Coordinating the Temperature Water Quality Standard and Umatilla Subbasin TMDL: Practical Considerations and Cumulative Effects Analysis

Table of Contents

September 24, 2007

(finalized following public comment period for co-review of this document and the City of Hermiston NPDES permit)

State of Oregon
Department of Environmental Quality

This document was prepared by TMDL program staff in the Pendleton DEQ office. For more information contact:

Don Butcher, Basin Coordinator
Department of Environmental Quality
700 SE Emigrant, Suite 330
Pendleton, Oregon 97801
butcher.don@deq.state.or.us

Introduction

The US Environmental Protection Agency (EPA) approved the current Umatilla Subbasin temperature Total Maximum Daily Load (TMDL) in May 2001. In March of 2004, the EPA approved a new temperature standard for Oregon. As the new standard and old TMDLs generally can be co-applied in a straightforward manner, the Department of Environmental Quality (DEQ, the Department), typically does not revise subbasin temperature TMDLs based solely on the issuance of the new standard. The Department has used individual-facility National Pollutant Discharge Elimination System (NPDES) permits as one of the primary mechanisms for coordinating between the current standard and the TMDL. However, there are some differences between the current standard and the TMDL that warrant clarification or further analysis. Accordingly, this document formalizes the Department's practice in meshing the TMDL and standard, and serves as a cumulative effects analysis. The issues addressed are applicable in the Umatilla Subbasin and include the following:

1. Replacing the TMDL target of 'no measurable increase' (0.25 ºF) with the human use allowance (HUA) of the new standard
2. Applying the TMDLs longitudinal profile of *system potential* summer afternoon temperature in the context of the new standard's natural condition criteria
3. Replacing biologically-based numeric criteria that have been revised in the new standard, e.g., the 64 ºF (17.8 ºC) salmonid rearing criteria in the prior standard has been slightly modified to 18 ºC (64.4 ºF) in the new standard
4. Clarifying the season of criteria and wasteload allocation (WLA) application, both in terms of when the WLA/criteria applies and when the HUA 25% or 100% mixing proportions apply
5. Apportioning the new standard's HUA to various sources

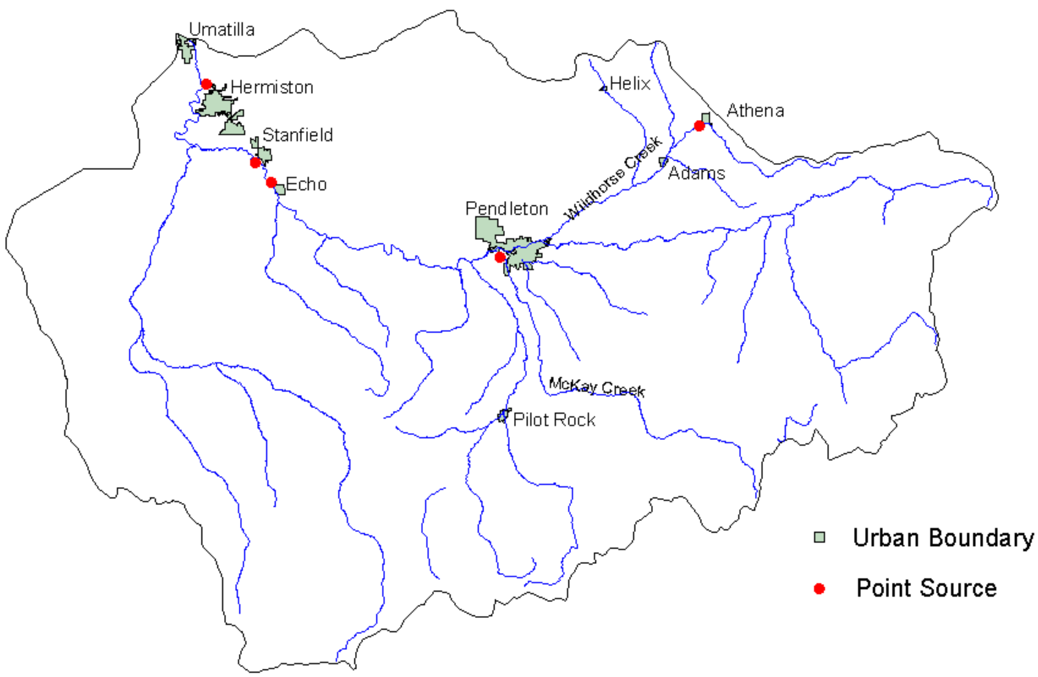
We emphasize here that evaluation of the last two issues is contingent upon existing facility configuration and design capacity. If facility modification is considered, in a manner that would increase design discharge or temperature, this analysis would have to be re-visited.

Background – NPDES Sources and Geography

Temperature simulation and mass balance calculations indicate that nonpoint sources dominate heating of the Umatilla River. From the TMDL temperature model, the Umatilla River from the North Fork to the mouth is exposed to 580 megawatts of solar radiation (based on August 10, 1998 assessment). As a contrasting example, at maximum dry weather design flow at average river flow in August, the Hermiston WWTP could produce a maximum 1.3 megawatt heat discharge [assuming 0.3 ºC (0.54 ºF) HUA].

That said, the application of the temperature standard to point sources is primarily where the greatest complexity and need for clarification exists. **Figure 1** illustrates the location of the five individual-facility NPDES sources in the Subbasin. All are municipal wastewater treatment plant (WWTP) facilities.

Figure 1. *Umatilla Subbasin individual-facility NPDES permitted discharges*



Of these five WWTPs, the Echo and Hermiston facilities discharge directly to the Umatilla River. The Pendleton WWTP discharges into the Umatilla River indirectly via the mouth of McKay Creek. The Stanfield outfall discharges indirectly to the Umatilla River via Stage Gulch and is being relocated to flow directly into the Umatilla River. The Athena WWTP discharges to Wildhorse Creek. The Hermiston and Pendleton WWTPs are permitted to discharge year round. The Echo, Stanfield and Athena WWTPs are permitted to discharge directly to surface water November 1 through April 30.

All four of the mainstem NPDES sources are located along the section of river extending from the City of Pendleton to the mouth of the Umatilla River. This reach is designated as supportive of salmon and steelhead spawning use from October 15 to May 15. In the warm season, the designated beneficial uses are salmon and trout rearing and migration.

Wildhorse Creek, the recipient of the Athena WWTP discharge, is designated for salmon and trout rearing and migration year around, with no spawning.

Recommendations

The recommendations below are addressed in the order listed in the introduction. This section addresses clarifications and principles of combining the TMDL and new standard, as well as referencing the appended cumulative effects analysis.

1. Replacing *no measurable increase*. The TMDL employs a maximum temperature allowance for river temperature increase of "no measurable increase," defined as 0.25 ºF (0.14 ºC). This allowance is logically replaced by the human use allowance of the new standard, generally established at a maximum cumulative increase of 0.3 ºC "for all NPDES point sources and nonpoint sources… above the applicable criteria after complete mixing in the water body, and at the point of maximum impact" (OAR 340-041-0028 (12)(b). Subsequent discussion in this document addresses apportionment of the 0.3 ºC HUA among the various sources.

