

Section 11: Drought

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Why is Drought a Threat to Yamhill County?

A drought is a long period of abnormally low precipitation that persists long enough to produce a serious hydrologic imbalance.¹ Drought is a normal part of virtually every climate on the planet, even relatively wet climates. It is the most complex of all natural hazards, and it affects more people than any other hazard. Analysis shows that it can be as expensive as floods and hurricanes.²

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services.

The impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between \$6 billion and \$8 billion annually in the United States and occur primarily in agriculture, transportation, recreation and tourism, forestry, and energy sectors.³ Social and environmental impacts are also significant, although it is difficult to quantify these impacts.

Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion.⁴ Droughts also bring increased problems with insects and diseases to forests and reduce growth.⁵ The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.

Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this “natural” hazard.

Historical Drought Events

Oregon

1928-1941

A significant drought affected all of Oregon from 1928 to 1941. The prolonged statewide drought created significant problems for the agriculture industry. The first of the three Tillamook Forest burns occurred during this drought in 1933.⁶

1985-1994

Although not as severe as the 1976-77 drought in any one year, the cumulative effect of ten dry years caused problems statewide. The peak year was 1992, when a drought emergency was declared. In the seven-year period from 1986-1992, Medford received only five years worth of precipitation and others areas of southern Oregon were also hard

significantly affected. Forests throughout Oregon suffered from a lack of moisture with fires common and insect pests flourishing.⁷

2000-2001

Severe drought conditions affected southern, central, and eastern Oregon in response to a larger drought that impacted the western United States. According to the US Department of Agriculture's SNOTEL network, the mid-March 2001 snow pack water equivalents generally ranged from 45 to 75 percent of normal in key watershed areas from the Cascades to the northern Rockies.⁸

In 2001, Governor Kitzhaber declared a drought emergency for eighteen counties in southern, central, and eastern Oregon. Yamhill County was not one of them.

The period from October 2000 to February 2001 was the second driest such period during the 106-year period of record in Washington and Oregon.⁹ Washington, Oregon, and Idaho experienced its second-driest March-February period on record, with a twelve-month precipitation total slightly less than two-thirds of the long-term average.¹⁰ Only March 1976 to February 1977 was drier in the Northwest.¹¹

2003

In Oregon, Wasco and Washington counties are designated as primary disaster areas due to damages and losses caused by ongoing drought, which started January 1, 2003.¹² Yamhill County is also eligible because it is one of nine contiguous counties (Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Tillamook and Yamhill). The Secretary of Agriculture declared the listed counties having disasters due to drought on March 22, 2004.¹³

Northwestern Oregon

1976-1981

During this drought period in western Oregon, low stream flows prevailed. The period between 1976 and 1977 was the single driest year of the century. The Portland Airport received only 7.19 inches of rain between October 1976 and February 1977.¹⁴

In the twelve-month period from September 1976 through August 1977, Corvallis received only 22.2 inches of precipitation, only 52 percent of the "normal" of 42.7 inches.¹⁵ During the winter of that year, airborne dry ice seeding was used in Polk County as a means of enhancing winter precipitation for agricultural use.

2005

February 2005 was the driest February on record since 1977, surpassing 2001's conditions.¹⁶ Governor Ted Kulongoski's Office posted a State of Oregon Drought and Fire Web page. This page features weekly updates, drought and fire information, and agency links.

With above normal temperatures, and knowing that water will be short this summer, some irrigators are already contacting Oregon Watermaster offices requesting permission to start irrigation a month early. In the Tualatin Basin the Watermaster reports sections of the Tualatin River, Gales Creek and the East Fork of Dairy Creek were all regulated to protect water rights. This is the first time that regulation has occurred in the pre-irrigation season period prior to May 1. Regulation normally begins in June or early July. Flow in the Tualatin River at Farmington is the lowest for this time of year since the Watermaster started keeping record in 1989. Irrigators are being told that water use outside the conditions of their permits, including time limits or season of use, is not discretionary.

