Memorandum

June 5, 2011

To: Ben Cope, EPA

From: Chris Berger, PSU

Subject: Review of Alternate Spokane River TMDL Scenario – with Alternate Seasonal Limits for Inland Empire Paper

Limnotech's alternate scenario for the Lake Spokane TMDL has been reviewed. The alternative was described in memorandum provided by Limnotech (Dilks and Helfand, 2011). This alternative includes alternative phosphorus limits for Idaho Dischargers, Spokane County and Inland Empire Paper.

Model Inputs

The only model input files affected by alternative were the constituent input files for the following dischargers: Post Falls, HARSB, Coeur d'Alene, Spokane County and Inland Empire Paper. Model inputs were adjusted as specified in the Limnotech memorandum. The alternative ammonia nitrogen, PO4-P, total phosphorus, CBOD ultimate, and CBOD-P concentrations of the Idaho dischargers were plotted in Figure 1 through Figure 5. The concentrations of model inputs for Spokane County and Inland Empire Paper were shown in Figure 6 through Figure 10.

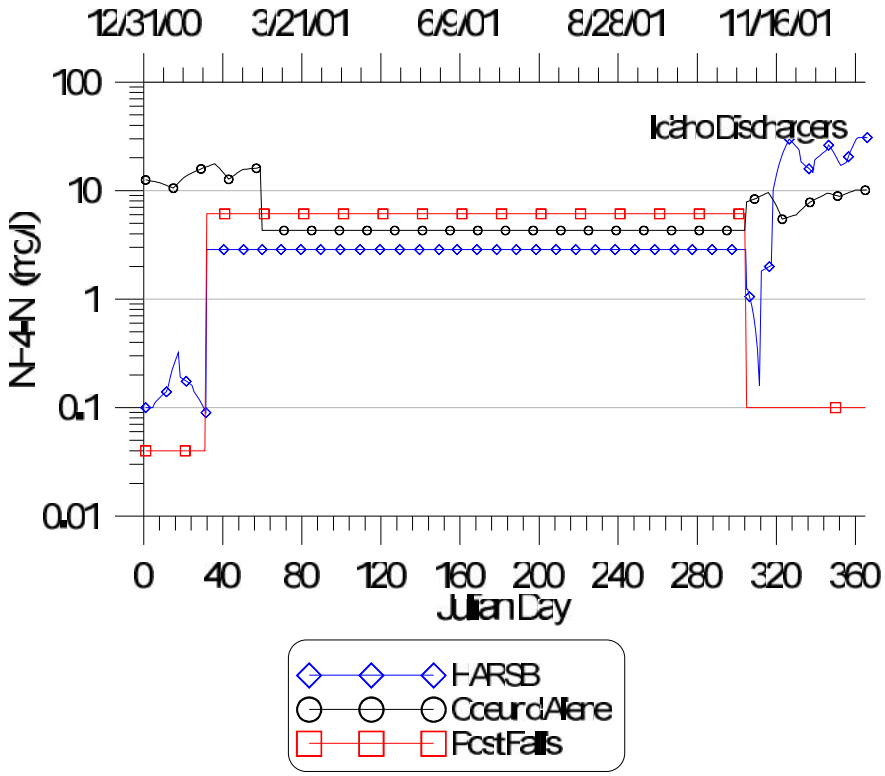

Figure 1. Ammonia nitrogen concentrations of Idaho dischargers for Limnotech alternative.

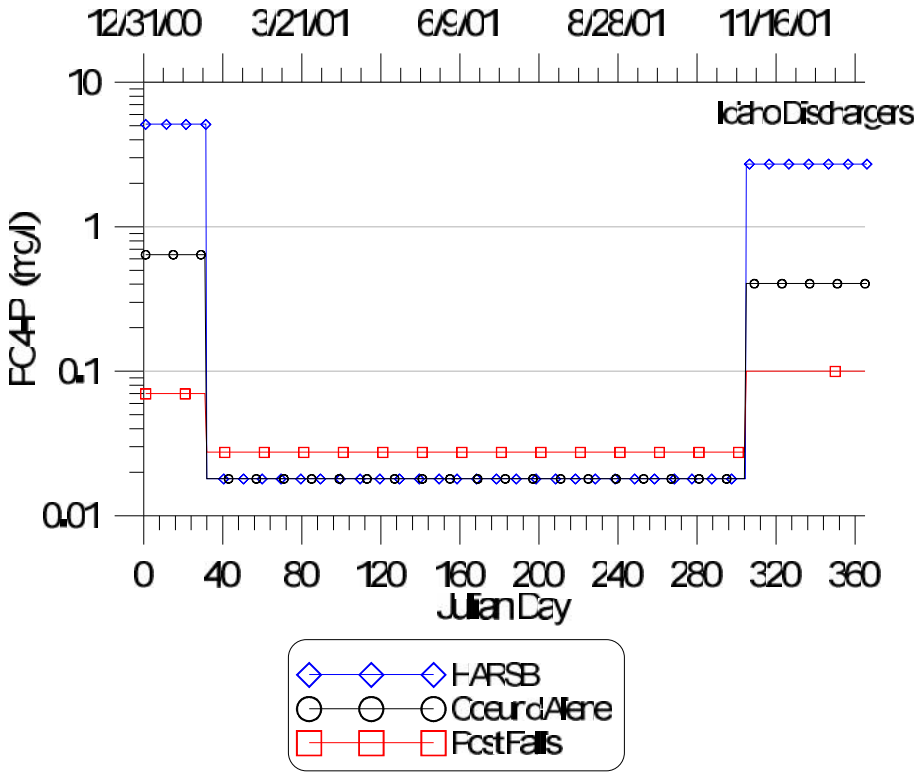

Figure 2. PO4-P concentrations of Idaho dischargers for Limnotech alternative.

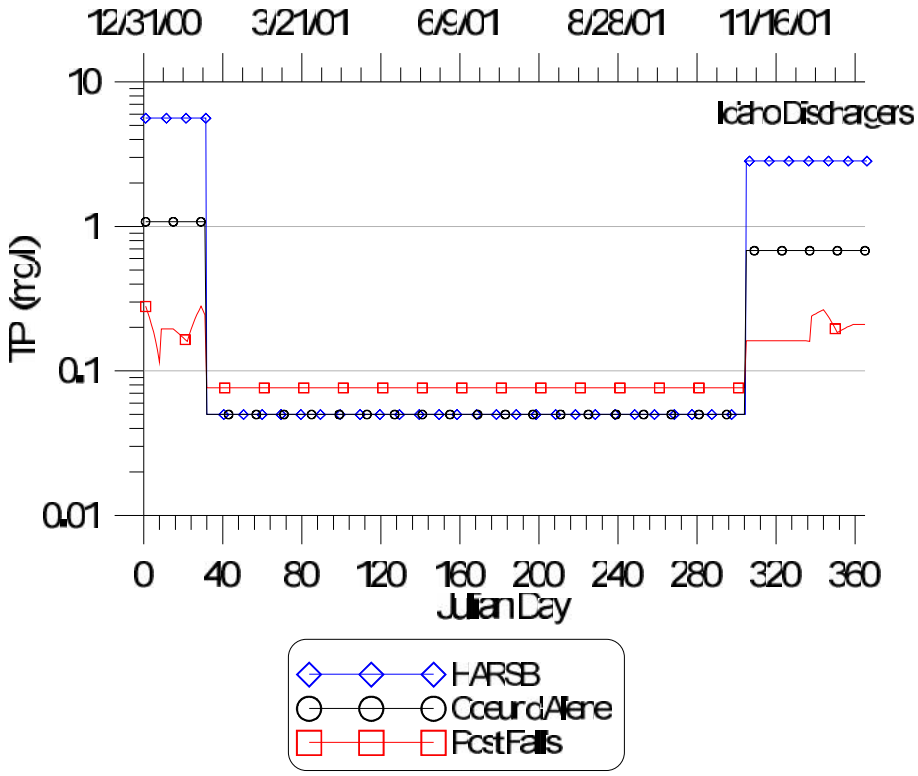

Figure 3. Total phosphorus concentrations of Idaho dischargers for Limnotech alternative.