2. Natural thermal potential (NTP). The temperature TMDL is based on simulation of August 10, 1998 temperature along the length of the Umatilla River. The simulation compares the existing and *system potential* afternoon temperature profiles. The Department considers the *system potential* temperature profile of the TMDL to meet the definition of the natural thermal potential of the natural condition criteria of the new standard (OAR 340-041-0028 (8).

Draft temperature standard guidance indicates that the 7-day average of the daily maximum (7dAM) stream temperature will generally be used as the metric for numeric and narrative temperature criteria, including the natural thermal potential. As a practical matter, the TMDL one-day maxima temperature simulation can be viewed similarly, as a threshold with which to compare to the 7dAM temperature of the Umatilla River.

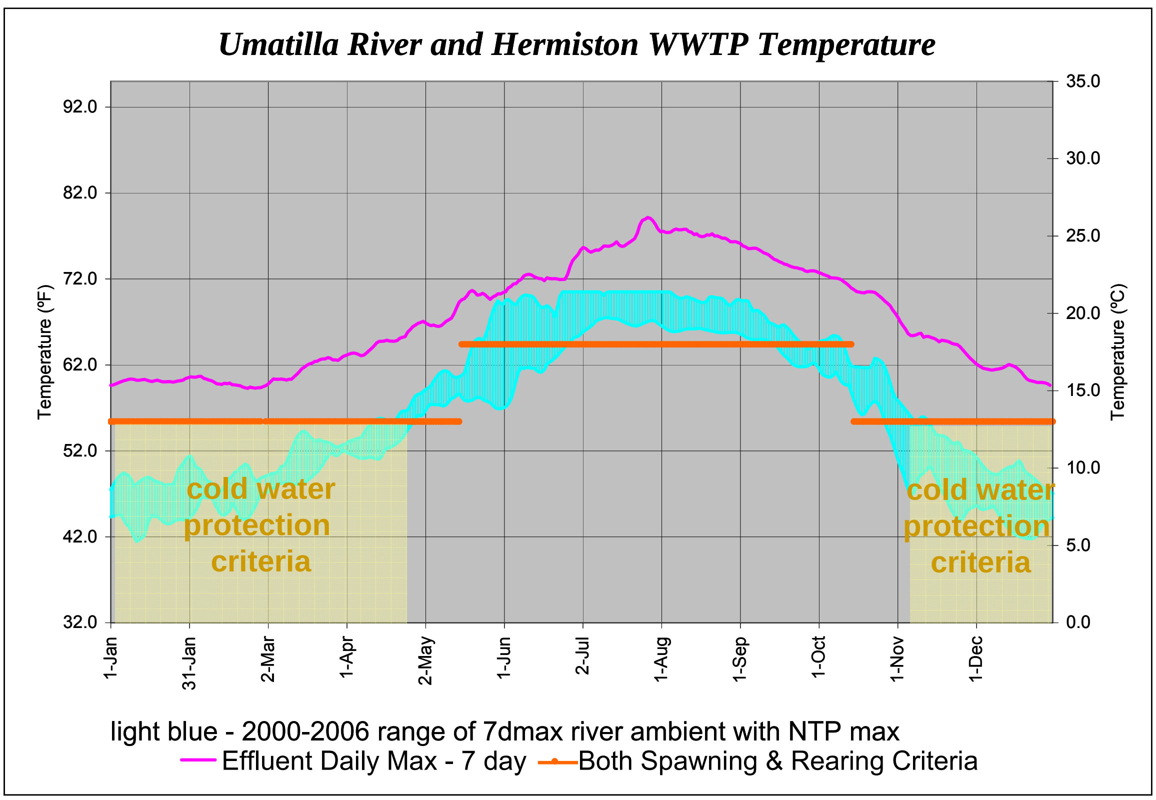
3. Changes to numeric criteria. The temperature TMDL references biologically-based numeric criteria of 64 ºF, 55 ºF and 50 ºF for salmonid rearing, salmonid spawning and bull trout. The salmonid rearing and spawning criteria have been replaced with 18 ºC and 13 ºC. The bull trout criteria have been modified and other criteria have been added. Where *numeric* criteria are applicable, NPDES permits should employ the new standard criteria rather than those discussed in the TMDL. Generally these adjustments are slight, e.g., changing 64 ºF (17.8 ºC) to 18.0 ºC (64.4 ºF).

Note that the application of the peak *system potential* temperatures from the TMDL assessment is retained through the application of the *narrative* natural condition criterion, as discussed previously.

4. WLA seasonality and mixing proportions. The season of the wasteload allocation is referenced to the critical period. During TMDL development, available data bracketed the critical period at June through September. More precisely, the critical period is defined in the TMDL as the interval during which the receiving water exceeds the salmonid rearing and migration criteria. In coordinating the new standard with the TMDL, confusion arises for the interval between the critical period and the spawning and cool season cold water protection criteria. This is clarified as follows:

For developing mainstem facility permit limits, the WLA target may be extended throughout the period that the rearing and migration numeric criterion (18.0 ºC) applies (May 16 – October 14). The logic of extending the applicable period for the WLA is similar to that employed in the Umatilla Subbasin TMDL development. At that time, the temperature model capability was limited to narrow time windows (1-day was used for this TMDL). In lieu of a wide season of simulation and in order to minimize human-caused warming over the full warm season, point sources were assigned a WLA target the lesser of the TMDL peak *system potential* temperature and ambient river temperature. Nonpoint sources were assigned temperature load allocations of zero. This minimizes human-causes heating, recognizing that as nonpoint source objectives are approached ambient temperatures will reduce to a more natural level, and the WLA temperature target will decrease through time. Similarly, if the WLA target applies throughout the salmon and trout rearing and migration time-frame, beneficial use protection is maximized throughout this interval. In fact, outside of the critical period this leads to limits that are more stringent than the 18.0 ºC criteria of the new standard. **Figure 2** illustrates an example scenario, with measured river and effluent temperature from the City of Hermiston. Note that Hermiston is the lowermost individual-facility NPDES source on the Umatilla River, where the river is generally warmest. This represents a worst-case scenario, because the seasons of background exceeding numeric criteria are the widest.

Figure 2. *Temperature data from the City of Hermiston.*



In the shoulder seasons just outside of the rearing and migration period, the Umatilla River remains relatively warm and the salmonid spawning criterion applies (13 ºC, 55.4 ºF). During these periods, 7dAM temperature exceeds 13 ºC in the mid and lower River, and hence the cold water protection criterion is not likely to apply for a period of 2-4 weeks in the Spring and Fall (**Figure 2**). This is a sensitive time, because spawning salmonids require cooler temperatures, and the temperature standard calls for application of the 13 ºC spawning criterion during these shoulder seasons.

