CITY OF POST FALLS

HAYDEN AREA REGIONAL SEWER BOARD

March 11, 2010

***Via FedEx and E-mail:* *tstu461@ecy.wa.gov***

Ted Sturdevant, Ecology Director
Department of Ecology
300 Desmond Drive SE
Lacey, Washington 98503

Re: Spokane River TMDL Dispute-Resolution Request
City of Post Falls/Hayden Area Regional Sewer Board

Dear Mr. Sturdevant:

The City of Post Falls and the City of Rathdrum, both of which discharge through the Post Falls wastewater treatment plant (collectively, "Post Falls"), and the Hayden Area Regional Sewer Board ("HARSB"), as a separate party to the dispute resolution, respectfully submit this supplemental brief to augment their dispute-resolution requests filed on February 26, 2010.

## I. EXECUTIVE SUMMARY

Post Falls and HARSB are excellent environmental stewards and support efforts to improve water quality in Lake Spokane reservoir. However, the Spokane River TMDL is not acceptable as it is currently written.

The current version of the TMDL has many problems. Some of the problems flow from a fundamentally false premise: that Lake Spokane reservoir should treated as if it were a natural lake. The reservoir has inherent characteristics, such its great depth and the long-retention time of water that passes through it, that will always prevent the reservoir from behaving like a natural lake. Because of this fundamental disconnect in the TMDL, the TMDL's analysis takes many flawed twists and turns, including (i) how water quality standards are applied; (ii) how the 10 μg/L phosphorus benchmark came to be; (iii) the lack of any focus on algae blooms; and (iv) the undefined obligations of Avista.

Notwithstanding all of these issues, Post Falls and HARSB are not seeking to have no TMDL in place at all. Instead, they seek to ensure that the TMDL be revised so that the TMDL allows load allocations that are technologically feasible under expected NPDES limits and so that Post Falls and HARSB have fair allocations for future growth.

Specifically, Post Falls and HARSB request the following changes to the TMDL:

- The addition of clarifying language that the TMDL does not require any concentration-based limits for phosphorus;
- The elimination of any load allocations for ammonia or a sufficient increase in the amount of ammonia allocations;
- The establishment of a load allocation for the Spokane River at the Washington-Idaho boundary;
- The re-allocation of loads to Idaho sources based on assumptions that are not illegal, inadequate, unfair, or arbitrary and capricious; the problems include
    - An illegal allocation for septic tanks which are point-source discharges;
    - Grossly disproportionate overall allocations between Washington and Idaho sources;
    - Use of different and arbitrary population-growth assumptions for Washington municipalities as compared to Idaho municipalities;
    - Setting phosphorus-discharge limits for Idaho dischargers for which "delta management" will be necessary to comply, even though no "delta management" opportunities are available to Idaho dischargers;
    - Washington non-point sources and tributaries receiving overly generous allocations;
    - Manipulation of modeling assumptions to Idaho's disadvantage, including use of different compliance targets and a pattern of twisting assumptions;
    - Ecology's pushing off revisiting loads for ten years, which is incompatible with Post Falls and HARSB's planning obligations; and
    - Overly generous treatment of Avista as compared to all dischargers;
- The loads for Post Falls and HARSB that the TMDL should reflect are as follows:

| | Total Phosphorus (lbs/day) | Ammonia (lbs/day) | CBOD (lbs/day) |
|---|---|---|---|
| Post Falls | 3.19 | 255[1] | 255[1] (March – Oct) |
| HARSB | 1.33 (seasonal average) | 107 (max/monthly)[1] 160 (max/weekly) (March – Oct) | 107 (max/monthly)[1] 160 (max/weekly) (March – Oct) |

- The clarification of the criteria for bio-availability studies and Ecology's expectations for how those studies will be conducted and applied.

[1] These limits represent 4 mg/L multiplied by expected flows (3.2 MGD for HARSB and 7.65 MGD for Post Falls).

## II. INTRODUCTION

The Washington Department of Ecology ("Ecology") issued a Total Maximum Daily Load ("TMDL") for the Spokane River and Lake Spokane reservoir on February 12, 2010.[2] Among other things, the TMDL seeks to reduce the amount of oxygen-demanding materials (including phosphorus, ammonia, and CBOD)[3] discharged into the Spokane River that winds up in the reservoir, 40 miles downstream from the Idaho border.

Post Falls and HARSB support the effort to improve water quality in Lake Spokane reservoir. Post Falls and HARSB are, and have been, excellent stewards of the environment. Post Falls has demonstrated its commitment to water quality with sustainable, biological treatment that has removed over 95 percent of nutrient inputs for over ten years. HARSB is the only discharger in the region that reuses its wastewater to grow crops during the growing season. As part of an acceptable resolution of the TMDL, Post Falls and HARSB are willing to do far more. Indeed, if it is determined to be necessary, they are committed to reducing the phosphorus levels in their discharges to the limits that technology allows: an average of 50 micrograms per liter ("µg/L") total phosphorus ("TP") over the course of the growing season.[4] If implemented, these barely measurable concentrations of phosphorus would represent some of the lowest limits in the country. Unfortunately, the TMDL seeks to go beyond this and to impose unachievable technological limits on Post Falls and HARSB and to limit growth in the communities they serve by allocating allowable loads to communities in Washington at the expense of communities in Idaho. As responsible stewards of ratepayer dollars and as entities responsible for growth in our communities, we cannot allow this.

Before we explain those points in more detail, please let us place these issues in the context of the water body the TMDL seeks to protect. Lake Spokane reservoir is a man-made water body, and it behaves like one. The reservoir is usually completely mixed (that is, un-stratified) each year between March and June due to snowmelt and run-off flowing through the reservoir. Dissolved oxygen ("DO") levels are not a problem during these spring months. The reservoir has a deep pool (up to 180 feet), which typically thermally stratifies between June and September. The stagnation of the deeper water results in low DO concentrations at the lower depths of the reservoir during these summer and early fall months. Ecology's own modeling clearly shows that these DO deficits are an inherent characteristic that will exist regardless of the levels of oxygen-demanding pollutants in the water.[5] Interestingly, the TMDL cites no evidence that the low levels of DO at the lower depths harm fish and other aquatic species. Indeed, the reservoir currently has an excellent bass fishery and will be stocked with 155,000 catchable, sterile rainbow trout each year as a condition of the Avista Utilities ("Avista") Federal Energy Regulatory Commission ("FERC") license.[6] The Washington Department of Fish and

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2 The TMDL's full title is "Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load, Water Quality Improvement Report, Revised February 2010, Publication No. 07-10-073."

3 CBOD stands for "carbonaceous biochemical oxygen demand."

4 Post Falls and HARSB are also committed to meeting the CBOD concentration targets set out in the TMDL, as long as the accompanying flow expectations are sufficient to allow for future growth. As discussed in Section III.B, the TMDL should impose no ammonia loads or expectations on Idaho dischargers.

5 See Spokane River Modeling Final Scenarios Report 2010, Portland State University (January 29, 2010, Tables 7-17 (showing dissolved oxygen levels below 9.5 mg/L in many segments of the reservoir throughout the compliance period.

6 Avista FERC License, Article 406 at 85.

Wildlife determined that the "Upper Falls, Nine Mile, and Lake Spokane reservoirs all offer littoral and limnetic habitats that are favorable to producing rainbow trout fisheries."[7]

In a number of ways, Ecology has taken a flawed regulatory approach to Lake Spokane reservoir. This water body is not a natural lake yet Ecology regulates it as if it were one. It is a mesotrophic (warm water) water body and has been regulated as one, yet Ecology aspires for it to be an oligotrophic (cold water) body. A nutrient water quality standard of 25 µg/L TP already exists to protect the reservoir, yet Ecology has undertaken no rulemaking to replace this water quality standard with a more stringent one. Indeed, Ecology insists that its new 10 µg/L "benchmark" for phosphorus levels at the entrance to Lake Spokane reservoir is not a water quality standard. In fact, this benchmark was determined inappropriately using an incorrect application of EPA's eco-region criteria and rests on a number of other questionable premises, as pointed out by the Idaho Department of Environmental Quality.

Ecology seeks to increase the water quality of the depths of the reservoir to protect habitat of certain fish, called the "Core Summer Salmonid Habitat." Yet the record includes no evidence that the depths of the reservoir have ever been, or ever could be, "Core Summer Salmonid Habitat."[8] Nonetheless, Ecology considers these depths as part of the "dominant aquatic habitat" that it must protect. Curiously, the TMDL does not apply the 9.5 milligrams per liter ("mg/L") DO water quality standard to the deeper part of the reservoir during the critical season.[9] Instead, it leaves the benchmark for the critical timeframe as a question mark and applies the 9.5 mg/L DO standard only "following lake turnover."[10] The agency then applies an alternate standard that human-caused conditions cannot decrease DO levels more than 0.2 mg/L below "natural conditions." In doing so, Ecology ignores that the conditions in Lake Spokane reservoir are made-made by the Avista dam, and therefore there are no "natural conditions" to which to compare the impact of upstream dischargers. Indeed, Ecology admits that if Lake Spokane reservoir were in its true natural condition (i.e., if it were a river), the water body would not be impaired.[11] Said another way, if Post Falls and HARSB would not have to make any

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7 WDFS, Comments on the Draft Environmental Impact Statement for FERC Projects P-2545 (Spokane River Developments) and P-12606 (Post Falls Project) and Modified Recommendations for Terms and Conditions, March 6, 2007 at 26.

8 Wash. Admin. Code § 173-201A, Table 200(1)(d).

9 TMDL at 9-10. Ecology does not explain why it leaves such a gaping hole in its analysis, but we can surmise. The agency's own "no-source" modeling shows that certain parts of the reservoir would never meet the 9.5 µg/L DO standard during the critical season, even if all human sources were removed. As such, it becomes very difficult for Ecology to justify having the standard in place.

10 TMDL at 9.

11 TMDL at I-4 (letter from Kelly Susewind to Michael Gearhard stating, "If we run the model without the reservoirs, then the critical conditions would be greatly altered and the problems with dissolved oxygen would appear to be non-existent, when in fact this is not the case."). Ecology's response to this argument, that the any oxygen-consuming materials would just travel to the next impoundment, is wholly unpersuasive. None of the downstream impoundments have "natural conditions" any more than Lake Spokane reservoir has. Idaho dischargers are being asked to meet treat their waters to a level to meet this artificial condition created by Avista, and the natural conditions of a river. Furthermore, the any Idaho-generated oxygen-consuming materials are continually being attenuated and dissipated naturally by the Spokane River. By the time it reaches another impoundment, there may only be Washington-generated materials left. Indeed, the TMDL offers no evidence that there would be any algae blooms at all in a downstream impoundment. The Lake Spokane reservoir, with its depth up to 180 feet, its great retention times for water passing through it, and its proximity to the large dischargers, such as the City of Spokane and Spokane County, may be the only host, however artificial it may be, that has the conditions to support algae blooms at the low phosphorus levels.

modifications to their treatment if the Avista's dam did not exist and so Lake Spokane reservoir were a river. Indeed, there would be no need for a TMDL. The need for the TMDL is created by the artificial conditions created by the reservoir. Post Falls and HARSB did not create the sources of the problem, but are being asked, and asked disproportionately, to solve the problem. On top of that, the TMDL piles on a page-long list of "conservative assumptions," many to Idaho's disadvantage, which are far beyond the normal practice for a TMDL.

In other places, the TMDL cites algae blooms as a significant impairment yet provides no analysis regarding whether the TMDL will end the algae blooms or even if it is possible to end algae blooms in this man-made water body. The TMDL will set in motion as much as $1 billion in infrastructure improvements among all dischargers, and the TMDL does not provide any analysis that these improvements will end the reason for the TMDL, stopping the algae blooms. The TMDL as designed does not offer a specific series of actions that will cause the reservoir to meet the water quality standard for dissolved oxygen. Instead, Avista is asked to come up with some "reasonable and feasible" measures that will make up the difference after the upstream dischargers have squeezed out every molecule of oxygen-demanding materials from their discharges that is technologically feasible, and then have removed even more oxygen-demanding materials through "delta management" (i.e., cleaning up other people's pollution). The TMDL does not define, and no one knows, whether Avista's responsibilities will require Avista to do a little or a lot, or if the financial burden on Avista will be a little or a lot, or even when Avista will start do what is "reasonable and feasible."

By way of constrast, the Idaho dischargers have not been asked to come up with a plan that is "reasonable and feasible" for their discharges. For example, they are not being given the opportunity to decline to make a change on the grounds that the cost of doing so would not be reasonable in light of the benefit. They have not just been asked to go to the maximum limits of science in treating their discharges, whatever the cost. Instead, the Idaho dischargers have been asked to go beyond the current limits of science, whatever the cost.

One cannot read these facts without asking the question: "Are we applying the right regulations to Lake Spokane reservoir?" Before as much as $1 billion is spent on technologies that create their own side streams of pollution and that expand the carbon footprints of every community in the region, perhaps we should revisit whether this reservoir really is like a natural lake, or whether we should simply accept it for what it is, a man-made water body, and treat it accordingly.

If the issues in the TMDL cannot be resolved in a reasonable manner, Post Falls and HARSB will look long and hard at reviving the use attainability analysis that was withdrawn five years ago on Ecology's promise that it would work with dischargers to reach a mutually agreeable resolution of the TMDL. The TMDL as currently written is not the agreeable resolution that was promised.

In part because the TMDL struggles so mightily to force the Lake Spokane reservoir "square peg" into the natural lake "round hole," the TMDL has many flaws. Post Falls and HARSB submitted many pages describing some of these flaws on October 29, 2009 and in the initial dispute-resolution document filed on February 26, 2010. Many other commenters to the previous draft of the TMDL submitted long lists of cogent complaints as well. We join in those comments and reserve the right to contend that the TMDL is invalid in all available forums and on any ground raised in any of these documents.

But Post Falls and HARSB's purpose in the dispute resolution is not to end up with no TMDL at all. Rather, we seek common ground and a resolution based on Post Falls and HARSB's reasonable needs and on principles of fairness applied to all parties.

As it stands, the TMDL is unacceptable to Post Falls and HARSB in four primary respects. First, the TMDL might be read to authorize the U.S. Environmental Protection Agency ("EPA") to calculate concentration-based limits for total phosphorus in Idaho National Pollutant Discharge Elimination System ("NPDES") permits at a maximum monthly average of 36 μg/L. This concentration is below what is technologically feasible to achieve on a consistent basis, thus placing Idaho municipalities at risk of ruinous fines for non-compliance. The TMDL should be clarified to state that the TMDL requires only mass-based phosphorus loads for Idaho dischargers, not concentration-based limits.

Second, the TMDL should eliminate loading assumptions for ammonia from Idaho sources or increase them sufficiently. The September 1, 2009 LimnoTech report (the "LimnoTech Report" attached as Exhibit "1"), which has never been rebutted, clearly demonstrates that ammonia from Idaho sources dissipates before it reaches Lake Spokane reservoir and that ammonia is not an issue even at many times the loading assumption in the TMDL.

Third, the TMDL should set a load allocation at the Idaho border for the portion of the Spokane River that lies within Idaho, not provide for individual allocations for Idaho dischargers or, by impliocation, set allocations between point-source and non-point-source dischargers. Setting a load at the Idaho border is a black-and-white application of the definition of what a TMDL is. By contrast, setting individual loads for Idaho dischargers is a violation of the sovereign rights of the State of Idaho.

Fourth, the TMDL provides an inadequate allocation for the future growth of the communities Post Falls and HARSB serve. This shortcoming of the TMDL is not necessary and can be addressed in a number of different ways. First, loads could be re-allocated from Washington municipalities or others that have no demonstrated need for them or who have not been asked to make required reductions; or second, the TMDL could incorporate modest changes to the modeling assumptions that would not materially alter the TMDL's prospects for success.

Finally, the TMDL needs to provide more clarity on the criteria for studies on the bio-availability of phosphorus in the system.

## III. DISCUSSION

### A. The TMDL should clarify that it does not require the imposition of concentration-based limits for phosphorus on Idaho sources.

Post Falls and HARSB cannot accept unachievable concentration-based phosphorus limits in their permits, and we do not want EPA to interpret the TMDL as requiring concentration limits. Unfortunately, the TMDL is anything but clear on this point. The TMDL reads:

> *Because EPA will develop and issue NPDES permits for Idaho point sources, Ecology worked closely with EPA to develop very specific assumptions about the anticipated permit-driven reductions of anthropogenic loading of phosphorus, CBOD, and ammonia from wastewater treatment plants and stormwater in Idaho. These assumptions are based on point sources discharging equivalent pollutant concentrations at wastewater treatment plants in both states, and have been incorporated into the model scenarios supporting this TMDL (see the estimated permit limits in Table 2 of PSU 2009). All of the assumed anthropogenic loading of these pollutants in Idaho comes from point sources (wastewater treatment plants and stormwater). The total assumed anthropogenic loading of phosphorus, $CBOD_5$ and ammonia from Idaho point sources are 7.2 lb/day, 497 lb/day, and 94.4 lb/day, respectively. These figures include 2.4 lb/day, 23 lb/day, and 0.4 lb/day of phosphorus, $CBOD_5$, and ammonia, respectively, from stormwater. The assumptions for individual sources can be found in Table 2 of PSU 2009. The assumed Idaho point source loads (including stormwater) account for 18 percent of the phosphorus, 15 percent of the $CBOD_5$, and 24 percent of the ammonia discharged by all of the point sources in both States (including stormwater and CSOs), under the wasteload allocations (see Table 5) and assumptions in this TMDL.*
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> *The goal of this TMDL is to achieve water quality standards for dissolved oxygen. The dissolved oxygen depletion predicted to result from these assumed Idaho pollutant loads is shown in Tables 14 and 15 of PSU (2010) (the Idaho only source assessment scenario results). EPA will incorporate permit limits into the NPDES permits for Idaho point source dischargers that ensure that the total dissolved oxygen depletion resulting from those dischargers is no greater than that shown in Tables 14 and 15.*[12]

Our understanding is EPA may be planning to issue permits including only mass limits for phosphorus. However, EPA's possible planning is not a sufficient assurance for Post Falls and HARSB, who will have to comply, every month, for many years, with whatever limits are ultimately approved. We request that the TMDL discussion regarding Idaho be revised to include the following language, to give clear direction to EPA:

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[12] TMDL at 34-35.

> *The State of Washington's interpretation is that permit conditions for Idaho points-source dischargers need include monthly maximum load limitations expressed only in terms of mass to meet the requirements of this TMDL. Concentration limits are not required for Idaho point-source dischargers.*

If mass limits for phosphorus are established with appropriate compliance schedules and increments for growth, the assumed performance level of phosphorus-removing technology becomes less of an immediate concern. Post Falls and HARSB can install appropriate technologies and determine through experience their capabilities, with the adequate time to identify and address any shortcomings in expected performance.

As it is, the current text of the TMDL does not clearly address whether concentration-based limits for phosphorus may be included, and therefore we need to protest strongly that 36 μg/L concentration limits are not achievable on a reliable basis. A concentration limit of 36 μg/L would place Post Falls and HARSB at repeated risk of ruinous fines for non-compliance. The City of Coeur d'Alene has briefed these concerns well, and we join its arguments fully. We believe the evidence is overwhelming on this point. For example, EPA's own two volume, peer-reviewed study states as follows: "Technologies are available to reliably attain an annual average of 0.1 milligrams per liter (mg/L) or less for TP..."[13] In addition, a team led by HDR Engineering determined that operating plants with advanced phosphorus removal technology could achieve 95$^{th}$ percentile perfomance of between 45 μg/L and 630 μg/L. HDR found no evidence that phosphorus removal below this range was possible on a reliable basis.[14] CH2MHill stated in their study, "...permit limits based on a long-term averaging period, such as seasonal averaging, appears essential to successful compliance with phosphorus effluent levels less than 100 μg/L."[15] The point of all of these studies is that valid statistical methods need to be used to calculate effluent limits that can be met on a reliable basis. The study on which the TMDL relies does not do that.

**B. The TMDL should eliminate any loading assumptions for ammonia pertaining to sources in Idaho or increase any ammonia limits sufficiently.**

The TMDL includes a loading assumption of 94.4 lbs/day of ammonia for Idaho sources. This assumption apparently was calculated from the concentration-based load allocations applied to Washington dischargers and the flow assumptions applied to Idaho dischargers. However, there is no basis for applying ammonia loading assumptions to Idaho dischargers. Ammonia dissipates quickly in water and would not reach Lake Spokane reservoir from Idaho sources in any material amount. EPA's comments have reinforced this conclusion. EPA has assured Post Falls and HARSB on several occasions that no ammonia limits would be required as a result of the TMDL, and the draft effluent

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[13] Municipal Nutrient Removal Technologies Reference Document, EPA 832-R-08-006 (September 2008).

[14] Dave Clark, HDR, et al., "What is the Limit of Technology (LOT?) A Rational and Quantitative Approach" (WEF 2009 Nutrient Removal Conference Preprint) at 13, attached as Exhibit "2".

[15] Dave Reynolds, CH2MHill, Dave Clark, HDR, "Evaluation of Exemplary WWTPs Practicing High Removal of Phosphorus" (CH2MHill, November 21, 2005), attached as Exhibit "3".

limits that Brian Nickel of EPA provided to the Idaho dischargers on February 19, 2010 (the "Idaho Draft Effluent Limits") did not include ammonia limits based on the TMDL.[16]

Further, the LimnoTech Report plainly shows that Idaho ammonia discharges are not an issue in Lake Spokane reservoir, even if Idaho discharged ammonia at levels many times higher than the loads in the TMDL would allow. LimnoTech modeled an eightfold increase in Idaho dischargers' ammonia levels, from 1 to 8 mg/L. The corresponding change in DO levels in Lake Spokane reservoir in the critical segment at the critical time is only 0.0077 mg/L, a difference that is non-measurable, non-detectable, and of no significance to meeting the obligations in the TMDL. We request that the references to ammonia loading assumptions for Idaho sources be eliminated or that any ammonia limits be increased sufficiently to be consistent with EPA's Idaho Draft Effluent Limits.

### C. The TMDL should be revised to establish a load allocation for the Spokane River at the Idaho border, not on individual dischargers.

The TMDL is plainly deficient in its failure to provide a load allocation to the Spokane River at the Idaho border.[17] EPA regulations offer a mathematical definition of a TMDL. A TMDL is "[t]he sum of the individual [wasteload allocations] for point sources and [load allocations] for nonpoint sources and natural background."[18] The EPA regulation goes on to offer an illustration of the definition of a TMDL: "If the receiving water has only one point source discharger, the TMDL is the sum of that point source [wasteload allocation] plus the [load allocations] for any nonpoint sources of pollution and natural background sources, tributaries, or adjacent segments."[19]

Thus, TMDLs consist only of wasteload allocations and load allocations. Load allocations, in turn, may consist of non-point source loads, natural background, and loads from tributaries and adjacent segments. Since Washington does not have authority to regulate sources in Idaho,[20] the only mechanism for the TMDL to affect the regulation of point-source dischargers in Idaho is to set a load allocation for the segment of the Spokane River that lies upstream in Idaho. This is a black-and-white requirement, yet the TMDL fails to meet it.

Ecology's responses to comments give three reasons for not setting a load at the border; they are wholly unpersuasive. Ecology's first reason is as follows:

> *First, phosphorus, ammonia, and CBOD are processed by natural phenomena (which are simulated in the CE-QUAL-W2 model) as they*

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16 "Preliminary Draft Effluent Limits for TP, CBOD and Ammonia," (EPA Region 10, February 23, 2010), attached as Exhibit "4."

17 The failure to set a load allocation is one of a number of state sovereignty issues that trouble us about the TMDL. Another is that Ecology is seeking to enforce in Idaho a water quality standard that allocates between natural and human caused loads. Frankly, we believe it is an unjustified intrusion into Idaho's sovereignty for Ecology to seek to influence this allocation. In part based on this argument, we reserve the right to contend that, in the absence of a numeric target in a properly adopted and EPA-approved water quality standard, the Idaho border constitutes natural background for purposes of the issuance of EPA permits in Idaho.

18 40 C.F.R. § 130.2(i).

19 *Id.* (emphasis added).

20 *Int'l Paper Co. v. Oullette*, 479 U.S. 481, 493 (1987) (holding that the only state law applicable to an interstate discharge is "the law of the State in which the point source is located").

> *travel downstream form the points of discharge, and the CE-QUAL-W2 model simulates these processes. Thus, the increase in loading of phosphorus, ammonia, and CBOD, relative to natural conditions, as measured or modeled at the state line, would not be equal to the loads of these parameters discharged in Idaho.*[21]

This statement is interesting from two different perspectives. Ecology is saying it can ignore the requirements of the Clean Water Act because it does not consider it feasible to model the impacts of attenuation at the Idaho border. In fact, Ecology has already done much or all of the necessary modeling in one of its studies by Portland State University.[22] Moreover, Ecology's statement flatly contradicts statements Ecology makes elsewhere in the TMDL that attenuation is not an important factor when considering the Idaho discharges. If attenuation makes an important difference from the discharge point in Idaho downstream a few miles to the border with Washington, attenuation is all the more critical to consider 40 or miles downstream from the Idaho border to the start of the Lake Spokane reservoir.

Ecology's second reason is a head-scratcher:

> *Second, it is necessary in this case to require very low levels of discharge of oxygen-demanding parameters in order to ensure compliance with water quality standards on a cumulative basis.*[23]

There is no reason why low levels of discharge would make it impractical or impossible to set a load for the Spokane River at the Idaho border. Ecology is uncomfortable about something in making this puzzling statement. The TMDL does not disclose the source of the discomfort, but one can surmise that if Ecology had set a load at the border, as it is required to do, Ecology would have set a load that most of the time would provide water quality below 10 µg/L TP. Ten 10 µg/L TP is the target that Ecology has set for itself at the inlet to Lake Spokane reservoir. This would make transparent what Ecology has hidden; that mathematically Ecology would be imposing a limit at the Idaho border, not only more stringent than its water quality standard for Washington rivers, but more stringent than the 10 µg/L TP artificially imposed target it has set for the start of the Lake Spokane reservoir. It would be one thing if Ecology set a 10 µg/L standard that Idaho must meet at the border, and if Washington dischargers want to dirty the water up when it reaches them then the Washington dischargers have to clean it back up to the same 10 µg/L standard. Just like Idaho dischargers, whatever Washington dischargers do to drop the water quality below the 10 µg/L standard they would be responsible to clean up by the time it reaches the start of Lake Spokane reservoir. By not setting a load allocation at the Idaho border, Ecology has hidden the mathematics that show that Ecology is requiring Idaho to not only meet the ultimate standard but to clean beyond it so that Washington would not have to clean its own pollution fully. Setting a load at the border would also show how laughably inequitable the allocation between the two States is where Washington point and non-point sources receive between 90.8 percent and 97.8 percent of the human loads of phosphorus,[24] but Washington is expected to have only 73 percent of the regional population in 2027. Whatever the relative numbers, EPA's regulations

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[21] TMDL at C-33.
[22] PSU 2010 Report at 8 (state line analysis of Idaho-only scenario).
[23] TMDL at C-33.
[24] *See* Section III.D.2.a, *infra*.

are completely clear that Ecology must set a load allocation at the Idaho border and be accountable for its decision.

Ecology's final reason for not setting a load allocation is equally unsatisfactory:

> *Third, the relevant water quality standard for dissolved oxygen is linked to natural background conditions, but natural background concentrations and loadings of oxygen-demanding parameters are not constant over time. Because of the "processing" of discharged pollution that occurs between the points of discharge and the state line, the fact that very low levels of discharge must be required in order to meet water quality standards, and because natural background concentrations and loadings of the relevant parameters are not constant over time, the increase in phosphorus, ammonia, and CBOD at the Washington-Idaho border, relative to natural conditions, would be impossible to measure.*[25]

The reference to being "impossible to measure" is a false standard and has no basis in practice or the law. Ecology has no need to "measure" anything to set a load allocation. Just like all the other load allocations and wasteload allocations have been set in the TMDL, the natural loads and human loads are modeled and set based on existing data and assumptions about discharges. EPA will then issue NPDES permits consistent with the load allocation (or with any TMDL the State of Idaho may adopt to address Washington's load allocation for the Spokane river). These permits will include the monitoring necessary to ensure compliance.

The response to comments then adds a troubling conclusion to the rationale:

> *Therefore, it is reasonable and appropriate for Ecology to make assumptions in the TMDL regarding the loads of phosphorus, CBOD, and ammonia that will be discharged in Idaho, because establishing a single, or even three, loading assumptions at the Washington-Idaho border would not necessarily provide assurance that water quality standards would be met in Lake Spokane. Furthermore, it would be impossible to determine through monitoring if the assumptions were being met.*[26]

This is plain wrong. And it is seemingly ignorant of the whole point of NPDES permits. Ecology has already modeled both natural background and the impact of Idaho dischargers at the Idaho border.[27] While we disagree with the amount allocated to the Idaho dischargers, it is not difficult arithmetic to add whatever allocation is given to dischargers (a fixed number) to whatever allocation is given to natural background flows (a variable number) to come up with a load allocation. When EPA later issues permits based on the allocation (or on corresponding Idaho TMDL), the results would both be monitored and measurable and would allow easy calculation of compliance with Washington's requirements.

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[25] TMDL at C-33.
[26] TMDL at C-33.
[27] PSU 2010 Report at Figure 1.

The issue is important to Post Falls and HARSB because the load allocations define the parameters EPA must apply in writing the NPDES permits. Ecology justifies the TMDL's approach to Idaho by citing 40 C.F.R. Section 122.4(d), which reads that permits may not issue in upstream States when "the imposition of conditions cannot ensure compliance with the applicable water quality requirements of all affected States."[28] The question then becomes what sort of "water quality requirements" has Ecology set that have to be addressed in permits for Idaho dischargers?

The TMDL appears to treat the applicable requirement as simply being EPA's application of the Washington DO standard to the Idaho permits. The TMDL states as follows:

> *Because EPA will develop and issue NPDES permits for Idaho point sources, Ecology worked closely with EPA to develop very specific assumptions about the anticipated permit-driven reductions of anthropogenic loading of phosphorus, CBOD, and ammonia from wastewater treatment plants and stormwater in Idaho.*[29]

Ecology cannot leave a donut hole in its load and wasteload allocations in the TMDL for EPA to make up as part of its permitting function. The Washington DO standard that Ecology purports to apply requires that "human actions considered cumulatively may not decrease the dissolved oxygen concentration more than 0.2 mg/L below natural conditions" when dissolved oxygen levels are lower than aquatic life criteria for core summer salmonid habitat.[30] In the absence of a process like a TMDL that allocates loads, this standard would allow EPA complete and arbitrary discretion as to how to apply the Washington ambiguous standard to the discharger. On the one hand, EPA could say that no permit can issue because others have already used up the allowable DO decrease in the water body. On the other hand, EPA could just as easily say that the discharger can itself use up the allowable DO reduction and prohibit all the other dischargers from continuing to discharge. EPA could also seek to justify untenable and unachievable concentration-based limits that discriminate against Idaho dischargers to the benefit of those in Washington. That is our concern here.

Setting a load allocation at the Idaho border accomplishes three additional benefits. First, doing so allows an apples-to-apples comparison of how Idaho is being treated compared to Washington in the application of Washington water quality standards or requirements. Second, doing so gets Ecology out of the improper role of purporting to dictate to Idaho municipalities how to comply with Washington's water quality requirements before the water reaches the Washington border. Finally, doing so gives the State of Idaho the sovereign flexibility to which it is lawfully entitled, to figure out how to comply with the load allocations that are ultimately determined. For example, Idaho might reduce natural background loadings and allocate those reductions to Idaho dischargers. Idaho might develop a trading framework or to allow Idaho dischargers to reallocate the loads among themselves. In making these decisions, the State of Idaho may want to favor agricultural interests over mining interests. It may want to favor tourism over agricultural interests. It want to accelerate or it may want to retard population growth in the area. How and what the State of Idaho does is, and how it values the many competing interests is within the authority of the State of Idaho. Ecology has no say

[28] 40 C.F.R. § 122.4(d).
[29] TMDL at 34-35.
[30] Wash. Admin. Code § 173-201A-200(d)(ii).

in any such Idaho matters, and the State of Washington has no business reaching into Idaho and making them. None of these benefits can be accomplished until Ecology follows the law and sets a load allocation at the Idaho border and renders unto Idaho the things that are Idaho's. We ask Ecology to revise the TMDL to set a load allocation at the Idaho border for the portion of the Spokane River that lies within Idaho.

## D. The load assumptions used for Post Falls and HARSB need to be increased because the methods used to allocate loads in the TMDL are illegal, inadequate, and unfair.

The TMDL will have the effect of capping phosphorus discharges from Post Falls at 1.5 lbs/day and from HARSB at 0.96 lbs/day.[31] The TMDL supposes these amounts to be adequate for Post Falls and HARSB's needs through 2027. They are not. Instead, the TMDL will have the effect of placing an arbitrary cap on growth in the communities that Post Falls and HARSB serve. This baseless action will cost the region billions of dollars in future economic growth. The way the TMDL allocates allowable phosphorus discharges is illegal and grossly unfair to Post Falls and HARSB.

The allocations violate clear provisions of the Clean Water Act. Further, reallocation is required because the TMDL's favorable treatment of Washington dischargers compared to Post Falls and HARSB denies equal treatment of the law and is arbitrary and capricious. Not only are Post Falls and HARSB treated poorly compared with other dischargers, all the dischargers are treated unfairly as compared to Avista. These issues are discussed in turn in the sections below.

### 1. The TMDL fails to eliminate loads for hydrologically connected, point source septic tanks as is required by the Clean Water Act.

The TMDL fails to account for the elimination of the illegal discharges from septic tanks that are occurring in the vicinity of Lake Spokane reservoir as the Clean Water Act requires. The chart at page M-4 of the TMDL includes the determination that the groundwater upstream of Lake Spokane reservoir and in the Lake Spokane watershed contains between 39.5 and 246.1 lbs/day of anthropogenic loads of phosphorus.[32] The TMDL does not allege that these septic tanks are fully compliant and are not impacting ground water or surface water. Indeed, the TMDL contains overwhelming and uncontradicted evidence that a significant part of the loads reaching the Lake Spokane reservoir come from leaking septic tanks. For example, Spokane County estimates that as many as 3,400 active septic tanks have the potential to "breakthrough with increased phosphorus loading to the aquifer and the Spokane River (HDR 2007)."[33] The County estimates "phosphorus loading may be reduced by up to 20 lbs/day when these septic tanks are removed upon construction of the new wastewater treatment plant."[34] Despite this, the TMDL does include allocate a loading for these septic tanks. Post Falls and HARSB's own brief investigation, uncontradicted by Ecology, shows that there are about 1,600 septic tanks near Lake Spokane reservoir with about 25 percent being

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[31] Many of the same issues apply to CBOD because load assumptions for CBOD are calculated using the same flow assumptions as are used for phosphorus. Our comments will focus on phosphorus because it is the main emphasis of the TMDL.

[32] The minimum of 39.5 pounds per day in October is more than all the rest of the point source waste load allocations combined.

[33] TMDL at 55 (MIP).

[34] TMDL at 55.

within 500 feet of the reservoir.[35] These septic tanks, allowed by Ecology regulations and permitted by Spokane County, are starkly absent from Ecology's TMDL analysis of the loadings on Lake Spokane reservoir.

Notwithstanding this evidence, the TMDL does not estimate the loadings from the septic tanks or establish a wasteload allocation for them. Ecology wrongly understands all these septic tanks to be non-point sources of pollution.

The law is clear that septic systems are point sources as that term is defined in 40 C.F.R. § 122.2 because they are "containers" that hold "solid waste" and "sewage."[36] Septic tanks often escape regulation under the Clean Water Act because when correctly designed and installed, pollutants do not break through to surface water. But if pollutant breakthroughs do occur, septic tanks become point sources which cannot discharge legally to surface water in the absence of an NPDES permit. Since neither Ecology nor EPA has authorized any septic tank discharges to surface water, the only permissible conclusion is that any leaking septic tanks are discharging illegally and must be curtailed.

The implication for the TMDL is simply that the TMDL cannot include a wasteload or load allocation to legitimize illegal discharges or the State of Washington's unwillingness to eliminate those discharges.[37] Nor can this part of the groundwater load be available to Washington dischargers for delta management – an offset cannot be offered where the State of Washington has simply failed to do its job.

To remedy this deficiency in the TMDL, Ecology is first obligated (i) to estimate the loads coming into Lake Spokane reservoir from illegal discharges from septic tanks; (ii) to commit to eliminating those sources and their impacts, with a timeframe; and (iii) re-run the model with the reduced loads. Given the relatively large volume of phosphorus it appears the septic tanks are contributing, we expect that the revised modeling will offer enough leeway to accommodate more realistic assumptions about Post Falls and HARSB's future needs. Post Falls and HARSB do not object to a portion of the reduced load being allocated to Spokane County to reflect the amount of treatment capacity needed to serve the septic tanks it is replacing, but for Spokane County to receive a full 12 to 20 lbs/day of offset for septic tanks when it can operate on far less violates the principle of "equity" on which Ecology states the TMDL is based.[38]

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35 TMDL at C-72 (Comment 42 and response).

36 40 C.F.R. § 122.2; *United States v. Lucas*, 516 F.3d 316, 332 (5th Cir. 2007), *cert. denied*, 129 S. Ct. 116 (2008). EPA made its position very clear in *Lucas* that "the CWA does not exempt septic tanks from the permit requirement." *Brief for the United States* at 23. "Counts 30-41 charged defendants with knowingly causing pollutants, including sewage and domestic wastewater, to be discharged from a septic system, a point source, into waters of the United States without a permit 'issued under the authority of Section 402' of the CWA." *Id.* at 51. "Septic tanks, which discharge pollutants from a point source, are otherwise covered." *Id.* at 52.

37 N.H. Dep't of Envtl. Servs., *Total Maximum Daily Load (TMDL) Study for Bacteria in Little Harbor, New Hampshire*, June 2006, at 27 ("Allocations for illicit connections and failing septic systems were also set to zero because these discharges are illegal."); *id.* at 40 ("It is unlikely that EPA could approve a TMDL that appears to allow illegal discharges.") (comment); Environmental Protection Agency, Region 5, *Wasteload Allocation*, at 13 ("Don't assign loads to illegal sources (SSOs, straight pipes, permit exceedances)").

38 That is, point-source dischargers' allocations are based on equivalent application of technology.

**2. The TMDL's load and wasteload allocations need to be reallocated because the current loading assumptions deny Post Falls and HARSB equal protection under the law, are arbitrary and capricious, and fail to provide Idaho dischargers with sufficient allocations for future growth.**

As discussed in the following sections, (i) the overall load and wasteload allocations between Washington and Idaho are grossly disproportionate based on population or land area; (ii) the TMDL uses unsupportable population projections to favor Washington municipalities over Idaho; (iii) Washington dischargers get the benefit of "delta management" opportunities not available to Idaho dischargers and apparently necessary for compliance; (iv) the TMDL fails to require baseline reasonable reductions of groundwater inputs in and near the reservoir; (v) Washington tributaries (and point-source dischargers thereon) and non-point sources are required to make only modest reductions compared with Idaho; (vi) the TMDL uses arbitrary and inconsistent compliance measures to the disadvantage of Idaho dischargers; and (vii) the TMDL's offer to re-allocate loads after ten years does not offer Idaho municipalities sufficient assurance that their future growth will be accommodated or sufficient ability to plan for growth.

**a) Overall load and wasteload allocations are grossly disproportionate because Washington receives over 90 percent of the allocated loads whereas it will have only 73 percent of the 2027 population and contains less than 35 percent of the land in the watershed.**

The TMDL allows the discharge of between 78 and 329 lbs/day of human-caused phosphorus, depending on the season. While the TMDL does not expressly set wasteload allocations for sources on the Spokane River upstream of the Idaho border (which would be impermissible under EPA regulations), the TMDL makes clear that human sources in Idaho can expect to receive the equivalent of 7.2 lbs/day of phosphorus wasteload allocations, including both point source and stormwater discharges. Washington sources get the remainder, which is over 90 percent of the allocations. The relative allocations are as follows:

**Comparison of Washington and Idaho load allocations[39]**

| Month and season | Total human load (lbs/day) | Load allocated to Washington (lbs/day) | Washington percentage | Load allocated to Idaho (lbs/day) | Idaho percentage |
|---|---|---|---|---|---|
| March-May | 329 | 321.8 | 97.8 | 7.2 | 2.2 |
| June | 119 | 111.8 | 93.9 | 7.2 | 6.1 |
| July-October | 78 | 70.8 | 90.8 | 7.2 | 9.2 |

These numbers are impossible to justify given that Washington is expected to include just 73 percent of the region's population in 2027 and Idaho 28 percent (see discussion in Section D.2.b) below). This gross disproportion also cannot be justified based on land area. As stated in the TMDL,

39 TMDL at 31, Table 4 (overall human loadings); *id.* at 35 (assumed Idaho loadings); *id.* at 34, 39 and 40 (Washington loadings).

"[t]he river drains an area of about 6,640 square miles in two states. Approximately 2,295 square miles are within Washington, with the remainder of the watershed in Idaho."[40] This means that 4,345 square miles of the watershed are in Idaho and that Idaho contains 65.4 percent of the land in the watershed and Washington contains 34.6 percent. The TMDL contains no other information that would justify the relative allocation.

**b) The TMDL's population projections are unsupportable because they overestimate growth in Washington and underestimate it in Idaho.**

The TMDL allocates the allowable municipal discharges based on population assumptions that are grossly inconsistent with historical growth patterns and any realistic expectation of future growth. Post Falls hired consultants TischlerBise to analyze, among other things, the appropriateness of the TMDL's population assumptions. The TischlerBise report is attached as Exhibit "5." As set forth in Figure 9 of the TischlerBise report, at the end of the time horizon the TMDL analyzes, the population of the watershed is expected to reside 73 percent in Washington and 27 percent in Idaho. The TMDL significantly skews these expectations, allocating 81.4 percent of the municipal discharge rights to Washington, and only 18.6 percent to Idaho.[41]

**Figure 9. Population Shift Due to Growth Cap**

| | 2010 | 2020 | 2025 | 2027 | 2030 |
|---|---|---|---|---|---|
| **Woods & Poole Economics** | | | | | |
| ***Spokane Trends*** | 475,973 | 544,063 | 578,975 | 593,016 | 614,077 |
| Average Annual Growth | 6,648 | 6,809 | 6,982 | 7,020 | 7,020 |
| Spokane Share of Metro | 76.4% | 74.2% | 73.3% | 73.0% | 72.5% |
| ***Kootenai Trends*** | 146,904 | 189,275 | 210,874 | 219,573 | 232,622 |
| Average Annual Growth | 4,715 | 4,237 | 4,320 | 4,350 | 4,350 |
| Kootenai Share of Metro | 23.6% | 25.8% | 26.7% | 27.0% | 27.5% |
| **Washington Department of Ecology** | | | | | |
| ***Spokane Phosphorous*** | 483,771 | 589,243 | 641,978 | 663,073 | 694,714 |
| Average Annual Growth | 10,547 | 10,547 | 10,547 | 10,547 | 10,547 |
| Spokane Share of Metro | 77.7% | 80.2% | 81.2% | **81.6%** | 82.1% |
| ***Kootenai Phosphorous*** | 138,743 | 145,080 | 148,249 | 149,516 | 151,418 |
| Average Annual Growth | 634 | 634 | 634 | 634 | 634 |
| Kootenai Share of Metro | 22.3% | 19.8% | 18.8% | **18.4%** | 17.9% |

TischlerBise Report at 12.

This misallocation gives Washington municipalities an unfair and unjustified economic development advantage over their counterparts in Idaho. It is illegal and just plain wrong for the TMDL to do this.[42] In addition, the City of Spokane's allocation is based on a flow estimate that

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40 TMDL at 13.

41 TMDL, Table 5, p. 34-35.

42 This disproportion can be depicted in other ways as well. See Exhibit "6" showing the disproportionate number of pounds per 100,000 population allocated under the TMDL. Spokane receives 5.21 lbs/100,000 population compared with Post Falls, which receives only 1.87 lbs/100,000 population.

includes up to 9.6 MGD for infiltration/inflow. Spokane will likely be able to eliminate much of that over time, allowing them an additional wasteload allocation that is not needed to serve its population.[43]

TischlerBise also analyzed the extent of the economic disadvantage to Idaho if the TMDL's de facto growth cap were imposed on Idaho communities. The results are staggering. If the TMDL remained in place until 2030, the Idaho regional economy would lose a staggering **$3.5 billion** a year, effectively cutting the economy in half of what it would be without the cap.[44] It is completely outrageous and unacceptable that Ecology would propose to hamstring the north Idaho regional economy in this way.

Figure 15. Potential Impact on the Kootenai County's Economy

| *Gross Regional Product* | | | | 2010-2030 | |
|---|---|---|---|---|---|
| *Kootenai County, ID* | 2010 | 2020 | 2030 | *Increase* | Avg Anl |
| Projected GRP *(millions of $2004)* | $3,917 | $5,429 | $7,502 | $3,584 | 4.6% |
| Projected Population | 146,904 | 189,275 | 232,622 | 85,718 | 2.9% |
| Projected Jobs | 83,382 | 104,277 | 130,342 | 46,960 | 2.8% |
| Total Population and Jobs | 230,286 | 293,552 | 362,964 | 132,678 | 2.9% |
| GRP per Person and Job | $17,000 | $18,500 | $20,700 | | |

*Source: Woods & Poole Economics, Inc.*

| *Kootenai County GRP* | *(in millions of 2004 dollars)* | | | 2010-2030 | | ***Potential Economic Impact*** |
|---|---|---|---|---|---|---|
| | 2010 | 2020 | 2030 | Increase | Avg Anl | |
| WA Dept of Ecology Growth Cap | $3,917 | $3,711 | $3,930 | $13 | 0.0% | ($3,572) |

TischlerBise Report at 19.

No environmental concerns justify this misallocation. LimnoTech has confirmed that 1.5 lbs/day of loading could be transferred from the City of Spokane to Post Falls without increasing DO levels in the reservoir.[45]

**c) Washington dischargers get the benefit of "delta management" opportunities, which are not available to Idaho dischargers and according to the TMDL likely are necessary for compliance.**

The TMDL blatantly contradicts itself regarding "delta management," or in other words, the requirement that point-source dischargers who cannot meet their loads through technological means clean up other people's pollution as a condition of discharge. Post Falls and HARSB complained during the comment period that "delta management" opportunities were not available to them, while "delta management" opportunites are available to Washington dischargers. In response, Ecology writes opposite conclusions, depending on which side of the border the discharger is. To Idaho dischargers, Ecology respond to a comment that "The Idaho allocation improperly assumes that effluent offsets are available in Idaho" as follows:

43 Excerpt from Spokane's Capital Facilities and Utilities Plan, p. 28, attached as Exhibit "7".
44 See also Exhibit "8," showing the effective population cap the TMDL places on Post Falls and Rathdrum.
45 Memo from Dave Dilks to Sid Fredrickson, "Water Quality Assessment of Loading Trade between Post Falls and City of Spokane" (LimnoTech March 11, 2010), attached as Exhibit "9."

> Response: *Ecology chose to base the draft TMDL on the TMDL #1 modeling scenario, including the corresponding assumptions for Idaho sources, for the reasons stated on Page 21 of the draft TMDL. The availability or non-availability of offsets was not a factor in this decision. The draft TMDL does not state that Ecology assumes that effluent offsets are available in Idaho and Ecology has made no such assumption.* ***As stated in the summary response to Part R, Ecology and EPA believe that the loading assumptions for phosphorus, for the Idaho dischargers, in the draft TMDL are, in fact, achievable with available technology.***[46]

In other words, Ecology's story to Idaho dischargers is that it can meet the assumed loads in the TMDL without opportunities for delta management.

Ecology tells a much different story to Washington dischargers and Avista. In fact, the strong likelihood that the assigned loads cannot be met by technology alone are right in the definition of "delta management:"

> ***Delta:*** *The phosphorus concentration difference between what improvements wastewater treatment plant technology can achieve and the final wasteload allocations.*[47]

The TMDL and managed implementation plan ("MIP") discuss delta management at length and make no secret of the fact it is likely to be needed:

> *The dischargers and Avista can and will likely need to pursue actions to reduce nonpoint sources of pollution to the mainstem of the river and the tributaries, in order to reduce their 'delta' and meet the wasteload allocation (Dischargers) and dissolved oxygen responsibility (Avista).*
>
> *The term "delta" refers to the difference between what technology can achieve, such as advanced wastewater treatment for phosphorus removal, and the final wasteload allocation, which must achieve compliance with water quality standards. For example, if wastewater effluent from the Liberty Lake Sewer and Water District averages 50 μg/L total phosphorus over the critical season, that discharger will need to reduce an average of 14 μg/L of phosphorus (or more correctly its mass equivalent) through target pursuit actions, described in the Managed Implementation Plan section, in order to meet the final wasteload allocation of 36 μg/L (see Wasteload Allocations section and Table 5).*[48]

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[46] TMDL at C-38 (emphasis added).
[47] TMDL at A-3.
[48] TMDL at 37-38.

Ecology's position is simply inconsistent and outrageous. Idaho dischargers cannot be held to a standard they cannot meet based on opportunities they do not have.

**d) The TMDL's failure to require baseline reductions of groundwater inputs in and near the reservoir is arbitrary and capricious and eliminates loads that could be allocated to Idaho sources.**

The TMDL determines that 39.5 to 246.1 lbs/day of anthropogenic loading from the groundwater enter the reservoir in and around Long Lake. A portion of this comes from septic tanks, which we have already discussed, and which need to be removed from the load. Ecology frankly admits that a part of the load is probably overestimated, because it does not have good data. The remainder comes from non-point sources of pollution. However, the TMDL does not analyze the potential for reductions of these loads through the application of best management practices as it did for tributaries. The TMDL says: "For groundwater, no percent reductions are assigned so the entire nonpoint load is available for credit to a Dischargers [sic] delta upon Ecology approval."[49]

This approach is discriminatory against Idaho dischargers and is unnecessary. First, we question whether a TMDL can be based on making delta opportunities available to dischargers in one State that are not available to those in other States, especially when Ecology admits those opportunities are likely needed for compliance. To rectify this, some non-source reductions should be introduced into the model as part of the baseline that are not eligible for delta management (as in the other tributaries). Second, the TMDL includes numerous "margins of safety" that it can rely on without deliberately overestimating the groundwater inputs into the reservoir. In this regard, our understanding is that a non-point source study is being planned as we speak that will provide better data on phosphorus levels of groundwater entering the reservoir. Under these circumstances, Ecology could easily adjust the groundwater assumptions by a small amount to accommodate the small increment that Idaho dischargers need.

**e) Washington non-point sources and tributaries to the Spokane River are required to make only modest reductions, notwithstanding the presence of a point source on the Little Spokane.**

In contrast to Idaho dischargers who are asked to do the impossible, some Washington dischargers are handled with kid gloves. Such is the case with the tributary and non-point source allocations in the TMDL. Without discussion or analysis, the TMDL attributes 20 to 50 percent seasonal load reductions to Hangman Creek and Coulee Creek and 36 percent to the Little Spokane River. These reductions are far lower than in prior drafts of the TMDL. The TMDL cites the WARMF model and "best professional judgment" as the basis for this determination, but does not include a definition of "WARMF" or any analysis. The TMDL also does not mention or analyze that the Little Spokane River includes the Spokane Trout Hatchery, a point-source discharger. It appears the Little Spokane River was analyzed only for non-point source reductions. The analysis should be revised to reflect the reductions the hatchery can achieve through the installation of technology.

49 TMDL at 39, Table 6a, note 1.

**f) The TMDL uses inconsistent and arbitrary compliance measures and manipulates the modeling to exaggerate the impact of Idaho's dischargers.**

The TMDL is rife with evidence that the harsh sentence meted out to Idaho dischargers was pre-determined without regard to the underlying facts or the science. First, Ecology relies on faulty modeling to ensure that its pre-determined outcome of an Idaho growth cap is achieved. Second, the TMDL uses arbitrary and inconsistent compliance measures, applying them or ignoring them arbitrarily in each case to favor Washington and to disadvantage Idaho.

***(i) The TMDL applies arbitrary and inconsistent compliance measures to Idaho dischargers.***

Turning first to the compliance measures, the TMDL is a DO TMDL. The State of Washington sets a water quality standard for "lakes" (including reservoirs) designated for "Core Summer Salmonid Habitat" of 9.5 mg/L DO. However, Ecology does not purport to apply this standard to the troublesome depths of Lake Spokane reservoir during the times of concern, presumably because the agency's own "no source" modeling shows that the standard is not met even in the absence of human sources of pollution. There is also no evidence that the deeper areas in the reservoir have ever been "Core Summer Salmonid Habitat" since the dam was installed.[50] Ecology has promulgated an alternate water quality standard for salmonid habitat designated lakes that do not meet the 9.5 mg/L DO standard. In such lakes, "human actions considered cumulatively may not cause the DO of that water body to decrease more than 0.2 mg/L below natural conditions."[51] Leaving aside the enormously important issue that the low DO conditions in the depths of Lake Spokane reservoir are due to the dam and not to natural conditions, the TMDL applies the 0.2 mg/L human-caused change in DO as the applicable water quality standard.

The connection between DO in Lake Spokane reservoir and upstream dischargers is the fact that nutrients in the water column can contribute to reductions in DO in the reservoir. The problem is Ecology's modeling shows that, even applying every reduction it can imagine and some that we argue are impossible, it is not possible to reduce nutrient inputs to the point where human-caused DO sags do not exceed 0.2 mg/L in Lake Spokane reservoir.[52] This is where things start to get interesting.

Given the impossibility of keeping DO sags to no more than 0.2 mg/L in the man-made reservoir, Ecology then, for this purpose only, recognizes that Lake Spokane reservoir is not a natural lake, and that Avista, the owner and operator of the dam, has responsibilities under Washington law to implement "all reasonable and feasible improvements" to address the problems it has caused.[53] Ecology then stops looking at the DO standard (except for Idaho dischargers, see below), and arbitrarily draws a line, saying that the upstream dischargers' responsibility is cumulatively to hit a benchmark of 10 μg/L phosphorus (and accompanying ammonia and CBOD limits) at the inlet to Lake Spokane reservoir. Ecology contends that the 10 μg/L benchmark is not a water quality standard, but

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50 We question the beneficial-use designation given these facts.
51 Wash. Admin. Code § 173-201A-200(1)(d)(ii).
52 *See* PSU 2010 Report, Tables 13 and 14 (attached as Exhibit "10") (showing DO sags up to 0.78 mg/L compared to the no-source scenario).
53 Wash. Admin. Code § 173-201A-510(5)(b)(ii).

rather is a "reasonable division of responsibility" between the upstream dischargers and Avista.[54] Thus, the effect becomes clear: meeting the 10 µg/L TP limit is the upstream dischargers' responsibility; increasing DO above the levels these phosphorus reductions will achieve is Avista's responsibility. The TMDL contains no information as to the extent of Avista's responsibilities, or whether it will be easy, hard, or impossible for Avista to bridge the gap to meet the standard. Avista was supposed to file a report with Ecology in December 2009 about its proposed actions for compliance, but we have been unable to locate the report, and we request that Ecology provide a copy to us for review.

An additional issue the TMDL addresses is how to define the point-source dischargers' obligations to meet the 10 µg/L phosphorus standard. The TMDL claims it allocates those obligations based on the "equivalent application of technology." That is, all the dischargers have to install the best available technology that will allow them to meet a maximum monthly average phosphorus limit of 50 µg/L phosphorus.

In summary, Ecology performed DO modeling as part of the TMDL analysis. However, it used a different method for allocating responsibilities under the TMDL apparently because it never shows compliance with the 0.2 mg/L DO standard Ecology would apply. Instead, the "reasonable division of responsibility" in the TMDL is for dischargers to make the reductions needed for water at Segment 154 to contain approximately 10 µg/L phosphorus and any additional responsibilities belong to Avista. Further, point-source dischargers are subject to the "equivalent application of technology" in their wastewater plants to meet a maximum monthly average of 50 µg/L phosphorus in their plants.

Had Ecology applied the 10 µg/L TP scenario to Idaho dischargers, it would have determined that the Idaho dischargers are an insignificant part of the issue and could be given an adequate allocation. In fact, the 2010 PSU Report analyzed the impact of Idaho dischargers on the 10 µg/L TP benchmark. The results are shown in Figure 2 of the PSU 2010 Report, which is reproduced here:

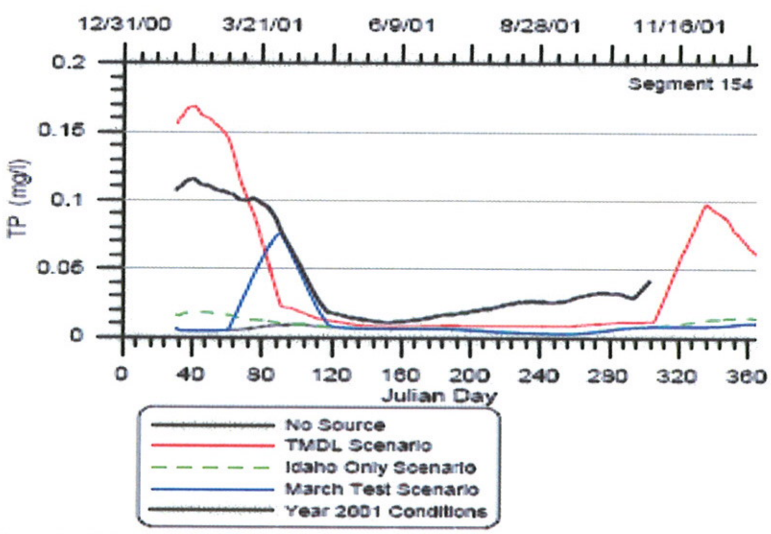


Figure 2. 30-day running average total phosphorus concentrations at segment 154 in Long Lake of the no source scenario, the TMDL scenario, Idaho only scenario, March test scenario and for year 2001 conditions.

PSU 2010 Report at 9.

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[54] TMDL at C-148, C-149, and C-154.

This graph illustrates there is no discernable difference in total phosphorus levels between the Idaho-only scenario and the no-source scenario during the seasons of concern in the TMDL. The underlying data are even more compelling.[55] During the March 1 to October 31 timeframe, the modeling shows that Idaho dischargers have <u>no effect</u> on phosphorus levels at Segment 154 on 175 of the 245 days in this timeframe, or 71 percent of the time. In June through September, this conclusion is even more striking. Idaho discharges have no effect on phosphorus levels on 98 of 122 days, or 80 percent of the time, with a maximum impact of 1 μg/L. The average impact from March through October is only 0.4 μg/L. In sum, the average impact of the Idaho dischargers is a rounding error in the modeling, amounting to approximately four percent of the phosphorus permitted in the river during the timeframe of concern. Clearly, Idaho dischargers have no meaningful impact on Ecology's ability to achieve a 10 μg/L "equitable basis for division" at the inlet to Lake Spokane reservoir.

However, Ecology did not apply the 10 μg/L TP benchmark to Idaho dischargers, nor did it even mention this result in the TMDL. Instead, Ecology moved Idaho's goal line. The issue became something other than meeting 10 μg/L phosphorus at Segment 154. Instead, Ecology asked PSU to run an "Idaho-only model" which showed that, while Idaho discharges **improved** or had no impact on DO levels much of the time, at certain times of the year and at certain depths, the miniscule Idaho discharges reduced DO levels by up to 0.12 mg/L (or 0.17 mg/L if the top eight feet of the reservoir are ignored). Based on this modeling, Ecology protests there is no room to accommodate Idaho's needs. In response to a comment, Ecology wrote:

> *However, the PSU (2009) report shows that, even at the reduced levels of discharge assumed in the draft TMDL, the Idaho dischargers, by themselves, cause a dissolved oxygen decrease of up to 0.1 – 0.15 mg/L in Lake Spokane, which is 50 – 75% of the cumulative human-caused dissolved oxygen decrease allowed in lakes and reservoirs by the Washington water quality standards . . . .*[56]

In making this statement, Ecology conveniently forgets that it is not using the 0.2 mg/L standard to measure the Idaho dischargers' compliance. It forgets that it has decided Avista must play a role in meeting the standard and that it has created an "reasonable division of responsibility" between the dischargers and Avista. In short, the benchmark the TMDL sets for the dischargers is not that their discharges must not reduce DO more than 0.2 mg/L DO, because Avista must play a role in some of that reduction; rather, cumulatively, the dischargers cannot have an impact that would cause the water at the inlet of Lake Spokane reservoir to exceed approximately 10 μg/L TP.

It is completely inconsistent and arbitrary to apply the 0.2 mg/L DO standard as an "Idaho-only" matter. To apply the 0.2 mg/L standard to Idaho dischargers is to treat them differently from other dischargers and to make them bear a portion of Avista's obligation. Thus, even if we accept Ecology's assessment of a "0.1 to 0.15 mg/L" impact (which, as we will see, is questionable), it is only relevant as compared to the contributions of the other dischargers. When one makes that comparison, Idaho's share of the DO impact is minor. The PSU 2010 Report includes a run showing all sources

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[55] See Exhibit "11" (compilation of Segment 154 data).
[56] TMDL at C-36.

discharging at allowable levels in the TMDL (the "TMDL run") as well as a run excluding all sources except Idaho sources (this is the "Idaho-only" run). The TMDL run includes certain results where the 0.2 mg/L DO standard is exceeded (see highlighted areas of Tables 13 and 14 in Exhibit "12"). For these times and places of concern, the "Idaho-only" scenario shows the Idaho dischargers' contributions to the exceedences (see highlighted areas of Tables 15 and 16 in Exhibit "12"). When these numbers are laid side-by-side, the Idaho percentage averages only 15.3 percent of the total impact through the end of the compliance period (see calculations in Exhibit "12").[57]

Elsewhere, the TMDL seems to rely on "discharging equivalent pollutant concentrations" as the basis for allocating loads between point-source dischargers.[58] However, the treatment of dischargers is not equivalent at all because the TMDL allocates a load to a discharger and not a concentration. Because of the future growth discrepancies set forth in Section III.D.2.b above, the City of Spokane, in particular, will receive a load allocation that it can either reserve for future growth, or could conceivably use to discharge at a higher concentration. Ecology's draft permit for Spokane, attached as Exhibit "13," nowhere indicates that concentration-based limits will be required.

**(ii)** ***Ecology manipulates the modeling to the disadvantages of Idaho dischargers.***

As discussed above, the Idaho-only scenario shows that Idaho dischargers have a negligible effect on total phosphorus levels at the inlet to Lake Spokane reservoir. This raises the question: why would the Idaho-only scenario show relatively substantial changes in DO levels based on immaterial additions of phosphorus?

LimnoTech, which is Post Falls, HARSB. and Coeur d'Alene's modeling expert, has determined that the PSU model has significant "stability issues" that are causing the model to overestimate DO impacts from the Idaho dischargers within Lake Spokane reservoir.[59] LimnoTech was asked to compare the expected incremental effect of oxygen demanding materials from Idaho dischargers with the effects of discharges from the City of Spokane. As one would expect, the model showed that the City of Spokane discharge had a much larger impact: Spokane introduced 300 times the concentration of phosphorus, and 3.7 times the concentration of chlorophyll-a, into Lake Spokane reservoir as did the Idaho dischargers. However, then things go haywire:

> *The 'special DO output' generated by the model showed dissolved oxygen concentrations associated with the Incremented Idaho scenario to be approximately 0.5 mg/l different than the results of the other scenarios for large periods of time. The result was completely inconsistent with all other water quality model predictions from that*

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[57] Ecology appears to rely on modeling that ignores the top eight feet of the reservoir, which is set forth in Tables 7 to 10 of the PSU 2010 Report. However, it appears to have conceded that the entire reservoir should be modeled, *see* TMDL at C-153, Comment T.49.

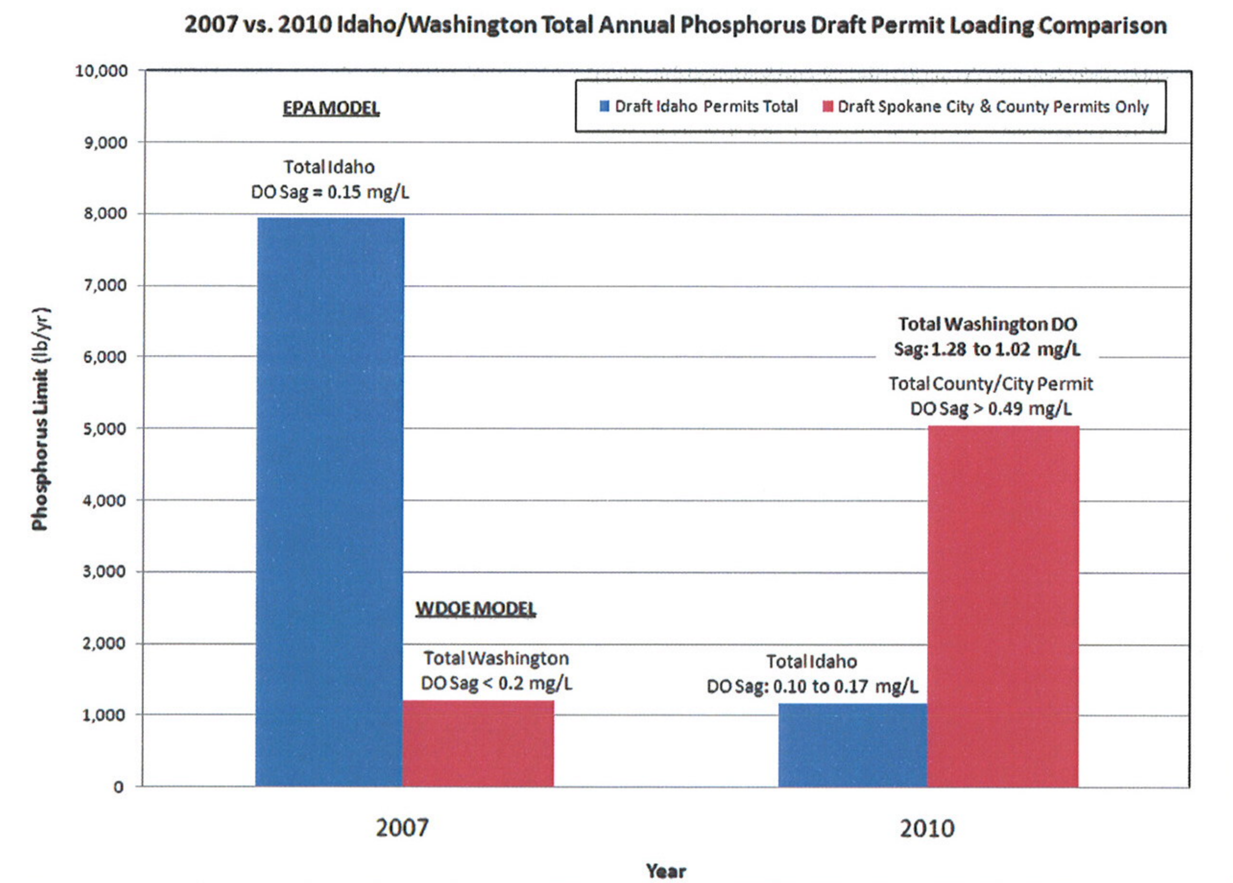
[58] TMDL at 35.

[59] Memorandum from Dave Dilks to Sid Fredrickson, "Direct Assessment of Attenuation of Idaho Sources of Phosphorus" (March 11, 2010), attached as Exhibit "14" (the "March 2010 LimnoTech Memo").

> *scenario, and led to the investigation of model stability issues discussed below.*[60]

What LimnoTech uncovered was that the model is predicting widely variable flows between the TMDL and the Idaho Incremented Scenario, up to plus or minus 450 cubic feet per second. This is completely inconsistent with how the model should function: the flows should be nearly identical.[61] This huge variation in flows provides a logical explanation for why Idaho DO impacts would be overestimated. The bottom line: there is a problem with how the model is treating Idaho DO impacts within the reservoir, which brings the conclusions of PSU's Idaho-only scenario into question. With so much at stake in this TMDL, the model should be debugged and re-run.

Another reason to doubt the correctness of Idaho-only scenario is to compare the results of the modeling in 2007 versus 2010. In 2007, the modeling predicted a DO sag of 0.15 mg/L from a discharge of approximately 8,000 lbs/year of phosphorus from Idaho sources. In 2010, the modeling predicted a 0.10 to 0.17 mg/L DO sag based on a discharge of only about 1,000 lbs/year, as illustrated in the following chart. These results simply do not add up. Something is wrong with the PSU model.

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[60] March 2010 LimnoTech Memo at 5-6.
[61] March 2010 LimnoTech Memo at 6.

Consider the evidence: First, attenuation is an accepted natural process and would be expected in the 40-plus miles of river between the Idaho dischargers and the reservoir. Second, both PSU and LimnoTech predict that Idaho dischargers introduce only de minimis levels of phosphorus into Lake Spokane reservoir. The PSU 2010 Report phosphorus modeling is clearly inconsistent with its own 2010 DO modeling. Third, the PSU 2010 DO modeling is wildly inconsistent with the 2007 modeling of Idaho impacts. In addition, LimnoTech's September 2009 modeling predicts only negligible decreases in DO from the Idaho discharges, even if the discharges are increased to 100 μg/L or even 200 μg/L. Finally, LimnoTech has discovered significant instability and flow variability in the models prediction of the DO impacts of Idaho dischargers in Lake Spokane reservoir where those issues should not exist. This evidence strongly suggests (i) that PSU 2010 DO modeling is incorrect, (ii) that Idaho's discharges dissipate almost completely between their discharge points and Lake Spokane reservoir, and (iii) the discharges have only a de minimis impact on DO levels in Lake Spokane reservoir.

In addition, Idaho dischargers are given no benefit from increases in FERC-mandated minimum flows from Post Falls Dam. Instead, Ecology discounts this benefit, which should accrue to benefit of the Idaho dischargers but do not under the current TMDL, as a "margin of safety." In fact, the benefit of 0.04 mg/L DO[62] provided by the FERC flows is significant in the context of the tiny allocations allowed by the TMDL, and, in a properly operating model, this could provide the margin for a sufficient load allocation for Idaho's future growth. In addition, Ecology states it cannot include the FERC-mandated flows because they are not guaranteed, but the TMDL is devoid of information that there is any likelihood the required flows would not be delivered within the one-in-ten-year timeframe required by Washington's water quality standards.

Other parties to the dispute resolution (including the City of Coeur d'Alene and Inland Empire Paper) have raised valid and well argued points about the modeling that we will not repeat in detail here. Among these are (i) that Ecology arbitrarily rejected TMDL scenario #2; (ii) that Ecology arbitrarily ignored modeling of the top eight feet of the Lake Spokane reservoir; and (iii) that Ecology arbitrarily used different translator criteria to reduce the basis for the assumed Idaho loading allocations from 50 μg/L TP to 36 μg/L TP. We fully join in these arguments and ask that they be addressed during the dispute resolution.

**g) The TMDL's offer to re-allocate loads after ten years does not offer Idaho municipalities sufficient assurance that their future growth will be accommodated or sufficient ability to plan for growth.**

In response to Post Falls and HARSB's concerns regarding the inadequacy of the allocations for future growth, Ecology shrugs its shoulders and says that the numbers can be readjusted at the ten-year re-evaluation point. This is not acceptable to Post Falls and HARSB. These entities have to plan for services twenty or more years in the future and cannot afford to be hamstrung for a decade or more by unreasonable restrictions in the TMDL. The problems need to be addressed now.

It is also not acceptable to state that the assumptions were based on information the utilities provided themselves, especially as to Post Falls. Ecology did not announce uniform criteria for how

62 This value is determined by subtracting the TMDL#1 values (Table 12) from the FERC flow impact source assessment scenario in the 2009 PSU Report.

growth assumptions should be managed. Post Falls and HARSB did their best to provide reasonable assessments of future growth. As soon as it became clear that other municipalities were being allowed to use more generous bases to assess future growth, Post Falls sought to provide consistent information, yet this was ignored.[63] If Ecology is serious about "equity" in allocating loads, it will readjust the municipal loads now to use the best information and consistent assumptions for all dischargers.

**2. All of the dischargers, including Post Falls and HARSB, are treated unfairly as compared to Avista.**

The TMDL arbitrarily allocates responsibilities between the dischargers and Avista. Avista is required by Washington law to install "all reasonable and feasible improvements" to address the violation of the water quality standards that Avista has caused.[64] Ecology's tortured and inconsistent interpretation of its water quality standards makes it difficult to understand how this requirement can be applied. Avista built the dam that created the Lake Spokane reservoir and is therefore responsible for creating a waterbody with low DO concentrations at lower depths. However, Ecology does not apply the DO water quality standard to those areas. Rather, areas those are subject to regulation based on the 0.2 mg/L reduction above natural levels, even though these areas are not natural and therefore have no natural level of DO to set the baseline. Until Ecology addresses this fundamental disconnect, any allocation between the dischargers and Avista is inherently arbitrary. We are down the rabbit hole.

However, if somehow this is determined to be a reasonable way to interpret the water quality standards, we believe the responsibilities have been allocated backwards. Ecology already has a TMDL in place for Lake Spokane reservoir that has proven insufficient, in Ecology's view, to meet the water quality standards. Washington law states that it is now Avista's responsibility to identify "all reasonable and feasible improvements" to address the water quality problems it has caused, which, under Ecology's interpretation, include the volumes of the reservoir with low DO levels. The law plainly requires that Avista install all such improvements. There is no basis for Ecology to revise the TMDL and impose a de facto new nutrient water quality standard until Avista's obligations are met. Otherwise, no one can evaluate the relative burden that Avista must bear compared to the dischargers.

## E. The criteria for and use of studies on bio-availability of phosphorus require clarification.

In the TMDL response to comments, Ecology declined to modify the following statement regarding the possibility using phosphorus bio-availability studies to modify permissible loads:

> *NPDES permit holders may seek to prove to Ecology that a certain stable fraction of their phosphorus discharge is not bioavailable in the river environment for a time sufficient to consider it not bio-available and not a nutrient source. If Ecology agrees, the pounds of phosphorus that are not bioavailable will be recognized as contributing toward achieving the total phosphorus wasteload allocation.*[65]

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[63] Letters from Terry Werner to Brian Nickel and David Moore, January 6, 2010, attached as Exhibit "15."
[64] Wash. Admin. Code § 173-201A-510(5)(b)(ii).
[65] TMDL at C-94 to C-95.

Ecology should identify the criteria applicable to such studies and to clarify that such studies would be applicable to addressing the loading assumptions applied to Idaho dischargers by EPA during the NPDES-permitting process. We request that such language be developed during the dispute resolution process.

## IV. DESIRED OUTCOME OR RESOLUTION

We have described nearly thirty pages of serious problems with the TMDL. Yet, as we stated at the outset, our goal is only to achieve the allocations that are necessary for consistent compliance and to provide for future growth. Our preferred option is to revise the TMDL to include the following information: (i) the requested language regarding concentration-based limits set forth in Section "A" above; clarifying language regarding bio-availability studies discussed in Section "E" above; and (iii) a load allocation for Idaho sufficient for EPA to grant the following wasteload allocations to Post Falls and HARSB in their NPDES permits[66] (in addition to a consistent load to meet the City of Coeur d'Alene's needs):

| | Total Phosphorus (lbs/day) | Ammonia (lbs/day) | CBOD (lbs/day) |
|---|---|---|---|
| Post Falls | 3.19 | 255[67] | 255[1] (March – Oct) |
| HARSB | 1.33 (seasonal average) | 107 (max/monthly)[1] 160 (max/weekly) (March – Oct) | 107 (max/monthly)[1] 160 (max/weekly) (March – Oct) |

Alternatively, we request that the TMDL be remanded to staff to revise the TMDL to address each of the concerns we have raised.

## V. REQUEST FOR ORAL PRESENTATION

We reiterate the request that Post Falls and HARSB **each** be given an opportunity for a presentation to the Dispute Resolution Panel in accordance with the original submittal of February 26, 2010. Post Falls and HARSB are separate entities serving separate populations who are given different load assumptions under the TMDL. Each should be heard on equal terms with other filers.

66 See Memorandum from Paul Klatt to Terry Werner, "Post Falls Phosphorus, $CBOD_5$ and Amonia Waste Load Allocation Needs for Future Population (JUB March 11, 2010), attached as Exhibit "16."

67 These limits represent 4 mg/L multiplied by expected flows (3.2MGD for HARSB and 7.65 MGD for Post Falls).

If you have any questions, please contact our legal counsel, Gary Allen, at (208) 388-1200.

Sincerely,

Clay Larkin, Mayor
City of Post Falls

Ronald B. McIntire, Chairman
Hayden Area Regional Sewer Board

cc: James Bellatty, Water Quality Section Manager

**EXHIBITS**

| | |
|---|---|
| 1 | LimnoTech Study |
| 2 | Dave Clark, HDR, et al., "What is the Limit of Technology (LOT?) A Rational and Quantitative Approach" (WEF 2009 Nutrient Removal Conference Preprint) at 13 |
| 3 | Dave Reynolds, CH2MHill, Dave Clark, HDR, "Evaluation of Exemplary WWTPs Practicing High Removal of Phosphorus" (CH2MHill, November 21, 2005) |
| 4 | "Preliminary Draft Effluent Limits for TP, CBOD and Ammonia," (EPA Region 10, February 23, 2010) |
| 5 | TischlerBise Report |
| 6 | Chart showing the disproportionate number of pounds per 100,000 population allocated under the TMDL. Spokane receives 5.21 lbs/100,000 population compared with Post Falls, which receives only 1.87 lbs/100,000 population. |
| 7 | Spokane's Capital Facilities and Utilities Plan, p. 28 |
| 8 | Chart showing the effective population cap the TMDL places on Post Falls and Rathdrum |
| 9 | Memo from Dave Dilks to Sid Fredrickson, "Water Quality Assessment of Loading Trade between Post Falls and City of Spokane" (LimnoTech March 11, 2010) |
| 10 | 2010 PSU Report |
| 11 | Compilation of Segment 154 data |
| 12 | Idaho Percentage Averages |
| 13 | Ecology Draft Permit for Spokane |
| 14 | Memorandum from Dave Dilks to Sid Fredrickson, "Direct Assessment of Attenuation of Idaho Sources of Phosphorus" (March 11, 2010) |
| 15 | Letters from Terry Werner to Brian Nickel and David Moore, January 6, 2010 |
| 16 | J-U-B Engineers chart showing 2007 wasteload allocations versus 2010 wasteloads allocations and Idaho allocations versus Washington allocation |

**Exhibit 1**

LimnoTech
Water | Environment | Scientists | Engineers

# MEMORANDUM

**DATE:** September 1, 2009

**FROM:** David Dilks, Joseph Helfand

**PROJECT:** CDAL09

**TO:** Sid Fredrickson

**CC:** Kris Holm, James Tupper, Dave Clark

**SUBJECT:** **Results of CE-QUAL-W2 Model Sensitivity Analyses in Response to Different Levels of Idaho Point Source Discharge**


## Summary

LimnoTech conducted a series of simulations using the most recent version of the CE-QUAL-W2 model to define the incremental dissolved oxygen impact in Long Lake associated with different levels of phosphorus and ammonia in the effluent of Idaho point source discharges. Ammonia permit limits of 8 mg/L for Idaho discharges resulted in a decrease in dissolved oxygen of less than 0.01 mg/l at the critical Long Lake segment during the critical late August period, compared to TMDL Alternative #1. This incremental impact is very small and likely less than a level that the model is capable of distinguishing. Total phosphorus limits of 100 and 200 ug/L for the Idaho discharges resulted in incremental dissolved oxygen decreases of 0.01 and 0.05 mg/l, respectively. These incremental decreases associated with higher phosphorus limits are only 0.7 to 3% of the decrease in critical dissolved oxygen associated with TMDL Alternative #1.


## Background

U.S. EPA and Washington Department of Ecology are developing a Total Maximum Daily Load for nutrients and oxygen demanding materials designed to minimize the anthropogenic affects on dissolved oxygen in Long Lake. A series of draft TMDL scenarios have been run to date (PSU, 2009), with all simulations assuming an ammonia permit limit of 1.0 mg/l and phosphorus permit limit of 50 ug/l for Idaho point source dischargers.

The purpose of this work is to examine the incremental impact of Idaho point source (i.e. Coeur d'Alene, Post Falls, and Hayden) ammonia and phosphorus discharges on Long Lake dissolved oxygen as predicted by the most recent version of CE-QUAL-W2. This memorandum documents the analyses that were conducted, and is divided into sections discussing:

- Scenarios Evaluated
- Model Results


501 Avis Drive
Ann Arbor, MI 48108
**734-332-1200**
Fax: 734-332-1212
www.limno.com

**Scenarios Evaluated**

The Draft Spokane River Management Scenarios Report (PSU, 2009) examined four alternative scenarios, corresponding to one "no source" scenario and three alternative TMDL scenarios. All scenarios were conducted using Year 2001 flows. TMDL Alternative #1, which corresponds to point sources set at a 50 ppb TP maximum monthly average and nonpoint sources set to achievable reductions, was used as the basis for this Idaho sensitivity analysis. Four simulations were conducted, and summarized in Table 1. TMDL Alternative #1 was first run, completely unchanged from what was provided by EPA. The second simulation changed TMDL Alternative #1 by adjusting the assumed Idaho ammonia permit limits from 1.0 mg/l to 8.0 mg/l. The assumed increase in ammonia concentrations was counterbalanced by a decrease in nitrate concentration. A comparison of the difference in predicted Long Lake dissolved oxygen concentrations between these two simulations will demonstrate the incremental water quality effect of a change in ammonia concentration from the Idaho point sources.

**Table 1. Scenarios Examined**

| Scenario | Assumed Idaho Ammonia Limit* (mg/l) | Assumed Idaho Phosphorus Limit* (ug/l) |
|---|---|---|
| TMDL Alternative #1 | 1.0 | 50 |
| Increased Ammonia | 8.0 | 50 |
| TP = 100 ug/l | 1.0 | 100 |
| TP = 200 ug/l | 1.0 | 200 |

*Model input concentrations were set at 71% of the permit limit values for ammonia and phosphorus, representing the wasteload allocation following the procedure used in PSU(2009)

The third and fourth simulations investigated the dissolved oxygen impact of higher phosphorus concentrations in the Idaho effluent. The third simulation changed TMDL Alternative #1 by adjusting the assumed Idaho phosphorus permit limits from 50 ug/l to 100 ug/l. The fourth simulation changed TMDL Alternative #1 by adjusting the assumed Idaho phosphorus permit limits from 50 ug/l to 200 ug/l. Predicted Long Lake dissolved oxygen concentrations for each of these simulations, compared to the results from TMDL Alternative #1, will demonstrate the incremental water quality effect of changes in phosphorus concentration from the Idaho point sources.

Each scenario simulation consisted of three sequential model runs, as structured by PSU. The first simulation considers the Idaho portion of the Spokane River, the second simulation considers the Washington portion of the Spokane River, and the third simulation considers Long Lake. Model predictions at the downstream boundary of each of the first two simulations are directly passed to serve as input for the upstream boundary for the next simulation in the sequence.

Analysis of model results focused on the "special output" provided by PSU for the Long Lake TMDL, which corresponds to semi-monthly average minimum dissolved oxygen in the hypolimnion of each model segment. Particular focus was given to late August dissolved oxygen predictions for model segment 36 (formerly referred to as segment 188), which the draft TMDL scenarios identified as the critical time and location for dissolved oxygen impacts.

## Model Results

The scenarios in Table 1 were run on single processor computers, and the incremental impact of alternative Idaho effluent limits on Long Lake dissolved oxygen was examined. The results are shown in Table 2 for the critical lake segment and time period. The increased Idaho ammonia discharge is predicted to decrease minimum hypolimnetic dissolved oxygen by 0.0077 mg/l, which is likely an amount smaller than can be accurately discriminated by the model. The incremental impact of the increased phosphorus limits are 0.011 and 0.045 mg/l respectively. The PSU (2009) Scenarios report indicated that TMDL Alternative #1 would decrease the critical dissolved oxygen in Long Lake by 1.5 mg/l. The incremental oxygen decreases of 0.011 and 0.045 mg/l associated with higher Idaho phosphorus limits correspond to only 0.7 to 3.0 % of this deficit.

**Table 2. Incremental Dissolved Oxygen Impacts at Critical Segment and Time**

| Scenario | Incremental Impact (mg/l) |
|---|---|
| Increased Ammonia | -0.0077 |
| TP = 100 ug/l | -0.011 |
| TP = 200 ug/l | -0.045 |

A complete listing on incremental impacts at all Long Sake segments and times is provided in the appendix.

## References

Portland State University, 2009. DRAFT Spokane River Management Scenarios Report. Technical Report EWR-04-09. Water Quality Research Group. Department of Civil and Environmental Engineering. Maseeh College of Engineering and Computer Science. June, 2009

# Appendix
# Incremental Dissolved Oxygen Impact (mg/) at All Segments and Times

These tables represent the incremental dissolved oxygen impacts associated with each scenario, and are created by calculating the difference between the scenario output and the results from TMDL Alternative #1. Negative numbers indicate that the scenario results in a lower dissolved oxygen than predicted by TMDL Alternative #1.

