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Volunteer Monitoring Watershed Science Risk Communication

Comments on Draft Total Maximum Daily Load (TMDL) for Phosphorus in Cayuga Lake, New York, https://www.dec.ny.gov/chemical/23835.html

by

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July 2, 2021

Executive Summary

These comments are directed at phosphorus loading estimates in the draft TMDL. They compare the TMDL with dissolved and particulate phosphorus loading estimates from three other, independent sources, and they comment on the significance of differences so large that the TMDL qualifies as a statistical outlier compared to the other three sets of phosphorus loading estimates. Analyses indicate:

1. The Draft TMDL estimate for total phosphorus (TP) loading from non-point sources, 207 short tons/year, is approximately twice as large as the consensus estimate from three independent sources, 115 short tons/year. (Note: Units of "short tons" are used in these comments to avoid confusion with metric tons. One short ton equals 2,000 lbs, which are the units used by the Draft TMDL.)
2. The Draft TMDL estimate for soluble reactive (dissolved) phosphorus (SRP) loading from non-point sources, 17 short tons/year, is almost four times lower than the consensus estimate from three independent sources, 62 short tons/year.
3. The Draft TMDL estimates for total and dissolved phosphorus loading are inconsistent with certified laboratory measurements of TP and SRP at the mouths of a dozen Cayuga Lake tributary streams north of the impaired southern end segment.
4. The very large inconsistencies between the Draft TMDL and three independent estimates of dissolved and particulate phosphorus loading as well as Draft TMDL inconsistencies with multi-year measurements of TP and SRP concentrations in Cayuga Lake tributary streams put TMDL implementation at risk by undermining stakeholder confidence in the types and magnitude of phosphorus reductions they, particularly agricultural stakeholders, are expected to achieve.
5. The SWAT model that was used as the basis for estimating phosphorus loading for the 792 square mile Cayuga Lake watershed was validated using phosphorus measurements for the 129 square mile Fall Creek watershed, then extrapolated to the remaining 663 square miles without further validation. We recommend that certified phosphorus measurements representative of drainages in the northern ~60% of the watershed and available online at

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http://www.database.communityscience.org/monitoringregions/1 be used to validate the SWAT model and revise TP and SRP loading estimates, as necessary.

These comments are based in large part on long-term phosphorus data sets for Cayuga Lake tributary streams that have been built by the Community Science Institute (CSI) in partnership with groups of citizen volunteers beginning in 2002 in Fall Creek and expanding over the years to include a dozen volunteer groups monitoring 16 drainages comprising 70% of the Cayuga Lake watershed in 2021. Our program has been covered for most of its history by a DEC-approved quality assurance project plan (QAPP) that incorporates CSI's in-house certified water quality testing lab (NYSDOH-ELAP# 11790). Our volunteer stream monitoring partnerships receive generous financial support from a dozen municipal and county governments in the Cayuga Lake watershed. Results of laboratory analyses are disseminated online approximately eight weeks following sample collection by volunteers and may be accessed free of charge at www.database.communityscience.org.

Comments

TMDL Section 4.1 states that independent nutrient loading estimates were performed for five southern streams as part of the 2013 Cayuga Lake Model (CLM) monitoring program; that these loading estimates were extrapolated on the basis of land area and land use to unmonitored drainages to the north comprising approximately 50% of the Cayuga Lake drainage; and that the Source Water Assessment Tool (SWAT) model was used to predict loads within each land use category.

The development of the SWAT model is described in the Phase 2 Final Report (2017) of the Cayuga Lake Modeling Project (CLMP), (https://www.dec.ny.gov/docs/water_pdf/cornelllscclmpphase2.pdf), specifically in Section 8 entitled "Modeling the Cayuga Lake Watershed with SWAT." Section 8.1 states the purpose of the SWAT model as follows:

"We developed a SWAT v2012 model (Neitsch et al. 2011) for the Cayuga Lake watershed to 1) estimate current precipitation driven discharge and loading of total suspended solids (TSS), Nitrate + Nitrite (NOX) and total phosphorus (TP) to Cayuga Lake, and 2) to evaluate best management practices in reducing TP loading to Cayuga Lake."