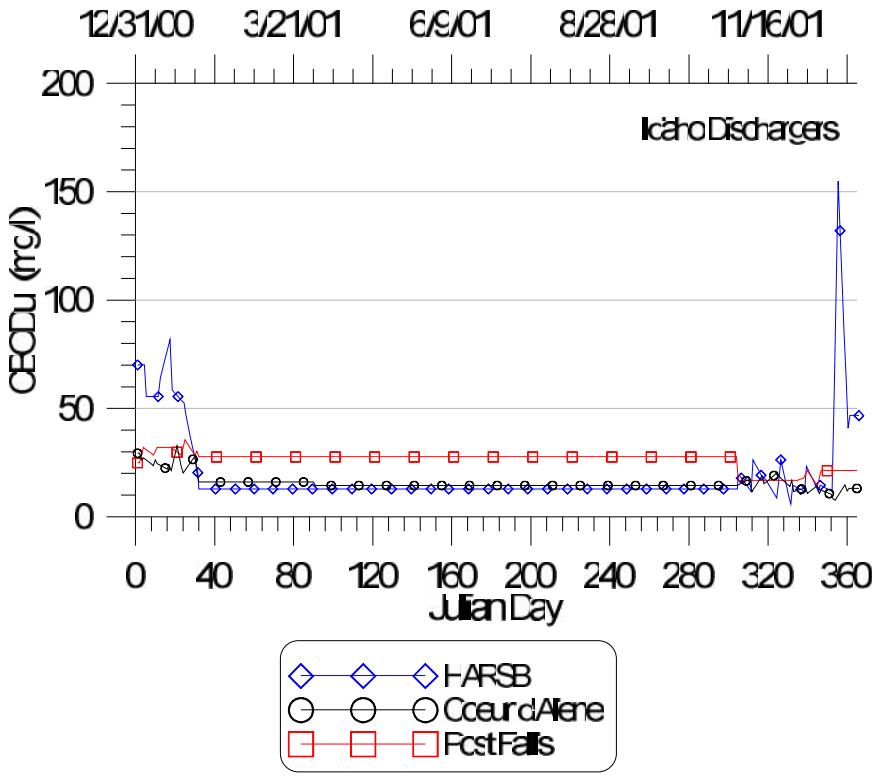

Figure 4. CBOD ultimate concentrations of Idaho dischargers for Limnotech alternative.

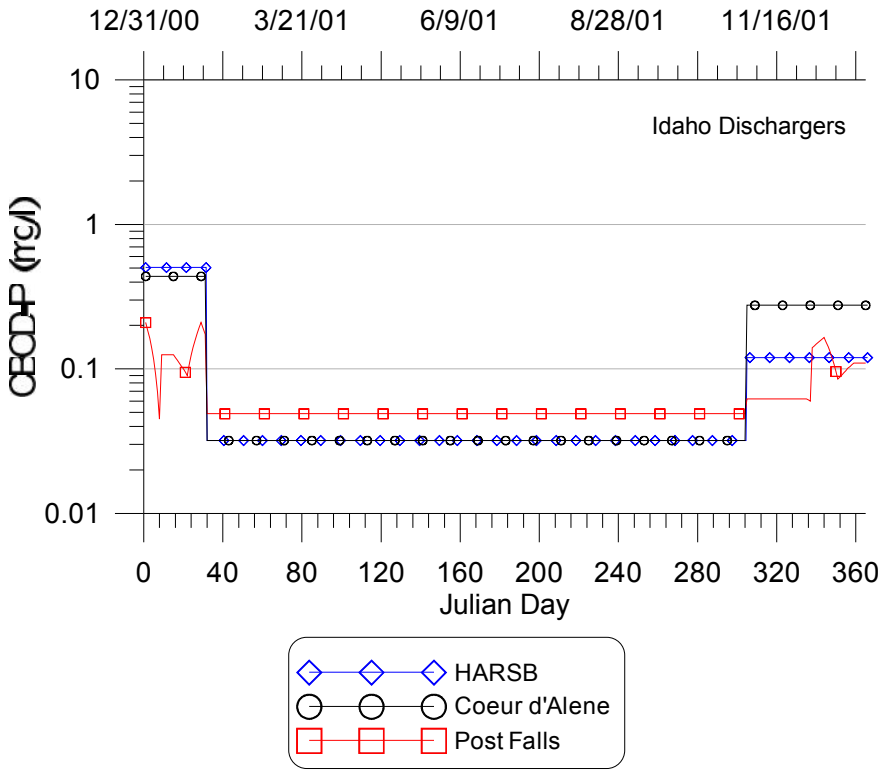

Figure 5. CBOD-P concentrations of Idaho dischargers for Limnotech alternative.

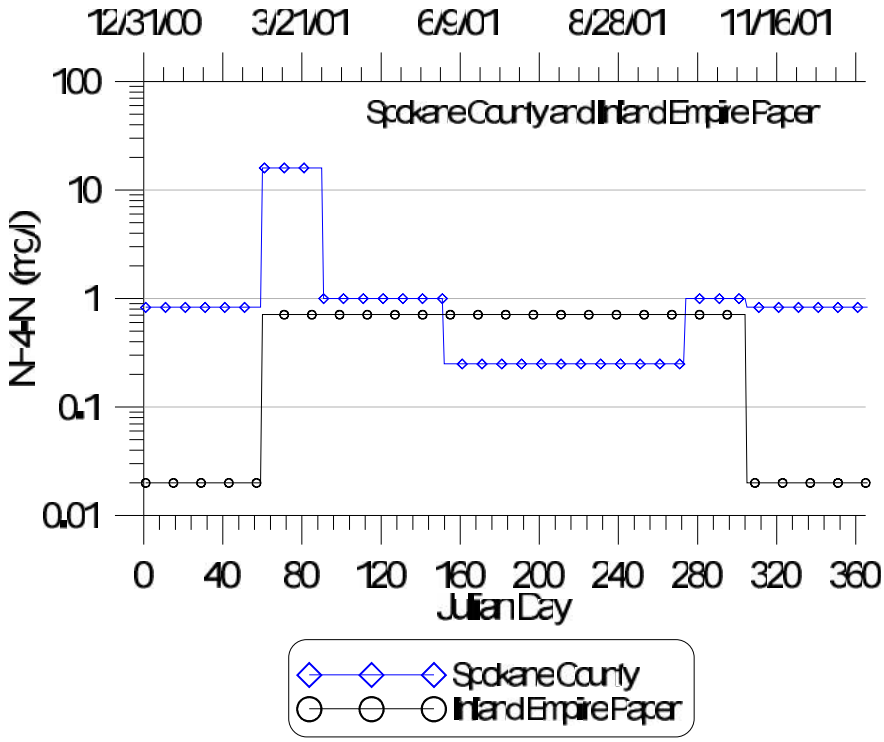

Figure 6. Ammonia nitrogen concentrations of Spokane County and Inland Empire Paper for the Limnotech alternative.