## Increased Ammonia Scenario

| Long Lake | | | | | Julian Day | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| segment | 121 | 136 | 152 | 167 | 182 | 197 | 213 | 228 | 244 | 259 | 274 | 289 |
| 5 | -0.0402 | -0.0007 | -0.0281 | 0.0673 | -0.0618 | -0.0008 | -0.0022 | -0.0012 | -0.0027 | -0.0038 | -0.004 | -0.008 |
| 6 | -0.0645 | -0.0018 | 0.002 | 0.005 | -0.0246 | 0.0042 | -0.0033 | -0.0007 | -0.002 | -0.0036 | -0.006 | -0.008 |
| 7 | -0.038 | -0.0019 | -0.0033 | -0.0002 | -0.0282 | 0.0002 | -0.0005 | -0.0014 | -0.0019 | -0.0039 | -0.006 | -0.007 |
| 8 | 0.011 | -0.0027 | -0.0042 | 0.0033 | -0.0373 | 0 | -0.0009 | -0.0012 | -0.0016 | -0.0042 | -0.006 | -0.007 |
| 9 | 0.006 | -0.0049 | -0.005 | -0.0038 | -0.0365 | 0.0005 | -0.0009 | -0.0009 | -0.0013 | -0.0035 | -0.007 | -0.007 |
| 10 | 0 | -0.0053 | -0.0123 | 0 | -0.0291 | 0.0003 | -0.0012 | -0.0007 | -0.0006 | -0.0026 | -0.006 | -0.006 |
| 11 | 0.005 | -0.0061 | -0.0164 | -0.005 | -0.026 | -1E-04 | -0.0008 | -0.0002 | -0.0004 | -0.0022 | -0.006 | -0.006 |
| 12 | 0.004 | -0.0059 | -0.0129 | -0.0083 | -0.0365 | -0.0008 | -0.0016 | -0.0004 | -0.0004 | -0.0025 | -0.0054 | -0.006 |
| 13 | -0.003 | -0.0062 | -0.011 | -0.008 | -0.0326 | -0.0014 | -0.0005 | -0.0006 | 0.0006 | -0.0017 | -0.0043 | -0.006 |
| 14 | 0.005 | -0.0071 | -0.0123 | -0.0162 | -0.0321 | -0.0003 | 0.0016 | -0.0009 | 0.0006 | -0.0023 | -0.0043 | -0.006 |
| 15 | 0.006 | -0.007 | -0.011 | -0.0162 | -0.034 | -0.0016 | 0.0013 | -0.0004 | 0.0006 | -0.0019 | -0.004 | -0.006 |
| 16 | 0.007 | -0.0071 | -0.014 | -0.0161 | -0.0539 | -0.0045 | 0.0021 | -0.0003 | 0.0005 | -0.0014 | -0.0039 | -0.005 |
| 17 | 0.016 | -0.0074 | -0.017 | -0.0226 | -0.0517 | -0.0077 | 0.0017 | -0.0014 | 0.0002 | -0.0014 | -0.0036 | -0.004 |
| 18 | 0.002 | -0.008 | -0.018 | -0.0277 | -0.0591 | -0.0097 | 0.001 | -0.0033 | -0.001 | -0.0016 | -0.0032 | -0.003 |
| 19 | -0.006 | -0.008 | -0.015 | -0.0338 | -0.066 | -0.0107 | 0.0022 | -0.0025 | -0.0017 | -0.0012 | -0.0027 | -0.0025 |
| 20 | -0.007 | -0.006 | -0.0117 | -0.0269 | -0.0725 | -0.0145 | 0.0003 | -0.0025 | -0.0028 | -0.002 | -0.0026 | -0.0016 |
| 21 | -0.007 | -0.008 | -0.0126 | -0.0215 | -0.0593 | -0.0167 | -0.0019 | -0.0018 | -0.0031 | -0.0035 | -0.0028 | -0.0012 |
| 22 | -0.003 | -0.007 | -0.0141 | -0.0175 | -0.0555 | -0.0188 | -0.0045 | -0.0025 | -0.0037 | -0.0048 | -0.003 | -0.0014 |
| 23 | -0.005 | -0.008 | -0.0128 | -0.014 | -0.0642 | -0.0191 | -0.0062 | -0.0034 | -0.0047 | -0.0059 | -0.0026 | -0.0013 |
| 24 | -0.005 | -0.007 | -0.0126 | -0.004 | -0.0629 | -0.0196 | -0.0064 | -0.0042 | -0.0046 | -0.0054 | -0.0024 | -0.0008 |
| 25 | -0.008 | -0.007 | -0.0141 | -0.0027 | -0.0574 | -0.0212 | -0.0086 | -0.0063 | -0.0058 | -0.006 | -0.0028 | -0.0014 |
| 26 | -0.004 | -0.008 | -0.0167 | -0.0019 | -0.0371 | -0.0201 | -0.0077 | -0.0063 | -0.0058 | -0.0045 | -0.0031 | -0.0015 |
| 27 | -0.006 | -0.009 | -0.0141 | -0.0082 | -0.0344 | -0.0198 | -0.0075 | -0.0065 | -0.0057 | -0.0028 | -0.0034 | -0.0014 |
| 28 | -0.009 | -0.0096 | -0.0133 | -0.009 | -0.0309 | -0.0185 | -0.0075 | -0.0063 | -0.0051 | -0.0017 | -0.0032 | -0.0018 |
| 29 | -0.011 | -0.0096 | -0.0125 | -0.0104 | -0.0242 | -0.0179 | -0.0083 | -0.0063 | -0.0048 | 0.0005 | -0.0036 | -0.0022 |
| 30 | -0.008 | -0.0091 | -0.0122 | -0.0202 | -0.0213 | -0.017 | -0.0078 | -0.0054 | -0.0055 | 0.0004 | -0.0036 | -0.0022 |
| 31 | -0.011 | -0.0103 | -0.0143 | -0.018 | -0.0234 | -0.0168 | -0.0091 | -0.0064 | -0.0051 | -0.0006 | -0.0028 | -0.0023 |
| 32 | -0.01 | -0.0108 | -0.019 | -0.016 | -0.0243 | -0.0163 | -0.0104 | -0.0055 | -0.0053 | -0.0031 | -0.0037 | -0.0024 |
| 33 | -0.008 | -0.0105 | -0.0201 | -0.0121 | -0.0276 | -0.015 | -0.0121 | -0.0052 | -0.0051 | -0.0042 | -0.0056 | -0.0039 |
| 34 | -0.016 | -0.0098 | -0.0137 | -0.0121 | -0.0293 | -0.0149 | -0.0145 | -0.0064 | -0.0063 | -0.0061 | -0.0069 | -0.0055 |
| 35 | -0.014 | -0.01 | -0.0131 | -0.0124 | -0.0273 | -0.0146 | -0.0159 | -0.0068 | -0.0068 | -0.0082 | -0.0072 | -0.006 |
| 36 | -0.003 | -0.0099 | -0.0111 | -0.0106 | -0.021 | -0.0139 | -0.016 | -0.0077 | -0.0073 | -0.0109 | -0.0144 | -0.0098 |

## TP = 100 ug/l Scenario

| Long Lake | | | | Julian Day | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **segment** | **121** | **136** | **152** | **167** | **182** | **197** | **213** | **228** | **244** | **259** | **274** | **289** |
| **5** | 0.0242 | 0.0019 | 0.047 | 0.0062 | -0.0329 | -0.0019 | -0.0017 | -0.0016 | 0.002 | -0.0003 | 0 | -0.049 |
| **6** | 0.014 | 0.0016 | 0.0293 | 0.006 | -0.0022 | 0.0015 | -0.0031 | -0.0016 | 0.0011 | -0.0013 | -0.004 | 0.001 |
| **7** | -0.1061 | 0.0017 | 0.0086 | 0.0024 | -0.0026 | -0.0032 | -0.0029 | -0.0024 | 0.0002 | -0.0016 | -0.003 | 0.002 |
| **8** | 0.007 | 0.0027 | 0.0006 | 0.0129 | -0.0047 | -0.004 | -0.0038 | -0.0027 | 0.0002 | -0.0046 | -0.003 | -0.004 |
| **9** | 0.009 | 0.0053 | -0.0084 | 0.0061 | -0.0057 | -0.0041 | -0.0036 | -0.0024 | -0.0005 | -0.0046 | -0.004 | -0.004 |
| **10** | 0.007 | 0.0067 | -0.0169 | 0.0063 | -0.0059 | -0.004 | -0.0035 | -0.0021 | -0.0006 | -0.005 | -0.004 | -0.003 |
| **11** | 0.005 | 0.007 | -0.0211 | 0.0059 | -0.0066 | -0.0035 | -0.0028 | -0.0023 | -0.0004 | -0.0048 | -0.004 | -0.003 |
| **12** | 0.015 | 0.0072 | -0.016 | -0.0023 | -0.0061 | -0.0035 | -0.0037 | -0.0032 | -0.0006 | -0.004 | -0.0037 | -0.002 |
| **13** | 0.004 | 0.0083 | -0.011 | 0.003 | -0.0059 | -0.0041 | -0.0049 | -0.0051 | -0.0018 | -0.0046 | -0.0017 | -0.002 |
| **14** | -0.004 | 0.009 | -0.007 | 0.0004 | -0.01 | -0.0062 | -0.006 | -0.0064 | -0.0029 | -0.0067 | -0.002 | -0.002 |
| **15** | -0.005 | 0.009 | -0.006 | -0.0024 | -0.0122 | -0.0099 | -0.0071 | -0.0075 | -0.0034 | -0.0077 | -0.0023 | -0.002 |
| **16** | 0 | 0.009 | -0.019 | -0.004 | -0.0116 | -0.0153 | -0.0081 | -0.011 | -0.0047 | -0.0087 | -0.0034 | -0.002 |
| **17** | 0.013 | 0.0093 | -0.018 | -0.0083 | -0.0135 | -0.0177 | -0.0089 | -0.0126 | -0.0074 | -0.0098 | -0.0037 | -0.001 |
| **18** | 0.006 | 0.01 | -0.011 | -0.0099 | -0.018 | -0.0183 | -0.0094 | -0.0147 | -0.0102 | -0.0112 | -0.004 | 0 |
| **19** | 0.002 | 0.011 | 0.001 | -0.0145 | -0.0181 | -0.0179 | -0.0096 | -0.0141 | -0.0114 | -0.0127 | -0.0045 | -0.0003 |
| **20** | 0.011 | 0.013 | 0.002 | -0.0155 | -0.0208 | -0.0205 | -0.0115 | -0.0148 | -0.0143 | -0.0159 | -0.0057 | 0.0004 |
| **21** | 0.007 | 0.012 | 0.0023 | -0.0132 | -0.0237 | -0.0223 | -0.014 | -0.0142 | -0.0147 | -0.018 | -0.0061 | 0.0002 |
| **22** | 0.008 | 0.012 | -0.0112 | -0.0134 | -0.0243 | -0.0231 | -0.0152 | -0.0144 | -0.0128 | -0.0197 | -0.0083 | -0.0005 |
| **23** | 0.012 | 0.012 | -0.0188 | -0.0138 | -0.0235 | -0.0227 | -0.0157 | -0.0139 | -0.0134 | -0.0196 | -0.0094 | -0.0007 |
| **24** | 0.011 | 0.013 | -0.0142 | -0.0115 | -0.0275 | -0.023 | -0.0173 | -0.0152 | -0.0129 | -0.0181 | -0.0101 | -0.0008 |
| **25** | 0.01 | 0.011 | -0.0166 | -0.0099 | -0.0258 | -0.021 | -0.0162 | -0.0138 | -0.0097 | -0.0174 | -0.0121 | -0.0017 |
| **26** | 0.025 | 0.012 | -0.0152 | -0.0069 | -0.0086 | -0.0195 | -0.0162 | -0.0131 | -0.0079 | -0.0146 | -0.0115 | -0.0019 |
| **27** | 0.029 | 0.013 | -0.0095 | -0.0054 | -0.0089 | -0.0197 | -0.018 | -0.0143 | -0.0085 | -0.0135 | -0.0128 | -0.0023 |
| **28** | 0.022 | 0.014 | -0.01 | -0.0052 | -0.0105 | -0.0185 | -0.0193 | -0.0151 | -0.0088 | -0.0109 | -0.0133 | -0.0037 |
| **29** | 0.025 | 0.0137 | -0.0141 | -0.0051 | -0.011 | -0.0201 | -0.0219 | -0.0184 | -0.01 | -0.008 | -0.0155 | -0.0046 |
| **30** | 0.019 | 0.015 | -0.0141 | -0.0049 | -0.0064 | -0.0204 | -0.0224 | -0.0191 | -0.0107 | -0.006 | -0.015 | -0.0041 |
| **31** | 0.02 | 0.0143 | -0.0123 | -0.004 | -0.0057 | -0.0185 | -0.0201 | -0.0173 | -0.0084 | -0.0054 | -0.014 | -0.006 |
| **32** | 0.033 | 0.0157 | -0.0195 | -0.0029 | -0.0049 | -0.017 | -0.0187 | -0.0159 | -0.0062 | -0.003 | -0.0099 | -0.0049 |
| **33** | 0.036 | 0.0172 | -0.0187 | 1E-04 | 0.0024 | -0.0156 | -0.0162 | -0.0142 | -0.0041 | -0.0015 | -0.0062 | 0.0004 |
| **34** | 0.036 | 0.0159 | -0.0057 | 0.0003 | 0.0024 | -0.0153 | -0.0161 | -0.0152 | -0.0066 | -0.003 | -0.0081 | 0.0001 |
| **35** | 0.03 | 0.0148 | -0.0034 | -0.0005 | 0.0005 | -0.0176 | -0.0182 | -0.0174 | -0.0089 | -0.0055 | -0.0061 | -0.0005 |
| **36** | 0.064 | 0.0215 | 0.0021 | 0.0058 | 0.0064 | -0.0118 | -0.0121 | -0.011 | -0.0043 | -0.0013 | 0.0068 | 0.0151 |

## TP = 200 ug/l Scenario

| Long Lake | Julian Day | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| segment | 121 | 136 | 152 | 167 | 182 | 197 | 213 | 228 | 244 | 259 | 274 | 289 |
| 5 | -0.0153 | 0.0019 | 0.0653 | 0.1284 | 0.0194 | -0.003 | -0.001 | -0.0031 | 0.0007 | 0.0083 | 0.001 | -0.001 |
| 6 | -0.0642 | 0.0026 | 0.0247 | -0.0058 | 0.0067 | -0.0006 | -0.0025 | -0.0041 | -0.0014 | 0.0045 | -0.004 | -0.002 |
| 7 | -0.037 | 0.0053 | 0.0038 | -0.007 | -0.0106 | -0.0071 | -0.0041 | -0.0045 | -0.0034 | 0.0009 | -0.003 | 0.001 |
| 8 | 0.015 | 0.0055 | -0.0118 | 0.0073 | -0.0081 | -0.0057 | -0.0054 | -0.0055 | -0.0042 | -0.0054 | -0.003 | -0.004 |
| 9 | 0.006 | -0.0009 | -0.0179 | -0.0021 | -0.0066 | -0.0068 | -0.0052 | -0.0049 | -0.004 | -0.0051 | -0.002 | -0.003 |
| 10 | 0.006 | -0.0048 | -0.0374 | 0.0049 | -0.0031 | -0.007 | -0.0051 | -0.0047 | -0.0031 | -0.0054 | -0.001 | 0 |
| 11 | 0.001 | -0.0046 | -0.0396 | 0.0049 | -0.0028 | -0.0069 | -0.0043 | -0.0045 | -0.0018 | -0.0025 | 0 | 0.006 |
| 12 | -0.009 | -0.0049 | -0.0278 | -0.0009 | -0.0049 | -0.0078 | -0.0057 | -0.0062 | -0.0016 | -0.0019 | 0.001 | 0.007 |
| 13 | -0.011 | -0.0063 | -0.021 | -0.002 | -0.0028 | -0.0081 | -0.0065 | -0.0088 | -0.0014 | -0.0034 | 0.0031 | 0.008 |
| 14 | 0.007 | -0.0072 | -0.0166 | -0.0112 | -0.0087 | -0.0122 | -0.008 | -0.0118 | -0.0032 | -0.0076 | 0.0013 | 0.007 |
| 15 | 0.002 | -0.007 | -0.0221 | -0.0093 | -0.0112 | -0.0222 | -0.0108 | -0.0138 | -0.0044 | -0.0092 | 0.0005 | 0.006 |
| 16 | -0.002 | -0.0078 | -0.03 | -0.0094 | -0.0259 | -0.032 | -0.0163 | -0.0201 | -0.0064 | -0.0124 | -0.0017 | 0.006 |
| 17 | -0.007 | -0.0076 | -0.027 | -0.0161 | -0.0239 | -0.0336 | -0.0187 | -0.0217 | -0.0101 | -0.0152 | -0.0025 | 0.006 |
| 18 | -0.017 | -0.007 | -0.027 | -0.0217 | -0.0225 | -0.0331 | -0.0214 | -0.0232 | -0.011 | -0.0186 | -0.0037 | 0.006 |
| 19 | -0.01 | -0.008 | -0.022 | -0.027 | -0.0261 | -0.0306 | -0.0228 | -0.024 | -0.0118 | -0.0222 | -0.0078 | 0.0056 |
| 20 | -0.009 | -0.008 | -0.0201 | -0.0244 | -0.0295 | -0.0339 | -0.0285 | -0.0271 | -0.0158 | -0.0286 | -0.0084 | 0.0065 |
| 21 | -0.011 | -0.009 | -0.0198 | -0.0247 | -0.0353 | -0.0364 | -0.0341 | -0.0308 | -0.0182 | -0.0348 | -0.0099 | 0.0057 |
| 22 | -0.011 | -0.008 | -0.032 | -0.0248 | -0.0305 | -0.0383 | -0.0368 | -0.0346 | -0.0204 | -0.0406 | -0.0148 | 0.004 |
| 23 | -0.01 | -0.008 | -0.0386 | -0.0238 | -0.0336 | -0.0377 | -0.0375 | -0.0352 | -0.0207 | -0.0422 | -0.0168 | 0.0035 |
| 24 | -0.007 | -0.006 | -0.0279 | -0.0176 | -0.0358 | -0.0395 | -0.0397 | -0.0381 | -0.0227 | -0.0402 | -0.0189 | 0.0028 |
| 25 | -0.004 | -0.008 | -0.0283 | -0.0155 | -0.0366 | -0.0387 | -0.04 | -0.0403 | -0.0261 | -0.0437 | -0.0248 | 0.0008 |
| 26 | 0.004 | -0.007 | -0.0299 | -0.0105 | -0.0345 | -0.0379 | -0.0403 | -0.0405 | -0.0268 | -0.0408 | -0.0258 | 0 |
| 27 | 0.005 | -0.007 | -0.0265 | -0.0102 | -0.0326 | -0.0387 | -0.0416 | -0.0422 | -0.0287 | -0.0398 | -0.0291 | -0.0012 |
| 28 | 0.003 | -0.0064 | -0.0325 | -0.01 | -0.0307 | -0.0377 | -0.0424 | -0.0427 | -0.0299 | -0.0363 | -0.0313 | -0.0047 |
| 29 | 0.011 | -0.0067 | -0.0374 | -0.0086 | -0.0323 | -0.0395 | -0.0455 | -0.0471 | -0.0338 | -0.031 | -0.0377 | -0.0063 |
| 30 | 0.008 | -0.0064 | -0.0326 | -0.0135 | -0.0298 | -0.0394 | -0.0456 | -0.0478 | -0.0363 | -0.0278 | -0.0388 | -0.0073 |
| 31 | 0.016 | -0.008 | -0.0275 | -0.0145 | -0.0282 | -0.0377 | -0.0443 | -0.0462 | -0.0358 | -0.0261 | -0.04 | -0.0125 |
| 32 | 0.031 | -0.0076 | -0.039 | -0.014 | -0.0272 | -0.0373 | -0.0444 | -0.0466 | -0.0347 | -0.0234 | -0.0393 | -0.0139 |
| 33 | 0.038 | -0.0069 | -0.0407 | -0.0095 | -0.0259 | -0.0366 | -0.0436 | -0.0465 | -0.0344 | -0.0235 | -0.038 | -0.0099 |
| 34 | 0.024 | -0.0082 | -0.0259 | -0.0067 | -0.0274 | -0.0344 | -0.0434 | -0.0475 | -0.0386 | -0.027 | -0.0439 | -0.0161 |
| 35 | 0.018 | -0.0096 | -0.0284 | -0.0061 | -0.0287 | -0.0348 | -0.0454 | -0.0496 | -0.0414 | -0.0316 | -0.0396 | -0.0204 |
| 36 | 0.048 | -0.0071 | -0.0293 | -0.0065 | -0.028 | -0.0325 | -0.0424 | -0.0455 | -0.0393 | -0.032 | -0.0236 | 0.0061 |

# Exhibit 2

# What is the Limit of Technology (LOT)? A Rational and Quantitative Approach

J.B. Neethling, HDR; David Stensel, University Washington;
Denny Parker, Brown and Caldwell; Charles Bott, HRSD; Sudhir Murthy, DCWASA;
Amit Pramanik, WERF; and Dave Clark, HDR
HDR Engineering Inc.
2365 Iron Point Road, Suite 300
Folsom, CA 95630

## ABSTRACT

What is the Limit of Technology (LOT)? This question has been raised and answered by regulators, designers, operators, researchers and others. However, in each case, the answer was typically generated without a detailed quantitative analysis and represents the perspective of the investigator, his/her objective, goals, and overt or covert agenda.

The term "Limit of Technology" is typically used to convey the lowest possible concentration to which a compound of interest can be reduced using a particular technique. In its broadest sense, the term is applied to convey the lowest achievable concentration using any technology. The deficiency with this approach is that the definition is not robust and is subject to the interpretation of the analyst.

This paper presents a simple statistical method to provide a rational and repeatable method to determine the performance of a technology. The term "Limit of Technology" or "LOT" is expanded by introducing a new term: "Technology Achievable Limit" (TAL). Three TAL levels are evaluated to represents the lowest, median, and reliably achievable performance. The best performance is determined from the best 14-day (14d) performance achievable in a year – the TAL-14d representing the 3.84th percentile of the performance data. The reliable performance is determined by the treatment objectives and reliability. The reliable TAL could be represented by the TAL-90%, TAL-95%, TAL-99%, or even some other value, depending on the permit requirements (annual, monthly, or daily) and the reliability required by the owner/operator. Designers can use TAL values to assess the ability to meet certain permit requirements. Operating data shows that the TAL-14d is between 50 to 60 percent and 40 to 50 percent of the median for total nitrogen and total phosphorus removal plants, respectively. The TAL-95% values range from 180 to 250 percent of the median for nitrogen, and 200 to 300 percent for phosphorus, respectively.

## KEYWORDS

Limit of technology, nitrogen, phosphorus, process performance assessment

## LIMIT OF TECHNOLOGY APPROACHES

What is the "Limit of Technology?" This question has been raised and answered by regulators, designers, operators, researchers, environmental advocates and others. However, in each case, the answer is based on the perspective of the author, his or her objective, goals, and overt or covert agenda. For instance, a plant operator would consider the limit of technology to be the best that can be achieved by the facilities at the treatment plant, the designer as the best performance reliably achievable by implementing/adding appropriate technology, and others as the best performance that has ever been achieved by any technology anywhere.

Economical considerations are added in some instances. The EPA regulatory framework "… require[s] application of the best available technology economically achievable for such category or class, which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants…" (CWA section 301(b), 33 U.S.C. § 1311(b)).

The "Best Available Technology" is determined from a number of factors. The Clean Water Act (CWA) requires "…consideration of the reasonableness of the relationship between the costs of attaining a reduction in effluents and the effluent reduction benefits derived, and the comparison of the cost and level of reduction of such pollutants from the discharge from publicly owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources, and shall take into account the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate…" (CWA section 301(b), 33 U.S.C. § 1314(b)(4)(B)).

The term "Limit of Technology" is typically used to convey the lowest possible concentration to which a compound of interest can be reduced using a particular technique. In its broadest sense, the term is applied to convey the lowest achievable concentration using any technology. The deficiency with this approach is that the definition is not robust and is subject to the interpretation of the analyst.

Bott et al. (2007) investigated the LOT to determine the factors or "Boundary Conditions" that limit the ability to reach the LOT. The boundary condition represents the LOT in terms of the state and knowledge of nutrient removal technologies. The questions posed in this work were "how low can we go?" and "what is stopping us from going lower?" Bott et al. (2007) did not establish the limits or any measure of how to determine them, but rather focused on the conditions that prevent technology to achieve better results (low temperature, toxicity, etc.).

There is currently no formal definition of the "Limit of Technology" or LOT. This is appropriate since the factors that limit the performance of a technology are dependent on the type of technology, environmental factors, engineering and operational conditions, and a host of other factors.

The term "Limit of Technology" or "LOT" can be defined using percentile statistics to define Technology Achievable Limits (TALs). Three TAL levels are evaluated to represents the lowest, the median, and the reliably achievable performance. The approach can be used to determine the best performance, the reliable performance, or other descriptor that allows for a rational interpretation of the results. This presentation must also include the source of the data and the conditions under which data is collected. For example, LOT could change for the same application when the plant is experiencing normal loadings versus a year when unseasonably high peak flows and cold temperatures are experienced.

## LOT TERMS BASED ON STATISTICAL PERFORMANCE OF THE TECHNOLOGY

### Technology Achievable Limits (TAL)

The term *Technology Achievable Limit* or TAL is used to describe the performance measured from a specific technology. Because the performance of a process can be manipulated by the operator and is affected by many factors, the TAL must be defined in terms of the specific conditions under which the data is collected. Table 1 shows the key conditions that affect performance of a technology and the data collected. The information in Table 1 should be reported along with TAL values whenever possible.

**Table 1 - Specific Conditions associated with Technology Achievable Limits**

| Condition | Report | Significance |
|---|---|---|
| Treatment goal | Numerical value and period | The treatment goal is typically the regulatory permit limit. In some cases, the goal is lower than the permit. This represents the main target for the operator. Operators can choose to reduce chemicals, energy consumption, etc. to increase efficiency. |
| Data source | Data source, period, frequency | Regulatory controlled data (permit reports) are the most commonly used data source. Data is assumed to be from a certified laboratory. The dataset duration (number years) and frequency of data collected (samples per period) should be noted. Averaging of data (monthly reports) can be used under certain circumstances; daily data is commonly used. |
| Season or period | Season | The data period of data collection impacts the conclusion regarding performance. If the dataset is less than a year, no firm conclusions regarding annual operation can be drawn (unless the plant experiences no seasonal changes). |
| Exclusions | Conditions or data excluded | In some cases a know problem may skew the data (construction, for example). This should not be used to eliminate "poor" or "good" data. |
| Treatment capacity | Load and capacity | Plants typically operate below their design capacity. |
| Scale | Pilot, bench, full, etc. | The scale of the process impacts the ability to control the performance. Plants (pilot or other) that have the ability to fully control the influent composition or flow will typically perform better. |
| Solids processing | Type and recycle stream management | Recycle streams from solids processing could impact performance of nutrient removal plants attempting to achieve low limits. |
| Special conditions | Special conditions | Special conditions that applies to the application. Industrial contributions, extreme cold or warm conditions, seasonal visitors or slug loads, etc. |

The conditions in Table 1 address the external factors that may affect performance. For example, a permit requirement of 1 mg/L total phosphorus (TP) would dictate the level of care and effort needed from the operator to meet the permit in an economical way. Internal operational conditions (such as chemical addition, amount of chemicals added, sludge age, loading rates, etc.) that are within the control of the operator would affect the performance. That does not mean the data is "bad" or not representative, but that it reflect the constraints or targets set for the operation. Successful operation for the plant is defined by its ability to meet the permit – not necessarily to exceed the permit.

In some applications, the treatment goal is "the best possible performance." These cases are typically associated with internal agency goals, technology demonstrations, or some other factors. Data collected under these conditions would represent the best achievable performance.

Data from pilot or bench scale processes are typically sheltered from normal fluctuations experienced by full scale facilities. Many pilot and demonstration units are operated under steady state conditions and well-controlled environments, removed from the impacts of slug loads or solids processing. The performance from these applications should be more reliable and achieve better results than the same technology when operated under "real world" conditions.

Three TAL limits are proposed: the lowest limit, the median, and the reliable limit.

**Lowest Technology Achievable Limit**

The Lowest Technology Achievable Limit represents the best performance possible with the technology under the optimal or best operating conditions. The optimal conditions could be carefully controlled laboratory conditions with defined, treatable influents. For full scale performance, the lowest TAL represent the lowest concentrations (best performance) observed. The lowest TAL is defined as the achievable levels under the conditions of operation that can be sustained for a period of time. The lowest TAL is therefore not the minimum or lowest value ever measured, but a performance level sustained for a period.

We propose that the lowest TAL achievable concentration is **the performance that remains sustainable for a 2-week period in one year.** Note that the 14-day TAL, or TAL-14d, is exceeded 50 out of 52 weeks per year and is therefore not an appropriate permit limit. It is proposed instead for other reasons. Wastewater composition varies diurnally from day to day as the service area activity changes due to normal human activity. In many cases, a weekly pattern can also be seen as the population shifts from weekday to weekend activities. A 2-week period would capture two cycles of this pattern. Nutrient removal biological processes operate over a large range of sludge age conditions, but typically at a sludge age between 8 and 20 days. A 2-week period would therefore capture one sludge age of operation. Chemical systems typically respond quicker to changes in operation (for example, increased chemical doses). A 2-week period is still reasonable for these systems to capture the performance level over two weekly periods.

The lowest TAL can be determined from operating data via two methods: (1) calculating the running 14 day average and determining the minimum value; and (2) determining the 3.84th percentile (14/365 = 3.84 percent), if the data is randomly distributed (wastewater treatment plant data are typically log normal distributed).

Figure 1 shows the daily data and 14-day running average from a plant operated to achieve low phosphorus. This particular facility attempts to remain below 0.1 mg/L and strives to go "as low as you can go." The lowest concentration reported in the 14-day trend is 0.036 mg/L in 2005. In the following years (going year by year), the lowest 14-day average concentrations are 0.044 and 0.038 mg/L, respectively. The numerical average over three years is 0.039 mg/L. This compares well with the 3.84th percentile from a probability plot (Figure 2) of 0.040 mg/L.

**Figure 1 - Daily data of secondary effluent from operation plant showing daily data and a 14-day running average for plant striving to achieve 0.1 mg/L TP.**

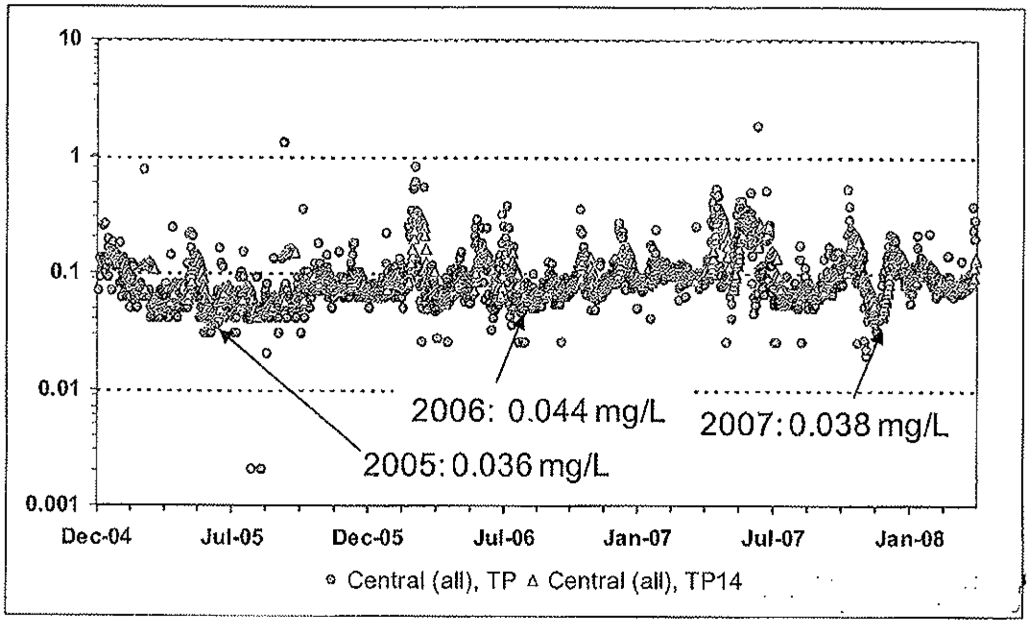
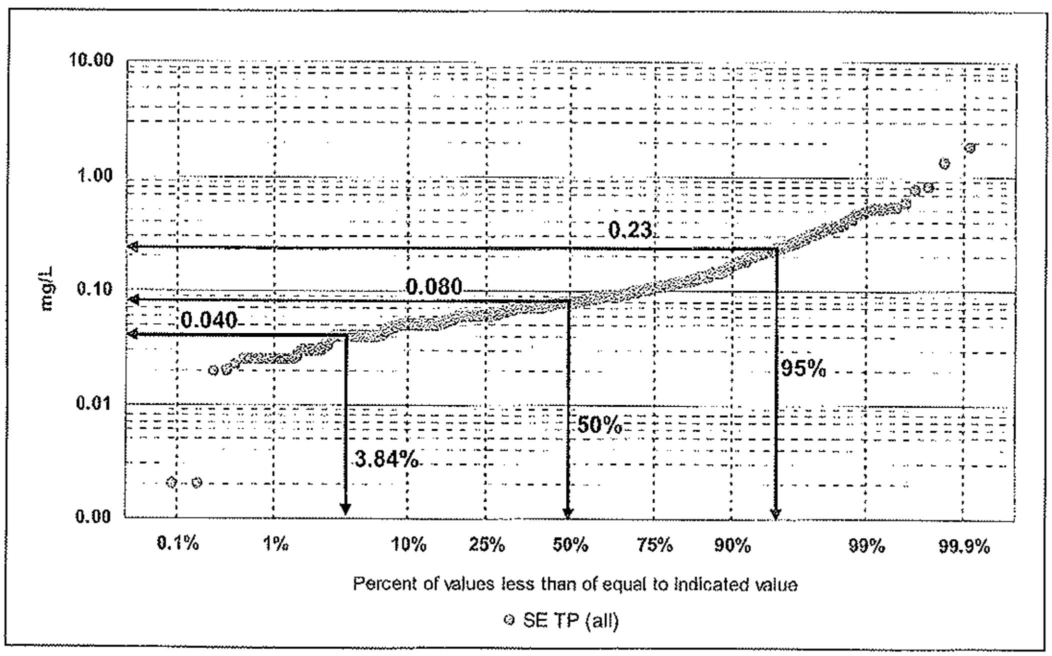
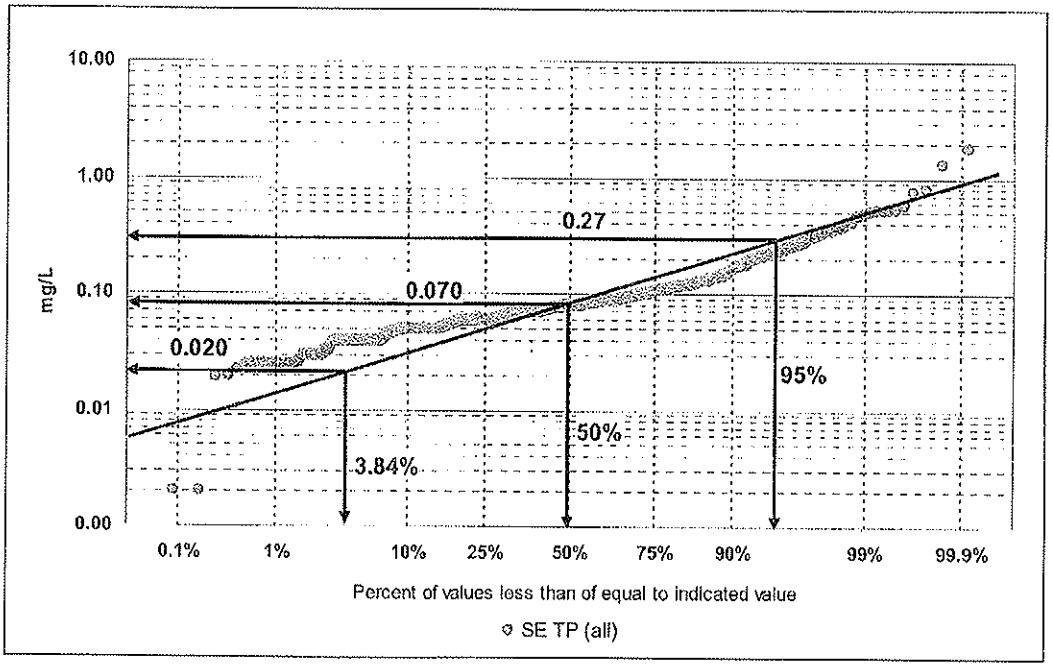



**Figure 2 - Probability scale plot of secondary effluent phosphorus data showing 3.84th, 50th, and 95th percentiles of the data.**



The data in the probability plot (Figure 2) for this case shows a definite curve (non-linear) trend. If a log-normal distribution is assumed (Figure 3), the statistical mean, standard deviation, coefficient of variance and other statistics can be calculated. The log-normal line in this dataset highlights a clear curvature in the data – meaning that the data does not fit to the log-normal distribution, amplified at the lower and upper ranges. Since a log scale is used, the deviation at the edges is further amplified. When determining the lower and upper percentiles, this deviation can introduce a large deviation from actual performance. It is therefore recommended to use the simple statistic – using the log-normal plot mainly to illustrate the data. The percentiles can readily be calculated from simply the ranking data.

**Figure 3 - Probability plot of secondary effluent phosphorus data showing 3.84th, 50th, and 95th percentiles of the data showing a log-normal distribution line and determining the percentiles based on this log-normal distribution.**




## Average Technology Achievable Limit

The average/mean or median technology limit (TAL-50%) represents a measure of the concentration that was achieved on a statistical annual average basis. We used the median (the 50th percentile data number) in this paper rather than the arithmetic average, because it is impacted less by extreme values resulting from upset events. The median and arithmetic average is typically used for permit calculations to calculate average values. An annual mass limit is another example of an annual average limit – in this case the results are flow weighted to produce the total annual mass loading.

Parker et al. (2009) argues that, for many receiving water environments, using an annual averaged statistic for permit compliance provides equal environmental protection compared to monthly or daily based permits. The longer averaging period reduces the impact of unexpected performance perturbations on the reported plant performance and reduces the probability of reporting violations that may have no environmental significance

A median based permit provides the ability for an operation to succeed. Clean Water Services, located near Portland, OR, operated under a monthly median permit to meet very low phosphorus limits (0.07 mg/L for many years and presently 0.10 mg/L TP). This type of permit provides opportunities for the operator to catch up in operation if unexpected excursions appear. For example, the Durham plant experienced an upset when waste activated sludge was sent to the primary sludge fermenter due to a valve positioning problem, causing an upset in the fermenter that caused a trickle down effect to upset the EBPR process. Under an average permit structure, the few days of upset would make permit compliance difficult – yet a median based permit meant that each daily sample contributes equal weight to meeting the permit. The plant was able to meet the permit by adjusting operation and increasing the chemical feed to make up for the biological upset.

## Reliable Technology Achievable Limit

Jimenez, et al. (2007) used the 95 percent statistic to determine a basis for the reliability of plant performance. Parker et al. (2009) extended the concept to use the 95th percentile value annual average as a better measure for evaluating technologies and a superior probability tool than the 92nd percentile value for maximum month permit evaluations. Using the TAL notation, the 95th percentile would be noted as the TAL-95%. For this dataset, the TAL-95% is 0.23 mg/L (Figure 2).

Monthly based permits are commonly used in practice, since compliance reports are filed monthly and permits set maximum month (sometimes 30-day) limits. As noted by Parker et al. (2009), plant performance and assessment of its ability to comply with monthly limits should not be based on average or even 91.7th percentile (11/12th percentile or 335/365th percentiles). The 91.7th percentile is the treatment level exceeded once a year – in other words, the plant will fail one month per year.

## Technology Variability from TAL-14d performance

Treatment plants operate under variable conditions. Beyond daily diurnal variation, plants experience seasonal patterns. These fairly predictable patterns include flow and load variations. Municipal plants serving bedroom communities often follow a typical diurnal flow pattern with peaks occurring in the morning and early evening. Load variations are more difficult to predict and may or may not coincide with flow variations. In addition, some constituents may peak at different times; for example, ammonia peaks often occur in the very early morning and late evening, while BOD peaks tend to be more moderate and more closely follow flow variations. This means that the composition of the wastewater (BOD/N and other ratios) change during the course of the typical day.

Shorter duration fluctuations are more difficult to manage – these include external factors (a rain storm for example) or internal factors (operating dewatering equipment and returning the liquid to the plant intermittently). Construction activities, equipment failure, toxicity, etc. cause effluent excursions and impacts the performance. These impacts are magnified for shorter duration averaging periods (monthly, weekly, daily).

Using a similar approach as Bott et al. (2009), deviations from the lowest achievable performance can be assessed using the relationship between the TAL values, by determining the ratio of the 3.84th, 50th and 95th percentiles as a measure of variability. The ratio between these values represents the variability of performance, and it provides a measure of the differences in performance between the LOT, average, and maximum month limits. The ratio of the 50th to 3.84th percentile represents the difference between the average limit achievable compared to the TAL-14d, while the 95th to 50th percentile represents the ability of a technology to meet monthly limits compared to annual values.

These variability measures will allow designers to set appropriate safety margins to meet permit limits consistently. Low variability means that the safety factor for design or the margin of safety can be reduced. Permit limit averaging time (average, monthly, weekly) will determine the acceptable variability.

### Technology Reliability

Parker et al. (2009) used the "excursion frequency," or the number of exceedances in a permit cycle, as a measure of plant reliability in the context of permit compliance. This provides a basis for determining the reliability of the plant performance that is easy to understand. The authors use the TAL values at 50th, 90th, 95th and 99th percentiles to establish the reliability of meeting annual, monthly, or daily permit levels.

The TAL values provide the measure of reliability that can be used to evaluate a design. When the reliability of a technology is known, that can be factored into the design of a facility. Higher or lower percentiles would be selected based on the technology performance and an agency's tolerance for risk. The reliability of a design can be increased by including some design features to increase the TAL value to meet the target (permit) and a higher TAL percentage. For example, in order to improve reliability, a tertiary clarifier can be included in the design as an additional barrier for phosphorus removal. The improved reliability of the feature can be weighed by the agency against the added cost for constructing and operating the process.

## APPROACH TO CALCULATING TAL VALUES

### Data set size required

The accuracy and reliability of the performance improves with a larger dataset. How much data is needed? How do fewer samples affect the calculated results (for example, plants collecting samples daily versus those collecting data once a week)?

Data collection practices vary from plant to plant. Some (typically larger) full scale facilities collect data on a daily basis. Small and medium size facilities typically collect less data – from a few times per week (3-5) to one sample per week. In order to determine the statistical performance of the plant, the dataset should be sufficiently large.

Several calculations were performed using the same set of data to test the impact to the data set size. The data set in Figure 1 contains about 1,200 data points from a phosphorus removal plant. Values were selected from this dataset at random to generate a subset. Subsets contain between 10 and 600 randomly selected values from the original data set.

Table 2 shows the predicted three TAL values from the original and the subsets for the phosphorus data set. The results demonstrate the impact of the dataset on calculating the percentiles:

- The median values (TAL-50%) remains the same (at 0.080 mg/L) as the dataset is reduced to 10 data points. The TAL-50% value for this dataset is lower than the numeric average (0.101 mg/L). It is interesting to note that the average remains consistently at about 0.101 mg/L while the median remains around 0.080 mg/L. This is because the random selection of the data retained the statistical distribution of the data, even the number of data points dropped to 10 points. The difference between median and average values for this set is due to the curvature in the data, as shown in Figure 3.
- The TAL-95% value remains consistent to about 75 data points. Since the 95th percentile selects from the upper 5 percent of the data (1/20th) the result is not surprising, indicating that more than the recurrence interval of the data is required (1 in 20 for the 95th percentile).
- The TAL-14d value remains consistent to between 75 and 150 data points. With less than 20 data point, the TAL-14d cannot be calculated from the data and any estimate such as a "less than" value is unreliable.

Table 3 shows a similar analysis for a set of nitrogen data. The original data set contained 780 data points. The results demonstrate the impact of the dataset on calculating the percentiles from this total nitrogen data set:

- The median values (TAL-50%) remains the same (at 0.83 mg/L) as the dataset is reduced to 10 data points. However, the median changes from the original data set when the number of data points was reduced to 150 points. The TAL-50% value for this dataset is lower than the numeric average (0.96 mg/L). It is interesting to note that the average remains consistently higher than the median remains. The difference between median and average values for this set is due to the curvature in the data.
- The TAL-95% value remains consistent to about 150 data points.
- The TAL-14d value remains consistent to between 75 and 150 data points. With less than 20 data point, the TAL-14d cannot be calculated from the data and any estimate such as a "less than" value is unreliable.

This set of phosphorus and a set of nitrogen data shows consistent results with a dataset of between 75 and 150 data points. It is not clear if the same rule would apply to all data sets.

**Table 2 – Calculation probabilities with different data sets for Phosphorus data**

| | 1200 values | 600 values | 300 values | 150 values | 75 values | 40 values | 20 values | 10 values |
|---|---|---|---|---|---|---|---|---|
| TAL-14d | 0.040 | 0.040 | 0.040 | 0.044 | 0.026 | 0.032 | <0.025 [a] | <0.065[a] |
| TAL-50% | 0.080 | 0.082 | 0.080 | 0.081 | 0.078 | 0.089 | 0.080 | 0.075 |
| TAL-95% | 0.233 | 0.260 | 0.211 | 0.231 | 0.260 | 0.259 | 0.194 | >0.128 [a] |
| | | | | | | | | |
| Average | 0.101 | 0.106 | 0.099 | 0.107 | 0.109 | 0.120 | 0.092 | 0.099 |
| Minimum | 0.0020 | 0.0020 | 0.0020 | 0.0190 | 0.020 | 0.032 | 0.025 | 0.065 |
| Maximum | 1.800 | 0.805 | 0.750 | 0.750 | 0.750 | 0.805 | 0.220 | 0.240 |

Note:

a. Too few data points to calculate the 3.84$^{th}$ or 95$^{th}$ percentile. Value reported as "less than" the lowest value or "greater than" the highest value

**Table 3 – Calculation probabilities with different data sets for Nitrogen data**

| | 780 values | 600 values | 300 values | 150 values | 75 values | 40 values | 20 values | 10 values |
|---|---|---|---|---|---|---|---|---|
| TAL-14d | 0.21 | 0.21 | 0.21 | 0.21 | 0.24 | 0.26 | <0.21 | <0.32 |
| TAL-50% | 0.83 | 0.85 | 0.84 | 0.94 | 0.91 | 0.86 | 0.72 | 0.75 |
| TAL-95% | 2.11 | 2.14 | 2.08 | 1.89 | 2.13 | 1.60 | 1.06 | 1.14 |
| | | | | | | | | |
| Average | 0.96 | 0.96 | 0.96 | 1.01 | 1.02 | 1.00 | 0.71 | 0.82 |
| Minimum | 0.12 | 0.12 | 0.21 | 0.18 | 0.21 | 0.26 | 0.21 | 0.32 |
| Maximum | 4.48 | 3.77 | 3.77 | 3.05 | 3.43 | 3.05 | 1.18 | 1.37 |

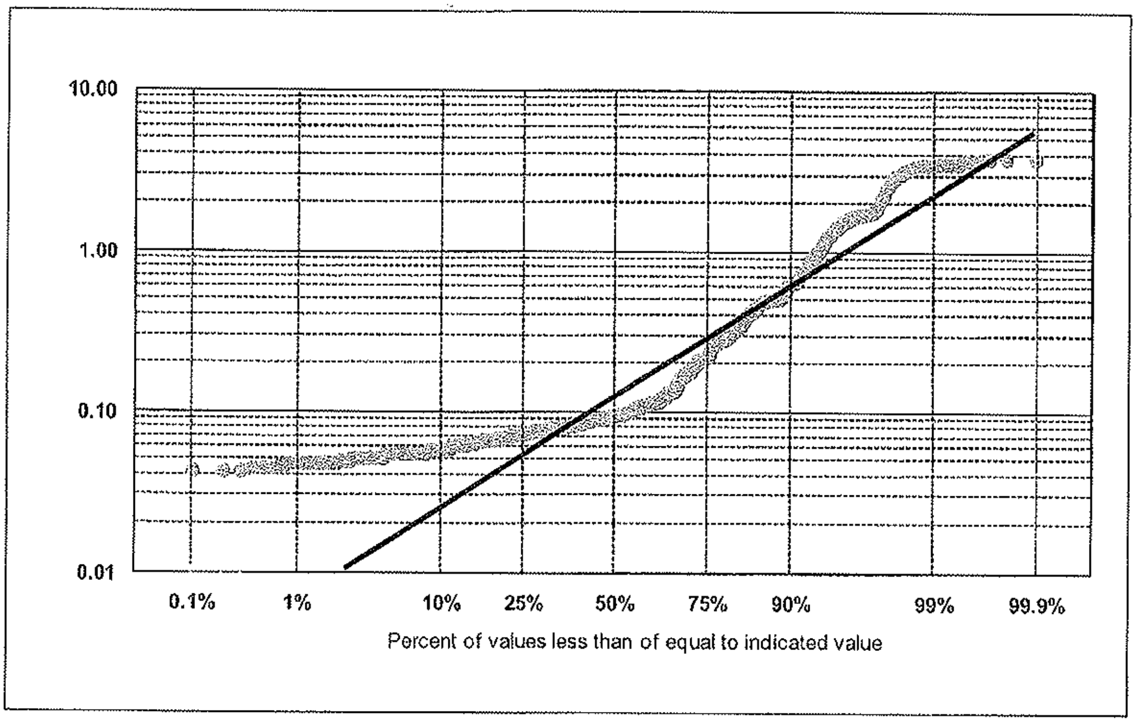
Note:

a. Too few data points to calculate the 3.84$^{th}$ or 95$^{th}$ percentile. Value reported as "less than" the lowest value or "greater than" the highest value

## Upset Conditions and Other Excursions

Figure 4 shows the log probability plot for a plant that experienced an upset condition. The data is characterized by an S-shape – the data appears as two data sets: the "normal" operation and the "upset" condition. Considering the overall plant performance (including upset and other conditions) all data should be included in the analysis. If the distribution behaves as indicated in this set, it is clear that calculating data based on an assumed log-normal distribution will not provide accurate information. The same condition exists when the reported data includes data below the detection limit, causing a straight horizontal line at the lower end.

**Figure 4 - Dataset that includes an upset condition.**




In order to provide values that represent the actual plant operation, the TAL values can be determined from the rank (percentile) value, rather than an assumed distribution. Log-normal plots provide a good visual method for determining outliers or understand the data set.

See Bott et al. (2009) for an in depth discussion addressing data sets that do not follow a log normal distribution.

## APPLICATION OF LIMITS TO DATA SETS

Workshop 101 at WEFTEC08 (Chicago, IL) assembled operators and managers from 11 different treatment plants operating nutrient removal facilities. Three years of operational data from these plants were collected and analyzed statistically. The same data were used to calculate the TAL values for the 11 facilities. Parker et al. (2009) reported the findings from the presentation and summarized the facilities included in this study.

### Nitrogen Removal

Table 4 shows the TAL total nitrogen concentrations calculated from the six plants that have nitrogen limits. The table also shows the process and permit limits for the facilities. The results show that the multistage (Fiesta Village) and separate stage (River Oaks) processes achieved the lowest TAL-14d values. The control over a tertiary denitrification process provides the ability to reduce nitrate to low concentrations.

**Table 4 – Total Nitrogen TAL Concentration From Plants[a]**

| | Process | Permit[c] | 14 d | 50% | 95% | 14 d/50% | 95%/50% |
|---|---|---|---|---|---|---|---|
| DCWASA | Nit | 7.5 (4.2) | 2.50 | 5.33 | 9.65 | 0.47 | 1.81 |
| WSSC | Comb | 7 | 2.10 | 3.40 | 6.20 | 0.62 | 1.82 |
| Eastern EWRF Orange Co | Comb | 5 | 2.09 | 3.67 | 8.18 | 0.57 | 2.23 |
| Fiesta Village | Mult | 3 | 0.21 | 0.83 | 2.11 | 0.26 | 2.54 |
| Truckee Meadows | SepSt | 2 | 1.20 | 1.77 | 4.26 | 0.68 | 2.40 |
| River Oaks | SepSt | 3.75 | 0.78 | 1.45 | 2.92 | 0.54 | 2.01 |

Note:

a. Plant data presented at Workshop 101, WEFTEC08 conference, Chicago, IL

b. Process: Comb=Combined nitrogen removal in one process; Nit=Nitrification only; SepSt=Separate stage denitrification following nitrification; Mult=Multiple stages for nitrification/denitrification

c. Permit limits are shows only as an indication of the requirement under which the plant operates. Permits requirements varies – for example DCWASA operates under an annual limit

The TAL-14d concentration for the six plants analyzed is typically 50 to 60 percent of the median performance. The exception is Fiesta Village, where the lowest achievable limit is 26 percent of the median performance. All the plants met the permit required total nitrogen limit. Since these all add an external carbon source to reduce the nitrate concentrations, the achievable limit may be related to the operator's initiative to reduce chemical feed for cost control as well as specific plant design features.

The 95th percentile performance is between 1.8 and 2.5 times the median performance.

The performance variability (both TAL-14d/TAL-50% and TAL-95%/TAL-50% ratios) appears to increase as the median value decreases. This indicates that as the performance improves (median concentration lower), the performance variability increase. This fact should be considered when designing facilities that need to achieve low nitrogen concentrations.

**Phosphorus Removal**

Table 5 shows the TAL total phosphorus concentrations calculated from the seven plants that reported phosphorus data (Clark County showed two separate trains). The table also shows the process and permit limits for the facilities. The results show that the two stage chemical addition, often in combination with EBPR, produced low effluent concentrations. Cauley Creek is a single stage chemical addition process operating an MBR that meets very low concentrations. The ability to have multiple stages for phosphorus removal appears to improve performance.

**Table 5 – Total Phosphorus TAL Concentration From Plants[a]**

| | Process | Permit[c] | 14 d | 50% | 95% | 14 d/50% | 95%/50% |
|---|---|---|---|---|---|---|---|
| Rock Creek | 2B | 0.1 | 0.025 | 0.065 | 0.210 | 0.38 | 3.2 |
| Gwinnett County | 1B | 0.13 (0.08) | 0.020 | 0.040 | 0.110 | 0.50 | 2.8 |
| DCWASA | 2 | 0.18 | 0.020 | 0.080 | 0.180 | 0.25 | 2.3 |
| CCWRD-Central Plant | 2B | 0.14 | 0.040 | 0.080 | 0.233 | 0.50 | 2.9 |
| CCWRD-AWT | 2B | 0.14 | 0.040 | 0.082 | 0.176 | 0.49 | 2.1 |
| Cauley Creek | 1B | 0.13 | 0.040 | 0.080 | 0.160 | 0.50 | 2.0 |
| WSSC | 1 | 1 | 0.050 | 0.140 | 0.650 | 0.36 | 4.6 |
| Eastern EWRF Orange Co | 1B | 2 | 0.100 | 0.190 | 0.630 | 0.53 | 3.3 |
| Breckenridge | 2B | 0.050 | 0.004 | 0.012 | 0.045 | 0.33 | 3.8 |

Note:

a. Plant data presented at Workshop 101, WEFTEC08 conference, Chicago, IL

b. Process: 1=Single stage chemical addition; 2=Multistage chemical addition; B= Biological phosphorus removal

c. Permit limits are shows only as an indication of the requirement under which the plant operates. Permits requirements varies – for example Rock Creek operates under a monthly median permit; DCWASA operates under an annual limit

The TAL-14d concentrations for the nine processes analyzed are typically 40 to 50 percent of the median performance. The exception is DCWASA and Breckenridge, where the lowest achievable limit is 25 to 33 percent of the median performance using multiple stage chemical addition.

The 95th percentile performance is typically between two and three times the median performance. Breckenridge and WSSC report nearly four and five times the median, respectively. Breckenridge had the lowest TAL-50% value. WSSC exceed its phosphorus goals and rely on chemical sludge from a drinking water plant sent to the wastewater plant. Since the delivery of the chemical solids is not well controlled, the phosphorus removal at this plant also varies more.

Similar to total nitrogen, the upper performance is significantly further away from the median compared to the lower end. This implies that when the plant performance decreases and effluent concentrations increase, that increase is much more dramatic. It is more akin to a plant upset or interference that causes the process to deteriorate rapidly. The phosphorus performance variability (both TAL-14d/TAL-50% and TAL-95%/TAL-50% ratios) appears to show only a weak relationship to the median value.

## SUMMARY AND CONCLUSION

A simple statistical technique can be used to analyze treatment plant data to determine the limit of the technology in the application. Using the percentiles of the performance data can provide insight to the lowest and the reliable technology achievable limits or TALs. Understanding the differences in TAL-14d, median, and TAL-95% values, regulators can determine the ability of technology to meet given permit limits and its impact on existing plants. Designers would be able to quantify plant performance in clear terms to understand the variability and safety margins that should be applied to designs.

Using the data reported by full scale facilities, the paper showed that:

- The *Technology Achievable Limit* or TAL can be used to describe the performance measured from a specific technology. The TAL represents the performance that is achieved by a technology under specific conditions and expressed in terms of the statistical performance of the process.
- The lower 14-day per year performance (3.84th percentile or rank) represents the lowest TAL value. This provides a unbiased value of the optimal performance of the technology – the best the technology can achieve. This is indicated by the TAL-14d value.
- All data should be included in the analysis. If special circumstances exist to exclude some data, the exclusions should be clearly stated.
- Full scale plant performance for total nitrogen showed that the TAL-14d value of a typical plant is 50 to 60 percent of the median value. The TAL-95% is 180 to 250 percent of the median value.
- Full scale plant performance for total phosphorus showed that the TAL-14d value of a typical plant is 40 to 50 percent of the median value. The TAL-95% is 200 to 300 percent of the median value.
- The operating conditions and specific conditions under which the data was collected impacts the TAL values. Permit or target treatment goals, external factors such as wet weather or industrial discharges, and internal factors such a construction impacts the variability of the results.

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# Exhibit 3

# Evaluation of Exemplary WWTPs Practicing High Removal of Phosphorus

**PREPARED FOR:** Spokane River TMDL Collaboration, Technical Working Group

**PREPARED BY:** Dave Reynolds, CH2M HILL
Dave Clark, HDR

**COPIES:** John Spencer, CH2M HILL
Glen Daigger, CH2M HILL
J. B. Neethling, HDR

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This memorandum was prepared to provide information regarding the performance of exemplary wastewater treatment plants (WWTPs) practicing high removal of phosphorus to assist in determining effluent phosphorus concentrations that are achievable with current wastewater treatment technologies. The Technology Work Group for the Spokane River TMDL identified a number of exemplary WWTPs that were practicing high removal of phosphorus and achieving effluent total phosphorus concentrations of 50 µg/L or less. Nine WWTPs were selected from this group and detailed evaluations were performed. The nine WWTPs were selected based on size, technologies utilized and confidence that the effluent data were reasonable. A tenth WWTP, Breckenridge, Colorado was added because the information became available and it represented potentially the lowest effluent phosphorus concentration of the entire group. The 10 plants were (from largest to smallest):

- Las Vegas, Nevada
- Alexandria, Virginia
- Rock Creek (Portland area), Oregon
- Durham (Portland area), Oregon
- Cauley Creek (Atlanta area), Georgia
- Lone Tree (Arapahoe County), Colorado
- Walton, New York
- Iowa Hill (Breckenridge), Colorado
- Pinery, Colorado
- Stamford, New York

Two years of daily effluent total phosphorus data were obtained for each WWTP and the log normal average and coefficient of variation were calculated for each year. The data for each WWTP were used without modification except to correct obvious data entry errors. The log normal average was used because the log normal distribution typically fits the data better than a normal distribution. The log normal coefficient of variation (COV) is a simple numerical representation of the variation of data. A larger COV indicates greater variation of daily data. Graphs of annual daily data and the log normal average for each WWTP illustrate the variation of the daily data.

Preliminary analyses of the short-term, small-scale pilot studies of phosphorus removal at the City of Spokane River Park Water Reclamation Facility (RPWRF) are also presented for information. Small-scale pilot studies have been performed using Parkson DynaSand D2 Filtration, US Filter Microfloc Trident and Zenon Membrane Filtration technologies and they provide information on what effluent concentrations of total phosphorus may be possible for the City of Spokane. Each pilot has operated for approximately 1 month.

The effluent concentrations are presented in terms of μg/L and mg/L. There are 1,000 μg/L in 1 mg/L. To convert from mg/L to μg/L, multiply by 1,000. The following are examples of the conversion:

0.10 mg/L = 100 μg/L

0.05 mg/L = 50 μg/L

## Summary of Results

Table 1 summarizes the evaluation of full-scale exemplary WWTPs practicing high removals of total phosphorus. Factors that appear to be associated with effluent phosphorus concentrations at the exemplary plants include effluent permit limits, treatment plant size, treatment technology, method of solids processing, and the availability of a sufficient number of qualified operators and staff. Another factor that may affect the observed performance is the frequency of sampling and laboratory analytical considerations. Larger WWTPs had higher effluent phosphorus permit limits, had higher effluent phosphorus concentration and included anaerobic digestion. It is not possible to determine cause and effect from the information gathered. While associations exist between effluent phosphorus concentration, effluent phosphorus permit limits, plant size and anaerobic digestion it is not possible to determine which are causative, the magnitude of causative effect and which are just coincidental. The effluent phosphorus concentrations based on the actual daily data for the majority of WWTPs was significantly higher than the information produced by the Technology Work Group for the Spokane River TMDL appeared to show. Plants of substantial size (>2.5 mgd) had similar effluent performance with both chemical clarification followed by media filtration, and membrane bioreactor (MBR) with chemical addition. The larger plants reviewed in this investigation had daily 24-hour composite effluent monitoring and were measuring phosphorus concentrations greater than 25 μg/L. The amount of effluent data is greater and daily sampling of 24-hour composite samples ensures that process variability is well documented. The higher concentrations of effluent total phosphorus require less stringent quality control in the laboratory and are less subject to variation in laboratory analysis. This adds confidence to the reported phosphorus concentration in the effluent.

Exemplary plants reporting the lowest effluent phosphorus concentrations in the range of 8 to 46 μg/L were relatively small (<2.5 mgd), had lower effluent phosphorus limits, had newer phosphorus removal technologies, had limited solids processing and limited sampling and effluent testing. These associations also do not prove cause and effect and it is not possible to determine which factors are causative and most significant. The results from the smaller WWTPs suggest that the larger WWTPs using new phosphorus removal technologies may be able to achieve these lower effluent total phosphorus concentrations. However, the effects of plant size and solids processing must be determined from full-scale operation to confirm if this is indeed feasible. Effluent sampling and laboratory analysis may also significantly affect the apparent performance of the smaller WWTPs. Most of the smaller WWTPs sampled once per week or as little as twice per month. One did not use 24-hour composite samples. The result is the number of effluent data are much less and the potential exists that process variability is not captured with the reduced sampling. The effluent phosphorus concentrations are much less and there is evidence (see later section) that laboratory methods for measurement of phosphorus concentrations less than 25 μg/L are subject to substantial variability. The result of the limited sampling and challenges of measuring low concentrations of total effluent phosphorus is reduced confidence in the reported effluent total phosphorus concentrations for the smaller WWTPs.

The substantially sized treatment plants evaluated in this investigation (> 2.5 mgd) are more comparable to most of the facilities discharging to the Spokane River. These larger facilities are achieving effluent total phosphorus in the range of 71 to 179 μg/L total phosphorus. Notable plants of substantial size employing chemical clarification and media filtration that have performance in this range include the Rock Creek (34 mgd) and Durhman (25 mgd) plants in Oregon. The 5 mgd membrane bioreactor plant (MBR) at Cauley Creek, GA also has effluent phosphorus performance in this range.

The Rock Creek and Durham plants have one of the most restrictive phosphorus limits at 100 μg/L. Rock Creek has achieved effluent total phosphorus concentration of 71 and 82 μg/L over the phosphorus removal season of May to October in 2004 and 2005. Similarly, the Durham plant has achieved effluent total phosphorus concentration of 102 and 73 μg/L over the phosphorus removal seasons in 2004 and 2005. Rock Creek total effluent phosphorus has increased from 48 to 57 μg/L for the years 2001, 2002 and 2003. The recent increase in effluent phosphorus at Rock Creek and Durham is attributed to an increase in effluent total phosphorus concentration in the NPDES permit which now allows monthly median total phosphorus in their effluent of 100 and 110 μg/L, respectively. Less alum is required to be added to meet the less stringent NPDES permit and this saves the wastewater utility money.

All of the exemplary plants examined had data points well above and below the mean. This variability may be related to a variety of conditions that have not been fully assessed in this analysis (process changes, upset, chemical feed, temperature, level of operator experience, etc.) which may, or may not be controllable. For these reasons, permit limits based on a long-term averaging period, such as seasonal averaging, appears essential to successful compliance with phosphorus effluent levels less than 100 μg/L.

**TABLE 1**
Summary of Exemplary WWTPs in U.S. Practicing High Phosphorus Removal

| Facility | Average Design Flow (mgd) | Recent Average Flow (mgd) | NPDES Total Phosphorus Limit (µg/L) | Final Effluent Log Normal Average Total Phosphorus (µg/L) | | Coefficient of Variation of Final Effluent Total Phosphorus | | Liquids Process | Solids Process |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Year 1 | Year 2 | Year 1 | Year 2 | | |
| Las Vegas, Nevada | 91 | 63 | 170 | 179 | 152 | 0.28 | 0.52 | 30-mgd biological nutrient removal, trickling filters and activated sludge for remainder, blended followed by filtration | Thickening, anaerobic digestion and dewatering. |
| Alexandria, Virginia | 54 | 40 | Month 180, week 270 | 134 | 88 | 0.76 | 0.48 | Ferric chloride primary clarification, activated sludge, ferric chloride secondary clarification, alum chemical clarification, multimedia filtration | Pasteurization, anaerobic digestion and dewatering |
| Rock Creek (Portland area), Oregon | 34 | 32 | Month median 100 May 1 through October 31 | 82 | 71 | 0.48 | 0.47 | Alum primary clarification, activated sludge secondary, alum-chemical clarification, alum - multimedia filtration | Anaerobic digestion and dewatering |
| Durham (Portland area), Oregon | 25 | 17 | Month median 110 May 1 through October 31 | 102 | 73 | 1.01 | 0.65 | Biological nutrient removal with alum addition to primary, secondary and chemical clarifiers followed by sand filtration | Fermentation of primary sludge, thickening of waste activated and chemical sludges, anaerobic digestion of primary and waste activated sludge and dewatering |

**TABLE 1**
Summary of Exemplary WWTPs in U.S. Practicing High Phosphorus Removal

| Facility | Average Design Flow (mgd) | Recent Average Flow (mgd) | NPDES Total Phosphorus Limit (µg/L) | Final Effluent Log Normal Average Total Phosphorus (µg/L) | | Coefficient of Variation of Final Effluent Total Phosphorus | | Liquids Process | Solids Process |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Year 1 | Year 2 | Year 1 | Year 2 | | |
| Cauley Creek (Atlanta area), Georgia | 5.0 | 4.1 | 130 | 123 | 86 | 0.57 | 0.31 | Biological nutrient removal with added ferric chloride followed by membrane bioreactor | Thickening, aerobic digestion and dewatering |
| Lone Tree (Arapahoe County) Colorado | 2.4 | 1.6 | Daily 50 | 40 | 30 | 0.64 | 0.53 | Ferric chloride membrane bioreactor using Zenon membranes | Aerobic digestion and dewatering |
| Walton, New York | 1.6 | 1.1 | 150 | | 46 | | 0.76 | Activated sludge with coagulant addition followed by dual stage Dynasand filtration | Aerobic digestion and dewatering |
| Iowa Hill (Breckenridge), Colorado | 1.5 | 0.8 | Daily 50, annual 225 lbs | 9 | 8 | 1.01 | 0.93 | Activated sludge with bio-P, BAF, Densadeg with alum, Dynasand filtration | None |
| Pinery, Colorado | 1.0 | 0.6 | Month 50, daily 100, annual 150 lbs | 29 | 31 | 0.40 | 0.41 | 5-stage Bardenpho, Trident process with alum (adsorption clarification, multimedia filtration) | Holding basins, dewatering and air drying |
| Stamford, New York | 0.5 | 0.4 | 200 | | 20 | | 0.96 | Activated sludge with coagulant addition followed by dual stage Dynasand filtration | Aerobic digestion and dewatering |

Table 2 summarizes the pilot testing results at the RPWRF and indicates that 20 µg/L is probably the best any filtration or membrane technology can achieve. Small full-scale facilities indicate that 30 to 40 µg/L are more likely the best effluent concentrations achievable with current filtration or membrane technologies for full-scale facilities. The best years for Rock Creek indicate that 50 to 60 µg/L may be achievable with conventional multimedia effluent filters. The effects of plant size and solids processing are significant unknowns that could affect the ability of plants of substantial size to achieve very low levels of total phosphorus. Nonideal conditions, partial failures of large numbers of parallel process units and human challenges of operating larger systems with large numbers of parallel process units could reduce the ability of larger WWTPs to reliably achieve extremely low concentrations of total phosphorus. Anaerobic digestion may release phosphorus changing chemical requirements or create chemical forms of phosphorus that are not removed by chemical reaction and affect phosphorus removal when attempting to achieve extremely low effluent concentrations.

**TABLE 2**
Summary of Fall 2005 RPWRF Phosphorus Removal Technology Pilot Testing

| Technology | Final Effluent Log Normal Average Total Phosphorus (µg/L) | Coefficient of Variation of Final Effluent Total Phosphorus (µg/L) |
|---|---|---|
| US Filter MicroflocTrident | 18 | 0.47 |
| Parkson DynaSand D2 Filtration | 16 | 0.35 |
| Zenon Membrane Filtration | 16 | 0.46 |

At this time, the lowest demonstrated effluent total phosphorus limit for plants of substantial size (>2.5 mgd) is 100 µg/L based on using a seasonal discharge limit. This limit has been achieved by Rock Creek, Durham, one of two years for Alexandria and one of two years at Cauly Creek. Rock Creek and Durham had effluent total phosphorus limits of 70 µg/L for several years prior to 2004 and 2005. Both plants were able to achieve 50 to 60 µg/L to comply with this effluent limit. However, both of these WWTPs had experience with high levels of phosphorus removal prior to the initiation of these limits and the processes were familiar to plant staff and process control analysts. Phosphorus removal and new wastewater treatment unit processes will be added to all the Spokane River WWTPs. There will be a need to train operations and maintenance staff, learn optimum control strategies and debugging new wastewater treatment unit processes to achieve optimum results. Overly restrictive effluent limits will be counter-productive because they will discourage experimentation to determine how well the new processes can perform for fear of violating NPDES permit limits. Seasonal averaging appears essential to successful compliance at low effluent phosphorus levels since actual plant performance shows a high degree of variability at all plants examined. It may seem counterintuitive, but short-term limits must be substantially higher than the seasonal limits because of the inherent variability of the effluent concentration and fewer results included in the averages for the shorter time periods.

It is likely that concentrations of phosphorus less than 100 µg/L can be achieved at larger plants only by use of more chemicals, better process control, highly trained operators, and state-of-the-art phosphorus removal technology.

It is recommended that longer-term, larger-scale pilot plants be operated to assist in the selection of the phosphorus removal technology that achieves the lowest concentrations of final effluent phosphorus in a cost effective manner. Engineering studies should be conducted using the data from the recently completed pilot studies to evaluate phosphorus removal technologies. Factors including initial capital cost, space requirements and ability to fit on available site area, chemical requirements, operation and maintenance issues and final effluent phosphorus concentration should be evaluated to determine one or two technologies for additional pilot testing. It is recommended that the pilot test be approximately 1 mgd and continue for a period of 1 year. A final engineering evaluation should be conducted to determine the phosphorus removal technology to implement.

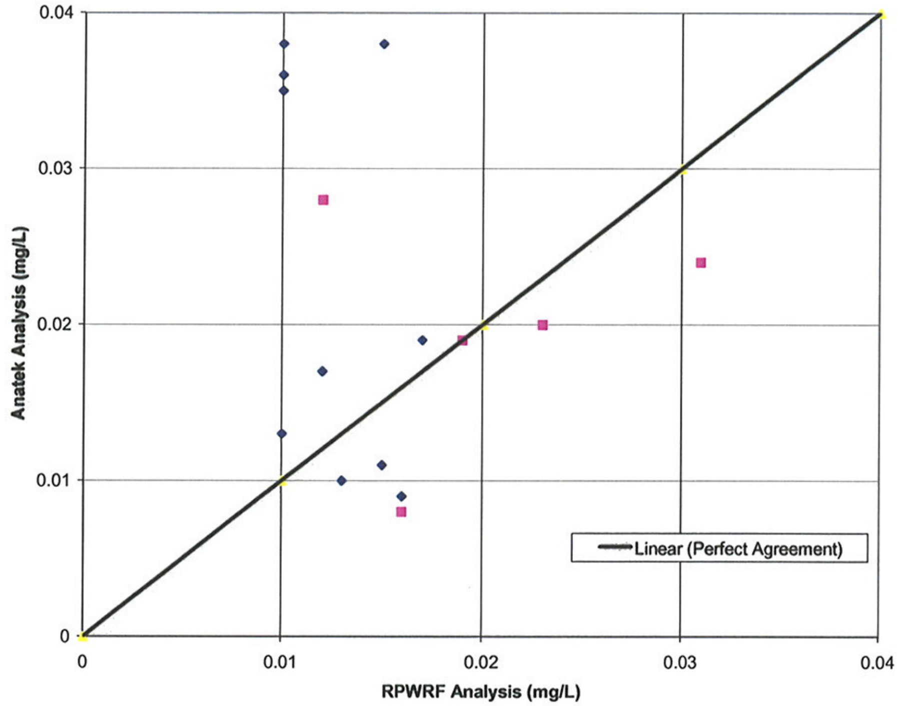
It is recommended that the new facilities be operated for a period of 5 years to establish the final NPDES permit limits for final effluent phosphorus. Issues such as operating large numbers of parallel treatment processes, optimum chemical dosages and operating strategies and the effect of anaerobic digestion can not be determined from pilot testing. This can only be determined from full-scale operation at the WWTPs. It is likely that there will be construction and startup issues that will affect the first year of operation and it is unlikely that optimum phosphorus removal will be achieved. The next 2 years would provide the opportunity to experiment with different strategies to optimize performance. The final 2 years would provide the opportunity to operate using agreed upon strategies to determine the lowest feasible final effluent phosphorous concentrations and this data would be used to establish final NPDES limits.

## Analytical Considerations

RPWRF and an accredited private local laboratory in the Spokane area split samples for analysis of total phosphorus during the pilot testing of phosphorus removal technologies at the RPWRF. The results of the laboratory analyses are shown in Figure 1. The individual measurements are shown as points on the graph. The straight line represents perfect correlation between the measurements made by the two laboratories. The results varied widely, so much that there is no meaningful statistical correlation of the results. Typical variation was 2-6 µg/L and several samples varied by more than 25 µg/L. As a result, it is important to recognize the challenges of evaluating WWTPs operating at very low effluent concentrations of total phosphorus and complying with very low total phosphorus effluent permit limits.

Analytical quality control is essential to obtain reliable laboratory results at very low concentrations. The quality of the total phosphorus concentrations in the data used for this analysis is unknown and the uncertainty level in individual measurements is potentially similar in magnitude to the desired effluent total phosphorus concentration. It is more of a challenge for smaller WWTPs to achieve the necessary level of quality control with laboratory staff that may have less training and fewer resources to conduct the laboratory analysis. The RPWRF experience indicates that even two highly skilled laboratories can measure very different concentrations of phosphorus in the same sample.

**Figure 1. Analytical Phosphorus Measurement**




RPWRF laboratory staff determined that the quantitation limit for total phosphorus was 5 μg/L. This is the lowest concentration that can be measured with the phosphorus analysis technique used by RPWRF and is comparable to the best several universities can measure. This creates some uncertainty about the data for the Iowa Hill (Breckenridge, Colorado) WWTP that has a substantial amount of data between 1 and 10 μg/L.

# Las Vegas, Nevada

The City of Las Vegas operates a 91-mgd advanced treatment plant that combines an older plant with a relatively new (May 2003) biological nutrient removal facility (BNR). The process includes multiple parallel trains with trickling filters, activated sludge, effluent filters and the new BNR facilities. The older treatment plant consists of trickling filters, nitrification activated sludge, and effluent filtration. Chemical phosphorus removal was practiced at the older plant with chemical addition (ferric) prior to primary clarification. The new BNR facility started operation in May 2003 and treats 30 mgd of the total plant flow. The BNR effluent is combined with the old treatment system prior to effluent filtration.

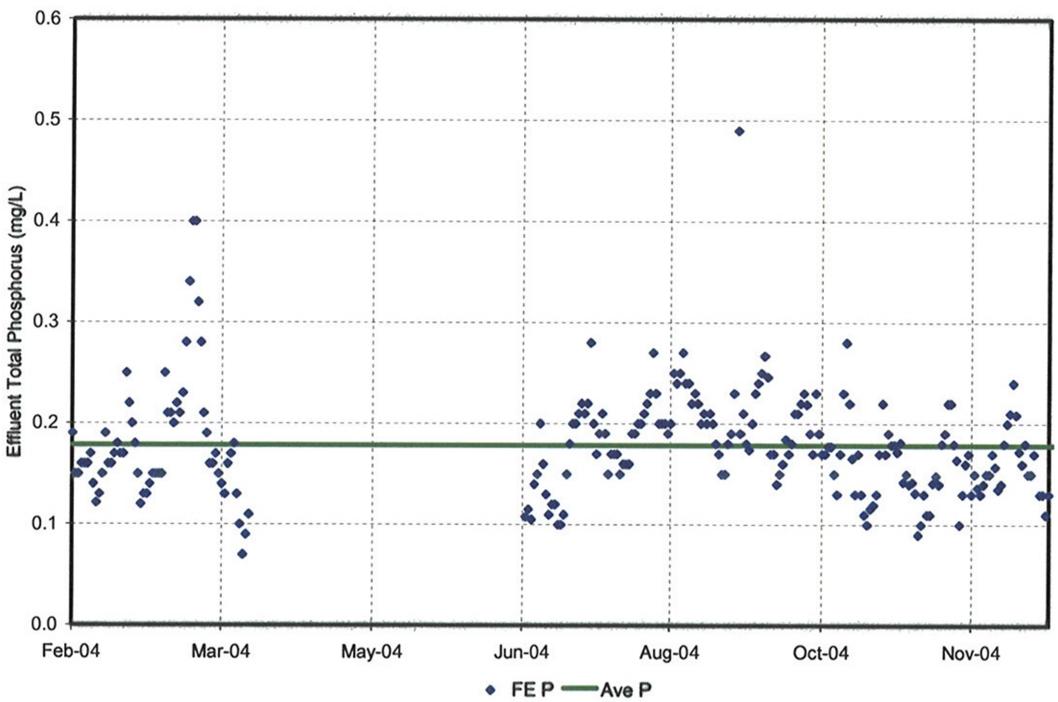
The relatively new (May 2003) biological nutrient removal facility consists of four 7.5-mgd activated sludge process trains with three anaerobic zones, three anoxic zones, and a complete mixed aerobic zone. The aerobic zone is designed as a racetrack with mixers moving the liquid around the basin. Primary clarification is available with ferric feed as an option, mainly used for odor control at low doses.

The solids processing system consists of gravity thickening of primary sludge, centrifuge thickening of waste activated sludge, anaerobic digestion, dewatering and truck hauling of biosolids.

The City of Las Vegas plant discharges into the Las Vegas Wash, which ultimately flows into Lake Mead and the Colorado River. Seasonal phosphorus and ammonia limits apply to the plant. The mass load allocation to the Las Vegas Wash is shared with two other wastewater plants: Clark County and the City of Henderson. As flow increases, the effluent concentration limit decreases. Summer and winter effluent limits for phosphorus at 91 mgd are 0.17 mg/L (126 lbs/day). The summer (March through October) effluent ammonia nitrogen limits are 0.48 mg/L (366 lbs/day) and the winter (November to March) limits are 0.56 mg/L (427 lbs/day).

Daily Las Vegas plant effluent phosphorus data was reviewed from February 1 to December 23, 2004 and from January 1 to July 9, 2005. This data is shown graphically in Figures 2 and 3. The log normal mean of the daily effluent data for 2004 was 0.179 mg/L and for 2005 was 0.152 mg/L.

**Figure 2. 2004 Las Vegas WWTP Effluent TP**




# Alexandria, Virginia

Alexandria, Virginia is a 54-mgd WWTP. Phosphorus removal is accomplished by ferric chloride addition prior to the primary clarifiers, ferric chloride addition following activated sludge ahead of the secondary clarifiers, alum addition prior to chemical clarifiers and multimedia filtration. Solids are processed by pasteurization, anaerobic digestion and dewatering. Daily total phosphorus in the final effluent data for 2003 and 2004 are shown in Figures 4 and 5 along with the log normal average for each year. Final effluent total phosphorus averaged 134 and 88 µg/L well within the permit limit of 180 µg/L for a monthly average. The effluent total phosphorus in 2004 is much lower than in 2003 and there is less daily variation.

**Figure 3. 2005 Las Vegas WWTP Effluent TP**

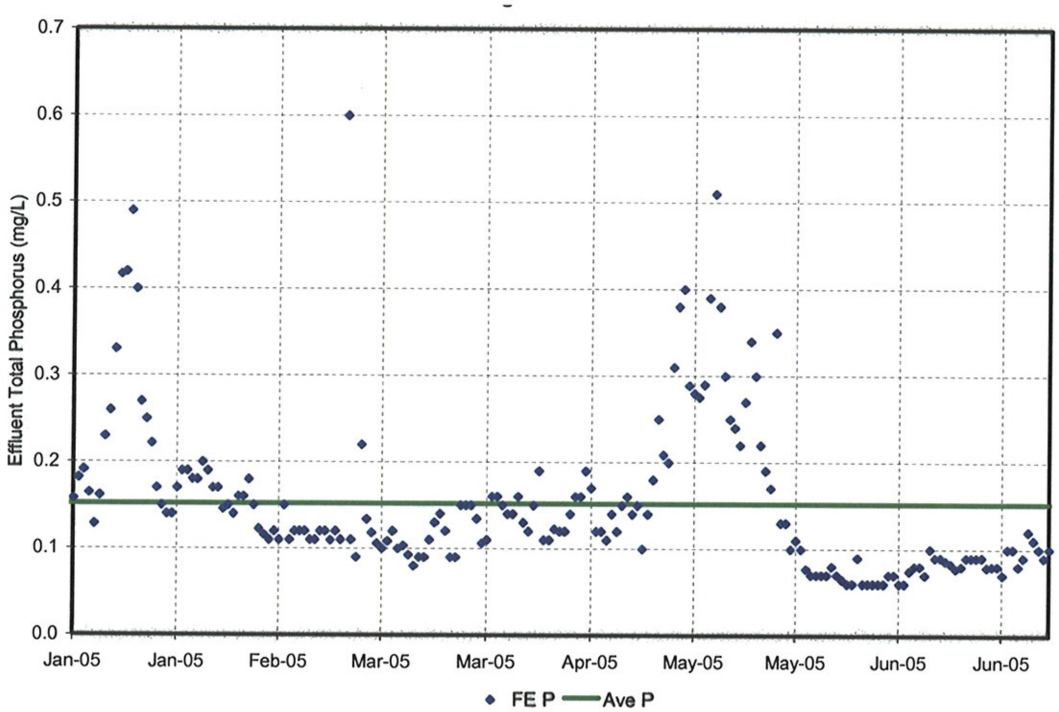



**Figure 4. 2003 Alexandria, Virginia Effluent Phosphorus**

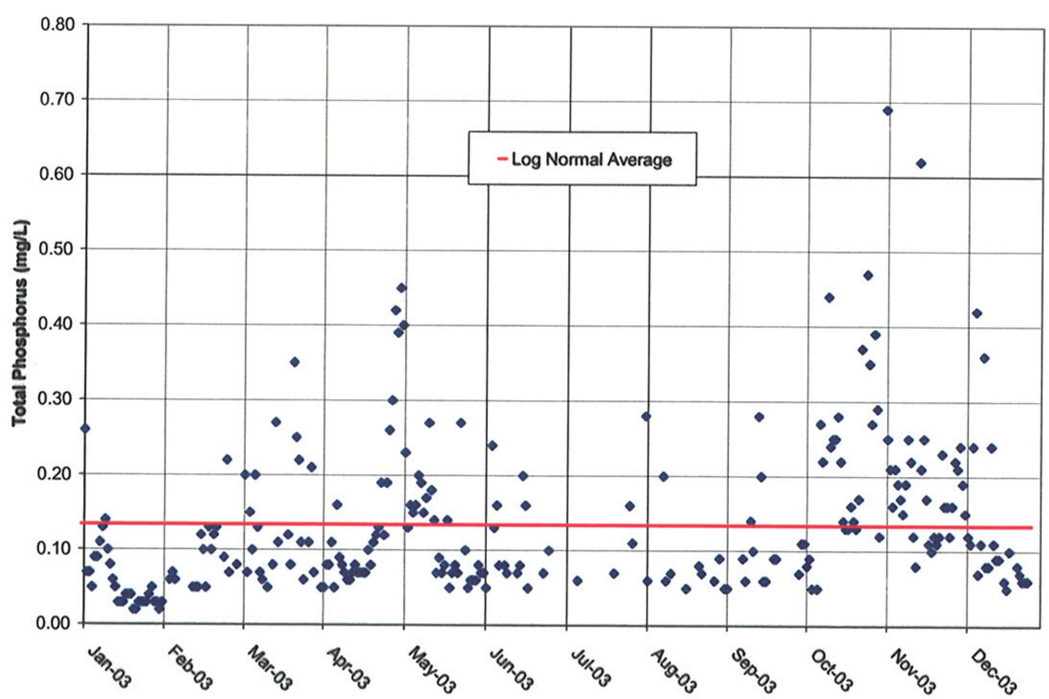
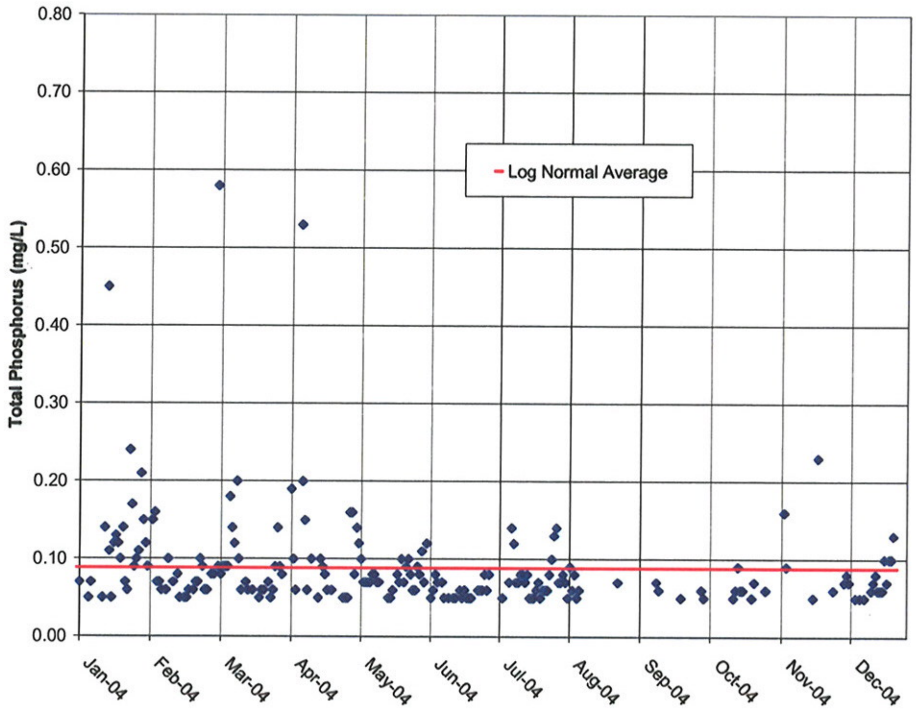


**Figure 5. 2004 Alexandria, Virginia Effluent Phosphorus**




# Rock Creek, Oregon

Rock Creek WWTP has a capacity of 34 mgd. It is operated by Clean Water Services and serves the Hillsboro area west of Portland. Phosphorus is removed by alum addition to the primary clarifiers, alum addition followed by chemical clarification and alum addition followed by multimedia filtration. Solids are processed by anaerobic digestion and dewatering. Daily total phosphorus in the final effluent for years 2004 and 2005 is shown in Figures 6 and 7 with the log normal average for the phosphorus removal season which runs from May to November. Effluent total phosphorus is higher in 2004 than 2005, but was fairly consistent. Effluent total phosphorus was less than the seasonal average of 100 μg/L.

Average effluent total phosphorus is higher in 2004 and 2005 compared to 2001 through 2003 when log average effluent total phosphorus was 48 to 57 μg/L. The NPDES limits for phosphorus were relaxed from 70 μg/L to 100 μg/L and apparently the WWTP is able to reduce chemicals and reduce the phosphorus removal efficiency. The daily data show periods where total effluent phosphorus is 25 to 50 μg/L, but there are other periods when total effluent phosphorus is much higher. With this data, it is not possible to conclude what the minimum effluent concentration of total phosphorus would be if the NPDES permit limits for total phosphorus were lower.

**Figure 6. 2004 Rock Creek, Oregon Effluent Phosphorus**

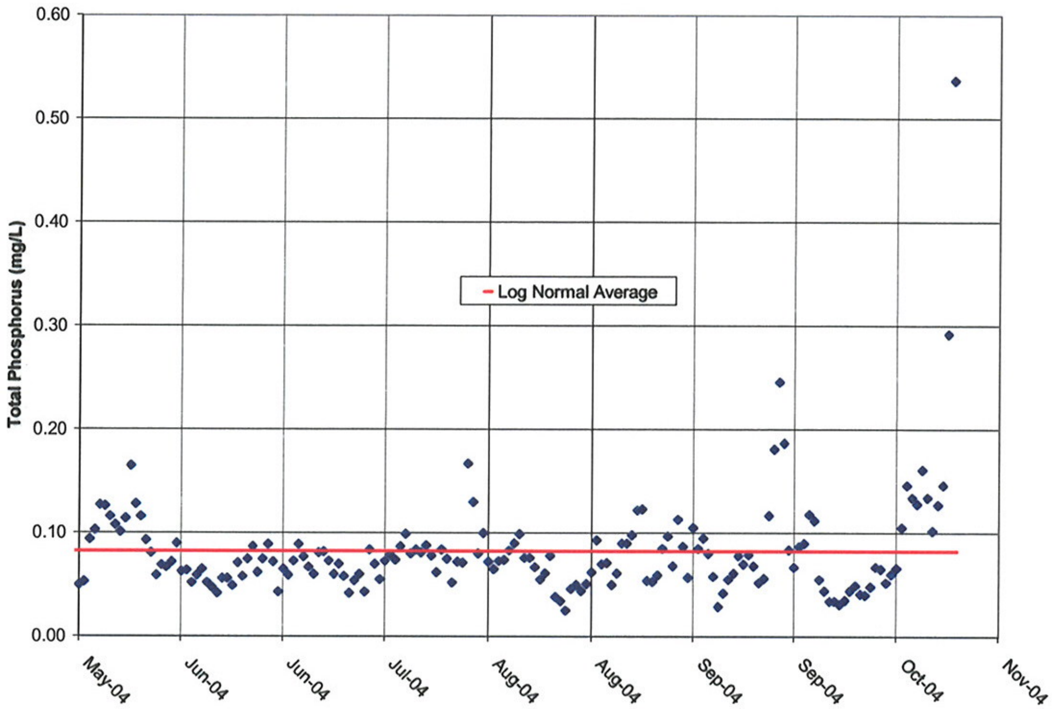
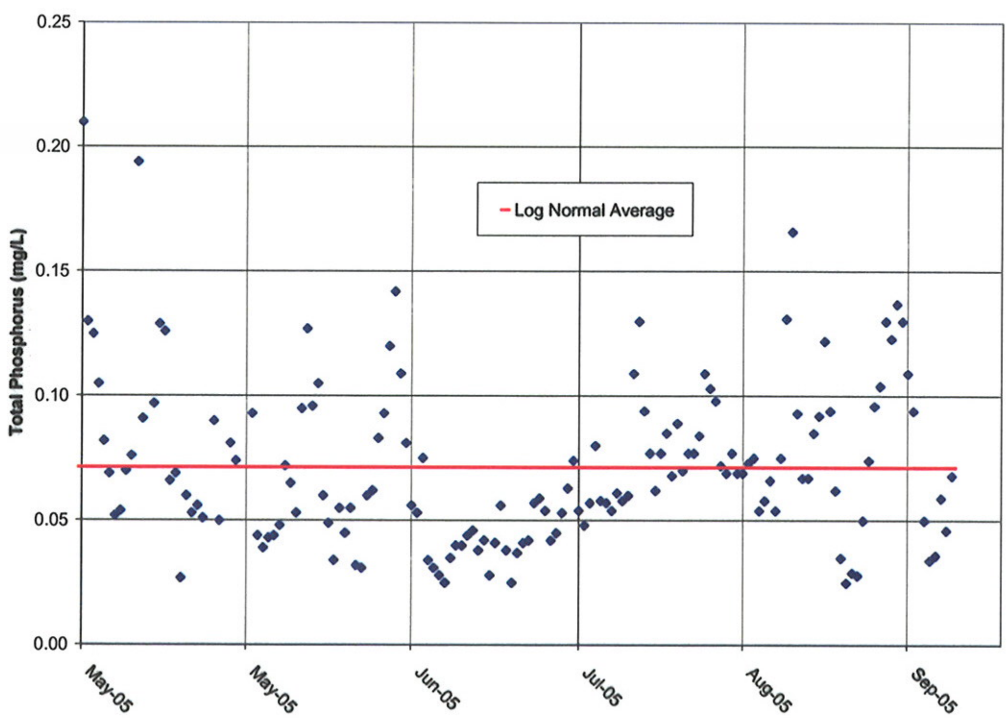



**Figure 7. 2005 Rock Creek, Oregon Effluent Phosphorus**



## Durham, Oregon

The Durham facility located in Tigard, Oregon is operated by Clean Water Services of Washington County (District). The plant was designed to operate as a biological phosphorus removal plant in either UCT or $A^2O$ mode and typically operated in $A^2O$. Alum can be added upstream of the primary, secondary, and tertiary treatment processes to meet the seasonal total phosphorus limit.

The biological nutrient removal process follows screening, grit removal, and primary clarification. Lime is added for alkalinity control. Denitrification is practiced to recover alkalinity and oxygen but there is no total nitrogen control requirement in the effluent discharge permit. The tertiary process consists of chemical clarifiers using alum and polymer, followed by sand media filters. Sodium hypochlorite is used for disinfection and sodium bisulfate is used for dechlorination.

Primary sludge is fermented in a two-stage fermenter/thickener, and volatile fatty acids (VFAs) are elutriated and returned to the secondary treatment process. Waste-activated sludge and chemical sludge are thickened using centrifuges. Primary, waste activated and chemical sludges are anaerobically digested and centrifuge dewatered prior to land application. Dewatering centrate is returned to the primary effluent pump station upstream of the aeration basins. Ferric can be added to the anaerobic digester feed for odor and struvite control.

The Durham plant discharges to the Tualitin River and operates under a watershed NPDES discharge permit that includes multiple treatment plants. Discharge permit limits are seasonal and the plant is required to remove phosphorus and ammonia nitrogen (nitrification) between the months of April and November. During the summer months, the plant must an effluent phosphorus concentration of 0.110 mg/L and an effluent ammonia nitrogen concentration of 1 mg/L on a monthly median basis.

