Lower Boise River Implementation Plan Total Phosphorus

Final

Lower Boise Watershed Council
and the
Department of Environmental Quality

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Executive Summary

The Idaho Department of Environmental Quality (IDEQ) prepared the Snake River – Hells Canyon Total Maximum Daily Load (SR-HC TMDL) (IDEQ/ODEQ 2004) in conjunction with the Oregon Department of Environmental Quality (ODEQ), the Environmental Protection Agency (EPA), and a Public Advisory Team (PAT) for the Snake River from its intersection with the Oregon/Idaho border near Adrian, Oregon (RM 409) to immediately upstream of the inflow of the Salmon River (RM 188). As the report states, "The overall goal of the SR-HC TMDL is to improve water quality in the SR-HC TMDL reach by reducing pollution loadings from all appropriate sources to meet water quality standards and restore full support of designated beneficial uses" (IDEQ/ODEQ 2004, p. 17).

To reduce "nuisance" algal growth in the Snake River upstream from Brownlee Reservoir, the SR-HC TMDL establishes a May 1 to September 30 instream total phosphorus (TP) target of 0.07 milligrams per liter (mg/L) in concert with a mean growing season limit for chlorophyll *a* of 14 micrograms per liter (ug/L) (nuisance threshold of 30 ug/L with exceedance threshold of no greater than 25%) for the SR-HC reach upstream from Brownlee Reservoir. To meet this target, the SR-HC TMDL allocates TP loads to point sources and nonpoint sources discharging directly to the SR-HC reach and treats tributaries to the reach "as discrete, nonpoint sources for the purposes of loading analysis and allocation within this TMDL" (IDEQ/ODEQ 2004, pp. 21, 235, 439, 447). The SR-HC TMDL assigned target concentrations of 0.07 mg/L to the mouths of each of the SR-HC reach tributaries as the basis for determining seasonal tributary loading that will attain the SR-HC reach instream TP target (IDEQ/ODEQ 2004, p. 447).

After EPA approved the SR-HC TMDL in September 2004, the task of developing TP allocations for tributary point and nonpoint sources in order to attain the concentration-based tributary targets of 0.07 mg/L fell to IDEQ and the tributary watershed advisory groups (WAGs). Idaho Code section 39-3611(6) provides: "If a pollutant load is allocated to a tributary inflow as part of a downstream TMDL, the director shall develop a plan to meet such allocation in consultation with the tributary watershed advisory group." The SR-HC TMDL anticipated that, in consultation with tributary WAGs, "existing or future tributary TMDL processes will distribute load allocations in the form of load allocations and/or waste load allocations within their specific watersheds", "as an extension of the SR-HC TMDL process" (IDEQ/ODEQ 2004, pp. 21, 235, 439-440, 447).

The Lower Boise Watershed Council (LBWC) serves as the Lower Boise River WAG pursuant to its articles and bylaws, and Title 39, Chapter 36 of the Idaho Code. TP allocations have been developed in consultation with the LBWC to attain the 0.07 mg/L target assigned to the Boise River by the SR-HC TMDL. Attainment of this target will be measured at the mouth of the Boise River. This allocation framework allocates the 0.07 mg/L Parma target to lower Boise River nutrient sources on an equitable and reasonable basis.

Total Phosphorus Allocations

Based on the available information for each of the sources, current loads at the locations of each source in the watershed are estimated as summarized in Table A.

Table A. Summary of Estimated Current (Baseline) Source Loads in kg/day

Source Loads	Load Kg/day
WWTFs	670
Stormwater	79
Agricultural	792
Background	89
Ground Water	31
Sum Source Loads	1660

Monitoring data at Parma indicate that Parma loads are approximately 1,029 kilograms per day (kg/day), compared to the estimated source load of 1,660 kg/day. This means that through a combination of reuse and/or attenuation, not all of the phosphorus generated by sources reaches Parma.[1] By calculating relative contributions, the Parma-adjusted loads are shown in Table B. Note that applying these relative contributions conservatively overestimates the load that reaches Parma, as compared to the available empirical monitoring data.

Table B. Summary of Estimated Current (Baseline) Parma-adjusted Loads in kg/day

Parma Loads	Load Kg/day
WWTFs	309
Stormwater	46
Agricultural	642
Background	9
Ground Water	24
Sum Parma Loads	1,029

A summary of the overall load reduction approach is as follows:

