2 – Hydrology

Overview

This section summarizes hydrologic conditions of the lower Tualatin River watershed within the limits of the SWMACC District illustrated in **Figure 3**. In order to evaluate stressors and responses throughout the SWMACC District watersheds, the reviewers summarized hydrologic conditions in the watershed, the extent of flooding, and the future risks to stream channels as the watershed continues to develop.

Data Reviewed

This analysis consisted of evaluating existing data, reports, and modeling results. Key data sources are listed below:

- FEMA Flood Insurance Maps and Modeling
- Metro RLIS GIS Data – Watersheds, streams, roads
- Washington County Soil and Water Conservation District - Lower Tualatin Watershed Analysis
- Pacific Water Resources – Hydrologic Modeling for Watersheds 2000 Project for Clean Water Services
- Clean Water Services Watersheds 2000 GIS data – Nodes and sections
- USGS Gage 14207500 Tualatin River at West Linn, Oregon

Watershed Conditions

The Tualatin River watershed drains 712 square miles on the eastern side of the coast range (USGS 2010). The SWMACC District is located in the lower Tualatin River watershed which consists of ranges of hills separated by the Tualatin Plain. The Portland hills are the northern boundary while the Chehalem Mountains and Parrett Mountain form the southwestern boundary and Bull Mountain and Cooper Mountain form the northwestern boundary.

The Tualatin River watershed has a moderate climate; summers are warm and generally dry, while winters are cool and wet. Temperatures are moderated by the moist climate. Weather is often cloudy, but precipitation is generally concentrated in the winter months. Roughly 67 percent of precipitation occurs between November and March. This precipitation comes mainly in the form of rain. Minor amounts of snow fall during the winter, however snowfall is not a major source of precipitation. Annual precipitation ranges from 39 to 55 inches (Hawksworth 2001). **Table 1-1** lists the Tualatin River subwatersheds and streams within the SWMACC District. Watershed areas marked “Undefined” in **Table 1-1** are not available.

Intermittent Drainages 1 and 2 originate at storm sewer outfalls. The size and configuration of the areas draining to these outfalls are unknown. It is also possible that portions of the intermittent drainages are piped and ditched but this is also unknown.

Table 1-1. Subwatersheds and streams that are within the SWMACC District.

Subwatershed	Stream	Drainage Area (sq mi)	Percent in District
Tualatin	Tualatin River	712*	2%
Fields	Fields Creek	0.65	100%
Tualatin	Unnamed Tributary 1	Undefined	100%
	Unnamed Tributary 2	Undefined	100%
	Unnamed Tributary 3	Undefined	100%
Athey	Athey Creek	0.78	100%
Saum	Saum Creek	4.6	45%
Fanno	Fanno Creek	15.1	1.5%
	Ball Creek	1.9	2%
Tualatin	Intermittent Drainage 1	Undefined	--
	Oswego Canal	Undefined	--
	Unnamed Tributary 4	Undefined	--
Pecan	Pecan Creek	0.73	65%
Shipley	Shipley Creek	0.19	100%
Wilson	Wilson Creek	2.0	100%
Tualatin	Unnamed Tributary 5	Undefined	100%
	Unnamed Tributary 6	Undefined	100%
Tate	Tate Creek	Undefined	--
South Rock	South Rock Creek	6.2	30%
	Intermittent Drainage 2	Undefined	--

* The Tualatin River watershed area includes all tributary subwatershed areas.

Ten of the watersheds listed above are completely within the SWMACC District: Fields Creek, all Unnamed Tributaries except 4, Shipley Creek, and Wilson Creek. Based on visual observation ,Intermittent Drainages 1 and 2 may be completely within the SWMACC District as well. The County would have more opportunities to make improvements in these watersheds as they are completely within the SWMACC District.

The Oswego Canal was built in 1872 by the Lake Oswego Corporation to divert water from the Tualatin River to Lake Oswego. The amount of water diverted is regulated by an electronically controlled head gate (LOC 2010). The Canal drains a small portion of the Rivergrove area; however, since the Canal diverts water from the Tualatin River out of the District it may not be a priority for the County.

Flow Regulation

Flow in the main stem Tualatin River is affected by two dams: 1) The Scoggins Dam which is located on Scoggins Creek in the upper Tualatin River watershed, and 2) The Lake Oswego Diversion Dam which is located at River Mile (RM) 3.45 just upstream of the confluence with Unnamed Tributary 1.

