CORE COMPONENT 1: DEVELOPING AQUATIC LIFE CRITERIA FOR PRIORITY POLLUTANTS

A GREAT SALT LAKE WATER QUALITY STRATEGY

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SEPTEMBER 2014

Utah Division of Water Quality

A water quality strategy to ensure Great Salt Lake continues to provide important recreational, ecological, and economic benefits for current and future generations.

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ACRONYMS AND ABBREVIATIONS

CFR	*Code of Federal Regulations*
CWA	Clean Water Act
EPA	United States Environmental Protection Agency
TMDL	Total Maximum Daily Load
UAC	Utah Administrative Code
UDWQ	Utah Division of Water Quality
UPDES	Utah Pollution Discharge Elimination System
UPRR	Union Pacific Railroad
WET	Whole-effluent Toxicity
UAA	Use Attainability Analysis

CORE COMPONENT 1: DEVELOPING AQUATIC LIFE NUMERIC CRITERIA FOR PRIORITY POLLUTANTS

UTAH DIVISION OF WATER QUALITY

1. INTRODUCTION

This component of the Great Salt Lake Strategy (hereafter "the Strategy") documents a process for establishing numeric water quality criteria for the protection of Great Salt Lake's aquatic life. These criteria will be developed for pollutants with a focus on United States Environmental Protection Agency (EPA) priority pollutants because of their potential toxicity to aquatic life. Numeric criteria are a cornerstone of the Utah Division of Water Quality's (UDWQ's) programs to protect water quality. This component of the Strategy provides the rationale and explanation related to establishing numeric criteria for Great Salt Lake including the following:

- Need for numeric criteria for Great Salt Lake
- Site-specific context for Great Salt Lake criteria, particularly with regard to linkages between Great Salt Lake's aquatic life designated uses and salinity
- Process for deriving numeric criteria including resource

Water Quality Standards versus Water Quality Criteria

The terms "standards" and "criteria" are often used interchangeably but technically are not synonymous. Criteria (both numeric and narrative) identify the water quality necessary to protect the designated uses. Water quality standards, on the other hand, are all the provisions that provide water quality protection. In addition to criteria, standards also include designated uses and antidegradation.

prioritization

- Process by which numeric criteria may be used in UDWQ programs, including monitoring, assessment, discharge permits (Utah Pollution Discharge Elimination System [UPDES]), and antidegradation provisions that minimize, wherever practicable, water quality degradation
- Near-term actions for stakeholder participation and a preliminary schedule to derive numeric criteria

2. NEED FOR NUMERIC CRITERIA FOR GREAT SALT LAKE

Efficient and effective management of Great Salt Lake (hereafter "the Lake") resources requires an understanding of the water quality that must be maintained to ensure long-term protection of the Lake's designated uses. UDWQ has the regulatory mandate to protect water quality for current and future generations. To meet this regulatory responsibility, UDWQ implements several interrelated programs: sets water quality standards, monitors and assesses attainment of water quality goals, and issues UDPES and stormwater permits for discharges affecting the Lake. Currently, there is only one numeric criterion for one bay and few toxicity studies directly applicable to the organisms residing in the Lake that can be used to interpret the potential impacts of existing or proposed pollutant inputs to the Lake. This lack of clearly defined water quality protections for the Lake complicates the regulation of pollutant discharges to the Lake in a manner that is both protective and fair. Overprotective water quality regulations are needlessly costly for industry and municipalities. Underprotective regulations are potentially illegal and would be detrimental to the Lake's ecosystem and designated uses including millions of birds (waterfowl, shorebirds, and other water-oriented wildlife including their necessary food chain) and recreation (frequent and infrequent primary and secondary contact recreation). Clearly, a strategy is needed to fill key knowledge gaps to generate appropriate water quality criteria for the Lake that are efficient and scientifically defensible.

> ***UDWQ's Objective for Developing Numeric Criteria for the Great Salt Lake***
>
> *Set clearly defined and defensible pollutant concentrations—numeric criteria—that are needed to ensure that Great Salt Lake continues to provide its important ecological and economic*

What regulatory mechanisms are used to protect water quality in Great Salt Lake?

