WYOMING BUREAU OF LAND MANAGEMENT

2023 Air Resource Monitoring Report

(Data through 2022)

Sheridan BLM-WARMS Site

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1. Introduction

The Bureau of Land Management (BLM) authorizes activities that can affect air resources by releasing pollutants into the atmosphere, therefore, Wyoming-BLM has prepared this air monitoring report to inform and educate the public about air resource issues on BLM managed lands in Wyoming. The report assists the BLM in managing air resources by establishing current conditions and monitoring trends for National Environmental Policy Act (NEPA) analysis. Additionally, the report is used to promote education, awareness, and transparency of air resources on public lands. Engaging the public, various levels of government, and tribes through cooperative airshed management is a key to protecting air quality.

This report should be incorporated by reference into NEPA documents and to provide an opportunity to reduce paperwork and redundant analysis in the NEPA process. Incorporation by reference should follow the process outlined in the BLM NEPA handbook (H-1790-1).

1.1 Air Resource Management

The airshed concept is a means for evaluating the local and regional air quality effects of a pollutant source. An airshed is a volume of air that is generally homogeneous with respect to atmospheric properties and the dispersion of air pollutants. In Wyoming, geographical and meteorological constraints often define an airshed's boundaries and limit the dispersion of pollutants away from a source. The size of an airshed can vary from small valleys that are a few miles across to larger urban or regional areas that can be tens or hundreds of miles across.

Pollutants move through an airshed by two processes: transport and dispersion. Transport is movement caused by a time-averaged wind flow, with pollutants moving on scales of miles per hour. Dispersion is much smaller movement, primarily caused by localized turbulence on the scale of inches or feet. The transportation and dispersion extent of pollutants is the main factor for the area covered by an airshed.

2. Regulatory Framework

This section discusses the laws, policies, and directives that guides the BLM in its multiple use mission with respect to air resources.

2.1 Federal Land Policy and Management Act

Federal Land Policy and Management Act (FLPMA) of 1976 [43 U.S.C. §§ 1701-1785], often referred to as the BLM's "Organic Act," provides the majority of the BLM's legislated authority, direction policy, and basic management guidance. This Act outlines the BLM's role as a multiple use land management agency and provides for management of the public lands under principles of multiple use and sustained yield. The Act directs public lands to be managed "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values" (Sec. 102. (a) (8)). To fulfill this responsibility, the BLM's land use plans ensure "compliance with applicable pollution control laws, including State and Federal air, water, noise, or other pollution standards or implementation plans" (Sec. 202. (a)(8)). Accordingly, BLM leases and ensures operating permits for fossil fuels comply with all state and federal air pollution requirements. FLPMA also gives the BLM authority to revoke or suspend any BLM-authorized activity that is found to be in violation of regulations applicable to public lands and/or noncompliance with applicable state or federal air quality standards or implementation plans, thus ensuring that the BLM can provide for compliance with applicable air quality standards, regulations, and implementation plans (Sec. 302(c)). Thus, when authorizing activities, the BLM assumes full compliance with applicable state and federal air quality requirements, emissions standards, and related equipment and performance standards in effect at the time.

2.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. § 4321 et seq.) ensures that information on the potential environmental and human impact of federal actions is available to public officials and citizens before decisions are made and actions are taken. One of the purposes of the act is to "promote efforts which will prevent or eliminate damage to the environment and biosphere" and to promote human health and welfare. This act requires that agencies prepare a detailed statement on the environmental impact of the proposed action for major federal actions expected to significantly affect the quality of the human environment (Section 102(C)). In addition, agencies are required, to the fullest extent possible, to use a "systematic, interdisciplinary approach" in planning and decision-making processes that may have an impact on the environment (Section 102(A)).

2.3 Clean Air Act

The Clean Air Act (CAA) of 1963 [42 U.S.C. § 1857 et seq.], as amended and recodified [42 U.S.C. § 7401 et seq.] is the primary Federal legislation and provides the framework for protecting and enhancing the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population (Section 101(b)(1)). The Act focuses on reducing criteria air pollutants and hazardous air pollutants. As required by the CAA, EPA has established National Ambient Air Quality Standards (NAAQS) for criteria pollutants (Section 109 (a)(1)(A)). Compliance and enforcement of these Federal requirements is delegated to applicable Tribal, State, and local regulatory agencies (Sections 107(a), 301(d), 302). The CAA also allows these agencies to establish regulations which are more, but not less, stringent than the Federal requirement (Section 116) (EPA 2007). The BLM has no authority to determine how air quality standards will be achieved nor to determine if an area is following air quality standards.

2.4 Other Guidance and Policies

Other guidance and policy are useful for the BLM in managing air resources. While this guidance is not required by law, it can be useful for managing and analyzing air resources. Such guidance includes, but is not limited to:

- Council on Environmental Quality (CEQ) guidance on NEPA analysis,
- CEQs NEPA guidance on consideration of GHG emissions and climate change,
- Federal Land Managers' Air Quality Related Values Work Group (FLAG), and
- BLM Guidance for Conducting Air Quality General Conformity Determinations (BLM IM2013-025 2012) (BLM IB 2014-084 2014).

2.5 Specific Regulatory Requirements for the Oil and Gas Industry

Federal Rules

The EPA has established emissions control requirements in the New Source Performance Standards (NSPS) at 40 CFR Part 60 that apply to coal, oil, and natural gas production facilities (40 CFR 60, Subparts OOOO and OOOOa), for example, and serve to control methane emissions from oil and natural gas industry sources. Subpart OOOOa requires reduced emissions completions ("green" completions) on new hydraulically fractured gas wells as well as emissions controls on pneumatic controllers, pumps, storage vessels, and compressors. Other relevant NSPS requirements under 40 CFR Part 60 include:

- Subpart GG – Standards of Performance for Stationary Gas Turbines
- Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

- Subpart JJJJ – Standards of Performance for Stationary Spark Ignition Internal Combustion Engines
- Subpart K – Standards of Performance for Storage Vessels for Petroleum Liquids for which Construction, Reconstruction, or Modification Commenced after June 11, 1973 and prior to May 19, 1978
- Subpart Ka – Standards of Performance for Storage Vessels for Petroleum Liquids for which Construction, Reconstruction, or Modification Commenced after May 18, 1978 and prior to July 23, 1984
- Subpart Kb – Standards of Performance for Storage Vessels for Petroleum Liquids for which Construction, Reconstruction, or Modification Commenced after July 23, 1984
- Subpart KKK – Standards of Performance for Equipment Leaks of VOC from Onshore Natural Gas Processing Plants for Which Construction, Reconstruction, or Modification Commenced After January 20, 1984, and on or Before August 23, 2011
- Subpart KKKK – Standards of Performance for Stationary Combustion Turbines
- Subpart OOOO – Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution for which Construction, Modification, or Reconstruction Commenced after August 23, 2011
- Subpart OOOOa – Standards of Performance for Crude Oil and Natural Gas Production, Transmission, and Distribution for which Construction, Modification, or Reconstruction Commenced on or after September 18, 2015
- Subpart TTTT - Standards of Performance for Greenhouse Gas Emissions for Electric Generating Units
- Subpart Y - Standards of Performance for Coal Preparation and Processing Plants

State Rules

The Wyoming Department of Environmental Quality/Air Quality Division (WDEQ-AQD) is responsible for ensuring that air in Wyoming meets health and safety standards established under the CAA. To fulfil this responsibility, the WDEQ-AQD is required by the federal government to ensure compliance with the NAAQS statewide. Additionally, the state ensures compliance with visibility standards through regional haze rules. The WDEQ-AQD enacts rules pertaining to air quality standards, develops plans to meet the federal standards, when necessary, issues preconstruction and operating permits to stationary sources, and ensures compliance with State and Federal air quality rules (WDEQ 2022).

EPA’s Tribal Authority Rule gives Tribes the ability to develop air quality management programs, write rules to reduce air pollution and implement, and enforce their rules in Indian Country. While state and local agencies are responsible for all CAA requirements, Tribes may develop and implement only those parts of the CAA that are appropriate for their lands (EPA 2007).

While the EPA, State, and Tribes have regulatory authority to control air pollution emissions, it is the mission of the BLM to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

2.6 Regulated Air and Atmospheric Values

2.6.1. Criteria Air Pollutants

The EPA has established NAAQS for six common air pollutants (also known as "criteria air pollutants"). These pollutants are found all over the U.S. Concentrations of air pollutants greater than the national standards represent a risk to human health and the environment. Criteria pollutants include carbon monoxide, nitrogen dioxide, ozone, particulate matter, sulfur dioxide, and lead, and are discussed below. Periodically, the EPA reviews the latest science to ensure that NAAQS appropriately protect human health and safety and to update the standards when necessary. Indicators for assessing environmental impacts from criteria air pollutants include emissions (mass per unit of time) and concentrations (mass per volume, or number of molecules over total molecules).

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless gas emitted from incomplete combustion of carbon-containing materials. The greatest sources of CO to outdoor air are cars, trucks, and other vehicles or machinery that burn fossil fuels. Very high levels of CO usually do not occur in outdoor environments. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. This can cause specific complications in people who have some types of heart disease as they are especially vulnerable to the effects of CO when exercising or under increased stress. For these individuals, short-term exposure to elevated CO may be accompanied by angina, a type of chest pain caused by reduced blood flow to the heart. Other symptoms of carbon monoxide exposure include headache, nausea, rapid breathing, weakness, exhaustion, dizziness, and confusion (Center for Disease Control 2018). At extremely high levels, CO can cause hypoxia (severe oxygen deficiency) and death (EPA, 2018).

Nitrogen Oxides

Nitrogen oxides (NO_x) are a group of highly reactive gasses and include nitrogen dioxide (NO_2), nitrous acid, and nitric acid. While EPA's NAAQS cover this entire group of NO_x, NO_2 is the component of greatest interest and the indicator for the larger group of nitrogen oxides. NO_2 forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO_2 is linked with several adverse effects on the respiratory system (EPA, 2018). High concentration of NO_2 can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms. Longer exposures to elevated concentrations of NO_2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma and lung cancer, as well as children and the elderly are generally at greater risk for the health effects of NO_2. Nitrogen dioxide exposure has also been linked to cardiovascular harm, lower birth weight in newborns, and an increased risk of premature death (American Lung Association 2023). NO_2 and other NO_x interact with water, oxygen, and other chemicals in the atmosphere to produce acid rain. High levels of NO_2 are also harmful to vegetation, damaging foliage, decreasing growth, and reducing crop yields (Rowland 1985).

Ozone

Ground-level ozone (O_3) is a secondary pollutant. It is formed by a chemical reaction between NO_x and volatile organic compounds (VOCs) in the presence of sunlight (photochemical oxidation). Sources of ozone precursors for NO_x and VOCs include motor vehicle exhaust, industrial emissions, gasoline vapors, biogenic emissions (e.g., terpenes), wood burning, and chemical solvents. Abundant solar radiation drives the photochemical reaction and creates ground-level O_3. Primary health effects from O_3 exposure range from breathing difficulty to permanent lung damage. Ozone aggressively attacks lung tissue by reacting chemically with it, making it a unique pollutant because it can cause issues in otherwise healthy individuals (American Lung Association 2023). Anyone who spends time outdoors where ozone pollution levels are high is at risk, but especially those who are pregnant, children and teens, those over 65, people with existing lung diseases, and people who work or exercise outdoors. Short-term exposure to ozone pollution results in temporary obstruction of airways, causing shortness of breath, wheezing, and coughing. Long-term exposure to ozone is linked to aggravation of asthma or chronic obstructive pulmonary disease (COPD) and is one of many causes of asthma and COPD development, especially in newborns. Long-term exposure to ozone is linked to a higher risk of death from respiratory diseases associated with increases in ground-level ozone. Lifetime ozone exposure has also been linked to an increased risk of metabolic disorders, including glucose intolerance, hyperglycemia, and diabetes. High concentrations of ground-level O_3 contributes to plant and ecosystem damage. Many tree species are particularly susceptible to ozone damage including the black cherry, quaking aspen, white pine, ponderosa pine, and red alder. Exposure to ozone increases the plants' risk of disease, damage from insects, effects of other pollutants, and harm from severe weather (EPA 2022). Ozone pollution is a significant contributor to haze and was referred to as "smog" for many years.

While ozone is generally considered a summertime air pollutant, in certain parts of the country it has become a wintertime issue due to highly concentrated precursor pollutants under low-level temperature inversions and additional photochemical reaction from snow reflecting solar radiation back into the atmosphere. This is of particular concern in the Upper Green River Basin of Wyoming where wintertime ozone concentrations can exceed the NAAQS for extended periods of time in the winter months.

Ozone and its precursors are a regional air quality issue due to possible transport hundreds of miles from origination, thus maximum O_3 levels can occur at locations many miles downwind from the sources.

Particulate Matter (PM10 AND PM2.5)

Airborne particulate matter (PM) consists of tiny coarse-mode (PM10) or fine-mode (PM2.5) particles or aerosols combined with dust, dirt, smoke, and liquid droplets. PM2.5 have diameters that are generally 2.5 micrometers or smaller and derive primarily from the incomplete combustion of fuel sources and secondarily formed aerosols. PM10 have diameters that are generally 10 micrometers or smaller and derive primarily from crushing, grinding, or abrasion of surfaces. Sources of particulate matter include industrial processes, power plants, vehicle exhaust, fugitive dust, construction activities, home heating, and fires. Due to the size of these particles, they can travel deep into the bronchioles of the lungs and can enter the bloodstream (EPA 2023). Many scientific studies have linked breathing PM to serious health problems, including aggravated asthma, increased respiratory symptoms, difficult or painful breathing, chronic bronchitis, decreased lung function, nonfatal heart attacks, irregular heartbeat, and premature death. In adults, long-term particle pollution is linked to worsening of heart disease/atherosclerosis/COPD, higher risk of developing diabetes, higher risk of developing fatal lung cancer, impaired cognitive functioning, and increased risk of Parkinson's disease/Alzheimer's disease/other dementias (American Lung Association 2023). Particulate matter is a major cause of reduced visibility. It can stain and damage stone and other materials, including culturally important objects, such as monuments and statues (EPA, 2018). Airborne dust can also deposit on snow. This dust deposition accelerates snowmelt by reducing albedo through surface darkening and enhanced snow grain growth (Skiles and Painter 2016). The degree of advanced snowmelt during has a linear relationship to the amount of dust loading on the snowpack, which can affect the availability of late season water in areas dependent on snowmelt to fill their watersheds.

Sulfur Dioxide

Sulfur dioxide (SO_2) is one of a group of highly reactive gases known as "oxides of sulfur" or SO_x. SO_2 can react with other compounds in the atmosphere to form fine particles, PM2.5. The largest sources of SO_2 emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels like diesel by locomotives, large ships, and non-road equipment. SO_2 is linked with several adverse effects on the respiratory system (EPA, 2018). The consequences of exposure include wheezing, shortness of breath, chest tightness, and reduced lung function. People with asthma, particularly children, are sensitive to these effects of SO_2. At high concentrations, gaseous SO_x

can harm trees and plants by damaging foliage and decreasing growth. SO_2 and other sulfur oxides can contribute to acid rain.

Lead

Lead (Pb) is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have historically been from fuels in on-road motor vehicles (such as cars and trucks) and industrial sources. As a result of EPA's regulatory efforts to remove lead from gasoline, emissions of lead from the transportation sector declined by 95% between 1980 and 1999, and levels of lead in the air decreased by 94% during the same period. Major sources of lead emissions to the air today are ore and metals processing and piston-engine aircraft using leaded aviation gasoline (EPA, 2018). Depending on the level of exposure, lead can adversely affect the nervous system, kidney function, immune system, reproductive and developmental systems, and the cardiovascular system. Lead exposure also affects the oxygen carrying capacity of the blood. Lead can accumulate in the body over time, where it is stored in bones along with calcium. The lead effects most likely to be encountered in current populations are neurological effects in children. Infants and young children are especially sensitive to lead exposures, which may contribute to behavioral problems, learning deficits, lowered IQ, and hyperactivity. Children are also at an increased risk of slowed growth, hearing problems, and anemia. Adults exposed to lead can suffer from cardiovascular effects, decreased kidney function, and both male and female reproductive issues.

National Ambient Air Quality Standards (NAAQS)

The WDEQ-AQD is responsible to for ensuring compliance with the NAAQS within the state of Wyoming. Table 1 shows current NAAQS for the EPA designated criteria pollutants (EPA 2018).

Table 1. Primary Criteria Pollutant NAAQS.

Pollutant	Primary/ Secondary	Averaging Time	Level*	Form
Carbon Monoxide (CO)	primary	8 hours	9 ppm	Not to be exceeded more than once per year
		1 hour	35 ppm	
Lead (Pb)	primary and secondary	Rolling 3-month average	0.15 μg/m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)	primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	primary and secondary	1 year	53 ppb	Annual Mean
Ozone (O_3)	primary and secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Fine Particulate Matter ($PM_{2.5}$)	primary	1 year	12.0 μg/m^3	Annual mean, averaged over 3 years
	secondary	1 year	15.0 μg/m^3	Annual mean, averaged over 3 years
	primary and secondary	24 hours	35 μg/m^3	98th percentile, averaged over 3 years
Coarse Particulate Matter (PM_{10})	primary and secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)	primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year
* Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air (μg/m^3).				

2.6.2. Hazardous Air Pollutants (HAPs)

Hazardous air pollutants (HAP) are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental impacts. The EPA has classified

188 air pollutants as HAPs. Examples of listed HAPs associated with the oil and gas industry include formaldehyde, benzene, toluene, ethyl benzene, isomers of xylene (BTEX) compounds, and normal-hexane (n-hexane). Indicators for assessing environmental impacts from HAPs include emissions (mass per unit of time) and concentrations (mass per volume).

The CAA requires the EPA to regulate emissions of toxic air pollutants from a published list of industrial sources referred to as "source categories." The EPA has developed a list of source categories that must meet control technology requirements for these toxic air pollutants. Under Section 112(d) of the CAA, the EPA is required to develop regulations establishing national emission standards for hazardous air pollutants (NESHAP) for all industries that emit one or more of the pollutants in major source quantities. These standards are established to reflect the maximum degree of reduction in HAP emissions through application of maximum achievable control technology (MACT). Source categories for which MACT standards have been implemented include oil and natural gas production and natural gas transmission and storage.

Although HAPs do not have federal air quality standards, some states have established "thresholds" to evaluate human exposure for potential chronic inhalation illness and cancer risks. There are no applicable federal or State of Wyoming ambient air quality standards for assessing potential HAP impacts to human health and monitored background concentrations. Therefore, reference concentrations (RfC) for chronic inhalation exposures and reference exposure levels (REL) for acute inhalation exposures can be applied as evaluation criteria below provides the RfCs and RELs. Both the RfC and REL guideline values are for non-cancer effects (See Table 6).

2.6.3. Air Quality Related Values

Air resources also encompass Air Quality Related Values (AQRVs). Air pollution can impact AQRVs through ambient exposure to elevated atmospheric concentrations, such as O_3 effects to vegetation, impairment of scenic views by PM in the atmosphere, and deposition of air pollutants, such as sulfur and nitrogen compounds on the earth's surface through dry and wet precipitation. AQRVs are identified and managed within the respective jurisdictions of several land management agencies in designated Class I areas. The requirement to assess impacts to AQRVs is established in the CAA Prevention of Significant Deterioration (PSD) rules. PSD is a permitting program for new and modified major sources of air pollution that are located in attainment areas. The Federal land managers have the responsibility to consider whether new emissions from proposed major facilities (or modifications to major facilities) would have an adverse impact on AQRVs areas they manage. Impact indicators for visibility include changes to color and contrast for an exhaust or dust plume, or changes to light extinction (deciview) for a cumulative assessment. Indicators for deposition include the Deposition Analysis Threshold (DAT), and critical load thresholds, both measured as mass over area and time.

2.6.4. Greenhouse Gases

Greenhouse gases (GHGs) became regulated pollutants on January 2, 2011, under the PSD and Title V Operating Permit Programs (EPA 2018) because of their contribution to global climate change effects. These gases absorb energy emitted from the earth's surface and re-emit a larger portion of the heat back to the earth, rather than allowing the heat to escape into space, which would be the case under more natural conditions. The EPA's GHG Tailoring Rule (40 CFR § 51, 52, 70, et al.) set initial emissions thresholds for PSD and Title V permitting based on carbon dioxide equivalent (CO_2e). These thresholds apply to stationary sources that emit greater than 100,000 tons CO_2e per year (e.g., power plant, or landfill, etc.) or modifications of major sources with resulting emissions increase greater than 75,000 tons CO_2e per year.

In addition to the Tailoring Rule, the EPA requires reporting of GHGs from facilities with stationary sources that emit 25,000 metric tons CO_2e per year or more in the United States. The Mandatory Reporting Rule (40 CFR § 98, Subpart C) does not require control of GHGs, it only requires that sources above the threshold levels monitor and report emissions. Facilities used for injecting carbon dioxide for geological sequestration must report net emissions regardless of quantity (40 CFR § 98, Subpart RR). This provides a basis for future EPA policy decisions and regulatory initiatives regarding GHGs. Additional regulations and policies for GHG's are incorporated by reference from the BLM Specialist Report on Annual GHG Emissions and Climate Trends (BLM 2023).

2.6.5. Criteria for Detailed Analysis of Air Quality Pollutants in NEPA

Generally, the criteria followed for the inclusion of a detailed analysis in NEPA documents for air quality resources is based upon emission limits. This could result in a project being analyzed in detail below the emission levels, and not being analyzed in detail above the emission levels in Table 2. In most scenarios, project related mobile sources are excluded from the emission limits in Table 2 since they are dispersed over large distances. The emission limits in Table 2 are specific to point source/stationary sources. Exceptions to the exclusion of project related mobile source are possible based on specific project details. The criteria have been developed based on 40 CFR 52.21(b)(23)(i) and State of Wyoming/Department of Environmental Quality/Air Quality Division Wyoming Administrative Rules, Chapter 6, Section 13(b)(i) (WDEQ 2022).

Table 2. Emissions Criteria for Detailed Analysis of Air Quality in NEPA.

Pollutant	Emissions Limit
Sulfur Dioxide	40 tons per year
Nitrogen Oxides	40 tons per year
PM10 – Fugitive Emissions and Fugitive Dust*	5 tons per year
PM10 – Non-fugitive Emissions	15 tons per year
PM2.5	10 tons per year
Carbon Monoxide	100 tons per year
Lead	0.6 tons per year
Ozone	40 tons per year of volatile organic compounds or nitrogen oxides

*Fugitive emissions and fugitive dust from point/stationary sources.

2.6.6. Other Pollutants and Odors

The Bureau of Land Management primarily manages odors as a nuisance. Odors are usually not a reliable indicator of health impacts as toxic compounds can exhibit no odor or an odor threshold lower or higher than its REL. The human nose is particularly sensitive to compounds containing sulfide. The BLM issued Onshore Order No. 6 that provides requirements and standards for conducting oil and gas operations in an environment knows to or expected to contain hydrogen sulfide (H_2S) gas in order to protect human health and the environment.

3. Affected Environment – Baseline Conditions and Trends

3.1 Emissions

The National Emissions Inventory (NEI) is a comprehensive and detailed estimate of air emissions of criteria pollutants, criteria precursors, and hazardous air pollutants. The NEI is released every three years based primarily upon data provided by State, Local, and Tribal air agencies for sources in their jurisdictions and supplemented by data developed by the US EPA. The NEI is built using the Emissions Inventory System (EIS) first to collect the data from State, Local, and Tribal air agencies and then to blend that data with other data sources (EPA 2023). The NEI includes emissions estimates for point, nonpoint, and mobile sources (EPA 2023).

3.1.1. Point

Point sources include large energy and industrial sites, such as electric generating utilities, portland cement manufacturing plants, petroleum refineries, natural gas compressor stations, and facilities that manufacture pulp and paper, automobiles, machinery, chemicals, fertilizers, pharmaceuticals, glass, food products, and other products. Additionally, smaller point sources can include crematoria, dry cleaners, and gas stations. There are also some portable sources in the point source data category such as hot mix asphalt facilities. Point source data includes emissions from the landing and take-off points of aircraft operations, the ground support equipment at airports, and locomotive emissions within railyards (EPA 2023).

3.1.2.Nonpoint

Nonpoint, or area emission sources, are those that are too small or too numerous to be treated as point sources. This includes biogenics, and new for the 2020 NEI, all fires, including wildfires, prescribed burning and agricultural field burning. Residential heating, asphalt paving, solvent use, and oil and gas production are examples of nonpoint area sources. Some "nonroad" mobile sources such as trains and commercial marine vessels are discussed in the nonpoint category (EPA 2023).

3.1.3.Mobile

Onroad Mobile

Mobile sources include emissions from on-road vehicles that use gasoline, diesel, and other fuels. On-road sources includes passenger cars, motorcycles, minivans, sport-utility vehicles, light- and heavy-duty trucks, and buses. The mobile sources sector also includes emissions generated from parking areas, emissions from short-duration idle during pickups/deliveries, emissions from vehicles when they start, and emissions when vehicles are moving. It also includes "hoteling" emissions, which refers to the time spent idling in a diesel long-haul combination truck during federally mandated rest periods of long-haul trips (EPA 2023). Onroad emissions in the 2020 NEI are comprised of emission estimates based on version 3 of the MOVES model (EPA 2023).

Nonroad Mobile

Nonroad sources includes all mobile source emissions that do not operate on roads, excluding commercial marine vessels, railways, and aircraft. The emissions included in the NEI cover nonroad equipment in 10 broad economic sectors: construction, agriculture, industrial, lawn & garden (commercial and residential), commercial, logging, railroad support (excluding locomotives), recreational vehicles, recreational marine (pleasure craft; excluding commercial marine vessels), and underground mining (EPA 2023). Nonroad equipment emissions were computed using MOVES3, which incorporates the NONROAD model, and was used for all states other than California who has developed their own emissions tool.

3.1.4.Fugitive Dust

Fugitive dust refers to particulate matter that enters the atmosphere without first passing through a stack or duct designed to direct or control its flow. Fugitive dust has been linked to various respiratory issues including aggravated asthma, chronic bronchitis, emphysema, and chronic obstructive pulmonary disease. Common sources of fugitive dust include paved and unpaved roads, construction, and crops and livestock. Dust and particulate matter from these sources become fugitive when lifted into the air by turbulent air currents such as wind erosion, or mechanical forces such as vehicle traffic (EPA 2022).

Crops and Livestock

Fugitive dust emissions from agricultural tilling include the airborne soil particulate emissions produced during the preparation of agricultural lands for planting. Dust kicked up by animals refers to the dust emitted from different types of livestock feet. These emissions are primarily considered to be made by cattle and swine, but poultry emissions of dust are also examined. The calculations for estimating emissions from agricultural tilling involves distributing state-level tilling data by tilling type to the county level and developing a county-level emissions factor for each crop and tilling type. The calculations for estimating emissions from dust kicked up by animals involves multiplying the livestock counts by an emission factor (EPA 2023).

