Utah Lake Management Goals, Assessment Endpoints, Measures, and Targets

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Executive Summary

The Utah Lake Water Quality Study aims to develop nitrogen and phosphorus criteria to protect Utah Lake's designated beneficial uses including recreation, aquatic life, and agricultural uses.

To ensure that specific policy goals are clearly guiding the Utah Lake Water Quality Study, the Steering Committee has developed a summary of management goals that relate to water quality, specifically nutrients in the table below. The management goals will be incorporated into the Utah Lake Water Quality Study Numeric Nutrient Criteria Technical Framework document. This will set the direction for the scientific analyses and modeling that will be used to derive multiple policy scenarios for further evaluation. Along with the cost and feasibility associated with each scenario, the measures identified for each goal will be used to express differences in potential future conditions for the lake.

The management goals focus on recreation, aquatic life, agricultural, and downstream uses of Utah Lake. Below is a brief summary of the goals that are described in more detail in the table.

- **Recreation: Utah Lake supports a robust recreational industry and increased recreational opportunities and experiences for the community.** Related goals identify reduction of the magnitude, extent, and frequency of phytoplankton blooms (algae and cyanobacteria), protection of public health, and improving public perception of Utah Lake.
- **Aquatic Life: Utah Lake water quality supports a robust and healthy fishery as well as waterfowl and shorebird communities.** Related goals identify support of reproductive populations of June Sucker, sufficient habitat for the fish in Utah Lake, and ensuring that toxins do not threaten fish, waterfowl, or shorebirds. This goal also includes attainment of established water quality standards for dissolved oxygen, ammonia, and pH.
- **Agriculture: Toxins in Utah Lake do not harm livestock or crops.**
- **Downstream: Utah Lake water quality is protective of downstream uses of the Jordan River.** This includes protections for the drinking water designation in the Upper Jordan River, recreation and aquatic life, and secondary water uses downstream.

As noted above, the Steering Committee and Science Panel are still working toward developing NNC and undertaking studies to assist in those efforts. While the Management Goals Table represents a general agreement at this time on the direction of the overall study and general aspirations for the lake, there are still some issues being debated including whether potential changes to harmful algal blooms in future lake scenarios should be evaluated using measures of cyanobacteria (e.g., cell counts, biovolume).

Some members of the Steering Committee believe that these measures are critical because modeling toxin concentrations requires modeling harmful algal blooms using these measures, and that policy makers will be interested in differences in predicted harmful algal blooms associated with future nutrient scenarios.

However, others feel that phytoplankton is all the green stuff in Utah Lake. It includes both non-harmful algae and cyanobacteria. Cyanobacteria, a type of phytoplankton, come in all different sizes and some produce toxins. The cell size and toxins of each species vary too much for cell counts to be a reliable measurement. This concern comes from an interpretation of an EPA 2019 document that discusses the variability of cyanobacteria and its relation to health effects (see Section 7.5 page 94). Chlorophyll density is a good indicator to measure the amount of all phytoplankton growth. Public perception is green is toxic. However, directly testing for toxins is a good measurement for determining the toxin level in Utah Lake.

At this point, measures of harmful algal blooms (e.g., cyanobacteria cell counts) and more broadly nuisance algal blooms (e.g., chlorophyll a) are both included in the Table, however, results of the upcoming studies and further dialogue among the Steering Committee members could see this change in the future.

Achievement of the Utah Lake management goals cannot be accomplished through nutrient reduction alone. Other lake management efforts are critical to the overall restoration and protection of Utah Lake including fisheries management (e.g., June Sucker recovery and carp management), water management, and habitat restoration (e.g., Phragmites removal). Further, the timeframe to achieve these management goals and the scientific certainty that goals will be achieved will be important policy considerations and will be informed by outputs of the Utah Lake Water Quality Study.

