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7 September 2016

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Utah Division of Water Quality

Mr. Walter L. Baker, P.E.
Division of Water Quality
PO Box 144870
Salt Lake City, Utah 84114-4870

RE: 2016 Integrated Report

Dear Mr. Baker:

The District has reviewed the comments to be submitted to the Division prepared by the Jordan River/Farmington Bay Water Quality Council and by Dr. Theron Miller. The District supports and endorses these comments.

Very sincerely,

Dal D. Wayment

Dal D. Wayment, P.E.
General Manager

DDW/sm

DWQ-2016-013111

September 6, 2016

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Utah Division of Water Quality

Walter L. Baker, P.E.
Division of Water Quality
Utah Department of Environmental Quality
280 N 1460 West
PO Box 144870
Salt Lake City, Utah 84114-4870

Dear Mr. Baker,

The attached comments on the draft 2016 Integrated Report represent the collective comments and concerns of the Jordan River/Farmington Bay Water Quality Council and its members. We appreciate the amount of time and energy invested in this document by the Division.

Sincerely,

Central Valley Water Reclamation Facility,
Thomas A. Holstrom, P.E.
General Manager

South Davis Sewer District
Dal D. Wayment, P.E.
General Manager

Central Davis Sewer District
Leland Myers, P.E.
District Manager

South Valley Reclamation Facility,
Lee Rawlins
General Manager

for Craig White

South Valley Sewer District,
Craig White
General Manager

North Davis Sewer District
Kevin Cowan, P.E.
General Manager

Comments on Utah's Draft 2016 Integrated Report
Utah Division of Water Quality

The Utah Division of Water Quality issued its Draft 2016 Integrated Report (hereafter, 2016 Draft) on June 10, 2016. This document was originally open for public comment until August 9, 2016. Subsequently, DWQ extended the public comment period to September 8, 2016. The comments presented below have been developed by Hall & Associates on behalf of the Jordan River/Farmington Bay Water Quality Council. These comments address specific regulatory and technical issues with the assessment methods and findings presented in the 2016 Draft.

1. Regulatory Considerations

Utah's 2016 Integrated Report Assessment Methods (2016 Draft, Chapter 2) include new, more restrictive assessment procedures for addressing whether nitrogen and phosphorus are causing violations of the state narrative criteria (2016 Draft, Chapter 2 at 37, 74-75). This is considered the state's "narrative criteria implementation methodology" which EPA indicates may be set forth in 303(d) listing guidance. DEQ previously had a methodology for determining whether or not nutrient impairments of state waters was occurring. This methodology was used to designate waters as nutrient impaired (*i.e.*, in violation of narrative standards) (2014 CALM). These new assessment procedures constitute a new or revised water quality standard under the Clean Water Act.[1] Specifically, the new assessment procedures constitute a new or revised water quality standard if:

1. It is a legally binding provisions adopted or established by State law, and
2. The provisions address designated uses, water quality criteria to protect designated uses, and/or antidegradation requirements for waters of the United States, and
3. The provisions express or establish desired conditions (e.g., uses, criteria) or instream levels of protection for waters of the United States immediately or mandate how it will be expressed or established in the future, and
4. The provisions establish a new water quality standard or revise an existing water quality standard.

The 2016 Draft Assessment Methods amend the prior methodology, meet all of the listed thresholds and, in effect, establish new water quality standards for harmful algal blooms measured as cyanobacteria cell counts. New water quality standards are required to undergo rulemaking and cannot be imposed by the State in this manner.

Any new requirement that has the same effect as a water quality standard must be published as a proposed water quality standard for public review and comment and be submitted to USEPA for review. 40 CFR 131.20 and 131.21. That has not occurred in this case. Consequently, the use of

[1] USEPA, October 2012. *What Is a New or Revised Water Quality Standard Under CWA 303(c)(3)? Frequently Asked Questions*. Available at https://www.epa.gov/sites/production/files/2014-11/documents/cwa303faq.pdf.

the algal bloom thresholds in the Assessment Methods should be deferred until the proper rulemaking prerequisites have been followed and EPA has approved the use of these new water quality criteria.

2. Specific Comments on 2016 Draft

A. Chapter 2: 2016 303(d) Assessment Methods

i. Addressing Nitrogen and Phosphorus

The 2016 Draft Report discusses the use of screening values as the basis for identifying water quality impairments (i.e., narrative criteria violations) associated with nitrogen and phosphorus (2016 Draft, Chapter 2 at 37-38). The text in this section of the report notes that DWQ anticipates publishing and seeking public comment on draft procedures for conducting nutrient-related assessments such as using screening values for percent saturation of dissolved oxygen, with high daytime values above 110% saturation potentially indicating concerns with nighttime minimum dissolved oxygen. Waters listed as "impaired" based on these criteria will require nutrient load reductions either when a TMDL is developed or at the time of permitting.

