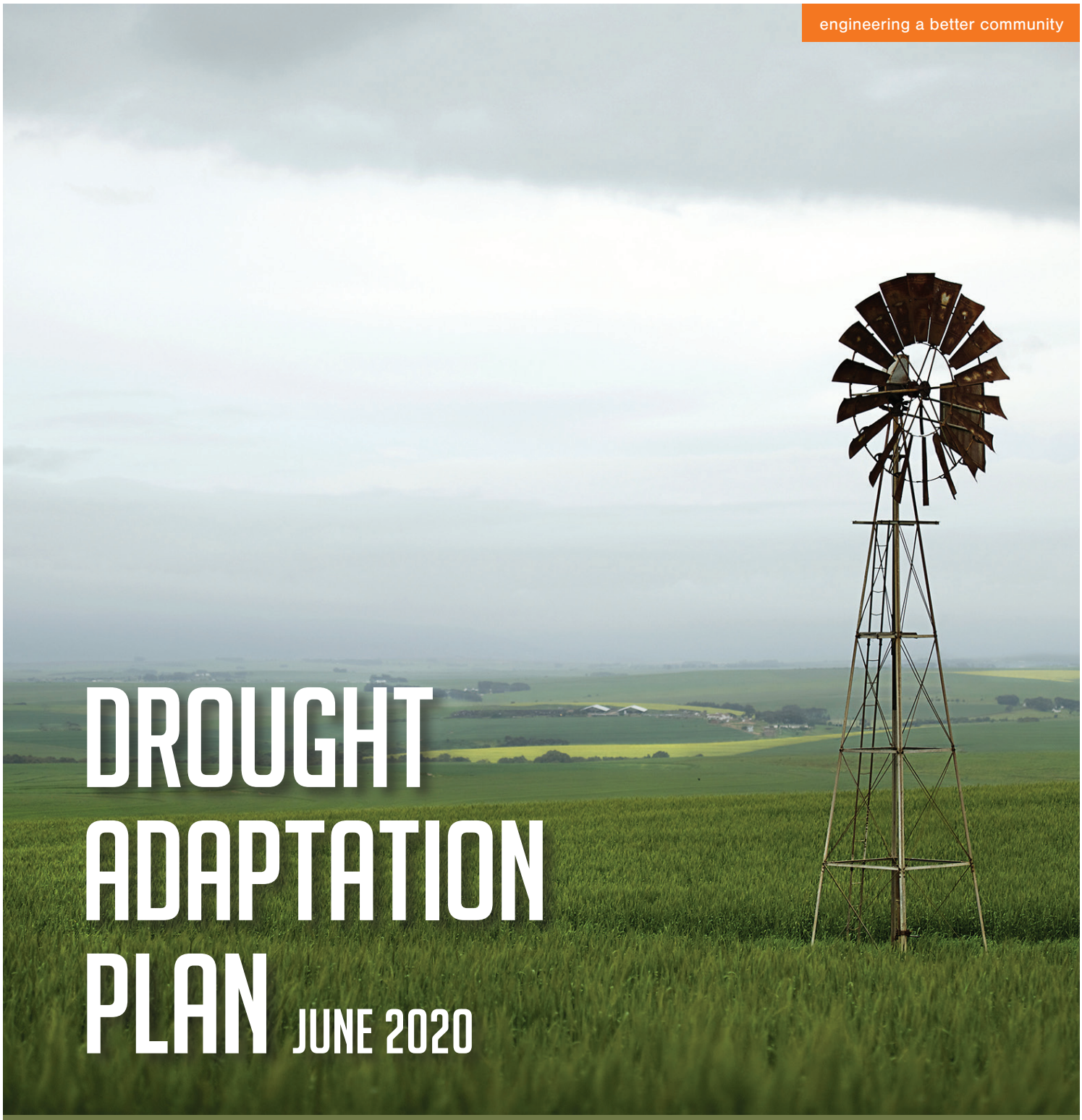


DROUGHT ADAPTATION PLAN JUNE 2020

PREPARED FOR
The People of Flandreau Santee Sioux Tribe
Flandreau Indian Reservation

PREPARED BY
Flandreau Santee Sioux Tribe
In collaboration with
Great Plains Tribal Water Alliance

BANNER
engineering a better community

Drought Adaptation Plan

PREPARED FOR

The People of Flandreau Santee Sioux Tribe
Flandreau Indian Reservation

PREPARED BY

Flandreau Santee Sioux Tribe

in collaboration with

Great Plains Tribal Water Alliance

June 2020

This is page is intentionally left blank.

Table of Contents

LIST OF FIGURES

LIST OF GRAPHS

LIST OF TABLES

LIST OF ACRONYMS

BIA	Bureau of Indian Affairs
BSCWS	Big Sioux Community Water System
DVA	Drought Vulnerability Assessment
EDDI	Evaporative Demand Drought Index
FSST	Flandreau Santee Sioux Tribe
GPTWA	Great Plains Tribal Water Alliance
HPRCC	High Plains Regional Climate Center
IEMP	Integrated Environmental Management Plan
MWRWS	Mni Wiconi Rural Water System
NDMC	National Drought Mitigation Center
NIDIS	National Integrated Drought Information System
NOAA	National Oceanic and Atmospheric Administration
SC-PDSI	Self-calibrated Palmer Drought Severity Index
TTT	Tribal Technical Teams
USDA	U.S. Department of Agriculture
USDM	United States Drought Monitor

EXECUTIVE SUMMARY

The Great Plains Tribal Water Alliance is comprised of four tribes: The Flandreau Santee Sioux Tribe (FSST), Rosebud Sioux Tribe, Oglala Sioux Tribe, and Standing Rock Sioux Tribe. The FSST hired Banner Associates Inc. to complete a Drought Adaptation Plan (DAP). The purpose of the DAP is to guide the FSST during times of drought with both adaptation and mitigation actions.

Preliminary research was completed for the FSST in the form of a Drought Vulnerability Assessment (DVA). Within the DVA, vulnerabilities were determined for eight sectors: Legal Rights and Infringements, Tribal Lifeways, Water, Land, Wildlife, Agriculture, Public Health, and Tribal Data Monitoring. Through research, coordination with a technical committee, and field visits, specific vulnerabilities and mitigation strategies were identified and are shown below:

Vulnerabilities

1. Contamination of Big Sioux Aquifer
2. Overtaxing the Water System
3. Drought Exacebated Flooding
4. FSST Land Leases and Effects to Agriculture

Mitigation Strategies

1. Protection of Groundwater Recharge Zone and Focus in Quality Drinking Water
2. Best Management Practices Implementation for Construction and Agricultural Practices
3. Water Storage Options for the Supression and Additional Water Uses
4. Water Use Education and Restrictions
5. Stormwater Retention Systems
6. Livestock Management
7. Crop Management

After preliminary research and field visits, the DAP and drought mitigation projects were created to assist the tribe in planning and mitigation.

The DAP was developed from research on climate and recommended actions during drought, based on the needs of each sector. The DAP requires diligent monthly monitoring of drought conditions using drought indices that track the severity of flash drought and long-term drought. Indices used include the Evaporative Demand Drought Index (EDDI) and the U.S. Drought Monitor (USDM). There are also four categories that detail current drought severity based on both EDDI and USDM:

- Normal (No USDM or EDDI)
- Alert (USDM of D0, 1-month EDDI of ED 1-4)
- Warning (USDM of D1-2)
- Emergency (USDM of D3-4)

Each category has a specified set of proactive and reactive actions for the Tribal government to take.

For each mitigation strategy potential projects and funding for these projects were identified. The mitigation projects are meant to aid the Tribe in developing adequate infrastructure that will minimize the effects of drought. Some projects, like those dealing with water demand and restriction, require partnerships with private entities that are responsible for water distribution. Federal funding opportunities for each of the projects were also identified, detailing both the grant opportunity as well as the federal agency responsible for its distribution.

1.0 Introduction

The Drought Adaptation Plan (DAP) was developed as a planning tool to identify and prioritize Flandreau Santee Sioux Tribal (FSST) government responses before, during, and after drought. The recommendations in the DAP were created by understanding the important Tribal resources and the vulnerabilities of those resources to drought. Key Tribal program directors, staff, council members, government officials, and members met to identify and prioritize strategies and plans most beneficial for the Tribe.

Three other Tribes active in the Great Plains Tribal Water Alliance (GPTWA) worked collectively in developing the DAP and include the Oglala Sioux Tribe, Rosebud Sioux Tribe, and Standing Rock Sioux Tribe. The DAPs were funded by the Bureau of Indian Affairs (BIA) FY17 and FY18 Tribal Resilience Program, Adaptation Planning Grant: Category 2. The Tribes worked collectively in learning about drought adaptation through the joint water conferences and workshops. Although the Tribes worked together on overarching drought adaptation concepts, each Tribe has a unique DAP tailored for the respective reservation.

The FSST DAP is the third resource document in a series documenting drought vulnerabilities and baseline resource conditions. Each report builds on information and data documented in the previous one. The previous two resource documents include:

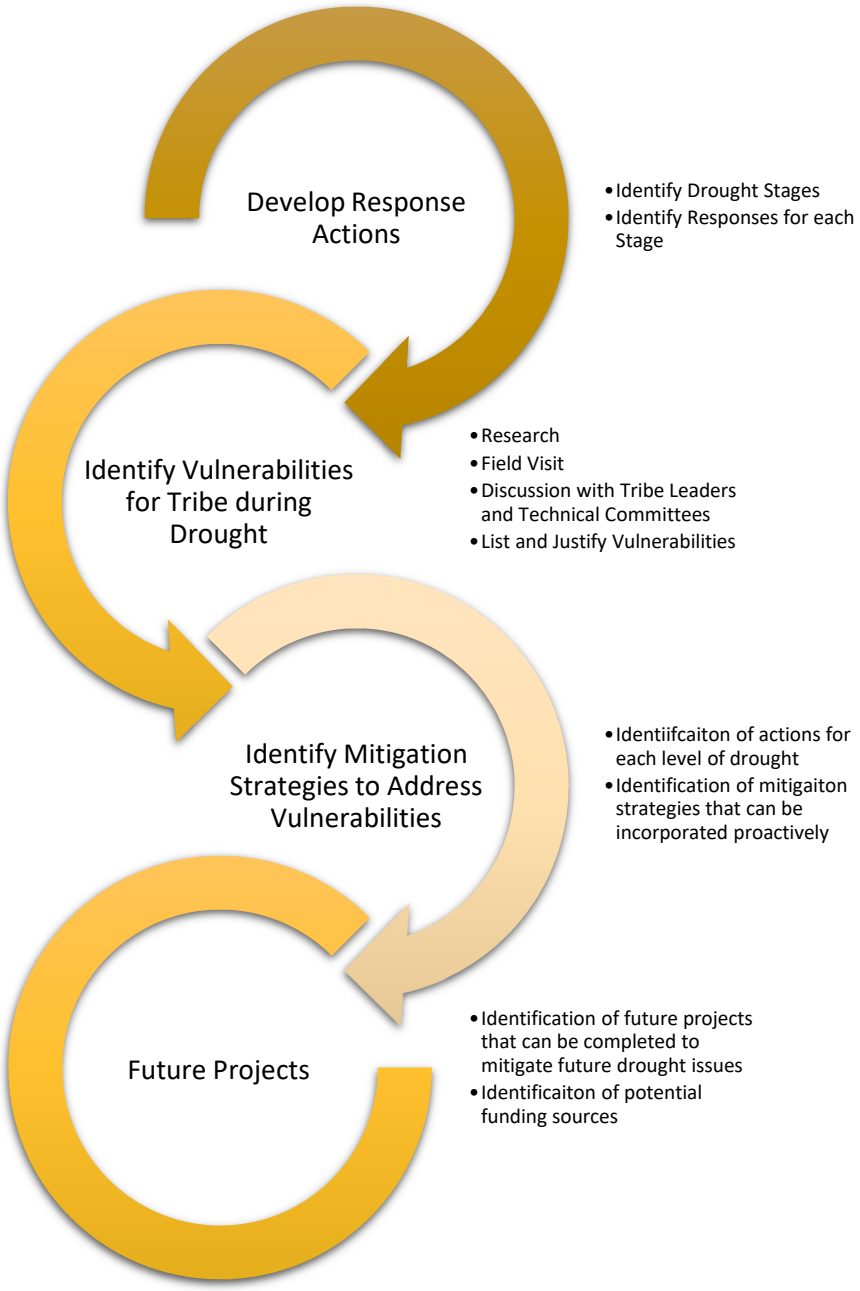
- *Flandreau Santee Sioux Tribe Integrated Environmental Management Plan for Cultural, Natural, and Water Resources (IEMP)*
- *Flandreau Santee Sioux Tribe Drought Vulnerability Assessment (DVA)*

***Photos 1, 2, and 3**- Example of drought conditions.*

The objectives of this DAP are to:

- Coordinate with Tribal leaders to develop a list of drought vulnerabilities, previously determined from the DVA, that need to be addressed immediately,
- Identify drought mitigation strategies that would best resolve the vulnerabilities, and
- Identify the projects that would meet the mitigation strategy and identify potential funding sources for the top two priority projects.

The process to achieve the objectives for this DAP is shown in the flow chart.