The HUA mixing proportion is another seasonal issue. Rules provide that criteria be assessed at 25-percent mixing with receiving water prior to a TMDL or cumulative effects analysis (CEA). Afterward, compliance is assessed at full mixing (OAR 340-041-0028(12)(b)). As a matter of Departmental practice, though the WLAs were calculated based on 25-percent mixing, they have been re-calculated in permits to accommodate the full mixing allowed by the new standard. Because no TMDL or other CEA was prepared for the time frame outside of the critical period, 25-percent mixing would be applied during the portion of the year outside the season covered by the TMDL. The spawning season cold water protection criterion, however, explicitly allows full mixing, so this window where the standard restricts thermal mixing to 25% of the river flow, is brief. It generally only occurs for 2-4 weeks preceding May 15 and after mid-October, as discussed in the preceding paragraph. The current temperature standard's rationale for allowing only 25% of the river for mixing prior to a TMDL is that the calculated effect of a point source discharge needs to use conservative assumptions (25% of stream volume) if there has not been a cumulative effects analysis. It is recommended, in this case, that full mixing be allowed year round. This is because (1) load allocations will lead to reduced river temperature, ultimately eliminating nonpoint source cumulative effects, (2) thermal overlap between point sources is not an issue – refer to appended CEA, (3) a highly complex array of permit limits is impractical to implement and enforce, and (4) the maximum potential change in allowable river temperature, depending on whether assessed as 25 or 100 percent mixing, is slight, as described in the following:

> With a maximum HUA of 0.3 ºC, a facility is allowed to increase the river temperature above criteria by 0.3 ºC / 4 with 25% mixing and 0.3 ºC with 100% mixing. Therefore, while this could allow a significant difference in effluent temperature, the difference in river temperature between the two scenarios is limited to 0.225 ºC. The point here is not to set or apportion HUA, which is discussed in **Appendix 1**, but rather to add context to the deliberation over mixing proportions, by noting that the difference in the river temperature associated with the two alternatives is not great.

Note that this discussion only applies outside of the mixing zone. The recent temperature standard includes provisions to be applied within the mixing zone as well. In summary of the HUA mixing and WLA/criterion seasonality, permits for discharge to the Umatilla River should be based on ***full mixing year round***, and whichever is more practical of the following:

Scenario 1:

- Set limits based on the lesser of ambient river temperature and peak TMDL-NTP during March 16 through October 14.
- Set limits based on 13.0 ºC for the October 15 - May 15 spawning season outside of cold water protection criterion applicability (the spawning cold water protection criteria applies when 7dAM river temperature is less than 13.0 ºC).
- Set limits based on the spawning cold water protection criterion for the remainder of the year.

Scenario 2:

- Set limits based on the lesser of ambient river temperature and peak NTP from the TMDL while the river exceeds 18.0 ºC.
- Set limits based on 18.0 ºC during the shoulder seasons when the ambient river temperature is less than 18.0 ºC, outside of the designated October 15 to May 15 spawning period.
- October 15 - May 15 spawning season and the enveloped cold water protection criterion period: set limits as in Scenario 1.

There is yet another scenario applicable to an existing individual-facility NPDES source in the Umatilla Subbasin – that of the City of Athena WWTP, discharging to Wildhorse Creek November 1 through April 30. Here there is no assessment of *system potential* or NTP, no spawning designation and no warm season discharge is allowed. The numeric criterion for Wildhorse Creek is 18.0 ºC year round. Accordingly, most of the above discussion is not relevant, but if there were a need, full mixing could be invoked for the four reasons listed above.

5. Apportioning the HUA to various sources. The HUA can be variously apportioned to point sources, nonpoint sources and reserve capacity for future growth. The Umatilla Subbasin temperature TMDL allocated zero loading capacity to human nonpoint sources. The TMDL development process determined that population growth would be addressed through modifications to point sources and associated WLA and permits. Accordingly, the entire 0.3 ºC human use allowance is allotted to the individual-facility NPDES permitted sources.

In order to apportion the 0.3 ºC among the various sources, a CEA was carried out and is reported in **Appendix 1**. **Table 3** of **Appendix 1** lists the allowable HUA by facility and season of discharge.

Appendix 1. Cumulative Effects Analysis

Model Scenarios and Output

This analysis evaluates (1) whether facilities are capable of increasing receiving water temperature significantly, and (2) the degree to which, if any, a 0.3 ºC temperature increase in receiving water at one facility can cause a temperature increase at a downstream facility. This necessitates addressing conditions where downstream heat retention is most favored. A high level of retention is expected in the following situations:

- River discharge is high, providing more thermal inertia and greater downstream velocity
- Evaporation rates are low (i.e., low air temperature or high humidity)
- Air is warm and solar heating rates are high, thus supporting retention of elevated temperature

Various neighboring facilities are evaluated in this CEA, keeping in mind that in the warm season between April 30 and November 1 only two facilities are discharging; and during the spawning cold water protection period, all facilities receive an allowance greater than 0.3 ºC (OAR 340-041-0028(12)). This narrows down the time frame and facility combinations to evaluate. Various mainstem river conditions were simulated using the Umatilla River TMDL temperature model (Heat Source 6.0 – August 10, 1998 model build used in 2001 TMDL). The model predicts temperature for a 24-hour period. The 3:00 P.M. longitudinal temperature output was selected herein to represent the general worst-case time of day for the Umatilla River in the lower 55 miles where the mainstem individual-facility NPDES sources are located.

Model scenarios were run for varying discharge, humidity, air temperature and shade levels to test the sensitivity of instream heat retention to these conditions. In each model, a warm-water input was simulated in the vicinity of the Pendleton WWTP, as the uppermost mainstem point source addressed, to test downstream heat retention. This 0.12-0.25 cubic meter per second (CMS) mass transfer was applied at Birch Creek, 3.1 kilometers below the Pendleton WWTP. This discharge is equivalent to 4.2-8.8 cubic feet per second (CFS). The Birch Creek location was selected as a convenient existing tributary input node in the model. The temperature of the introduced warm water input varies for different scenarios, and was set to cause a 0.3 ºC increase in river temperature. The model runs are all variations on the existing condition calibration for August 10, 1998. Shade, humidity and air temperature were all tested individually at the model date. At this time, river discharge in Pendleton was 1.25 CMS (44.1 CFS) with an additional 5.27 CMS (186 CFS) entering the river at McKay Creek (the Pendleton WWTP is at the mouth of McKay Creek). **Figures 3** and **4** plot the temperature profiles of these scenarios.

Then varying river flow scenarios were run individually as well. River discharge was decreased by eliminating the large input at Mckay Creek, and then increased to 2.8, 6.0 and 15.0 CMS (100, 212 and 530 CFS) in the upper basin and held constant downstream to below Stanfield. **Figure 5** plots model temperature output for various flow scenarios. As evident when comparing **Figures 3-5**, river discharge is the dominant controller of downstream heat retention.