Comment

These procedures have serious regulatory implications and the identified numeric values are the "applicable standard" when interpreting the narrative criteria. Therefore, these numeric values should not be used as bases for listing waters as impaired until they have been vetted through a peer review process and issued for public notice and comment. Under federal law, the State may not use new narrative criteria as "applicable standards" until USEPA approval occurs. (40 CFR 131.21).

ii. Lake and Reservoirs (2016 Draft, Chapter 2 at 58)

a. Tier I Assessment

In its assessment of lakes, DWQ indicates that it is using targeted monitoring and a tiered approach to ensure public health protection from potential harmful algal blooms (2016 Draft, Chapter 2 at 58-59). Tier I consists of evaluations of Drinking Water and Recreational Use Support. "DWQ will use the recommendations by the World Health Organization to guide this assessment." (2016 Draft, Chapter 2 at 59). The World Health Organization (WHO) recommendations (*Guidelines for safe recreational water environments*; WHO, 2003) are based on aggregate cyanobacteria cell counts for thresholds of human health risk associated with potential exposure to cyanotoxins (generally via ingestion) and are summarized in the table below from the 2016 Draft (Table 10 at Chapter 2 at 60).

Indicator (units)	Low Risk	Moderate Risk	High Risk
Chlorophyll-a (µg/L)	<10	10-50	>50
Cyanobacteria cell counts (cells/mL)	<20,000	20,000 – 100,000	>100,000

As noted above, the identified numeric values are the "applicable standard" when interpreting the narrative criteria. Therefore, these numeric values should not be used as bases for listing waters as impaired until they have been vetted through a peer review process, been issued for public notice and comment, and approved by USEPA. However, as discussed in the WHO Guidelines, the human health concern is attributed to cyanotoxins, not cyanobacteria counts or chlorophyll-a concentration. Cyanobacteria count is a step removed from cyanotoxin and should not be used as a proxy. Moreover, chlorophyll-a concentration is further removed from cyanotoxin concentration and cannot be used as a proxy for use impairment. Chlorophyll-a concentrations can be elevated without a cyanobacteria bloom if other forms of algae are responsible for the elevated chlorophyll-a concentration. Under this circumstance, there is no possibility of exposure to excessive levels of cyanotoxin and uses are not impaired.

- Drinking Water Use Support

The 2016 Draft (Chapter 2 at 59-60) uses the WHO threshold values as the basis for evaluating Drinking Water Use Support and Recreational Use Support as part of its Tier I Assessments. With regard to drinking water use protection, the 2016 Draft notes that excessive growth of cyanobacteria can also lead to taste and odor problems, which increases drinking water treatment costs. In some instances, sources of drinking water may need to be temporarily excluded from the water supply until a cyanobacteria bloom subsides. Some species of cyanobacteria can produce cyanotoxins that are harmful to people and other animals (2016 Draft, Chapter 2 at 59). Other forms of phytoplankton do not pose this threat.

<u>Comments</u>

In-lake cyanobacteria cell counts have no direct relationship to drinking water uses, as such uses occur "after" treatment, as mandated by the Safe Drinking Water Act, Surface Water Treatment Rules. There is no explanation of how treatment reduces these compounds. Moreover, a use is not impaired merely because the cost for treatment increases. By federal law, all surface waters must be extensively treated prior to use in a public water system. Potable water supplies continually monitor and adjust treatment in response to raw water quality and changes in the cost to provide treatment do not prevent such use. It is not apparent that, in Utah, cyanobacteria levels cause any significant increase in surface water treatment needs or costs. Consequently, asserting "use impairment" due to this cause is speculative.

The presence of cyanotoxins in a drinking water supply is a concern if treatment cannot remove the toxins to an acceptable level. Since not all cyanobacteria produce toxins and those that can produce toxins do not always produce toxins, it would seem that using cyanobacteria cell density is not the appropriate metric. Drinking Water Use Support should be based on meeting specific cyanotoxin thresholds in the potable water supply, after treatment, as suggested by USEPA. USEPA's webpage for Guidelines and Recommendations for Harmful Algal Blooms, cyanobacteria and cyanotoxins begins with an acknowledgment that "[c]urrently there are no U.S. federal water quality criteria, or regulations for cyanobacteria or cyanotoxins in drinking water under the Safe Drinking Water Act (SDWA) or in ambient waters under the Clean Water Act (CWA)" despite decades of awareness of the potential health impacts.[2] As of the last webpage update on March 15, 2016, EPA expects to release draft ambient water quality criteria for cyanotoxins for the protection of recreational activities in freshwater in Fall 2016. EPA has developed Health Advisories (HA) for cyanotoxins (e.g., microcystins and cylindrosperopsin) but not cyanobacteria cell counts. Similarly, EPA has developed Health Effect Support Documents (HESD) for cyanotoxins (e.g., microcystins, cylindrospermopsin, and anatoxin-a) but not cyanobacteria cell counts.

While it should seem obvious, drinking water uses cannot apply to Great Salt Lake since it has no such use. Such uses to be protected should apply, if at all, at the point of water intake. Lastly, it should be noted that drinking water use is not a CWA Section 101(a) use that must be protected under the Clean Water Act. It is separately regulated under the Safe Drinking Water Act. Therefore, this impact should not be specified as a Clean Water Act water quality standard or impairment.

