April 10, 2009

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Subject: Second Follow-up to the March 25, 2009 Spokane River Dissolved Oxygen TMDL Meeting

Dear EPA, Ecology and DEQ representatives:

In our April 3, 2009 letter to you, the Spokane River Stakeholder Group identified a number of issues, concerns and questions relating to the agency proposed decisions and direction and indicated that we would be providing more detailed comments and suggestions relating to our issues and concerns.

The following discussion attempts to clarify and expand the more important aspects of our concerns, and where possible we have tried to offer suggestions and possible alternatives.

Is there enough analysis of scenarios:

The Stakeholder Group is concerned that the agencies may have reduced the number of scenarios too severely to identify the range of implementable discharge requirements, which could result in technically and/or financially infeasible requirements for discharger permits and Avista. The objective of a TMDL process is to determine combinations of loadings from non-point and point sources that would result in compliance with the water quality standard, and it is critical that the TMDL process be scientifically and legally defensible.

For the current Spokane River CE-QUAL-W2 model update, the water quality modeling has been limited by the regulatory agencies to predetermined effluent phosphorus concentrations not greater than 50 ug/L. Determination of the upper limit of allowable point source discharge loadings is needed to ensure fiscally responsible water resources management, and that the effort is in the public's beneficial interest. It is also important to evaluate the upper limit allowable to point source discharges in order to determine the appropriate margin of safety for the TMDL. EPA and Ecology should not assume that only a limit below 50 ug/L will provide an adequate margin of safety.

> ***Suggestion/Request:*** If the outcome of the 50 ug/L total phosphorus (TP) scenario results in predicted water quality that is better than its standard, the regulatory agencies should run additional model iterations at progressively higher effluent phosphorus concentrations to determine the upper boundary condition that achieves the water quality standard. We are interested in having the agencies run enough scenarios to provide an equitable, and scientifically defensible TMDL.

A related concern is that nutrient targets (e.g., 0.25 mg/L Ammonia) are being determined prior to running the appropriate model scenarios that will predict allowable loads that will achieve DO water quality standards.

The Dischargers are concerned that ammonia targets will be set lower than needed to not cause or contribute to an exceedence of the dissolved oxygen criteria. The agencies additional model iterations should include progressively higher ammonia and CBOD concentrations to determine the concentrations that do not cause or contribute to dissolved oxygen criteria exceedences. This is particularly needed for the Idaho discharges since the effects of these pollutants degrade in the river with distance from the discharge. Using a higher TP concentration for the Idaho dischargers does make sense in that assimilation (attenuation) of phosphorus will be greater for Idaho than Washington. Modeling scenarios should mimic reality as much as possible.

> ***Suggestion/Request:*** Run enough appropriate scenarios to determine the nutrient concentrations (e.g., Ammonia) that achieve the water quality standard, rather than assigning predetermined concentrations.

Dual Assessment:

The Spokane River Stakeholder Group supports the use of dual assessment points in the lower Spokane River and in the transition zone at the upper end of the Lake Spokane reservoir. However, we have concern with regard to using lake assessment points below the upper end of the Lake Spokane reservoir as part of the modeling effort.

Assessment points down-lake should not be used to determine what measures can or should be undertaken to improve DO because Lake Spokane reservoir is a large, artificial water body, created by a dam that will never attain the DO levels of a free-flowing river. Instead, the focus should be on the riverine and transition zones. In order for numeric criteria to serve their intended purpose of supporting existing and designated uses, assessment points should be placed where there is available aquatic habitat. Ecology's water quality standards require such an approach, providing that: "D.O. measurements should be taken to represent the ***dominant aquatic habitat*** of the monitoring site." WAC 173-201A-200(1)(d)(iv)(emphasis added).

In this case, the habitat identified by WDFW is the spawning and rearing habitat in the river and shallow part of the upper lake. By establishing assessment points in that vicinity, Ecology can provide reasonable assurance that numeric criteria will be met where the other essential habitat conditions exist.

Suggestion/request: For these reasons, the dischargers and Avista recommend that Ecology and EPA use assessment points in the riverine and transitions zones of the upper Lake Spokane reservoir for modeling purposes.

Riverine Assessment:

The Dischargers in the Stakeholder Group have concerns regarding 1) the proposed 10 ppb Total Phosphorus "target" (where does it come from and how will it be applied), 2) the location of the assessment point (Segment 157 versus 154), and 3) the use of a phosphorus "target" instead of a dissolved oxygen target/criteria to determine compliance with water quality standards (there is no state phosphorus water quality criteria approved by EPA for the Spokane River).

The EPA approved water quality standards for Washington establish an average eutrophic zone concentration of total phosphorus not to exceed 25 ug/L during the period of June 1 to October 31 for the Spokane River from Long Lake Dam to Nine Mile Bridge. WAC 173-201A-602 Table 602 WRIA 54 n.2(a). There are no established nutrient water quality criteria for the Spokane River from Nine Mile Bridge to the Idaho border.

