

## Comments on Chapter 2, Assessment Methods

T. Miller

1. On page 38, bottom paragraph entitled "Screening Values" insert: "or 7-day or 30-day chronic criteria." after "minima"
2. General comment on *E. coli*: To my knowledge, the only lake where beach *E. coli* values are regularly measured is Lake Powell. As part of the early methods development with Dr. William Moellmer, it was determined that beach closures were due to illegal dumping of houseboat holding tanks. In turn, contamination of beach water typically lasted 3-5 days, depending on location on the lake protection of wind and water currents. This type of contamination is highly ephemeral and does not constitute entire lake closure or listing as impaired. As Dr. Moellmer recommended to the National Park Service, and which was implemented in about 1995, it was illegal for any houseboat to possess the ability to self-pump its holding tank and routine inspections were implemented for all houseboats registered on Lake Powell. These beach closures include only tiny percentages of the lake at any time, and additional measures as part of a TMDL, other than massive fines if caught, would not be practicable.
3. Page 45, paragraph entitled "Duplicate and Replicate Samples"

Comment: There is no statistical reason for selecting the extreme value. For example, is this hoping for potential impairment to be determined? and does this demonstrate DWQ's bias toward this end? This is misuse of science and the data. It may equally be one or the other. I suggest you take the average of the two numbers to give equal weight. Or better yet, put the site in Category 3 and collect another round or two of data and increase your certainty for such an important decision! This present method is just not acceptable.

4. Page 46, Table 7. DO parameter

Comment: It has now been 6 years and at least two Triennial Reviews (comment on the 2010 IR) since I first brought this unacceptable, misrepresentation of the 7-day or 30-day chronic criteria by using instantaneous grab samples - to the attention of DWQ and EPA. How this method even passed and continues to pass EPA scrutiny continues to baffle the mind and suggests that EPA is remiss in performing oversight duties. But again, this is still against EPA's 1986 guidelines. Now these guidelines are only 30 years old. Yet, DWQ does not follow the simple method of identifying the daily maximum and minimum and then averaging these numbers for the appropriate 7-day or 30-day average. When high-profile DO assessments and TMDLS are dependent upon such a simple and doable process for determining the 7-day or 30-day average numbers such as the Jordan River, this remains inexcusable. For example, these numbers are easily acquired by monitoring between 0730 and 0930 and between 1630

and 1830 in the evening. This does not even require much, if any overtime. Again, the case continues that the Jordan River should never have been listed based on 7-day or 30-day criteria violations because they were never documented. Furthermore, DWQ might respond that there have been a few instances where such 7-day violations have occurred as more recently documented using the recording sondes. But again, I have demonstrated in our TAC meetings that such violations are associated with storm flows that mobilize various sources of reduced organic matter that have accumulated in storm drains, storm vaults and tributary and mainstem backwater areas. Moreover, capture and containment of such high flows and associated contaminants with the intention of withholding this organic debris and subsequent decomposition products, such as methane and H<sub>2</sub>S are unmitigatable, except for perhaps artificial aeration. Nevertheless, these pockets of reduced and readily oxidizable organic compounds accumulate because of long term practices include damming, diversions, and channelization and hence qualifies the Jordan River for a UAA based on at least one of the section 301.10(g) factors – principally hydrologic modification as well as natural conditions associated with the flashy storm events.

5. Page 47 Paragraph entitled "Toxic Parameters"

Comments on Bullet 1: EPA's criteria already accounts for toxics that bioaccumulate. Hence, this point is moot. Hence, the probability of Type 1 error increases with lower.

Comment on Bullet 2: Same comment as for Bullet 1 applies. Also, this is not a valid reason to require fewer data points. In reality, the variability of tissue data warrants a larger data set to gain some confidence in the data. Your approach may make less work up front (the only reason for changing this from prior IR cycles (that required at least 10 samples), but a false positive will make much more work trying to chase a TMDL.

Comment on Bullet 3: Same comment as for Bullets 1 and 2: EPA has gone to great and very expensive lengths to establish what are very conservative criteria, and for sensitive life history stages, particularly given the safety margins that are applied. Rather, it appears that DWQ is being even more ultra-conservative and actually more careless by being less scientifically rigorous. I would strongly suggest that you use this "four sample routine" as only a screening tool to place the site in the 3A category, to be followed up with additional sampling, rather than launching into full-on 5A and TMDL process. This could save DWQ lots of head-ache from false positives and expensive TMDLs.

6. Page 48. Paragraph entitled: Equation-Based Toxic Parameters,  
midway through paragraph

Comment: remove the word "only"

Page 48. Bullet entitled: Only hardness-dependent toxics:

Comment: FYI, All hardness values are calculated from Ca and Mg laboratory measurements. Isn't this part of DWQ's standard analyte list? Also, 100 mg/L is very minimal. Most waters in Utah are well above this. I suggest you use a default of at least 150 mg/L or better yet, wait until the next cycle when you actually have real data. Again, making use of Category 3 - insufficient data, would be the best decision until you actually have scientific data. DWQ has spent many pages describing the strict needs of data and describing high data quality objectives and then falls far short of scientific understanding and evaluation when it comes to making an assessment decision. In short, estimating hardness in this manner is basically a "WAG" when it comes to determining a value as critical as hardness for calculating criteria for divalent metals. This should be considered unacceptable by DWQ QA/QC personnel. Also, when it comes to listings on such minimal data, DWQ should at least perform the Biotic Ligand Model to determine if actual violation of the metal criterion really occurs.

7. Page 53, last paragraph.

Comment: Only 11 watershed variables are listed when determining stream reference condition? And without any site-specific data?. DWQ needs to explain how staff can use watershed or regional indicators without confirmation using site-specific physical characters associated with the actual sample site. There is a plethora of site-specific variables that directly influence the invertebrate community at a particular site. To leap from watershed indicators to taxa lists – whether for reference or target sites, needs the additional conformational data to support reference and assessment decisions, DWQ may have done this, but it is not explained in this section. This needs to be clearly explained. For example just review Idaho DEQ Temperature Criteria. In short, such changes in temperature or substrate particle size or allochthonous vs autochthonous energy sources, etc, etc. (natural transitions described in River Continuum Theory), dominate the environmental variables that drive natural shifts in benthic communities (i.e. read Odum or Hynes). Such shifts cannot be detected using mean watershed indicators that have incorporated 1<sup>st</sup> order to 8<sup>th</sup> order streams in one assessment. It is just not possible as a scientific approach. RIVPACS apparently ignores or vastly simplifies these principles. This is one reason, of many, (See Dr. David Richards' comments), why RIVPACS alone is a poor and often misleading metric of stream health.

8. Page 57, last paragraph

Comment: Because of the issues described above, DWQ should only use RIVPACS models as a screening tool and list O/E "violations" as only 3A or 3C – more information is needed - until you have made site-specific visits to include the complete EMAP protocols of physical habitat of reference sites and target sites and include additional metrics now used by all other western states (such as Montana) that have used RIVPACS models for just such screening purposes or in combination with a suite of additional metrics. Omission of this procedure and other valuable will just continually be

challenged by stream ecologists and will indeed result in erroneous assessment conclusions that are environmentally unsound and may be extremely costly for society if TMDL development proceeds including costly restoration practices that result in no biological improvement because of the constraints of basic river continuum principles.

9. Page 60 Table 10

Comment: Unfortunately, and even throughout the science review panel meetings, insufficient time was provided to thoroughly review DWQ's proposed protocol. A profound oversight was that the WHO recommendations are inaccurately cited and the associated literature used in developing these guidelines are weak anecdotal studies. For instance, the "WHO Chlorophyll a thresholds are based on an important caveat: that this metric is only useful if the phytoplankton community is dominated by Cyanobacteria (WHO pages 201-205). This is one of basic tenets of the Central Davis SD comments by Leland Myers. Indeed Chl a by itself has little utility in predicting cyanobacterial blooms and particularly toxigenic cyanobacteria. Additional comments related to this subject are included in the Review of Chapters 5 and 6.

10. Page 66. Paragraph entitled Toxics: Dissolved metals

Comment: DWQ should consider that in most every case where toxic metals are elevated near the sediments, the fish are excluded from this zone because of hypoxia. This is part of the chemistry that releases metals from the sediment. Review your data to confirm this for yourself. Therefore, on your return visit, described in the next section, collect a sample from the inhabitable zone or wait until turnover for a more thorough evaluation to see if fish are actually exposed. In fact, benthic foraging during turnover events is likely the major time and condition that methyl Hg can ascend through the food chain. The point is that there is not a thing you can do about it unless you prescribe artificial hypolimnetic aeration which has been used to some success by USGS. Further, with continual accumulating data indicating that the primary source of Hg is atmospheric deposition, a TMDL is pretty much a waste of time.

11. Page 68. Paragraph entitled: Weight of Evidence

Comment: Two points does not a trend make. With DWQ's assessment schedule of once every six years, DWQ will only visit a site (**maybe**) twice in ten years. This should be extended to all available data and then make sure the slope is statistically significant. Or better yet return to the two-year schedule that DWQ used to collect appropriate samples and data. Thinking that a six-year schedule is adequate, when seasonal succession alone may cause rapid and hundreds of % changes in Chl a or cyanotoxins is just ludicrous. If DWQ can't collect more representative data, then it should shorten the list of lakes or hire more people. With the current sampling schedule, DWQ should use the acquired data as a screening exercise, assess the waterbody as 3A (insufficient dat) and plan to perform more frequent and rigorous testing in order to more fully

understand the magnitude, seasonality and frequency of the actual presence of cyanotoxins.

12. Page 71. Figure 8.

Comment: Explain this figure in greater detail.

13 Page 80. Last paragraph

After the word “waterbodies” Suggest replacing the word “and” with the word “with”

Finally, it appears more and more that DWQ dedicates less and less effort performing rigorous data collection science, and objective scrutiny. Alternatively, DWQ places more and more onerous on a potential discharger or his permit when it comes to establishing truly scientifically-based criteria or performing assessments or developing Water Effects Ratios or performance of BLM and then strenuously resists accepting rigorous scientific endeavor and results when a permittee or his representative goes through this process. Alternative, in prior years, DWQ staff worked closely with permittees to understand their concerns and share in additional scientific analysis or monitoring when it was appropriate. Reducing required sample sizes for assessment or resisting performing site-specific criteria/UAA analyses are prime example of this practice. What happened? DWQ management should allow staff some time to keep up on the literature, engage in meaningful dialogue with permittees, share monitoring and data evaluation and expect more scientific rigor and objective evaluation from its staff, not less. This will restore trust, reduce confrontation and ultimately provide for better management of water quality and the issues that we all care about. With a little more scientific investigation, for the purpose of providing adequate accountability, the POTW group would be VERY willing to support and plan for necessary controls or upgrades where potential benefits have been demonstrated with a higher probability of success than presently exists. All we are asking for is a little more accountability and less speculation or guessing.

COMMENTS ON CHAPTER 6, FARMINGTON BAY  
T. MILLER

An important consideration for DWQ in performing a recreational use assessment is the issue most described by Tom\_ankov\_a et al. (2013). In order to avoid misinterpretation, the following are quotations from this report:

“Density of macroinvertebrates declined by two-thirds, from 15 300 individuals m<sup>-2</sup> in 1997/1998 to 5115 individuals m<sup>2</sup> in 2010, with concomitant declines in biomass. These changes coincided with a sustained decline in phytoplankton concentration and a sudden decline in the overwintering numbers of diving ducks, principally pochard, tufted duck and goldeneye (Tom\_ankov\_a et al., 2013).