- Recreational Use Support Assessment

With regard to recreational use support, the 2016 Draft (Chapter 2 at 60) notes that human health can be put at risk when exposed to algal toxins through skin contact, inhalation, or ingestion. This exposure pathway exists through multiple methods of recreation in lakes such as boating, water-skiing, and swimming. Recreational uses are considered supported if cyanobacteria cell counts are less than 20,000 cells/mL. Uses are not supported if cyanobacteria cell counts are greater than 100,000 cells/mL for more than one sampling event and/or other narrative indicators suggest an impairment of recreational uses (e.g., chlorophyll-a). If there is one exceedance greater than 20,000 cells/mL, the data are considered insufficient to determine whether the uses are attained.

The referenced use-support and use-impairment targets, once again, come directly from the WHO Guidance. The basis for these target concentrations of cyanobacteria cell counts is discussed in the WHO Guidance (See, Attachment 1). The Guidance provides specific rationales for the assignment of adverse health effects associated with cyanobacteria cell counts in Table 10 from the 2016 Draft. The use of cyanobacterial cell counts as a metric for determining recreational use support, based on the WHO Guidance, is inappropriate for the following reasons.

[2] USEPA. Guidelines and Recommendations. Last updated March 15, 2016. https://www.epa.gov/nutrient-policy-data/guidelines-and-recommendations

Comments

The low risk threshold (<20,000 cyanobacterial cells/mL) is based on a single study (Pilotto et al., 1997). The scientific defensibility of this study and underlying assumptions need to be carefully reviewed, not simply accepted. Additional support is necessary if the DWQ wishes to propose this threshold as the basis for determining use attainment. Moreover, DWQ must make public notice that it intends to use this numeric threshold and provide the public with the opportunity to review the supporting data and comment on the efficacy of the threshold as a basis for making such assessments.

As discussed in the 2016 Draft, the intended protection is based on exposure to algal toxins via ingestion, but the basis for the WHO recommendation is not cyanotoxin exposure but skin irritation ("the irritative or allergenic effects of other cyanobacterial compounds…"). Water quality standards for other parameters, necessary to ensure recreational use protection, are based on protection from significant health impacts (e.g., significant illness, cancer). It is not apparent how one effect translates to the other, or the severity of the skin irritation, should it arise.

As described in the WHO Guidance, the moderate risk cell concentration range of 20,000 – 100,000 cells/mL represents a threshold for recreational users to reach a dose of microcystin that meets the tolerable daily intake for drinking water, previously described as a level that would be safe *for continuous consumption over a lifetime*. As described, this is equivalent to a "no observed effect" threshold and would be more appropriate as a recreational use attainment threshold. However, for this to be an appropriate threshold, a swimmer would need to swim every day in a cyanobacteria bloom that produces microcystin and swallow 100 mL of such lake water every day over a lifetime. This level of exposure does not seem plausible. Alternatively, for a "single day" exposure concern, the effect from ingestion would need to be documented as acute (*i.e.*, short term serious adverse health impact) which is not demonstrated in the underlying reports. Consequently, this threshold requires public review and comment.

The use impairment threshold, >100,000 cyanobacteria cells/mL, is discussed in the WHO Guidance as a cell density that can result in the formation of a scum layer, with the remaining assessment discussing the potentially severe health effects associated with scums. The scum layer may contain cyanobacteria cell concentrations a thousand times higher (100,000,000 cells/mL) than the ambient water concentration. The risk of incidental water consumption associated with the scum layer is not the same as the risk associated with full body contact. Consequently, the impairment threshold is not supported by the evaluation.

As discussed in the WHO Guidance, the relationship between cyanobacteria concentration and cyanotoxin concentration is very tenuous and cannot serve as a surrogate for a specific "recreational use" cyanotoxin criterion. As described, cyanotoxins may be present "if" the right cyanobacteria are present. If the right cyanobacteria are not present, cyanotoxins would not be a concern and the threshold would be overly conservative. The 2016 Draft intends to address the potential harmful effects of cyanotoxins. To the extent that cyanobacteria cell concentration threshold is not a measure of microcystin concentration, cyanobacteria cell concentration is inappropriate as an impairment metric. It would seem that the proper threshold would be microcystin concentration.

The WHO Guidance notes that health outcomes depend upon cyanobacteria density, type of cyanobacteria present, and duration of exposure, none of which are addressed in the 2016 Draft or fully explained in the WHO Guidance. EPA criteria guidance emphasizes that concentration, frequency, and duration of exposure are key components that must be assessed to properly establish a defensible WQS. These factors need to be adequately considered in evaluating whether the proposed threshold is appropriate.

The concern regarding cyanotoxin exposure and possible health impacts is replete with unsupported assumptions and compounded worst case guesses (see emphasis in text from WHO Guidance in Attachment 1). The use of these assumptions in determining a water quality criterion clearly requires a scientific peer review to ensure that it is appropriate for criteria application.