Introduction

The Utah Lake Water Quality Study (ULWQS) Management Goals Table below presents a structure for simultaneously considering management goals, assessment endpoints, measures, and targets for Utah Lake water quality. Utah Lake has water quality standards, established by law and regulation, based on its current designated uses. These have to be protected or restored. These uses (recreation, aquatic life, and agriculture) are by default broad management goals and the Utah Lake Steering Committee has developed more specific management goals and assessment endpoints for each of these uses. In many cases the management goals are directional, rather than absolute. Assessment endpoints are the mechanisms by which we will evaluate whether or not we are making progress and/or achieving specific management goals. They are quantified using specific measures (attributes that change in response to nutrient exposure, e.g., algal biomass) with associated targets (numeric thresholds of measures that define support for the management goals, e.g., nutrient concentrations)[1].

Table Definitions:

Designated Beneficial Use: As defined in Utah Administrative Code R317-2

- Class 1C -- Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water
- Class 2A -- Protected for frequent primary contact recreation where there is a high likelihood of ingestion of water or a high degree of bodily contact with the water. Examples include, but are not limited to, swimming, rafting, kayaking, diving, and water skiing.
- Class 3B -- Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
- Class 3D -- Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.
- Class 4 -- Protected for agricultural uses including irrigation of crops and stock watering.

Management goals are statements about the desired condition for societal, economic, and ecological values of concern including recreation, aquatic life, and agricultural values (EPA 1998). Management goals may come from the law, interpretations of the law (e.g., regulation), agency resource management mandates, desired outcomes voiced by community leaders and the public, and interests expressed by affected parties. Goals are often value-based and directional – using language such as improve, maintain, prevent, protect, reduce, restore, reestablish, etc. – rather than absolute.

Assessment endpoints represent explicit expressions of what is to be protected and should be neutral and specific. They are operationally defined by an ecological entity and any of its attributes (EPA 1998). Ideal endpoints are relevant to specific management goals. For example, fish are valued ecological entities used in management goals; reproduction and age class structure are some of their important attributes. Together "fish reproduction and age class structure" form an assessment endpoint. Assessment endpoints may not always be

[1] *United States Environmental Protection Agency (EPA). 1998. Guidelines for Ecological Risk Assessment. EPA/630/R-95/002F. United States Environmental Protection Agency, Washington, DC. https://www.epa.gov/sites/production/files/2014-11/documents/eco_risk_assessment1998.pdf (Accessed June 4, 2020).*

distinguishable from measures and sometimes can be measured directly. This can lead to some confusion between assessment endpoints and measures.

Measures (i.e., measure of effect and measure of exposure) are attributes of an assessment endpoint, or its surrogate, that can be used to assess and quantify progress toward achieving a management goal (EPA 1998).

Targets are the numeric thresholds of measures that define support for the management goal, including existing criteria in Utah's Water Quality Standards regulations. Many are still to be developed (TBD) by, for example, the ULWQS or through a cost-benefit analysis.

Target Source is the source of information and data used to develop target values.

Current Conditions is a summary of the most recent five years of existing data and information associated with each measure.

Study/information gaps highlight some work remaining to be done or how measures or targets might be refined or developed.

TBD are to be determined through future Science Panel analyses and Steering Committee review.

Utah Lake Water Quality Study Management Goals Table. Please note the following pages are formatted for 11x17 printing.

