Tualatin Subbasin TMDL

Chapter 3

Amendment to 2001 Waste Load Allocations for Ammonia Under 2001 Dissolved Oxygen TMDL for the Tualatin Basin

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3.1 Purpose of Ammonia TMDL Amendment

The main purpose of this amendment is to provide waste load allocations (WLA) for ammonia for the new summer discharges at the Forest Grove and Hillsboro Waste Water Treatment Facilities (WWTF) in the Tualatin Basin. This amendment is not altering the quantity of ammonia load delivered to the Tualatin River as described in the 2001 TMDL. This amendment is only changing the discharge locations where portions of that load may be delivered to the Tualatin River. Another purpose of this revision is to clarify that DEQ allows sources to use pollutant trading to meet their load and waste load allocations. Details about trading are included in Section 4.4 of the Water Quality Management Plan that accompanies this TMDL revision, as well as in DEQ's internal management directive regarding trading (DEQ, 2009).

The 2001 TMDL provides waste load allocations for ammonia for the Rock Creek and Durham Advanced Waste Water Treatment Facilities (AWWTF). The Forest Grove and Hillsboro Waste Water Treatment Facilities (WWTF) were not provided with allocations because they have historically not discharged during summer, the critical period for dissolved oxygen concentrations in the lower Tualatin River. The Watershed Permit included National Pollution Discharge Elimination System (NPDES) permits for all four Clean Water Services Waste Water Treatment Facilities as well as the Municipal Separate Storm Sewer System (MS4) Permit. Future permit renewals will also be watershed permits, covering all of these discharges in a single permit. The 2005 Watershed Permit included the 2001 ammonia WLA both in the form of a bubble allocation that allowed trading among the two treatment plants that discharged during summer as well as individual load limits for each discharge location.

This TMDL amendment will include a modification to the bubble allocation included in the 2005 permit by allowing the transfer of some of the ammonia load to the Forest Grove and Hillsboro WWTFs and thus accommodating summer discharge at these locations, but maintaining the same limits on the quantity of ammonia delivered the lower river where dissolved oxygen problems have historically occurred.

This amendment is organized into four sections: this Introduction (3.1); a Background Section (3.2) that briefly summarizes the existing TMDL, the pollutants that affect dissolved oxygen, and the bubble allocation included in the 2005 Watershed Permit; the Rationale for the Ammonia Amendment (3.3); and a Conclusion that shows the specific changes to the 2001 TMDL (3.4). Appendix (3-A,) will include the original TMDL allocations.

3.2 Background

This section summarizes the main features of the 2001 TMDL for Dissolved Oxygen in the Tualatin Basin, as it pertains to the waste load allocations for ammonia that target dissolved oxygen concentrations in the lower Tualatin River. All four of the Clean Water Services WWTF discharge to the mainstem Tualatin River. Water quality impairments of dissolved oxygen have historically occurred only in the lower mainstem Tualatin River. This amendment will focus discussion on the elements of the 2001 TMDL that affect waste load allocations and dissolved oxygen in the lower Tualatin River. The dissolved oxygen water quality criteria are described, and there is a brief summary of the Dissolved Oxygen TMDL history, followed by a description of the major findings from the water quality modeling work. The section concludes by describing how the 2001 TMDL waste load allocations for ammonia were included in the Clean Water Services 2005 National Pollution Discharge Elimination System Permit, also known as the Watershed Permit.

The dissolved oxygen criteria applicable in the mainstem Tualatin River during the summertime critical period is the cool water criterion of a minimum of 6.5 mg/L, as set out in Oregon Administrative Rule 340-

041-0016(1)(c). Oregon rule also allows lower dissolved oxygen levels if intensive monitoring is conducted, and the following criteria are met concurrently; a 30 day mean of 6.5 mg/L, a 7 day minimum mean of 5.0 mg/L and an absolute minimum 4.0 mg/L. These criteria remain unchanged from the targets of the 2001 TMDL, although the rule citation was changed in 2005.

Several Tualatin Basin tributaries are included on Oregon's list of impaired waters, but the mainstem Tualatin River is not. A TMDL to address dissolved oxygen impairment in Tualatin Basin (river miles 3.4 to 39) was completed in 1988. Oregon completed its' first list of impaired waters, known as the 303(d) list from the applicable section of the federal Clean Water Act, in 1998. The lower Tualatin River was not included on the 303(d) list for dissolved oxygen impairment because an approved TMDL was already in place. The 1988 TMDL for dissolved oxygen was revised in 2001 based on improved water quality models of the Tualatin River. The 2001 TMDL for Dissolved Oxygen in the Tualatin Basin is being amended by this chapter, not replaced, so the 2001 TMDL is still in effect. The 2001 TMDL provided load allocations for both settleable volatile solids and ammonia, and waste load allocations for ammonia for the Clean Water Services Waste Water Treatment Facilities at Rock Creek and Durham. These load and waste allocations must remain in place to ensure that water quality is not impaired.

Water Quality models for the 2001 TMDL ranked the contributions of oxygen demanding pollutants in the mainstem Tualatin River in order of decreasing impact: sediment oxygen demand (SOD), carbonaceous oxygen demand (CBOD), algal respiration, zooplankton respiration, and nitrogenous biological oxygen demand (NBOD; ammonia as a key contributor). Discharge permits for waste water treatment plants include discharge limits for both CBOD and ammonia. The 2001 TMDL included waste load allocations for ammonia (NBOD) for the Clean Water Services Waste Water Treatment Facilities, but did not include allocations for CBOD. The waste load allocations for ammonia became the basis for discharge limits in the Watershed NPDES permit issued to Clean Water Services in 2005. These ammonia allocations were based on limiting the in-river ammonia concentration in the lower Tualatin River at the Oswego Dam site, at River Mile 3.4. In-river ammonia loads were calculated based on river flow, upstream dissolved oxygen concentration, and month of the year. Limits for discharges from waste-water treatment plants were computed after accounting for upstream ammonia sources, ammonia decay between the discharge site and the Oswego Dam site, and a 5% margin of safety factor. The resulting load, in pounds per day, was used to set ammonia limits in the subsequent NPDES discharge permit for the two wastewater treatment plants that discharge during summer. These loads change during the TMDL season, depending on Tualatin River flow and dissolved oxygen concentrations. The most restrictive allocations are set during early fall when both river flow and dissolved oxygen are low.