The potential dose of cyanotoxin associated with recreational uses – where ingestion is minor - cannot be compared with continuous exposure over a lifetime from drinking water ingestion. Thus, for waters where full body contact recreation cannot occur (e.g., very shallow water), the proposed criteria should not be applicable.

These thresholds should not apply to kayaking or boating (recreational activities occurring above the water surface) as the potential for dermal exposure would be minimized in comparison with full body contact.

The proposed chlorophyll-a target is not scientifically defensible, as chlorophyll-a is not a good indicator of the presence or concentration of cyanotoxins, and should be removed from the proposed criteria.

For these reasons, the recommended cyanobacteria cell density thresholds need to be peer reviewed and presented to the public for review and comment before it is used to assess recreational use impairment.

b. Tier II Assessments

Tier II Assessments are described as "weight of evidence" criteria that consider three types of data to assess compliance with Utah's narrative standard. (See, 2016 Draft, Chapter 2 at 68 et seq.). These types of data are:

1. Increasing TSI trend over the long-term period (~10 years) or a TSI-Chl-a greater than 50;
2. Water-quality based fish kills or winter DO measures not meeting the criterion when measured; and,
3. Evaluation of Phytoplankton community.

Carlson's TSI estimates are calculated for Secchi depth, total phosphorus concentration, and chlorophyll-a. These are treated as independent indicators and are not averaged. The TSI for chlorophyll-a is calculated using the following formula:

$$TSI\text{-}Chl\text{-}a = 9.81 \ln(Chl\text{-}a) + 30.60, \text{ where Chl-a concentrations in } \mu g/L$$

Back-calculating the chlorophyll-a concentration that results in a TSI > 50 yields a chlorophyll-a concentration >7.2 μg/L. The TSI is evaluated for the period from May through September. Figure 17 (2016 Draft, Chapter 2 at 69) indicates that a single exceedance of the TSI-Chl-a, combined with a phytoplankton community dominated by cyanobacteria, is sufficient to characterize a water as impaired.

Comments

It is not clear whether the data collected are averaged over the reporting cycle (May – September) and then a TSI is calculated, or if a TSI value is calculated for each sample and the results are averaged, or if TSI values are independently considered for individual samples.

Assuming that individual TSI values are considered independently, the Tier II assessment of "not supporting" is overly stringent given that phytoplankton communities go through successional periods with periodic blooms occurring under natural conditions. Consequently, a measurement during a normal bloom could trigger an impairment listing that is not representative of the reporting cycle. If this is the case, the TSI is being treated as an acute water quality standard and is inconsistent with the underlying basis for the recommendations contained in the WHO Guidance. At a minimum, monthly measurements over the growing period (May through September) should be averaged to make an informed decision on the status of a lake.

In describing the relatively low probability of adverse health effects, the WHO Guidance characterized a cyanobacteria cell count under 20,000 cells/mL as having a chlorophyll-a concentration of 10 μg/L. The Tier II TSI-Chl-a threshold is triggered when chlorophyll-a concentrations are greater than 7.2 μg/L. Since the WHO Guidance notes that impairments are not expected for cyanobacteria cell counts under 20,000 cells/mL, equivalent to 10 μg/L chlorophyll-a, it is inappropriate to set the TSI-Chl-a threshold at a concentration that is tripped when a significantly lower chlorophyll-a concentration occurs.

iii. Narrative Criteria

Finally, with regard to the phytoplankton community, DWQ intends to apply the cyanobacterial cell count thresholds from Tier I Lake Assessment for determining impairments due to harmful algal blooms as part of a narrative assessment (2016 Draft, Chapter 2 at 75).

Comments

Use of the WHO Guidance cyanobacteria cell count thresholds is inappropriate for the reasons discussed previously for the Tier I assessments.

iv. Total Phosphorus Threshold for Cyanobacteria Human Health Impacts Prevention

The WHO Guidelines recommend total phosphorus concentrations in the range of 0.01-0.03 μg/L to prevent toxic accumulations of cyanobacteria (at 154). This range of TP concentrations exceeds the background levels observed in virtually all Utah surface water bodies. Chorus and Bartram (1999) (cited in the WHO Guidelines as the basis for the cyanobacteria recreational guidelines; at 150) presents a TP concentration target of 0.03-0.05 *mg*/L as a concentration critical for limiting cyanobacterial biomass. Even assuming that the Guidelines' units are incorrectly reported and are supposed to be 0.01-0.03 *mg*/L, the vast majority of, if not all, Utah surface water bodies would still naturally exceed this level. Thus, one would conclude that the cyanobacteria blooms are naturally occurring and should not be considered use impairments under the Clean Water Act.

Comments

The Clean Water Act does not regulate natural conditions, such as a plant growth occurring due to naturally occurring background TP concentration. Therefore, this range of TP concentrations is unattainable in Utah surface water bodies and cannot be regulated to control cyanobacteria under the CWA. Moreover, if these low levels of TP are able to promote cyanobacterial blooms, then these blooms should also be considered a natural condition not subject to regulation.