Construction

Construction dust refers to residential and non-residential construction activity, which are functions of acreage disturbed for construction and volume of soil excavated for construction. Residential construction activity is developed from data obtained from the U.S. Department of Commerce's Bureau of the Census (EPA 2023). The calculations for estimating the emissions from non-residential construction involve first estimating the acres disturbed from non-residential construction in each county. Emissions factors for PM_{10} and $PM_{2.5}$ are calculated based on precipitation-evaporation values and dry silt content in each county. The total amount of acres disturbed is multiplied by these emissions factors to estimate emissions of PM from non-residential construction (EPA 2023)

3.1.5. Paved Roads

The paved road dust sector reflects emissions of particulate matter from vehicles driving over paved roads. Uncontrolled paved road emissions were calculated at the county level by roadway type. This was done by multiplying the county/roadway class paved road vehicle miles traveled (VMT) by the appropriate paved road emission factor. VMT data on US roads can be obtained by the Federal Highway Administration (FHWA) (EPA 2023).

3.1.6. Unpaved Roads

The unpaved road dust sector reflects emissions of particulate matter from vehicles driving over unpaved roads. Uncontrolled unpaved road emissions were calculated at the county level by roadway type. This was done by multiplying the county/roadway class unpaved road VMT by the appropriate unpaved road emission factor. Emissions by roadway class were then totaled to the county level and adjusted for meteorological conditions, silt content, and speed (EPA 2023).

3.1.7. Criteria Pollutant Emissions

Statewide emissions data from 2020 NEI is presented in Table **3**. The 2020 inventory contains the best available existing emissions information. Inventories are subject to change if new information becomes available for the NEI reporting year. Emissions from common source categories that occur on public lands include categories such as dust (livestock, construction, paved and unpaved roads), fires (prescribed, wildfire, wood burning), industrial processes (oil & gas, and mining).

Table 3. 2020 Statewide Criteria Air Pollutant and Precursor Emissions (tpy) by County.

County	CO	NO_x	PM10	PM2.5	SO_2	VOC	NH_3	County Total
Albany	186,531.01	5,165.55	33,785.28	17,264.82	1,290.91	52,017.64	4,621.33	300,676.53
Big Horn	6,655.55	1,013.35	11,008.93	1,707.99	28.7854	6,555.06	2,654.16	29,623.83
Campbell	11,980.60	3,221.50	22,351.63	3,002.39	43.8557	14,048.10	2,137.29	56,785.36
Carbon	203,878.69	5,845.37	33,720.59	18,414.72	1,363.15	60,968.47	6,403.60	330,594.57
Converse	8,142.10	4,562.45	8,947.50	1,451.00	47.3269	9,355.72	2,101.53	34,607.62
Crook	4,665.55	1,312.15	9,831.09	1,359.62	6.60243	14,840.32	1,090.61	33,105.93
Fremont	11,736.27	2,319.81	33,000.91	4,004.28	18.6732	16,992.26	2,693.50	70,765.70
Goshen	3,880.05	1,909.98	9,734.08	1,419.63	7.11739	5,902.02	3,139.04	25,991.91
Hot Springs	2,412.81	507.6275	4,664.25	605.8565	6.3124	3,755.07	698.3352	12,650.26
Johnson	8,955.10	1,392.50	7,332.91	1,308.68	48.7934	9,524.75	1,765.82	30,328.56
Laramie	14,503.66	4,454.31	25,391.11	3,322.68	21.9282	6,382.81	2,497.10	56,573.60
Lincoln	6,316.50	1,695.29	22,510.27	2,750.28	12.7153	11,559.03	1,170.56	46,014.64
Natrona	14,787.14	2,644.95	25,330.78	3,175.06	29.7351	11,306.82	1,505.43	58,779.91
Niobrara	2,921.55	1,186.68	5,893.27	768.9626	3.69439	5,705.31	1,681.13	18,160.59
Park	12,866.08	1,687.57	28,388.77	3,655.58	39.9609	18,787.26	2,082.96	67,508.19
Platte	5,557.81	1,929.45	5,266.47	942.8672	18.4752	5,633.23	2,491.83	21,840.13
Sheridan	12,842.29	1,853.20	14,861.76	2,508.68	81.4332	10,099.97	1,413.63	43,660.95
Sublette	7,150.64	965.557	14,444.53	1,971.58	20.8128	12,390.84	2,420.41	39,364.38
Sweetwater	12,771.65	6,113.12	15,518.45	1,984.68	20.0916	12,450.43	942.9773	49,801.40
Teton	20,897.13	1,180.13	24,651.35	3,769.78	91.5789	17,990.17	748.2505	69,328.39
Uinta	4,864.53	1,951.19	9,289.76	1,245.49	9.44161	4,060.38	1,808.24	23,229.04
Washakie	13,489.46	836.0193	6,679.04	1,704.13	105.61	6,274.37	1,606.81	30,695.44
Weston	3,089.65	1,573.86	7,440.37	938.7033	4.42585	8,197.16	995.6291	22,239.80
State Total	**580,895.83**	**55,321.60**	**380,043.08**	**79,277.45**	**3,321.43**	**324,797.20**	**48,670.15**	**1,472,326.74**

3.1.8. Hazardous Air Pollutant Emissions

The NEI contains HAP emissions as part of the total NEI. Total HAPs emissions for each county is presented in Table 4, including a subset of emissions sources related to activities occurring on BLM managed lands. HAPs emissions breakdown into five main categories: vegetation, soils, and wildfires comprise 60% of total state emissions with prescribed fire accounting for 39%, and oil and gas production accounting for 1 %.

Table 4. 2020 Statewide BLM-Managed Lands Hazardous Air Pollutant Emissions (tpy) by County.

County	Vegetation and Soils	Wildfire	Prescribed Fire	Oil and Gas Production	County Total
Albany	1,511.31	-	10,353.60	-	11,864.91
Big Horn	1,116.36	47.04	39.52	1.37	1,204.28
Campbell	2,352.62	19.22	239.77	18.31	2,629.92
Carbon	2,721.11	3.60	10,951.74	4.21	13,680.66
Converse	1,533.31	9.21	181.32	135.93	1,859.78
Crook	2,148.85	7.33	6.02	1.16	2,163.36
Fremont	3,231.00	4.27	31.38	7.71	3,274.37
Goshen	1,026.18	11.60	3.37	-	1,041.16
Hot Springs	716.30	0.06	38.56	1.75	756.67
Johnson	1,637.82	4.79	358.69	1.80	2,003.10
Laramie	919.29	0.72	20.70	-	940.70
Lincoln	1,599.71	1.32	7.44	99.03	1,707.50
Natrona	1,955.02	7.88	106.16	7.10	2,076.17
Niobrara	1,194.74	-	17.03	-	1,211.77
Park	2,248.41	18.88	168.43	8.35	2,444.07
Platte	926.30	9.96	108.14	-	1,044.41
Sheridan	1,279.74	1.46	574.48	--	1,855.68
Sublette	1,571.95	0.61	119.13	42.28	1,733.98
Sweetwater	2,919.10	1.27	71.98	8.08	3,000.43
Teton	1,764.98	-	596.81		2,361.79
Uinta	692.27	-	22.49	0.73	715.50
Washakie	810.62	169.77	634.78	4.57	1,619.73
Weston	1,455.27	1.69	10.31	0.20	1,467.46
Total	**37,332.27**	**320.69**	**24,661.86**	**342.57**	**62,657.40**

Common HAPs emitted in the oil and gas industry include benzene, toluene, ethyl benzene, mixed xylenes, formaldehyde, normal-hexane, acetaldehyde, and methanol. Statewide these individual pollutants make up 95% of the HAPs emissions from the oil and gas production. **Table 5** presents the emissions of these pollutants from the oil and gas industry in Wyoming. Only counties with oil and gas production sources are included in **Table 5**.

Table 5. 2020 Hazardous Air Pollutant Emissions from Oil and Gas Production

County	Acetaldehyde (tpy)	Benzene (tpy)	Ethylbenzene (tpy)	Formaldehyde (tpy)	Hexane (tpy)	Naphthalene (tpy)	Toluene (tpy)	Xylenes (tpy)	Total of the listed HAPs (tpy)
Albany	1,677.47	408.65	8.31	3,229.89	60.86	432.47	355.34	288.94	6,461.93
Big Horn	184.09	14.50	4.59	238.35	8.69	6.69	28.98	18.67	504.55
Campbell	388.57	29.95	9.25	661.99	27.37	18.72	74.68	47.13	1,257.66
Carbon	1,891.42	427.57	6.46	3,563.52	54.66	456.56	353.70	293.92	7,047.81
Converse	236.94	19.18	5.20	464.37	18.72	12.27	35.97	25.62	818.28
Crook	360.67	9.15	4.97	683.17	5.77	4.23	26.50	18.37	1,112.84
Fremont	438.50	23.65	9.97	574.25	15.16	10.36	63.71	41.53	1,177.12
Goshen	143.86	8.03	4.05	216.26	4.20	3.09	24.57	15.72	419.78
Hot Springs	96.12	6.05	4.08	131.92	3.34	2.86	19.50	15.09	278.96
Johnson	273.19	21.78	5.48	422.22	6.30	18.13	38.50	29.17	814.76
Laramie	168.71	31.76	17.48	222.56	22.14	16.61	114.32	74.25	667.83
Lincoln	242.68	22.51	8.53	320.70	24.42	6.29	66.48	49.91	741.52
Natrona	281.30	34.93	16.05	380.05	44.30	15.98	120.67	74.40	967.68
Niobrara	161.69	7.31	7.26	259.61	3.77	2.15	30.65	24.79	497.23
Park	377.78	26.37	8.95	509.00	17.84	14.48	59.70	39.64	1,053.76
Platte	142.15	11.85	4.47	219.70	6.02	8.33	28.54	19.90	440.95
Sheridan	294.75	36.43	6.76	476.08	11.43	30.01	59.50	41.45	956.42
Sublette	236.47	19.72	7.37	327.32	24.73	8.42	52.33	35.78	712.15
Sweetwater	361.18	23.92	11.09	499.56	32.75	14.37	81.87	53.26	1,078.00
Teton	395.17	48.17	11.71	565.68	12.41	34.00	79.26	57.90	1,204.30
Uinta	103.63	10.83	4.91	136.71	7.56	6.37	30.61	20.40	321.04
Washakie	219.97	36.81	3.85	364.79	8.63	34.74	46.67	36.85	752.31
Weston	223.06	6.53	3.88	397.35	4.59	2.24	20.78	14.66	673.10
State Total	**8,899.35**	**1,285.67**	**174.66**	**14,865.06**	**425.66**	**1,159.38**	**1,812.82**	**1,337.37**	**29,959.98**

No monitored concentration data is available for HAPs on lands managed by BLM, so the EPA Air Toxics Screening Assessment tool (AirToxScreen) is used to evaluate impacts from existing HAPs emissions in each county and the entire state of Wyoming (EPA 2022). AirToxScreen provides a snapshot of outdoor air quality with respect to emissions of HAPs and estimates the cancer risks from breathing air toxics over a lifetime of exposure (70 years). The AirToxScreen tool cannot provide precise exposure and risks for a specific person and is best used for a cumulative assessment for larger areas (e.g., county, state, national). The EPA has determined that, for the entire state of Wyoming the total cancer risk is 11.8 in 1 million (EPA 2022) and all the counties range from 10.03 to 15.19 in 1 million, see Table **6**. This cancer risk is within the acceptable range of risk published by the EPA of 100 in 1 million as discussed in the National Contingency Plan, 40 CFR § 300.430. The noncancer respiratory hazard (Hazard Index) for the entire state of Wyoming is 0.13, and ranges from 0.10 to 0.18 for all the counties in Wyoming. Hazard index (HI) values less than one mean it is unlikely that air toxics will cause adverse noncancer health effects over a lifetime of exposure.

Table 6. Total Cancer Risk and Noncancer Respiratory Hazard from Existing Hazardous Air Pollutant Emissions (2019 Reporting Year).

County	Total Cancer Risk (per million)	BACKGROUND Cancer Risk (per million)	Oil & Gas Cancer Risk (per million)	Total Respiratory Hazard Index (HI)
Albany	12.08	2.46	0.01	0.13
Big Horn	11.65	2.77	0.41	0.13
Campbell	13.03	2.74	0.38	0.14
Carbon	10.66	2.51	0.04	0.11
Converse	12.23	2.68	0.79	0.14
Crook	11.75	2.75	0.21	0.12
Entire State	12.34	2.62	0.16	0.14
Fremont	10.92	2.65	0.18	0.12
Goshen	12.66	2.75	0.01	0.13
Hot Springs	10.87	2.70	0.18	0.12
Johnson	10.39	2.66	0.16	0.10
Laramie	13.86	2.58	0.11	0.18
Lincoln	10.04	2.53	0.10	0.10
Natrona	12.38	2.64	0.10	0.14
Niobrara	11.41	2.70	0.26	0.11
Park	10.79	2.68	0.26	0.12
Platte	11.89	2.69	0.03	0.12
Sheridan	12.45	2.76	0.01	0.13
Sublette	10.03	2.51	1.01	0.10
Sweetwater	15.19	2.55	0.05	0.18
Teton	10.38	2.52	0.00	0.11
Uinta	11.71	2.52	0.08	0.12
Washakie	12.26	2.75	0.18	0.14
Weston	11.71	2.73	0.15	0.12
Entire State	**11.79**	**2.64**	**0.20**	**0.13**

3.1.9. Greenhouse Gas Emissions and Sinks

Current ongoing global climate change is caused, in part, by the atmospheric buildup of GHGs, which may persist for decades or even centuries. The buildup of GHGs such as carbon dioxide (CO_2), methane (CH_4,), nitrous oxide (N_2O), and fluorinated gases since the start of the industrial revolution has substantially increased atmospheric concentrations of these compounds compared to historical background levels. Because GHGs circulate freely throughout Earth's atmosphere, climate change is a cumulative global issue.

A detailed discussion of climate change science and predicted impacts, as well as the existing and reasonably foreseeable GHG emissions associated with BLM's actions, are included in the BLM Specialist

Report on Annual Greenhouse Gas Emissions and Climate Trends (hereinafter referred to as the Annual GHG Report). The Annual GHG report presents the estimated emissions of greenhouse gases attributable to fossil fuels produced on lands and mineral estate managed by the BLM. The Annual GHG Report is available at https://www.blm.gov/content/ghg/2022.

The impact of a given GHG on global warming depends both on its radiative forcing and how long it lasts in the atmosphere. Each GHG varies with respect to its concentration in the atmosphere and the amount of outgoing radiation absorbed by the gas relative to the amount of incoming radiation it allows to pass through (i.e., radiative forcing). Different GHGs also have different atmospheric lifetimes. Some, such as methane, react in the atmosphere relatively quickly (on the order of 12 years); others, such as carbon dioxide, typically last for hundreds of years or longer. Climate scientists have calculated a factor, known as the global warming potential (GWP), for each GHG that accounts for these effects.

The GWP is used as a conversion factor to convert a mixture of different GHG emissions into carbon dioxide equivalents (CO2e). The larger its GWP, the more the specific gas warms the Earth as compared to CO2. The BLM uses the 100-year time horizon for GWPs in most report metrics, to be consistent with the scientific and regulatory communities that develop climate change assessments and policy. The 100-year GWP (GWP100) was adopted by the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol and is now used widely as the default metric by researchers and regulators. Global Warming Potentials from the IPCC AR 6 are summarized in **Table 7**.

Table 7. Greenhouse Gases and Their Global Warming Potentials.

Time Horizon	Carbon Dioxide (CO_2)	Methane (CH_4) Fossil	Methane (CH_4) Non-Fossil	Nitrous Oxide (N_2O)
100-year	1	29.8	27.2	273
20-year	1	82.5	80.8	273

Source: (IPCC 2021)

Emissions

State, national, and global annual GHG emissions from the Annual GHG Report are presented in Table 8 (BLM 2023). Global emissions were obtained from the Emissions Database for Global Atmospheric Research (EDGAR) (EDGAR 2022). National and state emissions come from the EPA Inventory of US Greenhouse Gases Emission and Sinks 1990-2021 (EPA 2022). Note that state-level data is not yet available for 2021.

Table 8. Annual State, National, and Global GHG Emissions (CO2e) in Megatonnes (Mt) per Year.

Area	1990	2005	2017	2018	2019	2020	2021
Global	33,208.5	42,319.7	51,010.7	52,081.2	52,356.6	50,485.3	52,598.9
United States	6,487.3	7,477.4	6,561.8	6,754.8	6,617.9	6,026	6,340.2
US Fossil CO_2	4,728.2	5,747.3	4,852.5	4,989.8	4,855.9	4,344.9	4,639.1
Wyoming	**77.3616**	**97.0352**	**90.0628**	**91.6585**	**85.2203**	**79.1958**	**NA**

Source: Annual GHG Report (Table 5-1 and Table 5-2), state data is not yet available for 2021.

GHG emissions information is available in the most recent NEI (2020) and includes emissions data for mobile sources, prescribed fires, and wildfires while the FLIGHT tool includes emissions data for major industrial facilities. No reliable information for residential, commercial, agriculture, and fugitive emissions are available at county level scales. County level anthropogenic GHG emissions from the NEI is provided in **Table 9**.

Table 9 County level GHG Emissions (CO2e) in Metric Tonnes (t) for the 2020 Reporting Year

County	CO_2 (t)	CH_4 (t)	N_2O (t)	County Total
Albany	2,572,183.62	8,743.74	6.95	2,580,934.30
Big Horn	141,997.06	66.45	2.22	142,065.73
Campbell	613,782.34	191.46	9.08	613,982.88
Carbon	2,687,870.33	9,541.49	5.73	2,697,417.55
Converse	539,494.94	170.02	8.39	539,673.35
Crook	197,391.86	25.03	2.25	197,419.14
Fremont	406,588.93	59.96	6.17	406,655.06
Goshen	226,729.34	29.19	4.38	226,762.91
Hot Springs	65,287.27	28.65	0.83	65,316.75
Johnson	305,414.07	220.43	1.81	305,636.30
Laramie	1,129,836.90	89.65	15.77	1,129,942.32
Lincoln	244,821.53	26.09	3.74	244,851.36
Natrona	717,868.87	130.20	10.87	718,009.93
Niobrara	120,768.15	24.19	1.79	120,794.13
Park	369,305.27	167.21	5.45	369,477.94
Platte	313,967.42	112.24	3.59	314,083.25
Sheridan	425,034.98	358.89	5.49	425,399.36
Sublette	157,926.70	131.35	1.64	158,059.69
Sweetwater	1,128,165.07	111.48	11.95	1,128,288.50
Teton	421,638.31	543.21	4.02	422,185.53
Uinta	413,146.74	39.04	4.55	413,190.33
Washakie	239,578.45	533.83	1.37	240,113.65
Weston	158,823.53	21.87	3.23	158,848.64
State Total	**13,597,621.68**	**21,365.67**	**121.25**	**13,619,108.60**

3.1.10. Federal Fossil Fuel Emissions

Oil and Gas

Estimated annual GHG emissions from existing oil and gas wells for fiscal year 2022 are incorporated from the Annual GHG report and presented in **Table 10** and 11. The estimates presented here include emissions from the full oil and gas lifecycle, including emissions arising from activities outside of the BLM's jurisdiction (such as emissions associated with refining and processing). Emissions from coal production on the federal mineral estate in FY 2022 are provided in **Table 12**. The coal emissions estimates were obtained by multiplying the representative emission factors (Table 4-1, Annual GHG report) by the state-specific production amounts (Table 4-2, Annual GHG report). The estimates cover emissions from the typical coal lifecycle, including emissions arising from activities outside of the BLM's jurisdiction (such as emissions associated with coal exports).

Table 10. GHG Emissions from Oil Production on the Federal Mineral Estate in Fiscal Year 2022. (Mt CO2e) [1]

Area	Oil Extraction	Oil Processing	Oil Transport	Oil Combustion	Total Oil
Wyoming	3.6665	2.5248	0.5002	21.55	28.24
Onshore Total	35.2774	24.2925	4.8124	207.31	271.69
Federal Total	55.7236	56.199	11.1331	479.6	602.66

[1]Information obtained from the Annual GHG report, Chapter 7, Table 7-4.

Table 11. GHG Emissions from Gas Production on the Federal Mineral Estate in Fiscal Year 2022. (Mt CO2e) [1]

Area	Gas Extraction (mcf)	Gas Processing	Gas Transport	Gas Combustion	Total Gas
Wyoming	5.7095	1.9513	12.5446	54.9	75.1
Onshore Total	20.5536	7.0244	45.159	197.63	270.36
Federal Total	25.2504	8.6033	55.3094	242.05	331.21

[1]Information obtained from the Annual GHG report, Chapter 7, Table 7-11.

Coal

The total coal production within Wyoming for fiscal year 2022 from the federal mineral estate represents about 4% of the total amount produced from federal lands. Data from the Department of the Interior's Office of Natural Resources Revenue indicate that Wyoming's 2022 coal production of 233,022,508 tons (see Table 12).

Table 12. GHG Emissions from Coal Production on the Federal Mineral Estate in Fiscal Year 2022. (Mt CO2e) [1]

Area	2022 Production (tons)	Extraction CO2e	Processing CO2e	Transport CO2e	Combustion CO2e	Total CO2e
Wyoming	233,022,508	3.2157	0.8715	5.7299	393.66	403.48
Federal Total	270,220,938	4.80	1.40	9.77	475.79	491.76

[1]Information obtained from the Annual GHG report, Chapter 7, Table 7-1.

3.2 Air Quality Index and Air Pollutant Concentrations

Air Quality Index

Air quality for Wyoming is examined using the EPA Air Quality Index Summary Report (EPA 2023). The Air Quality Index (AQI) is an indicator of overall air quality as it accounts for all criteria air pollutants in a county and is one way to quickly evaluate how clean or polluted the air is. The EPA calculates a daily AQI based on local air monitoring data. The terms "Good", "Moderate", and "Unhealthy" help to interpret the AQI. When the AQI value is in the good range, pollutant concentrations are well below the NAAQS and air pollution poses little or no risk. Moderate AQI values occur when pollution is below but near the NAAQS and voluntary emission reduction measures are encouraged. The AQI is considered unhealthy when the NAAQS is exceeded, and major pollution sources are often required to implement mandatory emission reduction measures. Counties without AQI data usually have fewer air pollutant sources and are assumed to have good air quality. Statistical AQI data from 2020 to 2022 is presented in Table 13. Proposed projects occurring in counties with more than 1% (approximate number of annual exceedances allowed for the O_3 NAAQS) of days with an unhealthy AQI, could merit further NEPA air quality impacts.

Table 13. 2020-2022 Wyoming AQI Index Summary Statistics by County.

		Number of Days When AQI was…			Percentage of Days Rated …		
County	**# Days with AQI**	**Good**	**Moderate**	**Unhealthy**	**Good**	**Moderate**	**Unhealthy**
Albany	1096	676	393	22	61.7	35.9	2.0
Big Horn	1085	1029	53	3	94.8	4.9	0.3
Campbell	1096	681	387	26	62.1	35.3	2.4
Carbon	1013	1013	0	0	100.0	0.0	0.0
Converse	1096	892	196	8	81.4	17.9	0.7
Fremont	1096	834	248	13	76.1	22.6	1.2
Johnson	1094	991	95	8	90.6	8.7	0.7
Laramie	1093	891	186	14	81.5	17.0	1.3
Lincoln	1096	980	109	7	89.4	9.9	0.6
Natrona	1096	927	159	10	84.6	14.5	0.9
Park	618	584	32	2	94.5	5.2	0.3
Platte	941	837	77	11	88.9	8.2	1.2
Sheridan	1095	964	124	7	88.0	11.3	0.6
Sublette	1096	858	225	12	78.3	20.5	1.1
Sweetwater	1096	767	305	17	70.0	27.8	1.6
Teton	1096	945	129	17	86.2	11.8	1.6
Uinta	1095	1047	46	2	95.6	4.2	0.2
Weston	1059	949	109	1	89.6	10.3	0.1

Air Quality Design Values

Design values can be used to further evaluate the air quality for areas with poor air quality. A design value describes the air quality of a location with respect to the NAAQS and are typically used to classify Non-Attainment Areas (NAA) and evaluate progress towards meeting the NAAQS. The EPA annually publishes the most recently computed design values (EPA 2023). The $PM_{2.5}$, NO_2, and O_3 design values for Wyoming are presented in Tables 14-18. Design values for PM_{10}, CO, SO_x, and lead are below the NAAQS and can be found on the EPA website (EPA, Air Quality Design Values 2023).

Table 14. County-level Design Value History for the PM2.5 Annual NAAQS (12 µg/m3).

County	2011-2013 µg/m³	2012-2014 µg/m³	2013-2015 µg/m³	2014-2016 µg/m³	2015-2017 µg/m³	2016-2018 µg/m³	2017-2019 µg/m³	2018-2020 µg/m³	2019-2021 µg/m³	2020-2022 µg/m³	Meets NAAQS
Albany	4.9	4.8	4.3	4.1	4.3	4.6	4.5	4.9	NA	NA	Yes
Campbell	NA	NA	4.2	4.7	4.8	4.5	3.3	NA	NA	NA	Yes
Fremont	7.8	7.4	6.9	6.6	6.8	7.2	7.2	7.2	2.4	2.0	Yes
Laramie	4.8	4.7	4.1	4.2	4.2	4.4	4.3	3.4	4.1	4.9	Yes
Natrona	4.8	4.8	4.6	4.7	4.9	5.0	4.7	4.7	NA	3.8	Yes
Park	4.6	4.4	4.1	3.8	4.3	4.3	4.0	3.8	4.3	4.9	Yes
Sheridan	7.6	7.2	6.9	7.0	7.3	7.2	7.0	6.5	6.3	NA	Yes
Sublette	NA	NA	5.0	5.0	5.1	5.3	4.7	3.8	3.5	3.6	Yes
Sweetwater	5.7	5.5	4.8	4.7	5.1	5.3	5.1	NA	NA	NA	Yes
Teton	5.3	5.2	4.7	4.5	4.6	4.8	4.5	4.5	4.4	4.5	Yes

Table 15. County-level Design Value History for the PM2.5 24-hour NAAQS (35 µg/m3).

County	2011-2013 µg/m³	2012-2014 µg/m³	2013-2015 µg/m³	2014-2016 µg/m³	2015-2017 µg/m³	2016-2018 µg/m³	2017-2019 µg/m³	2018-2020 µg/m³	2019-2021 µg/m³	2020-2022 µg/m³	Meets NAAQS
Albany	12	13	13	13	13	13	13	21	NA	NA	Yes
Campbell	NA	NA	16	14	19	19	15	NA	NA	NA	Yes
Fremont	28	27	25	23	23	24	25	28	NA	16	Yes
Laramie	12	13	16	17	15	11	11	18	15	24	Yes
Natrona	14	15	14	13	16	17	16	20	23	16	Yes
Park	14	14	15	17	23	22	17	20	22	25	Yes
Sheridan	20	18	24	26	24	23	21	24	27	NA	Yes
Sublette	NA	NA	13	13	16	20	18	17	18	19	Yes
Sweetwater	17	16	13	15	19	20	19	NA	NA	NA	Yes
Teton	16	16	13	13	15	18	19	24	30	32	Yes

Table 16. County-level Design Value History for the NO2 1-Hour NAAQS (100 ppb).