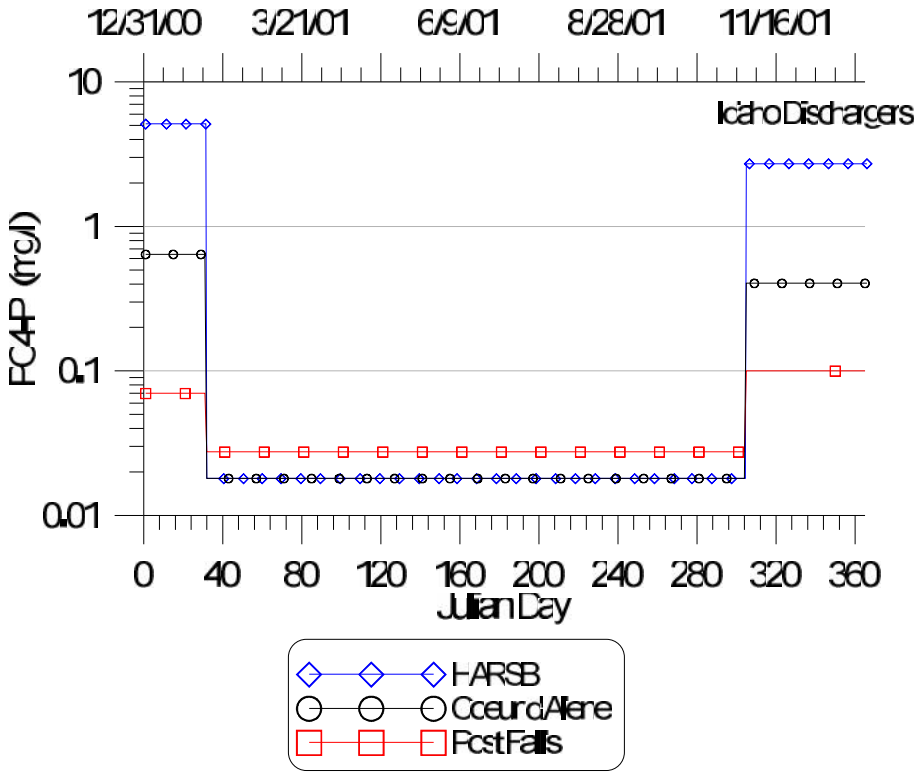

Figure 7. PO4-P concentrations of Spokane County and Inland Empire Paper for the Limnotech alternative.

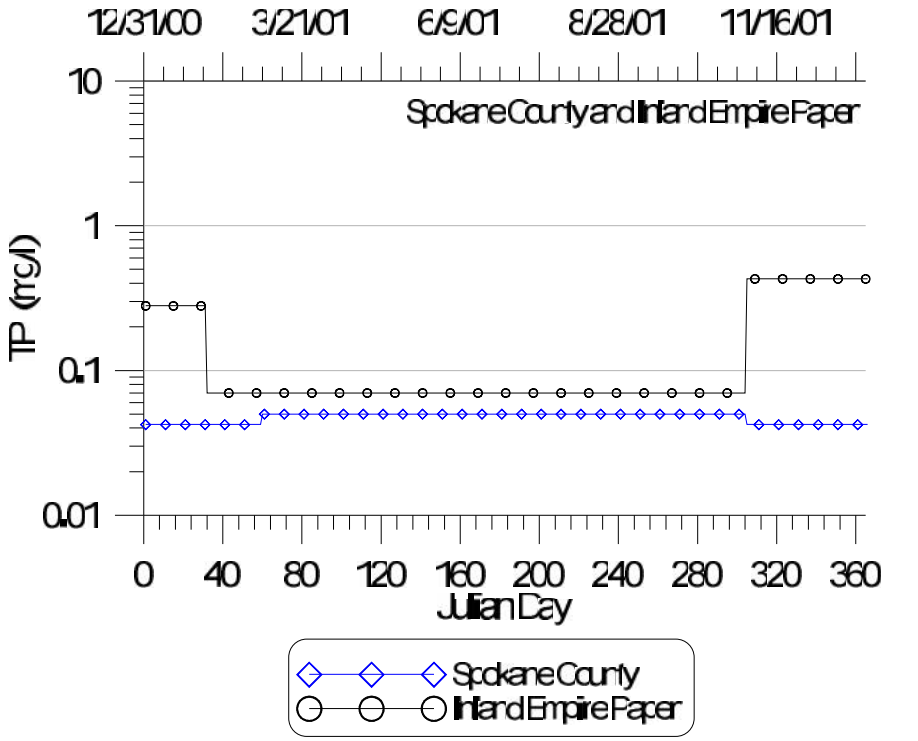

Figure 8. Total phosphorus concentrations of Spokane County and Inland Empire Paper for the Limnotech alternative.

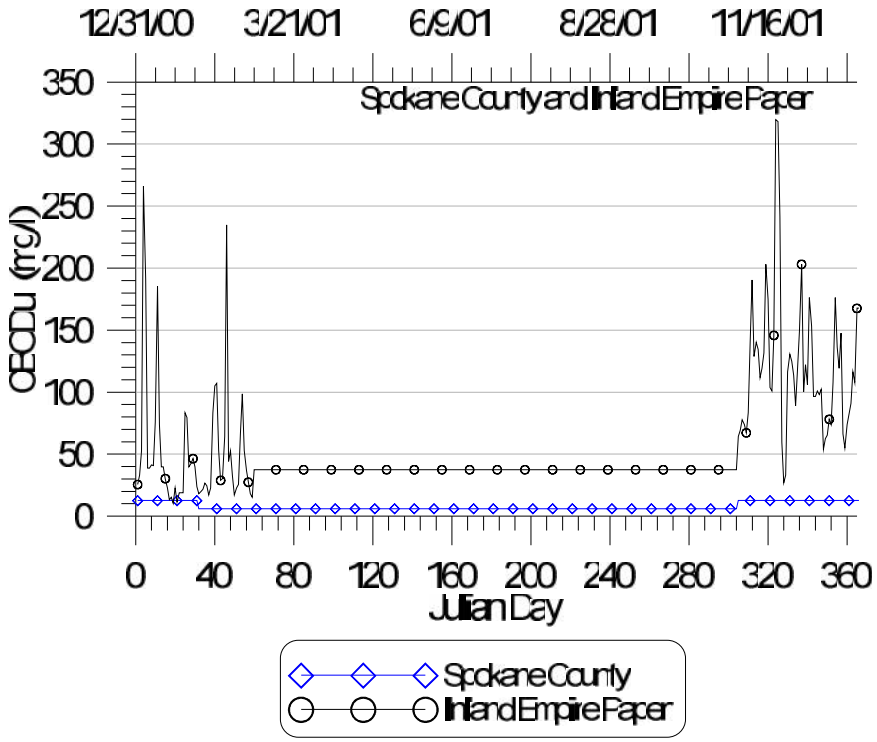

Figure 9. CBOD ultimate concentrations of Spokane County and Inland Empire Paper for the Limnotech alternative.