Figure 3. *August 10, 1998 temperature simulation with a 0.3 ºC point increase in Umatilla River temperature introduced at Birch Creek. Humidity and air temperature are varied to test their influence on instream heat retention.*

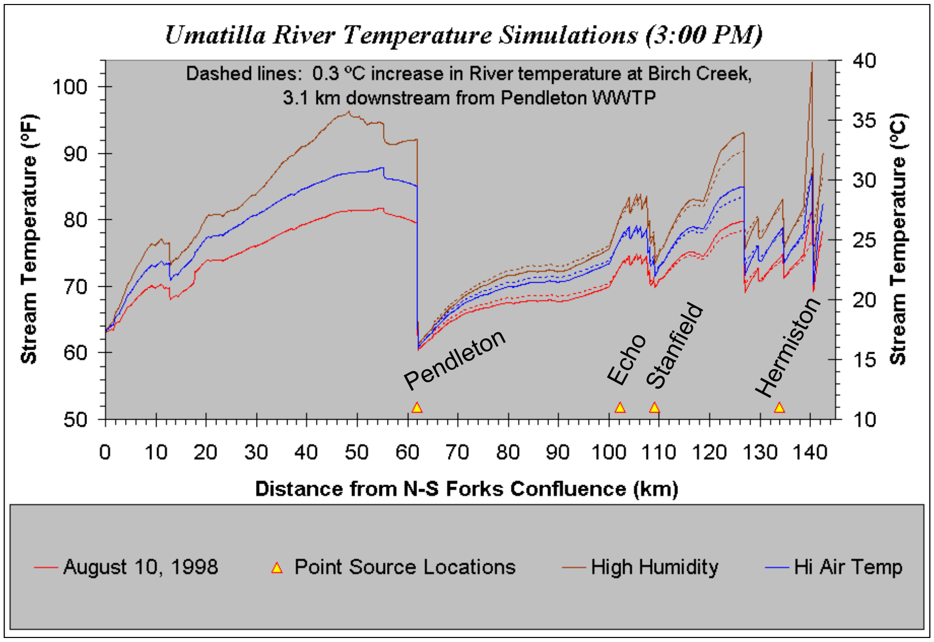


Figure 4. *August 10, 1998 temperature simulation with a 0.3 ºC point increase in Umatilla River temperature introduced at Birch Creek. Shade height and density are varied along the length of the river to test this influence on instream heat retention.*

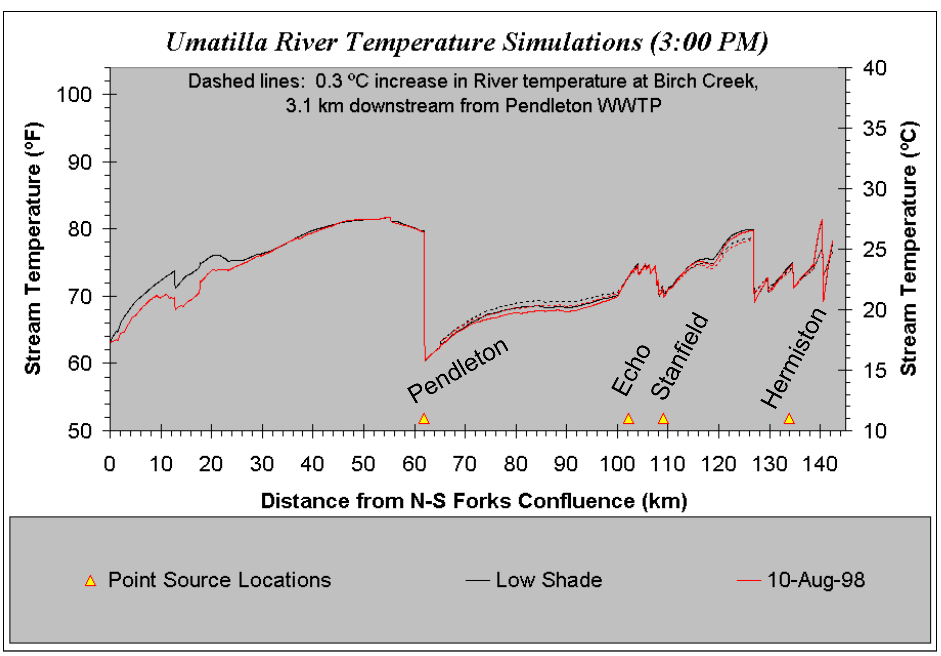
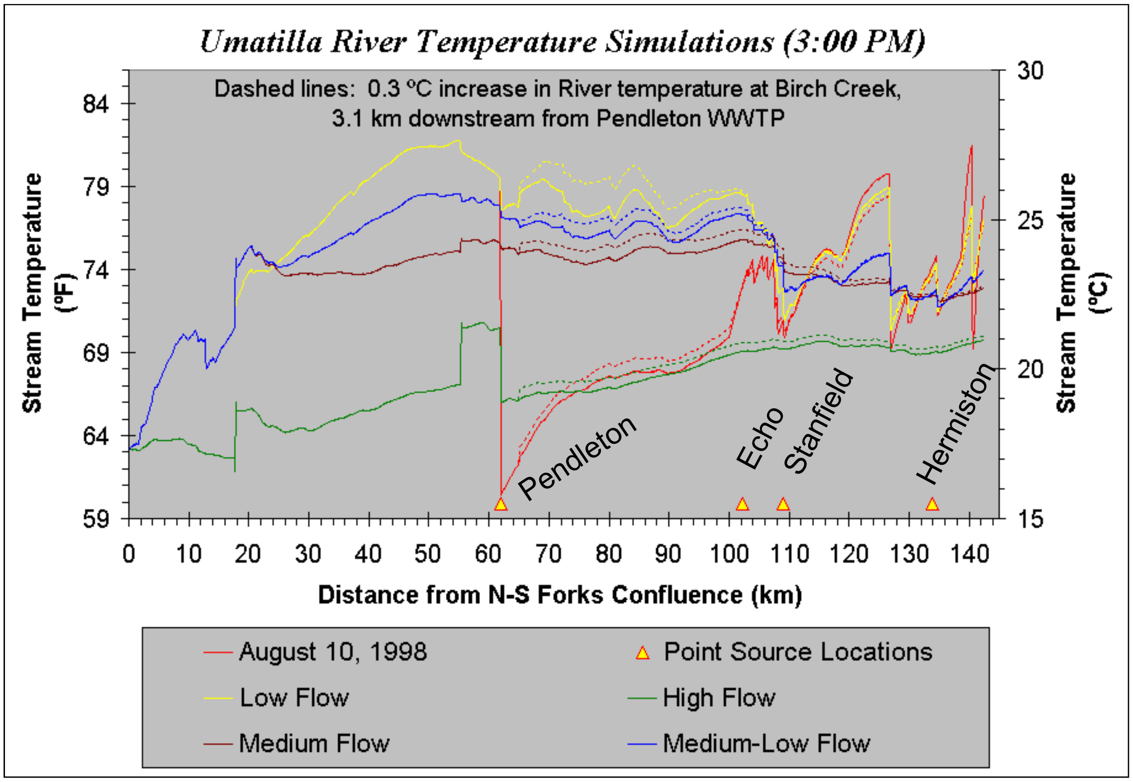
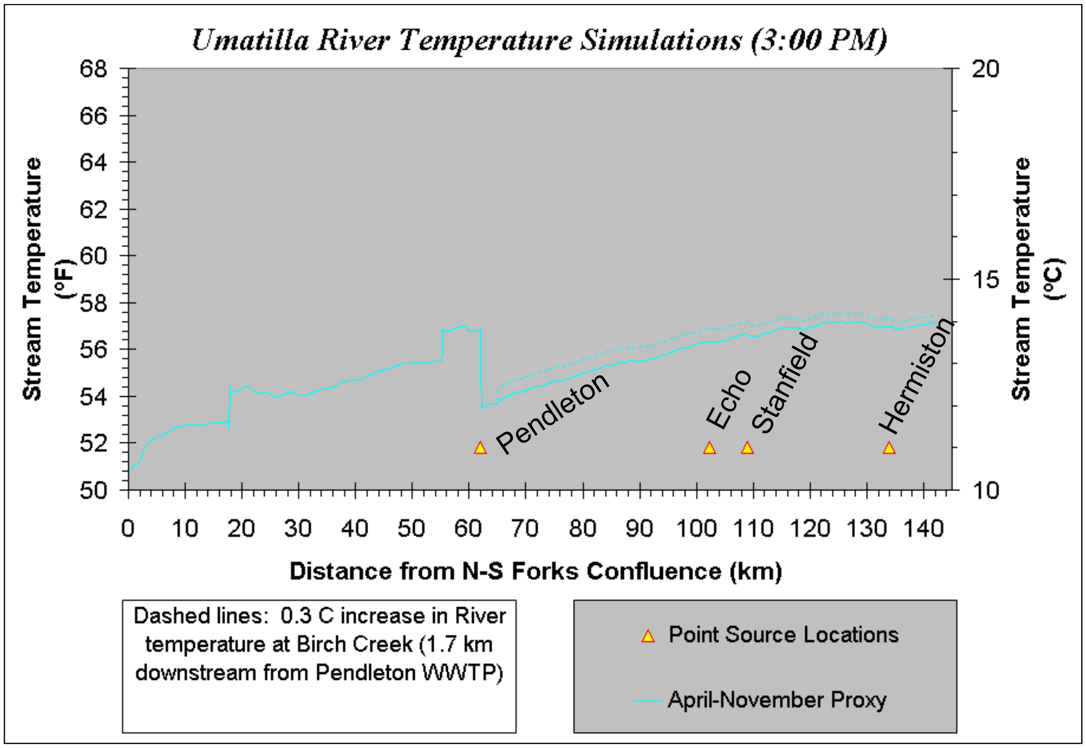