County	2011-2013 (ppb)	2012-2014 (ppb)	2013-2015 (ppb)	2014-2016 (ppb)	2015-2017 (ppb)	2016-2018 (ppb)	2017-2019 (ppb)	2018-2020 (ppb)	2019-2021 (ppb)	2020-2022 (ppb)	Meets NAAQS
Campbell	32	35	49	31	30	29	30	NA	NA	NA	Yes
Carbon	NA	NA	NA	NA	NA	29	29	29	30	27	Yes
Converse	NA	NA	NA	35	4	31	31	13	15	16	Yes
Fremont	5	5	5	5	35	4	4	4	4	4	Yes
Johnson	NA	NA	NA	NA	NA	NA	3	1	1	6	
Laramie	35	NA	NA	40	40	34	33	31	29	28	Yes
Natrona	NA	NA	NA	NA	NA	38	36	35	34	34	Yes
Sublette	30	22	19	20	24	24	24	19	18	18	Yes
Sweetwater	22	20	35	32	32	32	35	36	35	33	Yes
Uinta	12	12	12	12	13	13	14	NA	NA	NA	Yes

Table 17. County-level Design Value History for the NO2 Annual NAAQS (53 ppb).

County	2011-2013 (ppb)	2012-2014 (ppb)	2013-2015 (ppb)	2014-2016 (ppb)	2015-2017 (ppb)	2016-2018 (ppb)	2017-2019 (ppb)	2018-2020 (ppb)	2019-2021 (ppb)	2020-2022 (ppb)	Meets NAAQS
Campbell	9	10	7	4	5	5	4	1	1	1	Yes
Carbon	1	6	7	5	6	5	3	4	4	3	Yes
Converse	3	4	4	2	3	3	3	2	1	1	Yes
Fremont	1	2	1	1	0	1	1	1	1	1	Yes
Goshen	NA	NA	NA	4	NA	NA	1	NA	NA	NA	NA
Johnson	NA	NA	NA	NA	NA	NA	3	1	1	1	Yes
Laramie	4	4	4	4	4	4	4	3	3	3	Yes
Natrona	6	5	5	5	5	5	2	4	5	4	Yes
Sublette	2	2	1	3	5	6	3	2	2	2	Yes
Sweetwater	4	3	3	4	3	3	1	3	3	3	Yes
Teton	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	Yes
Uinta	2	2	2	2	2	2	2	NA	NA	NA	NA

Table 18. County-level Design Value History for the Ozone 8-hr NAAQS (0.070 ppm).

County	2011-2013 (ppm)	2012-2014 (ppm)	2013-2015 (ppm)	2014-2016 (ppm)	2015-2017 (ppm)	2016-2018 (ppm)	2017-2019 (ppm)	2018-2020 (ppm)	2019-2021 (ppm)	2020-2022 (ppm)	Meets NAAQS
Albany	NA	0.068	0.066	0.064	0.064	0.066	0.067	0.067	0.067	0.068	Yes
Big Horn	NA	NA	0.059	0.060	0.063	0.061	0.060	0.059	0.060	0.060	Yes
Campbell	0.064	0.063	0.060	0.060	0.060	0.062	0.061	0.060	0.064	0.066	Yes
Carbon	0.062	0.062	0.060	0.059	0.061	0.063	0.064	NA	NA	NA	Yes
Converse	NA	NA	NA	NA	NA	NA	0.063	0.064	NA	0.066	Yes
Fremont	0.066	0.064	0.063	0.063	0.062	0.063	0.064	0.065	0.068	0.067	Yes
Johnson	NA	NA	NA	NA	NA	NA	NA	NA	0.066	0.065	Yes
Laramie	0.068	0.067	0.065	0.063	0.063	0.064	0.064	0.062	0.064	0.065	Yes
Natrona	NA	NA	0.062	0.060	0.061	0.063	0.062	0.063	0.065	0.065	Yes
Sublette	0.076	0.064	0.062	0.063	0.063	0.065	0.072	0.070	0.074	0.067	No
Sweetwater	0.066	0.064	0.067	0.066	0.067	0.066	0.066	0.065	0.066	0.065	Yes
Teton	0.065	0.063	0.061	0.060	0.061	0.062	0.062	0.063	0.064	0.062	Yes
Uinta	0.065	0.063	0.063	0.061	0.062	0.062	0.065	0.067	NA	NA	Yes
Weston	NA	NA	0.062	0.060	0.061	NA	NA	0.062	0.064	0.064	Yes

Monitoring Data

State, Federal, and Tribal agencies operate several air pollutant monitoring stations across the State of Wyoming. Air pollutant data from these stations is available on the EPA Air Data website (EPA 2022). Most air monitors are situated to measure air quality in both neighborhoods and industrial areas. A few stations are in rural areas by various Federal agencies to monitor air quality conditions and trends at National Parks and other public lands, and to identify background concentrations away from major emission sources. The WDEQ 2023 Network Plan shows air pollutant trends for state-operated monitoring stations (WDEQ 2023). Air monitoring data from the current year is not analyzed as data is incomplete for the year, in the process of being quality assured, and considered preliminary until May 1 of the following year.

Air Quality Related Values (AQRV)

Visibility

Pollution in the atmosphere can impair scenic views by degrading the contrast, colors, and distance an observer is able to see. Visibility can be assessed in terms of the distance that a person can distinguish a large dark object on the horizon and is measured as the standard visual range in miles. Visibility is monitored using methodologies established by the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program. The particulates that contribute to haze are collected on filters at each IMPROVE site. Samples are then measured to determine how visibility is impacted over time and by which pollutants.

A deciview (dv) is a unit of measurement to quantify human perception of visibility. It is derived from the natural logarithm of atmospheric light extinction coefficient. A one deciview change is roughly the smallest perceptible change in visibility. Because visibility at any one location is highly variable throughout the year, it is characterized by three groupings: the clearest 20% days, average 20% days, and haziest 20% days. Visibility degradation is primarily due to sulfate, nitrate, and particulate matter in the atmosphere, with contributions from both anthropogenic and natural sources. Measuring progress in air pollution control can be challenging because natural sources largely beyond human control such as dust storms and wildfire smoke can produce significant visibility impairment over large areas for days to weeks at a time. Under the auspices of the 2017 Regional Haze Rule revisions, the EPA proposed a new visibility tracking metric– most impaired days – to better characterize visibility conditions and trends. The most impaired days are those with the most impairment from anthropogenic sources while the haziest grouping now better represents days with haze from natural sources. Total haze on the most impaired days is used to track progress toward Regional Haze Rule goals. Comparing trends in the 20% haziest days with the 20% most impaired days provides a method to assess impacts from episodic events, like wildfires, which have greatly affected visibility throughout the western United States in recent years (Burke, et al. 2021). More information about the EPA's impairment framework can be found at: http://vista.cira.colostate.edu/Improve/impairment/. Visibility information can be found at the Federal Land Managers Environmental Database (FLM 2019). Figures 2 through 5 illustrate visibility trends based on air monitoring data from three Wyoming sites and one South Dakota IMPROVE site for the clearest, haziest, and most impaired categories. The haziest days have shown little improvement due to many years with large wildfire smoke episodes. However, most impaired days and clearest days for all monitoring sites slowly improve over several years.

Figure 1. National Parks, Wilderness Areas, and National Parks in and surrounding Wyoming.

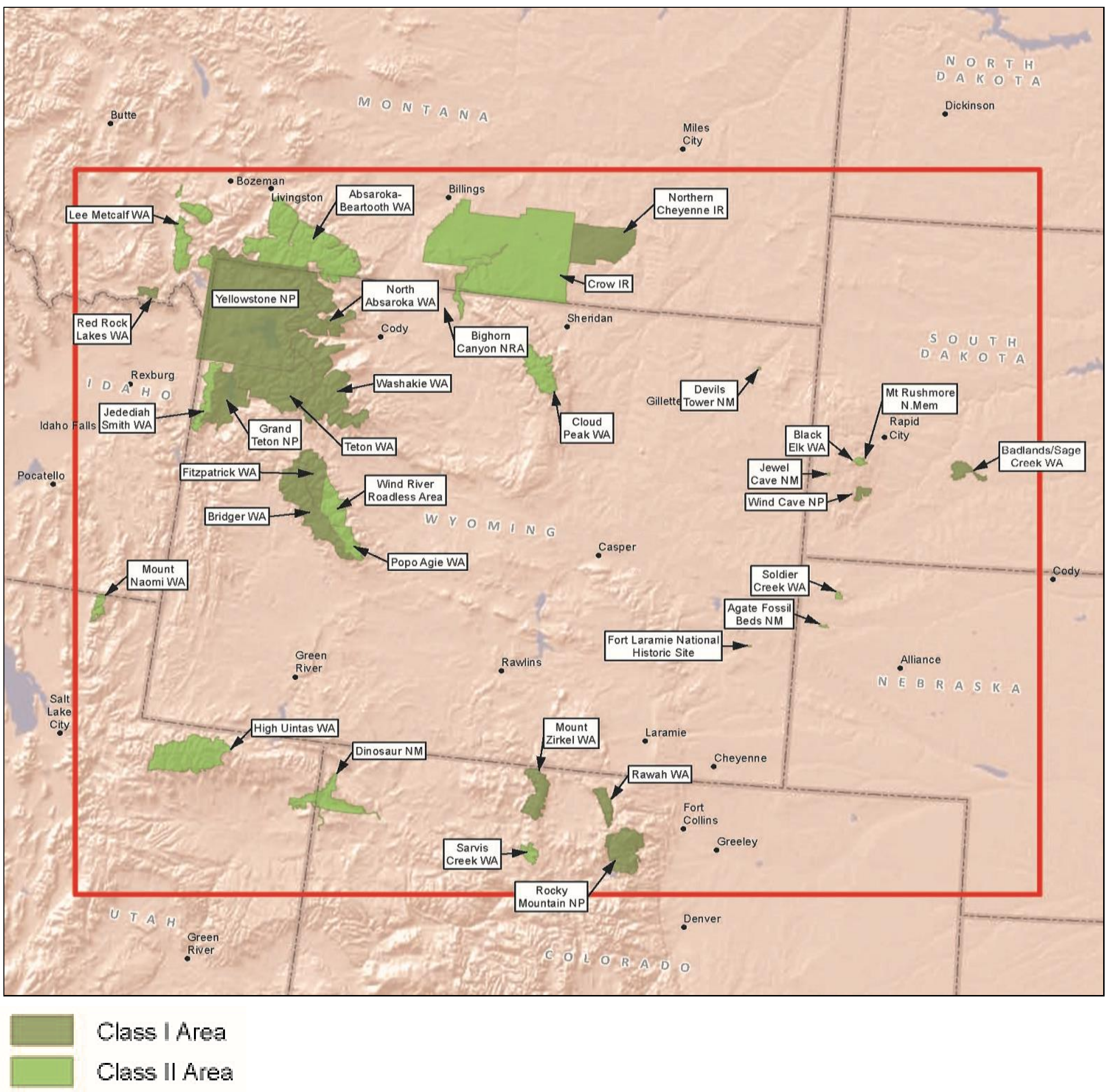


Figure 2. Visibility Trends at Yellowstone NP.

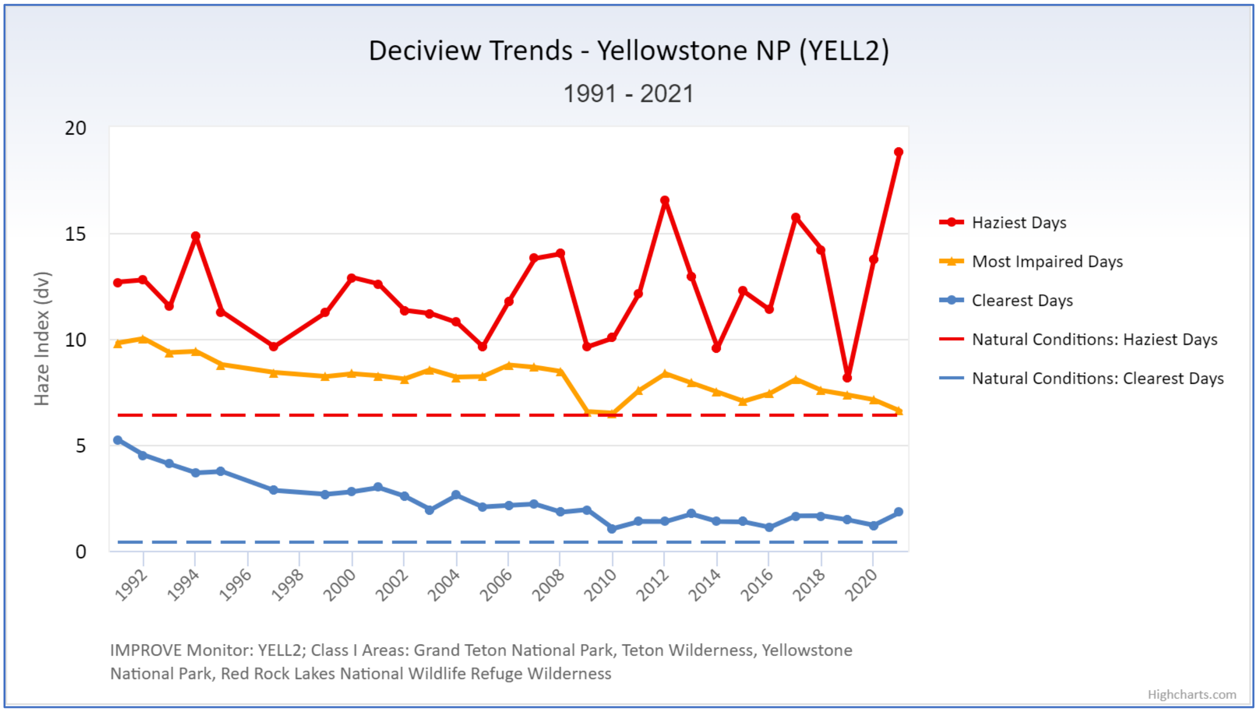


Figure 3. Visibility Trends at Bridger Wilderness.

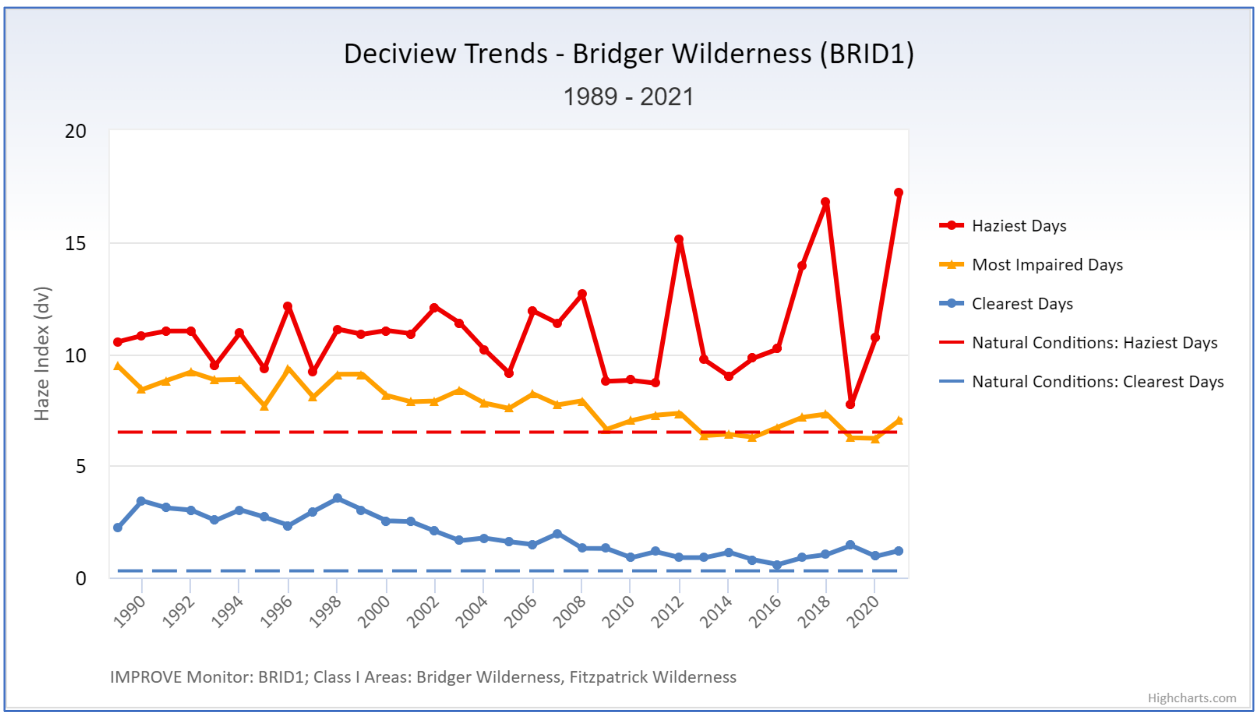


Figure 4. Visibility Trends at North Absaroka Wilderness Area.

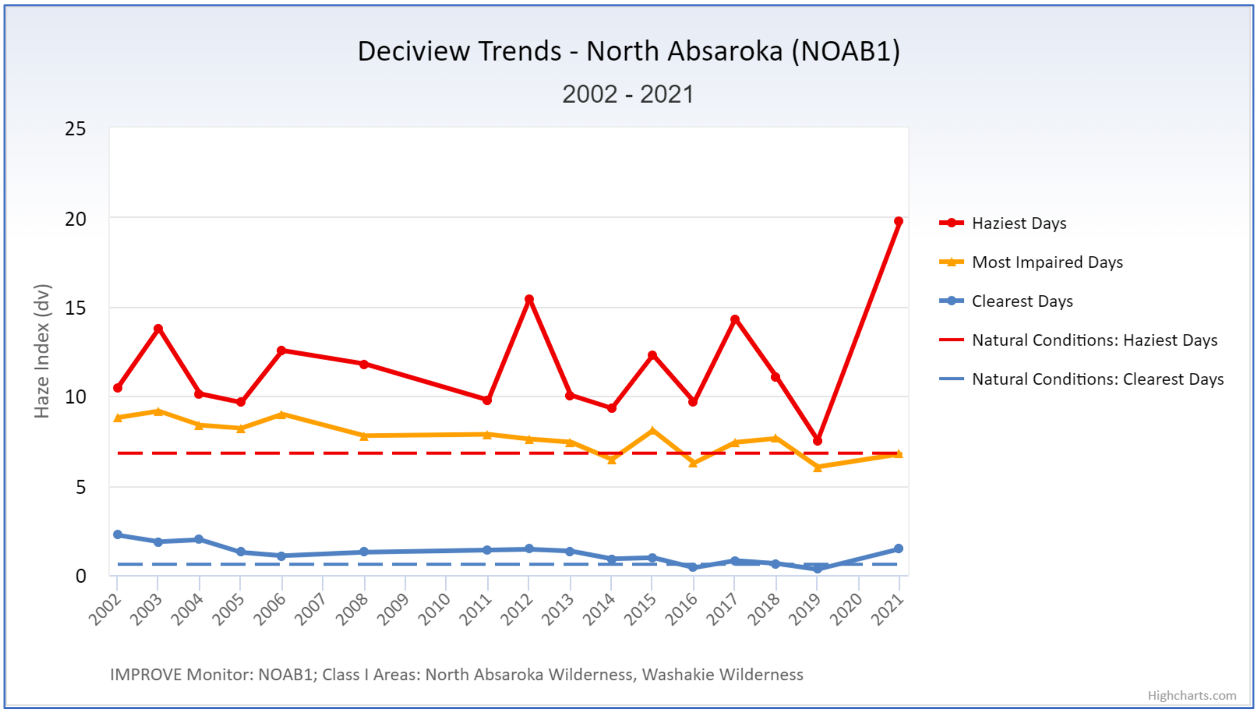
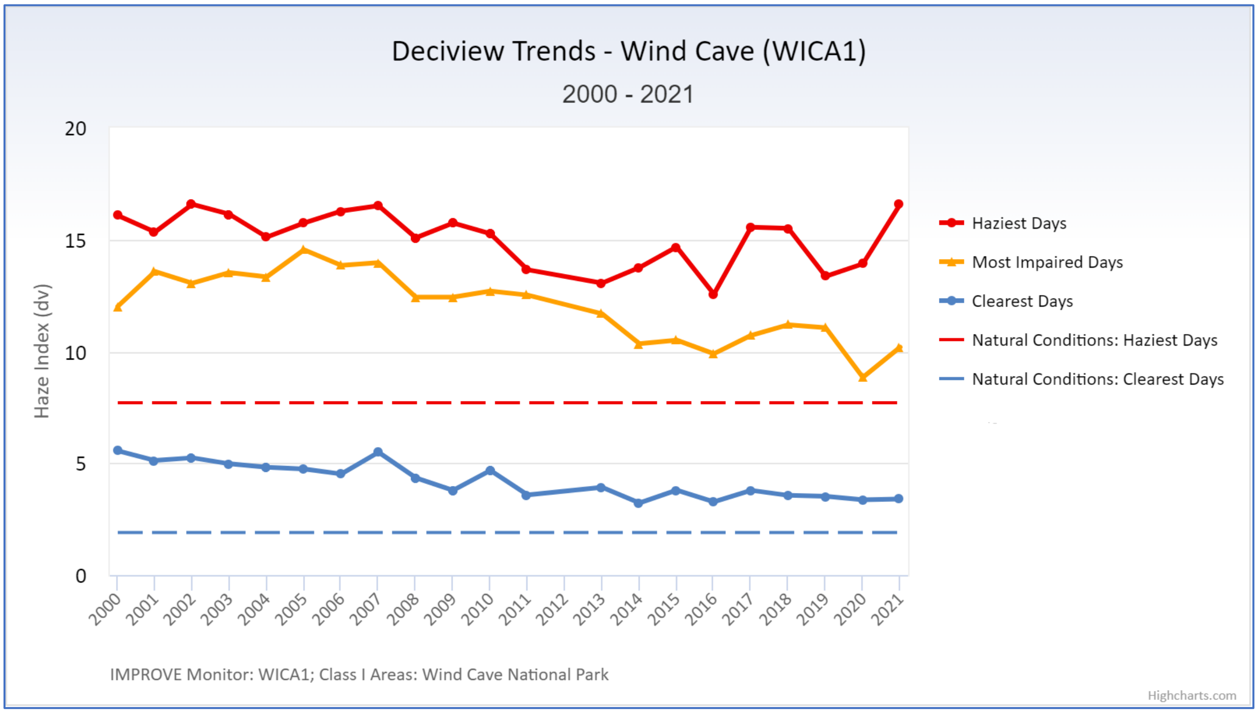


Figure 5. Visibility Trends at Wind Cave NP.



Atmospheric Deposition

Sulfur and nitrogen compounds that can be deposited on terrestrial and aquatic ecosystems include nitric acid (HNO_3), nitrate (NO_3^-), ammonium (NH_4^+), and sulfate (SO_4^{2--}). Nitric acid (HNO_3) and nitrate (NO_3^-) are not emitted directly into the air, but form in the atmosphere from industrial and automotive emissions of nitrogen oxides (NO_x); and SO_4^{2--} is formed in the atmosphere from industrial emission of sulfur dioxide (SO_2). Deposition of HNO_3, NO_3^-, and SO_4^{2-} can adversely affect plant growth, soil chemistry, lichens, aquatic environments, and petroglyphs (ancient carvings and/or engravings on rock surfaces). Ammonium (NH_4^+) is volatilized from animal feedlots and from soils following fertilization of crops.

Wet atmospheric deposition (precipitation that deposits the aforementioned chemical compounds) is measured at National Atmospheric Deposition Program (NADP) sites: Pinedale, Sink's Canyon, South Pass, Newcastle, and Wind Cave. Wet deposition is characterized by the concentration of nitrate ion (NO_3^-), sulfate ion (SO_4^{-}), and ammonium (NH_4^+) ions in precipitation samples.

The National Atmospheric Deposition Program (NADP) was established in 1977 under State Agricultural Experiment Station (SAES) leadership to address the problem of atmospheric deposition and its effects on agricultural crops, forests, rangelands, surface waters, and other natural and cultural resources. The NADP is a public, nonprofit, unincorporated, interstate association of parties interested in atmospheric deposition and its effects. It is structured as a cooperative program that represents coordinated efforts of many individuals in federal, state, academic, and private organizations to operate monitoring sites, report data, and oversee research activities related to atmospheric deposition. (NADP 2022).

Dry deposition (air that carries chemical compounds and deposits them on the earth's surface) is measured at three Clean Air Status and Trends Network (CASTNET) sites in Pinedale (Sublette County), Newcastle (Weston County), and Basin (Big Horn County). Information concerning dry deposition can be found at EPA's Clean Air Status and Trends Network monitoring program (EPA, CASTNET 2022)

Current data indicate a decrease in sulfate and nitrate ions for all Wyoming NADP sites in precipitation samples. However, concentrations for the ammonium ion are either steady or slowly increasing at sites.

For the three Wyoming CASTNET sites, concentration data indicate a decrease for all pollutant species at Pinedale and Newcastle. However, the Basin concentrations increase from 2016 to 2017.

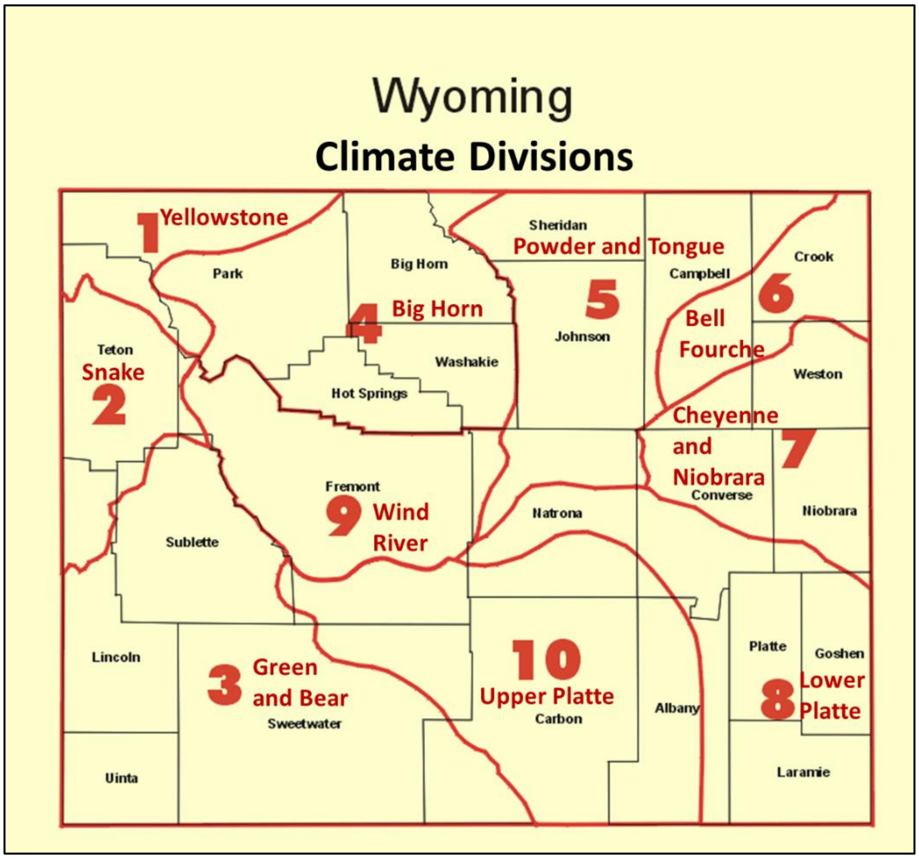
3.3 Climate and Climate Change

Climate is the composite of generally prevailing weather conditions, such as temperature and precipitation, of a particular region throughout the year, averaged over a series of years. Climate change is the long-term (several decades or longer) alteration of atmospheric weather patterns (temperature, precipitation, winds, etc.), but changes could also occur in other parts of the climate system such as the hydrosphere (water), cryosphere (ice), biosphere (living organisms, ecosystems), or lithosphere. One important way to track the causes and effects of climate change is through the use of indicators. Climate indicators show trends over time in key aspects of the environment. Many indicators are meteorological related. Other indicators include greenhouse gas emissions, sea level, growing season length, ecosystems, and others. Only climate indicators related to air resources are discussed in this document.