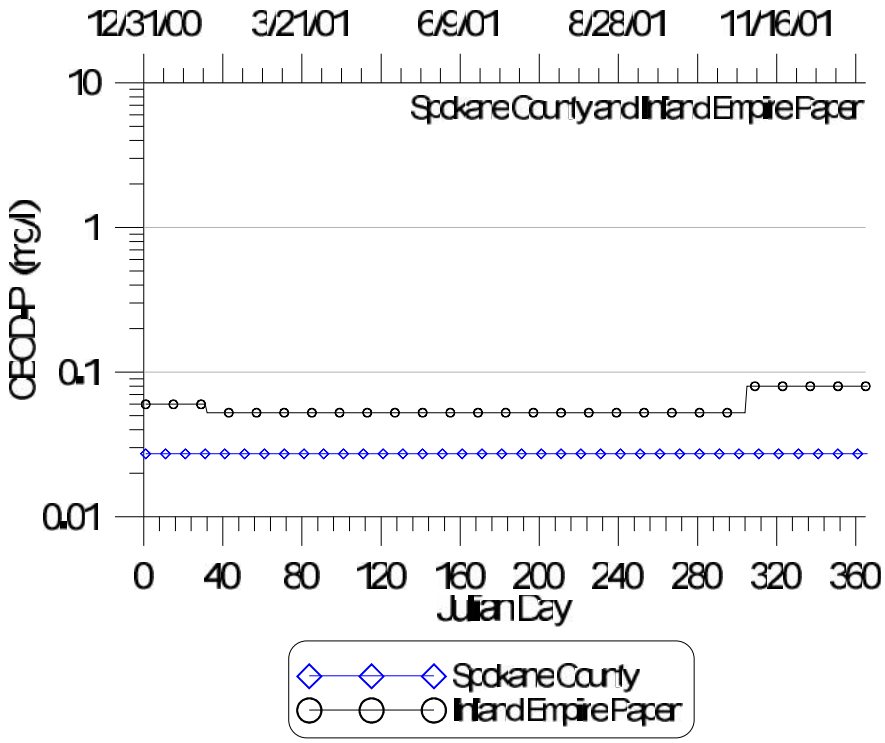

Figure 10. CBOD-P concentrations of Spokane County and Inland Empire Paper for the Limnotech alternative.

Results

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 TMDL scenario and the Limnotech alternative were listed in Table 1 and Table 2. 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 greatest reduction in average DO concentration with respect to the TMDL alternative was -0.0314 mg/l which occurred during November 1-15 in model segment 188. The largest increase in DO concentration was 0.0250 mg/l that occurred September 16-30 in model segment 177. There was no difference in the alternative results between the PSU run and Limnotech run simulations. Table 3 and Table 4 show that the differences in the PSU and Limnotech run simulations were zero for all model segments and time periods. PSU was unable to replicate the results shown in "Table 5" of the Limnotech memorandum (Dilks and Helfand, 2011). The table summarizes increases and decreases in Avista responsibility relative to the TMDL scenario. It is stated that the results were rounded to 0.1 mg/l and perhaps only more explanation of how this was done is necessary.

Table 1. Limnotech alternative average dissolved oxygen concentrations at greater than 8 m depth for June 1 to September 15 compared with TMDL scenario concentrations.

The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The Limnotech alternative 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	**9.66**	*9.65*	0.01	**9.77**	*9.79*	-0.01	**9.50**	*9.49*	0.00	**9.61**	*9.60*	0.01	**9.66**	*9.65*	0.01	**9.85**	*9.84*	0.01	**10.00**	*9.98*	0.01
159	**9.84**	*9.84*	0.00	**9.84**	*9.85*	-0.02	**9.53**	*9.53*	0.01	**9.63**	*9.62*	0.01	**9.64**	*9.63*	0.01	**9.79**	*9.78*	0.01	**9.94**	*9.93*	0.01
160	**9.88**	*9.89*	-0.01	**9.81**	*9.82*	-0.01	**9.47**	*9.47*	0.00	**9.59**	*9.58*	0.01	**9.57**	*9.56*	0.01	**9.71**	*9.70*	0.01	**9.88**	*9.87*	0.01
161	**9.86**	*9.88*	-0.02	**9.90**	*9.91*	-0.01	**9.52**	*9.52*	0.00	**9.58**	*9.58*	0.01	**9.56**	*9.55*	0.01	**9.69**	*9.68*	0.01	**9.86**	*9.84*	0.01
162	**9.89**	*9.92*	-0.03	**9.98**	*9.98*	0.00	**9.53**	*9.52*	0.00	**9.60**	*9.59*	0.01	**9.54**	*9.53*	0.01	**9.62**	*9.61*	0.01	**9.80**	*9.79*	0.01
163	**9.95**	*9.97*	-0.01	**10.04**	*10.04*	0.00	**9.56**	*9.55*	0.00	**9.64**	*9.63*	0.01	**9.54**	*9.53*	0.01	**9.53**	*9.52*	0.01	**9.74**	*9.73*	0.01
164	**10.03**	*10.04*	-0.01	**10.06**	*10.07*	-0.01	**9.52**	*9.51*	0.00	**9.63**	*9.62*	0.00	**9.48**	*9.47*	0.01	**9.38**	*9.37*	0.01	**9.63**	*9.62*	0.01
165	**10.06**	*10.07*	-0.01	**10.08**	*10.09*	-0.01	**9.37**	*9.37*	0.00	**9.53**	*9.53*	0.00	**9.37**	*9.35*	0.01	**9.12**	*9.11*	0.01	**9.51**	*9.50*	0.01
166	**10.02**	*10.03*	-0.01	**10.01**	*10.02*	-0.01	**9.06**	*9.06*	0.00	**9.31**	*9.30*	0.00	**9.16**	*9.15*	0.01	**8.86**	*8.85*	0.01	**9.39**	*9.38*	0.01
167	**10.03**	*10.03*	-0.01	**9.97**	*9.97*	-0.01	**8.87**	*8.87*	0.00	**9.08**	*9.07*	0.01	**8.98**	*8.97*	0.01	**8.64**	*8.63*	0.01	**9.28**	*9.27*	0.01
168	**10.09**	*10.10*	0.00	**9.90**	*9.90*	-0.01	**8.58**	*8.58*	0.00	**8.64**	*8.64*	0.01	**8.62**	*8.61*	0.01	**8.22**	*8.20*	0.02	**9.12**	*9.11*	0.01