The Stakeholders are concerned that Ecology and EPA have not followed a lawful or appropriate method to modify the existing nutrient criteria for Lake Spokane reservoir or to set nutrient criteria in the Spokane River above the lake, independent of allocations of phosphorus loading to achieve the dissolved oxygen water quality criteria. First, Lake Spokane reservoir and the Spokane River are not currently listed under section 303(d) as being impaired for phosphorus. Second, Washington water quality criteria, WAC 173-201A-230, and Ecology guidance on nutrient criteria development in Washington (Moore 2004) outline a process for developing lake-specific criteria that has not been implemented to derive the proposed phosphorus target in the water quality modeling. Third, Ecology's stated position to EPA in its Nutrient Criteria Development in Washington State – Phosphorus, at 36 (May 2004), is that it would not develop statewide nutrient criteria for rivers:

> During the same review timeframe that Ecology used to develop the lake nutrient criteria, Ecology evaluated the feasibility and benefits of establishing nutrient criteria for flowing water systems. Ecology examined periphyton growth, chlorophyll *a*, nitrogen, and total phosphorus levels in ecoregions on the west and east sides of the state. Ecology's researchers were unable to find a predictive relationship between excess production and eutrophication and measured nutrient concentrations. Flow rates, shading, and available light are also confounding factors in eutrophication processes in streams and rivers. Thus, efforts to develop statewide nutrient criteria for river and stream systems were curtailed. Ecology has chosen an alternative pathway for the control of nutrient concentrations in riverine systems that rely on other indicators and triggers for trophic health, and more water body specific modeling to select nutrient threshold values.
>
> Washington State has established aquatic life criteria for pH and dissolved oxygen, which serve as sensitive indicators of riverine eutrophication. The most utilitarian of these measures is dissolved oxygen. Throughout most of the state, a single daily minimum below 9.5 mg/L in the upper watershed or below 8.0 mg/L in the lower watershed causes waters to be examined for potential impairment. In a few select slow moving streams heavily impacted by human alteration, and typically in the arid region of the state, a single daily minimum 6.5 mg/L serves as the trigger. While these dissolved oxygen values were set to provide a high level of protection and support for metabolic function, they also set a standard that cannot be attained in rivers with nuisance algal growth.
>
> In establishing permit limits or in establishing load and wasteload allocations through

> TMDLs or water clean up plans, the role of nutrients in affecting oxygen levels is evaluated and protective limits established where nutrients are interfering with attainment of the daily minimum oxygen levels. Thus compliance plans for the dissolved oxygen criteria examine the influence of BOD, nutrients, and temperature to ensure the trophic health of the water body is maintained or restored."
>
> ***Suggestion/request:*** For these reasons, the Stakeholders recommend that Ecology and EPA not include phosphorus targets in the model.

Reservoir Assessment:

Implementation of the TMDL should acknowledge that the goal within the reservoir is to attain the highest water quality possible and recognize that it may not be reasonable or feasible to achieve a dissolved oxygen criteria that applies to natural lakes. Implementation of the DO TMDL should consider the extent to which the existing and designated uses of Lake Spokane reservoir (including aquatic resources) are already being maintained and protected. It should be clearly understood that the water quality modeling of the reservoir is a tool that can be used to achieve the highest water quality possible, but does not itself establish a numeric standard or limit that would be applicable to a discharger or Avista. We assume that Ecology will continue to honor both commitment to investment stability and the schedule for achieving water quality standards that are an integral part of the Foundational Concepts and Managed Implementation Plan.

As indicated above, we suggest the use of assessment points in the lower Spokane River and in the transition zone at the upper end of Lake Spokane reservoir. The reservoir assessment currently identified by the agencies is not an adequate approach to establish compliance targets within the reservoir. The reservoir assessment as currently proposed indicates the agencies are not focusing on protection of the existing and designated uses of Lake Spokane reservoir (including aquatic resources) when evaluating compliance with water quality standards. We are also concerned that the multiple factors and management objectives that affect water quality and the beneficial uses in Lake Spokane reservoir are not being recognized.

> ***Suggestion/request:*** We strongly recommend the use of assessment points in the lower Spokane River and in the transition zone at the upper end of Lake Spokane reservoir. Also, the approach to selecting and averaging cells to determine whether the model predicts compliance with the 0.2 mg/L differential water quality standard needs to be explicitly defined and consistent with the management of the Lake Spokane reservoir. The approach needs to recognize the accuracy and precision of the model in both a longitudinal (segment-by-segment) and vertical direction. An approach that incorporates exceedance frequency would better describe the variability in water quality and the ability of the model to predict the small differences in water quality that form the basis for the water quality criteria being applied.

Although the agencies have indicated that the increased FERC flows from the Post Falls HED will be incorporated into the reservoir assessment, it is not clear at this point how they intend to accomplish this.