The TMDL allocations were adopted in the subsequent NPDES permit for Clean Water Services. At the time of its' issuance, the 2005 NPDES Watershed Permit for Clean Water Services was an innovative permit because it was designed to meet the permit requirements for four municipal treatment plants as well as the Municipal Separate Storm Sewer System (MS4) permit. In addition, this permit outlined the basis for pollutant trading for both thermal impacts and oxygen-consuming pollutants. Trading for oxygen-consuming pollutants provides flexibility to allow discharge of different levels of oxygen demanding pollutants (NBOD and CBOD) from each of the discharge locations, but is designed in such a way that instream water quality requirements are met. In this case, the 2005 permit defined limits for oxygen-demanding loads that can be traded between the Clean Water Services' treatment plants at Rock Creek and Durham AWWTF for their summertime discharges. This kind of a trade is sometimes referred to as a bubble allocation trade; trading may only occur among the sources defined in the 'bubble.'

As mentioned above, the TMDL for dissolved oxygen includes a waste load allocation for ammonia in the Clean Water Services discharge, but the TMDL does not include a limit for CBOD constituents in effluent. Limits for CBOD are always included in discharge permits for sewage treatment plants, and were sufficiently limiting that the TMDL did not add additional discharge restrictions. However, several factors were considered in developing the bubble allocation that allows flexibility in the discharge loads for oxygen-demanding pollutants in effluent. When differing concentrations are discharged at different locations, the bubble allocation must be designed so that allowable pollutant discharges do not contribute to impaired water quality downstream of any of the discharge locations.

In order to develop the oxygen-demanding bubble allocation, the loading capacity of oxygen-demanding pollutants in the lower Tualatin River was determined. This is the river location with the greatest sensitivity to oxygen-demanding pollutants in the mainstem Tualatin River. Then contributions from the watershed upstream of the sensitive area were quantified, and a 5% margin of error was included in the summation to identify potential pollutant loads from the waste water treatment sources. Finally, a straightforward water quality model that estimated the in-river decay of CBOD and NBOD between the discharge locations and the lower river was used to identify effluent loads of CBOD and NBOD that could be discharged from the AWWTFs. This trading bubble ceiling is set weekly, using the sum of the allowed discharge of NBOD and CBOD that would persist at the Oswego Dam site after in-river decay. This sum is based on the weekly average river flow and temperature, and is independent of effluent discharge volume. To determine compliance with the bubble allocation, weekly median values of pollutant actually discharged are compared to the allowable load.

The Watershed Permit described an option to trade oxygen-demanding constituents between the Rock Creek and Durham Treatment Plants. The permit also included ammonia limits for each discharge site. The permit limits using either the trading approach or limits at each discharge comply with the 2001 TMDL and either condition will limit ammonia discharges sufficiently to protect downstream dissolved oxygen levels. The individual discharges limits in the permit reflect the equation included in Figure 64 of the 2001 TMDL. However the design concentration values in the permit differ from those included in Table 36. The main difference between Table 36 in the TMDL, and the design concentrations in Schedule A (3) of the Watershed permit involve the duration of the compliance window; Table 36 in the TMDL is based on meeting a monthly median value, while the design concentrations in Schedule A (3) reflect a weekly compliance window. The values in Table 36 were modified to the weekly timeframe using the multiplier of 1.3, as directed by the 2001 TMDL in Figure 64. Some additional conditions were made; for simplicity the same design concentration values were used for the Durham and Rock Creek discharge locations. Also, two different tiers were defined in the permit: higher design concentration values apply when in-river dissolved oxygen levels are higher; lower values must be used when in-river dissolved oxygen concentration values create a situation where discharges are more likely to contribute to dissolved oxygen violations. The adoption of the two-tier system based on instream dissolved oxygen concentrations was described in the 2004 NPDES Permit Evaluation Report:

> *The in-river dissolved oxygen trigger for moving between Tier 1 and Tier 2 is based on the results of a statistical analysis of hourly dissolved oxygen monitoring data (1991-2002 for Oswego Dam, 1997-2002 for RM 24.5). It was found that the mean dissolved oxygen of the previous calendar week was the best predictor of an exceedance of water quality standards, and was therefore chosen as the appropriate predictor variable. The 6.7 mg/L dissolved oxygen concentration was selected through a process of testing a series of values, and selecting a value that reduced the overall error rates of the prediction. The applicability of this trigger value was then checked using the historic data. The prediction based on the mean dissolved oxygen concentration of the previous week and the actual outcomes were statistically analyzed. In addition, each instance of a false negative error (failing to predict a water quality violation that actually occurred) was examined to determine if any unusual circumstances had occurred.*

3.3 Rationale for Ammonia Amendment

This amendment does not propose any changes to the total ammonia load that can be discharged into the Tualatin River. As noted in the section above, in-river ammonia loads based on river flow and temperature are used to set treatment plant limits. Thus as population growth in the basin drives

increases in plant discharge volumes, total ammonia loads discharged from wastewater treatment facilities may not exceed the WLA set in the 2001 TMDL.
However, this TMDL amendment will allow summertime ammonia discharge to occur at additional locations. Currently, summer time discharge occurs only at the Rock Creek (river mile 37.7) and Durham (river mile 9.3) AWWTFs. Wet season discharge occurs at the upstream Forest Grove and Hillsboro WWTFs, but during summer time raw wastewater is piped to Rock Creek for discharge.

There are three potential impacts to consider with the change in discharge location; near-field effects in the Tualatin River associate with the new summer discharge locations, far-field effects from the new discharges, and what if any changes are required to the bubble allocation computation. Near-field effects include those that may occur close to the new discharge locations. For this purpose, near-field effects will include any water quality impacts caused by discharges at Forest Grove (river mile 53.8) and Hillsboro (river mile 43.3) to a point in the river just downstream of the Rock Creek treatment plant at river mile 37.7. Far-field impacts include water quality impacts from river mile 37.7 to the lower Tualatin River where low dissolved oxygen concentrations historically occurred. These are measured at the Oswego Dam, at river mile 3.4.

Near-field Impacts: The near-field water quality impacts for the Forest Grove and Hillsboro wastewater treatment plant summer discharges were described using CE-Qual-W2, a complex water quality model. This model was used to describe the impacts of both total phosphorus and oxygen-demanding pollutants such as ammonia from the proposed upper river summer discharges at Forest Grove and Hillsboro WWTFs. Details describing how this model was calibrated, and the model runs and results have been included in Appendix 2-A to Chapter 2, the TMDL amendment for total phosphorus.

The Tualatin River is a very slow moving system in the lower reaches. The lower river reaches were flooded by the Missoula floods, and filled with sediment, resulting in a generally flat topography. In addition, in-stream rock sills in the lower river have created consecutive reservoir-like reaches of slow-moving water. The upper river in contrast has a greater slope, and faster moving water. The Rock Creek AWWTF is located close to this transition in river character.