- *Dissolved phosphorus, not total phosphorus, is recognized as the principal driver of eutrophication in phosphorus-limited systems (Prestigiacomo et al, 2016). Please explain why modeling of total phosphorus loading was prioritized over dissolved phosphorus loading.*

Section 8.1 states further: "Model development and calibration was first performed for the Fall Creek watershed, a large tributary to the south end of Cayuga Lake… Hydrologic parameters defining the precipitation-runoff response of the watershed derived from calibration of the Fall Creek watershed were then extrapolated to the entire Cayuga Lake watershed."

- *Dissolved phosphorus concentrations in northeastern tributaries of Cayuga Lake are reported to average seven times higher than dissolved phosphorus concentrations in Fall Creek (O'Leary et al, 2019, Table 5). These observations suggest that the contribution of dissolved phosphorus is significantly higher in these northeastern sub-watersheds than in Fall Creek. In view of these published findings, please justify the decision to use Fall Creek as a model to predict phosphorus loading throughout the entire Cayuga Lake watershed without further validation.*

Section 8.2 of the Phase 2 Final Report states: "Dairy manure is applied to all row crops and a subset of pastures within the Fall Creek watershed (Table 8-1). These schedules were determined after discussions with experts from a number of county Soil and Water Conservation Districts (SWCDs) in the Finger Lakes region (K. Czymmek et al., personal communication, May 2015)."

- *Dairy manure is likely to be a driver of the elevated dissolved phosphorus runoff documented in northeastern tributary streams (O'Leary et al, 2019, Table 5). Please provide a second table, in addition to Table 8-1, showing that the application schedule for dairy manure in northeastern sub-watersheds of Cayuga Lake, for example, Yawger Creek or Salmon Creek, is the same as the application schedule in the Fall Creek sub-watershed.*
- *The application of chemical fertilizer, the other major source of dissolved phosphorus, is not mentioned in the SWAT model narrative in Section 8. Please provide application schedules for chemical fertilizer in the Fall Creek sub-watershed and at least one northeastern sub-watershed, such as Yawger Creek or Salmon Creek, to verify that they are similar. If chemical fertilizer is omitted from the SWAT model because none is applied in the Cayuga Lake watershed, then so state.*

Section 8.5 of the Phase 2 Final Report, "Model Corroboration Results," states: "We manually adjust the PHOSKD and ERORGP parameters to reproduce the estimated TDP [total dissolved phosphorus] and PP [particulate phosphorus] loads for Fall Creek."

- *Please state the source of the TDP and PP loading results that are being used to adjust the PHOSKD and ERORGP parameters in the SWAT model for Fall Creek.*
- *Please justify the apparent decision not to validate the SWAT model extrapolation for the northern ~50% of the Cayuga Lake watershed using publicly available measurements of total and dissolved phosphorus concentrations under a wide range of flow conditions in northern tributary streams. For example, certified TP and SRP data sets for ten locations from the mouth to the headwaters of Salmon Creek are available beginning in 2006*

(http://www.database.communityscience.org/monitoringsets/6); for 15 locations from the mouths to the headwaters of Paines, Mill, Deans and Townline Creeks since 2009 ("Direct Streams" monitoring set, http://www.database.communityscience.org/monitoringsets/11); for two locations on Canoga Creek (http://database.communityscience.org/monitoringsets/42) and three locations on Burroughs Creek (http://database.communityscience.org/monitoringsets/43) since 2015; and for four locations on Yawger Creek (http://database.communityscience.org/monitoringsets/47) and two locations on Great Gully Creek (http://database.communityscience.org/monitoringsets/48) since 2017. All told, over 1,500 certified TP and SRP measurements performed since 2006 are currently available for streams that enter Cayuga Lake north of the four streams that flow into the impaired southern end segment. If, in fact, none of these publicly available data sets were used to validate the SWAT model for the northern ~50% of the Cayuga Lake watershed, explain why not.