> ***Suggestion/request:*** Please provide an explanation of how the Post Falls HED discharge flow will be incorporated into the currently proposed reservoir assessment scenario. Avista notes that since it is responsible for these increased flows it should therefore be credited for the benefits that result from them.

Managing the reservoir as Oligotrophic:

The Spokane River Stakeholder Group takes exception with establishing a goal of oligotrophic for Lake Spokane reservoir. Lake Spokane reservoir is a mesotrophic water body, and supports a warm-water fishery.

Ecology has previously found Lake Spokane reservoir is and was of a mesotrophic state. The following is excerpted from the Ecology's nutrient development criteria:

"Oligotrophic Conditions – Low algal productivity will generally exist with TP in the range of 0 to 10 µg/L (Nordin, 1985; Funk and Moore, 1985; Gilliom 1984; OECD, 1982; Simpson and Reckhow, 1979). Carlson, (1977) states that at TP ranges from 0 to 12 µg/L, mean chlorophyll-*a* will be less than 3 µg/L and Secchi transparency depths will be greater than 5 meters. Water-uses are supported for recreation, drinking water, and aquatic life. The water is generally of high clarity and is aesthetically pleasing. According to Nordin (1985), and Ney, et al (1990), fisheries productivity will be quite low at TP concentrations less than 5 µg/L.

Mesotrophic Conditions -- Moderate algal productivity will generally exist with TP in the range of 10 to 20 µg/L (OECD 1982; and others) or 12 to 24 µg/L (Carlson,1977), chlorophyll-*a* in the range of 2 to 6 µg/L, and Secchi transparency depths between 3 and 5 meters (Gilliom, 1984). Cold-water fisheries may be adversely affected by some degree of hypolimnetic oxygen depletion. There may be additional benefits to salmonids in lakes from having TP less than 15 µg/L (Nordin, 1985)." [1]

Please note that this same document – Table 2.2, page 13 – refers to Lake Spokane reservoir as mesotrophic as described by Patmont in 1987.[2]

Ecology's own assessment for protecting DO in Lake Spokane reservoir acknowledges, in part, a mesotrophic condition:

> "Even though the URS (1981) report highlighted the need for public input as "essential" for selecting an appropriate water quality criterion for protecting beneficial uses, there does not appear to have been much public involvement or intergovernmental coordination (e.g., Fish and Wildlife) in determining the beneficial uses of Lake Spokane reservoir, or in determining the lake criterion (time- and area-weighted average euphotic zone TP concentration of 25 ug/L)."
>
> **Suggestion/request:** Continue to acknowledge and manage the impoundment known as Lake Spokane reservoir as mesotrophic.

WWTP Performance Memo (EPA Region 10, March 24, 2009): The Stakeholder Group has concerns and questions regarding this memo – why it was done, how it will be used, the accuracy and applicability to Spokane River dischargers. Also of significant concern are the monthly limits versus seasonal limits.

Please see Attachment 1, Review of March 24, 2009 EPA Region 10 Memorandum on Wastewater Treatment Plants Achieving Low Effluent Phosphorus Concentrations, for a description of our concerns and technical discussion.

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[1] Moore, A., Hicks, M., *Nutrient Criteria Development In Washington State Phosphorus*, Washington State Department of Ecology, Water Quality Program, Watershed Management Section, April 2004. Publication Number 04-10-033.

[2] Patmont, C.R., et al, *The Spokane River Basin: Allowable Phosphorus Loading*, Harper-Owes, Seattle, WA. 1987.

> **Suggestion/request:** Based on the discussion provided in Attachment 1, effluent phosphorus at 50 ug/L should still be based on a long-term mean or median as has been discussed historically in Spokane River DO TMDL collaboration meetings.

Non-point Sources and Delta Elimination Plan under the Foundational Concepts:

The dischargers and Avista are very concerned about the proposal recently suggested by Ecology to assume that non-point sources of phosphorus will be reduced by approximately 30 to 38 percent over the next 10-20 years due to the efforts of entities other than the dischargers and Avista. There is no factual basis for this assumption, and it would effectively preclude the dischargers and Avista from contributing to the effort to reduce phosphorus loading due to non-point sources. In other words, it would nullify the Delta Elimination Plan approach contained in the Foundational Concepts.

The purpose of a Delta Elimination Plan was to provide a point source discharger a means to "offset" that portion of its required discharge reduction that was unattainable through the application of technology. The source of these "offsets" ranged from septic tank elimination to reductions of non-point source discharges entering the main stem of the Spokane River through its tributaries.

During discussions at Ecology's meeting with Washington State stakeholders on March 20, 2009 and at the EPA meeting with all stakeholders on March 25, 2009, a question was raised regarding the "level of control" that was being assumed for non-point sources on tributaries to generate the approximate 30 to 38 percent reduction in phosphorus contribution. It was explained by Ecology that these assumed reductions were estimated from the imposition of TMDLs for other water quality parameters associated with the identified tributaries and not the Spokane River. It was further pointed out that these expected reductions resulted from the best controls that could be put in place and that the controls assumed were very stringent.