Results from the upper river water quality model indicate that summer discharges at Forest Grove and Hillsboro would result in a very minor decrease in dissolved oxygen concentrations measured just upstream of the Rock Creek discharge. These results are shown in **Figure 3-1** (taken from Exhibit 2-16, in Appendix 2-A of this document). This figure depicts differences between two scenarios; the current condition with no summer discharge at the two upstream sewage treatment plants, and the future condition when summer discharges occur at both the Forest Grove and Hillsboro locations. Dissolved oxygen concentrations in the Tualatin River remain well above the applicable summer criterion of 6.5 mg dissolved oxygen/L. The figure shows only a slight decrease of less than 0.1 mg dissolved oxygen/L. **Table 3-1** provides the minimum, median and maximum difference in dissolved oxygen between the two scenarios. Dissolved oxygen impacts this small are defined as non-degrading in Oregon water quality standards (OAR 340-041-0004(3)), and as such is not subject to Oregon’s Antidegradation Policy (OAR 340-041-0004).

Figure 3-1. Model-predicted instantaneous dissolved oxygen at Rood Road with and without Forest Grove and Hillsboro waste water treatment facilities discharging to the Tualatin River. Borrowed from Appendix 2-A, Tualatin River Total Maximum Daily Loads: Total Phosphorus and Dissolved Oxygen Analyses for the Upper River Final Report.

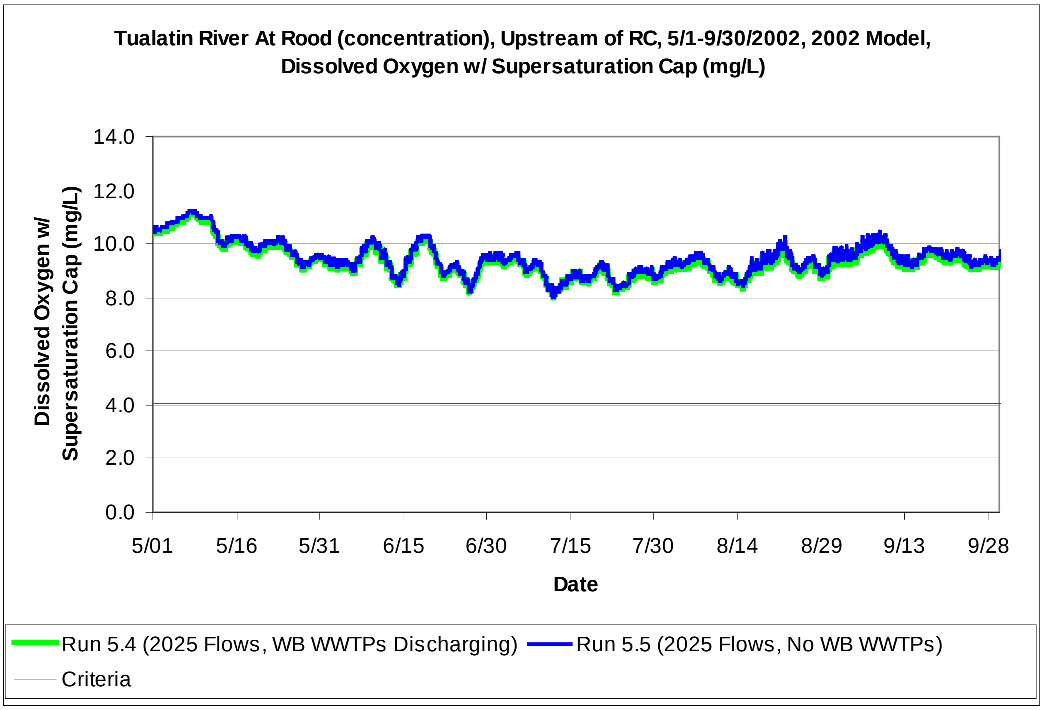


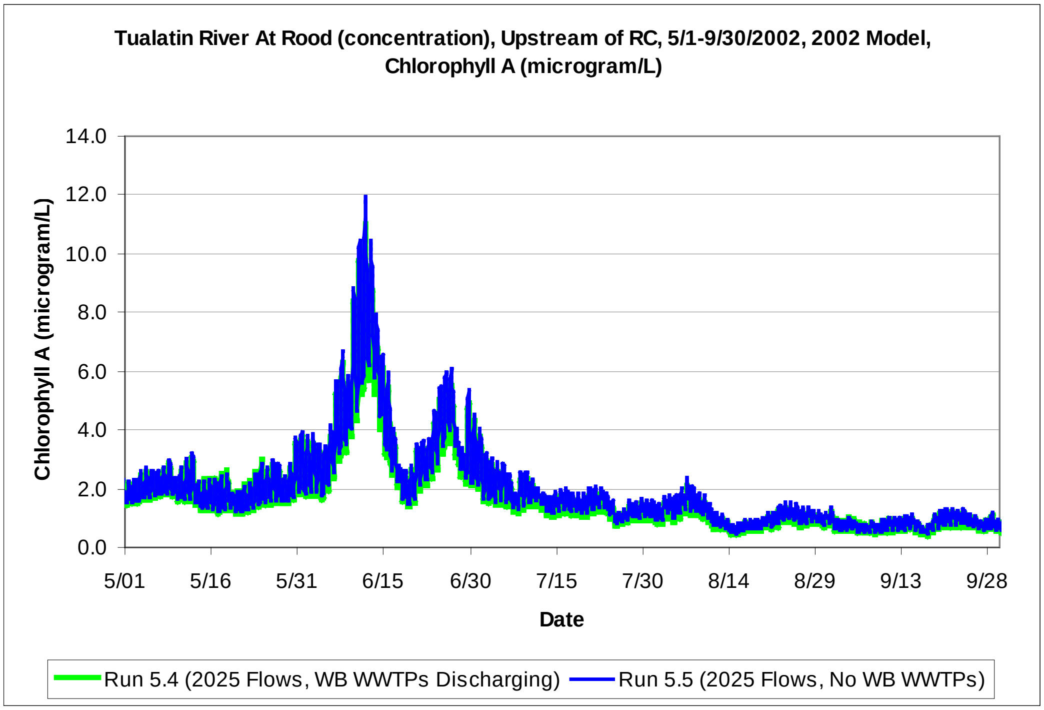
Table 3-1. Summary statistics of the difference in dissolved oxygen at the Rood Road site (River Mile 38.4) for the two modeled scenarios in Figure 3-1, comparing daily dissolved oxygen with and without upper river discharges from Hillsboro and Forest Grove for the time period from May 1, 2001 through September 28, 2001. The water quality model scenarios predict that dissolved oxygen concentrations at Rood Road are generally slightly lower with the upstream discharges than without the upstream discharges.