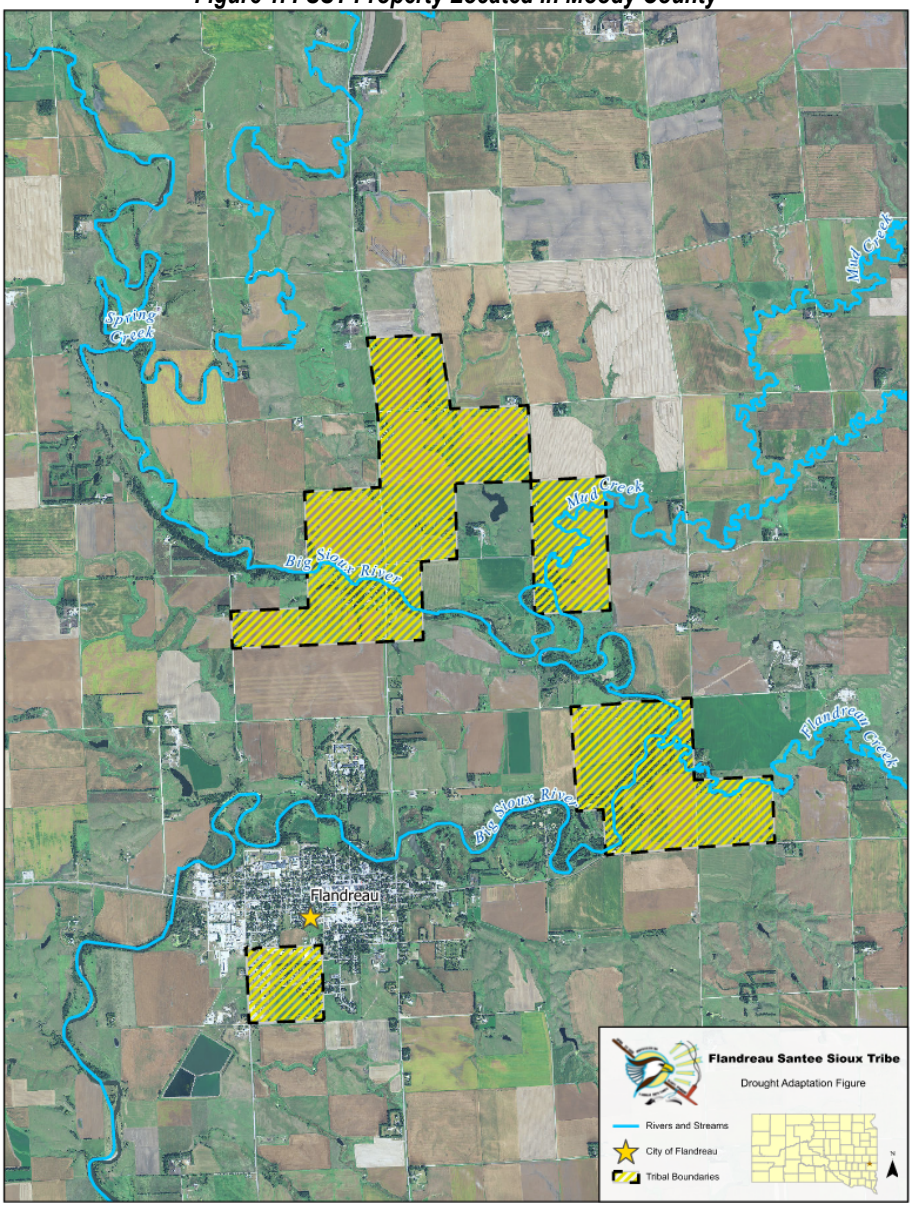


1.1 FSST Reservation Location

The FSST Reservation is located in eastern South Dakota north of Sioux Falls, near the Minnesota border. Tribal lands comprise over 2,500 acres with the majority of property located in Moody County with property also located in the Black Hills. The FSST Reservation was established in 1889 by the United States' partition of the Great Sioux Reservation. Please refer to ***Figure 1.*** The City of Flandreau (Flandreau) is partially located within the Reservation border and lies on the edge of the Big Sioux River. The surface water of the Big Sioux River interacts with the area geology to create an aquifer (Hansen), which provides a highly reliable drinking water source to members and non-members. The Big Sioux River and the Big Sioux Aquifer are the respective primary and secondary water sources for the reservation.

This DAP will focus on FSST lands located in Moody County.

Figure 1. FSST Property Located in Moody County



1.2 FSST Government

The FSST's Tribal Council or Executive Committee is comprised of eight total elected officials, with four trustees and four officers. The officers are president, vice president, secretary, and treasurer. The elected officials must live within the designated Tribal lands. Officials are elected in staggered terms to ensure that there are experienced officials in office.

1.3 FSST Land Description

FSST's land base is roughly 2,500 acres which is primarily scattered around Flandreau. Most of the larger lots of land are either leased or used for the Tribe's bison herd. An image of the land base can be viewed in ***Figure 1***. Most of the land base consists of rolling hills and is well maintained. A small portion of the land base is located on parcels inside the City of Flandreau; these parcels consist of several housing units used and maintained by Tribal members. The Tribe has always resided along the Big Sioux River, however, a recent change in the Big Sioux River channel has occurred. The natural formation of an oxbow has recently occurred, placing the residents at constant risk of flooding hazards.

1.4 Climate and Demographics

Eastern South Dakota, including Flandreau, has a humid continental climate, which is typified by four distinct seasons and large seasonal temperature differences, with warm to hot, humid summers and cold winters. The area experiences roughly 26 inches of rainfall and 29 inches of snowfall annually (U.S. Climate Data, 2020). While droughts are uncommon to the area, flooding tends to be more prevalent.

The demographics utilized for this plan will be based upon Flandreau and will utilize 2018 American Community Survey data. The estimated population of Flandreau is 2,438 of which 24.7% are Native Americans. The median household income is roughly $46,020, which when compared to the median household income of South Dakota, which is $56,499, indicates that roughly 15.7% of all people living in Flandreau are living below the poverty level in South Dakota. The unemployment rate in Flandreau is 3.6% for the civilian work force. (US Census Bureau, 2018).

Photos 4 and 5: Aerial Photo of the Big Sioux River Oxbow near Flandreau

1.5 Project Partners

The development of the DAP considered four components: project partners, timeframe, methods, and data sources. The project partners worked on focusing the DAP toward the specific needs of the FSST. The timeframe and methods for creating the draft DAP were essential to finalizing the DAP before July 2020. All field visit and follow-up meetings were used to create a well-rounded document. The components that led to the finalization of the DAP are detailed below.

The grant proposal that was submitted by the FSST and on behalf of the SRST had identified project partners that would be participating in the work. The partners included GPTWA and their interns, Louis Berger (now Banner Associates, Inc.), each Tribe, the National Drought Mitigation Center, and the National Oceanic and Atmospheric Administration. The partners and their specific roles are described below and can also be found in ***Table 1***.

- **FSST-** The FSST is the project lead. Helping project participants coordinate field visits, interviews, and offering guidance and feedback on the DAPs throughout the project. The FSST team is led by Natural Resource Brownfield Coordinator Elizabeth Wakeman and 106 Water Technician Jonathan Shrader. Elizabeth has worked with the Tribe for numerous years, bringing experience, knowledge, and personal contacts that have facilitated the gathering of feedback for the development of this document.

- **Great Plains Tribal Water Alliance-**The GPTWA is the original founding coalition for preserving the prior reserved water rights of the Missouri River under aboriginal title, the 1851 Fort Laramie Treaty, the 1868 Fort Laramie Treaty, and other judicially established territories in North Dakota, South Dakota, and Nebraska. The GPTWA was established in 2006 by the SRST, OST, and RST, and now includes the FSST. All Tribes within the Great Plains Region are welcome to participate in the GPTWA. The public outreach, research, and education offered by GPTWA is dedicated to protecting and preserving the Great Sioux Nation Indian Water Rights for the use of water in the Missouri River, tributaries, and all aquifers and ground water sources located within the exterior boundaries of the Great Plains Region. As its sacred obligation, the GPTWA will provide technical and policy recommendations for the protection of all water resources for the next seven generations.

  The GPTWA serves as the organizing vehicle to collaborate with the Tribes, BIA, and relevant federal and state agencies to develop DAPs in a phased approach. This multi-Tribal approach follows the model for the Mni Wiconi Rural Water System (MWRWS), where federal and state governments worked with several Tribes to build, monitor, and maintain their water infrastructure. This partnership builds on historical and cultural networks to support and sustain water resource planning efforts after the grant period.

- **GPTWA Interns-** The project team worked with the South Dakota School of Mines and Technology and Oglala Lakota College in Rapid City, South Dakota, to identify two engineering or science students entering their upperclassmen years to work on this project. The students that were hired for the project are enrolled members of South Dakota Tribes. Their goal was to

work with the Tribe's technical staff and other key resource personnel to assist in the development of a DAP for each Tribe. The interns acted as a team, sharing important methods and processes that helped them tailor plans for the Tribes. These students developed important skills and acquired knowledge about drought vulnerabilities and mitigation strategies to assist the Tribes in the future.

- **National Drought Mitigation Center-** The National Drought Mitigation Center's primary task was to offer professional and technical guidance to the GPTWA Interns, offer insight on field visit coordination, participate in field visits and surveys, and to offer guidance on development of the DAP.

- **National Oceanic and Atmospheric Administration-** NOAA was tasked to participate as a conference speaker and to offer information to the partnering Tribes of the GPTWA. Concurrently two of their interns accompanied GPTWA Interns and Banner Associates on field visits. NOAA had also included cost-match with $10,000 for Tribal Technical Team Members to travel to the GPTWA Fall Conference.

Table 1. Drought Adaptation Partners

Agency	Partners
Great Plains Tribal Water Alliance	Oglala Sioux Tribe Rosebud Sioux Tribe Flandreau Santee Sioux Tribe Standing Rock Sioux Tribe
GPTWA Interns	Amanda Booton-Popken Elisha Yellow Thunder
Flandreau Santee Sioux Tribal Leaders	Elizabeth Wakeman, Natural Resources Jonathan Schrader, Natural Resources Mark Allen, Natural Resources Scott Anderson, Land Management Anthony Reider, Tribal President Kristi Bietz, Tribal Council Donalda Montoya, Tribal Council
National Drought Mitigation Center	Cody Knutson, Water Resource Scientist
National Oceanic and Atmospheric Administration	Doug Kluck, Central Region Climate Services Director Emily Bamford, Graduate Student Marianne Shiple, Graduate Student

1.6 Methods to Identify Vulnerabilities and Mitigation Strategies

To identify the vulnerabilities and mitigation measures, research, field visits, and coordination with FSST and other identified experts and stakeholders was completed. The sections below discuss each vulnerability and mitigation strategy. During the original research effort, several online sources were used to develop the mitigation strategies list. The DVA was used to identify the vulnerabilities for each Tribe and tailor the mitigation strategies to these. The IEMP was also used in preliminary research. The mitigation strategies were gained through the work of other Tribes and through sources based in arid areas of the world. The field visit data that was gathered was primarily the viewpoints of Tribal leaders and their professional opinions on the Tribe's needs. The project partners also provided online articles, sources, background documents, and more.

1.6.1 Research

Preliminary research was completed for the FSST for both an IEMP and DVA. The DVA utilized available research and became a guide on how to conduct adaptation planning for drought conditions. Extensive scholarly research was also completed using the databases ProQuest, EBSCO, and Google Scholar. Journals, publications, government documents, and articles regarding climate change, drought mitigation and planning, and Tribal, federal, and state political land interactions were read, notated, and cited in an annotated bibliography. This research was conducted to establish baseline information on types of drought adaptation and mitigation management practices that have been done in the past. This research allowed for specific practices and other methods to be considered for the Great Plains Tribes.

Climate change resilience and adaptation research were completed to establish base knowledge regarding how Tribal councils, programs, and members are building resilience and adapting to extreme weather events caused by current climate change trends. The drought mitigation and planning research was completed to obtain examples of how other areas, such as Tribal nations and states, are identifying drought vulnerabilities within their communities. It was also conducted to see how indigenous nations are using drought mitigation to prepare and alleviate potential threats to their ancestral territories and cultural resources. Land and legal interactions, both historical and current, were examined to better understand the environment Tribal nations must navigate to develop and implement a drought adaptation plan.

1.6.2 Field Visits

The meeting with the FSST was the first Tribal field visit with the meeting structured as a conversation. This format was then restructured to be respectful of future meeting times, as these discussions were aimed to be about an hour per interview but ended up spanning a much longer timeframe. FSST utilized after visit conference calls for missed meetings, or meetings that were cut short due to time overages.

Interviews with key Tribal leaders and program directors, staff, Tribal council, government officials, and Tribal members were scheduled ahead of time. The meetings and interviews were conducted at the Department of Natural Resources and the Tribal Council Chambers. A meeting was sought to be held at Flandreau Indian School to further discuss problems faced during drought, but the meeting was later held as a phone interview. After field visits, follow up phone calls were made to collect additional information. The field visits yielded discussions on a variety of issues, but focus centered around flooding issues exacerbated by drought .

1.6.3 Project Coordination

The project time frame was formed around grant submission and award, a kick-off meeting, research, field visits, follow-up meetings and phone or video calls, and drafting the DAP. Once the grant was awarded, it was determined that two Tribal interns were needed to develop the DAP and a request for applications was made available in November 2018. The potential interns were offered positions at the end of December 2018 and work began on February 4th, 2019. A meeting was held to provide background documents to the interns and explain the goals and objectives of the DAP.