Wyoming climate is determined by its inland location, distance from the equator, elevation, wide range of topography, and location with respect to storm paths across the western United States. Elevations range from 3,100 feet in the southwest part of the state to 13,700 feet in the Wind River Range Mountains. Mountain ranges in western United States also influence climate in Wyoming. Pacific storms must cross these ranges before reaching Wyoming where much of the moisture in the storms falls as precipitation. Consequently, storms reaching Wyoming are relatively dryer and produce less precipitation (WRCC 2018).

The National Center for Environmental Information (NCEI) divides Wyoming into ten climate divisions: Yellowstone, Snake, Green and Bear, Big Horn, Powder and Tongue, Bell Fourche, Cheyenne and Niobrara, Lower Platte, Wind River, and Upper Platte as show by Figure 6. Wyoming Climate Divisions are organized based on areas with similar terrain and weather stations observing the same general climate conditions. All climate divisions in Wyoming have some general similarities such as winter having the highest amount of monthly precipitation.

Figure 6. NOAA National Centers for Environmental Information Climate Divisions.



Climate Normals

Climate normals are three-decade averages of climatological variables including temperature and precipitation, updated every 10 years, with the 1991–2020 U.S. Climate normals dataset serving as the latest release. It contains average daily and monthly temperature, precipitation, snowfall, heating and cooling degree days, frost/freeze dates, and growing degree days calculated from observations at approximately 9,800 stations (NCEI 2021). Climate normals representative for each field office are found in the climate normal section of Appendix A (Climate Data). Prevailing wind information is also presented in wind roses and monthly tables but are only available for airports with continuous measurements. Wind roses are a polar plot to visually present wind speed and direction.

Climate Trends

Trend analysis is a technique used to estimate future conditions based on historically observed trends. The main assumption behind trend analysis is that what happened in the past is expected to happen in the future. Average temperature and precipitation and trend information for each Wyoming climate division is compiled from the NCEI Climate at a Glance Website (NOAA/NCEI 2020) and is shown in Figures 7-26.

Figure 7. Wyoming Yellowstone Climate Division 1 Precipitation Trend.

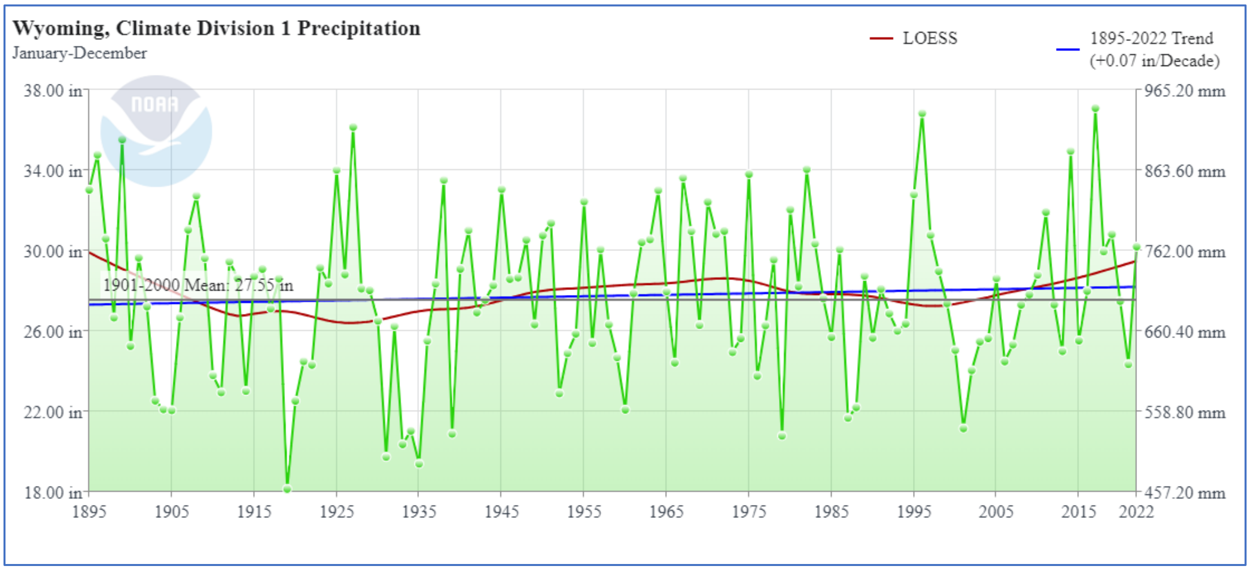


Figure 8. Wyoming Snake Climate Division 2 Precipitation Trend.

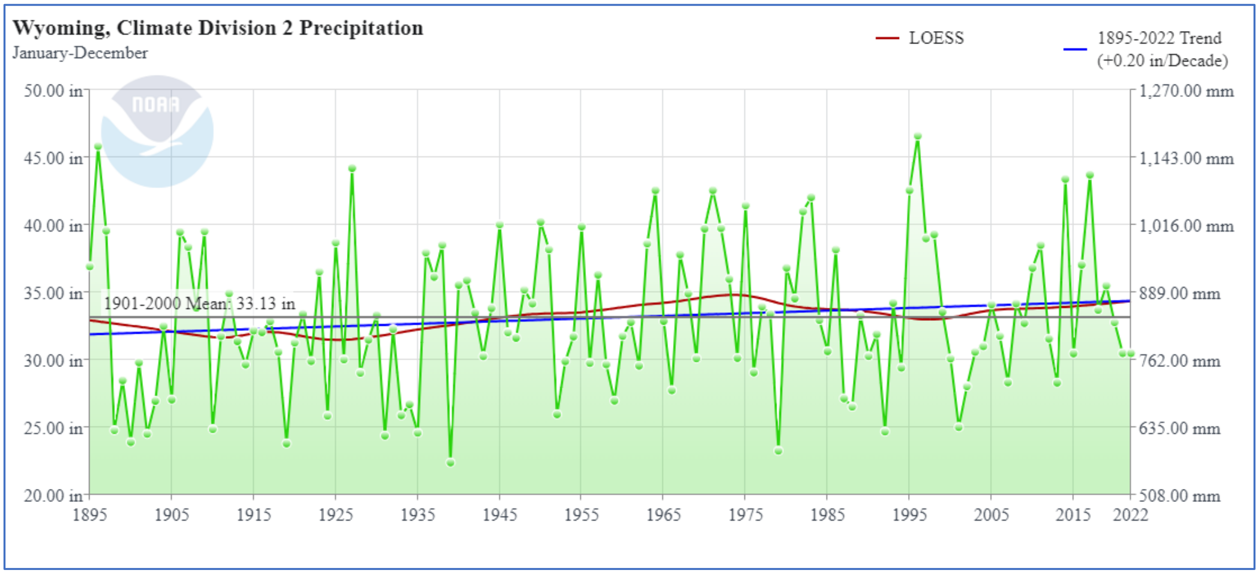


Figure 9. Wyoming Green and Bear Climate Division 3 Precipitation Trend.

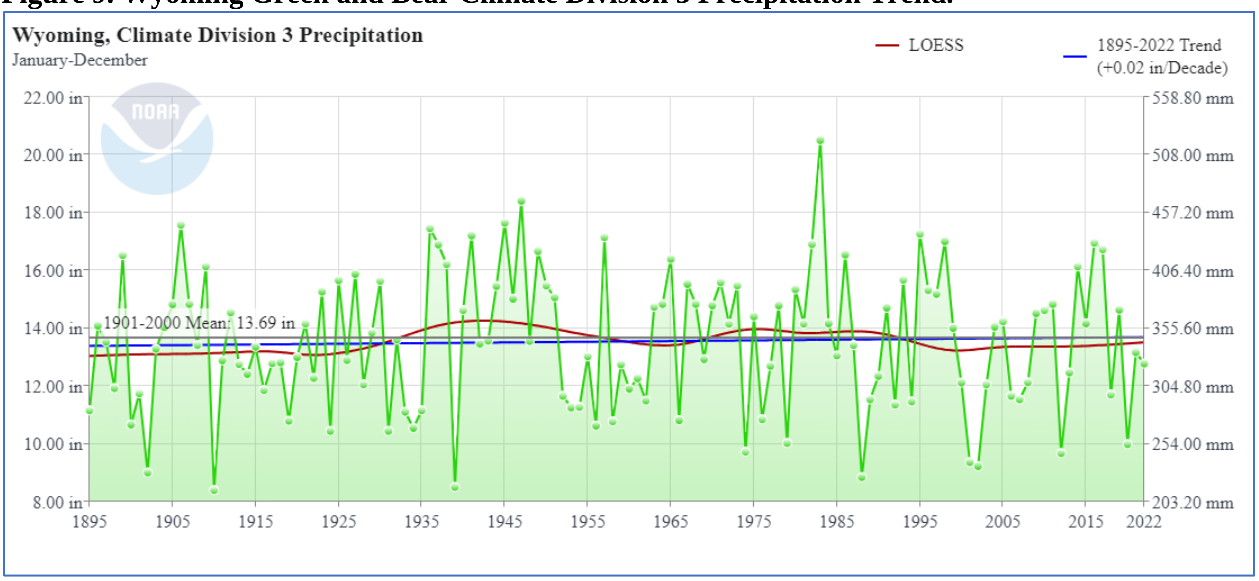


Figure 10. Wyoming Big Horn Climate Division 4 Precipitation Trend.

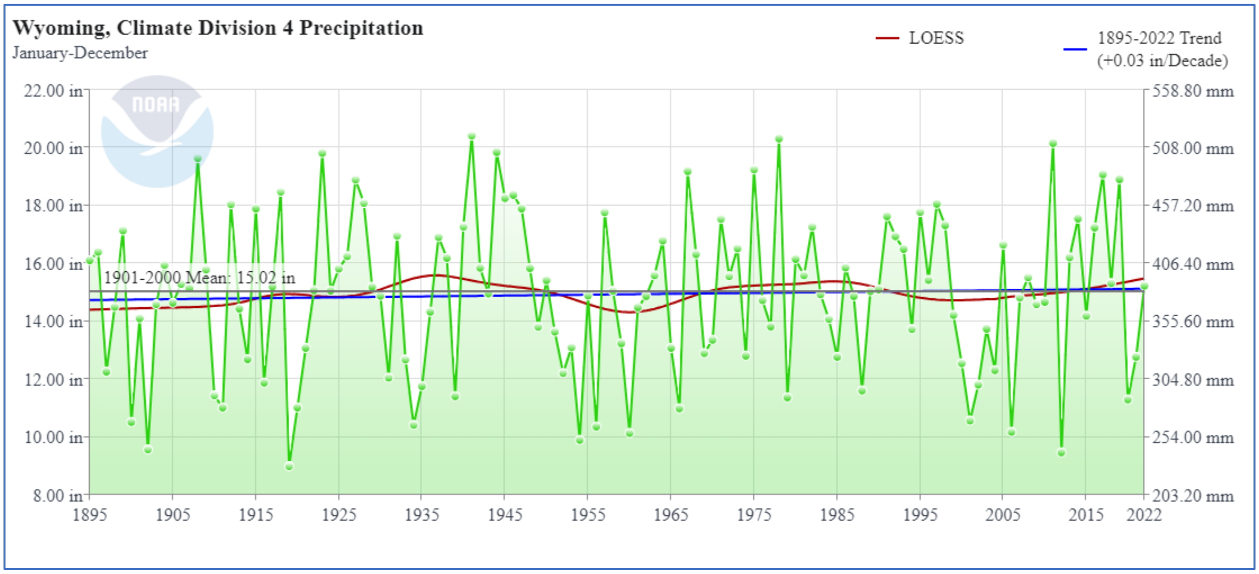


Figure 11. Wyoming Powder and Tongue Climate Division 5 Precipitation Trend.

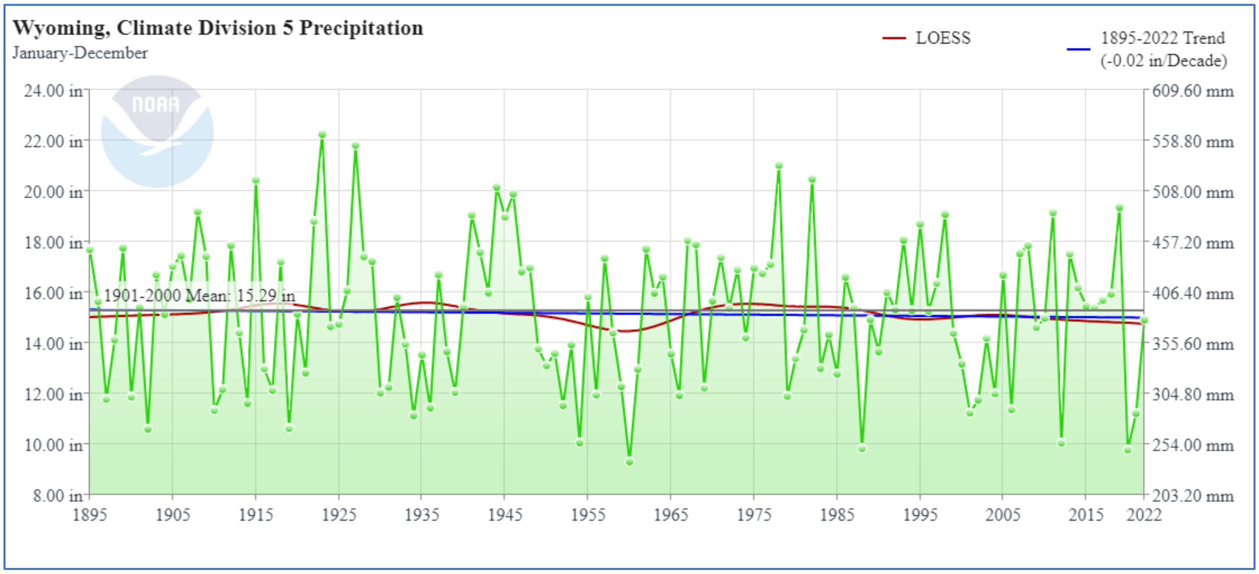


Figure 12. Wyoming Bell Fourche Climate Division 6 Precipitation Trend.

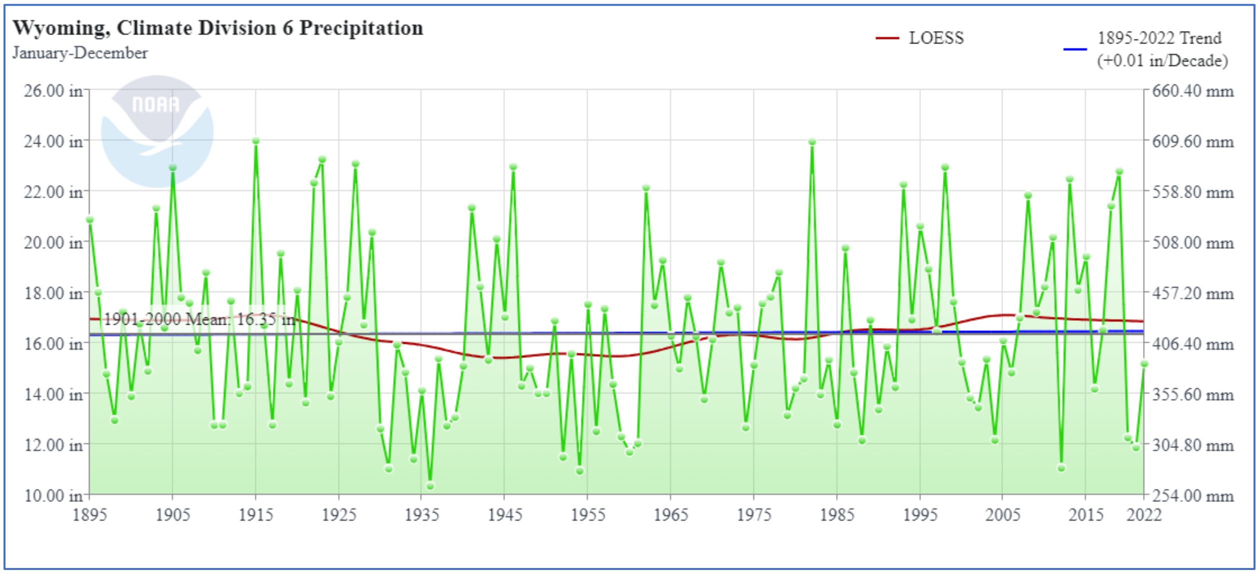


Figure 13. Wyoming Cheyenne and Niobrara Climate Division 7 Precipitation Trend.

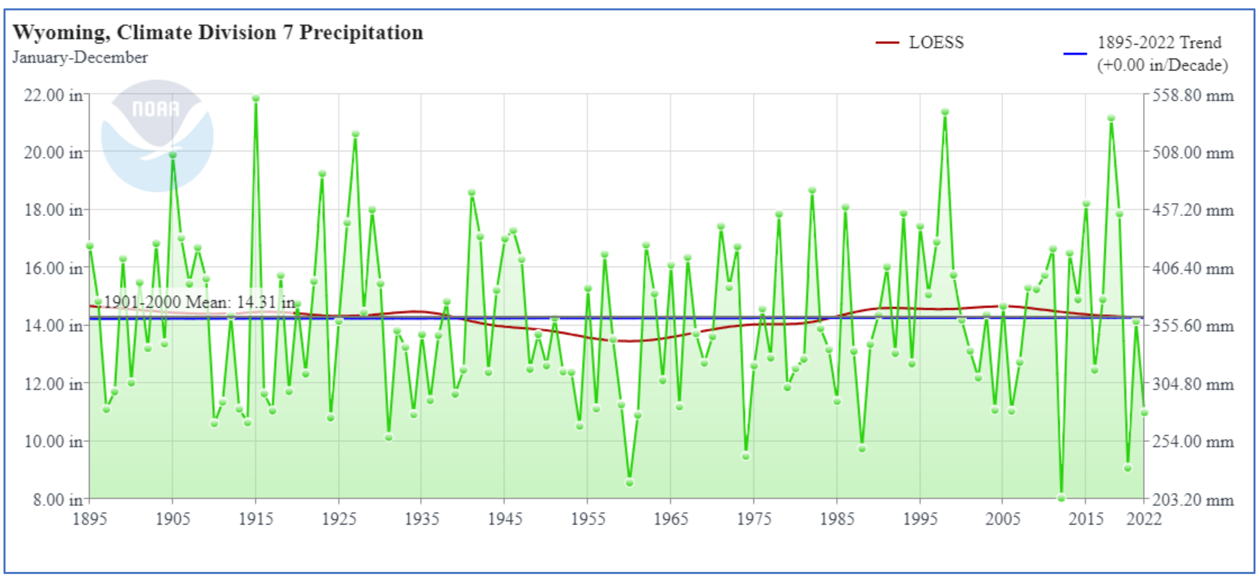


Figure 14. Wyoming Lower Platte Climate Division 8 Precipitation Trend.

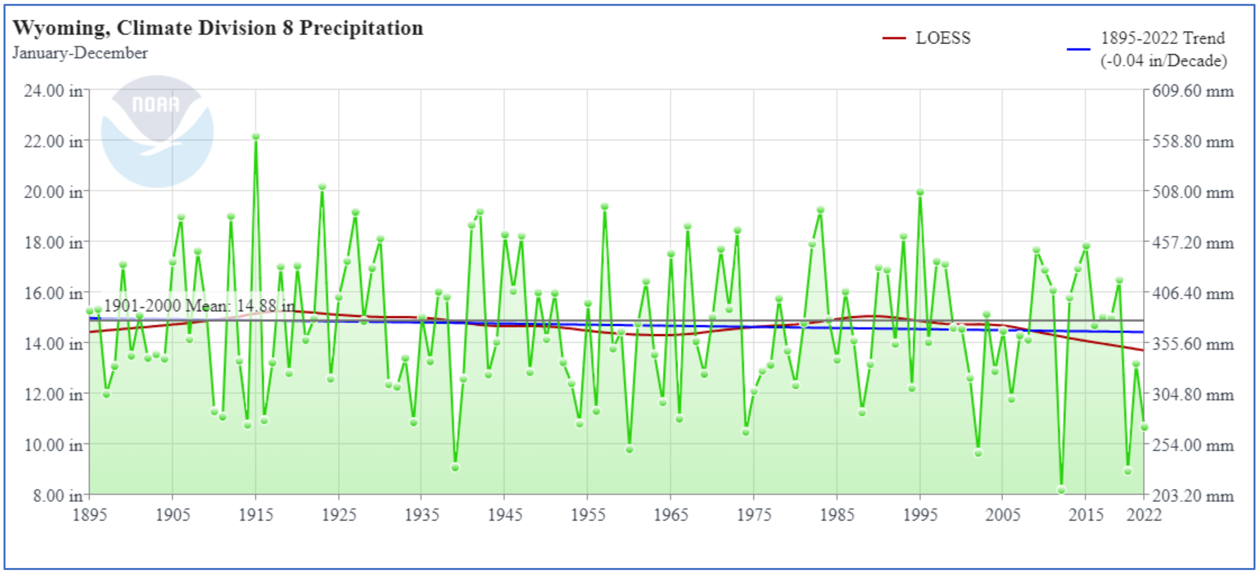


Figure 15. Wyoming Wind River Climate Division 9 Precipitation Trend.

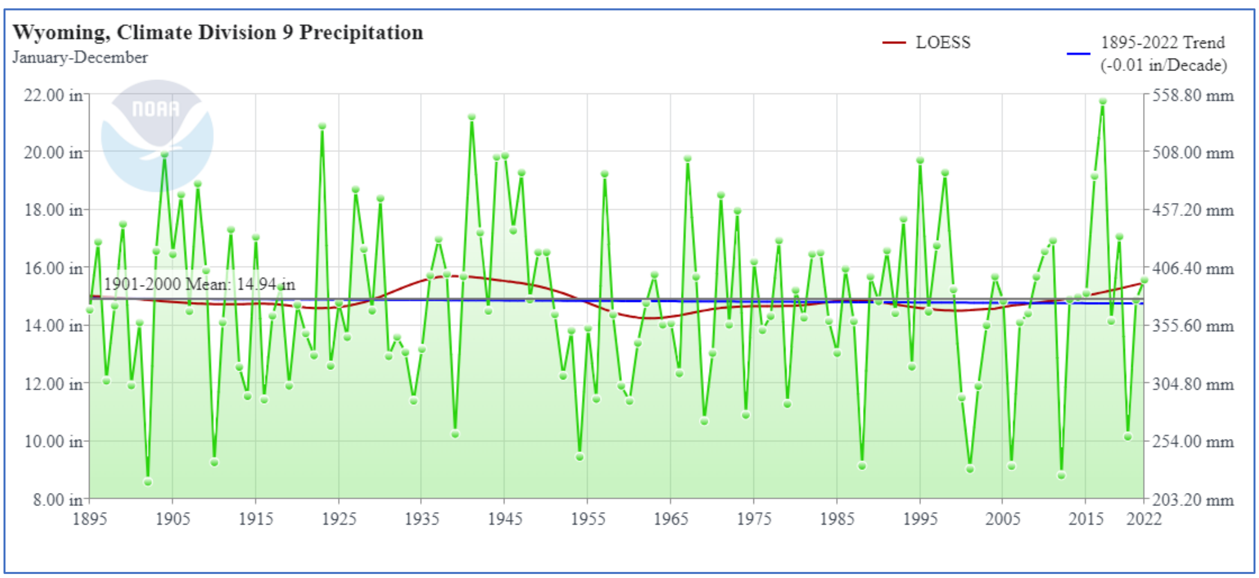


Figure 16. Wyoming Wind River Climate Division 10 Precipitation Trend.

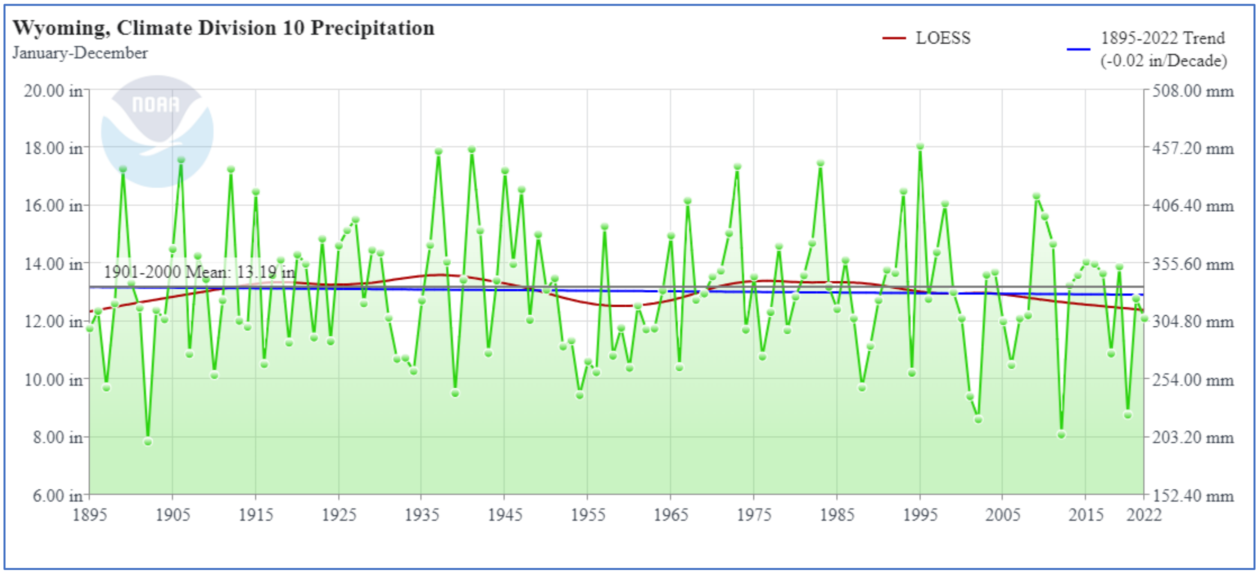


Figure 17. Wyoming Yellowstone Climate Division 1 Temperature Trend.