Daily Durham plant effluent phosphorus data was reviewed from May 10 to October 20, 2004 and from May 9 to July 29, 2005. The data is shown graphically in Figures 8 and 9. The log normal mean of the daily effluent data for 2004 was 0.102 mg/L and for 2005 was 0.073 mg/L.

The solids process consists of waste solids thickening with a membrane sludge thickener, followed by aerobic digestion, and centrifuge dewatering of digested sludge.

## Cauley Creek, Georgia

The Cauley Creek Wastewater Reclamation Facility is located in North Fulton County, Georgia and consists of nitrification, denitrification, and both biological and chemical phosphorus removal. The treatment process consists of preliminary treatment with screening and grit removal, followed by secondary treatment with pre-anoxic, anaerobic and aerobic sequences for nitrogen and phosphorus removal and membrane biological reactor (MBR) for liquid and solids separation, and UV disinfection. A ferric dose of 15 to 20 mg/L is added before the flow reaches the MBR tank for chemical enhanced phosphorus to meet the effluent total phosphorus limit.

**Figure 8. 2004 Durham AWWTP Effluent TP**

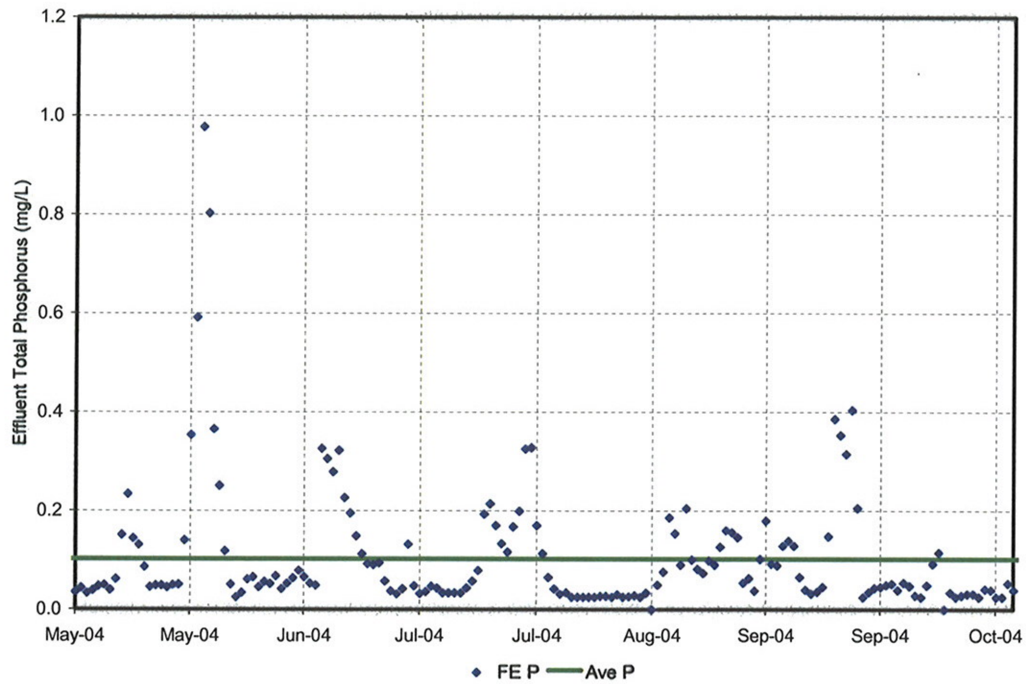
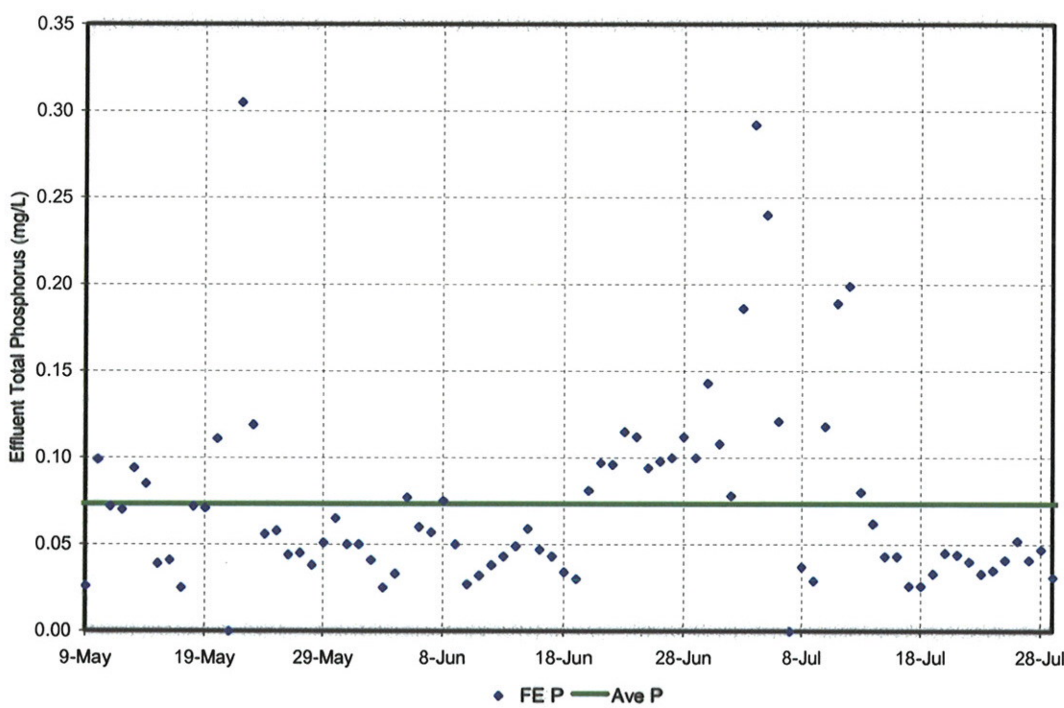



**Figure 9. 2005 Durham AWWTP Effluent TP**




Fulton County sells much of the reclaimed wastewater from the Cauley Creek plant for reuse to local customers, such as golf courses. Unsold treated wastewater is either used to irrigate on-site hayfields or stored on-site in effluent holding ponds. During the cold weather season, the facility can discharged treated effluent to Cauley Creek, a tributary to the Chatahoochee River. Effluent discharge requirements for total phosphorus are

<0.13 g/L. There are also effluent requirements for turbidity (<0.5 NTU), BOD (<2.9 mg/L), TSS (<5 g/L), total nitrogen (<10 mg/L), and ammonia nitrogen (<0.5 mg/L).

Daily Cauley Creek plant effluent phosphorus data was reviewed from September 10 to December 31, 2004 and from January 20 to January 31, 2005. This data is shown in Figures 10 and 11. The log normal mean of the daily effluent data for 2004 was 0.123 mg/L and for 2005 was 0.086 mg/L.

Figure 10. 2004 Cauley Creek Effluent TP

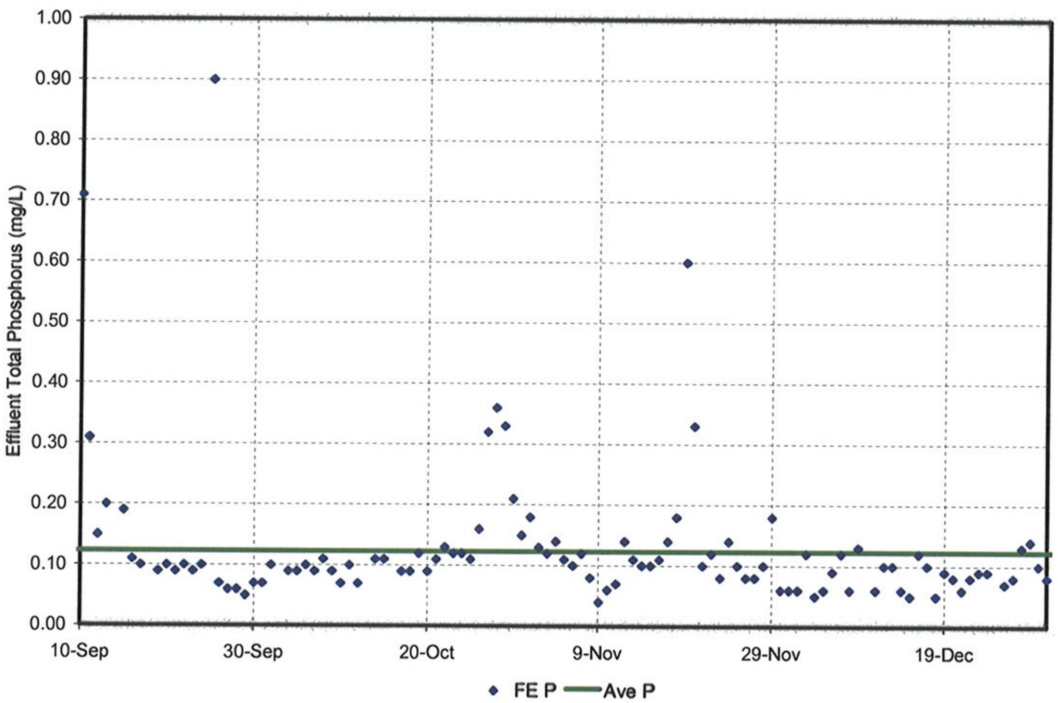
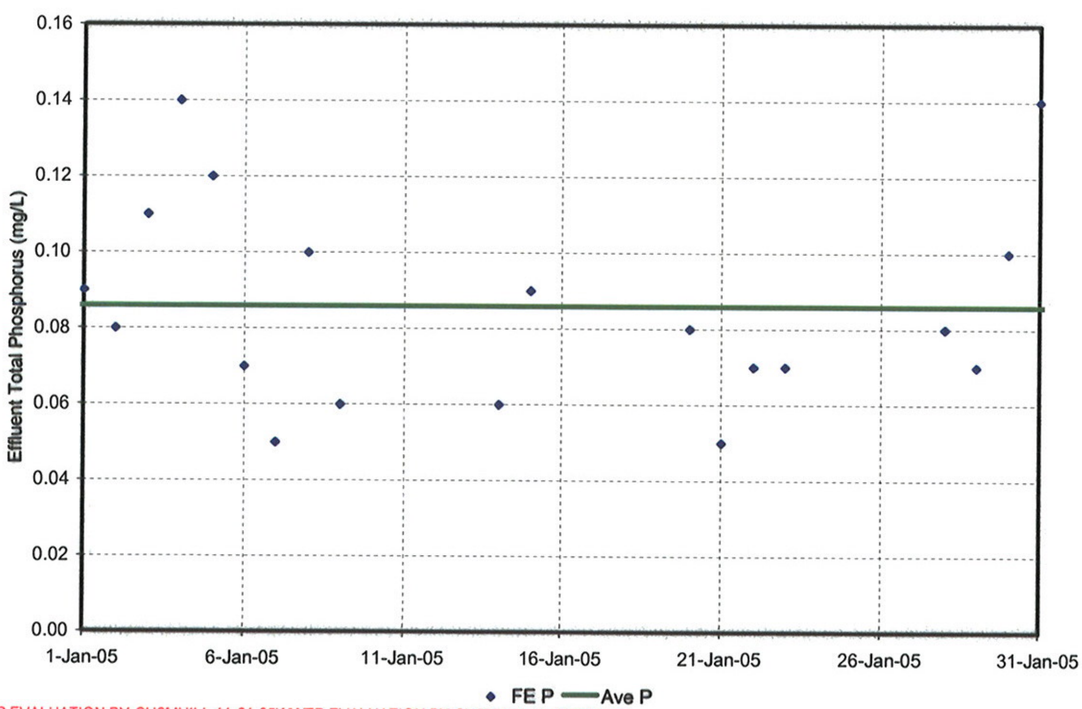


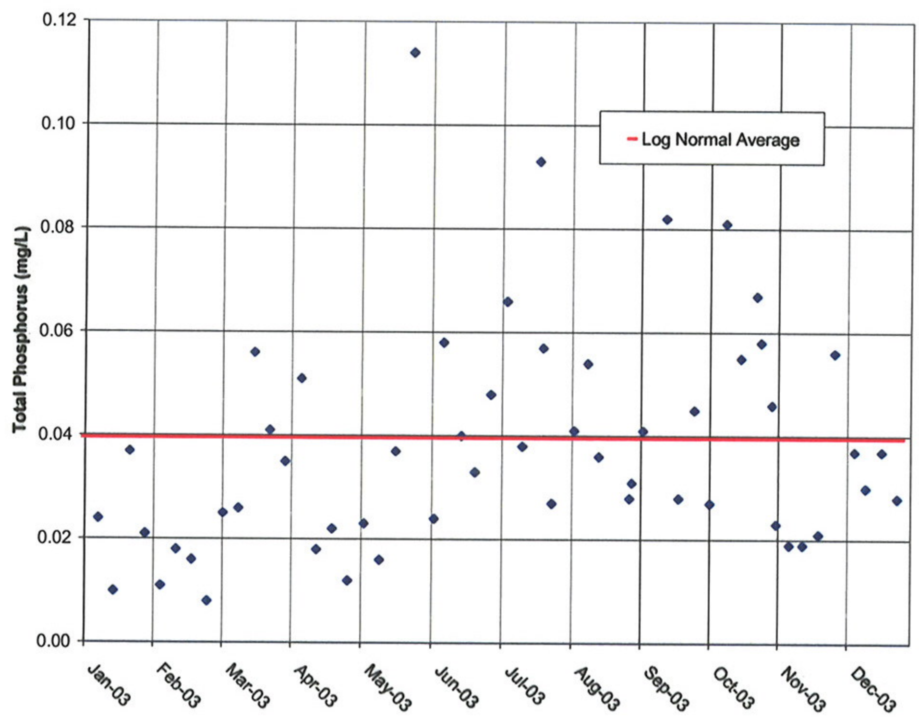

Figure 11. 2005 Cauley Creek Effluent TP



# Lone Tree, Colorado

Lone Tree WWTP has a capacity of 2.4 mgd. It serves Arapahoe County Colorado in the Denver area. Zenon membranes in a bioreactor activated sludge process using ferric chloride to precipitate phosphorus are used for phosphorus removal. Solids are processed using aerobic digestion and dewatering. Effluent total phosphorus in 2003 and 2004 are shown in Figures 12 and 13. Effluent total daily phosphorus limit is reportedly 50 μg/L. Total effluent phosphorus log normal average concentration was 40 μg/L in 2003 and 30 μg/L in 2004. Daily results frequently exceed 50 μg/L. Lone Tree is a small WWTP and the effluent sampling frequency is once per week. There are periods of time where final effluent total phosphorus is 20 μg/L or less, but there are other times when the total phosphorus is much higher.

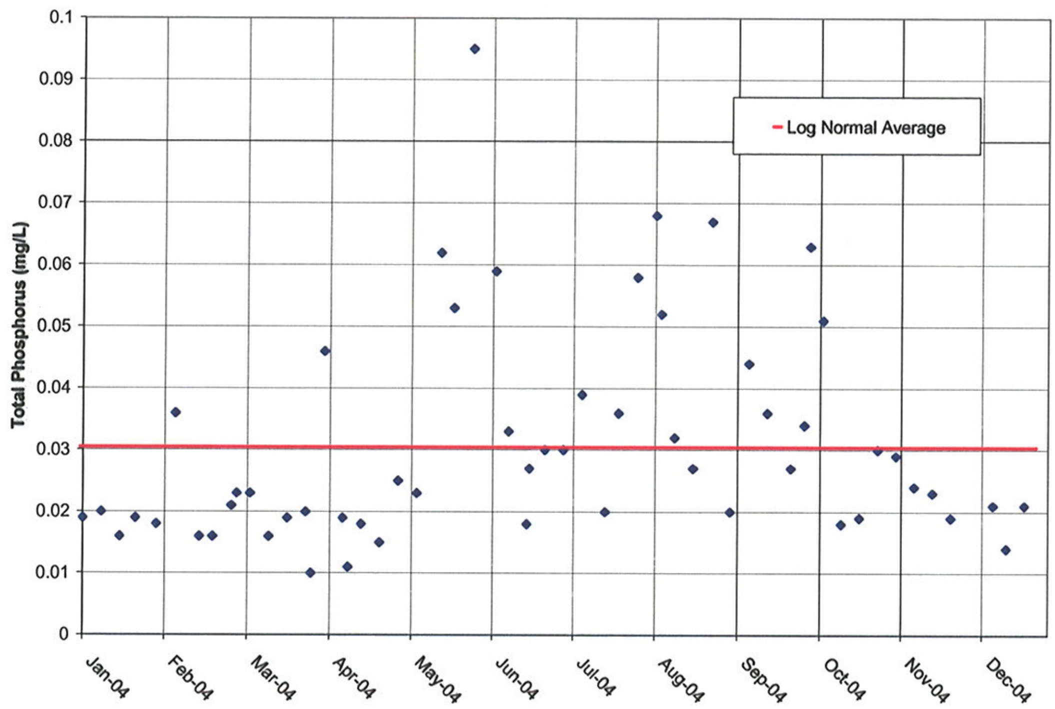
**Figure 12. 2003 Lone Tree (Arapahoe County), Colorado Effluent Phosphorus**




# Walton, New York

The Village of Walton facility is an activated sludge treatment plant with dual sand filtration of the secondary effluent. The dual sand process uses two Parkson DynaSand™ continuous backwash upflow filters in series. The first filter is approximately 2 meters in depth and uses coarse sand media. The second filter is approximately 1 meter in depth and uses fine sand media. A coagulant is added before the first stage filter to precipitate soluble phosphorus and a lamella settler is used to capture solids between stages and improve process throughput. A variety of coagulants have been used in this process including PASS®

**Figure 13. 2004 Pine Tree (Arapahoe County), Colorado Effluent Phosphorus**




(Poly-aluminum-silicate-sulfate), manufactured by Handy Chemical (now Eaglebrook, Inc.). The plant has an influent equalization basin and chlorine disinfection of the effluent.

Waste solids are aerobically digested, dewatered in a belt filter press, and landfilled.

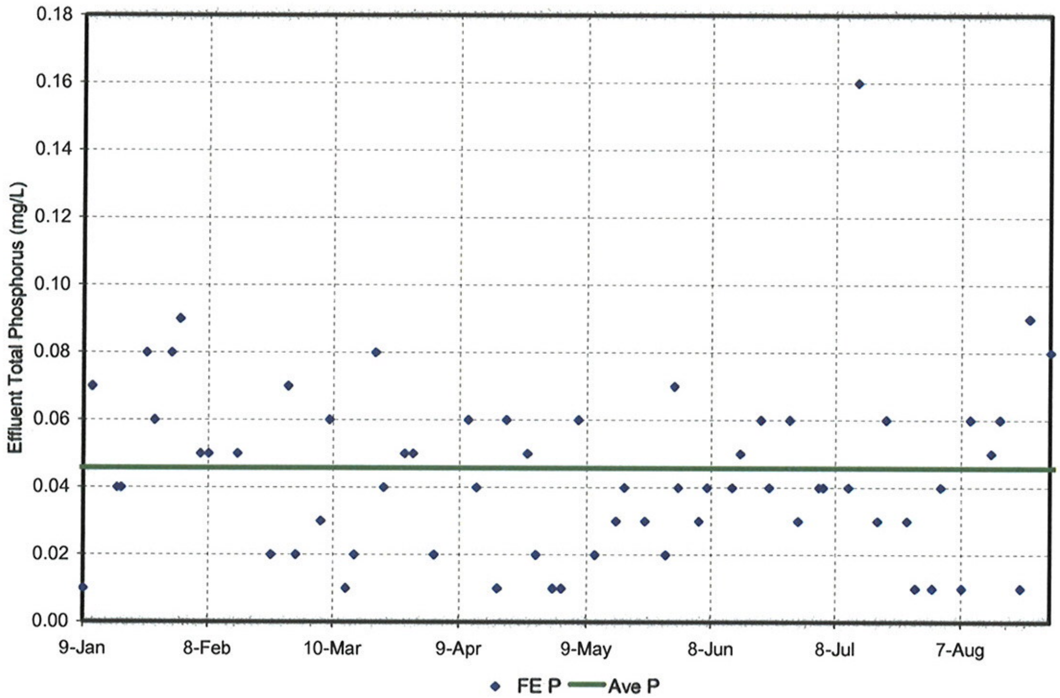
The Walton plant discharges to the New York City watershed where effluent phosphorus limits are between 1.0 mg/L and 0.2 mg/L depending upon plant flow. The Walton permit was recently revised to lower the monthly average phosphorus limit to 0.15 mg/L, based on a 24-hour composite sample taken once a week, in order to increase permitted flows to 1.55 mgd. There is also a mass loading limit for phosphorus of 1.95 lbs/day which was based on the historically permitted flow rate of 1.17 mgd and an effluent limit of 0.2 mg/L.

Walton plant effluent phosphorus data taken weekly from January 9 to August 28, 2005 was reviewed and are shown in Figure 14. The log normal mean of the weekly effluent data for 2005 was 0.046 mg/L. The effluent data ranged from 0.01 to 0.49 mg/L in 2005.

# Iowa Hill, Colorado

The Iowa Hill WWTP has a design capacity of 1.5 mgd. It serves the Breckenridge area. Phosphorus removal is accomplished in three steps. First, phosphorus is removed biologically using activated sludge with an anaerobic zone. Then phosphorus is removed using alum with chemical clarification in proprietary process known as the Densadeg process. Settled solids are recirculated in the Densadeg process. The final step is filtration using Parkson Dynasand effluent filters. Solids are not processed at the WWTP as they are sent to another WWTP for processing.

**Figure 14. 2005 Walton WWTP Effluent TP**




Figures 15 and 16 show daily and log normal average final effluent total phosphorus in 2003 and 2004. The average in both years is reported to be less than 10 µg/L. As discussed earlier, the large number of laboratory observations less than 10 µg/L is in apparent conflict with RPWRF laboratory experience and Iowa Hill laboratory procedures should be reviewed in detail before the results are accepted as fact.

## Pinery, Colorado

The Pinery WWTP has a capacity of 1.0 mgd. It removes phosphorus initially using a five-stage biological activated sludge process called the Bardenpho process. The phosphorus is removed using alum in U.S. Filter's Trident process consisting of adsorption clarification followed by multimedia filtration.

Figures 17 and 18 show daily and log normal average final effluent total phosphorus in 2003 and 2004. The average for both years is approximately 30 µg/L. They are easily meeting their NPDES effluent total phosphorus of 50 µg/L for a monthly average and 100 µg/L for a maximum day. The coefficient of variation is low for both years indicating very stable and consistent operation with small variation.

## Stamford, New York

The Village of Stamford facility is an activated sludge treatment plant with dual sand filtration of the secondary effluent. The dual sand process uses two Parkson DynaSand™ continuous backwash upflow filters in series. The first filter is approximately two meters in depth and uses coarse sand media. The second filter is approximately one meter in depth

**Figure 15. 2003 Iowa Hill (Breckenridge), Colorado Effluent Phosphorus**

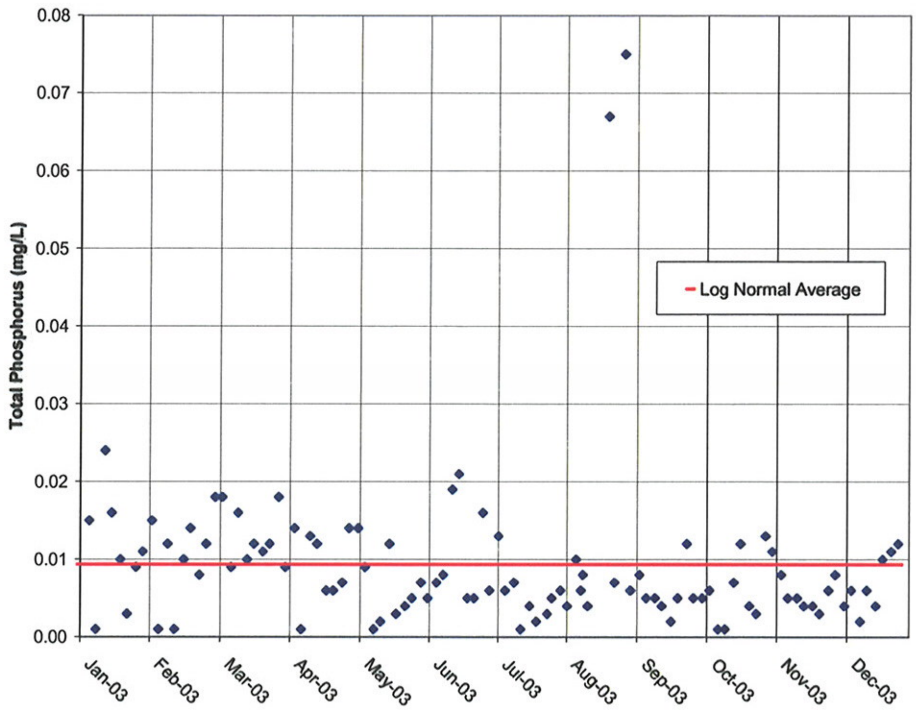



**Figure 16. 2004 Iowa Hill (Breckenridge), Colorado Effluent Phosphorus**

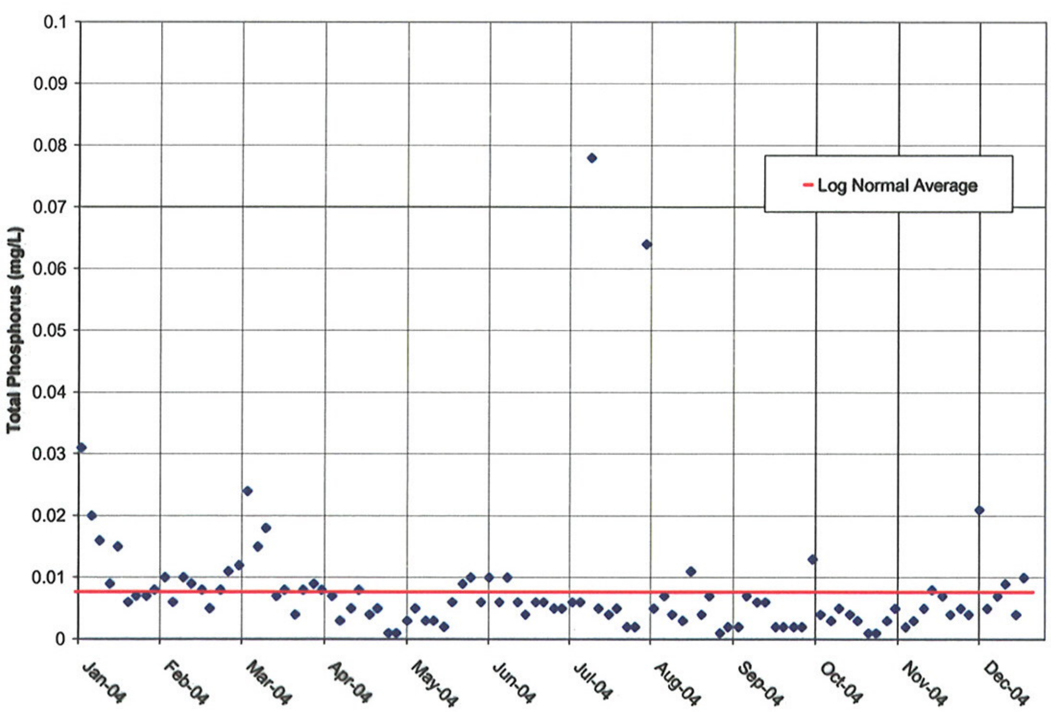


**Figure 17. 2003 Pinery, Colorado Effluent Phosphorus**

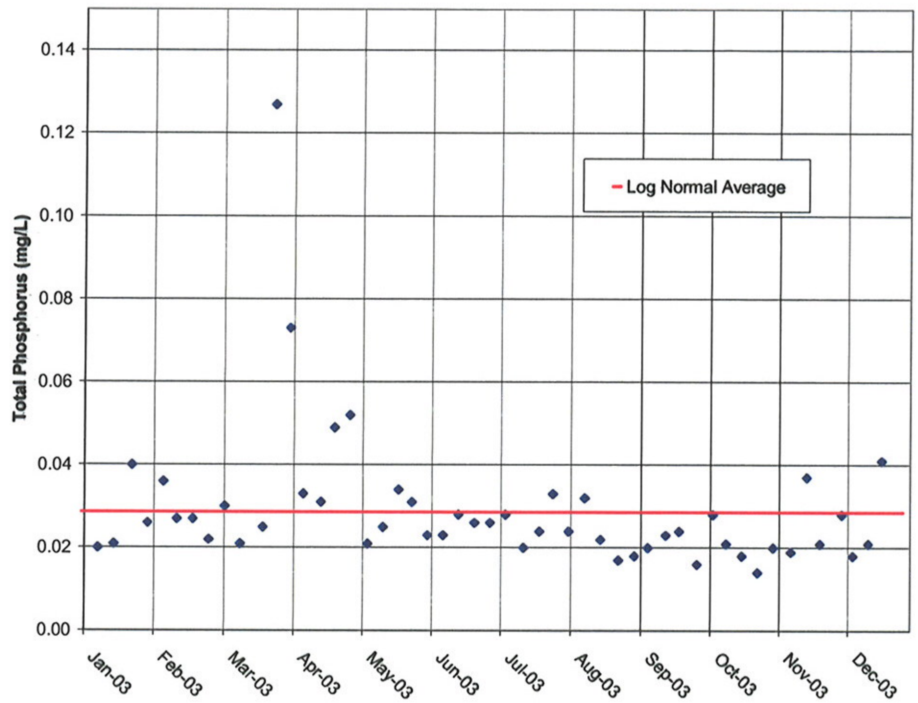
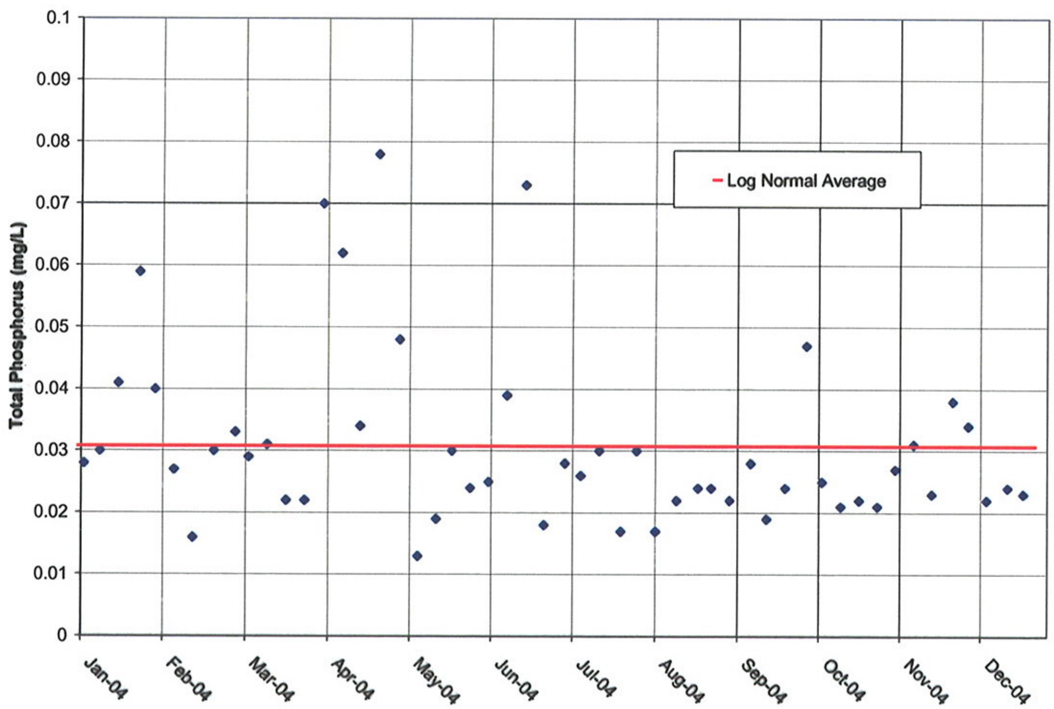



**Figure 18. 2004 Pinery, Colorado Effluent Phosphorus**



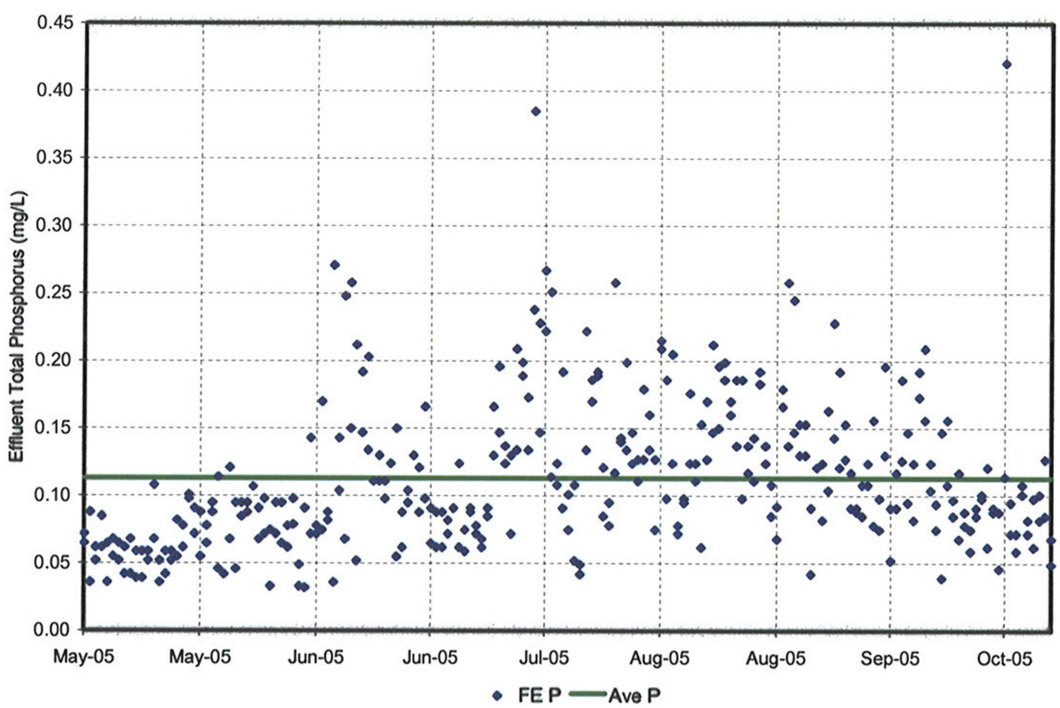
and uses fine sand media. A coagulant is added before the first stage filter to precipitate soluble phosphorus and a lamella settler is used to capture solids between stages and improve process throughput. A variety of coagulants have been used in this process including PASS® (Poly-aluminum-silicate-sulfate), manufactured by Handy Chemical (now Eaglebrook, Inc.). The plant has chlorine disinfection of the effluent.

Waste solids are aerobically digested, dewatered in a belt filter press, and landfilled.

The Village of Stamford plant discharges to the New York City watershed where effluent phosphorus limits are between 1.0 mg/L and 0.2 mg/L depending upon plant flow. The Stamford permit has a monthly average phosphorus limit to 0.20 mg/L, based on a 6-hour composite sample taken twice a month.

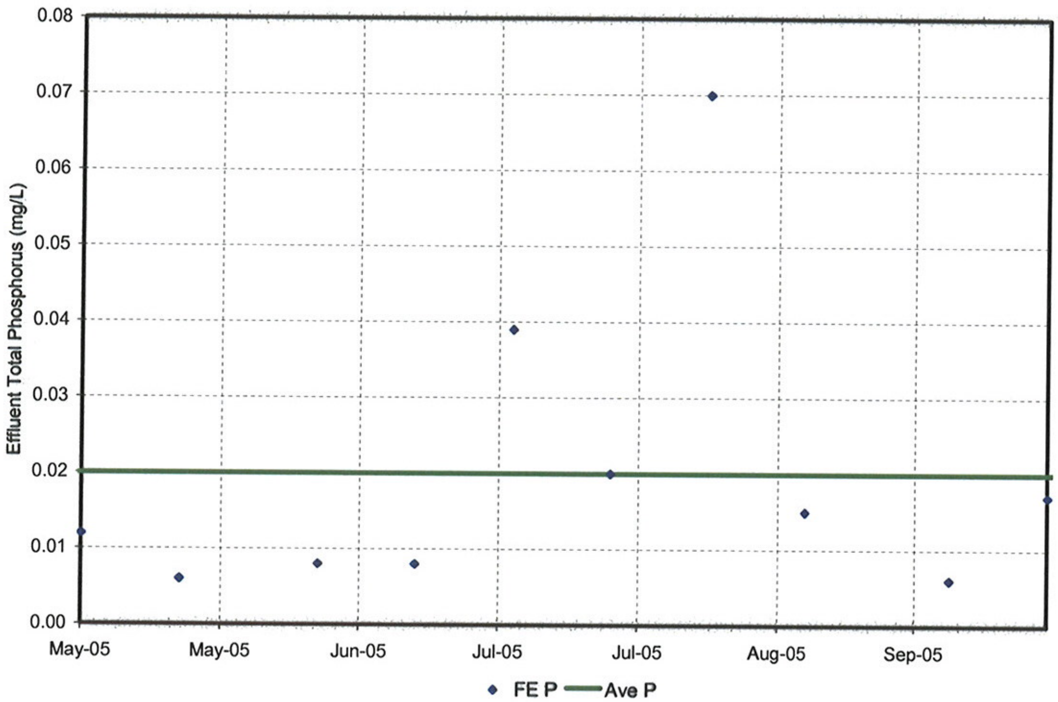
Stamford plant effluent ortho phosphorus data from field test kit analysis of morning and afternoon grab samples taken from May 1 to October 16, 2005 (335 data points) was reviewed and is shown in Figure 19. The log normal mean of the grab sample effluent data for 2005 was 0.113 mg/L. The effluent data ranged from 0.03 to 0.42 mg/L in 2005.

**Figure 19. 2005 Stamford WWTP Effluent Ortho-P (AM and PM Grab Samples and Field Tests)**




From January through August 2005, the average effluent phosphorus reported by the Stamford plant was 0.015 mg/L based on certified laboratory analysis of the twice monthly 6-hour composite samples. Examination of 10 Stamford data points from May through September from certified laboratory testing of 6 hour composite samples taken twice show a range from 0.006 to 0.039 mg/L. This is shown in Figure 20. The log normal mean of the twice monthly samples from the summer of 2005 was 0.02 mg/L. These values for total phosphorus are significantly lower than the orthophosphate values from the field test kit grab samples.

**Figure 20. Stamford WWTP Effluent TP (Lab Samples)**



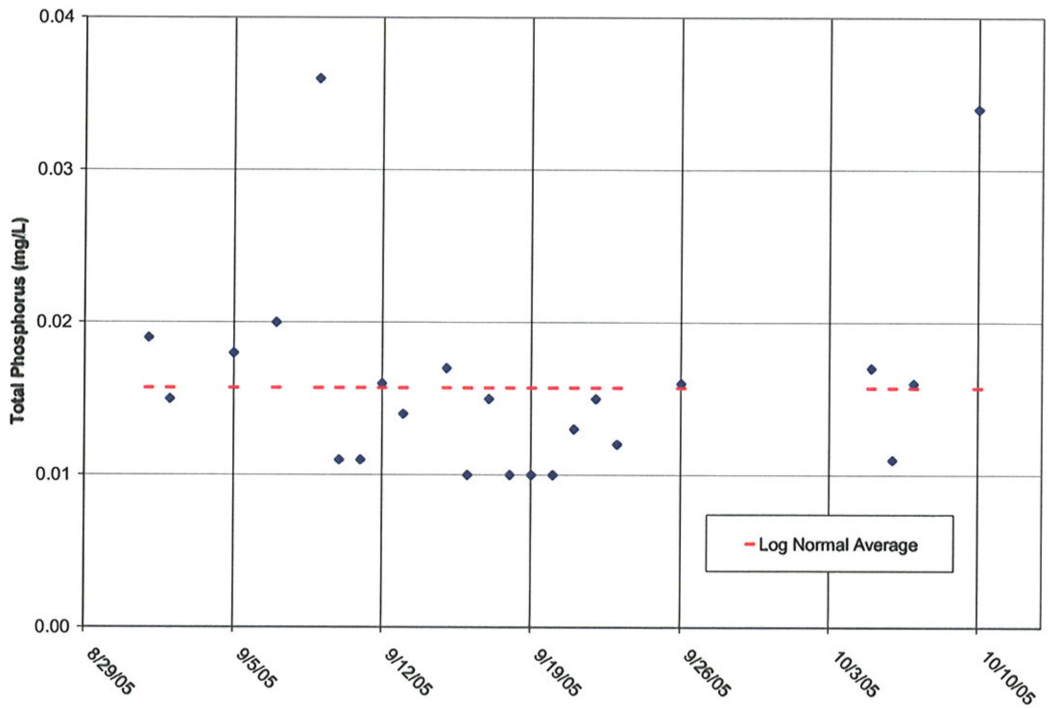

# Fall 2005 RPWRF Phosphorus Removal Technology Pilot Testing

Pilot testing of phosphorus removal technologies was conducted in September and October of 2005 at the RPWRF operated by the City of Spokane. Parkson Dynasand D2 filtration, US Filter Microfloc Trident and Zenon membrane filtration each operated pilot facilities for approximately 1 month each. These technologies were previously identified as having the potential to achieve the lowest total phosphorus in the final effluent. Final effluent phosphorus was analyzed by the RPWRF laboratory and some samples were split with Anatek, a privately owned laboratory in the Spokane area.

Parkson Dynasand D2 filtration consists of alum precipitation of phosphorus followed by filtration by two Parkson continuous backwash sand filters operated in series. The first stage filter uses larger sand grain size than the second stage filter. It has been applied in New York state and reportedly can reduce total phosphorus to as low as 10 μg/L. Figure 21 summarizes the pilot test results of the Parkson Dynasand D2 filtration technology. The log normal average of all the data is 16 μg/L. Some of the individual data were as low as 10 μg/L and a couple were greater than 30 μg/L. Pilot testing was conducted from September 1 to October 10, 2005 and 24 samples were analyzed.

US Filter Microfloc Trident consists of alum or ferric chloride precipitation of phosphorus followed by an adsorption clarifier. The adsorption clarifier uses plastic beads in an upflow clarifier to flocculate and remove solids. The plastic beads reduce the size of the clarifier. The clarifier is followed by a multimedia conventional filter. Figure 22 summarizes the pilot results for the Trident technology. The log normal average of all the data is 18 µg/L.

**Figure 21. Parkson DynaSand D2 Filtration Pilot Effluent Phosphorus**




Individual data were as low as 9 µg/L and one was nearly 50 µg/L. Pilot testing results are for the period August 18 to October 7, 2005 and 20 samples were analyzed. Additional pilot testing was conducted late in October 2005, but the results were not available at the time this memorandum was prepared.

Zenon membrane filtration consists of alum precipitation of phosphorus, flocculation and filtration through immersed ultrafiltration membranes. The pores size of the membranes is smaller than suspended solids, pathogenic parasites and ova, bacteria and some virus. Figure 23 summarizes the pilot results for the Zenon technology. The log normal average for all the data is 16 µg/L. Individual data were as low as 8 µg/L and one was greater than 30 µg/L. Pilot testing was conducted from September 26 to October 19, 2005 and 17 samples were analyzed. The pilot testing was ongoing at the time this memorandum was prepared and additional data gathered after October 19 are not included in this evaluation.

# Application of Pilot Testing Results to Predict Performance of Full Scale WWTPs

The pilot testing conducted in the fall of 2005 demonstrates the lowest concentrations achievable by state-of-the-art coagulation with metal salts and filtration with sand filters in series, multimedia filters or ultrafiltration membranes. The minimum average total

**Figure 22. US Filter MIcrofloc Trident Pilot Effluent Phosphorus**

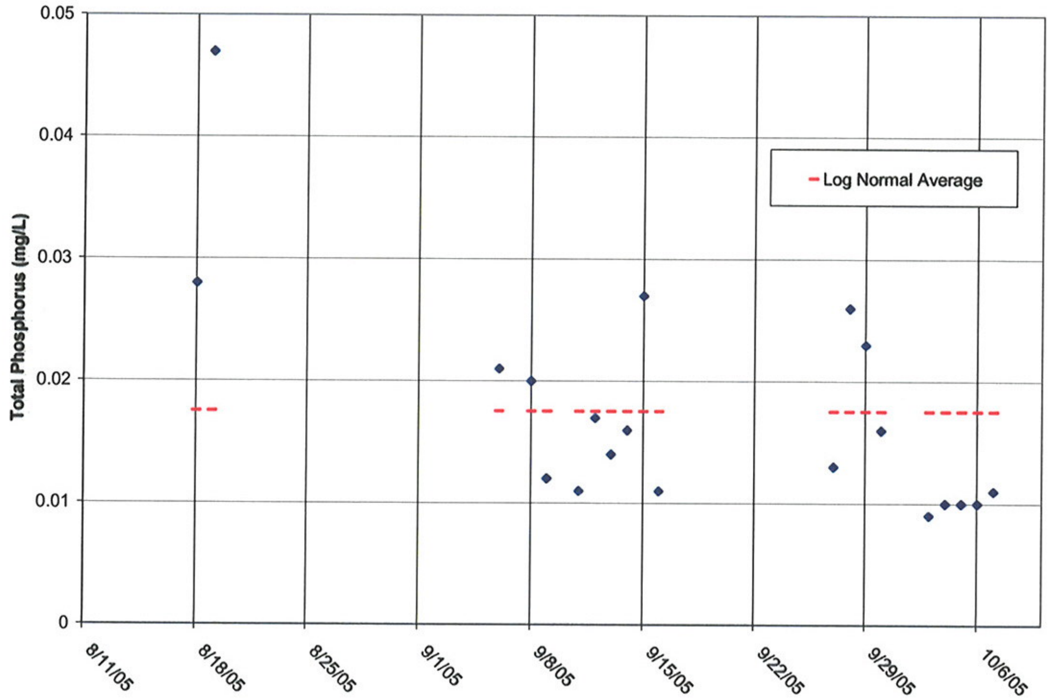
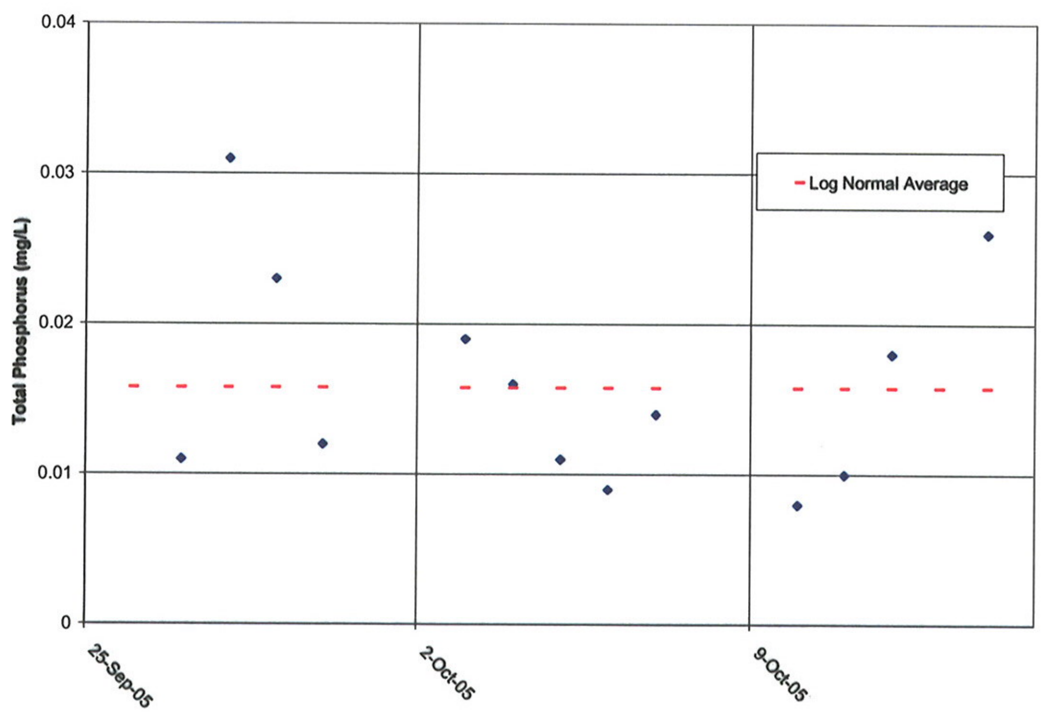



**Figure 23. Zenon Membrane Filtration Pilot Effluent Phosphorus**



phosphorus concentration appears to be approximately 20 μg/L. All technologies could achieve total phosphorus concentrations of 10 μg/L on occasion, but all had samples much greater than 20 μg/L. These results were achieved over a short period of time using a very small pilot system operated by a highly trained technician with a very high incentive to be successful and no constraints were imposed on the quantity of coagulant chemicals used.

A full-scale facility must achieve results 200+ days per year with greatly varying influent conditions that may challenge standard operating strategies on occasion. Often the cause of poor results will be unknown and the changes to achieve success will also be unknown resulting in periods of operation by trial and error. This will lead to periods of poorer performance that can be observed in the full-scale facility data presented earlier and probably contributes to the variation in performance observed in the pilot testing. This is one reason why the full-scale facility will likely not be able to match the performance of the pilot facilities for at least periods of time.

A full-scale facility will have much larger individual process units and have many parallel trains of these process units. The pilot facility consisted of a single small process unit. A small unit is more likely to have "ideal" characteristics than a larger unit. The larger unit may not perform as well as the smaller unit because of the differences from "ideal" characteristics. In addition, many of these larger units must be operated in parallel. Additional process units increase the potential of a failure or partial failure of an individual unit that can reduce treatment performance. The requirement for multiple parallel process units and the need to respond to major changes in flow due to rainfall or snowmelt adds the potential for human error that can reduce treatment performance. These are additional reasons why a full-scale facility will likely not match the performance of the pilot facilities.

A full-scale facility requires a large number of trained operation and maintenance personnel of varying ability and motivation. A large facility requires 365 day per year, 24-hour-per-day operation and maintenance. There are five different crews needed to perform the operation and a large maintenance crew. The phosphorus removal process is an essential process, but only a part of the overall wastewater treatment plant facility. The level of attention provided by the pilot plant operating technician can not be duplicated by a full-scale facility because the labor costs would be exorbitant. With a large team of people there is inherently variation in skill levels and motivation compared to the pilot plant operating technician who is specifically trained to make the pilot unit perform and has no other duties. This will also contribute to the lower performance of the full-scale facility compared to the pilot facilities.

Last, the full-scale facility will have to treat the entire flow and deal with the recycle streams and impacts from anaerobic digestion that the pilot facility did not need to because it operated only a short time on a small fraction of the total flow. It is impossible to quantify the impact of these effects, but given the very low final effluent total phosphorus concentrations that are desired, small and subtle changes could be significant.

The only way to determine what minimum effluent concentrations of total phosphorus are reliably achievable is to operate the full-scale facilities for a period of time to gather operating data. Pilot testing is valuable for providing data to quantify what is possible with a given technology and to help evaluate competing technologies. The uncertainties associated with scaling up from pilot testing to full-scale operation are greater than the desired final effluent total phosphorus concentration. Therefore, it is recommended that final total phosphorus limits be established after 5 years of full-scale operation using the final 2 years of operation to establish the limits. The first 3 years will be needed to work through the construction and startup issues and to optimize the process so that the next 2 years reflect the best operation possible.

WWTP evaluation by CH2MHill 11-21-05.DOC

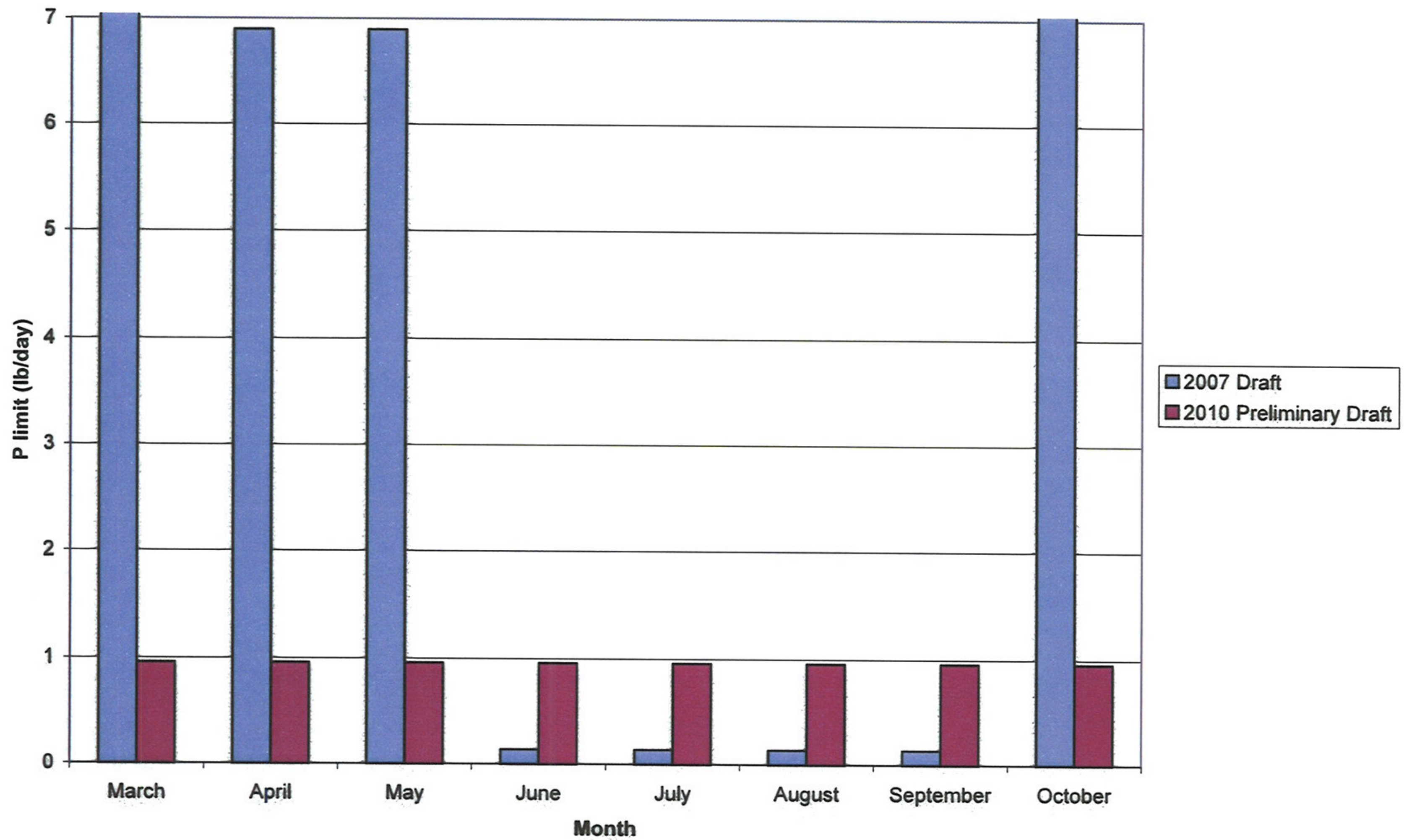
# Exhibit 4

**Preliminary draft. Pre-decisional.**

The following figures are preliminary and could change prior to issuance of draft permits for public review and comment.

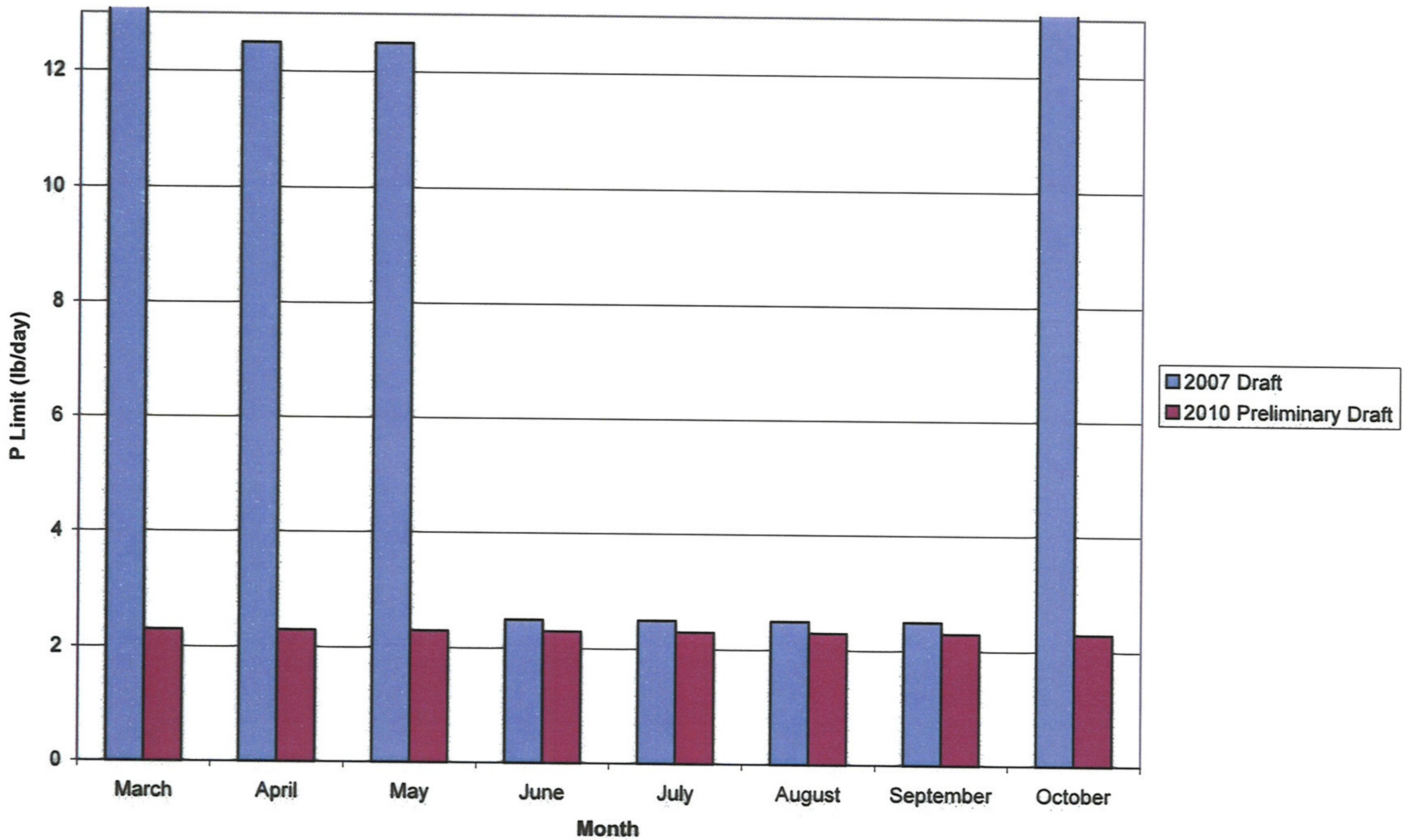
| Preliminary Draft Effluent Limits for TP, CBOD and Ammonia | | | | |
|---|---|---|---|---|
| Parameter | Units | Effluent Limits | | |
| | | Average Monthly Limit | Average Weekly Limit | Maximum Daily Limit |
| **City of Coeur d'Alene** | | | | |
| **Total Phosphorus as P** (March – October) | µg/L | Report | Report | — |
| | lb/day | Seasonal Average Limit: 2.3 lb/day | | |
| **Total Phosphorus as P** (Nov. – Feb.) | lb/day | Phosphorus management plan BMPs. | | |
| **Five-Day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)** (November – February) | mg/L | 25 | 40 | — |
| | lb/day | 1251 | 2002 | — |
| | % removal | 85% (min.) | — | — |
| **Five-Day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)** (March – October) | mg/L | 25 | 40 | — |
| | lb/day | 273 | 436 | — |
| | % removal | 85% (min.) | — | — |
| **Total Ammonia as N** (March – June and October) | mg/L | 8.7 | — | 16.8 |
| | lb/day | 435 | — | 841 |
| **Total Ammonia as N** (July – Sept., effluent flow $\leq$ 4.2 mgd) | mg/L | 10 | — | 29 |
| | lb/day | 350 | — | 1000 |
| **Total Ammonia as N** (July – Sept., effluent flow > 4.2 mgd) | mg/L | 7.4 | — | 21 |
| | lb/day | 370 | — | 1100 |
| **Total Ammonia as N** (November – February) | No limits. Monitor and report only. | | | |
| **City of Post Falls** | | | | |
| **Total Phosphorus as P** (March – October) | µg/L | Report | Report | — |
| | lb/day | Seasonal Average Limit: 1.5 lb/day | | |
| **Total Phosphorus as P** (Nov. – Feb.) | lb/day | Phosphorus management plan BMPs. | | |
| **$CBOD_5$** (November – February) | mg/L | 25 | 40 | — |
| | lb/day | 726 | 1161 | — |
| | % removal | 85% (min.) | — | — |
| **$CBOD_5$** (March – October) | mg/L | 25 | 40 | — |
| | lb/day | 185 | 296 | |
| | % removal | 85% (min.) | — | — |
| **Total Ammonia as N** (March – October) | mg/L | 5.44 | — | 22.3 |
| | lb/day | 158 | — | 647 |
| **Total Ammonia as N** (November – February ) | mg/L | 25.4 | — | 91.7 |
| | lb/day | 737 | — | 2661 |
| **Hayden Area Regional Sewer Board** | | | | |
| **Total Phosphorus as P** (March – October) | µg/L | Report | Report | — |
| | lb/day | Seasonal Average Limit: 0.96 lb/day | | |
| **Total Phosphorus as P** (Nov. – Feb.) | lb/day | Phosphorus management plan BMPs. | | |
| **$CBOD_5$** (November – February) | mg/L | 25 | 40 | — |
| | lb/day | 500 | 800 | — |
| | % removal | 85% (min.) | — | — |
| **$CBOD_5$** (March – October) | mg/L | 25 | 40 | — |
| | lb/day | 139 | 223 | — |
| | % removal | 85% (min.) | — | — |
| **Total Ammonia as N** (March –October, and June – September when the Spokane River flow is greater than 2,000 CFS) | mg/L | 5.20 | — | 20.2 |
| | lb/day | 104 | — | 404 |
| **Total Ammonia as N** (June – September when the Spokane River flow is less than or equal to 2,000 CFS) | mg/L | 1.43 | — | 5.54 |
| | lb/day | 29 | — | 111 |
| **Total Ammonia as N** (November - February) | mg/L | 22.4 | — | 87.0 |
| | lb/day | 448 | — | 1741 |

HARSB P Limit Comparison 2007 vs. 2010

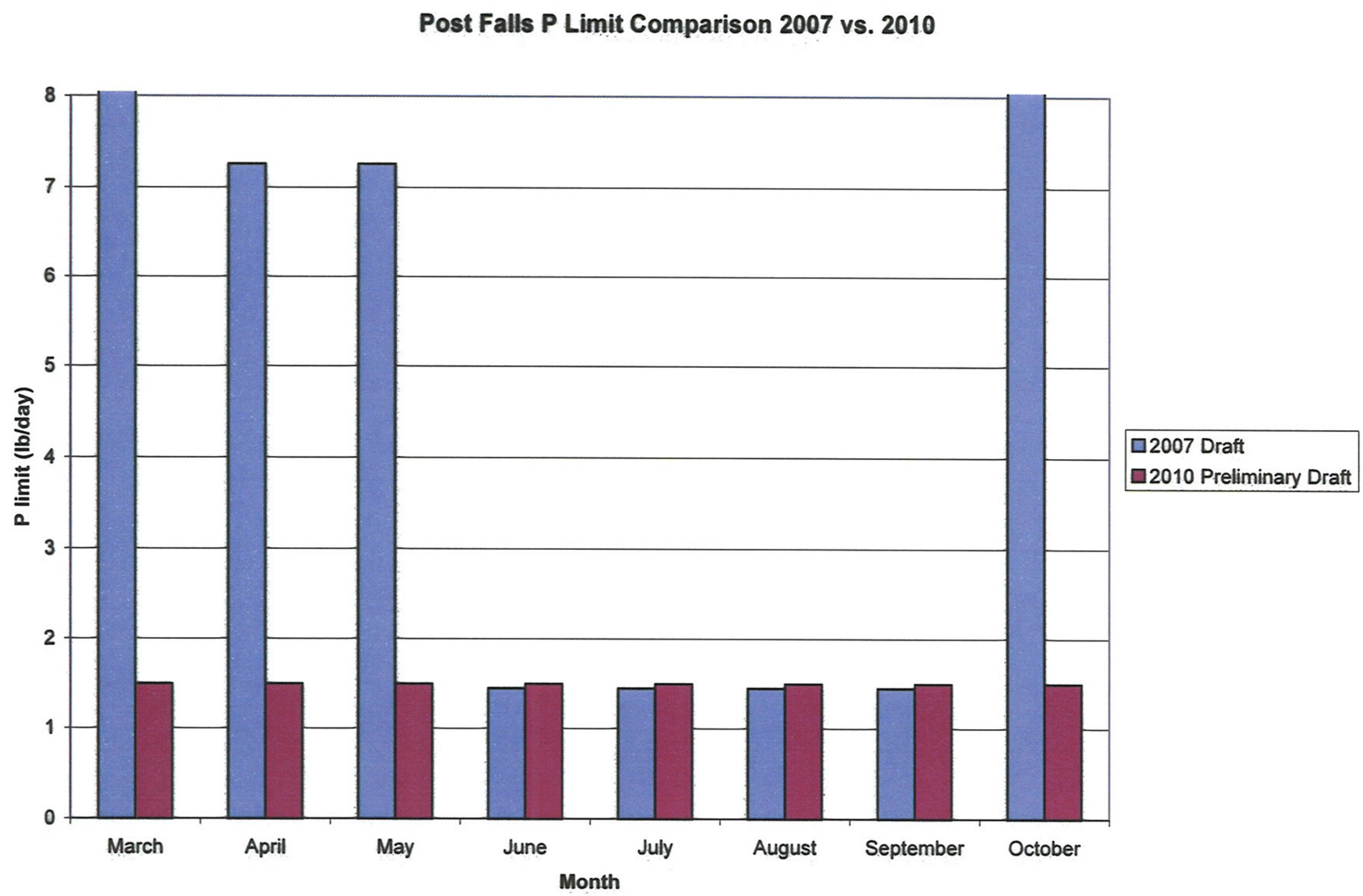



2010 preliminary draft figures could change prior to public comment.

## Coeur d'Alene P Limit Comparison 2007 vs. 2010




2010 preliminary draft figures could change prior to public comment.




2010 preliminary draft figures could change prior to public comment.

**Exhibit 5**

# Evaluation of Proposed Phosphorous Discharge Regulations

Prepared for

CITY OF POST FALLS

Prepared by

TischlerBise
Fiscal, Economic & Planning Consultants

02/26/10

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TischlerBise
Fiscal, Economic & Planning Consultants

4701 SANGAMORE ROAD | SUITE S240 | BETHESDA, MD 20816
T: 800.424.4318 | F: 301.320.4860

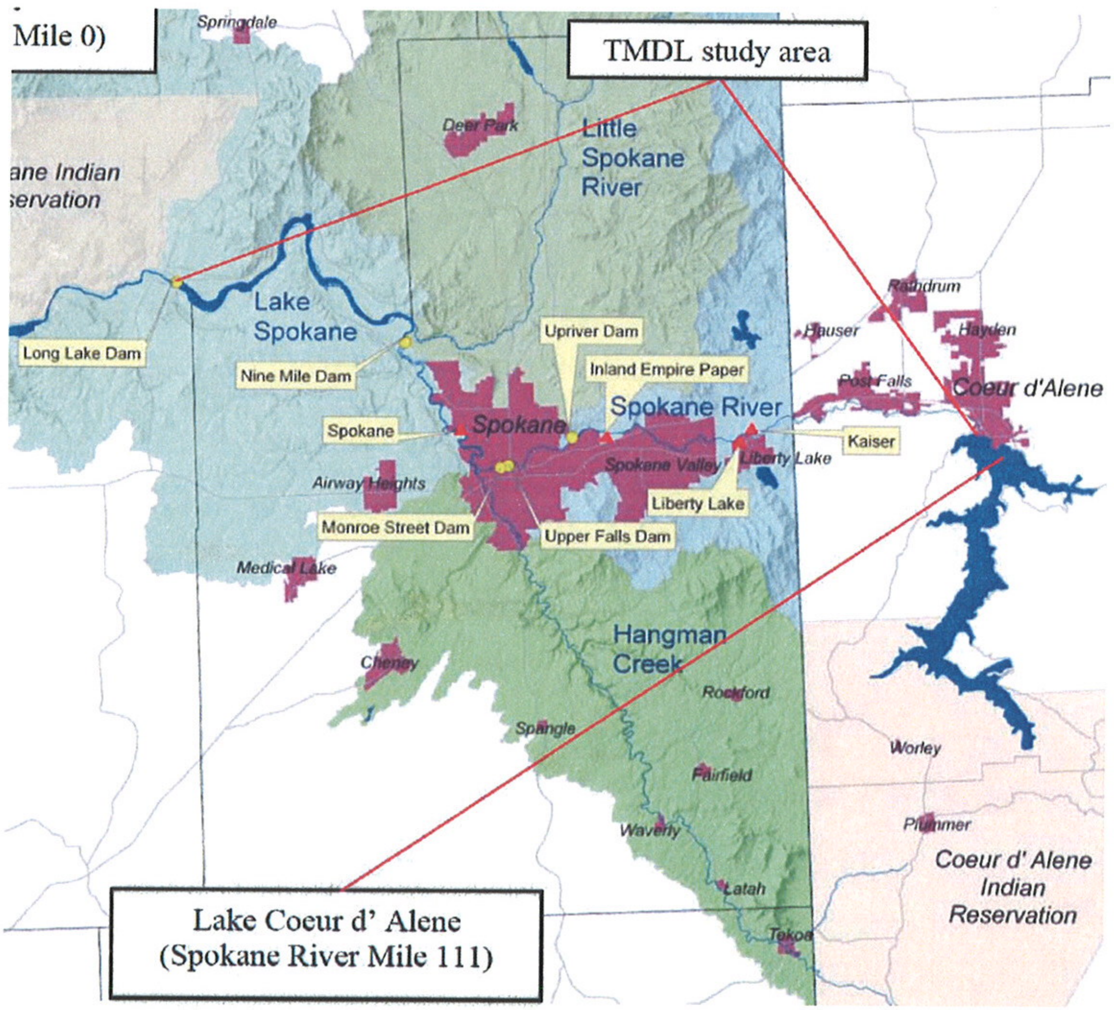
43460 RIDGE PARK DRIVE | SUITE 200W | TEMECULA, CA 92590
T: 951.719.8478 | F: 301.320.4860

WWW.TISCHLERBISE.COM

## Executive Summary

For readers unfamiliar with the setting and regulatory context discussed in this report, Figure 1 provides a map of the Spokane River study area, which straddles the state line between Washington and Idaho. Water quality regulations approved by the State of Washington will also apply to wastewater treatment plants in Idaho, with enforcement provided by the U.S. Environmental Protection Agency through National Pollutant Discharge Elimination System (NPDES) permits.

**Figure 1. Map of Spokane River Study Area**




***Map Source: Washington Department of Ecology 2009.***

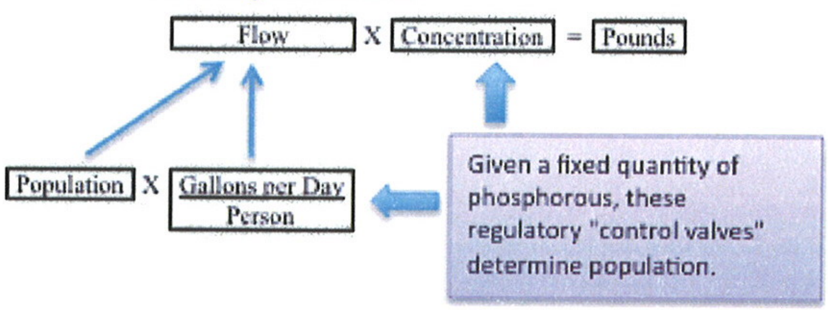
Reid Ewing, a professor at the University of Utah, periodically writes about "Research You Can Use" in *Planning* magazine. A recent contribution discussed evaluation research and provides a useful lens for examining the *Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load Water Quality Improvement Report* by Washington's Department of Ecology, dated February 2010, and the *Spokane River Modeling Final Scenarios* by Portland State University's Department Water Quality Research Group, dated January 2010. Dr. Ewing reminds us of a hierarchy for general types of evaluation research, with evaluation of inputs being the basic level, evaluation of outputs having mid-range utility and evaluation of outcomes providing the most benefit. Obtaining verifiable, good outcomes would be the best result of the proposed water quality standards for the Spokane River basin.

This report intends to assess the effects of water quality improvements, proposed by Washington Department of Ecology (hereafter referred to as "Ecology"), on the City of Post Falls and Kootenai County, Idaho. The Ecology analysis requires numerous quantitative inputs to a complex computer model that simulates possible water quality changes in the Spokane River, specifically the level of dissolved oxygen in Lake Spokane. Model inputs are discussed in the "Demographic Analysis" section. Model outputs are discussed in the "Evaluation of Water Quality Model." The TischlerBise evaluation concludes with an assessment of the likely outcomes from implementation of the proposed phosphorous discharge regulations.

The regulatory environment is a complex web of rules, technical studies, and extensive documentation. For example, the latest versions of the two key documents evaluated by TischlerBise contain more than 400 pages. The myriad of details makes it difficult to see the forest for the trees. This evaluation is intended to aid decision-makers by summarizing the process, calculations, and likely effects of the proposed water quality regulations.

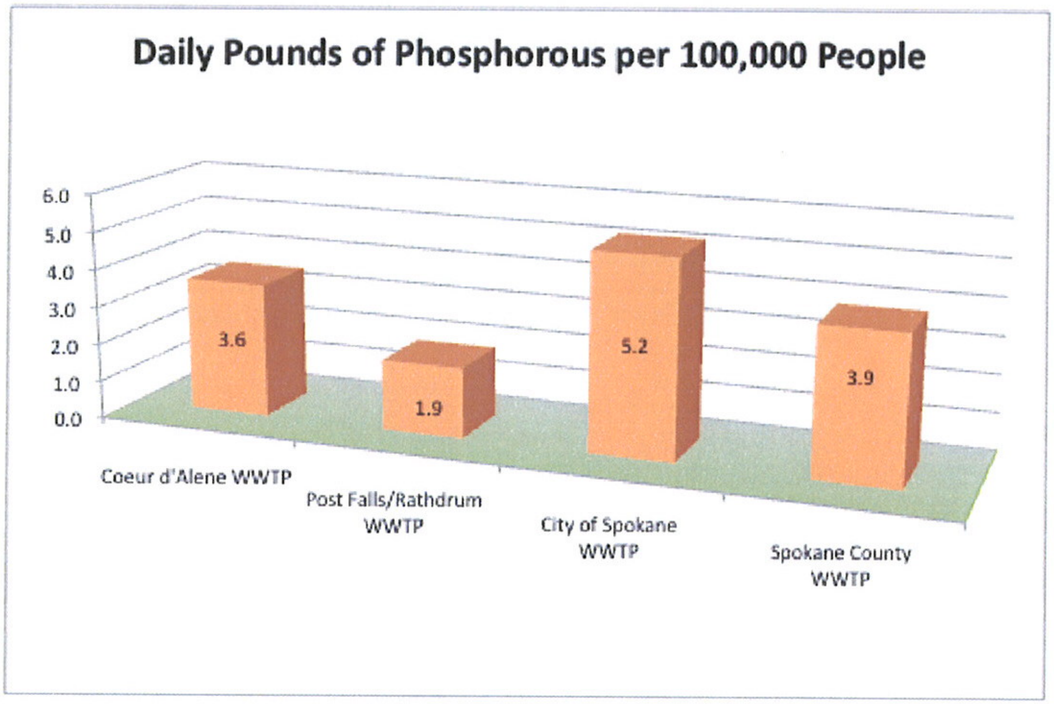
The typical regulatory outcome is a maximum amount of pollutant for a specific point source (i.e. a prescriptive standard). In the Spokane River basin, pounds of phosphorous were determined for Waste Water Treatment Plants (WWTP) owned and operated by three local governments in Idaho and three in Washington. Key calculations used to derive the pounds of phosphorous are summarized in Figure 2. Working backwards through the formula, it is evident that the pounds prescribed to each WWTP will essentially determine the service area population.

Figure 2. Schematic of Key Calculations



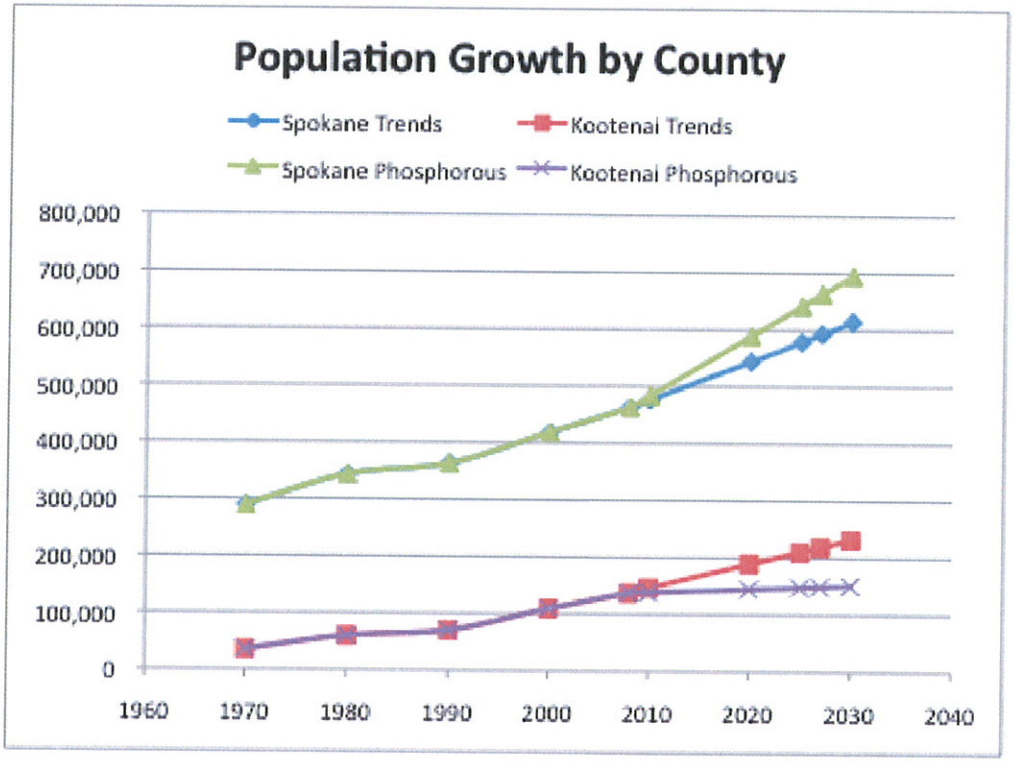
With a direct and strong correlation between each jurisdiction's phosphorous allocation and their likely population cap, it is important for regulators to equitably adjust their "control valves" to yield similar levels of pollutant for each person in the Spokane River basin. If not, the agencies will likely face equal protection challenges, claiming arbitrary and capricious setting of phosphorous limits that result in windfalls for some jurisdictions and wipeouts for others. As an equal protection test, TischlerBise derived pounds of phosphorous per 100,000 people for two sewer service areas in Idaho and two in Washington. As shown in Figure 3, there are wide disparities in daily pounds of phosphorous per 100,000 people, with the City of Spokane receiving more than double the allocation of Post Falls and Rathdrum. The graph below was derived from Ecology's proposed discharge limits and population projections by sewer service area obtained from websites of the respective local governments.

Figure 3. Graph of Phosphorous Allocation by Jurisdiction




The amount of phosphorous allocated by Ecology will become a de facto growth cap for each sewer service area. To assess the impact of the proposed regulations, TischlerBise compared Ecology's 2027 phosphorous allocation by county to past and projected population shares for Spokane and Kootenai Counties. In 2027, Ecology allocated 4.74 daily pounds of phosphorous to sewer service providers in Kootenai County (18.4%) and 21.06 pounds to Spokane County (81.6%). As shown in Figure 4, the proposed allocation will alter population growth trends. Historical population data from 1970 through 2008 indicates Kootenai County has gained population share over time from 11% in 1970 to almost 23% in 2008. Implementation of Ecology's proposed phosphorous allocations with cause a decline in Kootenai County's population share, as indicated by the flat projection line in the graph below. In contrast, Spokane County will experience an up turn in population growth, as indicated by the steeper slope in the line graph. As a basis of comparison, trend projections from Woods & Poole Economics are shown for both counties.

Figure 4. Graph of Population Growth by County




The current regulatory approach is based on a prescriptive standard that dictates a fixed quantity of phosphorous for a specific point source. The use of prescriptive standards sets up a zero-sum game, whereby each jurisdiction has to beggar their neighbor to maximize their waste load allocation. Given this scenario, there are huge economic incentives for each jurisdiction to overstate projected wastewater flow, yet the Ecology did not critically evaluate population projections and per capita wastewater flow assumptions used to derive projected effluent flow in 2027. The simple solution to this problem is for water quality regulations to specify the same output concentration (i.e. a performance standard) for all wastewater treatment plants in the watershed. It is not necessary to derive a specific quantity of phosphorous to each sewer service provider if all wastewater plants have the same quality output. Adopting a performance standard for the entire watershed allows market forces to determine where development takes place.

To evaluate the economic impact of the Ecology growth cap, TischlerBise used linear regression models, calibrated to Kootenai County data from 1970 through 2008, to forecast Gross Regional Product (GRP), earnings by place of work, and personal income by place of residence. If Kootenai County's regional job-share declines at the same rate as population, economic activity is forecast to remain stagnate through 2030. In comparison to a GRP of $7.5 billion, as forecast by Woods & Poole Economics, the growth cap will decrease GRP by $3.6 billion in 2030. Projected Kootenai County earnings will be reduced by $2.5 billion in the year 2030, in comparison to the Woods & Poole trends projection. Kootenai County's aggregate personal income in 2030 is also forecast to decrease by almost $4.3 billion in comparison to the economic forecast based on past trends. These economic impacts are expressed in 2004 dollars (i.e., not inflated over time). Based on the above analysis of economic impacts from the proposed water quality regulations, Ecology's de facto growth cap will effectively shrink the local economy by 50%.

A recent study published by the U.S. Environmental Projection Agency (Ragsdale 2007) indicated residential sewer rates charged to maintain and operate advanced wastewater treatment facilities, with low phosphorous discharges, ranged from $18 to $46 per month. In comparison, the City of Post Falls currently charges a residential customer approximately $27 per month for sewer service. Based on preliminary cost estimates for capital improvements necessary to comply with proposed discharge regulations, each sewer customer in Post Falls will face a sewer rate increase of approximately $21 per month. Another EPA study (Kang et al 2008) estimated annual increases in sewer expenditures per pound of phosphorous removed. Based on average daily wastewater flow in 2008, Post Falls will be required to remove at least 139 pounds of phosphorous each day, or approximately 50,735 pounds per year. At the upper end of the documented unit costs, sewer expenditures in Post Falls could increase approximately $342,000 per year. The on-going cost of phosphorous removal would be passed on to existing sewer customers resulting in a rate increase of approximately $3 per month. In total, sewer customers in Post Falls may experience a rate increase of approximately $24 per month due to the proposed phosphorous discharge regulations.

To evaluate alternative means of improving water quality in the Spokane River basin, it would be advantageous to have a comprehensive summary of all sources of phosphorous and the magnitude of their contributions, both currently and for the 20-year planning horizon. The Post Falls and the Long Lake dams provide unique opportunities to "calibrate" water quality models. If not already available, water flow and phosphorous concentrations could be monitored at both dams on a daily basis, with this data used as "control totals" for the ID and WA portions of the Spokane River basin. With flow and concentration data from both dams, it would be possible to calculate the total daily phosphorous load in the river. The aggregate phosphorous load could provide an important "reality check" on the computer model output for both point and non-point sources. It is impossible to adequately evaluate alternatives and make good public policy decisions without a reasonable understanding of current and proposed phosphorous contributions from point and non-point sources.

## Demographic Analysis

In general, the smaller the geographic area, the more difficult it is to accurately forecast population and job growth. The Washington Department of Ecology's water quality analysis for the Spokane River basin is based on population projections for six individual sewer service areas (three areas in Idaho and three areas in Washington). As shown in the formula below, excerpted from water quality analysis, projected effluent flow (in millions of gallons per day) is a key factor determining the quantity of phosphorous that will be permitted from each wastewater treatment plant. In simple terms, the volume of flow is multiplied by the concentration of phosphorous in the effluent to yield the maximum pounds per day of phosphorous permitted.

**Equation 1. Wasteload allocations for point sources.**

2027 Eff. Flow *(MGD)* × Seasonal Avg. Conc. in Table 4 *(ppm)*

### Problem with Effluent Flow Assumptions

Unfortunately, the current regulatory approach is based on a prescriptive standard that dictates a fixed quantity of phosphorous for a specific point source. The use of prescriptive standards sets up a zero-sum game, whereby each jurisdiction has to beggar their neighbor to maximize their waste load allocation. Given this scenario, there are huge economic incentives for each jurisdiction to overstate projected wastewater flow, yet the Washington Department of Ecology did not evaluate critically evaluate population projections and per capita wastewater flow assumptions used to derive projected effluent flow in 2027.

The simple solution to this problem is for water quality regulations to specify the same output concentration (i.e. a performance standard) for all wastewater treatment plants in the watershed. It is not necessary to derive a specific quantity of phosphorous to each sewer service provider if all wastewater plants have the same quality output. Adopting a performance standard for the entire watershed allows market forces to determine where development takes place.

If environmental regulators insist on a prescriptive standard for each wastewater treatment plant (i.e. pounds of phosphorous per day), the accuracy of the 2027 effluent projections becomes a major point of contention. The following sections evaluate important demographic data that must be considered to determine reasonable effluent flow projections for each sewer service area.

### Population Growth

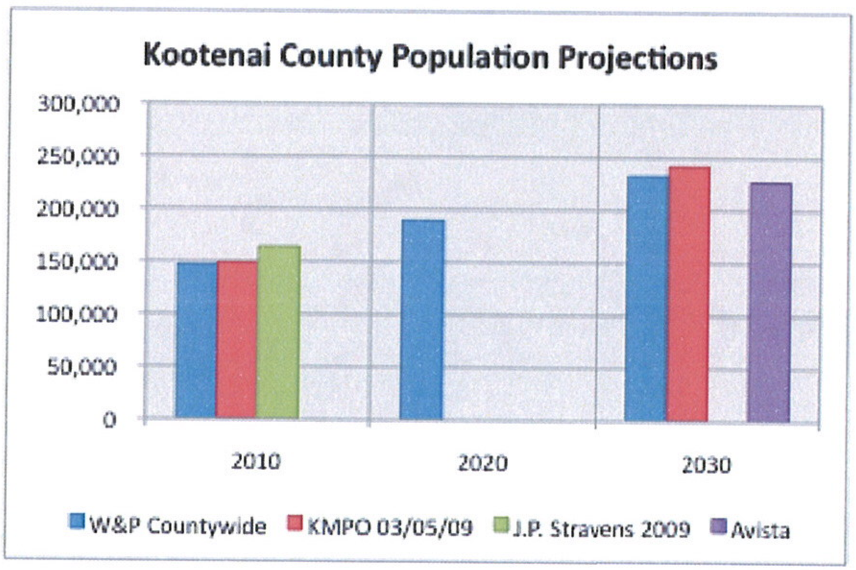
Figure 5 provides historical data on countywide population for Kootenai and Spokane Counties from the U.S. Census Bureau. The table indicates average annual population change between each time period and each county's population share. In the last 18 years, population growth has accelerated in Kootenai County, but remained relatively stable in Spokane County.

Figure 5. Historical County-Level Population Growth

| | 1970 | 1980 | 1990 | 2000 | 2008 |
|---|---|---|---|---|---|
| | U.S. Census Bureau | | | | |
| ***Spokane Trends*** | 289,339 | 343,083 | 363,029 | 418,827 | 462,677 |
| Average Annual Growth | | 5,374 | 1,995 | 5,580 | 5,481 |
| Spokane Share of Metro | 89.0% | 85.1% | 83.7% | 79.3% | 77.1% |
| ***Kootenai Trends*** | 35,591 | 60,036 | 70,443 | 109,546 | 137,475 |
| Average Annual Growth | | 2,445 | 1,041 | 3,910 | 3,491 |
| Kootenai Share of Metro | 11.0% | 14.9% | 16.3% | 20.7% | 22.9% |

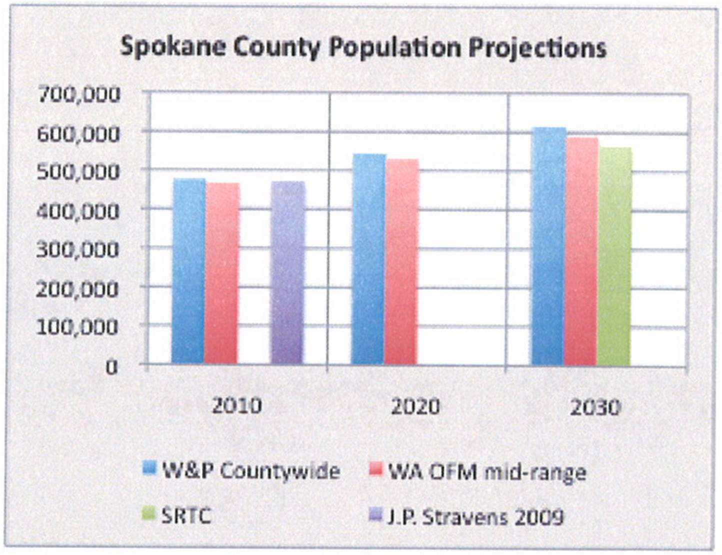
Looking forward, the crystal ball gets cloudy, with different sources indicating a variation in countywide projections (see Figure 6). The local transportation planning agency (KMPO) is less optimistic than a local demographer (J.P. Stravens) in the short run, but more optimistic about projected population in 2030. Even with a large and stable geographic area like Kootenai County, there is more than six percent variation in the 2030 projections. For smaller, sewer service areas with frequently changing boundaries, the confidence interval for 20 year population projections is very broad and full of caveats.