	Minimum	25th Percentile	Median	75th Percentile	Maximum
Dissolved Oxygen with no upstream discharges minus dissolved oxygen with Forest Grove and Hillsboro discharging	-0.01[1]	0.070	0.095	0.118	0.190

[1]The negative difference here indicates that on some occasions, summer discharges at Forest Grove and Hillsboro are predicted to have a very minor benefit to dissolved oxygen concentrations in the reach.

Another potential impact of ammonia is on plant-life. Nitrogen is a required plant nutrient, and some algae prefer nitrogen in the form of ammonia, with higher uptake rates for ammonia than for nitrates or nitrites, the other common inorganic nitrogen forms. Thus a possible impact of the upstream discharges is to increase algae populations levels in the upper river. Using chlorophyll as an indicator, the water quality model predicts that discharges from the Forest Grove and Hillsboro treatment plants will decrease instream chlorophyll rather than stimulate algal growth. The effect of additional discharges on chlorophyll in the Upper Tualatin River is shown in **Figure 3-2** (Exhibit 2-19 in Appendix 2-A of this TMDL). This Figure shows results for chlorophyll *a* at Rood Road because that is the most downstream location for the Upper River and therefore is expected to show the maximum potential effect on algal growth by discharges to the Upper River.

Figure 3-2. Model-predicted Chlorophyll *a* at Rood Road with and without Forest Grove and Hillsboro waste water treatment facility discharges, taken directly from the Total Phosphorus Modeling Report in Appendix 2-A.



Figures 3-1 and **3-2** depict water quality changes at the lower boundary of the upper river model, and show the quality of water delivered to the lower reach of the Tualatin. Additional results from the water quality model show similar impacts throughout the upper river reach, and over the entire summer period. These can be found in **Appendix 2-A**.

Far-field Impacts: Existing impacts from the Rock Creek and Durham AWWTF were characterized in the 2001 TMDL. With no changes to the ammonia concentrations at the boundary to the lower river (located just downstream of the Rock Creek Treatment Plant), no far-field impacts are anticipated to occur with the addition of upstream discharges. As described above, this TMDL amendment does not provide for any changes to the allowable in-stream ammonia loads in the lower Tualatin River. Ammonia load that is discharged at either of the upstream waste water treatment plants (Forest Grove or Hillsboro) will be subtracted from the allowable ammonia load discharged at the Rock Creek waste water treatment plant.

Bubble Allocation for NBOD; The 2005 Watershed National Pollution Discharge Elimination System Permit that covers wastewater treatment plant effluent for all four Clean Water Services treatment plants included a bubble allocation for the summer discharge of the oxygen-demanding pollutants of NBOD and CBOD. This allocation was briefly described at the end of **Section 3.2** above, and allowed effluent concentrations of both NBOD and CBOD to fluctuate, as long as the total load of oxygen-demanding pollutants was not exceeded at the downstream Oswego Dam site. This TMDL amendment allows the bubble allocation to be adopted in future permits, and describes how the bubble can accommodate the additional upstream effluent sources.

As described in **Section 3.2**, summer-time discharge limit calculations for NBOD at the Rock Creek and Durham treatment plants account for NBOD and CBOD decay as effluent travels downstream to the oxygen-sensitive lower river. Future NPDES permits may include summer discharges of NBOD and CBOD at Forest Grove and Hillsboro, which would certainly undergo some level of decay as the river travels downstream to Rock Creek. However, a bubble allocation is designed to provide flexibility both in effluent character and effluent volume among the plants, while ensuring that water quality is protected. In this situation, no summer discharge currently occurs at the two upstream WWTFs; it is instead routed to the Rock Creek AWWTF. In order to accommodate the current operating scenario, as well as one including discharge at one or both upstream locations, no decay of NBOD or CBOD discharged from Forest Grove or Hillsboro will be estimated in the upper river reach. Decay of these pollutants will instead be estimated only for the river reach downstream of the Rock Creek AWWTF. Thus the revised bubble allocation will result in the same NBOD and CBOD limits delivered to the Oswego Dam site at river mile 3.4 as are currently allowed.

The 2005 Clean Water Services Watershed permit also included summer-season ammonia load limits for each discharging AWWTF. Future NPDES permits that include summer discharges from Forest Grove and/or Hillsboro WWTF will limit the total ammonia loads from Forest Grove, Hillsboro and Rock Creek to the same weekly load now included for the Rock Creek Facility.

Current Dissolved Oxygen Conditions in the Lower Tualatin River: A look at the current river conditions and recent discharge levels from Clean Water Services AWWTF provide further evidence that relocating the discharge loads are unlikely to affect water quality in the lower Tualatin River. **Table 3-2** shows the discharged loads for ammonia for various time periods from prior to the 1988 TMDL through 2007. Permit limits are also included in the table, showing how both discharged loads and permit limits for ammonia have decreased over time.

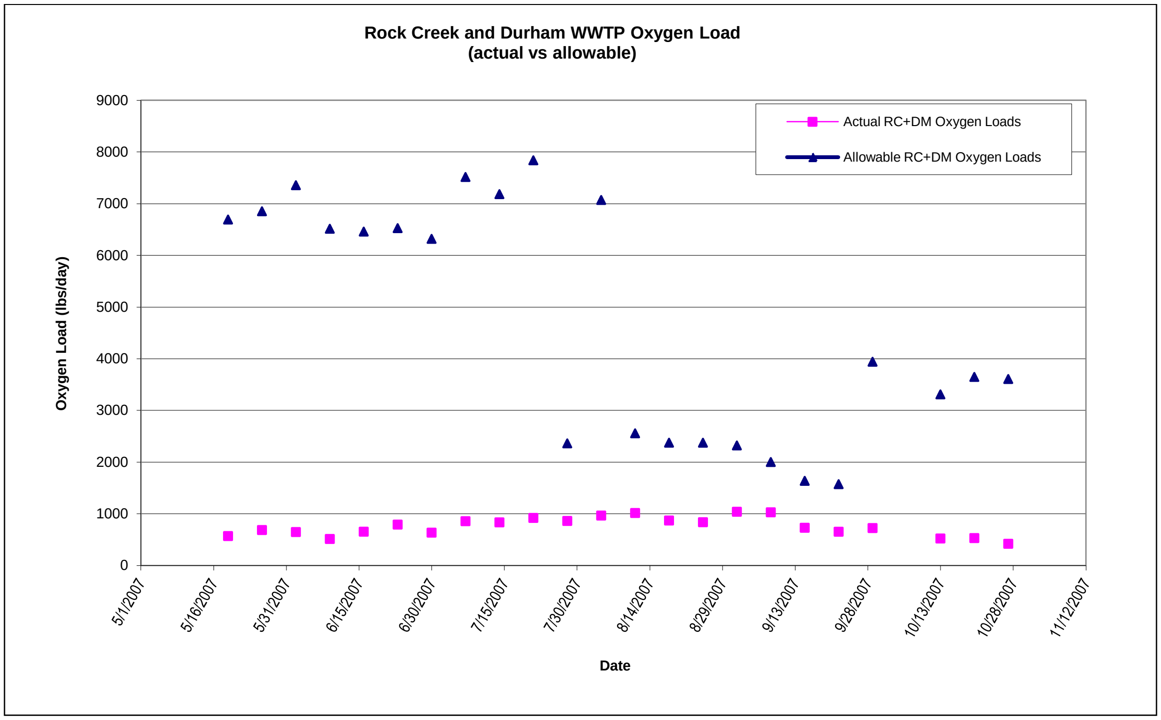
Table 3-2. Ammonia (NBOD) loads in pounds per day discharged from Rock Creek and Durham Advanced Waste Water Treatment Plants at various times since 1988. Permit limits for each plant and time period are included in parentheses.