“In an effort to control eutrophication, tertiary treatment was introduced in 1981 at major sewage treatment works in the Lough Neagh catchment (Foy et al., 2003). Initially, total phosphorus concentrations decreased (Heaney et al., 2001), but the impact was only temporary, and by the late 1990s, total phosphorus values exceeded those prior to control efforts, mostly due to non-point source pollution (Heaney et al., 2001) and retention and release of phosphorus from the sediments (Foy et al., 2003). Bunting et al. (2007) noted that, in the 1990s, water column concentrations of NO<sub>3</sub> reached a historical maximum, while P concentrations also remained high, resulting in a historical peak in chlorophyll-a concentration. This maximum in algal biomass coincided with Bigsby’s (2000) macroinvertebrate study and a period when large numbers of diving ducks overwintered on the Lough. Today, Lough Neagh remains extremely eutrophic, but the recent reductions in chlorophyll-a concentrations (and probably underlying primary production) are likely to reflect changes in nutrient availability or dynamics and are clearly worthy of further study.

“In other lakes, improvements in water quality have led to shifts in the macroinvertebrate communities (Schloesser et al., 1995; Carter et al., 2006) and decreased total macroinvertebrate abundance (Köhler et al., 2005). In the Firth of Forth in Scotland, attempts to improve water quality by installation of sewage treatment works resulted in a decline in overwintering diving ducks, namely scaup and goldeneye (Campbell, 1984); however, it was unclear whether the declines were caused by the loss of food carried in the sewage or the actual decline of macroinvertebrates associated with the sewage (Campbell, 1984). Thus, the decline in macroinvertebrates at Lough Neagh and concomitant changes in overwintering duck populations may well be an unintended consequence of improving water quality. “

From these quotations, it is clear that nutrient reductions may or may not work and this failure may be twofold: 1) there are other unknowns associated with uncontrolled nonpoint sources, including atmospheric deposition and sediment nutrient recycling; and 2) there may be an unintended overwhelming decline in higher levels in the food chain that directly rely on primary production for their health, survival and reproduction. This very same issue has been proposed by myself numerous times while in conversation with DWQ staff. For example, Marden, 2014 reported the remarkable diversity and biomass of the zooplankton and macroinvertebrates in Farmington Bay and Cavitt (2006 and

2010) has reported the dietary preference and direct utilization of macroinvertebrates by both waterfowl and shorebirds as they nest and later stage in impoundments and sheetflow wetlands of Farmington Bay. Moreover, this is not even considering the evidence that whatever nitrogen gets “fixed” by these heterocysteous cyanobacteria and the entire Farmington Bay bloom itself, is consumed by the Artemia in the South arm of Great Salt Lake (Gilbert Bay) (Dr. Gary Belovski, presentation to Great Salt Lake Ecosystem Program, Technical advisory Committee). Gilbert Bay Artemia production both supports waterbirds such as eared Grebes and goldeneye ducks (Conover 2008), as well as contributes to a several- hundred- million- dollar per/ year brine shrimp cyst-harvesting industry. Moreover, during an average harvest, brine shrimp cyst removal includes the annual removal of approximately 225 tons of phosphorus (personal observations and simple calculation). Hence, the effort to reduce nutrients in Farmington Bay may have unintended consequences upon unintended consequences. It is clear, from the few cases discussed above and from what we know thus far about Farmington Bay and the South Arm, that implementation of drastic nutrient reduction may indeed lead to drastic reduction in waterfowl and shorebird numbers (Tom \_ankov \_ et al. 2013) as well as hinder the economic benefits of a renewable resource. Yet, it appears that, under the auspices of independent applicability, DWQ intends to list Farmington Bay and proceed toward a typical TMDL that has no regard for the consequences, nor the accountability for such actions. Hence, it appears that the tiny number of apparent recreationists who mostly visit Farmington bay when the cyanobacteria bloom, if it occurs, is gone, takes precedence. Most certainly, DWQ needs to recognize that research and subsequent reports that, in collaboration with large grants from Central Davis Sewer District and the EPA WPDG grant program, describe the ecosystem services and phenomenal value in supporting millions of waterfowl and shorebirds. Assuring that the nutrient-based availability of food resources for all life stages of millions of these waterfowl and shorebirds should take high precedence over the remote, perceived risk of a handful of recreations who visit Farmington Bay for the purpose of watching this visual phenomenon or hunting and again, which largely occurs after peek blooms have diminished. We need to be much more certain that any perceived benefits will outweigh the much larger potential for having the unintended consequences of reducing the carrying capacity of these wetlands by starvation. We must assure that these waterbirds have sufficient resources to successfully nest and stage in, and migrate from this most critical refuge that includes the impounded and sheetflow habitats of Farmington Bay for so many millions of birds. As scientists, resource managers and regulators, let’s be more certain this is not another case of unintended consequences.

Despite the literature cited in Chapter 6 concerning the correlation between cyanotoxin concentration and cell counts or Chla, The Marden et al. (2015) report, clearly displays the very reason why cell counts or Chl a alone inadequately predict cyanotoxin. Is this why DWQ did not graph total cyanobacteria cells against cyanotoxin concentration- because the Pseudoanabaena species in the Bay is not a toxin producer? The same is true for Chl a. There is simply not a significant relationship between cyanotoxin concentrations and cell counts or Chl a. Hence, two of the three indicators fail to predict cyanotoxin concentrations in Farmington Bay. For example, on the surface, Table 2 is

an attempt to demonstrate that there were substantial numbers of exceedences for all three indicators. However, I suggest DWQ plot each of these data points on a temporal scale. Chl a may be high or low in relation to nodularin and cell counts will reach very high numbers while nodularin will be well below the 20 ug/L threshold.

Notwithstanding, because *Nodularia* is similar to *Microcystis* in its ability to produce significant concentrations of nodularin (one of the microcystin compounds), at about 100,000 cells/mL, This adds further credence to my comment for Chapter 5, that WHO was willing to use 100,000 cell/mL counts or 50 ug/L Chl a as SECONDARY threshold indicators because the great majority of cyanobacteria blooms and the great majority of research as a whole in North America and worldwide indeed focuses on *Microcystis* (Juan et al. 2014). With other species, this relationship may or may not have any predictive value. Therefore, as with comments for Chapter 5, the Indicator thresholds need to be modified to include the requirement for the bloom to be a *microcystis* or *nodularia* bloom before Chl a or cell counts have any validity. Because Chapters 5 and 6 make for a similar case of impairment using a mostly similar set of references, my comments provided for Chapter 5 to apply to Chapter 6. As such we should expect similar detail of response for both chapters.

Finally, and to reiterate, unfortunately, it appears that DWQ is prioritizing the recreational support assessment far in front of an aquatic life and waterfowl and shorebird beneficial use assessment. As an aquatic ecologist, and I'm sure I speak for all other aquatic and wildlife ecologists and managers that are familiar with Farmington Bay, I highly recommend that the "waterfowl and shorebird and the necessary aquatic life in their foodchain" beneficial use support receive higher priority than recreational use. In short, just place signage at the points of access when toxins appear and let's keep working hard to ensure that the waterfowl and shorebirds retain this most critical and special habitat.

## Literature Cited

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- Tomankov I., Boland H., Reid N. & Fox A.D. (2013) Assessing the extent to which temporal changes in waterbird community composition are driven by either local, regional or global factors. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 23, 343–355.

Yuan, L.L., A.I. Pollard, S. Pather, J.L. Oliver, and L. D'Anglada. 2014. Managing microcystin: identifying national-scale thresholds for total nitrogen and chlorophyll a. *Freshwater Biology* 59: 1970-1981.

## **Comments on Chapter 5: Narrative Standard Assessment and Application to Utah Lake**

### **T Miller**

Page 8, Paragraph entitled: Harmful algal bloom indicators for recreational use attainment

Comment: The WHO uses this cell count because it is associated with production of about 20 ug/L microcystin from *Microcystis* (Reference). This should not be construed to think that this relationship occurs with non toxin producers or weak toxin producers such as *aphanizomenon*. In fact, recent EPA documents exclude *aphanizomenon* from the list of microcystin producers (EPA 2015).

The reason for this is the relationship between the 100,000 cell count and the expected 20 ug/L microcystin concentration just does not hold up for *aphanizomenon* blooms and this is true for Utah Lake and hence should be excluded from the assessment method application.

Also as for the use the 50 ug/L Chl a concentrations, WHO specifies that this metric may be useful When toxin producing cyanobacteria are dominant! DWQ excluded the remainder of the sentence presented in the WHO document - stating that Chl a concentrations are an indicator when cyanobacteria dominated the phytoplankton community. This fact should require DWQ to revisit their assessment criteria and make the appropriate adjustment in the assessment protocol. I suggest that the Technical Advisory Group be re-assembled to discuss this important omission.

Page 9, Figure 1.

Comment: Toxins should be the primary indicator. As suggested throughout the WHO 1999 and the 2003 documents, these secondary indicators are to be used as screening tools and supporting evidence and primary assessment tools.

Page 9. Table 1.

Comment: Again. This table constitutes and oversimplification of WHO advice. The use of Chl a is similar to the Cell counts in that WHO includes the caveat “when cyanobacteria are dominant” or “when cyanobacteria dominate the phytoplankton community” . cell Hence Chl a and cell counts need to be excluded from the assessment criteria. In addition, with the ability of DWQ and other agencies to measure cyanotoxins, there is no excuse NOT TO USE the direct measure of the toxin itself.

Page 10 Reference to Stewart et al. 2006 and and Pilotto, et 1997

Comment: reference or citation of Stewart et al. is miss-quoted. Stewart et al. did not use cell counts as their metric. It was cell surface area. Your citation is misleading and you should not use it in this way.

Also, See comments on Pilotto (1997) in my Chapter 3 comments i.e. Although Pilotto has been cited by EPA, it is not a strong reference (i.e. see my comments on the Utah lake listing in Chapter 3 and Dr. Richards' review of the Pilotto et al. 1997 paper).

Page 15, Exceedences of Primary Indicator: Cyanobacteria cell counts, Figure 4.

Comment: This Figure clearly shows the nature of the targeted sampling that occurred during the 2014 bloom and which DWQ now uses to "list" Utah Lake. In short, there are two issues here:

1) The ONLY sites that had exceedences were very localized harbor samples. As with other states' assessment methods, this does not support the decision to close and especially to list the lake as impaired. This is dramatic unscientific and unprecedented overreaction to this very localized problem.

2) The dramatic photographs, undoubtedly included to persuade the reader of how "nasty" these local blooms were, only support my statement – that these blooms are VERY localized, and targeted surface skim samples or actually beach windrowed samples of the scum were used to make this erroneous and over-reactive assessment of Utah Lake. Consequently, this does not warrant listing of the lake – only posting of signs that warn users not to wade or swim where scums occur. I think DWQ should comment on its apparent objective to gather and present any evidence that supports its agenda to target POTWs for drastic nutrient removal; and that this is occurring before DWQ is allowing the TMDL and necessary data associated with loading sources and phosphorus speciation and fate in the lake is gathered and analyzed by the appropriate scientific community. I suggest this is highly premature, absent of essential scientific underpinnings and misleading and highly inappropriate. It subverts stakeholder trust who themselves are beholden to the public and elected officials to provide transparent accountability for the programs and budgets of which they are accountable. 2. The bloom was > 99% Aphanizomenon, (see Miller 2014) at these locations. This species is a relatively very poor toxin producer. Indeed, except for the beached sample in Lindon harbor, the 20 ug/L recreational threshold WAS NOT VIOLATED.

Page 17, Paragraph entitled: Chlorophyll a concentrations

Comment: See comments above concerning the use of Chl a or cell counts as primary indicators for HAB assessments. Indeed the figures and tables provide data that support my comments – that an aphanizomenon bloom is not considered a major toxin producer; only in the most unique beach/surface scum sample that has been blown to a beach or trapped in a harbor.

Page 18, the 2015 bloom; Although there is uncertainty in identifying this event as a HAB, it did result in a public health advisory for recreational uses in Lindon Harbor (8/20/2015).

