

# 2015 Summary Drought Conditions for Thurston County, Washington

## 1 DISCUSSION AND OVERVIEW

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It may surprise people to look at the current precipitation amounts and conclude that we are indeed in a drought. If you look solely at those precipitation numbers for 2015 you would not suspect that Thurston County was suffering from an acute drought. That is because a drought is not caused by lack of precipitation alone. It involves a much more complex set of climate conditions that, together, create the parched conditions from the mountains to the sea and from the land surface to the underground aquifers. These conditions also must persist over several months or seasons. The sections below provide some facts that explain why we are currently in a declared drought in Thurston County and Washington State.

In general, droughts are very complex and caused by a number of factors such as the following:

- Lack of rainfall *or* lack of the *normal pattern* of rainfall as is the case for Thurston County
- Only 3.8 inches of rain since April 1, 2015
- Below average rainfall in winter “capture and store” months
- No large “Pineapple Express” storms since January 2009. Before 2009 there was at least one every year, and usually two per winter.
- Low winter snow pack in higher elevations. Only 10 to 21 percent of normal snowpack fell in the winter of 2014 – 2015.
- Low atmospheric humidity (<20 percent) in spring and summer leading to excessive water loss by plants and leaf damage to sunburn
- Sustained high temperatures in summer *and* in winter see chart below
- Low soil moisture stressing roots and exacerbating low humidity

If we look at the past 5 years, we see that our rainfall pattern has been drying in the winter months beginning in 2011. As seen in the table below, monthly rainfall in the winter has changed dramatically over the past five years. If you only look at the annual rainfall numbers you can see that there is no consistency in the pattern of above or below average over the past five years. So this alone is not a good measure of drought. What is the key that is causing droughts in our region is the change in precipitation in winter months. They have been getting drier and warmer. The table below shows the lack of winter precipitation and this is very much a factor in Thurston County’s current drought. Prior to 2011 the wet winter months were actually wet and cold. They included large storms or periods of very wet weather that recharged the shallow and intermediate aquifers and heavy mountain snows replenished the snow pack. There was only one period of normal snowfall in the Cascades in November 2014. After that period there was only sporadic snowfall followed by very high freezing levels above 8000 feet with precipitation falling mainly in the form of rain.

Month	63 year Average	2015/ $\Delta$	2014/ $\Delta$	2013/ $\Delta$	2012/ $\Delta$	2011/ $\Delta$
January	8.40	3.83/ -4.57	5.31/ -3.09	4.01/ -4.39	7.64/-0.76	6.83/-2.02
February	5.80	5.55/ -0.25	9.16/ +3.36	4.31/ -1.49	5.25/ -0.55	5.40/-0.40
March	4.85	5.95/ +1.10	10.46/ +5.61	4.38/ -0.47	8.76/ +3.91	8.82/+3.97
April	3.11	1.82/ -1.29	4.95/ +1.84	5.03/ +1.92	4.83/ +1.72	5.06/+1.95
May	1.83	0.63/ -1.20	3.71/ +1.88	3.03/ +1.20	2.56/ +0.72	4.06/+2.23
June	1.42	0.15/ -1.27	1.26/ -0.16	2.08/ + 0.66	1.89/ +0.47	0.17/-1.25
July	0.77	0.09/ -0.68	0.37/ -0.40	0.00/ -0.77	0.99/ +0.22	1.57/+0.80
August	1.31	1.10/ -0.21	2.20/ -0.89	1.28/ +0.03	0.05/ -1.26	0.21/-1.10
September	2.35	0.9/ NA	2.54/ -0.19	9.68/ +7.33	0.00/ -2.35	1.82/-0.53
October	4.60	---	7.26/ +2.66	1.76/ -2.48	7.88/+3.28	4.17/-0.43
November	8.83	---	6.43/ -2.40	4.10/ -4.73	9.56/+0.73	7.45/-1.38
December	8.55	---	6.64/ -1.91	1.26/ -7.29	10.84/+2.29	4.59/-3.96
<b>Total</b>	<b>51.8</b>		<b>60.3/ +8.5</b>	<b>40.9/-10.9</b>	<b>60.2/+8.4</b>	<b>50.2/-1.6</b>

Colored numbers are the change or departure from average. Blue = inches above average/ Red = inches below average

## 1.1 TEMPERATURE/HUMIDITY

2015 was the warmest year on record for much of the northern hemisphere including western Washington. The second warmest year was 2014. For Western Washington, the high temperature and the low humidity plays a very important role in this current drought because our region, with its forests and abundant vegetation, requires abundant soil and air moisture to maintain a healthy foliage. When high temperatures and low humidity reach a critical point the evapotranspiration rate becomes higher than the uptake of increasingly diminished soil moisture. If plants cannot maintain leaf moisture they become susceptible to solar radiation burn and cell death. Below are some numbers to contemplate.