Under both state law (Utah Administrative Code [UAC] R317) and federal Clean Water Act (CWA) authority, UDWQ is entrusted with the responsibility to restore and maintain the chemical, physical, and biological integrity of Utah's lakes, rivers, and wetlands. Water quality goals specified in Section 101(a) of CWA establishes three minimum requirements, wherever attainable, for state water quality standards programs: (1) water quality that supports propagation of fish, shellfish, and wildlife; (2) water quality that supports recreation in and on the water; and (3) no discharges of toxics in toxic amounts.

The first CWA requirement to meet these goals is the designation of uses, commonly termed designated uses. Water quality designated uses are descriptions of how a water body will be used by humans and other organisms, or in other words what the water quality is intended to support. The current designated uses assigned to Great Salt Lake (UAC R317-2-6.5) are primary and secondary contact recreation (e.g., water quality sufficient to swim at Antelope Island or wade while duck hunting at one of the Wildlife Management Areas) and wildlife protection (water quality sufficient for waterfowl, shorebirds, and other water-oriented wildlife including their necessary food chain).

The second CWA requirement is to establish and enforce water quality criteria (Section 303(C)(2)(B)). In this context, criteria are simply descriptions of specific water quality objectives that must be met to ensure protection of designated uses. Utah uses both narrative and numeric water quality criteria. Narrative criteria are descriptions of conditions that should be avoided (e.g., undesirable odors) or unacceptable activities (e.g., dumping trash or debris). Numeric criteria describe concentrations—and associated averaging periods—of pollutants or other water quality parameters that should not be exceeded to support specific designated uses.

Most surface waters in Utah have numerous numeric criteria established to protect multiple designated uses (e.g., drinking water supply, aquatic life, recreation, agriculture). Criteria for each parameter and designated use are established by UDWQ based on a review of recommendations from the United States Environmental Protection Agency (EPA). EPA recommendations for criteria protective of aquatic life are based on a resource intensive process that includes a systematic compilation and analysis of numerous toxicological studies that evaluate the effects of each pollutant on many aquatic organisms—including fish, insects, algae and plants—in several life stages. By leveraging these intensive national investigations, UDWQ has established numeric criteria for over 70 specific pollutants that together ensure long-term protections of aquatic life for Utah's lakes and streams. Yet, for several reasons discussed here, the Lake has only a single numeric criterion that describes the maximum selenium concentration in bird eggs necessary to protect the aquatic wildlife designated uses for Gilbert Bay. Like all waters, many pollutants are present within the Lake, yet with the exception of selenium, insufficient information exists to precisely determine how much is too much for this unique ecosystem.

The lack of numeric criteria does not mean that the Lake is without water quality protections. All discharges to the Lake are required to have a UPDES permit[1]. In addition, all tributaries to the Lake have assigned designated uses and associated numeric criteria. Discharges to these tributaries are permitted to maintain criteria in the receiving water and in downstream waters. The UPDES permits also require the permittees to conduct periodic whole-effluent toxicity (WET)[2] tests to ensure that the discharges aren't toxic. For direct discharges to the Lake or indirect discharges via the tributaries, the designated uses of the Lake are protected with WET testing and Utah's Narrative Standards that apply to all surface waters of the state. This Narrative Standard (UAC R317-2-7.2) states:

> *It shall be unlawful, and a violation of these regulations, for any person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste; or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by bioassay or other tests performed in accordance with standard procedures.*

Narrative standards are inherently subjective but are an important water quality tool because they prohibit undesirable conditions that are sometimes difficult to detect with routine water quality data. For instance, most would agree that it should be unlawful for an individual to dump tires into a lake or stream, but the deleterious effects of this action would be difficult to capture with routine water quality samples. However, the narrative standards are even more difficult to interpret when applied to a waterbody such as the Lake that is unique and constantly changing, and for which the potential effects of pollutants are poorly understood. These uncertainties have resulted in conflicting interpretations regarding whether the Lake's water quality complies with the narrative standard or would continue to comply following proposed municipal or industrial discharges. These potentially conflicting interpretations, combined with an additional potential for subjectivity due to scientific

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[1] More information on the UPDES permitting process is available at http://www.waterquality.utah.gov/permits/index.htm

[2]WET tests are conducted by exposing standard test organisms to the effluent and determining if toxic effects (e.g., growth, survival, reproduction) are observed. See http://water.epa.gov/scitech/methods/cwa/wet/upload/2004_12_28_pubs_wet_draft_guidance.pdf for more information.

uncertainty about the Lake's ecological processes, make it more difficult for the regulated community to understand, plan for, and ultimately comply with the Utah Water Quality Act and CWA regulations. Regulatory uncertainty can unnecessarily inhibit economic growth. For this reason, numeric criteria for the Lake are desired by the regulated community.