Figure 5. *Temperature simulation based on August 10, 1998 with 0.3 ºC mass transfer just below the Pendleton WWTP. Flow is varied to test its influence on instream heat retention.*



Having determined that heat input in the Pendleton area does not produce a measurable increase in river temperature at downstream point sources, *during the low-flow warm season*, model scenarios were prepared to represent fall and spring conditions. There are limitations to this approach, given that the model is an early version of heat source and does not accommodate varying the solar day/angle and cloud cover. Additionally, the model was not setup to address flows above approximately 15 CMS (530 CFS). Nonetheless, the model sheds substantial light on heat retention during the times of concern and is able to represent those factors that control heat retention, within the range of flows where heat retention is most sensitive. Two scenarios were considered as proxies for conditions present in early November and late April, as these are the critical shoulder seasons for the winter dischargers and have relevance for the Pendleton and Hermiston discharges as well. Both scenarios, unlike those described previously, are combination scenarios. Flow, shade, air temperature and tributary input water temperature were simultaneously modified to approximate November and April conditions. A point temperature increase of 0.3 ºC was introduced as before, at Birch Creek. Ultimately, only one model scenario is reported here to address both months, as the difference between April and November, in terms of heat retention control, is river discharge. Even at the lower November flow, there is very little attenuation of heating in the lower river. In April there is essentially none. The April-November scenario is shown in **Figure 6**.

Figure 6. *August 10, 1998 temperature simulation with a 0.3 ºC point increase in Umatilla River temperature below the Pendleton WWTP. Air temperature and shade are set to balance November and April conditions, while flow is based on the lower of the two months.*



Model Documentation

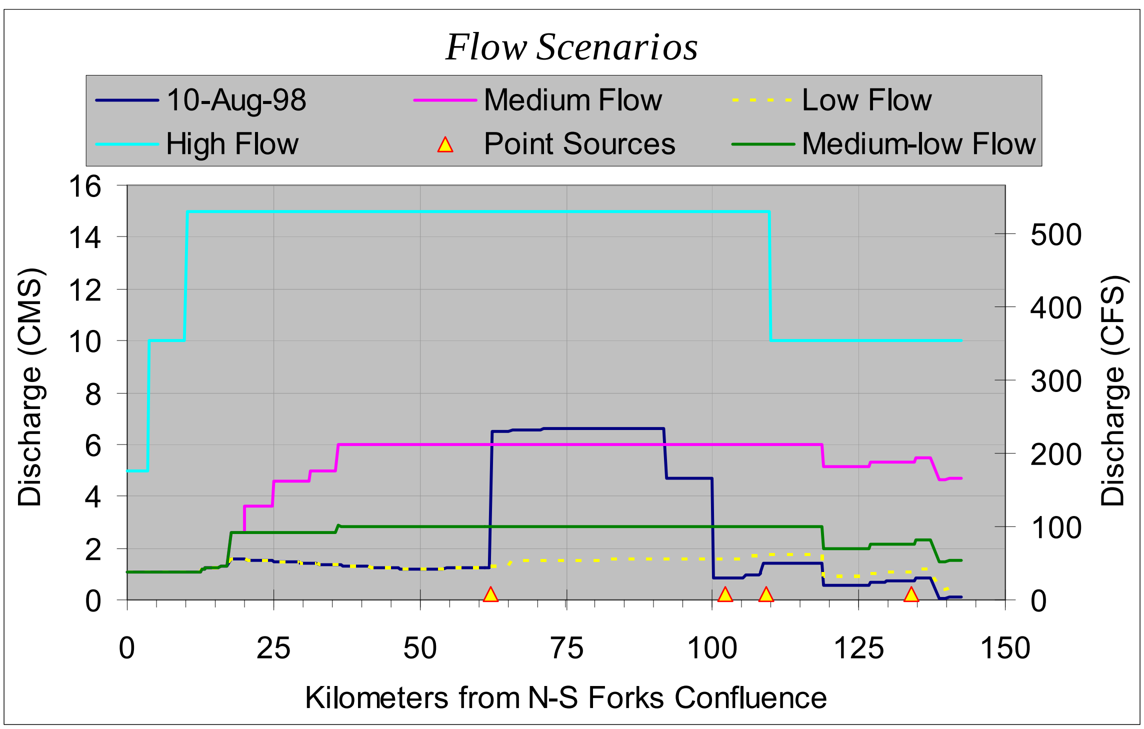
The model, inputs other than those described here, and methodology are described in Appendix 4 of the *Umatilla River Basin Total Maximum Daily Load and Water Quality Management Plan* (approved by US Environmental Protection Agency May 2001). The following list provides specifics for the various model scenarios run for this report.