- *Please explain the rationale for using Fall Creek results in the CSI database (http://database.communityscience.org/monitoringsets/2) to validate the SWAT model for Fall Creek ("Technical Briefing, Cayuga Lake Modeling Project, May 19, 2014, https://www.dec.ny.gov/docs/water_pdf/clmptacmtg20140519f.pdf) while apparently bypassing data that have been available in the CSI database since 2006 for validation of the SWAT model for tributary streams north of the impaired southern end segment (see links, above).*

Table 11 in Draft TMDL Section 4.1 and Table 16 in Draft TMDL Section 7.2 provide total phosphorus loading estimates to the Impaired Southern End segment.

- *According to Table 11, the Impaired Southern End segment is estimated to load 71,597 lbs/year, or 35.8 short tons/year of total phosphorus. According to Table 16, which gives the TP loading estimates for each of the four streams entering the Impaired Southern End Segment, the total is 77,020 lbs/year, or 38.5 short tons/year. Please explain the discrepancy of 2.7 short tons/year between the TP loading estimates for the Impaired Southern End Segment in Tables 11 and 16.*

Comment Table 1 shows there is excellent agreement between the Draft TMDL loading estimates for the four southern tributaries in Table 16 and loads estimated by the Community Science Institute for the same four streams using USGS LOADEST software (Runkel et al, 2004) based on stream samples collected by CSI volunteers, certified analyses performed in the CSI lab, and USGS gauging station flow records. This agreement suggests that the SWAT model process and CSI's volunteer monitoring partnerships arrive at similar loading estimates when both programs collect stream samples and perform measurements of phosphorus concentrations.

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Comment Table 1

Comparison of CSI and Draft TMDL Total Phosphorus Loading Estimates for "Impaired Southern End" Tributary Streams

Stream	Drainage Area (mi^2)	Community Science Institute (short tons/year)[a]	Draft TMDL, Table 16 (short tons/year)[b]	
Fall Creek	129	19.56[c]	21.6	
Six Mile Creek @ Bethel Grove	39	5.69[c]	6.28	
Cascadilla Creek	13.7	1.07	1.56	
Cayuga Inlet	92.4	8.13	9.12	
Total "Impaired Southern End" TP Load	**274**	**34.45**	**38.56**	

[a] from ValuesPenningroth, S. Presentation to Cayuga County Water Quality Management Agency, April 1, 2021, slide 7, http://www.communityscience.org/outreach-and-education/public-event-presentations/,

[b] Draft TMDL Table 16. Units of lbs/year converted to short tons/year (2,000 lbs/short ton)

[c] Loads estimated using USGS LOADEST software (Runkel et al, 2004) based on certified measurements of TP in CSI's certified laboratory (NYSDOH-ELAP ID# 11790) and flow measurements by USGS gauging stations

Tables 11-14 in Draft TMDL Section 4.1 present non-point sources of annual TP loading to each of the four segments of Cayuga Lake, and these sum to 200.2 short tons/year. Table 16 in TMDL Section 7.2 presents annual non-point source TP loading by sub-basin, and these sum to 207.3 short tons/year.

- *Please explain the difference of 7.1 short tons/year in the non-point source TP loading estimates for the Cayuga Lake watershed in Section 4.1, Tables 11-14, and Section 7.2, Table 16.*

Comment Table 2 compares non-point source TP loading estimates in the Draft TMDL with estimates reported by three other sources: The Community Science Institute, 2021; Haith et al, 2012; and Likens, 1974. Agreement is good among all four estimates for TP loading from Fall Creek and the Cayuga Inlet to the impaired southern end segment (the one exception is Likens' high TP estimate for the Cayuga Inlet). For three streams north of the impaired southern segment for which separate TP loading estimates are available, the Draft TMDL estimates exceed the estimates of the other three studies, and some are considerably higher. The Draft TMDL's total non-point source Cayuga Lake loading estimate, 207 short tons TP/year, exceeds the mean of the other three estimates, 115 short

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tons/year, by almost a factor of two. The Draft TMDL estimate exceeds the mean of the other three estimates by 11 standard deviations, indicating it is an outlier with respect to these three independent TP loading estimates.