Time Period	Rock Creek Treatment Plant	Durham Treatment Plant
Prior to 1988 TMDL 1988	3880	2100
After 1988 TMDL Implementation 1994[1]	473 (Permit Limit 783[2])	20 (Permit Limit 394[2])
Before 2001 TMDL 2000	160 (Permit Limit 783[2])	33 (Permit Limit 394[2])
After 2001 TMDL 2007	6.9 (Permit Limit 170[3])	14.3 (Permit Limit 170[3])

[1]Based on a flow of 20 MGD and the actual effluent concentration
[2]Based on a Tualatin River flow at Farmington of 150 cfs and effluent flow of 20 MGD
[3]Based on the most restrictive season of autumn performance and permit limits; Tualatin River flow at Farmington of 150 cfs, and low downstream dissolved oxygen levels

As noted above in Section 3.2, because dissolved oxygen concentrations in the Tualatin River are strongly related to flow and temperature conditions the TMDL set ammonia loads for different time periods between May 1 and November 15. The loading capacity of the river changes with the ambient dissolved oxygen concentration. **Figure 3-3** shows how the bubble allocation for oxygen-demanding pollutants (CBOD and NBOD) set in the 2005 Watershed Permit changes during the TMDL time period. The figure also shows the actual discharges from the two Clean Water Services AWWTFs at Rock Creek and Durham.

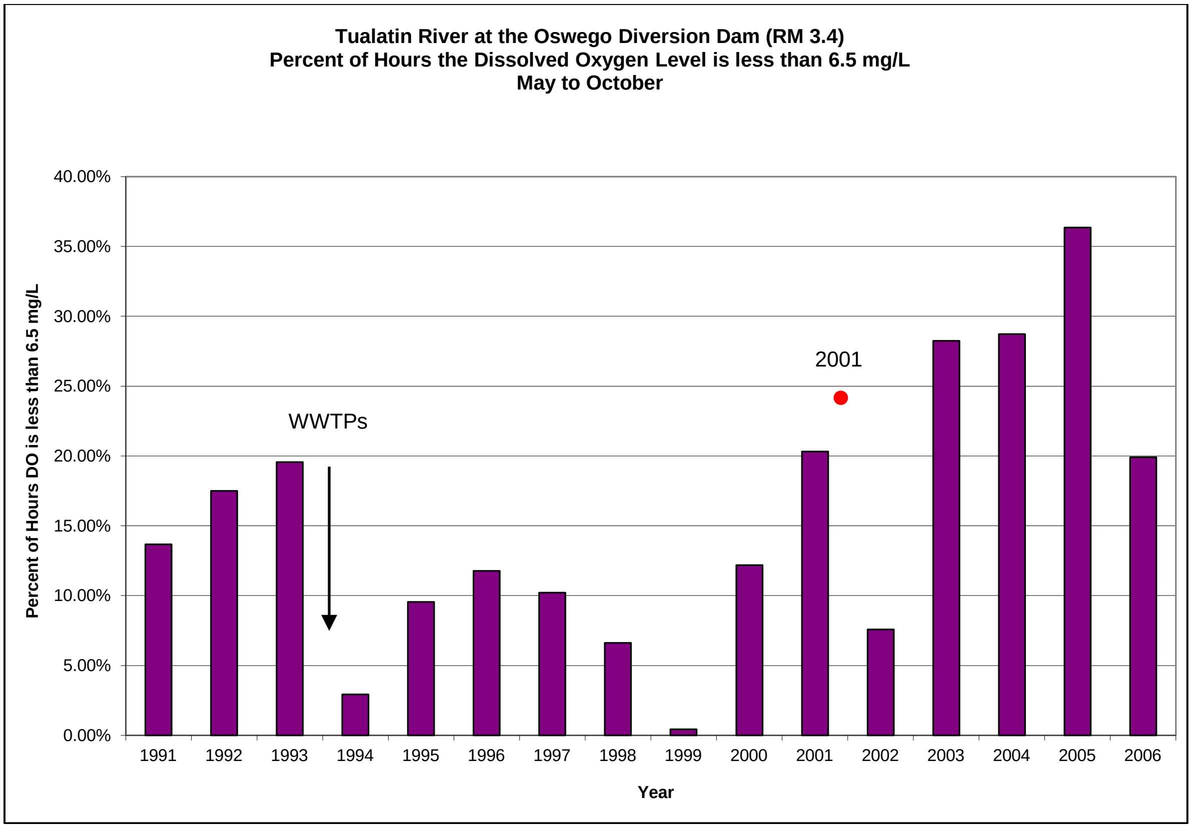
Figure 3-3. The allowable oxygen-demand and the actual oxygen demand for Clean Water Services Rock Creek and Durham Treatment Plants during the TMDL season of 2007. The Y-axis shows the pounds per day of actual and allowable (2005 Watershed Permit) oxygen-demanding substances in discharged water (CBOD + NBOD).



