Drought Risk Assessment

This plan is an update of the 2004 City of Redmond Hazard Mitigation Plan (HMP). Although it is an update, this document has been redesigned so that it looks, feels, and reads differently than the original. This is due to several factors: new hazard information has become available that drives new definitions of risk, the City has matured and new capabilities are now available, and the new format will allow readers to more easily understand the content. In addition, the 2004 HMP included several action items that have been completed, creating an opportunity for developing new mitigation strategies.

11.1 Identifying Drought Hazards

A drought is an extended period (usually one or more seasons) of abnormally low precipitation. It is a condition of climate dryness severe enough to reduce soil moisture, water and snow levels below the minimum level necessary for sustaining normal plant life, animal life, and economic systems. Droughts are often exacerbated by overuse of the water supply by residents. Secondary effects that may result from drought may include fire, landslides and economic impacts.[120]

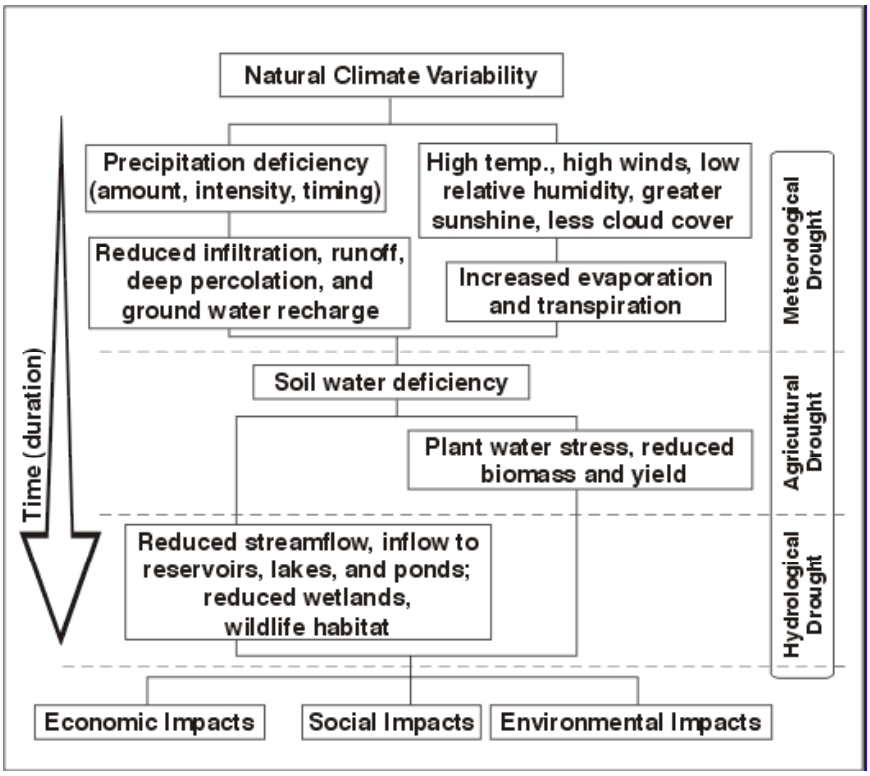

Figure 8: Concept of Drought
Source: National Drought Mitigation Center, "Concept of drought."

In 1989, the Washington State Legislature gave permanent drought relief authority

120 National Drought Mitigation Center, "What is Drought," University of Nebraska, Lincoln. http://drought.unl.edu/whatis/concept.hmtl.

to the Department of Ecology and enabled them to issue orders declaring drought emergencies (RCW 43.83B.400-430 and Chapter 173-166 WAC). In order to declare a drought in the State of Washington, two characteristics must be met:

- The water supply for the area must be below 75% of normal levels
- Water uses and users in the area must be likely to incur undue hardships because of the water shortage.[121]

60% of the water used by Redmond comes from the Cedar and Tolt watersheds, supplied by Seattle Public Utilities (SPU). The watersheds provide potable water to numerous cities in King County. The reservoirs have a limited capacity and therefore, large rain events in the winter do not necessarily prevent summer droughts. The reservoirs must be continually fed by rain and snowmelt to have an adequate supply. Redmond does not have direct control over the amount of water it will be allotted during times of drought and must share a drought's impact among numerous other cities.[122]

The other 40% of Redmond's water is supplied by five main groundwater wells located in the City. [123] The wells are recharged by rain. During a drought that lasts for a short period, Redmond's groundwater supply may incur no significant changes; however, water stored in soil can be rapidly depleted during extended dry periods. Additionally, when drought conditions abate, groundwater takes longer to recover than soil water reserves, stream-flow, reservoirs and lakes.[124]

121 Washington State Legislature, "Revised Code of Washington," http://apps.leg.wa.gov/RCW/.
122 Seattle Public Utilities, "Cedar and Tolt Watersheds,"City of Seattle, http://www.seattle.gov/util/About_SPU/Water_System/Water_Sources_&_Treatment/index.asp.
123 City of Redmond, "Drinking Water," City of Redmond, http://www.ci.seattle.wa.us/util/About_SPU/Water_System/Water_Supply/SPU01_001850.asp.
124 City of Redmond, "Wellhead Protection," City of Redmond, http://www.redmond.gov/insidecityhall/publicworks/environment/groundwaterordinance.asp.