Comment: Explain how far DWQ is willing to accept uncertainty, i.e. without ANY quantitative data, a public health advisory was released for Lindon Marina. This only points to the need to acquire more and better science to support the actions. The ramifications associated unwarranted public opinion and economic hardship is addressed elsewhere in my comments which again, aligns with the overreaction of closing the entire lake or listing the entire based on a very few beach or harbor samples.

#### Page 18 **Utah Lake dog deaths**

The report states: UDWQ recognizes the uncertainty associated with diagnosing the causes of these deaths and directly linking them to algal toxins, and initial reports for the first reported death did not identify a conclusive cause of death. However, veterinarian investigations into the second reported death did conclude ingestion of cyanobacteria or cyanotoxins to be the cause of death. This finding was based on the dog's symptoms including rapid breathing, the veterinarian's past experience dealing with cyanotoxin poisonings in another state, and clear signs of exposure to cyanobacteria including the presence of cyanobacteria on the dog's nose. Despite the lack of confirmation that cyanobacteria poisoning was the cause of the death for the dog that died on October 5, 2014, UDWQ and Utah Department of Health scientists still suspect cyanobacteria as the sole or a contributing cause of death for both dogs. Both dogs died within hours of being in the water where toxin-producing cyanobacteria were present. The symptoms exhibited were consistent with cyanotoxin poisoning, specifically neurotoxins.

This statement is among the worst of anecdotal statements that occur in the IR. Why would DWQ present totally anecdotal statements when an appropriate necropsy WAS NOT PERFORMED? Indeed the only investigation was based on what the dog owners told the Vet – indeed cyanobacteria on the nose were not even confirmed by microscopically – nothing was actually confirmed. And why is DWQ abjectly ignoring the profession conclusions of a Vet that did perform a complete necropsy? Could it be because these conclusions did not support DWQ's agenda?. i.e. When a qualified veterinarian that performed a thorough necropsy that concludes that "it was acute cardiovascular collapse"...and "Blue-green algae is not identified in gastric contents and Anatoxin-a and microcystin toxins are not identified chemically, making blue-green algae toxicity highly unlikely.", should this be just ignored or minimized, because it doesn't support DWQ's agenda?

In my own literature review of the toxicology of cyanotoxin exposure, every CONFIRMED death included all of the above indicators. Indeed the presence of cyanobacteria cells and toxins in the mouth and stomach contents is the “smoking gun” of cyanoabacterial intoxication. The DWQ/UDPH denial of the valid Veterinary Report is nothing more than arrogance and a mind closed to all but what fits the agenda. I could think of 10 other ways to say the same thing, but in short, this is just unacceptable ignorance of good science. Did I say this was agenda-driven?

Hence, I can only encourage DWQ to have the necessary patience to allow the acquisition of the essential data needed to understand this complex system and upon which sound scientific and policy decisions can be made. The current use of such weak and anecdotal information and the way it is being used reflects poorly on DWQ’s scientific credibility and undermines public and stakeholder trust and hinders the systematic process of scientific investigation that is essential to determine if and to what degree Utah Lake algae blooms can be mitigated.

#### Page 21 Paleolimnology

Comment: All lakes become increasing eutrophic over time. Read any limnology text and DWQ staff will understand this natural phenomenon. What really counts, is whether Utah Lake has changed since 1975.

#### Page 21 Review of Boland’s Dissertation

DWQ Stated: This study found that pre-settlement diatoms in the lake reflected a greater representation of oligo/meso-trophic diatom taxa and benthic taxa. This means that historic conditions were very likely less turbid and typified by lower nutrient conditions.

Comment: DWQ needs to explain the significance of this statement. For example, paleo- and Geological studies tell us that the lake was deeper (e.g. Boland’s data “suggests” that the lake was 3 meters deeper at 1850). But the lake has been known to be deeper at various times during and following the existence of Lake Bonneville (up to 400 feet deeper; this would likely allow the lake to be less turbid). Of course, the greater questions are: Was the water clearer a century ago when the lake generally receded to its current depth; and more importantly, did clear water exist before November 28, 1975? It is “very likely” that the answer to both of these questions is NO. Hence, although it would be highly preferential, it is unlikely that any action can be taken that will clear the lake up. For example, having spent many days on Utah Lake sampling since 2014, and under various weather conditions, we have made several important observations: First, hydrologic records reveal that the lake has spent most of its time since 2000 below the compromise level. Hence, shallow littoral zones extend from 100 m to >500 m from the current shoreline. Consequently, ANY wind mobilizes fine clay and silt material- reducing Secchi depths to <10 cm. Because such winds generally occur most days of the week, the littoral zone is constantly characterized by highly turbid water and constantly shifting sand, silt and clay bottom materials, making SAV

germination nearly impossible. During this past spring there was a small protected bay between Provo Bay and the State Park that was starting to support a few *Stuckenia* plants, however, as the lake receded approximately 3 feet this year, that area was left dry. This characteristic of severe annual fluctuations and near-constant turbulence from wind action will continue to preclude Utah Lake from developing a clear condition or developing extensive areas of SAV— regardless of carp or nutrient removal.

Please be mindful that I have included other comments on the listing of Utah and Provo Bay in my review of Chapter 3.

## **Literature Cited**

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## Comments on Chapter 3, Utah Lake and Tributaries

T Miller

**Listing:** Jordan River/Utah Lake UT16020202-027 Beer Creek and tributaries from confluence with Spring Creek to headwaters 5 Not Supporting OE Bioassessment 3C Low 2014 16.5.

**Comment:** DWQ needs to provide the data used to make this assessment. Such could be provided in the appendix. In particular, the sample site location needs to be identified as well as the reference sites used to develop the "Expected taxa" for this reach. There likely is not a lot of data, so providing this data will not be time-consuming nor require a lot of extra pages. The question focuses on what reach in Utah is a low gradient valley stream in the same elevation range that is absent stressors associated with agricultural/rural development. Also, see comments provided for other reaches within the Jordan River Watershed concerning the O/E assessment. Please address those comments for this listing as well.

Jordan River/Utah Lake UT16020202-027 Beer Creek Beer and tributaries from confluence with Spring Creek to headwaters 5 Not Supporting Total Ammonia 3C Low 2016 16.5

Just to remind DWQ, this reach was the only reach of the entire Utah Lake/Jordan River Watershed that contains the freshwater mussel, *Anodonta* sp. We also measured elevated ammonia in Beer Creek (close to the current chronic ammonia criterion). DWQ's response should be a part DWQ's Review of Dr. Richard's report on mussel distribution, as it presents clear evidence that local species are not susceptible to the new proposed nor the existing ammonia criteria. Further, with the intensity of surrounding agricultural practices and the amount of organic rich sediments, these elevated ammonia measurements are likely a combination of instream nutrient recycling and agricultural runoff.

**Listing:** Utah Lake UT-L-16020201- 004\_01 Utah Lake Utah Lake other than Provo Bay 5 Not Supporting Harmful algal blooms 2B High 2016 87929

**Comment: To be applied to both Farmington Bay proposed listing and Utah Lake listing.**

The primary concern about listing lakes for recreational impairment due to HABs is the degree of regulatory reaction to the occurrence of such blooms. Granted, this is a relatively new field of research but the appearance of such blooms has been occurring for decades to hundreds of years and across most midwest and western states (Boland, 1976, L Meyers comments: 2016 IR). Most states that have a HAB assessment program have a tiered approach for monitoring and placing warning signs and finally lake closure. These protocols require additional detail, particularly specific identification of toxigenic cyanobacteria AND the presence of significant concentrations (either 6, 10 or 20 ug/L) toxin themselves. For example Washington lists the following "species of concern" in their monitoring program:

- *Microcystis*
- *Anabaena*
- *Aphanizomenon*
- *Gloeotrichia*
- *Oscillatoria/Planktothrix*
- *Cylindrospermopsis*
- *Lyngbya*
- *Nostoc*.

If any of these taxa are identified in weekly monitoring samples, additional samples are collected to determine if toxins are present and that concentrations meet a certain threshold. Washington's recreation threshold is much more conservative (6 ug/L microcystin) than WHO (1999) recommendations (20 ug/L microcystins), at which point the warning signs are posted. Nevertheless, note that both potentially toxigenic taxa and the toxins must be present at designated thresholds before warning signs are posted. Moreover, Washington does not "list" lakes as impaired at this level of toxin.

Although Nebraska has not posted their policy on beach or lake closures, Nebraska requires more empirical toxin concentration data, correlating with the 20 ug/L WHO recreational limit for posting or closing a lake. More notably, Nebraska does not list a lake as Impaired until there are > 20 ug/L microcystin in > 10% of samples. Clearly, Utah has adopted the most conservative approach known for assessing, closing and listing Utah Lake as impaired. First, it is common knowledge that, although Aphanizomenon is a toxin producer, it is not a prolific toxin producer. Although it was always the most abundant taxa during the 2014 bloom (Miller 2014), the lake and even the beaches contained little toxin. Only from the controversial sample collected from the windrowed pile of scum on the edge of the beach within Lindon Marina, was the 20 ug/L threshold exceeded and all samples collected in the open water of Utah Lake were below or very near detection limits of 0.05 ug/L.

Again, aphanizomenon, the dominant cyanobacterium during the bloom, and again during the minor blooms in a couple of the harbors in 2015 and again during the 2016 bloom is a very weak toxin producer (i.e. even during the more extensive bloom of 2016, where cell counts exceeded 20-30 million, microcystin was largely undetectable. Indeed, only beach scum samples at Lincoln Marina and Sandy beach, where cell counts were near 40,000,000/mL, exceeded 20 ug/L microcystin. Therefore WHO's assumption that 100,000 cell/mL count needs to be more fully read and understood because it was developed based on how the 100,000 cells/mL correlates to a microcystin concentration of 20 ug/L of *Microcystis auroginosa* (WHO 1999). Again, use of this metric when the cyanobacterial population is dominated by a non toxin producer or a weak toxin producer such as aphanizomenon is not valid as it results in overprotection and overregulation.

Even so, phytoplankton samples collected throughout the lake, and at the beach near Saratoga Springs during the 2014 bloom, including surface skims, contained far less than the 100,000 cells/mL threshold suggested by the WHO and which is in DWQ's assessment protocol. Yet, DWQ has decided to list all of Utah Lake. Moreover, DWQ did not even collect samples for Chl a analysis. Therefore, except for two samples (one a surface skim sample at the Utah Lake outlet and the other, the beach scoop within Lindon Marina), no samples contained > 100,000 cells/mL. In fact, all three metrics of DWQ's own threshold criteria for listing a lake as impaired for HABs WERE NOT MET during this 2014 bloom event. At the most, DWQ need only place signage warning swimmers and waders to stay off the beach areas in Lindon Marina and keep their pets away from the beach. All samples collected from open water zones of the lake were well below any of the three threshold metrics. This is a very public and potentially very expensive decision that deserves proper assessment, transparency and considerable scientific scrutiny. Again, from Chapter 5. "The assessment methods identify two exceedances of this indicator as a recreational use impairment." These occurred from wind driven accumulations within Lindon Marina and at the Utah Lake outlet and not in any of the samples of the open water. The lake itself was perfectly safe. Therefore, the listing criteria for lakes should include at least 10 samples from multiple sites around the lake (and not targeted sites at the beaches; DWQ's current data set is from sampling beaches and harbors and hence, this is

a beach closure issue and not a lake impairment or closure issue), across at least a 2-year assessment cycle and result in at least 10% exceedence of both the cell counts and microcystin concentrations. This will avoid the unnecessary and inappropriate overreaction that has occurred in this listing. This would be similar to the Nebraska protocol, which has been accepted by EPA.