Figure 6. Alternative Population Projections for Kootenai County



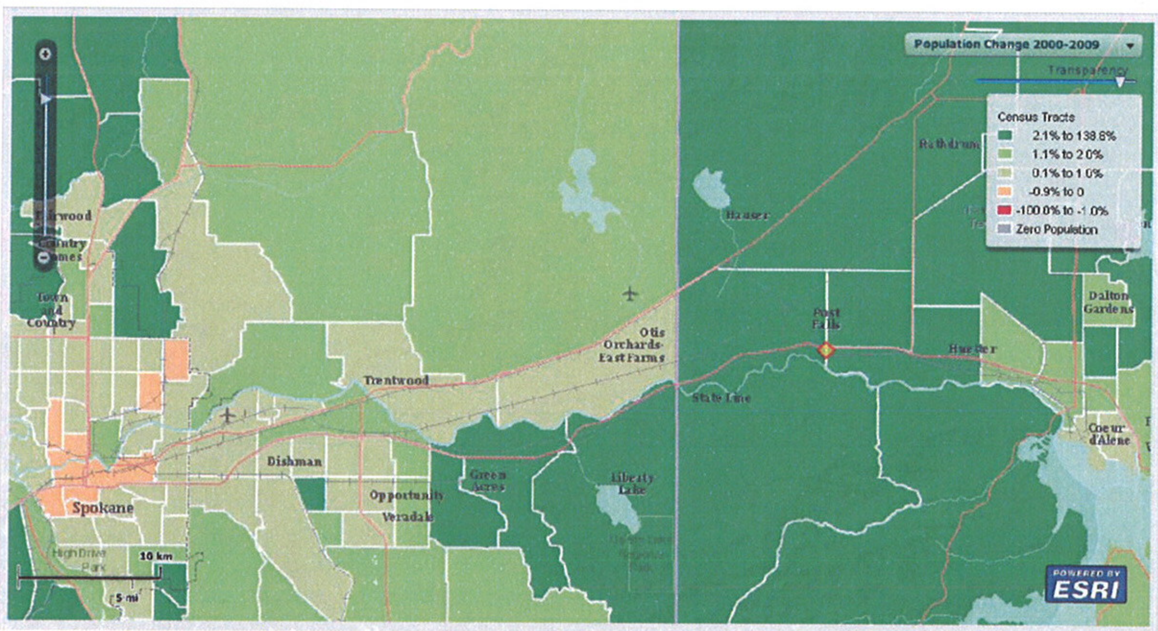

As shown in Figure 7, a similar pattern is seen in population projections for Spokane County. The most conservative 2030 projection is from the local transportation-planning agency (SRTC). The Spokane County population projection from Woods & Poole Economics is 9% higher than the SRTC projection.

Figure 7. Alternative Spokane County Population Projections




In comparison to Kootenai County, sewer service area projections for Spokane County are even more difficult because the County is planning to open a new wastewater treatment plant and some areas within the City of Spokane have lost population over the past nine years (see Figure 8). In contrast, faster population growth (shown with dark green in the map below) has occurred in Liberty Lakes, Post Falls, and Hayden.

Figure 8. Population Change by Census Tract 2000-2009



The purpose of this brief population analysis is to highlight the difficulty of small area population projections 20 years into the future. Because pounds of phosphorous are directly correlated to population, Ecology's 2027 allocation will reverse past trends by increasing population share in Spokane County and decreasing share in Kootenai County. Figure 9 indicates the likely change in population share over time due to the proposed water quality regulations.

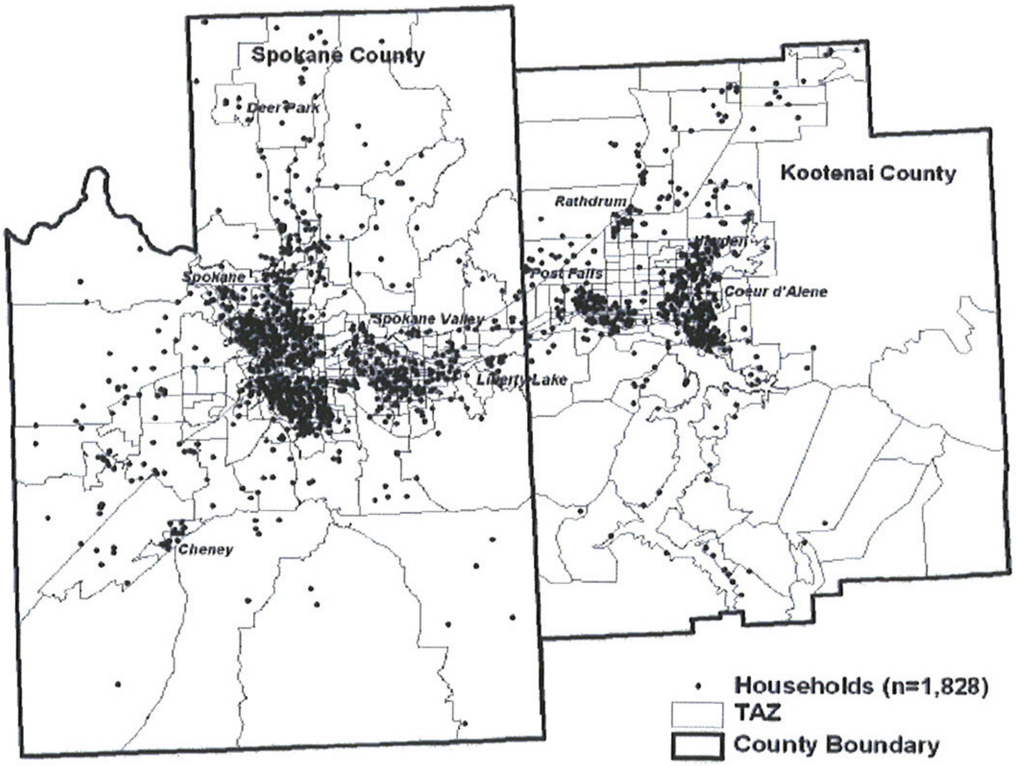
### Figure 9. Population Shift Due to Growth Cap

| | 2010 | 2020 | 2025 | 2027 | 2030 |
|---|---|---|---|---|---|
| | **Woods & Poole Economics** | | | | |
| ***Spokane Trends*** | 475,973 | 544,063 | 578,975 | 593,016 | 614,077 |
| Average Annual Growth | 6,648 | 6,809 | 6,982 | 7,020 | 7,020 |
| Spokane Share of Metro | 76.4% | 74.2% | 73.3% | 73.0% | 72.5% |
| ***Kootenai Trends*** | 146,904 | 189,275 | 210,874 | 219,573 | 232,622 |
| Average Annual Growth | 4,715 | 4,237 | 4,320 | 4,350 | 4,350 |
| Kootenai Share of Metro | 23.6% | 25.8% | 26.7% | 27.0% | 27.5% |
| | **Washington Department of Ecology** | | | | |
| ***Spokane Phosphorous*** | 483,771 | 589,243 | 641,978 | 663,073 | 694,714 |
| Average Annual Growth | 10,547 | 10,547 | 10,547 | 10,547 | 10,547 |
| Spokane Share of Metro | 77.7% | 80.2% | 81.2% | **81.6%** | 82.1% |
| ***Kootenai Phosphorous*** | 138,743 | 145,080 | 148,249 | 149,516 | 151,418 |
| Average Annual Growth | 634 | 634 | 634 | 634 | 634 |
| Kootenai Share of Metro | 22.3% | 19.8% | 18.8% | **18.4%** | 17.9% |

## A Better Way

Changing the regulatory approach to rely on a consistent performance standard for all wastewater treatment plants in the entire watershed would end the zero-sum game and negate the need for accurate small area development projections. This recommendation provides a better governance structure and it is consistent with the everyday experience of living and working in the Spokane River basin. The urban corridor along I-90 between Spokane and Coeur d'Alene is an interconnected metropolitan area with many residents working and shopping in adjacent communities. In 2005, the Metropolitan Planning Organizations for Spokane and Kootenai Counties funded a regional travel survey by NuStats. Figure 10 indicates the location of households surveyed and graphically depicts the proximity of communities located along the Spokane River. The 2005 travel survey indicated 13 percent of Kootenai households make work trips into Spokane County, while nine percent of shopping trips were destined for Spokane County.

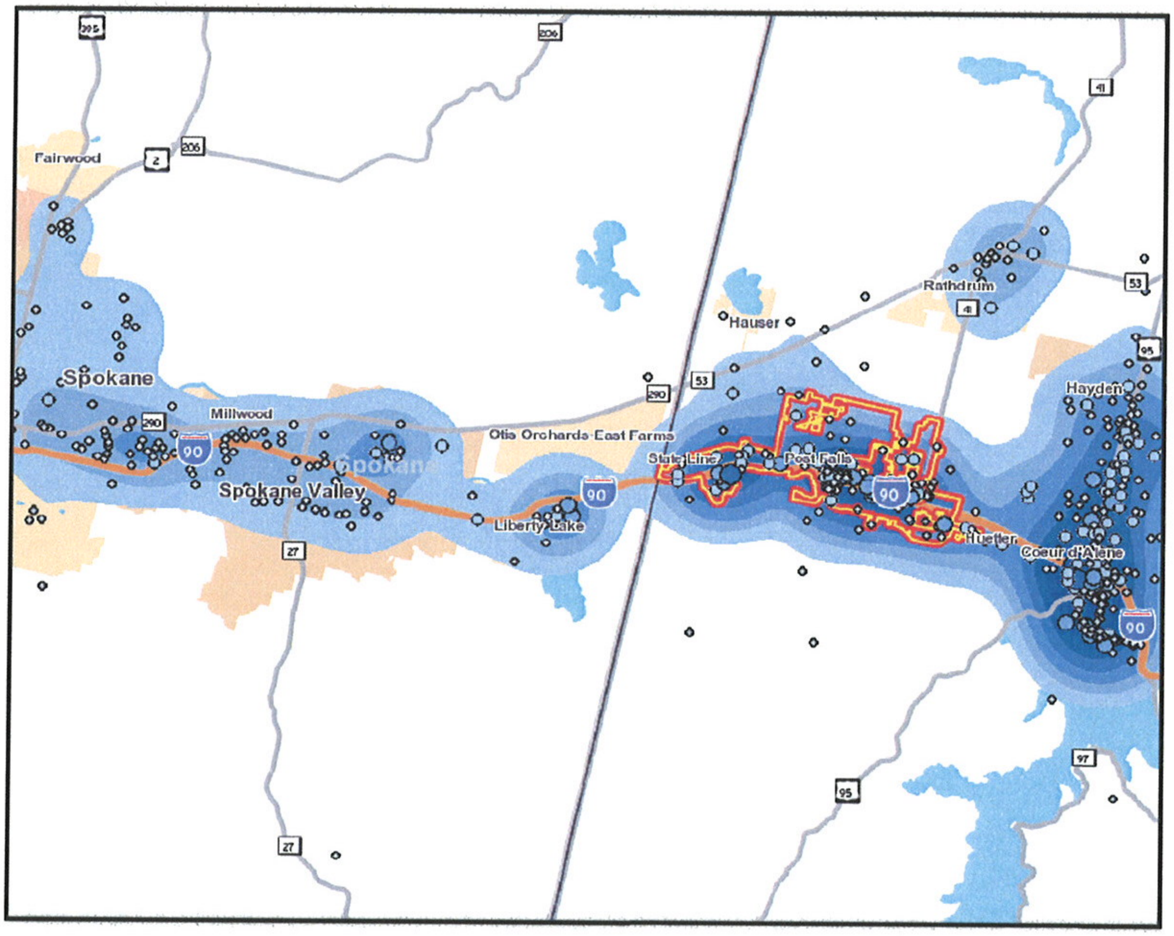
Figure 10. General Location of Households in the Spokane River Watershed




*N=1,221 Spokane County and 607 Kootenai County unweighted households.*

The U.S. Census Bureau's web application named "OnTheMap" can also be used to document 2008 travel patterns for working residents in small geographic areas like Post Falls. As shown in Figure 11, 30.4% of workers living in Post Falls traveled east to Coeur d'Alene and 20.2% traveled west to Spokane County for their daily journey to work. In essence, Post Falls is a linking community in the string of pearls along the Spokane River. Efforts to enhance the environmental quality of an important natural asset should be a unifying force for the region, not one that fosters unnecessary rivalry. A change from prescriptive to performance standards would help to unify the region.

Figure 11. Interconnectivity of Commuting Patterns



## Evaluation of Water Quality Model

To evaluate alternative means of improving water quality in the Spokane River, it would be advantageous to have a comprehensive summary of all sources of phosphorous and the magnitude of their contributions, both currently and for the 20-year planning horizon. The 399-page Water Quality Improvement Report from Washington's Department of Ecology (WDOE February 2010) provides pieces of the puzzle, but not in a format conducive to effective decision-making. It would be ideal to summarize current and projected data on water flow, by point and non-point sources, the concentration of phosphorous in the water, and the resulting phosphorous load (expressed as pounds per day). As shown in Figure 12, TischlerBise attempted to prepare a summary of phosphorous contributions using data from the Water Quality Improvement Report and the Spokane River Modeling Scenarios prepared by Portland State University (January 2010). The former provides data for the Washington sources (see Ecology Tables 3-6), with the Idaho data obtained from the later source (see PSU Table 2).

Although flows from point sources might be consistent throughout the year, non-point sources fluctuate significantly from the wet, winter months to the dry, summer months. Because summer phosphorous loading is the critical indicator for algae blooms, TischlerBise included "groundwater" flow amounts for July-October. Groundwater flow was split between ID and WA based on the Federal Energy Regulatory Commission (FERC) requirement that the Post Falls dam release at least 600 cubic feet per second.

The Post Falls and the Long Lake dams provide unique opportunities to "calibrate" water quality models. If not already available, water flow and phosphorous concentrations could be monitored at both dams on a daily basis, with this data used as "control totals" for the ID and WA portions of the Spokane River basin. With flow and concentration data from both dams, it would be possible to derive the total daily phosphorous load in the river. The aggregate phosphorous load could provide an important "reality check" on the computer model output for both point and non-point sources.

Although the comprehensive summary table of current and projected conditions (see Figure 12) needs refinement, regulators should provide this type of concise summary as an essential component in the decision-making process. It is impossible to adequately evaluate alternatives and make good public policy decisions without a reasonable understanding of current and proposed phosphorous contributions from point and non-point sources.

Figure 12. Summary of Phosphorous Contributions by Source

**Estimated Phosphorous in the Spokane River July through October**

| *Sources* | Million Gallons per Day | | Milligrams per Liter | | Pounds per Day | |
|---|---|---|---|---|---|---|
| | 2001 | 2027 | 2001 | 2027 | 2001 | 2027 |
| ***Idaho*** | | | | | | |
| Coeur d'Alene WWTP | 3.30 | 7.60 | 1.000 | 0.036 | 27.54 | 2.28 |
| HARSB WWTP | 1.50 | 3.20 | 1.000 | 0.036 | 12.52 | 0.96 |
| Post Falls/Rathdrum WWTP | 2.40 | 5.00 | 1.000 | 0.036 | 20.03 | 1.50 |
| ID Urban Stormwater | 0.80 | 0.93 | 0.310 | 0.310 | 2.07 | 2.41 |
| ID Groundwater | 371.00 | 371.00 | 0.004 | 0.004 | 12.38 | 12.38 |
| ID Subtotal | 379.00 | 387.73 | | | 74.54 | 19.54 |
| Cubic Feet per Second | 586 | 600 | | | | |
| Acre-Feet per Year | 1,163 | 1,190 | | | | |
| ***Washington*** | | | | | | |
| Liberty Lake WWTP | 0.60 | 1.50 | 4.108 | 0.036 | 20.57 | 0.45 |
| City of Spokane WWTP | 37.30 | 40.80 | 0.857 | 0.042 | 266.76 | 14.30 |
| Spokane County WWTP | 0.00 | 18.00 | 0.000 | 0.042 | 0.00 | 6.31 |
| Inland Empire Paper | 4.30 | 4.10 | 0.342 | 0.036 | 12.27 | 1.23 |
| Kaiser Aluminum | 15.90 | 15.40 | 0.019 | 0.025 | 2.52 | 3.21 |
| Combined Sewer Overflows | 0.20 | 0.12 | 0.950 | 0.950 | 1.59 | 0.95 |
| WA Urban Stormwater | 2.00 | 2.36 | 0.310 | 0.310 | 5.17 | 6.11 |
| Three Tributaries | 242.37 | 242.37 | 0.016 | 0.016 | 33.19 | 33.19 |
| Groundwater Upstream of Lake | 752.96 | 752.96 | 0.008 | 0.008 | 47.76 | 47.76 |
| Surface Runoff Lake Watershed | 116.34 | 116.34 | 0.025 | 0.025 | 24.27 | 24.27 |
| WA Subtotal | 1,171.97 | 1,193.95 | | | 414.10 | 137.78 |
| Cubic Feet per Second | 1,813 | 1,847 | | | | |
| Acre-Feet per Year | 3,597 | 3,664 | | | | |
| ***Total Basin*** | | | | | | |
| Grand Total | 1,550.97 | 1,581.68 | | | 488.64 | 157.32 |
| Cubic Feet per Second | 2,400 | 2,447 | | | | |
| Acre-Feet per Year | 4,760 | 4,854 | | | | |

**Lacking "control totals" at Post Falls and Long Lake dams, for both flow and phosphorous concentration, TischlerBise can only point out a few apparent weaknesses in the water quality analysis. First, the phosphorous problem requires an accurate understanding of the relationship between the quantity of phosphorous and the volume of water in Spokane River. The total summer flow estimated in the table above is roughly 1.6 billion gallons per day. As shown in Figure 13, TischlerBise used land area and annual precipitation to estimate the total water volume falling in the Spokane River basin. On an average annual basis, the basin is receiving roughly 7.2 billion gallons per day. Although this simplistic comparison of inputs and outputs does not account for groundwater recharge, evaporation, and dams being opened and closed, it does suggest there might be additional "unaccounted for" water.**

### Figure 13. Annual Precipitation in the Spokane River Basin by State

| | |
|---|---|
| ***Idaho Basin*** | |
| 4,345 | square miles of the Spokane River Basin is in ID |
| 2,780,800 | acres in ID portion of Spokane River basin |
| 26.0 | inches of average annual precipitation in Post Falls per year |
| 6,025,067 | acre-feet per year of precipitation in ID portion |
| 5,379 | million gallons per day of precipitation in ID portion |
| ***Washington Basin*** | |
| 2,295 | square miles of the Spokane River Basin is in WA |
| 1,468,800 | acres in WA portion of Spokane River basin |
| 16.5 | inches of average annual precipitation in Spokane per year |
| 2,019,600 | acre-feet per year of precipitation in WA portion |
| 1,803 | million gallons per day of precipitation in WA portion |
| 7,182 | Total MGD in the Spokane River Basin |

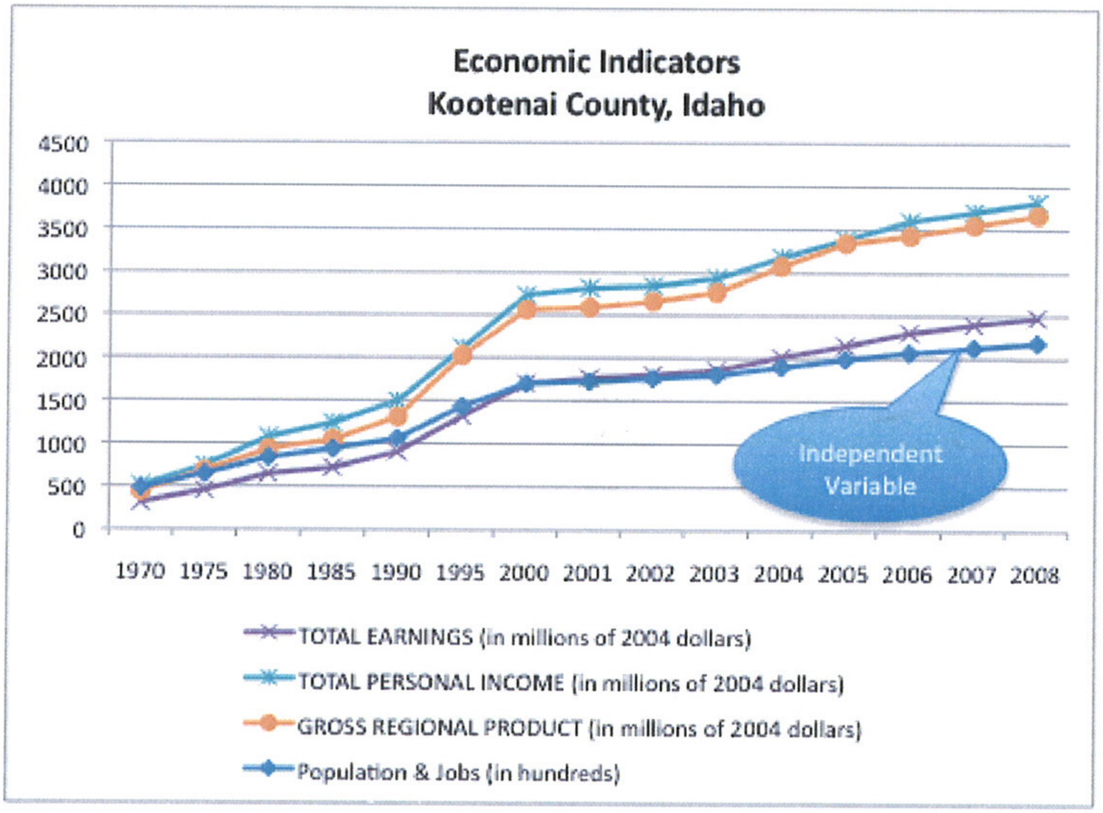
*Source: Sq Mi data from Executive Summary, Spokane River and Lake Spokane Draft Water Quality Improvement Report, WA Dept. of Ecology, September 2009.*

A second weakness in the water quality modeling effort is the insufficient analysis of stormwater runoff from agricultural and rural areas. As stated on page 30 of the draft water quality improvement report (WDOE September 2009), "The nonpoint total phosphorous source load accounts for a large portion of the overall load, especially during the spring months." Ag/rural lands include a significant number of large-lot housing units on septic tanks, plus the phosphorous loading from crop fertilizer and livestock waste. Apparently, the water quality analysis considers Ag/rural stormwater to be "groundwater," yet the phosphorous loading from these areas would have to be greater than the level measured in local wells.

## Economic Impact

This section discusses potential economic impacts on Kootenai County due to more stringent water quality regulations. If the U.S. EPA imposes a prescriptive phosphorous standard, with a quantitative cap on the daily weight of phosphorous discharged, the three sewer-service providers in Kootenai County will face a de facto growth cap. The likely effect of a growth cap on Kootenai County economic indicators can be determined by examining demographic and economic data purchased from Woods & Poole Economics (2008). As shown in Figure 14, population plus jobs (the independent variable) is a strong predictor of three important economic indicators: 1) Gross Regional Product, 2) Earnings by place of work, and 3) Income by place of residence. These three economic indicators are discussed further in the following sections.

Figure 14. Population & Jobs as a Predictor of Economic Activity




It should be noted that this analysis of economic impact focuses on the impact to future growth in the region. The new regulations may have an adverse affect on existing businesses, resulting in closures or downsizing, a loss of jobs, a decrease in population, and an overall decline in existing economic activity. Possible effects on existing economic activity are discussed in the "Cost Estimates" section of this report. It also should be noted that this discussion is limited to the impact on the Coeur d'Alene Metropolitan Statistical

Area, which is comprised of Kootenai County. It does not account for the potential economic impact on the State of Idaho economy. Given the Coeur d'Alene MSA accounts for 7.5 percent of the State's Gross Domestic Product, any negative impact on the regional economy will adversely affect the State's economy and fiscal condition.

## Gross Regional Product

A good measure of general economic activity is Gross Regional Product (GRP), which indicates the overall size of a metropolitan area's economy. As shown in Figure 15, Kootenai County's current GRP is estimated at approximately $3.9 billion, growing 5.3 percent annually over the past 10 years. Kootenai County's economy is projected to grow at approximately 4.6 percent per year over the next twenty years with a projected GRP of approximately $7.5 billion by the year 2030. This reflects an almost doubling of economic activity with a projected increase of $3.6 billion in the region. Projections shown below are from Woods & Poole Economics (2008). Also shown in Figure 15 are economic activity per person and job, which is projected to grow from $17,000 today to $20,700 by the year 2030.

TischlerBise used a linear regression model, calibrated to Kootenai County data from 1970 through 2008, to forecast gross regional product, earnings by place of work, and personal income by place of residence, as shown in the tables below. Given the new water quality regulations, Kootenai County's share of regional population and jobs will decline over time (see Figure 9 above and related text). Instead of a GRP of $7.5 billion by 2030, economic activity is forecast to remain stagnate for the next 20 years.

Figure 15. Potential Impact on the Kootenai County's Economy

| ***Gross Regional Product*** *Kootenai County, ID* | 2010 | 2020 | 2030 | 2010-2030 Increase | 2010-2030 Avg Anl |
|---|---|---|---|---|---|
| Projected GRP *(millions of $2004)* | $3,917 | $5,429 | $7,502 | $3,584 | 4.6% |
| Projected Population | 146,904 | 189,275 | 232,622 | 85,718 | 2.9% |
| Projected Jobs | 83,382 | 104,277 | 130,342 | 46,960 | 2.8% |
| Total Population and Jobs | 230,286 | 293,552 | 362,964 | 132,678 | 2.9% |
| GRP per Person and Job | $17,000 | $18,500 | $20,700 | | |

*Source: Woods & Poole Economics, Inc.*

| *Kootenai County GRP* *(in millions of 2004 dollars)* | 2010 | 2020 | 2030 | 2010-2030 Increase | 2010-2030 Avg Anl | ***Potential Economic Impact*** |
|---|---|---|---|---|---|---|
| WA Dept of Ecology Growth Cap | $3,917 | $3,711 | $3,930 | $13 | 0.0% | ($3,572) |

## Earnings by Place of Work

Earnings include wages and salaries, other labor income like tips, and proprietors' income. Earnings data are by place of work. If an employee works in one county but resides in another, their earnings are counted in the county where the job is located. Because earnings relate to workers' compensation, they are not a measure of company earnings or profits. Earnings in Kootenai County grew by 5.5 percent annually over the past decade. Over the next 20 years, Woods & Poole projects earnings to increase by 4.6% annually, with the average job accounting for $39,000 in earnings by 2030 (amounts are 2004 dollars). Because jobs are the best predictor of earnings, TischlerBise used a linear regression model, with jobs as the independent variable, to quantify the potential decrease in earnings in Kootenai County. As shown in the bottom-right corner of Figure 16, projected countywide earnings will be reduced by $2.5 billion in the year 2030 as a result of Ecology's de facto growth cap.

Figure 16. Recent and Projected Kootenai County Earnings

| Earnings<br>Kootenai County, ID | 2010 | 2020 | 2030 | 2010-2030 Increase | Avg Anl |
|---|---|---|---|---|---|
| Projected Earnings *(millions of $2004)* | $2,647 | $3,671 | $5,078 | $2,431 | 4.6% |
| Projected Jobs | 83,382 | 104,277 | 130,342 | 46,960 | 2.8% |
| Earnings per Job | $31,700 | $35,200 | $39,000 | | |

*Source: Woods & Poole Economics, Inc.*

| Kootenai County Earnings (in millions of 2004 dollars) | 2010 | 2020 | 2030 | 2010-2030 Increase | Avg Anl | Potential Economic Impact |
|---|---|---|---|---|---|---|
| WA Dept of Ecology Growth Cap | $2,351 | $2,388 | $2,544 | $193 | 0.4% | ($2,534) |

## Personal Income by Place of Residence

As shown in Figure 17, aggregate personal income in Kootenai County (expressed in 2004 dollars) is projected to increase faster over the next 20 years than it did in the previous decade. Per capita income is projected to increase from $27,800 in 2010 to $36,200 by 2030. The Woods & Poole data on personal income includes all labor income, dividends, interests, and transfer payments; tabulated by place of residence. Therefore, population is the best independent variable to use in a linear regression model. Based on Ecology's de facto growth cap, aggregate personal income in 2030 is forecast to decrease by almost $4.3 billion, as shown in the bottom-right corner of the table below.

Figure 17. Personal Income in Kootenai County

| Personal Income<br>Kootenai County, ID | 2010 | 2020 | 2030 | 2010-2030 Increase | Avg Anl |
|---|---|---|---|---|---|
| Personal Income *(millions of $2004)* | $4,080 | $5,862 | $8,424 | $4,343 | 5.3% |
| Projected Population | 146,904 | 189,275 | 232,622 | 85,718 | 2.9% |
| Income per Person | $27,800 | $31,000 | $36,200 | | |

*Source: Woods & Poole Economics, Inc.*

| Kootenai County Personal Income (in millions of 2004 dollars) | 2010 | 2020 | 2030 | 2010-2030 Increase | Avg Anl | Potential Economic Impact |
|---|---|---|---|---|---|---|
| WA Dept of Ecology Growth Cap | $3,749 | $3,960 | $4,171 | $421 | 0.6% | ($4,253) |

## Regional Competitiveness

Although Coeur d'Alene MSA and the Spokane MSA are technically classified as two metro areas, the two counties are interconnected and economic success or failure in one area is likely to affect the other. In two recent "best of" rankings, both Coeur d'Alene and Spokane metros received high scores relative to comparable areas throughout the United States. In the Forbes Best Small Places for Business and Careers (March 2009), Coeur d'Alene ranked 33rd out of 179 based on factors such as cost of doing business, cost of living, crime rate, historical and projected job growth, educational attainment, and income growth. Spokane ranked 29th out of 200 metro areas. In the Milken Institute and Greenstreet Real Estate Partner's Best-Performing Cities Index (Where America's Jobs are Created and Sustained, November 2009), the Coeur d'Alene MSA was ranked 15th out of 124 small cities (down from 2nd in 2008) and Spokane was ranked 41st out of 200 large cities (down from 35th in 2008). The Milken Institute's rankings include trends in job growth, wages, high-tech job growth, and population.

Based on the above analysis of economic impacts from the proposed water quality regulations, a de facto growth cap will effectively shrink Kootenai County's economy in 2030 by 50%. Although population and jobs normally attracted to the Idaho portion of the Spokane River basin will be redirected downstream to Washington, the predicted decline in economic activity may decrease the region's ability to compete with other metropolitan areas.

## Cost Estimates

J-U-B Engineers completed Post Fall's Wastewater Treatment Plant (WWTP) Master Plan in July 2008. The Master Plan provides information on the current performance of the sewer system and estimates the cost of future capital improvements that might be necessary to meet anticipated water quality standards. The 2008 Master Plan anticipated a phosphorous discharge standard of 50 micrograms per liter within the next ten years, which would require extensive modification of the plant to include chemical coagulation and mechanical filtration of the effluent. The Master Plan also recommended spray irrigation of effluent for Biological Nutrient Removal (BNR). Post Falls is proceeding to implement BNR, with significant expenditures to acquire land and construct infrastructure for expansion of the wastewater treatment plant.

The effect of more stringent phosphorous removal is evident in a comparison of the daily quantities expected from the current and proposed regulations. Table 1-2 in the WWTP Master Plan indicates 189 pounds of phosphorous from an average daily flow of 3.1 Million Gallons per Day (MGD) under current regulations. In contrast, the water quality standards proposed by Washington Department of Ecology would limit the Post Falls WWTP to 1.5 pounds of phosphorous from an average daily flow of 5.0 MGD.

### Monthly User Charge Increase

The U.S. Environmental Protection Agency released a report titled "Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorous" (Ragsdale 2007) that provides 23 case studies of wastewater treatment plants operated by local governments in the United States. The abstract of this study states, "Cost of applying tertiary treatment for phosphorous removal is affordable, when measured by the monthly residential sewer fees charged by the municipalities that operate these exemplary facilities. The monthly residential sewer rates charged to maintain and operate the entire treatment facility ranged from as low as $18 to the highest fee of $46." In comparison, the City of Post Falls currently charges a residential customer approximately $27 per month for sewer service.

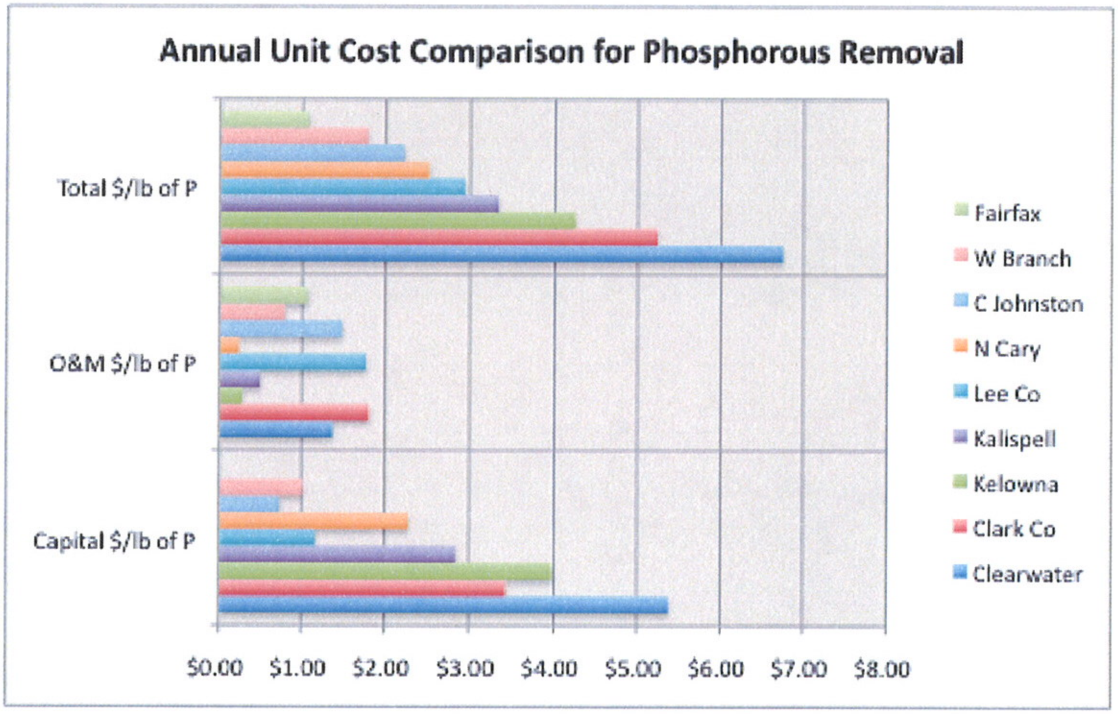
### Capital Improvements

Table 19-1 in the J-U-B Master Plan provides preliminary cost estimates for capital improvements needed to both expand WWTP capacity and meet anticipated regulatory standards for phosphorous removal. Two major improvements are needed primarily for regulatory compliance. First, Post Falls will spend approximately $13.2 million to implement BNR, improve oxygenation ditches, acquire a secondary clarifier, provide anoxic tanks, and UV modules. The second major expenditure of approximately $14.3 million is for effluent coagulation and filtration infrastructure specifically for phosphorous removal. If the City bond financed the total capital cost of $27.5 million over 20 years, at 6% annual interest, debt service payments would be approximately $2.4 million per year. Given a rate base of approximately 9,600 sewer customers in 2008, each customer would face a sewer rate increase of approximately $21 per month, or $252 annually, to pay for these capital improvements.

## Estimated Annual Costs per Pound of Phosphorous Removed

An extensive reference document published by the U.S. Environmental Protection Agency (Kang, et al 2008) provides capital and operating costs for both retrofitting and expanding wastewater treatment plants for nutrient removal. Data were collected and summarized for nine locations ranging from Florida to British Columbia. Design flows ranged from 3 MGD for a plant in Kalispell, MT to 110 MGD for a plant in Clark County, NV. To normalize costs in a format that facilitates more meaningful comparisons, the report converted annual capital and Operation & Maintenance (O&M) costs to dollars per pound of phosphorous removed. To annualize capital costs, the report assumed 20 year bond financing at six percent interest. O&M only included the additional cost of energy, chemicals, and extra sludge disposal associated with nutrient removal. As shown in Figure 18, annual unit costs ranged from $1 to almost $7 per pound of phosphorous removed.

Figure 18. Cost per Pound of Phosphorous Removed




Based on the average daily wastewater flow in 2008 and the average influent concentration of 7 mg of phosphorous per liter, Post Falls will be required to remove at least 139 pounds of phosphorous each day, or approximately 50,735 pounds per year. At the average cost increase of $3.34 per pound of phosphorous removed, sewer expenditures will increase by at least $169,000 per year. At the upper end of the documented unit costs, sewer expenditures in Post Falls could increase approximately $342,000 per year. These on-going costs would be passed on to existing sewer customers.

## References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Federal Energy Regulatory Commission. 2009. ***Avista Corporation Order Issuing New License and Approving Annual Charges*** (June 18th).

J.P. Stravens. 2009. ***Inland Northwest Demographics.***

J-U-B Engineers. 2008. ***City of Post Falls Wastewater Treatment Plant Master Plan.***

Kang, Shin Joh, with Kevin Olmstead, Krista, Takacs, and James Collins. 2008. ***Municipal Nutrient Removal Technologies.*** Prepared by Tetra Tech under U.S. Environmental Protection Agency contract. EPA 832-R-08-006.

Portland State University. 2010. ***Spokane River Modeling Scenarios.***

Ragsdale, David. 2007. ***Advanced Wastewater Treatment to Achieve Low Concentrations of Phosphorous.*** U.S. Environmental Protection Agency Region 10: EPA 910-R-07-002.

U.S. Environmental Protection Agency. 2000. ***Nutrient Criteria Technical Guidance Manual: Rivers and Streams.*** EPA-822-B-00-002.

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Washington Department of Ecology. 2010. ***Water Quality Improvement Report.***

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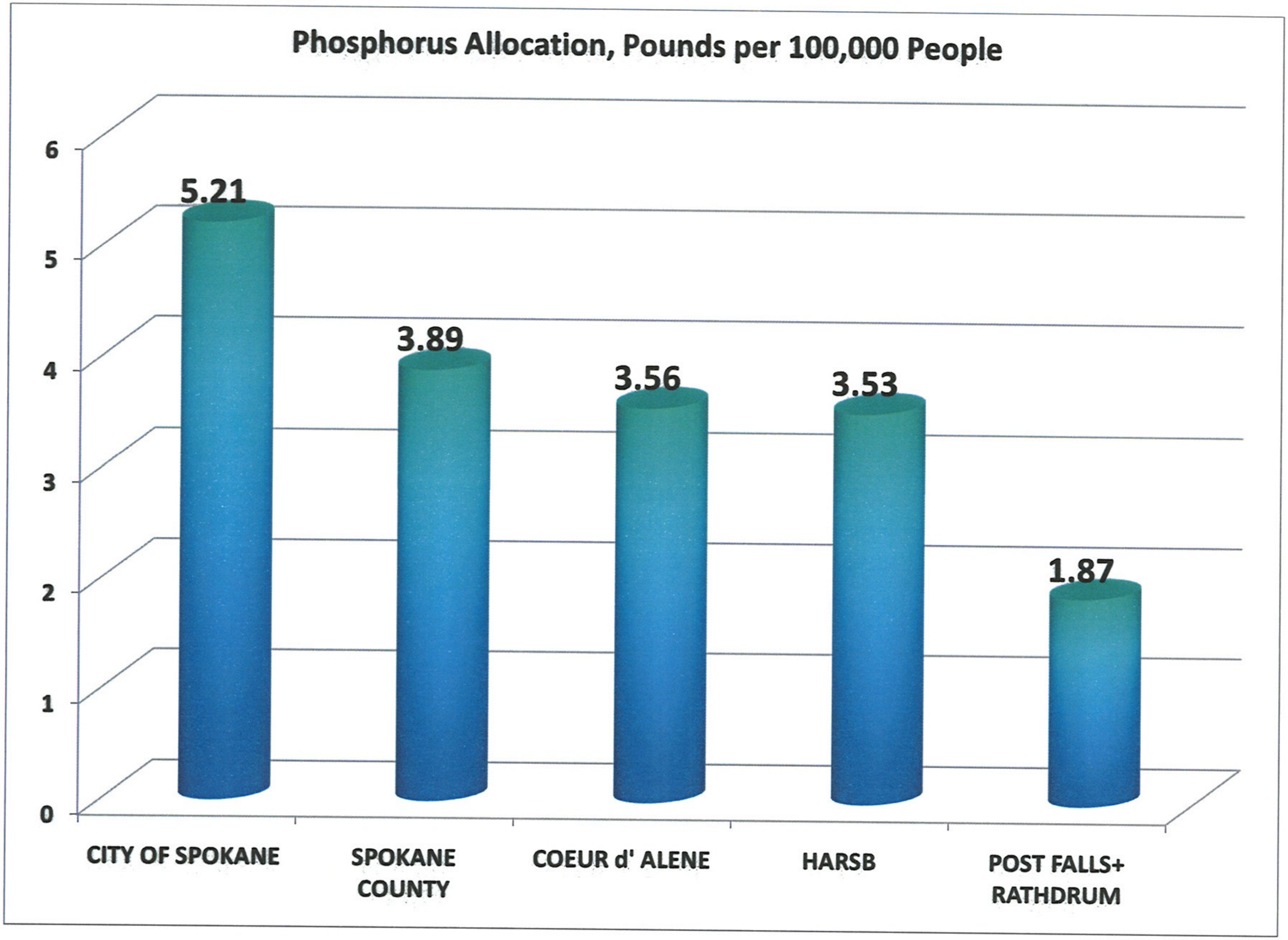
# Exhibit 6


Phosphorus Allocation, Pounds per 100,000 People
6
5
4
3
2
1
0
5.21
3.89
3.56
3.53
1.87
CITY OF SPOKANE
SPOKANE COUNTY
COEUR d' ALENE
HARSB
POST FALLS+ RATHDRUM

# Exhibit 7

## 19.6 SANITARY SEWER

### Service Area

Spokane's Advanced Waste Water Treatment Plant (SAWTP) serves the city, portions of the urbanized unincorporated county, and several other communities. The city serves these additional areas based on interlocal agreements, which are similar to contracts. Some of these agreements are for small amounts of capacity while others, like the agreement with Spokane County, are for ten million gallons per day. With the multitude of users, the SAWTP is a regional system.

Because of existing agreements, the SSAWTP will most likely always be a regional system, although capacity will have to be increased dramatically, or other treatment solutions found, to accommodate the region's growth. See Map CFU 6, "Sewer Service Area," to view the extent of the SAWTP service area.

### Inventory of Existing Facilities

#### Sanitary Sewer Treatment Facilities

The SAWTP system doesn't consist of a treatment plant alone. There are over 800 miles of pipes connecting the treatment plant with the service area. These pipes also connect to lift stations that help get sanitary sewer to the treatment plant when the force of gravity is not available. On top of that there are other facilities like inverted siphons, catch basins and drywells, and combined sewer overflow structures (CSOs). See the table below for a full inventory of the SAWTP system.

**TABLE CFU 24 INVENTORY OF EXISTING SANITARY SEWER FACILITIES**

| Facility Category | Quantity | Units |
|---|---|---|
| **Treatment Plant** | 1 | each |
| **Sewage Lift Stations** | 27 | each |
| **Sanitary Collection System** | 290 | miles |
| **Storm Water Collection System** | 130 | miles |
| **Combined Sewer Collection System** | 400 | miles |
| **Inverted Siphons** | 14 | each |
| **Catch Basins and Drywells** | 14000 | each |
| **CSO Regulating Structures** | 30 | each |

See Map CFU 7, "Waste Water and Storm Water Facilities," to view the location of the major sanitary sewer and storm water facilities.

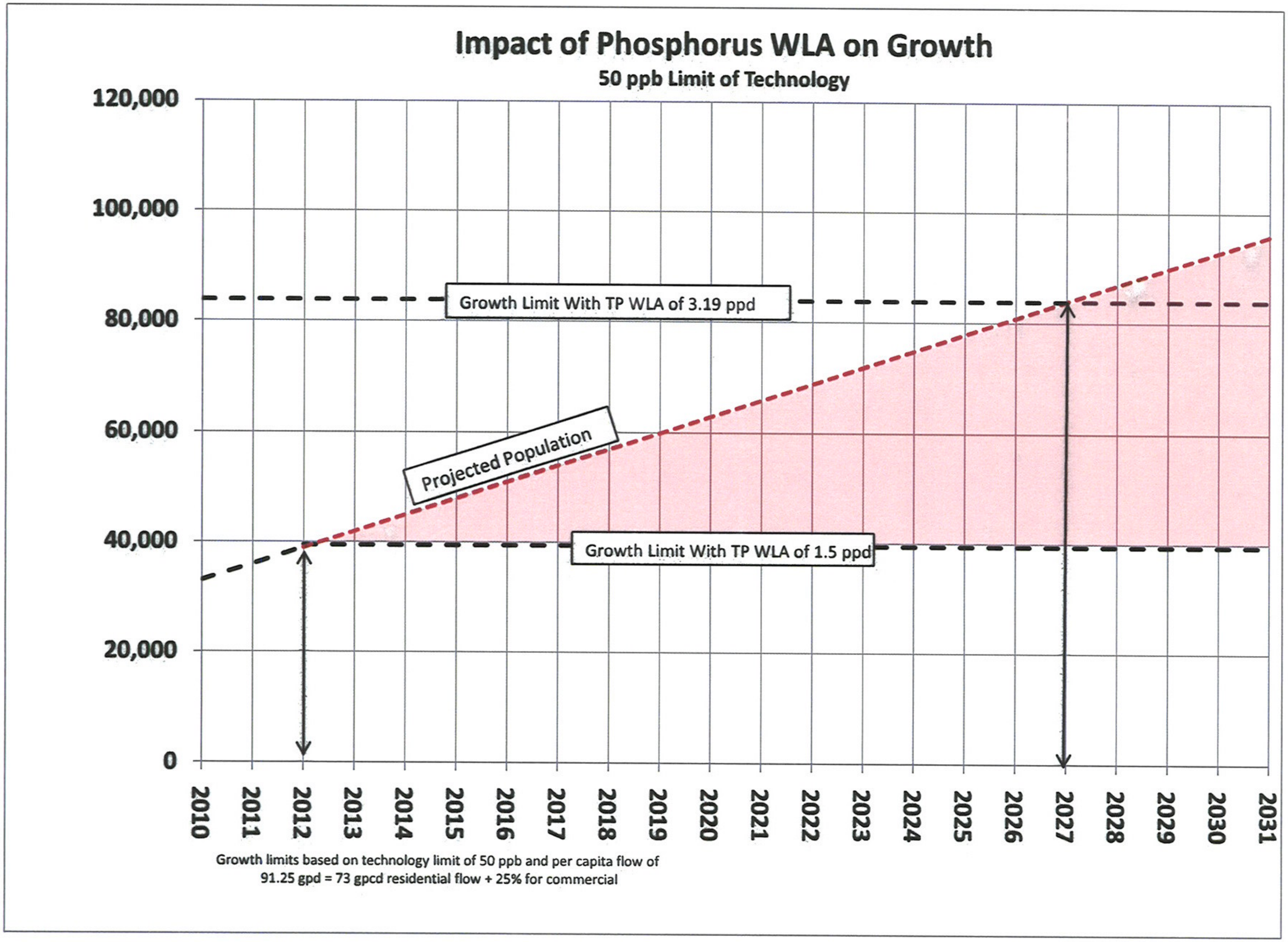
### FUTURE NEEDS

#### Existing Demand and Capacity

The SAWTP has the capacity to process 44 million gallons per day of regionally generated sanitary sewer. Of the 44 MGD, the city has, through interlocal agreements, transferred 10 MGD to Spokane County to serve unincorporated urban areas that are on septic systems and over the aquifer. This leaves the city with control of 34 MGD of SAWTP capacity. Of the 34 MGD the city has about 2.3 MGD in surplus to serve future population growth. This will accommodate about 23,529 persons.

Currently, the SAWTP is processing an average of 40.7 million gallons per day (MGD) of regional sanitary sewer. This includes about 9.6 MGD that are associated with variable flow. Variable flow is water that infiltrates or inflows into the system and is not associated with sanitary sewer users. The city continues to make improvements to the SAWTP system to limit the amount of variable flow.

# Exhibit 8


Impact of Phosphorus WLA on Growth
50 ppb Limit of Technology
120,000
100,000
80,000
60,000
40,000
20,000
0
Growth Limit With TP WLA of 3.19 ppd
Projected Population
Growth Limit With TP WLA of 1.5 ppd
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
Growth limits based on technology limit of 50 ppb and per capita flow of
91.25 gpd = 73 gpcd residential flow + 25% for commercial

# Exhibit 9

LimnoTech
Water | Environment | Scientists | Engineers

DATE: March 11, 2010

# MEMORANDUM

FROM: Dave Dilks

PROJECT: SPOCFP

TO: Michael Neher

CC:

SUBJECT: Water Quality Assessment of Loading Trade between Post Falls and City of Spokane

## Summary

LimnoTech applied the recently updated CE-QUAL-W2 model of the Spokane River system to assess the dissolved oxygen impact of trading 1.5 pounds of phosphorus per day as allocated in the TMDL from the City of Spokane to Post Falls. Model results indicate that this trade will result no appreciable change in dissolved oxygen concentrations in Lake Spokane. It is expected the similar conclusions would be drawn concerning trades of the same magnitude between Post Falls and other phosphorus sources in the vicinity of Spokane.

## Introduction

Washington Department of Ecology (2010) developed a Total Maximum Daily Load for nutrients and oxygen demanding materials designed to minimize the anthropogenic affects on dissolved oxygen in Long Lake. This TMDL assigned allocations to point source discharges to the Spokane River in Washington and Idaho.

The purpose of this work is to examine a shift in the TMDL allocation, reducing the City of Spokane's allocation of phosphorus by 1.5 pounds of per day, and shifting this load to Post Falls The memorandum is divided into two sections:

- Scenarios Evaluated
- Model Results

## Scenarios Evaluated

Two scenarios were simulated to allow an assessment of the water quality impacts of shifting 1.5 pounds phosphorus loading from the City of Spokane to Post Falls. The input assumptions used for each scenario are as follows:

- **TMDL:** This scenario matches TMDL Alternative #1 as provided in the final TMDL.
- **Incrementally increased City of Spokane phosphorus load:** This scenario is identical to the TMDL alternative, with the exception that phosphorus concentration from the City of Spokane AWWTP was decreased by an amount that resulted a 1.5 pound per day reduction in loading, and the Post Falls phosphorus concentration was raised by an amount that resulted a 1.5 pound per day increase in loading.

501 Avis Drive
Ann Arbor, MI 48108
**734-332-1200**
Fax: 734-332-1212
www.limno.com

Each scenario simulation consisted of three sequential model runs, as structured by PSU. The first simulation considers the Idaho portion of the Spokane River, the second simulation considers the Washington portion of the Spokane River, and the third simulation considers Long Lake. Model predictions at the downstream boundary of each of the first two simulations are directly passed to serve as input for the upstream boundary for the next simulation in the sequence.

Analysis of model results focused on the "special output" provided by PSU for the Long Lake TMDL, which corresponds to semi-monthly average minimum dissolved oxygen in the hypolimnion of each model segment. Particular focus was given to late August dissolved oxygen predictions for model segments 34 through 36 (formerly referred to as segments 186 through 188), which the TMDL scenarios identified as the critical time and locations for dissolved oxygen impacts.

## Model Results

The scenarios in Table 1 were run on single processor computers, and the incremental impact of the phosphorus trade on Long Lake dissolved oxygen was examined. The results for the critical lake segments and time period range between very small (i.e. < 0.003 mg/l) positive and negative numbers. All of these observed differences are smaller than the replication error of the model. These results indicate that this trade will result no appreciable change in dissolved oxygen concentrations in Lake Spokane. Because the magnitude of the change is so small, it is expected the similar conclusions would be drawn concerning trades of the same magnitude between Post Falls and other phosphorus sources in the vicinity of Spokane.

A complete listing on incremental impacts at all Long Lake segments and times is provided in the appendix.

## References

Washington Department of Ecology, 2010. Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load, Water Quality Improvement Report. Revised February, 2010. Publication No. 07-10-073.

## Appendix
## Incremental Dissolved Oxygen Impact (mg/) at All Segments and Times

This table represents the incremental dissolved oxygen impacts associated with the phosphorus trading scenario, and was created by calculating the difference between the scenario output and the results from TMDL. Negative numbers indicate that the scenario results in a lower dissolved oxygen than predicted by TMDL Alternative #1.

| Long Lake Segment | Julian Day 121 | 136 | 152 | 167 | 182 | 197 | 213 | 228 | 244 | 259 | 274 | 289 | 305 | 320 | 335 | 350 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | |
| 5 | -0.0041 | 0.0002 | 0.012 | -0.0878 | -0.0931 | -0.0371 | -0.0423 | -0.0442 | -0.0482 | -0.0436 | -0.02 | -0.012 | -0.039 | -0.003 | 0 | 0 |
| 6 | -0.0742 | 0.0008 | 0.0025 | -0.0111 | -0.0003 | -0.0355 | -0.0477 | -0.0452 | -0.0441 | -0.0402 | -0.024 | -0.015 | -0.004 | -0.002 | 0.001 | 0.001 |
| 7 | -0.016 | 0.0006 | -0.0041 | -0.0106 | 0.0168 | -0.0329 | -0.0389 | -0.0431 | -0.0434 | -0.0403 | -0.024 | -0.016 | -0.004 | 0 | 0 | 0 |
| 8 | 0.003 | 1E-04 | -0.0148 | -0.0185 | 0.0174 | -0.0331 | -0.0387 | -0.0427 | -0.0423 | -0.0381 | -0.024 | -0.018 | -0.005 | -0.001 | -0.001 | 0.001 |
| 9 | 0.002 | -0.001 | -0.0152 | -0.0165 | 0.0119 | -0.0333 | -0.0386 | -0.042 | -0.0405 | -0.0396 | -0.023 | -0.019 | -0.005 | 0 | 0 | 0 |
| 10 | 0.001 | -0.0015 | -0.0277 | -0.0168 | 0.0098 | -0.0316 | -0.0369 | -0.0384 | -0.0368 | -0.0364 | -0.025 | -0.02 | -0.005 | -0.001 | 0.001 | 0 |
| 11 | 0.002 | -0.0015 | -0.0171 | -0.015 | -0.0015 | -0.0296 | -0.0332 | -0.0328 | -0.0299 | -0.0324 | -0.024 | -0.021 | -0.006 | -0.001 | 0 | 0.001 |
| 12 | 0.007 | -0.0027 | -0.003 | -0.007 | -0.0022 | -0.026 | -0.0315 | -0.0303 | -0.0255 | -0.0292 | -0.023 | -0.021 | -0.006 | -0.002 | 0.001 | 0.001 |
| 13 | 0.001 | -0.0028 | -0.009 | -0.006 | 0.0058 | -0.0235 | -0.0289 | -0.0307 | -0.0241 | -0.0259 | -0.019 | -0.018 | -0.006 | -0.002 | 0.001 | 0.001 |
| 14 | 0.012 | -0.003 | -0.006 | -0.01 | 0.0062 | -0.0217 | -0.0264 | -0.0334 | -0.0243 | -0.0255 | -0.0189 | -0.018 | -0.007 | 0 | 0.001 | 0 |
| 15 | 0.008 | -0.003 | -0.004 | -0.0073 | 0.0037 | -0.0203 | -0.0302 | -0.0351 | -0.0244 | -0.0249 | -0.0181 | -0.017 | -0.007 | 0.002 | 0 | 0.001 |
| 16 | 0.004 | -0.003 | -0.007 | -0.0141 | 0.0121 | -0.0183 | -0.0609 | -0.0393 | -0.0248 | -0.0264 | -0.0176 | -0.016 | -0.007 | 0.002 | 0.001 | 0 |
| 17 | 0.007 | -0.003 | -0.011 | -0.0258 | 0.0157 | -0.0182 | -0.0645 | -0.0387 | -0.0249 | -0.0279 | -0.0174 | -0.014 | -0.008 | 0.001 | 0.001 | 0.001 |
| 18 | 0.001 | -0.003 | -0.013 | -0.019 | 0.009 | -0.018 | -0.0611 | -0.0353 | -0.0224 | -0.0274 | -0.0165 | -0.012 | -0.007 | 0 | 0.001 | 0 |
| 19 | -0.005 | -0.003 | -0.012 | -0.0153 | 0.005 | -0.0163 | -0.0539 | -0.0348 | -0.0201 | -0.027 | -0.0158 | -0.01 | -0.006 | 0 | 0.001 | 0 |
| 20 | -0.005 | -0.004 | -0.019 | -0.0161 | 0.0065 | -0.0141 | -0.0487 | -0.0354 | -0.0179 | -0.0264 | -0.0157 | -0.0085 | -0.005 | 0 | 0.001 | 0.001 |
| 21 | -0.002 | -0.004 | -0.0113 | -0.0106 | 0.0086 | -0.0139 | -0.0384 | -0.0361 | -0.015 | -0.0257 | -0.0162 | -0.0079 | -0.002 | 0 | 0.001 | 0.001 |
| 22 | -0.001 | -0.003 | -0.008 | -0.008 | 0.0112 | -0.0145 | -0.0314 | -0.0357 | -0.0118 | -0.0255 | -0.0168 | -0.0085 | -0.003 | 0 | 0.001 | 0.001 |
| 23 | -0.003 | -0.003 | -0.0071 | -0.0143 | 0.0132 | -0.0137 | -0.0263 | -0.0347 | -0.0092 | -0.0247 | -0.0164 | -0.0082 | -0.004 | 0 | 0.001 | 0.001 |
| 24 | -0.003 | -0.003 | -0.0158 | -0.0211 | 0.0108 | -0.0131 | -0.0199 | -0.0338 | -0.0089 | -0.023 | -0.0161 | -0.0072 | -0.002 | 0 | 0.001 | 0.001 |
| 25 | -0.004 | -0.003 | -0.0103 | -0.0181 | 0.0285 | -0.011 | -0.0133 | -0.0319 | -0.0084 | -0.0223 | -0.0163 | -0.0084 | -0.003 | 0 | 0.001 | 0.001 |
| 26 | -0.003 | -0.003 | -0.0098 | -0.0172 | 0.0291 | -0.0107 | -0.0089 | -0.0295 | -0.0079 | -0.0202 | -0.0161 | -0.0087 | -0.0033 | 0 | 0 | 0.001 |
| 27 | -0.002 | -0.003 | -0.0107 | -0.0183 | 0.0271 | -0.0108 | -0.0064 | -0.0263 | -0.0099 | -0.0191 | -0.0159 | -0.0082 | -0.0029 | 0 | 0 | 0 |
| 28 | 0.001 | -0.002 | -0.0144 | -0.0084 | 0.0192 | -0.0111 | -0.0038 | -0.0207 | -0.0123 | -0.0163 | -0.0166 | -0.0078 | -0.0029 | 0 | 0 | 0.001 |
| 29 | -0.001 | 0 | -0.0161 | -0.0038 | 0.0176 | -0.0115 | -0.0021 | -0.0135 | -0.0157 | -0.0126 | -0.0145 | -0.0132 | -0.0033 | 0 | 0 | 0.002 |
| 30 | -0.002 | -0.001 | -0.0211 | -0.0036 | 0.0148 | -0.012 | -0.0025 | -0.009 | -0.0171 | -0.0079 | -0.0135 | -0.0153 | -0.0034 | 0 | 0 | 0.002 |
| 31 | -0.003 | 0.0019 | -0.0149 | -0.0011 | 0.0034 | -0.0103 | -0.0021 | -0.0061 | -0.0157 | -0.0051 | -0.0129 | -0.0127 | -0.0033 | -0.001 | 0 | 0.001 |
| 32 | -0.006 | 0.0026 | -0.0093 | -0.0014 | 0.0056 | -0.0062 | -0.001 | -0.0019 | -0.0104 | 0.0011 | -0.008 | -0.0166 | -0.004 | -0.001 | 0 | 0.001 |
| 33 | -0.007 | 0.0041 | -0.0033 | 0.0006 | 0.0116 | -0.0012 | 0.0019 | 0.0026 | -0.0056 | 0.0044 | -0.0078 | -0.0196 | -0.0053 | -0.002 | 0 | 0.001 |
| 34 | -0.008 | 0.005 | 0.0002 | -0.002 | 0.0071 | 0 | 0.0018 | 0.0034 | -0.0051 | 0.0019 | -0.0112 | -0.0152 | -0.0068 | -0.001 | -0.001 | 0 |
| 35 | -0.013 | 0.0049 | -0.0024 | -0.0009 | 0.004 | -0.0002 | 0.0008 | 0.003 | -0.0045 | -0.0027 | -0.011 | -0.0119 | -0.0101 | -0.002 | 0 | 0 |
| 36 | 0 | 0.0295 | 0.0122 | 0.0084 | 0.0119 | 0.0072 | 0.0074 | 0.0097 | 0.0037 | -0.0004 | -0.0139 | -0.0331 | -0.0328 | -0.002 | 0 | 0.001 |

# Exhibit 10

# Spokane River Modeling Final Scenarios Report 2010

Water Quality Research Group
Department of Civil and Environmental Engineering
Maseeh College of Engineering and Computer Science

Technical Report EWR-01-10
January 29, 2010

Portland State
UNIVERSITY

# Spokane River Modeling Final Scenarios Report 2010

Technical Report EWR-01-10

Water Quality Research Group
Department of Civil and Environmental Engineering
Maseeh College of Engineering and Computer Science
Portland State University
Portland, Oregon 97201-0751

Environmental Protection Agency

January 2010

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# Introduction

Spokane River Total Maximum Daily Load (TMDL) final scenarios were simulated using the CE-QUAL-W2 models developed for the Washington Department of Ecology and the Environmental Protection Agency. The scenarios were run with varying concentrations for tributaries and point sources. The four scenarios simulated were:

- No Source Scenario
- TMDL Scenario
- Idaho Only Scenario
- March Test Scenario

The Upper Spokane River system is located in the Northeastern part of Washington State and flows from Coeur d'Alene Lake, Idaho at RM (River Mile) 111.3 downstream to Long Lake dam at RM 32.5. The Washington Department of Ecology will issue a dissolved oxygen TMDL for the Spokane River from the Idaho border to Long Lake Dam. EPA will issue NPDES permits to wastewater treatment plants on the Idaho portion of the Spokane River, and the Idaho Department of Environmental Quality will issue 401 certifications for those permits. The Spokane Tribe developed a model of Spokane Arm, downstream of the project area, to assess water quality impacts in its jurisdictional waters. The TMDL, along with a 401 certification for the FERC relicensing of Spokane River dams, will reduce phosphorus loadings and affect minimum in-stream flows in the Spokane River.

Existing CE-QUAL-W2 water quality models (Washington and Idaho) of Upper Spokane River were updated to the more recent version 3.6 (Berger et al.,2009). These models were used to help determine the impact of the TMDL and the FERC relicensing on the Spokane River water quality. The models were originally developed by Portland State University for the Washington Department of Ecology and EPA to simulate temperature, dissolved oxygen, nutrients, algae, and organic matter. The updated model simulates the year 2001, and the calibration has also been checked for the year 2000.

Prior reports prepared for the Spokane River modeling in Washington and Idaho include:

- Annear et al. (2001) - Upper Spokane River Model: Boundary Conditions and Model Setup for 1991 and 2000
- Berger et al. (2002) - Upper Spokane River Model: Calibration for 1991 and 2000
- Slominski et al. (2002) - Upper Spokane River Model: Boundary Conditions and Model Setup for 2001 where information such as the following were detailed:
    1. Inflows, temperatures, and water quality
    2. Meteorological conditions
    3. Bathymetry of the Spokane River and Long Lake and the model grid
    4. Reservoir operations and structure information
- Berger et al. (2003) - Upper Spokane River Model: Calibration for 2001
- Annear et al. (2005)- Upper Spokane River Model in Idaho: Boundary Conditions and Model Setup for 2001 and 2004.
- Wells and Berger (2009)- Spokane River in Idaho and Washington TMDL Water Quality and Hydrodynamic Modeling, Quality Assurance Project Plan.
- Berger et al. (2009)- Spokane River Modeling Report 2009, Model Update and Calibration Check.

- Water Quality Research Group (2009) - Spokane River Modeling Scenarios Report 2009

The focus of this present study was to perform the following tasks:

- Converting the Upper Spokane River CE-QUAL-W2 models (Washington and Idaho) to version 3.6
- Reviewing and updating model boundary conditions
- Check model calibration
- Meet with stakeholders
- Develop and Run Modeling Scenarios
- Create reports on calibration and scenario runs

In this study Portland State University was responsible for updating the model, checking model calibration, applying the model to the scenarios runs, and writing a final report. This report documents the final aspect of this scope of work –the final modeling scenarios.

# Modeling Scenarios

## *Description*

Four modeling scenarios were simulated. These included a no source scenario, a TMDL scenario, a Idaho only scenario, and a March test scenario. The no source scenario technical specifications were listed in Table 1. Technical specification for the TMDL scenario was listed in Table 2. Constituent concentrations apply for March 1 through October 31. Year 2001 concentrations were applied for the rest of the year. The Idaho only scenario used TMDL conditions in Idaho and no source conditions in Washington. The March test scenario used Year 2001 conditions during March 1-31 and no source conditions for the rest of the year.

Hangman Creek and Little Spokane River constituent concentrations for the no source scenario and the TMDL scenario were listed in
Table 3 through Table 6. Coulee Creek concentrations were assumed to the same as those for Hangman Creek. For constituent not specified (DO, alkalinity, etc.), the concentrations were assumed to be equal to 2001 concentrations.

For the TMDL scenario storm water inflows were included for Idaho and Washington. The Idaho storm water flows were placed in model segment 4 (Idaho model). The Washington storm water flows were placed in model segment 114 (Washington model). Combined sewer overflows (CSOs) were also included in the Washington model at segment 114. The constituent concentrations used for storm water and CSOs in the TMDL scenario were listed in Table 2.

Changes to these scenarios with respect to the scenarios completed in December, 2009 (Water Quality Research Group, 2009) include:

- No source scenario ground water ortho-phosphate (PO4P) set to 0.004 mg/l
- TMDL scenario ground water ammonia-nitrogen set to 0.005 mg/l uniformly
- Corrected tributary CBODP concentrations
- Inland Empire Paper and Kaiser Aluminum discharge corrected in TMDL scenario
- Inland Empire Paper PO4P to Total P ratio changed to 0.25
- Start and end dates of low TMDL concentrations set to 3/1/2001 and 11/1/2001, respectively
- Semi-monthly averages of the daily minimum, volume-averaged DO calculated for full water column in addition to hypolimnion

**Table 1. Technical specifications for no source scenario (EPA, WA Department of Ecology).**

| | MUNICIPAL AND INDUSTRIAL POINT SOURCES | | | | | | | | | SW & CSO | | NONPOINT SOURCES | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Descriptor for NPDES sources | Coeur d' Alene | HARSB | Post Falls | Liberty Lake | Inland Empire Paper | Kaiser Aluminum | Spokane | Spokane County | Storm Water | CSO | Ground Water | Little Spokane River | Hangman/Coulee Creek | Upstream Boundary |
| *Shaded cells are user-input values that are used to calculate other values in this table* | | | | | | | | | | | | | | | |
| | ***Design Flow and Maximum Monthly Average Discharge*** | | | | | | | | | ***WLAs*** | | ***Nonpoint Source Load Allocations*** | | | |
| Discharge (MGD) F2 | design flow | 0 F1 | 0 F1 | 0 F1 | 0 F1 | 0 F1 | 0 F1 | 0 F1 | 0 F1 | 0.0 | 0.0 | 2001 F1 | 2001 | 2001 | 2001 |
| Maximum Monthly Average TP (mg/l) | na | na | na | na | na | na | na | na | na | na | na | Natural | Natural | Natural | 2001 |
| Maximum Monthly Average CBOD5 (mg/l) | na | na | na | na | na | na | na | na | na | na | na | Natural | Natural | Natural | 2001 |
| Maximum Monthly Average NH4N (mg/l) | na | na | na | na | na | na | na | na | na | na | na | Natural | Natural | Natural | 2001 |
| | ***Model Input Values = Wasteload Allocations = Long Term Average Discharge*** | | | | | | | | | ***Model Inputs*** | | ***Model Inputs*** | | | |
| TP WLA (mg/l) | na | na | na | na | na | na | na | na | na | na | na | 0.004 | See spread-sheets | See spread-sheets | 2001 |
| PO4P (mg/L) F4 | na | na | na | na | na | na | na | na | na | na | na | 0.004 | See spread-sheets | See spread-sheets | 2001 |
| CBODult WLA (mg/L) | na | na | na | na | na | na | na | na | na | na | na | 0.000 | See spread-sheets | See spread-sheets | 2001 |
| NH4N WLA (mg/l) | na | na | na | na | na | na | na | na | na | na | na | 0.005 | See spread-sheets | See spread-sheets | 2001 |
| ***Water and Wastewater Characteristic Ratios*** | | | | | | | | | | | | | | | |
| KBOD (/day) F3 | na | na | na | na | na | na | na | na | na | na | na | na | 2001 | 2001 | 2001 |
| PO4P ratio | na | na | na | na | na | na | na | na | na | na | na | 0.5 | See spread-sheets | See spread-sheets | 2001 |
| BODP F5 | calculated from TP and PO4P | na | na | na | na | na | na | na | na | na | na | 0.000 | See spread-sheets | See spread-sheets | 2001 |
| Estimated Limit Factor | na | na | na | na | na | na | na | na | na | na | na | na | na | na | na |

| NOTES | |
|---|---|
| *hydrologic setting:* | River flows are 2001 conditions (critical TMDL design year). They are characteristic of a 1-in-10 low flow year. |
| *Other* | SOD set to improved level = 0.25 g DO/m2-day |
| *Nonpoint characteristics* | Tributaries are set to 2001 flows and estimated natural pollutant concentrations based on headwater concentrations. Separate spreadsheets provide estimated natural conditions concentrations of all parameters of interest for each month. |
| F1 | Mean 2001 flow from each WWTP is re-located to groundwater, specifically to the nearest, downstream, gaining groundwater reach |
| F2 | |
| F3 | |
| F4 | PO4P = TP * (% PO4P) |
| F5 | PO4P+BODP = TP (Equation corrected after public comment period) |
| F6 | CBODult = CBOD5/(1-e^(-5*KBOD)) |
| F7 | |
| F8 | |
| F9 | |

**Table 2. Technical specifications for the TMDL Scenario (EPA, WA Department of Ecology).**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Name* Final TMDL Scenario (December 2009) | | | | | | | | | | | | | | |
| *Description:* | This is the final TMDL scenario for comparison to the NO SOURCE baseline. Orange cells denote changes in values or corrections made after the public comment period. | | | | | | | | | | | | | | |
| | MUNICIPAL AND INDUSTRIAL POINT SOURCES | | | | | | | | SW & CSO | | NONPOINT SOURCES | | | | |
| Parameter | Descriptor for NPDES sources | Coeur d' Alene | HARSB | Post Falls | Liberty Lake | Inland Empire Paper | Kaiser Aluminum | Spokane | Spokane County | Storm Water | CSO | Ground Water | Little Spokane River | Hangman/Coulee Creek | Upstream Boundary |
| *Shaded cells are user-input values that are used to calculate other values in this table* | | | | | | | | | | | | | | | |
| | *Design Flow and Maximum Monthly Average Discharge* | | | | | | | | *WLAs* | | *Nonpoint Source Load Allocations* | | | | |
| Discharge (MGD) F2 | design flow | 7.6 | 3.2 | 5.0 | 1.5 | 4.1 | 15.4 | 50.8 | 8.0 | WA 2.36 / ID 0.93 | 0.12 | 2001 | 2001 | 2001 | 2001 |
| Maximum Monthly Average TP (mg/l) | F8 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.035 | 0.050 | 0.050 | 0.310 | 0.950 | 2001 | % reduction | % reduction | 2001 |
| Maximum Monthly Average CBOD5 (mg/l) | F8 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 3.0 | 30.0 | 2001 | % reduction | % reduction | 2001 |
| Maximum Monthly Average (Spring) NH4N (mg/l) | March-May; Oct. F8 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.10 | 1.00 | 1.00 | 0.05 | 1.0 | 2001 | % reduction | % reduction | 2001 |
| Maximum Monthly Average (Summer) NH4N (mg/l) | June-Sept. F8 | 1.00 | 1.00 | 1.00 | 0.25 | 1.00 | 0.10 | 0.25 | 0.25 | 0.05 | 1.0 | 2001 | % reduction | % reduction | 2001 |
| | *Model Input Values = Wasteload Allocations = Seasonal Average Discharge* | | | | | | | | *Model Inputs* | | *Model Inputs* | | | | |
| TP WLA (mg/l) | Avg Performance | 0.036 | 0.036 | 0.036 | 0.036 | 0.036 | 0.025 | 0.042 | 0.042 | 0.310 | 0.950 | 2001 | See spread-sheets | See spread-sheets | 2001 |
| PO4P (mg/L) F4 | calculated | 0.013 | 0.013 | 0.013 | 0.013 | 0.009 | 0.005 | 0.015 | 0.015 | 0.062 | 0.190 | 2001 | See spread-sheets | See spread-sheets | 2001 |
| CBODult WLA (mg/L) F6 | Avg Performance | 16.1 | 16.1 | 16.1 | 16.1 | 37.5 | 7.5 | 18.8 | 12.6 | 13.6 | 47.5 | 2001 | See spread-sheets | See spread-sheets | 2001 |
| NH4N WLA Spring (mg/l) F1 | March-May; Oct | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.07 | 0.83 | 0.83 | 0.05 | 1.00 | 2001 | See spread-sheets | See spread-sheets | 2001 |
| NH4N WLA Summer (mg/l) F1 | June-Sept | 0.71 | 0.71 | 0.71 | 0.18 | 0.71 | 0.07 | 0.21 | 0.21 | 0.05 | 1.00 | 2001 | See spread-sheets | See spread-sheets | 2001 |
| *Water and Wastewater Characteristic Ratios* | | | | | | | | | | | | | | | |
| KBOD (/day) F3 | available data | 0.05 | 0.05 | 0.05 | 0.05 | 0.02 | 0.13 | 0.05 | 0.08 | 0.05 | 0.20 | 2001 | 2001 | 2001 | 2001 |
| PO4P ratio | available data | 0.35 | 0.35 | 0.35 | 0.35 | 0.25 | 0.2 | 0.35 | 0.35 | 0.2 | 0.2 | 2001 | See spread-sheets | See spread-sheets | 2001 |
| BODP F5 | calculated from TP and OP | 0.0234 | 0.0234 | 0.0234 | 0.0234 | 0.0270 | 0.0200 | 0.0273 | 0.0273 | 0.2480 | 0.7600 | 2001 | See spread-sheets | See spread-sheets | 2001 |
| Estimated Limit Factor F7 | TSD method; CV=0.6 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.2 | 1.2 | 1.0 | 1.0 | na | na | na | na |

NOTES

| | |
|---|---|
| *hydrologic setting:* | River flows are 2001 conditions (critical TMDL design year). They are characteristic of a 1-in-10 low flow year. WWTF flows are set to design flows. |
| *Other* | SOD set to improved level = 0.25 g DO/m2-day. Identical to No Source assumption. |
| *Nonpoint characteristics* | Time series concentrations for TP, NH4N, and CBOD5 are found in separate spreadsheet documents. NPS % reductions applied to the difference between 2001 and natural conditions: Hangman and Coulee: 20% (Mar-May, Nov-Dec), 40% (June), 50% (Jul - Oct) // Little Spokane: 36% (Mar - Dec). |
| F1 | Seasonal-varying WLAs for Municipal WWTPs in Washington |
| F2 | Municipal WWTP design flows are projected flows for 2027 |
| F3 | KBOD rates are based on lowest current municipal rate, data/analysis submitted by HDR for Spokane County, and 2001 rate for industrials |
| F4 | PO4P = TP * (% PO4P) |
| F5 | PO4P+BODP = TP (Equation corrected after public comment period) |
| F6 | CBODult = CBOD5/(1-e^(-5*KBOD)) |
| F7 | Factors are from EPA's Tech Support Doc (TSD) for translation of seasonal average WLAs to monthly average permit limits. Pg. 103, Table 5-2. Spokane factors lower due to more frequent monitoring (daily). |
| F8 | The listed concentration is multiplied by the flow and a units conversion factor (8.34) to obtain the estimated loading limit |

**Table 3. Hangman and Coulee Creek concentrations for the no source scenario (EPA, WA Department of Ecology).**

| Month | Mid-month Julian Day | PO4-P (mg/l) | Total P (mg/l) | CBOD ultimate (mg/l) | CBODP (mg/l) | Ammonia Nitrogen (mg/l) | Algae Group 1 (mg/l) | Algae Group 2 (mg/l) | Algae Group 3 (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| Jan | 14 | 0.013 | 0.021 | 1.4 | 0.0063 | 0.010 | 0.081 | 0.081 | 0.081 |
| Feb | 44 | 0.017 | 0.037 | 1.4 | 0.0194 | 0.013 | 0.041 | 0.041 | 0.041 |
| Mar | 74 | 0.024 | 0.075 | 1.4 | 0.0503 | 0.010 | 0.069 | 0.069 | 0.069 |
| Apr | 105 | 0.013 | 0.035 | 1.4 | 0.0207 | 0.005 | 0.073 | 0.073 | 0.073 |
| May | 135 | 0.022 | 0.041 | 1.4 | 0.0180 | 0.012 | 0.073 | 0.073 | 0.073 |
| Jun | 166 | 0.013 | 0.023 | 1.4 | 0.0086 | 0.006 | 0.101 | 0.101 | 0.101 |
| Jul | 197 | 0.013 | 0.021 | 1.4 | 0.0056 | 0.009 | 0.147 | 0.147 | 0.147 |
| Aug | 227 | 0.013 | 0.021 | 1.4 | 0.0061 | 0.005 | 0.095 | 0.095 | 0.095 |
| Sep | 258 | 0.013 | 0.021 | 1.4 | 0.0065 | 0.005 | 0.068 | 0.068 | 0.068 |
| Oct | 288 | 0.016 | 0.023 | 1.4 | 0.0060 | 0.010 | 0.071 | 0.071 | 0.071 |
| Nov | 319 | 0.015 | 0.022 | 1.4 | 0.0061 | 0.010 | 0.066 | 0.066 | 0.066 |
| Dec | 350 | 0.024 | 0.034 | 1.4 | 0.0093 | 0.010 | 0.084 | 0.084 | 0.084 |
| | | | | | | | | | |
| Mean | | 0.016 | 0.031 | 1.4 | 0.014 | 0.009 | 0.081 | 0.081 | 0.081 |

**Table 4. Hangman and Coulee Creek concentrations for the TMDL scenario (EPA, WA Department of Ecology).**

| Month | Mid-month Julian Day | PO4-P (mg/l) | Total P (mg/l) | CBOD ultimate (mg/l) | CBODP (mg/l) | Ammonia Nitrogen (mg/l) | Algae Group 1 (mg/l) | Algae Group 2 (mg/l) | Algae Group 3 (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| Jan | 14 | 0.023 | 0.041 | 3.320 | 0.0157 | 0.010 | 0.162 | 0.162 | 0.162 |
| Feb | 44 | 0.056 | 0.136 | 3.320 | 0.0775 | 0.044 | 0.154 | 0.154 | 0.154 |
| Mar | 74 | 0.077 | 0.173 | 3.320 | 0.0941 | 0.066 | 0.159 | 0.159 | 0.159 |
| Apr | 105 | 0.029 | 0.077 | 3.320 | 0.0457 | 0.010 | 0.160 | 0.160 | 0.160 |
| May | 135 | 0.048 | 0.090 | 3.320 | 0.0396 | 0.026 | 0.160 | 0.160 | 0.160 |
| Jun | 166 | 0.020 | 0.044 | 2.840 | 0.0221 | 0.012 | 0.192 | 0.192 | 0.192 |
| Jul | 197 | 0.018 | 0.037 | 2.408 | 0.0148 | 0.015 | 0.258 | 0.258 | 0.258 |
| Aug | 227 | 0.013 | 0.027 | 2.071 | 0.0117 | 0.005 | 0.123 | 0.123 | 0.123 |
| Sep | 258 | 0.013 | 0.026 | 2.343 | 0.0117 | 0.005 | 0.086 | 0.086 | 0.086 |
| Oct | 288 | 0.016 | 0.028 | 2.300 | 0.0110 | 0.010 | 0.088 | 0.088 | 0.088 |
| Nov | 319 | 0.015 | 0.028 | 2.300 | 0.0120 | 0.010 | 0.085 | 0.085 | 0.085 |
| Dec | 350 | 0.024 | 0.038 | 2.300 | 0.0132 | 0.010 | 0.094 | 0.094 | 0.094 |
| | | | | | | | | | |
| Mean | | 0.029 | 0.062 | 2.8 | 0.031 | 0.019 | 0.143 | 0.143 | 0.143 |

**Table 5. Little Spokane River concentrations for the no source scenario (EPA, WA Department of Ecology).**

| Month | Mid-month Julian Day | PO4-P (mg/l) | Total P (mg/l) | CBOD ultimate (mg/l) | CBODP (mg/l) | Ammonia Nitrogen (mg/l) | Algae Group 1 (mg/l) | Algae Group 2 (mg/l) | Algae Group 3 (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| Jan | 14 | 0.012 | 0.015 | 1.4 | 0.0009 | 0.012 | 0.137 | 0.137 | 0.137 |
| Feb | 44 | 0.010 | 0.016 | 1.4 | 0.0042 | 0.010 | 0.120 | 0.120 | 0.120 |
| Mar | 74 | 0.011 | 0.014 | 1.4 | 0.0018 | 0.012 | 0.077 | 0.077 | 0.077 |
| Apr | 105 | 0.009 | 0.011 | 1.4 | 0.0010 | 0.005 | 0.076 | 0.076 | 0.076 |
| May | 135 | 0.008 | 0.011 | 1.4 | 0.0018 | 0.005 | 0.078 | 0.078 | 0.078 |
| Jun | 166 | 0.006 | 0.008 | 1.4 | 0.0008 | 0.005 | 0.073 | 0.073 | 0.073 |
| Jul | 197 | 0.006 | 0.009 | 1.3 | 0.0025 | 0.005 | 0.043 | 0.043 | 0.043 |
| Aug | 227 | 0.006 | 0.009 | 1.3 | 0.0019 | 0.005 | 0.032 | 0.032 | 0.032 |
| Sep | 258 | 0.006 | 0.009 | 1.4 | 0.0030 | 0.005 | 0.037 | 0.037 | 0.037 |
| Oct | 288 | 0.006 | 0.006 | 1.4 | 0.0001 | 0.005 | 0.018 | 0.018 | 0.018 |
| Nov | 319 | 0.005 | 0.008 | 1.4 | 0.0025 | 0.005 | 0.021 | 0.021 | 0.021 |
| Dec | 350 | 0.009 | 0.012 | 1.4 | 0.0023 | 0.005 | 0.024 | 0.024 | 0.024 |
| | | | | | | | | | |
| Mean | | 0.008 | 0.011 | 1.4 | 0.002 | 0.007 | 0.061 | 0.061 | 0.061 |

**Table 6. Little Spokane River concentrations for the TMDL scenario (EPA, WA Department of Ecology).**

| Month | Mid-month Julian Day | PO4-P (mg/l) | Total P (mg/l) | CBOD ultimate (mg/l) | CBODP (mg/l) | Ammonia Nitrogen (mg/l) | Algae Group 1 (mg/l) | Algae Group 2 (mg/l) | Algae Group 3 (mg/l) |
|---|---|---|---|---|---|---|---|---|---|
| Jan | 14 | 0.013 | 0.026 | 2.104 | 0.0099 | 0.012 | 0.241 | 0.241 | 0.241 |
| Feb | 44 | 0.013 | 0.031 | 2.104 | 0.0149 | 0.011 | 0.235 | 0.235 | 0.235 |
| Mar | 74 | 0.015 | 0.040 | 2.104 | 0.0211 | 0.051 | 0.219 | 0.219 | 0.219 |
| Apr | 105 | 0.014 | 0.032 | 2.104 | 0.0144 | 0.042 | 0.219 | 0.219 | 0.219 |
| May | 135 | 0.012 | 0.030 | 2.104 | 0.0141 | 0.011 | 0.219 | 0.219 | 0.219 |
| Jun | 166 | 0.007 | 0.023 | 2.104 | 0.0131 | 0.005 | 0.218 | 0.218 | 0.218 |
| Jul | 197 | 0.009 | 0.016 | 1.300 | 0.0064 | 0.005 | 0.078 | 0.078 | 0.078 |
| Aug | 227 | 0.009 | 0.015 | 1.300 | 0.0053 | 0.007 | 0.056 | 0.056 | 0.056 |
| Sep | 258 | 0.007 | 0.015 | 1.660 | 0.0075 | 0.005 | 0.061 | 0.061 | 0.061 |
| Oct | 288 | 0.007 | 0.019 | 1.592 | 0.0115 | 0.005 | 0.054 | 0.054 | 0.054 |
| Nov | 319 | 0.009 | 0.021 | 1.592 | 0.0111 | 0.005 | 0.055 | 0.055 | 0.055 |
| Dec | 350 | 0.015 | 0.027 | 1.592 | 0.0117 | 0.009 | 0.056 | 0.056 | 0.056 |
| | | | | | | | | | |
| Mean | | 0.011 | 0.025 | 1.8 | 0.012 | 0.014 | 0.142 | 0.142 | 0.142 |

## *Results*

### River

Total phosphorus concentrations for the scenarios were plotted for the Idaho-Washington state line, segment 154 in Long Lake, and segment 157 in Long Lake. The total phosphorus concentrations plotted were a 30 day running average. Figure 1 shows the predicted total phosphorus concentrations for the state line.

Figure 2 and Figure 3 show the total phosphorus concentrations for segments 154 and 157 in Long Lake. CBOD ultimate for segment 154 was plotted in Figure 4. Segment 154 dissolved oxygen and ammonia nitrogen were shown in Figure 5 and Figure 6, respectively.