Unless there has been some misunderstanding, the potential source for "offsets" needed due to the inability of technology to deliver the required phosphorus discharge reductions has essentially been substantially diminished. If this is the case, the viability of Delta Elimination Plans is at risk and places both point source dischargers and Avista in even more untenable positions.

> **Suggestion/request:** The Delta Elimination component described in the Foundational Concepts should be updated to reflect the current DO TMDL (e.g., it should recognize that Avista may use non-point source reductions to meet its DO requirements under the TMDL, just as point source dischargers are allowed to do). It should also clearly outline a path forward to establish a baseline of the amount of nutrients from non-point sources entering the reservoir from both tributaries and the main stem of the river. In establishing a baseline, it would allow us to track the effectiveness of each non-point source phosphorus reduction effort, thereby providing a basis for the sponsors of those efforts to receive credits.

Responsibility for non-point source reduction:

In order to develop equitable requirements for managing loads, non-point sources should be addressed in the modeling and in the interpretation of model output. It is not fair to ignore or place less importance on issues or their effects because they are complex or challenging to quantify. For instance, Avista's responsibility should not include nutrient loads contributed by others, including Little Spokane River loads, groundwater and agricultural loadings to Lake Spokane reservoir, and septic system loadings from Suncrest and other near lake developments. Currently, the model does not attempt to address the loadings from septic systems and fertilizer use at the 1,645 homes in the Suncrest Development, which is located on permeable sediments (coarse sands and loamy sands) adjacent to Lake Spokane

reservoir in Stevens County. A single septic system can contribute as much as 35 pounds of nitrate per year.

> **Suggestion/request:** We encourage the agencies to distinguish loads from the various sources (including Little Spokane River loads, groundwater, agricultural, and septic system loadings to the Lake Spokane reservoir) in the interpretation of predicted DO in the model.

Because the reservoir is a sink for nutrients entering throughout the year and from year-to-year, the mass-load dynamics and variety of these nutrient inflows should be factored into the assessment of water quality effects and appropriate load responsibilities. These include tributary loads for both the modeled period and other seasons of the year. We recognize that the model may be accurate for the low flow, high temperature conditions of 2001. However, it does not accurately represent total phosphorus loading occurring year-round, particularly from Hangman Creek. Considerably higher total phosphorus loads have been measured in Hangman Creek compared with 2001 conditions, and neither the dischargers nor Avista are responsible for these loads. While the upper reaches of Lake Spokane reservoir likely are minimally affected by off-season nutrient loading, considerable deposition of sediments and their associated phosphorus loads occurs in the slower, deeper portions of Lake Spokane reservoir.

> **Suggestion/request:** We encourage the agencies to model years other than just 2001 to gain an understanding of the variability of the effects of non-point and point source discharges, and establish to what degree 2001 is representative of a 1 in 10 year occurrence.

We want to reiterate our interest in maintaining collaborative efforts with you in the development of the Spokane River DO TMDL. We look forward to hearing from you and discussing these concerns and suggestions. If you have questions or would like additional information please feel free to contact Sarah Hubbard-Gray at GeoEngineers (541-389-1926 or shubbardgray@geoengineers.com) and she will coordinate with our group and get back to you.

Sincerely,

Executive Committee, Spokane River Stakeholder Group

Signed by Sarah Hubbard-Gray, GeoEngineers Facilitator for Spokane River Stakeholder Group, on behalf of the Executive Committee

Executive Committee, Spokane River Stakeholder Group

Dale Arnold - City of Spokane
Bruce Rawls – Spokane County
Speed Fitzhugh – Avista
Sid Fredrickson – City of Coeur d'Alene
Ken Windram – Hayden Area Regional Sewer Board
Tom Agnew – Liberty Lake Sewer and Water District
Terry Werner – City of Post Falls
Doug Krapas – Inland Empire Paper Company
Bud Leber – Kaiser Aluminum

CC: Governor Christine Gregoire
Governor C.L. “Butch” Otter
Senator Maria Cantwell
Senator Patty Murray
Representative Cathy McMorris Rodgers
State Senator Chris Marr
State Representative Timm Ormsby
Senator Mike Crapo
Senator James E Risch
Congressman Walt Minnick
Jay Manning – Ecology
Laurie Mann – EPA Region 10
Ben Cope – EPA Region 10
Tom Laurie – WDOE HQ
Dave Moore – WDOE ERO
John Tindall – IDEQ
Toni Hardesty - IDEQ Director

Attachment 1

Review of March 24, 2009 EPA Region 10 Memorandum on Wastewater Treatment Plants Achieving Low Effluent Phosphorus Concentrations

EPA has distributed a March 24, 2009 Memorandum from Brian Nickel (EPA, Region 10) to David Moore (Ecology, Eastern Region Office) containing an analysis of low effluent phosphorus treatment facilities:

> ***"Subject: Summary of previous reports and discharge monitoring report data for wastewater treatment plants achieving low effluent phosphorus concentrations"***

The EPA Memorandum presents a review of effluent performance from a select group of low phosphorus treatment facilities. The memorandum suggests that effluent phosphorus of less than 50 ug/L can be attained and calculates the median effluent concentration of the plants selected for the memorandum as 35 ug/L.