Clean Water Services discharge loads were fairly consistent throughout the TMDL season in 2007, and always remained well below the most restrictive permitted limit that applies during the autumn season. This TMDL amendment is not changing the waste load allocations for Clean Water Services, so allowable loads depicted in **Figure 3-2** will not change. However, the addition of upstream summer discharges may result in actual loads to the Tualatin River that more closely approach the allowed loads. The 2001 TMDL limits for ammonia were determined using a conservative approach and are still considered protective of dissolved oxygen in the Lower Tualatin River.

Despite continuing improved treatment at Clean Water Services AWWTFs with the discharge of both lower phosphorus concentrations and lower ammonia loads, dissolved oxygen in the lower Tualatin River has changed since the adoption of the 1988 TMDL. In general, dissolved oxygen concentrations are lower over more hours of the day than they were in the early 1990s. **Figure 3-4** shows the percent of hours that dissolved oxygen concentrations were below the 6.5 mg/L criterion during the TMDL season of each year. The number of hours that dissolved oxygen concentrations were below this criterion has increased, especially since the issuance of the 2001 TMDL.

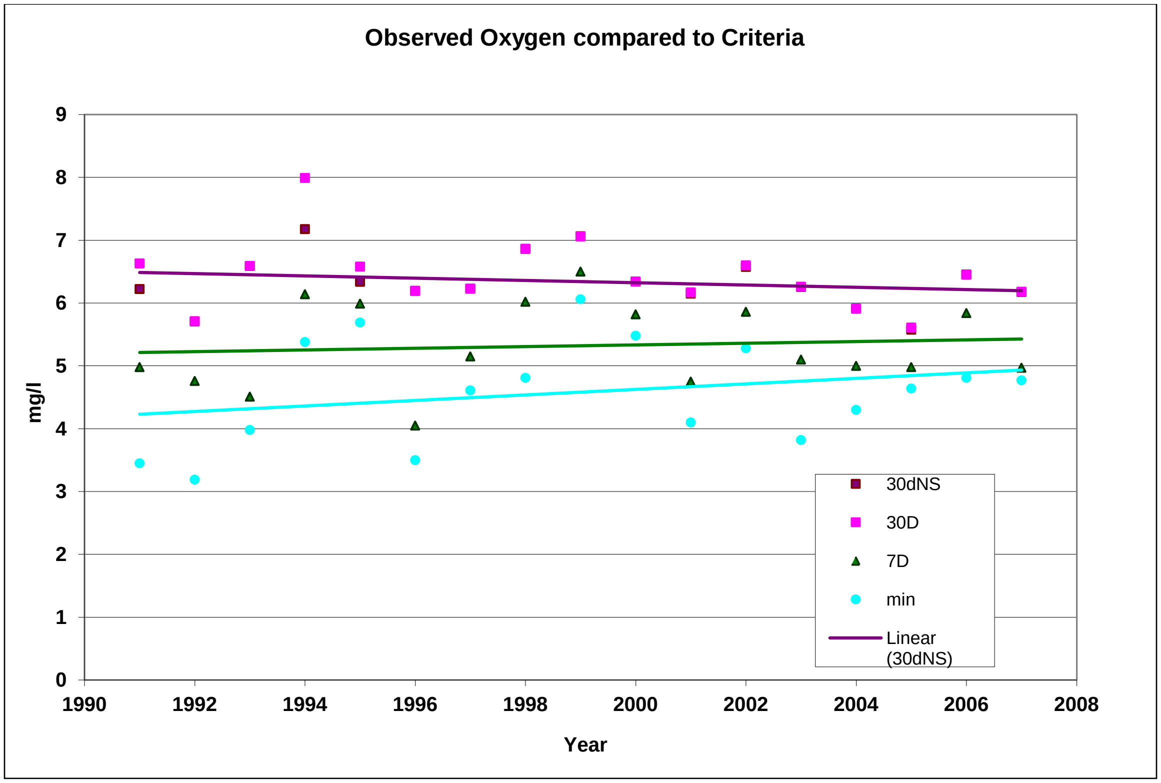
Figure 3-4. The percent of hours in each TMDL season that dissolved oxygen levels were less than 6.5 mg/L at the Oswego Dam at River Mile 3.4 in the Lower Tualatin River.



Looking more closely at the data, it appears that the daily variation in dissolved oxygen concentrations has become smaller; the minimum values are higher than they were historically, and maximum values are lower than they were historically. **Figure 3-5** shows how the values of various oxygen criteria have changed at the Oswego Dam site since the 1990, when the first continuously recording dissolved oxygen probes were deployed. None of the regression lines in this figure represent statistically significant trends.

The figure shows how the data compare to three of Oregon's dissolved oxygen criteria; all three must be met concurrently for the dissolved oxygen concentrations to provide sufficient support for the beneficial uses in the Tualatin River. The thirty day average corrected for supersaturation (30dNS) is not part of Oregon's standard. It reflects the 30 day average of dissolved oxygen values that exclude measurements of super-saturated oxygen. When the 30day average dissolved oxygen value is greater than the 30-day average corrected for supersaturation, the 30 day average is likely influenced by dense algal blooms that contribute to supersaturated conditions.

Figure 3-5. Observed values for various dissolved oxygen statistics at the Oswego Dam site (RM 3.4) from 1990-2007.



Legend Label	Legend Label Description	Statistic	Statistic Description	Criterion
30dNS	The lowest of the 30-day daily-mean dissolved oxygen concentrations for the summer, where individual points have been corrected for supersaturation.	30-Day Mean Minimum, data corrected for super-saturation before calculating daily averages.	The minimum value of the 30-consecutive-day running mean. Daily means, after correcting for supersaturation, are used to calculate this statistic	
30D	The lowest of the 30-day daily-mean dissolved oxygen concentrations for the summer.	30-Day Mean Minimum	The minimum value of the 30-consecutive-day running mean.	**6.5 mg/L**
7D	The lowest of the 7-day minimum dissolved oxygen levels for the summer	7-Day minimum mean	The 7-day running average of the daily minimum value	**5.0 mg/L**
min	The lowest dissolved oxygen reading for the summer	Absolute minimum	The daily minimum value	**4.0 mg/L**

This graph has at least three points to note; first, the occurrence of supersaturation decreased greatly by 2000, as the points for 30dNS and 30D are super-imposed after 2000. This data coincides with the decrease in observed pH violations, and generally lower chlorophyll levels. Second, the 30-day averages have decreased over time which in part reflects the decrease in supersaturation. Third, the minimum values have increased over time. The lack of very high and very low values conform to both the hypothesis and other observed data that show lower incidences of algal blooms. **Figure 2.3** (presented in Chapter 2) shows the decrease in pH violations over time as total phosphorus concentrations decreased in the lower Tualatin River. The dissolved oxygen changes occur concurrently with dramatic decreases in ammonia loads from the AWWTF, as well as decreases in total phosphorus concentrations. A closer look at dissolved oxygen concentrations during two different years demonstrates that the low values occur in late summer and early autumn, when allowable ammonia loads discharge limits for total phosphorous are low. Data from 2002 and 2005 in **Figure 3-6** illustrate the recent declining trend.