Primary Contact Recreation

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
2A. Primary contact recreation use (human health, Recreation experience, Lake aesthetics)	Harmful algal blooms (HAB) will not create toxins that threaten public health.	Algal toxin concentrations	Microcystin concentration	8 ug/L	North: 0-41,000, 26.7 % above Middle: 0-150, 6.3 % above South: 0-3,400, 25.5% above	EPA guidance WQS, R317-2-14[2]	Frequency/duration to be incorporated from EPA guidance
			Cylindrospermopsin concentration	15 ug/L	No data available	EPA guidance WQS, R317-2-14[2]	Frequency/duration to be incorporated from EPA guidance
			Anatoxin concentration	15 ug/L	North: 0-0.49, 0% above Middle: 0-0.2, 0% above South: 0-0.85, 0% above	Utah HAB guidance WQS, R317-2-14[2]	
	HAB occurrence is limited in spatial extent and infrequent to support robust recreational industry and community.	Magnitude, frequency, and duration of algal blooms.	Annual number of lake closures due to HABs	• Microcystin:2,000 ug/L • Anatoxin: 90 ug/L • Cylindrosprmopsin15 ug/L • Cyanobacteria density: 10M cells/mL	Weeks with ≥ 1 site closed: 2016: 2 north, 2 middle, 10 south 2017: 0 2018: 14 north, 0 middle, 11 south 2019: 0 north, 0 middle, 2 south	Utah HAB guidance WQS, R317-2-7.2[2]	
			Duration/frequency: Percent of recreation season with algal biomass exceeding health and nuisance thresholds at each monitoring site and target recreation site (e.g. marinas, beaches).	• Cyanobacteria density: TBD • Toxigenic Cyanobacteria density: TBD • Cyanobacteria relative abundance: TBD • Toxigenic Cyanobacteria relative abundance: TBD • Cyanobacteria biovolume: TBD • Chlorophyll-a: TBD	Percent of time exceeding TBD nuisance thresholds: Cyanobacteria Density: TBD Chlorophyll distributions (µg/L): Main basin: 19.9 ± 26.7 (range: 0-176.0, 230 samples, 55 nondetects) North: TBD Middle: TBD South: TBD Goshen Bay: 35.5 ± 39.6 (range: 0-150.0, 34	Recreation survey Cost/benefit analysis. Proposed EPA NNC criteria[3] R317-2-7.2[2]	Recreation survey to help determine nuisance thresholds for algal/cyanobacteria density. Need to agree on target sites for marinas and beaches for model output and monitoring. Refer to the Science Panel for recommendations.

[2] *Rule R317-2. Standards of Quality for Waters of the State.* https://rules.utah.gov/publicat/code/r317/r317-002.htm

[3] *Draft Ambient Water Quality Criteria Recommendations for Lakes and Reservoirs of the Conterminous United States*. https://www.epa.gov/nutrient-policy-data/draft-ambient-water-quality-criteria-recommendations-lakes-and-reservoirs

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
					samples, 3 nondetects) Provo Bay: 107.9 ± 100.0 (range: 3.5-379.3, 36 samples, 0 nondetects)		
	Improve submersible recreation (swimming, paddle boarding, water skiing, etc.) experience.		Extent: Maximum % of lake surface exceeding algal biomass nuisance thresholds (reported separately for Provo Bay, Goshen Bay, and Open Water regions).	• Cyanobacteria density: TBD • Toxigenic Cyanobacteria density: TBD • Cyanobacteria relative abundance: TBD • Toxigenic Cyanobacteria relative abundance: TBD • Cyanobacteria biovolume: TBD • Chlorophyll-a: TBD	A method to determine % of lake surface from a spatial interpolation of sites has yet to be developed. Concentration distributions across sites are listed as a placeholder. **Cyanobacteria distributions (cells/mL):** Main Basin: 376,428 ± 3,211,116 (range: 0-49,457,774, 604 samples) North: TBD Middle: TBD South: TBD Provo Bay: 606,549 ± 2,607,071 (range: 0-22,750,342, 111 samples) **Chlorophyll distributions (µg/L):** Main basin: 19.9 ± 26.7 (range: 0-176.0, 230 samples, 55 nondetects) North: TBD Middle: TBD South: TBD Goshen Bay: 35.5 ± 39.6 (range: 0-150.0, 34 samples, 3 nondetects) Provo Bay: 107.9 ± 100.0 (range: 3.5-379.3, 36 samples, 0 nondetects)	Recreation survey Cost/benefit analysis. Proposed EPA NNC criteria[3] R317-2-7.2[2]	
			Magnitude: Maximum	• Cyanobacteria density: TBD • Toxigenic Cyanobacteria	**Cyanobacteria Density (cells/mL):**	Recreation survey	