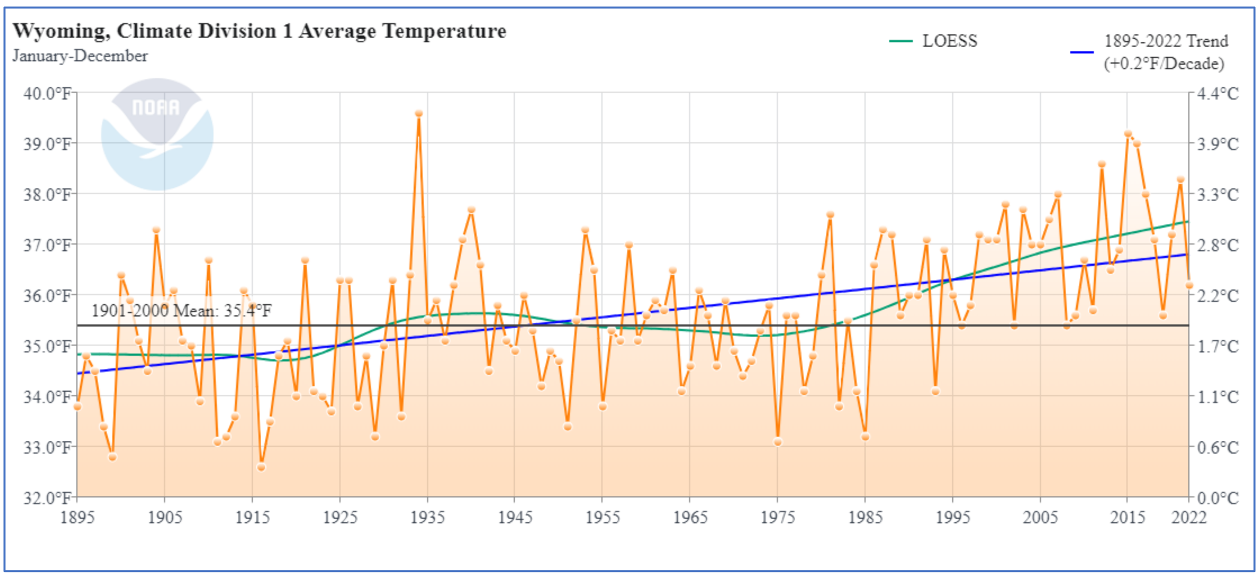


Figure 18. Wyoming Snake Climate Division 2 Temperature Trend.

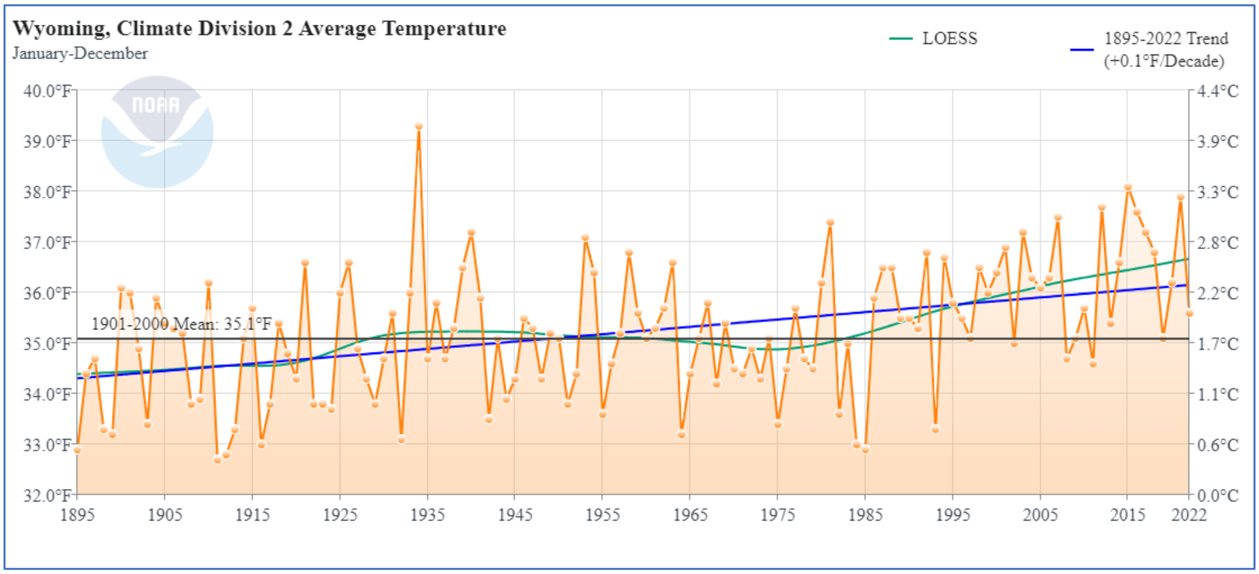


Figure 19. Wyoming Green and Bear Climate Division 3 Temperature Trend.

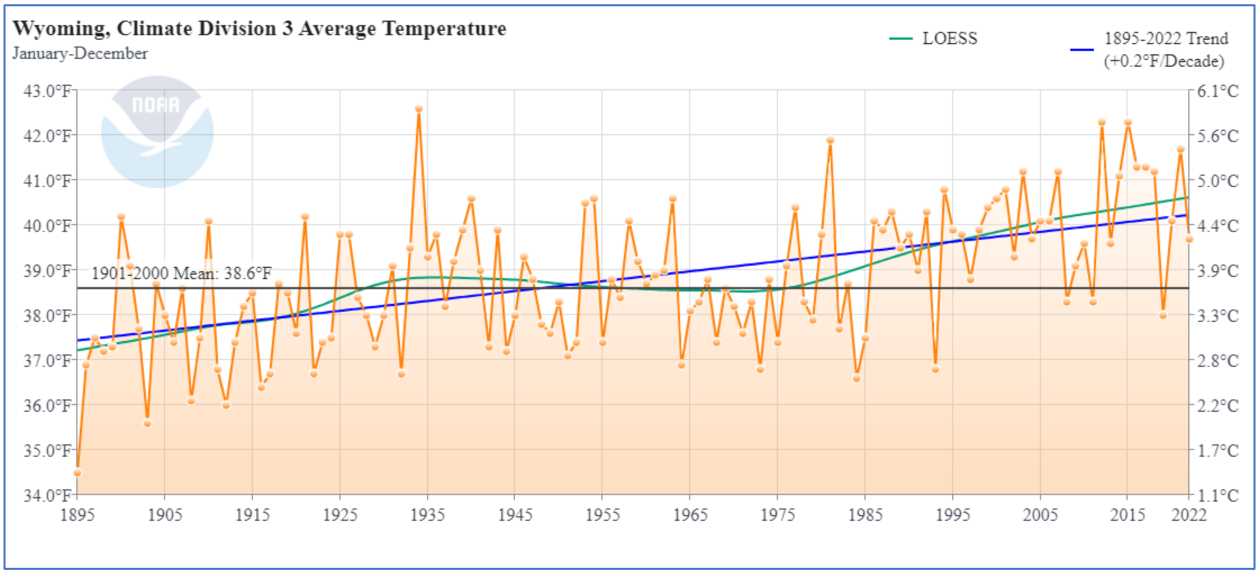


Figure 20. Wyoming Big Horn Climate Division 4 Temperature Trend.

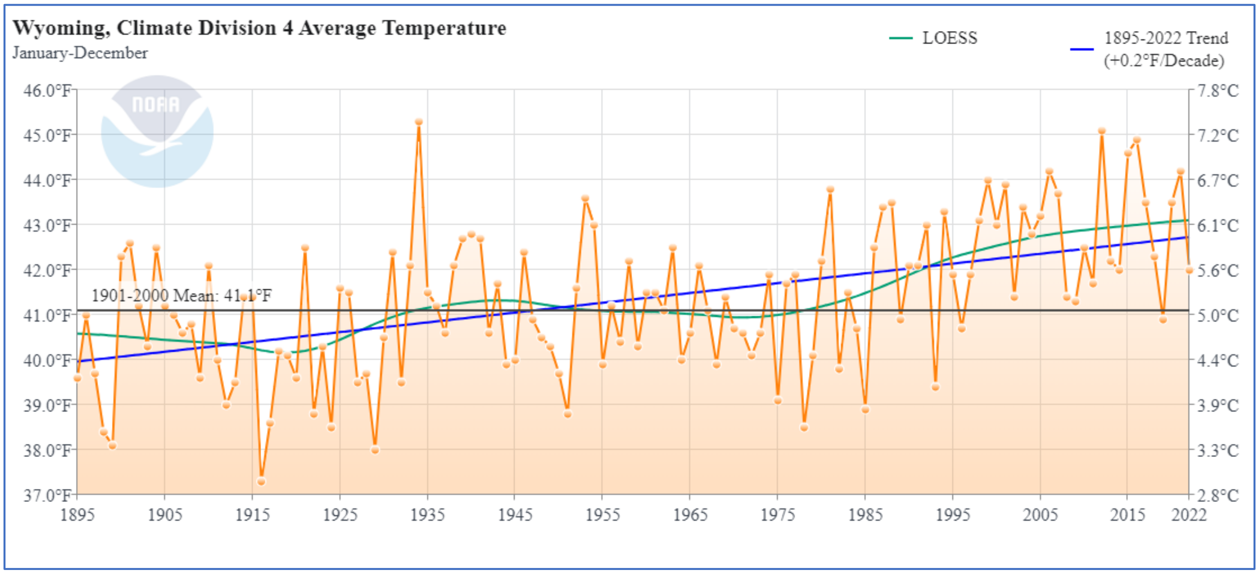


Figure 21. Wyoming Powder and Tongue Climate Division 5 Temperature Trend.

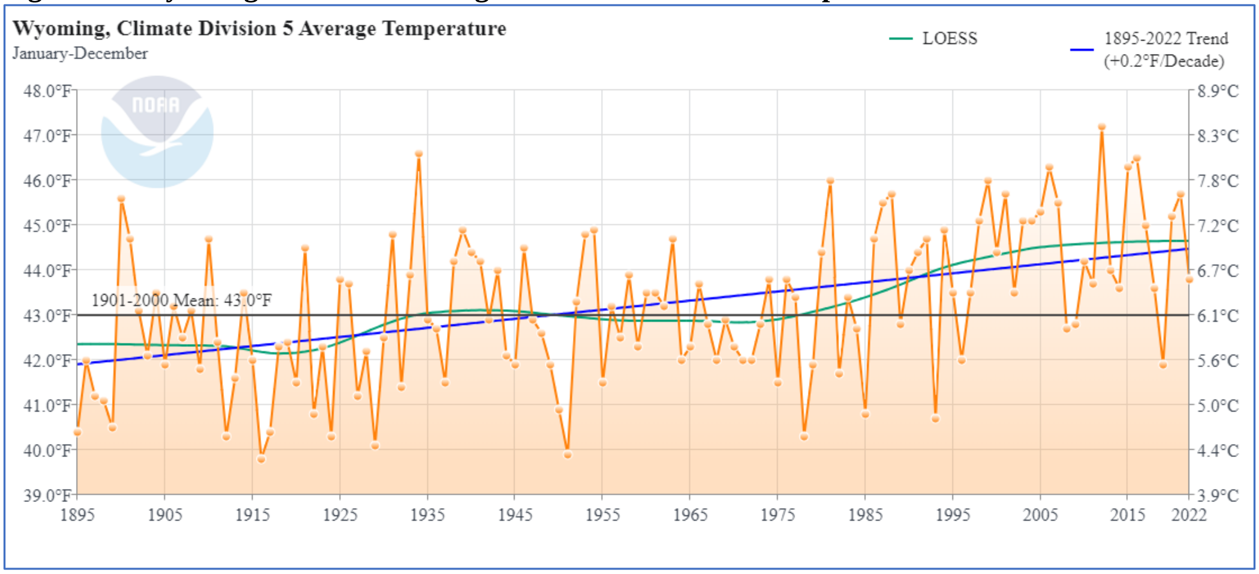


Figure 22. Wyoming Bell Fourche Climate Division 6 Temperature Trend.

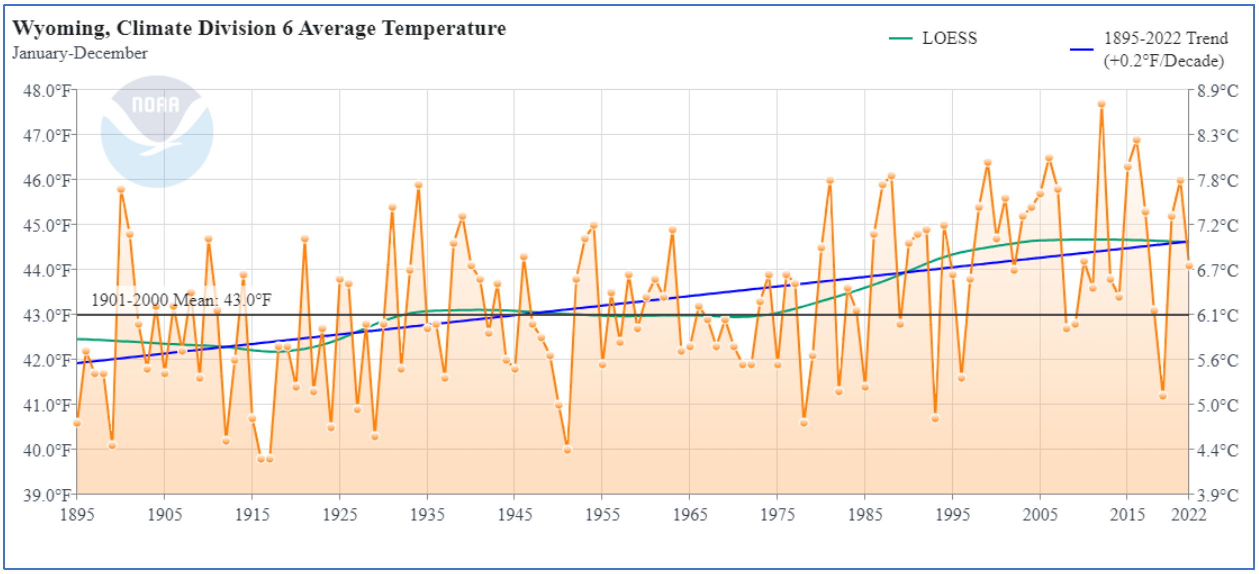


Figure 23. Wyoming Cheyenne and Niobrara Climate Division 7 Temperature Trend.

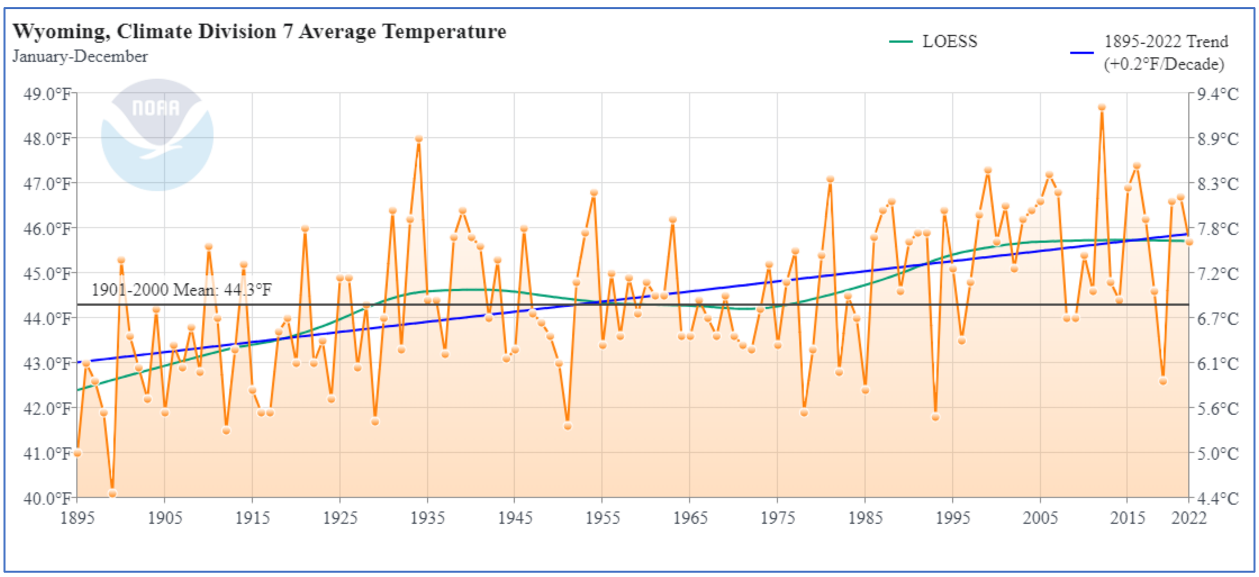


Figure 24. Wyoming Lower Platte Climate Division 8 Temperature Trend.

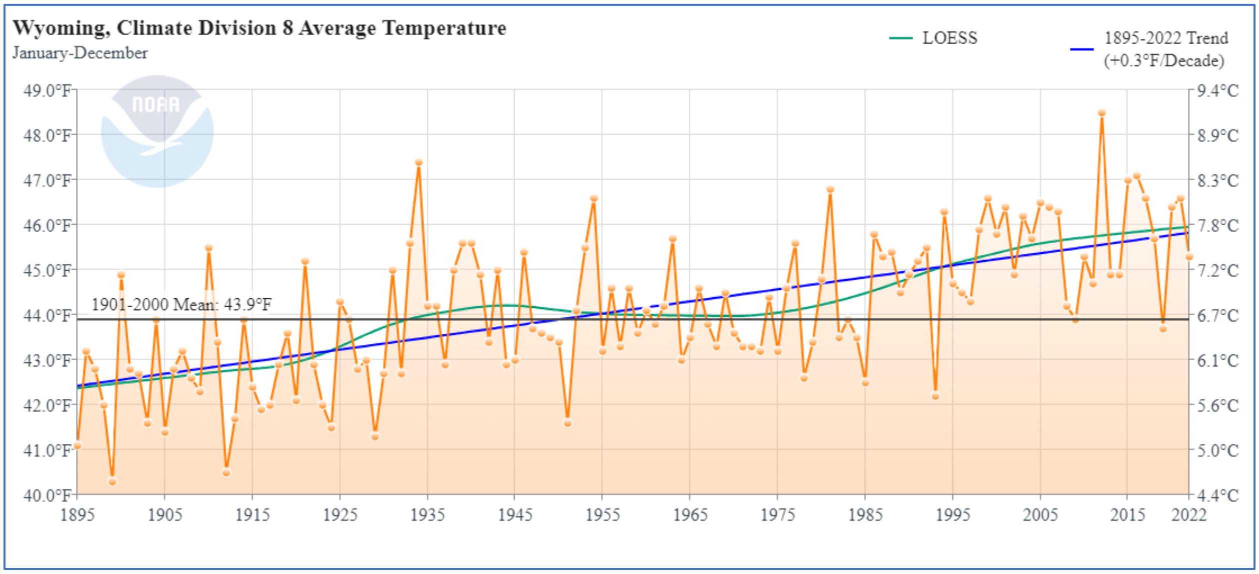


Figure 25. Wyoming Wind River Climate Division 9 Temperature Trend.

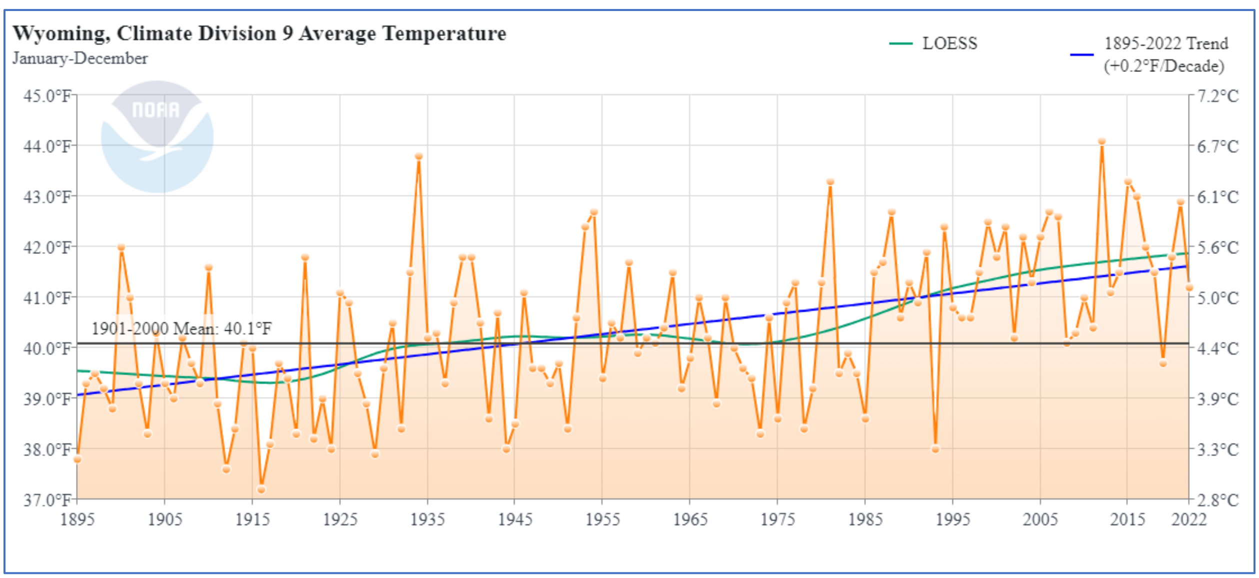
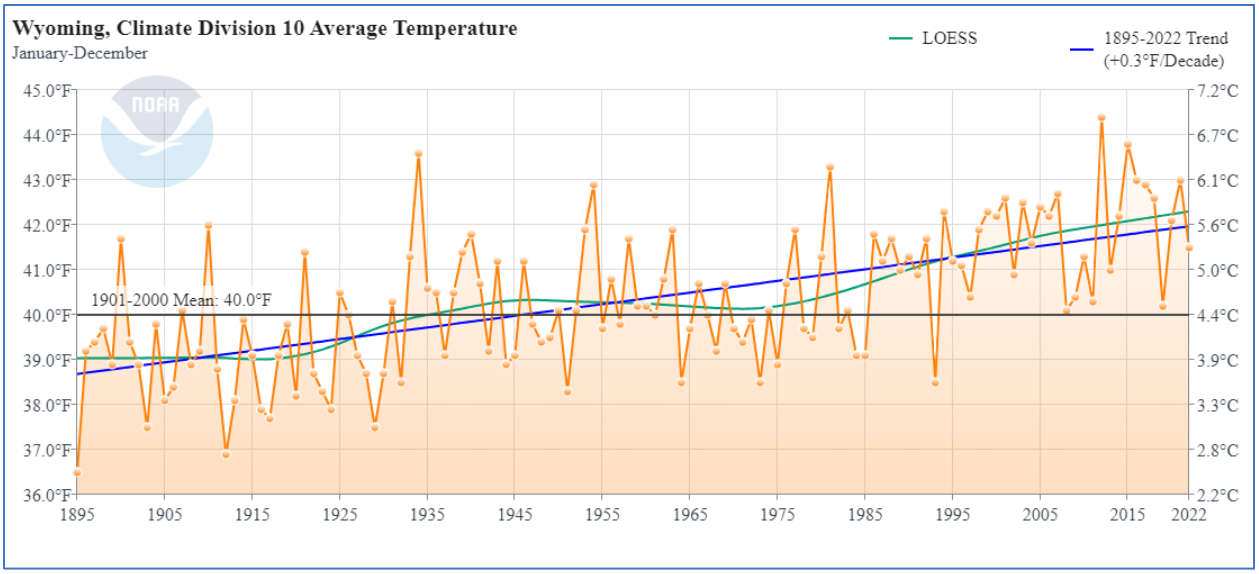


Figure 26. Wyoming Wind River Climate Division 10 Temperature Trend.



Climate Change and Climate Projections

The Annual GHG report contains general background information on climate change and specific climate model projections for the State of Wyoming. Climate projections under a higher emissions scenario (RCP8.5) indicate that Wyoming could warm by as much as 15ºF above current levels by the end of the century, though the mean RCP8.5 increase for the state is about 10ºF hotter than recent temperatures. Under a lower emissions scenario, warming is projected to be about 2ºF to 5ºF above the 1991-2020 mean. Increases in average temperatures will be accompanied by increases in heat wave intensity and decreases in cold wave intensity.

Climate models are not consistent in their projections of precipitation for Wyoming, including winter precipitation. However, projected rising temperatures will increase the average lowest elevation at which snow falls (the snow line). Continuing recent trends, this will increase the likelihood that precipitation will fall as rain instead of snow, reducing water storage in the snowpack, particularly at lower elevations that are currently on the margins of reliable snowpack accumulation. In addition, extreme precipitation is projected to increase, potentially increasing the frequency and intensity of floods.

Droughts, a natural part of Wyoming's climate, are expected to become more intense. Higher temperatures will amplify the effects of naturally occurring dry spells by increasing the rate of loss of soil moisture. Most of Wyoming's water is supplied by the snowpack, and changes to the snow/rain ratio could result in less water storage. Additionally, higher spring temperatures can cause early melting of the snowpack, decreasing water availability during the already dry summer months. The projected increase in the intensity of naturally occurring droughts will increase the occurrence and severity of wildfires.

Additional information on climate change projections for Wyoming can be found on NOAA's U.S. Climate Resilience Toolkit website (https:// https://statesummaries.ncics.org/chapter/wy/).

3.4 BLM Monitoring Activities

BLM Wyoming conducts air monitoring to evaluate on-the-ground air resource conditions to determine trends. Existing air monitoring networks do not always adequately cover areas managed by the. BLM does not conduct air monitoring to determine attainment status of an area under the requirements of the CAA, that being a function of the appropriate federal, state, or tribal regulatory agency.

The Wyoming Air Resource Monitoring System (WARMS) network is an air quality monitoring network maintained by Bureau of Land Management, Wyoming State Office (BLM-WSO). There are seven stations scattered throughout Wyoming, see Figure 27. The WARMS network began operation in 2000 to measure air quality parameters and particulate concentrations according to Clean Air Status and Trends Network (CASTNET) protocols. The WARMS sites formally became a part of the CASTNET network in 2012 and began participating in the National Atmospheric Deposition Program (NADP) Passive Ammonia Monitoring Network (AMON) in 2015. The WARMS network provides relevant air quality data to:

- Assess existing conditions.
- Evaluate long term trends in air quality conditions.
- Evaluate the effectiveness of prescribed mitigation measures and adaptive management strategies.
- Inform management decisions on public lands, particularly in wilderness study areas and areas of critical environmental concern.
- Provide readily available access to air quality data for BLM staff, other federal, state, and tribal agencies, BLM contractors, the scientific community, and the public.

Figure 27. WARMS Monitor Locations.