If the current conditions persist, many irrigators will not have sufficient supply for their needs. Public water providers - cities, water districts, and others - will experience some shortages. Low stream flows will also mean problems for fish and other aquatic life. Recreational water users - boaters, fishers, and others - and the state's recreation industry will be impacted by low reservoir levels and low streams and rivers.

Characteristics of Drought in Oregon

Weather Patterns

A drought is a period of drier than normal conditions that results in water-related problems.¹⁷ Drought occurs in virtually every climatic zone, but its characteristics vary significantly from one region to another.¹⁸ Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate.¹⁹

In Oregon, drought is often associated with El Niño events. In strong El Niño situations, warmer than normal waters cover nearly the entire eastern and central tropical Pacific.²⁰ The area of strong convection, which produces large rain clouds, usually shifts eastward as waters in those areas warm.²¹ In the western Pacific, easterly trade winds often reverse and blow from the west, reducing ocean temperatures.²²

Warmer temperatures in the central and eastern Pacific cause much greater cloudiness in those regions, while cooler than average temperatures in the western Pacific cause that normally very active area to be less cloudy, with fewer storms and less rainfall.²³ Both the polar and subtropical jet streams are changed as well.²⁴ The former often dips southward over the North Pacific, and then veers northward into Alaska.²⁵ Although some storms still reach the Northwest, they tend to be less frequent than during average years.²⁶ This causes the Northwest to be generally drier than average during such an event.

Drought Hazard Assessment

Hazard Identification

The severity of the drought depends upon the degree of moisture deficiency, and the duration and size of the affected area. There are four different ways to define drought:

- Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some “normal” or average amount) and the duration of the dry period.²⁷ Definitions of meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region.
- Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced groundwater or reservoir levels, etc.²⁸ In short, agricultural drought refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.²⁹
- Hydrological drought is associated with the effects of periods of precipitation (including snowfall), and shortfalls on surface or subsurface water supply (i.e., stream flow, reservoir and lake levels, groundwater).³⁰ The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system.³¹ Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts.³² For example, a precipitation deficiency may result in a rapid depletion of soil moisture that is almost immediately discernible to agriculturalists, but the impact of this deficiency on reservoir levels may not affect hydroelectric power production or recreational uses for many months.³³ Also, water in hydrologic storage systems (e.g., reservoirs, rivers) is often used for multiple and competing purposes (e.g., flood control, irrigation, recreation, navigation, hydropower, wildlife habitat), further complicating the sequence and quantification of impacts.
- Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought.³⁴ Socioeconomic drought refers to the situation that occurs when physical water shortage begins to affect people.³⁵ Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.³⁶

Developing drought climatology i.e., investigating drought phenomena and causes for Yamhill County and the Mid-Willamette Valley region in general provides a greater understanding of its characteristics and the probability of recurrence at various levels of severity. Information of this type is extremely beneficial in the development of response and mitigation strategies and preparedness plans.

Sequence of Drought Impacts

The sequence of impacts associated with meteorological, agricultural, and hydrological drought further emphasizes their differences. When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water (i.e., water held to soil particles). Soil water can be rapidly depleted during extended dry periods.³⁷ If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface water (i.e., reservoirs and lakes) and subsurface water (i.e., groundwater), for example, are usually the last to be affected. A short-term drought that persists for 3 to 6 months may have little impact on these sectors, depending on the characteristics of the hydrologic system and water use requirements.

Vulnerability and Risk

A vulnerability assessment that describes the number of lives or amount of property exposed to elements of drought has not yet been conducted for Yamhill County. Depending on its severity, drought poses a risk for agricultural and timber losses, as well as for property damage, disruption of water supplies, and availability in urban and rural areas.

Factors included in assessing drought risk include agricultural practices, including crop types and varieties grown, soil types, topography, and water storage capacity. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed. Insufficient data currently exists to complete a risk analysis.