From February until June of 2019, the GPTWA interns worked to develop an understanding of each tribe's vulnerabilities and create a list of mitigation strategies that could be used for the tribes. After university courses ended in May, a kick-off meeting was held to determine field visit dates. FSST field visit dates were scheduled for June 4th and 5th. During the field visit, a two-day meeting was held to gain feedback from Tribal leaders on the vulnerabilities and mitigation strategies.

Upon completion of the field visits, a follow-up survey was sent to start a tangible list of priorities. The priorities and mitigation strategies that were selected were used to write the DAP for FSST. The original draft of the FSST's DAP was submitted on September 30, 2019 for comment. This draft was revised based on the need for additional information on how each sector would respond during different phases of a drought.

In late 2019 through early 2020, follow up meetings were sought in order to discuss the DAP. However, due to scheduling conflicts and the emergence of SARS-CoV-2 (COVID-19) no follow up meetings were conducted. Though the Spring 2020 GPTWA Conference was cancelled because of SARS-CoV-2, the DAP vulnerabilities, mitigation strategies, and proposed projects were reviewed via video conference meetings. Comments from the video conference were addressed and a draft document was finalized.

2.0 Drought Occurrence Assessment for FSST

The Moody County Pre-Disaster Mitigation Plan (2014) identified the county as having a low probability to experience drought. If a drought were to occur, due to the low occurrence and the Tribe's unfamiliarity with that weather condition, a drought would be very detrimental to the members and non-members in the area.

2.1 Drought Prediction and Identification

Drought impacts are typically spread over large areas. There are many parameters and indices to choose from when predicting and identifying drought. Some measurable parameters include temperature, precipitation, soil moisture, reservoir/lake levels, streamflow, groundwater, snowpack, snow water equivalent, evapotranspiration, vegetation health/stress, and environmental and socioeconomic impacts. Indices exist that utilize the parameters noted to show the drought's severity. Common indices include the percent of normal precipitation, deciles, Standardized Precipitation Index (SPI/SPEI), Palmer Drought Severity Index (PDSI, SC-PDSI), and Aridity Index. Hydrologic drought indices include the Palmer Hydrological Drought Index (PHDI) and Surface Water Supply Index (SWSI) (World Meteorological Organization & Global Water Partnership, 2016).

Drought indices play an important role in understanding drought. They simplify complex relationships and provide good communication tools for diverse audiences/users. They are a quantitative assessment of anomalous climatic conditions: intensity, duration, and spatial extent. They provide a historical reference showing the probability of recurrence, assisting in planning and design applications.

It is important to take careful consideration into choosing indicators and triggers for drought. Droughts are very dynamic and are not specific to one indicator. Precipitation alone is only part of the equation when assessing drought conditions. Soil moisture, humidity, and temperature also have a huge impact on drought and can exacerbate drought conditions. Indices, like the PDSI, estimate the movement of water in in the air, ground, and on the surface. However, calibrating a PDSI to a desired location is a process that requires extensive knowledge of soil properties and statistical analysis. Indices, like the PDSI, also come with a lag in data that could be weeks, or even months, meaning that actual notification of a drought may come too late. When choosing drought indices or indicators, it is imperative that its risk, lag, and ease of use are all considered.

For drought, it is important to start with creating adaptation plans. Once adaptation plans have been developed, the plan components should be followed and monitored to confirm an early warning system is initiated. Ideally, the early warning system is initiated before the drought occurs. After the drought occurs, an assessment should be done to develop the best response possible. The response initiated will eventually lead to a recovery of the situation. Reconstruction and mitigation follow recovery and allow for better preparation for the next situation. Once the cycle is complete, planning must start again to prepare for the next drought.

2.2 Drought Hazard Profile

A drought hazard profile is a way to analyze the various aspects of drought. For the drought hazard profile of the FSST, the history of drought and related impacts were assessed, along with the probability of recurrent drought. Drought history (in the form of drought severity) is provided by the National Drought Mitigation Center

and can be obtained from the United States Drought Monitor (USDM). Drought severity is displayed on a scale of no drought, D0 (Abnormally Dry), D1 (Moderate Drought), D2 (Severe Drought), D3 (Extreme Drought), and D4 (Exceptional Drought). The data are also normalized by the percent area of the selected location that is affected by drought. For the FSST, Moody County was selected as the study area. The USDM has been made available on the internet on a weekly basis since January 4, 2000 (USDM 2020).

Along with the USDM, drought history can also be obtained using a PDSI and SC-PDSI. The PDSI is an effective index at determining long term drought. It uses precipitation, temperature, as well as evaporation and transpiration data to create an index that numerically represents the severity of a drought. However, when this index was created, soil conditions in Kansas and Iowa were utilized, which creates error for other parts of the country. The SC-PDSI corrects for different local conditions so values below -3, which represent extreme drought, occur roughly 10 percent of the time (World Meteorological Organization & Global Water Partnership 2016). SC-PDSI data is available for Moody County from a period of 1916 to 2017 (NMDC 2020)

Overall, eastern South Dakota doesn't experience drought in severity and frequency like western South Dakota. In general, Eastern South Dakota is both wetter and more humid, making it a prime environment for most of the state's crop production. However, because agriculture is the primary industry in eastern South Dakota, droughts that occur have a large effect on the economy for the entire state.

2.3 Drought History

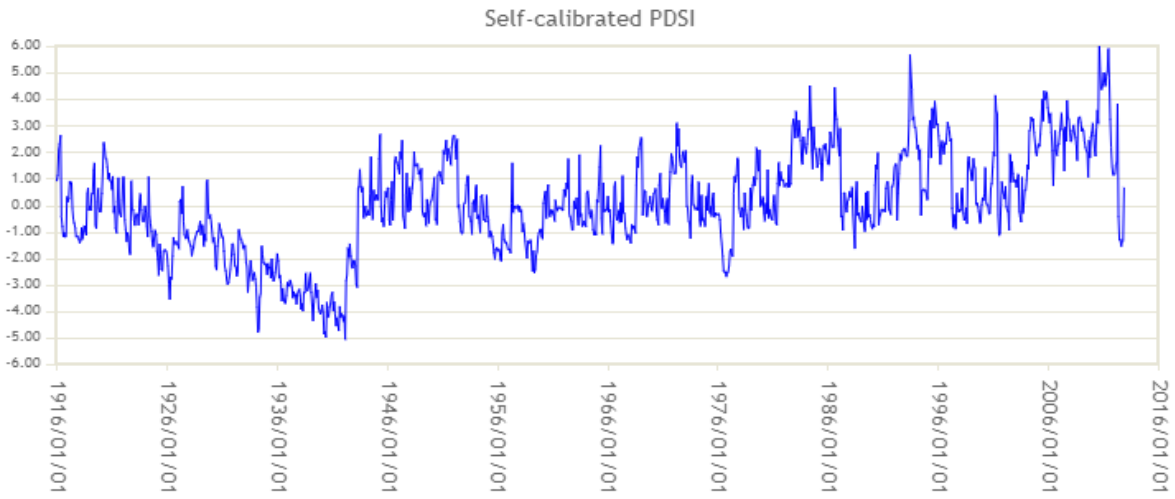
The drought history for the FSST was developed using the USDM, Drought Risk Atlas, and the Drought Impact Reporter. The data used were from the weather station located in Flandreau. Weather stations collect important information needed to analyze drought history. Some of the information collected include precipitation, temperature, relative humidity, and windspeed (NMDC 2020).**Table 2** shows the station information from the weather station in Flandreau.

Table 2: Drought Risk Atlas Station Data for Flandreau, South Dakota

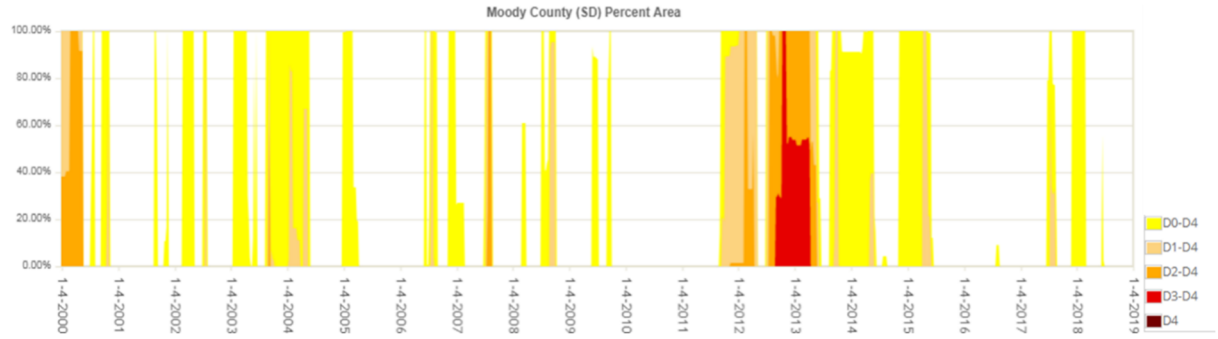
Climate Division: 7	Time Period: January 1, 1916–December 31, 2016	Years of Record: 100
392984: FLANDREAU	Latitude: 44.052	Longitude: -96.593
Elevation: 1560 ft.	State: South Dakota	County: Moody

*Graph 1 sho*ws the SC-PDSI history for the Flandreau station from the Drought Risk Atlas and *Graph 2* shows the USDM percent area statistics for each category of the instances of recorded drought for Moody County, South Dakota from 2000 to 2019.

Graph 1. Drought Risk Atlas SC-PDSI History for Flandreau, SD from 1916 to 2016



Graph 2. USDM Percent Area of Different Drought Categories for Moody County



Historical occurrences of drought in Moody County have also been documented in the following years (**NMDC, 2020**):

- 1929 to 1943: The worst recorded drought on record took place in the Dirty Thirties with the lowest SC- PDSI of -5.08. This was recorded in April of 1942.
- 1958 to 1960. Another recorded drought peaked in April of 1959 with a SC-PDSI of -2.50.
- 1975 to 1977. The second worst recorded drought on record was from 1975 to 1977. The lowest SC-PDSI recorded was -2.71 in November of 1976.

The most recent occurrence of drought has been in 2012–2013.The data from the Drought Impact Reporter aligns directly with the data produced by the USDM showing a severe drought during late 2012 into 2013. In October 2012 during this time, most of South Dakota was engrossed in either extreme or exceptional drought. Secondary impacts of this drought included cattle being sold at auction when water supplies were low, and pastures were bare. The executive director of the South Dakota Stock Grower Association expected massive cattle herd liquidations without substantial rain events (NMDC 2020).

Entering the 2013 growing season, the U.S. Department of Agriculture began declaring counties as primary and secondary disaster areas related to drought in January. Farmers in affected counties had eight months from the date of the declaration to apply for low-interest emergency loans. Laura Edwards, the State Climatologist, said that much of the southern South Dakota corn crop during these years was affected by drought, leading farmers to cut it for silage (NMDC 2020).

2.4 Probability of Future Drought

The National Climate Assessment of the Northern Great Plains includes Nebraska, South Dakota, North Dakota, Montana and Wyoming. The basis of the assessment is to analyze current available resources and use modeled projections to determine what will happen to those resources over the next half century. The assessment is analyzed in various sections: water, agriculture, recreation and tourism, energy, as well as indigenous peoples. These analyses discuss the increased probability of extreme events, like flooding and drought, through 2050 (National Climate Assessment 2018).

The National Climate Assessment states that changes in precipitation in winter and spring months will have an impact on the current climate. In winter and spring, more precipitation is projected, with an increase in extreme events, in both volume and intensity. In the summer, no change to precipitation is projected. Agriculturally, the growing season will be extended, and spring will begin earlier. However, higher temperatures are also projected for the region and more extreme daytime highs and nighttime lows will stress crops. Increased temperatures will result in higher evaporative demand, which is a measure of how thirsty the atmosphere is. This increase will result in more frequent drought and heatwaves across the region, which will reduce crop yields and quality of livestock forage. Additionally, increased temperatures will increase the range of pests within the region (National Climate Assessment 2018).

Additionally, landscape fragmentation is increasing in the context of energy development activities in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles. Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events occurring within an already highly variable climate system (National Climate Assessment, 2018).

The magnitude of expected changes will exceed those experienced in the last century, resulting increased strain on available water resources. This strain may signal increased competition for communities struggling to meet water demand. Existing adaptation and planning efforts are often inadequate to respond to these projected impacts. Although projections suggest more frequent and more intense droughts, heavy downpours, and heat waves, people can reduce vulnerabilities with new technologies, community-driven policies, and the judicious use of resources. Changing extremes in precipitation are projected across all seasons, including higher likelihoods of both increasing heavy rain and snow events and more intense droughts. Winter and spring precipitation and heavy downpours are both projected to increase in the north, leading to increased runoff and flooding that will reduce water quality and erode soils (National Climate Assessment, 2018).

3.0 Drought Vulnerability Analysis

The vulnerability, or risk, of a society to drought may be defined generally as the extent to which it will be affected by periods of natural water shortages. The DVA that was previously completed determined the drought vulnerabilities specific to FSST. The DVA utilized a division of vulnerabilities regarding the following sectors: Legal Rights and Infringements, Tribal Lifeways, Water, Land, Wildlife, Agriculture, Public Health, and Data Monitoring. This information from the DVA and further coordination completed for this project was utilized to analyze the existing water sources and uses of water by the FSST. The following further discusses the water sources for the FSST and water uses of the FSST. This analysis is followed by the determination of the main drought vulnerabilities for the FSST.