Figure 3-6. Various Dissolved Oxygen Statistics at Oswego Dam (RM 3.4) during the TMDL seasons of 2002 (no oxygen violations) and 2005 (30-day average below 6.5 mg/L criterion).

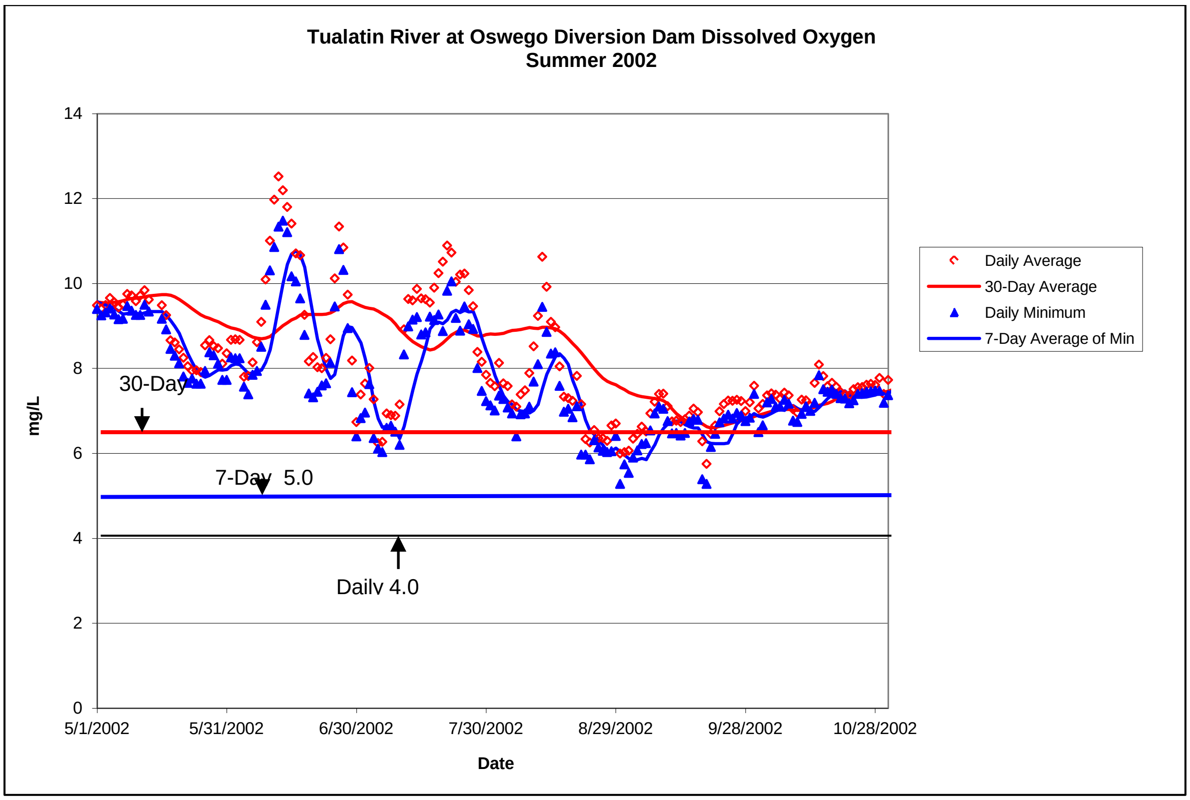
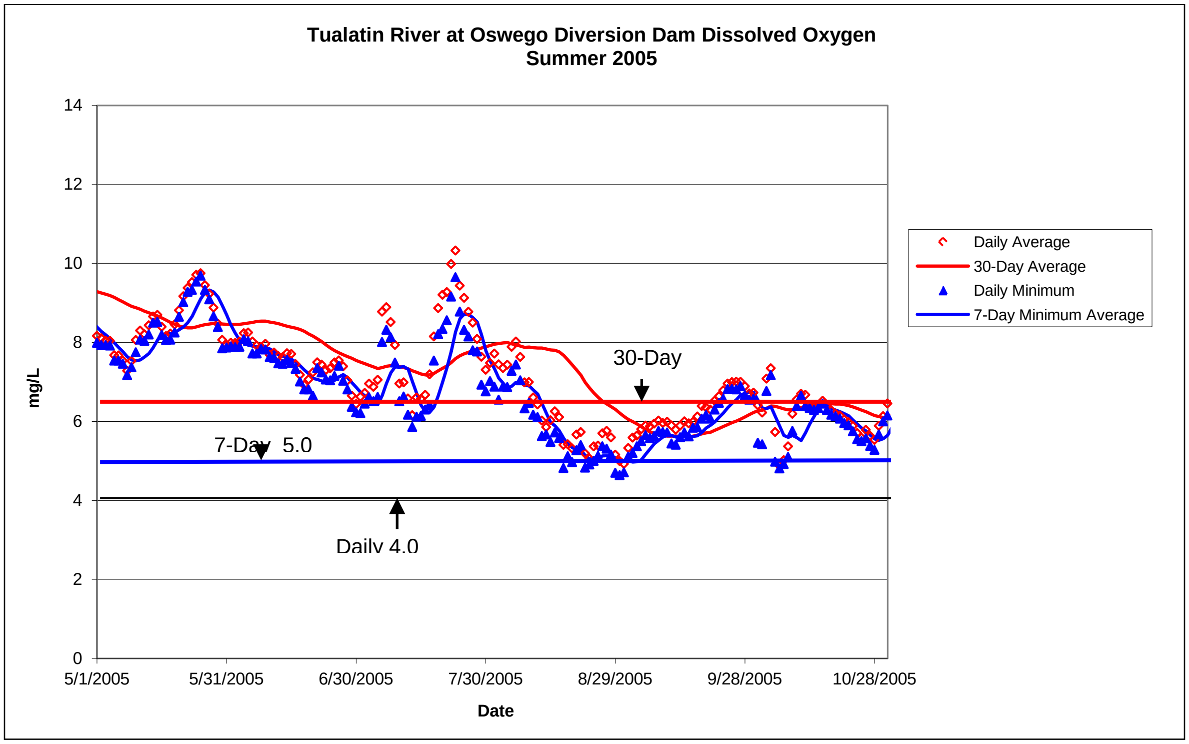


Figure 3-6, continued.