Generally, the facilities selected in the EPA Memorandum are smaller, may have been operating significantly below their design flow capacity, and do not include the solids processing facilities and recycle return loadings that full scale facilities for discharge to the Spokane River will include which may impact effluent performance. Key Spokane River dischargers such as the City of Spokane, Spokane County, and the City of Coeur d'Alene are all larger than the largest of the facilities included in the EPA Memorandum, which ranged from 0.5 to 4 mgd. These Spokane River dischargers all include anaerobic digestion for solids stabilization and will have solids processing recycle loadings. None of the facilities in the EPA Memorandum include anaerobic digestion. Consequently, the suggestion that effluent phosphorus of less than 50 ug/L can be achieved by Spokane River dischargers based on dissimilar reference facilities does not appear to be appropriate.

The plants selected in the EPA Memorandum do not have daily effluent phosphorus data for review and analysis. Phosphorus data from the plants analyzed in the EPA Memorandum are from sampling conducted twice per week, one per week, or at an unknown frequency.

The EPA Memorandum suggests using a 95^{th} percentile statistic of effluent performance is appropriate for Spokane River phosphorus discharges. This creates a communications issue since this approach deviates from past Spokane River TMDL discussions where the understanding was that longer term seasonal mean, or median values would be the basis for effluent phosphorus performance at 0.050 mg/L. Past analysis of reference facilities that considered mean performance have been conducted with this understanding. Since effluent limits are low and daily variability in effluent performance will be skewed to higher, rather than lower values, the 95^{th} percentile statistics will be considerably higher than the mean values.

For example, the Clean Water Services Durham treatment plant that has been used as a reference facility for previous Spokane River discussions has a substantial record of low phosphorus effluent performance. The Durham plant has a monthly median limit of 0.110 mg/L from May 1 through October 31. The 2004 summer season daily data has a log normal mean of 0.102 mg/L. However, the 95th percentile of the 2004 data set is 0.284 mg/L. So, the Durham plant would not be capable of meeting its 0.110 mg/L permit limit if it were defined on a 95th percentile statistic, as suggested by the EPA Memorandum.

Overview of EPA Region 10 Memorandum

The EPA Memorandum presents a summary of previous publications and studies of low effluent phosphorus facilities. The treatment plants selected in the EPA Memorandum are not representative of the facilities in consideration for discharge to the Spokane River in terms of size, solids processing and stabilization facilities, and solid recycle loadings to the liquid stream treatment processes. Plants selected for the EPA Memorandum are relatively small (0.5 to 4 mgd) and have either aerobic digestion facilities or no solids stabilization facilities. The EPA memorandum omits any commentary on the importance of these factors on final effluent performance.

The EPA Memorandum presents summary reviews of the following documents:

- Municipal Nutrient Removal Technologies Reference Document (Office of Wastewater Management, September 2008)
- Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus (Region 10, April 2007)
- Achieving Low Effluent Total Phosphorus Concentrations: How Low Can We Go? (Stantec, Inc.)
- Evaluation of Exemplary WWTPs Practicing High Removal of Phosphorus (Dave Reynolds, CH2MHILL and Dave Clark, HDR, November 21, 2005)
- Spokane River TMDL Collaboration (Memorandum dated September 14, 2005 from Ryan Orth of Ross and Associates to Len Bramble of the Washington Department of Ecology and Lars Hendron of the City of Spokane

The EPA Memorandum selected nine facilities reporting low monthly average effluent phosphorus concentrations for analysis. Table 1 places the facilities included in the EPA Memorandum in a broader context of other facilities studied as part of the Spokane River TMDL collaboration. Table 1 summarizes the effluent phosphorus from the plants in the EPA Memorandum next to the plants included in the Exemplary Plants Memorandum (2005) and the EPA Region 10 Study of Advanced Wastewater Treatment Plants (2007). The Exemplary Plants Memorandum analysis was focused on characterizing a variety of reference treatment process trains employed at full-scale to achieve low effluent phosphorus. This analysis emphasized the used of daily performance data to the maximum extent possible in order to characterize effluent variability.

Table 1 shows that many of the plants in the EPA Memorandum have been analyzed as part of the past reports and fall into the smaller range of plant capacities that have been

studied. Effluent phosphorus results reported for the plants in the EPA Memorandum are similar, and in some cases higher, than the results presented previously.