- Base model: the August 10, 1998 existing condition is the TMDL model calibration scenario.

For each model run, a companion scenario was run with introduced warm water input ranging from 0.12 - 0.25 CMS, at a temperature such that Umatilla River temperature in increased by 0.3 ºC. For all scenarios, an input was simulated at the mouth of Birch Creek, 3.1 kilometers below the Pendleton WWTP outfall at the mouth of McKay Creek. The introduced mass transfer replaced existing input (Birch Creek) with 24-hour uniform temperature discharges. This introduced discharge point is below referred to as a *human use allowance test*.

- Simulation of high humidity: the base model was run with humidity increased to 90% for the length of the river, for each hour of the model. The human use allowance test was applied at Birch Creek – 23.5 ºC at 0.25 CMS.
- Simulation of high air temperature: the base model was run with air temperature multiplied by 1.25 at each hour of the model. The human use allowance test was applied at Birch Creek – 23.5 ºC at 0.25 CMS.
- Simulation of decreased shade: the base model was run with 20% vegetation height and density along the entire river, on both sides. The human use allowance test was applied at Birch Creek – 23.5 ºC at 0.25 CMS.
- Simulation of low flow: the base model was run with McKay Creek input reduced from 5.27 CMS to 0.03 CMS. Major diversions near Echo were removed as well. Flow profiles for the flow scenarios are plotted in **Figure 7**. The human use allowance test was applied at Birch Creek – 31.0 ºC at 0.15 CMS.
- Simulation of medium flow: the base model was run with increased headwater flow and decreased diversions. The human use allowance test was applied at Birch Creek – 18.25 ºC at 0.25 CMS.
- Simulation of high flow: the medium flow model was run with additional increased headwater flow. The human use allowance test was applied at Birch Creek – 30.0 ºC at 0.25 CMS.
- Simulation of medium low flow: This final scenario was added to evaluate river discharge intermediate to the low and medium scenarios. The human use allowance test was applied at Birch Creek – 25.0 ºC at 0.25 CMS.

Figure 7. *Temperature simulated Umatilla River Flow Scenarios*



- Early November and Late April proxy: the base model was run with decreased air temperature (0.5x, resulting in the range 7-16 ºC) and decreased vegetation. Both vegetation height and density were reduced to 20% of the August 1998 condition. River upstream boundary and tributary input temperatures were reduced (multiplied all tributary and boundary condition stream temperatures by 0.6 – this produces a range of 7-12 ºC). The discharge profile of the high flow scenario was used. The human use allowance test was applied at Birch Creek (18.25 ºC at 0.25 CMS).

Near-Field Calculations

The simulations represented in **Figures 3-6** provide for evaluation of downstream heat retention. Another relevant analysis is whether a facility is capable of causing a near-field temperature increase that is a significant fraction of the potential human use allowance, based on a dilution calculation. For instance, the Athena WWTP discharge is diluted by Wildhorse Creek, transported downstream for 18 miles, and then again diluted by the Umatilla River. Even if no heat were dissipated from the Athena WWTP input, at maximum facility design flow and at the upper end of likely effluent temperature, it could only heat the Umatilla River by 0.025 ºC (**Table 1**) during its season of discharge. To be protective, lower-end receiving flows are considered in this analysis. Accordingly, the Athena WWTP can be allowed the full 0.3 ºC human use allowance, as even with highly protective assumptions the temperature increase at the Pendleton WWTP is negligible – less than one-tenth of the maximum potential HUA (0.3 ºC). This calculation was performed for each individual-facility NPDES discharge in the Subbasin, as follows:

> The equation below evaluates the change in river temperature via the influence of point source discharge, as if temperature were a conservative parameter. **Table 1** lists input parameters and equation results. Note that in **Table 1**, the river temperatures are based generally on **Figures 2** and **8**, or NTP for August. In the cooler months, temperatures below that which would trigger the spawning cold water protection criterion (13.0 ºC) were not selected. During this period, allowed human warming increments are explicit in rule (OAR 340-041-0028 (12)) and hence no analysis is needed.

$$\Delta Tm = \frac{(Tem - Tr) \times Qe}{Qe + Qr}$$

where ΔTm = maximum likely increase in river temperature immediately downstream of full mixing (ºC), given no targeted limitations
Tem = maximum likely effluent temperature (ºC)
Tr = river temperature immediately above point source (ºC)
Qe = effluent discharge (cubic meter per second)
Qr = river discharge immediately above point source (cubic meter per second)

Table 1. *Facility information for evaluating potential impact to the receiving water body.*

Source (from upstream to downstream)	Design flow (Qe, CFS)		Season of evaluation	Receiving stream 7Q10, seasonal low flow, or monthly 10th percentile (Qr, CFS)		River temperature above point source (Tr, ºC)	Maximum potential effluent temperature (Tem, ºC)*	ΔTm (ºC)
Athena WWTP	0.190	(0.123 mgd) (0.0054 cms)	Nov 1 thru Apr 30	10	Wildhorse Ck: 10 cfs (0.283 cms) –lowest 7-d avg 1998-2001	18	25	0.131
	0.190			52	Umatilla River: 52 cfs (1.472 cms) –lowest 7-d avg 1998-2005	18	25	0.025
Pendleton WWTP	8.510	(5.5 mgd) (0.241 cms)	August thru Nov 1	20	20 cfs 7Q10 from NPDES eval. (0.566 cms)	21	30	2.686
	8.510		April	576	Table 2	13	25	0.175
	8.510		May	1211	Table 2	15	25	0.070
	8.510		June	539	Table 2	18	30	0.187
	8.510		July	98	Table 2	20	30	0.799
	8.510		Nov	62.8	Table 2	13	20	0.835
Echo WWTP	0.185	(0.12 mgd) (0.005 cms)	Nov	65	65 cfs minimum from 3-yr recent data, Nov-Apr. (1.841 cms)	13	22	0.026
	0.185		April	576	Table 2	13	22	0.003
Stanfield WWTP	0.347	(0.224 mgd) (0.010 cms)	Nov	58	58 cfs 7Q10 from NPDES eval.(1.642 cms)	13	22	0.054
	0.347		April	576	Table 2	13	22	0.005
Hermiston WWTP	4.550	(2.94 mgd) (0.129 cms)	August thru Nov 1	58	58 cfs 7Q10 from NPDES eval. (1.642 cms)	21	30	0.655
	4.550		April	576	Table 2	13	25	0.094
	4.550		May	1211	Table 2	15	25	0.037
	4.550		June	539	Table 2	18	30	0.100
	4.550		July	98	Table 2	20	30	0.444
	4.550		Nov	142	Lower Umatilla River Gage 10th percentile, 1970-2005	13	20	0.217

Table abbreviations: mgd – million gallons per day, cfs – cubic feet per second, cms – cubic meter per second

**physical, not regulatory maximum – it is unlikely the facility could generate higher temperatures even with no targeted limitations.*

Discussion of Results

This discussion addresses whether individual facilities should be allowed the full Umatilla Subbasin 0.3 ºC HUA available to point sources, based on the analyses summarized previously in this Appendix. In addition, there are times when the combined facilities do not have the physical capacity to cause a cumulative exceedance of the HUA at any point in the river, and this is documented herein.