In short, even DWQ's primary criteria of exceeding 100,000 cells/mL was not met in any of the open water samples. herefore it is not appropriate to list the entire lake for HAB impairment. Therefore, a listing of category 3A, insufficient data should be used instead of category 5.

When compared with other states that assess for HABs, Utah is the only state that uses cell counts as the primary indicator. There is only minimal scientific evidence that supports this approach – and this evidence is predicated on data sets pertaining to *Microcystis* blooms.

Only the anecdotal data offered by Pilotto et al. 1997 – where they report that low cell counts MAY be related to various allergenic symptoms has supported the idea that cell counts alone may suggest the occurrence of symptoms. However, as explained in greater detail below and in the comments by Dr. David Richards, the second lowest cell count bin had an overall lower odds ratio than that of the lowest cell count bin. Although the authors tried to make the case that exposure to such low cell counts were statistically significant, there is a stronger case (based on odds ratios) that a few more cells actually imparted a protective effect against exposure to cyanobacteria cells. This is one of dangers of using this type of anecdotal data to make what should be a more scientific judgment or conclusion.

Also noteworthy, the final paragraph of the Pilotto et al. 1997 report reads: “ we cannot exclude the possibility that these symptoms may have been caused by other causative factors, for example, other microorganisms, that may have correlated with the presence of cyanobacteria.” This fact, coupled with the need to exclude participants that had recreated during the previous five days and to wait until the 7<sup>th</sup> day past recreation (because there was no significant occurrence of symptoms at the second day after exposure) before any level of significance was detected clearly suggests that exposure to other irritants have occurred after the supposed cyanobacteria exposure. There is simply no explanation for this delayed response except that the sample population (having been interviewed on day 2 following exposure) was now “aware and sensitized” to the symptoms, they could have been more attentive to ANY slight symptom which could have been anything from overeating, overdrinking, or rolling in the grass to cleaning out the attic between day 2 and day 7.

Stewart et al (2006), also cited in the IR in support of using just cell counts of total cyanobacteria, basically repeated the Pilotto et al. (1997) study. The main difference was that Stewart et al. (2006) measured toxin concentrations as well. From their introduction: “Specifically, we sought to: 1) quantify cyanotoxins in designated water recreation sites, and 2) assess the relationship between exposure to cyanobacteria and cyanotoxins in recreational waters and the incidence of reported symptoms.”

Notably, “Two statistically significant findings were identified: compared to the low exposure group, reporting of both respiratory symptoms, odds ratio (OR) 2.1 (95%CI: 1.1–4.0), and the pooled “any symptom”, OR 1.7 (95%CI: 1.0–2.9), was increased to be perhaps weakly significant in the high exposure group. Clearly, the authors tried every which way to demonstrate significant results. For example, “the significance of the latter result was not maintained with the exclusion of subjects with recent prior recreational water exposure, OR 1.6 (95%CI: 0.8–3.2).”

Notably, Pilotto et al. (1997) had to exclude those individuals that had previous exposure in order to gain statistical significance, while Stewart et al. (2006) had to retain those that were previously exposed to create significance. These two reports, showing only slight significance of symptoms, but after opposite treatment of the data only exemplifies the overall confusion and inconsistency of data and conclusion that actually characterizes significant symptoms when exposed to low levels of cell counts or toxins. This should be noted in both Chapters 5 and 6 of the IR. Consequently, Utah Lake should not be listed in Category 5 but rather in Category 3A – additional information is necessary.

Stewart et al. (2006) further report: “The main findings of this work were that individuals exposed to recreational waters from which total cyanobacterial cell surface areas exceeded 12 mm<sup>2</sup>/mL were more likely to report symptoms, particularly respiratory symptoms, after exposure than those exposed to waters where cyanobacterial cell surface areas were less than 2.4 mm<sup>2</sup>/mL.

“Although the symptom category that appeared to be weighting the pooled “any symptom” category was that of respiratory symptoms, from Table 3 we see that respiratory symptom reporting was skewed towards the “mild” symptom rating. Therefore, the conclusion that symptom reporting was higher in individuals exposed to high cyanobacteria levels must be tempered by the observation that most reported respiratory symptoms were mild.” This further supports the premise that these low cell counts or small concentrations of toxins suggest minor allergenic responses, such as allergic to pollen, or ragweed or mold or myriad other microbes or dust – and not worthy of listing a lake on the 303(d) list of impaired waters.

Stewart et al. 2006 further note: “Epidemiological studies into recreational exposure to cyanobacteria are also few in number. Five have been published to date: three cross-sectional studies from the United Kingdom using identical survey instruments [2, 3, 4], a small case-control analysis from Australia [5], and a larger prospective cohort study, also from Australia [6]. The UK studies ( Philipp R 1992; Philipp R, Bates AJ, 1992; Philipp R, Brown M, Bell R, Francis F. 1992) and the smaller Australian study (5. El Saadi OE, Esterman AJ, Cameron S, Roder DM 1995) did not find any significant hazard from exposure to cyanobacterial blooms in recreational waters, but the study by Pilotto *et al* [6] reported an increase in illness amongst those exposed to relatively low levels of cyanobacteria (>5,000 cells per mL).”

Hence, 4 of 5 of the currently available studies did not find any significant hazard from exposure to cyanobacterial blooms in recreational waters and issues related to the 5<sup>th</sup> (Pilotto et al. 1997) has been discussed above, and the comments by Richards. But most notable, most of the current literature has not reported allergic symptoms to exposure to low concentrations of cyanobacteria cells. DWQ needs to present equal data demonstrating the state of the literature rather than “cherry picking” papers that align with DWQ’s agenda.

Stewart et al. (2006) further note: “Despite this limited and inconclusive evidence, the World Health Organization (WHO), Australia and several European countries have recommended guideline levels for recreational exposure to cyanobacteria [[7] (pp.149–54), [8]]. WHO guidelines present a three-tier approach, suggesting: 1) low probability of adverse health effects from waters with 20,000 cyanobacterial cells/mL or 10 µg chlorophyll-a/L, **if cyanobacteria are dominant** (emphasis added); 2) moderate probability of adverse effects from waters with

100,000 cells/mL or 50 µg chlorophyll-a/L, if cyanobacteria are dominant; Page 150, WHO, (2003), and 3) high probability of adverse effects from contact with and/or ingestion/aspiration of cyanobacteria at scum-forming densities [17] (p.150)]. However, the WHO (2003) clearly notes: “There is concern, however, that the current management practice in some countries (such as Australia or Germany) of warning all users or closing access to waterbodies is overly proscriptive. Such practices can result in unease amongst regular users of recreational waters that are affected by cyanobacteria, and can impact communities surrounding these waters, which are important social and economic resources.”

The above discussed data and this WHO conclusion, clearly suggests that Utah DWQ is overly proscriptive in their evaluation and are indeed guilty of causing unease amongst regular users of Utah Lake and this has indeed resulted in impacting important social and economic resources. With all the TV interviews and Op-ed newspaper articles, was this a biased agenda of DWQ?

Because of the very low to non-detectable cyanotoxin concentrations found in Utah Lake, the last sentence of the previous paragraph reflects the concerns of several Utah County Stakeholders. It should be the policy of the Division of Water Quality to understand the ramifications and withhold listing or even closing a lake when only sparse data, of an obviously known poor indicator of Cyanobacteria toxicity (cell counts alone), while toxin concentrations were non-detect except for two targeted beach scum scrapings, from a known poor toxin producer is used as the indicator. Other states and the WHO have recognized that cell counts alone can be a highly inaccurate indicator of exposure risk and as a result, have recommended the appropriate risk factor of actual toxin concentrations. Moreover, and I reiterate that the use of the indicator of 50 ug/L Chl a alone, is misused by DWQ. The WHO, and as cited in the above paragraph by Stewart et al. 2006, specifies the use of Chlorophyll a concentrations only if Cyanobacteria dominate the phytoplankton community.

DWQ also cited Lin et al. (2015) for support of the idea that despite low cell counts, cyanobacteria can cause allergenic responses. However, problems with including this study in support of DWQs case for symptoms are threefold, 1) None of the cyanobacteria taxa identified in this study are related to the freshwater taxa that occur in Utah Lake or to the brackish water taxa in Farmington Bay: 2) There were no measurements of actual cyanotoxin in the study. Yet it was presented as evidence that such low cell counts are dangerous with various symptoms after exposure to the cells alone; However, 3) there is NO supporting evidence of some minimal concentrations of toxin or otherwise NO scientific evidence in the literature at large that cell surface-based allergenic protein, or systematic identification of allergens or skin irritants, etc. even exists. In short, this supports the notion that DWQ is using anecdotal comments and pure speculation and misusing cell counts, and Chl a concentration to support the listing of Utah Lake and the intent to list Farmington Bay.

Although this remains a conundrum and should indeed be the subject of intense investigation, it reveals the fact that there is no current explanation for what is causing the reported symptoms. Hence, the conclusion by Stewart et al. (2006) “*Using levels of toxin-producing cyanobacteria as indirect measures of cyanotoxin presence may overestimate the public health risks*” is a reflection of the absence of empirical evidence/explanation of any link between cell counts and allergic responses. Therefore, although interesting, this supports the criticism that these studies are largely anecdotal in nature. Most noteworthy, is the fact that where cyanobacteria cell counts have been linked to such allergen symptoms, such as skin rash or runny nose, these symptoms

are associated with tier one, low risk responses, which have had no evidence of the presence particular allergens. Indeed, anyone who phoned in and reported allergic responses during the 2016 bloom, could have experienced what I suffer from, an allergy to phragmites pollen. But there was no and remains no scientifically controlled diagnostic observations that link exposure to these symptoms. Again, such anecdotal evidence and misuse of WHO guidelines should dictate that Utah Lake should not be Category 5 at this time, but placed in Category 3-insufficient data.

This provides additional support to the comments provided by Central Davis Sewer District, for the need to provide a stronger link between cell counts, cyanotoxin concentration and the potential allergic or toxic symptoms of exposure to Cyanobacteria. Until then, it is strongly recommended that DWQ protocol of using cell counts of toxin or nontoxin-producing cyanobacteria be altered to require the existence of microcystins in concentrations > 20 ug/L as the threshold in accordance with WHO guidelines. This should include the various tiers for signage or eventual closing of beaches and marinas, or, in the case of lakes, only when microcystin concentrations exceed 20 ug/L in the open water areas of the lake. As such, although cyanobacteria cell counts of significant toxin producing species (not Aphanizomenon) may be a good predictor of potential cyanotoxin concentrations (Dolman et al. 2012), DWQ has the obligation to do its due diligence and collect follow-up samples to confirm whether toxins exist in dangerous concentrations. Because only about half of all cyanobacteria are toxin producers and one of the most common cyanobacteria, Aphanizomenon, is a very poor toxin producer, cell counts alone are a weak and inaccurate indicator when the consequences of closing or listing a lake have significant perception and economic consequences. Unfortunately, such actions, including multiple media interviews by various DWQ members and op-ed articles in the news papers, were likely used and exaggerated to convince the public and elected officials that Utah Lake is experiencing this “sky is falling”, “life-threatening” bloom because of “excessive” nutrient loads from the POTWs. Such representation, without supporting scientific evidence and linkage is premature, disingenuous and serves to usurp the current efforts to perform the necessary studies needed to verify such linkages. Such media coverage and articles were intended only to serve DWQ’s agenda of POTW nutrient reduction to radical low values and to expedite this process prior to agreed-upon timelines. This bias needs to be recognized by DWQ and Utah’s elected officials.

The assessment criteria show be: 10% of samples over a representative area of the open water of the lake (not targeted marina or beach samples), collected over the two-year assessment cycle, that exceed 20 ug/L microcystin demonstrate that a lake should be listed on the 303(d) list. Following this thorough assessment, a scientific decision of beneficial use support is possible, and not before.