The Scoggins Dam was built in 1975 and has a storage capacity of 59,910 acre-feet. Most of the water in the reservoir is used for irrigation; however, approximately 12,900 acre-feet of the stored water is allocated for summertime flow augmentation. River discharge is managed in an attempt to maintain 150 cubic feet per second (cfs) at RM 33.3 (Farmington Road) in the upper watershed (Rounds 2010). From water years 1929 to 1974 the USGS gage at West Linn (14207500) received 84 percent of the annual Tualatin River discharge during the rainy season from November to March (Hawksworth 2001). Historic summer flows are low. The minimum recorded daily flow over this period was 0.2 cfs in August of 1966. After the dam was completed in 1975, the discharge in January was reduced by 500 cfs and the summer (June to September) low flows were increased by more than 100 cfs (Hawksworth 2001).

The Lake Oswego Diversion Dam was initially built in 1872 when the Oswego Canal was dug between the Tualatin River and Oswego Lake (LOC 2010). The diversion dam is a permanent structure owned by the Lake Oswego Corporation which has a 57.5 cfs surface water right. The Diversion Dam causes the river to backwater upstream approximately 3.2 river miles to the location of the Oswego Canal (RM 6.7). An electronically controlled head gate regulates the amount of water allowed in the Oswego Canal (LOC 2010). Between May and October, water is diverted from the Tualatin River to Lake Oswego via the Oswego Canal. Although diversions have been greater in the past, they currently do not exceed 20 cfs (Hawksworth 2001).

Several of the tributaries within the SWMACC District have in-line storage reservoirs, likely used for agricultural purposes:

- A reservoir on Athey Creek is located in the lower watershed just upstream of its confluence with the Tualatin River.
- Several in-line storage ponds are located in the upper watershed of Saum Creek outside of the SWMACC District.
- A reservoir on South Rock Creek is located in the upper watershed within the SWMACC District.
- A reservoir is located on Wilson Creek in the northern upper watershed.

The specific water rights, uses, storage volumes, and flows associated with these reservoirs are unknown. Since the reservoirs in Saum, Wilson, and South Rock Creek are in the upper watersheds, they may reduce flows in the lower watersheds depending on how they are managed.

Water rights within the Tualatin River watershed are reportedly over allocated. This condition is further discussed below in the Surface Water Rights section.

Hydrology and Hydraulics

The lower main stem of the Tualatin River has been continuously gaged since 1929 and a large amount of flow data is available. However, the rest of the streams within the SWMACC District are not gaged and have limited flow data.

The hydrology for the Tualatin River was recently analyzed for a FEMA Flood Insurance Study (FIS) published in 2008. The FIS flood maps identify the anticipated flooding areas associated with the 100-year recurrence interval storm event. The 100-year storm event is an event that has a 1-percent chance of occurring in any given year. The study used USGS flow gages at the mouth of the Tualatin River and on the Oswego Canal which have been recording flows since 1928. The recurrence interval event flows for the Tualatin River were determined based on flood frequency analysis of historic gaged annual peak flows after accounting for the effect of the upstream regulation at the Scoggins Dam. Flow losses observed at the Tualatin River Overflow at the Oswego Canal were considered at downstream locations along the Tualatin River (FEMA 2008).

Hydrologic information for Tualatin River subwatersheds was available from 2001 HEC-HMS modeling for Clean Water Services. The data was available in GIS format in both nodes at tributary outlets and cross sections along the channel. Discrepancies were found between the data sources, the reviewers generally found the node data to be more conservative which was preferred over the cross section data.

Table 2-2 lists the recurrence interval flows for the Tualatin River and the subwatersheds modeled within the SWMACC District. The FEMA FIS evaluated the hydrology at two locations: 1) At Bryant Road on Lake Oswego (LO), and 2) At the inlet on the Tualatin River (TR). The reviewers were unable to find hydrology information for Unnamed Tributaries 1 thru 6, Athey Creek, Pecan Creek, Shipley Creek, Wilson Creek, Tate Creek, and Intermittent Stream 1 and 2.

Table 2-2. Reported hydrology for Subwatersheds that are within the SWMACC District.