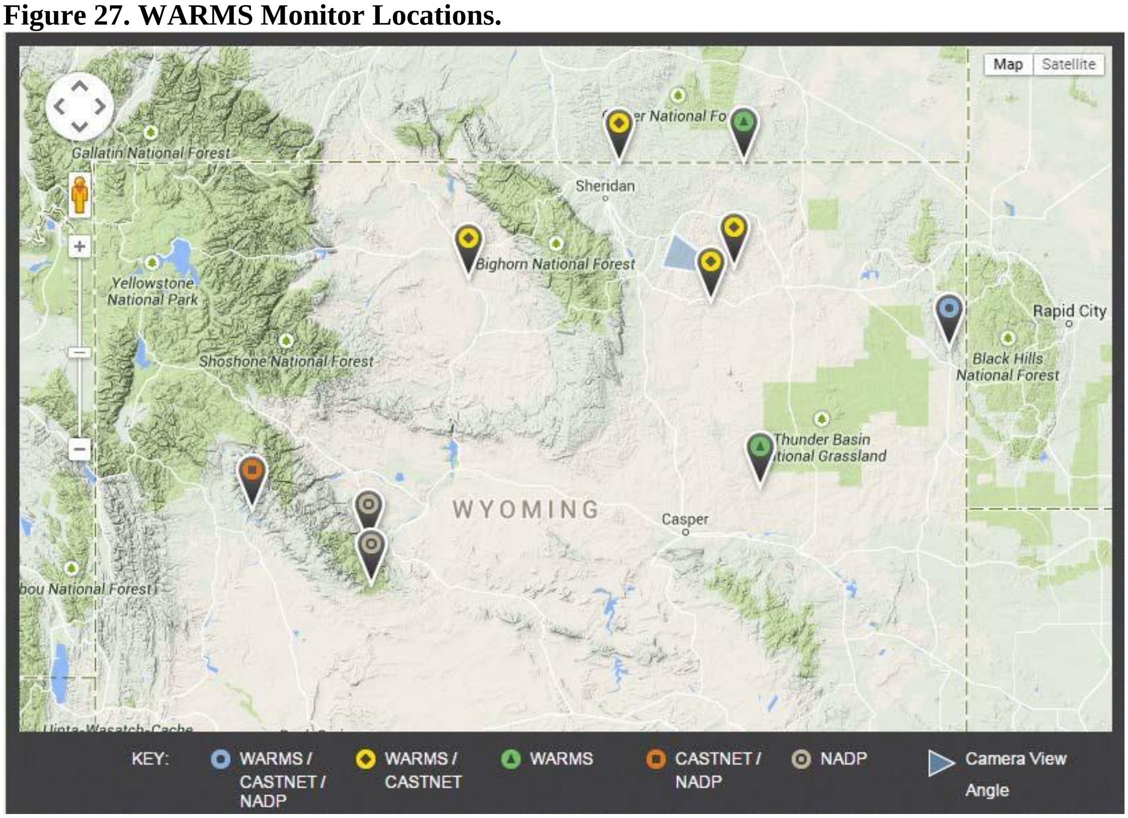
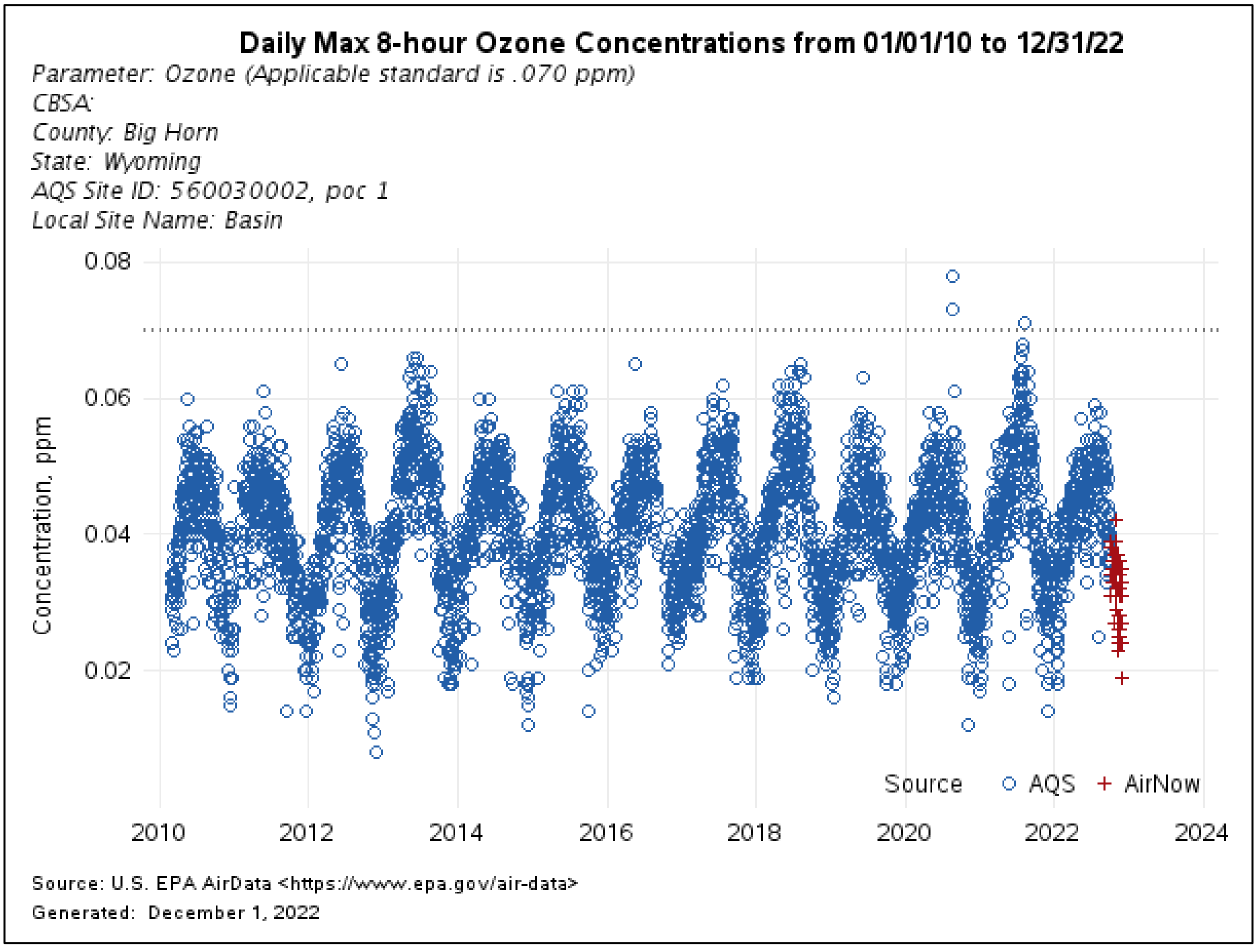


Figure 28 shows the maximum daily 8-hour Ozone concentrations for the Basin, Wyoming WARMS site. The 2010 to present data show no discernable trends.

Figure 28. Basin, Wyoming WARMS Daily Max 8-hour Ozone Concentrations.



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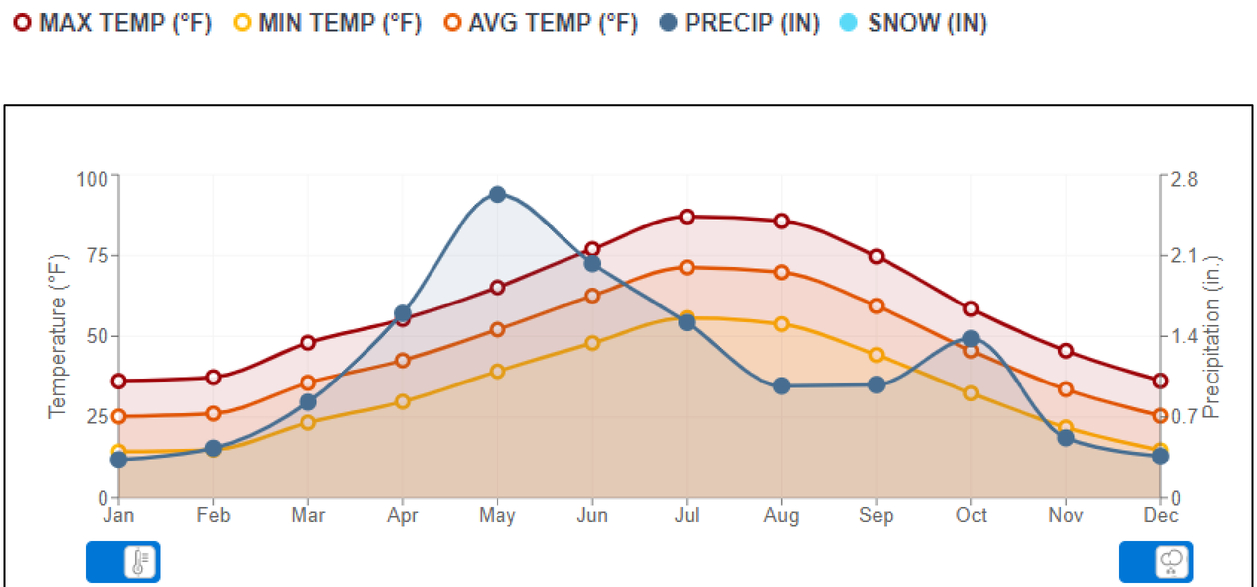
Appendix A (Climate Data)

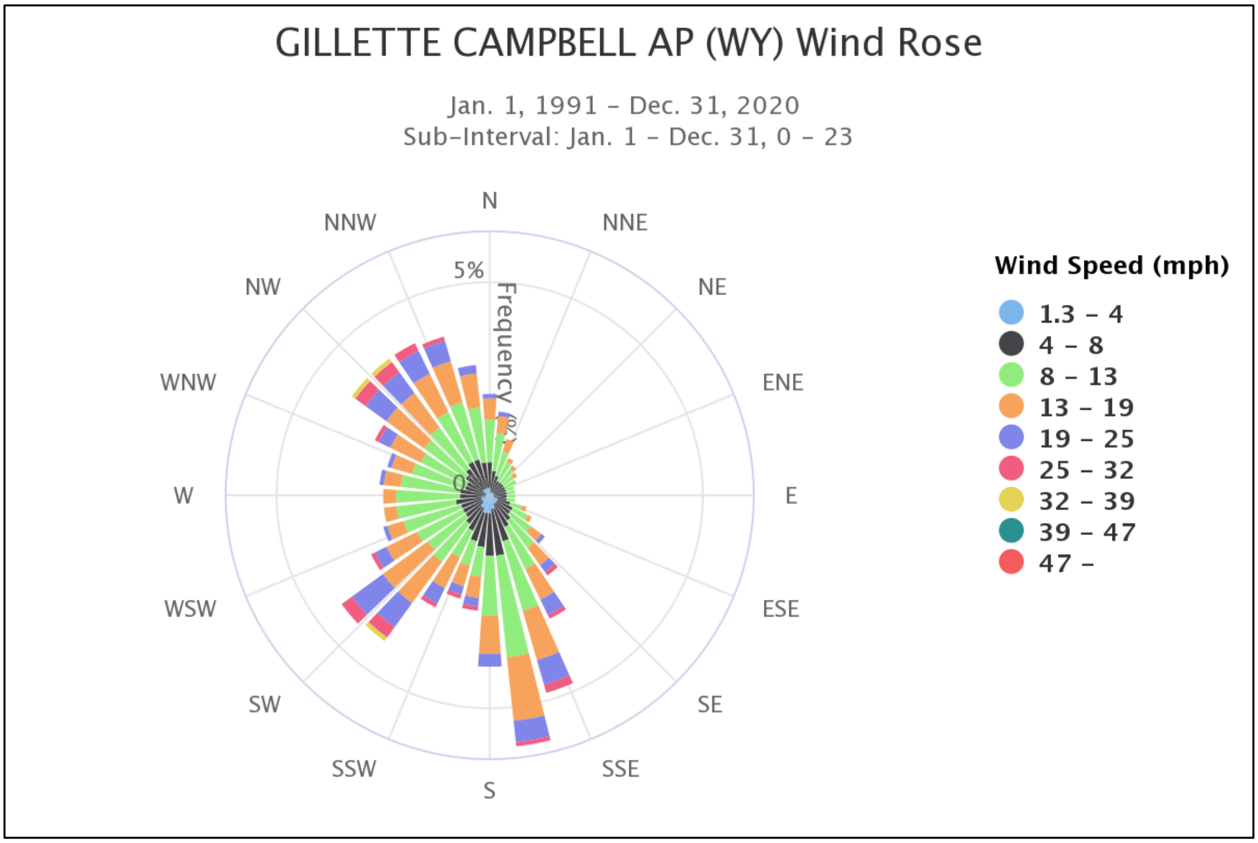
Buffalo Field Office

Figure 29. Climate Normals (1991-2020) for Gillette.



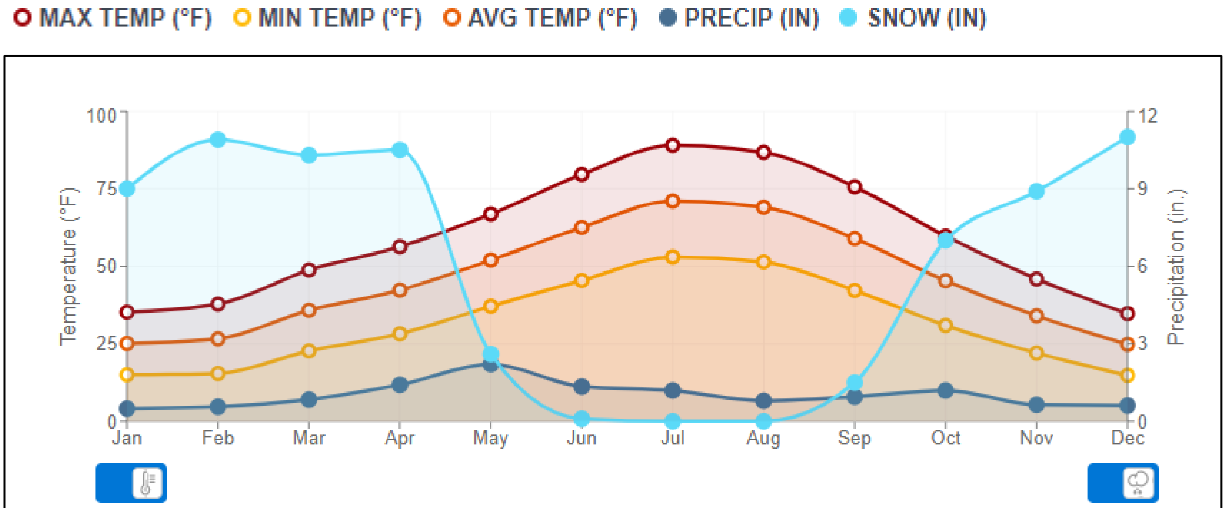
Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)
Jan	36.1	14.3	25.2	0.33
Feb	37.3	14.9	26.1	0.43
Mar	48.0	23.3	35.6	0.83
Apr	55.3	29.8	42.5	1.60
May	65.1	39.1	52.1	2.63
Jun	77.0	47.9	62.5	2.03
Jul	87.0	55.7	71.3	1.52
Aug	85.7	53.8	69.8	0.97
Sep	74.7	44.2	59.4	0.98
Oct	58.5	32.4	45.5	1.38
Nov	45.5	21.8	33.6	0.52
Dec	36.2	14.7	25.4	0.36

Figure 30. Wind Rose for Gillette.



Casper Field Office

Figure 31. Climate Normals (1991-2020) for Casper.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	35.2	15.0	25.1	0.49	9.0
Feb	37.8	15.4	26.6	0.56	10.9
Mar	48.8	22.7	35.8	0.84	10.3
Apr	56.3	28.2	42.3	1.41	10.5
May	66.8	37.1	52.0	2.21	2.6
Jun	79.6	45.4	62.5	1.34	0.1
Jul	89.0	53.0	71.0	1.19	0.0
Aug	86.7	51.4	69.0	0.79	0.0
Sep	75.6	42.2	58.9	0.95	1.5
Oct	59.7	30.9	45.3	1.19	7.0
Nov	45.9	22.0	34.0	0.64	8.9
Dec	34.7	14.8	24.8	0.61	11.0

Figure 32. Wind Rose for Casper.

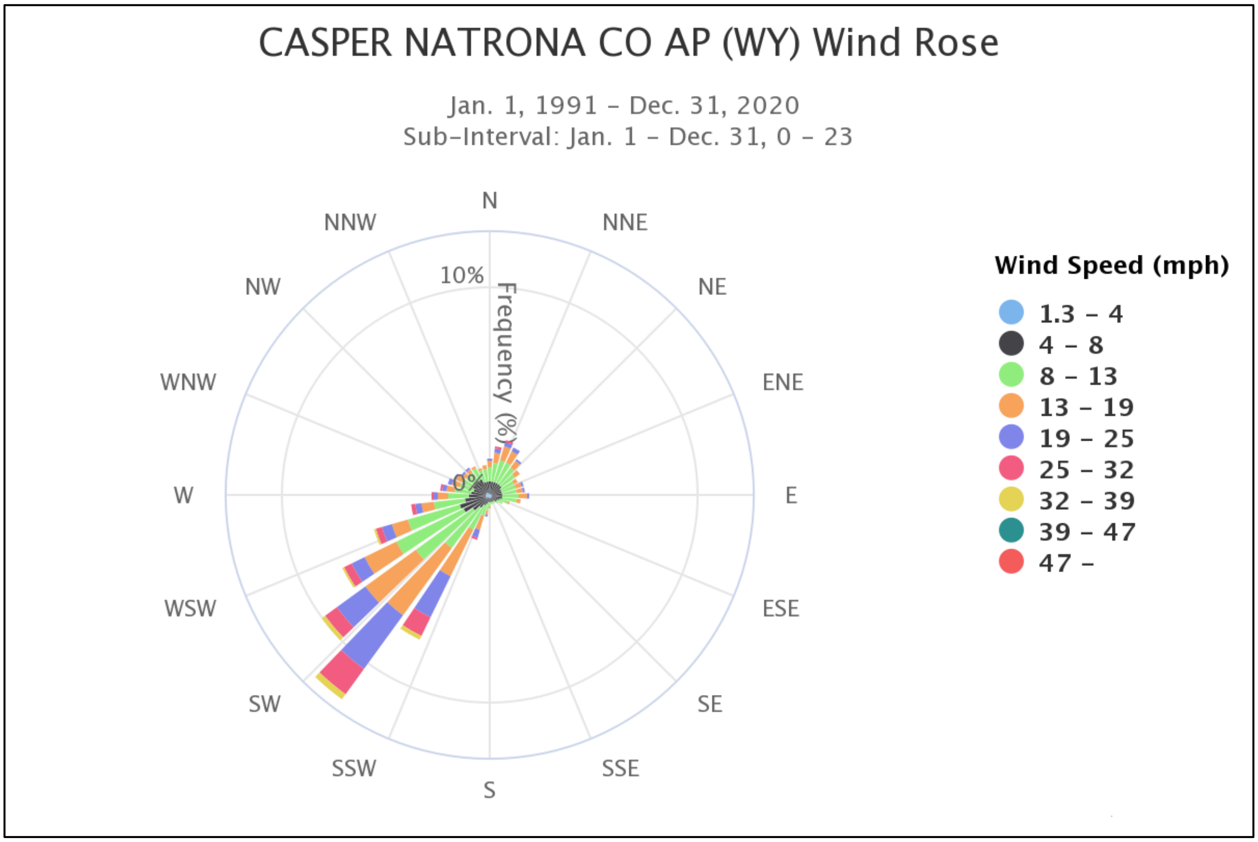
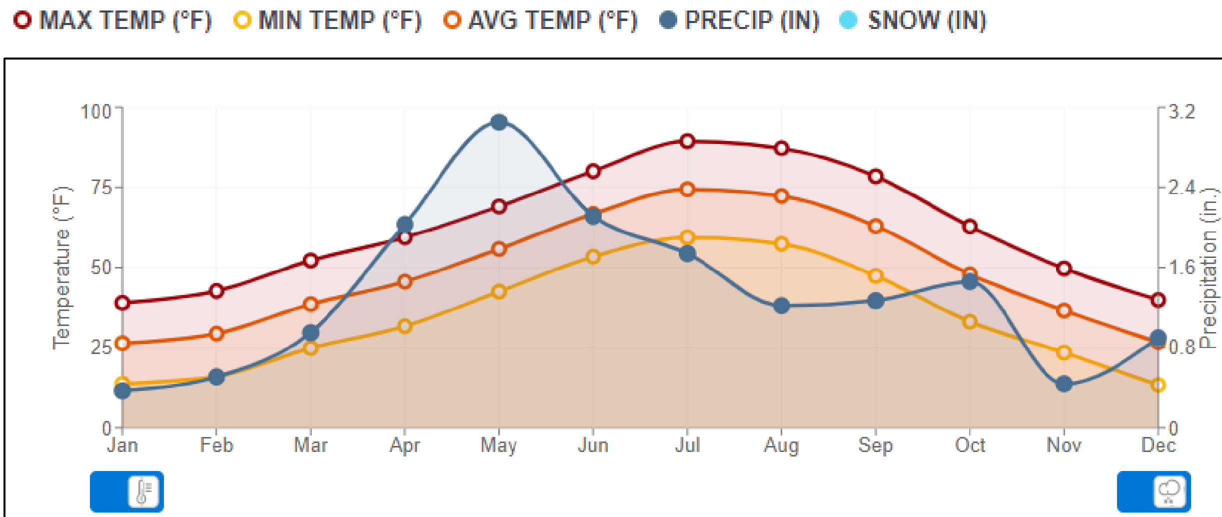


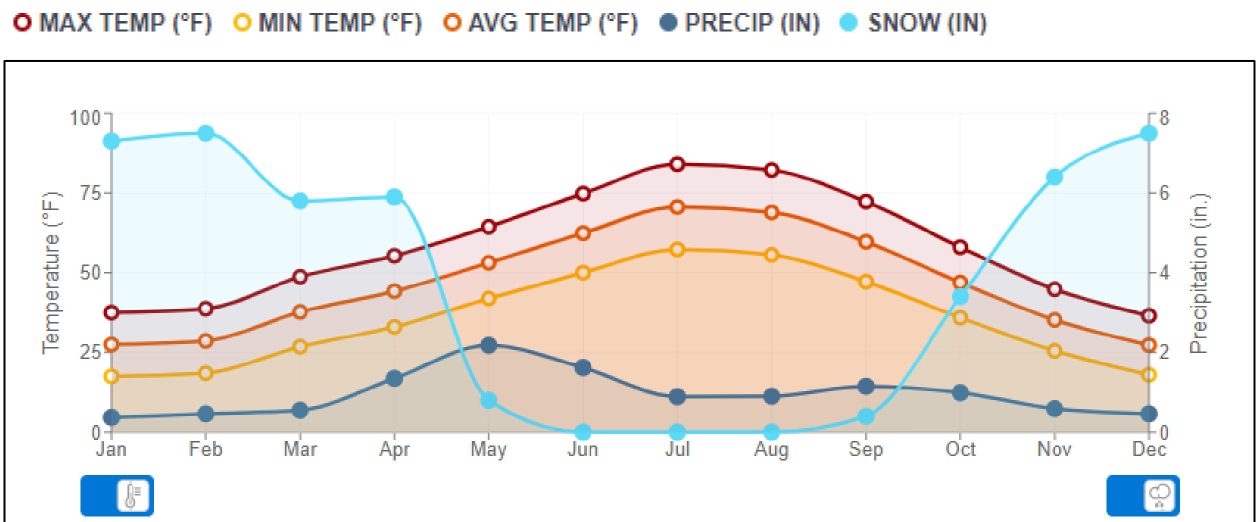
Figure 33. Climate Normals (1991-2020) for Guernsey.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)
Jan	39.0	13.8	26.4	0.37
Feb	42.7	16.1	29.4	0.51
Mar	52.2	24.9	38.6	0.95
Apr	59.4	31.7	45.6	2.03
May	69.0	42.5	55.8	3.05
Jun	80.0	53.4	66.7	2.11
Jul	89.4	59.4	74.4	1.74
Aug	87.2	57.4	72.3	1.22
Sep	78.4	47.4	62.9	1.27
Oct	62.8	33.1	47.9	1.46
Nov	49.7	23.5	36.6	0.44
Dec	39.9	13.4	26.7	0.90

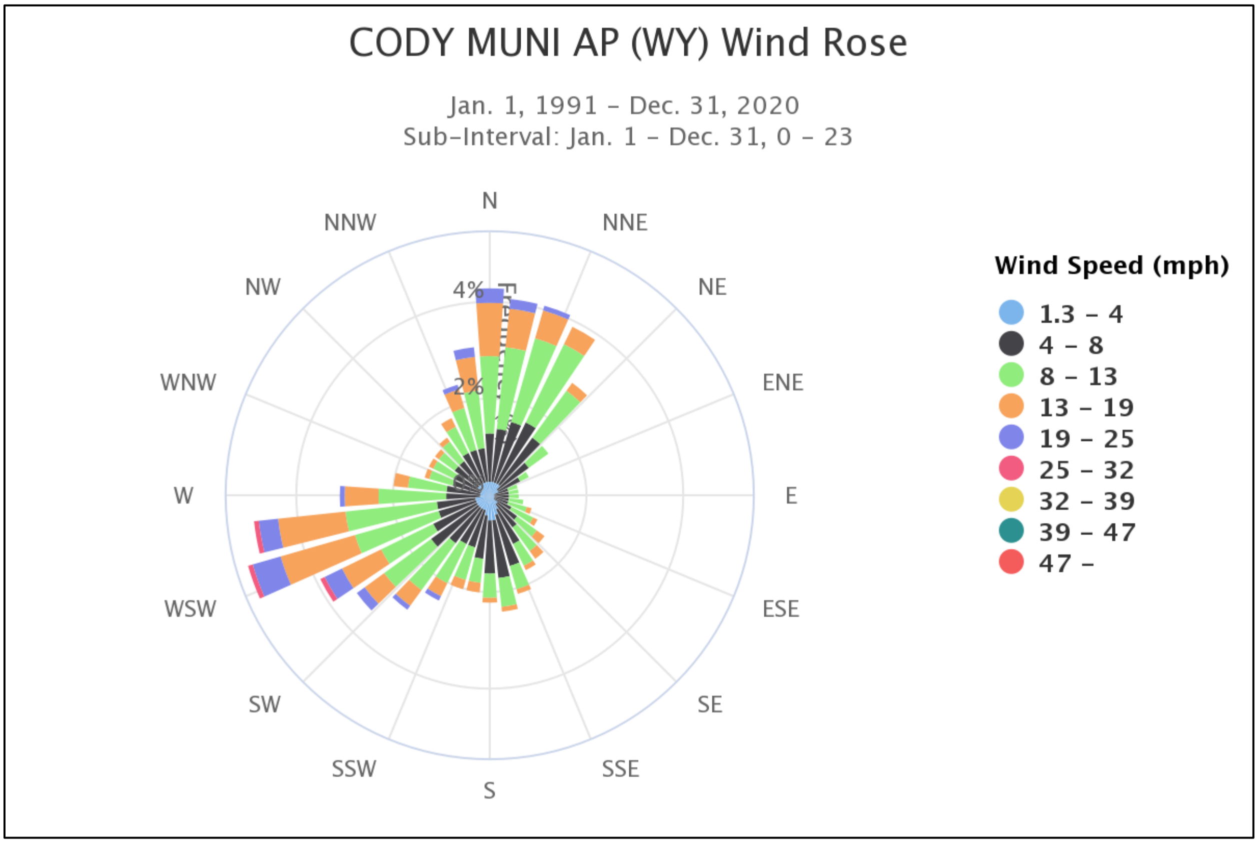
Cody Field Office

Figure 34. Climate Normals (1991-2020) for Cody.