A review of the potential for toxin entry from inhalation is also warranted. Utah’s IR and EPA documents (e.g. Health Effects Support Document for the Cyanobacterial Toxin Microcystins: EPA Document Number: 820R15102, June 15, 2015) suggest that inhalation is also an important route of exposure. Two papers often cited on this subject is that of Fitzgeorge et al. (1994), and Ito et al. (2001). In the Fitzgeorge report, two types of dosing were prepared; (50 microg/L) in the water used as a fine aerosol spray

(resulting in a dose of 0.0005 ug/kg) and a second sublethal dosing mechanism using the same 50 microg/L in daily intranasal instillation (i.n.) for seven days. The second method resulted in a total dose of 31.3 ug/kg. The aerosol resulted in no adverse effects while the i.n. caused a 75% increase in liver weight after 7 days.

Similarly, Ito et al. (2001) evaluated the distribution of purified microcystin-LR after intratracheal instillation of lethal doses in male ICR mice. Microcystin-LR in saline solution was instilled at doses of 50, 75, 100, 150 and 200 µg/kg into 34 mice; three mice were sham-exposed as controls. Mortality was 100% in 12 mice receiving doses of 100 µg/kg and greater. At 75 µg/kg, two of four mice died, while no deaths occurred in 18 mice given 50 µg/kg intratracheally.

These are the seminal studies implicating potential inhalation as a mode of exposure.

However, Backer et al. (2008) sought to evaluate the true exposure of microcystins in an actual recreational setting in a lake experiencing a microcystis bloom. They planned to monitor individuals participating in boating, swimming, jet skiing, and waterskiing during a bloom of at least 10 ug/L microcystin. However, the study got underway a week later when microcystin concentrations fell to 3-5 ug/L. They collected air samples from above the lake surface as well as at the shoreline and found that microcystin was in air samples at slightly above detection limits (0.00378 ng/m<sup>3</sup>). EPA (2015) cited this paper as evidence that air samples above a lake experiencing a microcystis bloom contained some aerosol –containing microcystin and consequently reported that this is a valid mechanism of exposure. However, Backer (2008) found that with such low air concentrations blood concentrations of MC were all below detection limits (0.147 ug/L). Moreover, given this low exposure level, study participants reported no symptom increases following recreational exposure to microcystins. Backer et al. conducted a more recent study on two lakes in California that did contain  $\geq 10$  ug/L MC (Backer et al 2009).

In this report Backer et al. (2009) reported microcystin concentrations ranged from 14.5 to 357 ug/L using the ELISA method. However, relatively very little MC was actually aerosolized ranging from 0.0 to 0.8 ng/m<sup>3</sup>. Further, the daily mean concentrations of MC in air sampler carried by individuals did not correlate with the concentrations of *Microcystis* spp. cells, dissolved MC, or total MC in the Bloom Lake water.

Despite this unpredictability Backer et al. 2009 found slight increases in nasal mucosal swabs in post activity participants as compared to pre-activity samples. The average aerosolized MC concentration above the lake surface was 0.3 ng/m<sup>3</sup> and the average nasal swab of the exposed group was 0.39 ng. With the average exposure time of 109 minutes and an inhalation rate of 25 L/min during light exercise the exposed group would have been exposed to 0.8 ng during that day's visit. Although this provides evidence that inhalation may be a valid route of exposure Backer et al. 2009 provided this evaluation:

“There is limited information from animal studies available for comparison with our data. Benson et al. (2005) examined the toxicity of MC-LR in mice after inhalation exposure.

The investigators exposed mice to 260 mg MC/m<sup>3</sup> for 0.5–2 h each day for 7 days and observed treatment related microscopic lesions in the nasal cavities of mice in the groups exposed for longer times. Although the overall NOAL dose was 3 ug/kg, exposure to 260 mg/m<sup>3</sup> for ½, 1 and 2 hrs was the treatment. While these results suggest that the nasal cavity may be the primary site of response to inhaled MC, these experimental doses are many orders of magnitude greater than those we have documented in our study participants.”

Backer et al. (2009) further reported: “The second important component of environmental epidemiologic studies is an accurate measure of the health outcome. Based on anecdotal reports and earlier studies (Pilotto et al., 1997; Stewart et al., 2006a), we hypothesized in this and our previous study (Backer et al., 2008) that exposure to aerosolized MC during recreational activities in lakes with *M. aeruginosa* blooms would result in increased frequencies of self-reported acute dermal or respiratory symptoms over baseline. Some study participants reported throat and skin irritation after being in the bloom-affected waters. However, these are common symptoms with myriad causes and only a few participants reported such symptoms. Thus, we were not able to demonstrate differences in symptom reporting between exposed and unexposed participants, nor were we able to examine associations between reported symptoms and environmental measurements (cyanobacterial cell concentrations, water and air MC concentrations, or other water quality parameters).”

The reason why I go into such detail about this issue is to inform DWQ and EPA that even waterskiing and swimming resulted in participants receiving very low doses of MC (with no significant increase in symptoms. Therefore, unless a subject is standing in the spray of an airboat for at least 109 minutes, and taking deep breaths, the risk of accumulation of MC by aerosol inhalation is virtually nil.

So what should be the accurate representation of the current state of knowledge, given that the Backer et al. (2008 and 2009) studies included non-detectable concentrations of microcystins in blood from people directly at risk for swallowing water or inhaling spray while swimming, water skiing, jet skiing, or boating during an algal bloom that actually included high concentrations of MC? In other words, it appears that EPA and DWQ are inappropriately exaggerating and incorrectly extrapolating unrelated laboratory studies to real field conditions using speculation and anecdotal data. Yet, the only quantitative report available today dismisses inhalation by recreationists as a valid route of entry. Therefore, accurate representation in the IR should read that “although forced nasal or tracheal instillation of extremely high concentrations of MC in mice can be lethal, there is currently no reasonable scientific, quantitative link between exposure of recreationists that were boating, swimming, jet skiing, and waterskiing, during a microcystis bloom than included high MC concentrations (Backer et al. 2009) Yet, respiratory ailments were not recorded nor was MC detected in the blood of the participants. Therefore, although further study may be warranted, inhalation during recreation activities does not appear to be of concern at this time.

**Listing:** Utah Lake UT-L-16020201- 004\_01 Utah Lake Utah Lake other than Provo Bay 5 Not Supporting Total Phosphorus 3B High 2014 87929

**Comment:** As of 2014 Utah Lake had remained the only lake that was listed for the narrative standard for P of 0.025 mg/L. Even at that time, it was DWQ policy and my practice when employed with DWQ, not to list for a narrative standard for a nutrient without confirmation with a parameter that has numeric standard, such as low DO or high pH. This policy particularly applied to Utah Lake because it very rarely stratifies, eliminating the tendency for hypolimnetic hypoxia AND Utah Lake always contained a diverse and abundant fishery containing several popular game fish as well as necessary forage species and abundant zooplankton, indicative of a fully supporting lake ecosystem. This ecological condition persisted with an abundant and diverse fishery and zooplankton population throughout the summer of 2016 as well as the 2014 and 2015 years. There was no evidence of fish kills or stress, no evidence of bird stress or mortalities and the abundant zooplankton community has been sustained. In short, there never was and there is still no evidence that the elevated P concentrations have any adverse impact on aquatic life uses and therefore, Utah Lake should be removed from the 303(d) Category 5 list for phosphorus impairment to aquatic life – because it doesn't exist.

Also, if Provo Bay is currently classified as part of Utah Lake (i.e. 3B fishery), why specifically is Provo Bay assessed separately from the lake. In other words, with an order of magnitude more P in Provo Bay than the Lake proper why specifically is Provo Bay not listed for 3B non supporting for P while the lake proper is listed for 3B non supporting for P? Why the contradiction?

## Provo Bay

**Listing** UT-L-16020201- 004\_02 Provo Bay Provo Bay portion of Utah Lake 5 Not Supporting pH 3B High 2016 3609

**Comment:** This waterbody is clearly misclassified. For all but two of the past 17 years, water levels in Provo Bay have been prohibitively shallow for use by warmwater fishes. It has been shallow (<20 cm) and very clear - even during spring runoff in May and June. This condition has prevented fish from inhabiting the bay (either by stranding or succumbing to predation by piscivorous birds). During the summer of 2014, 2015 and 2016 the Bay has averaged < 10 cm as it is even difficult to sample by airboat. Alternatively, Provo Bay should be classified as a 3D habitat for waterfowl and shorebirds. For example, during the visits of 2014, 2015 and 2016, the Bay has contained an estimated 10,000 to 15,000 American avocets, white faced ibis, blacknecked stilts, dowitchers, and a few hundred waterfowl of various species. Indeed Provo Bay has been key waterfowl and shorebird habitat for decades (Dick Bueller, personal communication 2016). Therefore, as with the use class for Farmington Bay impounded wetlands, a UAA/site specific criteria modification should be performed to appropriately classify the Bay for what it is currently so importantly used for and remove the pH, DO and ammonia criteria because they are internally generated – exactly similar to Farmington Bay impoundments (See Table 1). Hence an Assessment Category of 3A (insufficient data) should be used until this information can be appropriately evaluated and assembled, including an active pursuit of a UAA.

Further, I learned that DWQ's assessment data included the years from 2008 to 2014. Eliminating the obvious outliers, there was 5-6 readings over pH 9.0. As this was >10% of readings, pH measurements were performed at least 50-60 times. As these measurements

were from just one sampling site, there had to be either 40 to 50 visits to this site, or there were multiple individual recordings of pH while at the site. Clearly, there were multiple readings performed in the bay that was < 0.5 m deep, totally clear and homogeneous from top to bottom. Therefore, measurements throughout the water column were simply replicates of the same pH value and DWQ used the accumulation of these data recordings, only a few seconds apart, to acquire enough data points to meet the 10% of measurements threshold. Is this biased? Are these indeed independent, representative data points from a 1 ft to 1.5 ft deep isolated waterbody? Finally, as opposed to previous assessments, why did DWQ suddenly decide to separate Provo Bay from the remainder of Utah Lake? .

**Listing** :Utah Lake UT-L-16020201- 004\_02 Provo Bay Provo Bay portion of Utah Lake 5 Not Supporting Total Ammonia 3B High 2016 3609

**Comment:** The comment provided for the pH listing above, applies to the listing for total ammonia. Notably, multiple months and years of DMR data from the Provo POTW has demonstrated that ammonia consistently remains about 0.03 mg/L. Therefore the elevated ammonia concentrations are the result of decomposition of organic matter in this productive and important wetland habitat (See Table 2 below) rather than from any point sources. There is simply no way of controlling this internal generation of ammonia and elevated pH. Therefore, numeric ammonia criteria should be similarly removed from Provo Bay.

Table 1. Relationship of nitrogen concentrations between the source water that services Ambassador duck Club (the Surplus Canal) and that which services Newstate Pond 47 (Lower Jordan above the State Canal). Note that the Surplus Canal and the lower Jordan River contains between 0.07 and 0.53 mg/L ammonia while Ambassador #1 pond contains 0.62 – 1.36 mg/L and Newstate #47 contains 0.72 – 1.42 mg/L. This is clear evidence for internal generation of ammonia in these impoundments.