Stream	Recurrence Interval Event Flow (cfs)						
	2-year	5-year	10-year	25-year	50-year	100-year	500-year
Tualatin River*	8,200	12,500	15,750	20,545	24,200	27,900	36,000
Saum Creek**	430	-	780	960	1,080	1,200	1,500
Fanno Creek**	1,440	1,850	2,110	2,450	2,690	2,940	3,560
Oswego Canal (at LO)*	-	-	250	-	2,700	5,700	12,500
Oswego Canal (at TR)*	-	-	250	-	1,600	2,800	6,200
South Rock Creek**	370	480	550	640	700	760	930
Ball Creek**	250	330	370	420	460	500	590

* Source: 2008 FEMA FIS
** Source: Clean Water Services Watersheds 2000 Node data

The hydrologic and hydraulic modeling used to determine these recurrence interval flows is based on site-specific information and was prepared relatively recently. However there are some limitations associated with this information:

- These recurrence interval flows do not take into account the increased impervious services from recent development over the last 10 years which are likely to increase the recurrence interval flows.
- These recurrence interval flows are for the entire stream watersheds, some of which are not completely within the SWMACC District.
- The tributary flow analysis was conducted with limited calibration data due to the limited hydrologic information known about these tributaries.

100-Year Floodplain

Engineers recently mapped the 100-year floodplain in a FEMA Flood Insurance Study published in 2008. During this study the lower Tualatin River 100-year floodplain was mapped from its confluence with the Willamette River to approximately 850 feet downstream of RM 8, at the Clackamas-Washington County line. A HEC-RAS model of the Lower Tualatin River was developed to define the 100-year floodplain boundary. **Figure 3** shows the extent of the predicted 100-year flood event. Key conclusions and data available from this analysis are summarized below.

- The downstream 1,200 feet of the Tualatin River experience backwater flood effects from the Willamette River during the 100-year recurrence interval event.
- The Oswego Diversion Dam raises the water surface elevation of the 10-year event flow by approximately 4 feet and at the 100-year event by approximately 2 feet. About 4000 feet further upstream the I-205 bridges also causes an upstream backwater effect – raising the 100-

year water surface elevation by approximately one foot. These bridges do not affect the water surface elevation of the 10-year event.

- Flooding in the Tualatin River caused by the 100-year event is estimated to extend across mainly agricultural areas of the floodplain. Flooding extends only slightly into the West Linn city limits. Several houses in the southern Rivergrove city limits are in the 100-year floodplain.
- The 100-year floodplain was mapped at the following tributaries confluences with Tualatin River: Shipley Creek, Pecan Creek, Athey Creek, Unnamed Tributaries 3, 4 and 5, Saum Creek, and Wilson Creek. It was not clear to the reviewers if these confluence areas are mapped based on elevations along the Tualatin River or if they take into account backwatering of the tributaries.

The existing 100-year floodplain analysis does not include a review of future conditions due to increased peak discharges. Additional HEC-RAS modeling of future conditions could be run to evaluate changes to the 100-year floodplain footprint.

Surface Water Rights

Prior to the construction of the Scoggins Dam, the lowest recorded stream flow on the Tualatin River was 0.2 cfs. This low flow may have been due to over allocation of surface water resources during summer months. **Table 2-4** lists the number of reported water rights and their uses for the Lower Tualatin River Watershed as of 2001.

Table 2-4. Lower Tualatin River Water Rights by use (Hawksworth 2001)

USE	Number of Water Rights	Average Right (cfs)	Cumulative Rights (cfs)	Percent of total Rights
Agriculture	2	0.890	1.78	1.48%
Aesthetic	2	0.010	0.02	0.02%
Domestic	5	0.750	0.31	0.26%
Domestic/Stock	1	0.010	0.01	0.01%
Fish	5	0.278	1.36	1.13%
Fire Protection	4	0.020	0.08	0.07%
Irrigation and Domestic	1	1.400	1.40	1.16%
Irrigation and Stock	1	0.005	0.01	0.00%
Industrial/Manufacturing	3	1.019	3.06	2.54%
Irrigation	233	0.212	49.57	38.50%
Supplemental Irrigation	6	0.254	1.52	1.26%
Livestock	5	0.033	0.17	0.14%
Power *	1	57.500	57.50	47.75%
Recreation	3	1.130	3.39	2.81%
Wildlife	2	0.035	0.07	0.06%
TOTAL	274		120.43	100.00%

* The Lake Oswego corporation no longer diverts water for this water right during the summer.