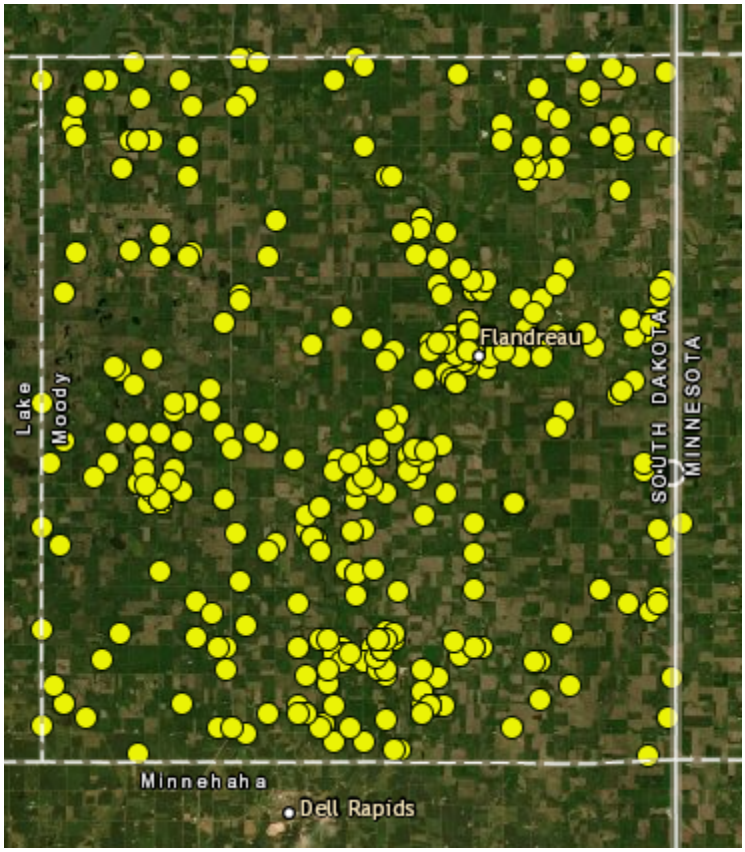
3.1 Water Sources

Due to the FSST's small land base, the Tribe has created a partnership with Flandreau and surrounding towns in Moody and Brookings Counties. In the past, the FSST had provided their people with water through their own system. This changed in the early 2000s when the Tribe received access to the Big Sioux Community Water System (BSCWS). BSCWS is available to FSST members and property within and outside of the city limits of Flandreau. Within the city limits, much of the FSST infrastructure, including the water system, is in place due to the partnership with Flandreau.

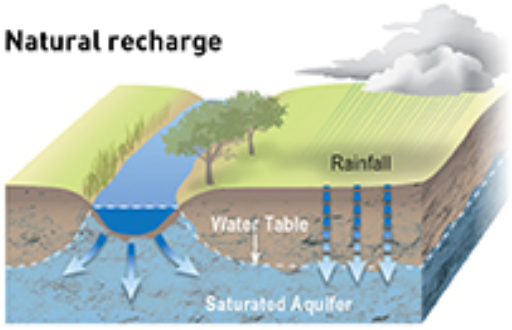
The BSCWS is the primary rural water system that serves the Flandreau Reservation, portions of Moody, Lake, and Brookings Counties, and all the communities of Colman, Egan, Wentworth, Flandreau and Trent. The BSCWS pulls water primarily from the Big Sioux Aquifer. The Big Sioux Aquifer is a shallow sand and gravel aquifer (Hansen). BSCWS has eight wells, each approximately 40 feet deep, located within the Big Sioux River valley in central Moody County, SD. Well-head protection ordinances are in place in Moody County and follow the *South Dakota Wellhead Protection Guidelines* published by the South Dakota Department of Environment and Natural Resources (SDDENR) (1995), and efforts are ongoing to protect raw water quality. BSCWS also purchases water from Minnehaha Community Water Corporation, which pumps water from wells in the Big Sioux Aquifer (BSCWS 2019). In the occurrence of insufficient water supplies, the water system operators believe a 1-year supply of water exists in the aquifer. In that time period, BSCWS could locate and drill a new well system (personal communication, Martin Jarrett, BSCWS, 2017).

Several private wells also exist throughout Moody County and these wells would also pump water from the Big Sioux Aquifer. A search of SDDENR's "Well Completion Reports" map found there to be a total of 495 private wells located in the county. The listed wells had completion dates ranging from the 1930's up to 2019, with most of them being completed in the 1990's and 2000's. Each well was owned by either a private house/landowner or a business. ***Figure 2*** below displays a map of all completed wells on record, obtained from the SDDENR website.

Figure 2: SDDENR Map of Completed Wells in Moody County, SD
(Yellow dots are private wells)



The water BSCWS pumps from the wells originally comes from the surface, and very slowly seeps down into the aquifer. Most of the natural recharge of the aquifer is through filtration from the Big Sioux River. The Big Sioux River and tributaries provides recharge to the Big Sioux Aquifer due to the geology of the area (personal communication, Martin Jarrett, BSCWS, 2017). As water travels over the surface of the land or through the ground, it can dissolve naturally occurring minerals, and pick up substances resulting from the presence of animals or from human activity. Too much of any substance, either naturally occurring or resulting from human activities, can be considered a contaminant (BSCWS 2019).



Graphic 3. Natural Recharge of an Aquifer

To consider the water quality of the Big Sioux River and tributaries that are recharging the water source in this area, the *2020 South Dakota Integrated Report for Surface Water Quality Assessment* was reviewed. The SDDENR provides a summary of detected contaminants in bodies of water throughout South Dakota as part of their bi-annual Integrated Report. The pertinent information that the summary lists includes: the water body and test location, the detected contaminant(s), the observation year, and the total maximum daily load (TMDL) schedule, which is essentially a "repair-by" date, and whether the situation is of high or low priority. The 2020 Integrated Report noted three named

waterbodies that are in the area in Moody County, the Big Sioux River, Bachelor Creek, and Flandreau Creek. Bachelor and Flandreau Creek were contaminated with *E. Coli* and have a TMDL scheduled for 2028. The Big Sioux River was contaminated with total suspended solids (TSS) and mercury. Mercury was noted in fish sampling in 2016 (SDDENR 2020). Natural sources of mercury include volcanoes, forest fires, ore, and fossil fuels such as coal and petroleum. The main way that people are exposed to mercury is by eating fish and shellfish that have high levels of methylmercury. Typically, mercury is natural but can also occur when mercury is released from a container, from a product or device that breaks. If mercury is not immediately cleaned up from the spill, it evaporates and becomes an invisible, odorless, toxic vapor (US EPA 2020). Mercury levels have not been an issue for groundwater in this area (BSWCS 2019).

BSWCS's Drinking Water Report identifies all detected contaminates in the drinking water provided by BSWCS. The 2019 report indicates no threatening levels of any EPA regulated contaminants. However, ***Table 3*** lists the highest recorded levels of each contaminant with the major source of each contaminant. Seven primary sources of contamination are listed:

1. Corrosion of household plumbing systems
2. Leaching from wood preservatives and septic systems
3. Erosion of natural deposits
4. Water additives for teeth strengthening
5. Discharge from fertilizer and aluminum factories
6. By-products of water chlorination
7. Runoff from fertilizer use

Some of these contamination sources, specifically item 4 and 6, are results from water treatment plants, meaning they are easier to control and less of threat to water quality. The other listed contamination sources, however, are more difficult to trace and control. For this reason, any contaminant that lists one of these sources is a threat to water quality.

Table 4 lists the levels of water contaminants that are currently not regulated by the EPA.

Table 3. 2019 Detected Regulated Contaminants for BSWCS

Substance	90% Level	Test Sites > Action Level	Date Tested	Highest Level Allowed (AL)	Ideal Goal	Units	Major Source of Contaminant
Copper	0.0	0	05/09/18	AL=1.3	0	ppm	Corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives.
Lead	1	0	05/09/18	AL=15	0	ppb	Corrosion of household plumbing systems; erosion of natural deposits.

Substance	Highest Level Detected	Range	Date Tested	Highest Level Allowed (MCL)	Ideal Goal (MCLG)	Units	Major Source of Contaminant
Fluoride	0.96	0.56 - 0.96	11/14/19	4	4	ppm	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories.
Fluoride *	0.81	0.38 - 0.81	06/27/19	4	4	ppm	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories.
Haloacetic Acids (RAA)	11.1		09/26/19	60	0	ppb	By-product of drinking water chlorination. Results are reported as a running annual average of test results.
Haloacetic Acids (RAA) *	12.2		08/26/19	60	0	ppb	By-product of drinking water chlorination. Results are reported as a running annual average of test results.
Nitrate (as Nitrogen)	6.0		07/29/19	10	10	ppm	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.
Nitrate (as Nitrogen) *	2.3		07/10/19	10	10	ppm	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.
Total trihalomethanes (RAA)	30.5		09/26/19	80	0	ppb	By-product of drinking water chlorination. Results are reported as a running annual average of test results.
Total trihalomethanes (RAA) *	26.8		08/26/19	80	0	ppb	By-product of drinking water chlorination. Results are reported as a running annual average of test results.

Table 4: 2019 Detected Unregulated Contaminants for BSWCS

Substance	Level Detected	Units	Date Tested	Range
Bromide	49.000	µg/L	02/05/2019	26.000-49.000
Manganese	0.460	µg/L	07/16/2019	0.460-0.460
HAA5	8.100	µg/L	07/16/2019	7.300-8.100
HAA6Br	8.260	µg/L	07/16/2019	6.550-8.260
HAA9	14.460	µg/L	07/16/2019	12.350-14.460
Total Organic Carbon	2100.0	µg/L	02/05/2019	1100.0-2100.0

3.2 Water Use

3.2.1 Domestic and Municipal

Flandreau reported for 2019 that 100 percent of their water is purchased from BSCWS and within the city limits are 2,341 customers. On average 291,000 gallons of water are used a day from these customers (City of Flandreau 2019). BSCWS reported serving more than 5,337 total customers in 2019 and on average 2,030,00 gallons of water per day (BSCWS 2019).

According to Moody County's Emergency Management Director, impacts of drought today are less impactful now than in the past. This was attributed it to the advancement of irrigation, field sprinklers, and wells. These technologic advancements allow for more effective and efficient use of water. Additionally, after long drought periods, flooding can become an issue for infrastructure in the area. For example, during drought, vegetation cover is reduced. This reduction in vegetation cover followed by flooding events can cause runoff that is faster flowing, causing the headwater to rise faster and can cause more erosion in an area.

3.2.2 Tribal Lifeways

The bison is held in significant cultural significance to the Tribe. The Tribe does have a bison herd, which is currently 50-60 head. The Tribe has had issues with the pasture the herd utilized being overgrazed and the herd having an outbreak of Brucellosis. In the past, the bison was used as the primary food source for indigenous peoples. Since the bisons near extinction and recent revival, many other Tribes have taken upon themselves to develop their own herds. Although these bison are no longer wild and hunted, they are still leaner than the modern cow. The bison is utilized for spiritual ceremonies, for funerals, or for food assistance for the elders of the FSST.

Photo 6. Bison herd

3.2.3 Agricultural Practices

FSST has trust land that can be used for farming that is leased out to Tribal members and non-members. In times of drought the lease amounts can decrease due to a reduction in demand from farmers and reduction in yields from crops. The majority of the FSST lease

land is primarily used for farming, including grazing and row crops. This reduction in lease amounts and crop yields would affect the finances of the FSST.

Farmers in the area choose to have a water hook up from BSCWS for their households and some choose to water their livestock herds. Those that do not have a BSCWS likely have private wells in the Big Sioux Aquifer. Irrigation is present in the area and private wells or surface water is utilized as the sources, rural water is not utilized. Restrictions have not had to be utilized often; lawn watering restrictions have been utilized for short periods of time. If BSCWS needs to reduce their water usage then this will be distributed equally among all users (personal communication, Martin Jarrett, BSCWS, 2020).

The Tribe identifies the Big Sioux River's flow rate as their main indicator of drought. Bad years for drought on the Reservation have been identified as 1976, 1988, and 2017. Historically, flooding events are becoming a larger vulnerability for the FSST. Drought followed by flooding can cause more effects due to lower vegetation cover, which can cause runoff to increase in speed. This faster moving runoff can cause additional erosion and affect infrastructure (i.e. washed out roads). Another form of weather that causes a vulnerability to the FSST is windstorms, as the topography of the area offers few natural breaks from high winds. Adding high winds and hail to a drought situation, the threat of topsoil degradation becomes a concern. As soil dries out and winds increase, the topsoil can erode, leading to economic losses and decreases in yield. No-till farming practices are implemented in the area and help to reduce topsoil degradation.

Modern technology has mitigated many of the effects that drought has on the agricultural sector compared to the past, including the development of irrigation. Although Flandreau is in an area that receives adequate rainfall during the warm season, droughts do occur. These droughts would affect ranchers, farmers, and the Tribe. During a drought, farmers and ranchers who lease land from the Tribe must produce crops and cattle with reduced water and available resources.

3.2.4 Fish and Wildlife/Recreation

According to South Dakota Game, Fish, and Parks (SD GFP), wildlife populations are steadily increasing. Historic references indicate that animal sightings were extremely rare in the late 1930s. The Big Sioux River is used for fishing, but the fish that are caught should not be eaten due to the water quality. River otters were reintroduced to the river and can still be seen (Mark Allen, GAP Coordinator, Personal Communication, 2019). In 2017, the following animals were reported in the harvest reports: geese, ducks, doves, and deer. Specific data on the animals on the reservation cannot be narrowed down any further due to those numbers being reported to SD GFP.