Table 1. Comparison of Reported Effluent Results from EPA Region 10 Memorandum[1] with Summary of Exemplary WWTPs in U.S. Practicing High Phosphorus Removal[2] and EPA Region 10 Report[3]

Facility	Average Design Flow (mgd)	March 24, 2009 USEPA Region 10 Memorandum[1]	Exemplary Plants Final Effluent Log Normal Average Total Phosphorus[2] (µg/L)		USEPA Region 10 Advanced Wastewater Treatment Plant Report[3]	
		Maximum Monthly Average Phosphorus Concentration P (µg/L)[4]	Year 1	Year 2	Average Effluent P (µg/L)	Range of Monthly Average P (µg/L)
Las Vegas, Nevada	91	Not Reported[5]	179	152	Not Reported[7]	Not Reported[7]
Alexandria, Virginia	54	Not Reported[5]	134	88	65	40 - 100
Rock Creek (Portland area), Oregon	34	Not Reported[5]	82	71	70	40 - 90
Durham (Portland area), Oregon	25	Not Reported[5]	102	73	70	50 100
Cauley Creek (Atlanta area), Georgia	5.0	Not Reported[5]	123	86	Not Reported[7]	Not Reported[7]
Indian River County Utilities West Regional WWTF, Florida	4.0	25	Not Reported[6]	Not Reported[6]	Not Reported[7]	Not Reported[7]
Snake River WWTP, Colorado	2.6	40	Not Reported[6]	Not Reported[6]	15	10 - 40
Lone Tree (Arapahoe County) Colorado	2.4	48	40	30	Not Reported[7]	Not Reported[7]
Walton, New York	1.6	25		8[8]	<10	<5 - <6
Iowa Hill (Breckenridge), Colorado	1.5	23	9	8	55	17 to 130
Farmer's Korner, Colorado	1.5	23	Not Reported[6]	Not Reported[6]	7	2 - 36
Stonegate Village WWTP	1.1	35	Not Reported[6]	Not Reported[6]	Not Reported[7]	Not Reported[7]
Pinery, Colorado	1.0	55	29	31	29	21 - 74
Grand Gorge STP,	0.50	50	Not Reported[6]	Not Reported[6]	<40	0 - 50

Facility	Average Design Flow (mgd)	March 24, 2009 USEPA Region 10 Memorandum[1]	Exemplary Plants Final Effluent Log Normal Average Total Phosphorus[2] (μg/L)		USEPA Region 10 Advanced Wastewater Treatment Plant Report[3]	
		Maximum Monthly Average Phosphorus Concentration P (μg/L)[4]	Year 1	Year 2	Average Effluent P (μg/L)	Range of Monthly Average P (μg/L)
New York						
Stamford, New York	0.5	21		20	<11	<5 - <6

[1] USEPA Region 10, Memorandum from Brian Nickel of EPA Region 10 to David Moore of Washington Ecology, "Subject: Summary of previous reports and discharge monitoring report data for wastewater treatment plants achieving low effluent phosphorus concentrations," March 24, 2009.
[2] November 21, 2005 "Evaluation of Exemplary WWTPs Practicing High Removal of Phosphorus". Year 1 data is generally 2004 and Year 2 is generally a portion of the year 2005.
[3] USEPA Region 10, "Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus," EPA 910-R-07-002, April 2007
[4] From Table 6 of EPA Memorandum with the Exception of Indian River County Utilities West Regional WWTF values taken from Table 7.
[5] Not included in EPA Memorandum
[6] Not included in Exemplary Plants review
[7] Not include in EPA Region 10 Report.
[8] Corrected Walton effluent performance data from certified laboratory presented in August 16, 2006 Advanced Treatment Process Evaluation Workshop and supersedes results reported in the original Exemplary Plants Memorandum.

The EPA Memorandum discusses a recent EPA publication titled "Municipal Nutrient Removal Technologies Reference Document" (September 2008) evaluating the performance and costs of facilities removing nitrogen and phosphorus. EPA examined effluent nitrogen and phosphorus performance at 29 full scale treatment plants in the United States and one in Canada. Detailed process information and costs were analyzed for more than 40 different treatment technologies for removing nitrogen and phosphorus from municipal wastewater. Nine facilities were studied in depth with case studies presented in an appendix.

Table 2 summarizes the effluent phosphorus from 16 facilities included in the EPA Reference Document. The EPA Memorandum selectively presents effluent phosphorus results from just three of the smallest of these facilities that report the lowest effluent phosphorus.