- From April through early September 2015, there were 21 days with temperatures above 90 degrees. Five days were at or above 100 degrees locally. Typically we have 10 days at or above 90 degrees.
- 34 Days were above 80 degrees and the vast majority of the rest of this time was in the mid to upper 70s.
- Record temperature in January 26, 2015 of 66 degrees. Also 66 in February and 74 degrees March 26, 2015.
- Only 7 days since January 1, 2015 below 32 degrees. If you had a poor apple crop this year that is why. They require a lot more cold weather to produce good yields.
- Evapotranspiration (ET) measures the amount of water lost from the hydrologic cycle to evaporation from plants and atmospheric conditions. The typical ET loss up to this date is 18 inches. Evapotranspiration loss in 2015 is 24 inches up through September 1, 2015.
- Soil moisture is 75 percent below normal in the upper two feet of earth

- Record low relative humidity of 8 percent on numerous occasions in July and August
- 2015 was the worst wildfire season on record. 2014 was the second worst.

This is what is causing the wildfires to burn out of control and to spread so fast. There is very little available water in the vegetation to slow the spread of fire. The lack of humidity also allows the fires to ignite surrounding vegetation easier and burn hotter.

## 1.2 GROUNDWATER

Groundwater levels for the winter of 2014 and for 2015 are actually at or near normal levels in the basins that are routinely monitored by Thurston County. There was a slight increasing trend in the groundwater over the past five years. The consecutive dry and warm winters will likely cause groundwater levels to drop some but nowhere near record low levels seen in 2000 and 2001.

Groundwater is a result of several years of many different complex hydrologic cycles interacting with surface and subsurface waters. For this reason, the effects of any one of these systems may not cause an immediate decline in groundwater overall. The typical groundwater cycle for Thurston County's aquifers is:

- One (1) year lag for the upper shallow (less than fifty feet) aquifers such as Salmon Creek Basin;
- Three (3) to five (5) years for areas where the groundwater static depth is below fifty feet such as in the Scatter Creek Aquifer
- Tens to hundreds (possibly even thousands) of years for the deep, massive groundwater aquifers such as the McAllister deep wellfield and the artesian well sources.
- Prolonged droughts lasting multiple seasons or years will affect all aquifers at some point because the withdrawal/use rate will exceed the recharge rate.
- Effects of drought are usually not seen in groundwater in the same season it occurs. It will be identified in the future as the lag times listed above approach.

Areas where groundwater is immediately affected by surface waters is where it is in direct hydraulic connectivity with a surface water source such as a river, wetland or lake. These systems can be dramatically affected within one season in response to their source supply. Examples of these types of aquifers occur along almost every river system in the County. Even if the main aquifer is not regulated by a river or surface source some components of it can be because they are so intimately connected.

The most striking example of this type of relationship occurs in the Scatter Creek Aquifer. This aquifer is unique in many ways but it is also dependent on input from the Chehalis River. It is only in the last couple miles where it interacts hydraulically with the Chehalis River. The majority of the aquifer does not directly interact with the river but where it does near Grand Mound the water levels can fluctuate in lockstep with the Chehalis. This occurs in droughts and floods affecting groundwater as the river rises or falls.

During this recent drought only the shallow and intermediate aquifers are showing a response currently. The ones that are showing dramatically lower water levels are the aquifers in connection with major river systems as discussed in the next section.

### 1.3 STREAMFLOWS

Although hydraulically we are not having record low rainfall, some rivers and streams in our area are at record lows. This is affecting not only Thurston County but the entire western U.S. California is by far the most affected but in 2014 Washington and Oregon were added to the drought concern list. In 2015 Washington State was placed well within a severe drought declaration. Below are some astonishing numbers that illustrate the lack of surface water available for drinking water, power generation, irrigation and fish flows. Many of Western Washington’s largest rivers recorded their lowest levels in history in 2015.

There is only one river in Thurston County with its source high in the Cascade Mountains. The Nisqually River with headwaters originating from Mt Rainier is directly affected by snowmelt from the higher elevation snowfields and glaciers. Two other rivers, the Deschutes River and the Chehalis River, also have their sources in the Cascades but at lower elevations that are modestly affected by snowmelt. Chehalis River with sources from Cascade foothills and the Willapa Hills. Another main tributary to the Chehalis is the Skookumchuck River which is regulated by the Skookumchuck Dam. All of these rivers are closely tied to shallow aquifers in their lower reaches that are very much influenced by the amount of water these rivers carry as discussed in the groundwater section 1.2.

All other streams in Thurston County come from low hills, wetlands, groundwater or short semi-urbanized sources. Below is a table showing current and average streamflows from some of our rivers and streams around Thurston County as of August 31, 2015.