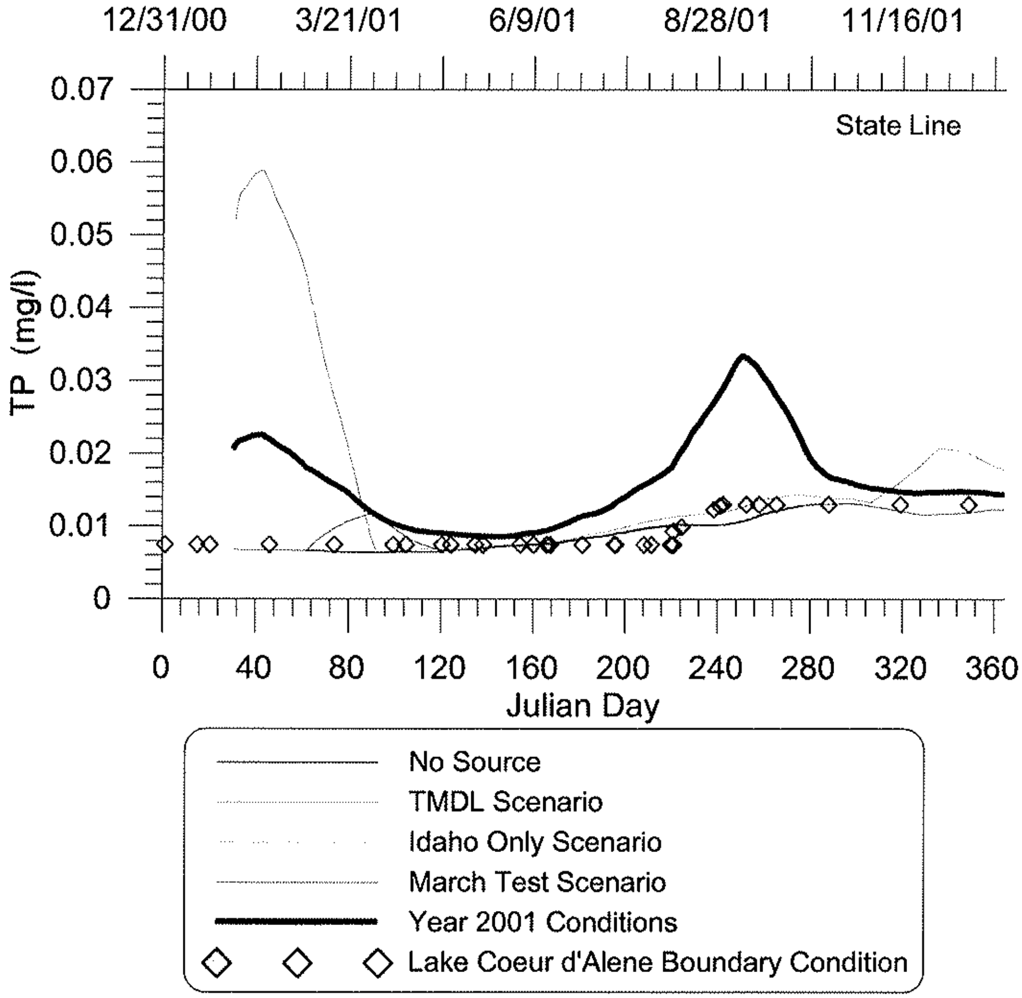


**Figure 1. 30-day running average total phosphorus concentrations at the state line of the no source scenario, the TMDL scenario, Idaho only scenario, March test scenario and for year 2001 conditions.**

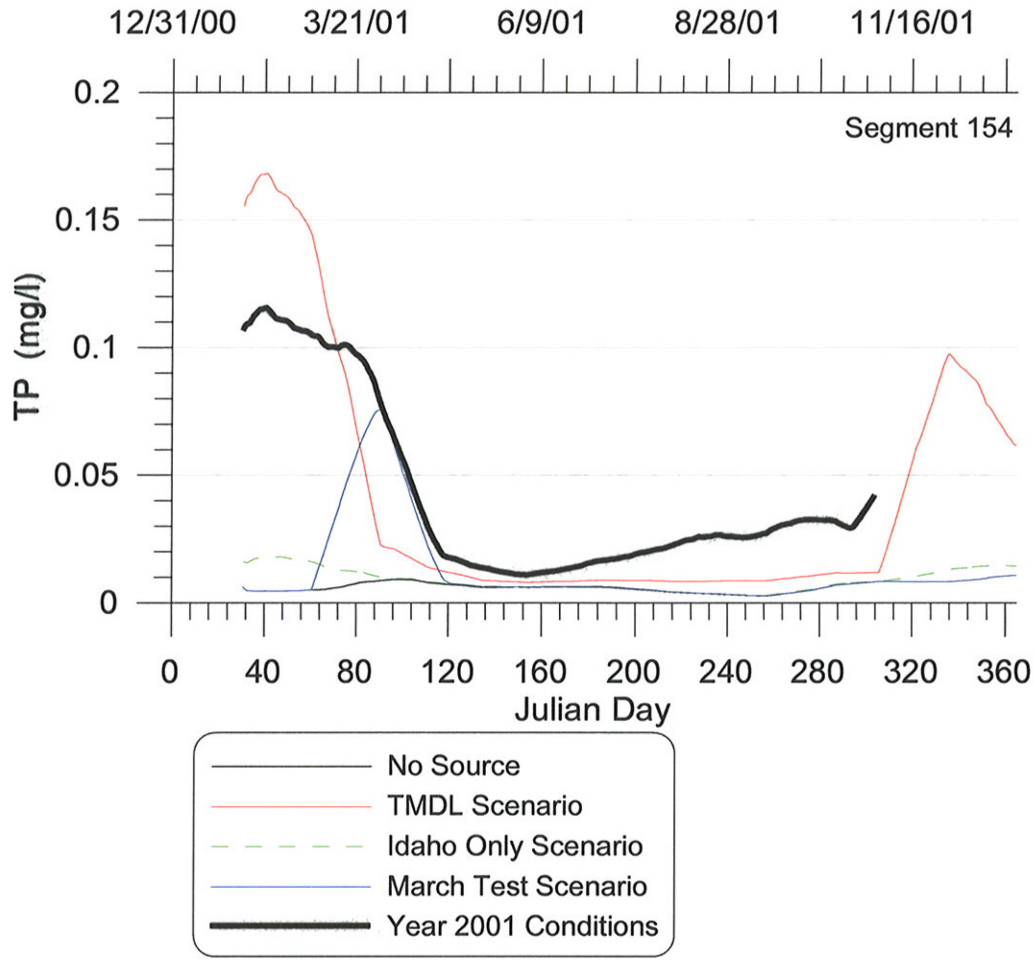


**Figure 2. 30-day running average total phosphorus concentrations at segment 154 in Long Lake of the no source scenario, the TMDL scenario, Idaho only scenario, March test scenario and for year 2001 conditions.**

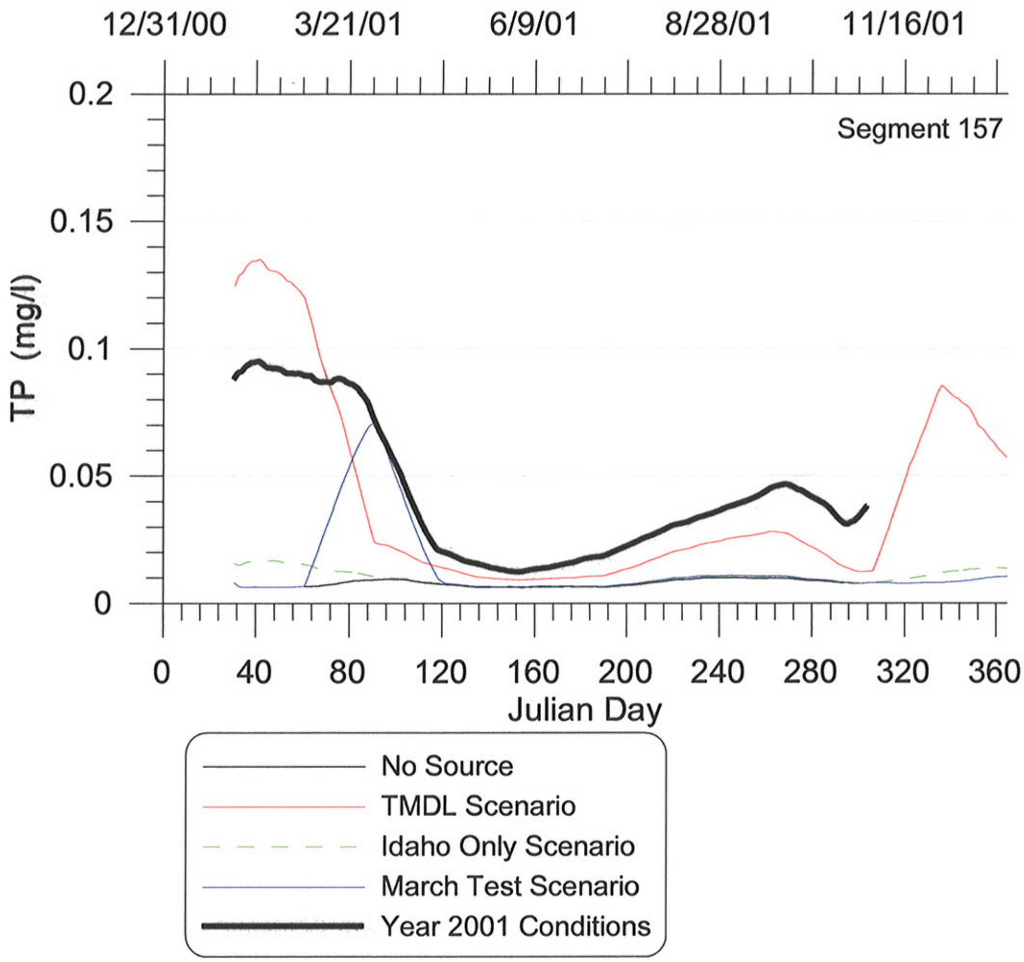


**Figure 3. 30-day running average total phosphorus concentrations at segment 157 in Long Lake of the no source scenario, the TMDL scenario, Idaho only scenario, March test scenario and for year 2001 conditions.**

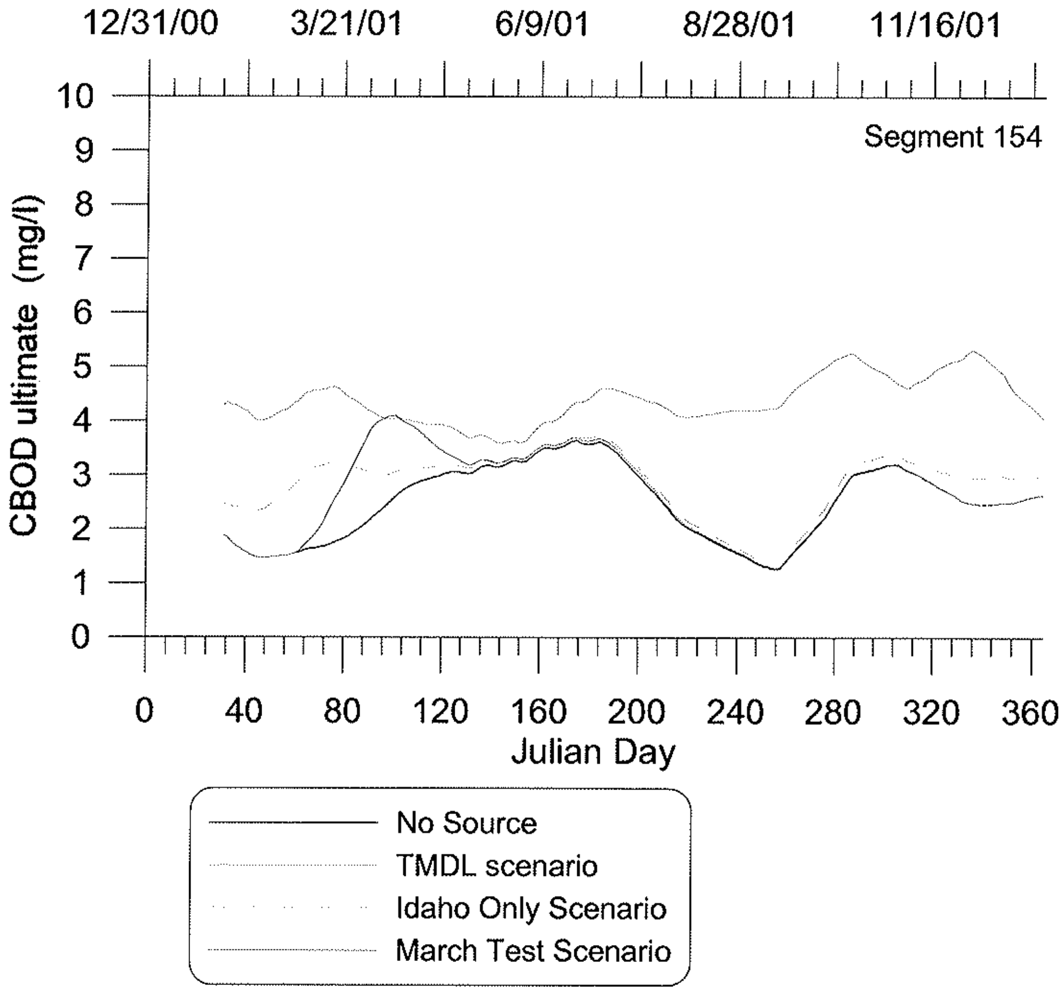


**Figure 4. 30-day running average total CBOD ultimate concentrations at segment 154 in Long Lake of the no source scenario, the TMDL scenario, Idaho only scenario, and March test scenario.**

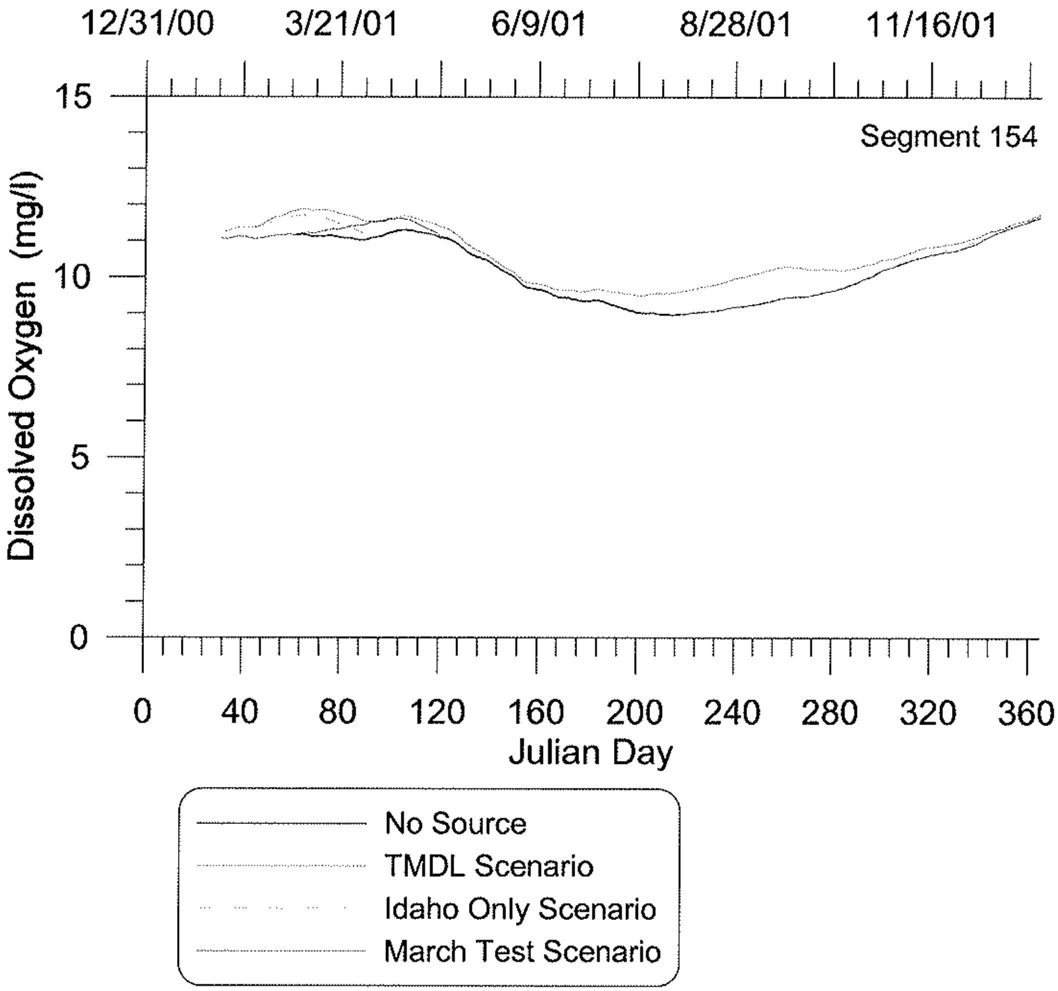


**Figure 5. 30-day running average dissolved oxygen concentrations at segment 154 in Long Lake of the no source scenario, the TMDL scenario, Idaho only scenario, and March test scenario.**

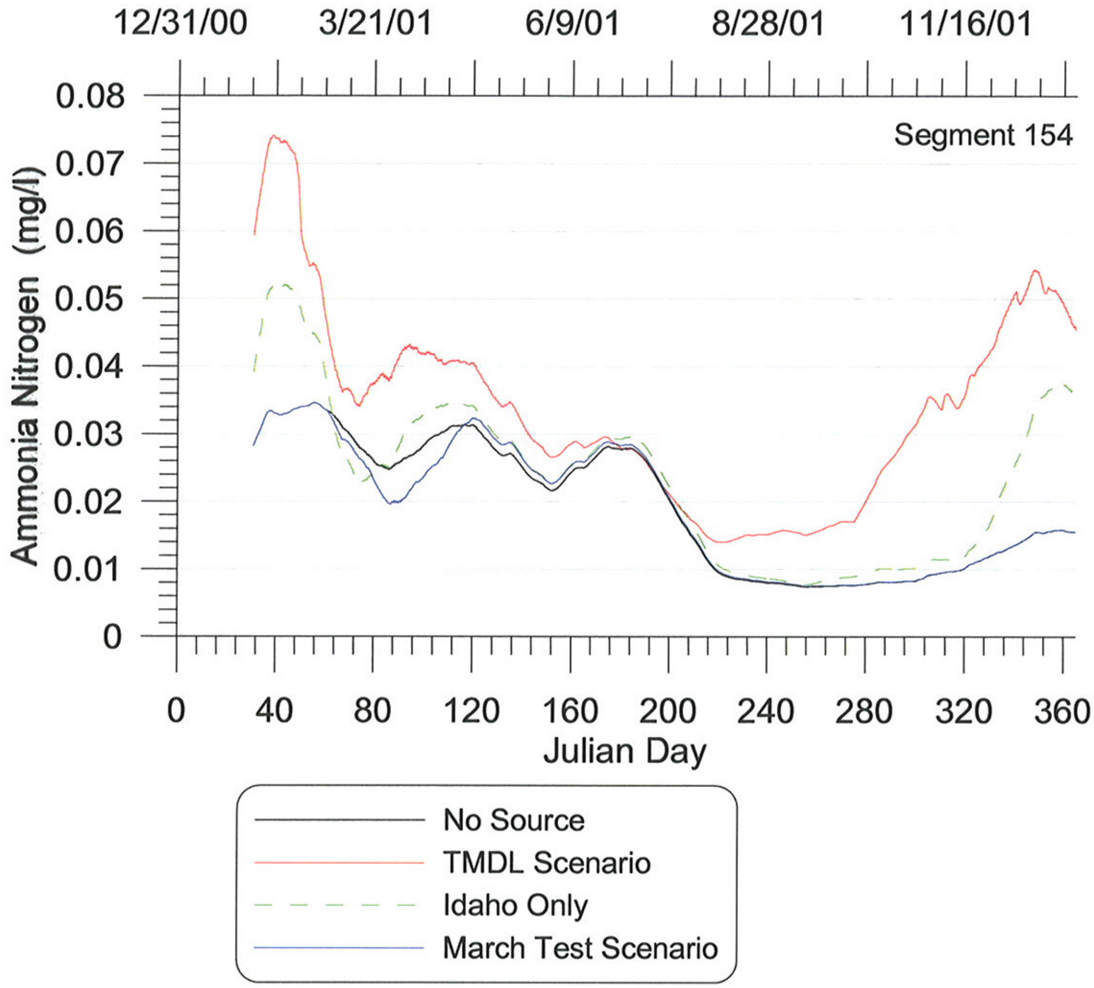


**Figure 6. 30-day running average ammonia nitrogen concentrations at segment 154 in Long Lake of the no source scenario, the TMDL scenario, Idaho only scenario, and March test scenario.**

### Reservoir

The semi-monthly averages of the daily minimum, volume-averaged DO in the hypolimnion (greater than 8 m depth) of each Long Lake segment (158-188) for the scenarios were listed in Table 7 through Table 12. Long Lake segments 154, 155, and 156 were shallower than 8 m and not included in the tables. Long Lake segment 157 was also not included because the segment satisfies the greater than 8 m depth criterion barely for only part of the time period. The water level difference between the scenarios was small but not zero, and the middle of the bottom most active cell may be greater than greater than 8 m for one scenario while the other was less than 8 m. For comparison the no source concentrations were also listed along with the difference in dissolved oxygen concentration between the TMDL, Idaho only, and March test and the no source scenario. The greatest DO difference of the TMDL scenario with respect to the no source scenario was 1.22 mg/l, which occurred during the August 16-31 time period in model segment 187, one segment upstream from Long Lake dam. The Idaho only scenario differed from the no source at a maximum of 0.17 mg/l during August 1-15 at the dam segment (segment 188).

The semi-monthly averages of the daily minimum, volume-averaged DO for the full water column of all Long Lake segments (154-188) were listed in Table 13 through Table 18. The greatest difference between the no source and the TMDL scenario was 0.78 mg/l and occurred at the dam segment (segment 188) during the August 16-31 time period.

**Table 7. TMDL scenario average dissolved oxygen concentrations at greater than 8 m depth for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the TMDL predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 158 | **9.42** | *9.66* | -0.24 | **9.42** | *9.79* | -0.36 | **9.06** | *9.49* | -0.43 | **9.11** | *9.60* | -0.49 | **9.14** | *9.65* | -0.50 | **9.31** | *9.84* | -0.54 | **9.46** | *9.99* | -0.52 |
| 159 | **9.54** | *9.84* | -0.31 | **9.46** | *9.86* | -0.41 | **9.13** | *9.53* | -0.40 | **9.19** | *9.62* | -0.43 | **9.19** | *9.63* | -0.44 | **9.32** | *9.78* | -0.46 | **9.47** | *9.93* | -0.47 |
| 160 | **9.57** | *9.88* | -0.32 | **9.45** | *9.85* | -0.40 | **9.12** | *9.47* | -0.35 | **9.19** | *9.58* | -0.39 | **9.18** | *9.56* | -0.38 | **9.30** | *9.70* | -0.41 | **9.44** | *9.87* | -0.43 |
| 161 | **9.56** | *9.87* | -0.31 | **9.51** | *9.94* | -0.43 | **9.16** | *9.52* | -0.36 | **9.19** | *9.57* | -0.38 | **9.19** | *9.55* | -0.36 | **9.30** | *9.68* | -0.38 | **9.45** | *9.84* | -0.40 |
| 162 | **9.56** | *9.89* | -0.33 | **9.55** | *10.01* | -0.46 | **9.16** | *9.53* | -0.36 | **9.18** | *9.59* | -0.40 | **9.18** | *9.53* | -0.35 | **9.26** | *9.61* | -0.36 | **9.41** | *9.79* | -0.38 |
| 163 | **9.58** | *9.96* | -0.38 | **9.59** | *10.06* | -0.47 | **9.18** | *9.56* | -0.38 | **9.17** | *9.63* | -0.46 | **9.17** | *9.53* | -0.36 | **9.18** | *9.52* | -0.34 | **9.31** | *9.73* | -0.42 |
| 164 | **9.61** | *10.03* | -0.42 | **9.58** | *10.08* | -0.50 | **9.15** | *9.52* | -0.36 | **9.14** | *9.62* | -0.48 | **9.13** | *9.47* | -0.34 | **9.10** | *9.37* | -0.27 | **9.20** | *9.62* | -0.42 |
| 165 | **9.62** | *10.05* | -0.43 | **9.57** | *10.10* | -0.53 | **9.06** | *9.38* | -0.31 | **9.09** | *9.53* | -0.44 | **9.07** | *9.36* | -0.29 | **8.96** | *9.12* | -0.15 | **9.11** | *9.50* | -0.39 |
| 166 | **9.59** | *10.03* | -0.43 | **9.51** | *10.03* | -0.51 | **8.87** | *9.07* | -0.20 | **8.98** | *9.30* | -0.32 | **8.97** | *9.15* | -0.19 | **8.82** | *8.85* | -0.03 | **9.07** | *9.38* | -0.31 |
| 167 | **9.59** | *10.03* | -0.44 | **9.48** | *9.98* | -0.50 | **8.73** | *8.87* | -0.14 | **8.84** | *9.07* | -0.23 | **8.87** | *8.97* | -0.10 | **8.69** | *8.63* | 0.06 | **9.01** | *9.27* | -0.26 |
| 168 | **9.61** | *10.10* | -0.49 | **9.43** | *9.91* | -0.48 | **8.52** | *8.58* | -0.06 | **8.55** | *8.63* | -0.08 | **8.66** | *8.57* | 0.09 | **8.44** | *8.20* | 0.25 | **8.95** | *9.11* | -0.17 |
| 169 | **9.62** | *10.16* | -0.54 | **9.37** | *9.82* | -0.45 | **8.41** | *8.41* | 0.00 | **8.36** | *8.37* | -0.01 | **8.47** | *8.31* | 0.16 | **8.25** | *7.92* | 0.33 | **8.85** | *8.91* | -0.06 |
| 170 | **9.60** | *10.18* | -0.57 | **9.28** | *9.72* | -0.43 | **8.37** | *8.36* | 0.00 | **8.27** | *8.23* | 0.04 | **8.37** | *8.17* | 0.20 | **8.13** | *7.71* | 0.41 | **8.69** | *8.66* | 0.04 |
| 171 | **9.58** | *10.17* | -0.59 | **9.23** | *9.66* | -0.42 | **8.40** | *8.39* | 0.01 | **8.23** | *8.17* | 0.06 | **8.31** | *8.07* | 0.23 | **8.04** | *7.55* | 0.49 | **8.57** | *8.43* | 0.14 |
| 172 | **9.50** | *10.08* | -0.58 | **9.08** | *9.46* | -0.38 | **8.23** | *8.17* | 0.06 | **7.96** | *7.80* | 0.15 | **7.98** | *7.63* | 0.35 | **7.70** | *7.07* | 0.63 | **8.35** | *8.06* | 0.29 |
| 173 | **9.40** | *9.96* | -0.56 | **8.96** | *9.31* | -0.35 | **8.12** | *8.00* | 0.12 | **7.80** | *7.55* | 0.24 | **7.80** | *7.36* | 0.44 | **7.51** | *6.78* | 0.73 | **8.15** | *7.75* | 0.40 |
| 174 | **9.29** | *9.80* | -0.51 | **8.81** | *9.12* | -0.31 | **7.96** | *7.79* | 0.18 | **7.59** | *7.27* | 0.33 | **7.56** | *7.05* | 0.51 | **7.26** | *6.42* | 0.84 | **7.85** | *7.34* | 0.51 |
| 175 | **9.20** | *9.68* | -0.48 | **8.69** | *8.99* | -0.30 | **7.86** | *7.66* | 0.19 | **7.46** | *7.09* | 0.37 | **7.40** | *6.84* | 0.56 | **7.09** | *6.21* | 0.87 | **7.62** | *7.04* | 0.58 |
| 176 | **9.12** | *9.59* | -0.47 | **8.63** | *8.91* | -0.29 | **7.83** | *7.60* | 0.22 | **7.41** | *6.99* | 0.42 | **7.39** | *6.79* | 0.60 | **7.06** | *6.13* | 0.93 | **7.55** | *6.91* | 0.64 |
| 177 | **8.93** | *9.31* | -0.38 | **8.35** | *8.54* | -0.19 | **7.50** | *7.19* | 0.31 | **6.99** | *6.46* | 0.53 | **6.92** | *6.22* | 0.70 | **6.56** | *5.54* | 1.03 | **7.01** | *6.24* | 0.77 |
| 178 | **8.85** | *9.21* | -0.36 | **8.27** | *8.42* | -0.15 | **7.44** | *7.10* | 0.33 | **6.92** | *6.34* | 0.58 | **6.88** | *6.15* | 0.73 | **6.51** | *5.47* | 1.05 | **6.89** | *6.06* | 0.82 |
| 179 | **8.79** | *9.14* | -0.35 | **8.24** | *8.37* | -0.13 | **7.42** | *7.07* | 0.35 | **6.88** | *6.27* | 0.61 | **6.86** | *6.11* | 0.76 | **6.51** | *5.44* | 1.07 | **6.81** | *5.92* | 0.89 |
| 180 | **8.73** | *9.05* | -0.32 | **8.19** | *8.30* | -0.10 | **7.38** | *7.02* | 0.36 | **6.83** | *6.19* | 0.64 | **6.81** | *6.03* | 0.79 | **6.49** | *5.42* | 1.07 | **6.67** | *5.75* | 0.92 |
| 181 | **8.66** | *8.95* | -0.29 | **8.15** | *8.21* | -0.06 | **7.36** | *6.97* | 0.39 | **6.78** | *6.08* | 0.70 | **6.74** | *5.89* | 0.85 | **6.47** | *5.36* | 1.12 | **6.52** | *5.53* | 0.99 |
| 182 | **8.67** | *8.95* | -0.28 | **8.16** | *8.21* | -0.05 | **7.41** | *7.01* | 0.39 | **6.84** | *6.13* | 0.71 | **6.78** | *5.92* | 0.86 | **6.56** | *5.46* | 1.10 | **6.53** | *5.52* | 1.01 |
| 183 | **8.55** | *8.78* | -0.23 | **8.00** | *7.98* | 0.02 | **7.26** | *6.85* | 0.42 | **6.70** | *5.97* | 0.73 | **6.58** | *5.69* | 0.89 | **6.37** | *5.29* | 1.08 | **6.29** | *5.27* | 1.02 |
| 184 | **8.54** | *8.75* | -0.21 | **7.98** | *7.94* | 0.04 | **7.30** | *6.88* | 0.42 | **6.77** | *6.01* | 0.76 | **6.63** | *5.71* | 0.92 | **6.43** | *5.33* | 1.10 | **6.30** | *5.34* | 0.96 |
| 185 | **8.47** | *8.63* | -0.16 | **7.94** | *7.87* | 0.07 | **7.29** | *6.88* | 0.41 | **6.78** | *6.00* | 0.78 | **6.58** | *5.64* | 0.94 | **6.42** | *5.29* | 1.12 | **6.23** | *5.27* | 0.95 |
| 186 | **8.34** | *8.44* | -0.10 | **7.84** | *7.74* | 0.10 | **7.18** | *6.76* | 0.42 | **6.63** | *5.84* | 0.79 | **6.37** | *5.41* | 0.96 | **6.24** | *5.08* | 1.16 | **5.96** | *4.93* | 1.03 |
| 187 | **8.31** | *8.40* | -0.09 | **7.85** | *7.75* | 0.09 | **7.23** | *6.79* | 0.44 | **6.66** | *5.83* | 0.83 | **6.36** | *5.35* | 1.01 | **6.27** | *5.05* | 1.22 | **5.96** | *4.90* | 1.07 |
| 188 | **8.20** | *8.25* | -0.05 | **7.67** | *7.56* | 0.11 | **7.10** | *6.65* | 0.45 | **6.53** | *5.71* | 0.83 | **6.15** | *5.17* | 0.98 | **6.07** | *4.88* | 1.19 | **5.73** | *4.68* | 1.05 |

**Table 8. TMDL scenario average dissolved oxygen concentrations at greater than 8 m depth for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the TMDL predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No source | TMDL | Difference | No source | TMDL | Difference | No source | TMDL | Difference | No source | TMDL | Difference | No source | TMDL | Difference | No source | TMDL | Difference | No source | TMDL | Difference |
| 158 | 9.63 | 9.91 | -0.28 | 9.99 | 10.08 | -0.08 | 10.49 | 10.55 | -0.05 | 10.67 | 10.85 | -0.19 | 10.80 | 10.80 | 0.00 | 11.43 | 11.49 | -0.06 | 11.50 | 11.54 | -0.05 |
| 159 | 9.62 | 9.85 | -0.23 | 10.01 | 10.09 | -0.09 | 10.51 | 10.56 | -0.05 | 10.70 | 10.89 | -0.19 | 10.83 | 10.81 | 0.01 | 11.43 | 11.49 | -0.06 | 11.51 | 11.58 | -0.07 |
| 160 | 9.60 | 9.79 | -0.19 | 10.01 | 10.10 | -0.09 | 10.52 | 10.56 | -0.04 | 10.69 | 10.90 | -0.21 | 10.82 | 10.78 | 0.04 | 11.43 | 11.48 | -0.05 | 11.50 | 11.59 | -0.09 |
| 161 | 9.60 | 9.77 | -0.18 | 10.02 | 10.10 | -0.08 | 10.52 | 10.54 | -0.03 | 10.69 | 10.88 | -0.19 | 10.83 | 10.77 | 0.06 | 11.43 | 11.48 | -0.05 | 11.49 | 11.57 | -0.08 |
| 162 | 9.58 | 9.74 | -0.16 | 10.04 | 10.12 | -0.08 | 10.55 | 10.57 | -0.03 | 10.67 | 10.83 | -0.16 | 10.82 | 10.73 | 0.09 | 11.43 | 11.46 | -0.04 | 11.49 | 11.57 | -0.07 |
| 163 | 9.52 | 9.72 | -0.20 | 10.01 | 10.12 | -0.10 | 10.57 | 10.60 | -0.04 | 10.66 | 10.80 | -0.15 | 10.81 | 10.70 | 0.11 | 11.42 | 11.45 | -0.02 | 11.49 | 11.56 | -0.07 |
| 164 | 9.41 | 9.66 | -0.25 | 9.91 | 10.06 | -0.16 | 10.55 | 10.60 | -0.04 | 10.65 | 10.79 | -0.13 | 10.80 | 10.66 | 0.14 | 11.40 | 11.41 | -0.01 | 11.48 | 11.54 | -0.06 |
| 165 | 9.30 | 9.59 | -0.29 | 9.77 | 10.00 | -0.23 | 10.47 | 10.54 | -0.07 | 10.65 | 10.79 | -0.14 | 10.81 | 10.64 | 0.17 | 11.39 | 11.38 | 0.01 | 11.47 | 11.53 | -0.06 |
| 166 | 9.26 | 9.47 | -0.21 | 9.70 | 9.91 | -0.22 | 10.42 | 10.48 | -0.06 | 10.60 | 10.70 | -0.10 | 10.78 | 10.59 | 0.20 | 11.37 | 11.33 | 0.04 | 11.45 | 11.49 | -0.04 |
| 167 | 9.20 | 9.36 | -0.16 | 9.63 | 9.85 | -0.22 | 10.37 | 10.42 | -0.05 | 10.59 | 10.67 | -0.08 | 10.79 | 10.58 | 0.21 | 11.36 | 11.30 | 0.06 | 11.43 | 11.48 | -0.05 |
| 168 | 9.15 | 9.23 | -0.09 | 9.56 | 9.78 | -0.22 | 10.28 | 10.36 | -0.08 | 10.59 | 10.64 | -0.05 | 10.80 | 10.57 | 0.23 | 11.34 | 11.27 | 0.08 | 11.43 | 11.47 | -0.04 |
| 169 | 9.10 | 9.13 | -0.03 | 9.49 | 9.70 | -0.21 | 10.17 | 10.28 | -0.11 | 10.61 | 10.66 | -0.05 | 10.79 | 10.55 | 0.25 | 11.27 | 11.11 | 0.16 | 11.41 | 11.43 | -0.03 |
| 170 | 9.03 | 9.01 | 0.02 | 9.40 | 9.60 | -0.20 | 10.04 | 10.17 | -0.13 | 10.56 | 10.63 | -0.07 | 10.79 | 10.51 | 0.28 | 11.20 | 10.92 | 0.28 | 11.38 | 11.37 | 0.01 |
| 171 | 8.96 | 8.86 | 0.10 | 9.31 | 9.48 | -0.17 | 9.91 | 10.06 | -0.15 | 10.48 | 10.54 | -0.06 | 10.75 | 10.44 | 0.31 | 11.20 | 10.92 | 0.28 | 11.36 | 11.31 | 0.05 |
| 172 | 8.86 | 8.65 | 0.21 | 9.26 | 9.40 | -0.13 | 9.82 | 9.99 | -0.16 | 10.37 | 10.41 | -0.04 | 10.72 | 10.40 | 0.32 | 11.29 | 11.06 | 0.23 | 11.43 | 11.39 | 0.04 |
| 173 | 8.75 | 8.46 | 0.30 | 9.21 | 9.31 | -0.09 | 9.77 | 9.91 | -0.14 | 10.29 | 10.29 | 0.01 | 10.68 | 10.35 | 0.33 | 11.29 | 11.03 | 0.26 | 11.46 | 11.41 | 0.05 |
| 174 | 8.56 | 8.16 | 0.40 | 9.17 | 9.18 | -0.01 | 9.75 | 9.85 | -0.09 | 10.27 | 10.24 | 0.03 | 10.66 | 10.33 | 0.33 | 11.27 | 10.97 | 0.30 | 11.45 | 11.38 | 0.07 |
| 175 | 8.37 | 7.92 | 0.45 | 9.09 | 9.06 | 0.02 | 9.73 | 9.80 | -0.07 | 10.24 | 10.19 | 0.05 | 10.64 | 10.32 | 0.32 | 11.26 | 10.95 | 0.32 | 11.46 | 11.37 | 0.08 |
| 176 | 8.27 | 7.77 | 0.50 | 8.95 | 8.87 | 0.08 | 9.67 | 9.72 | -0.05 | 10.16 | 10.08 | 0.08 | 10.60 | 10.30 | 0.29 | 11.24 | 10.90 | 0.34 | 11.50 | 11.39 | 0.11 |
| 177 | 7.79 | 7.15 | 0.64 | 8.66 | 8.46 | 0.21 | 9.69 | 9.70 | -0.01 | 10.15 | 10.05 | 0.10 | 10.58 | 10.29 | 0.29 | 11.21 | 10.86 | 0.36 | 11.50 | 11.37 | 0.13 |
| 178 | 7.60 | 6.88 | 0.71 | 8.50 | 8.23 | 0.26 | 9.68 | 9.67 | 0.01 | 10.12 | 10.00 | 0.12 | 10.55 | 10.27 | 0.28 | 11.19 | 10.83 | 0.37 | 11.52 | 11.37 | 0.15 |
| 179 | 7.53 | 6.75 | 0.78 | 8.44 | 8.13 | 0.31 | 9.65 | 9.63 | 0.02 | 10.08 | 9.93 | 0.15 | 10.52 | 10.25 | 0.27 | 11.18 | 10.80 | 0.38 | 11.58 | 11.40 | 0.18 |
| 180 | 7.36 | 6.51 | 0.85 | 8.30 | 7.92 | 0.38 | 9.62 | 9.57 | 0.05 | 10.06 | 9.88 | 0.17 | 10.50 | 10.23 | 0.28 | 11.17 | 10.78 | 0.39 | 11.61 | 11.40 | 0.21 |
| 181 | 7.18 | 6.24 | 0.94 | 8.12 | 7.64 | 0.49 | 9.54 | 9.43 | 0.11 | 10.04 | 9.84 | 0.20 | 10.48 | 10.20 | 0.28 | 11.16 | 10.76 | 0.40 | 11.59 | 11.35 | 0.24 |
| 182 | 7.03 | 6.04 | 0.98 | 7.97 | 7.47 | 0.49 | 9.41 | 9.25 | 0.16 | 10.04 | 9.83 | 0.21 | 10.48 | 10.19 | 0.29 | 11.15 | 10.74 | 0.41 | 11.56 | 11.31 | 0.25 |
| 183 | 6.66 | 5.63 | 1.03 | 7.59 | 7.01 | 0.58 | 9.28 | 9.09 | 0.19 | 10.02 | 9.79 | 0.23 | 10.47 | 10.17 | 0.30 | 11.15 | 10.74 | 0.41 | 11.59 | 11.30 | 0.29 |
| 184 | 6.50 | 5.50 | 1.01 | 7.29 | 6.69 | 0.61 | 9.14 | 8.88 | 0.25 | 10.01 | 9.76 | 0.25 | 10.46 | 10.16 | 0.31 | 11.14 | 10.73 | 0.41 | 11.59 | 11.29 | 0.31 |
| 185 | 6.31 | 5.29 | 1.01 | 7.02 | 6.35 | 0.67 | 8.90 | 8.56 | 0.34 | 10.00 | 9.74 | 0.26 | 10.46 | 10.16 | 0.31 | 11.13 | 10.71 | 0.42 | 11.59 | 11.26 | 0.33 |
| 186 | 5.94 | 4.89 | 1.05 | 6.66 | 5.82 | 0.84 | 8.64 | 8.26 | 0.38 | 9.96 | 9.68 | 0.29 | 10.46 | 10.15 | 0.31 | 11.11 | 10.67 | 0.44 | 11.55 | 11.21 | 0.34 |
| 187 | 5.88 | 4.81 | 1.08 | 6.39 | 5.52 | 0.87 | 8.51 | 8.14 | 0.37 | 9.94 | 9.63 | 0.31 | 10.44 | 10.12 | 0.32 | 11.09 | 10.64 | 0.45 | 11.52 | 11.18 | 0.34 |
| 188 | 5.57 | 4.52 | 1.04 | 5.88 | 5.12 | 0.76 | 7.96 | 7.52 | 0.44 | 9.91 | 9.52 | 0.39 | 10.40 | 10.08 | 0.32 | 11.07 | 10.61 | 0.46 | 11.55 | 11.19 | 0.36 |

**Table 9. Idaho only scenario average dissolved oxygen concentrations at greater than 8 m depth for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the Idaho only scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 158 | **9.42** | *9.41* | 0.01 | **9.42** | *9.43* | 0.00 | **9.06** | *9.06* | 0.00 | **9.11** | *9.10* | 0.01 | **9.14** | *9.13* | 0.01 | **9.31** | *9.30* | 0.01 | **9.46** | *9.46* | 0.01 |
| 159 | **9.54** | *9.52* | 0.02 | **9.46** | *9.47* | -0.01 | **9.13** | *9.12* | 0.01 | **9.19** | *9.18* | 0.01 | **9.19** | *9.17* | 0.02 | **9.32** | *9.31* | 0.01 | **9.47** | *9.45* | 0.01 |
| 160 | **9.57** | *9.56* | 0.01 | **9.45** | *9.46* | -0.01 | **9.12** | *9.11* | 0.01 | **9.19** | *9.17* | 0.01 | **9.18** | *9.16* | 0.02 | **9.30** | *9.28* | 0.01 | **9.44** | *9.43* | 0.01 |
| 161 | **9.56** | *9.56* | 0.00 | **9.51** | *9.52* | -0.01 | **9.16** | *9.15* | 0.01 | **9.19** | *9.18* | 0.01 | **9.19** | *9.17* | 0.02 | **9.30** | *9.29* | 0.01 | **9.45** | *9.44* | 0.01 |
| 162 | **9.56** | *9.58* | -0.02 | **9.55** | *9.56* | -0.01 | **9.16** | *9.15* | 0.01 | **9.18** | *9.17* | 0.01 | **9.18** | *9.16* | 0.02 | **9.26** | *9.25* | 0.01 | **9.41** | *9.41* | 0.01 |
| 163 | **9.58** | *9.60* | -0.02 | **9.59** | *9.59* | -0.01 | **9.18** | *9.17* | 0.01 | **9.17** | *9.17* | 0.00 | **9.17** | *9.16* | 0.01 | **9.18** | *9.18* | 0.00 | **9.31** | *9.31* | 0.00 |
| 164 | **9.61** | *9.63* | -0.02 | **9.58** | *9.58* | 0.00 | **9.15** | *9.14* | 0.01 | **9.14** | *9.14* | 0.00 | **9.13** | *9.12* | 0.01 | **9.10** | *9.10* | 0.00 | **9.20** | *9.20* | -0.01 |
| 165 | **9.62** | *9.65* | -0.02 | **9.57** | *9.57* | 0.00 | **9.06** | *9.04* | 0.02 | **9.09** | *9.08* | 0.00 | **9.07** | *9.06* | 0.01 | **8.96** | *8.96* | 0.01 | **9.11** | *9.12* | -0.01 |
| 166 | **9.59** | *9.61* | -0.02 | **9.51** | *9.52* | 0.00 | **8.87** | *8.83* | 0.04 | **8.98** | *8.96* | 0.01 | **8.97** | *8.95* | 0.02 | **8.82** | *8.80* | 0.02 | **9.07** | *9.08* | 0.00 |
| 167 | **9.59** | *9.61* | -0.02 | **9.48** | *9.49* | -0.01 | **8.73** | *8.68* | 0.05 | **8.84** | *8.82* | 0.02 | **8.87** | *8.85* | 0.02 | **8.69** | *8.66* | 0.03 | **9.01** | *9.01* | 0.00 |
| 168 | **9.61** | *9.63* | -0.02 | **9.43** | *9.44* | -0.01 | **8.52** | *8.46* | 0.05 | **8.55** | *8.51* | 0.04 | **8.66** | *8.63* | 0.03 | **8.44** | *8.41* | 0.04 | **8.95** | *8.95* | 0.00 |
| 169 | **9.62** | *9.65* | -0.03 | **9.37** | *9.37* | 0.00 | **8.41** | *8.35* | 0.06 | **8.36** | *8.32* | 0.04 | **8.47** | *8.44* | 0.04 | **8.25** | *8.21* | 0.04 | **8.85** | *8.84* | 0.01 |
| 170 | **9.60** | *9.63* | -0.03 | **9.28** | *9.28* | 0.00 | **8.37** | *8.31* | 0.06 | **8.27** | *8.22* | 0.05 | **8.37** | *8.32* | 0.04 | **8.13** | *8.08* | 0.05 | **8.69** | *8.69* | 0.01 |
| 171 | **9.58** | *9.61* | -0.03 | **9.23** | *9.23* | 0.01 | **8.40** | *8.33* | 0.07 | **8.23** | *8.18* | 0.05 | **8.31** | *8.26* | 0.05 | **8.04** | *7.99* | 0.05 | **8.57** | *8.56* | 0.01 |
| 172 | **9.50** | *9.53* | -0.03 | **9.08** | *9.07* | 0.01 | **8.23** | *8.16* | 0.07 | **7.96** | *7.90* | 0.06 | **7.98** | *7.92* | 0.06 | **7.70** | *7.64* | 0.06 | **8.35** | *8.33* | 0.02 |
| 173 | **9.40** | *9.43* | -0.03 | **8.96** | *8.95* | 0.01 | **8.12** | *8.04* | 0.08 | **7.80** | *7.72* | 0.07 | **7.80** | *7.72* | 0.07 | **7.51** | *7.44* | 0.07 | **8.15** | *8.13* | 0.02 |
| 174 | **9.29** | *9.31* | -0.02 | **8.81** | *8.79* | 0.02 | **7.96** | *7.88* | 0.08 | **7.59** | *7.51* | 0.09 | **7.56** | *7.47* | 0.08 | **7.26** | *7.17* | 0.08 | **7.85** | *7.81* | 0.03 |
| 175 | **9.20** | *9.23* | -0.02 | **8.69** | *8.67* | 0.02 | **7.86** | *7.77* | 0.08 | **7.46** | *7.37* | 0.09 | **7.40** | *7.31* | 0.09 | **7.09** | *7.00* | 0.09 | **7.62** | *7.58* | 0.04 |
| 176 | **9.12** | *9.14* | -0.02 | **8.63** | *8.61* | 0.02 | **7.83** | *7.74* | 0.09 | **7.41** | *7.31* | 0.10 | **7.39** | *7.30* | 0.09 | **7.06** | *6.96* | 0.09 | **7.55** | *7.50* | 0.05 |
| 177 | **8.93** | *8.94* | -0.01 | **8.35** | *8.32* | 0.03 | **7.50** | *7.41* | 0.09 | **6.99** | *6.88* | 0.11 | **6.92** | *6.81* | 0.11 | **6.56** | *6.45* | 0.11 | **7.01** | *6.94* | 0.07 |
| 178 | **8.85** | *8.86* | -0.01 | **8.27** | *8.24* | 0.03 | **7.44** | *7.34* | 0.10 | **6.92** | *6.80* | 0.12 | **6.88** | *6.77* | 0.11 | **6.51** | *6.39* | 0.12 | **6.89** | *6.81* | 0.08 |
| 179 | **8.79** | *8.80* | -0.01 | **8.24** | *8.20* | 0.04 | **7.42** | *7.32* | 0.10 | **6.88** | *6.75* | 0.12 | **6.86** | *6.75* | 0.12 | **6.51** | *6.39* | 0.12 | **6.81** | *6.72* | 0.09 |
| 180 | **8.73** | *8.73* | -0.01 | **8.19** | *8.16* | 0.03 | **7.38** | *7.28* | 0.10 | **6.83** | *6.71* | 0.13 | **6.81** | *6.70* | 0.12 | **6.49** | *6.37* | 0.12 | **6.67** | *6.58* | 0.09 |
| 181 | **8.66** | *8.66* | 0.00 | **8.15** | *8.11* | 0.03 | **7.36** | *7.26* | 0.10 | **6.78** | *6.64* | 0.13 | **6.74** | *6.61* | 0.12 | **6.47** | *6.34* | 0.13 | **6.52** | *6.42* | 0.11 |
| 182 | **8.67** | *8.67* | 0.00 | **8.16** | *8.13* | 0.03 | **7.41** | *7.31* | 0.10 | **6.84** | *6.71* | 0.13 | **6.78** | *6.66* | 0.12 | **6.56** | *6.44* | 0.13 | **6.53** | *6.42* | 0.11 |
| 183 | **8.55** | *8.55* | 0.01 | **8.00** | *7.96* | 0.04 | **7.26** | *7.15* | 0.11 | **6.70** | *6.56* | 0.14 | **6.58** | *6.45* | 0.13 | **6.37** | *6.23* | 0.13 | **6.29** | *6.17* | 0.12 |
| 184 | **8.54** | *8.53* | 0.01 | **7.98** | *7.95* | 0.04 | **7.30** | *7.19* | 0.11 | **6.77** | *6.62* | 0.14 | **6.63** | *6.50* | 0.14 | **6.43** | *6.30* | 0.13 | **6.30** | *6.18* | 0.12 |
| 185 | **8.47** | *8.45* | 0.02 | **7.94** | *7.90* | 0.04 | **7.29** | *7.18* | 0.11 | **6.78** | *6.63* | 0.14 | **6.58** | *6.44* | 0.14 | **6.42** | *6.28* | 0.14 | **6.23** | *6.10* | 0.13 |
| 186 | **8.34** | *8.31* | 0.03 | **7.84** | *7.79* | 0.05 | **7.18** | *7.07* | 0.11 | **6.63** | *6.48* | 0.15 | **6.37** | *6.22* | 0.15 | **6.24** | *6.09* | 0.15 | **5.96** | *5.82* | 0.15 |
| 187 | **8.31** | *8.28* | 0.03 | **7.85** | *7.80* | 0.05 | **7.23** | *7.12* | 0.11 | **6.66** | *6.51* | 0.15 | **6.36** | *6.19* | 0.16 | **6.27** | *6.11* | 0.16 | **5.96** | *5.81* | 0.15 |
| 188 | **8.20** | *8.15* | 0.05 | **7.67** | *7.62* | 0.05 | **7.10** | *6.99* | 0.11 | **6.53** | *6.38* | 0.16 | **6.15** | *5.98* | 0.17 | **6.07** | *5.91* | 0.16 | **5.73** | *5.57* | 0.16 |

**Table 10. Idaho only scenario average dissolved oxygen concentrations at greater than 8 m depth for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the Idaho only scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 158 | 9.63 | 9.61 | 0.02 | 9.99 | 9.95 | 0.04 | 10.49 | 10.46 | 0.03 | 10.67 | 10.74 | -0.07 | 10.80 | 10.84 | -0.04 | 11.43 | 11.48 | -0.05 | 11.50 | 11.53 | -0.03 |
| 159 | 9.62 | 9.59 | 0.03 | 10.01 | 9.96 | 0.04 | 10.51 | 10.48 | 0.03 | 10.70 | 10.78 | -0.08 | 10.83 | 10.87 | -0.04 | 11.43 | 11.48 | -0.05 | 11.51 | 11.55 | -0.04 |
| 160 | 9.60 | 9.57 | 0.03 | 10.01 | 9.97 | 0.04 | 10.52 | 10.48 | 0.04 | 10.69 | 10.78 | -0.09 | 10.82 | 10.86 | -0.04 | 11.43 | 11.48 | -0.05 | 11.50 | 11.54 | -0.04 |
| 161 | 9.60 | 9.57 | 0.03 | 10.02 | 9.98 | 0.04 | 10.52 | 10.48 | 0.04 | 10.69 | 10.77 | -0.09 | 10.83 | 10.87 | -0.04 | 11.43 | 11.48 | -0.05 | 11.49 | 11.54 | -0.05 |
| 162 | 9.58 | 9.55 | 0.03 | 10.04 | 10.00 | 0.04 | 10.55 | 10.51 | 0.04 | 10.67 | 10.75 | -0.08 | 10.82 | 10.87 | -0.05 | 11.43 | 11.48 | -0.06 | 11.49 | 11.55 | -0.05 |
| 163 | 9.52 | 9.50 | 0.02 | 10.01 | 9.97 | 0.04 | 10.57 | 10.52 | 0.04 | 10.66 | 10.74 | -0.08 | 10.81 | 10.86 | -0.05 | 11.42 | 11.48 | -0.05 | 11.49 | 11.54 | -0.05 |
| 164 | 9.41 | 9.39 | 0.02 | 9.91 | 9.87 | 0.03 | 10.55 | 10.51 | 0.04 | 10.65 | 10.73 | -0.07 | 10.80 | 10.86 | -0.06 | 11.40 | 11.45 | -0.05 | 11.48 | 11.53 | -0.05 |
| 165 | 9.30 | 9.29 | 0.02 | 9.77 | 9.74 | 0.03 | 10.47 | 10.43 | 0.04 | 10.65 | 10.72 | -0.07 | 10.81 | 10.86 | -0.05 | 11.39 | 11.44 | -0.05 | 11.47 | 11.51 | -0.05 |
| 166 | 9.26 | 9.25 | 0.02 | 9.70 | 9.67 | 0.03 | 10.42 | 10.38 | 0.04 | 10.60 | 10.65 | -0.05 | 10.78 | 10.84 | -0.06 | 11.37 | 11.42 | -0.05 | 11.45 | 11.50 | -0.05 |
| 167 | 9.20 | 9.18 | 0.02 | 9.63 | 9.60 | 0.02 | 10.37 | 10.33 | 0.04 | 10.59 | 10.64 | -0.04 | 10.79 | 10.85 | -0.06 | 11.36 | 11.41 | -0.05 | 11.43 | 11.48 | -0.05 |
| 168 | 9.15 | 9.12 | 0.03 | 9.56 | 9.53 | 0.02 | 10.28 | 10.24 | 0.04 | 10.59 | 10.63 | -0.03 | 10.80 | 10.86 | -0.06 | 11.34 | 11.39 | -0.04 | 11.43 | 11.48 | -0.05 |
| 169 | 9.10 | 9.07 | 0.03 | 9.49 | 9.46 | 0.02 | 10.17 | 10.14 | 0.03 | 10.61 | 10.64 | -0.02 | 10.79 | 10.86 | -0.07 | 11.27 | 11.31 | -0.03 | 11.41 | 11.46 | -0.05 |
| 170 | 9.03 | 9.00 | 0.03 | 9.40 | 9.37 | 0.02 | 10.04 | 10.01 | 0.03 | 10.56 | 10.58 | -0.02 | 10.79 | 10.85 | -0.06 | 11.20 | 11.21 | -0.01 | 11.38 | 11.42 | -0.05 |
| 171 | 8.96 | 8.93 | 0.03 | 9.31 | 9.29 | 0.02 | 9.91 | 9.89 | 0.03 | 10.48 | 10.49 | 0.00 | 10.75 | 10.81 | -0.05 | 11.20 | 11.21 | -0.01 | 11.36 | 11.40 | -0.04 |
| 172 | 8.86 | 8.82 | 0.04 | 9.26 | 9.24 | 0.03 | 9.82 | 9.80 | 0.02 | 10.37 | 10.36 | 0.01 | 10.72 | 10.75 | -0.03 | 11.29 | 11.31 | -0.02 | 11.43 | 11.47 | -0.04 |
| 173 | 8.75 | 8.71 | 0.04 | 9.21 | 9.19 | 0.03 | 9.77 | 9.75 | 0.02 | 10.29 | 10.28 | 0.02 | 10.68 | 10.70 | -0.02 | 11.29 | 11.31 | -0.02 | 11.46 | 11.49 | -0.04 |
| 174 | 8.56 | 8.52 | 0.04 | 9.17 | 9.13 | 0.03 | 9.75 | 9.73 | 0.03 | 10.27 | 10.25 | 0.02 | 10.66 | 10.68 | -0.02 | 11.27 | 11.28 | -0.01 | 11.45 | 11.48 | -0.03 |
| 175 | 8.37 | 8.33 | 0.04 | 9.09 | 9.05 | 0.04 | 9.73 | 9.71 | 0.03 | 10.24 | 10.22 | 0.02 | 10.64 | 10.66 | -0.02 | 11.26 | 11.27 | -0.01 | 11.46 | 11.48 | -0.03 |
| 176 | 8.27 | 8.23 | 0.04 | 8.95 | 8.91 | 0.04 | 9.67 | 9.64 | 0.03 | 10.16 | 10.14 | 0.03 | 10.60 | 10.60 | -0.01 | 11.24 | 11.24 | 0.00 | 11.50 | 11.52 | -0.02 |
| 177 | 7.79 | 7.73 | 0.05 | 8.66 | 8.61 | 0.05 | 9.69 | 9.66 | 0.03 | 10.15 | 10.12 | 0.03 | 10.58 | 10.58 | 0.00 | 11.21 | 11.21 | 0.01 | 11.50 | 11.52 | -0.02 |
| 178 | 7.60 | 7.54 | 0.06 | 8.50 | 8.44 | 0.06 | 9.68 | 9.64 | 0.03 | 10.12 | 10.09 | 0.03 | 10.55 | 10.55 | 0.00 | 11.19 | 11.18 | 0.01 | 11.52 | 11.54 | -0.02 |
| 179 | 7.53 | 7.47 | 0.06 | 8.44 | 8.38 | 0.06 | 9.65 | 9.62 | 0.03 | 10.08 | 10.05 | 0.03 | 10.52 | 10.52 | 0.00 | 11.18 | 11.16 | 0.02 | 11.58 | 11.59 | -0.01 |
| 180 | 7.36 | 7.29 | 0.07 | 8.30 | 8.24 | 0.07 | 9.62 | 9.59 | 0.04 | 10.06 | 10.02 | 0.03 | 10.50 | 10.49 | 0.01 | 11.17 | 11.15 | 0.02 | 11.61 | 11.62 | -0.01 |
| 181 | 7.18 | 7.11 | 0.07 | 8.12 | 8.05 | 0.08 | 9.54 | 9.49 | 0.04 | 10.04 | 10.00 | 0.04 | 10.48 | 10.47 | 0.01 | 11.16 | 11.13 | 0.03 | 11.59 | 11.60 | 0.00 |
| 182 | 7.03 | 6.95 | 0.08 | 7.97 | 7.89 | 0.08 | 9.41 | 9.36 | 0.05 | 10.04 | 10.00 | 0.04 | 10.48 | 10.47 | 0.01 | 11.15 | 11.12 | 0.03 | 11.56 | 11.56 | 0.00 |
| 183 | 6.66 | 6.57 | 0.09 | 7.59 | 7.50 | 0.09 | 9.28 | 9.23 | 0.05 | 10.02 | 9.98 | 0.04 | 10.47 | 10.45 | 0.02 | 11.15 | 11.12 | 0.03 | 11.59 | 11.58 | 0.00 |
| 184 | 6.50 | 6.40 | 0.10 | 7.29 | 7.20 | 0.10 | 9.14 | 9.08 | 0.06 | 10.01 | 9.96 | 0.05 | 10.46 | 10.44 | 0.02 | 11.14 | 11.11 | 0.03 | 11.59 | 11.58 | 0.01 |
| 185 | 6.31 | 6.20 | 0.11 | 7.02 | 6.91 | 0.11 | 8.90 | 8.83 | 0.07 | 10.00 | 9.95 | 0.05 | 10.46 | 10.45 | 0.02 | 11.13 | 11.10 | 0.03 | 11.59 | 11.57 | 0.02 |
| 186 | 5.94 | 5.81 | 0.13 | 6.66 | 6.54 | 0.12 | 8.64 | 8.56 | 0.08 | 9.96 | 9.90 | 0.06 | 10.46 | 10.44 | 0.01 | 11.11 | 11.08 | 0.03 | 11.55 | 11.53 | 0.02 |
| 187 | 5.88 | 5.75 | 0.14 | 6.39 | 6.26 | 0.13 | 8.51 | 8.43 | 0.08 | 9.94 | 9.87 | 0.06 | 10.44 | 10.43 | 0.01 | 11.09 | 11.06 | 0.03 | 11.52 | 11.50 | 0.02 |
| 188 | 5.57 | 5.42 | 0.15 | 5.88 | 5.75 | 0.13 | 7.96 | 7.88 | 0.09 | 9.91 | 9.84 | 0.07 | 10.40 | 10.40 | 0.00 | 11.07 | 11.04 | 0.03 | 11.55 | 11.53 | 0.03 |

**Table 11. March test scenario average dissolved oxygen concentrations at greater than 8 m depth for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the March test scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 158 | 9.42 | 9.43 | -0.01 | 9.42 | 9.43 | 0.00 | 9.06 | 9.06 | -0.01 | 9.11 | 9.10 | 0.01 | 9.14 | 9.13 | 0.01 | 9.31 | 9.30 | 0.01 | 9.46 | 9.45 | 0.01 |
| 159 | 9.54 | 9.55 | -0.01 | 9.46 | 9.48 | -0.02 | 9.13 | 9.13 | 0.00 | 9.19 | 9.18 | 0.01 | 9.19 | 9.17 | 0.02 | 9.32 | 9.30 | 0.02 | 9.47 | 9.44 | 0.02 |
| 160 | 9.57 | 9.58 | -0.01 | 9.45 | 9.48 | -0.02 | 9.12 | 9.12 | 0.00 | 9.19 | 9.18 | 0.01 | 9.18 | 9.15 | 0.02 | 9.30 | 9.28 | 0.02 | 9.44 | 9.42 | 0.02 |
| 161 | 9.56 | 9.57 | -0.01 | 9.51 | 9.54 | -0.03 | 9.16 | 9.16 | 0.00 | 9.19 | 9.19 | 0.01 | 9.19 | 9.16 | 0.02 | 9.30 | 9.28 | 0.02 | 9.45 | 9.43 | 0.02 |
| 162 | 9.56 | 9.57 | -0.01 | 9.55 | 9.58 | -0.03 | 9.16 | 9.16 | 0.00 | 9.18 | 9.18 | 0.00 | 9.18 | 9.16 | 0.02 | 9.26 | 9.24 | 0.01 | 9.41 | 9.40 | 0.01 |
| 163 | 9.58 | 9.61 | -0.02 | 9.59 | 9.62 | -0.03 | 9.18 | 9.18 | -0.01 | 9.17 | 9.19 | -0.01 | 9.17 | 9.16 | 0.01 | 9.18 | 9.18 | 0.00 | 9.31 | 9.32 | -0.01 |
| 164 | 9.61 | 9.65 | -0.04 | 9.58 | 9.61 | -0.03 | 9.15 | 9.16 | -0.01 | 9.14 | 9.17 | -0.02 | 9.13 | 9.13 | 0.00 | 9.10 | 9.10 | 0.00 | 9.20 | 9.21 | -0.02 |
| 165 | 9.62 | 9.66 | -0.04 | 9.57 | 9.61 | -0.04 | 9.06 | 9.06 | 0.00 | 9.09 | 9.11 | -0.02 | 9.07 | 9.07 | 0.00 | 8.96 | 8.96 | 0.01 | 9.11 | 9.13 | -0.02 |
| 166 | 9.59 | 9.64 | -0.04 | 9.51 | 9.56 | -0.05 | 8.87 | 8.86 | 0.01 | 8.98 | 8.99 | -0.01 | 8.97 | 8.96 | 0.01 | 8.82 | 8.81 | 0.02 | 9.07 | 9.08 | -0.01 |
| 167 | 9.59 | 9.64 | -0.05 | 9.48 | 9.53 | -0.05 | 8.73 | 8.71 | 0.02 | 8.84 | 8.85 | 0.00 | 8.87 | 8.86 | 0.01 | 8.69 | 8.67 | 0.02 | 9.01 | 9.02 | -0.01 |
| 168 | 9.61 | 9.67 | -0.06 | 9.43 | 9.48 | -0.05 | 8.52 | 8.50 | 0.02 | 8.55 | 8.54 | 0.01 | 8.66 | 8.64 | 0.02 | 8.44 | 8.41 | 0.04 | 8.95 | 8.95 | 0.00 |
| 169 | 9.62 | 9.69 | -0.07 | 9.37 | 9.40 | -0.03 | 8.41 | 8.38 | 0.03 | 8.36 | 8.35 | 0.01 | 8.47 | 8.44 | 0.03 | 8.25 | 8.21 | 0.04 | 8.85 | 8.85 | 0.00 |
| 170 | 9.60 | 9.69 | -0.09 | 9.28 | 9.32 | -0.04 | 8.37 | 8.34 | 0.03 | 8.27 | 8.25 | 0.01 | 8.37 | 8.34 | 0.03 | 8.13 | 8.08 | 0.04 | 8.69 | 8.69 | 0.00 |
| 171 | 9.58 | 9.68 | -0.10 | 9.23 | 9.27 | -0.04 | 8.40 | 8.37 | 0.03 | 8.23 | 8.21 | 0.01 | 8.31 | 8.27 | 0.03 | 8.04 | 8.00 | 0.04 | 8.57 | 8.57 | 0.01 |
| 172 | 9.50 | 9.60 | -0.11 | 9.08 | 9.12 | -0.04 | 8.23 | 8.19 | 0.04 | 7.96 | 7.93 | 0.02 | 7.98 | 7.94 | 0.04 | 7.70 | 7.65 | 0.05 | 8.35 | 8.34 | 0.01 |
| 173 | 9.40 | 9.50 | -0.10 | 8.96 | 9.00 | -0.04 | 8.12 | 8.07 | 0.04 | 7.80 | 7.76 | 0.03 | 7.80 | 7.75 | 0.05 | 7.51 | 7.46 | 0.06 | 8.15 | 8.14 | 0.02 |
| 174 | 9.29 | 9.38 | -0.09 | 8.81 | 8.84 | -0.03 | 7.96 | 7.92 | 0.05 | 7.59 | 7.55 | 0.04 | 7.56 | 7.50 | 0.05 | 7.26 | 7.19 | 0.06 | 7.85 | 7.82 | 0.02 |
| 175 | 9.20 | 9.28 | -0.08 | 8.69 | 8.72 | -0.03 | 7.86 | 7.81 | 0.05 | 7.46 | 7.41 | 0.05 | 7.40 | 7.34 | 0.06 | 7.09 | 7.02 | 0.06 | 7.62 | 7.59 | 0.03 |
| 176 | 9.12 | 9.20 | -0.08 | 8.63 | 8.67 | -0.04 | 7.83 | 7.78 | 0.05 | 7.41 | 7.36 | 0.05 | 7.39 | 7.33 | 0.06 | 7.06 | 6.99 | 0.06 | 7.55 | 7.52 | 0.04 |
| 177 | 8.93 | 8.99 | -0.06 | 8.35 | 8.38 | -0.03 | 7.50 | 7.44 | 0.06 | 6.99 | 6.92 | 0.07 | 6.92 | 6.85 | 0.07 | 6.56 | 6.48 | 0.08 | 7.01 | 6.96 | 0.05 |
| 178 | 8.85 | 8.91 | -0.05 | 8.27 | 8.29 | -0.02 | 7.44 | 7.38 | 0.06 | 6.92 | 6.84 | 0.08 | 6.88 | 6.81 | 0.07 | 6.51 | 6.43 | 0.08 | 6.89 | 6.83 | 0.06 |
| 179 | 8.79 | 8.84 | -0.05 | 8.24 | 8.25 | -0.01 | 7.42 | 7.35 | 0.06 | 6.88 | 6.80 | 0.08 | 6.86 | 6.80 | 0.07 | 6.51 | 6.43 | 0.08 | 6.81 | 6.74 | 0.06 |
| 180 | 8.73 | 8.77 | -0.05 | 8.19 | 8.21 | -0.02 | 7.38 | 7.32 | 0.06 | 6.83 | 6.75 | 0.08 | 6.81 | 6.75 | 0.07 | 6.49 | 6.42 | 0.08 | 6.67 | 6.61 | 0.06 |
| 181 | 8.66 | 8.70 | -0.04 | 8.15 | 8.16 | -0.02 | 7.36 | 7.30 | 0.06 | 6.78 | 6.69 | 0.08 | 6.74 | 6.67 | 0.07 | 6.47 | 6.40 | 0.08 | 6.52 | 6.45 | 0.07 |
| 182 | 8.67 | 8.71 | -0.04 | 8.16 | 8.18 | -0.02 | 7.41 | 7.35 | 0.06 | 6.84 | 6.76 | 0.08 | 6.78 | 6.72 | 0.07 | 6.56 | 6.49 | 0.07 | 6.53 | 6.47 | 0.07 |
| 183 | 8.55 | 8.58 | -0.03 | 8.00 | 8.01 | -0.02 | 7.26 | 7.20 | 0.06 | 6.70 | 6.62 | 0.08 | 6.58 | 6.51 | 0.07 | 6.37 | 6.30 | 0.07 | 6.29 | 6.22 | 0.07 |
| 184 | 8.54 | 8.57 | -0.04 | 7.98 | 8.01 | -0.03 | 7.30 | 7.26 | 0.04 | 6.77 | 6.70 | 0.07 | 6.63 | 6.58 | 0.06 | 6.43 | 6.37 | 0.06 | 6.30 | 6.25 | 0.05 |
| 185 | 8.47 | 8.52 | -0.05 | 7.94 | 7.98 | -0.04 | 7.29 | 7.27 | 0.02 | 6.78 | 6.72 | 0.05 | 6.58 | 6.53 | 0.05 | 6.42 | 6.37 | 0.05 | 6.23 | 6.18 | 0.04 |
| 186 | 8.34 | 8.38 | -0.04 | 7.84 | 7.87 | -0.03 | 7.18 | 7.16 | 0.02 | 6.63 | 6.57 | 0.06 | 6.37 | 6.31 | 0.06 | 6.24 | 6.18 | 0.06 | 5.96 | 5.90 | 0.06 |
| 187 | 8.31 | 8.34 | -0.03 | 7.85 | 7.88 | -0.03 | 7.23 | 7.21 | 0.02 | 6.66 | 6.59 | 0.07 | 6.36 | 6.29 | 0.07 | 6.27 | 6.20 | 0.07 | 5.96 | 5.90 | 0.06 |
| 188 | 8.20 | 8.31 | -0.11 | 7.67 | 7.79 | -0.12 | 7.10 | 7.15 | -0.05 | 6.53 | 6.52 | 0.01 | 6.15 | 6.15 | 0.01 | 6.07 | 6.06 | 0.01 | 5.73 | 5.72 | 0.02 |

**Table 12. March test scenario average dissolved oxygen concentrations at greater than 8 m depth for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the March test scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 158 | 9.63 | 9.62 | 0.01 | 9.99 | 9.98 | 0.01 | 10.49 | 10.49 | 0.00 | 10.67 | 10.67 | 0.00 | 10.80 | 10.81 | 0.00 | 11.43 | 11.43 | 0.00 | 11.50 | 11.50 | 0.00 |
| 159 | 9.62 | 9.60 | 0.02 | 10.01 | 10.00 | 0.01 | 10.51 | 10.50 | 0.01 | 10.70 | 10.70 | 0.00 | 10.83 | 10.83 | 0.00 | 11.43 | 11.43 | 0.00 | 11.51 | 11.51 | 0.00 |
| 160 | 9.60 | 9.58 | 0.02 | 10.01 | 10.00 | 0.01 | 10.52 | 10.51 | 0.00 | 10.69 | 10.69 | 0.00 | 10.82 | 10.82 | 0.00 | 11.43 | 11.43 | 0.00 | 11.50 | 11.50 | 0.00 |
| 161 | 9.60 | 9.58 | 0.02 | 10.02 | 10.01 | 0.01 | 10.52 | 10.51 | 0.00 | 10.69 | 10.69 | 0.00 | 10.83 | 10.83 | 0.00 | 11.43 | 11.43 | 0.00 | 11.49 | 11.49 | 0.00 |
| 162 | 9.58 | 9.56 | 0.02 | 10.04 | 10.03 | 0.01 | 10.55 | 10.54 | 0.00 | 10.67 | 10.67 | 0.00 | 10.82 | 10.83 | 0.00 | 11.43 | 11.43 | 0.00 | 11.49 | 11.49 | 0.00 |
| 163 | 9.52 | 9.52 | 0.01 | 10.01 | 10.01 | 0.00 | 10.57 | 10.56 | 0.00 | 10.66 | 10.66 | 0.00 | 10.81 | 10.81 | 0.00 | 11.42 | 11.42 | 0.00 | 11.49 | 11.49 | 0.00 |
| 164 | 9.41 | 9.42 | 0.00 | 9.91 | 9.91 | 0.00 | 10.55 | 10.55 | 0.00 | 10.65 | 10.65 | 0.00 | 10.80 | 10.80 | 0.00 | 11.40 | 11.40 | 0.00 | 11.48 | 11.48 | 0.00 |
| 165 | 9.30 | 9.32 | -0.01 | 9.77 | 9.77 | -0.01 | 10.47 | 10.47 | 0.00 | 10.65 | 10.65 | 0.00 | 10.81 | 10.81 | 0.00 | 11.39 | 11.39 | 0.00 | 11.47 | 11.47 | 0.00 |
| 166 | 9.26 | 9.27 | -0.01 | 9.70 | 9.71 | -0.01 | 10.42 | 10.42 | 0.00 | 10.60 | 10.60 | 0.00 | 10.78 | 10.79 | 0.00 | 11.37 | 11.38 | 0.00 | 11.45 | 11.45 | 0.00 |
| 167 | 9.20 | 9.21 | -0.01 | 9.63 | 9.63 | -0.01 | 10.37 | 10.37 | 0.00 | 10.59 | 10.59 | 0.00 | 10.79 | 10.80 | 0.00 | 11.36 | 11.36 | 0.00 | 11.43 | 11.43 | 0.00 |
| 168 | 9.15 | 9.15 | 0.00 | 9.56 | 9.56 | -0.01 | 10.28 | 10.28 | 0.00 | 10.59 | 10.59 | 0.00 | 10.80 | 10.80 | 0.00 | 11.34 | 11.34 | 0.00 | 11.43 | 11.43 | 0.00 |
| 169 | 9.10 | 9.10 | 0.00 | 9.49 | 9.50 | -0.01 | 10.17 | 10.17 | 0.00 | 10.61 | 10.61 | 0.00 | 10.79 | 10.80 | 0.00 | 11.27 | 11.28 | 0.00 | 11.41 | 11.41 | 0.00 |
| 170 | 9.03 | 9.03 | 0.00 | 9.40 | 9.41 | -0.01 | 10.04 | 10.04 | 0.00 | 10.56 | 10.56 | 0.00 | 10.79 | 10.79 | 0.00 | 11.20 | 11.20 | 0.00 | 11.38 | 11.38 | 0.00 |
| 171 | 8.96 | 8.96 | 0.00 | 9.31 | 9.32 | -0.01 | 9.91 | 9.91 | 0.00 | 10.48 | 10.48 | 0.00 | 10.75 | 10.76 | 0.00 | 11.20 | 11.20 | 0.00 | 11.36 | 11.36 | 0.00 |
| 172 | 8.86 | 8.86 | 0.00 | 9.26 | 9.27 | -0.01 | 9.82 | 9.83 | 0.00 | 10.37 | 10.37 | 0.00 | 10.72 | 10.72 | 0.00 | 11.29 | 11.29 | 0.00 | 11.43 | 11.43 | 0.00 |
| 173 | 8.75 | 8.75 | 0.00 | 9.21 | 9.22 | 0.00 | 9.77 | 9.77 | 0.00 | 10.29 | 10.29 | 0.00 | 10.68 | 10.68 | 0.00 | 11.29 | 11.29 | 0.00 | 11.46 | 11.46 | 0.00 |
| 174 | 8.56 | 8.56 | 0.00 | 9.17 | 9.17 | 0.00 | 9.75 | 9.76 | 0.00 | 10.27 | 10.27 | 0.00 | 10.66 | 10.66 | 0.00 | 11.27 | 11.27 | 0.00 | 11.45 | 11.45 | 0.00 |
| 175 | 8.37 | 8.37 | 0.00 | 9.09 | 9.09 | 0.00 | 9.73 | 9.73 | 0.00 | 10.24 | 10.24 | 0.00 | 10.64 | 10.64 | 0.00 | 11.26 | 11.26 | 0.00 | 11.46 | 11.46 | 0.00 |
| 176 | 8.27 | 8.26 | 0.01 | 8.95 | 8.95 | 0.00 | 9.67 | 9.67 | 0.00 | 10.16 | 10.16 | 0.00 | 10.60 | 10.60 | 0.00 | 11.24 | 11.24 | 0.00 | 11.50 | 11.50 | 0.00 |
| 177 | 7.79 | 7.77 | 0.01 | 8.66 | 8.66 | 0.00 | 9.69 | 9.69 | 0.00 | 10.15 | 10.15 | 0.00 | 10.58 | 10.58 | 0.00 | 11.21 | 11.22 | 0.00 | 11.50 | 11.50 | 0.00 |
| 178 | 7.60 | 7.58 | 0.02 | 8.50 | 8.49 | 0.00 | 9.68 | 9.67 | 0.00 | 10.12 | 10.12 | 0.00 | 10.55 | 10.55 | 0.00 | 11.19 | 11.20 | 0.00 | 11.52 | 11.52 | 0.00 |
| 179 | 7.53 | 7.51 | 0.02 | 8.44 | 8.44 | 0.00 | 9.65 | 9.65 | 0.00 | 10.08 | 10.08 | 0.00 | 10.52 | 10.52 | 0.00 | 11.18 | 11.18 | 0.00 | 11.58 | 11.58 | 0.00 |
| 180 | 7.36 | 7.33 | 0.03 | 8.30 | 8.30 | 0.01 | 9.62 | 9.63 | 0.00 | 10.06 | 10.05 | 0.00 | 10.50 | 10.50 | 0.00 | 11.17 | 11.17 | 0.00 | 11.61 | 11.61 | 0.00 |
| 181 | 7.18 | 7.14 | 0.04 | 8.12 | 8.12 | 0.00 | 9.54 | 9.53 | 0.01 | 10.04 | 10.03 | 0.01 | 10.48 | 10.48 | 0.00 | 11.16 | 11.16 | 0.00 | 11.59 | 11.59 | 0.00 |
| 182 | 7.03 | 6.98 | 0.05 | 7.97 | 7.96 | 0.00 | 9.41 | 9.39 | 0.02 | 10.04 | 10.03 | 0.00 | 10.48 | 10.48 | 0.00 | 11.15 | 11.15 | 0.00 | 11.56 | 11.57 | 0.00 |
| 183 | 6.66 | 6.61 | 0.06 | 7.59 | 7.58 | 0.01 | 9.28 | 9.28 | 0.00 | 10.02 | 10.02 | 0.00 | 10.47 | 10.47 | 0.00 | 11.15 | 11.15 | 0.00 | 11.59 | 11.59 | 0.00 |
| 184 | 6.50 | 6.46 | 0.05 | 7.29 | 7.29 | 0.01 | 9.14 | 9.13 | 0.01 | 10.01 | 10.01 | 0.00 | 10.46 | 10.46 | 0.00 | 11.14 | 11.14 | 0.00 | 11.59 | 11.60 | 0.00 |
| 185 | 6.31 | 6.26 | 0.05 | 7.02 | 7.00 | 0.02 | 8.90 | 8.88 | 0.02 | 10.00 | 10.00 | 0.00 | 10.46 | 10.46 | 0.00 | 11.13 | 11.13 | 0.00 | 11.59 | 11.59 | 0.00 |
| 186 | 5.94 | 5.88 | 0.06 | 6.66 | 6.63 | 0.03 | 8.64 | 8.65 | -0.01 | 9.96 | 9.96 | 0.01 | 10.46 | 10.45 | 0.00 | 11.11 | 11.11 | 0.00 | 11.55 | 11.55 | 0.00 |
| 187 | 5.88 | 5.81 | 0.07 | 6.39 | 6.35 | 0.04 | 8.51 | 8.52 | -0.01 | 9.94 | 9.92 | 0.01 | 10.44 | 10.44 | 0.00 | 11.09 | 11.09 | 0.00 | 11.52 | 11.52 | 0.00 |
| 188 | 5.57 | 5.54 | 0.03 | 5.88 | 5.86 | 0.01 | 7.96 | 7.94 | 0.02 | 9.91 | 9.84 | 0.07 | 10.40 | 10.40 | 0.00 | 11.07 | 11.07 | 0.00 | 11.55 | 11.55 | 0.00 |

**Table 13. TMDL scenario average dissolved oxygen concentrations for full water column for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the TMDL predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.27 | 9.32 | -0.05 | 8.84 | 9.00 | -0.16 | 8.75 | 9.24 | -0.49 | 8.85 | 9.37 | -0.51 | 8.84 | 9.39 | -0.55 | 9.11 | 9.75 | -0.64 | 9.29 | 9.89 | -0.61 |
| 155 | 9.20 | 9.28 | -0.08 | 8.84 | 9.01 | -0.17 | 8.79 | 9.24 | -0.45 | 8.78 | 9.23 | -0.45 | 8.81 | 9.29 | -0.47 | 9.03 | 9.61 | -0.57 | 9.13 | 9.67 | -0.54 |
| 156 | 9.18 | 9.29 | -0.10 | 8.86 | 9.05 | -0.18 | 8.81 | 9.25 | -0.43 | 8.88 | 9.33 | -0.45 | 8.90 | 9.42 | -0.53 | 9.07 | 9.70 | -0.63 | 9.25 | 9.86 | -0.61 |
| 157 | 9.21 | 9.35 | -0.14 | 9.10 | 9.40 | -0.30 | 8.93 | 9.39 | -0.46 | 8.94 | 9.55 | -0.61 | 8.82 | 9.41 | -0.59 | 8.81 | 9.43 | -0.61 | 9.11 | 9.72 | -0.60 |
| 158 | 9.31 | 9.55 | -0.24 | 9.40 | 9.84 | -0.44 | 8.99 | 9.53 | -0.54 | 8.96 | 9.67 | -0.71 | 8.90 | 9.52 | -0.63 | 8.87 | 9.49 | -0.62 | 9.12 | 9.77 | -0.65 |
| 159 | 9.45 | 9.80 | -0.35 | 9.51 | 10.03 | -0.52 | 9.07 | 9.67 | -0.60 | 9.01 | 9.75 | -0.74 | 8.94 | 9.58 | -0.63 | 8.88 | 9.47 | -0.58 | 9.12 | 9.76 | -0.63 |
| 160 | 9.57 | 9.98 | -0.41 | 9.52 | 10.05 | -0.53 | 9.08 | 9.72 | -0.65 | 8.99 | 9.72 | -0.73 | 8.92 | 9.53 | -0.60 | 8.84 | 9.38 | -0.54 | 9.08 | 9.67 | -0.59 |
| 161 | 9.66 | 10.09 | -0.43 | 9.49 | 10.07 | -0.58 | 9.05 | 9.78 | -0.73 | 8.92 | 9.70 | -0.78 | 8.82 | 9.42 | -0.60 | 8.71 | 9.22 | -0.52 | 8.97 | 9.56 | -0.59 |
| 162 | 9.67 | 10.09 | -0.42 | 9.48 | 10.15 | -0.67 | 9.07 | 9.84 | -0.77 | 8.83 | 9.55 | -0.72 | 8.77 | 9.31 | -0.54 | 8.64 | 9.10 | -0.46 | 8.89 | 9.47 | -0.58 |
| 163 | 9.66 | 10.10 | -0.44 | 9.50 | 10.32 | -0.82 | 9.10 | 9.91 | -0.81 | 8.83 | 9.53 | -0.70 | 8.79 | 9.32 | -0.53 | 8.62 | 9.03 | -0.42 | 8.84 | 9.43 | -0.59 |
| 164 | 9.67 | 10.17 | -0.49 | 9.53 | 10.43 | -0.90 | 9.12 | 9.91 | -0.78 | 8.85 | 9.53 | -0.68 | 8.80 | 9.30 | -0.50 | 8.63 | 9.00 | -0.37 | 8.85 | 9.41 | -0.56 |
| 165 | 9.72 | 10.32 | -0.60 | 9.55 | 10.56 | -1.02 | 9.13 | 10.00 | -0.88 | 8.80 | 9.51 | -0.71 | 8.72 | 9.21 | -0.49 | 8.54 | 8.88 | -0.34 | 8.77 | 9.33 | -0.56 |
| 166 | 9.73 | 10.37 | -0.64 | 9.56 | 10.52 | -0.96 | 9.11 | 9.97 | -0.86 | 8.83 | 9.52 | -0.69 | 8.74 | 9.18 | -0.44 | 8.57 | 8.85 | -0.28 | 8.82 | 9.34 | -0.52 |
| 167 | 9.77 | 10.52 | -0.75 | 9.55 | 10.58 | -1.03 | 9.04 | 9.87 | -0.83 | 8.75 | 9.43 | -0.68 | 8.66 | 9.08 | -0.41 | 8.49 | 8.74 | -0.25 | 8.77 | 9.27 | -0.50 |
| 168 | 9.73 | 10.51 | -0.78 | 9.48 | 10.41 | -0.93 | 8.86 | 9.52 | -0.66 | 8.60 | 9.11 | -0.51 | 8.57 | 8.84 | -0.27 | 8.37 | 8.45 | -0.08 | 8.74 | 9.13 | -0.39 |
| 169 | 9.66 | 10.49 | -0.82 | 9.41 | 10.27 | -0.86 | 8.74 | 9.30 | -0.56 | 8.46 | 8.88 | -0.42 | 8.46 | 8.65 | -0.19 | 8.26 | 8.27 | 0.00 | 8.69 | 8.99 | -0.31 |
| 170 | 9.60 | 10.45 | -0.84 | 9.33 | 10.13 | -0.80 | 8.69 | 9.21 | -0.52 | 8.37 | 8.75 | -0.38 | 8.38 | 8.55 | -0.17 | 8.18 | 8.14 | 0.04 | 8.60 | 8.83 | -0.23 |
| 171 | 9.56 | 10.42 | -0.86 | 9.26 | 10.03 | -0.77 | 8.66 | 9.17 | -0.51 | 8.32 | 8.65 | -0.33 | 8.34 | 8.50 | -0.16 | 8.12 | 8.07 | 0.05 | 8.53 | 8.71 | -0.18 |
| 172 | 9.50 | 10.34 | -0.83 | 9.15 | 9.88 | -0.73 | 8.56 | 9.02 | -0.46 | 8.17 | 8.42 | -0.25 | 8.19 | 8.30 | -0.10 | 7.97 | 7.89 | 0.08 | 8.44 | 8.55 | -0.11 |
| 173 | 9.46 | 10.25 | -0.79 | 9.10 | 9.75 | -0.66 | 8.47 | 8.81 | -0.34 | 8.06 | 8.19 | -0.14 | 8.07 | 8.04 | 0.03 | 7.84 | 7.61 | 0.22 | 8.34 | 8.33 | 0.01 |
| 174 | 9.39 | 10.11 | -0.73 | 9.01 | 9.60 | -0.59 | 8.37 | 8.64 | -0.27 | 7.93 | 8.00 | -0.06 | 7.92 | 7.81 | 0.12 | 7.68 | 7.38 | 0.30 | 8.17 | 8.07 | 0.10 |
| 175 | 9.33 | 10.02 | -0.69 | 8.94 | 9.49 | -0.55 | 8.30 | 8.54 | -0.24 | 7.87 | 7.90 | -0.03 | 7.84 | 7.68 | 0.15 | 7.60 | 7.28 | 0.32 | 8.04 | 7.90 | 0.14 |
| 176 | 9.26 | 9.91 | -0.65 | 8.88 | 9.38 | -0.50 | 8.26 | 8.44 | -0.19 | 7.82 | 7.79 | 0.04 | 7.80 | 7.60 | 0.21 | 7.56 | 7.17 | 0.39 | 7.98 | 7.75 | 0.22 |
| 177 | 9.12 | 9.67 | -0.56 | 8.67 | 9.08 | -0.41 | 8.00 | 8.08 | -0.09 | 7.50 | 7.34 | 0.16 | 7.46 | 7.13 | 0.33 | 7.19 | 6.68 | 0.51 | 7.58 | 7.21 | 0.36 |
| 178 | 9.06 | 9.59 | -0.53 | 8.61 | 8.98 | -0.37 | 7.95 | 8.00 | -0.05 | 7.45 | 7.24 | 0.20 | 7.43 | 7.07 | 0.36 | 7.15 | 6.61 | 0.54 | 7.49 | 7.07 | 0.42 |
| 179 | 9.01 | 9.52 | -0.50 | 8.58 | 8.92 | -0.34 | 7.92 | 7.94 | -0.02 | 7.42 | 7.17 | 0.24 | 7.41 | 7.03 | 0.39 | 7.15 | 6.59 | 0.56 | 7.43 | 6.95 | 0.48 |
| 180 | 8.97 | 9.45 | -0.48 | 8.56 | 8.88 | -0.32 | 7.91 | 7.91 | 0.00 | 7.40 | 7.14 | 0.26 | 7.39 | 6.99 | 0.40 | 7.15 | 6.60 | 0.56 | 7.35 | 6.84 | 0.51 |
| 181 | 8.91 | 9.36 | -0.45 | 8.51 | 8.79 | -0.28 | 7.87 | 7.84 | 0.04 | 7.34 | 7.02 | 0.32 | 7.32 | 6.86 | 0.46 | 7.11 | 6.51 | 0.61 | 7.22 | 6.65 | 0.57 |
| 182 | 8.93 | 9.38 | -0.45 | 8.55 | 8.84 | -0.29 | 7.96 | 7.95 | 0.00 | 7.44 | 7.15 | 0.29 | 7.42 | 6.98 | 0.44 | 7.24 | 6.68 | 0.56 | 7.29 | 6.76 | 0.53 |
| 183 | 8.82 | 9.21 | -0.39 | 8.40 | 8.62 | -0.22 | 7.79 | 7.72 | 0.07 | 7.28 | 6.93 | 0.35 | 7.21 | 6.70 | 0.51 | 7.04 | 6.43 | 0.61 | 7.03 | 6.44 | 0.59 |
| 184 | 8.82 | 9.20 | -0.38 | 8.41 | 8.62 | -0.21 | 7.86 | 7.81 | 0.05 | 7.37 | 7.01 | 0.36 | 7.29 | 6.78 | 0.51 | 7.13 | 6.53 | 0.60 | 7.09 | 6.54 | 0.54 |
| 185 | 8.78 | 9.12 | -0.34 | 8.41 | 8.61 | -0.20 | 7.90 | 7.88 | 0.02 | 7.42 | 7.05 | 0.37 | 7.31 | 6.84 | 0.48 | 7.19 | 6.61 | 0.58 | 7.10 | 6.57 | 0.53 |
| 186 | 8.63 | 8.89 | -0.26 | 8.28 | 8.41 | -0.13 | 7.75 | 7.67 | 0.08 | 7.23 | 6.78 | 0.45 | 7.08 | 6.55 | 0.53 | 6.98 | 6.27 | 0.70 | 6.79 | 6.11 | 0.68 |
| 187 | 8.60 | 8.85 | -0.24 | 8.31 | 8.46 | -0.16 | 7.80 | 7.74 | 0.06 | 7.27 | 6.81 | 0.46 | 7.10 | 6.57 | 0.53 | 7.03 | 6.29 | 0.74 | 6.82 | 6.12 | 0.71 |
| 188 | 8.52 | 8.74 | -0.22 | 8.16 | 8.29 | -0.12 | 7.66 | 7.56 | 0.11 | 7.14 | 6.67 | 0.48 | 6.92 | 6.36 | 0.55 | 6.84 | 6.06 | 0.78 | 6.62 | 5.90 | 0.72 |