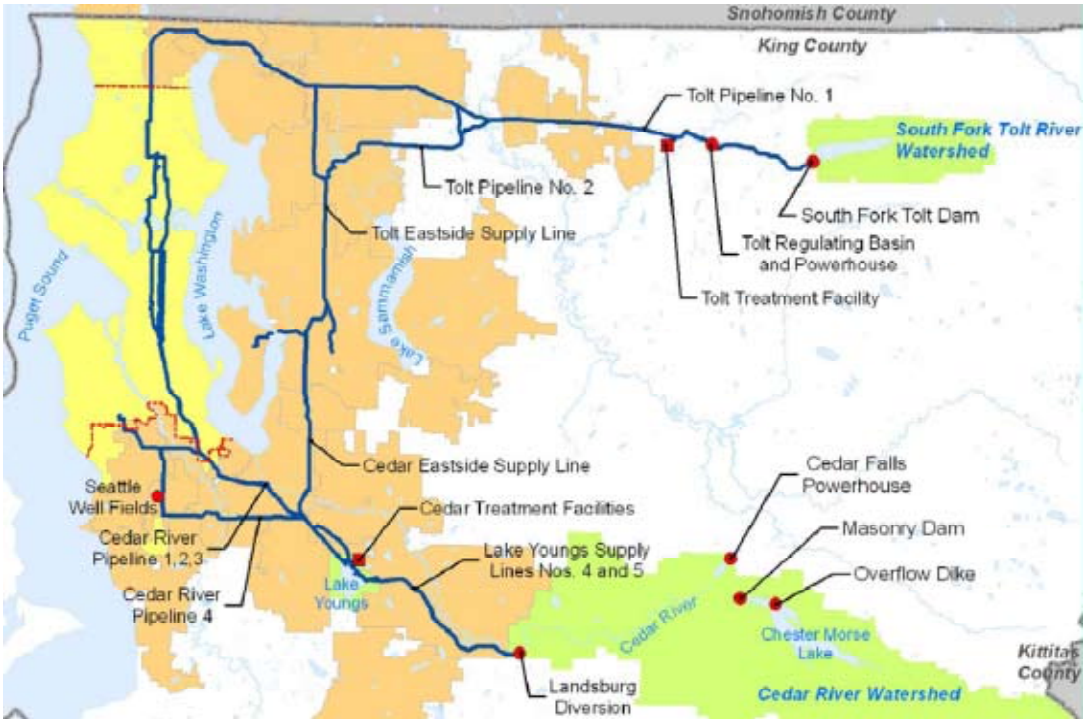

Figure 9: South Fork Tolt Water Management Plan
Source: Seattle Public Utilities, "South Fork Tolt Water Management Plan".

11.2 Profiling Drought Hazard Events

A. Location

Since the whole City of Redmond relies on shared water sources, the entire City will be affected by a drought. Past droughts in the Puget Sound Region have resulted in water use restrictions and higher water charges. Redmond business and residents were consequently unable to adequately maintain landscaping. Water shortages cause loss of vegetation, including the 1,300 acres of parks located in the City.[125]

B. Timing and Duration

A short-term drought lasts anywhere from three to six months while long-term droughts can last for several years.[126] Given the history of drought in the Puget Sound region, it is likely that any drought that would affect Redmond would only last for a short period, taking place in spring and/or summer months, and would be easily forecast well before it occurred.

C. Severity

Droughts in the Pacific Northwest are likely to: reduce potable water supplies, provide inadequate stream flow volumes to support fish, increase the threat of wildfires, and pose a threat to vegetation that relies on natural precipitation. The severity of a

125 City of Redmond, "About Redmond," City of Redmond, http://www.redmond.gov/aboutredmond/general2.asp.
126 National Drought Mitigation Center, "What is Drought?" University of Nebraska, Lincoln, http://drought.unl.edu/whatis/concept.hmt.

drought can be reduced by water conservation technology and practices. The length of the recovery period is determined by the intensity of the drought, duration, and quantity of precipitation received as the drought recedes.[127]

In 2001, Seattle Public Utilities decreased the risks associated with a drought to its users and the salmon runs through designed, monitored, and implemented water conservation tactics.[128]

D. Frequency

Previous Occurrences
Since 1900, about fifteen droughts of various durations have affected the Puget Sound Region, the most recent droughts occurred in 2001 and 2005[129].