169	**10.14**	*10.15*	-0.01	**9.80**	*9.81*	-0.01	**8.41**	*8.42*	0.00	**8.38**	*8.37*	0.01	**8.37**	*8.36*	0.01	**7.94**	*7.92*	0.02	**8.92**	*8.90*	0.02
170	**10.16**	*10.18*	-0.01	**9.69**	*9.71*	-0.01	**8.37**	*8.37*	0.00	**8.24**	*8.24*	0.01	**8.23**	*8.22*	0.01	**7.73**	*7.71*	0.02	**8.66**	*8.65*	0.02
171	**10.15**	*10.17*	-0.02	**9.64**	*9.65*	-0.01	**8.39**	*8.40*	0.00	**8.18**	*8.17*	0.01	**8.12**	*8.11*	0.01	**7.57**	*7.55*	0.02	**8.44**	*8.42*	0.01
172	**10.07**	*10.09*	-0.02	**9.44**	*9.45*	-0.01	**8.17**	*8.18*	-0.01	**7.81**	*7.81*	0.00	**7.68**	*7.67*	0.01	**7.10**	*7.08*	0.01	**8.06**	*8.04*	0.02
173	**9.96**	*9.97*	-0.01	**9.29**	*9.31*	-0.01	**8.00**	*8.01*	-0.01	**7.56**	*7.56*	0.00	**7.40**	*7.39*	0.01	**6.81**	*6.79*	0.01	**7.75**	*7.73*	0.02
174	**9.79**	*9.80*	-0.01	**9.11**	*9.12*	-0.01	**7.79**	*7.80*	-0.01	**7.27**	*7.27*	0.00	**7.07**	*7.07*	0.00	**6.44**	*6.43*	0.01	**7.34**	*7.32*	0.02
175	**9.67**	*9.68*	0.00	**8.96**	*8.98*	-0.01	**7.67**	*7.68*	0.00	**7.10**	*7.10*	0.00	**6.86**	*6.86*	0.00	**6.24**	*6.23*	0.01	**7.04**	*7.02*	0.02
176	**9.57**	*9.58*	-0.01	**8.89**	*8.90*	-0.01	**7.61**	*7.61*	0.00	**7.00**	*7.00*	0.00	**6.80**	*6.80*	0.00	**6.15**	*6.14*	0.01	**6.92**	*6.90*	0.02
177	**9.29**	*9.30*	-0.01	**8.52**	*8.53*	-0.01	**7.20**	*7.20*	0.00	**6.46**	*6.46*	0.00	**6.23**	*6.23*	0.00	**5.56**	*5.55*	0.01	**6.24**	*6.22*	0.02
178	**9.20**	*9.21*	-0.01	**8.41**	*8.42*	-0.01	**7.10**	*7.11*	0.00	**6.34**	*6.34*	0.00	**6.16**	*6.16*	0.00	**5.48**	*5.48*	0.01	**6.07**	*6.05*	0.02
179	**9.13**	*9.14*	-0.01	**8.36**	*8.37*	-0.01	**7.07**	*7.07*	0.00	**6.27**	*6.27*	0.00	**6.11**	*6.10*	0.00	**5.46**	*5.45*	0.00	**5.92**	*5.91*	0.01
180	**9.04**	*9.05*	-0.01	**8.28**	*8.29*	-0.01	**7.02**	*7.02*	0.00	**6.19**	*6.19*	0.00	**6.02**	*6.02*	0.00	**5.43**	*5.43*	0.00	**5.76**	*5.75*	0.01
181	**8.93**	*8.95*	-0.02	**8.19**	*8.21*	-0.01	**6.96**	*6.96*	0.00	**6.08**	*6.08*	0.00	**5.88**	*5.88*	0.00	**5.36**	*5.36*	0.00	**5.54**	*5.54*	0.01
182	**8.94**	*8.96*	-0.02	**8.20**	*8.20*	0.00	**7.01**	*7.01*	0.00	**6.13**	*6.13*	0.00	**5.92**	*5.91*	0.00	**5.46**	*5.46*	0.00	**5.53**	*5.53*	0.00
183	**8.77**	*8.78*	-0.01	**7.97**	*7.97*	0.00	**6.84**	*6.84*	0.00	**5.97**	*5.97*	0.00	**5.68**	*5.68*	0.00	**5.29**	*5.29*	0.00	**5.28**	*5.28*	0.00
184	**8.74**	*8.75*	-0.01	**7.93**	*7.93*	0.00	**6.88**	*6.88*	0.00	**6.01**	*6.01*	0.00	**5.71**	*5.71*	0.00	**5.33**	*5.33*	0.00	**5.35**	*5.35*	0.00
185	**8.62**	*8.63*	0.00	**7.86**	*7.86*	0.00	**6.88**	*6.88*	0.00	**6.01**	*6.00*	0.00	**5.64**	*5.64*	0.01	**5.30**	*5.29*	0.00	**5.28**	*5.28*	0.00
186	**8.44**	*8.46*	-0.01	**7.73**	*7.72*	0.00	**6.76**	*6.76*	0.00	**5.84**	*5.84*	0.00	**5.41**	*5.41*	0.00	**5.08**	*5.08*	0.00	**4.93**	*4.94*	0.00
187	**8.40**	*8.42*	-0.01	**7.74**	*7.74*	0.00	**6.79**	*6.80*	0.00	**5.83**	*5.83*	0.00	**5.35**	*5.35*	0.00	**5.04**	*5.05*	0.00	**4.90**	*4.90*	0.00
188	**8.27**	*8.29*	-0.02	**7.56**	*7.56*	0.00	**6.66**	*6.66*	0.00	**5.72**	*5.72*	0.01	**5.18**	*5.18*	0.01	**4.89**	*4.88*	0.00	**4.68**	*4.69*	0.00