**Table 14. TMDL scenario average dissolved oxygen concentrations for full water column for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the TMDL predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.37 | 9.71 | -0.34 | 9.89 | 10.10 | -0.21 | 10.32 | 10.43 | -0.11 | 10.59 | 10.81 | -0.23 | 10.83 | 10.83 | 0.00 | 11.53 | 11.52 | 0.01 | 11.58 | 11.58 | 0.00 |
| 155 | 9.29 | 9.58 | -0.29 | 9.74 | 9.93 | -0.18 | 10.29 | 10.39 | -0.10 | 10.59 | 10.78 | -0.19 | 10.74 | 10.73 | 0.01 | 11.38 | 11.43 | -0.05 | 11.48 | 11.49 | -0.01 |
| 156 | 9.38 | 9.74 | -0.36 | 9.72 | 9.89 | -0.17 | 10.27 | 10.35 | -0.08 | 10.55 | 10.72 | -0.17 | 10.72 | 10.70 | 0.01 | 11.39 | 11.45 | -0.05 | 11.48 | 11.47 | 0.00 |
| 157 | 9.50 | 9.94 | -0.45 | 9.86 | 10.07 | -0.22 | 10.37 | 10.47 | -0.11 | 10.61 | 10.78 | -0.18 | 10.78 | 10.76 | 0.02 | 11.42 | 11.49 | -0.06 | 11.49 | 11.52 | -0.02 |
| 158 | 9.46 | 9.95 | -0.50 | 10.06 | 10.32 | -0.26 | 10.54 | 10.67 | -0.13 | 10.69 | 10.94 | -0.26 | 10.81 | 10.83 | -0.02 | 11.44 | 11.50 | -0.06 | 11.52 | 11.59 | -0.07 |
| 159 | 9.42 | 9.91 | -0.49 | 10.06 | 10.31 | -0.25 | 10.58 | 10.71 | -0.13 | 10.76 | 11.05 | -0.30 | 10.84 | 10.85 | -0.01 | 11.44 | 11.51 | -0.06 | 11.53 | 11.62 | -0.09 |
| 160 | 9.34 | 9.82 | -0.47 | 10.01 | 10.23 | -0.22 | 10.57 | 10.67 | -0.10 | 10.75 | 11.02 | -0.26 | 10.82 | 10.80 | 0.03 | 11.44 | 11.50 | -0.06 | 11.53 | 11.62 | -0.09 |
| 161 | 9.20 | 9.73 | -0.53 | 9.94 | 10.17 | -0.23 | 10.58 | 10.66 | -0.08 | 10.75 | 11.00 | -0.25 | 10.84 | 10.79 | 0.05 | 11.43 | 11.48 | -0.05 | 11.52 | 11.60 | -0.08 |
| 162 | 9.13 | 9.66 | -0.52 | 9.85 | 10.14 | -0.28 | 10.59 | 10.67 | -0.07 | 10.74 | 10.98 | -0.23 | 10.84 | 10.77 | 0.07 | 11.44 | 11.47 | -0.03 | 11.52 | 11.59 | -0.08 |
| 163 | 9.07 | 9.62 | -0.55 | 9.64 | 10.05 | -0.41 | 10.57 | 10.66 | -0.09 | 10.74 | 10.96 | -0.22 | 10.84 | 10.74 | 0.10 | 11.44 | 11.47 | -0.03 | 11.52 | 11.60 | -0.07 |
| 164 | 9.06 | 9.60 | -0.54 | 9.54 | 9.99 | -0.45 | 10.44 | 10.59 | -0.15 | 10.72 | 10.92 | -0.20 | 10.83 | 10.70 | 0.13 | 11.42 | 11.43 | -0.01 | 11.52 | 11.59 | -0.07 |
| 165 | 8.96 | 9.52 | -0.56 | 9.41 | 9.91 | -0.51 | 10.26 | 10.49 | -0.23 | 10.72 | 10.90 | -0.18 | 10.84 | 10.67 | 0.16 | 11.42 | 11.39 | 0.03 | 11.54 | 11.60 | -0.06 |
| 166 | 9.00 | 9.48 | -0.48 | 9.40 | 9.86 | -0.46 | 10.22 | 10.43 | -0.21 | 10.67 | 10.80 | -0.14 | 10.82 | 10.62 | 0.19 | 11.40 | 11.34 | 0.06 | 11.51 | 11.56 | -0.05 |
| 167 | 8.95 | 9.40 | -0.45 | 9.33 | 9.78 | -0.45 | 10.15 | 10.38 | -0.22 | 10.65 | 10.77 | -0.11 | 10.82 | 10.62 | 0.20 | 11.39 | 11.32 | 0.07 | 11.50 | 11.54 | -0.04 |
| 168 | 8.94 | 9.29 | -0.35 | 9.32 | 9.71 | -0.39 | 10.07 | 10.31 | -0.24 | 10.64 | 10.73 | -0.09 | 10.82 | 10.59 | 0.23 | 11.38 | 11.29 | 0.09 | 11.49 | 11.52 | -0.04 |
| 169 | 8.91 | 9.21 | -0.30 | 9.28 | 9.64 | -0.37 | 9.95 | 10.18 | -0.23 | 10.64 | 10.72 | -0.09 | 10.81 | 10.57 | 0.24 | 11.34 | 11.21 | 0.13 | 11.47 | 11.50 | -0.03 |
| 170 | 8.86 | 9.12 | -0.25 | 9.22 | 9.58 | -0.35 | 9.85 | 10.08 | -0.23 | 10.52 | 10.65 | -0.12 | 10.79 | 10.52 | 0.28 | 11.29 | 11.09 | 0.20 | 11.44 | 11.45 | -0.01 |
| 171 | 8.81 | 9.04 | -0.23 | 9.17 | 9.51 | -0.34 | 9.76 | 10.00 | -0.24 | 10.40 | 10.50 | -0.09 | 10.76 | 10.45 | 0.31 | 11.28 | 11.06 | 0.22 | 11.43 | 11.42 | 0.02 |
| 172 | 8.76 | 8.95 | -0.19 | 9.14 | 9.46 | -0.32 | 9.71 | 9.93 | -0.22 | 10.29 | 10.34 | -0.05 | 10.69 | 10.39 | 0.31 | 11.34 | 11.12 | 0.22 | 11.57 | 11.53 | 0.04 |
| 173 | 8.74 | 8.82 | -0.09 | 9.13 | 9.40 | -0.26 | 9.68 | 9.85 | -0.17 | 10.22 | 10.20 | 0.02 | 10.65 | 10.34 | 0.31 | 11.33 | 11.07 | 0.26 | 11.64 | 11.58 | 0.06 |
| 174 | 8.64 | 8.64 | 0.00 | 9.11 | 9.31 | -0.20 | 9.67 | 9.79 | -0.12 | 10.19 | 10.14 | 0.05 | 10.63 | 10.31 | 0.32 | 11.29 | 10.99 | 0.30 | 11.61 | 11.53 | 0.09 |
| 175 | 8.54 | 8.50 | 0.04 | 9.07 | 9.24 | -0.17 | 9.65 | 9.75 | -0.09 | 10.16 | 10.09 | 0.07 | 10.61 | 10.30 | 0.31 | 11.28 | 10.97 | 0.31 | 11.66 | 11.55 | 0.12 |
| 176 | 8.47 | 8.35 | 0.12 | 9.00 | 9.11 | -0.11 | 9.61 | 9.68 | -0.07 | 10.11 | 10.01 | 0.10 | 10.57 | 10.29 | 0.28 | 11.25 | 10.92 | 0.33 | 11.70 | 11.55 | 0.15 |
| 177 | 8.14 | 7.88 | 0.27 | 8.81 | 8.81 | 0.01 | 9.63 | 9.66 | -0.03 | 10.10 | 9.98 | 0.12 | 10.55 | 10.29 | 0.26 | 11.22 | 10.87 | 0.34 | 11.66 | 11.50 | 0.16 |
| 178 | 8.02 | 7.68 | 0.33 | 8.71 | 8.65 | 0.06 | 9.63 | 9.64 | -0.01 | 10.08 | 9.94 | 0.14 | 10.53 | 10.27 | 0.26 | 11.19 | 10.84 | 0.36 | 11.68 | 11.50 | 0.18 |
| 179 | 7.97 | 7.58 | 0.39 | 8.67 | 8.57 | 0.10 | 9.61 | 9.61 | 0.01 | 10.05 | 9.89 | 0.16 | 10.51 | 10.25 | 0.26 | 11.18 | 10.81 | 0.37 | 11.71 | 11.50 | 0.21 |
| 180 | 7.86 | 7.43 | 0.43 | 8.59 | 8.43 | 0.16 | 9.60 | 9.57 | 0.03 | 10.03 | 9.84 | 0.18 | 10.49 | 10.22 | 0.27 | 11.17 | 10.78 | 0.39 | 11.71 | 11.47 | 0.24 |
| 181 | 7.72 | 7.19 | 0.53 | 8.45 | 8.19 | 0.26 | 9.53 | 9.45 | 0.08 | 10.01 | 9.81 | 0.20 | 10.47 | 10.19 | 0.28 | 11.16 | 10.76 | 0.40 | 11.67 | 11.41 | 0.26 |
| 182 | 7.68 | 7.16 | 0.52 | 8.37 | 8.11 | 0.25 | 9.45 | 9.33 | 0.12 | 10.01 | 9.79 | 0.21 | 10.47 | 10.18 | 0.29 | 11.15 | 10.75 | 0.40 | 11.65 | 11.37 | 0.27 |
| 183 | 7.36 | 6.74 | 0.61 | 8.06 | 7.70 | 0.36 | 9.35 | 9.19 | 0.15 | 10.00 | 9.76 | 0.24 | 10.46 | 10.16 | 0.30 | 11.15 | 10.74 | 0.41 | 11.66 | 11.36 | 0.30 |
| 184 | 7.29 | 6.70 | 0.59 | 7.88 | 7.50 | 0.37 | 9.24 | 9.03 | 0.21 | 9.99 | 9.74 | 0.25 | 10.46 | 10.15 | 0.31 | 11.14 | 10.73 | 0.41 | 11.65 | 11.33 | 0.32 |
| 185 | 7.22 | 6.65 | 0.58 | 7.72 | 7.29 | 0.43 | 9.06 | 8.78 | 0.28 | 9.99 | 9.72 | 0.27 | 10.46 | 10.15 | 0.31 | 11.13 | 10.71 | 0.42 | 11.64 | 11.31 | 0.33 |
| 186 | 6.83 | 6.10 | 0.72 | 7.35 | 6.74 | 0.61 | 8.84 | 8.51 | 0.33 | 9.96 | 9.67 | 0.29 | 10.45 | 10.14 | 0.31 | 11.11 | 10.68 | 0.43 | 11.60 | 11.26 | 0.34 |
| 187 | 6.80 | 6.04 | 0.76 | 7.16 | 6.53 | 0.63 | 8.73 | 8.40 | 0.33 | 9.94 | 9.63 | 0.30 | 10.44 | 10.13 | 0.32 | 11.10 | 10.65 | 0.45 | 11.56 | 11.22 | 0.34 |
| 188 | 6.52 | 5.77 | 0.75 | 6.75 | 6.20 | 0.55 | 8.33 | 7.94 | 0.39 | 9.92 | 9.56 | 0.36 | 10.41 | 10.09 | 0.32 | 11.07 | 10.61 | 0.46 | 11.61 | 11.26 | 0.35 |

**Table 15. Idaho only scenario average dissolved oxygen concentrations for full water column for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the Idaho only scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.27 | 9.28 | -0.01 | 8.84 | 8.85 | 0.00 | 8.75 | 8.75 | 0.00 | 8.85 | 8.86 | 0.00 | 8.84 | 8.83 | 0.00 | 9.11 | 9.12 | 0.00 | 9.29 | 9.29 | 0.00 |
| 155 | 9.20 | 9.21 | -0.01 | 8.84 | 8.85 | 0.00 | 8.79 | 8.80 | -0.01 | 8.78 | 8.78 | 0.00 | 8.81 | 8.81 | 0.00 | 9.03 | 9.03 | 0.00 | 9.13 | 9.13 | 0.00 |
| 156 | 9.18 | 9.19 | -0.01 | 8.86 | 8.85 | 0.02 | 8.81 | 8.82 | 0.00 | 8.88 | 8.87 | 0.00 | 8.90 | 8.89 | 0.00 | 9.07 | 9.08 | 0.00 | 9.25 | 9.25 | 0.00 |
| 157 | 9.21 | 9.21 | 0.00 | 9.10 | 9.09 | 0.01 | 8.93 | 8.93 | 0.00 | 8.94 | 8.95 | -0.01 | 8.82 | 8.83 | -0.01 | 8.81 | 8.83 | -0.01 | 9.11 | 9.13 | -0.01 |
| 158 | 9.31 | 9.31 | 0.00 | 9.40 | 9.40 | 0.00 | 8.99 | 9.00 | 0.00 | 8.96 | 8.97 | -0.01 | 8.90 | 8.91 | -0.01 | 8.87 | 8.88 | -0.01 | 9.12 | 9.14 | -0.01 |
| 159 | 9.45 | 9.45 | 0.00 | 9.51 | 9.52 | -0.01 | 9.07 | 9.08 | -0.01 | 9.01 | 9.03 | -0.01 | 8.94 | 8.96 | -0.01 | 8.88 | 8.90 | -0.01 | 9.12 | 9.14 | -0.01 |
| 160 | 9.57 | 9.58 | 0.00 | 9.52 | 9.53 | 0.00 | 9.08 | 9.09 | -0.01 | 8.99 | 9.01 | -0.02 | 8.92 | 8.94 | -0.01 | 8.84 | 8.85 | -0.01 | 9.08 | 9.09 | -0.01 |
| 161 | 9.66 | 9.68 | -0.02 | 9.49 | 9.49 | 0.00 | 9.05 | 9.07 | -0.02 | 8.92 | 8.94 | -0.02 | 8.82 | 8.84 | -0.02 | 8.71 | 8.73 | -0.02 | 8.97 | 8.98 | -0.02 |
| 162 | 9.67 | 9.68 | -0.01 | 9.48 | 9.49 | -0.01 | 9.07 | 9.10 | -0.03 | 8.83 | 8.86 | -0.02 | 8.77 | 8.79 | -0.02 | 8.64 | 8.66 | -0.02 | 8.89 | 8.91 | -0.02 |
| 163 | 9.66 | 9.67 | -0.01 | 9.50 | 9.53 | -0.03 | 9.10 | 9.14 | -0.03 | 8.83 | 8.85 | -0.02 | 8.79 | 8.81 | -0.02 | 8.62 | 8.63 | -0.02 | 8.84 | 8.86 | -0.02 |
| 164 | 9.67 | 9.69 | -0.02 | 9.53 | 9.57 | -0.04 | 9.12 | 9.15 | -0.03 | 8.85 | 8.87 | -0.02 | 8.80 | 8.82 | -0.02 | 8.63 | 8.65 | -0.02 | 8.85 | 8.87 | -0.02 |
| 165 | 9.72 | 9.75 | -0.03 | 9.55 | 9.60 | -0.05 | 9.13 | 9.16 | -0.04 | 8.80 | 8.82 | -0.03 | 8.72 | 8.74 | -0.02 | 8.54 | 8.55 | -0.01 | 8.77 | 8.79 | -0.02 |
| 166 | 9.73 | 9.76 | -0.04 | 9.56 | 9.61 | -0.05 | 9.11 | 9.14 | -0.03 | 8.83 | 8.85 | -0.02 | 8.74 | 8.75 | -0.01 | 8.57 | 8.57 | -0.01 | 8.82 | 8.83 | -0.02 |
| 167 | 9.77 | 9.82 | -0.05 | 9.55 | 9.60 | -0.06 | 9.04 | 9.06 | -0.02 | 8.75 | 8.77 | -0.02 | 8.66 | 8.68 | -0.01 | 8.49 | 8.50 | 0.00 | 8.77 | 8.79 | -0.01 |
| 168 | 9.73 | 9.78 | -0.05 | 9.48 | 9.52 | -0.04 | 8.86 | 8.87 | -0.01 | 8.60 | 8.60 | 0.00 | 8.57 | 8.57 | 0.00 | 8.37 | 8.36 | 0.01 | 8.74 | 8.75 | -0.01 |
| 169 | 9.66 | 9.72 | -0.05 | 9.41 | 9.45 | -0.03 | 8.74 | 8.74 | 0.00 | 8.46 | 8.45 | 0.01 | 8.46 | 8.45 | 0.01 | 8.26 | 8.24 | 0.02 | 8.69 | 8.69 | -0.01 |
| 170 | 9.60 | 9.65 | -0.05 | 9.33 | 9.36 | -0.03 | 8.69 | 8.68 | 0.01 | 8.37 | 8.36 | 0.01 | 8.38 | 8.37 | 0.01 | 8.18 | 8.16 | 0.02 | 8.60 | 8.60 | 0.00 |
| 171 | 9.56 | 9.61 | -0.05 | 9.26 | 9.28 | -0.02 | 8.66 | 8.66 | 0.01 | 8.32 | 8.31 | 0.01 | 8.34 | 8.33 | 0.01 | 8.12 | 8.10 | 0.02 | 8.53 | 8.53 | 0.00 |
| 172 | 9.50 | 9.55 | -0.04 | 9.15 | 9.18 | -0.02 | 8.56 | 8.55 | 0.01 | 8.17 | 8.15 | 0.02 | 8.19 | 8.17 | 0.02 | 7.97 | 7.95 | 0.02 | 8.44 | 8.44 | 0.00 |
| 173 | 9.46 | 9.50 | -0.04 | 9.10 | 9.11 | -0.01 | 8.47 | 8.44 | 0.03 | 8.06 | 8.02 | 0.03 | 8.07 | 8.04 | 0.03 | 7.84 | 7.80 | 0.03 | 8.34 | 8.33 | 0.01 |
| 174 | 9.39 | 9.42 | -0.04 | 9.01 | 9.01 | 0.00 | 8.37 | 8.34 | 0.03 | 7.93 | 7.89 | 0.04 | 7.92 | 7.88 | 0.04 | 7.68 | 7.64 | 0.04 | 8.17 | 8.15 | 0.01 |
| 175 | 9.33 | 9.36 | -0.03 | 8.94 | 8.94 | 0.00 | 8.30 | 8.27 | 0.04 | 7.87 | 7.82 | 0.05 | 7.84 | 7.79 | 0.05 | 7.60 | 7.55 | 0.05 | 8.04 | 8.02 | 0.02 |
| 176 | 9.26 | 9.29 | -0.03 | 8.88 | 8.88 | 0.00 | 8.26 | 8.21 | 0.04 | 7.82 | 7.77 | 0.05 | 7.80 | 7.75 | 0.05 | 7.56 | 7.50 | 0.05 | 7.98 | 7.95 | 0.03 |
| 177 | 9.12 | 9.14 | -0.02 | 8.67 | 8.66 | 0.01 | 8.00 | 7.94 | 0.05 | 7.50 | 7.43 | 0.07 | 7.46 | 7.39 | 0.07 | 7.19 | 7.12 | 0.07 | 7.58 | 7.53 | 0.04 |
| 178 | 9.06 | 9.08 | -0.02 | 8.61 | 8.59 | 0.02 | 7.95 | 7.89 | 0.06 | 7.45 | 7.37 | 0.08 | 7.43 | 7.35 | 0.07 | 7.15 | 7.08 | 0.07 | 7.49 | 7.44 | 0.05 |
| 179 | 9.01 | 9.03 | -0.02 | 8.58 | 8.56 | 0.02 | 7.92 | 7.86 | 0.06 | 7.42 | 7.33 | 0.08 | 7.41 | 7.34 | 0.07 | 7.15 | 7.07 | 0.08 | 7.43 | 7.37 | 0.06 |
| 180 | 8.97 | 8.98 | -0.01 | 8.56 | 8.53 | 0.02 | 7.91 | 7.85 | 0.06 | 7.40 | 7.32 | 0.08 | 7.39 | 7.32 | 0.08 | 7.15 | 7.07 | 0.08 | 7.35 | 7.29 | 0.06 |
| 181 | 8.91 | 8.92 | -0.01 | 8.51 | 8.48 | 0.02 | 7.87 | 7.81 | 0.07 | 7.34 | 7.25 | 0.09 | 7.32 | 7.24 | 0.08 | 7.11 | 7.03 | 0.09 | 7.22 | 7.15 | 0.07 |
| 182 | 8.93 | 8.94 | -0.01 | 8.55 | 8.53 | 0.02 | 7.96 | 7.89 | 0.06 | 7.44 | 7.36 | 0.09 | 7.42 | 7.34 | 0.08 | 7.24 | 7.16 | 0.08 | 7.29 | 7.22 | 0.07 |
| 183 | 8.82 | 8.82 | 0.00 | 8.40 | 8.37 | 0.03 | 7.79 | 7.72 | 0.07 | 7.28 | 7.19 | 0.09 | 7.21 | 7.12 | 0.09 | 7.04 | 6.95 | 0.09 | 7.03 | 6.95 | 0.08 |
| 184 | 8.82 | 8.82 | 0.00 | 8.41 | 8.38 | 0.03 | 7.86 | 7.79 | 0.07 | 7.37 | 7.27 | 0.10 | 7.29 | 7.20 | 0.09 | 7.13 | 7.04 | 0.09 | 7.09 | 7.01 | 0.08 |
| 185 | 8.78 | 8.78 | 0.00 | 8.41 | 8.38 | 0.03 | 7.90 | 7.83 | 0.07 | 7.42 | 7.33 | 0.10 | 7.31 | 7.22 | 0.09 | 7.19 | 7.10 | 0.09 | 7.10 | 7.01 | 0.09 |
| 186 | 8.63 | 8.62 | 0.01 | 8.28 | 8.24 | 0.04 | 7.75 | 7.67 | 0.07 | 7.23 | 7.12 | 0.11 | 7.08 | 6.98 | 0.11 | 6.98 | 6.87 | 0.10 | 6.79 | 6.69 | 0.10 |
| 187 | 8.60 | 8.59 | 0.01 | 8.31 | 8.28 | 0.03 | 7.80 | 7.73 | 0.07 | 7.27 | 7.16 | 0.11 | 7.10 | 7.00 | 0.11 | 7.03 | 6.92 | 0.11 | 6.82 | 6.72 | 0.11 |
| 188 | 8.52 | 8.49 | 0.03 | 8.16 | 8.12 | 0.04 | 7.66 | 7.59 | 0.08 | 7.14 | 7.03 | 0.12 | 6.92 | 6.80 | 0.12 | 6.84 | 6.72 | 0.12 | 6.62 | 6.50 | 0.12 |

**Table 16. Idaho only scenario average dissolved oxygen concentrations for full water column for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the Idaho only scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.37 | 9.36 | 0.01 | 9.89 | 9.87 | 0.02 | 10.32 | 10.30 | 0.02 | 10.59 | 10.66 | -0.07 | 10.83 | 10.86 | -0.03 | 11.53 | 11.54 | -0.01 | 11.58 | 11.58 | 0.00 |
| 155 | 9.29 | 9.28 | 0.01 | 9.74 | 9.72 | 0.02 | 10.29 | 10.28 | 0.02 | 10.59 | 10.64 | -0.04 | 10.74 | 10.75 | -0.01 | 11.38 | 11.42 | -0.04 | 11.48 | 11.49 | -0.01 |
| 156 | 9.38 | 9.36 | 0.01 | 9.72 | 9.70 | 0.02 | 10.27 | 10.25 | 0.02 | 10.55 | 10.59 | -0.04 | 10.72 | 10.72 | -0.01 | 11.39 | 11.44 | -0.04 | 11.48 | 11.48 | -0.01 |
| 157 | 9.50 | 9.49 | 0.01 | 9.86 | 9.83 | 0.02 | 10.37 | 10.35 | 0.02 | 10.61 | 10.66 | -0.05 | 10.78 | 10.80 | -0.02 | 11.42 | 11.47 | -0.05 | 11.49 | 11.51 | -0.02 |
| 158 | 9.46 | 9.45 | 0.00 | 10.06 | 10.03 | 0.03 | 10.54 | 10.51 | 0.02 | 10.69 | 10.77 | -0.08 | 10.81 | 10.85 | -0.04 | 11.44 | 11.48 | -0.04 | 11.52 | 11.57 | -0.05 |
| 159 | 9.42 | 9.42 | 0.00 | 10.06 | 10.03 | 0.03 | 10.58 | 10.56 | 0.03 | 10.76 | 10.86 | -0.10 | 10.84 | 10.89 | -0.05 | 11.44 | 11.50 | -0.05 | 11.53 | 11.58 | -0.05 |
| 160 | 9.34 | 9.34 | 0.00 | 10.01 | 9.98 | 0.03 | 10.57 | 10.54 | 0.03 | 10.75 | 10.85 | -0.09 | 10.82 | 10.87 | -0.04 | 11.44 | 11.49 | -0.06 | 11.53 | 11.58 | -0.05 |
| 161 | 9.20 | 9.21 | -0.01 | 9.94 | 9.91 | 0.03 | 10.58 | 10.55 | 0.03 | 10.75 | 10.84 | -0.09 | 10.84 | 10.88 | -0.04 | 11.43 | 11.49 | -0.06 | 11.52 | 11.57 | -0.05 |
| 162 | 9.13 | 9.14 | -0.01 | 9.85 | 9.83 | 0.02 | 10.59 | 10.56 | 0.04 | 10.74 | 10.83 | -0.09 | 10.84 | 10.89 | -0.05 | 11.44 | 11.49 | -0.05 | 11.52 | 11.57 | -0.05 |
| 163 | 9.07 | 9.08 | -0.01 | 9.64 | 9.63 | 0.01 | 10.57 | 10.53 | 0.03 | 10.74 | 10.83 | -0.09 | 10.84 | 10.89 | -0.05 | 11.44 | 11.50 | -0.06 | 11.52 | 11.58 | -0.05 |
| 164 | 9.06 | 9.06 | -0.01 | 9.54 | 9.54 | 0.01 | 10.44 | 10.41 | 0.03 | 10.72 | 10.80 | -0.08 | 10.83 | 10.88 | -0.05 | 11.42 | 11.47 | -0.05 | 11.52 | 11.57 | -0.05 |
| 165 | 8.96 | 8.98 | -0.01 | 9.41 | 9.41 | 0.00 | 10.26 | 10.24 | 0.02 | 10.72 | 10.79 | -0.07 | 10.84 | 10.89 | -0.05 | 11.42 | 11.47 | -0.05 | 11.54 | 11.59 | -0.05 |
| 166 | 9.00 | 9.00 | -0.01 | 9.40 | 9.40 | 0.01 | 10.22 | 10.20 | 0.02 | 10.67 | 10.72 | -0.05 | 10.82 | 10.87 | -0.05 | 11.40 | 11.44 | -0.04 | 11.51 | 11.56 | -0.05 |
| 167 | 8.95 | 8.95 | 0.00 | 9.33 | 9.33 | 0.01 | 10.15 | 10.13 | 0.02 | 10.65 | 10.70 | -0.04 | 10.82 | 10.88 | -0.06 | 11.39 | 11.44 | -0.04 | 11.50 | 11.55 | -0.05 |
| 168 | 8.94 | 8.93 | 0.00 | 9.32 | 9.31 | 0.01 | 10.07 | 10.05 | 0.02 | 10.64 | 10.67 | -0.03 | 10.82 | 10.88 | -0.06 | 11.38 | 11.42 | -0.04 | 11.49 | 11.54 | -0.05 |
| 169 | 8.91 | 8.90 | 0.01 | 9.28 | 9.27 | 0.01 | 9.95 | 9.93 | 0.02 | 10.64 | 10.66 | -0.03 | 10.81 | 10.87 | -0.06 | 11.34 | 11.38 | -0.04 | 11.47 | 11.52 | -0.05 |
| 170 | 8.86 | 8.85 | 0.01 | 9.22 | 9.21 | 0.01 | 9.85 | 9.83 | 0.02 | 10.52 | 10.55 | -0.02 | 10.79 | 10.85 | -0.06 | 11.29 | 11.31 | -0.03 | 11.44 | 11.49 | -0.05 |
| 171 | 8.81 | 8.80 | 0.01 | 9.17 | 9.16 | 0.01 | 9.76 | 9.75 | 0.02 | 10.40 | 10.41 | -0.01 | 10.76 | 10.81 | -0.05 | 11.28 | 11.30 | -0.02 | 11.43 | 11.48 | -0.04 |
| 172 | 8.76 | 8.75 | 0.01 | 9.14 | 9.13 | 0.01 | 9.71 | 9.69 | 0.01 | 10.29 | 10.28 | 0.01 | 10.69 | 10.71 | -0.02 | 11.34 | 11.37 | -0.02 | 11.57 | 11.60 | -0.04 |
| 173 | 8.74 | 8.72 | 0.02 | 9.13 | 9.12 | 0.02 | 9.68 | 9.66 | 0.02 | 10.22 | 10.20 | 0.02 | 10.65 | 10.66 | -0.01 | 11.33 | 11.34 | -0.02 | 11.64 | 11.67 | -0.03 |
| 174 | 8.64 | 8.62 | 0.02 | 9.11 | 9.09 | 0.02 | 9.67 | 9.65 | 0.02 | 10.19 | 10.17 | 0.02 | 10.63 | 10.64 | -0.01 | 11.29 | 11.30 | -0.01 | 11.61 | 11.64 | -0.03 |
| 175 | 8.54 | 8.52 | 0.02 | 9.07 | 9.05 | 0.02 | 9.65 | 9.63 | 0.02 | 10.16 | 10.14 | 0.02 | 10.61 | 10.61 | 0.00 | 11.28 | 11.28 | 0.00 | 11.66 | 11.68 | -0.02 |
| 176 | 8.47 | 8.45 | 0.03 | 9.00 | 8.97 | 0.03 | 9.61 | 9.59 | 0.02 | 10.11 | 10.09 | 0.02 | 10.57 | 10.57 | 0.00 | 11.25 | 11.24 | 0.01 | 11.70 | 11.71 | -0.02 |
| 177 | 8.14 | 8.11 | 0.04 | 8.81 | 8.78 | 0.04 | 9.63 | 9.60 | 0.03 | 10.10 | 10.07 | 0.03 | 10.55 | 10.55 | 0.00 | 11.22 | 11.21 | 0.01 | 11.66 | 11.67 | -0.02 |
| 178 | 8.02 | 7.97 | 0.04 | 8.71 | 8.67 | 0.04 | 9.63 | 9.60 | 0.03 | 10.08 | 10.05 | 0.03 | 10.53 | 10.53 | 0.01 | 11.19 | 11.18 | 0.01 | 11.68 | 11.69 | -0.01 |
| 179 | 7.97 | 7.92 | 0.04 | 8.67 | 8.62 | 0.05 | 9.61 | 9.59 | 0.03 | 10.05 | 10.02 | 0.03 | 10.51 | 10.50 | 0.01 | 11.18 | 11.16 | 0.02 | 11.71 | 11.71 | -0.01 |
| 180 | 7.86 | 7.82 | 0.05 | 8.59 | 8.54 | 0.05 | 9.60 | 9.57 | 0.03 | 10.03 | 9.99 | 0.03 | 10.49 | 10.47 | 0.02 | 11.17 | 11.15 | 0.02 | 11.71 | 11.71 | 0.00 |
| 181 | 7.72 | 7.67 | 0.05 | 8.45 | 8.39 | 0.06 | 9.53 | 9.50 | 0.04 | 10.01 | 9.97 | 0.04 | 10.47 | 10.45 | 0.02 | 11.16 | 11.13 | 0.03 | 11.67 | 11.67 | 0.00 |
| 182 | 7.68 | 7.63 | 0.05 | 8.37 | 8.31 | 0.06 | 9.45 | 9.40 | 0.04 | 10.01 | 9.97 | 0.04 | 10.47 | 10.45 | 0.02 | 11.15 | 11.13 | 0.03 | 11.65 | 11.64 | 0.00 |
| 183 | 7.36 | 7.30 | 0.06 | 8.06 | 7.99 | 0.07 | 9.35 | 9.30 | 0.05 | 10.00 | 9.96 | 0.04 | 10.46 | 10.44 | 0.02 | 11.15 | 11.12 | 0.03 | 11.66 | 11.65 | 0.01 |
| 184 | 7.29 | 7.22 | 0.07 | 7.88 | 7.80 | 0.07 | 9.24 | 9.18 | 0.05 | 9.99 | 9.95 | 0.05 | 10.46 | 10.44 | 0.03 | 11.14 | 11.11 | 0.03 | 11.65 | 11.64 | 0.01 |
| 185 | 7.22 | 7.15 | 0.07 | 7.72 | 7.64 | 0.08 | 9.06 | 9.00 | 0.06 | 9.99 | 9.94 | 0.05 | 10.46 | 10.44 | 0.02 | 11.13 | 11.10 | 0.03 | 11.64 | 11.62 | 0.02 |
| 186 | 6.83 | 6.74 | 0.09 | 7.35 | 7.25 | 0.10 | 8.84 | 8.77 | 0.07 | 9.96 | 9.90 | 0.06 | 10.45 | 10.44 | 0.01 | 11.11 | 11.08 | 0.03 | 11.60 | 11.58 | 0.02 |
| 187 | 6.80 | 6.70 | 0.10 | 7.16 | 7.06 | 0.10 | 8.73 | 8.66 | 0.07 | 9.94 | 9.88 | 0.06 | 10.44 | 10.43 | 0.01 | 11.10 | 11.06 | 0.03 | 11.56 | 11.54 | 0.02 |
| 188 | 6.52 | 6.41 | 0.11 | 6.75 | 6.65 | 0.10 | 8.33 | 8.25 | 0.08 | 9.92 | 9.86 | 0.06 | 10.41 | 10.40 | 0.01 | 11.07 | 11.04 | 0.03 | 11.61 | 11.59 | 0.02 |

**Table 17. March test scenario average dissolved oxygen concentrations for full water column for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the March test scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.27 | 9.28 | -0.01 | 8.84 | 8.85 | -0.01 | 8.75 | 8.76 | -0.01 | 8.85 | 8.86 | -0.01 | 8.84 | 8.84 | 0.00 | 9.11 | 9.12 | -0.01 | 9.29 | 9.29 | 0.00 |
| 155 | 9.20 | 9.21 | -0.01 | 8.84 | 8.85 | -0.01 | 8.79 | 8.81 | -0.01 | 8.78 | 8.79 | -0.01 | 8.81 | 8.81 | 0.00 | 9.03 | 9.03 | 0.00 | 9.13 | 9.13 | 0.00 |
| 156 | 9.18 | 9.19 | -0.01 | 8.86 | 8.86 | 0.00 | 8.81 | 8.82 | -0.01 | 8.88 | 8.88 | 0.00 | 8.90 | 8.90 | 0.00 | 9.07 | 9.08 | -0.01 | 9.25 | 9.25 | 0.00 |
| 157 | 9.21 | 9.22 | -0.01 | 9.10 | 9.11 | -0.01 | 8.93 | 8.94 | -0.02 | 8.94 | 8.97 | -0.03 | 8.82 | 8.86 | -0.03 | 8.81 | 8.84 | -0.03 | 9.11 | 9.14 | -0.02 |
| 158 | 9.31 | 9.32 | -0.01 | 9.40 | 9.43 | -0.03 | 8.99 | 9.02 | -0.03 | 8.96 | 9.00 | -0.04 | 8.90 | 8.93 | -0.04 | 8.87 | 8.90 | -0.03 | 9.12 | 9.15 | -0.03 |
| 159 | 9.45 | 9.47 | -0.02 | 9.51 | 9.54 | -0.03 | 9.07 | 9.11 | -0.04 | 9.01 | 9.06 | -0.05 | 8.94 | 8.98 | -0.04 | 8.88 | 8.92 | -0.04 | 9.12 | 9.16 | -0.03 |
| 160 | 9.57 | 9.60 | -0.02 | 9.52 | 9.56 | -0.03 | 9.08 | 9.13 | -0.05 | 8.99 | 9.05 | -0.06 | 8.92 | 8.97 | -0.04 | 8.84 | 8.87 | -0.04 | 9.08 | 9.11 | -0.03 |
| 161 | 9.66 | 9.70 | -0.04 | 9.49 | 9.54 | -0.05 | 9.05 | 9.13 | -0.08 | 8.92 | 9.00 | -0.08 | 8.82 | 8.88 | -0.06 | 8.71 | 8.76 | -0.05 | 8.97 | 9.01 | -0.05 |
| 162 | 9.67 | 9.70 | -0.03 | 9.48 | 9.55 | -0.08 | 9.07 | 9.16 | -0.09 | 8.83 | 8.91 | -0.08 | 8.77 | 8.83 | -0.06 | 8.64 | 8.69 | -0.05 | 8.89 | 8.94 | -0.05 |
| 163 | 9.66 | 9.69 | -0.03 | 9.50 | 9.62 | -0.12 | 9.10 | 9.21 | -0.11 | 8.83 | 8.91 | -0.08 | 8.79 | 8.85 | -0.06 | 8.62 | 8.66 | -0.05 | 8.84 | 8.89 | -0.05 |
| 164 | 9.67 | 9.72 | -0.05 | 9.53 | 9.68 | -0.15 | 9.12 | 9.23 | -0.11 | 8.85 | 8.93 | -0.08 | 8.80 | 8.86 | -0.06 | 8.63 | 8.67 | -0.04 | 8.85 | 8.90 | -0.05 |
| 165 | 9.72 | 9.80 | -0.08 | 9.55 | 9.74 | -0.19 | 9.13 | 9.26 | -0.14 | 8.80 | 8.89 | -0.09 | 8.72 | 8.78 | -0.06 | 8.54 | 8.58 | -0.04 | 8.77 | 8.82 | -0.05 |
| 166 | 9.73 | 9.82 | -0.09 | 9.56 | 9.73 | -0.18 | 9.11 | 9.24 | -0.13 | 8.83 | 8.91 | -0.09 | 8.74 | 8.79 | -0.05 | 8.57 | 8.60 | -0.03 | 8.82 | 8.86 | -0.04 |
| 167 | 9.77 | 9.90 | -0.13 | 9.55 | 9.75 | -0.20 | 9.04 | 9.17 | -0.13 | 8.75 | 8.83 | -0.09 | 8.66 | 8.71 | -0.05 | 8.49 | 8.52 | -0.02 | 8.77 | 8.81 | -0.04 |
| 168 | 9.73 | 9.87 | -0.14 | 9.48 | 9.64 | -0.16 | 8.86 | 8.96 | -0.10 | 8.60 | 8.66 | -0.06 | 8.57 | 8.60 | -0.03 | 8.37 | 8.37 | 0.00 | 8.74 | 8.76 | -0.02 |
| 169 | 9.66 | 9.82 | -0.16 | 9.41 | 9.56 | -0.15 | 8.74 | 8.82 | -0.08 | 8.46 | 8.51 | -0.05 | 8.46 | 8.47 | -0.02 | 8.26 | 8.26 | 0.00 | 8.69 | 8.71 | -0.02 |
| 170 | 9.60 | 9.78 | -0.17 | 9.33 | 9.46 | -0.14 | 8.69 | 8.76 | -0.07 | 8.37 | 8.41 | -0.04 | 8.38 | 8.40 | -0.02 | 8.18 | 8.17 | 0.00 | 8.60 | 8.62 | -0.02 |
| 171 | 9.56 | 9.75 | -0.18 | 9.26 | 9.39 | -0.13 | 8.66 | 8.73 | -0.07 | 8.32 | 8.36 | -0.04 | 8.34 | 8.36 | -0.02 | 8.12 | 8.12 | 0.00 | 8.53 | 8.54 | -0.01 |
| 172 | 9.50 | 9.68 | -0.18 | 9.15 | 9.28 | -0.12 | 8.56 | 8.62 | -0.06 | 8.17 | 8.20 | -0.03 | 8.19 | 8.20 | -0.01 | 7.97 | 7.97 | 0.00 | 8.44 | 8.45 | -0.01 |
| 173 | 9.46 | 9.62 | -0.16 | 9.10 | 9.20 | -0.11 | 8.47 | 8.51 | -0.04 | 8.06 | 8.07 | -0.01 | 8.07 | 8.07 | 0.00 | 7.84 | 7.82 | 0.01 | 8.34 | 8.34 | -0.01 |
| 174 | 9.39 | 9.54 | -0.15 | 9.01 | 9.10 | -0.09 | 8.37 | 8.40 | -0.03 | 7.93 | 7.94 | 0.00 | 7.92 | 7.91 | 0.01 | 7.68 | 7.66 | 0.02 | 8.17 | 8.17 | 0.00 |
| 175 | 9.33 | 9.47 | -0.14 | 8.94 | 9.03 | -0.09 | 8.30 | 8.32 | -0.02 | 7.87 | 7.87 | 0.00 | 7.84 | 7.82 | 0.01 | 7.60 | 7.58 | 0.02 | 8.04 | 8.04 | 0.01 |
| 176 | 9.26 | 9.39 | -0.13 | 8.88 | 8.96 | -0.08 | 8.26 | 8.27 | -0.01 | 7.82 | 7.81 | 0.01 | 7.80 | 7.79 | 0.02 | 7.56 | 7.53 | 0.03 | 7.98 | 7.96 | 0.01 |
| 177 | 9.12 | 9.22 | -0.10 | 8.67 | 8.73 | -0.06 | 8.00 | 7.99 | 0.00 | 7.50 | 7.47 | 0.03 | 7.46 | 7.43 | 0.03 | 7.19 | 7.15 | 0.04 | 7.58 | 7.55 | 0.03 |
| 178 | 9.06 | 9.16 | -0.10 | 8.61 | 8.66 | -0.06 | 7.95 | 7.94 | 0.01 | 7.45 | 7.41 | 0.03 | 7.43 | 7.39 | 0.03 | 7.15 | 7.11 | 0.04 | 7.49 | 7.45 | 0.03 |
| 179 | 9.01 | 9.10 | -0.09 | 8.58 | 8.63 | -0.05 | 7.92 | 7.91 | 0.01 | 7.42 | 7.38 | 0.04 | 7.41 | 7.38 | 0.03 | 7.15 | 7.11 | 0.04 | 7.43 | 7.39 | 0.04 |
| 180 | 8.97 | 9.05 | -0.09 | 8.56 | 8.61 | -0.05 | 7.91 | 7.90 | 0.01 | 7.40 | 7.36 | 0.04 | 7.39 | 7.36 | 0.03 | 7.15 | 7.11 | 0.04 | 7.35 | 7.31 | 0.04 |
| 181 | 8.91 | 8.98 | -0.08 | 8.51 | 8.55 | -0.04 | 7.87 | 7.86 | 0.01 | 7.34 | 7.30 | 0.04 | 7.32 | 7.28 | 0.04 | 7.11 | 7.07 | 0.04 | 7.22 | 7.18 | 0.04 |
| 182 | 8.93 | 9.01 | -0.08 | 8.55 | 8.60 | -0.05 | 7.96 | 7.95 | 0.00 | 7.44 | 7.41 | 0.04 | 7.42 | 7.39 | 0.03 | 7.24 | 7.21 | 0.04 | 7.29 | 7.25 | 0.04 |
| 183 | 8.82 | 8.89 | -0.07 | 8.40 | 8.44 | -0.04 | 7.79 | 7.78 | 0.01 | 7.28 | 7.24 | 0.04 | 7.21 | 7.17 | 0.04 | 7.04 | 7.00 | 0.04 | 7.03 | 6.99 | 0.04 |
| 184 | 8.82 | 8.89 | -0.07 | 8.41 | 8.46 | -0.05 | 7.86 | 7.86 | 0.00 | 7.37 | 7.33 | 0.03 | 7.29 | 7.26 | 0.03 | 7.13 | 7.10 | 0.03 | 7.09 | 7.06 | 0.03 |
| 185 | 8.78 | 8.86 | -0.08 | 8.41 | 8.47 | -0.06 | 7.90 | 7.92 | -0.02 | 7.42 | 7.40 | 0.02 | 7.31 | 7.30 | 0.02 | 7.19 | 7.17 | 0.02 | 7.10 | 7.08 | 0.02 |
| 186 | 8.63 | 8.69 | -0.06 | 8.28 | 8.33 | -0.05 | 7.75 | 7.76 | -0.01 | 7.23 | 7.20 | 0.03 | 7.08 | 7.05 | 0.03 | 6.98 | 6.94 | 0.03 | 6.79 | 6.76 | 0.04 |
| 187 | 8.60 | 8.66 | -0.05 | 8.31 | 8.36 | -0.05 | 7.80 | 7.82 | -0.02 | 7.27 | 7.23 | 0.04 | 7.10 | 7.07 | 0.04 | 7.03 | 6.99 | 0.04 | 6.82 | 6.78 | 0.04 |
| 188 | 8.52 | 8.63 | -0.11 | 8.16 | 8.27 | -0.11 | 7.66 | 7.73 | -0.06 | 7.14 | 7.14 | 0.00 | 6.92 | 6.92 | -0.01 | 6.84 | 6.84 | 0.00 | 6.62 | 6.61 | 0.01 |

**Table 18. March test scenario average dissolved oxygen concentrations for full water column for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the March test scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.37 | 9.37 | 0.00 | 9.89 | 9.89 | 0.00 | 10.32 | 10.32 | 0.00 | 10.59 | 10.59 | 0.00 | 10.83 | 10.83 | 0.00 | 11.53 | 11.53 | 0.00 | 11.58 | 11.58 | 0.00 |
| 155 | 9.29 | 9.29 | 0.00 | 9.74 | 9.74 | 0.00 | 10.29 | 10.29 | 0.00 | 10.59 | 10.59 | 0.00 | 10.74 | 10.74 | 0.00 | 11.38 | 11.38 | 0.00 | 11.48 | 11.48 | 0.00 |
| 156 | 9.38 | 9.38 | 0.00 | 9.72 | 9.72 | 0.00 | 10.27 | 10.27 | 0.00 | 10.55 | 10.55 | 0.00 | 10.72 | 10.72 | 0.00 | 11.39 | 11.39 | 0.00 | 11.48 | 11.48 | 0.00 |
| 157 | 9.50 | 9.50 | 0.00 | 9.86 | 9.86 | 0.00 | 10.37 | 10.37 | 0.00 | 10.61 | 10.61 | 0.00 | 10.78 | 10.78 | 0.00 | 11.42 | 11.42 | 0.00 | 11.49 | 11.49 | 0.00 |
| 158 | 9.46 | 9.47 | -0.01 | 10.06 | 10.06 | 0.00 | 10.54 | 10.54 | 0.00 | 10.69 | 10.69 | 0.00 | 10.81 | 10.81 | 0.00 | 11.44 | 11.44 | 0.00 | 11.52 | 11.52 | 0.00 |
| 159 | 9.42 | 9.44 | -0.01 | 10.06 | 10.06 | 0.00 | 10.58 | 10.58 | 0.00 | 10.76 | 10.76 | 0.00 | 10.84 | 10.84 | 0.00 | 11.44 | 11.44 | 0.00 | 11.53 | 11.53 | 0.00 |
| 160 | 9.34 | 9.36 | -0.02 | 10.01 | 10.01 | 0.00 | 10.57 | 10.57 | 0.00 | 10.75 | 10.75 | 0.00 | 10.82 | 10.82 | 0.00 | 11.44 | 11.44 | 0.00 | 11.53 | 11.53 | 0.00 |
| 161 | 9.20 | 9.23 | -0.03 | 9.94 | 9.94 | 0.00 | 10.58 | 10.58 | 0.00 | 10.75 | 10.75 | 0.00 | 10.84 | 10.84 | 0.00 | 11.43 | 11.44 | 0.00 | 11.52 | 11.52 | 0.00 |
| 162 | 9.13 | 9.17 | -0.03 | 9.85 | 9.86 | -0.01 | 10.59 | 10.59 | 0.00 | 10.74 | 10.74 | 0.00 | 10.84 | 10.84 | 0.00 | 11.44 | 11.44 | 0.00 | 11.52 | 11.52 | 0.00 |
| 163 | 9.07 | 9.11 | -0.04 | 9.64 | 9.66 | -0.02 | 10.57 | 10.56 | 0.00 | 10.74 | 10.74 | 0.00 | 10.84 | 10.84 | 0.00 | 11.44 | 11.44 | 0.00 | 11.52 | 11.52 | 0.00 |
| 164 | 9.06 | 9.09 | -0.04 | 9.54 | 9.56 | -0.02 | 10.44 | 10.44 | 0.00 | 10.72 | 10.72 | 0.00 | 10.83 | 10.83 | 0.00 | 11.42 | 11.42 | 0.00 | 11.52 | 11.52 | 0.00 |
| 165 | 8.96 | 9.00 | -0.04 | 9.41 | 9.43 | -0.03 | 10.26 | 10.27 | 0.00 | 10.72 | 10.72 | 0.00 | 10.84 | 10.84 | 0.00 | 11.42 | 11.42 | 0.00 | 11.54 | 11.54 | 0.00 |
| 166 | 9.00 | 9.03 | -0.03 | 9.40 | 9.42 | -0.02 | 10.22 | 10.22 | 0.00 | 10.67 | 10.67 | 0.00 | 10.82 | 10.82 | 0.00 | 11.40 | 11.40 | 0.00 | 11.51 | 11.51 | 0.00 |
| 167 | 8.95 | 8.98 | -0.03 | 9.33 | 9.36 | -0.02 | 10.15 | 10.16 | -0.01 | 10.65 | 10.65 | 0.00 | 10.82 | 10.82 | 0.00 | 11.39 | 11.39 | 0.00 | 11.50 | 11.50 | 0.00 |
| 168 | 8.94 | 8.96 | -0.02 | 9.32 | 9.33 | -0.02 | 10.07 | 10.08 | -0.01 | 10.64 | 10.64 | 0.00 | 10.82 | 10.82 | 0.00 | 11.38 | 11.38 | 0.00 | 11.49 | 11.49 | 0.00 |
| 169 | 8.91 | 8.93 | -0.02 | 9.28 | 9.29 | -0.02 | 9.95 | 9.95 | -0.01 | 10.64 | 10.64 | 0.00 | 10.81 | 10.81 | 0.00 | 11.34 | 11.34 | 0.00 | 11.47 | 11.47 | 0.00 |
| 170 | 8.86 | 8.88 | -0.02 | 9.22 | 9.24 | -0.02 | 9.85 | 9.85 | -0.01 | 10.52 | 10.52 | 0.00 | 10.79 | 10.79 | 0.00 | 11.29 | 11.29 | 0.00 | 11.44 | 11.44 | 0.00 |
| 171 | 8.81 | 8.83 | -0.01 | 9.17 | 9.19 | -0.01 | 9.76 | 9.77 | -0.01 | 10.40 | 10.40 | 0.00 | 10.76 | 10.76 | 0.00 | 11.28 | 11.28 | 0.00 | 11.43 | 11.44 | 0.00 |
| 172 | 8.76 | 8.77 | -0.01 | 9.14 | 9.15 | -0.01 | 9.71 | 9.71 | -0.01 | 10.29 | 10.29 | 0.00 | 10.69 | 10.69 | 0.00 | 11.34 | 11.35 | 0.00 | 11.57 | 11.57 | 0.00 |
| 173 | 8.74 | 8.74 | -0.01 | 9.13 | 9.14 | -0.01 | 9.68 | 9.68 | 0.00 | 10.22 | 10.22 | 0.00 | 10.65 | 10.65 | 0.00 | 11.33 | 11.33 | 0.00 | 11.64 | 11.64 | 0.00 |
| 174 | 8.64 | 8.65 | -0.01 | 9.11 | 9.12 | -0.01 | 9.67 | 9.67 | 0.00 | 10.19 | 10.19 | 0.00 | 10.63 | 10.63 | 0.00 | 11.29 | 11.29 | 0.00 | 11.61 | 11.62 | 0.00 |
| 175 | 8.54 | 8.55 | -0.01 | 9.07 | 9.08 | -0.01 | 9.65 | 9.66 | 0.00 | 10.16 | 10.16 | 0.00 | 10.61 | 10.61 | 0.00 | 11.28 | 11.28 | 0.00 | 11.66 | 11.66 | 0.00 |
| 176 | 8.47 | 8.48 | 0.00 | 9.00 | 9.01 | -0.01 | 9.61 | 9.61 | 0.00 | 10.11 | 10.11 | 0.00 | 10.57 | 10.57 | 0.00 | 11.25 | 11.25 | 0.00 | 11.70 | 11.70 | 0.00 |
| 177 | 8.14 | 8.14 | 0.00 | 8.81 | 8.82 | 0.00 | 9.63 | 9.63 | 0.00 | 10.10 | 10.10 | 0.01 | 10.55 | 10.55 | 0.00 | 11.22 | 11.22 | 0.00 | 11.66 | 11.66 | 0.00 |
| 178 | 8.02 | 8.01 | 0.01 | 8.71 | 8.71 | 0.00 | 9.63 | 9.63 | 0.00 | 10.08 | 10.08 | 0.00 | 10.53 | 10.53 | 0.00 | 11.19 | 11.20 | 0.00 | 11.68 | 11.68 | 0.00 |
| 179 | 7.97 | 7.96 | 0.01 | 8.67 | 8.67 | 0.00 | 9.61 | 9.61 | 0.00 | 10.05 | 10.04 | 0.00 | 10.51 | 10.51 | 0.00 | 11.18 | 11.18 | 0.00 | 11.71 | 11.71 | 0.00 |
| 180 | 7.86 | 7.85 | 0.02 | 8.59 | 8.58 | 0.00 | 9.60 | 9.60 | 0.00 | 10.03 | 10.02 | 0.00 | 10.49 | 10.48 | 0.00 | 11.17 | 11.17 | 0.00 | 11.71 | 11.71 | 0.00 |
| 181 | 7.72 | 7.70 | 0.02 | 8.45 | 8.45 | 0.00 | 9.53 | 9.53 | 0.00 | 10.01 | 10.01 | 0.00 | 10.47 | 10.47 | 0.00 | 11.16 | 11.16 | 0.00 | 11.67 | 11.67 | 0.00 |
| 182 | 7.68 | 7.65 | 0.03 | 8.37 | 8.37 | 0.00 | 9.45 | 9.43 | 0.01 | 10.01 | 10.00 | 0.00 | 10.47 | 10.47 | 0.00 | 11.15 | 11.15 | 0.00 | 11.65 | 11.65 | 0.00 |
| 183 | 7.36 | 7.32 | 0.03 | 8.06 | 8.05 | 0.01 | 9.35 | 9.34 | 0.00 | 10.00 | 10.00 | 0.00 | 10.46 | 10.46 | 0.00 | 11.15 | 11.15 | 0.00 | 11.66 | 11.66 | 0.00 |
| 184 | 7.29 | 7.26 | 0.03 | 7.88 | 7.87 | 0.01 | 9.24 | 9.23 | 0.01 | 9.99 | 9.99 | 0.00 | 10.46 | 10.46 | 0.00 | 11.14 | 11.14 | 0.00 | 11.65 | 11.65 | 0.00 |
| 185 | 7.22 | 7.19 | 0.03 | 7.72 | 7.71 | 0.01 | 9.06 | 9.05 | 0.01 | 9.99 | 9.98 | 0.00 | 10.46 | 10.46 | 0.00 | 11.13 | 11.13 | 0.00 | 11.64 | 11.64 | 0.00 |
| 186 | 6.83 | 6.79 | 0.04 | 7.35 | 7.33 | 0.02 | 8.84 | 8.85 | -0.01 | 9.96 | 9.95 | 0.01 | 10.45 | 10.45 | 0.00 | 11.11 | 11.11 | 0.00 | 11.60 | 11.60 | 0.00 |
| 187 | 6.80 | 6.75 | 0.05 | 7.16 | 7.13 | 0.03 | 8.73 | 8.74 | -0.01 | 9.94 | 9.93 | 0.01 | 10.44 | 10.44 | 0.00 | 11.10 | 11.09 | 0.00 | 11.56 | 11.56 | 0.00 |
| 188 | 6.52 | 6.50 | 0.02 | 6.75 | 6.74 | 0.01 | 8.33 | 8.32 | 0.01 | 9.92 | 9.87 | 0.06 | 10.41 | 10.41 | 0.00 | 11.07 | 11.07 | 0.00 | 11.61 | 11.61 | 0.00 |

## Summary

A water quality and hydrodynamic model, CE-QUAL-W2 Version 3.6 (Cole and Wells, 2008), was used to simulate modeling scenarios for the Spokane River from the outlet of Lake Coeur d'Alene, Idaho to the outlet of Long Lake in Washington. Four model scenario were simulated: a no source scenario, a TMDL scenario, a Idaho Only Scenario, and a March test scenario.

The semi-monthly averages of the daily minimum, volume-averaged DO in the hypolimnion (greater than 8 m depth) and the full water column of each Long Lake segment (157-188) for the scenarios were tabulated. The greatest difference in average dissolved oxygen concentration in the hypolimnion between the no source and the TMDL scenario was 1.22 mg/l, which occurred in the August 16-31 time period. For the full water column the largest difference was 0.78 mg/l.

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# Exhibit 11

| Julian Day | Date | No Source TP (mg/L) | Idaho Only TP (mg/L) | TMDL #1 TP (mg/L) | March Only TP (mg/L) | Idaho Impact TP (mg/L) |
|---|---|---|---|---|---|---|
| 60.003 | 1-Mar | 0.006 | 0.014 | 0.131 | 0.006 | 0.008 |
| 61.003 | 2-Mar | 0.006 | 0.014 | 0.034 | 0.079 | 0.008 |
| 62.003 | 3-Mar | 0.006 | 0.015 | 0.028 | 0.084 | 0.009 |
| 63.003 | 4-Mar | 0.006 | 0.013 | 0.023 | 0.097 | 0.007 |
| 64.003 | 5-Mar | 0.006 | 0.012 | 0.023 | 0.08 | 0.006 |
| 65.002 | 6-Mar | 0.006 | 0.009 | 0.02 | 0.083 | 0.003 |
| 66.001 | 7-Mar | 0.007 | 0.008 | 0.02 | 0.091 | 0.001 |
| 67.002 | 8-Mar | 0.008 | 0.009 | 0.027 | 0.093 | 0.001 |
| 68.001 | 9-Mar | 0.009 | 0.011 | 0.031 | 0.088 | 0.002 |
| 69.003 | 10-Mar | 0.009 | 0.01 | 0.03 | 0.09 | 0.001 |
| 70.003 | 11-Mar | 0.009 | 0.01 | 0.031 | 0.09 | 0.001 |
| 71.003 | 12-Mar | 0.009 | 0.009 | 0.029 | 0.082 | 0 |
| 72.003 | 13-Mar | 0.008 | 0.009 | 0.026 | 0.085 | 0.001 |
| 73.003 | 14-Mar | 0.009 | 0.01 | 0.031 | 0.11 | 0.001 |
| 74.003 | 15-Mar | 0.009 | 0.01 | 0.031 | 0.087 | 0.001 |
| 75.003 | 16-Mar | 0.014 | 0.015 | 0.031 | 0.089 | 0.001 |
| 76.003 | 17-Mar | 0.011 | 0.012 | 0.025 | 0.087 | 0.001 |
| 77.002 | 18-Mar | 0.011 | 0.011 | 0.023 | 0.082 | 0 |
| 78.003 | 19-Mar | 0.011 | 0.012 | 0.025 | 0.079 | 0.001 |
| 79.003 | 20-Mar | 0.01 | 0.011 | 0.021 | 0.08 | 0.001 |
| 80.003 | 21-Mar | 0.011 | 0.011 | 0.022 | 0.081 | 0 |
| 81.003 | 22-Mar | 0.011 | 0.012 | 0.024 | 0.088 | 0.001 |
| 82.003 | 23-Mar | 0.008 | 0.008 | 0.015 | 0.065 | 0 |
| 83.003 | 24-Mar | 0.008 | 0.008 | 0.014 | 0.07 | 0 |
| 84.003 | 25-Mar | 0.007 | 0.008 | 0.013 | 0.062 | 0.001 |
| 85.003 | 26-Mar | 0.007 | 0.008 | 0.014 | 0.054 | 0.001 |
| 86.003 | 27-Mar | 0.008 | 0.009 | 0.015 | 0.068 | 0.001 |
| 87.003 | 28-Mar | 0.008 | 0.008 | 0.014 | 0.055 | 0 |
| 88.003 | 29-Mar | 0.008 | 0.008 | 0.014 | 0.048 | 0 |
| 89.002 | 30-Mar | 0.008 | 0.008 | 0.014 | 0.02 | 0 |
| 90.003 | 31-Mar | 0.007 | 0.008 | 0.013 | 0.017 | 0.001 |
| 91.003 | 1-Apr | 0.007 | 0.008 | 0.013 | 0.016 | 0.001 |
| 92.003 | 2-Apr | 0.007 | 0.008 | 0.012 | 0.009 | 0.001 |
| 93.003 | 3-Apr | 0.008 | 0.009 | 0.015 | 0.009 | 0.001 |
| 94.003 | 4-Apr | 0.008 | 0.008 | 0.013 | 0.008 | 0 |
| 95.002 | 5-Apr | 0.008 | 0.008 | 0.014 | 0.008 | 0 |
| 96.003 | 6-Apr | 0.008 | 0.008 | 0.013 | 0.008 | 0 |
| 97.003 | 7-Apr | 0.008 | 0.008 | 0.013 | 0.008 | 0 |
| 98.003 | 8-Apr | 0.008 | 0.008 | 0.014 | 0.008 | 0 |
| 99.003 | 9-Apr | 0.008 | 0.008 | 0.014 | 0.008 | 0 |
| 100.002 | 10-Apr | 0.008 | 0.008 | 0.014 | 0.008 | 0 |
| 101.003 | 11-Apr | 0.008 | 0.008 | 0.013 | 0.008 | 0 |
| 102.003 | 12-Apr | 0.008 | 0.008 | 0.013 | 0.008 | 0 |
| 103.001 | 13-Apr | 0.009 | 0.009 | 0.015 | 0.009 | 0 |
| 104.003 | 14-Apr | 0.008 | 0.008 | 0.014 | 0.008 | 0 |
| 105.002 | 15-Apr | 0.006 | 0.007 | 0.01 | 0.007 | 0.001 |
| 106.002 | 16-Apr | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 107.001 | 17-Apr | 0.006 | 0.006 | 0.009 | 0.006 | 0 |

Segment 154 Model Results for Total Phosporus (PSU, Jan. 2010)

| | No Source TP (mg/L) | Idaho Only TP (mg/L) | TMDL #1 TP (mg/L) | March Only TP (mg/L) | Idaho Impact TP (mg/L) |
|---|---|---|---|---|---|
| Minimum | 0.0030 | 0.0030 | 0.0080 | 0.0030 | 0.0000 |
| Maximum | 0.0140 | 0.0150 | 0.1310 | 0.1100 | 0.0090 |
| Average | 0.0060 | 0.0065 | 0.0117 | 0.0144 | 0.0004 |
| Standard Deviation | 0.0020 | 0.0025 | 0.0093 | 0.0242 | 0.0012 |
| Frequency of 0 | | | | | 175 |
| Frequency of 0 (June - Sept) | | | | | 98 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 108.003 | 18-Apr | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 109.001 | 19-Apr | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 110.002 | 20-Apr | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 111.003 | 21-Apr | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 112.003 | 22-Apr | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 113.002 | 23-Apr | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 114.003 | 24-Apr | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 115.001 | 25-Apr | 0.005 | 0.006 | 0.008 | 0.006 | 0.001 |
| 116.002 | 26-Apr | 0.005 | 0.006 | 0.008 | 0.006 | 0.001 |
| 117.003 | 27-Apr | 0.005 | 0.006 | 0.008 | 0.006 | 0.001 |
| 118.003 | 28-Apr | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 119.002 | 29-Apr | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 120.003 | 30-Apr | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 121.003 | 1-May | 0.007 | 0.007 | 0.009 | 0.007 | 0 |
| 122.003 | 2-May | 0.008 | 0.008 | 0.013 | 0.008 | 0 |
| 123.003 | 3-May | 0.007 | 0.007 | 0.009 | 0.007 | 0 |
| 124.003 | 4-May | 0.007 | 0.007 | 0.008 | 0.007 | 0 |
| 125.003 | 5-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 126.003 | 6-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 127.003 | 7-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 128.003 | 8-May | 0.005 | 0.006 | 0.008 | 0.006 | 0.001 |
| 129.003 | 9-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 130.003 | 10-May | 0.005 | 0.006 | 0.008 | 0.006 | 0.001 |
| 131.003 | 11-May | 0.005 | 0.005 | 0.008 | 0.005 | 0 |
| 132.003 | 12-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 133.003 | 13-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 134.003 | 14-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 135.003 | 15-May | 0.007 | 0.007 | 0.008 | 0.007 | 0 |
| 136.003 | 16-May | 0.007 | 0.007 | 0.008 | 0.007 | 0 |
| 137.003 | 17-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 138.003 | 18-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 139.003 | 19-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 140.003 | 20-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 141.003 | 21-May | 0.005 | 0.006 | 0.008 | 0.005 | 0.001 |
| 142.003 | 22-May | 0.005 | 0.005 | 0.008 | 0.005 | 0 |
| 143.003 | 23-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 144.003 | 24-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 145.003 | 25-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 146.003 | 26-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 147.003 | 27-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 148.003 | 28-May | 0.007 | 0.007 | 0.008 | 0.007 | 0 |
| 149.003 | 29-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 150.003 | 30-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 151.003 | 31-May | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 152.003 | 1-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 153.003 | 2-Jun | 0.006 | 0.007 | 0.009 | 0.007 | 0.001 |
| 154.003 | 3-Jun | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 155.003 | 4-Jun | 0.007 | 0.007 | 0.008 | 0.007 | 0 |
| 156.003 | 5-Jun | 0.007 | 0.007 | 0.009 | 0.007 | 0 |
| 157.003 | 6-Jun | 0.007 | 0.007 | 0.009 | 0.007 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 158.003 | 7-Jun | 0.006 | 0.007 | 0.008 | 0.007 | 0.001 |
| 159.003 | 8-Jun | 0.006 | 0.007 | 0.008 | 0.007 | 0.001 |
| 160.003 | 9-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 161.003 | 10-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 162.003 | 11-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 163.003 | 12-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 164.003 | 13-Jun | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 165.003 | 14-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 166.003 | 15-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 167.003 | 16-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 168.003 | 17-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 169.003 | 18-Jun | 0.005 | 0.006 | 0.008 | 0.006 | 0.001 |
| 170.003 | 19-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 171.003 | 20-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 172.003 | 21-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 173.003 | 22-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 174.003 | 23-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 175.003 | 24-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 176.003 | 25-Jun | 0.005 | 0.006 | 0.009 | 0.006 | 0.001 |
| 177.003 | 26-Jun | 0.006 | 0.006 | 0.008 | 0.006 | 0 |
| 178.003 | 27-Jun | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 179.003 | 28-Jun | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 180.003 | 29-Jun | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 181.003 | 30-Jun | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 182.003 | 1-Jul | 0.006 | 0.007 | 0.01 | 0.007 | 0.001 |
| 183.003 | 2-Jul | 0.007 | 0.007 | 0.01 | 0.007 | 0 |
| 184.003 | 3-Jul | 0.006 | 0.007 | 0.01 | 0.007 | 0.001 |
| 185.003 | 4-Jul | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 186.003 | 5-Jul | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 187.003 | 6-Jul | 0.006 | 0.006 | 0.01 | 0.006 | 0 |
| 188.003 | 7-Jul | 0.006 | 0.006 | 0.009 | 0.006 | 0 |
| 189.003 | 8-Jul | 0.005 | 0.006 | 0.009 | 0.005 | 0.001 |
| 190.003 | 9-Jul | 0.005 | 0.005 | 0.009 | 0.005 | 0 |
| 191.003 | 10-Jul | 0.005 | 0.005 | 0.009 | 0.005 | 0 |
| 192.003 | 11-Jul | 0.004 | 0.005 | 0.009 | 0.005 | 0.001 |
| 193.003 | 12-Jul | 0.004 | 0.005 | 0.008 | 0.004 | 0.001 |
| 194.003 | 13-Jul | 0.004 | 0.005 | 0.009 | 0.005 | 0.001 |
| 195.003 | 14-Jul | 0.004 | 0.005 | 0.009 | 0.005 | 0.001 |
| 196.003 | 15-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 197.003 | 16-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 198.003 | 17-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 199.003 | 18-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 200.003 | 19-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 201.003 | 20-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 202.003 | 21-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 203.003 | 22-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 204.003 | 23-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 205.003 | 24-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 206.003 | 25-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 207.003 | 26-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 208.003 | 27-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 209.003 | 28-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 210.003 | 29-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 211.003 | 30-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 212.003 | 31-Jul | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 213.003 | 1-Aug | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 214.003 | 2-Aug | 0.004 | 0.004 | 0.008 | 0.004 | 0 |
| 215.003 | 3-Aug | 0.004 | 0.004 | 0.009 | 0.004 | 0 |
| 216.003 | 4-Aug | 0.004 | 0.004 | 0.009 | 0.004 | 0 |
| 217.003 | 5-Aug | 0.004 | 0.004 | 0.009 | 0.004 | 0 |
| 218.003 | 6-Aug | 0.004 | 0.004 | 0.009 | 0.004 | 0 |
| 219.003 | 7-Aug | 0.004 | 0.004 | 0.009 | 0.004 | 0 |
| 220.003 | 8-Aug | 0.003 | 0.004 | 0.008 | 0.003 | 0.001 |
| 221.003 | 9-Aug | 0.003 | 0.004 | 0.008 | 0.003 | 0.001 |
| 222.003 | 10-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 223.003 | 11-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 224.003 | 12-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 225.003 | 13-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 226.003 | 14-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 227.003 | 15-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 228.003 | 16-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 229.003 | 17-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 230.003 | 18-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 231.003 | 19-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 232.003 | 20-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 233.003 | 21-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 234.003 | 22-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 235.003 | 23-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 236.003 | 24-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 237.003 | 25-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 238.003 | 26-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 239.003 | 27-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 240.003 | 28-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 241.003 | 29-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 242.003 | 30-Aug | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 243.003 | 31-Aug | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 244.003 | 1-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 245.003 | 2-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 246.003 | 3-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 247.003 | 4-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 248.003 | 5-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 249.003 | 6-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 250.003 | 7-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 251.003 | 8-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 252.003 | 9-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 253.003 | 10-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 254.003 | 11-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 255.003 | 12-Sep | 0.003 | 0.003 | 0.009 | 0.003 | 0 |
| 256.003 | 13-Sep | 0.003 | 0.003 | 0.008 | 0.003 | 0 |
| 257.003 | 14-Sep | 0.004 | 0.004 | 0.01 | 0.004 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 258.003 | 15-Sep | 0.006 | 0.006 | 0.012 | 0.006 | 0 |
| 259.003 | 16-Sep | 0.006 | 0.007 | 0.012 | 0.006 | 0.001 |
| 260.003 | 17-Sep | 0.006 | 0.007 | 0.012 | 0.006 | 0.001 |
| 261.003 | 18-Sep | 0.006 | 0.007 | 0.012 | 0.006 | 0.001 |
| 262.003 | 19-Sep | 0.006 | 0.007 | 0.012 | 0.006 | 0.001 |
| 263.003 | 20-Sep | 0.006 | 0.007 | 0.012 | 0.006 | 0.001 |
| 264.003 | 21-Sep | 0.006 | 0.007 | 0.011 | 0.006 | 0.001 |
| 265.003 | 22-Sep | 0.006 | 0.006 | 0.011 | 0.006 | 0 |
| 266.003 | 23-Sep | 0.006 | 0.006 | 0.011 | 0.006 | 0 |
| 267.003 | 24-Sep | 0.006 | 0.006 | 0.011 | 0.006 | 0 |
| 268.003 | 25-Sep | 0.006 | 0.006 | 0.011 | 0.006 | 0 |
| 269.003 | 26-Sep | 0.006 | 0.007 | 0.012 | 0.006 | 0.001 |
| 270.003 | 27-Sep | 0.006 | 0.007 | 0.012 | 0.006 | 0.001 |
| 271.003 | 28-Sep | 0.006 | 0.007 | 0.011 | 0.006 | 0.001 |
| 272.003 | 29-Sep | 0.006 | 0.007 | 0.011 | 0.006 | 0.001 |
| 273.003 | 30-Sep | 0.006 | 0.006 | 0.011 | 0.006 | 0 |
| 274.003 | 1-Oct | 0.006 | 0.006 | 0.011 | 0.006 | 0 |
| 275.003 | 2-Oct | 0.006 | 0.006 | 0.011 | 0.006 | 0 |
| 276.003 | 3-Oct | 0.007 | 0.008 | 0.012 | 0.007 | 0.001 |
| 277.003 | 4-Oct | 0.008 | 0.009 | 0.013 | 0.008 | 0.001 |
| 278.003 | 5-Oct | 0.009 | 0.009 | 0.013 | 0.009 | 0 |
| 279.003 | 6-Oct | 0.008 | 0.009 | 0.013 | 0.008 | 0.001 |
| 280.003 | 7-Oct | 0.008 | 0.008 | 0.012 | 0.008 | 0 |
| 281.003 | 8-Oct | 0.008 | 0.009 | 0.013 | 0.008 | 0.001 |
| 282.003 | 9-Oct | 0.008 | 0.008 | 0.012 | 0.008 | 0 |
| 283.003 | 10-Oct | 0.008 | 0.009 | 0.012 | 0.008 | 0.001 |
| 284.003 | 11-Oct | 0.008 | 0.009 | 0.013 | 0.008 | 0.001 |
| 285.003 | 12-Oct | 0.009 | 0.009 | 0.013 | 0.009 | 0 |
| 286.003 | 13-Oct | 0.009 | 0.009 | 0.013 | 0.009 | 0 |
| 287.003 | 14-Oct | 0.009 | 0.009 | 0.012 | 0.009 | 0 |
| 288.003 | 15-Oct | 0.008 | 0.009 | 0.012 | 0.008 | 0.001 |
| 289.003 | 16-Oct | 0.008 | 0.009 | 0.012 | 0.008 | 0.001 |
| 290.003 | 17-Oct | 0.009 | 0.009 | 0.013 | 0.009 | 0 |
| 291.003 | 18-Oct | 0.009 | 0.009 | 0.012 | 0.009 | 0 |
| 292.003 | 19-Oct | 0.009 | 0.009 | 0.013 | 0.009 | 0 |
| 293.003 | 20-Oct | 0.008 | 0.009 | 0.012 | 0.008 | 0.001 |
| 294.003 | 21-Oct | 0.008 | 0.008 | 0.012 | 0.008 | 0 |
| 295.003 | 22-Oct | 0.008 | 0.009 | 0.013 | 0.008 | 0.001 |
| 296.003 | 23-Oct | 0.009 | 0.009 | 0.013 | 0.009 | 0 |
| 297.003 | 24-Oct | 0.008 | 0.008 | 0.012 | 0.008 | 0 |
| 298.003 | 25-Oct | 0.008 | 0.009 | 0.012 | 0.008 | 0.001 |
| 299.003 | 26-Oct | 0.009 | 0.009 | 0.012 | 0.009 | 0 |
| 300.003 | 27-Oct | 0.009 | 0.01 | 0.013 | 0.009 | 0.001 |
| 301.003 | 28-Oct | 0.011 | 0.011 | 0.015 | 0.011 | 0 |
| 302.003 | 29-Oct | 0.009 | 0.009 | 0.012 | 0.009 | 0 |
| 303.003 | 30-Oct | 0.009 | 0.009 | 0.013 | 0.009 | 0 |
| 304.003 | 31-Oct | 0.009 | 0.01 | 0.013 | 0.009 | 0.001 |

# Exhibit 12

# COMPARISON OF IDAHO DO IMPACTS TO OVERALL DO IMPACTS

| Segment | July 16-31 TMDL | July 16-31 Idaho | Idaho % | Aug 1-15 TMDL | Aug 1-15 Idaho | Idaho % | Aug 16-31 TMDL | Aug 16-31 Idaho | Idaho % | Sept 1-15 TMDL | Sept 1-15 Idaho | Idaho % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 173 | | | | | | | 0.22 | 0.03 | 12.00% | | | |
| 174 | | | | | | | 0.30 | 0.04 | 11.76% | | | |
| 175 | | | | | | | 0.32 | 0.05 | 13.51% | | | |
| 176 | | | | 0.21 | 0.05 | 19.23% | 0.39 | 0.05 | 11.36% | 0.22 | 0.03 | 12.00% |
| 177 | | | | 0.33 | 0.07 | 17.50% | 0.51 | 0.07 | 12.07% | 0.36 | 0.04 | 10.00% |
| 178 | 0.20 | 0.08 | 28.57% | 0.36 | 0.07 | 16.28% | 0.54 | 0.07 | 11.48% | 0.42 | 0.05 | 10.64% |
| 179 | 0.24 | 0.08 | 25.00% | 0.39 | 0.07 | 15.22% | 0.56 | 0.08 | 12.50% | 0.48 | 0.06 | 11.11% |
| 180 | 0.26 | 0.08 | 23.53% | 0.40 | 0.08 | 16.67% | 0.56 | 0.08 | 12.50% | 0.51 | 0.06 | 10.53% |
| 181 | 0.32 | 0.09 | 21.95% | 0.46 | 0.08 | 14.81% | 0.61 | 0.09 | 12.86% | 0.57 | 0.07 | 10.94% |
| 182 | 0.29 | 0.09 | 23.68% | 0.44 | 0.08 | 15.38% | 0.56 | 0.08 | 12.50% | 0.53 | 0.07 | 11.67% |
| 183 | 0.35 | 0.09 | 20.45% | 0.51 | 0.09 | 15.00% | 0.61 | 0.09 | 12.86% | 0.59 | 0.08 | 11.94% |
| 184 | 0.36 | 0.10 | 21.74% | 0.51 | 0.09 | 15.00% | 0.60 | 0.09 | 13.04% | 0.54 | 0.08 | 12.90% |
| 185 | 0.37 | 0.10 | 21.28% | 0.48 | 0.09 | 15.79% | 0.58 | 0.09 | 13.43% | 0.53 | 0.09 | 14.52% |
| 186 | 0.45 | 0.11 | 19.64% | 0.53 | 0.11 | 17.19% | 0.70 | 0.10 | 12.50% | 0.68 | 0.10 | 12.82% |
| 187 | 0.46 | 0.11 | 19.30% | 0.53 | 0.11 | 17.19% | 0.74 | 0.11 | 12.94% | 0.71 | 0.11 | 13.41% |
| 188 | 0.48 | 0.12 | 20.00% | 0.55 | 0.12 | 17.91% | 0.78 | 0.12 | 13.33% | 0.72 | 0.12 | 14.29% |
| **Average Idaho Percentage:** | | | **22.29%** | | | **16.40%** | | | **12.54%** | | | **12.06%** |
| **July 16 - Oct 31 Average:** | | | **15.33%** | | | | | | | | | |

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# COMPARISON OF IDAHO DO IMPACTS TO OVERALL DO IMPACTS

| Segment | Sept 16-30 TMDL | Sept 16-30 Idaho | Idaho % | Oct 1-15 TMDL | Oct 1-15 Idaho | Idaho % | Oct 16-31 TMDL | Oct 16-31 Idaho | Idaho % | Nov 1-15 TMDL | Nov 1-15 Idaho | Idaho % | Nov 16-30 TMDL | Nov 16-30 Idaho | Idaho % | Dec 1-15 TMDL | Dec 1-15 Idaho | Idaho % | Dec 16-31 TMDL | Dec 16-31 Idaho | Idaho % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 167 | | | | | | | | | | | | | 0.20 | -0.06 | -42.86% | | | | | | |
| 168 | | | | | | | | | | | | | 0.23 | -0.06 | -35.29% | | | | | | |
| 169 | | | | | | | | | | | | | 0.24 | -0.06 | -33.33% | | | | | | |
| 170 | | | | | | | | | | | | | 0.28 | -0.06 | -27.27% | 0.20 | -0.03 | -17.65% | | | |
| 171 | | | | | | | | | | | | | 0.31 | -0.05 | -19.23% | 0.22 | -0.02 | -10.00% | | | |
| 172 | | | | | | | | | | | | | 0.31 | -0.02 | -6.90% | 0.22 | -0.02 | -10.00% | | | |
| 173 | | | | | | | | | | | | | 0.31 | -0.01 | -3.33% | 0.26 | -0.02 | -8.33% | | | |
| 174 | | | | | | | | | | | | | 0.32 | -0.01 | -3.23% | 0.30 | -0.01 | -3.45% | | | |
| 175 | | | | | | | | | | | | | 0.31 | 0.00 | 0.00% | 0.31 | 0.00 | 0.00% | | | |
| 176 | | | | | | | | | | | | | 0.28 | 0.00 | 0.00% | 0.33 | 0.01 | 2.94% | | | |
| 177 | 0.27 | 0.04 | 12.90% | | | | | | | | | | 0.26 | 0.00 | 0.00% | 0.34 | 0.01 | 2.86% | | | |
| 178 | 0.33 | 0.04 | 10.81% | | | | | | | | | | 0.26 | 0.01 | 3.70% | 0.36 | 0.01 | 2.70% | | | |
| 179 | 0.39 | 0.04 | 9.30% | | | | | | | | | | 0.26 | 0.01 | 3.70% | 0.37 | 0.02 | 5.13% | 0.21 | -0.01 | -5.00% |
| 180 | 0.43 | 0.05 | 10.42% | | | | | | | | | | 0.27 | 0.02 | 6.90% | 0.39 | 0.02 | 4.88% | 0.24 | 0.00 | 0.00% |
| 181 | 0.53 | 0.05 | 8.62% | 0.26 | 0.06 | 18.75% | | | | 0.20 | 0.04 | 16.67% | 0.28 | 0.02 | 6.67% | 0.40 | 0.03 | 6.98% | 0.26 | 0.00 | 0.00% |
| 182 | 0.52 | 0.05 | 8.77% | 0.25 | 0.06 | 19.35% | | | | 0.21 | 0.04 | 16.00% | 0.29 | 0.02 | 6.45% | 0.40 | 0.03 | 6.98% | 0.27 | 0.00 | 0.00% |
| 183 | 0.61 | 0.06 | 8.96% | 0.36 | 0.07 | 16.28% | | | | 0.24 | 0.04 | 14.29% | 0.30 | 0.02 | 6.25% | 0.41 | 0.03 | 6.82% | 0.30 | 0.01 | 3.23% |
| 184 | 0.59 | 0.07 | 10.61% | 0.37 | 0.07 | 15.91% | 0.21 | 0.05 | 19.23% | 0.25 | 0.05 | 16.67% | 0.31 | 0.03 | 8.82% | 0.41 | 0.03 | 6.82% | 0.32 | 0.01 | 3.03% |
| 185 | 0.58 | 0.07 | 10.77% | 0.43 | 0.08 | 15.69% | 0.28 | 0.06 | 17.65% | 0.27 | 0.05 | 15.63% | 0.31 | 0.02 | 6.06% | 0.42 | 0.03 | 6.67% | 0.33 | 0.02 | 5.71% |
| 186 | 0.72 | 0.09 | 11.11% | 0.61 | 0.10 | 14.08% | 0.33 | 0.07 | 17.50% | 0.29 | 0.06 | 17.14% | 0.31 | 0.01 | 3.13% | 0.43 | 0.03 | 6.52% | 0.34 | 0.02 | 5.56% |
| 187 | 0.76 | 0.10 | 11.63% | 0.63 | 0.10 | 13.70% | 0.33 | 0.07 | 17.50% | 0.30 | 0.06 | 16.67% | 0.32 | 0.01 | 3.03% | 0.45 | 0.03 | 6.25% | 0.34 | 0.02 | 5.56% |
| 188 | 0.75 | 0.11 | 12.79% | 0.55 | 0.10 | 15.38% | 0.39 | 0.08 | 17.02% | 0.36 | 0.06 | 14.29% | 0.32 | 0.01 | 3.03% | 0.46 | 0.03 | 6.12% | 0.35 | 0.02 | 5.41% |
| Average Idaho Percentage: | | | 10.56% | | | 16.14% | | | 17.78% | 14.83% | | 15.92% | | | -5.17% | | | 1.17% | | | 2.35% |
| Jul 16 - Oct 31 Average: | | | 15.33% | | | | | | | | | | | | | | | | | | |

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**Table 13. TMDL scenario average dissolved oxygen concentrations for full water column for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the TMDL predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | **9.27** | *9.32* | -0.05 | **8.84** | *9.00* | -0.16 | **8.75** | *9.24* | -0.49 | **8.85** | *9.37* | -0.51 | **8.84** | *9.39* | -0.55 | **9.11** | *9.75* | -0.64 | **9.29** | *9.89* | -0.61 |
| 155 | **9.20** | *9.28* | -0.08 | **8.84** | *9.01* | -0.17 | **8.79** | *9.24* | -0.45 | **8.78** | *9.23* | -0.45 | **8.81** | *9.29* | -0.47 | **9.03** | *9.61* | -0.57 | **9.13** | *9.67* | -0.54 |
| 156 | **9.18** | *9.29* | -0.10 | **8.86** | *9.05* | -0.18 | **8.81** | *9.25* | -0.43 | **8.88** | *9.33* | -0.45 | **8.90** | *9.42* | -0.53 | **9.07** | *9.70* | -0.63 | **9.25** | *9.86* | -0.61 |
| 157 | **9.21** | *9.35* | -0.14 | **9.10** | *9.40* | -0.30 | **8.93** | *9.39* | -0.46 | **8.94** | *9.55* | -0.61 | **8.82** | *9.41* | -0.59 | **8.81** | *9.43* | -0.61 | **9.11** | *9.72* | -0.60 |
| 158 | **9.31** | *9.55* | -0.24 | **9.40** | *9.84* | -0.44 | **8.99** | *9.53* | -0.54 | **8.96** | *9.67* | -0.71 | **8.90** | *9.52* | -0.63 | **8.87** | *9.49* | -0.62 | **9.12** | *9.77* | -0.65 |
| 159 | **9.45** | *9.80* | -0.35 | **9.51** | *10.03* | -0.52 | **9.07** | *9.67* | -0.60 | **9.01** | *9.75* | -0.74 | **8.94** | *9.58* | -0.63 | **8.88** | *9.47* | -0.58 | **9.12** | *9.76* | -0.63 |
| 160 | **9.57** | *9.98* | -0.41 | **9.52** | *10.05* | -0.53 | **9.08** | *9.72* | -0.65 | **8.99** | *9.72* | -0.73 | **8.92** | *9.53* | -0.60 | **8.84** | *9.38* | -0.54 | **9.08** | *9.67* | -0.59 |
| 161 | **9.66** | *10.09* | -0.43 | **9.49** | *10.07* | -0.58 | **9.05** | *9.78* | -0.73 | **8.92** | *9.70* | -0.78 | **8.82** | *9.42* | -0.60 | **8.71** | *9.22* | -0.52 | **8.97** | *9.56* | -0.59 |
| 162 | **9.67** | *10.09* | -0.42 | **9.48** | *10.15* | -0.67 | **9.07** | *9.84* | -0.77 | **8.83** | *9.55* | -0.72 | **8.77** | *9.31* | -0.54 | **8.64** | *9.10* | -0.46 | **8.89** | *9.47* | -0.58 |
| 163 | **9.66** | *10.10* | -0.44 | **9.50** | *10.32* | -0.82 | **9.10** | *9.91* | -0.81 | **8.83** | *9.53* | -0.70 | **8.79** | *9.32* | -0.53 | **8.62** | *9.03* | -0.42 | **8.84** | *9.43* | -0.59 |
| 164 | **9.67** | *10.17* | -0.49 | **9.53** | *10.43* | -0.90 | **9.12** | *9.91* | -0.78 | **8.85** | *9.53* | -0.68 | **8.80** | *9.30* | -0.50 | **8.63** | *9.00* | -0.37 | **8.85** | *9.41* | -0.56 |
| 165 | **9.72** | *10.32* | -0.60 | **9.55** | *10.56* | -1.02 | **9.13** | *10.00* | -0.88 | **8.80** | *9.51* | -0.71 | **8.72** | *9.21* | -0.49 | **8.54** | *8.88* | -0.34 | **8.77** | *9.33* | -0.56 |
| 166 | **9.73** | *10.37* | -0.64 | **9.56** | *10.52* | -0.96 | **9.11** | *9.97* | -0.86 | **8.83** | *9.52* | -0.69 | **8.74** | *9.18* | -0.44 | **8.57** | *8.85* | -0.28 | **8.82** | *9.34* | -0.52 |
| 167 | **9.77** | *10.52* | -0.75 | **9.55** | *10.58* | -1.03 | **9.04** | *9.87* | -0.83 | **8.75** | *9.43* | -0.68 | **8.66** | *9.08* | -0.41 | **8.49** | *8.74* | -0.25 | **8.77** | *9.27* | -0.50 |
| 168 | **9.73** | *10.51* | -0.78 | **9.48** | *10.41* | -0.93 | **8.86** | *9.52* | -0.66 | **8.60** | *9.11* | -0.51 | **8.57** | *8.84* | -0.27 | **8.37** | *8.45* | -0.08 | **8.74** | *9.13* | -0.39 |
| 169 | **9.66** | *10.49* | -0.82 | **9.41** | *10.27* | -0.86 | **8.74** | *9.30* | -0.56 | **8.46** | *8.88* | -0.42 | **8.46** | *8.65* | -0.19 | **8.26** | *8.27* | 0.00 | **8.69** | *8.99* | -0.31 |
| 170 | **9.60** | *10.45* | -0.84 | **9.33** | *10.13* | -0.80 | **8.69** | *9.21* | -0.52 | **8.37** | *8.75* | -0.38 | **8.38** | *8.55* | -0.17 | **8.18** | *8.14* | 0.04 | **8.60** | *8.83* | -0.23 |
| 171 | **9.56** | *10.42* | -0.86 | **9.26** | *10.03* | -0.77 | **8.66** | *9.17* | -0.51 | **8.32** | *8.65* | -0.33 | **8.34** | *8.50* | -0.16 | **8.12** | *8.07* | 0.05 | **8.53** | *8.71* | -0.18 |
| 172 | **9.50** | *10.34* | -0.83 | **9.15** | *9.88* | -0.73 | **8.56** | *9.02* | -0.46 | **8.17** | *8.42* | -0.25 | **8.19** | *8.30* | -0.10 | **7.97** | *7.89* | 0.08 | **8.44** | *8.55* | -0.11 |
| 173 | **9.46** | *10.25* | -0.79 | **9.10** | *9.75* | -0.66 | **8.47** | *8.81* | -0.34 | **8.06** | *8.19* | -0.14 | **8.07** | *8.04* | 0.03 | **7.84** | *7.61* | 0.22 | **8.34** | *8.33* | 0.01 |
| 174 | **9.39** | *10.11* | -0.73 | **9.01** | *9.60* | -0.59 | **8.37** | *8.64* | -0.27 | **7.93** | *8.00* | -0.06 | **7.92** | *7.81* | 0.12 | **7.68** | *7.38* | 0.30 | **8.17** | *8.07* | 0.10 |
| 175 | **9.33** | *10.02* | -0.69 | **8.94** | *9.49* | -0.55 | **8.30** | *8.54* | -0.24 | **7.87** | *7.90* | -0.03 | **7.84** | *7.68* | 0.15 | **7.60** | *7.28* | 0.32 | **8.04** | *7.90* | 0.14 |
| 176 | **9.26** | *9.91* | -0.65 | **8.88** | *9.38* | -0.50 | **8.26** | *8.44* | -0.19 | **7.82** | *7.79* | 0.04 | **7.80** | *7.60* | 0.21 | **7.56** | *7.17* | 0.39 | **7.98** | *7.75* | 0.22 |
| 177 | **9.12** | *9.67* | -0.56 | **8.67** | *9.08* | -0.41 | **8.00** | *8.08* | -0.09 | **7.50** | *7.34* | 0.16 | **7.46** | *7.13* | 0.33 | **7.19** | *6.68* | 0.51 | **7.58** | *7.21* | 0.36 |
| 178 | **9.06** | *9.59* | -0.53 | **8.61** | *8.98* | -0.37 | **7.95** | *8.00* | -0.05 | **7.45** | *7.24* | 0.20 | **7.43** | *7.07* | 0.36 | **7.15** | *6.61* | 0.54 | **7.49** | *7.07* | 0.42 |
| 179 | **9.01** | *9.52* | -0.50 | **8.58** | *8.92* | -0.34 | **7.92** | *7.94* | -0.02 | **7.42** | *7.17* | 0.24 | **7.41** | *7.03* | 0.39 | **7.15** | *6.59* | 0.56 | **7.43** | *6.95* | 0.48 |
| 180 | **8.97** | *9.45* | -0.48 | **8.56** | *8.88* | -0.32 | **7.91** | *7.91* | 0.00 | **7.40** | *7.14* | 0.26 | **7.39** | *6.99* | 0.40 | **7.15** | *6.60* | 0.56 | **7.35** | *6.84* | 0.51 |
| 181 | **8.91** | *9.36* | -0.45 | **8.51** | *8.79* | -0.28 | **7.87** | *7.84* | 0.04 | **7.34** | *7.02* | 0.32 | **7.32** | *6.86* | 0.46 | **7.11** | *6.51* | 0.61 | **7.22** | *6.65* | 0.57 |
| 182 | **8.93** | *9.38* | -0.45 | **8.55** | *8.84* | -0.29 | **7.96** | *7.95* | 0.00 | **7.44** | *7.15* | 0.29 | **7.42** | *6.98* | 0.44 | **7.24** | *6.68* | 0.56 | **7.29** | *6.76* | 0.53 |
| 183 | **8.82** | *9.21* | -0.39 | **8.40** | *8.62* | -0.22 | **7.79** | *7.72* | 0.07 | **7.28** | *6.93* | 0.35 | **7.21** | *6.70* | 0.51 | **7.04** | *6.43* | 0.61 | **7.03** | *6.44* | 0.59 |
| 184 | **8.82** | *9.20* | -0.38 | **8.41** | *8.62* | -0.21 | **7.86** | *7.81* | 0.05 | **7.37** | *7.01* | 0.36 | **7.29** | *6.78* | 0.51 | **7.13** | *6.53* | 0.60 | **7.09** | *6.54* | 0.54 |
| 185 | **8.78** | *9.12* | -0.34 | **8.41** | *8.61* | -0.20 | **7.90** | *7.88* | 0.02 | **7.42** | *7.05* | 0.37 | **7.31** | *6.84* | 0.48 | **7.19** | *6.61* | 0.58 | **7.10** | *6.57* | 0.53 |
| 186 | **8.63** | *8.89* | -0.26 | **8.28** | *8.41* | -0.13 | **7.75** | *7.67* | 0.08 | **7.23** | *6.78* | 0.45 | **7.08** | *6.55* | 0.53 | **6.98** | *6.27* | 0.70 | **6.79** | *6.11* | 0.68 |
| 187 | **8.60** | *8.85* | -0.24 | **8.31** | *8.46* | -0.16 | **7.80** | *7.74* | 0.06 | **7.27** | *6.81* | 0.46 | **7.10** | *6.57* | 0.53 | **7.03** | *6.29* | 0.74 | **6.82** | *6.12* | 0.71 |
| 188 | **8.52** | *8.74* | -0.22 | **8.16** | *8.29* | -0.12 | **7.66** | *7.56* | 0.11 | **7.14** | *6.67* | 0.48 | **6.92** | *6.36* | 0.55 | **6.84** | *6.06* | 0.78 | **6.62** | *5.90* | 0.72 |