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
	Swimming beaches and shoreline access locations are open all summer without nuisance algae or public health advisories.		seasonal algal biomass (collected as integrated water column sample) at each monitoring site and target recreation site (e.g. marinas, beaches).	density: TBD • Cyanobacteria relative abundance: TBD • Toxigenic Cyanobacteria relative abundance: TBD • Cyanobacteria biovolume: TBD • Chlorophyll-a: TBD	Main Basin: 0-49,457,774 North: TBD Middle: TBD South: TBD Provo Bay: 0-22,750,342 **Chlorophyll (µg/L):** Main Basin: 22.3-176.0 North: TBD Middle: TBD South: TBD Goshen Bay: 150.0 Provo Bay: 379.3	Cost/benefit analysis. Proposed EPA NNC criteria[3] R317-2-7.2[2]	
	Recreation water quality standards are supported	Support of 2A Recreational Use Standards	pH	6.5 – 9	North: 8.19-9.23[4] (1% over) Middle: 8.70-10.10 (11% over) South: 8.20-9.45 (6% over) Provo Bay: 7.98-9.70 (11% over)	WQS, R317-2-14[2]	
			Narrative water quality standards	See targets above.	NA	R317-2-7.2. [2]	Recreation survey to help determine nuisance thresholds for
	Increase recreational opportunities and experiences.	Lake visitation and satisfaction statistics.	Annual visitation to Utah Lake.	Number of person-days per season or year: TBD	Monthly visitation surveys (2003-2020) available for Utah Lake State Park[5]but does not address all access points. Annual visitation to Utah Lake State Park [1] 2003-2019:	Cost/benefit analysis.	Recreation survey to help determine user experience issues related to water quality.

[4] Formatting of this style indicates total range

[5]Utah State Park visitation data. https://stateparks.utah.gov/resources/park-visitation-data/

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
					207,677 ± 80,434 (range: 83,076-336,952)		
	Improve public perception of Utah Lake water quality.		Measures from recreation survey to assess user experiences related to water quality.	User perception: TBD	TBD	Cost/benefit analysis.	
	Sport fish are safe for human consumption.	Fish tissue algal toxin concentrations Mollusk tissue algal toxin concentration	Algal toxin concentrations: TBD.	TBD	EPA/FWS to provide results for several studies examining cyanotoxin effects on fish and waterfowl are underway with results expected 2021.	TBD	Literature on protective values for fish consumption; or support for recreational values as protective of fish consumption exposure risks.

Warm Water Aquatic Life

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
3B. Warm water fishery use	Warm water fishery is robust and healthy.	Water quality conditions	Minimum dissolved oxygen	3.0 mg/L	North: 7.76 ± 1.27[6] (0% under) Middle: 7.72 ± 1.42 (0% under) South: 8.01 ± 1.45 (0% under) Provo Bay: 4.70 ± 2.40 (29% under)	WQS, R317-2-14[2]	
			• 7-Day average dissolved oxygen • Supersaturation	• 7-Day Average: 4.0 mg/L • Supersaturation: TBD	North: 8.20 ± 1.10 (0% under) Middle: 8.50 ± 1.10 (0% under) South: 8.55 ± 1.23 (0% under) Provo Bay: 7.88 ± 2.75 (1% under)	WQS, R317-2-14[2]	
			• 30-Day average dissolved oxygen • Supersaturation	• 30-Day Average: 5.5 mg/L • Supersaturation: TBD	North: 8.15 ± 0.91 (0% under) Middle: 8.48 ± 0.81 (0% under) South: 8.48 ± 1.02 (0% under) Provo Bay: 7.21 ± 1.93 (19% under)	WQS, R317-2-14[2]	
			pH	6.5 – 9	North: 8.19-9.23[4] (1% over) Middle: 8.70-10.10 (11% over) South: 8.20-9.45 (6% over) Provo Bay: 7.98-9.70 (11% over)	WQS, R317-2-14[2]	
			Ammonia	pH and Temperature dependent (mg/L)	Main basin: 0.06 ± 0.27 (range: 0-4.95, 404 samples, 217 nondetects) Goshen Bay: 0.01 ± 0.02 (range: 0-0.09, 30 samples, 24 nondetects) Provo Bay: 0.25 ± 0.40 (range: 0-1.88, 33 samples, 0 nondetects)	WQS, R317-2-14[2]	
		Food abundance and diversity	Zooplankton composition/diversity/abundance.	TBD	Taxa richness: 13 (9 with >5% occurrence), community composition dependent on lake level and carp abundance[7]; additional data have been collected by WFWQC	JSRIP and FWS Proposed EPA NNC	Ongoing SP research/EPA NLA Analysis; add specific target for June sucker if

