capita loss.

Table 2. 2012 Agriculture Statistics for Utah's Counties

County	Farms	Total acres	Market Value of products sold	Estimated Market value of land and buildings (avg. per farm)
Beaver	277	189,995	$288,501,000	$1,370,005
Box Elder	1235	1,170,736	$169,546,000	$1,140,029
Cache	1217	268,511	$142,884,000	$778,555
Carbon	319	240,652	$9,011,000	$918,619
Daggett	51	0	$2,322,000	$824,250
Davis	493	55,017	$36,760,000	$723,596
Duchesne	1058	1,088,559	$57,123,000	$856,720
Emery	587	156,229	$14,075,000	$452,336
Garfield	279	91,533	$12,043,000	$746,087
Grand	81	0	$3,873,000	$1,571,892
Iron	509	532,464	$136,747,000	$1,973,149
Juab	353	242,909	$28,357,000	$825,640
Kane	183	125,441	$4,683,000	$966,693
Millard	728	577,405	$180,624,000	$1,114,355
Morgan	301	228,678	$20,362,000	$1,196,672
Piute	123	37,843	$16,949,000	$901,668
Rich	158	409,359	$32,825,000	$2,606,137
Salt Lake	630	78,162	$21,521,000	$586,952
San Juan	746	1,608,901	$13,358,000	$805,649
Sanpete	901	284,311	$147,407,000	$679,514
Sevier	674	122,328	$62,951,000	$548,010
Summit	618	270,061	$24,151,000	$996,972
Tooele	476	347,024	$40,386,000	$870,779
Uintah	1231	0	$46,627,000	$930,443
Utah	2462	343,077	$222,630,000	$742,896
Wasatch	450	149,224	$12,181,000	$1,266,053
Washington	579	147,991	$12,647,000	$934,486
Wayne	187	42,361	$15,735,000	$914,590
Weber	1121	117,415	$39,872,000	$609,955
Total	18027	8,926,186	$1,816,151,000	$28,852,702

Source: US Department of Agriculture 2012 Census.

Figure 11. Per Capita Loss of Market Value of Products Sold

County	Per Capita Loss of Market Value of Products Sold
Beaver County	$42,157.46
Rich County	$13,843.76
Millard County	$13,402.14
Piute County	$10,543.81
Wayne County	$5,747.23
Sanpete County	$4,908.16
Box Elder County	$3,084.31
Sevier County	$2,892.23
Duchesne County	$2,742.57
Iron County	$2,615.68
Juab County	$2,403.61
Garfield County	$2,298.20
Daggett County	$2,206.29
Morgan County	$1,736.66
Emery County	$1,318.77
Uintah County	$1,273.50
Cache County	$1,129.60
San Juan County	$817.31
Kane County	$619.50
Tooele County	$601.58
Summit County	$592.34
Carbon County	$424.83
Wasatch County	$390.11
Grand County	$384.98
Utah County	$360.40
Weber County	$160.23
Davis County	$105.40
Washington County	$76.37
Salt Lake County	$19.07
State of Utah	$583.21

*Data derived from USDA and Kem C. Gardner Policy Institute

All four agriculture categories from Table 2 were arranged from most to least and then ranked from 1 to 29 for each county. For example, the number of farms per county was arranged from the greatest number of farms per county to the least number of farms per county. Then each county was ranked, starting at the greatest, from 1 to 25 because some of the counties had the same ranking score. This was done for all four categories and then all four of the county rankings were totaled to get ranking scores. The county with the lowest score indicates the greatest amount of potential agriculture loss associated with drought.

Table 3. Utah Counties Ranked for Potential Drought Losses*

Rank	County	Ranking Scores
1	Box Elder	15
2	Millard	24
3	Iron	29
4	Utah	34
5	Duchesne	35
6	Cache	42
7	Beaver	43
8	Sanpete	46
9	Rich	47
9	Summit	47
11	San Juan	51
11	Tooele	51
12	Uintah	52
13	Morgan	59
14	Juab	64
14	Wasatch	64
14	Weber	64
15	Sevier	66
15	Washington	66
16	Carbon	72
17	Davis	77
18	Salt Lake	78
19	Emery	79
20	Kane	81
21	Wayne	83
22	Grand	86
23	Piute	87
24	Garfield	91
25	Daggett	104

*Data taken from Table 2

Climate Change Impacts

Changes in climate will likely cause an increase in drought hazard in Utah. Utah is the second-driest state in the United States; historically Utah has experienced many droughts, but future changes in climate will increase the probability of severe and long-duration droughts. The historical record in Utah shows that drought is a common occurrence. However, the record of drought in the more distant past shows a record of even more severe and longer duration drought. Records of streamflow and drought in the Bear River, Logan River, and Weber River basins of northern Utah derived from tree-ring reconstructions show that droughts between 1100 and 1900 were generally more severe and of longer duration than droughts of the historical twentieth-century record.[1–3] The longest drought recorded in the tree-ring records was a 70-year drought in the Bear River basin during the thirteenth century. The risk of multi-decade drought occurring in the twenty-first century is at least 80% to 90%; the risk of a drought of 35 years or more is 20% to 50%, and the risk of a 50-year drought is 5% to 10%.[4] It is important to note that the risk of decade-scale drought in northern Utah is likely lower than the risk of decade-scale drought in southern Utah. Increases in the incidence of drought will also increase the risk of wildfire in Utah. High temperatures and dry conditions associated with drought will increase the risk for wildfire in Utah. Increased incidence of wildfire may in turn degrade air quality and pose a health risk to sensitive populations.