The 2016 Draft (Chapter 5 at 21) discusses whether cyanobacteria are naturally occurring in Utah Lake. The discussion indicates that cyanobacteria concentrations appear to have increased since pre-European settlement, but no data are presented to indicate when these concentrations increased, how much they increased, or why they increased. The available data need to be presented to the public and peer reviewed to assess whether HAB occurrence should be considered a natural occurrence or whether other conditions (e.g., hydromodification) are responsible for the apparent increase in cyanobacteria concentration in Utah Lake.

B. Chapter 3: River and Stream Assessments

The Rivers and Stream Assessments claim that the State Canal is not supporting designated uses due to exceedances of water quality criteria for total ammonia (2016 Draft, Chapter 3 at 24). This listing is incorrect and should be removed from the 303(d) list.

Over the course of a year and a half, DWQ and the Jordan River/Farmington Bay Water Quality Council have traded letters concerning the need for more stringent total ammonia wasteload allocations for the Jordan River and State Canal. These letters and evaluations are incorporated here by reference and include the following:

- DWQ November 2014 Preliminary Wasteload Allocations for Ammonia

  Preliminary WLAs for the five POTWs discharging to the Jordan River and State Canal were based on steady-state water quality modeling, with all POTWs on the Jordan River and State Canal discharging at their design flows and permitted loads.

- Council July 16, 2015 Letter to DWQ

Comment that preliminary ammonia WLAs were unnecessarily conservative and request that a probabilistic model be used to develop the WLAs with consideration for EPA's updated 2013 water quality criteria for ammonia.

- DWQ November 5, 2015 Response to Council

  DWQ presented revised WLAs using the 5-year average flows for the POTWs and steady-state modeling as a surrogate for probabilistic modeling. Analysis showed that load reductions were still required under current ammonia criteria.

- Council April 5, 2016 Letter to DWQ

  DWQ finally provided the water quality monitoring data for the Jordan River and State Canal, on February 8, 2016, that served as the basis for the revised WLAs included in the November 5, 2015 letter. The WLA in the November 5, 2015 assessment paired measured upstream pH values for the Jordan River at the confluence with the State Canal and measured instream total ammonia concentrations below the SDSD North WWTP to conclude that the ammonia criteria were exceeded. The April 5, 2016 letter presented an evaluation with ammonia concentration and pH predicted using steady-state mixing considerations, to show that current ammonia criteria are not exceeded based on current permit limits.

- DWQ July 7, 2016 letter presents DWQ's response to the April 5, 2016 evaluations. In this letter, DWQ notes that "Due to diel fluctuation of temperature and pH, we decided to use the continuous sonde data upstream of the North Plant in order to get a more accurate estimate of the mean monthly temperature and pH. This was considered preferential to utilizing the concurrent instantaneous field measurement of temperature and pH at the downstream grab sampling site, which weren't always available." Based on this screening evaluation, DWQ concluded that the SDSD North discharge caused an exceedance of the state ammonia water quality criteria. "Rather than revisit the evaluation conducted for our November 2015 letter to you, we instead refer this matter to the public comment period associated with the issuance of the draft 303(d) list, upon which you are welcome to provide comments." With regard to the wasteload allocation evaluations presented in the Council's April 5, 2016 letter, DWQ commented that the Council's WLA uses alternative methods and procedures, such as use of the 5-year average flows in the analysis, are not consistent with state regulations.

<u>Comments</u>

As described in the July 7, 2016, DWQ violated its own 2016 Draft procedures for evaluating total ammonia. Chapter 2 (at 49) describes how DWQ evaluates ammonia criteria for the purpose of assessing aquatic life use support:

> "if a field pH or temperature reading is unavailable, a correction factor cannot be made and the result value for ammonia will be removed from the assessment."

DWQ used pH and temperature values upstream of the SDSD North WWTP to evaluate criteria compliance at the downstream sampling station. This assessment ignores the known influence of the discharge on pH and temperature and is contrary to the method that the

Department said it would use in evaluating ammonia toxicity. The rationale for doing so, "due to diel fluctuation of temperature and pH", has no scientific merit. For this reason, alone, the listing should be removed and re-categorized as "insufficient information" to make a determination.

Use of the 5-year average POTW flows for calculating WLAs was originally suggested by DWQ as a way to address the Council's request that probabilistic modeling be used to assess the need for more stringent ammonia WLAs. The DWQ response to the Council's April 5, 2016 letter, indicating that effluent limits for POTWs must be based on the design flow of the facility is more stringent that USEPA regulations and guidance, which explicitly allow for the use of probabilistic models to develop more accurate WLAs. As such, this requirement is contrary to Utah Code 19-5-105, which provides "no rule that the board makes for the purpose of the state administering a program under the federal Clean Water Act or the federal Safe Drinking Water Act may be more stringent than the corresponding federal regulations which address the same circumstances." Consequently, the Council reiterates its request that future WLAs for ammonia limits in the Jordan River are based on probabilistic modeling.