[6] Formatting of this style indicates mean ± standard deviation

[7] Landom K and Walsworth TE. 2020. Biotic community response to Common Carp removal and lake level fluctuations in Utah Lake, UT. Draft report submitted to the June Sucker Recovery Implementation Program.

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
						criteria[3]	available.
			Macroinvertebrate composition/diversity/abundance	TBD	Taxa richness: 20 (15 with >5% occurrence), community composition dependent on carp abundance[5]. Additional data have been collected by WFWQC	JSRIP and FWS	Ongoing SP research/EPA NLA Analysis; add specific target for June sucker if available.
			Phytoplankton composition/diversity and abundance	TBD	7 divisions present Cells/mL: Main basin: 405,957 ± 3,212,407 (range: 0-49,457,774, 604 samples) North: TBD Middle: TBD South: TBD Provo Bay: 695,885 ± 2,620,745 (range: 221-22,758,585, 111 samples)	EPA NLA index[8]	
			Mollusk composition/diversity/abundance	TBD	Surveys have been conducted by WFWQC	UDWR and FWS	
	HAB toxins do not cause fish mortality.	Algal toxin concentrations	Microcystin concentration	TBD	North: 0-41,000 µg/L Middle: 0-150 µg/L South: 0-3,400 µg/L	TBD	Need to research potential toxicity of cyanotoxins on fish. USFWS fish tissue cyanotoxin data available winter 2021.
			Cylindrospermopsin concentration	TBD	No data available	TBD	
			Anatoxin/saxatoxin concentration	TBD	**Anatoxin:** North: 0-0.49 µg/L Middle: 0-0.2 µg/L South: 0-0.85 µg/L **Saxitoxin:** no data available	TBD	