- Significant reduction of phosphorus in effluent from wastewater treatment facilities (WWTFs) within three National Pollutant Discharge Elimination System (NPDES) permit cycles. The proposed approach consists of three steps with an ultimate 15-year time frame for WWTF controls: 1) 1 mg/L, 80+% reduction, via enhanced biological phosphorus removal (EBPR) or equivalent within the first permit cycle; 2) 0.5 mg/L, 90-92% reduction, within the second permit cycle; and 3) 0.200 mg/L, 96-97% reduction, within the third permit cycle.
- An overall TP reduction goal of 50% will be implemented by stormwater dischargers and applied to new development and substantial redevelopment. The 50% TP reduction from stormwater would be accomplished through establishing best management practices (BMPs) that target phosphorus reduction, and increased attention to on-site stormwater inspection, maintenance, and public education.
- Voluntary BMP implementation on agricultural lands, contingent on available funding levels and previously-developed implementation plans. This analysis assumes 50% BMP effectiveness, which is lower than the 68% achieved in the Rock Creek Project (IDEQ/ODEQ 2004, Appendix I**)**. Reductions in TP discharges from irrigated lands greater than 50% will require conversion to sprinkler irrigation, zero discharge, and other treatment methods that may be feasible in certain locations, but cannot be applied broadly due to financial constraints, hydrology, crop requirements, and other factors affecting BMP implementation.

[1] Under low flow conditions, loading at Parma is also lower. At flows of approximately 400 cubic feet per second (cfs), the daily loading at Parma is approximately 300 kg/day, which is less than 20% of the phosphorus loads estimated to be generated at each of the sources (1,660 kg/day).

- Conversion of agricultural land to other land uses is a critical assumption in meeting the TP load target at the mouth of the Boise River. Urban land has a lower phosphorus loading rate, on a per acre basis, than agricultural land. Thus, as agricultural land is converted to urban land use, there will be a subsequent reduction in phosphorus loading. Load allocations are based on actual land use conversion rates consistent with adaptive management identified in the SR-HC TMDL.

Given the combination of point and nonpoint sources in the watershed and their associated loads, all sources must be considered together to achieve the TP target of 0.070 mg/L at Parma. Under median flow conditions in the Boise River (1,225 cfs), the loading at Parma that achieves this concentration is 210 kg/day. (The SR-HC TMDL allocates 242 kg/day for the Boise River. However, this is based on median flows in the Snake River.)

Table C shows the long term prediction of time needed to reach a seasonal average of 0.07 mg/L TP in the lower Boise River watershed.

Table C. Long-term Prediction of a Seasonal Average of 0.07 mg/L

	Year														
Estimated Load at Parma (kg/day)	**Baseline**	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**% Change*** **
WWTF Load	309	112	63	30	31	33	35	37	38	40	42	44	45	47	49	-84%
Stormwater Load *	46	47	49	51	53	54	56	58	60	61	63	65	67	68	70	54%
Agriculture Load **	642	542	506	418	387	311	283	219	195	143	123	104	84	64	44	-93%
Ag reductions due to land use conversion **	0	40	79	119	158	198	237	277	316	356	395	435	474	514	553	-86%
Ag reductions due to BMPs **	0	60	56	105	97	133	121	146	130	143	123	104	84	64	44	-7%
Background	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	0%
Ground water	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	0%
Parma Load	1029	735	652	532	504	432	407	347	327	278	262	245	229	213	**197**	-81%

NOTES:

* Increases in stormwater loads due to land use conversion that is expected to add urban-suburban acreage.

** *Reductions in agricultural loads include two elements: reductions due to loss of agricultural lands (due to land use conversion 59%) and reductions due to BMP effectiveness (34%).*

*** % Change represents % difference between baseline and estimated long-term (Year 65) loads. Numbers are based on estimated future acreage (land use conversion rates).

The Lower Boise River model is used within this framework to show that the TP load reductions and attainment of the goal at Parma is estimated to be ultimately achieved via a combination of controlling point and nonpoint sources. Ultimately, the SR-HC target is the attainment of beneficial uses, which is driven by chlorophyll *a* levels that will need to be monitored in relationship to the TP goal.

Based on known river dynamics including assimilation, distance, and detention time in Brownlee Reservoir, this scenario will improve water quality in the Snake River and the reservoir.
The concept of nutrient spiraling by Newbold et al. (1981) describes variability in nutrient uptake, processing, and retention in streams and rivers. This concept has been examined in a number of subsequent studies, where abiotic and biotic interactions have been observed to control nutrient cycling rates (Thomas et al. 2005; Mulholland et al. 2001). The irrigation system in the Lower Boise River, with its numerous canals and ditches, effectively increases stream channel, stream bank, and riparian zone ratios. This in turn provides more opportunity for processing/assimilation via hyporheic exchanges and aquatic plant (algae, macrophytes) and animal (macroinvertebrates, bacteria) growth. MacCoy (2004) suggests this in her study of the Lower Boise River when she noted, "The tributaries contributed 1,290 lb/d [pounds per day], primarily as ortho-phosphorus, and 350 lb/d was lost, probably owing to withdrawals or plant uptake." She also noted this in the main Boise River, "…and 1,450 lb/d was lost, probably owing to irrigation withdrawals or plant uptake." This would suggest that phosphorus is attenuated in the Lower Boise River during the irrigation/growing season.