Table 2. Limnotech alternative average dissolved oxygen concentrations at greater than 8 m depth for September 16 to December 31 compared with TMDL scenario concentrations.

The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The Limnotech alternative 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*		
158	**9.92**	*9.91*	0.01	**10.08**	*10.08*	0.01	**10.55**	*10.55*	0.00	**10.85**	*10.85*	0.00	**10.80**	*10.80*	0.00	**11.49**	*11.49*	0.00	**11.54**	*11.54*	0.00
159	**9.86**	*9.85*	0.01	**10.10**	*10.09*	0.01	**10.56**	*10.56*	0.01	**10.88**	*10.89*	0.00	**10.81**	*10.81*	0.00	**11.49**	*11.49*	0.00	**11.58**	*11.58*	0.00
160	**9.80**	*9.79*	0.01	**10.11**	*10.10*	0.01	**10.56**	*10.56*	0.00	**10.89**	*10.90*	0.00	**10.78**	*10.78*	0.00	**11.48**	*11.48*	0.00	**11.58**	*11.59*	0.00
161	**9.78**	*9.77*	0.01	**10.11**	*10.10*	0.01	**10.55**	*10.54*	0.00	**10.87**	*10.87*	0.00	**10.76**	*10.77*	0.00	**11.47**	*11.48*	0.00	**11.57**	*11.57*	0.00
162	**9.75**	*9.74*	0.01	**10.13**	*10.12*	0.01	**10.58**	*10.57*	0.01	**10.82**	*10.83*	-0.01	**10.73**	*10.73*	0.00	**11.46**	*11.46*	0.00	**11.57**	*11.57*	0.00
163	**9.74**	*9.72*	0.01	**10.13**	*10.12*	0.01	**10.61**	*10.60*	0.01	**10.80**	*10.80*	-0.01	**10.70**	*10.70*	0.00	**11.44**	*11.45*	0.00	**11.56**	*11.56*	0.00
164	**9.67**	*9.66*	0.01	**10.07**	*10.06*	0.01	**10.60**	*10.59*	0.01	**10.78**	*10.79*	-0.01	**10.66**	*10.66*	0.00	**11.40**	*11.41*	0.00	**11.54**	*11.54*	0.00
165	**9.60**	*9.59*	0.01	**10.00**	*10.00*	0.01	**10.55**	*10.54*	0.01	**10.78**	*10.79*	-0.01	**10.64**	*10.64*	0.00	**11.38**	*11.38*	0.00	**11.53**	*11.53*	0.00
166	**9.48**	*9.47*	0.01	**9.92**	*9.91*	0.01	**10.48**	*10.47*	0.01	**10.69**	*10.70*	-0.01	**10.58**	*10.59*	-0.01	**11.33**	*11.33*	0.00	**11.49**	*11.49*	0.00
167	**9.37**	*9.36*	0.01	**9.86**	*9.85*	0.01	**10.43**	*10.42*	0.01	**10.66**	*10.67*	-0.01	**10.57**	*10.58*	-0.01	**11.30**	*11.30*	0.00	**11.48**	*11.48*	0.00
168	**9.24**	*9.23*	0.01	**9.78**	*9.78*	0.01	**10.37**	*10.36*	0.01	**10.64**	*10.64*	-0.01	**10.56**	*10.57*	-0.01	**11.26**	*11.27*	0.00	**11.46**	*11.47*	0.00
169	**9.14**	*9.13*	0.01	**9.71**	*9.70*	0.01	**10.29**	*10.28*	0.01	**10.66**	*10.66*	-0.01	**10.54**	*10.55*	-0.01	**11.11**	*11.11*	0.00	**11.43**	*11.43*	0.00
170	**9.02**	*9.01*	0.01	**9.60**	*9.60*	0.01	**10.18**	*10.17*	0.01	**10.62**	*10.63*	-0.01	**10.50**	*10.51*	-0.01	**10.91**	*10.92*	0.00	**11.37**	*11.37*	0.00
171	**8.87**	*8.86*	0.01	**9.49**	*9.48*	0.01	**10.07**	*10.06*	0.01	**10.54**	*10.54*	-0.01	**10.44**	*10.44*	-0.01	**10.91**	*10.92*	-0.01	**11.31**	*11.31*	0.00
172	**8.67**	*8.65*	0.01	**9.40**	*9.40*	0.01	**9.99**	*9.99*	0.01	**10.40**	*10.41*	0.00	**10.39**	*10.40*	-0.01	**11.05**	*11.06*	0.00	**11.39**	*11.39*	0.00
173	**8.47**	*8.46*	0.02	**9.32**	*9.31*	0.01	**9.91**	*9.90*	0.01	**10.28**	*10.29*	0.00	**10.35**	*10.35*	-0.01	**11.02**	*11.03*	0.00	**11.41**	*11.41*	0.00
174	**8.18**	*8.16*	0.02	**9.19**	*9.18*	0.01	**9.85**	*9.85*	0.01	**10.24**	*10.24*	0.00	**10.32**	*10.33*	-0.01	**10.97**	*10.97*	0.00	**11.38**	*11.38*	0.00
175	**7.94**	*7.92*	0.02	**9.07**	*9.06*	0.01	**9.81**	*9.80*	0.00	**10.19**	*10.19*	0.00	**10.31**	*10.32*	-0.01	**10.94**	*10.95*	0.00	**11.37**	*11.37*	0.00
176	**7.79**	*7.76*	0.02	**8.88**	*8.87*	0.01	**9.72**	*9.72*	0.00	**10.07**	*10.08*	0.00	**10.30**	*10.30*	-0.01	**10.90**	*10.90*	0.00	**11.39**	*11.39*	0.00
177	**7.17**	*7.14*	0.02	**8.47**	*8.46*	0.01	**9.70**	*9.69*	0.00	**10.05**	*10.05*	0.00	**10.28**	*10.29*	-0.01	**10.86**	*10.86*	0.00	**11.37**	*11.37*	0.00
178	**6.90**	*6.88*	0.02	**8.24**	*8.23*	0.01	**9.67**	*9.67*	0.00	**10.00**	*10.00*	0.00	**10.27**	*10.27*	-0.01	**10.82**	*10.83*	-0.01	**11.37**	*11.37*	0.00
179	**6.77**	*6.75*	0.02	**8.14**	*8.13*	0.01	**9.63**	*9.63*	0.00	**9.93**	*9.93*	0.00	**10.24**	*10.25*	-0.01	**10.80**	*10.80*	-0.01	**11.40**	*11.40*	0.00
180	**6.53**	*6.51*	0.02	**7.93**	*7.92*	0.01	**9.58**	*9.57*	0.00	**9.88**	*9.88*	0.00	**10.22**	*10.22*	-0.01	**10.78**	*10.78*	0.00	**11.40**	*11.40*	0.00
181	**6.25**	*6.23*	0.02	**7.65**	*7.63*	0.01	**9.43**	*9.43*	0.00	**9.84**	*9.84*	0.00	**10.19**	*10.20*	-0.01	**10.75**	*10.76*	0.00	**11.35**	*11.35*	0.00
182	**6.05**	*6.04*	0.01	**7.48**	*7.47*	0.01	**9.24**	*9.24*	0.00	**9.83**	*9.83*	0.00	**10.18**	*10.19*	-0.01	**10.74**	*10.75*	0.00	**11.31**	*11.31*	0.00
183	**5.64**	*5.62*	0.01	**7.02**	*7.01*	0.01	**9.09**	*9.09*	0.00	**9.79**	*9.79*	0.00	**10.16**	*10.17*	-0.01	**10.73**	*10.74*	-0.01	**11.30**	*11.30*	0.00
184	**5.49**	*5.49*	0.00	**6.70**	*6.68*	0.01	**8.88**	*8.88*	0.00	**9.76**	*9.76*	0.00	**10.15**	*10.16*	-0.01	**10.72**	*10.73*	-0.01	**11.28**	*11.29*	0.00
185	**5.29**	*5.29*	0.00	**6.35**	*6.34*	0.01	**8.55**	*8.55*	0.00	**9.73**	*9.73*	0.00	**10.15**	*10.16*	-0.01	**10.70**	*10.71*	-0.01	**11.26**	*11.26*	0.00
186	**4.88**	*4.89*	0.00	**5.81**	*5.81*	0.01	**8.25**	*8.25*	0.00	**9.67**	*9.67*	0.00	**10.14**	*10.14*	-0.01	**10.67**	*10.67*	-0.01	**11.20**	*11.21*	0.00
187	**4.80**	*4.80*	-0.01	**5.51**	*5.51*	0.01	**8.13**	*8.13*	0.00	**9.62**	*9.63*	0.00	**10.12**	*10.12*	-0.01	**10.64**	*10.64*	-0.01	**11.17**	*11.18*	0.00
188	**4.51**	*4.52*	-0.01	**5.10**	*5.10*	0.00	**7.50**	*7.50*	-0.01	**9.49**	*9.52*	-0.03	**10.07**	*10.08*	-0.01	**10.61**	*10.61*	0.00	**11.19**	*11.19*	0.00

Table 3. Difference between PSU run and Limnotech run scenario results for dissolved oxygen concentrations at greater than 8 m depth for June 1 to September 15.