**Table 15. Idaho only scenario average dissolved oxygen concentrations for full water column for June 1 to September 15 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the Idaho only scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | June 1-15 | | | June 15-30 | | | July 1-15 | | | July 16-31 | | | Aug 1-15 | | | Aug 16-31 | | | Sept 1-15 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.27 | 9.28 | -0.01 | 8.84 | 8.85 | 0.00 | 8.75 | 8.75 | 0.00 | 8.85 | 8.86 | 0.00 | 8.84 | 8.83 | 0.00 | 9.11 | 9.12 | 0.00 | 9.29 | 9.29 | 0.00 |
| 155 | 9.20 | 9.21 | -0.01 | 8.84 | 8.85 | 0.00 | 8.79 | 8.80 | -0.01 | 8.78 | 8.78 | 0.00 | 8.81 | 8.81 | 0.00 | 9.03 | 9.03 | 0.00 | 9.13 | 9.13 | 0.00 |
| 156 | 9.18 | 9.19 | -0.01 | 8.86 | 8.85 | 0.02 | 8.81 | 8.82 | 0.00 | 8.88 | 8.87 | 0.00 | 8.90 | 8.89 | 0.00 | 9.07 | 9.08 | 0.00 | 9.25 | 9.25 | 0.00 |
| 157 | 9.21 | 9.21 | 0.00 | 9.10 | 9.09 | 0.01 | 8.93 | 8.93 | 0.00 | 8.94 | 8.95 | -0.01 | 8.82 | 8.83 | -0.01 | 8.81 | 8.83 | -0.01 | 9.11 | 9.13 | -0.01 |
| 158 | 9.31 | 9.31 | 0.00 | 9.40 | 9.40 | 0.00 | 8.99 | 9.00 | 0.00 | 8.96 | 8.97 | -0.01 | 8.90 | 8.91 | -0.01 | 8.87 | 8.88 | -0.01 | 9.12 | 9.14 | -0.01 |
| 159 | 9.45 | 9.45 | 0.00 | 9.51 | 9.52 | -0.01 | 9.07 | 9.08 | -0.01 | 9.01 | 9.03 | -0.01 | 8.94 | 8.96 | -0.01 | 8.88 | 8.90 | -0.01 | 9.12 | 9.14 | -0.01 |
| 160 | 9.57 | 9.58 | 0.00 | 9.52 | 9.53 | 0.00 | 9.08 | 9.09 | -0.01 | 8.99 | 9.01 | -0.02 | 8.92 | 8.94 | -0.01 | 8.84 | 8.85 | -0.01 | 9.08 | 9.09 | -0.01 |
| 161 | 9.66 | 9.68 | -0.02 | 9.49 | 9.49 | 0.00 | 9.05 | 9.07 | -0.02 | 8.92 | 8.94 | -0.02 | 8.82 | 8.84 | -0.02 | 8.71 | 8.73 | -0.02 | 8.97 | 8.98 | -0.02 |
| 162 | 9.67 | 9.68 | -0.01 | 9.48 | 9.49 | -0.01 | 9.07 | 9.10 | -0.03 | 8.83 | 8.86 | -0.02 | 8.77 | 8.79 | -0.02 | 8.64 | 8.66 | -0.02 | 8.89 | 8.91 | -0.02 |
| 163 | 9.66 | 9.67 | -0.01 | 9.50 | 9.53 | -0.03 | 9.10 | 9.14 | -0.03 | 8.83 | 8.85 | -0.02 | 8.79 | 8.81 | -0.02 | 8.62 | 8.63 | -0.02 | 8.84 | 8.86 | -0.02 |
| 164 | 9.67 | 9.69 | -0.02 | 9.53 | 9.57 | -0.04 | 9.12 | 9.15 | -0.03 | 8.85 | 8.87 | -0.02 | 8.80 | 8.82 | -0.02 | 8.63 | 8.65 | -0.02 | 8.85 | 8.87 | -0.02 |
| 165 | 9.72 | 9.75 | -0.03 | 9.55 | 9.60 | -0.05 | 9.13 | 9.16 | -0.04 | 8.80 | 8.82 | -0.03 | 8.72 | 8.74 | -0.02 | 8.54 | 8.55 | -0.01 | 8.77 | 8.79 | -0.02 |
| 166 | 9.73 | 9.76 | -0.04 | 9.56 | 9.61 | -0.05 | 9.11 | 9.14 | -0.03 | 8.83 | 8.85 | -0.02 | 8.74 | 8.75 | -0.01 | 8.57 | 8.57 | -0.01 | 8.82 | 8.83 | -0.02 |
| 167 | 9.77 | 9.82 | -0.05 | 9.55 | 9.60 | -0.06 | 9.04 | 9.06 | -0.02 | 8.75 | 8.77 | -0.02 | 8.66 | 8.68 | -0.01 | 8.49 | 8.50 | 0.00 | 8.77 | 8.79 | -0.01 |
| 168 | 9.73 | 9.78 | -0.05 | 9.48 | 9.52 | -0.04 | 8.86 | 8.87 | -0.01 | 8.60 | 8.60 | 0.00 | 8.57 | 8.57 | 0.00 | 8.37 | 8.36 | 0.01 | 8.74 | 8.75 | -0.01 |
| 169 | 9.66 | 9.72 | -0.05 | 9.41 | 9.45 | -0.03 | 8.74 | 8.74 | 0.00 | 8.46 | 8.45 | 0.01 | 8.46 | 8.45 | 0.01 | 8.26 | 8.24 | 0.02 | 8.69 | 8.69 | -0.01 |
| 170 | 9.60 | 9.65 | -0.05 | 9.33 | 9.36 | -0.03 | 8.69 | 8.68 | 0.01 | 8.37 | 8.36 | 0.01 | 8.38 | 8.37 | 0.01 | 8.18 | 8.16 | 0.02 | 8.60 | 8.60 | 0.00 |
| 171 | 9.56 | 9.61 | -0.05 | 9.26 | 9.28 | -0.02 | 8.66 | 8.66 | 0.01 | 8.32 | 8.31 | 0.01 | 8.34 | 8.33 | 0.01 | 8.12 | 8.10 | 0.02 | 8.53 | 8.53 | 0.00 |
| 172 | 9.50 | 9.55 | -0.04 | 9.15 | 9.18 | -0.02 | 8.56 | 8.55 | 0.01 | 8.17 | 8.15 | 0.02 | 8.19 | 8.17 | 0.02 | 7.97 | 7.95 | 0.02 | 8.44 | 8.44 | 0.00 |
| 173 | 9.46 | 9.50 | -0.04 | 9.10 | 9.11 | -0.01 | 8.47 | 8.44 | 0.03 | 8.06 | 8.02 | 0.03 | 8.07 | 8.04 | 0.03 | 7.84 | 7.80 | 0.03 | 8.34 | 8.33 | 0.01 |
| 174 | 9.39 | 9.42 | -0.04 | 9.01 | 9.01 | 0.00 | 8.37 | 8.34 | 0.03 | 7.93 | 7.89 | 0.04 | 7.92 | 7.88 | 0.04 | 7.68 | 7.64 | 0.04 | 8.17 | 8.15 | 0.01 |
| 175 | 9.33 | 9.36 | -0.03 | 8.94 | 8.94 | 0.00 | 8.30 | 8.27 | 0.04 | 7.87 | 7.82 | 0.05 | 7.84 | 7.79 | 0.05 | 7.60 | 7.55 | 0.05 | 8.04 | 8.02 | 0.02 |
| 176 | 9.26 | 9.29 | -0.03 | 8.88 | 8.88 | 0.00 | 8.26 | 8.21 | 0.04 | 7.82 | 7.77 | 0.05 | 7.80 | 7.75 | 0.05 | 7.56 | 7.50 | 0.05 | 7.98 | 7.95 | 0.03 |
| 177 | 9.12 | 9.14 | -0.02 | 8.67 | 8.66 | 0.01 | 8.00 | 7.94 | 0.05 | 7.50 | 7.43 | 0.07 | 7.46 | 7.39 | 0.07 | 7.19 | 7.12 | 0.07 | 7.58 | 7.53 | 0.04 |
| 178 | 9.06 | 9.08 | -0.02 | 8.61 | 8.59 | 0.02 | 7.95 | 7.89 | 0.06 | 7.45 | 7.37 | 0.08 | 7.43 | 7.35 | 0.07 | 7.15 | 7.08 | 0.07 | 7.49 | 7.44 | 0.05 |
| 179 | 9.01 | 9.03 | -0.02 | 8.58 | 8.56 | 0.02 | 7.92 | 7.86 | 0.06 | 7.42 | 7.33 | 0.08 | 7.41 | 7.34 | 0.07 | 7.15 | 7.07 | 0.08 | 7.43 | 7.37 | 0.06 |
| 180 | 8.97 | 8.98 | -0.01 | 8.56 | 8.53 | 0.02 | 7.91 | 7.85 | 0.06 | 7.40 | 7.32 | 0.08 | 7.39 | 7.32 | 0.08 | 7.15 | 7.07 | 0.08 | 7.35 | 7.29 | 0.06 |
| 181 | 8.91 | 8.92 | -0.01 | 8.51 | 8.48 | 0.02 | 7.87 | 7.81 | 0.07 | 7.34 | 7.25 | 0.09 | 7.32 | 7.24 | 0.08 | 7.11 | 7.03 | 0.09 | 7.22 | 7.15 | 0.07 |
| 182 | 8.93 | 8.94 | -0.01 | 8.55 | 8.53 | 0.02 | 7.96 | 7.89 | 0.06 | 7.44 | 7.36 | 0.09 | 7.42 | 7.34 | 0.08 | 7.24 | 7.16 | 0.08 | 7.29 | 7.22 | 0.07 |
| 183 | 8.82 | 8.82 | 0.00 | 8.40 | 8.37 | 0.03 | 7.79 | 7.72 | 0.07 | 7.28 | 7.19 | 0.09 | 7.21 | 7.12 | 0.09 | 7.04 | 6.95 | 0.09 | 7.03 | 6.95 | 0.08 |
| 184 | 8.82 | 8.82 | 0.00 | 8.41 | 8.38 | 0.03 | 7.86 | 7.79 | 0.07 | 7.37 | 7.27 | 0.10 | 7.29 | 7.20 | 0.09 | 7.13 | 7.04 | 0.09 | 7.09 | 7.01 | 0.08 |
| 185 | 8.78 | 8.78 | 0.00 | 8.41 | 8.38 | 0.03 | 7.90 | 7.83 | 0.07 | 7.42 | 7.33 | 0.10 | 7.31 | 7.22 | 0.09 | 7.19 | 7.10 | 0.09 | 7.10 | 7.01 | 0.09 |
| 186 | 8.63 | 8.62 | 0.01 | 8.28 | 8.24 | 0.04 | 7.75 | 7.67 | 0.07 | 7.23 | 7.12 | 0.11 | 7.08 | 6.98 | 0.11 | 6.98 | 6.87 | 0.10 | 6.79 | 6.69 | 0.10 |
| 187 | 8.60 | 8.59 | 0.01 | 8.31 | 8.28 | 0.03 | 7.80 | 7.73 | 0.07 | 7.27 | 7.16 | 0.11 | 7.10 | 7.00 | 0.11 | 7.03 | 6.92 | 0.11 | 6.82 | 6.72 | 0.11 |
| 188 | 8.52 | 8.49 | 0.03 | 8.16 | 8.12 | 0.04 | 7.66 | 7.59 | 0.08 | 7.14 | 7.03 | 0.12 | 6.92 | 6.80 | 0.12 | 6.84 | 6.72 | 0.12 | 6.62 | 6.50 | 0.12 |

**Table 14. TMDL scenario average dissolved oxygen concentrations for full water column for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the TMDL predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.37 | 9.71 | -0.34 | 9.89 | 10.10 | -0.21 | 10.32 | 10.43 | -0.11 | 10.59 | 10.81 | -0.23 | 10.83 | 10.83 | 0.00 | 11.53 | 11.52 | 0.01 | 11.58 | 11.58 | 0.00 |
| 155 | 9.29 | 9.58 | -0.29 | 9.74 | 9.93 | -0.18 | 10.29 | 10.39 | -0.10 | 10.59 | 10.78 | -0.19 | 10.74 | 10.73 | 0.01 | 11.38 | 11.43 | -0.05 | 11.48 | 11.49 | -0.01 |
| 156 | 9.38 | 9.74 | -0.36 | 9.72 | 9.89 | -0.17 | 10.27 | 10.35 | -0.08 | 10.55 | 10.72 | -0.17 | 10.72 | 10.70 | 0.01 | 11.39 | 11.45 | -0.05 | 11.48 | 11.47 | 0.00 |
| 157 | 9.50 | 9.94 | -0.45 | 9.86 | 10.07 | -0.22 | 10.37 | 10.47 | -0.11 | 10.61 | 10.78 | -0.18 | 10.78 | 10.76 | 0.02 | 11.42 | 11.49 | -0.06 | 11.49 | 11.52 | -0.02 |
| 158 | 9.46 | 9.95 | -0.50 | 10.06 | 10.32 | -0.26 | 10.54 | 10.67 | -0.13 | 10.69 | 10.94 | -0.26 | 10.81 | 10.83 | -0.02 | 11.44 | 11.50 | -0.06 | 11.52 | 11.59 | -0.07 |
| 159 | 9.42 | 9.91 | -0.49 | 10.06 | 10.31 | -0.25 | 10.58 | 10.71 | -0.13 | 10.76 | 11.05 | -0.30 | 10.84 | 10.85 | -0.01 | 11.44 | 11.51 | -0.06 | 11.53 | 11.62 | -0.09 |
| 160 | 9.34 | 9.82 | -0.47 | 10.01 | 10.23 | -0.22 | 10.57 | 10.67 | -0.10 | 10.75 | 11.02 | -0.26 | 10.82 | 10.80 | 0.03 | 11.44 | 11.50 | -0.06 | 11.53 | 11.62 | -0.09 |
| 161 | 9.20 | 9.73 | -0.53 | 9.94 | 10.17 | -0.23 | 10.58 | 10.66 | -0.08 | 10.75 | 11.00 | -0.25 | 10.84 | 10.79 | 0.05 | 11.43 | 11.48 | -0.05 | 11.52 | 11.60 | -0.08 |
| 162 | 9.13 | 9.66 | -0.52 | 9.85 | 10.14 | -0.28 | 10.59 | 10.67 | -0.07 | 10.74 | 10.98 | -0.23 | 10.84 | 10.77 | 0.07 | 11.44 | 11.47 | -0.03 | 11.52 | 11.59 | -0.08 |
| 163 | 9.07 | 9.62 | -0.55 | 9.64 | 10.05 | -0.41 | 10.57 | 10.66 | -0.09 | 10.74 | 10.96 | -0.22 | 10.84 | 10.74 | 0.10 | 11.44 | 11.47 | -0.03 | 11.52 | 11.60 | -0.07 |
| 164 | 9.06 | 9.60 | -0.54 | 9.54 | 9.99 | -0.45 | 10.44 | 10.59 | -0.15 | 10.72 | 10.92 | -0.20 | 10.83 | 10.70 | 0.13 | 11.42 | 11.43 | -0.01 | 11.52 | 11.59 | -0.07 |
| 165 | 8.96 | 9.52 | -0.56 | 9.41 | 9.91 | -0.51 | 10.26 | 10.49 | -0.23 | 10.72 | 10.90 | -0.18 | 10.84 | 10.67 | 0.16 | 11.42 | 11.39 | 0.03 | 11.54 | 11.60 | -0.06 |
| 166 | 9.00 | 9.48 | -0.48 | 9.40 | 9.86 | -0.46 | 10.22 | 10.43 | -0.21 | 10.67 | 10.80 | -0.14 | 10.82 | 10.62 | 0.19 | 11.40 | 11.34 | 0.06 | 11.51 | 11.56 | -0.05 |
| 167 | 8.95 | 9.40 | -0.45 | 9.33 | 9.78 | -0.45 | 10.15 | 10.38 | -0.22 | 10.65 | 10.77 | -0.11 | 10.82 | 10.62 | 0.20 | 11.39 | 11.32 | 0.07 | 11.50 | 11.54 | -0.04 |
| 168 | 8.94 | 9.29 | -0.35 | 9.32 | 9.71 | -0.39 | 10.07 | 10.31 | -0.24 | 10.64 | 10.73 | -0.09 | 10.82 | 10.59 | 0.23 | 11.38 | 11.29 | 0.09 | 11.49 | 11.52 | -0.04 |
| 169 | 8.91 | 9.21 | -0.30 | 9.28 | 9.64 | -0.37 | 9.95 | 10.18 | -0.23 | 10.64 | 10.72 | -0.09 | 10.81 | 10.57 | 0.24 | 11.34 | 11.21 | 0.13 | 11.47 | 11.50 | -0.03 |
| 170 | 8.86 | 9.12 | -0.25 | 9.22 | 9.58 | -0.35 | 9.85 | 10.08 | -0.23 | 10.52 | 10.65 | -0.12 | 10.79 | 10.52 | 0.28 | 11.29 | 11.09 | 0.20 | 11.44 | 11.45 | -0.01 |
| 171 | 8.81 | 9.04 | -0.23 | 9.17 | 9.51 | -0.34 | 9.76 | 10.00 | -0.24 | 10.40 | 10.50 | -0.09 | 10.76 | 10.45 | 0.31 | 11.28 | 11.06 | 0.22 | 11.43 | 11.42 | -0.01 |
| 172 | 8.76 | 8.95 | -0.19 | 9.14 | 9.46 | -0.32 | 9.71 | 9.93 | -0.22 | 10.29 | 10.34 | -0.05 | 10.69 | 10.39 | 0.31 | 11.34 | 11.12 | 0.22 | 11.57 | 11.53 | 0.02 |
| 173 | 8.74 | 8.82 | -0.09 | 9.13 | 9.40 | -0.26 | 9.68 | 9.85 | -0.17 | 10.22 | 10.20 | 0.02 | 10.65 | 10.34 | 0.31 | 11.33 | 11.07 | 0.26 | 11.64 | 11.58 | 0.04 |
| 174 | 8.64 | 8.64 | 0.00 | 9.11 | 9.31 | -0.20 | 9.67 | 9.79 | -0.12 | 10.19 | 10.14 | 0.05 | 10.63 | 10.31 | 0.32 | 11.29 | 10.99 | 0.30 | 11.61 | 11.53 | 0.06 |
| 175 | 8.54 | 8.50 | 0.04 | 9.07 | 9.24 | -0.17 | 9.65 | 9.75 | -0.09 | 10.16 | 10.09 | 0.07 | 10.61 | 10.30 | 0.31 | 11.28 | 10.97 | 0.31 | 11.66 | 11.55 | 0.09 |
| 176 | 8.47 | 8.35 | 0.12 | 9.00 | 9.11 | -0.11 | 9.61 | 9.68 | -0.07 | 10.11 | 10.01 | 0.10 | 10.57 | 10.29 | 0.28 | 11.25 | 10.92 | 0.33 | 11.70 | 11.55 | 0.12 |
| 177 | 8.14 | 7.88 | 0.27 | 8.81 | 8.81 | 0.01 | 9.63 | 9.66 | -0.03 | 10.10 | 9.98 | 0.12 | 10.55 | 10.29 | 0.26 | 11.22 | 10.87 | 0.34 | 11.66 | 11.50 | 0.15 |
| 178 | 8.02 | 7.68 | 0.33 | 8.71 | 8.65 | 0.06 | 9.63 | 9.64 | -0.01 | 10.08 | 9.94 | 0.14 | 10.53 | 10.27 | 0.26 | 11.19 | 10.84 | 0.36 | 11.68 | 11.50 | 0.16 |
| 179 | 7.97 | 7.58 | 0.39 | 8.67 | 8.57 | 0.10 | 9.61 | 9.61 | 0.01 | 10.05 | 9.89 | 0.16 | 10.51 | 10.25 | 0.26 | 11.18 | 10.81 | 0.37 | 11.71 | 11.50 | 0.18 |
| 180 | 7.86 | 7.43 | 0.43 | 8.59 | 8.43 | 0.16 | 9.60 | 9.57 | 0.03 | 10.03 | 9.84 | 0.18 | 10.49 | 10.22 | 0.27 | 11.17 | 10.78 | 0.39 | 11.71 | 11.47 | 0.21 |
| 181 | 7.72 | 7.19 | 0.53 | 8.45 | 8.19 | 0.26 | 9.53 | 9.45 | 0.08 | 10.01 | 9.81 | 0.20 | 10.47 | 10.19 | 0.28 | 11.16 | 10.76 | 0.40 | 11.67 | 11.41 | 0.24 |
| 182 | 7.68 | 7.16 | 0.52 | 8.37 | 8.11 | 0.25 | 9.45 | 9.33 | 0.12 | 10.01 | 9.79 | 0.21 | 10.47 | 10.18 | 0.29 | 11.15 | 10.75 | 0.40 | 11.65 | 11.37 | 0.26 |
| 183 | 7.36 | 6.74 | 0.61 | 8.06 | 7.70 | 0.36 | 9.35 | 9.19 | 0.15 | 10.00 | 9.76 | 0.24 | 10.46 | 10.16 | 0.30 | 11.15 | 10.74 | 0.41 | 11.66 | 11.36 | 0.27 |
| 184 | 7.29 | 6.70 | 0.59 | 7.88 | 7.50 | 0.37 | 9.24 | 9.03 | 0.21 | 9.99 | 9.74 | 0.25 | 10.46 | 10.15 | 0.31 | 11.14 | 10.73 | 0.41 | 11.65 | 11.33 | 0.30 |
| 185 | 7.22 | 6.65 | 0.58 | 7.72 | 7.29 | 0.43 | 9.06 | 8.78 | 0.28 | 9.99 | 9.72 | 0.27 | 10.46 | 10.15 | 0.31 | 11.13 | 10.71 | 0.42 | 11.64 | 11.31 | 0.32 |
| 186 | 6.83 | 6.10 | 0.72 | 7.35 | 6.74 | 0.61 | 8.84 | 8.51 | 0.33 | 9.96 | 9.67 | 0.29 | 10.45 | 10.14 | 0.31 | 11.11 | 10.68 | 0.43 | 11.60 | 11.26 | 0.33 |
| 187 | 6.80 | 6.04 | 0.76 | 7.16 | 6.53 | 0.63 | 8.73 | 8.40 | 0.33 | 9.94 | 9.63 | 0.30 | 10.44 | 10.13 | 0.32 | 11.10 | 10.65 | 0.45 | 11.56 | 11.22 | 0.34 |
| 188 | 6.52 | 5.77 | 0.75 | 6.75 | 6.20 | 0.55 | 8.33 | 7.94 | 0.39 | 9.92 | 9.56 | 0.36 | 10.41 | 10.09 | 0.32 | 11.07 | 10.61 | 0.46 | 11.61 | 11.26 | 0.35 |

**Table 16. Idaho only scenario average dissolved oxygen concentrations for full water column for September 16 to December 31 compared with no source scenario concentrations.**

**The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The no source scenario predictions were in bold and the Idaho only scenario predictions were italicized. The difference in DO predictions between the scenarios were underlined.**

| Segment | Sept 16-30 | | | Oct 1-15 | | | Oct 16-31 | | | Nov 1-15 | | | Nov 16-30 | | | Dec 1-15 | | | Dec 16-31 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 154 | 9.37 | 9.36 | 0.01 | 9.89 | 9.87 | 0.02 | 10.32 | 10.30 | 0.02 | 10.59 | 10.66 | -0.07 | 10.83 | 10.86 | -0.03 | 11.53 | 11.54 | -0.01 | 11.58 | 11.58 | 0.00 |
| 155 | 9.29 | 9.28 | 0.01 | 9.74 | 9.72 | 0.02 | 10.29 | 10.28 | 0.02 | 10.59 | 10.64 | -0.04 | 10.74 | 10.75 | -0.01 | 11.38 | 11.42 | -0.04 | 11.48 | 11.49 | -0.01 |
| 156 | 9.38 | 9.36 | 0.01 | 9.72 | 9.70 | 0.02 | 10.27 | 10.25 | 0.02 | 10.55 | 10.59 | -0.04 | 10.72 | 10.72 | -0.01 | 11.39 | 11.44 | -0.04 | 11.48 | 11.48 | -0.01 |
| 157 | 9.50 | 9.49 | 0.01 | 9.86 | 9.83 | 0.02 | 10.37 | 10.35 | 0.02 | 10.61 | 10.66 | -0.05 | 10.78 | 10.80 | -0.02 | 11.42 | 11.47 | -0.05 | 11.49 | 11.51 | -0.02 |
| 158 | 9.46 | 9.45 | 0.00 | 10.06 | 10.03 | 0.03 | 10.54 | 10.51 | 0.02 | 10.69 | 10.77 | -0.08 | 10.81 | 10.85 | -0.04 | 11.44 | 11.48 | -0.04 | 11.52 | 11.57 | -0.05 |
| 159 | 9.42 | 9.42 | 0.00 | 10.06 | 10.03 | 0.03 | 10.58 | 10.56 | 0.03 | 10.76 | 10.86 | -0.10 | 10.84 | 10.89 | -0.05 | 11.44 | 11.50 | -0.05 | 11.53 | 11.58 | -0.05 |
| 160 | 9.34 | 9.34 | 0.00 | 10.01 | 9.98 | 0.03 | 10.57 | 10.54 | 0.03 | 10.75 | 10.85 | -0.09 | 10.82 | 10.87 | -0.04 | 11.44 | 11.49 | -0.06 | 11.53 | 11.58 | -0.05 |
| 161 | 9.20 | 9.21 | -0.01 | 9.94 | 9.91 | 0.03 | 10.58 | 10.55 | 0.03 | 10.75 | 10.84 | -0.09 | 10.84 | 10.88 | -0.04 | 11.43 | 11.49 | -0.06 | 11.52 | 11.57 | -0.05 |
| 162 | 9.13 | 9.14 | -0.01 | 9.85 | 9.83 | 0.02 | 10.59 | 10.56 | 0.04 | 10.74 | 10.83 | -0.09 | 10.84 | 10.89 | -0.05 | 11.44 | 11.49 | -0.05 | 11.52 | 11.57 | -0.05 |
| 163 | 9.07 | 9.08 | -0.01 | 9.64 | 9.63 | 0.01 | 10.57 | 10.53 | 0.03 | 10.74 | 10.83 | -0.09 | 10.84 | 10.89 | -0.05 | 11.44 | 11.50 | -0.06 | 11.52 | 11.58 | -0.05 |
| 164 | 9.06 | 9.06 | -0.01 | 9.54 | 9.54 | 0.01 | 10.44 | 10.41 | 0.03 | 10.72 | 10.80 | -0.08 | 10.83 | 10.88 | -0.05 | 11.42 | 11.47 | -0.05 | 11.52 | 11.57 | -0.05 |
| 165 | 8.96 | 8.98 | -0.01 | 9.41 | 9.41 | 0.00 | 10.26 | 10.24 | 0.02 | 10.72 | 10.79 | -0.07 | 10.84 | 10.89 | -0.05 | 11.42 | 11.47 | -0.05 | 11.54 | 11.59 | -0.05 |
| 166 | 9.00 | 9.00 | -0.01 | 9.40 | 9.40 | 0.01 | 10.22 | 10.20 | 0.02 | 10.67 | 10.72 | -0.05 | 10.82 | 10.87 | -0.05 | 11.40 | 11.44 | -0.04 | 11.51 | 11.56 | -0.05 |
| 167 | 8.95 | 8.95 | 0.00 | 9.33 | 9.33 | 0.01 | 10.15 | 10.13 | 0.02 | 10.65 | 10.70 | -0.04 | 10.82 | 10.88 | -0.06 | 11.39 | 11.44 | -0.04 | 11.50 | 11.55 | -0.05 |
| 168 | 8.94 | 8.93 | 0.00 | 9.32 | 9.31 | 0.01 | 10.07 | 10.05 | 0.02 | 10.64 | 10.67 | -0.03 | 10.82 | 10.88 | -0.06 | 11.38 | 11.42 | -0.04 | 11.49 | 11.54 | -0.05 |
| 169 | 8.91 | 8.90 | 0.01 | 9.28 | 9.27 | 0.01 | 9.95 | 9.93 | 0.02 | 10.64 | 10.66 | -0.03 | 10.81 | 10.87 | -0.06 | 11.34 | 11.38 | -0.04 | 11.47 | 11.52 | -0.05 |
| 170 | 8.86 | 8.85 | 0.01 | 9.22 | 9.21 | 0.01 | 9.85 | 9.83 | 0.02 | 10.52 | 10.55 | -0.02 | 10.79 | 10.85 | -0.06 | 11.29 | 11.31 | -0.03 | 11.44 | 11.49 | -0.05 |
| 171 | 8.81 | 8.80 | 0.01 | 9.17 | 9.16 | 0.01 | 9.76 | 9.75 | 0.02 | 10.40 | 10.41 | -0.01 | 10.76 | 10.81 | -0.05 | 11.28 | 11.30 | -0.02 | 11.43 | 11.48 | -0.04 |
| 172 | 8.76 | 8.75 | 0.01 | 9.14 | 9.13 | 0.01 | 9.71 | 9.69 | 0.01 | 10.29 | 10.28 | 0.01 | 10.69 | 10.71 | -0.02 | 11.34 | 11.37 | -0.02 | 11.57 | 11.60 | -0.04 |
| 173 | 8.74 | 8.72 | 0.02 | 9.13 | 9.12 | 0.02 | 9.68 | 9.66 | 0.02 | 10.22 | 10.20 | 0.02 | 10.65 | 10.66 | -0.01 | 11.33 | 11.34 | -0.02 | 11.64 | 11.67 | -0.03 |
| 174 | 8.64 | 8.62 | 0.02 | 9.11 | 9.09 | 0.02 | 9.67 | 9.65 | 0.02 | 10.19 | 10.17 | 0.02 | 10.63 | 10.64 | -0.01 | 11.29 | 11.30 | -0.01 | 11.61 | 11.64 | -0.03 |
| 175 | 8.54 | 8.52 | 0.02 | 9.07 | 9.05 | 0.02 | 9.65 | 9.63 | 0.02 | 10.16 | 10.14 | 0.02 | 10.61 | 10.61 | 0.00 | 11.28 | 11.28 | 0.00 | 11.66 | 11.68 | -0.02 |
| 176 | 8.47 | 8.45 | 0.03 | 9.00 | 8.97 | 0.03 | 9.61 | 9.59 | 0.02 | 10.11 | 10.09 | 0.02 | 10.57 | 10.57 | 0.00 | 11.25 | 11.24 | 0.01 | 11.70 | 11.71 | -0.02 |
| 177 | 8.14 | 8.11 | 0.04 | 8.81 | 8.78 | 0.04 | 9.63 | 9.60 | 0.03 | 10.10 | 10.07 | 0.03 | 10.55 | 10.55 | 0.00 | 11.22 | 11.21 | 0.01 | 11.66 | 11.67 | -0.02 |
| 178 | 8.02 | 7.97 | 0.04 | 8.71 | 8.67 | 0.04 | 9.63 | 9.60 | 0.03 | 10.08 | 10.05 | 0.03 | 10.53 | 10.53 | 0.01 | 11.19 | 11.18 | 0.01 | 11.68 | 11.69 | -0.01 |
| 179 | 7.97 | 7.92 | 0.04 | 8.67 | 8.62 | 0.05 | 9.61 | 9.59 | 0.03 | 10.05 | 10.02 | 0.03 | 10.51 | 10.50 | 0.01 | 11.18 | 11.16 | 0.02 | 11.71 | 11.71 | -0.01 |
| 180 | 7.86 | 7.82 | 0.05 | 8.59 | 8.54 | 0.05 | 9.60 | 9.57 | 0.03 | 10.03 | 9.99 | 0.03 | 10.49 | 10.47 | 0.02 | 11.17 | 11.15 | 0.02 | 11.71 | 11.71 | 0.00 |
| 181 | 7.72 | 7.67 | 0.05 | 8.45 | 8.39 | 0.06 | 9.53 | 9.50 | 0.04 | 10.01 | 9.97 | 0.04 | 10.47 | 10.45 | 0.02 | 11.16 | 11.13 | 0.03 | 11.67 | 11.67 | 0.00 |
| 182 | 7.68 | 7.63 | 0.05 | 8.37 | 8.31 | 0.06 | 9.45 | 9.40 | 0.04 | 10.01 | 9.97 | 0.04 | 10.47 | 10.45 | 0.02 | 11.15 | 11.13 | 0.03 | 11.65 | 11.64 | 0.00 |
| 183 | 7.36 | 7.30 | 0.06 | 8.06 | 7.99 | 0.07 | 9.35 | 9.30 | 0.05 | 10.00 | 9.96 | 0.04 | 10.46 | 10.44 | 0.02 | 11.15 | 11.12 | 0.03 | 11.66 | 11.65 | 0.01 |
| 184 | 7.29 | 7.22 | 0.07 | 7.88 | 7.80 | 0.07 | 9.24 | 9.18 | 0.05 | 9.99 | 9.95 | 0.05 | 10.46 | 10.44 | 0.03 | 11.14 | 11.11 | 0.03 | 11.65 | 11.64 | 0.01 |
| 185 | 7.22 | 7.15 | 0.07 | 7.72 | 7.64 | 0.08 | 9.06 | 9.00 | 0.06 | 9.99 | 9.94 | 0.05 | 10.46 | 10.44 | 0.02 | 11.13 | 11.10 | 0.03 | 11.64 | 11.62 | 0.02 |
| 186 | 6.83 | 6.74 | 0.09 | 7.35 | 7.25 | 0.10 | 8.84 | 8.77 | 0.07 | 9.96 | 9.90 | 0.06 | 10.45 | 10.44 | 0.01 | 11.11 | 11.08 | 0.03 | 11.60 | 11.58 | 0.02 |
| 187 | 6.80 | 6.70 | 0.10 | 7.16 | 7.06 | 0.10 | 8.73 | 8.66 | 0.07 | 9.94 | 9.88 | 0.06 | 10.44 | 10.43 | 0.01 | 11.10 | 11.06 | 0.03 | 11.56 | 11.54 | 0.02 |
| 188 | 6.52 | 6.41 | 0.11 | 6.75 | 6.65 | 0.10 | 8.33 | 8.25 | 0.08 | 9.92 | 9.86 | 0.06 | 10.41 | 10.40 | 0.01 | 11.07 | 11.04 | 0.03 | 11.61 | 11.59 | 0.02 |

# Exhibit 13

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
*4601 N Monroe Street ∘ Spokane, Washington 99205-1295 ∘ (509)329-3400*

February 16, 2010

Mr. Dale Arnold
City of Spokane
Wastewater Management
909 E Sprague Avenue
Spokane, WA 99202-2127

Dear Mr. Arnold:

Re: Factual Review Fact Sheet NPDES Permit No. WA-002447-3
Riverside Park Water Reclamation Facility

Enclosed for the City's review and comment is the Department of Ecology's (Ecology) draft of the Fact Sheet for the City of Spokane's NPDES Permit No. WA-002447-3, Riverside Park Water Reclamation Facility. Ecology requests comments on factual mistakes be returned by March 3, 2010.

Send any corrections you may have to:

Richard Koch, P.E.
Department of Ecology
Water Quality Program
4601 N Monroe Street
Spokane, WA 99205-1295

Ecology will make the appropriate corrections in the draft fact sheet and permit and place a public notice in a local newspaper. An official draft permit copy and fact sheet will be mailed along with a copy of the public notice. There will be a 30 day public comment period from the date of publication. At that time, you will have the opportunity to submit comments on requirements and/or conditions in the permit.

If a meeting with the permit manager would be helpful or facilitate review please contact Richard A. Koch, P.E Facility Manager at (509)329-3519 or by email.

Sincerely,

Virginia Darrell

Virginia S. Darrell, P.E.
Water Quality Program
Permit Unit Supervisor

VSD:RAK:eh

cc/enc: Lars Hendron, P.E.
Tim Pelton, RPWRF Supervisor
Bruce Rawls, Spokane County Utilities
cc: Richard A. Koch, P.E., Ecology/WQ-ERO

Issuance Date: ?, 2010
Effective Date: ?, 2010
Expiration Date: ?, 2015

# NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM WASTE DISCHARGE PERMIT No. WA-002447-3

State of Washington
DEPARTMENT OF ECOLOGY
Olympia, Washington 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

City of Spokane Riverside Park Water Reclamation Facility and
Combined Sewer Overflows (CSOs)
4401 N. Aubrey L. White Parkway
Spokane, WA 99205
And
Spokane County (Pretreatment Program)
Division of Utilities – 1026 W. Broadway Ave.
Spokane, WA 99260-0430

| | |
|---|---|
| Plant Location:<br>4401 N. Aubrey L. White Parkway; Spokane | Receiving Water:<br>Spokane River |
| Water Body I.D. No.:<br>WA-54-1020 (old)<br>QZ45UE (new) | Discharge Location:<br>Latitude: 47° 41' 43" N<br>Longitude: 117° 28' 26" W |
| Plant Type: Activated Sludge | CSO Outfalls: 23 Outfalls |

is authorized to discharge in accordance with the special and general conditions that follow.

James M. Bellatty
Water Quality Section Supervisor
Eastern Regional Office
Washington State Department of Ecology

# TABLE OF CONTENTS

**GENERAL CONDITIONS**

## SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions of this permit for additional submittal requirements.

| Permit Section | Submittal | Frequency | First Submittal Date |
|---|---|---|---|
| S3. | Discharge Monitoring Report | Monthly | |
| S3.E | Noncompliance Notification | As necessary | |
| S4.B. | Plans for Maintaining Adequate Capacity | As necessary | |
| S4.C. | Notification of New or Altered Sources | As necessary | |
| S4.E. | Waste load Assessment | Annually | July 1, 2010 |
| S5.G. | Operations and Maintenance Manual Update | Annually | |
| S6.A.1.k | Sewer User Ordinance Update | | October 1, 2011 |
| S6.A.2. | Accidental Spill Plan | 1/permit cycle | October 1, 2014 |
| S6.A.5. | Pretreatment Report for City of Spokane | 1/year | March 31, 2011 |
| S6.A.6 | Submit Industrial Pretreatment Program | | June 30, 2010 |
| S6.D | Local Limits update | | April 15, 2011 |
| S6.E | Mercury Control Plan | | September 1, 2010 |
| S7.A.1.j | Multi-jurisdictional agreements | | May 15, 2010 |
| S7.A.1.k | Sewer User Ordinance Update | | December 15, 2011 |
| S7.A.2. | Accidental Spill Plan | 1/permit cycle | October 15, 2011 |
| S7.A.5. | Pretreatment Report for Spokane County | 1/year | May 1, 2011 |
| S7.A.6. | Submit Industrial Pretreatment Program | | June 15, 2010 |
| S7.D | Local Limits update | | August 15, 2011 |
| S7.E | Mercury Control Plan | | September 15, 2010 |
| S8.B. | Residual Solids Management Plan | 1/permit cycle | |
| S9. | Spill Plan | 1/permit cycle | October 1, 2014 |
| S12. | Quality Assurance Plan for Priority Pollutants | | |
| | Quality Assurance Plan for Toxics | | |
| | Quality Assurance Plan for Temperature | | |
| S13.B | Combined Sewer Overflow Report | Annually | |

| Permit Section | Submittal | Frequency | First Submittal Date |
|---|---|---|---|
| S13.C | Combined Sewer Overflow Reduction Plan Amendment | As needed | |
| S13.D | Combined Sewer Overflow (CSO) Maintenance and Inspection Plan Update | Annually | October 1, 2010 |
| S13.E | CSO Maintenance and Inspection Report | Annually | March 1, 2011 |
| S15.A | Initial Delta Elimination Plan<br>Delta Elimination Plan update | <br>Annually | February 1, 2011<br>February 1, 2012 |
| S15.B. | Engineering Report or Wastewater Facilities Plan submission | | June 15, 2012 |
| S15.C. | Contract Documents submitted for construction of phosphorus removal process units to achieve Final TP effluent limitations | | December 1, 2012 |
| S15.E. | Substantial Completion for the construction of phosphorus removal technologies | | October 31, 2015 |
| S15.F | Compliance with Spokane River and Lake Spokane DO TMDL WLAs | | March 1, 2018 |
| S16. | Application for Permit Renewal | 1/permit cycle | December 15, 2014 |
| G1. | Notice of Change in Authorization | As necessary | |
| G4. | Reporting Planned Changes | As necessary | |
| G5. | Engineering Report for Construction or Modification Activities | As necessary | |
| G21 | Reporting Anticipated Non-compliance | As necessary | |
| G22 | Reporting Other Information | As necessary | |

# SPECIAL CONDITIONS

## S1. DISCHARGE LIMITATIONS

### A. Interim Effluent Limitations

All discharges and activities authorized by this permit shall be consistent with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit.

Beginning on the effective date of this permit and lasting through the expiration date of this permit, the Permittee is authorized to discharge municipal wastewater at the permitted location subject to complying with the following limitations:

| Low Flow Season (July-Oct) **EFFLUENT LIMITATIONS[a]: OUTFALL # 005A** | | |
|---|---|---|
| **Parameter** | **Average Monthly** | **Average Weekly** |
| Biochemical Oxygen Demand (5 day) | 30 mg/L, 10,759 lbs/day | 45 mg/L, 16,138 lbs/day |
| Total Suspended Solids | 30 mg/L, 10,759 lbs/day | 45 mg/L, 16,138 lbs/day |
| Fecal Coliform Bacteria | 200/100 mL | 400/100 mL |
| pH | Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9. | |
| **Parameter** | **Average Monthly** | **Maximum Daily[b]** |
| Total Residual Chlorine[c] | 8.5 µg/L, 3.12 lbs/day | 22.2 µg/L, 14.26 lbs/day |
| Total Ammonia (as $NH_3$-N) | 3.1 mg/L, 1,112 lbs/day | 7.5 mg/L, 2,690 lbs/day |
| Phosphorus (total as P) | See Note f below | |
| Zinc (tot. recoverable) | 45.2 µg/L | 97.5 µg/L |
| High Flow Season (Nov-June) **EFFLUENT LIMITATIONS[a]: OUTFALL # 005A** | | |
| **Parameter** | **Average Monthly** | **Average Weekly** |
| Biochemical Oxygen Demand (5 day) | 30 mg/L, 10,759 lbs/day<br>85% removal of influent BOD | 45 mg/L, 16,138 lbs/day |
| Total Suspended Solids | 30 mg/L, 10,759 lbs/day<br>85% removal of influent TSS | 45 mg/L, 16,138 lbs/day |
| Fecal Coliform Bacteria | 200/100 mL | 400/100 mL |
| pH | Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9. | |
| **Parameter** | **Average Monthly** | **Maximum Daily[b]** |
| Total Residual Chlorine[c] | 8.5 µg/L, 4.3 lbs/day | 22.2 µg/L, 24.0 lbs/day |
| Phosphorus (total as P) | See Note f below | |

| | | |
|---|---|---|
| Zinc (tot. recoverable) | 45.2 µg/L | 97.5 µg/L |
| [a]The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean. | | |
| [b]The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day. | | |
| [c] Indicates the range of permitted values. When pH is continuously monitored, excursions between 5.0 and 6.0, or 9.0 and 10 shall not be considered violations provided no single excursion exceeds 60 minutes in length and total excursions do not exceed 7 hours and 30 minutes per month. Any excursions below 5.0 and above 10.0 are violations. The instantaneous maximum and minimum pH shall be reported monthly. | | |
| [d]The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day. | | |
| [e] There are no ammonia toxicity-based effluent limits when the Spokane River's 7-day average flow is greater than 5000 cfs as measured at the USGS gage at Cochran Street. New information can be cause for modification. | | |
| [f] Seasonal chemical phosphorus removal must be initiated by no later than April 15, or terminate no earlier than October 15. The monthly average shall be calculated using only the days when chemical removal is required. The monthly average effluent limitation shall be 0.63 mg/L. The Daily maximum effluent limitation shall be 1.10 mg/L. | | |

B. Effluent Limitations for Compliance with the Spokane River DO TMDL

Beginning **March 1, 2018** the Permittee must comply with the following effluent limitations and employ the full phosphorus removal process train including chemical addition during the season March 1 to October 31.

| (March – Oct) **EFFLUENT LIMITATIONS[a]: OUTFALL # 005A** | | |
|---|---|---|
| **Parameter** | **Average Monthly** | **Daily Maximum** |
| Carbonaceous Biochemical Oxygen Demand – 5 day ($CBOD_5$) March 1 to Oct. 31 | 1778 lbs/day | |
| Total Phosphorus (as P) March 1 to Oct. 31 | 17.8 lbs/day See note f | |
| Total Ammonia (as $NH_3$-N) | | |
| For "season" of March 1 to May 31 | 351 lbs/day | |
| For "season" of June 1 to Sept. 30 | 89 lbs/day | 7.5 mg/L |
| For "season" of Oct. 1 to Oct. 31 | 351 lbs/day | |
| **EFFLUENT LIMITATIONS[a]: OUTFALL # 005A** | | |
| **Parameter** | **Average Monthly** | **Average Weekly** |
| Carbonaceous Biochemical Oxygen Demand – 5 day ($CBOD_5$) Nov. 1 thru Feb. [c] | 30 mg/L, 8775 lbs/day | 45 mg/L, 13,162 lbs/day |
| Total Suspended Solids [c] | 30 mg/L, 8775 lbs/day | 45 mg/L, 13,162 lbs/day |
| Fecal Coliform Bacteria | 200/100 mL | 400/100 mL |
| pH | Daily minimum is equal to or greater than 6 and the daily maximum is less than or equal to 9. | |
| **Parameter** | **Average Monthly** | **Maximum Daily[b]** |
| Total Residual Chlorine[c] | 8.5 µg/L, 4.3 lbs/day | 22.2 µg/L, 24.0 lbs/day |
| Zinc (tot. recoverable) | 45.2 µg/L | 97.50 µg/L |
| [a]The average monthly and weekly effluent limitations are based on the arithmetic mean of the samples taken with the exception of fecal coliform, which is based on the geometric mean. | | |
| [b]The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day. | | |
| [c] Indicates the range of permitted values. When pH is continuously monitored, excursions between 5.0 and 6.0, or 9.0 and 10.0 shall not be considered violations provided no single excursion exceeds 60 minutes in length and total excursions do not exceed 7 hours and 30 minutes per month. Any excursions below 5.0 and above 10.0 are violations. The | | |

| |
|---|
| instantaneous maximum and minimum pH shall be reported monthly. |
| [d]The maximum daily effluent limitation is defined as the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For other units of measurement, the daily discharge is the average measurement of the pollutant over the day. |
| [e] The given limits of 30 mg/L and 45 mg/L are default values. During data gathering for the "Ten Year" assessment performance based limits will be calculated. |
| f. See compliance schedule item S15.A for reporting of Delta Elimination Plan mass earned and expended. |

Footnotes:

(1) The method detection limit (MDL) for Total Residual Chlorine is 10 µg/L. The respective quantification level (QL) is obtained by multiplying the MDL by 5 (50 µg/L).

The method detection level (MDL) for cadmium, lead, and zinc, are 0.013 µg/L, 0.015 µg/L, and 0.14 µg/L respectively using EPA method 1638. The respective quantification levels (QL) are obtained by multiplying each MDL by 5 (0.065 µg/L, 0.080 µg/L, and 0.70 µg/L).

The method detection level (MDL) for Total phosphorus is 5 µg/L r using the method listed in Appendix A or USEPA method 365.3.

The method detection level (MDL) for total ammonia using the method listed in Appendix A.

These QLs will be used for assessment of compliance with these effluent limits. If the Permittee is unable to attain the MDL and QL in its effluent due to matrix effects, the Permittee shall submit a matrix specific MDL and QL to the Department by (nine months after the effective date). The matrix specific MDL and QL shall be calculated as follows:

MDL = 3.14 x (standard deviation of 7 replicate spiked samples). This corresponds to the calculation of the method detection limit, as defined in 40 CFR Part 136, Appendix B, with the provision that the MDL be calculated for a specific effluent matrix.

The QL = 5 x MDL

Check standards at concentrations equal to the QL shall be analyzed alongside all compliance monitoring samples. Check standards shall be produced independently of calibration standards and maintained as a part of the Permittee's records. All check standard recovery data and duplicate measurements shall be submitted to the Department in the discharge monitoring report. The Department's precision goal is +/- 20%.

(2) If the measured effluent concentration is below the QL as determined in Footnote #1

above, the Permittee shall report NQ for non-quantifiable.

Average values shall be calculated as follows: measurements below the MDL = 0; measurements greater than the MDL = the measurement.

When sample measurements for compliance with mass-based limits fall below the MDL, the average loading shall be calculated using a concentration value of zero.

When sample measurements for compliance with mass-based limits fall above the MDL, the average loading shall be calculated using the measured concentration.

C. Mixing Zone Descriptions

The maximum boundaries of the mixing zones are defined as follows:

The mixing zone dimensional boundary shall be variable as defined by the effluent plume where the percent effluent is equivalent to that calculated from the maximum dilution factor. The dilution factor will be derived based on the maximum fraction of the river flow authorized for acute (2.5%) and chronic (25%) mixing zones at the established critical conditions (seasonal 7Q20). At no time shall the mixing zone cause a loss of sensitive or important habitat, substantially interfere with the existing or characteristic uses of the water body, result in damage to the ecosystem, or adversely affect public health. The calculated dilution factors at critical conditions are as follows:

| **Dilution Factors** (% effluent = 100 x 1/dil. factor) | Low River Flow Period (July – October) | | High River Flow Period (November – June) | |
|---|---|---|---|---|
| | Acute | Chronic | Acute | Chronic |
| Aquatic Life | 1.17 (85%) | 3.96 (25%) | 1.23 (81%) | 6.40 (16%) |
| Human Health, Carcinogen | 12.75 (8%, annually based) | | | |
| Human Health, Non-carcinogen | 5.19 (19%, annually based) | | | |

## S2. MONITORING REQUIREMENTS

A. Monitoring Schedule

| MAIN PLANT DISCHARGE AT OUTFALL 005A | | | | |
|---|---|---|---|---|
| **PARAMETER** | **UNITS** | **SAMPLE POINT** | **SAMPLING FREQUENCY** | **SAMPLE TYPE** |
| Flow, avg., & max | MGD | raw sewage<br>final effluent | Continuous[1]<br>Continuous[1] | Metered<br>Metered |
| pH, min. & max. | s.u. | raw sewage<br>final effluent | Continuous[1]<br>Continuous[1] | Metered<br>Metered |
| Temp | °C | raw sewage<br>final effluent<br>Receiving water upstream of outfall and downstream of mixing zone | Daily<br>Daily<br>Continuous June through September | Grab<br>Grab<br>Metered |
| $BOD_5$ [1] monthly avg., weekly avg., in years 1 to 4 of permit. In fifth year of permit see note 6 | mg/l, lbs/day, % removal | raw sewage<br>final effluent | Daily<br>Daily | 24 hr. comp.<br>24 hr. comp. |
| TSS | mg/l, lbs/day, % removal | raw sewage<br>final effluent | Daily<br>Daily | 24 hr. comp.<br>24 hr. comp. |
| Dissolved Oxygen | mg/l | final effluent | Daily | Grab |
| Total Residual Chlorine[2] | mg/l, lbs/day | final effluent | 2/day | Grab |
| Chlorine Usage | lbs/day | --- | Daily | Report |
| Fecal Coliform | c.f.u. | final effluent | 3/week | Grab |
| Total Nitrogen (TN as N) | mg/l | raw sewage<br>final effluent | 1/week<br>1/week | 24 hr. comp.<br>24 hr. comp. |
| Nitrate + Nitrite ($NO_3$+$NO_2$ as N) | mg/l | raw sewage<br>final effluent | 1/week<br>1/week | 24 hr. comp.<br>24 hr. comp. |
| Total Ammonia ($NH_4$ as N), monthly avg., daily max., in years 1 to 4 of permit. In fifth year of permit see notes 6 &7 | mg/l, lbs/day | raw sewage<br>final effluent | 3/week<br>Daily | 24 hr. comp.<br>24 hr. comp. |
| Alkalinity, (total as $CaCO_3$) | mg/l | final effluent | 3/week | Grab |

| MAIN PLANT DISCHARGE AT OUTFALL 005A | | | | |
|---|---|---|---|---|
| **PARAMETER** | **UNITS** | **SAMPLE POINT** | **SAMPLING FREQUENCY** | **SAMPLE TYPE** |
| Total Phosphorus (as P) monthly average and daily max. in years 1 to 4 of permit. In fifth year of permit see notes 6 & 8 | mg/l, lbs/d | raw sewage<br>final effluent | Daily<br>Daily | 24 hr. comp.<br>24 hr. comp. |
| Aluminum | µg/L | raw sewage<br>final effluent | 1/ 2 weeks when using Alum | 24 hr. comp. |
| Arsenic [3] | µg/L | raw sewage<br>final effluent | 1/ 2 weeks | 24 hr. comp |
| Cadmium [3] | µg/L | raw sewage<br>final effluent | 1/ 2 weeks | 24 hr. comp |
| Copper [3] | µg/L | raw sewage<br>final effluent | 1/ 2 weeks | 24 hr. comp |
| Lead [3] | µg/L | raw sewage<br>final effluent | 1/ 2 weeks | 24 hr. comp |
| Zinc [3] | µg/L | raw sewage<br>final effluent | 1/ 2 weeks | 24 hr. comp |
| Mercury [3] | µg/L | raw sewage<br>final effluent | 1/month | 24 hr. comp. |
| Silver [3] | µg/L | raw sewage<br>final effluent | 1/month | 24 hr. comp. |
| Total PCBs [5] | pg/L | raw sewage<br>2 collection system locations | Once each in July, & Nov. thru May | 24 hr. comp. |
| Total PCBs [5] | pg/L | final effluent | 1/ quarter | 24 hr. comp. |
| Total PCBs [5] | pg/L | Biosolids | 2/ year (winter & summer) | Man. comp. |
| 2,3,7,8, TCDDs [5] | pg/L | raw sewage<br>2 collection system locations | Once in July, & monthly Nov. thru May | 24 hr. comp. |
| 2,3,7,8, TCDDs [5] | pg/L | final effluent | 1/ quarter | 24 hr. comp. |
| 2,3,7,8, TCDDs [5] | pg/L | Biosolids | 2/ year (winter & summer) | Man. comp. |
| PBDE [5] (polybrominated diphenyl ethers) | pg/L | raw sewage<br>final effluent | 1/quarter | 24 hr. comp. |

| MAIN PLANT DISCHARGE AT OUTFALL 005A | | | | |
|---|---|---|---|---|
| **PARAMETER** | **UNITS** | **SAMPLE POINT** | **SAMPLING FREQUENCY** | **SAMPLE TYPE** |
| PBDE [5] (polybrominated diphenyl ethers) | pg/L | Biosolids | 2/ year (winter & summer) | Man. comp. |
| Priority Pollutants | SEE SPECIAL CONDITION S6.B | | | |
| Biomonitoring | SEE SPECIAL CONDITIONS S10 and S11 | | | |
| CSO Monitoring | SEE SPECIAL CONDITION S12.E.3 | | | |

[1] Beginning in the fourth year of the permit, the permittee shall begin monitoring for $BOD_5$ and $CBOD_5$ to establish a correlation of $BOD_5$ to $CBOD_5$

[2] Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. Sampling shall be taken by hourly grab samples when continuous monitoring is not possible.

[3]Total Residual Chlorine analyses using the spectrophotometric DPD method.

[4]Sampling and analyses shall be performed using the appropriate methods from the EPA 1600 series.

[5] See permit section S12.

[6] Beginning March 1, 2018; for the 3 parameters ($CBOD_5$, $NH_3$ and TP) with WLAs established by the Spokane River and Lake Spokane DO TMDL, the monthly discharge monitoring report must provide the following information for compliance monitoring and compliance projections: monthly average, daily maximum, running total for the "season," running average for the "season," projected trend of total lbs. and average concentration and average daily lbs. for remainder of the "season" with compliance target indicated. If the trend projection indicates a probability of noncompliance with the allowable mass limitations at the end of the "season," the permittee must communicate the anticipated result of the projection with the monthly discharge monitoring report including a preliminary plan for bringing the trend projection back into probable compliance. After reviewing the preliminary plan with the department's permit manager the plan must be finalized, implemented and submitted to the department.

[7] The reporting limit for Total Ammonia (as N) is 50 ug/L, the analytical protocol is listed in Appendix A.

[8] The reporting limit for Total Phosphorus is 5 ug/L, the analytical protocol is listed in Appendix A

B. Sampling and Analytical Procedures

Samples and measurements taken to meet the requirements of this permit shall be representative of the volume and nature of the monitored parameters, including representative sampling of any unusual discharge or discharge condition, including bypasses, upsets and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit shall conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136 or to the latest revision of *Standard Methods for the Examination of Water and Wastewater* (APHA), unless otherwise specified in this permit or approved in writing by the Department of Ecology (Department).

C. Flow Measurement

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the quantity of monitored flows. The devices shall be installed, calibrated, and maintained to ensure that the accuracy of the measurements are consistent with the accepted industry standard for that type of device. Frequency of calibration shall be in conformance with manufacturer's recommendations and at a minimum frequency of at least one calibration per year. Calibration records shall be maintained for at least three years.

D. Laboratory Accreditation

All monitoring data required by the Department shall be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories*, Chapter 173-50 WAC. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. Conductivity and pH shall be accredited if the laboratory must otherwise be registered or accredited. The Department exempts crops, soils, and hazardous waste data from this requirement pending accreditation of laboratories for analysis of these media.

## S3. REPORTING AND RECORDKEEPING REQUIREMENTS

The Permittee shall monitor and report in accordance with the following conditions. The falsification of information submitted to the Department shall constitute a violation of the terms and conditions of this permit.

A. Reporting

The first monitoring period begins on the effective date of the permit. Monitoring results shall be submitted monthly. Monitoring data obtained during each monitoring period shall be summarized, reported, and submitted on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by the Department. DMR forms shall be received by the Department no later than the 15th day of the month following the completed monitoring period, unless otherwise specified in this permit. Priority pollutant analysis data shall be submitted no later than forty-five (45) days following the monitoring period. Unless otherwise specified, all toxicity test data shall be submitted within sixty (60) days after the sample date. The report(s) shall be sent to the Department of Ecology, Eastern Regional Office, 4601 North Monroe, Suite 202, Spokane, Washington 99205-1295.

In addition to the monthly report, a monthly summary report form (EPA No. 3320-1) shall be received no later than the 15th day of the following month.

All laboratory reports providing data for organic and metal parameters shall include the following information: sampling date, sample location, date of analysis, parameter name, CAS number, analytical method/ number, method detection limit (MDL), laboratory practical quantitation limit (PQL), reporting units, and concentration detected.

Discharge Monitoring Report forms must be submitted monthly whether or not the facility was discharging. If there was no discharge during a given monitoring period, submit the form as required with the words "no discharge" entered in place of the monitoring results.

B. Records Retention

The Permittee shall retain records of all monitoring information for a minimum of three (3) years. Such information shall include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. This period of retention shall be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by the Department.

C. Recording of Results

For each measurement or sample taken, the Permittee shall record the following information: (1) the date, exact place, method, and time of sampling or measurement; (2) the individual who performed the sampling or measurement; (3) the dates the analyses were performed; (4) the individual who performed the analyses; (5) the analytical techniques or methods used; and (6) the results of all analyses.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit using test procedures specified by Condition S2 of this permit, then the results of such monitoring shall be included in the calculation and reporting of the data submitted in the Permittee's DMR.

E. Noncompliance Notification

In the event the Permittee is unable to comply with any of the terms and conditions of this permit due to any cause, the Permittee shall:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance, correct the problem and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to the Department within (30) days after becoming aware of the violation.

2. Immediately notify the Department of the failure to comply.

3. Submit a detailed written report to the Department within thirty (30) days (five [5] days for upsets and bypasses), unless requested earlier by the Department. The report shall contain:

   a. a description of the noncompliance and its cause;
   b. the period of noncompliance, including exact dates and times;
   c. the estimated time noncompliance is expected to continue if it has not been corrected;
   d. steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance; and
   e. if the non compliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

   Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

F. Maintaining a Copy of This Permit

A copy of this permit must be kept at the treatment plant and be made available upon request to the public or Ecology inspectors.

## S4. FACILITY LOADING

A. Design Criteria

The flows and waste loadings from approved engineering report for the Spokane Riverside Park Water Reclamation Facility (design year 2015) are shown below. The approved influent flows and loading (also known as the design criteria) shall not be exceeded:

| Parameter | Dry Season | Wet Season |
|---|---|---|
| Average flow, MGD$^{(1)}$ | 55.9 | 60.6 |
| Maximum Monthly flow, MGD | 59.6 | 79.8 |
| Maximum Day flow, MGD | 103.9 | 129.5 |
| Peak Hour flow, MGD$^{(2)}$ | 130 | 130 |
| $BOD_5$ influent loading, lb./day | | |
| Annual Average | 85,100 | |
| Maximum Month | 102,120 | |
| Maximum Day | 170,200 | |
| TSS influent loading, lb./day | | |
| Annual Average | 85,100 | |
| Maximum Month | 102,120 | |

| | |
|---|---|
| Maximum Day | 170,200 |
| TKN influent loading, lb./day | |
| Annual Average | 16,300 |
| Maximum Month | 19,560 |
| Maximum Day | 32,600 |
| TP influent loading, lb./day | |
| Annual Average | 2,270 |
| Maximum Month | 2,570 |
| Maximum Day | 3,630 |

Note: (1) The collaboration effort that produced the "Foundational Concepts" which this permit is implementing established an average annual dry weather flow of 43.0 MGD for the time period of this permit cycle. See the accompanying Fact Sheet for additional detail.

(2) The capacity of the primary and secondary treatment processes is 150 MGD with one clarifier out of service and 180 MGD with all clarifiers in service. A peak CSO flow for the July 2001 Conceptual Design Report was assumed to be 250 MGD.

B. Plans for Maintaining Adequate Capacity

The permittee shall submit to the Department a plan and a schedule for continuing to maintain capacity when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months; or

2. when the projected increase would reach design capacity within five years,

whichever occurs first. If such a plan is required, it shall contain a plan and schedule for continuing to maintain capacity. The capacity as outlined in this plan must be sufficient to achieve the effluent limitations and other conditions of this permit. This plan shall address any of the following actions or any others necessary to meet the objective of maintaining capacity.

1. Analysis of the present design including the introduction of any process modifications that would establish the ability of the existing facility to achieve the effluent limits and other requirements of this permit at specific levels in excess of the existing design criteria specified in paragraph A above.
2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.
3. Limitation on future sewer extensions or connections or additional waste loads.
4. Modification or expansion of facilities necessary to accommodate increased flow or waste load.

5. Reduction of industrial or commercial flows or waste loads to allow for increasing sanitary flow or waste load.

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by the Department prior to any construction. The plan shall specify any contracts, ordinances, methods for financing, or other arrangements necessary to achieve this objective.

C. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment

D. Notification of New or Altered Sources

The Permittee shall submit written notice to the Department whenever any new discharge or a substantial change in volume or character of an existing discharge into the POTW is proposed which: (1) would interfere with the operation of, or exceed the design capacity of, any portion of the POTW; (2) is not part of an approved general sewer plan or approved plans and specifications; or (3) would be subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act. This notice shall include an evaluation of the POTW's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the POTW, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

E. Waste load Assessment

The Permittee shall conduct an annual assessment of their flow and waste load and submit a report to the Department by July 1, 2008 and annually thereafter. The report shall contain the following:

An indication of compliance or noncompliance with the permit effluent limitations, for TP this assessment shall include a calculation of the coefficient of variation for the season April 1 through October 31;

The report shall provide a statistical analysis of the facilities performance removing Total Phosphorus, $BOD_5$, $CBOD_5$ and ammonia on a monthly average basis, 30 day rolling average basis, seasonal average basis, and seasonal median basis.

A comparison between:
the existing and design monthly average dry weather flows,
the existing and design monthly average wet weather flows
the existing and design peak flows,
the existing and design $BOD_5$,
the existing and design total suspended solids loadings,
the existing and design total phosphorus,
the existing and design total ammonia.

The percentage increase in the above parameters since the last annual report.

The report shall also state the present and design population or population equivalent, projected population growth rate, and the estimated date upon which the design capacity is projected to be reached, according to the most restrictive of the parameters above.

The interval for review and reporting may be modified if the Department determines that a different frequency is sufficient.

## S5. OPERATION AND MAINTENANCE

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a Permittee only when the operation is necessary to achieve compliance with the conditions of this permit.

A. Certified Operator

An operator certified for at least a Class IV plant by the state of Washington shall be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class III plant shall be in charge during all regularly scheduled shifts.

B. O & M Program

The Permittee shall institute an adequate operation and maintenance program for the entire sewage system. Maintenance records shall be maintained on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records shall clearly specify the frequency and type of maintenance recommended by the manufacturer and shall show the frequency and type of maintenance performed. These maintenance records shall be available for inspection at all times.

C. Short-term Reduction

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limitations on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee shall give written notification to the Department, if possible, 30 days prior to such activities, detailing the reasons for, length of time of, and the potential effects of the reduced level of treatment. This notification does not relieve the Permittee of its obligations under this permit.

D. Electrical Power Failure

The Permittee is responsible for maintaining adequate safeguards to prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations either by means of alternate power sources, standby generator, or retention of inadequately treated wastes.

The Permittee shall maintain Reliability Class II (EPA 430/9-74-001) at the wastewater treatment plant, which requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions, except vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but shall be sufficient to maintain the biota.

E. Prevent Connection of Inflow

The Permittee shall strictly enforce their sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

F. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited, and the Department may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, or 3) is applicable.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health as determined by the Department prior to the bypass. The Permittee shall submit prior notice, if possible at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.

c. The Department is properly notified of the bypass as required in condition S3E of this permit.

3. Bypass which is anticipated and has the potential to result in noncompliance of this permit

The Permittee shall notify the Department at least thirty (30) days before the planned date of bypass. The notice shall contain: (1) a description of the bypass and its cause; (2) an analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing; (3) a cost-effectiveness analysis of alternatives including comparative resource damage assessment; (4) the minimum and maximum duration of bypass under each alternative; (5) a recommendation as to the preferred alternative for conducting the bypass; (6) the projected date of bypass initiation; (7) a statement of compliance with SEPA; (8) a request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated; and (9) steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above shall be considered during preparation of the engineering report or facilities plan and plans and specifications and shall be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

The Department will consider the following prior to issuing an administrative order for this type bypass:

a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.

c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, the Department will approve or deny the request. The public shall be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by the Department under RCW 90.48.120.

G. Operations and Maintenance Manual

The approved Operations and Maintenance Manual shall be kept available at the treatment plant and all operators shall follow the instructions and procedures of this manual.

An Operations and Maintenance (O&M) Manual update shall be prepared by the Permittee in accordance with WAC 173-240-080 and be submitted to the Department for approval by December 1, 2007 and annually thereafter as additional upgrades and improvements are made. The permittee shall confirm this review by letter to the Department. Substantial changes or updates to the O&M Manual shall be submitted to the Department whenever they are incorporated into the manual.

In addition to requirements of WAC 173-240-080 (1) through (5) the O&M Manual shall include:

1. Emergency procedures for plant shutdown and cleanup in event of wastewater system upset or failure.

2. Wastewater system maintenance procedures that contribute to the generation of process wastewater

3. Any directions to maintenance staff when cleaning, or maintaining other equipment or performing other tasks which are necessary to protect the operation of the wastewater system (e.g. defining maximum allowable discharge rate for draining a tank, blocking all floor drains before beginning the overhaul of a stationary engine.)

4. Safety provisions through design feature and safety procedures provided by operational considerations and periodic training classes. This includes fail safe features for sludge digestion facilities, chlorination facilities, and other chemical storage and handling facilities.

5. The treatment plant process control monitoring schedule and control systems.

## S6. PRETREATMENT (CITY OF SPOKANE)

A. General Requirements

1. The Permittee shall implement the Industrial Pretreatment Program in accordance with the legal authorities, policies, procedures, and financial provisions described in the Permittee's approved pretreatment program submittal entitled "Industrial Pretreatment Program" dated September 30, 1987; any approved revisions thereto; and the General Pretreatment Regulations (40 CFR Part 403). The Ordinance section containing the local limits was last updated March 31, 2003.

   A meeting was held on October 20, 2004 at the Department of Ecology Eastern Regional Office on the subject of Spokane-area pretreatment. The Department of Ecology, City of Spokane, Spokane County, and the City of Spokane Valley agreed that the City of Spokane has the authority to administer its delegated Pretreatment Program to their present and future sewer customers located within their designated sewer service areas in City of Spokane Valley, in Spokane County, and in the City of Spokane. For the purpose of this permit and pretreatment program delegation, this applies to the present and future sewer customers who contribute wastewater into the City of Spokane sewer collection system and are located either within or outside of the corporate limits of the City of Spokane. This applies to Brenntag Pacific in the City of Spokane Valley, and Johanna Beverages, Reliance Trailer, and eventually with Goodrich in the West Plains Area of Spokane County. The City acknowledges that as owner and operator of a wastewater collection system and POTW it is their responsibility to protect their infrastructure, and accepts the obligations of a Delegated Pretreatment Program.

   Both the City of Spokane and Spokane County, as the control authority for their Delegated Pretreatment Programs, will continue to enforce and update, if necessary and appropriate, their interlocal agreements and/or multijurisdictional pretreatment agreement with "contributing" jurisdictions such as Millwood, Liberty Lake, and Airway Heights. Some of these actions may include conducting Industrial User Surveys, monitoring, and permitting commercial and/or industrial users.

   At a minimum, the following pretreatment implementation activities shall be undertaken by the Permittee:

   a. Enforce categorical pretreatment standards promulgated pursuant to Section 307(b) and (c) of the Federal Clean Water Act (hereinafter, the Act), prohibited discharge standards as set forth in 40 CFR 403.5, local limitations specified in Section 13.03.0416 of Ordinance 13.03, or state standards, which ever are most stringent or apply at the time of issuance or modification of a local industrial waste discharge permit. Locally derived limitations shall be defined as pretreatment standards under Section 307(d) of the Act and shall not be limited to categorical industrial facilities.

b. Issue industrial waste discharge permits to all significant industrial users [SIUs, as defined in 40 CFR 403.3(v)] contributing to the treatment system, including those from other jurisdictions. Industrial waste discharge permits shall contain as a minimum, all the requirements of 40 CFR 403.8 (f)(l)(iii). The Permittee shall coordinate the permitting process with the Department regarding any industrial facility, which may possess a state waste discharge permit issued by the Department. Once issued, an industrial waste discharge permit will take precedence over a state-issued waste discharge permit.

c. Maintain and update, as necessary, records identifying the nature, character, and volume of pollutants contributed by industrial users to the POTW. Records shall be maintained for at least a three-year period.

d. Perform inspections, surveillance, and monitoring activities on industrial users to determine and/or confirm compliance with applicable pretreatment standards and requirements. A thorough inspection of SIUs shall be conducted annually. Frequency of regular local monitoring of SIU wastewaters shall normally be commensurate with the character and volume of the wastewater but shall not be less than once per year. Sample collection and analysis shall be performed in accordance with 40 CFR Part 403.12(b)(5)(ii)-(v) and 40 CFR Part 136.

e. Enforce and obtain remedies for noncompliance by any industrial users with applicable pretreatment standards and requirements. Once violations have been identified, the Permittee shall take timely and appropriate enforcement action to address the noncompliance. The Permittee's action shall follow its enforcement response procedures and any amendments, thereof.

f. Publish, at least annually in a newspaper of general circulation in the Permittee's service area, a list of all nondomestic users which, at any time in the previous 12 months, were in significant noncompliance as defined in 40 CFR 403.8(f)(2)(viii) through 40 CFR 403.8(f)(2)(viii)(H).

g. If the Permittee elects to conduct sampling of a SIU's discharge in lieu of the user self-monitoring, it shall sample and analyze for all regulated pollutants in accordance with 40 CFR Part 403.12(b)(5)(ii)-(v), 40 CFR 403.12(g), and 40 CFR Part 136. The character and volume of the samples shall be representative of the discharge and shall provide adequate data to determine compliance, but in no case should sampling occur less than two (2) times per year.

h. Develop and maintain a data management system designed to track the status of the Permittee's industrial user inventory, industrial user discharge characteristics, and compliance status.

i. Maintain adequate staff, funds, and equipment to implement its pretreatment program.

j. Establish, where necessary, multijurisdictional pretreatment agreements with contributing jurisdictions to ensure compliance with applicable pretreatment requirements by commercial or industrial users within these jurisdictions. These multijurisdictional pretreatment agreements shall identify the agency responsible for the various implementation and enforcement activities to be performed in the contributing jurisdiction. . In addition, the Permittee is required to develop a multi-jurisdictional agreement that outlines the specific roles, responsibilities, and pretreatment activities of each jurisdiction. These agreements will be in accordance with 40 CFR 403, RCW 90.48, and other State and Federal Regulations. Sample multi-jurisdictional agreements are available in EPA's Multi-jurisdictional Manual. The City of Spokane's current pretreatment interlocal agreements with City of Spokane Valley, Spokane County, and City of Airways Heights will be updated with multi-jurisdictional agreements by **May 30, 2010**.

k. The City of Spokane's sewer user ordinance will be updated by **October 1, 2011**. This update should reflect the 40 CFR 403 changes that occurred in 2006 on the Pretreatment Streamlining. The State of Washington's draft sewer user ordinance is available for this update.

2. The Permittee shall review, change if necessary, and submit to the Department for approval by **October 1, 2014**; an updated Accidental Spill Prevention Program. The program, as approved by the Department, shall include a schedule for implementation, and shall become an enforceable part of these permit conditions.

3. The Permittee must evaluate any new designated Significant Industrial User with in one year of designation for a plan or other action to control Slug Discharges and also in accordance with 40 CFR 403.8(f)(1)(iii)(B)(6), 40 CFR 403.8(f)(2)(vi) and 40 CFR 403.8(f)(2)(vi)(A)-(D).

4. Whenever it has been determined, on the basis of information provided to or obtained by the Department, that any waste source contributes pollutants to the Permittee's treatment works in violation of Subsection (b), (c), or (d) of Section 307 of the Act, and the Permittee has not taken adequate corrective action, the Department shall notify the Permittee of this determination. Failure by the Permittee to commence an appropriate enforcement action within 30 days of this notification may result in appropriate enforcement action by the Department against the source and/or the Permittee.

5. Pretreatment Report

   Each Pretreatment Program Permittee shall provide to the Department an annual report that briefly describes its program activities during the previous calendar year. This report shall be submitted no later than March 31 of each year to: Washington Department of Ecology, Eastern Regional Office, 4601 North Monroe Street, Spokane, WA 99205-1295.

The report shall include the requirements listed in 40 CFR 403.12(h)(i)(1)-(5) and the following additional information:

a. An updated nondomestic inventory (Industrial User Survey).

b. Results of wastewater sampling at the treatment plant as specified in **S6.B.** The Permittee shall calculate removal rates for each pollutant and evaluate the adequacy of the existing local limitations in Section 13.03.0416 of Ordinance 13.03 in prevention of treatment plant interference, pass through of pollutants that could affect receiving water quality, and sludge contamination.

c. Status of program implementation, including:

  (1) Any substantial modifications to the pretreatment program as originally approved by the Department, including staffing and funding levels.

  (2) Any interference, upset, or permit violations experienced at the POTW that are directly attributable to wastes from industrial users.

  (3) Listing of industrial users inspected and/or monitored, and a summary of the results.

  (4) Listing of industrial users scheduled for inspection and/or monitoring for the next year, and expected frequencies.

  (5) Listing of industrial users notified of promulgated pretreatment standards and/or local standards. Indicate which industrial users are on compliance schedules and the final date of compliance for each.

  (6) Listing of industrial users issued industrial waste discharge permits.

  (7) Planned changes in the pretreatment program implementation plan. (See subsection S6.A.6. below.)

d. Status of compliance activities, including:

  (1) Listing of industrial users that failed to submit baseline monitoring reports or any other reports required under 40 CFR 403.12 and in the Permittee's current Industrial Pretreatment program Enforcement Response Plan and Industrial Sampling and Monitoring Guidance Manual.

  (2) Listing of industrial users that were at any time during the reporting period not complying with federal, state, or local pretreatment standards or with applicable compliance schedules for achieving those standards, and the duration of such noncompliance.

(3) Summary of enforcement activities and other corrective actions taken or planned against noncomplying industrial users. The Permittee shall supply to the Department a copy of the public notice of facilities that were in significant noncompliance.

e. Local Limits updates and any other updates specified in S6.C and S6.D.

6. The Permittee shall request and obtain approval from the Department prior to implementing any significant changes to the local pretreatment program as approved. The procedure of 40 CFR 403.8 and 40 CFR 403.18 shall be followed. Also, due to changes in 40 CFR 403, the City will resubmit their industrial pretreatment program for approval by **June 15, 2010.**

B. Monitoring Requirements

The Permittee shall monitor its influent, effluent, and sludge for the priority pollutants identified in Tables II and III of Appendix D of 40 CFR Part 122 as amended, any compounds identified as a result of Condition S2 and S6.B.4, and any other pollutants expected from nondomestic sources using U.S. EPA-approved procedures for collection, preservation, storage, and analysis. Influent, effluent, and sludge samples shall be tested for the priority pollutant metals (Table III, 40 CFR 122, Appendix D) on a quarterly basis throughout the term of this permit. Influent, effluent, and sludge samples shall be tested for the organic priority pollutants (Table II, 40 CFR 122, Appendix D) on an annual basis.

1. The POTW influent and effluent shall be sampled on a day when industrial discharges are occurring at normal to maximum levels. Samples for the analysis of acid and base/neutral extractable compounds and metals shall be 24-hour composites. Samples for the analysis of volatile organic compounds shall be collected using grab sampling techniques at equal intervals for the total of four grab samples per day.

   A single analysis for volatile pollutants (Method 624) may be run for each monitoring day by compositing equal volumes of each grab sample directly in the GC purge and trap apparatus in the laboratory, with no less than 1 ml of each grab included in the composite.

   Unless otherwise indicated, all reported test data for metals shall represent the total amount of the constituent present in all phases, whether solid, suspended, or dissolved, elemental or combined including all oxidation states.

   Wastewater samples must be handled, prepared, and analyzed by GC/MS in accordance with the U.S. EPA Methods 624 and 625 (October 26, 1984).

2. A sludge sample shall be collected concurrent with a wastewater sample and may be taken as a single grab of residual sludge. Sampling and analysis shall conform to U.S. EPA Methods 624 and 625 unless the Permittee requests an alternate method and it has been approved by the Department.

3. Cyanide, phenols, and oils shall be taken as grab samples. Oils shall be hexane soluble or equivalent, and should be measured in the influent and effluent only.

4. In addition to quantifying pH, oil and grease, and all priority pollutants, a reasonable attempt should be made to identify all other substances and quantify all pollutants shown to be present by gas chromatograph/mass spectrometer (GC/MS) analysis per 40 CFR 136, Appendix A, Methods 624 and 625. Determinations of pollutants should be attempted for each fraction, which produces identifiable spectra on total ion plots (reconstructed gas chromatograms). Determinations should be attempted from all peaks with responses 5% or greater than the nearest internal standard. The 5% value is based on internal standard concentrations of 30 μg/l, and must be adjusted downward if higher internal standard concentrations are used or adjusted upward if lower internal standard concentrations are used. Non-substituted aliphatic compounds may be expressed as total hydrocarbon content. Identification shall be attempted by a laboratory whose computer data processing programs are capable of comparing sample mass spectra to a computerized library of mass spectra, with visual confirmation by an experienced analyst. For all detected substances which are determined to be pollutants, additional sampling and appropriate testing shall be conducted to determine concentration and variability, and to evaluate trends.

C. Reporting of Monitoring Results

The Permittee shall include a summary of monitoring results in the Annual Pretreatment Report.

D. Local Limit Development

By **April 15, 2011**, the Permittee shall, in consultation with the Department, reevaluate and update their local limits in order to prevent pass through or interference. The permittee should refer to EPA's Local Limits Development Guidance dated July 2004. The permittee should also consider Total Toxic Organics, Phosphorus, metals, and conventional pollutants in their revised local limits. Upon determination by the Department that any pollutant present causes pass through or interference, or exceeds established sludge standards, the Permittee shall establish new local limits or revise existing local limits as required by 40 CFR 403.5. In addition, the Department may require revision or establishment of local limits for any pollutant discharged from the POTW that has a reasonable potential to exceed the Water Quality Standards, Sediment Standards, or established effluent limits, or causes whole effluent toxicity. The determination by the Department shall be in the form of an Administrative Order.

The Department may modify this permit to incorporate additional requirements relating to the establishment and enforcement of local limits for pollutants of concern. Any permit modification is subject to formal due process procedures pursuant to state and federal law and regulation.

E. Mercury Control Plan

The Permittee shall develop and submit to the Department of Ecology a Mercury Control Plan. The Plan will begin with a Dental plan. The plan shall be expanded as the Department of Ecology develops and releases further guidance. The Mercury Control Plan shall be submitted to the Department of Ecology by September 1, 2010.

Mercury Plan development guidance can be found at the following locations:

| | |
|---|---|
| Ecology mercury web site | http://www.ecy.wa.gov/mercury/ |
| For Dental Plan guidance | http://www.ecy.wa.gov/dentalbmps/index.html |
| Reduction plan guidance | http://www.ecy.wa.gov/biblio/0303001.html |

## S7. PRETREATMENT (SPOKANE COUNTY)

A. General Requirements

1. The Permittee shall implement the Industrial Pretreatment Program in accordance with the legal authorities, policies, procedures, and financial provisions described in the Permittee's approved pretreatment program submittal entitled "Industrial Pretreatment Program" and updated on February 5, 2001; any approved revisions thereto; and the General Pretreatment Regulations (40 CFR Part 403). The Ordinance section containing the local limits was last updated March 31, 2003..

A meeting was held on October 20, 2004 at the Department of Ecology Eastern Regional Office on the subject of Spokane-area pretreatment. The Department of Ecology, City of Spokane, Spokane County, and the City of Spokane Valley agreed that Spokane County has the authority to administer its Delegated Pretreatment Program to their present and future sewer customers located within their designated sewer service areas in Spokane County and in the City of Spokane Valley. For the purpose of this permit and pretreatment program delegation, this applies to customers who contribute wastewater into the Spokane County sewer collection system and are located outside of the corporate limits of the City of Spokane and within the City of Spokane Valley and Spokane County. Existing permitted facilities that this applies to, Ecolite, Galaxy Compound Semiconductors, Honeywell, Kemron Northwest, American On-Site Services and Novation in the City of Spokane Valley, and the Mica Landfill in Spokane County.. The County acknowledges that as owner and operator of a wastewater collection system it is their responsibility to protect their infrastructure, and by agreement the infrastructure of the downstream POTW, and accepts the obligations of a Delegated Pretreatment Program.

Both the City of Spokane and Spokane County, as the control authority for their Delegated Pretreatment Programs, will continue to enforce and update, if necessary and appropriate, their interlocal agreements and/or multijurisdictional pretreatment agreement with "contributing" jurisdictions such as Millwood, Liberty Lake, the City of Spokane Valley and the City of Spokane. Some of these actions will include conducting Industrial User Surveys, monitoring, and permitting commercial and/or industrial users.

At a minimum, the following pretreatment implementation activities shall be undertaken by the Permittee:

a. Enforce categorical pretreatment standards promulgated pursuant to Section 307(b) and (c) of the Federal Clean Water Act (hereinafter, the Act), prohibited discharge standards as set forth in 40 CFR 403.5, local limitations specified in Section 08.03.4160 of Ordinance 8.03, or state standards, which ever are most stringent or apply at the time of issuance or modification of a local industrial waste discharge permit. Locally derived limitations shall be defined as pretreatment standards under Section 307(d) of the Act and shall not be limited to categorical industrial facilities.

b. Issue industrial waste discharge permits to all significant industrial users [SIUs, as defined in 40 CFR 403.3(v)] contributing to the treatment system, including those from other jurisdictions. Industrial waste discharge permits shall contain as a minimum, all the requirements of 40 CFR 403.8 (f)(l)(iii). The Permittee shall coordinate the permitting process with the Department regarding any industrial facility, which may possess a state waste discharge permit issued by the Department. Once issued, an industrial waste discharge permit will take precedence over a state-issued waste discharge permit.

c. Maintain and update, as necessary, records identifying the nature, character, and volume of pollutants contributed by industrial users to the POTW. Records shall be maintained for at least a three-year period.

d. Perform inspections, surveillance, and monitoring activities on industrial users to determine and/or confirm compliance with applicable pretreatment standards and requirements. A thorough inspection of SIUs shall be conducted annually. Frequency of regular local monitoring of SIU wastewaters shall normally be commensurate with the character and volume of the wastewater but shall not be less than once per year. Sample collection and analysis shall be performed in accordance with 40 CFR Part 403.12(b)(5)(ii)-(v) and 40 CFR Part 136.

e. Enforce and obtain remedies for noncompliance by any industrial users with applicable pretreatment standards and requirements. Once violations have been identified, the Permittee shall take timely and appropriate enforcement action to address the noncompliance. The Permittee's action shall follow its enforcement response procedures and any amendments, thereof.

f. Publish, at least annually in a newspaper of general circulation in the Permittee's service area, a list of all nondomestic users which, at any time in the previous 12 months, were in significant noncompliance as defined in 40 CFR 403.8(f)(2)(viii) through 40 CFR 403.8(f)(2)(viii)(H).

g. If the Permittee elects to conduct sampling of a SIU's discharge in lieu of the user self-monitoring, it shall sample and analyze for all regulated pollutants in accordance with 40 CFR Part 403.12(b)(5)(ii)-(v), 40 CFR 403.12(g), and 40 CFR Part 136. The character and volume of the samples shall be representative of the discharge and shall provide adequate data to determine compliance, but in no case should sampling occur less than two (2) times per year.

h. Develop and maintain a data management system designed to track the status of the Permittee's industrial user inventory, industrial user discharge characteristics, and compliance status.

i. Maintain adequate staff, funds, and equipment to implement its pretreatment program.

j. Establish, where necessary, multijurisdictional pretreatment agreements with contributing jurisdictions to ensure compliance with applicable pretreatment requirements by commercial or industrial users within these jurisdictions. These multijurisdictional pretreatment agreements shall identify the agency responsible for the various implementation and enforcement activities to be performed in the contributing jurisdiction. In addition, the Permittee is required to develop a multi-jurisdictional agreement that outlines the specific roles, responsibilities, and pretreatment activities of each jurisdiction. These agreements will be in accordance with 40 CFR 403, RCW 90.48, and other State and Federal Regulations. Sample multi-jurisdictional agreements are available in EPA's Multi-jurisdictional Manual. The County of Spokane's current pretreatment interlocal agreements with City of Spokane Valley, City of Spokane, Millwood, and Liberty Lake will be updated with multi-jurisdictional agreements by **May 30, 2010**.

k. The County of Spokane's sewer user ordinance will be updated by **December 15, 2011**. This update should reflect the 40 CFR 403 changes that occurred in 2006 on the Pretreatment Streamlining. The State of Washington's draft sewer user ordinance is available for this update.

2. The Permittee must evaluate any new designated Significant Industrial User with in one year of designation for a plan or other action to control Slug Discharges and also in accordance with 40 CFR 403.8(f)(1)(iii)(B)(6), 40 CFR 403.8(f)(2)(vi) and 40 CFR 403.8(f)(2)(vi)(A)-(D).

3. Whenever it has been determined, on the basis of information provided to or obtained by the Department, that any waste source contributes pollutants to the Permittee's treatment works in violation of Subsection (b), (c), or (d) of Section 307 of the Act, and the Permittee has not taken adequate corrective action, the Department shall notify the Permittee of this determination. Failure by the Permittee to commence an appropriate enforcement action within 30 days of this notification may result in appropriate enforcement action by the Department against the source and/or the Permittee.

4. Pretreatment Report

Each Pretreatment Program Permittee shall provide to the Department an annual report that briefly describes its program activities during the previous calendar year. This report shall be submitted no later than May 1 of each year to: Washington Department of Ecology, Eastern Regional Office, 4601 North Monroe Street, Spokane, WA 99205-1295.

The report shall include the requirements listed in 40 CFR 403.12(h)(i)(1)-(5) and the following additional information:

a. An updated nondomestic inventory (Industrial User Survey).

b. Results of wastewater sampling at the treatment plant as specified in **S7.B.** The Permittee shall calculate removal rates for each pollutant and evaluate the adequacy of the existing local limitations in Section 8.03.4160 of Ordinance 08.03 in prevention of treatment plant interference, pass through of pollutants that could affect receiving water quality, and sludge contamination.

c. Status of program implementation, including:

(1) Any substantial modifications to the pretreatment program as originally approved by the Department, including staffing and funding levels.