Table 2. Summary of Low Phosphorus Facilities Reported in EPA Municipal Nutrient Removal Technologies Reference Document[1]

Facility	Average Effluent P (mg/L)	Treatment Process
Penticton, British Columbia	0.3	University of Cape Town (UCT) process with filter
Genesee County, Michigan,	0.24	Anoxic/oxic (A/O) process (no chemical and no filter)
Kelowna, British Columbia	0.139	Westbank process with fermenter and filter
Clean Water Services Durham, Oregon	0.132	A2O with volatile fatty acid (VFA), chemical, tertiary clarifier, and filter
Kalispell, Montana	0.12	Modified UCT with fermenter and filter
Clark County, Nevada	0.10	A/O with filter
Truckee Meadows, Nevada	< 0.1	PhoStrip with filter
Lee County, Florida	0.098	Oxidation ditch with denitrification filter with alum
Chelsea, Michigan	0.090	Chemical addition with flocculating clarifier
Fairfax County, Virginia	0.090	Step-feed AS with fermenter and filter
Hyrum, Utah	0.070	Membrane bioreactor
McMinnville, Oregon	0.058	Chemical addition with tertiary clarifier and filter,
Pinery, Colorado[2]	0.031	5-Stage Bardenpho with chemical and filter
Lone Tree Creek, Colorado[2]	0.027	Membrane bioreactor
Breckenridge, Colorado[2]	0.010 (literature report)	Enhanced biological phosphorus removal with chemical addition and filter
Brighton, Michigan	0.01	Chemical addition with tertiary filter and infiltration basin (land treatment process eliminated from consideration in EPA Memorandum)

[1] Source: Table ES-1, EPA. 2008. Municipal Nutrient Removal Technologies Reference Document, Volume 1 – Technical Report. EPA 832-R-08-006. Washington, DC.
[2] Included in USEPA Region 10, Memorandum from Brian Nickel of EPA Region 10 to David Moore of Washington Ecology, "Subject: Summary of previous reports and discharge monitoring report data for wastewater treatment plants achieving low effluent phosphorus concentrations," March 24, 2009.

The EPA Memorandum offers little insight into factors important in governing how low effluent phosphorus effluent can be accomplished. No new information is provided about treatment technologies or the factors determining effluent performance. The important

results from local pilot testing of low phosphorus treatment technologies specific to local wastewater chemistry are not included in the EPA Memorandum.

In contrast, the EPA Reference Document (2008) cites a number of factors that are key to low effluent phosphorus performance:

> *"The key factors included, for biological removal, an adequate supply of VFAs in the wastewater (and the use of a fermenter to generate additional VFAs where needed), the size of the anaerobic and aerobic zones, the number of swing zones, the sludge age, the control of secondary release, and the depth of the sludge blanket in the secondary clarifier. For chemical removal, the key factors included the number of chemical application points, the dosage, the need for a tertiary clarifier, and the type of filters for final polishing. Management of recycle flows is another key factor for reliable operations."*

By selecting only small facilities that do not include anaerobic digestion facilities, the EPA Memorandum ignores one of the most significant challenges in achieving low effluent phosphorus. Larger wastewater facilities generally employ anaerobic digestion to efficiently stabilize solids removed in the treatment process, reduce the quantity of solids produced, and recover energy from digester gas production. Thickening and dewatering recycled loadings from solids processing must be addressed and while their impact can be reduced in the design of the treatment process, recycle loadings remain a significant challenge to accommodate in the liquid stream process. Significantly, liquid stream performance cannot be enhanced at the expense of the solids stream in larger plants with complete solids processing through thickening, anaerobic digestion, and dewatering.

The EPA Memorandum attempts to address the issue of plant size by suggesting that the treatment technologies included in the memorandum "can be scaled to larger facilties." Little consideration is given to the other factors that may be important in making a treatment process selection, such as the construction cost for facilities, operating costs, chemical use, solids generated, physical plant site space requirements, etc. These are important factors. Some of the technologies included in the EPA Memorandum, such as dual sand filtration with chemical, have never been built at a capacity greater than 2 to 4 mgd. Other treatment process trains in the EPA Memorandum are one-of-a-kind systems that exist in only one location.

The EPA Memorandum makes reference to a proposal from Veolia Water North American offering a process guarantee of effluent phosphorus less than 0.050 mg/L. It should be noted that this Veolia offering was made in a proposal marketing effort for the Spokane County Regional Water Reclamation Facility as part of a proposal for the design/build/operation (DBO) contract procurement process. This proposal was based on a treatment process train that has never been built or operated in a full scale facility. This proposal was not selected based on a detailed technical review.

Treatment Process Pilot Studies Provide Spokane River Specific Results

No consideration is given in the EPA Memorandum to the site specific low phosphorus treatment pilot studies that have been conducted to investigate the limits of treatment technologies with local wastewater for discharge to the Spokane River. The City of Spokane, City of Coeur d'Alene, and Inland Empire Paper each have conducted well designed and carefully managed pilot testing programs using multiple treatment technologies with well documented results.