For these reasons, the impairment listing indicating that the State Canal is impaired for ammonia should be removed.

C. Chapter 4: Lakes and Reservoir Assessments

The Lake and Reservoir Assessments (2016 Draft, Chapter 4) show that Utah Lake is not supporting designated uses due to harmful algal blooms and total phosphorus. (Chapter 4 at 14)

Comments

The listing for impairment due to harmful algal blooms is premature since the assessment methodology for harmful algal blooms has not undergone peer review or public notice and comment.

The listing of Utah Lake as impaired by total phosphorus is inconsistent with the Methods presented in the 2016 Draft. Chapter 2 notes that the Department is developing comprehensive assessment methods to identify sites with nutrient-related problems, but these methods have not yet been published or approved. (Chapter 2 at 37). Similarly, the Methods confirm that the Department does not have assessment methods to delist an assessment unit for phosphorus (Chapter 2 at 88). Without having the necessary methods to list or delist a use impairment cause, the current impairment listing for total phosphorus is not defensible.

The WHO Guidelines recommend total phosphorus concentrations below 0.03 mg/L to prevent toxic accumulations of cyanobacteria. Utah Lake may naturally exceed this level. Consequently, cyanobacteria blooms may be naturally occurring and should not be considered use impairments under the Clean Water Act. More research is required to assess whether cyanobacteria blooms are a natural condition for Utah Lake. If this is the case, the lake should not be listed under Assessment Unit Category 5.

The impairment listing for Utah Lake for total phosphorus and hazardous algal blooms should be withdrawn pending adoption of rules, after peer review and public notice, to specify appropriate impairment thresholds for cyanobacteria and total phosphorus.

D. Chapter 5: Narrative Standard Assessment of Recreational Use Support in Lakes and Reservoirs and Application to Utah Lake

The 2016 Draft provides an expanded narrative standard assessment of recreational use support for Utah Lake (Chapter 5). This assessment is based on the harmful algal bloom (HAB) assessment method and the Tier II lake assessment method presented in Chapter 2 of the 2016 Draft. (2016 Draft, Chapter 5 at 8).

> UDWQ's HAB assessment method is based on an exceedance of 100,000 cyanobacteria cells per milliliter (cells/mL), an established indicator of human health risk. The assessment methods identify two exceedances of this indicator as a recreational use impairment. While cyanobacteria cell counts are the primary indicator for assessment purposes, two supplemental indicators are also used as confirmation of the primary indicator: cyanotoxin concentrations exceeding 20 µg/L and algal growth measured as chlorophyll a concentrations exceeding 50 µg/L (Figure 1). The World Health Organization has defined thresholds for all three indicators that are associated with a low, moderate, high, and very high relative probability of acute human health effects in recreational waters (Table 1). Exposure routes that may result in negative human health effects from HABs and cyanotoxins include dermal contact, inhalation, or ingestion of cyanobacteria or associated cyanotoxins.

The discussions presented in Chapter 5 provide additional descriptions of the two supplemental indicators used as confirmation for the HAB indicator. Microcystin concentrations are used as confirmatory evidence of toxin producing algae that pose a human health risk to recreational uses. (2016 Draft, Chapter 5 at 11). The 50 µg/L chlorophyll-a concentration is characterized as an indicator of increasing cyanobacterial dominance and has a positive relationship with cyanotoxin concentration.

Based on the methodology described above and water quality samples collected in 2014, DWQ assessed Utah Lake to be impaired for hazardous algal blooms. The data are summarized in Chapter 5 (pages 15 – 17). These data show HABs > 100,000 cells/mL for several stations (Lindon Harbor, State Park Harbor, and Lake outlet), one microcystin concentration > 20 µg/L, and 33 chlorophyll-a concentrations > 50 µg/L. The single microcystin concentration exceeding the indicator level was for a shoreline sample. "This sample was collected from a targeted location along the shoreline as recommended by Utah's HAB guidance to assess the highest risk of exposure at a point of potential recreational contact". (2016 Draft, Chapter 5 at 16).

<u>Comments</u>

Use of the 100,000 cyanobacteria cell/mL concentration as a use impairment indicator should be peer reviewed and proposed as a use impairment threshold for public review and comment. The use of this threshold was discussed in comments on Chapter 2 and are applicable here.

The phytoplankton water quality samples, used to assess exceedance of the HAB threshold concentration, were not collected in accordance with the specified method contained in the 2016 Draft (See, 2016 Draft, Chapter 2 at 58) and cannot be used to make an assessment concerning Tier I drinking water use support or recreational use support.

> *The algal sample, which is analyzed for taxonomic composition and primary production (chlorophyll a), is collected as a composite sample from two times the depth of the Secchi disc reading to the surface up to a maximum of 2 meters.*

All of the samples illustrated in Chapter5-Figure 4 of the 2016 Draft, which exceeded 100,000 cells/mL, were collected at the surface and it is not apparent whether full body or secondary contact recreation is even possible in these locations. Consequently, the exposure thresholds upon which the human health threat is based cannot be assessed. Moreover, it is not apparent that the targeted sampling procedures used by DWQ are consistent with the procedures used in the WHO Guidance to set the threshold concentrations. WHO selected the 100,000 cells/mL threshold as a water column concentration that could promote the formation of dense scums at the surface, not a concentration of cyanobacteria in a scum layer.