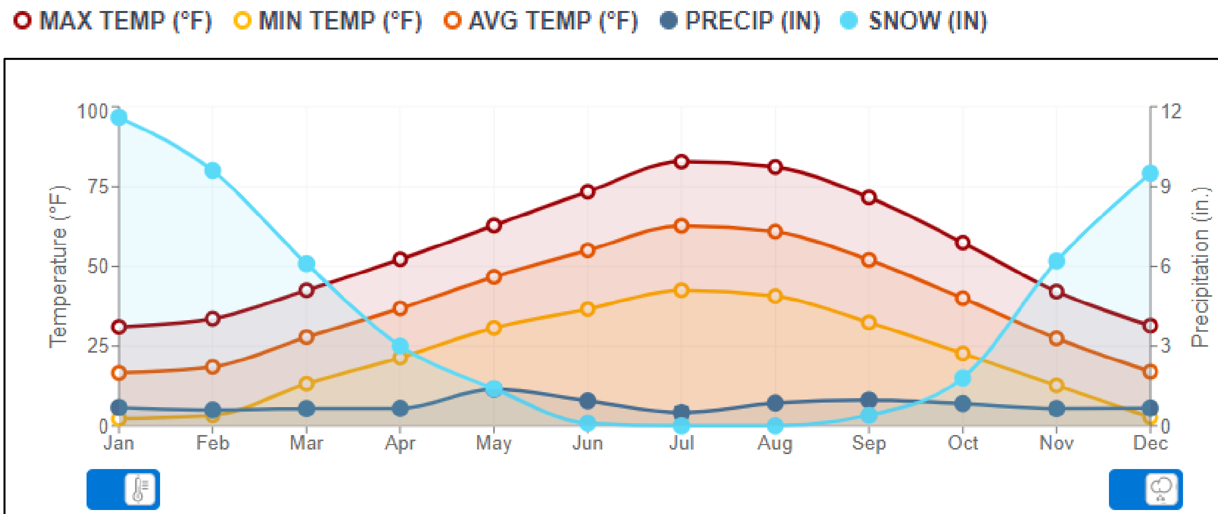
Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	37.5	17.5	27.5	0.37	7.3
Feb	38.7	18.5	28.6	0.46	7.5
Mar	48.7	26.8	37.7	0.55	5.8
Apr	55.3	33.0	44.2	1.35	5.9
May	64.4	41.9	53.1	2.18	0.8
Jun	74.8	50.0	62.4	1.62	0.0
Jul	84.0	57.3	70.6	0.89	0.0
Aug	82.2	55.6	68.9	0.90	0.0
Sep	72.3	47.2	59.7	1.15	0.4
Oct	58.0	35.9	46.9	0.99	3.4
Nov	44.8	25.5	35.2	0.59	6.4
Dec	36.5	18.0	27.3	0.46	7.5

Figure 35. Wind Rose for Cody.



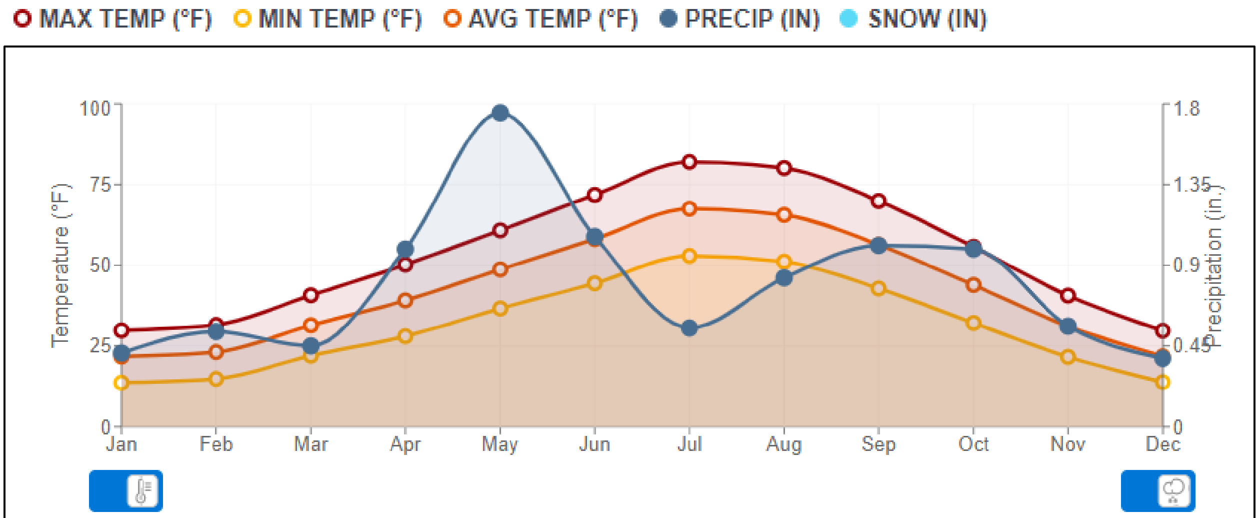
Kemmerer Field Office

Figure 36. Climate Normals (1991-2020) for Kemmerer.



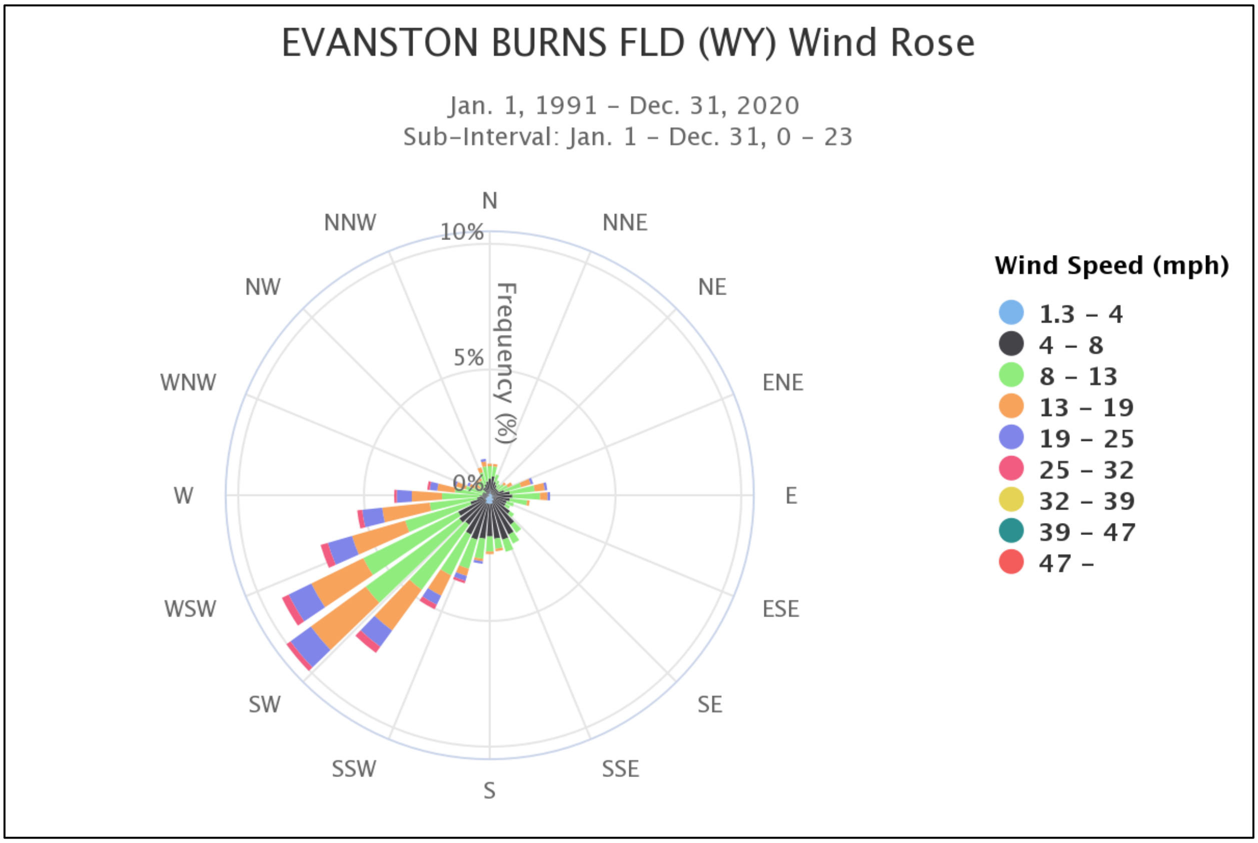
Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	31.0	2.2	16.6	0.69	11.6
Feb	33.6	3.3	18.5	0.60	9.6
Mar	42.5	13.2	27.8	0.65	6.1
Apr	52.2	21.4	36.8	0.66	3.0
May	62.8	30.7	46.7	1.38	1.4
Jun	73.4	36.6	55.0	0.94	0.1
Jul	82.8	42.5	62.7	0.50	0.0
Aug	81.1	40.7	60.9	0.86	0.0
Sep	71.6	32.4	52.0	0.97	0.4
Oct	57.4	22.7	40.0	0.84	1.8
Nov	42.1	12.7	27.4	0.65	6.2
Dec	31.4	2.7	17.0	0.67	9.5

Figure 37. Climate Normals (1991-2020) for Evanston.



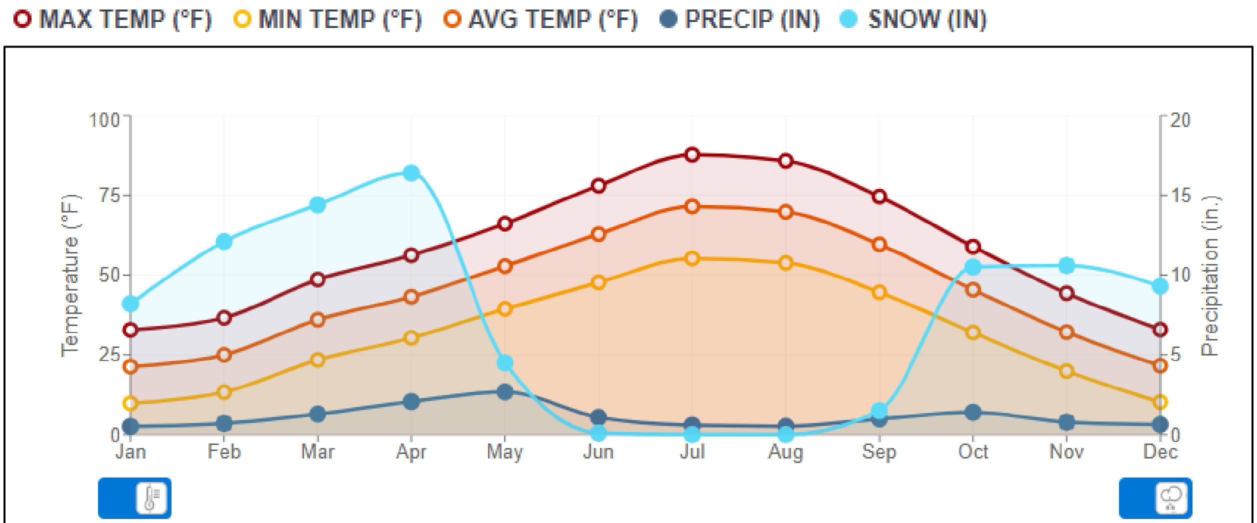
Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)
Jan	29.8	13.6	21.7	0.41
Feb	31.5	14.8	23.1	0.53
Mar	40.7	22.0	31.4	0.45
Apr	50.2	28.0	39.1	0.99
May	60.8	36.6	48.7	1.75
Jun	71.8	44.4	58.1	1.06
Jul	82.0	52.9	67.5	0.55
Aug	80.1	51.1	65.6	0.83
Sep	69.9	42.8	56.3	1.01
Oct	55.7	32.1	43.9	0.99
Nov	40.6	21.6	31.1	0.56
Dec	29.7	13.8	21.8	0.38

Figure 38. Wind Rose for Evanston.



Lander Field Office

Figure 39. Climate Normals (1991-2020) for Lander.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	32.8	9.8	21.3	0.51	8.2
Feb	36.6	13.3	25.0	0.70	12.1
Mar	48.6	23.4	36.0	1.29	14.4
Apr	56.2	30.3	43.2	2.07	16.4
May	66.1	39.4	52.8	2.68	4.5
Jun	78.0	47.7	62.8	1.08	0.1
Jul	87.7	55.2	71.5	0.59	0.0
Aug	85.8	53.8	69.8	0.52	0.0
Sep	74.6	44.6	59.6	0.98	1.5
Oct	58.9	32.0	45.4	1.40	10.5
Nov	44.3	19.9	32.1	0.78	10.6
Dec	32.9	10.2	21.6	0.63	9.3

Figure 40. Wind Rose for Lander.

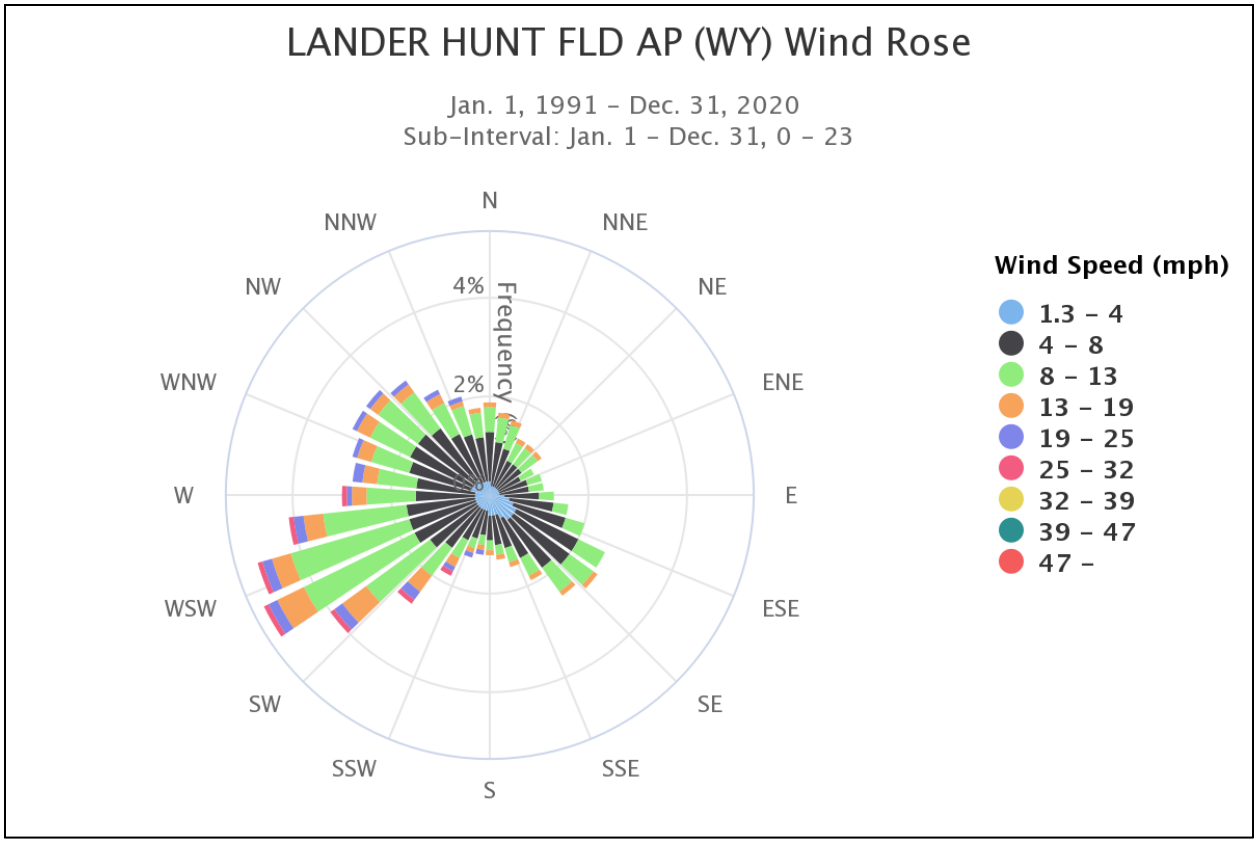
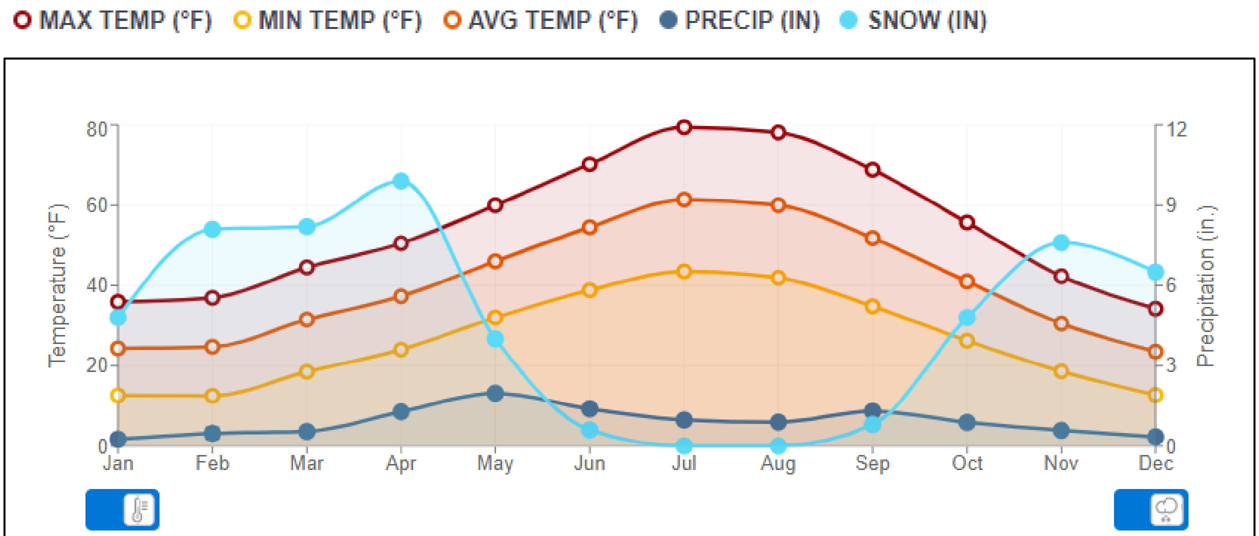


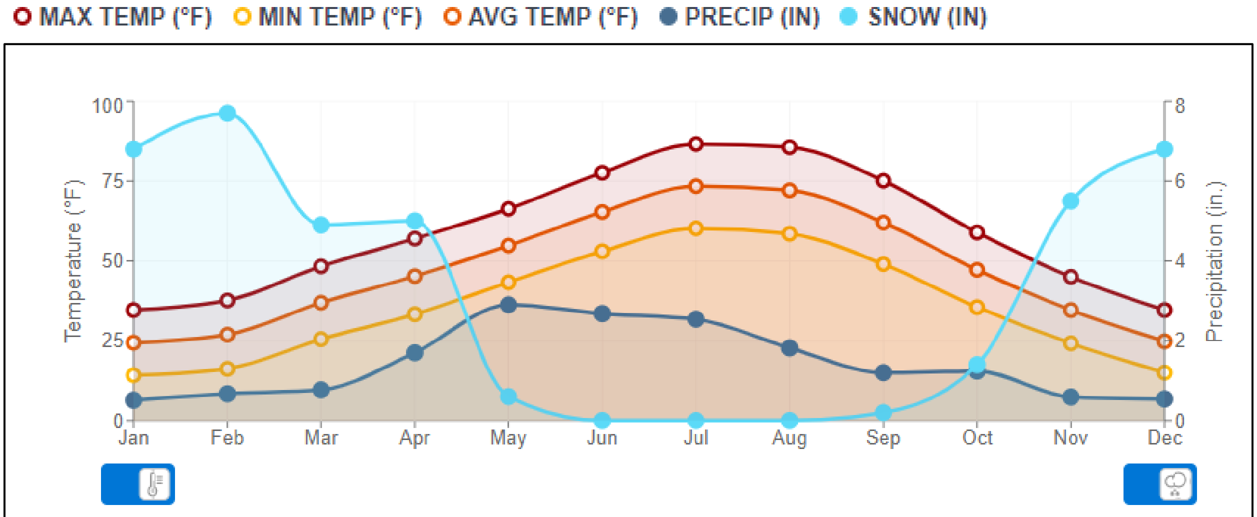
Figure 41. Climate Normals (1991-2020) for Dubois.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	35.9	12.6	24.3	0.25	4.8
Feb	36.9	12.5	24.7	0.47	8.1
Mar	44.5	18.5	31.5	0.54	8.2
Apr	50.5	24.0	37.3	1.28	9.9
May	60.0	32.0	46.0	1.97	4.0
Jun	70.2	38.8	54.5	1.39	0.6
Jul	79.4	43.5	61.4	0.97	0.0
Aug	78.1	41.9	60.0	0.89	0.0
Sep	68.8	34.8	51.8	1.30	0.8
Oct	55.7	26.2	41.0	0.88	4.8
Nov	42.3	18.6	30.5	0.58	7.6
Dec	34.2	12.7	23.5	0.34	6.5

Newcastle Field Office

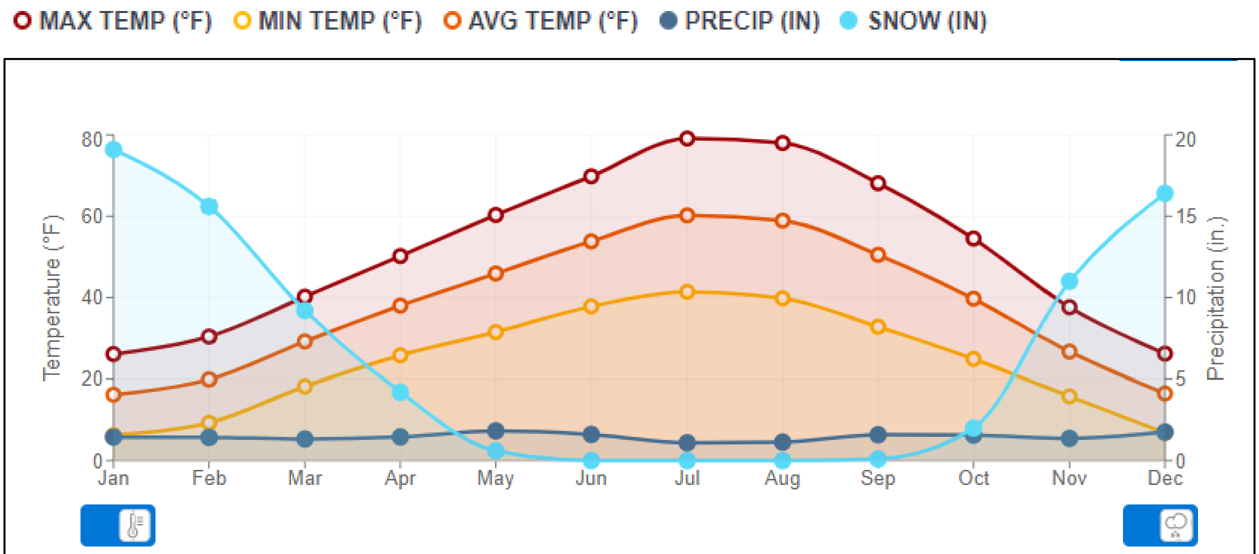
Figure 42. Climate Normals (1991-2020) for Newcastle.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	34.6	14.2	24.4	0.51	6.8
Feb	37.6	16.2	26.9	0.67	7.7
Mar	48.3	25.5	36.9	0.77	4.9
Apr	57.0	33.3	45.2	1.70	5.0
May	66.3	43.3	54.8	2.90	0.6
Jun	77.6	53.0	65.3	2.68	0.0
Jul	86.6	60.2	73.4	2.54	0.0
Aug	85.6	58.5	72.1	1.82	0.0
Sep	75.1	49.0	62.0	1.20	0.2
Oct	58.9	35.5	47.2	1.24	1.4
Nov	45.0	24.2	34.6	0.59	5.5
Dec	34.6	15.0	24.8	0.54	6.8

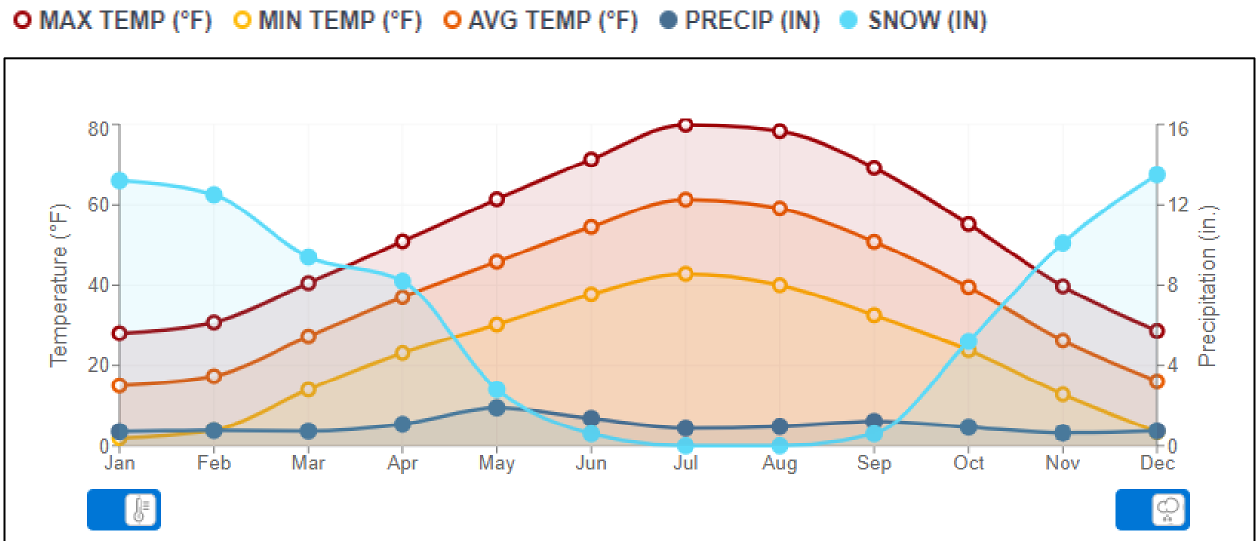
Pinedale Field Office

Figure 43. Climate Normals (1991-2020) for Jackson.



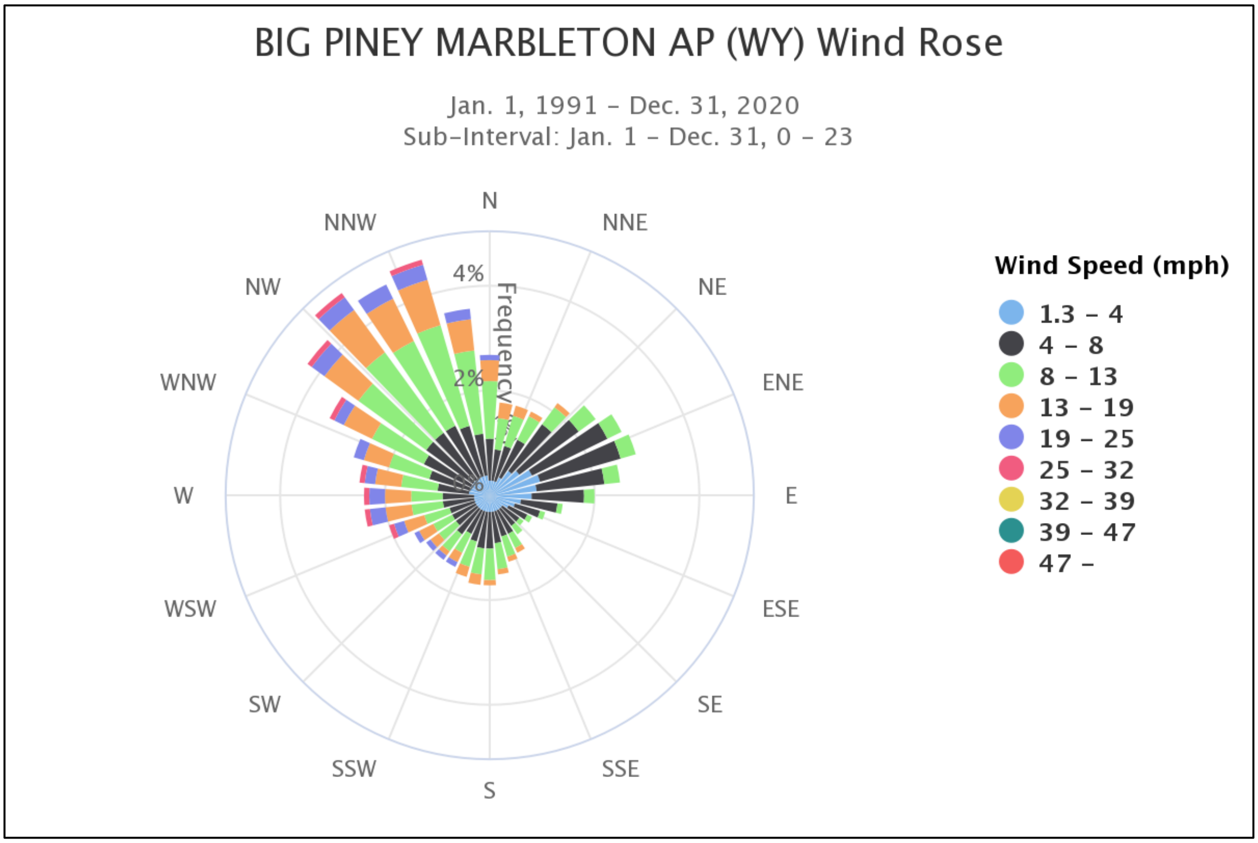
Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	26.1	6.3	16.2	1.45	19.1
Feb	30.4	9.3	19.9	1.43	15.6
Mar	40.2	18.2	29.2	1.33	9.2
Apr	50.2	25.8	38.0	1.46	4.2
May	60.3	31.5	45.9	1.83	0.6
Jun	69.8	37.8	53.8	1.61	0.0
Jul	79.1	41.4	60.2	1.10	0.0
Aug	78.0	39.8	58.9	1.14	0.0
Sep	68.1	32.8	50.5	1.59	0.1
Oct	54.5	24.9	39.7	1.57	2.0
Nov	37.6	15.8	26.7	1.37	11.0
Dec	26.2	6.8	16.5	1.76	16.4

Figure 44. Climate Normals (1991-2020) for Pinedale.