3.2.5 Fire Suppression

The Flandreau Fire Department provides fire protection and emergency response services to the Flandreau community. It is a volunteer-operated department consisting of a single station in Flandreau. The Fire Department's mission is to prevent the loss of life and property. In addition to responding to fires, the Flandreau Fire Department also responds to medical emergencies, motor vehicle accidents, rescue calls, and incidents involving hazardous materials. Fire hydrants within town are maintained by Flandreau.

Fire response services are another primary user of the BSCWS. Currently, there is concern that emergency fire services may not be able to fully rely on the water system to put out fires as the high consumptive use

would overstress the system. As an example, in 2017 there was a structure fire where emergency services drew down the water storage in Flandreau's water tower and had to pull directly from BSCWS pipeline. The water usage directly from the BSCWS system for this fire suppression had to be stopped or the water system would have not been sufficient for the other users. In the occurrence of widespread fires, the various volunteer fire departments need to have a reliable water source of water to attend to those high demands (personal communication, Martin Jarrett, BSCWS, 2017).

This is page is intentionally left blank

Table 5. 2019 Detected Regulated Contaminants for BSWCS

Water Use Sector	Surface Water Supply	Groundwater Supply	Water Management	Drought Risk
Domestic and Municipal	Not applicable.	Rural water, BSCWS, available and utilizes wells in Big Sioux Aquifer. Private wells would also utilize wells within Big Sioux Aquifer.	BSCWS has been the water provider since 2000. Within city limits, FSST has agreement with Flandreau for water system infrastructure.	LOW RISK for quantity- one water source but source quantity appears to be reliable. MEDIUM RISK- Quality is a concern since the aquifer is shallow and pollutants could contaminate the system. MEDIUM RISK- Drought causing reduction in vegetation cover.
Tribal Lifeways	Bison herd utilizes surface water for water source.	Unknown if herd utilizes a private well or BSCWS source for water.	FSST manages the bufallo herd.	MEDIUM RISK- Overgrazing of the bison pasture could cause issues for forage levels during drought.
Agriculture	For irrigation and livestock watering, farmers do utilize surface water; the number of systems is unknown. BSCWS is utilized for livestock watering. No irrigation. Rural households are served by BSCWS for drinking water.	Private wells may be utilized for livestock, irrigation and drinking water.	Managed by individual farmers leasing FSST property to determine to have either private well or receive water from BSCWS.	LOW RISK for quantity- Big Sioux Aquifer and surface waters are utilized and are currently reliable.
Fish and Wildlife/Recreation	Rivers, tributaries, lakes, stock ponds, oxbows and wetlands in the area.	Springs and wells, in some cases livestock water sources pumped from wells is drank by wildlife.	Managed by SD Dept. of Game Fish and Parks and SD Dept. of Environment and Natural Resources. Managed by the City of Flandreau for recreation areas in town.	LOW RISK- water quantity is not as large of a concern with the Big Sioux River and its tributaries present on Reservation property. MEDIUM RISK- Contaminents have affected limited contact recreation beneficial use of the Big Sioux River.
Fire Suppression	Not applicable.	BSCWS has been utilized for fire suppression in the area of rural water services. Flandreau provide the hydrants and maintain their own hydrant system. During past fires, water use from the system was discontinued due to lack of supply for users and fire suppression.	Fire departments are managed by the Flandreau. Fire hydrants are managed by Flandreau. BSCWS manages the water supply for fire suppression.	HIGH RISK- A large fire has happened in past, and an alternative water source had to be found. An alternative water source for fire suppression activities is needed.

This is page is intentionally left blank

3.3 Priority Drought Vulnerabilities

Drought vulnerabilities were identified in the previous DVA. Please refer to *Appendix A.* The table shows the results of the responses, as well as their specified rank. A lower score represented what interviewees perceived to be the biggest vulnerabilities. The top five drought vulnerabilities were primarily determined from discussions with Moody County's Emergency Management Director, FSST's Water Quality Specialist, FSST's Natural Resource Department's Brownfield Coordinator, and BSCWS Administrator.

In addition to this ranking process of the previous vulnerabilities, additional coordination occurred during the finalization of this report with a technical committee that included U.S. Geological Services, Moody County Conservation District, National Drought Mitigation Center, and BSCWS. The information previously gathered in the DVA, research, and coordination for this project identified the following vulnerabilities as priorities for FSST to focus upon:

3.3.1 Vulnerability #1: Contamination of the Big Sioux Aquifer

The BSCWS Administrator noted that the region's potable water source is the groundwater table, which would have to sustain a multi-year drought event to become unusable. So, quantity is not as much of a vulnerability as maintaining quality of the one source, the Big Sioux Aquifer. As noted, the Big Sioux River and its tributaries are exhibiting levels of monitored pollutants. The Big Sioux River and its tributaries are recharge areas for the Big Sioux Aquifer. In addition, the aquifer is shallow so vulnerable to pollution from the surface activities.

3.3.2 Vulnerability #2: Overtaxing the Water System

Another recognized vulnerability was the fire suppression system, which can overwhelm the water system if used for an extended amount of time to extinguish a fire. The fire departments would likely have to rely on stock dams, the Big Sioux River, and area lakes to draw water from during extended amounts of fire-fighting time. This situation occurred in 2017, when a fire in downtown Flandreau was being fought for several hours. The fire department had to rely on local stock dams and lakes to put the structural fire out. BSCWS provided as much water as possible, even shutting off water to specific areas of town to increase its capacity, but supplemental water sources were still required.

3.3.3 Vulnerability #3: Drought Exacerbated Flooding

In the Flandreau area, flooding events have been an issue. A drought followed by flooding can severely affect this area. Bare areas can occur after a drought due to vegetation die out. Lack of vegetation coverage can cause major concerns for flood events, which are occurring in this area more recently. The lack of vegetation allows for more runoff and higher velocity of flow from the runoff, which can create more erosion issues.

3.3.4 Vulnerability #4: FSST Land Leases Affected by Drought

FSST land is currently utilized for livestock production and row crops.

Performance of livestock is a function of nutrient requirements and intake. The quantity and quality of the available forage are the primary regulators of nutrient intake in grazing cattle. Animal performance will decline whenever remaining forage falls below a minimum level. Even when drought does not occur, animal

performance declines as the summer grazing season progresses. These seasonal declines are due to plant maturity. If plant growth is stopped by drought, forage quality may decline rapidly because livestock selectively graze the highest quality forage first. The rate of decline of forage quality and quantity during drought is much more pronounced during drought than in an average growing season. Drought often reduces the number of days during which green forage is available to livestock (NDMC 2020). The issue of the reduced amount of forage requires famers to lose profit, which in turn can reduce the lease money the Tribe would receive.

In addition to impacts to livestock, a drought in South Dakota would have significant economic impacts on agricultural production, production costs, and gross revenue from crops. The major crops in the area include corn, soybeans, wheat, sunflowers, and oats, and yields of these crops can be utilized to estimate economic losses (Diersen, Taylor and May, 2002). The USDA National Agricultural Statistics Service (2020) valued the state's 2019 field and miscellaneous crops at $4.56 billion, which is down 22 percent from 2018. In South Dakota, there are periods of hot, dry weather in at least parts of the state. If the hot and dry weather occurs during grain pollination and fertilization, negative effects on yields may be substantial. Yields may be reduced at any time during the growing season when water usage exceeds supply, and early season drought stress may reduce total plant size and grain yields (Kleinjan 2017).

4.0 Drought Monitoring and Response Actions

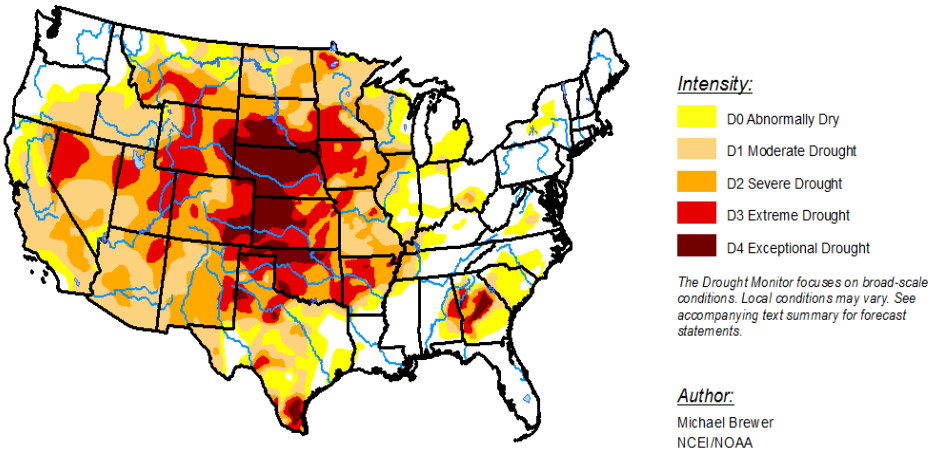
There are various methods and indices that track current drought conditions across the country. Many include different variables, like precipitation, soil moisture, and humidity. For FSST, two monitoring indices will be utilized, the US Drought Monitor (USDM) and the Evaporation Demand Drought Index (EDDI).

4.1 Drought Monitoring

4.1.1 USDM

The USDM is a semi-objective drought index that brings together several experts from the National Drought Mitigation Center, National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, and the National Integrated Drought Information System. Using a variety of different tools, including indices like the Palmer Drought Severity Index (PDSI), to determine current drought conditions throughout the U.S. There are four classification levels of intensity: D0 (abnormally dry), D1 (moderate drought), D2 (severe drought, D3 (extreme drought), and D4 (exceptional drought). ***Figure 3*** shows the USDM for the continental U.S during the 2012 drought.

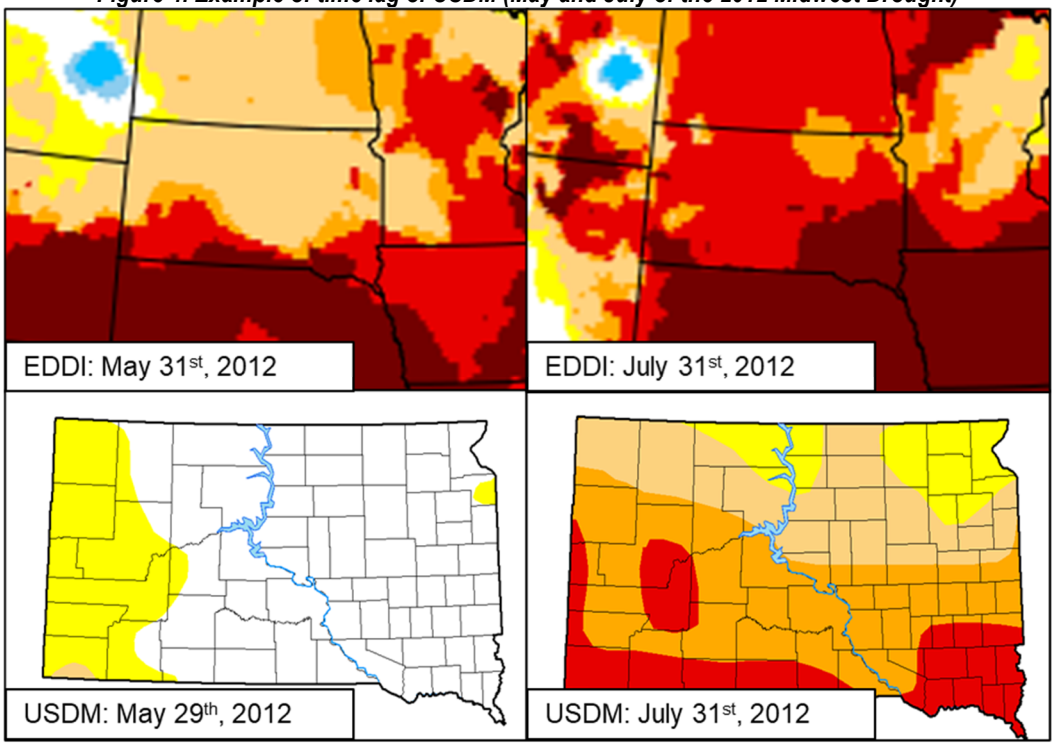
Figure 3. USDM (Example Figure from October 30th, 2012)



4.1.2 EDDI

The EDDI is an experimental drought monitoring tool developed by climate scientists at NOAA. It is an index based on “evaporative demand”, which is basically a measure of how thirsty the atmosphere is. It uses measurements of temperature, humidity, windspeed, and solar radiation; all of which both contribute to and reflect the dying out of soil and vegetation. It is measured at different levels of intensity, similar to the USDM to the effect that: ED0 = D0, ED1 = D1, ED2 = D2 etc. However, it is not equivalent to the USDM because it does not measure soil conditions. What makes EDDI unique compared to the USDM is that it can measure “flash droughts”, which are short, intense periods of drying that can take a major toll on crop yields when they occur. EDDI can also show the early signs of a developing long term term drought. This is due to the fact that EDDI only has a 5-day lag in data compared to the USDM, which has a lag of over a month. Please refer to ***Figure 4*** showing the USDM taking months to show the severity observed by EDDI.