The primary challenges to establishing numeric criteria to protect the Lake's designated uses are the Lake's unique biology, chemistry, and hydrology, which preclude the use of nationally derived numeric criteria. Great Salt Lake is a terminal lake, meaning there is no outflow (Figure 1). Water can only leave the system through evaporation, leaving most minerals and metals to accumulate in the Lake. In some bays, the Lake is extremely salty, 3 to 7 times more than the ocean and very few organisms have adapted to survive in these hypersaline (i.e., salinity higher than the ocean) conditions. Salinity also affects how a pollutant behaves in the environment and its toxicity to aquatic organisms. Moreover, these conditions vary extensively within the major bays of the Lake, so the effects of pollutants on designated uses could also vary throughout the Lake. Defensible numeric criteria for the Lake must account for the Lake's site-specific characteristics.

Numeric Criteria

In this strategy, numeric criteria refer to criteria derived using a process similar to Guidelines for Deriving Numerical National Water Quality Criteria for Protection of Aquatic Organisms and Their Uses (EPA, 1985). This process evaluates species-specific sensitivity to individual pollutants. Although the alternative methods to numeric criteria development discussed (e.g., biological assessments) are likely to demonstrate numeric thresholds, the thresholds are derived from an evaluation of multiple stressors (e.g., pollutants, habitat, etc.) and multiple responses (e.g., pH, shift in community structure, etc.) and therefore can not be used as numeric criteria.

Numeric criteria may not be the best approach for every pollutant. A different approach is needed for some conventional[3] and non-conventional[4] parameters. For example, dissolved oxygen and pH have numeric criteria for most Utah waters. Although defined as pollutants in regulation, these parameters are responses to pollution. This distinction is highlighted in wetlands.

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[3]Pollutants typical of municipal sewage, and for which municipal secondary treatment plants are typically designed; defined by Federal Regulation (40 *Code of Federal Regulations* [CFR] 401.16) as biological oxygen demand, total suspended solids , fecal coliform bacteria, oil and grease, and pH.

[4]All pollutants not included in the list of conventional or toxic pollutants in 40 CFR Part 401. Includes pollutants such as chemical oxygen demand, total organic carbon, nitrogen, and phosphorus.