In Brownlee Reservoir, given its short retention time (34 days on average), phosphorus moves rapidly through the reach (IDEQ/ODEQ 2004, p. 316). However, this is dependent on season, water year, and tributary input. It should also be noted that the largest biomass of algae occurs in May and June, coinciding with spring runoff, and begins to taper off in July, August, and September (IDEQ/ODEQ 2004, figure 3.2.20). This suggests that phosphorus coming into Brownlee Reservoir in those months from the Lower Boise River would not contribute to significant algae blooms.

It is important to note that this estimation relies on a variety of data sources and numerous assumptions in the absence of appropriate data. This information will require additional analysis during the adaptive implementation period. Recognizing that there are multiple uncertainties in projecting achievement of the target over a long-term period, the critical uncertainties include the following:

- Actual rate of land use conversion
- Effects of that land use conversion on runoff and infiltration
- Urban-suburban water demand and use
- Urban-suburban stormwater runoff concentrations (wet- and dry-weather)
- Effectiveness of stormwater BMPs
- Effectiveness of agricultural BMPs
- Ability of ground water phosphorus levels to recover in converted areas
- Future drainage and water management policies

Implementation Strategies

The time frame for achieving these allocations will depend on the rate of land use conversion, the available funding that can be applied to nonpoint agricultural BMPs, and the recovery rate of ground water as land uses are converted. The long-term time frame may be shortened if funding for non point source control is increased substantially and quickly, and/or significant technological breakthroughs occur in nonpoint source control technology.

The implementation schedule is designed to be flexible within an adaptive management framework. The Federal Clean Water Act and the Idaho Water Quality Standards (IDAPA 58.01.02) indicate that in general, actions taken should achieve the highest attainable use through the implementation of point and nonpoint source control programs.

The concept of adaptive management allows for on-the-ground implementation to proceed where uncertainty exists about how and when reduction targets will be met. The adaptive management approach acknowledges that beneficial uses may not be restored for a long period of time, but provides a short-term pathway by which to gauge progress toward that goal.

It may take some period of time to fully implement the appropriate management practices, particularly in this watershed, because of the rapidly changing land use patterns. Many producers are reluctant to commit to financing long-term pollutant management activities because of the rapid land use transitions that are occurring.

The specific level of reduction realized by attainment of the concentration-based target is dependent on the type of water year and the tributary. Setting a concentration-based target means that in high flows, the loading delivered at the target value will be greater than the load delivered at the target value during medium or low-flow years. Low and average flow years may show a larger relative percentage reduction in nutrient loading by meeting the 14 ug/L mean growing season chlorophyll *a* concentration and 0.07 mg/L TP targets as loading is based on instream flow (load = flow x concentration).

For the Lower Boise River, concentration reductions under varying flows have been calculated. The average reductions required are 73%, 79%, and 80% for high, median, and low-flow conditions respectively.

The Lower Boise River Implementation Plan allocations when fully implemented are projected to result in an 82% load reduction in low-flow years.

The 90th percentile flow duration interval (90% of flows exceed) for May – September (379 cfs Boise River at Parma) was considered as an appropriate low flow scenario. Based on the projected nonpoint source loads after full implementation and land use conversion and even with total removal of wastewater effluents from the river, a less than or equal to target of 0.07 mg/L total phosphorus in the Boise River at Parma is not achievable during low flow scenarios such as these. However, as seen in Table C, when loads are based on mean flows, a seasonal average concentration of 0.07 mg/L is achievable.

All of these reasons indicate that an adaptive management approach to implementation is appropriate. The stakeholders involved in developing these allocations remain committed to ensuring implementation and continue toward meeting the water quality goals outlined in the SR-HC TMDL.

During the period of adaptive management, focused monitoring will continue to be important. Monitoring should take place at four levels:

1. SR-HC Reach. IDEQ has committed to monitoring this reach as stipulated in the SR-HC TMDL. In addition to the conditions stipulated in the SR-HC TMDL, an equally important monitoring objective is to assess whether beneficial uses are being attained, especially as related to the phosphorus loading and progress toward the target.

2. Lower Boise River Reach. Continued monitoring at key monitoring locations in the lower Boise River (Glenwood, Middleton, and Parma) and at the mouth of key tributaries will provide an indication of how well nonpoint source improvements are performing.

3. BMP Effectiveness Monitoring. Monitoring will be focused on evaluating specific treatment to verify BMPs are properly installed, maintained, and working as designed; evaluating the effectiveness of implementation actions for reducing pollutant loading; gathering information to fill data gaps; and making effectiveness monitoring results available to the public.

4. NPDES Permit Monitoring. Monitoring will be conducted to comply with WWTF discharge limits and municipal separate storm sewer system (MS4) requirements not addressed above.