(2) Any interference, upset, or permit violations experienced at the POTW that are directly attributable to wastes from industrial users.

(3) Listing of industrial users inspected and/or monitored, and a summary of the results.

(4) Listing of industrial users scheduled for inspection and/or monitoring for the next year, and expected frequencies.

(5) Listing of industrial users notified of promulgated pretreatment standards and/or local standards. Indicate which industrial users are on compliance schedules and the final date of compliance for each.

(6) Listing of industrial users issued industrial waste discharge permits.

(7) Planned changes in the pretreatment program implementation plan. (See subsection S7.A.6. below.)

d. Status of compliance activities, including:

(1) Listing of industrial users that failed to submit baseline monitoring reports or any other reports required under 40 CFR 403.12 and in accordance with the Permittee's current pretreatment program.

(2) Listing of industrial users that were at any time during the reporting period not complying with federal, state, or local pretreatment standards or with applicable compliance schedules for achieving those standards, and the duration of such noncompliance.

(3) Summary of enforcement activities and other corrective actions taken or planned against noncomplying industrial users. The Permittee shall supply to the Department a copy of the public notice of facilities that were in significant noncompliance.

e. Local Limits updates and any updates specified in S7.C. and S7.D.

6. The Permittee shall request and obtain approval from the Department prior to implementing any significant changes to the local pretreatment program as approved. The procedure of 40 CFR 403.8 and 40 CFR 403.18 shall be followed. Also, due to changes in 40 CFR 403, the County will resubmit their industrial pretreatment program for approval by June 15, 2010.

B. Monitoring Requirements

The Permittee shall monitor its influent, effluent, and sludge for the priority pollutants identified in Tables II and III of Appendix D of 40 CFR Part 122 as amended, any compounds identified as a result of Condition S2 and S7.B.4, and any other pollutants expected from nondomestic sources using U.S. EPA-approved procedures for collection, preservation, storage, and analysis. Influent, effluent, and sludge samples shall be tested for the priority pollutant metals (Table III, 40 CFR 122, Appendix D) on a quarterly basis throughout the term of this permit. Influent, effluent, and sludge samples shall be tested for the organic priority pollutants (Table II, 40 CFR 122, Appendix D) on an annual basis.

1. The POTW influent and effluent shall be sampled on a day when industrial discharges are occurring at normal to maximum levels. Samples for the analysis of acid and base/neutral extractable compounds and metals shall be 24-hour composites. Samples for the analysis of volatile organic compounds shall be collected using grab sampling techniques at equal intervals for the total of four grab samples per day.

A single analysis for volatile pollutants (Method 624) may be run for each monitoring day by compositing equal volumes of each grab sample directly in the GC purge and trap apparatus in the laboratory, with no less than 1 ml of each grab included in the composite.

Unless otherwise indicated, all reported test data for metals shall represent the total amount of the constituent present in all phases, whether solid, suspended, or dissolved, elemental or combined including all oxidation states.

Wastewater samples must be handled, prepared, and analyzed by GC/MS in accordance with the U.S. EPA Methods 624 and 625 (October 26, 1984).

2. A sludge sample shall be collected concurrent with a wastewater sample and may be taken as a single grab of residual sludge. Sampling and analysis shall conform to U.S. EPA Methods 624 and 625 unless the Permittee requests an alternate method and it has been approved by the Department.

3. Cyanide, phenols, and oils shall be taken as grab samples. Oils shall be hexane soluble or equivalent, and should be measured in the influent and effluent only.

4. In addition to quantifying pH, oil and grease, and all priority pollutants, a reasonable attempt should be made to identify all other substances and quantify all pollutants shown to be present by gas chromatograph/mass spectrometer (GC/MS) analysis per 40 CFR 136, Appendix A, Methods 624 and 625. Determinations of pollutants should be attempted for each fraction, which produces identifiable spectra on total ion plots (reconstructed gas chromatograms). Determinations should be attempted from all peaks with responses 5% or greater than the nearest internal standard. The 5% value is based on internal standard concentrations of 30 µg/l, and must be adjusted downward if higher internal standard concentrations are used or adjusted upward if lower internal standard concentrations are used. Non-substituted aliphatic compounds may be expressed as total hydrocarbon content. Identification shall be attempted by a laboratory whose computer data processing programs are capable of comparing sample mass spectra to a computerized library of mass spectra, with visual confirmation by an experienced analyst. For all detected substances which are determined to be pollutants, additional sampling and appropriate testing shall be conducted to determine concentration and variability, and to evaluate trends.

C. Reporting of Monitoring Results

The Permittee shall include a summary of monitoring results in the Annual Pretreatment Report.

D. Local Limit Development

By **August 15, 2011**, the Permittee shall, in consultation with the Department, reevaluate and update their local limits in order to prevent pass through or interference. The permittee should refer to EPA's Local Limits Development Guidance dated July

2004. The permittee should also consider Total Toxic Organics, Phosphorus, metals, and conventional pollutants in their revise local limits. Upon determination by the Department that any pollutant present causes pass through or interference, or exceeds established sludge standards, the Permittee shall establish new local limits or revise existing local limits as required by 40 CFR 403.5. In addition, the Department may require revision or establishment of local limits for any pollutant discharged from the POTW that has a reasonable potential to exceed the Water Quality Standards, Sediment Standards, or established effluent limits, or causes whole effluent toxicity. The determination by the Department shall be in the form of an Administrative Order.

The Department may modify this permit to incorporate additional requirements relating to the establishment and enforcement of local limits for pollutants of concern. Any permit modification is subject to formal due process procedures pursuant to state and federal law and regulation.

E. Mercury Abatement and Control Plan

The Permittee shall develop and submit to the Department of Ecology a Mercury abatement and control plan beginning with a Dental plan. The plan shall be expanded as the Department of Ecology develops and releases further guidance. The Mercury Control Plan shall be submitted to the Department of Ecology by **September 15, 2010.**

Mercury Plan development guidance can be found at the following locations:

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|---|---|
| Ecology mercury web site | http://www.ecy.wa.gov/mercury/ |
| For Dental Plan guidance | http://www.ecy.wa.gov/dentalbmps/index.html |
| Reduction plan guidance | http://www.ecy.wa.gov/biblio/0303001.html |

## S8. RESIDUAL SOLIDS

Residual solids include screenings, grit, scum, primary sludge, waste activated sludge, and other solid waste. The Permittee shall store and handle all residual solids in such a manner so as to prevent their entry into state ground or surface waters. The Permittee shall not discharge leachate from residual solids to state surface or ground waters.

## S9. SPILL PLAN

The Permittee shall by October 1, 2014 submit to the Department an update to the existing Spill Control Plan. The Permittee shall review the plan at least annually and update as needed. Changes to the plan shall be sent to the Department. The Plan and any supplements shall be followed throughout the term of the permit.

The updated Spill Control Plan shall include the following:

- A description of operator training to implement the Plan.
- A description of the reporting system which will be used to alert responsible managers and legal authorities in the event of a spill.

- A description of preventive measures and facilities (including an overall facility plot showing drainage patterns) which prevent, contain, or treat spills of these materials.
- A list of all oil and petroleum products, materials, which when spilled, or otherwise released into the environment, are designated Dangerous (DW) or Extremely Hazardous Waste (EHW) by the procedures set forth in WAC 173-303-070, or other materials which may become pollutants or cause pollution upon reaching state's waters.
- Plans and manuals required by 40 CFR Part 112, contingency plans required by Chapter 173-303 WAC, or other plans required by other agencies which meet the intent of this section may be submitted.

## S10. ACUTE TOXICITY

A. Effluent Testing Requirements

The Permittee shall test final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal. The two species listed below shall be used on each sample and the results submitted to the Department as a part of the permit renewal application process. The Permittee shall conduct acute toxicity testing on a series of five concentrations of effluent and a control in order to be able to determine appropriate point estimates and an NOEC. The percent survival in 100% effluent shall also be reported.

Acute toxicity tests shall be conducted with the following species and protocols:

1. Fathead minnow, *Pimephales promelas* (96-hour static-renewal test, method: EPA-821-R-02-012).
2. Daphnid, *Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna* (48-hour static test, method: EPA-821-R-02-012).

B. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.
2. Testing shall be conducted on 24-hour composite effluent samples. Samples taken for toxicity testing shall be cooled to 4 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in subsection A and the Department of Ecology Publication #WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test in order to determine dose response. Whenever a dilution series is used, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC.

8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing, and do not comply with the acute statistical power standard of 29% as defined in WAC 173-205-020, must be repeated on a fresh sample with an increased number of replicates to increase the power.

## S11. CHRONIC TOXICITY

A. Effluent Testing Requirements

The Permittee shall test final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal. All of the chronic toxicity tests listed below shall be conducted on each sample. The results of this chronic toxicity testing shall be submitted to the Department as a part of the permit renewal application process.

The Permittee shall conduct chronic toxicity testing on a series of at least five concentrations of effluent and a control in order to be able to determine appropriate point estimates and an NOEC. This series of dilutions shall include the acute critical effluent concentration (ACEC). The ACEC equals 85% effluent. The Permittee shall compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.

Chronic toxicity tests shall be conducted with the following species and the most recent version of the following protocols:

| Freshwater Chronic Toxicity Test Species | | Method |
|---|---|---|
| Fathead minnow | *Pimephales promelas* | EPA/600/4-91/002 |
| Water flea | *Ceriodaphnia dubia* | EPA/600/4-91/002 |
| Alga | *Selenastrum capricornutum* | EPA/600/4-91/002 |

B. Sampling and Reporting Requirements

1. All reports for effluent characterization or compliance monitoring shall be submitted in accordance with the most recent version of Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* in regards to format and content. Reports shall contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data on floppy disk for electronic entry into the Department's database, then the Permittee shall send the disk to the Department along with the test report, bench sheets, and reference toxicant results.

2. Testing shall be conducted on 24-hour composite effluent samples or grab samples. Samples taken for toxicity testing shall be cooled to 0 - 6 degrees Celsius while being collected and shall be sent to the lab immediately upon completion. The lab shall begin the toxicity testing as soon as possible but no later than 36 hours after sampling was ended.

3. All samples and test solutions for toxicity testing shall have water quality measurements as specified in Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* or most recent version thereof.

4. All toxicity tests shall meet quality assurance criteria and test conditions in the most recent versions of the EPA manual listed in subsection A. and the Department of Ecology Publication # WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If test results are determined to be invalid or anomalous by the Department, testing shall be repeated with freshly collected effluent.

5. Control water and dilution water shall be laboratory water meeting the requirements of the EPA manual listed in subsection A or pristine natural water of sufficient quality for good control performance.

6. The whole effluent toxicity tests shall be run on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test during compliance monitoring in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the ACEC and the CCEC.

8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing, and do not comply with the chronic statistical power standard of 39% as defined in WAC 173-205-020, must be repeated on a fresh sample with an increased number of replicates to increase the power.

## S12. RECEIVING WATER AND EFFLUENT STUDY

A. General Requirements

The Permittee shall conduct analyses of the receiving water and the wastewater facility's influent and effluent samples as listed in permit section S2 and collected in accordance with protocols, monitoring requirements, and QA/QC procedures specified in this section.

Raw sewage from the collection system and headworks and effluent samples must be analyzed for:

1. PCBs, 2,3,7,8 TCDDs and PBDE at the locations and at the minimum frequencies listed in the schedule in S2.

   A letter report of the results with attached laboratory data sheets shall be submitted to Ecology (ERO Water Quality Program permit manager and the urban waters staff) the annually. After each year of sampling for PCBs; 2,3,7,8 TCDDs and PBDE; the permittee and Ecology (ERO Water Quality Program permit manager and the urban waters staff) will review the data and a draft action plan of identified sources or potential sources. Annually the permittee and Ecology will confer and revise the locations of the raw sewage sampling in the collection system for these pollutants.

2. Temperature per the schedule in S2.

B. Protocols

PCBs, 2,3,7,8 TCDDs and PBDE sampling and analysis shall be accordance with the quality assurance plan and scope of work submitted to the Department of Ecology. The Permittee's quality assurance plan can use the quality assurance plan of Ecology's Urban Toxics Team for a starting point and submit the City's draft for review and approval no later than May 15, 2010.

Temperature must be monitored using micro-recording temperature devices known as thermistors. Ecology's Quality Assurance Project Plan Development Tool (*Continuous Temperature Sampling Protocols for the Environmental Monitoring and Trends*) contains protocols for continuous temperature sampling. This document is available online at http://www.ecy.wa.gov/programs/eap/qa/docs/QAPPtool/Mod6%20Ecology%20SOPs/Protocols/ContinuousTemperatureSampling.pdf. Calibration as specified in this document is not required if the permittee uses recording devices which are certified by the manufacturer. Ecology does not require manufacture-specific equipment as given in this document, however, if the Permittee wishes to use measuring devices from another company the accuracy must be demonstrated to be equivalent. The recording devices must be set to record at one-half hour intervals.

The Quality Assurance Project Plan for temperature must be submitted for review and approval no later than May 1, 2010

D. Quality Assurance/Quality Control Procedures

The Permittee must conduct all sampling and analysis in accordance with the guidelines given in ***Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies***, Ecology Publication 04-03-030 (http://www.ecy.wa.gov/pubs/0403030.pdf).

## S13. COMBINED SEWER OVERFLOWS

A. Discharge Locations

The following is a list of combined sewer overflows (CSOs), which are occasional point sources of pollutants as a result of precipitation events. Discharges from these sites are prohibited except as a result of and during precipitation events. No authorization is given by this permit for discharge from a CSO that causes adverse impacts that threaten characteristic uses of the receiving water as identified in the Water Quality Standards, Chapter 173-201A WAC.

| OUTFALL NUMBER | OVERFLOW STRUCTURE DESCRIPTION | OUTFALL DESCRIPTION |
|---|---|---|
| **Spokane River Discharges (North Bank)** | | |
| 002 | Hartley @ NW Blvd. | 0.5 miles downstream of WWTP |
| 006 | Kiernan @ NW Blvd | 0.25 miles upstream of WWTP |
| 007 | Columbia Circle @ NW Blvd | 0.4 miles upstream of WWTP |
| 010 | Cochran @ Buckeye | At Downriver Bridge |
| 012 | Nora @ Pettet Dr | 0.55 miles Upstream of Bridge |
| 014 | Sherwood @ Summit | 2.0 miles upstream of Bridge |
| 015 | Ohio @ Nettleton | 2.5 miles upstream of Bridge |
| **Discharges to Spokane River (South Bank)** | | |
| 016 | "A" @ Linton – Geiger | 1.45 miles downstream of Monroe St Dam |
| **Discharges to Hangman Creek** | | |
| 019 | Seventh @ Cannon | At High Bridge (East Side) |
| 020 | S. Manito Relief Sewer | 2.65 miles upstream of High Bridge |
| **Discharges to Spokane River (South Bank)** | | |
| 022 | Main @ Oak | 0.7 miles downstream at Monroe St. Dam |

| OUTFALL NUMBER | OVERFLOW STRUCTURE DESCRIPTION | OUTFALL DESCRIPTION |
|---|---|---|
| **Discharges to Spokane River (North Bank)** | | |
| 023 | Cedar @ Ide | 0.3 miles downstream of Monroe St. Dam |
| **Discharges to Spokane River (South Bank)** | | |
| 024 | Cedar @ Riverside | 0.3 miles downstream of Monroe St. Dam |
| 025 | Cedar @ Main | 0.3 miles downstream of Monroe St. Dam |
| 026 | Lincoln @ Spokane Falls Blvd | At Monroe St. Dam |
| 033 | Fifth @ Arthur<br>Third @ Perry<br>Third @ Arthur<br>First @ Arthur | 0.15 miles upstream of J. Keefe Bridge |
| 034 | Crestline @ Riverside | At Trent Bridge |
| 038 | Magnolia @ S. Riverton | 0.15 miles upstream of Mission |
| 039 | Altamont @ S. Riverton | 0.5 miles downstream of Greene |
| 040 | Regal @ S. Riverton | 0.25 miles downstream of Greene |
| **Discharge to Spokane River (North Bank)** | | |
| 041 | Rebecca @ Upriver Dr | 0.5 miles upstream of Greene |
| **Discharge to Spokane River (South Bank)** | | |
| 042 | Surro Dr | 0.5 miles downstream of Upriver Dam |

B. Combined Sewer Overflow Report

The Permittee shall submit annually a CSO Report to the Department for review and approval, which complies with the requirements of WAC 173-245-090(1).

C. Combined Sewer Overflow Reduction Plan

The Permittee shall submit, as necessary, an amendment of its CSO Reduction Plan to the Department for review and approval. The amendment shall comply with the requirements of WAC 173-245-090(2).

D. CSO Maintenance and Inspection Plan

The Permittee shall submit annually (beginning **October 1, 2010**) for review and approval a plan for the following calendar year to maintain the operation, monitoring and function of the remaining CSOs. The plan shall include inspection protocols based on lessons learned to ensure the CSOs are functioning as intended and that public safety and protection of the environment as ensured to the best extent possible.

E. CSO Maintenance and Inspection Report

The Permittee shall submit annually (beginning **March 1, 2011**) for review a progress report covering the previous calendar year, on visual and other inspection made of all CSOs including diversion weirs manhole and other potential structural features that could result in unmonitored CSO discharges. The report shall include a listing and brief description of corrections made. Corrective actions are to include training and updated construction contract language for work of city infrastructure that could result in damage or release of water or sewage to a sewer collection system.

F. CSO Compliance Schedule

In order to achieve the greatest reasonable reduction of combined sewer overflows at the earliest possible date, the City shall implement all portions of the approved CSO reduction plan and amendments dated December 4, 1998, March 10, 2000 and any subsequent amendments as approved by Ecology. The following elements of the approved combined sewer overflow reduction plan shall be accomplished in accordance with the following schedule of milestone dates.

1. Implementation of the approved schedule shall begin immediately.

2. No later than **December 31, 2017**, any discharge of CSO shall meet all final State and Federal requirements applicable to such discharges.

3. Continue CSO discharge monitoring as approved in the October 28, 2008 amendments or subsequent Department of Ecology approved changes to the monitoring plan..

4. The City shall continue the use of and the maintenance of its public notification system ensuring that the public receives adequate notification of CSO occurrences and CSO impacts whether due to weather events or dry weather conditions. The elements of the system includes but is not limited to the following:

   a) Posting of public notice signs in conspicuous locations near each CSO outfall and at locations used by river recreationists with pertinent information.

   b) A mechanism to alert persons using all receiving water bodies affected by CSOs during and following CSO events.

   c) A system to determine the nature and duration of conditions that are potentially harmful to users of the receiving water bodies due to CSOs.

   In the third year of the permit, the permittee shall meet with the Department of Ecology and the Health District to review the current public awareness and education plan and revise as appropriate. The public awareness and education plan shall include information and education on the sources and significance of bacteria and other pollutants in the river and what citizens can do to protect the city's wastewater collection system and the river.

5. The City must to the maximum extent possible use native plants in restoration of riparian zone at CSO to the river. If it isn't possible to employ native plants the City must consultant with the Department as the plant to be used.

6. The City must to the maximum extent possible use native plants in creation of "Storm Gardens" and similar means of reducing flows to CSOs.. If it isn't possible to employ native plants the City must consultant with the Department as the plant to be used.

## S14. RECLAMATION AND REUSE

A. Reclamation and Reuse Pilot and Demonstration Projects

When the permittee proposes a small scale pilot project for demonstration of concept and feasibility the permittee shall submit an engineering report describing the project. The report must describe the project with appropriate design and operational detail and must be submitted to both the Departments of Health and Ecology for review and approval. The permittee will maintain communications with the Departments of Health and Ecology and assist them in providing oversight of the concept and project feasibility and possible long term implementation.

B. Reclaimed Water Limitations ( Reserved for Future Use)

C. Reclaimed Water Monitoring Requirements ( Reserved for Future Use)

D. Reclamation and Reuse Implementation

For long term implementation of reclamation and reuse pilot projects, this permit will be reopened and modified as necessary to provide special conditions related to reclamation and reuse as provided by permit General Condition G3.B.3.

The permittee shall prepare a water reuse plan, which contains a summary description of the proposed water reuse system as described in the approved Engineering Report. The plan and an application for permit modification shall be submitted to the Departments of Health and Ecology at least 180 days before the reclamation and reuse project becomes operational. The engineering report and reuse plan shall meet the requirements of the state of Washington's "Water Reclamation and Reuse Standards (1997)" and be approved by both the Departments of Health and the Department of Ecology prior to the construction or modification of facilities for producing reclaimed water.

The Permittee shall review the plan at least annually and the plan shall be updated whenever new uses or users are added to the distribution system. A copy of the revised plan shall be submitted to Ecology and Health. The plan shall contain, but not be limited to, the following:

1. Description of the reuse distribution system;
2. Identification of uses, users, location of reuse sites.

3. Evaluation of reuse sites, estimated volume of reclaimed water use, means of application, and for irrigation or surface percolation uses, the application rates, water balance, expected agronomic uptake, potential to impact ground water or surface water at the site, background water quality and hydrogeological information necessary to evaluate potential water quality impacts.

E. Bypass Prohibited

There shall be no bypassing of untreated or partially treated wastewater from the reclamation plant or any intermediate unit processes to the distribution system or point of use at any time. All reclaimed water being distributed for beneficial use must meet Class A requirements at all times. Water not meeting Class A must be retained for additional treatment by diversion to a bypass storage lagoon or discharged to an authorized wastewater outfall.

The Departments of Ecology and Health shall be notified by telephone within 24 hours of any diversion to a bypass storage lagoon or authorized outfall. Substandard wastewater shall not be discharged to the reclaimed water distribution system or use areas without specific approval from the Departments of Health and Ecology.

F. Reliability

The Permittee shall maintain the highest reliability class as described in the Water Reclamation and Reuse Standards which require one of the following features for each of the critical reclamation treatment unit processes of oxidation, coagulation, filtration and disinfection:

1. Alarms and standby power source
2. Alarms and automatically actuated short-term (24-hour) storage or disposal provisions.
3. Automatically actuated long-term storage or disposal provisions for treated wastewater.

G. Use Area Responsibilities

1. A standard notification sign shall be developed by the Permittee using colors and verbiage approved by the state Department of Health. The signs shall be used in all reclaimed water use areas, consistent with the Water Reclamation and Reuse Standards.
2. Reclaimed water use, including runoff and spray shall be confined to the designated and approved use area. The incidental discharge of reclaimed water to waters of the State is not a violation of these requirements if the incidental discharge does not unreasonably affect the beneficial uses of the water, and does not result in exceeding an applicable water quality objective in the receiving water.
3. The Permittee shall control industrial and toxic discharges to the sanitary sewer that may affect reclaimed water quality through either a delegated pretreatment program with the Department of Ecology or assuring all applicable discharges have permits

issued under the Water Pollution Control Act, Chapter 90.48 RCW, and the State Waste Discharge Permit Regulation, Chapter 173-216 WAC.

4. Where the reclaimed water production, distribution and use areas are under direct control of the permittee, the Permittee shall maintain control and be responsible for all facilities and activities inherent to the production, distribution and use of the reclaimed water. The Permittee shall ensure that the reuse system operates as approved by the Departments of Health and Ecology.

H. Service and Use Area Agreement

Where the reclaimed water additional treatment, distribution system or use area is not under direct control of the permittee:

1. The person(s) who provides additional treatment, distributes, owns, or otherwise maintains control over the reclaimed water use area is responsible for reuse facilities and activities inherent to the production, distribution and use of the reclaimed water to ensure that the system operates as approved by the Departments of Health and Ecology in accordance with this Permit.
2. Reclaimed water uses, including runoff and spray, shall be confined to the designated and approved use areas. The incidental discharge of reclaimed water to waters of the State is not a violation of these requirements if the incidental discharge does not unreasonably affect the beneficial uses of the water, and does not result in exceeding an applicable water quality objective in the receiving water.
3. A binding Service and Use Area Agreement among the parties involved is required to ensure that construction, operation, maintenance, and monitoring meet all requirements of the Departments of Health and Ecology. This agreement must be consistent with the requirements of the Water Reclamation and Reuse Standards, 1997. A copy of each Service and Use Area Agreement must be submitted to and approved by the Departments of Health and Ecology prior to implementation.
4. The Service and Use Area Agreement shall provide the Permittee with authority to terminate service of reclaimed water to a customer violating the State Water Reclamation and Reuse Standards and restrictions outlined in the Service and Use Area Agreement. The Service and Use Area Agreements shall be approved by the Departments of Health and Ecology prior to the distribution of any reclaimed water.
5. No reclaimed water shall be distributed by the Permittee without a reclaimed water service and use agreement approved by the Departments of Health and Ecology.

I. Reclaimed Water Ordinance

The Permittee shall complete a local ordinance to include policies and procedures for the distribution and delivery of reclaimed water. The ordinance shall provide the Permittee with the authority to terminate service of reclaimed water from any customer violating the state Water Reclamation and Reuse Standards and restrictions outlined in the service and use agreement.

J. Irrigation Use

1. For any irrigation use of reclaimed water, the hydraulic loading rate of reclaimed water shall be determined based on a detailed water balance analysis. The calculated loading rate(s) and the parameters and methods used to determine the loading rate(s) shall be submitted to the Washington Department of Ecology for approval.
2. There shall be no runoff of reclaimed water applied to land by spray irrigation to any surface waters of the state or to any land not authorized by approved use agreement.
3. There shall be no application of reclaimed water for irrigation purposes when the ground is saturated or frozen.
4. The reclaimed water shall not be applied to the irrigation lands in quantities that:
   a. Significantly reduce or destroy the long-term infiltration rate of the soil.
   b. Cause long-term anaerobic conditions in the soil.
   c. Cause ponding of reclaimed water and produce objectionable odors or support insects or vectors.
   d. Cause leaching losses of constituents of concern beyond the treatment zone or in excess of the approved design. Constituents of concern are constituents in the reclaimed water, partial decomposition products, or soil constituents that would alter ground water quality in amounts that would affect current and future beneficial uses.

The Permittee shall maintain all irrigation agreements for lands not owned for the duration of the permit. The Permittee shall inform the Departments of Health and Ecology in writing of any proposed changes to existing agreements.

## S15. COMPLIANCE SCHEDULE

The following compliance schedule is to implement the "Foundational Concepts." At the present the "Foundational Concepts for the Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load (TMDL)" implements the Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load (TMDL) as the Managed Implementation Plan." The Department acknowledges that, depending on how the environment responds to these actions the model results coming out of the "10 year assessment" may yield revised final equivalent effluent limitations (see Section 303(d)(4)(A) of the Clean Water Act).

The Department also acknowledges that the following schedule may need to be amended in the future. Any request must be based on new information including progress made and appropriate justification. Any modification to the compliance schedule would be made pursuant to 40 CFR 122.62 or 122.63, as appropriate.

A. Annual Delta Elimination Plan Update

No later than **February 1, 2011** the Permittee shall submit to the Department the initial Delta Elimination Plan required by this permit. No later than **February 1, 2012** the Permittee shall submit to the Department the first annual update to the Delta Elimination Plan. The plan shall include an annual assessment of the previous Delta Management efforts, an accounting of "Delta" credits earned, expended and available for trading. Based on lessons learned from ongoing studies and evaluations of previously implemented best management practices, the report shall make recommendations for the upcoming year.

B. Engineering Report or Wastewater Facilities Plan Update

The Pilot Testing program is anticipated to conclude in December 2010. Therefore, no later than **June 15, 2012**, two copies of an approvable Wastewater Facilities Plan shall be prepared by the Permittee in accordance with WAC 173-240 and submitted to the Department for review and approval. The Wastewater Facilities Plan shall address the wastewater processes needed to reliable comply with the CBOD5, NH3 and TP WLAs of the Spokane River and Lake Spokane Dissolved Oxygen, provide siting options and piping and process options for future addition of process elements to achieve the final equivalent effluent limitations and water reclamation requirements as described in the "Water Reclamation and Reuse Standards" (Washington State Department of Ecology and Department of Health, 1997).

C. Project Manual (Plans and Specifications)

No later than **December 1, 2012** the Permittee shall submit to the Department for review and approval two copies of approvable plans and specifications in accordance with WAC 173-240 for upgrade of the existing wastewater treatment plant to meet the interim TP effluent limitations.

D. Construction Quality Assurance Plan

Prior to the start of construction, the Permittee shall submit to the Department a quality assurance plan as required by WAC 173-240.

E. Completion of Wastewater Treatment Plant Construction

No later than **October 31, 2015** the Permittee shall have substantially completed the construction of the additional phosphorus removal process units required to comply with the DO TMDL WLAs. The Wastewater Treatment Plant upgrades must produce an effluent reliably complying with an total phosphorus effluent limitation of 50 ug/L TP or lower concentration.

F. Compliance with Spokane River and Lake Spokane DO TMDL

No later than **March 1, 2018** the Permittee shall comply with the effluent limitations presented in permit conditions S1.B

## S16. APPLICATION FOR PERMIT RENEWAL

The Permittee shall submit an application for renewal of this permit by December 15, 2014.

# GENERAL CONDITIONS

## G1. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the Department shall be signed and certified.

A. All permit applications shall be signed by either a principal executive officer or a ranking elected official.

B. All reports required by this permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to the Department.

2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under paragraph B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph B.2 above must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section shall make the following certification:

> I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

## G2. RIGHT OF INSPECTION AND ENTRY

The Permittee shall allow an authorized representative of the Department, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.

B. To have access to and copy - at reasonable times and at reasonable cost - any records required to be kept under the terms and conditions of this permit.

C. To inspect - at reasonable times - any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor - at reasonable times - any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

## G3. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the permittee) or upon the Department's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5..

A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:

1. Violation of any permit term or condition.
2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
3. A material change in quantity or type of waste disposal.
4. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination [40 CFR part 122.64(3)].
5. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit [40 CFR part 122.64(4)].
6. Nonpayment of fees assessed pursuant to RCW 90.48.465.
7. Failure or refusal of the permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the permittee requests or agrees:

1. A material change in the condition of the waters of the state.

2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR part 122.62.

6. The Department has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:

1. Cause exists for termination for reasons listed in A1 through A7 of this section, and the Department determines that modification or revocation and reissuance is appropriate.

2. The Department has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G8) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new permittee.

## G4. REPORTING PLANNED CHANGES

The Permittee shall, as soon as possible, but no later than sixty (60) days prior to the proposed changes, give notice to the Department of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in: 1) the permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b); 2) a significant change in the nature or an increase in quantity of pollutants discharged; or 3) a significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation of the terms and conditions of this permit.

## G5. PLAN REVIEW REQUIRED

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications shall be submitted to the Department for approval in accordance with Chapter 173-240 WAC. Engineering reports, plans, and specifications shall be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities shall be constructed and operated in accordance with the approved plans.

## G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit shall be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

## G7. TRANSFER OF THIS PERMIT

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Department.

A. Transfers by Modification

Except as provided in paragraph (B) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies the Department at least 30 days in advance of the proposed transfer date.

2. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

3. The Department does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

## G8. REDUCED PRODUCTION FOR COMPLIANCE

The Permittee, in order to maintain compliance with its permit, shall control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

## G9. REMOVED SUBSTANCES

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

## G10. DUTY TO PROVIDE INFORMATION

The Permittee shall submit to the Department, within a reasonable time, all information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also submit to the Department upon request, copies of records required to be kept by this permit.

## G11. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

## G12. ADDITIONAL MONITORING

The Department may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

## G13. PAYMENT OF FEES

The Permittee shall submit payment of fees associated with this permit as assessed by the Department.

## G14. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

## G15. UPSET

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in condition S3.E; and 4) the Permittee complied with any remedial measures required under S4.C of this permit.

In any enforcement proceeding the Permittee seeking to establish the occurrence of an upset has the burden of proof.

## G16. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

## G17. DUTY TO COMPLY

The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

## G18. TOXIC POLLUTANTS

The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

## G19. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this Condition, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

## G20. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee shall give advance notice to the Department by submission of a new application or supplement thereto at least one hundred and eighty (180) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, shall be scheduled during noncritical water quality periods and carried out in a manner approved by the Department.

## G21. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to the Department, it shall promptly submit such facts or information.

## G22. COMPLIANCE SCHEDULES

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than fourteen (14) days following each schedule date.

# APPENDIX A
# EFFLUENT CHARACTERIZATION FOR POLLUTANTS
## THIS LIST INCLUDES EPA REQUIRED POLLUTANTS (PRIORITY POLLUTANTS) AND SOME ECOLOGY PRIORITY TOXIC CHEMICALS (PBTs)

The following table with analytical methods and levels is to be used as guidance for effluent characterization in NPDES permit applications, applications for permit renewal, and monitoring required by permit. This attachment is used in conjunction with Section V, Parts A, B, and C of EPA Application Form 2C, Parts A.12, B.6, and D of EPA application form 2A and with State applications. This attachment specifies effluent characterization requirements of the Department of Ecology. For application, analyze your wastewater for all parameters required by the application and any additional pollutants with an X in the left column. The data should be compiled from last year's data if it is a parameter routinely measured. If you are a primary industry category with effluent guidelines you may have some mandatory testing requirements (see Table 2C-2 of Form 2C). If you are a municipal POTW you also have some mandatory testing requirements which are dependent upon the design flow (see EPA form 2A).

The permit applications will specify the groups of compounds to be analyzed. Ecology may require additional pollutants to be analyzed within a group. The objectives are to reduce the number of analytical "non-detects" in applications and to measure effluent concentrations near or below criteria values where possible at a reasonable cost. If an applicant or Permittee knows that an alternate, less sensitive method (higher DL and QL) from 40 CFR Part 136 is sufficent to produce measurable results in their effluent, that method may be used for analysis.

| | **Pollutant & CAS No. *(if available)*** | **Recommended Analytical Protocol** | **Detection (DL)[2]** *µg/L unless specified* | **Quantitation Level (QL)[3]** *µg/L unless specified* |
|---|---|---|---|---|
| 1 | **CONVENTIONALS** | | | |
| | Biochemical Oxygen Demand | SM5210-B | | 2 mg/L |
| | Chemical Oxygen Demand | SM5220-D | | 10 mg/L |
| | Total Organic Carbon | SM5310-B/C/D | | 1 mg/L |
| | Total Suspended Solids | SM2540-D | | 5 mg/L |
| | Total Ammonia (as N) | SM4500-NH3-GH | | 0.3 mg/L |
| | Flow | Calibrated device | | |
| | Dissolved oxygen | 4500-OC/OG | | 0.2 mg/L |
| | Temperature (max. 7-day avg.) | Analog recorder or Use micro-recording devices known | | 0.2° C |

| | Pollutant & CAS No. *(if available)* | Recommended Analytical Protocol | Detection (DL)[2] *µg/L unless specified* | Quantitation Level (QL)[3] *µg/L unless specified* |
|---|---|---|---|---|
| | | as thermistors | | |
| | pH | SM4500-$H^+$ B | N/A | N/A |
| 1 | **NONCONVENTIONALS** | | | |
| | Total Alkalinity | SM2320-B | | 5 mg/L as CaCo3 |
| | Bromide (24959-67-9) | 4110 B | 100 | 400 |
| | Chlorine, Total Residual | 4500 Cl G | | 50.0 |
| | Color | SM2120 B/C/E | | 10 color unit |
| | Fecal Coliform | SM 9221E | N/A | N/A |
| | Fluoride (16984-48-8) | SM4500-F E | 25 | 100 |
| | Nitrate-Nitrite (as N) | 4500-NO3-E/F/H | | 100 |
| | Nitrogen, Total Kjeldahl (as N) | 4500-NH3-C/E/FG | | 300 |
| | Ortho-Phosphate ($PO_4$ as P) | 4500- PE/PF | 30 | 100 |
| | Phosphorus, Total (as P) | 4500-PE/PF | 30 | 100 |
| | Oil and Grease (HEM) | 1664A | | 5,000 |
| | Radioactivity | Table 1E | | |
| | Salinity | SM2520-B | | 3 PSS |
| | Settleable Solids | SM2540 -F | | 100 |
| | Sulfate (as mg/L $SO_4$) | SM4110-B | | 200 |
| | Sulfide (as mg/L S) | 4500-$S^2$F/D/E/G | | 200 |
| | Sulfite (as mg/L $SO_3$) | SM4500-SO3B | | 2000 |
| | Surfactants | SM5540 C | | 50 |
| | Total dissolved solids | SM2540 C | | 20 mg/L |
| | Total Hardness | 2340B | | 200 as CaCO3 |
| | Aluminum, Total (7429-90-5) | 200.8 | 2.0 | 10 |
| | Barium Total (7440-39-3) | 200.8 | 0.5 | 2.0 |
| | Boron Total (7440-42-8) | 200.8 | 2.0 | 10.0 |
| | Cobalt, Total (7440-48-4) | 200.8 | 0.05 | 0.25 |
| | Iron, Total (7439-89-6) | 200.8 | 12.5 | 50 |
| | Magnesium, Total (7439-95-4) | 200.8 | 10 | 50 |
| | Molybdenum, Total (7439-98-7) | 200.8 | 0.1 | 0.5 |
| | Manganese, Total (7439-96-5) | 200.8 | 0.1 | 0.5 |
| | Tin, Total (7440-31-5) | 200.8 | 0.3 | 1.5 |
| | Titanium, Total (7440-32-6) | 200.8 | 0.5 | 2.5 |
| 1 | **METALS, CYANIDE & TOTAL PHENOLS** | | | |
| | Antimony, Total (7440-36-0) | 200.8 | 0.3 | 1.0 |

| | Pollutant & CAS No. *(if available)* | Recommended Analytical Protocol | Detection (DL)[2] *µg/L unless specified* | Quantitation Level (QL)[3] *µg/L unless specified* |
|---|---|---|---|---|
| | Arsenic, Total (7440-38-2) | 200.8 | 0.1 | 0.5 |
| | Beryllium, Total (7440-41-7) | 200.8 | 0.1 | 0.5 |
| | Cadmium, Total (7440-43-9) | 200.8 | 0.05 | 0.25 |
| | Chromium (hex) dissolved (185-402-99) | SM3500-Cr EC | 0.3 | 1.2 |
| | Chromium, Total (7440-47-3) | 200.8 | 0.2 | 1.0 |
| | Copper, Total (7440-50-8) | 200.8 | 0.4 | 2.0 |
| | Lead, Total (7439-92-1) | 200.8 | 0.1 | 0.5 |
| | Mercury, Total (7439-97-6) | 1631E | 0.0002 | 0.0005 |
| | Nickel, Total (7440-02-0) | 200.8 | 0.1 | 0.5 |
| | Selenium, Total (7782-49-2) | 200.8 | 1.0 | 1.0 |
| | Silver, Total (7440-22-4) | 200.8 | 0.04 | 0.2 |
| | Thallium, Total (7440-28-0) | 200.8 | 0.09 | 0.36 |
| | Zinc, Total (7440-66-6) | 200.8 | 0.5 | 2.5 |
| | Cyanide, Total (7440-66-6) | 335.4 | 5 | 10 |
| | Cyanide, Available | SM4500-CN G | 5 | 10 |
| | Phenols, Total | EPA 420.1 | | 50 |
| | **DIOXIN** | | | |
| | 2,3,7,8-Tetra-Chlorodibenzo-P-Dioxin (176-40-16) | 1613B | 1.3 pg/L | 5 pg/L |
| 1 | **VOLATILE COMPOUNDS** | | | |
| | Acrolein (107-02-8) | 624 | 5 | 10 |
| | Acrylonitrile (107-13-1) | 624 | 1.0 | 2.0 |
| | Benzene (71-43-2) | 624 | 1.0 | 2.0 |
| | Bis(2-Chloroethyl)ether (111-44-4) | 611/625 | 1.0 | 2.0 |
| | Bis(2-Chloroisopropyl) ether (108-60-1) | 611/625 | 1.0 | 2.0 |
| | Bromoform (75-25-2) | 624 | 1.0 | 2.0 |
| | Carbon tetrachloride (108-90-7) | 624/601 or SM6230B | 1.0 | 2.0 |
| | Chlorobenzene (108-90-7) | 624 | 1.0 | 2.0 |
| | Chloroethane (75-00-3) | 624/601 | 1.0 | 2.0 |
| | 2-Chloroethylvinyl Ether (110-75-8) | 624 | 1.0 | 2.0 |
| | Chloroform (67-66-3) | 624 or SM6210B | 1.0 | 2.0 |
| | Dibromochloromethane (124-48-1) | 624 | 1.0 | 2.0 |
| | 1,2-Dichlorobenzene (95-50-1) | 624 | 1.9 | 7.6 |
| | 1,3-Dichlorobenzene (541- | 624 | 1.9 | 7.6 |

| | Pollutant & CAS No. *(if available)* | Recommended Analytical Protocol | Detection (DL)[2] *µg/L unless specified* | Quantitation Level (QL)[3] *µg/L unless specified* |
|---|---|---|---|---|
| | 73-1) | | | |
| | 1,4-Dichlorobenzene (106-46-7) | 624 | 4.4 | 17.6 |
| | 3,3'-Dichlorobenzidine (91-94-1) | 605/625 | 0.5 | 1.0 |
| | Dichlorobromomethane (75-27-4) | 624 | 1.0 | 2.0 |
| | 1,1-Dichloroethane (75-34-3) | 624 | 1.0 | 2.0 |
| | 1,2-Dichloroethane (107-06-2) | 624 | 1.0 | 2.0 |
| | 1,1-Dichloroethylene (75-35-4) | 624 | 1.0 | 2.0 |
| | 1,2-Dichloropropane (78-87-5) | 624 | 1.0 | 2.0 |
| | 1,3-dichloropropylene (mixed isomers) (542-75-6) | 624 | 1.0 | 2.0 |
| | Ethylbenzene (100-41-4) | 624 | 1.0 | 2.0 |
| | Methyl bromide (74-83-9) (Bromomethane) | 624/601 | 5.0 | 10.0 |
| | Methyl chloride (74-87-3) (Chloromethane) | 624 | 1.0 | 2.0 |
| | Methylene chloride (75-09-2) | 624 | 5.0 | 10.0 |
| | 1,1,2,2-Tetrachloroethane (79-34-5) | 624 | 1.9 | 2.0 |
| | Tetrachloroethylene (127-18-4) | 624 | 1.0 | 2.0 |
| | Toulene (108-88-3) | 624 | 1.0 | 2.0 |
| | 1,2-Trans-Dichloroethylene (156-60-5) (Ethylene dichloride) | 624 | 1.0 | 2.0 |
| | 1,1,1-Trichloroethane (71-55-6) | 624 | 1.0 | 2.0 |
| | 1,1,2-Trichloroethane (79-00-5) | 624 | 1.0 | 2.0 |
| | Trichloroethylene (79-01-6) | 624 | 1.0 | 2.0 |
| | Vinyl chloride (75-01-4) | 624/SM6200B | 1.0 | 2.0 |
| 1 | **ACID COMPOUNDS** | | | |
| | 2-Chlorophenol (95-57-8) | 625 | 1.0 | 2.0 |
| | 2,4-Dichlorophenol (120-83-2) | 625 | 0.5 | 1.0 |
| | 2,4-Dimethylphenol (105-67-9) | 625 | 0.5 | 1.0 |
| | 4,6-dinitro-o-cresol (534-52-1) (2-methyl-4,6,-dinitrophenol) | 625/1625B | 1.0 | 2.0 |

| | Pollutant & CAS No. *(if available)* | Recommended Analytical Protocol | Detection (DL)[2] *µg/L unless specified* | Quantitation Level (QL)[3] *µg/L unless specified* |
|---|---|---|---|---|
| | 2,4 dinitrophenol (51-28-5) | 625 | 1.0 | 2.0 |
| | 2-Nitrophenol (88-75-5) | 625 | 0.5 | 1.0 |
| | 4-nitrophenol (100-02-7) | 625 | 0.5 | 1.0 |
| | Parachlorometa cresol (59-50-7) (4-chloro-3-methylphenol) | 625 | 1.0 | 2.0 |
| | Pentachlorophenol (87-86-5) | 625 | 0.5 | 1.0[10] |
| | Phenol (108-95-2) | 625 | 2.0 | 4.0 |
| | 2,4,6-Trichlorophenol (88-06-2) | 625 | 2.0 | 4.0 |
| 1 | **BASE/NEUTRAL COMPOUNDS** (compounds in bold are Ecology PBTs) | | | |
| | Acenaphthene (83-32-9) | 625 | 0.2 | 0.4 |
| | Acenaphtylene (208-96-8) | 625 | 0.3 | 0.6 |
| | Anthracene (120-12-7) | 625 | 0.3 | 0.6 |
| | Benzidine (92-87-5) | 625 | 12 | 24 |
| | Benzyl butyl phthalate (85-68-7) | 625 | 0.3 | 0.6 |
| | Benzo(*a*)anthracene (56-55-3) | 625 | 0.3 | 0.6 |
| | **Benzo(j)fluoranthene (205-82-3)** | 625 | 0.5 | 1.0 |
| | **Benzo(r,s,t)pentaphene (189-55-9)** | 625 | 0.5 | 1.0 |
| | Benzo(*a*)pyrene (50-32-8) | 610/625 | 0.5 | 1.0 |
| | 3,4-benzofluoranthene (Benzo(b)fluoranthene) (205-99-2) | 610/625 | 0.8 | 1.6 |
| | 11,12-benzofluoranthene (Benzo(k)fluoranthene) (207-08-9) | 610/625 | 0.8 | 1.6 |
| | Benzo(*ghi*)Perylene (191-24-2) | 610/625 | 0.5 | 1.0 |
| | Bis(*2-chloroethoxy)*methane (111-91-1) | 625 | 5.3 | 21.2 |
| | Bis(*2-chloroethyl*)ether (111-44-4) | 611/625 | 0.3 | 1.0 |
| | Bis(*2-chloroisopropyl*)ether (108-60-1) | 625 | 0.3 | 0.6 |
| | Bis(*2-ethylhexyl*)phthalate (117-81-7) | 625 | 0.1 | 0.5 |
| | 4-Bromophenyl phenyl ether (101-55-3) | 625 | 0.2 | 0.4 |
| | 2-Chloronaphthalene (91-58-7) | 625 | 0.3 | 0.6 |
| | 4-Chlorophenyl phenyl ether (7005-72-3) | 625 | 0.3 | 0.5 |

| | Pollutant & CAS No. *(if available)* | Recommended Analytical Protocol | Detection (DL)[2] *µg/L unless specified* | Quantitation Level (QL)[3] *µg/L unless specified* |
|---|---|---|---|---|
| | Chrysene (218-01-9) | 610/625 | 0.3 | 0.6 |
| | **Dibenzo (a,j)acridine (224-42-0)** | 610M/625M | 2.5 | 10.0 |
| | **Dibenzo (a,h)acridine (226-36-8)** | 610M/625M | 2.5 | 10.0 |
| | Dibenzo(a-*h*)anthracene (53-70-3)(1,2,5,6-dibenzanthracene) | 625 | 0.8 | 1.6 |
| | Dibenzo(a,e)pyrene (192-65-4) | 610M/625M | 2.5 | 10.0 |
| | Dibenzo(a,h)pyrene (189-64-0) | 625M | 2.5 | 10.0 |
| | 3,3'-Dichlorobenzidine (91-94-1) | 605/625 | 0.5 | 1.0 |
| | Diethyl phthalate (84-66-2) | 625 | 1.9 | 7.6 |
| | Dimethyl phthalate (131-11-3) | 625 | 1.6 | 6.4 |
| | Di-n-butyl phthalate (84-74-2) | 625 | 0.5 | 1.0 |
| | 2,4-dinitrotoluene (121-14-2) | 609/625 | 0.2 | 0.4 |
| | 2,6-dinitrotoluene (606-20-2) | 609/625 | 0.2 | 0.4 |
| | Di-n-octyl phthalate (117-84-0) | 625 | 0.3 | 0.6 |
| | 1,2-Diphenylhydrazine (*as Azobenzene*) (122-66-7) | 1625B | 5.0 | 20 |
| | Fluoranthene (206-44-0) | 625 | 0.3 | 0.6 |
| | Fluorene (86-73-7) | 625 | 0.3 | 0.6 |
| | Hexachlorobenzene (118-74-1) | 612/625 | 0.3 | 0.6 |
| | Hexachlorobutadiene (87-68-3) | 625 | 0.5 | 1.0 |
| | Hexachlorocyclopentadiene (77-47-4) | 1625B/625 | 0.5 | 1.0 |
| | Hexachloroethane (67-72-1) | 625 | 0.5 | 1.0 |
| | Indeno(*1,2,3-cd*)Pyrene (193-39-5) | 610/625 | 0.5 | 1.0 |
| | Isophorone (78-59-1) | 625 | 0.5 | 1.0 |
| | **3-Methyl cholanthrene (56-49-5)** | 625 | 2.0 | 8.0 |
| | Naphthalene (91-20-3) | 625 | 0.3 | 0.6 |
| | Nitrobenzene (98-95-3) | 625 | 0.5 | 1.0 |
| | N-Nitrosodimethylamine (62-75-9) | 607/625 | 2.0 | 4.0 |
| | N-Nitrosodi-n-propylamine | 607/625 | 0.5 | 1.0 |

| | Pollutant & CAS No. *(if available)* | Recommended Analytical Protocol | Detection (DL)[2] *µg/L unless specified* | Quantitation Level (QL)[3] *µg/L unless specified* |
|---|---|---|---|---|
| | (621-64-7) | | | |
| | N-Nitrosodiphenylamine (86-30-6) | 625 | 0.5 | 1.0 |
| | **Perylene (198-55-0)** | 625 | 1.9 | 7.6 |
| | Phenanthrene (85-01-8) | 625 | 0.3 | 0.6 |
| | Pyrene (129-00-0) | 625 | 0.3 | 0.6 |
| | 1,2,4-Trichlorobenzene (120-82-1) | 625 | 0.3 | 0.6 |
| 1 | **PESTICIDES/PCBs** | | | |
| | Aldrin (309-00-2) | 608 | 0.025 | 0.05 |
| | alpha-BHC (319-84-6) | 608 | 0.025 | 0.05 |
| | beta-BHC (319-85-7) | 608 | 0.025 | 0.05 |
| | gamma-BHC (58-89-9) | 608 | 0.025 | 0.05 |
| | delta-BHC (319-86-8) | 608 | 0.025 | 0.05 |
| | Chlordane (57-74-9) | 608 | 0.025 | 0.05 |
| | 4,4'-DDT (50-29-3) | 608 | 0.025 | 0.05 |
| | 4,4'-DDE (72-55-9) | 608 | 0.025 | 0.05[10] |
| | 4,4' DDD (72-54-8) | 608 | 0.025 | 0.05 |
| | Dieldrin (60-57-1) | 608 | 0.025 | 0.05 |
| | alpha-Endosulfan (959-98-8) | 608 | 0.025 | 0.05 |
| | beta-Endosulfan (33213-65-9) | 608 | 0.025 | 0.05 |
| | Endosulfan Sulfate (1031-07-8) | 608 | 0.025 | 0.05 |
| | Endrin (72-20-8) | 608 | 0.025 | 0.05 |
| | Endrin Aldehyde (7421-93-4) | 608 | 0.025 | 0.05 |
| | Heptachlor (76-44-8) | 608 | 0.025 | 0.05 |
| | Heptachlor Epoxide (1024-57-3) | 608 | 0.025 | 0.05 |
| | PCB-1242 (53469-21-9) | 608 | 0.25 | 0.5 |
| | PCB-1254 (11097-69-1) | 608 | 0.25 | 0.5 |
| | PCB-1221 (11104-28-2) | 608 | 0.25 | 0.5 |
| | PCB-1232 (11141-16-5) | 608 | 0.25 | 0.5 |
| | PCB-1248 (12672-29-6) | 608 | 0.25 | 0.5 |
| | PCB-1260 (11096-82-5) | 608 | 0.13 | 0.5 |
| | PCB-1016 (12674-11-2) | 608 | 0.13 | 0.5 |
| | Toxaphene (8001-35-2) | 608 | 0.24 | 0.5 |

1. An X placed in this box means you must analyze for all pollutants in the group.
2. <u>Detection level (DL)</u> or detection limit means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte

concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B.

3. Quantitation Level (QL) is equivalent to EPA's Minimum Level (ML) which is defined in 40 CFR Part 136 as the minimum level at which the entire GC/MS system must give recognizable mass spectra (background corrected) and acceptable calibration points. These levels were published as proposed in the Federal Register on March 28, 1997.

# Exhibit 14

LimnoTech
Water | Environment | Scientists | Engineers

| | | |
|---|---|---|
| **DATE:** | **March 11, 2010** | **MEMORANDUM** |
| **FROM:** | **Dave Dilks** | |
| **PROJECT:** | **CDAL09** | |
| **TO:** | **Sid Fredrickson** | |
| **CC:** | | |
| **SUBJECT:** | Direct Assessment of Attenuation of Idaho Sources of Phosphorus | |

## Summary

LimnoTech applied the version of the CE-QUAL-W2 model of the Spokane River system used in the final TMDL to conduct a direct assessment of the attenuation of phosphorus between Idaho waters and Lake Spokane. Model results show that an increased phosphorus load from the City of Spokane causes nearly a four-fold larger increase in summer phosphorus concentrations delivered to Lake Spokane than an equivalent load discharged from Idaho sources. Model results also show that the increased phosphorus load from the City of Spokane causes more than a three-fold larger increase in summer chlorophyll concentrations in Lake Spokane than an equivalent load discharged from Idaho sources.

Problems with the current version of the lake water quality model prevented examination of the resulting dissolved oxygen effect. Small changes in effluent quality (without any changes in flow) resulted in large variability in predicted flows in Lake Spokane, rendering predictions of dissolved oxygen impact unreliable. It is not readily apparent which of the different flow patterns predicted by the model is accurate.

## Introduction

Washington Department of Ecology (2010) developed a Total Maximum Daily Load for nutrients and oxygen demanding materials designed to minimize the anthropogenic affects on dissolved oxygen in Lake Spokane. Point source dischargers from Idaho had provided comments on the draft TMDL that Idaho phosphorus loads are largely attenuated prior to reaching the lake. The response to comments in the TMDL rejected consideration of attenuation, stating:

> However, the analysis presented does not demonstrate that phosphorus or its impact upon dissolved oxygen in Lake Spokane is significantly attenuated between the Idaho dischargers' outfalls and Lake Spokane. That is, the commenters' analysis does not investigate whether increases in phosphorus loads equivalent to those they propose for Idaho sources would not cause similar dissolved oxygen decreases, if they were allowed to occur at a source located closer to Lake Spokane (e.g. the City of Spokane's AWWTP).

The purpose of this memorandum is to provide a direct assessment of attenuation, consistent with what was described in the response to TMDL comments. The memorandum is divided into three sections:

501 Avis Drive
Ann Arbor, MI 48108
**734-332-1200**
Fax: 734-332-1212
www.limno.com

- Scenarios Evaluated
- Model Results
- Model Stability Issues

## Scenarios Evaluated

Three scenarios were simulated to allow a direct assessment of the water quality impacts of increases in phosphorus loading from Idaho point sources, compared to identical increases in loading from the City of Spokane. The input assumptions used for each scenario are as follows:

- **TMDL:** This scenario matches TMDL Alternative #1 as provided in the final TMDL.
- **Incrementally increased Idaho phosphorus load:** This scenario is identical to the TMDL alternative, with the exception that phosphorus concentrations from all Idaho point sources were doubled from their TMDL values.
- **Incrementally increased City of Spokane phosphorus load:** This scenario is identical to the TMDL alternative, with the exception that phosphorus concentration from the City of Spokane AWWTP was increased by an amount that resulted an increased in loading (pounds) identically equal to increased loading represented in the previous scenario.

Each scenario simulation consisted of three sequential model runs, as structured by PSU. The first simulation considers the Idaho portion of the Spokane River, the second simulation considers the Washington portion of the Spokane River, and the third simulation considers Long Lake. Model predictions at the downstream boundary of each of the first two simulations are directly passed to serve as input for the upstream boundary for the next simulation in the sequence.

## Model Results

The scenarios described above were run on single processor computers, and the following model outputs were examined:

- Phosphorus concentrations delivered from the Spokane River to Lake Spokane
- Chlorophyll concentrations in Lake Spokane
- Dissolved oxygen concentrations in Lake Spokane

### *Phosphorus concentrations delivered from the Spokane River to Lake Spokane*

Model predictions of phosphorus concentrations were tabulated at the downstream boundary of the Spokane River model, for each of the three scenarios. Results of the three scenarios are shown in Figure 1.

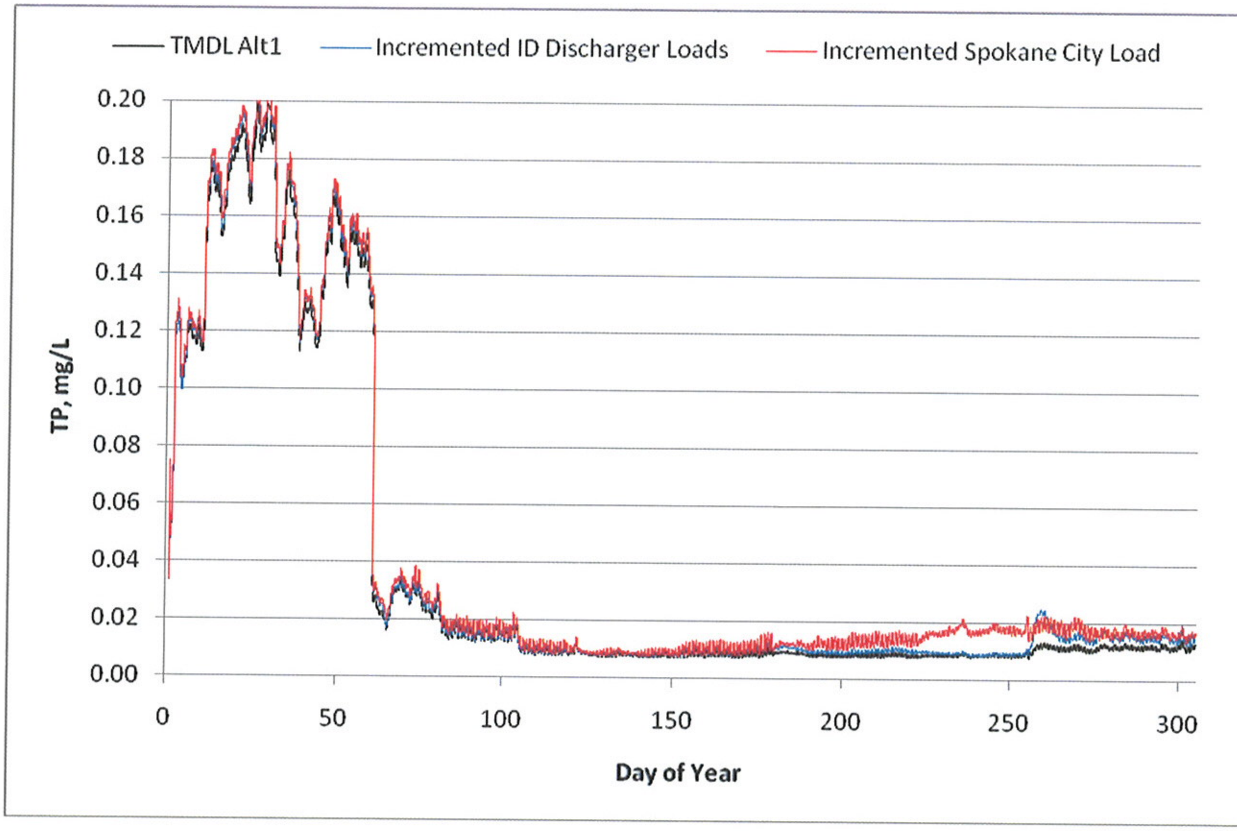


**Figure 1.**

**Comparison of Phosphorus Concentrations Delivered to Lake Spokane for Three Scenarios**

Figure 1 shows that the Incremented Idaho scenario delivers essentially identical total phosphorus concentration to Lake Spokane as the TMDL scenario, while the Incremented Spokane scenario delivers noticeably higher concentrations. The information in Figure 1 is condensed into summer averages for each scenario in Table 1. The Incremented Idaho scenario increases average phosphorus concentrations over the TMDL by 0.0012 mg/l, while the Incremented Spokane scenario increases average phosphorus concentrations by 0.0045 ug/l. This indicates that equivalent increases in phosphorus loads from the two sources result in than 3.75 times more additional phosphorus being delivered from the City of Spokane than from Idaho sources.

**Table 1. Summer-Average Phosphorus Concentration Delivered to Lake Spokane**

| Scenario | Total Phosphorus (mg/l) | Increase in Total Phosphorus over TMDL (mg/l) |
|---|---|---|
| TMDL | 0.0086 | - |
| Incremented Idaho | 0.0098 | 0.0012 |
| Incremented Spokane | 0.0132 | 0.0045 |

### *Chlorophyll concentrations in Lake Spokane*

Predicted chlorophyll concentrations were also tabulated in Lake Spokane, for each of the three scenarios. Results were analyzed at two locations in Lake Spokane, corresponding to CE-QUAL-W2 segments number 9 and 16.

Segment 9

Results of the three scenarios are shown in Figure 2 for CE-QUAL-W2 Segment 9, located near the upper end of the lake.

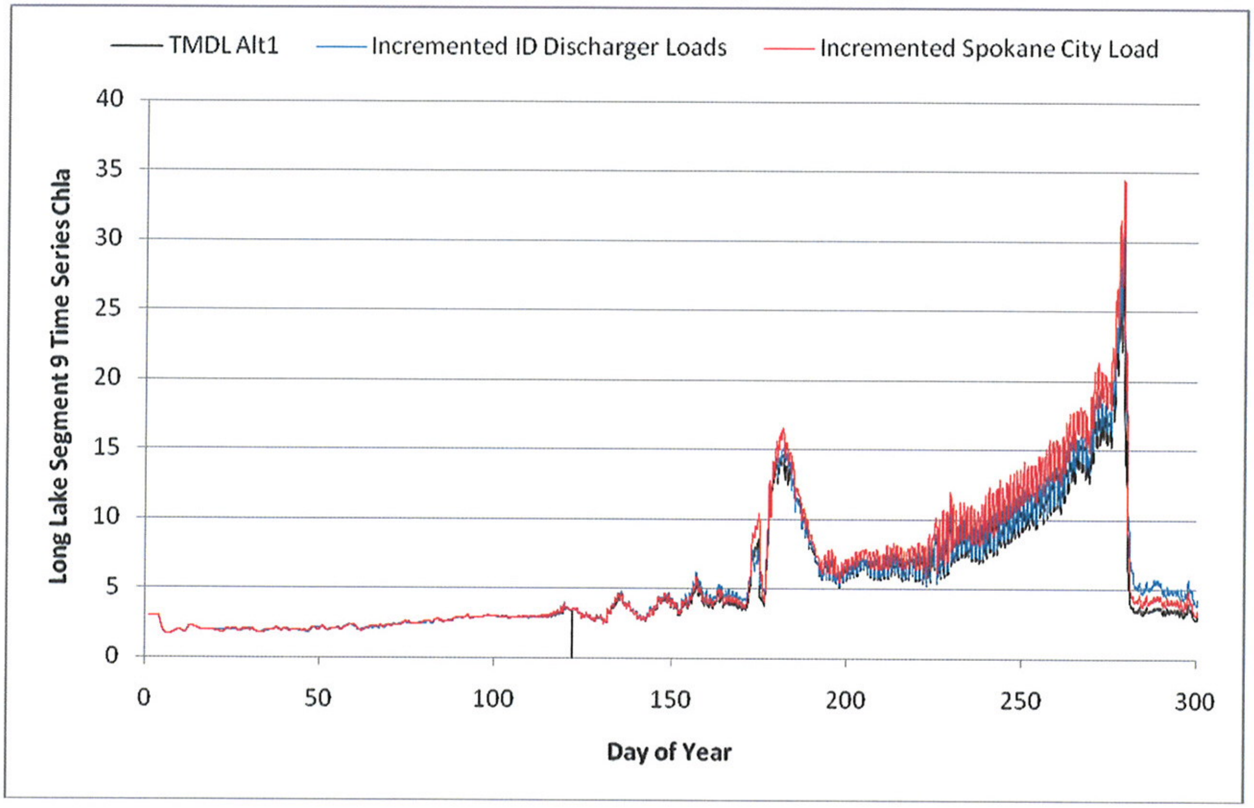


**Figure 2.**

**Comparison of Chlorophyll Concentrations for Lake Segment 9**

Figure 2 shows the Incremented Idaho scenario results in chlorophyll concentrations in Lake Spokane much more similar to the TMDL scenario than the Incremented Spokane scenario. The information in Figure 2 is condensed into summer averages for each scenario in Table 2. The Incremented Idaho scenario increases average chlorophyll concentrations by 0.269 ug/l over the TMDL, while the Incremented Spokane scenario increases average chlorophyll concentrations by 0.838 ug/l. This indicates that equivalent increases in phosphorus loads from the two sources result in more than 3.1 times more chlorophyll being generated from the increased City of Spokane load than from increased Idaho sources.

**Table 2. Summer-Average Chlorophyll Concentrations in Lake Spokane Segment 9**

| Scenario | Chlorophyll (ug/l) |
|---|---|
| TMDL | 6.966 |
| Incremented Idaho | 7.235 |
| Incremented Spokane | 7.804 |

Segment 16

Results of the three scenarios are shown in Figure 3 for CE-QUAL-W2 Segment 16, located further into the lake.

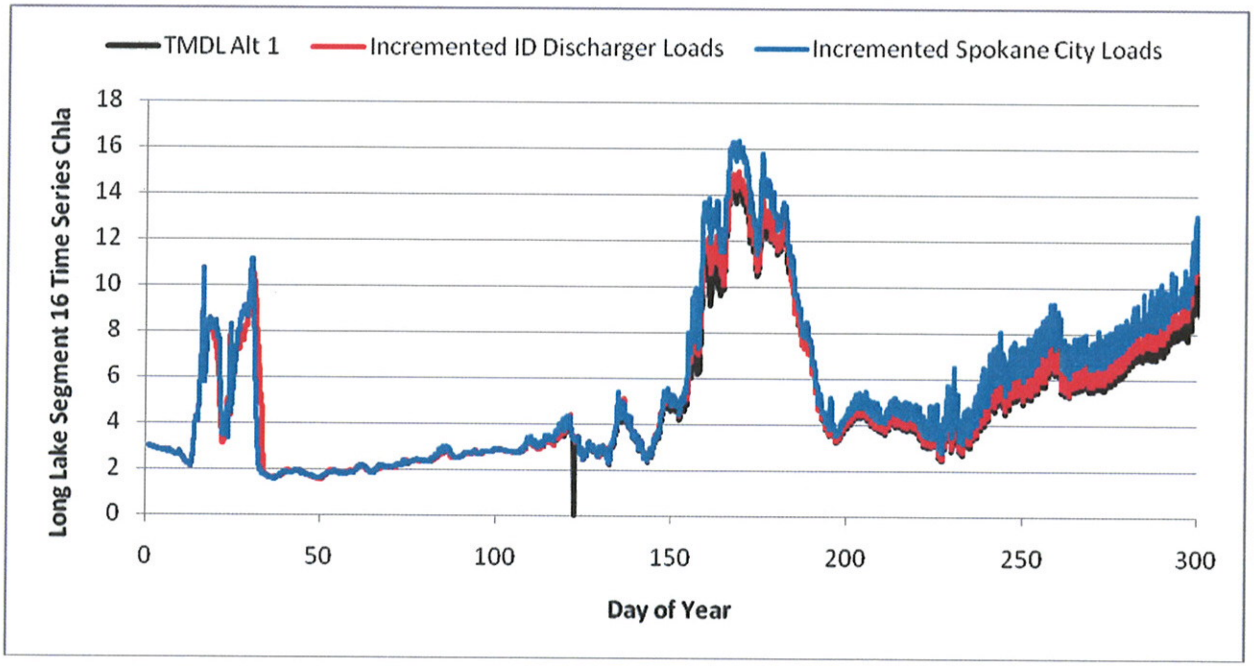


**Figure 3.**

**Comparison of Chlorophyll Concentrations in Lake Segment 16**

Figure 3 again shows the Incremented Idaho scenario results in chlorophyll concentrations in Lake Spokane much more similar to the TMDL scenario than does the Incremented Spokane scenario. The information in Figure 3 is condensed into summer averages for each scenario in Table 3. The Incremented Idaho scenario increases average chlorophyll concentrations by 0.236 ug/l over the TMDL, while the Incremented Spokane scenario increases average chlorophyll concentrations by 0.885 ug/l. This indicates that equivalent increases in phosphorus loads from the two sources result in more than 3.7 times more chlorophyll being generated from the increased City of Spokane load than from increased Idaho sources.

**Table 3. Summer-Average Chlorophyll Concentrations in Lake Spokane Segment 16**

| Scenario | Chlorophyll (ug/l) |
|---|---|
| TMDL | 6.746 |
| Incremented Idaho | 6.982 |
| Incremented Spokane | 7.631 |

### *Dissolved oxygen concentrations in Lake Spokane*

An attempt was made to conduct similar analyses of the affect of incremental phosphorus loads from the sources on Lake Spokane. The "special DO output" generated by the model showed dissolved oxygen concentrations associated with the Incremented Idaho scenario to be approximately 0.5 mg/l different than the results of the other scenarios for large periods of time. This result was completely inconsistent with all other water quality model predictions from that scenario, and led to the investigation of model stability issues discussed below.

## Model Stability Issues

Earlier versions of the Spokane River and Lake Spokane model exhibited stability problems, where small changes in water quality inputs (with no changes in flow inputs whatsoever) led to large variations in flow in Lake Spokane and resulting instability in predicted water quality. These problems were remedied by Portland State altering the treatment of river flow at Nine Mile Dam.

LimnoTech investigated the predicted flows for the most recent scenarios, and discovered that similar flow inconsistencies still exist with the new model. Figure 4 shows the difference in predicted flows between the TMDL and Incremented Idaho scenario in model Segment 2 over the course of the year. While flows for the two scenarios are expected to be identical or nearly so (which would result in differences at or near zero), actual differences in flow between the two scenarios are seen to be extensive. Large differences in flow between the scenarios start occurring around the 25$^{th}$ day of the year, and continue through day 190. The predicted flows differ between the two scenarios by as much as +/- 800 cfs. These flow variations propagate downstream through the lake, with flows in model segments 5 and 9 both varying by +/- 450 cfs between scenarios.

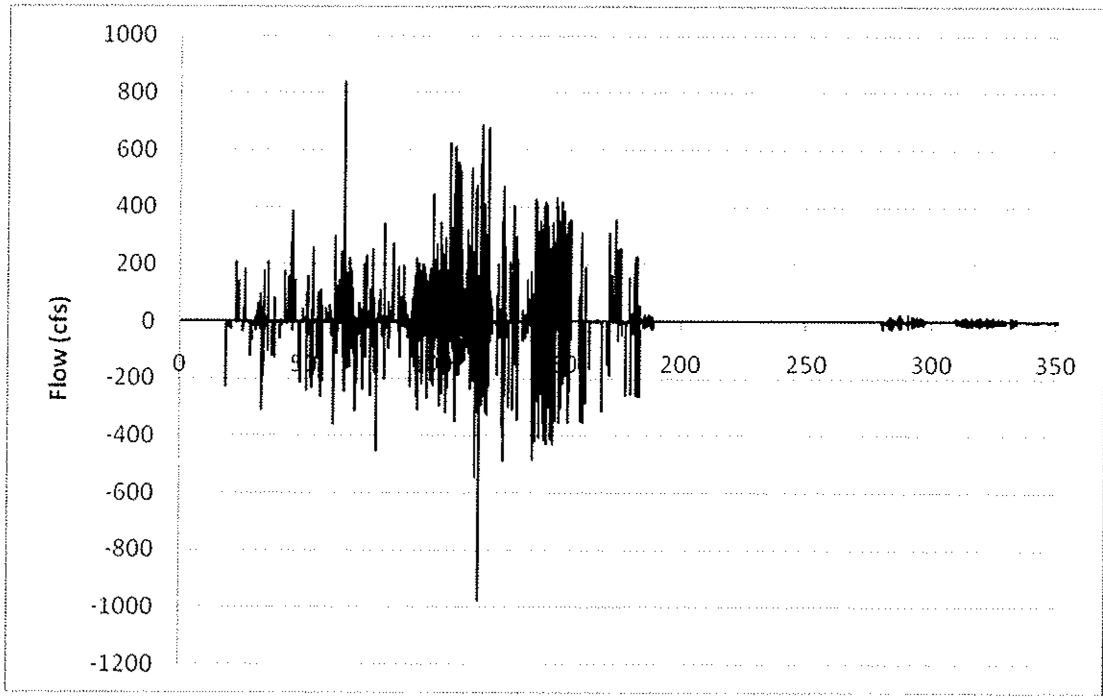


**Figure 4.**

**Differences in Predicted Flow between TMDL and Incremented Idaho for Lake Segment 2**

The two different flow patterns that result from these scenarios are likely the cause of the aberrant differences in predicted dissolved oxygen between scenarios. It cannot be readily determined which of the predicted flow patterns is most accurate.

## References

Washington Department of Ecology, 2010. Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load, Water Quality Improvement Report. Revised February, 2010. Publication No. 07-10-073.

# Exhibit 15

CITY OF
POST FALLS

Public Services Department
Office of the Director

Certified Mail 706 0810 0004 5528 7744



January 6, 2010

Brian Nickel
USEPA Region 10
1200 Sixth Avenue
Seattle, WA 98101

Dear Mr. Nickel,

The City of Post Falls respectfully requests that the flow and load allocations in the September 2009 draft dissolved oxygen TMDL for the Spokane River be amended to reflect the City's revised 2030 flow projection of 9.5 million gallons per day, as further explained in the attached memo. We anticipate that permitted phosphorus load allocations will be amended accordingly.

Sincerely,

Terry C. Werner

Terry C. Werner, Director
Department of Public Services

Cc: David Moore, WDOE
Jim Bellatty, WDOE
John Tindall, IDEQ
Ken Windram, HARSB

Attchment: Revised Flow Projections

2002 West Seltice Way, Post Falls, ID 83854 • *tel* (208)777-9857 • *fax* (208)773-0549 • www.postfallsidaho.org

# CITY OF POST FALLS

## REVISED FLOW PROJECTIONS

**January 5, 2010**

### Introduction

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The issue arises because the 2027 projected flow numbers for City of Spokane and Spokane County in the Draft TMDL are higher than warranted by historical population and wastewater flow trends. A review of available literature on the Internet provides an insight into the basis of planning for the City of Spokane and Spokane County.

### Dissolved Oxygen TMDL Report: Flows

In the Draft TMDL, WDOE offered the following 2027 wastewater flow rates: City of Spokane = 50.8 million gallons per day ("mgd") and Spokane County (new plant) = 8 mgd.[1] The combined 2027 projected flow of the two municipal dischargers is thus 58.8 mgd. Spokane County has rights to 10 mgd of capacity in the City of Spokane Advanced Wastewater Treatment Plant ("SAWTP").[4, 9]

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"Text book" domestic sewage characteristics include biochemical oxygen demand ("BOD") of 200 milligrams per liter ("mg/L"), total suspended solids ("TSS") of 225 mg/L, and total phosphorus ("TP") of 13 mg/L. Sewer sizing is often based on an average flow of 100 to 125 gallons per capita per day ("gpcd"). Infiltration and Inflow (" I/I") may be roughly estimated at 10% of average flow.[2]

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The City of Spokane sewer collection system has continually expanded since the first pipes were installed prior to 1900. The City of Spokane's first wastewater treatment plant became operational in 1958 providing basic primary treatment.[3] The 800+ mile collection system includes 400 miles of combined storm and sanitary sewers and since the mid-1990s has had an average of 450 sewage overflows per year.[5, 9] At an average annual flow of 41.25 mgd, the 1995 design loadings for influent BOD, TSS and TP were 51,500 lbs/day, 51,500 lbs/day, and 1,560 lbs/day respectively. These loads are equivalent to an annual average of 150, 150 and 4.5 mg/L, respectively.[4] Due to high I/I, the City of Spokane's raw sewage is quite dilute compared to "text book" and the Post Falls wastewater characteristics.

The City of Spokane's facility plan includes improvements to increase sewer capacity to handle combined storm flow, to reduce I/I and free-up capacity for sewage treatment at SAWTP, and to reduce the number of combined sewer overflows (CSOs). By reducing I/I, the City of Spokane expects to free-up 2 mgd of capacity for sewage treatment by 2021.[9]

**Population Projections**

The 2008 population of the City of Spokane is estimated at 204,400 people.[6] For planning purposes, the City of Spokane uses a 2026 projection of 270,673 people.[7] This would require an annual compound growth rate of 1.6 percent. Spokane's population in 1990 was 177,196 people.[13] Thus, the historic annual growth rate has been merely 0.7 percent since 1990, not the 1.6 percent offered.

The 2008 population of Spokane County was 462,677 people.[13] For planning purposes, Spokane County uses a 2026 projection of 639,160 people. This is based on the State of Washington's Office of Financial Management ("OFM") mid-range growth projection plus a 12.5 percent "variance." The OFM medium forecast for 2026 is 568,142 people. The "variance" adds another 71,018 bringing the 2026 planning number up to 639,160.[7] To achieve this growth, Spokane County would have to experience an annual compound growth rate of 1.8 percent. In contrast, the 2026 population projections generated by Avista Utilities and the Spokane Regional Transportation Commission were 554,300 for Spokane County,[7] an annual compound growth rate of only 1.1 percent. The County's population in 1990 was 361,364 people.[13] Thus, the historic annual growth rate has been 1.4 percent since 1990, much below Spokane County's estimate of 1.8 percent.

The Spokane County wastewater service area population for 2005 was 127,918 people. For wastewater facility planning purposes, Spokane County uses the middle population projection for 2030 of 167,564 people.[10] This equates to a growth rate of 1.1 percent, consistent with the estimate of the Spokane Regional Transportation Commission and much below the 1.8 percent estimate.

The 2008 population of Kootenai County was 137,475 people.[13] For planning purposes, Kootenai County uses a 2025 projection of between 158,900 and 270,673 people. This would require an annual compound growth rate of between 1 and 3 percent. The County's population in 1990 was 69,795 people.[13] Thus, the historic growth rate has been 3.8 percent since 1990. Over the period from 1970 to 2000, the County's average rate was 3.5 percent. Post Falls was the fastest growing city in the County between 1990 and 2000, with a population increase of 135 percent.[8]

Post Falls had a 2008 population of 26,460, and in1990 a population of 7,349 people.[13] Thus, the historic annual growth rate has been 7.4 percent since 1990. Post Falls also provides wastewater treatment for the City of Rathdrum, which must be included in the Post Falls wastewater flow projections. In 2008, the City of Rathdrum had a population of 6,821 people.[13] The City of Rathdrum's population in 1990 was 2,000 people.[13] Thus, the historic annual growth rate for Rathdrum has been 7.1 percent since 1990. The 2008 combined population served by the Post Falls wastewater treatment facility was 33,281 people. The 2030 projected population for the Rathdrum Area of City Impact ("ACI") is 14,118.[12] The moderate growth 2028 population projected for the Post Falls ACI is 69,732 people.[11] Normalizing the population projections for the two cities to 2030 (using a 3.5 percent rate) provides a combined population of 88,167 people $((14{,}118 + (69{,}732 \times 1.035^2))$.

**Wastewater Flow Projections**

In its Comprehensive Plan,[9] the City of Spokane selected a service level goal of managing 100 gallons of sewage per person per day because "although some citizens may generate less or more sanitary sewer, this is an accepted average that can be used for planning purposes." The City of Spokane indicates that future demand is based on 100 gpcd times the forecast population and that treatment capacity is based on the permitted capacity of SAWTP minus 9.6 mgd of flow due to I/I.[9] Based on these criteria, the City of Spokane's 2026 flow projection should be 9.6 + 27.0 = 36.6 mgd. Since 10 mgd of capacity is dedicated to Spokane County, a 2026 projected average plant flow of 46.6 mgd would be expected. However, the DO TMDL report uses a flow basis of 50.8 mgd. The difference of 4.2 mgd is unexplained, but this surplus flow projection has the effect of "banking" a 9 percent improvement in phosphorus wasteload allocation for the City of Spokane.

In its wastewater treatment plant planning report,[10] Spokane County decided that for 2030, wastewater flow projections for its service area would be based on 200 gallons per day per equivalent residential unit ("ERU") plus 0.25 commercial ERU for every new residential ERU. Spokane County defines an ERU as serving 2.5 persons. In addition, the County allocates 7.5 gpcd for I/I. Spokane County therefore used a flow per capita of 107.5 gallons per day ((200+50)/2.5+7.5) for its facility planning. For wastewater facility planning purposes, the County uses a medium growth projection for 2030 of 167,564 people.[10] This number times 107.5 gpcd equals 18 mgd of treatment capacity. Spokane County's new 8 mgd treatment plant (under construction) together with the 10 mgd contracted capacity at SAWTP will provide the capacity needed for 2030. Notably, the Draft TMDL uses Spokane County's flow projection for 2030 to calculate its wasteload, whereas WDOE/EPA asked Idaho communities to provide flow projections for 2027. The practical difference of this discrepancy is a gain of about 6,600 people, and a 4 percent increase in phosphorus WLA to the County.

**Wasteload Allocations**

Municipal effluent phosphorus WLAs are determined by WDOE for the City of Spokane and Spokane County, and by EPA for Post Falls and other Idaho permittees. Both WDOE and EPA (collectively, "the agencies") have indicated that permitted WLAs will be assigned proportionately to flow in soon-to-be-issued NPDES permits. The agencies have assured the regulated community that the assignment of WLAs will be "fair." The principal of fairness would suggest that one permittee would not be favored over the other. The agencies have requested flow projection data from the permittees, without guidance or supervision over how those projections should be derived, other than to project flows for the year 2027.

As the wastewater treatment agency for two cities, Post Falls is revising its 2030 flow projections to be consistent with the methods used by City of Spokane and Spokane County. In this calculation, the flow projection criteria used by Spokane County are used: flow per capita = 100 gpcd, I/I = 7.5 gpcd, and population = medium 2030 growth projection. As indicated above, the combined 2030 population for the Post Falls/Rathdrum ACIs is 88,167 people. The projected flow is therefore 9.5 mgd (88,167 x 107.5).

The Draft TMDL supposes an effluent phosphorus concentration of 0.036 mg/L for Post Falls compared to 0.042 ug/L for the City of Spokane and Spokane County. The reason that Post Falls is listed in the TMDL report at a lower concentration than the City of Spokane City and Spokane County is a matter of dispute with EPA and WDOE. In order to be fair, Post Falls should be issued a WLA derived by the same methods as was used for City of Spokane and Spokane County. Using 0.042 ug/L concentration consistent with the City of Spokane and Spokane

County, the Post Falls wastewater treatment facility should receive a phosphorus load allocation of 3.33 pounds per day.

**References**


1. WDOE, 2009, "Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load – Draft Water Quality Improvement Report, September 2009, Publication no. 07-10-073 (Revised)."
2. Lindburg, M. R., 1986, "Civil Engineering Reference Manual" pp 8-8 to 8-9.
3. http://www.spokaneriverpartners.com/uploads/Timeline_Graphic.pdf.
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5. Steele, K. D., May 16, 2004, "City routinely dumps sewage into river." Spokesman-Review.
6. Greater Spokane Incorporated, 2009, Website: www.relocatespokane.com.
7. City of Spokane, September 2006, "City of Spokane Initial Urban Growth Boundary Proposal and Residential Land Capacity Summary."
8. Kootenai County, 2009, Draft Comprehensive Plan.
9. City of Spokane, May 21, 2001, Comprehensive Plan/EIS.
10. Spokane County, December 17, 2007, Basis of Planning Summary.
11. Stravens, J.P., January 2, 2007, "Demographic Analysis & Growth Projections for City of Post Falls, ID."
12. Kootenai County Metropolitan Planning Organization, March 5, 2009, "KMPO Growth Projections."
13. U.S. Census Bureau.

CITY OF
POST FALLS

Public Services Department
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Certified Mail 706 0810 0004 5528 7737

January 6, 2010

David Moore
Department of Ecology
State of Washington
4601 N. Monroe St.
Spokane, WA 99205-1295

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Cc: Brian Nickel, USEPA
Jim Bellatty, WDOE
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Attchment: Revised Flow Projections

# CITY OF POST FALLS

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**Wasteload Allocations**

Municipal effluent phosphorus WLAs are determined by WDOE for the City of Spokane and Spokane County, and by EPA for Post Falls and other Idaho permittees. Both WDOE and EPA (collectively, "the agencies") have indicated that permitted WLAs will be assigned proportionately to flow in soon-to-be-issued NPDES permits. The agencies have assured the regulated community that the assignment of WLAs will be "fair." The principal of fairness would suggest that one permittee would not be favored over the other. The agencies have requested flow projection data from the permittees, without guidance or supervision over how those projections should be derived, other than to project flows for the year 2027.

As the wastewater treatment agency for two cities, Post Falls is revising its 2030 flow projections to be consistent with the methods used by City of Spokane and Spokane County. In this calculation, the flow projection criteria used by Spokane County are used: flow per capita = 100 gpcd, I/I = 7.5 gpcd, and population = medium 2030 growth projection. As indicated above, the combined 2030 population for the Post Falls/Rathdrum ACIs is 88,167 people. The projected flow is therefore 9.5 mgd (88,167 x 107.5).

The Draft TMDL supposes an effluent phosphorus concentration of 0.036 mg/L for Post Falls compared to 0.042 ug/L for the City of Spokane and Spokane County. The reason that Post Falls is listed in the TMDL report at a lower concentration than the City of Spokane City and Spokane County is a matter of dispute with EPA and WDOE. In order to be fair, Post Falls should be issued a WLA derived by the same methods as was used for City of Spokane and Spokane County. Using 0.042 ug/L concentration consistent with the City of Spokane and Spokane

County, the Post Falls wastewater treatment facility should receive a phosphorus load allocation of 3.33 pounds per day.

**References**


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13. U.S. Census Bureau.

**Exhibit 16**

**J-U-B ENGINEERS, Inc.**
Engineers•Surveyors •Planners
7825 Meadowlark Way
Coeur d'Alene, ID 83815
(208) 762-8787
Fax: (208) 762-9797

Date: March 11, 2010

To: City of Post Falls: Terry Werner, Public Services Director; Michael Neher, Environmental Coordinator

From: Paul Klatt, P.E.

Subject: Post Falls' Phosphorus, $CBOD_5$ and Ammonia Waste Load Allocation Needs for Future Population

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Per your request, I have reviewed the population projections and flow trends from the public sources cited herein in order to evaluate the City of Post Falls' need for total phosphorus waste load allocation (WLA) for the next 20 years. From this data, I believe that the City is justified in requesting an increase from the 1.50 pounds per day (ppd) that is currently assumed in Portland State University's Final Scenarios Report (PSU, 2010) and referenced in the Washington Department of Ecology's February 2010 Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load (TMDL - WDOE, 2010). The analysis supports Post Falls receiving a 3.19 ppd WLA based on a seasonal average with daily phosphorus testing.

Post Falls engaged J.P. Stravens in 2007 to look very carefully at where their boundaries and obligations will take them for the next 20 years. Stravens determined that Post Falls' Area of City Impact (ACI) will grow from 33,860 to 69,732 people by 2028 (Stravens, 2007).

The City of Rathdrum also discharges 100% of their wastewater to the Post Falls Water Reclamation Facility (WRF). Rathdrum believes that it is reasonable and prudent to include the March 2009 growth numbers projected by the Kootenai Metropolitan Planning Organization (KMPO, 2009) for planning their municipal boundaries and service obligations out to 2030. Rathdrum would grow from 7,173 to 14,118 people during that time. The results show that, even at less than 3.5% annual population growth (which is well below historical rates for the last 20 years) the combined city service areas will have 83,850 people by 2030.

All of the recent planning documents utilize a wastewater flow generation rate of 73 gallons per capita per day (gpcd) for both Rathdrum and Post Falls, including the 2009 Rathdrum Prairie Wastewater Master Plan (JUB, 2009). It is important to realize that these flow generation values DO NOT include the wastewater generated each day by commercial, industrial and municipal land uses. Rather than utilizing different commercial/industrial flow planning values for your communities, it is reasonable and prudent to employ the same additive factor of 25% of residential flow that Spokane County utilized to account for those land uses in their 2007 Facility Plan (Spokane County, 2007).

Cumulatively, the population and flow factors will create a 2030 flow rate for the Post Fall WRF of 7.65 mgd (83,850 people x 73 gpcd x 1.25). The 2010 TMDL accounted for only 5.0 mgd because that is the capacity of the current expansion that the City submitted - believing that all other entities were using a similar approach.

It is important to note that Post Falls is NOT allowing any increase in its flow projection to account for infiltration and inflow (I/I). While you can document conditions which create I/I, Post Falls' sewer system has been constructed in the last 25 years and you have never considered significant I/I to be a legitimate condition in modern construction, operation or maintenance of a sewer collection system. This is an important distinction since all total phosphorus allocations in the TMDL are based on projected flow rates rather than whether their origin is groundwater or stormwater as compared to wastewater.

As acknowledged by Appendix L as well as numerous comments to the TMDL, Post Falls and other municipal entities along the Spokane River have supported and/or performed significant research, pilot testing and application of the best phosphorus treatment technology available in the world. The conclusion is that a seasonal average or median value of 50 ug/L total phosphorus is an appropriate technologically achievable limit. Therefore, Post Falls is justified in requesting a seasonal average WLA of 3.19 pounds of total phosphorus per day in the revision to the February 2010 Total Maximum Daily Load Water Quality Improvement Report (7.65 mgd x 0.050 ppm x 8.34 pounds per gallon). This is a reasonable and prudent waste load allocation rather than the currently allocated 1.5 ppd.

It is important to note that the 5-day carbonaceous biochemical oxygen ($CBOD_5$) demand must be increased proportionately to the flow rate increase for Post Falls. At a reasonably achievable value of 4 mg/L (below the 5 mg/L listed in the PSU report), that would equate to 255 ppd. Additionally, ammonia appears to be insignificant for Idaho point sources, as documented in the September 1, 2009 LimnoTech modeling analysis utilizing 8 mg/L for all Idaho point sources and submitted in your October 30, 2009 comments to the Draft TMDL. However, the TMDL appears to provide Idaho point sources a WLA based on 0.71 mg/L. This should also be adjusted to a fair and reasonable WLA based on 4 mg/L of ammonia (255 ppd).

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