Community Drought Issues

Life and Property

Many drought-related economic impacts occur in agriculture and related sectors because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in crop and livestock production, drought is also associated with increases in insect infestations, plant disease, and wind erosion. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.³⁸

Both urban and rural water users are impacted by drought. Based on the severity of the drought, water usage may be limited or curtailed for

specific uses to ensure that sufficient water is available to maintain water pressure, firefighting supply, drinking, and sanitation requirements.

Environmental

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. Many species, however, will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.³⁹

Financial Cost

One of the major impediments to drought planning is its cost. Officials may find it difficult to justify the costs of a plan, which are immediate and fixed, against the unknown costs of some future drought. Unknown costs of drought are not all economic; they also include human suffering, damage to biological resources, and the degradation of the physical environment, items that are inherently difficult to estimate. Studies have shown that crisis-oriented drought response efforts are largely ineffective, poorly coordinated, untimely, and inefficient in terms of the resources allocated. For example, in the mid-1970s, the U.S. government spent more than \$7 billion in drought relief. Compared to such large expenditures, investing in drought preparedness i.e., mitigation projects is a sound economic decision. Mitigation efforts can use existing political and institutional structures, thereby reducing costs when drought actually impacts the county.

Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for local, state, and federal government. Less discretionary income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the stricken region. Reduced water supply impairs the navigability of rivers and results in increased transportation costs because products must be transported by rail or truck. Hydropower production may also be curtailed significantly.

Existing Mitigation Activities

County

The staff employed by the **Yamhill Soil and Water Conservation District** (Yamhill SWCD) provides technical assistance to landowners and operators regarding soil and water quality issues on their land. The staff also provides education and outreach on various natural resource issues and topics.

Federal

The **National Drought Mitigation Center** (NDMC), part of a federally coordinated effort to monitor droughts, helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management. Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning.

Mitigation Plan Goals

The plan goals addressed by each action item are identified as a means for monitoring and evaluating how well the mitigation plan is achieving its goals following implementation.

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organization begin implementing mitigation action items.

Goal #1: EMERGENCY OPERATIONS

Goal Statement: Coordinate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures and with various other agencies, as appropriate.

Goal #2: EDUCATION AND OUTREACH

Goal Statement: Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.

Goal #3: PARTNERSHIPS

Goal Statement: Develop effective partnerships with public and private sector organizations and significant agencies and businesses for future natural hazard mitigation efforts.

Goal #4: PREVENTIVE

Goal Statements:

- Develop and implement activities to protect human life, commerce, and property from natural hazards.
- Reduce losses and repetitive damage for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Goal #5: NATURAL RESOURCES UTILIZATION

Goal Statement: Link natural resources management, land use planning, and watershed planning with natural hazard mitigation activities to protect natural systems and allow them to serve natural hazard mitigation functions.

Goal #6: IMPLEMENTATION

Goal Statement: Implement strategies to mitigate the effects of natural hazards.

Drought Mitigation Action Items

Although drought is a natural hazard, it is possible to reduce the county's vulnerability and therefore lessen the risks associated with drought episodes. The impacts of drought, like those of other natural hazards, can be reduced through mitigation and preparedness (risk management). Planning ahead to mitigate drought gives decision makers the chance to relieve the most suffering at the least expense. Reacting to drought in "crisis mode" decreases self-reliance and increases dependence on government and donors.

The mitigation action items were formulated through research of regional mitigation plans, natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through a public open house at which the county received comments from stakeholders, guests, and county residents.

The drought action items provide direction on specific activities that organizations and residents in Yamhill County can undertake to reduce risk and prevent loss from drought. Each action item is followed by ideas for implementation, which can be used by local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from drought impacts in Yamhill County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Drought Action Items

Short-term drought action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-D #1: Support the technical services provided by county-based agencies on effective methods of water use curtailment.

Ideas for Implementation

- Support Yamhill SWCD, NRCS and Yamhill Basin Council when they provide technical services for local land owners on ways to reduce water use during drought emergencies, including voluntary and enforced methods, including no outside use of water (residential), mandatory reductions of certain uses, etc.