Comment Table 2						
Comparison of Draft TMDL with Three Independent Total Phosphorus Loading Estimates (short tons/year)						
Watershed	Draft TMDL, Table 16 (2021)		CSI (2021)[a]	Haith et al (2012)[b]	Likens (1970-71)[b,c]	
Fall Creek	21.6		19.6	18.6	22.8	
Combined Cayuga Inlet[d]	17.0		14.9	20.0	37.6	
Salmon Creek	39.9		15.3	14.6	11.0	
Taughannock Creek	10.9		7.9	7.9	5.6	
Great Gully	17.9		4.4	--	--	
Cayuga Lake	**207**		124	108	114	
			Mean CSI, Haith et al, Likens = 115 +/- 8.1 (SD) short tons TP/year			

[a] Values from Penningroth, S. Presentation to the Cayuga County Water Quality Management Agency, April 1, 2021, slide 7, http://www.communityscience.org/outreach-and-education/public-event-presentations/
[b] Values from Haith et al (2012), Table 8. Units of Mg/year (Megagrams/year) are converted to short tons/year by multiplying value by 1.1 short tons/Mg.
[c] Loading results reported in Likens (1974) and summarized in Haith et al (2012)
[d] Cayuga Inlet, Six Mile Creek and Cascadilla Creek

- *The discrepancy between the Draft TMDL estimate for TP loading to Cayuga Lake, 207 short tons TP/year, and a consensus estimate based on three independent sources, 115 short tons TP/year, strongly suggests that the SWAT model, while accurately reflecting TP loading to the impaired southern end segment, substantially overestimates TP loading from the northern ~50% of the watershed. Please justify the Draft TMDL estimate in light of contradictory evidence from three other sources.*
- *Please validate the SWAT model for named streams in the northern half of the Cayuga Lake watershed using certified TP concentration measurements that are publicly available in CSI's online database at http://www.database.communityscience.org/monitoringregions/1. If you do not validate the SWAT model for northern streams, please explain your reasoning.*
- *The 92 short tons TP/year discrepancy between the Draft TMDL and the independent consensus estimate is 50% greater than the Draft TMDL's*

phosphorus reduction goal of 66 short tons TP/year (goal is based on 30% reduction of total annual TP load from all sources). Please state whether you will remove Cayuga Lake from the 303(d) list for phosphorus impairment if a revised TP loading estimate is found to be similar to the consensus estimate of 115 short tons TP/year in Comment Table 2. If you will not delist Cayuga Lake for phosphorus, please justify.

The loading of phosphorus to Cayuga Lake, particularly dissolved phosphorus (see below), is a problem that is best addressed on a stream by stream basis. This approach allows local stakeholders to take ownership of the problem and devise solutions that work for their sub-watershed. Stakeholder buy-in is impeded by apportioning TP loading to drainage areas rather than to specific named streams.

- *Load reduction allocations should be revised and apportioned to named sub-watersheds, for example, the Salmon Creek watershed, the Yawger Creek watershed, etc.*

Draft TMDL Section 7.1 describes three forms of phosphorus measured in the laboratory: Total phosphorus (TP), total dissolved phosphorus (TDP), and soluble reactive phosphorus (SRP). It also describes two forms of phosphorus which are derived from the three measured forms: Particulate phosphorus (PP), which is calculated as TP – TDP; and soluble unreactive phosphorus (SUP), which is calculated as TDP – SRP. Figure 12 in Section 7.1 illustrates that, from a management perspective, the phosphorus forms of concern are SRP, SUP and PP.

Table 17 in Draft TMDL Section 7.2 presents "Average annual SRP loads…" for each sub-basin.

- *TDP is not included in Table 17. Please explain the omission of TDP from consideration of dissolved phosphorus loading to Cayuga Lake in light of the significance attached by the Draft TMDL to TDP as the basis for corroborating the SWAT model (see comments, above, on SWAT model corroboration described in Phase 2 Final Report, Section 8).*
- *SUP is not included in Table 17. Please explain the omission of SUP from consideration of dissolved phosphorus loading to Cayuga Lake in light of the importance attached to SUP as a significant component of dissolved phosphorus, the principal driver of cultural eutrophication (Figure 12).*
- *Why is the loading of dissolved phosphorus estimated in terms of SRP only (Table 17) when Section 7.1, Table 12, makes it clear that SUP is also a significant component of dissolved phosphorus in addition to SUP?*