The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The Limnotech results were in bold and the PSU results 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	**9.66**	*9.66*	0.00	**9.77**	*9.77*	0.00	**9.50**	*9.50*	0.00	**9.61**	*9.61*	0.00	**9.66**	*9.66*	0.00	**9.85**	*9.85*	0.00	**10.00**	*10.00*	0.00
159	**9.84**	*9.84*	0.00	**9.84**	*9.84*	0.00	**9.53**	*9.53*	0.00	**9.63**	*9.63*	0.00	**9.64**	*9.64*	0.00	**9.79**	*9.79*	0.00	**9.94**	*9.94*	0.00
160	**9.88**	*9.88*	0.00	**9.81**	*9.81*	0.00	**9.47**	*9.47*	0.00	**9.59**	*9.59*	0.00	**9.57**	*9.57*	0.00	**9.71**	*9.71*	0.00	**9.88**	*9.88*	0.00
161	**9.86**	*9.86*	0.00	**9.90**	*9.90*	0.00	**9.52**	*9.52*	0.00	**9.58**	*9.58*	0.00	**9.56**	*9.56*	0.00	**9.69**	*9.69*	0.00	**9.86**	*9.86*	0.00
162	**9.89**	*9.89*	0.00	**9.98**	*9.98*	0.00	**9.53**	*9.53*	0.00	**9.60**	*9.60*	0.00	**9.54**	*9.54*	0.00	**9.62**	*9.62*	0.00	**9.80**	*9.80*	0.00
163	**9.95**	*9.95*	0.00	**10.04**	*10.04*	0.00	**9.56**	*9.56*	0.00	**9.64**	*9.64*	0.00	**9.54**	*9.54*	0.00	**9.53**	*9.53*	0.00	**9.74**	*9.74*	0.00
164	**10.03**	*10.03*	0.00	**10.06**	*10.06*	0.00	**9.52**	*9.52*	0.00	**9.63**	*9.63*	0.00	**9.48**	*9.48*	0.00	**9.38**	*9.38*	0.00	**9.63**	*9.63*	0.00
165	**10.06**	*10.06*	0.00	**10.08**	*10.08*	0.00	**9.37**	*9.37*	0.00	**9.53**	*9.53*	0.00	**9.37**	*9.37*	0.00	**9.12**	*9.12*	0.00	**9.51**	*9.51*	0.00
166	**10.02**	*10.02*	0.00	**10.01**	*10.01*	0.00	**9.06**	*9.06*	0.00	**9.31**	*9.31*	0.00	**9.16**	*9.16*	0.00	**8.86**	*8.86*	0.00	**9.39**	*9.39*	0.00
167	**10.03**	*10.03*	0.00	**9.97**	*9.97*	0.00	**8.87**	*8.87*	0.00	**9.08**	*9.08*	0.00	**8.98**	*8.98*	0.00	**8.64**	*8.64*	0.00	**9.28**	*9.28*	0.00
168	**10.09**	*10.09*	0.00	**9.90**	*9.90*	0.00	**8.58**	*8.58*	0.00	**8.64**	*8.64*	0.00	**8.62**	*8.62*	0.00	**8.22**	*8.22*	0.00	**9.12**	*9.12*	0.00
169	**10.14**	*10.14*	0.00	**9.80**	*9.80*	0.00	**8.41**	*8.41*	0.00	**8.38**	*8.38*	0.00	**8.37**	*8.37*	0.00	**7.94**	*7.94*	0.00	**8.92**	*8.92*	0.00
170	**10.16**	*10.16*	0.00	**9.69**	*9.69*	0.00	**8.37**	*8.37*	0.00	**8.24**	*8.24*	0.00	**8.23**	*8.23*	0.00	**7.73**	*7.73*	0.00	**8.66**	*8.66*	0.00
171	**10.15**	*10.15*	0.00	**9.64**	*9.64*	0.00	**8.39**	*8.39*	0.00	**8.18**	*8.18*	0.00	**8.12**	*8.12*	0.00	**7.57**	*7.57*	0.00	**8.44**	*8.44*	0.00
172	**10.07**	*10.07*	0.00	**9.44**	*9.44*	0.00	**8.17**	*8.17*	0.00	**7.81**	*7.81*	0.00	**7.68**	*7.68*	0.00	**7.10**	*7.10*	0.00	**8.06**	*8.06*	0.00
173	**9.96**	*9.96*	0.00	**9.29**	*9.29*	0.00	**8.00**	*8.00*	0.00	**7.56**	*7.56*	0.00	**7.40**	*7.40*	0.00	**6.81**	*6.81*	0.00	**7.75**	*7.75*	0.00
174	**9.79**	*9.79*	0.00	**9.11**	*9.11*	0.00	**7.79**	*7.79*	0.00	**7.27**	*7.27*	0.00	**7.07**	*7.07*	0.00	**6.44**	*6.44*	0.00	**7.34**	*7.34*	0.00
175	**9.67**	*9.67*	0.00	**8.96**	*8.96*	0.00	**7.67**	*7.67*	0.00	**7.10**	*7.10*	0.00	**6.86**	*6.86*	0.00	**6.24**	*6.24*	0.00	**7.04**	*7.04*	0.00
176	**9.57**	*9.57*	0.00	**8.89**	*8.89*	0.00	**7.61**	*7.61*	0.00	**7.00**	*7.00*	0.00	**6.80**	*6.80*	0.00	**6.15**	*6.15*	0.00	**6.92**	*6.92*	0.00
177	**9.29**	*9.29*	0.00	**8.52**	*8.52*	0.00	**7.20**	*7.20*	0.00	**6.46**	*6.46*	0.00	**6.23**	*6.23*	0.00	**5.56**	*5.56*	0.00	**6.24**	*6.24*	0.00
178	**9.20**	*9.20*	0.00	**8.41**	*8.41*	0.00	**7.10**	*7.10*	0.00	**6.34**	*6.34*	0.00	**6.16**	*6.16*	0.00	**5.48**	*5.48*	0.00	**6.07**	*6.07*	0.00
179	**9.13**	*9.13*	0.00	**8.36**	*8.36*	0.00	**7.07**	*7.07*	0.00	**6.27**	*6.27*	0.00	**6.11**	*6.11*	0.00	**5.46**	*5.46*	0.00	**5.92**	*5.92*	0.00
180	**9.04**	*9.04*	0.00	**8.28**	*8.28*	0.00	**7.02**	*7.02*	0.00	**6.19**	*6.19*	0.00	**6.02**	*6.02*	0.00	**5.43**	*5.43*	0.00	**5.76**	*5.76*	0.00
181	**8.93**	*8.93*	0.00	**8.19**	*8.19*	0.00	**6.96**	*6.96*	0.00	**6.08**	*6.08*	0.00	**5.88**	*5.88*	0.00	**5.36**	*5.36*	0.00	**5.54**	*5.54*	0.00
182	**8.94**	*8.94*	0.00	**8.20**	*8.20*	0.00	**7.01**	*7.01*	0.00	**6.13**	*6.13*	0.00	**5.92**	*5.92*	0.00	**5.46**	*5.46*	0.00	**5.53**	*5.53*	0.00
183	**8.77**	*8.77*	0.00	**7.97**	*7.97*	0.00	**6.84**	*6.84*	0.00	**5.97**	*5.97*	0.00	**5.68**	*5.68*	0.00	**5.29**	*5.29*	0.00	**5.28**	*5.28*	0.00
184	**8.74**	*8.74*	0.00	**7.93**	*7.93*	0.00	**6.88**	*6.88*	0.00	**6.01**	*6.01*	0.00	**5.71**	*5.71*	0.00	**5.33**	*5.33*	0.00	**5.35**	*5.35*	0.00
185	**8.62**	*8.62*	0.00	**7.86**	*7.86*	0.00	**6.88**	*6.88*	0.00	**6.01**	*6.01*	0.00	**5.64**	*5.64*	0.00	**5.30**	*5.30*	0.00	**5.28**	*5.28*	0.00
186	**8.44**	*8.44*	0.00	**7.73**	*7.73*	0.00	**6.76**	*6.76*	0.00	**5.84**	*5.84*	0.00	**5.41**	*5.41*	0.00	**5.08**	*5.08*	0.00	**4.93**	*4.93*	0.00
187	**8.40**	*8.40*	0.00	**7.74**	*7.74*	0.00	**6.79**	*6.79*	0.00	**5.83**	*5.83*	0.00	**5.35**	*5.35*	0.00	**5.04**	*5.04*	0.00	**4.90**	*4.90*	0.00
188	**8.27**	*8.27*	0.00	**7.56**	*7.56*	0.00	**6.66**	*6.66*	0.00	**5.72**	*5.72*	0.00	**5.18**	*5.18*	0.00	**4.89**	*4.89*	0.00	**4.68**	*4.68*	0.00

Table 4. Difference between PSU run and Limnotech run scenario results for dissolved oxygen concentrations at greater than 8 m depth for September 16 to December 31.