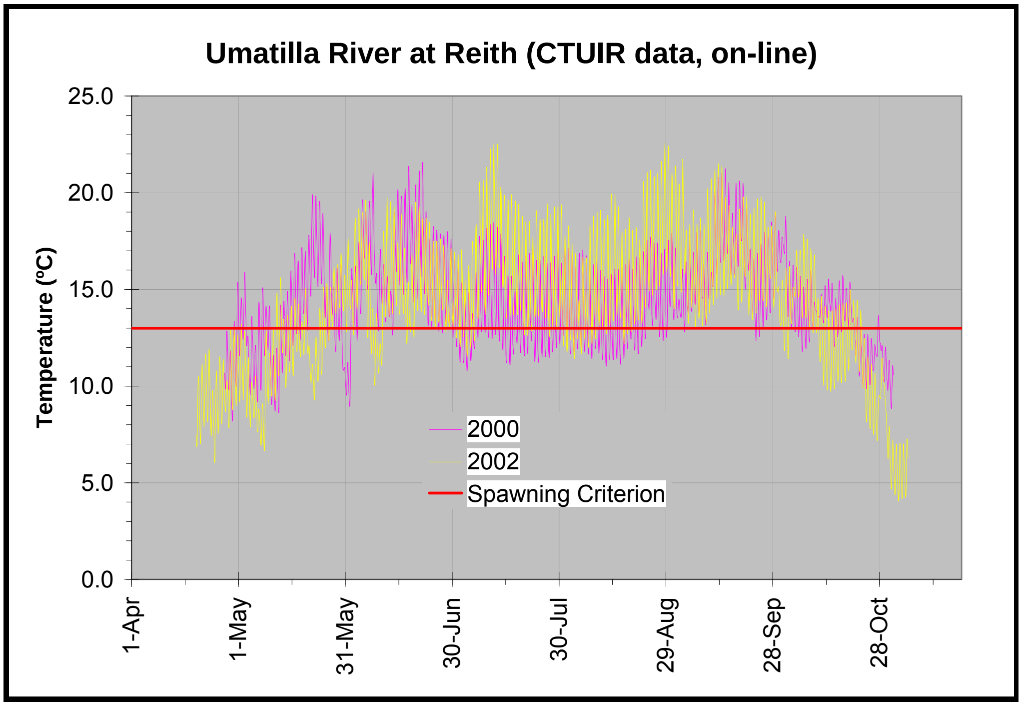
Generally, the reasoning of this section follows two paths. In a given time interval, if river flow is low enough, then thermal retention is slight and cumulative effects do not occur. If river flow is high, slight temperature increases carry far downstream, however the sum of maximum potential temperature increase from all facilities may be less than 0.3 ºC, due to high dilution. Assessment of the former situation was carried out through the temperature simulations portrayed in **Figures 3-6**. Assessment of the latter is based on the mixing calculations of **Table 1**. To be protective these assessments consider higher range flows when addressing downstream thermal retention and lower range flows when addressing the mitigating effect of dilution.

The following text is organized by season and facility, with some of the more obvious conclusions being dealt with first. The resultant apportionment of the human use allowance is shown in **Table 3**.

Athena WWTP, when discharge is allowed. Allowing the Athena WWTP 0.3 ºC is appropriate, during its November 1 through April 30 period of direct discharge. This discharge is not influenced by another facility, as it is the uppermost of the Subbasin individual NPDES sources. Its capability of heating receiving waters downstream to the next source of concern, the Pendleton WWTP, is not significant as described previously and as shown in **Table 1** (Umatilla River ΔTm). In addition to the fact that river heating from the Athena WWTP is minimal due to dilution, thermal retention instream is inferred to be slight as well. Umatilla River modeling shows that at low flow, a 0.3 ºC increases carries only a short distance downstream. Wildhorse Creek, the receiving water body, has much less flow than the Umatilla River and clearly could not maintain a 0.3 ºC anthropogenic increase for the 18 miles from Athena to Pendleton.

Pendleton and mainstem WWTPs while spawning cold water protection criterion applies. This criterion applies to the mainstem when the 7dAM river temperature is less than 13.0 ºC. During this interval, greater than 0.3 ºC increases are allowed via application of the cold water protection criterion, on the basis of 60-day averaging regardless of cumulative effects. As such, discussion of whether a full 0.3 ºC HUA is allowed is irrelevant, since heating above this level is allowed at each facility. This period typically begins late-October to mid-November and ends mid to late April (**Figures 2** and **8**).

Figure 8. *Umatilla River seasonal temperature pattern (data from CTUIR at Reith).*



Pendleton and mainstem WWTPs after spawning cold water protection criterion applies, until April 30. Thermal retention is favored during this high flow period (**Figure 6**). Simulation reveals that a residual warming of 0.18 ºC at Hermiston results from an increase of 0.32 ºC in the Umatilla River at Birch Creek However, this window is generally small to nonexistent in the Pendleton area, where the river in recent years is less than 13.0 ºC through the end of April (**Figure 8**). Regarding the Hermiston area, **Figure 2** indicates that the cold water protection criterion ends roughly April 10-25. As riparian conditions improve through time, this window of time between cold water (<13 ºC) and April 30 will narrow. Furthermore, the combined capability of Pendleton, Echo, Stanfield and Hermiston WWTPs to increase river temperature during April, with no heat attenuation between the facilities, amounts to 0.277 ºC (April in **Table 1**). This is less than the maximum HUA of 0.3 ºC. Accordingly, no reasonable potential exists for the applicable criterion to be exceeded by more than 0.3 ºC, due to these sources, at any point along the Umatilla River, during this period.

Pendleton and Hermiston WWTPs – May 1 through June 30. Echo and Stanfield are not permitted to discharge during this time frame, so the concern for May through June is whether thermal retention sustains from Pendleton to Hermiston. From **Table 2**, May and June upper-end 7-day flows in recent years are 1211, 539 (34.3, 15.3 CMS), respectively. The combined capability of Pendleton and Hermiston WWTPs to increase river temperature during May, with no heat attenuation between the facilities, amounts to 0.107 ºC (May in **Table 1**). In June, their combined maximum potential influence would be a river warming of 0.287 ºC. These increases are less than the maximum HUA of 0.3 ºC. Accordingly, no reasonable potential exists for the applicable criterion to be exceeded by more than 0.3 ºC, due to these sources, at any point along the Umatilla River during May and June.

Pendleton and Hermiston WWTPs – July. As with May and June, the Echo and Stanfield WWTPs are not permitted to discharge during July, so the WWTP of concern are those of Pendleton and Hermiston. In contrast with May and June, flow has decreased in the Umatilla River such that the upper potential aggregate heating of the River from the Pendleton and Hermiston WWTPs is 1.24 ºC (**Table 1**) – exceeding the maximum potential HUA of 0.3 ºC. To further evaluate the situation, longitudinal temperature simulation was carried out to test downstream thermal retention. The medium-low flow scenario of **Figure 7**, based on river discharge of 100 CFS (2.83 CMS) from above Pendleton to nine-kilometers below Stanfield, addresses July. The data plotted in **Figure 7** indicate that the introduced 0.3 ºC at Birch Creek diminishes to less than 0.02 ºC a few kilometers below Stanfield. Given the slight thermal retention and the conservative assumption of full design flow, there is no potential for significant thermal overlap between the Pendleton and Hermiston WWTPs. Accordingly, each will be allowed the full potential HUA of 0.3 ºC.