Coordinating Organization: Yamhill SWCD, Yamhill Basin Council, OSU Extension Service
Internal Partner: Planning, Emergency Management
External Partner: NRCS, WRD, water systems
Timeline: 2 years; on-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

ST-D #2: Encourage local governments to inter-tie water systems.

Ideas for Implementation

- Encourage local governments located proximate to one another, yet with separate water systems, to develop the physical capability to send water from one system to the other; and
- Assist local governments planning to inter-tie water systems with agreements necessary to execute such projects.

Coordinating Organization: Yamhill County, MWVCOG
Internal Partners: Planning, Public Works
External Partners: McMinnville Water & Light, Valley View Water Company, cities and rural communities; OECDD, Rural Development (funding sources); WRD, ODFW, PUC, NRCS, Yamhill SWCD, BLM
Timeline: 2 years; on-going
Plan Goals Addressed: Partnerships; Preventive; Implementation

Long-term (LT) Drought Action Items

Long-term drought action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-D #1: Support local agencies' training on water conservation measures to farmers and ranchers, including drought management practices for crops and livestock.

Ideas for Implementation

- In cooperation with OSU Extension Service and agricultural organizations prominent and respected within the farming and ranching community, build on existing outreach methods with the goal of providing water conservation/drought management training to farmers and ranchers.

Coordinating Organization: Yamhill SWCD
Internal Partner: Planning
External Partners: OSU Extension Service, NRCS, Yamhill Basin Council, Farm Bureau, ODA, WRD, ODFW
Timeline: 1 to 2 years, on-going
Plan Goals Addressed: Education & Outreach; Partnerships; Preventive; Natural Resources Utilization; Implementation

LT-D #2: Support the technical service and low-interest loans provided to farmers and ranchers so that they can develop livestock watering systems.

Note:

- Livestock water systems provide additional options for farmers and ranchers to provide drinking water, and can sometimes also improve riparian habitat. Systems can be divided into three types:
 - controlled access (to a river or stream);
 - gravity flow; and
 - pressure systems run by pumps, which are sometimes powered by wind or solar electricity.

Coordinating Organization: Yamhill SWCD

External Partners: ODA, WRD, OECDD, DEQ, ODFW, NRCS,
OSU Extension Service
Timeline: On-going
Plan Goals Addressed: Education & Outreach; Preventive;
Implementation

LT-D #3: Encourage storage of water, especially off-stream storage.

Ideas for Implementation

- Encourage storage facilities where they are needed and where they are feasible to construct e.g., very high in drainage basins so that the impact to anadromous fish would be minimal;
- Encourage development of aquifer storage and recovery projects i.e., diversion of surface water during times of abundance that is injected into underground aquifers for storage; and
- Support land management practices that slow down or prevent runoff i.e., retains water in the watershed such as creation of wetlands, catchment's depressions, diversion dikes, or terraces.

Coordinating Organization: Public Works
Internal Partner: GIS, Planning
External Partner: OSU Extension Service, Yamhill Basin
Council, NRCS, Yamhill SWCD, ODA, WRD,
DSL, ODFW, DEQ
Timeline: On-going
Plan Goals Addressed: Partnerships; Preventive; Natural Resources
Utilization; Implementation

LT-D #4: Support agencies' determination of locations for additional aquifer studies that might lead to greater water supplies and help determine funding sources for the studies.

NOTE: Studying aquifers may reveal under-utilized water resources and other information useful to water managers.

Ideas for Implementation

- Assist in the determination of which aquifers in Yamhill County would benefit by detailed studies and also assist in the determination of how these studies can be funded.