The results were reported for a semi-monthly time periods and Long Lake model segment numbers 158-188. The Limnotech results were in bold and the PSU results 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	**9.92**	*9.92*	0.00	**10.08**	*10.08*	0.00	**10.55**	*10.55*	0.00	**10.85**	*10.85*	0.00	**10.80**	*10.80*	0.00	**11.49**	*11.49*	0.00	**11.54**	*11.54*	0.00
159	**9.86**	*9.86*	0.00	**10.10**	*10.10*	0.00	**10.56**	*10.56*	0.00	**10.88**	*10.88*	0.00	**10.81**	*10.81*	0.00	**11.49**	*11.49*	0.00	**11.58**	*11.58*	0.00
160	**9.80**	*9.80*	0.00	**10.11**	*10.11*	0.00	**10.56**	*10.56*	0.00	**10.89**	*10.89*	0.00	**10.78**	*10.78*	0.00	**11.48**	*11.48*	0.00	**11.58**	*11.58*	0.00
161	**9.78**	*9.78*	0.00	**10.11**	*10.11*	0.00	**10.55**	*10.55*	0.00	**10.87**	*10.87*	0.00	**10.76**	*10.76*	0.00	**11.47**	*11.47*	0.00	**11.57**	*11.57*	0.00
162	**9.75**	*9.75*	0.00	**10.13**	*10.13*	0.00	**10.58**	*10.58*	0.00	**10.82**	*10.82*	0.00	**10.73**	*10.73*	0.00	**11.46**	*11.46*	0.00	**11.57**	*11.57*	0.00
163	**9.74**	*9.74*	0.00	**10.13**	*10.13*	0.00	**10.61**	*10.61*	0.00	**10.80**	*10.80*	0.00	**10.70**	*10.70*	0.00	**11.44**	*11.44*	0.00	**11.56**	*11.56*	0.00
164	**9.67**	*9.67*	0.00	**10.07**	*10.07*	0.00	**10.60**	*10.60*	0.00	**10.78**	*10.78*	0.00	**10.66**	*10.66*	0.00	**11.40**	*11.40*	0.00	**11.54**	*11.54*	0.00
165	**9.60**	*9.60*	0.00	**10.00**	*10.00*	0.00	**10.55**	*10.55*	0.00	**10.78**	*10.78*	0.00	**10.64**	*10.64*	0.00	**11.38**	*11.38*	0.00	**11.53**	*11.53*	0.00
166	**9.48**	*9.48*	0.00	**9.92**	*9.92*	0.00	**10.48**	*10.48*	0.00	**10.69**	*10.69*	0.00	**10.58**	*10.58*	0.00	**11.33**	*11.33*	0.00	**11.49**	*11.49*	0.00
167	**9.37**	*9.37*	0.00	**9.86**	*9.86*	0.00	**10.43**	*10.43*	0.00	**10.66**	*10.66*	0.00	**10.57**	*10.57*	0.00	**11.30**	*11.30*	0.00	**11.48**	*11.48*	0.00
168	**9.24**	*9.24*	0.00	**9.78**	*9.78*	0.00	**10.37**	*10.37*	0.00	**10.64**	*10.64*	0.00	**10.56**	*10.56*	0.00	**11.26**	*11.26*	0.00	**11.46**	*11.46*	0.00
169	**9.14**	*9.14*	0.00	**9.71**	*9.71*	0.00	**10.29**	*10.29*	0.00	**10.66**	*10.66*	0.00	**10.54**	*10.54*	0.00	**11.11**	*11.11*	0.00	**11.43**	*11.43*	0.00
170	**9.02**	*9.02*	0.00	**9.60**	*9.60*	0.00	**10.18**	*10.18*	0.00	**10.62**	*10.62*	0.00	**10.50**	*10.50*	0.00	**10.91**	*10.91*	0.00	**11.37**	*11.37*	0.00
171	**8.87**	*8.87*	0.00	**9.49**	*9.49*	0.00	**10.07**	*10.07*	0.00	**10.54**	*10.54*	0.00	**10.44**	*10.44*	0.00	**10.91**	*10.91*	0.00	**11.31**	*11.31*	0.00
172	**8.67**	*8.67*	0.00	**9.40**	*9.40*	0.00	**9.99**	*9.99*	0.00	**10.40**	*10.40*	0.00	**10.39**	*10.39*	0.00	**11.05**	*11.05*	0.00	**11.39**	*11.39*	0.00
173	**8.47**	*8.47*	0.00	**9.32**	*9.32*	0.00	**9.91**	*9.91*	0.00	**10.28**	*10.28*	0.00	**10.35**	*10.35*	0.00	**11.02**	*11.02*	0.00	**11.41**	*11.41*	0.00
174	**8.18**	*8.18*	0.00	**9.19**	*9.19*	0.00	**9.85**	*9.85*	0.00	**10.24**	*10.24*	0.00	**10.32**	*10.32*	0.00	**10.97**	*10.97*	0.00	**11.38**	*11.38*	0.00
175	**7.94**	*7.94*	0.00	**9.07**	*9.07*	0.00	**9.81**	*9.81*	0.00	**10.19**	*10.19*	0.00	**10.31**	*10.31*	0.00	**10.94**	*10.94*	0.00	**11.37**	*11.37*	0.00
176	**7.79**	*7.79*	0.00	**8.88**	*8.88*	0.00	**9.72**	*9.72*	0.00	**10.07**	*10.07*	0.00	**10.30**	*10.30*	0.00	**10.90**	*10.90*	0.00	**11.39**	*11.39*	0.00
177	**7.17**	*7.17*	0.00	**8.47**	*8.47*	0.00	**9.70**	*9.70*	0.00	**10.05**	*10.05*	0.00	**10.28**	*10.28*	0.00	**10.86**	*10.86*	0.00	**11.37**	*11.37*	0.00
178	**6.90**	*6.90*	0.00	**8.24**	*8.24*	0.00	**9.67**	*9.67*	0.00	**10.00**	*10.00*	0.00	**10.27**	*10.27*	0.00	**10.82**	*10.82*	0.00	**11.37**	*11.37*	0.00
179	**6.77**	*6.77*	0.00	**8.14**	*8.14*	0.00	**9.63**	*9.63*	0.00	**9.93**	*9.93*	0.00	**10.24**	*10.24*	0.00	**10.80**	*10.80*	0.00	**11.40**	*11.40*	0.00
180	**6.53**	*6.53*	0.00	**7.93**	*7.93*	0.00	**9.58**	*9.58*	0.00	**9.88**	*9.88*	0.00	**10.22**	*10.22*	0.00	**10.78**	*10.78*	0.00	**11.40**	*11.40*	0.00
181	**6.25**	*6.25*	0.00	**7.65**	*7.65*	0.00	**9.43**	*9.43*	0.00	**9.84**	*9.84*	0.00	**10.19**	*10.19*	0.00	**10.75**	*10.75*	0.00	**11.35**	*11.35*	0.00
182	**6.05**	*6.05*	0.00	**7.48**	*7.48*	0.00	**9.24**	*9.24*	0.00	**9.83**	*9.83*	0.00	**10.18**	*10.18*	0.00	**10.74**	*10.74*	0.00	**11.31**	*11.31*	0.00
183	**5.64**	*5.64*	0.00	**7.02**	*7.02*	0.00	**9.09**	*9.09*	0.00	**9.79**	*9.79*	0.00	**10.16**	*10.16*	0.00	**10.73**	*10.73*	0.00	**11.30**	*11.30*	0.00
184	**5.49**	*5.49*	0.00	**6.70**	*6.70*	0.00	**8.88**	*8.88*	0.00	**9.76**	*9.76*	0.00	**10.15**	*10.15*	0.00	**10.72**	*10.72*	0.00	**11.28**	*11.28*	0.00
185	**5.29**	*5.29*	0.00	**6.35**	*6.35*	0.00	**8.55**	*8.55*	0.00	**9.73**	*9.73*	0.00	**10.15**	*10.15*	0.00	**10.70**	*10.70*	0.00	**11.26**	*11.26*	0.00
186	**4.88**	*4.88*	0.00	**5.81**	*5.81*	0.00	**8.25**	*8.25*	0.00	**9.67**	*9.67*	0.00	**10.14**	*10.14*	0.00	**10.67**	*10.67*	0.00	**11.20**	*11.20*	0.00
187	**4.80**	*4.80*	0.00	**5.51**	*5.51*	0.00	**8.13**	*8.13*	0.00	**9.62**	*9.62*	0.00	**10.12**	*10.12*	0.00	**10.64**	*10.64*	0.00	**11.17**	*11.17*	0.00
188	**4.51**	*4.51*	0.00	**5.10**	*5.10*	0.00	**7.50**	*7.50*	0.00	**9.49**	*9.49*	0.00	**10.07**	*10.07*	0.00	**10.61**	*10.61*	0.00	**11.19**	*11.19*	0.00

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