Clean Water Services has been working with the US Geological Survey to identify what is causing the decreases in dissolved oxygen in the lower Tualatin River. Several ideas are being investigated, including low algal productivity, and contributions from sediment oxygen demand. Once more data is available that better identifies the sources of oxygen-demanding pollutants, this TMDL may be further revised to address additional pollutant sources.

However, CWS discharge levels of ammonia and total phosphorus are not considered significant contributors to the lower dissolved oxygen concentrations. As noted above, minimum dissolved oxygen concentrations are now higher, and the pH and chlorophyll indicators of algal bloom density show that algal blooms have been controlled by changes that occurred in response the 1988 and 2001 TMDLs. Water quality models used to develop the 2001 TMDL allocations for ammonia identified sediment oxygen demand (SOD), carbonaceous oxygen demand (CBOD), algal respiration, and zooplankton respiration, as larger contributors to low dissolved oxygen levels in the lower river than nitrogenous biological oxygen demand (NBOD; ammonia as a key contributor). Thus the recent changes in dissolved oxygen in the lower river are more likely attributed to factors other than ammonia discharges from the AWWTF, especially as these have declined concurrently with the dissolved oxygen levels. Improved conditions for sediment oxygen demand are expected to result from increased implementation of the total phosphorus and temperature TMDLs that in turn decrease sediment delivery to streams through erosion.

The 2005 Watershed Approach included monitoring requirements to track dissolved oxygen and nutrients including ammonia and total phosphorus in the Tualatin River. These requirements shall be continued in future permits, so that the impacts of the Clean Water Services discharges, if there are any, can be determined.

3.4 Conclusion and Specific Changes to WLA in Dissolved Oxygen TMDL

In order to accommodate the additional summer WWTF discharge locations, the only change to the 2001 Dissolved Oxygen TMDL is to add the new locations to the waste load allocation for the Rock Creek Waste Water Treatment Plant.

Table 3-3. Amendments to 2001 Dissolved Oxygen Tualatin Basin TMDL Table 36. Ammonia Design Concentrations for Rock Creek, the Tualatin River upstream of Rock Creek, and Clean Water Services Forest Grove, Hillsboro and Rock Creek WWTP

Seasonal Period	Loading Capacity Design Concentration	Margin of Safety (5%)	Tualatin River upstream of Rock Cr Load Allocation Design Concentration	Rock Cr. Load Allocation Design Concentration	Forest Grove, Hillsboro & Rock Cr WWTF Combined Waste Load Allocation Design Concentration
	Given as Design Concentration (mg NH_3-N/L)				
May	1.25	0.06	0.05	0.015	1.12
June	1.31	0.07	0.05	0.015	1.18
July	0.68	0.03	0.035	0.0125	0.60
August	0.29	0.01	0.03	0.01	0.24
Sept.-Nov. 15	0.195	*	0.03	0.01	0.155

* No margin of safety as a portion of the loading capacity was allocated for this period. See discussion above and in Section 4.3.11 [2001 TMDL for Dissolved Oxygen].

These design concentrations are to be used in conjunction with the monthly median flows of the Tualatin River at Farmington to determine the specific load allocations and wasteload allocations. The formulas for generating ammonia load and wasteload allocations for each month as well as daily loads in the Tualatin River Subbasin, along with additional provisions, are given **Figure 3-7**, below. No changes to this figure are included in this TMDL revision.

Figure 3-7. Formulas for using design concentrations to calculate ammonia waste load allocations. (Figure 64 from page 123 of the Tualatin Subbasin Total Maximum Daily Load).

Figure 64. Ammonia Allocations for the Tualatin River Subbasin
Wasteload Allocations
Monthly Mean Wasteload Allocation (lb. NH_3-N/day) = Wasteload Allocation Design Concentration x Monthly Median Flow x 5.39 (lb./day)/(mg/L)(cfs)

Load Allocations
Monthly Mean Load Allocation (lb. NH_3-N/day) = Load Allocation Design Concentration x Monthly Median Flow x 5.39 (lb./day)/(mg/L)(cfs)
Additional Allocation provisions: 1) There is a cap of a maximum concentration of 30 mg/L NH_3 as N on WWTP effluent. 2) WWTP loadings are allowed temporary increases as follows: ♦ Increases in loadings for a 1-day period of 50% over those indicated by the wasteload allocations (as determined above) – provided the 2-day mean loading is equal to or below the total wasteload allocation for this period. ♦ Increases in loadings for a 7-day period (or less) of 30% over those indicated by the wasteload allocations (as determined above) – provided the mean loading over a period twice the duration of the spike is equal to or below the wasteload allocation for this period. 3) For the period of September 1 through Nov. 15, the TMDL does not apply if the median flow at Farmington for the previous 7 days is equal to or greater than 350 cfs.
Notes: • The allocation design concentration (mg NH_3-N/L) is determined from either **Table 35** or **Table 36** for the specific time period and discharge (or location). • The monthly median flow (cfs) is measured at the Farmington gaging station. • 5.39 is a conversion factor.

To clarify how these values can be used, the Example Calculation on page 123, following Figure 64 (2001 TMDL for Dissolved Oxygen) is also modified as follows:

> *In order to determine the daily loading capacity in pounds per day, the appropriate design concentration from either **Table 35 or Table 36*** [2001 Ammonia TMDL] *would be multiplied by the monthly median flow at Farmington and a conversion factor (5.39 [lb./day]/[mg/L][cfs]. For example, if the median monthly flow at Farmington for July is 150 cfs, then the maximum daily wasteload allocation for Forest Grove, Hillsboro and the Rock Creek WWTP combined in pounds per day (for July) would be*:

Example
Monthly mean wasteload allocation for Forest Grove + Hillsboro + Rock Creek WWTF (Given conditions above) = 0.60(mg NH_3-N/L) x 150 (cfs) x 5.39 (lb./day)/(mg/L)(cfs) = <u>485 lb. NH_3-N/day</u>

3.5 References

CH2MHill. 2009. Tualatin River Total maximum Daily Load: Total Phosphorus and Dissolved Oxygen Analysis for the Upper River. Final Report submitted to Clean Water Services. Appears as Appendix 3A to this TMDL Revision.

DEQ. 2006. Final/Response to Comment: Fact Sheet and NPDES Wastewater Discharge Permit Evaluation for Clean Water Services and Washington County Department of Land Use and Transportation.

DEQ, 2009. Water Quality Trading in NPDES Permits Internal Management Directive. http://www.deq.state.or.us/wq/pubs/imds/wqtrading.pdf

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