Table 3 presents a summary of the pilot testing results from 2006 in Coeur d'Alene. Four technologies from different manufacturers were tested on their ability to reliably produce low effluent phosphorus concentrations:

- Zenon ZeeWeed™ 500 Ultrafiltration (ZW-500)
- US Filter Trident® HS-1 (THS-1)
- Parkson DynaSand D2 Advanced Filtration System (DSD2)
- Blue Water Dual-Stage Blue PRO™ (DSBP)

The best performance in the pilot tests resulted in effluent total phosphorus of 19 to 24 ug/L. Pilot studies represent the most ideal operational conditions possible and are isolated from the impacts of variable flows, peak loadings, and solids processing recycle return impacts. Full scale facilities would not be isolated from these impacts and therefore not be expected to be capable of sustained effluent performance at levels as low as in pilot testing.

Even under controlled circumstances at pilot scale and constant flow conditions, some technologies were unable to attain effluent concentrations as low as reported for some of the plants in the EPA Memorandum. For example, pilot testing with the Parkson Dual sand process with alum addition averaged about 40 ug/L. The EPA Memorandum reports that full scale facilities with this technology in Stamford, NY and Walton, NY have maximum monthly effluent phosphorus of 21 and 25 ug/L, respectively.

A key finding in pilot testing of tertiary treatment technologies in Coeur d'Alene is that effluent phosphorus composition varies between soluble and particulate phosphorus, and reactive and nonreactive phosphorus components. This data provides key insights as to the removal mechanisms in treatment and the potential for achieving low effluent phosphorus concentrations. The treatment technologies employ a variety of mechanisms to remove phosphorus and Table 3 illustrates the results in terms of phosphorus speciation. The membrane filter provides an absolute barrier to suspended solids and as a result, little or no particulate phosphorus remains after membrane filtration. Treatment processes that had difficulty capturing solids produced effluent with high particulate phosphorus, as can be seen in the Parkson dual sand filter results.

A key finding from pilot testing on local wastewater is that all treatment technologies produced a soluble nonreactive phosphorus component that is not biodegradable and cannot be removed by chemical precipitation or filtration. The soluble nonreactive

phosphorus concentration in the effluent from the pilot technologies ranged from 11 to 15 ug/L and suggests that no treatment technologies currently available will be able to achieve effluent below these levels. All, or a portion of this soluble nonreactive component that is not biodegradable in treatment may not be bioavailable in the Spokane River.

Table 3. Low Phosphorus Pilot Testing Summary from Coeur d'Alene[1]

Phosphorus Species	Zenon Ultrafiltration Membrane (ZW-500)	Trident High Solids Process (THS-1)	BlueWater Dual Sand Filtration (DSBP)	Parkson Dual Sand Filtration (DSD2)
Total Phosphorus (TP), μg/L	24.1	19.2	21.4	39.6
Soluble Total Phosphorus (sTP), μg/L	23.3	13.0	17.2	18.8
Soluble NonReactive Phosphorus (sNRP), μg/L	14.9	10.8	14.9	13.4
Soluble Reactive Phosphorus (sRP), μg/L	8.4	2.2	2.3	5.3
Particulate Phosphorus (pP), μg/L	0.9	6.2	4.2	30.9

[1] City of Coeur d'Alene, "Tertiary Phosphorus Removal Technology Pilot Study," HDR Engineering, Inc. January 2007

EPA Memorandum Part 2: Analysis of Effluent Data

The EPA Memorandum presents a statistical summary (percentiles, averages) for ten treatment facilities and the percentage of the time the average monthly concentrations are less than or equal to certain concentrations. The plants selected in the EPA Memorandum do not have daily effluent phosphorus data for review and analysis. Phosphorus data from the plants analyzed in the EPA Memorandum are from sampling conducted twice per week, one per week, or at an unknown frequency. Consequently, much of the variability in effluent performance may not be characterized by these data sets with infrequent sampling. Based on this analysis, the EPA Memorandum suggests a 95th percentile statistic of effluent performance is appropriate for Spokane River phosphorus discharges.

Historical discussions of effluent phosphorus limits for the Spokane River have been based on an understanding that long averaging periods and mean or median values would be used as reference points for discharge limits. Plant performance at other facilities was reviewed in this context. Introduction of the 95th percentile statistic of effluent clouds the past discussions that were the based on mean or median effluent phosphorus performance at 0.050 mg/L. Since effluent performance variability will be skewed to higher, rather than lower values, the 95th percentile statistics for plants with average performance near 0.050 mg/L will be considerably higher.

Surface water phosphorus discharges should receive special considerations for distinction from other effluent parameters, in particular toxic parameters, upon which much of the existing EPA permit writer's guidance is based. Appropriate NPDES discharge permit structures for nutrients should be based on long averaging periods, such as seasonal limits based on mean or median statistics. It's important that consideration be given to variability and reliability of effluent performance from advanced phosphorus removal facilities. Appropriate NPDES permit structures will avoid the creation of frameworks that result in compliance issues that are immaterial to surface water quality protection, such as maximum daily and maximum weekly limits, overly restrictive receiving water streamflow assumptions, and the assumption of extreme and improbable coincident events, such as statistical extremes occurring in both receiving waters and effluent discharge quality.