[8] *EPA National Lakes Assessment*

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
	Warm water fishery can support reproductive populations of June Sucker.	Water quality conditions	Minimum dissolved oxygen in Provo Bay and Provo River delta from July – September.	5.0 mg/L	3.52 ± 1.35 (range: 1.43-8.04) 85 % under	WQS, R317-2-14[2]	Check fish spawning seasons and temperature/DO requirements (PSOMAS report).
			7-Day dissolved oxygen in Provo Bay and Provo River delta from July – September.	6.0 mg/L	6.36 ± 1.55 (range: 3.94-9.89) 40 % under	WQS, R317-2-14[2]	
	Macrophyte habitat can support June sucker recovery and early life stages of other ecologically or recreationally important fish species.	Macrophyte abundance and distribution in Provo Bay, Utah Lake Littoral Zones, and Provo River delta.	Primary productivity (chl a/ algal turbidity) supportive of macrophyte re-establishment in target areas.	• Light compensation point: TBDClarity ($K_{d,}$ Secchi Depth): TBD • Chlorophyll a: TBD • Percent algal turbidity: TBD	18-26% of sampled locations are below the light compensation point for macrophyte growth (Tetra Tech Analysis Report)(based on 7-20 um/m2/s) 74 ± 8% of light attenuation is due to non-algal turbidity, specific effects of carp not currently known (Tetra Tech Analysis Report)	JSRIP and FWS	Literature review for algal turbidity supportive of macrophyte re-establishment.
	Carp population does not inhibit June sucker recovery.	Carp density and water quality indicators related to carp activity.	Carp population density	TBD	14 million kg wet weight (95 % CI: 10-23 million kg) 4.8 million individuals (95 % CI: 3.4-7.9 million) (Tetra Tech Analysis Report)	JSRIP and FWS	Ongoing SP research/EPA NLA Analysis; add specific target for June sucker if available.
			Percent change in non-algal turbidity associated with carp bioturbation.	TBD	74 ± 8% of light attenuation is due to non-algal turbidity, specific effects of carp not currently known (Tetra Tech Analysis Report)	JSRIP and FWS	
			Percent change in macrophyte composition, density, and distribution.	TBD	Targeted (non-representative) macrophyte surveys have been conducted[9]	JSRIP and FWS	

[9] Landom K, Dillinghan R, and Gaeta JW. 2019. Seasonal and annual changes in the near-shore Utah lake macrophyte community. Draft report submitted to the June Sucker Recovery Implementation Program.

Waterfowl, Shorebirds, and Other Water-Oriented Wildlife

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
3D. Waterfowl, shorebirds, and other water-oriented wildlife	Habitat conditions (e.g., shoreline vegetation; shallowly flooded and exposed vegetated and unvegetated mudflats; and open water) are supportive of waterfowl, shorebirds, and other water-oriented wildlife.	Nonnative plant abundance, diversity, and distribution.	Percent cover of Phragmites on Utah Lake shorelines.	TBD	Targeted (non-representative) macrophyte surveys have been conducted [9]	Cost/benefit analysis.	
		Macrophyte composition, abundance, diversity, and distribution.	Percent cover of emergent and submergent macrophytes in littoral waterfowl and shorebird habitat areas.	TBD	Targeted (non-representative) macrophyte surveys have been conducted [9]	Cost/benefit analysis.	
			Primary productivity (chl a/ algal turbidity) supportive of macrophyte re-establishment in target areas.	Clarity ($K_{d,}$ Secchi Depth): TBD	18-26% of sampled locations are below the light compensation point for macrophyte growth (Tetra Tech Analysis Report)	Cost/benefit analysis.	
	Macroinvertebrates provide a diverse and sufficient food source to birds that use the open water and shorelines of Utah Lake.	Invertebrate composition, abundance, diversity, and distribution.	Invertebrate index or density samples (and see 3B).	TBD	Taxa richness: 20 (15 with >5% occurrence), community composition dependent on carp abundance [7]; additional data have been collected by WFWQC	Cost/benefit analysis.	Audubon to provide measures if available from GSL habitat. Could rely on GSL health measures.
	HAB toxins do not threaten waterfowl and shorebirds and do not cause bird mortality.	Algal toxin concentrations.	Microcystin concentration	TBD	North: 0-41,000 µg/L Middle: 0-150 µg/L South: 0-3,400 µg/L	TBD	Need to research potential toxicity of cyanotoxins on birds.
			Cylindrospermopsin concentration	TBD	No data available	TBD	
			Anatoxin concentration	TBD	North: 0-0.49 µg/L Middle: 0-0.2 µg/L South: 0-0.85 µg/L	TBD	
	HAB spatial and temporal extent supportive of healthy waterfowl and shorebird habitat.	Harmful algal bloom magnitude and duration.	Maximum # days at each of littoral habitat exceeding TBD HAB threshold.	TBD	A method to determine littoral habitat areas and how to extrapolate sampled days to unsampled days has yet to be developed.	TBD	
			Maximum percent of littoral habitat area exceeding TBD HAB threshold.	TBD	A method to determine % of littoral habitat from a spatial interpolation of sites and a determination of which littoral areas are considered habitat has yet to be developed.	TBD	