2012 River to Wetlands Transition				
Ambassador Water Source	Surplus Canal	Surplus Canal	Surplus Canal	Surplus Canal
Date	6/6/2012	7/26/2012	8/28/2012	9/26/2012
NH <sub>4</sub>	0.35	0.22	0.07	0.53
NO <sub>3</sub>	2.13	4.12	3.42	3.02
PO <sub>4</sub>	0.72	1.02	1.16	0.68
Pond	Ambassador	Ambassador	Ambassador	Ambassador
Date	6/11/2012	7/9/2012	8/13/2012	9/10/2012
Average NH <sub>4</sub>	0.62	1.17	0.89	1.36
Average NO <sub>3</sub>	0.14	0.07	0.03	0.29
Average PO <sub>4</sub>	0.32	1.3	1.01	0.96
Newstate Water Source	Lower Jordan	Lower Jordan	Lower Jordan	Lower Jordan
Date	6/6/2012	7/26/2012	8/28/2012	9/26/2012
NH <sub>4</sub>	0.13	0.24	0.21	0.15
NO <sub>3</sub>	2.01	3.94	6.93	2.90
PO <sub>4</sub>	0.60	0.93	1.08	0.66
Pond	Newstate 47	Newstate 47	Newstate 47	Newstate 47
Date	6/11/2012	7/12/2012	8/20/2012	9/17/2012
Average NH <sub>4</sub>	(pond dry)	0.72	1.11	1.42
Average NO <sub>3</sub>	(pond dry)	0.03	0.08	0.29
Average PO <sub>4</sub>	(pond dry)	0.29	0.56	0.75

Based on DMR data from the Provo POTW, ammonia averages about 0.03 mg/L and pH averages about 7.6. Yet, the IR claims that Provo Bay is impaired due to ammonia and pH criteria violation. With pH presumably above 9, the ammonia chronic criterion is in the range of 2.5 mg/L. The only way that this is possible is from internal generation of ammonia from

decomposition of the organic-rich wetland sediments throughout the bay as well as the adjacent emergent marsh surrounding the bay and through elevated primary production, such as in Farmington Bay impounded wetlands. The only difference between FB impoundments and Provo Bay is that primary production in FB impoundments is primarily from SAV while that within Provo Bay is from benthic periphyton as the water is shallow and nearly completely clear. Some Stuckenia is also beginning to spread into the Bay from Mill Race which suggests that Provo Bay will likely continue to improve as waterfowl and shorebird habitat.

The following table includes data from our March June and and our first August sampling run (We were not allowed to sample during the July aphanizomenon bloom). Samples were analyzed in the certified laboratory at the Timpanogos SSD treatment facility. It is clear that the ammonia is low (see Provo DMR data) and clearly, there is no violation for ammonia in the Bay. Also, pH is notably low as it enters Provo Bay (Table3). pH in our monitoring never exceeded the Standard so we must request to see the data set that DWQ used to make this assessment. Nevertheless, pH is elevated above the value at the Provo POTW discharge point as well as at the point of entry into Provo Bay. Again, this is clear evidence that any elevation in pH is the result of Provo Bay internal processes, including elevation primary production and consumption of the majority of CO<sub>2</sub> that is generated within the bay.

Additional notable data concerning the dynamics of P has been collected during this project. Table 2. Also includes concentrations of various species of N and fractions of P. It is apparent that as water leaves the Provo POTW (P concentrations average approximately 3.5; DMR data) and follows the path through East Bay, down Mill Race and across Provo Bay, there is a dramatic decrease in total, ortho and dissolved P. For example, at the middle of the Bay the total P is only 0.96 mg/L in March but as low as 0.16 mg/L in the middle of June. This is telling evidence that the Utah Lake budget that currently uses DMR data vastly overestimates the actual concentration and load discharged from the Provo City POTW.

Also note that although the Provo POTW discharges 28 mg/L nitrate in its effluent, it has decreased to only 8.7 at the bottom of Mill Race, and to only 3.4 mg/L at 200 m from the Mill Race mouth and only 0.5 mg/L in mid Provo Bay during summer.

Clearly, when considering the reduction in phosphorus, ammonia and nitrate, these values are far below the discharge values, upon which DWQ's OCP was calculated. Not only is this estimate a misrepresentation of the reality of Provo Bay and Utah Lake, but the assimilation of these nutrients into this wetland ecosystem results abundant food resources and the full support of vast numbers and diversity in species of shorebirds and waterfowl.

Table 2. Water quality data from various samples collected from the mouth of tributaries and in Utah Lake samples. Note ammonia concentrations in Mill Race and in Provo Bay. Samples were analyzed in the certified lab at TSSD.

Site	Label	Date	Time	NH3-N	NO2-N	NO3-N	o-PO4-P	PO4-P	PO4-P Dis
Pelican Bay Marina	A	3/9/2016	1025	0.149	1.9	0.7	0.116	0.147	0.073
Utah lake Outlet	B	3/9/2016	1127	0.062	0.4	0.5	0.015	0.07	0.059
Lindon Marina	C	3/9/2016	1241	0.82	1.7	1.7	0.194	0.351	0.293
Battle Creek	D	3/9/2016	1322	0.1	0.3	2.2	0.183	0.235	0.248
South End Goshen Bay	E	3/10/2016		0.092	0.028	0.9	0.052	0.082	0.05
North End Goshen Bay	F	3/10/2016		0.047	0.14	0.6	0.018	0.046	0.02
Mid Lake Pelican PT	G	3/10/2016		0.016	0.014	0.4	0.004	0.046	0.021
Millrace @Provo Bay	H	3/10/2016		0.117	0.122	8.7	1.27	1.32	1.17
Hobble Creek at Provo Bay	I	3/10/2016		0.125	0.019	1.3	0.078	0.109	0.042
WQ Mid Provo Bay	J	3/10/2016		0.605	0.194	3.2	0.843	0.961	0.531
WQ Mouth of Provo Bay	K	3/10/2016		0.276	0.102	2.4	0.234	0.479	0.099
Millrace @Provo Bay		6/16/2016	1110	0.073	0.131	6.2	1.26	1.36	1.19
Provo Bay East		6/16/2016	1119	0.059	0.087	3.4	1.07	1.19	1.04
Mid Provo Bay		6/16/2016	1133	0.013	0.012	0.5	0.137	0.162	0.004
Provo Bay West		6/16/2016	1150	0.026	0.019	0.4	0.233	0.416	0.03
Provo Bay Middle		8/11/2016	10:30	0.518	0.02	0.5	0.465	0.542	0.254

Table 3 includes temperature, pH and dissolved oxygen at the mouth of Mill Race. The data includes late spring, summer and early fall. It is clear that the pH entering Provo bay is below the 9.0 aquatic life criterion.

Table 3. pH, temperature, and DO during 2016. Note data were collected in mid to late afternoon when maximum pH and temperature typically occurs.

Date	Time	pH	Temperature C	Rugged DO milligrams/L
5/16/2016	4:08:48 PM	8.17	18.32	10.18
7/5/16	3:45:07 PM	8.83	27.87	14.60
8/30/2016	3:16:34 PM	8.16	18.33	10.18

Therefore, again it is necessary to see the data the DWQ collected and the methods for analysis and assessment that resulted in an impaired classification. Moreover, if data

from the middle of the Bay were in exceedence of the criterion, this present data indicates that the elevated pH, as with the DO is internally generated from elevated primary production typical of the fully functioning impounded wetlands of Farmington Bay, Once again, this suggests that Provo Bay has been misclassified for at least the last 1.5 decades. Alternatively, the Bay has been fully supporting waterfowl and shorebirds in similar densities as Farmington Bay impounded and sheetflow wetlands (See Figure 1).

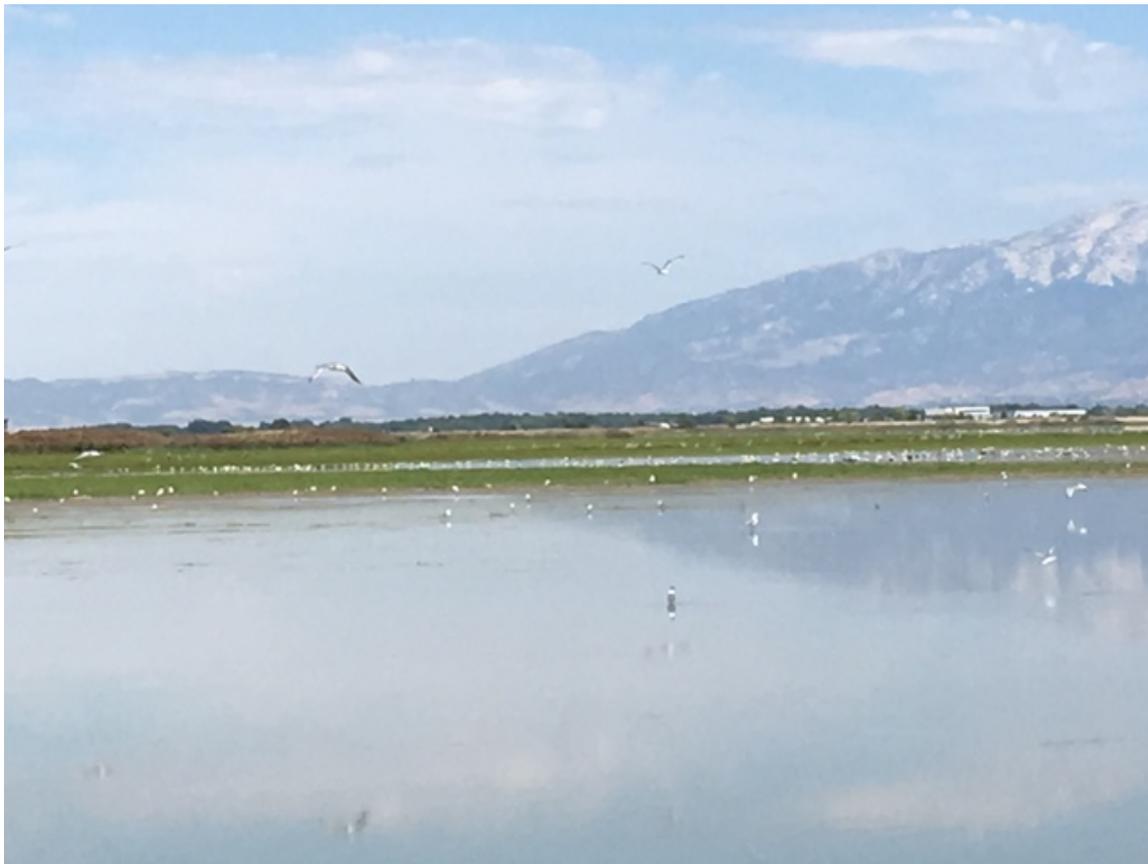


Figure 1. View of Provo Bay from the center bay sampling site looking northeast, August 29, 2016. This is a portion of the bird assemblage that included thousands of American avocets, blacknecked stilts, whitefaced ibis, dowitchers and California and franklins gulls. The water depth was about 4 cm throughout the Bay. Notably, despite the lake dropping approximately 90 cm (3 feet) since May, 2016, the Bay has declined approximately 8 cm, indicating that the bay functions as a combination of an impounded and sheetflow wetland and it is actually “perched” above and separate from Utah Lake proper. Therefore, if DWQ thinks it is important to separate the assessment of Provo Bay from Utah, DWQ should assess the Bay for what it has always been used for (i.e. a wetland).

In summary, these data sets beg the questions of where, when and how were samples collected in Provo Bay and how they were assessed by DWQ that justified listing as impaired? Because these data are contradictory, this data needs to be revealed before DWQ can list Provo Bay for pH or ammonia. More importantly, however, DWQ should engage in a UAA/Site-specific analysis that reflects the uses of Provo for at least the last 60 years and likely long before that.