Figure 4. Example of time lag of USDM (May and July of the 2012 Midwest Drought)



4.1.3 Drought Monitoring Conditions

Drought monitoring should occur after the end of each month and should show both the final one-month EDDI conditions, and USDM conditions for that month. Current conditions should be classified in four different categories with criteria shown in ***Table 5***. Both current EDDI and USDM conditions can be found at the following links:

USDM: https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?SD

EDDI: https://www.esrl.noaa.gov/psd/eddi/

4.2 Drought Response Actions

With each set of drought conditions, certain actions are suggested to be taken by local governments. Drought response actions are meant to allow local governments to adjust to the impacts of a drought. Even during a normal or wetter period, actions can be taken to further prepare for a potential drought. ***Table 5*** shows recommended drought adaptation actions under normal, alert, warning, and emergency conditions. All actions are broken down into each water use sector.

Table 6. Drought Monitoring Conditions and Response Actions

	Normal (No Drought)	Alert (Mild Drought)	Warning (Moderate Drought)	Emergency (Severe to Extreme Drought)
Drought Stage Parameters	No USDM Classification	D0 USDM Classification or one-month ED3-ED4 EDDI Classification	D1 and D2 USDM Classification	D3 and D4 USDM Classification
All Water Use Sectors	• Identify agencies that will head actions and plans. • Review Tribal codes and policies and if needed, establish additional codes and policies for water use conservation. • Develop a plan with the BSCWS about possible drought conditions and responses.	• Increase active enforcement of relevant Tribal codes and policies. • Monthly or quarterly report detailing current drought conditions to be made public.	• Prepare Drought Emergency Declaration. • Prepare letters to secretaries for drought determination. • Increase active enforcement of relevant Tribal codes and policies. • Monthly or quarterly report detailing current drought conditions to be made public.	• Declare Drought Emergency. • Send letters to secretaries for drought determination and assistance. • Support actions and resolutions for drought assistance funding. • Increase active enforcement of relevant Tribal codes and policies. • Monthly or quarterly report detailing current drought conditions to be made public.
Domestic and Municipal Use	• Distribute water conservation information to the community. • Review water restriction regulations and guidance, and if needed add additional. • Identify needs and develop proposals for the additions of flood control and water features for flood management.	• Encourage voluntary water use conservation efforts. • Limit firework displays. • Encourage drought resistant landscaping.	• Establish water use restrictions. • No firework displays.	• Establish water use restrictions. • No firework displays.
Agriculture	• Complete grazing assessments. • Encourage of crop rotation. • Encourage practices to reduce erosion of topsoil.	• Encouragement of grasses in pastures that need require less water. • Encourage row crops that need less water. • Encourage irrigation system efficiency checks and updates to improve efficiency. • Encourage practices to reduce erosion of topsoil. • Encourage pasture rotation for cattle.	• Encourage row crops that need less water. • Encourage drought resistant landscaping. • Encourage supplemental irrigation. • Encourage practices to reduce erosion of topsoil. • Encourage pasture rotation for cattle. • Encourage voluntary livestock reduction.	• Establish fire restrictions.
Fish and Wildlife/Recreation	• Develop wildlife habitat management plan. • Continue management of hunting and fishing licenses.	• Monitor conditions for fish and wildlife. • Monitor drought common disease outbreaks in big game. • Continue management of fishing and hunting licenses.	• Monitor conditions for fish and wildlife. • Monitor drought common disease outbreaks in big game. • Adjust hunting licenses to increase harvest, reducing impact on available forage. • Encourage prairie dog control to reduce competition for farm and rangeland.	• Monitor conditions for fish and wildlife. • Monitor drought common disease outbreaks in big game. • Adjust hunting licenses to increase harvest, reducing impact on available forage. • Encourage prairie dog control to reduce competition for farm and rangeland.
Fire Suppression	• Identify sources of water for structural fire and wildfire response. • Check availability of water carrying equipment.	• Coordinate with fire management regarding wildfire response. • Encourage practices to reduce erosion of topsoil. • Encourage pasture rotation for cattle.	• Coordinate with fire management regarding wildfire response.	• Coordinate with fire management regarding wildfire response.

This is page is intentionally left blank

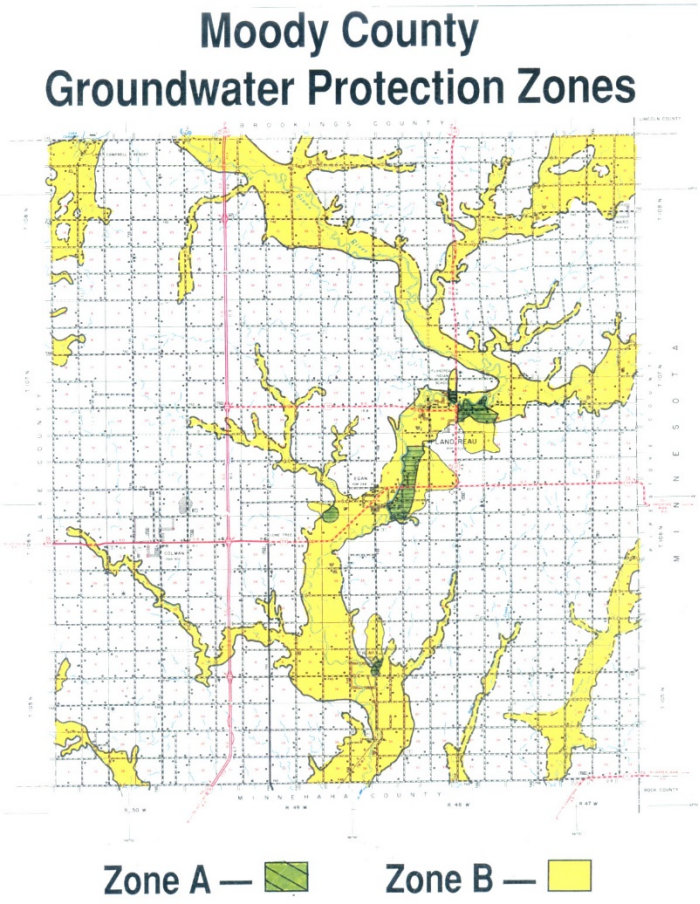
5.0 Drought Mitigation Strategies and Potential Future Projects

The purpose of this plan component is to develop mitigation strategies for this implementing long-term measures to reduce drought risk. As in dealing with any type of disaster, this type of strategic approach is referred to as risk management. ***Table 6*** shows the vulnerabilities identified and the mitigation strategy that addresses those vulnerabilities to reduce the risk to FSST during drought. Several projects are identified for each mitigation strategy and potential project funding.

The following sections discuss the mitigation strategies and the potential projects identified.

5.1 Protection of Groundwater Recharge Zone and Focus on Quality Drinking Water

Figure 5. Moody County Groundwater Protection Zones



Due to the reliance on one water source, the Big Sioux Aquifer, protection of that source from pollutants is needed. Protections are already in place; ***Figure 5*** shows the groundwater protection zones that were determined by East Dakota Water Development District. FSST can work with local agencies, state agencies and BSCWS to advocate for the protection of recharge areas. The work done for the FSST Brownfield Program including solid waste codes and addressing hazardous materials should continue. Communication with entities such as SDDENR, East Dakota Water Development District and BSCWS should continue throughout each drought stage.

In addition, water systems need assistance with contingency planning. FSST could work with these agencies to identify future projects including such as revising the existing groundwater protection zone map. For water quality, FSST could continue to advocate water quality monitoring of the Big Sioux Aquifer by coordinating with SDDENR, Flandreau, BSCWS and other agencies such as USGS.

FSST could implement education programs on the protection of aquifer recharge zones by producing informational materials, coordinating with the Tribal leaders to distribute information, and coordinating with schools for education opportunities. Many opportunities exist as well for education of FSST's children, such as the Big Sioux Water Festival or the Sioux Empire Water Festival. FSST could assist and present at these types of events indicating the importance of protection of the Big Sioux Aquifer.

5.2 Best Management Practices Implementation for Construction and Agricultural Practices

For projects that disturb more than one acre of land, a general construction National Pollutant Discharge Elimination System (NPDES). This requires the implementation of a Stormwater Pollution Prevention Plan (SWPPP). FSST can work with Flandreau and Moody County to review the requirements for BMPs for construction projects. Additional requirements that FSST can implement can be reviewed.

Livestock can cause issues for water quality in streams by elevating sediment in the streams and *E.Coli* from waste. Best management practices for agricultural practices that focuses on water quality include conservation buffers (i.e. grassed waterways, riparian buffers), conservation tillage, crop nutrient management, irrigation water management, and grazing management (i.e. livestock water access) (US EPA, 2020). The FSST Reservation does have property that does include reaches of the Big Sioux River and its tributaries. Moody County Conservation District has specific programs that would allow the protection of these waterways, future coordination would be able to identify the best programs for the Tribe.

5.3 Water Storage Options for Fire Suppression and Additional Water Uses

As noted in the vulnerability assessment, water availability was limited to serve the existing water needs and be utilized for the suppression of larger wildland fires. Retention basins, stock dams, larger wetlands, or the Big Sioux River and its tributaries could potentially also be water sources for fire suppression. Section 5.5 further discusses retention basins which are a possibility as a water source for fire suppression. Typically, retention basins are located in urban settings. For rural setting, opportunities for additional sources could be stock dams or larger wetland complexes.

An option of a water tower was considered, but would required maintenance and the water stored would need to be flushed once a week. This would not be a good options moving forward, instead the option of a shallow well would be more viable. FSST does have trust lands that the Big Sioux River flows through that a shallow well could be drill adjacent to the river. The well could be utilized but the Flandreau Fire Department during large fire events. FSST would need to coordinate with the department.

FSST also could identify these locations and work with landowners and/or leases to have agreements that allows these areas to be utilized in the event of a larger fire. These areas can then be relayed to the fire departments, including access to the areas determined. In addition, the Big Sioux River or its tributaries could be utilized with planning, and permitting with the SDDENR and U.S. Army Corps of Engineers would need to be investigated, including mechanisms to obtain the water.

5.4 Water Use Education and Restrictions

Many times, in older water systems leaks and breakdowns of the system can lead to loss of drinking water. FSST has agreements with the City of Flandreau regarding the water system. Additional coordination could occur to identify projects that would update or fix any segments of the system that are an issue. By completing these infrastructure updates, water would be conserved within the existing system, preparing for drought events.

Water use restrictions can also be utilized, either through voluntary user efforts or enforced efforts. Voluntary efforts can include incorporating practical measures every family can incorporate such as low-flow shower head and water efficient toilet. Education can be provided through social media to encourage these voluntary actions. Enforced restrictions can also be determined by FSST for water use such as lawn watering times

Figure 6. Example Voluntary Water Use Reduction Efforts

Reduction of water use for landscaping can also be incorporated, including timing and reduction of irrigation for traditional landscaping or even drought resistant landscaping. Drought resistant landscaping utilizes the growing of plants and grasses common to South Dakota or other similar drier climates. Prairie grasses and wildflowers offer an aesthetic alternative to traditional lawns that can be implemented and maintained using less water. Advertising campaigns can be used to spread information to residents about the individual aesthetic and economic benefits of drought resistant landscaping. Advertising campaigns can also serve as a how-to guide to implement drought resistant landscaping on their own property. The rise of social media has made it quick, easy, and inexpensive to spread information to local community members through various platforms.

5.5 Stormwater Retention System

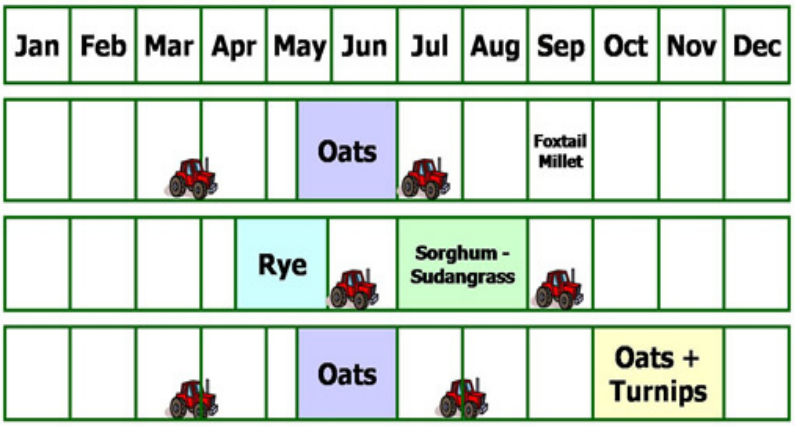
To mitigate issues caused by climatic changes from drought events to flood events in this area, flood control measures can be implanted in the area. The most common flood control measures involve both structural and non-structural mitigation. Structural mitigation includes implementing structures like flood control basins, levees, and dams to help divert and store water away from developed risk areas. Non-structural mitigation involves changing how people interact with the floodplain and associated risks if avoiding the area is not a viable option.

There are two types of flood control basins, dry basins and retention basins. The purpose of both types of basins is to capture stormwater runoff and allow time for the runoff to infiltrate into the soil. A retention basin will act as a pond with existing water already inside the basin, while a dry basin remains dry until a storm event. Both would help reduce flooding by funneling stormwater runoff away from developments and infrastructure into one location for it to infiltrate. Basins do not work well for features located within floodplains because the elevation of the river surface during a flood would be higher than the basin itself.