Pendleton and Hermiston WWTPs – August 1 through October 31. Again, Echo and Stanfield are not permitted to discharge during this period, so only Pendleton and Hermiston are considered. **Figures 3-5** indicate that at low flow, the introduced 0.3 ºC near Pendleton does not carry downstream to Echo, let alone Hermiston. This modeled low flow (**Figure 7**) is 1.53 – 1.74 CMS (54-61 CFS) from just below Pendleton to below Stanfield. The 90th percentile for 7-day average flow in Pendleton for 1998-2005 is provided in **Table 2**. As the upper range actual flow is similar to the simulated flow that showed no thermal retention well above Hermiston, given a 0.3 ºC increase in River temperature near Pendleton, 0.3 ºC may be allowed at each facility during August and September. October may be more in question. However, the medium-low simulated flow (2.83 CMS, 100 CFS) indicated only a 0.02 ºC carryover from Birch Creek to Hermiston. Given that 0.02 ºC is less than one-tenth of the full potential HUA and that the simulation was done at maximum facility design flow and higher than 90th percentile river flow, it is safe to apportion the full 0.3 ºC HUA to both facilities during this October. Another factor favoring this conclusion is that the simulated point of 0.3 ºC increase is 1.9 miles (3.1 km) below Pendleton. In summary, no reasonable potential exists for the applicable criterion to be significantly exceeded by more than 0.3 ºC, due to these sources, at any point along the Umatilla River during August through October.

Table 2. *Umatilla River 7-day average 90th percentile flow (aggregate multi-year data set for each month) in Pendleton, 1998-2005. Units are cubic feet per second.*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
90th percentile	1394	1210	1924	1565	1211	539	98.0	48.7	58.1	82.9	322	799
10th percentile				576	452	93.2	41.7	30.7	38.8	46.2	62.8	

Pendleton and mainstem WWTPs from November 1 until spawning cold water protection criterion applies. At this time, all of the point sources are allowed to discharge. In November, the maximum potential near-field river heating (**Table 1**) for the Pendleton, Echo, Stanfield and Hermiston facilities are 0.84, 0.026, 0.054 and 0.217 ºC, respectively, with this being conservatively assessed at facility maximum design flow and low river flow as in prior discussions. This resultant sum of 1.13 ºC un-attenuated heating exceeds the maximum potential HUA. However, at this low flow of roughly 60 CFS (**Table 1**), a 0.3 ºC river warming near Pendleton, the maximum potentially allowable HUA, attenuates entirely just upstream from Echo (**Figure 5**, low and medium-low flow scenarios). The issue then becomes this: at river flows that are too low for dilution to minimize near-field heating and too high to minimize downstream heat transfer, is there a cumulative effect?

The answer is simplified somewhat by first addressing the Echo and Stanfield discharges. Due to their low potential for heating, even at the low flows when the Umatilla River exhibits slight thermal retention downstream, Echo and Stanfield are assumed negligible. At 60 CFS a 0.3 ºC temperature increase near Pendleton attenuates entirely within about 20 miles. At this flow, the slight potential increase in river temperature from these facilities does not overlap with Pendleton or Hermiston. At twice that amount of flow, as the river begins to develop more thermal inertia (similar to the medium flow scenario of **Figure 5**), the maximum combined capacity of these facilities to heat the river amounts to 0.04 ºC (this calculation made as in **Table 1**) and significant downstream attenuation still occurs. In other words, these relatively small discharges lose their ability to significantly warm the river as instream flow increases to levels that lead to potential cumulative effects from downstream thermal retention. This narrows the discussion focus to Pendleton and Hermiston.

In November, the 90^{th} percentile Umatilla River flow ranges from 322 CFS at Pendleton to 600 CFS at Yoakum (14 miles upstream from Echo). At these flows, there is little attenuation between Pendleton and Hermiston, of a 0.3 ºC warming introduced near Pendleton (middle to high flow range in **Figure 5**). If the Umatilla River were to be heated by the maximum allowable 0.3 ºC in Pendleton and the 0.2 ºC maximum capacity potential at Hermiston, it is likely that river warming would exceed 0.3 ºC at Hermiston. However, at 600 CFS when thermal retention is high, the Hermiston WWTP maximum potential heating is 0.05 ºC (this calculation made as in **Table 1**), and it is unlikely that the Umatilla River would be warmed by more than 0.3 ºC at any point. Accordingly, no reasonable potential exists for the applicable criterion to be exceeded by more than 0.3 ºC, due to all four sources combined, at any point along the Umatilla River during this period.

Apportioning the Human Use Allowance

To summarize the preceding discussion, the Department considers that HUA restrictions to less than 0.3 ºC are unnecessary, at any time of year, for each of the five individual NPDES sources in the Umatilla Subbasin, as indicated in **Table 3**. Depending on the month and facility, this is because analysis indicates that the combined facilities either (1) lack cumulative thermal effects due to distance between sources and associated attenuation of introduced heat, or (2) do not possess the capacity, in terms of design flow and maximum likely effluent temperature, to collectively increase the Umatilla River temperature at any point by more than 0.3 ºC.

Table 3 identified the HUA for each facility at various seasons. The computer simulations, mass balance calculations and reasoning behind **Table 3** are described in previous sections of this Appendix.

Table 3. *Allowable HUA.*

Source	During Cold Water Protection (Spawning)	End of Cold Water Protection (Spawning) through April 30	May 1 though June 30	July	August 1 through October 31	November 1 through Beginning of Cold Water Protection (Spawning)
Athena WWTP	**> 0.3 ºC ****	**0.3 ºC**	**DNP**	**DNP**	**DNP**	**0.3 ºC**
Pendleton WWTP	**> 0.3 ºC ****	**NRP**	**NRP**	**0.3 ºC**	**0.3 ºC**	**0.3 ºC**
Echo WWTP	**> 0.3 ºC ****	**NRP**	**DNP**	**DNP**	**DNP**	**NRP**
Stanfield WWTP	**> 0.3 ºC ****	**NRP**	**DNP**	**DNP**	**DNP**	**NRP**
Hermiston WWTP	**> 0.3 ºC ****	**NRP**	**NRP**	**0.3 ºC**	**0.3 ºC**	**NRP**

***OAR 340-041-0028 (11)(A) and (B) allow 0.5-1.0 ºC increases above the 60-day average of ambient receiving water temperature when this criterion is applicable*
DNP – Discharge is not permitted
NRP – No Reasonable Potential exists for the receiving water body temperature to be increased by more than 0.3 ºC, due to combined permitted discharges, at any point along the Umatilla River.