River System	Source	Sept 2015 Flow *(cfs)	Average Flow for Sept (cfs)	Comment
<sup>1</sup> Nisqually River above Dam	Mt. Rainier	760	815	Slightly below normal
<sup>1</sup> Nisqually River Below Dam	Below Alder Lake	209	400	Below Normal
<sup>1</sup> Chehalis River @ Grand Mound	Cascade foothills /Skookumchuck Res/Willapa Hills	201	280	Below Normal
<sup>1</sup> Deschutes River @Rainier	Cascade foothills	22	35	<i>Much</i> below Normal
Black River @128 <sup>th</sup> Ave SE	Black Hills /Salmon Creek Basin	28	37	Below Normal
<sup>1</sup> Skookumchuck River @Bucoda	Cascade foothills	16	22	<i>Much</i> Below Normal

<sup>2</sup> McLane Creek @ Delphi Rd	Black Hills	1.8	3.8	Below Normal
<sup>2</sup> Green Cove Creek @36 <sup>th</sup> Ave NW	West Olympia wetlands	<0.1	>1.5	Lowest recorded
<sup>2</sup> Woodland Creek @Pleasant Glade Rd	Lake system -Lacey	11	14	Below Normal
<sup>2</sup> Percival Creek @ SPSCC	Surface and groundwater	1.8	<3	Below Normal
<sup>2</sup> Scatter Creek @ Rochester	Scatter Creek Aquifer/ Chehalis River	<dry	0.5	Below normal

\*Cfs (cubic feet per second)

<sup>1</sup>Indicates Data provided by USGS gauging network

<sup>2</sup>Data provided by Thurston County Water Resources- Environmental Monitoring Program

The data indicates that Thurston County's larger streams and rivers are adversely impacted by this current drought as of September 1, 2015.

- The Deschutes River and the Skookumchuck Rivers are Much Below Normal
- The Nisqually River and the Chehalis River are also well below normal; the lower reaches are controlled by dams and are manipulated for hydro power and fish flows.
- All creeks measured by Thurston County are below average for this time of year. Green Cove Creek is the lowest recorded level with almost no surface flow.
- In late August, many Western Washington Rivers flowing from the Cascades and the Olympics were at the lowest levels in recorded history because they are directly fed by mountain snowpack.

## 2 SUMMARY

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With Thurston County and Western Washington in a declared severe drought you may think that precipitation levels are to blame. Surprisingly, for Thurston County this is not necessarily the case. Although we are currently behind the average (52 inches) by about 8 inches so far, this is actually not that unusual. 2014 we were above average by almost 10 inches which is also not rare. So droughts are not caused solely by the lack of rain. It is important when this rain is delivered. Winter rains are essential to keeping us green and well-watered and over the past several years our wettest months (November, December and January) have been consistently well below average for rainfall (see above table). This is critical to recharging our streams and wetlands and storing water in the soil. The distribution of rainfall in the fall and spring causes the rain water to be diverted into plant growth and not into recharging our rivers and streams and wetlands so there is not much left by the time our hotter and drier summers arrive.

2015 has been the hottest year on record for Thurston County and most of the Northern hemisphere. For our region 2015 has also been the warmest on record for both winter and summer temperatures. Our winters have been drying out for the past five years with winter precipitation being about fifty percent below average and temperatures being several degrees above average. 2015 was preceded by the second warmest year on record, 2014, and one of the driest summers on record.

The temperature and the lack of winter precipitation have led to low humidity and low soil moisture but the record heat in the spring and summer of 2015 has been the major factor contributing to this current drought. There were almost two dozen days above 90 degrees this summer. In addition, the winter of 2014 -2015 saw 9 days above 60 degrees in February and March not just at the lower elevations but in the mountain passes as well. Although Thurston County has not felt the full effect of lack of mountain snow we have had our share of hot and dry weather. All of our local streams are below normal summer flows.

Air and soil moisture were at record low levels in July and August 2015 and combined with high UV and above average temperatures, it is estimated that one in twenty trees has been damaged or killed by the summer weather extremes in Western Washington. These very dry and hot conditions all around our region are responsible for the largest and most damaging fire season in state history. 2014 was surpassed by 2015 as the worst on record with well over one hundred square miles of forest and shrub lands involved in wildfires. The majority of the fires were east of the Cascades where drought conditions are categorized as Extreme.

As long as the drier warmer winters persist in our region we will be facing the continued threat of droughts. Although Thurston County is not directly reliant on mountain snows for our drinking water supplies it still affects us economically and recreationally. As long as the summer temperatures persistently soar and the humidity drops to record low levels we will continue to see record low river levels and record high fire danger for our region. If the massive and complex computer models are correct, we will continue to see warming into the foreseeable future. Once the climate becomes unstable there is no clear path to plan for in the future.