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## Comments concerning the listing of Mill Creek T. Miller

Jordan River/Utah Lake UT16020204-026 Mill Creek1-SLCity Mill Creek from confluence with Jordan River to Interstate 15 crossing 5 Not Supporting Dissolved Oxygen 3C Low 2014 0.9

**Comment:** This assessment decision is questionable. In the last six years of approximately monthly samples, we have only measured one DO value that was just slightly lower than the chronic criterion value (see below). Notably, this value is also within the instrument specifications for accuracy. Further, this measurement was relatively early in the morning and therefore would not likely have resulted in a 7-day or 30-day average violation. Moreover, DWQ likely used the inappropriate method of assessing chronic criteria violations which is to use instantaneous readings of < 5.5 mg/L as if they represented 7-day or 30-day average values. As this method continues to be drastically different than EPA's 1986 guidelines (Water Quality Criteria for Dissolved Oxygen), this remains an inappropriate manner of assessment. Although I provided comment on this listing during the 2012-2014 IR comment period and the 2010 IR comment period, it was not adequately addressed in the written response and appropriate assessment methods have not been adopted, despite EPA guidance was released 30 years ago. Therefore, I request again the sample location(s) used for this assessment and all of the accompanying data used in the assessment. For comparison, I have included some of the data collected by JR/FBWQC technicians that include both morning and afternoon measurements, even just one week apart, to demonstrate that it is unlikely that the chronic criteria, either the 7-day or 30-day average were actually in violation.

Table 1. Dissolved oxygen measurements made at different locations in lower Mill Creek. Data were selected in order to demonstrate diel variability, including morning minima and near-afternoon maxima.

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Mill Creek at 300 West, Above CV discharge, 8/6/2013, 8:17:31 AM, Dissolved Oxygen 5.39 mg/L

Mill Creek at 300 West, above CV discharge, 8/13/2013, 12:52:44 PM Dissolved Oxygen 8.17 mg/L

Mill Creek at confl. With Jordan River, 8/6/2013, 9:14:22 AM Dissolved Oxygen 5.82 mg/L

Mill Creek at RR Xing, 8/6/2013 1:37:39 PM Dissolved Oxygen 5.82 mg/L

Mill Creek below Central Valley discharge 8/13/2013 12:52:44 PM. Dissolved Oxygen 8.17 mg/L

Mill Creek below Central Valley discharge 8/26/2015 4:03:10 PM Dissolved Oxygen 6.29 mg/L

**Listing:** Jordan River/Utah Lake UT16020204-026 Mill Creek1-SLCity Mill Creek from confluence with Jordan River to Interstate 15 crossing 5 Not Supporting OE Bioassessment 3C Low

**Comment:** The same comments provided for Reaches 1,2 and 3 of the lower Jordan River also apply here. In short, the exact sample location(s) need to be identified so that data and model review can proceed. What are the reference sites for O/E need to be identified and the local

site-specific physical characteristics between Mill Creek sites and reference sites need to be provided in order to provide for transparent review and comment on this listing. It is difficult to imagine what other river systems in Utah function as valid reference sites for these low-gradient valley streams. This needs to be better defined. Also, please review the O/E comments provided by Dr. David Richards. Addressing these comments and applying the associated suggestions will greatly improve DWQ's ability to perform detailed and site-specific bioassessments that account for both the physical and ambient water quality associated with reference and target sites.

## Listing and comments on Chapter 3, with focus on the Jordan River T. Miller

### Lower Jordan River

**Listing:** Jordan River/Utah Lake UT16020204-001 Jordan River- Reach 1. Jordan River from Farmington Bay upstream contiguous with the Davis County line 5 Not Supporting Copper, Dissolved 3B; 3D Low 2014 8.6.

**Comment:** DWQ should perform at least the Biotic Ligand Model at sites listed for the divalent metals. This would provide clear evidence that these metals are not as toxic as EPA's and DWQ's hardness-based criteria. This would save immense amounts of time in listing and delisting or more time-consuming, expensive and unwarranted performance of a TMDL. This model can be performed in-house

**Listing:** Jordan River/Utah Lake UT16020204-001 Jordan River- Reach 1. Jordan River from Farmington Bay upstream contiguous with the Davis County line 5 Not Supporting OE Bioassessment 3B; 3D Low 2008 8.6

**Comment:** First, DWQ needs to understand that the Jordan River does not flow into Farmington Bay. Rather, the flow downstream from Burnham Dam is distributed throughout Newstate Duck Club, where it flows through approximately 25 ponds. This water then enters the Turpin Unit of the Farmington Bay Waterfowl Management Area. Finally, through 19 separate and adjustable culverts, this water is released to Farmington Bay. A small overflow sometimes enters the NW Oil Drain about 1 mile upstream from the west side of the Turpin Dike. The Reach description should end at Burton Dam, which is the last diversion of the River where it flows into impoundments owned by Newstate Duck Club. Also, the description does not include an upstream end of the reach in question. This needs to be added.

**Listing:** Jordan River/Utah Lake UT16020204-002 Jordan River-Reach 2. Jordan River from Davis County line upstream to North Temple Street 5 Not Supporting OE Bioassessment 3B; 3D Low 2008 6.1 **and**

**Listing:** Jordan River/Utah Lake UT16020204-003 Jordan River-Reach 3. Jordan River from North Temple to 2100 South 5 Not Supporting OE Bioassessment 3B Low 2008 2.7

**Comment (for Reaches 1, 2 and 3):** What are the reference sites for O/E? It is difficult to imagine what other river systems in Utah function as valid reference sites. I certainly believe and I would think that DWQ staff should believe this to be critical? Wouldn't DWQ agree that gross average watershed characteristics can hardly predict the macroinvertebrate community of Reach 1 of the Jordan River? There is a growing consensus among stream ecologists that (Brett Marshall, River continuum Concepts, David Richards, Oreohelix Consulting and others), that the only utility of O/E, it is as a screening tool, to list an AU as category 3 to follow-up with additional site surveys and comparisons of physical habitat characteristics with reference condition to determine that O/E is truly different from reference sites based only on WQ parameters or whether the physical condition of this channelized, straightened, dredged and dewatered segment is the cause. Again, as many times before, this is being requested in the

spirit of transparency and collaboration for the purpose of improving the assessment process. For example, all other western states that include O/E use many additional metrics to validate true impairment and assist in determining the cause. Utah is considered behind in identifying and performing more thorough bioassessments that include multiple metrics and indicators that elucidate various potential/stressors that ultimately dictate the composition of the macroinvertebrate community in a particular stream reach.

Clearly, Jordan River is the most high-profile stream segment of any Utah stream and has been the subject of millions of dollars worth of monitoring and research. DWQ should understand the importance of physical data associated with biological responses and understand that this entire lower reach consists of a highly modified depositional zone, most often characterized by several feet of organic-rich silt and clay with deposition occurring continually. It seems impossible to identify ANY reach of stream in Utah that would qualify as a reference reach for the lower Jordan or the site(s) sampled to represent the lower reaches of the Jordan River. Identification of such reference sites is critical in order to more thoroughly evaluate causation of the O/E impairment.

Also, DWQ needs identify the location of the sample site where biological collections are made. DWQ needs to list reference sites for all sites listed as impaired for O/E – such would be a welcome addition to the Appendix of the 305(b) section. Otherwise, it is impossible to provide a thorough and necessary scientific review that DWQ is requesting for this important document. Transparency is paramount. Also, see and address the additional comments presented herein and those provided by Dr. David Richards.

In short, DWQ should only use O/E as a screening tool, to list a AU in Category 3 to follow-up with additional site surveys and comparisons of physical habitat characteristics to determine that O/E and other critical metrics such as sensitive taxa, feeding guilds as well as important physical stressors that can co-vary with a water quality parameter such as turbidity, temperature, stream gradient, substrate size, riparian quality, adjacent land use, etc. are truly similar to reference sites. This is necessary to determine whether a water quality parameter or whether other physical condition(s) is the cause. All other states that include O/E use many additional metrics to validate true impairment cause. Utah needs to join other western states in performing better bioassessments that include multiple metrics and detailed physical habitat characterization as indicators of true reference condition?

As mentioned above, DWQ should identify the location(s) along these reaches of the sample site where biological collections are made. This will provide for a true scientific review of the assessment method. Finally, in addition to identifying these reference sites, taxa lists, that include the complete list of taxa, as well as the final list that is present at 50% of reference sites, should be provided in the appendix or under separate cover. Providing this important O/E data is critical in being able to provide a legitimate scientific review of the method and how it is applied. For example, we understand that DWQ collects EMAP – type physical data at each site, whether reference or targeted. This information provides for a more thorough understanding of the physical data used for reference condition and how it is compared to the targeted sites along the Jordan River. How this data fits into the assessment needs to be discussed.

**Listing:** Jordan River/Utah Lake UT16020204-001 Jordan River-Reach 1 Jordan River from Farmington Bay upstream contiguous with the Davis County line 5 TMDL Approved [Phase 1 approved] Dissolved Oxygen 3B; 3D High 2006 8.6 **and**

**Listing:** Jordan River/Utah Lake UT16020204-002 Jordan River-Reach 2. Jordan River from Davis County line upstream to North Temple Street 5 TMDL Approved [Phase 1 approved] Dissolved Oxygen 3B High 2006 6.1 **and**

**Listing:** Jordan River/Utah Lake UT16020204-003 Jordan River-Reach 3. Jordan River from North Temple to 2100 South 5 TMDL Approved [Phase 1 approved] Dissolved Oxygen 3B High 2008 2.7

**Comment:** As has been discussed many times, the cause of low DO excursions in the Lower Jordan River is elevated stormwater flow events. Although after some of these events the river takes a few days to perhaps a week or two to "recover", clearly, these watershed events mobilize reduced compounds such as methane, that are rapidly oxidized and particularly through urban landscapes where stormwater vaults and conduits accumulate all sorts of organic matter from street runoff, yard runoff, including grass clippings, leaf litter, etc. etc. During the worst of these recorded events (July 4-7, 2013), the DO in the lower Jordan River remained at or near 0.0 DO where the sondes were located for about 13 hours. Yet, daily observations within Legacy Nature Preserve and the State Canal indicated that no fish mortalities had occurred. Clearly there are substantial refuge areas where fish survival is ensured as indicated by the many carp that were observed before and after the event. These occasional excursions are impossible to predict and for all intent and purposes are impossible to mitigate. For example, if more sedimentation basins are constructed, this will only provide additional locations where organic matter will decompose- creating new pockets of methane and sulfide that will rapidly consume oxygen as these sediments are mobilized during a storm event. Since these are naturally occurring flood flows through channels that have been straightened, channelized, dewatered, regularly dredged, etc., primarily for the purpose of facilitating flood flows (and that have been constructed with no regard for aquatic habitat preservation or improvement), this characteristic qualifies for one or more of the section 131.10(g) factors including , (4) Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would re-suit in the attainment of the use; or (5) Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses;

We suggest that DWQ perform an UAA/ site-specific criteria modification that modifies the DO criterion and accounts for these occasional excursions. This would recognize the limitations of this drastically modified reach and save us all a lot of money, heartache and headache. Also, DWQ needs to list the dates and DO values where low DO events were recorded that support the continued listing of the Jordan River for low DO. This will correlate to high flow events.

In addition, although DWQ is currently proposing a method on how to assess high-frequency data, there continues to be no excuse for using the EPA method guidelines

of just retrieving the sonde data to capture the morning minima and afternoon maxima for 7 consecutive days to determine whether a Chronic DO violation has occurred.

**Listing:** Jordan River/Utah Lake UT16020204-001 Jordan River-1 Jordan River from Farmington Bay upstream contiguous with the Davis County line 5 Not Supporting E. coli 2B High 2010 8.6 **and**

**Listing:** Jordan River/Utah Lake UT16020204-002 Jordan River-2 Jordan River from Davis County line upstream to North Temple Street 5 Not Supporting E. coli 2B High 2006 6.1 **and**

**Listing:** Jordan River/Utah Lake UT16020204-003 Jordan River-3 Jordan River from North Temple to 2100 South 5 Not Supporting E. coli 2B High 2006 2.7 **and**

**Comment:** These reaches in the Lower Jordan River have been listed for many years. Yet, the priority is listed as “high”. As POTWs that discharge to the Jordan River have not violated discharge permit values for E. coli, the source of E. coli is most likely wildlife and waterfowl that inhabit the Jordan River and its tributaries. DWQ should proceed with a site-specific/UAA that acknowledges this condition.