King County Office of Emergency Management lists the most significant droughts affecting the Puget Sound region in the past thirty-five years as:

- **1965-1966:** The entire State was affected by drought conditions from June 1965 to December 1966.
- **June-August 1967:** No rain fell from the third week in June to the third week in September. 1,767 fires burned throughout the State.
- **October 1976-September 1977:** King County experienced precipitation levels 57 percent of normal. Stream flows averaged between 30 and 70 percent of normal. Temperatures were higher than normal, which resulted in algae growth and fish kills.
- **October 1991-September 1994:** Stream flows were between 30 and 60 percent of normal. Agriculture products suffered greatly. Thirty counties were designated as Emergency Drought Impact areas.
- **March of 2001:** The National Weather Service reported that the winter of 2000-01 was the driest since 1976-1977. It was also one of the five driest in the past 100 years.[130] Following above-average precipitation in the final two months of the year, the drought emergency formally expired on December 31, 2001.

Probability of Future Events
The possibility of drought affecting Redmond is moderate based on historical records. Seattle Public Utilities does provide a document titled "Current Water Supply Conditions and Outlook." Based on the history of drought in Puget Sound and Washington State there is a risk that some form of drought will affect Redmond at least once each decade, though the impacts may be mild. The frequency, duration and depth may increase with climate change.[131]

127 King County Office of Emergency Management, "Natural Hazards: Droughts," King County, http://www.kingcounty.gov/safety/prepare/residents_business/Hazards_Disasters/Droughts.aspx.
128 Seattle Post Intelligencer, "Seattle Drought Efforts Pay Off," Seattle Times, http://www.seattlepi.com/local/37701_drought05.shtml.
129 Puget Sound Business Journal, "Drought: Dry weather of 2005 drains reservoirs and ruins orchards," Puget Sound Business Journal, http://seattle.bizjournals.com/seattle/stories/2005/08/01/story2.html
130 King County Office of Emergency Management, "Natural Hazards: Droughts," King County, http://www.kingcounty.gov/safety/prepare/residents_business/Hazards_Disasters/Droughts.aspx.
131 National Center for Atmospheric Research, "Drought & Wildfire," http://www.ncar.ucar.edu/research/climate/drought.php.

While King County is not on Washington State's list of jurisdictions most vulnerable to drought, nor is it a critical area for drought according to the National Drought Mitigation Center; the historical record of both Western Washington and the State demonstrates that it is important to consider drought conditions as a potential impact to the region. Climate change will change the patterns of precipitation and the expanse of arid regions.[132] Even without changes in the overall quantity of precipitation, rain replacing snow will cause shortages in the summer water supply.

11.3 Assessing Drought Vulnerability

11.3.1 Overview

Western Washington and Redmond's economy are vulnerable to droughts. Reduced water supply will have an impact on the systems and people that require water. Reduced stream flows will impact wildlife and hydroelectric power. Landscapes, natural habitats, vegetation, and area parks and trails will be vulnerable.[133]

11.3.2 Profiling the Vulnerability

A. Man-made
Droughts have no significant impact on man-made structures. Lawns, gardens, and other human-manipulated landscapes and vegetation such as golf courses are vulnerable to droughts.

B. Natural
Drought may reduce stream flows, which will impact aquatic life and ecosystems that are dependent on the stream. Low stream flows will increase water temperatures affecting the migration and reproduction habits of salmon and trout.[134] A drought may also lead to insufficient recharge of aquifers, creating water shortages. Decreased precipitation will increase the likelihood of wildfires, as dry trees and brush have an increased risk of burning.

C. Systems
Reduction of available water in reservoirs intensifies the debate over water allocation among agricultural irrigators, municipal water authorities, environmental agencies, and industrial users. Additionally, water quanitity affects the availability and cost of electricity since Puget Sound is heavily reliant on hydroelectric power plants. The water supply and energy supply are vulnerable to a drought.

Drought will impact all populations in Redmond. Specific businesses that require larger portions of water to run their business (carwashes, golf courses, etc.) will be especially vulnerable if they do not have mitigation strategies in place to withstand the

132 International Panel on Climate Change and University of Washington Climate Impact Group, "Climate Change Scenarios," University of Washington, http://cses.washington.edu/cig/fpt/ccscenarios.shtml.
133 Seattle City Light, "Water Conditions: Rainfall and Snowpack," City of Seattle, http://www.seattle.gov/light/ctracks.html.
134 Washington Department of Fish and Wildlife, "Drought Planning," http://www.wdfw.wa.gov/drought/.

shortage. Additionally, increased electricity charges could place economic hardships on small businesses, and businesses that consume larger amounts of energy.

D. Population

Droughts will impact the entire region. Unless water restrictions are not sufficient to ration enough potable water to meet basic necessities, no specific populations will experience heightened vulnerability. However, the resulting increased electricity and water rates may be and economic hardship for limited income residents.

11.3.3 Analyzing Development Trends

The City of Redmond water system currently serves a residential population of approximately 51,530 and a business community with an estimated 85,775 employees.[135] Redmond does not have additional water supplies and their water service area is fixed. Future growth in the area will be limited to the water sources and sewer infrastructure currently available. Without conservation efforts, increased population in the area will strain water and sewer resources.

135 City of Redmond, "About Redmond," City of Redmond, http://www.redmond.gov/aboutredmond/general2.asp.