As discussed in Chapter 5, recreational exposure, including dermal contact, inhalation, and ingestion are all potential exposure routes for HABs (Chapter 5 at 9). We doubt that dermal contact and inhalation are significant exposure routes. For example, if dermal contact was significant, it is highly doubtful that DWQ staff collecting HAB scum samples in Utah Lake would risk exposure to high concentrations of toxic cyanobacteria. (See Figure 5, lower right panel, illustrated below).

Cyanotoxin threshold of 20 µg/L is characterized as an acute human health value. This is not correct. The WHO Guidance (at 151) states,

> *The level of 20µg microcystin/litre is equivalent to 20 times the WHO provisional guideline value concentration for microcystin-LR in drinking-water (WHO, 1998) and would result in consumption of an amount close to the tolerable daily intake (TDI) for a 60-kg adult consuming 100 ml of water while swimming (rather than 2 litres of drinking-water).*

As discussed above, the cyanotoxin threshold represents the allowable daily intake, every day, for a lifetime. This is not an acute exposure. The WHO Guidance further notes that such an exposure for a child would exceed the TDI, but we question whether the incidental consumption volume of 100 mL is appropriate for a scum layer that is confined to the surface of the water. Moreover, it is clear from the discussion that the exposure of concern is incidental consumption, not dermal contact or inhalation. Consequently, use of this supplemental indicator should be based on the ingestion only and the amount of incidental ingestion needs to be assessed for the scum layer if focused sampling, such as that conducted for this evaluation, is used in the future.

Chlorophyll-a should be dropped as a supplemental indicator because the available data for Utah Lake confirm that chlorophyll-a concentrations greater than 50 µg/L routinely occur in the lake without HABs exceeding 100,000 cells/mL For example, HABs exceeding 100,000 cells/mL have not been detected in Provo Bay, even though 74% of all water quality samples show chlorophyll-a above 50 µg/L. (2016 Draft, Chapter 5 at 15, 17).

The assessment methods, primary indicator, and supplemental indicators require a scientific peer review to determine whether they are appropriate for making recreational use support determinations. Once such a peer review is completed, the assessment and indicator thresholds must be proposed for public notice and comment before they can be used to list any waterbodies as impaired.

E. Chapter 6: Evaluation of Harmful Algal Bloom Data in Farmington Bay, Great Salt Lake

The 2016 Draft provides an evaluation of HAB data in Farmington Bay (Chapter 6). In discussing potential routes of exposure to HABs in Farmington Bay, DWQ cited infrequent primary and secondary contact recreation, including air boating, kayaking, canoeing, hunting, and bird watching. (Chapter 6 at 7). In assessing the available data, DWQ used the same indicators as those used for the formal HAB assessment of Utah Lake. (Chapter 6 at 8).

Comments

Use of the WHO Guidelines as the basis for evaluating recreational use impairment in Farmington Bay is improper because the routes of exposure in Farmington Bay are not relevant to the basis for the WHO Guidelines. The WHO thresholds are based primarily on incidental ingestion of waters containing elevated levels of microcystin. The primary exposure routes identified in Chapter 6 are dermal contact and potential inhalation. These exposure routes do not result in cyanotoxin doses consistent with the ingestion route. Consequently, the thresholds need to be reassessed.

Although the DWQ claims it used the same indicators as those used in Utah Lake, when evaluating cyanotoxins, it treated nodularin as being identical to microcystin-LR. The basis for treating these different cyanotoxins interchangeably needs to be presented to demonstrate that such a change is appropriate.

Threshold indicators for HABs and cyanotoxin concentration purported to impair recreational uses in Farmington Bay require peer review and public notice/comment to adopt regulations and procedures to make such assessments.

F. Chapter 7: Utahs's Draft Assessment Methods for High Frequency Data and Pilot Application for the Jordan River

The 2016 Draft provides draft assessment methods for high frequency data with application to dissolved oxygen measurements in the lower Jordan River (Chapter 7). As presented, these methods appear reasonable. However, the assessments presented for the lower Jordan River are preliminary and gaps in the available high frequency data need to be resolved. When DWQ assembles a complete data set, the data and evaluation should be presented to the public for review and comment prior to adoption.