Coordinating Organization: Public Works
Internal Partner: Planning, GIS
External Partner: Yamhill SWCD, WRD, ODA, DEQ, ODFW,
OECDD, DOGAMI, DLCD
Timeline: 3 to 5 years

Drought Resource Directory

County Resources

Yamhill Soil & Water Conservation District

The Yamhill Soil & Water Conservation District promotes wise use and conservation of Oregon's natural resources within Yamhill County. Yamhill SWCD provides local leadership, technical assistance, information, and improved access to state and federal cost-share assistance to make positive changes on an owner's land.

Contact: Yamhill Soil and Water Conservation District

Address: 2200 SW 2nd Street, McMinnville, OR 97128

Phone: 503-472-6403

Fax: 503-472-2459

Website: www.yamhillswcd.org

Email: yamhill-swcd@or.nacdnet.org

State Resources

Oregon Drought Council

Drought Council is responsible for assessing the impact of drought conditions and making recommendations to the Governor's senior advisors. Drought Council is chaired and facilitated by Oregon Emergency Management. The goal of the Drought Council is to "strive to reduce the effects of an impending drought through a coordinated federal, state, local, and voluntary effort, consisting of the development of drought plans, policies, and procedures, and through coordinated state response."

Contact: Oregon Drought Council - Oregon Emergency Management

Address: 3225 State Street, P.O. Box 14370, Salem, OR 97301

Phone: 503-378-2911

Water Availability Committee

The Water Availability Committee monitors conditions throughout the state and report these conditions monthly. The Committee advises the Drought Council, and is chaired by the Oregon Water Resource Department. Committee members include representatives from the National Weather Service, NW River Forecast Center, NRCS, US Geological Survey, State Climatologist, and Oregon Department of Forestry. The primary responsibility of the Water Availability Committee is to determine the appropriate Oregon Drought Severity Index for locations throughout the state.

Contact: Oregon Water Resources Department

Address: 725 Summer Street NE, Suite A, Salem, OR 97301

Phone: 503-986-0900

Fax: 503-986-0903

Oregon Department of Agriculture

The mission of the Oregon Department of Agriculture is 1) to ensure food safety and provide consumer protection; 2) to protect the natural resource base for present and future generations of farmers and ranchers, and 3) to promote economic development and expand market opportunities for Oregon agricultural products. The three broad policy areas of the mission statement are interdependent. Without a strong and healthy natural resource base – particularly land and water – there is little or no agricultural production to promote and market. Without assurance that the food produced in Oregon is safe, there is little chance that many agricultural products will be of interest to potential customers.

Contact: Oregon Department of Agriculture
Address: 635 Capitol St. NE, Salem, OR 97301-2532
Phone: 503-986-4550
Fax: 503-986-4747
Website: [http:// www.oregon.gov/ODA/](http://www.oregon.gov/ODA/)
Email: info@oda.state.or.us

Oregon Water Resources (WRD)

The Water Resources Department’s role during a drought is one of overseeing a managed, responsible use of Oregon’s water according to the water rights in place. Water Resources has three primary mechanisms to help individuals and communities cope with drought: emergency water use permits, temporary transfers of water rights, and use of existing right Option/Agreement. In counties where the Governor has declared a drought, residents may apply for emergency use permits. This means that a person in the county may apply to the Department for a permit to use water that they otherwise would not have right to. The permitting process for these counties is expedited in order to provide the use as soon as possible, if there is water available. The permit, however, is only valid for the extent of the drought and no longer than one year. Once the Governor undeclares the drought in the county, the emergency permits immediately become invalid. Additionally, due to the expedited review of the permits, potential for unseen harm to other users may be found later. In cases such as that, the emergency use permit may be suspended or rescinded immediately.

Contact: Northwest Region Manager,
Oregon Water Resources Department
Address: 725 Summer St NE, Suite A, Salem, Oregon 97301-1271
Phone: 503-986-0900
Fax: 503-986-0903
Website: <http://oregon.gov/OWRD/offices.shtml>

Oregon Water Resources Department (WRD) – Watermasters

The Oregon Water Resources Department has 20 watermaster offices statewide. Marion County is District 16. A watermaster’s job, during the summer months, is

to regulate the use of water among all the users. Regulation is done according to the date of priority - or the date an irrigator originally was granted the authority to use water. Some priority dates go back into the middle 1800's and some dates are as recent as this year. Irrigators with the oldest priority dates get their water first, and if there is water left over the younger priority dates are allowed to have water. In 2005, in many locations, only irrigators with the earliest priority dates will have sufficient water to meet their needs.