For any developments within the floodplain of the Big Sioux River, there are methods to reduce the effect of flooding. Adequate zoning laws prevent development within the floodplain, preventing any loss of the flood retention capacity. However, because significant cultural resources, like the Powwow grounds, are currently located within the floodplain, other actions can be taken. To control flooding to agricultural land and other municipal facilities, levees can be constructed. Levees are earthen embankments with wide bases that taper upwards. Properly constructed levees can hold back an elevated river as it enters flood stage. However, consistent maintenance is needed to ensure that the levee can continue to perform its intended function.

Stormwater management is at the convergence of multiple issues that involve pollution, emergency management, and rural development. Overall, the scope of funding for stormwater management is geared mostly toward emergency mitigation and pollution reduction in both urban and rural communities.

Figure 7. Example Planted Forage Schedule for Drought Conditions (National Drought Mitigation Center 2020)



5.6 Livestock Management

As noted earlier, drought can affect the amount of forage available. A few options are available for FSST to encourage or require leases to consider on their property. A pasture improvement assessment can be completed by local NRCS, Conservation District or Extension. Solutions such as working planted forage resources into the feeding strategy can be established. In addition, an evaluation of the reduction options to your herd can also be considered. This might create a better balance of the forage available and keep the herd healthy. The herd reduction strategies can include: 1) Selling feeder animals early, 2) Selling replacement breeding animals, 3) Reduce breeding animal numbers, 4) Selling the herd and ceasing production, and 5) Selling the heard and restocking later (National Drought Mitigation Center 2020). In addition, water sources to the herd need to be considered. FSST's property does border the Big Sioux River and its tributaries. A private or water line from BSCWS can also be provide for water to encourage options for watering. In addition, a review of any stock dams could be completed and if any maintenance activities (i.e. removing sedimentation) can be completed. FSST can encourage or require the farmers to complete these pasture improvement assessments and analyze the different water sources provided.

5.7 Crop Management

Water efficient crops and grasses can serve as an important resource in mitigating the effects of drought. There are many avenues a community could take in promoting the use of water efficient crops. The education and encouragement of farmers to produce water efficient crops could be done using both classes and advertising. FSST could also begin a program that would require the use of specific crops through funding. The funding could be used to subsidize crop seeds as well as provide resources for maintenance and harvest.

While the weather cannot be controlled, producers can manage for potential drought stress by using practices that conserve soil moisture and planting hybrids with a good overall stress tolerance. In some cases, planting early maturing hybrids may allow pollination and early development to take place prior to heat and drought conditions.

Drought tolerant corn and wheat are prevalent across the country. Drought tolerant corn varieties are genetically engineered strains of corn sold by companies throughout the US. As of 2016, only about 10 percent of irrigated corn in south Dakota was drought tolerant and over 20 percent of non-irrigated corn was DT. In the US, drought tolerant corn, since their commercial introduction in 2011, has seen increases in use

in response to frequent drought the plagues regions from West Texas to North Dakota. (McFadden et al, 2019). Drought resistant wheat, like hard red spring wheat, is common through much of the northern great plains. The states of South Dakota, North Dakota, Minnesota and Montana account for about 95 percent of hard red spring production in the US. Genetic Modification and breeding have improved both resistance to drought and yields in such condition, making each new strain better than the last (North Dakota Wheat Commission, 2020).

This is page is intentionally left blank

Table 7. Vulnerabilities, Mitigation Strategies, Potential Projects, and Potential Funding

Vulnerabilities	Mitigation Strategy	Potential Project	Potential Funding
#1: Contamination of Big Sioux Aquifer	Protection of Groundwater Recharge Zone and Focus on Quality Drinking Water	Advocate with local agencies, state agencies and BSCWS to protect the recharge areas for the aquifer. Revise the recharge zone map.	US EPA Office of Water, Office of Wetlands, Oceans and Watersheds. Section 319 of the Clean Water Act (CWA). Opportunities for eligible Tribes and intertribal consortia to develop and implement watershed-based plans and implement watershed projects that will results in significant steps towards solving Nonpoint Source (NPS) impairments on a watershed-wide basis. US EPA Water Pollution Control Section 106 Supplemental Grant. Provides support for state, interstate and eligible tribal recipients of Section 106 grants for Water Pollution Control Programs. Covers activites l,e,m water quality standards, water quality monitoring, impaired waters listing and total maximum daily loads development, National Polutant Discharge Elimination System permitting and enforcement and compliance. US EPA Office of Brownfields and Land Revitalization. Section 128(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), authorizes a noncompetitive grant program to establish and enhance state and tribal response programs, by providing training, research, and technical assistance to individuals and organizations, as appropriate, to facilitate the inventory of brownfields sites, site assessments, remediation of brownfield sites, community involvement, or site preparation. SD DENR Water and Waste Funding Program. Small Community Planning Grant. This program provides small communities with funds to hire an engineering consultant to develop a project specific engineering report. The engineering report's level of detail will be on par with the facilities plan required for SRF projects, The project sponsor must be an entity of government (county, municipality, or township), or a special purpose district with the authority to construct a water or wastewater project (sanitary, water user, watershed, or water project). Nonprofit organizations are also eligible provided they were formed for the primary purpose of supplying water or sanitary service. Nonprofit water systems applying for this grant must meet the definition of a community water system (a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents). Housing & Urban Development- Community Development Block Grant Program US Department of Agriculture- Rural Development Water & Waste Disposal Predevelopment Planning Grants; Rural Development Water and Waste Disposal Loan and grant Program; Water & Waste Disposal Grants to Alleviate Health Risks on Tribal Lands and Colonials
		Continue to implement FSST Brownfields program to prevent spills and regulated materials (US EPA 2020).	
		Education on protection of water sources and aquifer recharge zones.	
		Install or encourage filtration systems in homes.	
		Determine and create detention areas that could retain stormwater for flooding events that may follow drought	
	Best Management Practices implementation for construction and agricultural practices	Identify potential areas for riparian buffers or other BMPs along waterways on FSST property.	
#2: Overtaxing the Water System	Water storage options for fire suppression and additional water uses	Identify stock ponds, oxbows, or wetlands that could be available for water source for fire suppression. Creating or determining locations and putting agreements in place with landowners.	US EPA-Wetland Program Development Grant. The primary focus of these grants is to develop/refine state and tribal wetland programs. A secondary focus is to develop/refine local (e.g. county or municipal)programs. US EPA- Water Infrastructure Improvements for the Nation Act Grants; Drinking Water State Revolving Fund; Drinking Water Infrastructure Grant - Tribal Set-Aside Program Housing & Urban Development- Community Development Block Grant Program US Department of Agriculture- Emergency Community Water Assistance Grants; Special Evaluation Assistance for Rural Communities and Households US Department of Commerce- Public Works and Economic Development Facilities Program
		Drill a well adjacent to the Big Sioux River, approximately 20-30 feet deep, that will provide water source during rural fire event. Coordinate with Flandreau Fire Department to allow access to well.	
	Water Use Education and Restrictions	Identify BSCWS and Flandreau system losses and inefficiencies.	
		Work with the City of Flandreau and BSCWS to identify effective ways of enforcing water restrictions.	
#3: Drought Exacerbated Flooding	Stormwater Retention System	Determine and create detention areas within urban settings that could retain stormwater for flooding events that may follow drought. Consider levees for areas that are consistently flooded.	US EPA – Office of Chemical Safety and Pollution Prevention, Office of Pollution Prevention and Toxics, EPA Regional Pollution Prevention Program Offices. Opportunities to fund two-year Pollution Prevention assistance agreements for projects that provide technical assistance (e.g., information, training, tools) to businesses and their facilities to help them develop and adopt source reduction practices (also known as "pollution prevention" or "P2"). P2 means reducing or eliminating pollutants from entering any waste stream or otherwise being released into the environment prior to recycling, treatment, or disposal.

Vulnerabilities	Mitigation Strategy	Potential Project	Potential Funding
#4: FSST Land Leases and Effects to Agriculture	Livestock Management	Complete pasture improvement assessments in coordination with NRCS.	US Department of Agriculture - Farmers Market Promotion Program; Community Food Projects Competitive Grants Program; Conservation Innovation Grants; Conservation Stewardship Program; Environmental Quality Incentives Program USDA NRCS Community Compost and Food Waste Reduction (CCFWR) Project. provides assistance through a cooperative agreement to municipalities, counties, local governments, or city planners to develop and test strategies for planning and implementation that will 1) generate compost; 2) increase access to compost for agricultural producers; 3) reduce reliance on, and limit the use of, fertilizer; 4) improve soil quality; 5) encourage waste management and permaculture business development; 6) increase rainwater absorption; 7) reduce municipal food waste; and 8) divert food waste from landfills. USDA NRCS Urban Agriculture and Innovation Production (UAIP) Competitive Grants Program. UAIP supports the development of urban agriculture and innovative production activities by funding Planning Projects (PP) and Implementation Projects (IP). The purpose of PP is to support development of projects that will either initiate, build upon, or expand the efforts of farmers, gardeners, citizens, government officials, schools, and other stakeholders. USDA NRCS Wetland Mitigation Banking Program. Opportunities for the development and establishment of mitigation banks and banking opportunities solely for agricultural producers with wetlands subject to the Wetlands Conservation Compliance provisions of the 1985 Food Security. USDA NRCS Conservation Innovation Grants (CIG)-The purpose od CIG is to stimulate the development and adoption of innovative conservation approaches and technologies in conjunction with agricultural production. Unites States Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA), Farm and Ranch Stress Assistance Network. The purpose of the Farm and Ranch Stress Assistance Network (FRSAN) Program is to establish a network that connects individuals who are engaged in farming, ranching, and other agriculture-related occupations to stress assistance programs. The establishment of a network that assists farmers and ranchers in time of stress can offer a conduit to improving behavioral health awareness, literacy and outcomes for agricultural producers, workers and their families.
		Identify alternative water sources for livestock. Identify additionl feed options during drought.	
	Crop Management	Educational programs on growing and maintaining water efficient crops.	
		Irrigation system efficiency updates.	
		Develop lease rebate program to encourage the planting of drought resistant crops.	

6.0 Drought Adaptation Plan Maintenance

It is recommended that the Tribe continuously update the Drought Adaptation Plan. The updates should come every 5 years and it is recommended that the FSST's Natural Resources Department monitor the consistent updates. This will confirm that the Drought Adaptation Plan is consistently up-to-date and is beneficial during major droughts. To facilitate consistent updating on major plans, such as the Drought Adaptation Plan, the Federal Emergency Management Agency (FEMA) has funding sources available.

The Tribal department that oversees this plan can change based on both the needs of the Tribe and the most applicable projects to complete. It is also recommended that once a project is complete, a note or updated page be written to reflect the project completion and to ensure that one project is not repeated unnecessarily.

The Drought Adaptation Plan is written to be used to update the Tribe's Hazard or Multi-Hazard Mitigation Plan. The Drought Adaptation Plan also pulls information from the Drought Vulnerability Assessment.

7.0 Data/Process Gaps and Needs

The most important developmental tool for a Drought Adaptation Plan is a response from the affected people, the government leaders, and the experts of the area. To create a well-rounded plan, the differences in responses and professional opinions develop a solid understanding of the goals and needs of the Tribe. In a perfect scenario, all Tribal program directors, staff, Tribal council, government officials, and Tribal members invited would be able to attend and determine the exact projects and plans that the Tribe should pursue.

The Drought Adaptation Plan had excellent responses and follow-up responses, but the quantity of responses was low. When the Drought Adaptation Plan is updated, it is recommended that more time be dedicated to retrieving responses and seeking follow-up from the Tribal program directors, staff, Tribal council, government officials, and Tribal members. The original Drought Adaptation Plan was created to only use a two-day meeting to receive feedback, but because of the availability of Tribal program directors, staff, Tribal council, government officials, and Tribal members, it would've been more beneficial to meet individually with each person.

8.0 Conclusions and Next Steps

The information contained within this Drought Adaptation Plan should be implemented and used to seek funding for identified projects. The projects that are in this report were identified through the leadership of the Tribe. The future of the Tribe's resiliency to drought is dependent on the use of this report to work on the identified adaptation plan and projects. Subsequent action steps to the DAP should be seeking funding sources and pursuing the completion of each project outlined within.

For future, attempts should be made to reach all Tribal leaders. In the next iteration of the Drought Adaptation Plan, it is recommended to have longer field visits and individual meetings with each Tribal leader to better understand every leader's perspective.

9.0 References

The 2020 South Dakota Integrated Report for Surface Water Quality Assessment. South Dakota Department of Environment and Natural Resources. Retrieved from: https://denr.sd.gov/documents/SD_2020_IR_final.pdf

Big Sioux Community Water System, Inc. (BSCWS). "Annual Drinking Water Quality Report" January 1-December 31 2018.