Some background on the measurement of TDP, SRP and SUP is needed as context for the immediately preceding comments as well as for subsequent comments:

1. Two protocols are commonly used to measure TP and SRP: Standard Methods 4500 P-E; and EPA Method 365.3. The same reagents are used in both protocols; however, there are differences in their concentrations and the timing of their addition to the reaction mixture. A direct comparison of the two methods (on hypolimnion samples from Cayuga Lake) has shown that both yield essentially the same values for TP while the EPA protocol yields SRP values that average about 25% higher than the Standard Methods protocol. This difference, the chemical basis of which is not understood, points to the fact that SRP is operationally defined, i.e., it is not identical to orthophosphate; rather, it includes other forms of dissolved phosphorus such as polyphosphates and organic phosphorus compounds, and its value is determined by the protocol that is used to measure it (Effler et al, 2016).

2. The Standard Methods protocol was used to measure TP, TDP and SRP concentrations in Cayuga Lake tributary streams. These measurements form the basis for SWAT model estimates of phosphorus loading to Cayuga Lake.

3. The Standard Methods protocol and the EPA protocol can both be used to measure total dissolved phosphorus (TDP). TDP values obtained by the two protocols are very similar (Effler et al, 2016). However, because Standard Methods SRP tends to be lower than SRP measured by the EPA method, the calculated Standard Methods SUP value is higher (SUP = TDP – SRP). In the EPA method, by contrast, SRP approaches TDP, and the calculated SUP value is therefore lower. Effler et al (2016) note that from a practical management perspective, "In studies where no TDP measurements are made… SRP [by EPA protocol] would be a more useful measure than SRP [by Standard Method protocol] because it would more closely approach the total load of dissolved bioavailable P."

4. There is a regulatory dimension to TDP and SUP. TDP as measured by the Standard Methods protocol, and SUP calculated from TDP, are used in research aimed at modeling phosphorus pools and their bioavailability in lakes. From a regulatory perspective, however, TDP and, hence, SUP are not approved analytes in New York State. They are absent from New York State Department of Health-Environmental Laboratory Approval Program (NYSDOH-ELAP) application forms for laboratory certification (https://www.wadsworth.org/regulatory/elap/application-certification-for-labs) and also from the NYSDOH-approved list of analytes for non-potable water (https://www.wadsworth.org/regulatory/elap/requirements-for-laboratory-certification-certification, Fields of Accreditation, item 180.2, Non-potable). Note that the only phosphorus methods listed as approved are "Orthophosphate (as P)" and "Phosphorus, Total." While research results based on TDP and SUP may be used for informational purposes, they cannot be used as a basis for regulatory decision-making, such as the development of state environmental

policy and the enforcement of state environmental laws. Those kinds of decisions involve the expenditure of taxpayer dollars, and New York's public health law requires that governmental functions such as these be based solely on approved environmental laboratory methods (New York Public Health Law, Article 5, Title 1, Section 502, https://www.nysenate.gov/legislation/laws/PBH/502).

5. CSI's certified lab (NYSDOH-ELAP# 11790) has used the EPA method consistently since 2004 to measure SRP in streams and has not used TDP, precisely because it is not an approved analyte and therefore cannot be used for regulatory purposes. Fortunately, SRP determined by the EPA method approaches the value of TDP (Effler et al, 2016), and it is therefore a good choice for estimating dissolved phosphorus loading.

Draft TMDL Section 7.2, Table 17, column 3, lists the SRP loads for each sub-basin of Cayuga Lake, and these add up to 17.02 short tons of SRP loaded to the lake annually from non-point sources.

- *Do the SRP loading estimates in Table 17 refer to SRP as determined by the Standard Methods protocol, which was used to estimate loading in southern tributary streams (Prestigiacomo et al, 2016)? If so, please explain the absence of SUP from the dissolved phosphorus loading estimates in Table 17.*
- *Do loading estimates in Table 17 need to be adjusted upward by adding SUP? If so, by how much?*