Contact: Bill Ferber, District 15 Watermaster,
Oregon Water Resources Department
Address: 725 Summer St NE, Suite A, Salem, Oregon 97301-1271
Phone: 503-986-0892
Fax: 503-986-0903
Website: <http://oregon.gov/OWRD/offices.shtml>

Oregon Climate Service

The Oregon Climate Service (OCS) collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate information to those within and outside the state of Oregon and educates the citizens of Oregon on current and emerging climate issues. OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service
Address: Strand Agriculture Hall 326, Corvallis, OR 97331-2209
Phone: 541-737-5705
Fax: 541-737-5710
Website: <http://www.ocs.orst.edu>
Email: coas@oregonstate.edu

Federal Resources

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship. NOAA's drought information center is a roundup of the various NOAA Web sites and information on drought and climate conditions. Some external links are included for convenience.

Contact: National Oceanic and Atmospheric Administration
Address: 14th Street & Constitution Avenue, NW, Room 6217, Washington, DC 20230
Phone: 202-482-6090
Fax: 202-482-3154
Website: <http://www.drought.noaa.gov>
Email: answers@noaa.gov

National Drought Mitigation Center

The National Drought Mitigation Center (NMDC), part of a federally coordinated effort to monitor droughts, helps people and institutions

develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management. Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning.

Contact: National Drought Mitigation Center
Address: University of Nebraska–Lincoln
239 L.W. Chase Hall
P.O. Box 830749
Lincoln, NE 68583–0749
Phone: 402-472–6707
Fax: 402-472–6614
Website: <http://www.drought.unl.edu/index.htm>
Email: ndmc@drought.unl.edu

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230-1809
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

Natural Resources Conservation Service – National Water & Climate Center

Contact: Natural Resources Conservation Service
National Water and Climate Center
Address: 101 SW Main Street, Suite 1600, Portland, OR 97204-3224
Website: <http://www.wcc.nrcs.usda.gov>
Email: jmarron@wcc.nrcs.usda.gov

Additional Resources

Washington State University Extension Drought Alert

Access WSU Extension publications and news releases about drought concerns and issues, a list of experts on related subjects, and a list of useful links from other organizations and agencies.

Contact: Washington State University Extension Drought Alert
Address: 534 East Trent, PO Box 1495, Washington State University
Spokane, WA, 99210-1495
Phone: 509-358-7960
Website: <http://drought.wsu.edu/>

Drought - Endnotes

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³ Id.

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⁶ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

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⁸ National Drought Mitigation Center.

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¹⁴ National Drought Mitigation Center.

¹⁵ Taylor, George. “Weather Matters.” *Mid-Valley Sunday*. January 9, 2000.

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¹⁷ A. Moreland. U.S. Geological Survey. 1993. Open-File Report 93-642.

¹⁸ National Drought Mitigation Center.

¹⁹ Id.

²⁰ Taylor, George H. March 1998. *Impacts of the El Niño/Southern Oscillation on the Pacific Northwest*.

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²³ Id.

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²⁶ Id.

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²⁸ Id.

²⁹ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*.

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³¹ Id.

³² Id.

³³ Id.

³⁴ Id.

³⁵ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*.

³⁶ National Drought Mitigation Center, available on the World Wide Web <http://www.drought.unl.edu/index.htm>. Accessed August 24, 2004.

³⁷ Donahue, Roy L., Raymond W. Miller, and John C. Shickluna. 1983. *Soils: An Introduction to Soils and Plant Growth*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

³⁸ National Drought Mitigation Center

³⁹ Id.