Diersen, Matthew A., Gary Taylor, and Alan May. *Direct and Indirect Effects of Drought on South Dakota's Economy.* 2002. *Economics Commentator.* Paper 423. Retrieved from: https://openprairie.sdstate.edu/cgi/viewcontent.cgi?article=1422&context=econ_comm

Hansen, Donald S. *Appraisal of the Water Sources of the Big Sioux Aquifer, Moody County, South Dakota.* U.S. Geological Survey, Water Investigations Report 87-4057. Retrieved on June 5, 2020 from: https://pubs.usgs.gov/wri/1987/4057/report.pdf

Kleinjan, Johnathan. *South Dakota Corn: Drought and Heat Effects on Crop Production.* Retrieved from: https://agfax.com/2017/07/11/south-dakota-corn-drought-and-heat-effects-on-crop-production/

Moody County Pre-Disaster Mitigation Plan 2014-2018. First District Association of Local Governments, Watertown, South Dakota. Retrieved on June 5, 2020 from: http://www.1stdistrict.org/FD/downloads/moodcountypdm082014.pdf

National Climate Assessment of the Great Plains. Retrieved on June 5, 2020 from: https://nca2014.globalchange.gov/report/regions/great-plains

National Drought Mitigation Center, University of Nebraska (NDMC). Livestock Production and Drought, 2020. https://drought.unl.edu/ranchplan/DroughtBasics/LivestockProductionandDrought.aspx

North Dakota Wheat Commission, Hard Read Spring Wheat, 2020 https://www.ndwheat.com/buyers/NorthDakotaWheatClasses/HardRedSpringWheat/

South Dakota Wellhead Protection Guidelines. South Dakota Department of Environment and Natural Resources, Division of Environmental Regulation, Ground Water Quality Program, April 1995. Retrieved from: https://denr.sd.gov/des/gw/Wellhead/whpadocument.pdf

United States Census Bureau, *Flandreau city, South Dakota Geography Profile*, 2018, https://data.census.gov/cedsci/profile?g=1600000US4621540&q=Flandreau%20city,%20South%20Dakota

U.S. Environmental Protection Agency. *Funding Agricultural Best Management Practices with the Clean Water State Revolving Fund.* Retrieved from: https://www.epa.gov/sites/production/files/2018-01/documents/cwsrf_ag_bmp_fact_sheet_-_10.26.17.pdf

US EPA, Mercury. Viewed on 21 June 2020: https://www.epa.gov/mercury/basic-information-about-mercury

U.S. Climate Data – Flandreau, South Dakota. Retrieved on June 5, 2020 from: https://www.usclimatedata.com/climate/flandreau/south-dakota/united-states/ussd0113

United States Department of Agriculture, National Agricultural Statistics Service – Moody County, South Dakota. Retrieved from: https://usda.library.cornell.edu/concern/publications/ns064605c?locale=en&page=4

United States Drought Monitor, Moody County, South Dakota (USDM). 2020. https://droughtmonitor.unl.edu/Data/Timeseries.aspx

World Meteorological Organization (WMO) and Global Water Partnership (GWP), 2016: *Handbook of Drought Indicators and Indices* (M. Svoboda and B.A. Fuchs). Integrated Drought Management Programme (IDMP), Integrated Drought Management Tools and Guidelines Series 2. Geneva.

This is page is intentionally left blank

Appendix A- Project Coordination

There were two different types of interview questions. During the field visit, a handout was created that had four columns, Vulnerabilities, Rank, Mitigation Strategies, and Rank. This was done to have interviewees briefly look over both the vulnerabilities and mitigation strategies and identify which were most important in their professional opinion. Since a few of the Tribal program directors were unable to meet during the field visit, calls and emails were used for follow-up. An interview call took place using a fleshed-out questionnaire to develop numerical data.

Persons Interviewed

Tribal leaders that were interviewed during the field visit included:

Scott Anderson (Land Committee Director)
Mark Allen (GAP Coordinator)
Anthony Reider (Tribal President)
Kristi Bietz (Tribal Council)
Donalda Montoya (Tribal Council)
David Kills a Hundred (Tribal Council)

Most of the FSST's Council were contacted for their professional opinions on the drought vulnerabilities and drought mitigation strategies.

Follow up interviews included:

Terry Albers (Moody County Emergency Management)
Martin Jarrett (Big Sioux Rural Water System Administrator)
Elizabeth Wakeman (FSST Natural Resource Department's Brownfield Coordinator)
Tim Spade (Water Quality Specialist for FSST)
Monte Lovejoy (Tribal Historic Preservation Officer)

Vulnerabilities	Rank	Mitigation Strategies	Rank
City of Flandreau and Moody County have primary control of some systems.		Encouragement of crops that need less water	
Lease value decreases during drougth.		Encourage drought resistant landscaping	
Buffalo herd is limited to 50-60.		Water use restrictions	
Water Intake is susceptible to contamination.		Encourage dry land farming	
Fire suppression overtaxes water system/water towers.		Maintenance and repair programs on distribution infrastructure	
Flooding is prevalent in the area, but is exacerbated by drought.		Improving efficiency standards in buildings	
Drought effecting wildlife.		Catching and use of rainwater	
Lack of water and food for humans and animals.		Encouraged use of water efficient appliances	
Water quality/quantity declines.		Plastic liner to trap water for plants	
Air quality declines.		Drip irrigation	
Short period of record for Flandreau Weather Stations		Incentive pricing on water use	
		Peer pressure (sending comparisons of water use)	
		Using cover crops (like Barley)	
		Irrigation scheduling	
		Grazing management plans	
		Cross fencing	
		Reduce water use in food production (full washers, low flow)	
		Display water use to encourage low usage	
		Composting	
		Weatherizing homes and buildings	
		Putting treated wastewater into the ground to encourage GW replenishment	
		Reservoir Augmentation	
		Identifying new water sources before approving proposed development	
		Identifying all water demands	
		Updated the wastewater drinking plant	
		Stormwater management - retaining basin or dry basin	

Field Visit Interview Handout

FSST Drought Adaptation Questionnaire

Name: _____

Date: _____

1) Please rank the vulnerabilities listed below:

Vulnerabilities	Rank
City of Flandreau and Moody County have primary control of some systems.	
Lease value decreases during drought.	
Buffalo herd is limited to 50-60.	
Water Intake is susceptible to contamination.	
Fire suppression overtaxes water system/water towers.	
Flooding is prevalent in the area, but is exacerbated by drought.	
Drought effecting wildlife.	
Lack of water and food for humans and animals.	
Water quality/quantity declines.	
Air quality declines.	
Short period of record for Flandreau Weather Stations	

Follow-up Questionnaire (Page 1)

2) Please rank 5 (1 being the best) of the mitigation strategies below:

Mitigation Strategies	Rank
Encouragement of crops that need less water	
Encourage drought resistant landscaping	
Water use restrictions	
Encourage dry land farming	
Maintenance and repair programs on distribution infrastructure	
Improving efficiency standards in buildings	
Catching and use of rainwater	
Encouraged use of water efficient appliances	
Plastic liner to trap water for plants	
Drip irrigation	
Incentive pricing on water use	
Peer pressure (sending comparisons of water use)	
Using cover crops (like Barley)	
Irrigation scheduling	
Grazing management plans	
Cross fencing	
Reduce water use in food production (full washers, low flow)	
Display water use to encourage low usage	
Composting	
Weatherizing homes and buildings	
Putting treated wastewater into the ground to encourage GW replenishment	
Reservoir Augmentation	
Identifying new water sources before approving proposed development	
Identifying all water demands	
Updated the wastewater drinking plant	
Stormwater management - retaining basin or dry basin	

Follow-up Questionnaire (Page 2)

3) List any Vulnerabilities that we may have missed with an appropriate rank in your opinion.

4) List any Mitigation Strategies that we may have missed with an appropriate rank in your opinion.

Follow-up Questionnaire (Page 3)

Results of Survye from Field Visit

Mitigation Strategies	Total Score	Rank
Stormwater management - retaining basin or dry basin	13	**1**
Identifying all water demands	21	**2**
Water use restrictions	22	**3**
Composting	23	**4**
Encouragement of crops that need less water	24	**5**
Encourage drought resistant landscaping	25	**6**
Encourage dry land farming	25	**6**
Drip irrigation	25	**6**
Using cover crops (like Barley)	26	**9**
Irrigation scheduling	26	**9**
Weatherizing homes and buildings	26	**9**
Identifying new water sources before approving proposed development	26	**9**
Maintenance and repair programs on distribution infrastructure	27	**13**
Catching and use of rainwater	27	**13**
Grazing management plans	27	**13**
Improving efficiency standards in buildings	29	**16**
Encouraged use of water efficient appliances	29	**16**
Updated the wastewater drinking plant	29	**16**
Peer pressure (sending comparisons of water use)	30	**19**
Reduce water use in food production (full washers, low flow)	30	**19**
Display water use to encourage low usage	30	**19**
Cross fencing	31	**22**
Putting treated wastewater into the ground to encourage GW replenishment	32	**23**
Reservoir Augmentation	32	**23**
Plastic liner to trap water for plants	33	**25**
Incentive pricing on water use	35	**26**

Results from Drought Vulnerability Surveys.

Vulnerabilities	Total Score	Rank
Water Intake is susceptible to contamination.	9	**1**
Water quality/quantity declines.	9	**1**
Flooding is prevalent in the area but is exacerbated by drought.	14	**3**
Fire suppression overtaxes water system/water towers.	15	**4**
Lease value decreases during drought.	16	**5**
City of Flandreau and Moody County have primary control of some systems.	17	**6**
Drought affecting wildlife.	17	**6**
Air quality declines.	18	**8**
Lack of water and food for humans and animals.	20	**9**
Bison herd is limited to 50-60.	21	**10**
Short period of record for Flandreau Weather Stations	25	**11**

Appendix B- Additional Funding Sources

In each of the preceding subsections of 6.2, mitigation projects had corresponding federal grant opportunities, broken down by agency, in which the Tribe would qualify for. Below in this section is each listed grant opportunity, along with eligibility requirements and award information. Each grant is sorted in alphabetical order by agency (Dept. of Agriculture, Dept. of Commerce etc.)

Community Food Projects Competitive Program

Agency: Department of Agriculture
Eligibility: Tribal organizations.
Award: Awards range from $10,000 to $400,000; awardees must match funds dollar to dollar.

Conservation Innovation Grants

Agency: Department of Agriculture
Eligibility: Non-federal entities and individuals
Award: Awards decided through national and state competitions. Multi-year awards must be no longer than three years.

Conservation Stewardship Program

Agency: Department of Agriculture
Eligibility: Individuals that are included within USDA farm records management system. Must be in compliance with the highly erodible land and wetland conservation provisions and adjusted gross income.
Award: Individual technical assistance for employing conservation practices.

Emergency Community Water Assistance Grants

Agency: Department of Agriculture
Eligibility: Federally recognized Tribes seeking to prepare or recover an emergency that affects access to safe drinking water, like drought.
Award: $150,000 may be allocated to improve water distribution system.

Environmental Quality Incentives Program

Agency: Department of Agriculture
Eligibility: Voluntary program available to agricultural producers.
Award: Financial and technical assistance will be made to producers that are looking to better adapt to extreme changes in weather, like drought.

Farmers Market Promotion Program

Agency: Department of Agriculture
Eligibility: Tribal governments seeking to increase availability and consumption of domestically grown food.
Award: Awardees must submit progress reports and comply with program terms and conditions.

Special Evaluation Assistance for Rural Communities and Households

Agency: Department of Agriculture
Eligibility: Federally recognized Tribes with communities having populations less than 2,500. Communities must be seeking preliminary feasibility studies for water projects.

Award: Awards must be used in preliminary analyses, like feasibility studies, for projects that seek to improve water distribution system.

Water & Waste Disposal Loan & Grant Program

Agency: Department of Agriculture

Eligibility: Federally recognized Tribes and towns with less than 10,000 people seeking to improve water distribution and sanitation infrastructure.

Award: Projects must be financially sustainable. Loan interest rates are based off the median household income of the area to be served. Loans have a 40-year payback period.

Public Works and Economic Development Facilities Program

Agency: Department of Commerce

Eligibility: Federally recognized Tribes seeking to develop economically beneficial infrastructure, including public water works.

Award: $100,000 to $3,000,000. Applicants must demonstrate project's ability to establish long-term economic benefit, as well as achievability of project completion

Drinking Water State Revolving Fund

Agency: Environmental Protection Agency (awarded state-by-state)

Eligibility: Eligible for projects that seek to improve water system.

Award: DWSRS acts as an infrastructure bank, providing low interest loans to water systems, which they are required to pay back.

Drinking Water Infrastructure Grant – Tribal Set-Aside Program

Agency: Environmental Protection Agency

Eligibility: Eligible for Tribal projects that seek to improve water system.

Award: Any Tribe may receive a grant, with the option to allow Indian Health Services to administer funds for project. Funds cannot be used for monitoring, operation, or maintenance of the system.

Rural Utilities Service Solid Waste Management Grants

Agency: Environmental Protection Agency

Eligibility: Federally recognized Tribes with communities having populations less than 10,000 looking to reduce solid waste stream.

Award: Awards range from $74,000 to $900,000.

Tribal 319 Nonpoint Source Grant Program

Agency: Environmental Protection Agency

Eligibility: Federally recognized Tribes with an approved NPS assessment report in accordance with CWA section 319(a). Tribes also must have an approved NPS management program in accordance with CWA section 319(b). Tribes must also be approved for treatment in a similar manner as a state (TAS) in accordance with CWA section 518(e).

Award: Funding and technical assistance for the purpose of managing NPS pollution.

Water Infrastructure Improvements for the Nation Act Grants

Agency: Environmental Protection Agency (awarded state-by-state)
Eligibility: Projects that benefit low income Tribal communities primarily and directly.
Award: Dependent on availability of appropriations, cost share requirement of at least 45 percent.

Community Development Block Grant Program

Agency: Housing and Urban Development (awarded state-by-state)
Eligibility: Eligible for projects that seek to improve communities with populations of less than 50,000.
Award: Grants are issued by the state to local governments. Projects must adhere to federal and state regulations. Project activities and progress must be made public for citizen input and transparency purposes.