Comment Table 3 compares non-point source dissolved phosphorus loading estimates in the Draft TMDL, Section 7.2, Table 17, with three other studies: The Community Science Institute, 2021; Haith et al, 2012; and Likens, 1974. Agreement is reasonably good between the TMDL and CSI for Fall Creek and the Cayuga Inlet while dissolved phosphorus loading estimates reported by Haith et al (2012) and Likens (1970-71) are considerably higher for these two streams. In streams to the north of the impaired southern end segment, Draft TMDL estimates for dissolved phosphorus in Salmon Creek, Taughannock Creek and Great Gully are lower than the other three. The TMDL's total non-point source dissolved phosphorus loading estimate, 17 short tons/year, is 3.6 times lower than the mean of the other three estimates, 62 +/- 13 (SD) short tons/year. Moreover, the TMDL estimate is more than 3 standard deviations below the mean of the three independent SRP estimates, indicating that, like the TMDL's TP loading estimate, it is an outlier.

Comment Table 3					
Comparison of TMDL with Three Independent Estimates of Dissolved Phosphorus[a] Loading (short tons/year)					
Watershed	Draft TMDL, Table 17 (2021)	CSI (2021)[b]	Haith et al (2012)[c]	Likens (1970-71)[c,d]	
Fall Creek	2.06	3.81	11.2	10.9	
Combined Cayuga Inlet[e]	3.14	3.03	10.4	29.2	
Salmon Creek	4.26	6.33	8.7	5.8	
Taughannock Creek	1.28	1.89	4.7	3.7	
Great Gully	0.82	2.88	--	--	
Cayuga Lake	**17**	49	64	74	
		Mean CSI, Haith et al, Likens = 62 +/- 13 (SD) short tons dissolved phosphorus/year			

[a] Laboratory methods for determining dissolved phosphorus vary, however, results are reasonably comparable.
[b] Values from Penningroth, S. Presentation to the Cayuga County Water Quality Management Agency, April 1, 2021, slide 7, http://www.communityscience.org/outreach-and-education/public-event-presentations/
[c] Values from Haith et al (2012), Table 8. Units of Mg/year (Megagrams/year) are converted to short tons/year by multiplying value by 1.1 short tons/Mg.
[d] Loading results reported in Likens (1974) and summarized in Haith et al (2012)
[e] Cayuga Inlet, Six Mile Creek and Cascadilla Creek

- *The 3.6-fold discrepancy between the Draft TMDL estimate for dissolved phosphorus loading to Cayuga Lake and a consensus estimate based on three independent sources strongly suggests that the SWAT model, while reasonably accurate in its estimate of dissolved phosphorus loading to the impaired southern end segment, substantially underestimates loading from the other ~50% of the watershed.*
- *The SWAT model should be validated for named streams in the northern half of the Cayuga Lake watershed using certified SRP concentration measurements that are publicly available in CSI's online database at http://www.database.communityscience.org/monitoringregions/1. Please justify a decision not to validate the SWAT model.*

Comment Table 4 presents multi-year averages of SRP and TP concentrations under high flow ("stormwater") conditions at the mouths of 16 Cayuga Lake tributary streams monitored by CSI partnerships with community groups. Most nutrient runoff and loading occurs under high flow conditions following rainfall and snowmelt. Therefore, elevated SRP and TP concentrations under high flow conditions are indicative of substantial loading. In addition, the ratio of SRP to TP concentrations can be used to estimate the percentages of the total phosphorus load that enter the lake as SRP and PP (TP - SRP = PP).

What is the relationship between the stormwater SRP/TP concentration ratio and the SRP/TP loading ratio? This question can be answered for Fall Creek and Six Mile Creek where similar TP and SRP loading estimates have been reported independently by CSI and the Draft TMDL (see Comment Tables 1 and 3). In the case of Fall Creek, the SRP/TP loading ratio is 0.19 (based on CSI loading estimates) whereas the SRP/TP high flow ("stormwater") concentration ratio at the stream mouth is 0.14 (Comment Table 4). In the case of Six Mile Creek, the SRP/TP loading ratio is 0.15 and the SRP/TP high flow concentration ratio is 0.09 (Comment Table 4). Thus based on Fall Creek and Six Mile Creek, SRP/TP stormwater concentration ratios underestimate SRP/TP loading ratios by about 40% to 60%. Stated differently, the multi-year SRP/TP stormwater concentration ratios in Comment Table 4 correspond to minimum percentages of SRP loading and maximum percentages of PP loading to Cayuga Lake. For example, Salmon Creek, Paine's Creek and Canoga Creek transport at a minimum, respectively, 28%, 51% and 42% of their phosphorus loads as SRP and a maximum of 72%, 49% and 58%, respectively, as PP (Comment Table 4). The average high flow SRP/TP concentration ratio for 16 monitored streams is 33%, indicating that at least one-third and possibly as much as half of all phosphorus entering Cayuga Lake from non-point sources is dissolved and bioavailable. This is consistent (Comment Tables 2 and 3) with the independent consensus SRP/TP loading ratio of (62 short tons SRP/year) / (115 short tons TP/year), or 54%, while it is inconsistent with the Draft TMDL SRP/TP loading ratio of (17 short tons SRP/year) / (207 short tons TP/year) or 8%.