**Listing:** Jordan River/Utah Lake UT16020204-003 Jordan River-Reach 3 Jordan River from North Temple to 2100 South 5 Not Supporting **Total Phosphorus** Unknown\*\* Low 2008 2.7

**Comment:** This is a peculiar listing. What was the threshold for P used in this determination and how was it determined and why?. For example, all reaches of the Jordan River exceed the 0.05 mg/L narrative standard.

## State Canal

**Listing:** Jordan River/Utah Lake UT16020204-034 State Canal State Canal from Farmington Bay to confluence with the Jordan River 5 Not Supporting Dissolved Oxygen 3B; 3D Low 2014 0.0

**Comment:** To reiterate, it has been acknowledged that excursions of DO below the 5.5 mg/L chronic standard and the 4.0 acute standard occur as a result of storm events. As such see applicable comments concerning the DO impairment in Reaches 1, 2 and 3 of the JR. This canal was built for the sole purpose of conveying water from the Jordan River to the North-east impoundments of the Farmington Bay WMA. It was NOT intended to support a 3B fishery. In fact, the impoundments that this water flows into are treated annually with rotenone to eradicate carp and DWR has expressed interest in treating the State Canal with rotenone to provide greater elimination of carp for the greater beneficial use of waterfowl management.

In addition, preliminary analysis of benthic samples indicates that the benthos is nearly identical to that in the 3E waterway, the NW oil drain or to the impounded wetlands that have been studied for more than a decade. As both of these canals are perfect examples of severely habitat limited waterbodies, DWQ should acknowledge this fact and initiate UAA /Site-specific analysis and acknowledge that support for the highly invasive nuisance fish, the common carp, is not a valid use of the State Canal. A discussion of this process and how to proceed with the UAA is requested.

In addition, the State Canal has no east bank. The water spreads out over 20-30 acres at various locations along its downstream reaches. This area is owned and managed by DWR for waterfowl support. Moreover, the benthic community is similar to the benthos of the impounded wetlands located downstream. Therefore, we suggest that the State Canal and associated wetlands be incorporated in the UAA/site-specific adjustment of the Farmington Bay impounded wetlands at large. Again, this is scientifically appropriate and save a lot present and future contention over what are appropriate beneficial uses and classification.

In addition, the comments provided above for Reaches 1, 2 and 3 apply here and deserve an explanation.

**Listing:** Jordan River/Utah Lake UT16020204-034 State Canal State Canal from Farmington Bay to confluence with the Jordan River 5 Not Supporting Total Ammonia 3B; 3D Low 2016 0.0

**Comment:** DWQ needs to identify the exact location of this sampling site. Specifically, DWQ may be using the wrong pH value for this assessment. Please see the table below which is an excerpt of a report "pH and its affect on the ammonia criteria in the State Canal", currently in preparation. This report will meet all credible data criteria required by DWQ. Throughout our data set and DWQ's data base, no ammonia criteria violations have occurred in the State Canal upstream from the North Plant discharge. The problem with the assessment is that DWQ is using the pH value recorded by the data sonde located just upstream from the South Davis North plant or have collected instantaneous data at the Newstate bridge and used that value for pH for the ammonia criteria calculation and applied it to the ammonia data we collected in the subreach extending downstream from the North Plant discharge 900 m to the terminus of the canal. However, this analysis is inaccurate. DWQ is unaware of the modification of pH through this reach. For example, the average pH value throughout this study thus far = 7.62. When used in the current equation for calculating the ammonia criteria, the chronic ammonia criterion = 3.72 mg/L. This is obviously greater than the chronic criterion currently calculated by DWQ which uses the pH value of the State Canal measured at upstream locations of 8.16 which yields a criterion value of 1.82 mg/L. Until such time as a UAA is performed, South Davis Sewer Districts requests that the criterion be re-calculated using the appropriate pH value, or at least for now place the draft listing for the ammonia in the state Canal in Category 3 – more study is needed.

Table 1. summary of weekly values for ammonia, flow, pH, DO, conductance and temperature 300 m downstream from the South Davis North Plant. The average pH of this data set is 7.6, substantially lower than values used by DWQ in the draft wasteload calculation and ammonia permit spreadsheet provide earlier this year.

**State Canal 300 m downstream from SD North plant discharge**

Date:	Ammonia	Flow	pH	DO	EC/AC	Temp
3/28/16	-	-	7.69	7.333636	1445.156	10.44
4/1/16	-	-	7.02	8.8175	1587.483	15.05
4/7/16	-	-	7.404	7.1152	1439.598	13.72
4/15/16	-	-	7.51	5.638571	991.19	10.73
4/22/16	-	-	7.44	9.3052	1569.74	20.05
5/4/16	1.92	2.73	7.52	6.11125	1468.773	18.25
5/11/16	1.15	3.11	7.46	4.7875	1022.648	14.29
5/18/16	1.66	2.87	7.39	5.208571	1128.343	17.90
5/24/16	1.58	2.36	7.89	6.022951	1272.057	15.46
6/2/16	0.874	2.07	7.98	4.858333	1122.885	18.23
6/9/16	0.808	2.39	8.06	7.017295	1061.47	24.01
6/16/16	1.89	2.80	8.06	6.860963	1310.295	22.05
6/21/16	1.63	2.29	7.69	4.685328	1532.058	22.73

Jordan River/Utah Lake UT16020204-034 State Canal State Canal from Farmington Bay to confluence with the Jordan River5 Not Supporting Total Dissolved Solids 4 Low 2016 0.0

**Comment:** As mentioned in the comments for listing TDS in the middle/upper Jordan River, the source of elevated TDS is the fact that in all but two of the last 16 years, the Jordan River Watershed has experienced drought conditions. As such, Utah Lake has essentially become an evaporation pond, with required pumping for every bit of water leaving the lake. In addition, with the majority of tributary water being diverted for either culinary, or more significantly for irrigation, this has vastly reduced the ability of Utah Lake to adequately flush. Therefore, this violation is due the Section 131.10(g) factor 4. Hydrologic modification prevents to attainment of the use.

**Middle Jordan River**

**Listing:** Jordan River/Utah Lake UT16020204-004 Jordan River-Reach 4. Jordan River from 2100 South to the confluence with Little Cottonwood Creek 5 Not Supporting OE Bioassessment 3B Low 2010 5.7.

**Comment:** This reach is basically characterized as a transition zone between the deposition-dominated lower reaches (downstream from 2100 S) and the erosion-dominated upper reach (from about 14600 through the top of the narrows). It is important to understand these more subtle, yet critically important transitions between stream types. As such, comments provided

for the listing of Reaches 1, 2 and 3 apply to Reach 4 as well. To reiterate, it is critical to make sure that representative reference sites for each stream type are identified and sampled. For example, see Montana DEQ's method for identifying reference streams between the Western Forested ecoregion and the eastern prairie region. This is a great example for going beyond just the determination of O/E, and using watershed based mean geographic indicators of stream condition. Additional comments provided for the listing of the lower reaches of the Lower Jordan River also apply.

**Listing:** Jordan River/Utah Lake UT16020204-004 Jordan River - Reach 4. Jordan River from 2100 South to the confluence with Little Cottonwood Creek 5 Not Supporting E. coli 2B High 2014 5.7

**Comment:** Despite this more recent listing, the same comment as for the E. coli listing for the lower Jordan River applies. If DWQ does not agree that this E. coli is naturally occurring from wildlife and waterfowl, it should engage in detailed DNA studies to determine whether the bacteria are from humans or from natural sources.

**Listing:** Jordan River/Utah Lake UT16020204-005 Jordan River-Reach 5 Jordan River from the confluence with Little Cottonwood Creek to 7800 South 5 Not Supporting E. coli 2B High 2006 4.5

**Comment:** Same comment as for Reach 4.

**Listing:** Jordan River/Utah Lake UT16020204-005 Jordan River-5 Jordan River from the confluence with Little Cottonwood Creek to 7800 South 5 Not Supporting Temperature 3A Low 2006 4.5

**Comment:** As has been modeled, it is virtually impossible to mitigate this violation for temperature. The channel is vastly dewatered as a result of multiple diversions, reducing the mass of water necessary to preserve cool temperatures during daylight hours. In addition, riparian shading is virtually nil. DWQ should plan on performing a UAA.

**Listing:** Jordan River/Utah Lake UT16020204-005 Jordan River-5 Jordan River from the confluence with Little Cottonwood Creek to 7800 South 5 Not Supporting Total Dissolved Solids 4 Low 2006 4.5 .

**Comment:** If the TDS at this site is compared to the Utah Lake TDS and lake level and the years that the lake is below the compromise point, it will become clear that the TDS violation is due to the lack of flushing of Utah Lake. This is simply a case of hydrologic modification that prevents Utah Lake from flushing and turns it into an evaporation pond. DWQ should perform a UAA that accounts for this irreversible Condition: 40CFR section 131.10(g) condition "4" : Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use;

**Listing:** Jordan River/Utah Lake UT16020204-006 Jordan River-6 Jordan River from 7800 South to Bluffdale at 14600 South 5 Not Supporting Dissolved Oxygen 3A Low 2014 12.5

**Comment:** This listing is questionable. For example, I listed below most of the readings collected by JR/FBWQC technicians over the last several years and which were collected early in the morning to capture values that are near the diel minimum. In short, none of these values violate the minimum DO for the Jordan River. Where such a listing has huge implications as to the causes and sources, DWQ should list the raw data used for this assessment in the appendix so that a quick review of the data can be performed. As such, we now request a list of the data used for this assessment as a specific response to this comment.

Also, as commented elsewhere in this review and in earlier comments (on the 2010 and 2014 Integrated Reports), it is likely that DWQ used an inappropriate (using the mean of instantaneous readings) method that is not an accurate reflection of actual conditions rather than following the EPA guidelines outlined in EPA's water quality criteria for dissolved oxygen document published in 1986. After 30 years of this document being available, and DWQ has gone through at least two Triennial Revue sessions, this is inexcusable. DWQ need only place a reach suspected of chronic DO violation into Category 3 – insufficient data and then collect daily minima and maxima DO data on a priority basis. As such DWQ should place this reach in Category 3 until an accurate reassessment using EPA guidelines is performed. This really shouldn't be too much to expect for such a high-profile DO TMDL. In addition, although DWQ is currently proposing a method on how to assess high-frequency data, there continues to be no excuse for using the old fashioned method of just retrieving the sonde data to capture the morning minima and afternoon maxima for 7 consecutive days to determine whether a Chronic DO violation occurred. This at will comply with EPA guidelines.

Table 2. summary of summer DO data collected at 7800 S. Early-morning data was selected in order to observe the worst possible time of day for low DO measurements. Clearly because DO minimums occur between the hours of 0730 and 0930 (depending on season), these data are at or very near diel minima.

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7800 S 8/26/2015, 8:30:10 AM Dissolved Oxygen = 5.55 (mg/L)

7800 S 8/28/2012, 10:37:50 AM Dissolved Oxygen = 7.81 (mg/L)

7800 S 7/25/2012 11:45:40 AM Dissolved Oxygen = 8.47 (mg/L)

146 S 9/16/2015, 9:32:40 AM Dissolved Oxygen = 6.92 (mg/L)

146 S 8/28/2012 10:37:50 AM Dissolved Oxygen = 7.81 (mg/L)

146 S 8/26/2015 8:30:10 AM Dissolved Oxygen = 5.54 (mg/L)

**Listing:** Jordan River/Utah Lake UT16020204-006 Jordan River-6 Jordan River from 7800 South to Bluffdale at 14600 South 5 Not Supporting OE Bioassessment 3A Low 2008 12.5

**Comment:** See comments for O/E listings proposed elsewhere in this document.