Even if a decade or multi-decade drought does not occur in Utah, incidence of drought is certain to increase even if precipitation remains close to historic means. Temperatures have already increased by approximately 2°F in Utah. Further increases in temperature without reduction to future precipitation will cause more and longer droughts due to the impact of temperature on increasing evapotranspiration. Another consequence of drought, especially droughts caused by high temperatures, is that Utah residents will be exposed to increasing risk of heat-related illnesses. Average temperatures are increasing throughout Utah, but minimum temperatures are increasing faster than maximum temperatures, especially in urban areas.[5] High minimum temperatures are a risk to sensitive population groups in Utah and summer minimum temperatures will increase in Utah throughout the twenty-first century.

Development Trend Impacts

Utah is the second driest state and any development in the state divides the already limited water supply. Most development is taking place on agricultural land, transferring water usage from fields and livestock to homes and commercial. This trend changes the impacts of drought, spreading it across all levels of commerce and not primarily on agriculture. It also places more pressure on the shrinking agricultural industry and results in greater losses from drought.

Utah is one of the fastest growing states in the country. As Utah continues to grow in population, more development continues to invade these agricultural areas. Drought conditions and development are interrelated, as water use is increased, droughts can occur more readily. Drought is expected to increase in frequency and severity as a result of climate change. If the climate changes to warmer conditions and less precipitation for portions of Utah, then drought conditions and water shortages may exacerbate. Warmer conditions have contributed to decreases in spring snowpack and Colorado River flows, which are an important source of water for the region. Future water scarcity will be compounded by the state's rapid population growth (EPA.gov).

Based on the drought vulnerability analysis dealing with agriculture loss (see Table 4) Box Elder County came in as number one, followed by Millard, Iron, and Utah counties. All of which have had positive growth rates In terms of population numbers, Utah County is expected to have the most growth among these counties.

6.3 Assessment of State Drought Vulnerability and Potential Losses

Although state owned facilities are seldom threatened by drought directly, drought does increase the likelihood of wildfire. Thus, facilities at risk to wildfire are also at risk to drought as prolonged drought can heighten the wildfire risk. See the wildfire chapter for the state facilities at risk to wildfire. Drought also has an effect on the budgets of many state parks and the tourism industries relying on water based recreation, such as river running and water skiing.

However, as drought can have widespread effects a list of state facilities and their insured values is listed below.

Table 4. State-Owned Facilities and Insured Value

County	Count Facilities	Insured Value of Facilities
Beaver	35	$41,032,093
Box Elder	200	$298,041,925
Cache	613	$3,340,693,369
Carbon	113	$162,484,250
Daggett	20	$3,415,881
Davis	278	$1,393,256,017
Duchesne	72	$37,934,210
Emery	108	$41,071,459
Garfield	59	$20,808,298
Grand	81	$62,763,853
Iron	224	$490,154,483
Juab	41	$13,469,125
Kane	51	$15,679,404
Millard	78	$94,808,959
Morgan	48	$25,152,828
Piute	23	$4,841,000
Rich	84	$11,160,077
Salt Lake	1,463	$7,274,528,270
San Juan	111	$111,325,088
Sanpete	204	$437,926,899
Sevier	135	$209,506,871
Summit	128	$158,297,671
Tooele	89	$296,471,019
Uintah	117	$262,341,461
Utah	577	$2,272,452,584
Wasatch	178	$104,105,879
Washington	215	$620,545,353
Wayne	33	$4,730,187
Weber	317	$1,267,926,750
Total	5,695	$19,076,925,263

6.4 Mitigation Efforts for Drought Hazards

A new statewide rebate program, Utah Water Savers, is now available thanks to a $750,000 ongoing appropriation from the state legislature. Rebates can be claimed at Utah Water Savers. The announcement of the new rebate program was on May 17, 2018.

Statewide rebates will be given for the purchase of smart irrigation timers that save water by automatically adjusting watering schedules based on local weather and landscape needs. Additional rebates for replacing old toilets and completing water-efficient landscaping projects will be funded on a regional basis by local water providers. Plans are in place to add additional statewide rebates in the future. To view a complete list of available rebates in each area see UtahWaterSavers.com.

Utah Division of Water Resources

The DWRe plays a central role in drought mitigation and contingency planning. The DWRe hosts a multi-agency Governor's Drought Advisory Committee, which meets as needed, to evaluate drought conditions in the State.

The DWRe also maintains the State of Utah Drought Response Plan. This plan contains a comprehensive list of federal drought assistance programs and state drought-related assistance programs, as the state does not maintain a specific program. This plan is in the process of being updated but is currently still outdated.

The DWRe developed "*Drought in Utah: Learning from the Past – Preparing for the Future*", *2007*. This document emphasizes the need to plan and implement mitigation strategies to ensure a reliable water supply before a drought occurs in order to satisfy future water demand. The document includes nine mitigation strategies, response strategies, and recommendations. It has not been updated to date.

The DWRe also developed "*Drought Management Toolkit for Public Water Suppliers, March 2008*". This document is a simplified outline designed to give the water supplier ideas from which to initiate mitigation planning and to allow flexibility. The planning process addresses an overall water management methodology. Although this is not a required planning activity, it is highly recommended. It can be a standalone document or integrated into current water management plans and long term planning activities. In this document, the *Model Drought Mitigation Plan* outlines a broad step-by-step process for assessing a water system, identifying "weaknesses" or vulnerabilities within that system, and then developing a plan of action to address the identified weaknesses.

The DWRe also hosts the Division of Water Resources Conservation Program (website found at https://conservewater.utah.gov/materials.html). The website houses many resources to help educate the public, communities, and local governments about drought and ways to mitigate its effects. Some of these resources include: watering guide, conservation tips, water education, model ordinances, and outreach materials.