The largest water right use is for power. There is only one right under this use and it is owned by the Lake Oswego Corporation (LOC), the LOC no longer diverts water for this water right during the summer. The second largest water right is for irrigation with 232 rights under this use and a cumulative 46.36 cfs allocated. The irrigation water rights are mainly used during the summer months when flow on the lower Tualatin River is low.

The cumulative lower Tualatin River water rights equal approximately 120 cfs. However, this amount does not include all the water rights in the upper Tualatin River watershed. For example, the Tualatin Valley Irrigation District (TVID) jointly operates the Springhill Pumping Plant (RM 56.1) with the City of Hillsboro. The plant supplies municipal water to several of the member cities and the TVID operates a pressure pipeline that delivers irrigation water to about 10,000 acres of cropland. The TVID alone typically draws between 25 and 125 cfs of water from the river during the summer months, depending on irrigation needs.

The monthly mean Tualatin River flow, over the period of record from 1928 to 2009, at the USGS gage (14207500) near the river mouth is listed in **Table 2-5**. Note the low monthly mean flows in June through October (bold in **Table 2-5**). Prior to flow augmentation from the Scoggins Dam in 1975, the average monthly mean for July and August were 70 cfs and 21 cfs respectively.

Table 2-5: Tualatin River monthly mean flows at USGS Gage 14207500 (1929 to 2009).

Months	Monthly Mean Discharge (cfs)
January	3,910
February	3,630
March	2,710
April	1,590
May	690
June	**297**
July	**124**
August	**87**
September	**115**
October	**214**
November	1,120
December	3,110

Data Gaps

The following are data gaps or deficiencies in existing information that limits our understanding of hydrology within the SWMACC District:

- Flow data is lacking for the Tualatin River tributaries within the SWMACC District. Watershed boundaries will need to be delineated for unnamed tributaries 1 through 7 and the Oswego canal if hydrology analysis is to be performed.
- Watershed areas within the boundaries of the SWMACC District need to be delineated for South Rock Creek, Ball Creek, Fanno Creek, Lake Oswego Canal, Saum Creek, and Pecan Creek.
- A hydrologic analysis will need to be conducted for: Unnamed Tributaries 1 thru 6, Athey Creek, Pecan Creek, Shipley Creek, Wilson Creek, Tate Creek, and intermittent streams 1 and 2.
- Tributary recurrence interval flow data from Watersheds 2000 does not account for impervious surfaces caused by development over the last 10 years.
- The existing 100-year floodplain analysis does not include a review of future conditions due to increased peak discharges. Additional HEC-RAS modeling of future conditions could be run to evaluate changes to the 100-year floodplain footprint.

- In-line storage reservoirs exist in Athey Creek, Saum Creek, S. Rock Creek and Wilson Creek. The affect of these reservoirs on the flow in these tributaries is unknown and would need to be determined.
- A flashiness index analysis would help the County evaluate how stable the tributaries within the District are.

The Oregon Department of Water Resources (ODWR) provides an auto-delineation tool that could be used to delineate the undefined watersheds within the SWMACC District for the next phase of the watershed action plan. Watershed boundaries will need to be delineated for all subwatersheds to perform hydrologic analysis.

Recurrence interval flow data for the remainder of the tributaries could be determined using the ODWR autodelination and discharge program. This tool was tested on South Rock Creek. The area of the watershed within the SWMACC District was determined to be 2.1 square miles or 34 percent of the 6.2 square mile watershed. The recurrence interval flows determined for the area of South Rock Creek within the SWMACC District are listed in Table 3.

Table 2-3. South Rock Creek modeled recurrence interval flows

Stream	Source	Recurrence Interval Event Flow (cfs)						
		2yr	5 yr	10 yr	25 yr	50 yr	100 yr	500 yr
South Rock Creek (6.2 sq mi)	Watersheds 2000	370	480	550	640	700	760	930
SWMACC South Rock Creek (2.1 sq mi)	ODWR Tool	60	100	120	150	170	190	240
Percent of Total Watershed Flow:		16	21	22	23	24	25	26

Based on comparing the percent area (34%) to percent flow, this tool appears to provide a reasonable planning level estimate of recurrence interval flows for South Rock Creek and could be used to evaluate the rest of the tributaries at the next phase of the watershed action plan.

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