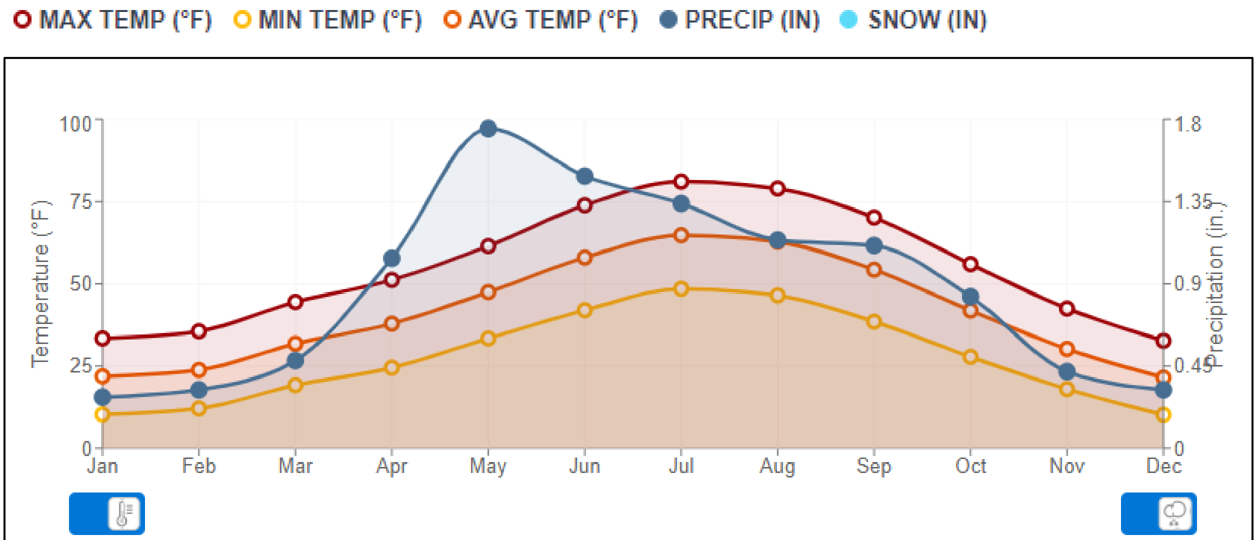
Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	28.0	1.9	15.0	0.70	13.2
Feb	30.7	3.9	17.3	0.76	12.5
Mar	40.5	14.0	27.2	0.73	9.4
Apr	50.9	23.1	37.0	1.07	8.2
May	61.4	30.2	45.8	1.89	2.8
Jun	71.3	37.7	54.5	1.36	0.6
Jul	79.9	42.8	61.3	0.88	0.0
Aug	78.3	40.0	59.1	0.96	0.0
Sep	69.2	32.5	50.8	1.21	0.6
Oct	55.2	23.8	39.5	0.93	5.2
Nov	39.7	12.8	26.2	0.64	10.1
Dec	28.6	3.4	16.0	0.74	13.5

Figure 45. Wind Rose for Big Piney.



Rawlins Field Office

Figure 46. Climate Normals (1991-2020) for Laramie.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)
Jan	33.4	10.3	21.9	0.28
Feb	35.6	12.1	23.8	0.32
Mar	44.5	19.2	31.8	0.48
Apr	51.2	24.5	37.9	1.04
May	61.5	33.4	47.5	1.75
Jun	73.9	42.0	58.0	1.49
Jul	81.1	48.5	64.8	1.34
Aug	79.0	46.5	62.8	1.14
Sep	70.2	38.5	54.3	1.11
Oct	56.0	27.8	41.9	0.83
Nov	42.5	18.0	30.2	0.42
Dec	32.7	10.2	21.5	0.32

Figure 47. Wind Rose for the Laramie.

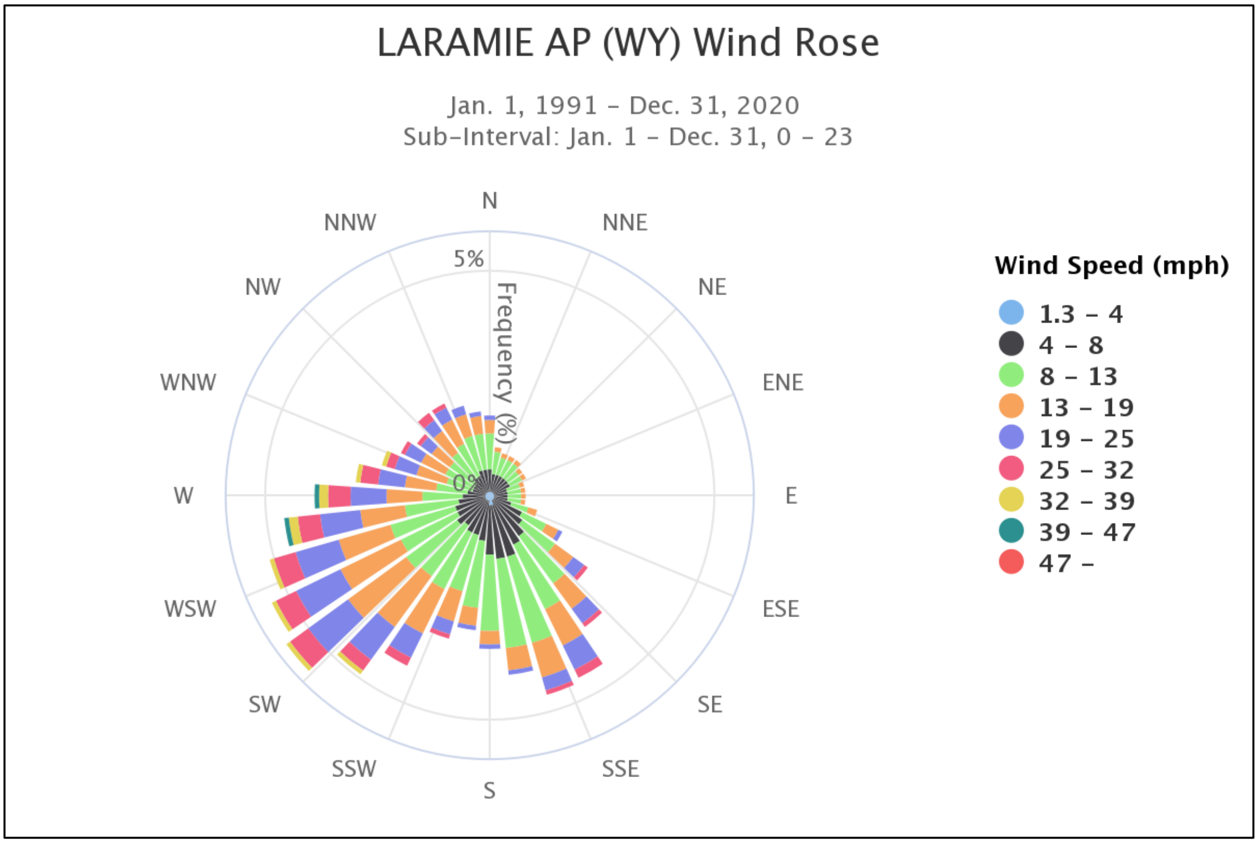
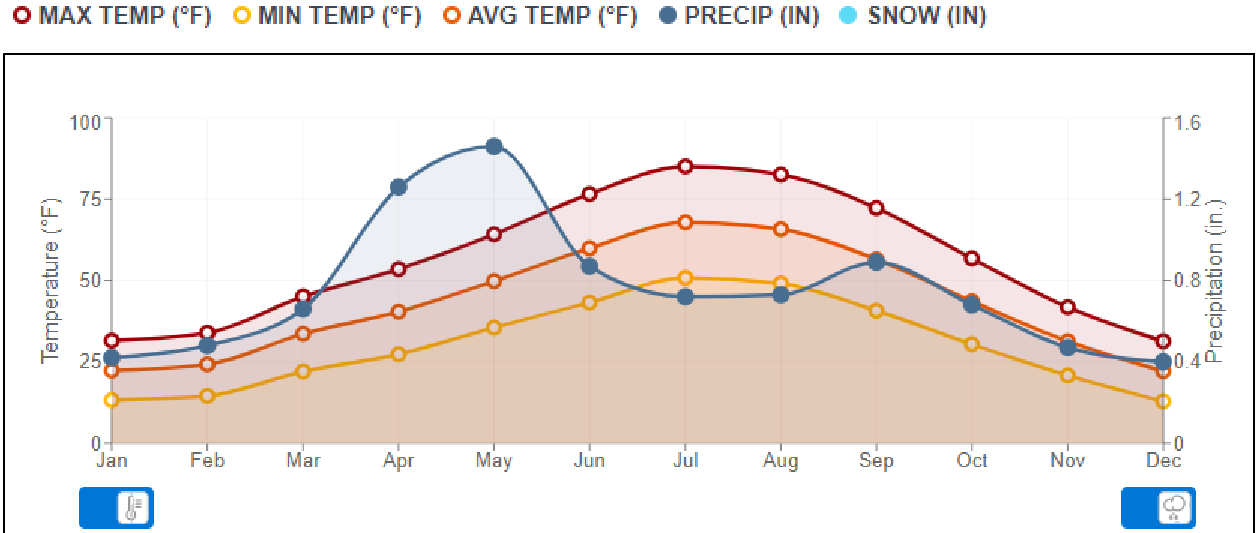


Figure 48. Climate Normals (1991-2020) for Rawlins.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)
Jan	31.5	13.2	22.3	0.42
Feb	33.9	14.5	24.2	0.48
Mar	45.1	22.0	33.6	0.66
Apr	53.5	27.3	40.4	1.26
May	64.2	35.5	49.8	1.46
Jun	76.6	43.2	59.9	0.87
Jul	85.1	50.8	67.9	0.72
Aug	82.6	49.1	65.8	0.73
Sep	72.3	40.7	56.5	0.89
Oct	56.8	30.4	43.6	0.68
Nov	41.8	20.8	31.3	0.47
Dec	31.3	12.8	22.1	0.40

Figure 49. Wind Rose for Rawlins.

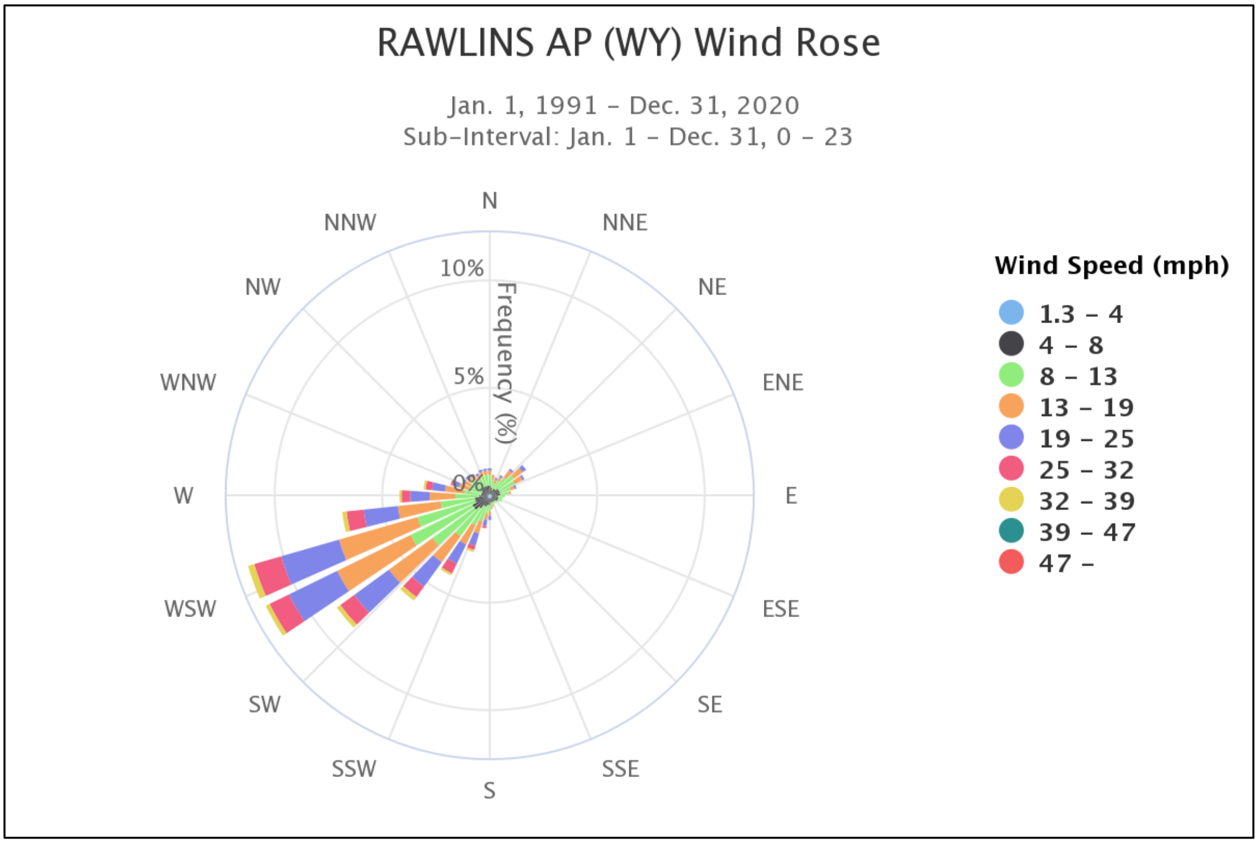
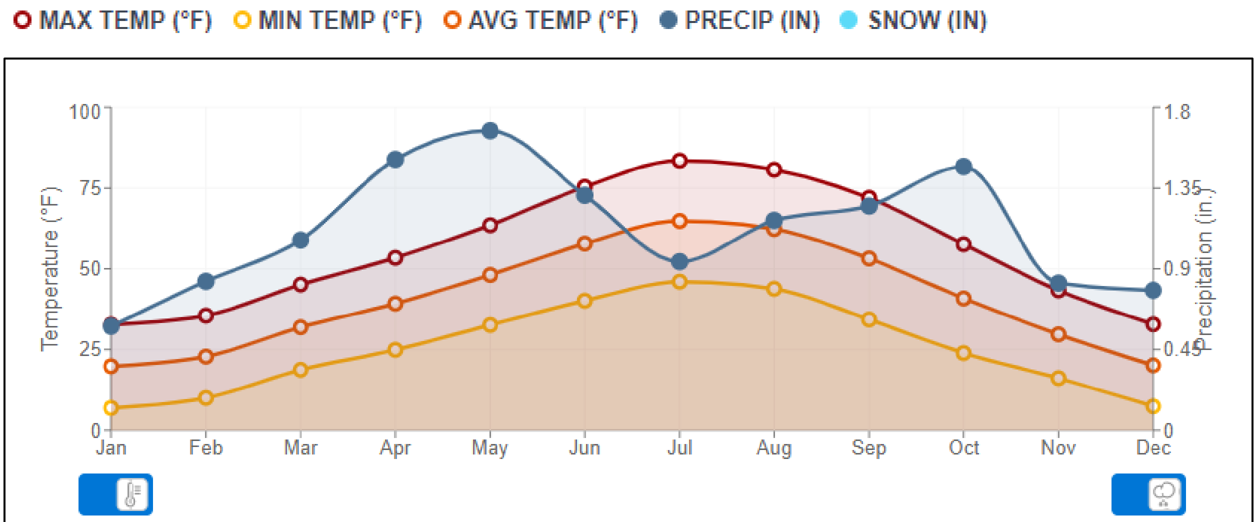


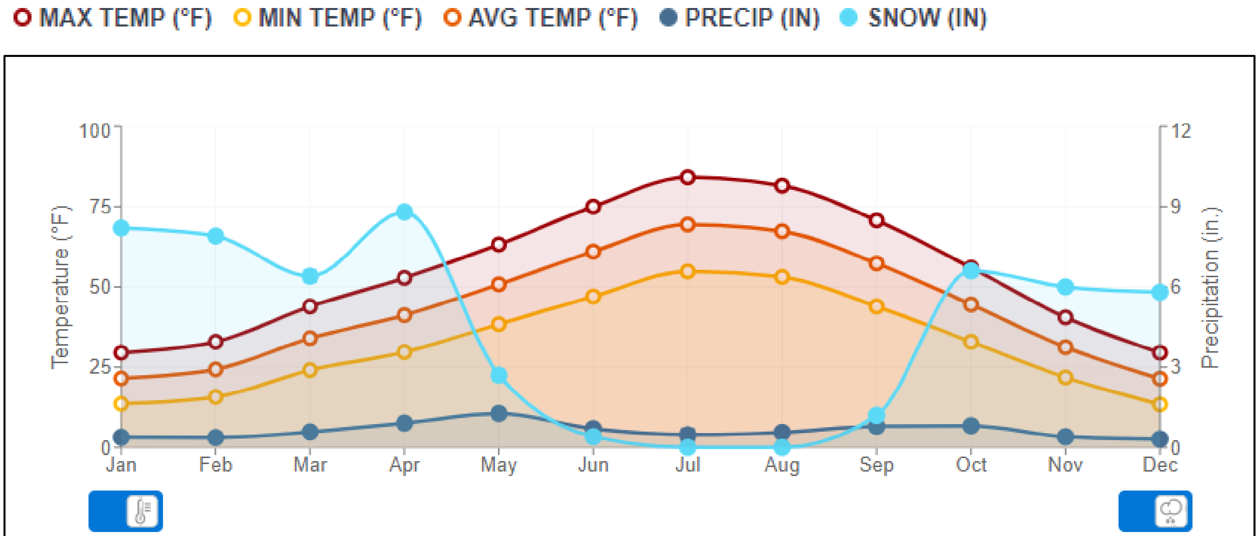
Figure 50. Climate Normals (1991-2020) for Saratoga.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)
Jan	32.7	6.9	19.8	0.58
Feb	35.5	10.0	22.8	0.83
Mar	45.1	18.7	31.9	1.06
Apr	53.4	24.9	39.2	1.51
May	63.5	32.6	48.1	1.67
Jun	75.4	40.1	57.8	1.31
Jul	83.5	46.0	64.8	0.94
Aug	80.7	43.8	62.3	1.17
Sep	72.0	34.3	53.2	1.25
Oct	57.6	23.9	40.8	1.47
Nov	43.3	16.1	29.7	0.82
Dec	32.8	7.4	20.1	0.78

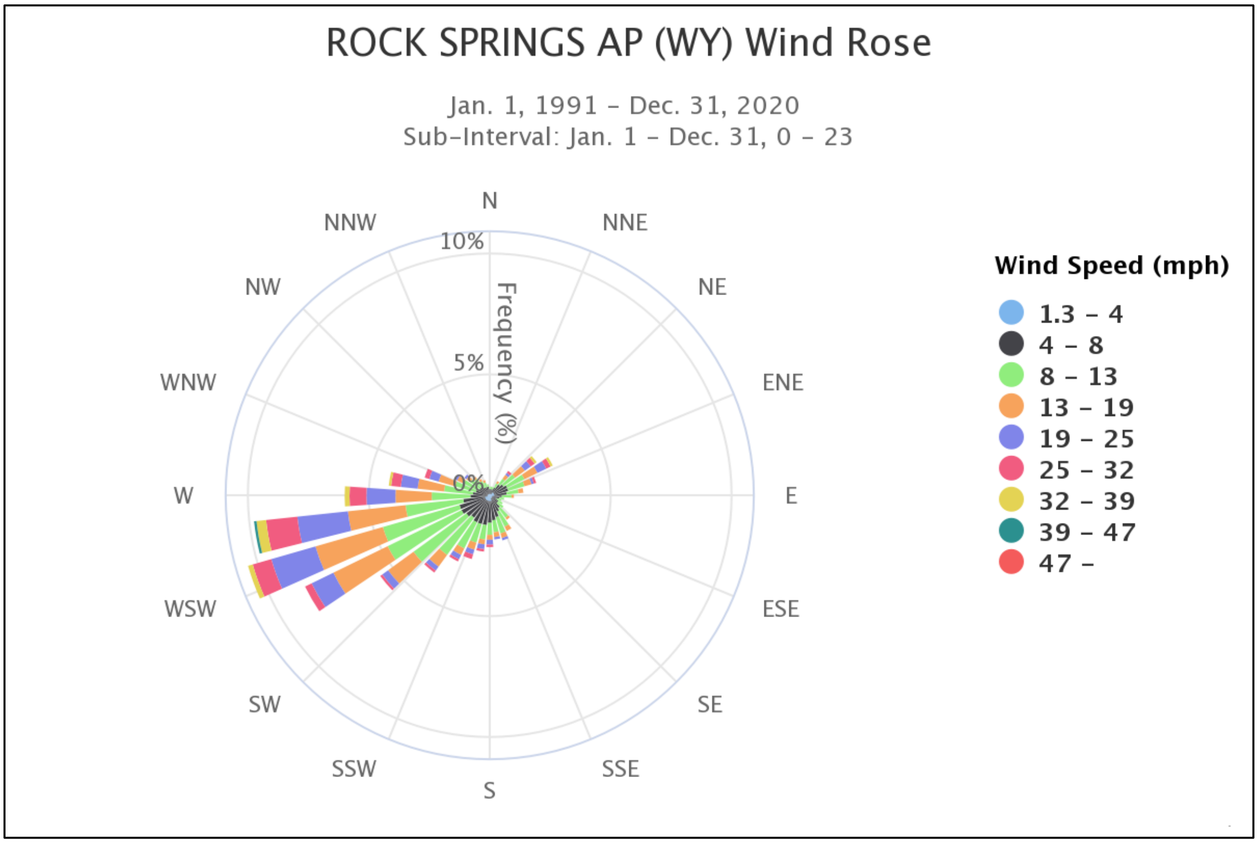
Rock Springs Field Office

Figure 51. Climate Normals (1991-2020) for Rock Springs.



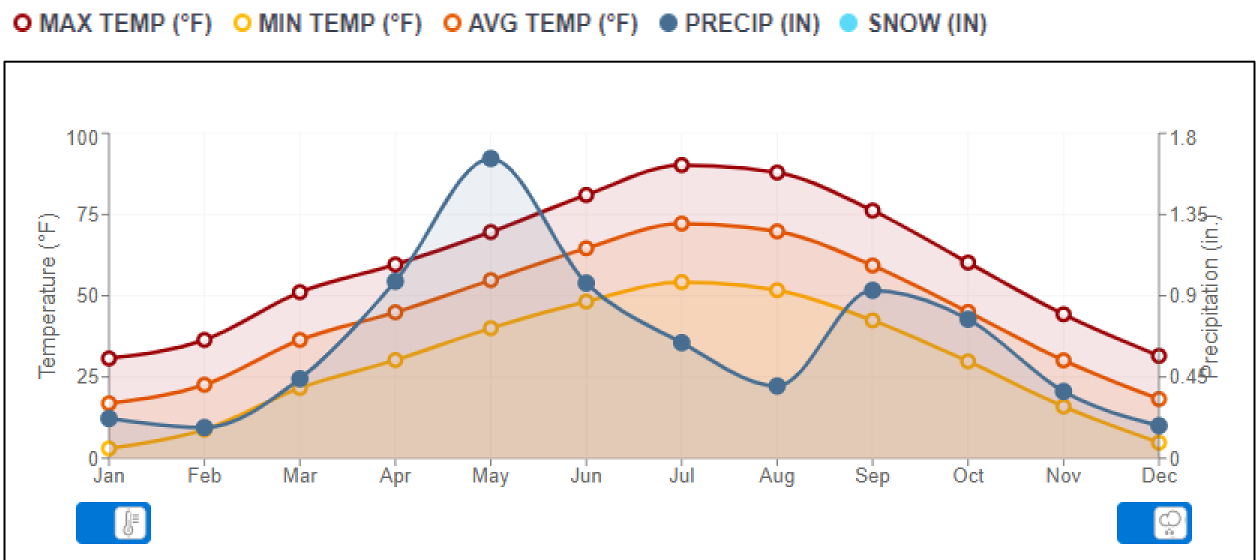
Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)	SNOW (IN)
Jan	29.5	13.6	21.5	0.38	8.2
Feb	32.9	15.7	24.3	0.37	7.9
Mar	43.9	24.1	34.0	0.58	6.4
Apr	52.8	29.7	41.2	0.91	8.8
May	63.2	38.4	50.8	1.27	2.7
Jun	75.0	47.0	61.0	0.70	0.4
Jul	84.1	54.8	69.4	0.47	0.0
Aug	81.5	53.1	67.3	0.56	0.0
Sep	70.7	43.9	57.3	0.79	1.2
Oct	56.0	32.9	44.5	0.81	6.6
Nov	40.5	21.8	31.2	0.40	6.0
Dec	29.5	13.4	21.4	0.31	5.8

Figure 52. Wind Rose for Rock Springs.



Worland Field Office

Figure 53. Climate Normals (1991-2020) for Worland.



Month	MAX TEMP (°F)	MIN TEMP (°F)	AVG TEMP (°F)	PRECIP (IN)
Jan	30.7	3.0	16.9	0.22
Feb	36.4	8.8	22.6	0.17
Mar	51.1	21.6	36.4	0.44
Apr	59.6	30.2	44.9	0.98
May	69.6	40.0	54.8	1.66
Jun	81.0	48.2	64.6	0.97
Jul	90.2	54.2	72.2	0.64
Aug	87.9	51.7	69.8	0.40
Sep	76.2	42.4	59.3	0.93
Oct	60.2	29.8	45.0	0.77
Nov	44.3	15.9	30.1	0.37
Dec	31.5	4.8	18.2	0.18

Figure 54. Wind Rose for Worland.