Comment Table 4						
Stormwater SRP and TP Concentrations at Mouths of Cayuga Lake Tributary Streams[a]						
Watershed[a] (years monitored)	Mean[b] Stormwater[c] SRP[d] (ug/L)	N[e]	Mean[b] Stormwater[c] TP[f] (ug/L)	N[e]	SRP[f] share of Stormwater TP (%)	PP[f] share of Stormwater TP (%)
Fall Creek (2002–present)	24.8	38	175.9	43	14	86
Six Mile Creek @ Bethel Grove (2004-present)	22.6	31	238.8	31	9	91
Cascadilla Creek (2009-present)	37.2	25	105.9	25	35	65
Cayuga Inlet (2007-present)	16.4	22	119.6	22	14	86
Salmon Creek (2006 – present)	65.8	22	233.5	22	28	72
Taughannock Creek (2006-present)	26.3	27	160.5	27	16	84
Trumansburg Creek (2006-present)	39.8	27	98.2	27	41	59
Direct Streams - Town Line Creek (2009-2012, 2015-present)	91.8	6	193.2	6	48	52
Direct Streams - Mill Creek (2009-2012, 2015-present)	128.4	7	399.4	7	32	68
Direct Streams - Paines Creek (2009-2012, 2015-present)	122.4	5	242.3	5	51	49
Direct Streams - Deans Creek (2009-2012, 2015-present	258.4	5	422.4	5	61	39
Burroughs Creek (2015-present)	187.9	5	494.4	5	38	62
Williamson Creek (2015-present)	144.0	5	524.0	5	27	73
Great Gully Creek (2017-present)	171.6	4	387.8	4	44	56
Canoga Creek[2] (2015-present)	146.6	5	348.3	5	42	58
Yawger Creek (2017 – present)	144.1	4	454.5	4	32	68
Average, all monitored streams					**33**	**67**

[a] Navigate to named streams from Cayuga Lake Watershed regional page in CSI's public online database, http://database.communityscience.org/monitoringregions/1
[b] Soluble reactive phosphorus (SRP) and total phosphorus (TP) graphs on monitoring set page for each stream (use drop-down menu on graph, hover cursor over stormwater icon)
[c] Stormwater average chosen as more representative of loading than base flow average
[d] SRP is considered to be 100% bioavailable
[e] Number of stormwater samples analyzed over the years stream has been sampled by a volunteer-CSI monitoring partnership
[f] TP = SRP + PP

- *There is solid evidence, described above, that the Draft TMDL overestimates the role of particulate phosphorus and underestimates the role of dissolved phosphorus in the ongoing cultural eutrophication of Cayuga Lake. Given that different strategies are required to manage dissolved and particulate phosphorus,* *how would a more accurate representation of dissolved phosphorus loading affect the Draft TMDL's guidance for reducing phosphorus loads?*

- *The underestimate of dissolved phosphorus loading and overestimate of particulate phosphorus loading undermine confidence in the TMDL as a guide to managing nutrient inputs to Cayuga Lake. Please explain how you would overcome stakeholder skepticism in the event that dissolved and particulate phosphorus loading estimates are not revised and the weight of evidence continues to indicate that stakeholder investment in BMPs directed at particulate phosphorus would be misdirected and do little to manage risks to water quality in Cayuga Lake.*

References

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