Agricultural Water Use

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
4. Agricultural Water Use	Water used to irrigate crops will not present health risk.	Algal toxin concentrations.	Microcystin, cylindrospermopsin, saxitoxin, anatoxin concentrations	TBD	**Microcystin** North: 0-41,000 µg/L Middle: 0-150 µg/L South: 0-3,400 µg/L **Cylindrospermopsin**: no data available **Anatoxin:** North: 0-0.49 µg/L Middle: 0-0.2 µg/L South: 0-0.85 µg/L **Saxitoxin:** no data available	TBD	Evaluate any recent research on crop uptake studies.
	Water used to water livestock will not pose health risk to animals.		Microcystin, cylindrospermopsin, saxitoxin, anatoxin concentrations	TBD		TBD	Literature review on thresholds for stock watering.

Downstream Uses and Other Utah Lake Water Uses

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
1C. Jordan River Drinking water use	Water released into the Jordan River is of sufficient quality to be used as source water for drinking.	Algal toxin concentrations	Microcystin concentration	TBD	North: 0-41,000 µg/L Middle: 0-150 µg/L South: 0-3,400 µg/L	TBD	Literature review for cell count and toxin thresholds for source waters (e.g. Lake Erie).
			Cylindrospermopsin concentration	TBD	No data available	EPA 2015 drinking water guidance	
		Toxic nutrient concentrations	Nitrate concentration	10 mg/L	Main basin: 0.52 ± 0.48 (range: 0-2.4, 83 samples, 8 nondetects) Goshen Bay: 0.36 ± 0.34 (range: 0.12-0.9, 5 samples, 0 nondetects) Provo Bay: 1.19 ± 1.50 (range: 0-5.5, 31 samples, 4 nondetects)	WQS, R317-2-14[2]	
2B. Recreational use	Assumed to be protective because UL 2A is more stringent.	NA	NA	NA	NA	NA	
3B. Warm water life	Protection of Jordan River aquatic life.	Organic matter load export to Jordan River (kg/yr)	Organic matter load (%)	38% reduction	FPOM load from Utah Lake: 3.7 million kg/yr (16.78% of total load)[10]	Phase 1 JR DO TMDL	
		See applicable 3B assessment endpoints from above	See applicable 3B measures from above.	NA	NA	NA	
3D. Waterfowl and shorebirds	Protection of downstream waterfowl and shorebirds.	See applicable 3D assessment endpoints from above	See applicable 3D measures from above.	NA	NA	NA	
4. Agricultural Water Use	See Agricultural Use section in table above.	See applicable 4 assessment endpoints from above	See applicable 4 measures from above.	NA	NA	NA	
Undefined Uses: Secondary Residential Water Use	Secondary use of Utah Lake water does not pose human health risk to residents.	Algal toxin concentrations	Microcystin concentration	Presumed to be protective if recreational thresholds are achieved within Utah Lake.	North: 0-41,000 µg/L Middle: 0-150 µg/L South: 0-3,400 µg/L	NA	

[10] Adams C and Arens H. 2013. Jordan River Total Maximum Daily Load Water Quality Study – Phase 1. Prepared for Utah Department of Environmental Quality.

Clean Water Act Use	Management Goal	Assessment Endpoint	Measures	Targets	Current Conditions	Target source	Study/information gaps
			Cylindrospermopsin concentration	Presumed to be protective if recreational thresholds are achieved within Utah Lake.	No data available	NA	
			Anatoxin concentration	Presumed to be protective if recreational thresholds are achieved within Utah Lake.	North: 0-0.49 µg/L Middle: 0-0.2 µg/L South: 0-0.85 µg/L	NA	