Attachment 1

WHO Guidance on Cyanobacteria Cell Counts

(*Guidelines for safe recreational water environments*, World Health Organization, 2003)

Relatively low probability of adverse health effects (<20,000 cyanobacterial cells/mL)

For protection from health outcomes not due to cyanotoxin toxicity, but rather to the irritative or allergenic effects of other cyanobacterial compounds, a guideline level of 20 000 cyanobacterial cells/ml (corresponding to 10µg chlorophyll-a/litre under conditions of cyanobacterial dominance) can be derived from the prospective epidemiological study by Pilotto et al. (1997). Whereas the health outcomes reported in this study were related to cyanobacterial density and duration of exposure, they affected less than 30% of the individuals exposed. At this cyanobacterial density, 2– 4µg microcystin/litre may be expected if microcystin-producing cyanobacteria are dominant, with 10µg/litre being possible with highly toxic blooms. This level is close to the WHO provisional drinking-water guideline value of 1µg/litre for microcystin- LR (WHO, 1998), which is intended to be safe for lifelong consumption. Thus, health outcomes due to microcystin are unlikely, and providing information for visitors to swimming areas with this low-level risk is considered to be sufficient.

(WHO Guidance at 149)

Moderate probability of adverse health effects (20,000-100,000 cyanobacterial cells/mL)

At higher concentrations of cyanobacterial cells, the probability of irritative symptoms is elevated. Additionally, cyanotoxins (usually cell-bound) may reach concentrations with potential health impact. To assess risk under these circumstances, the data used for the drinking-water provisional guideline value for microcystin-LR (WHO, 1998) may be applied. **Swimmers involuntarily swallow some water while swimming, and the harm from ingestion of recreational water will be comparable to the harm from ingestion of water from a drinking-water supply with the same toxin content.** For recreational water users with whole-body contact (see chapter 1), a swimmer can expect to ingest 100–200 ml of water in one session, sailboard riders and waterskiers probably more.

A level of 100 000 cyanobacterial cells/ml (which is equivalent to approximately 50µg chlorophyll-a/litre if cyanobacteria dominate) represents **a guideline value for a moderate health alert in recreational waters.** At this level, a concentration of 20mg microcystin/litre is **likely if the bloom consists of *Microcystis*** and has an average toxin content of 0.2 pg/cell, or 0.4µg microcystin/mg chlorophyll-a. Levels may be approximately double if *Planktothrix agardhii* dominates. With very high cellular microcystin content, 50–100µg microcystin/litre would be possible.

The level of 20µg microcystin/litre is equivalent to 20 times the WHO provisional guideline value concentration for microcystin-LR in drinking-water (WHO, 1998) and would result in consumption of an amount close to the tolerable daily intake (TDI) for a 60-kg adult consuming 100 ml of water while swimming (rather than 2 litres of drinking-water). However, a **15-kg child consuming 250 ml of water during extensive playing could be exposed to 10 times the TDI**. The health risk will be increased if the person exposed is particularly susceptible because of, for example, chronic hepatitis B. Therefore, cyanobacterial levels likely to cause microcystin concentrations of 20µg/litre should trigger further action.

Non-scum-forming species of cyanobacteria such as *Planktothrix agardhii* have been observed to reach cell densities corresponding to 250µg chlorophyll-a/litre or even more in shallow water bodies. Transparency in such situations will be less than 0.5 m measured with a Secchi disc. *Planktothrix agardhii* has been shown to contain very high cell levels of microcystin (1–2µg microcystin/mg chlorophyll-a), and therefore toxin concentrations of 200–400µg/litre can occur without scum formation.

An additional reason for increased alert at 100 000 cells/ml is the potential for some frequently occurring cyanobacterial species (particularly *Microcystis* spp. and *Anabaena* spp.) to form scums.

(WHO Guidance at 149 – 151)(Emphasis added)

High probability of adverse health effects (>100,000 cyanobacterial cells/mL)

Abundant evidence exists for potentially severe health outcomes associated **with scums caused by toxic cyanobacteria. No human fatalities have been unequivocally associated with cyanotoxin ingestion during recreational water activities**, although numerous animals have been killed by consuming water with cyanobacterial scum material. **This discrepancy can be explained by the fact that animals will drink greater volumes of scum-containing water in relation to their body weight,** whereas accidental ingestion of scums by humans during swimming will typically result in a lower dose.

Cyanobacterial scums can represent thousand-fold to million-fold concentrations of cyanobacterial cell populations. **Calculations suggest that a child playing in *Microcystis* scums for a protracted period and ingesting a significant volume could receive a lethal dose**, **although no reports indicate that this has occurred**. Based on evidence that a lethal oral dose of microcystin-LR in mice is 5000–11 600µg/kg body weight and sensitivity between individuals may vary approximately 10-fold, the ingestion of 5–50 mg of microcystin could be expected to cause acute liver injury in a 10-kg child. Concentrations of up to 24 mg microcystin/litre from scum material have been published (Chorus & Fastner, 2001). Substantially higher enrichment of scums—up to gelatinous consistency—is occasionally observed, of which accidental ingestion of smaller volumes could cause serious harm. **Anecdotal evidence indicates that children, and even adults, may be attracted to play in scums**. The presence of scums caused by cyanobacteria is thus a readily detected indicator of a risk of potentially severe adverse health effects for those who come into contact with the scums. Immediate action to control scum contact is recommended for such situations.

(WHO Guidance at 151 – 152)(Emphasis added)