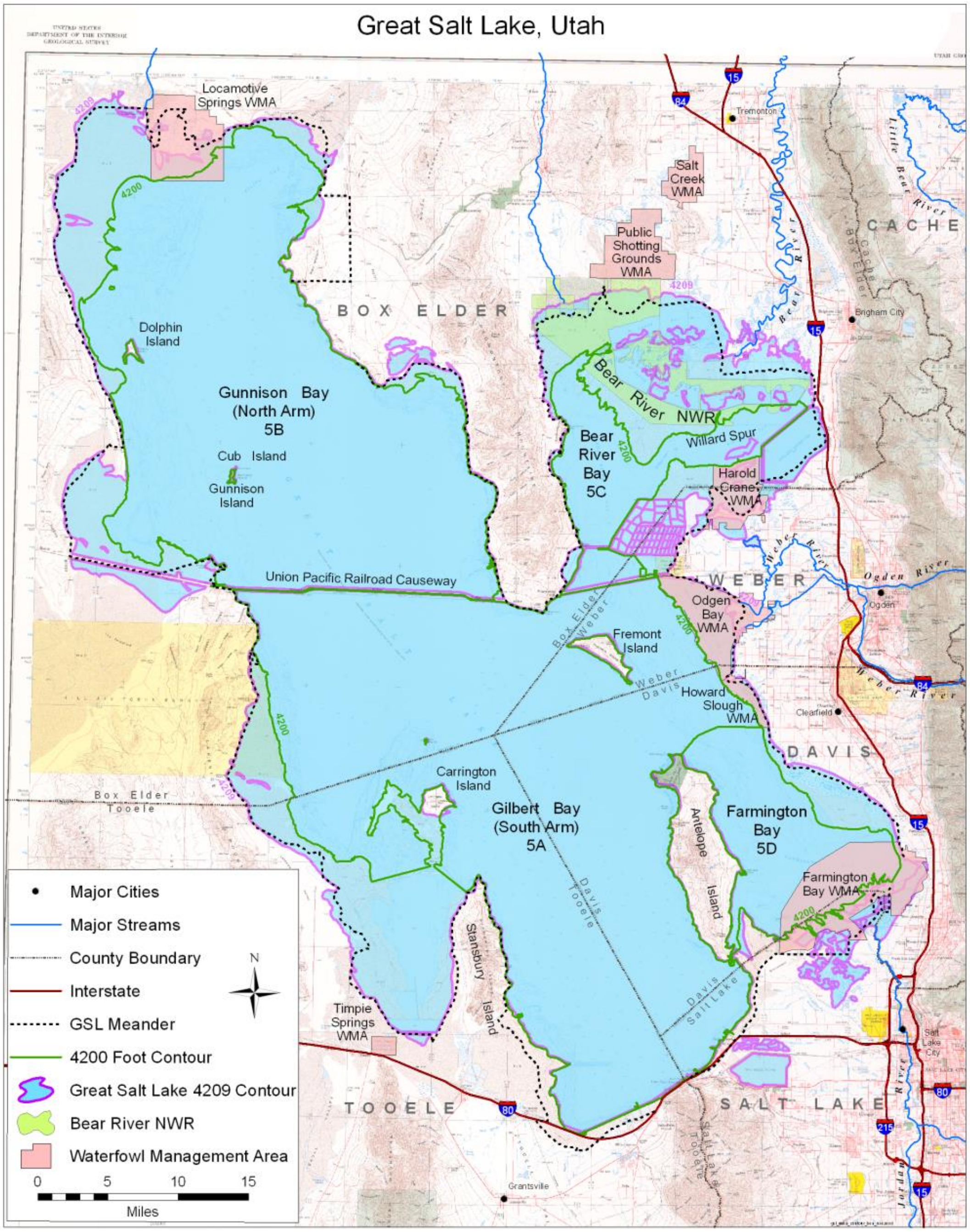

FIGURE 1. GREAT SALT LAKE, UTAH

Great Salt Lake is a saline terminal lake located in Northern Utah. The primary sources of water to the Lake are from precipitation and the Bear, Ogden, Weber, and Jordan Rivers. The Lake spans across five county boundaries (Box Elder, Weber, Davis, Tooele, and Salt Lake). The Great Salt Lake meander line represents the boundary of sovereign lands managed by the Utah Division of Forestry, Fire, and State Lands. The historic (1847–1986) average elevation of the Lake is 4,200 feet (United States Geological Survey, 2009). Utah Administrative Code designated uses for Great Salt Lake (Classes 5A through 5E) extend to an elevation of 4,208 feet. Since this contour is not available spatially, the 4,209-foot contour is shown.

Healthy, fully functioning wetlands often undergo large swings in dissolved oxygen concentrations and pH that would be considered detrimental in other waters. Therefore, numeric dissolved oxygen and pH criteria alone are poor predictors of wetland health. Accordingly, Utah's water quality standards were revised in 2009 so that numeric criteria for dissolved oxygen and pH do not apply to the impounded wetlands around the Lake. Other examples of effective alternatives to numeric criteria are biological assessment programs that interpret the narrative standard with objective and quantitative measures of biological health such as the multi-metric index developed for impounded wetlands. UDWQ believes that a holistic approach to the Lake will result in more reliable and precise water quality protections. Such an approach is embraced by a recent effort to define health for the Lake (GSLAC 2012).

What was learned from developing the selenium criterion for Gilbert Bay?

In 2008 UDWQ concluded several years of investigations aimed at generating a numeric selenium criterion for the Lake. This research was time consuming and expensive, costing over $2.5 million. To repeat this process for all pollutants within the Lake would require decades, not to mention an incredible amount of resources that simply do not exist. Fortunately, among the many lessons learned from the selenium research was that, while existing research from other waterbodies rarely directly applies to the Lake, much of it can be modified and adapted to provide a starting point for developing numeric water quality criteria for the Lake. These experiences also highlight the critical importance of understanding whether research conducted elsewhere applies to the unique biological, chemical, and physical conditions found within the Lake.

What would be accomplished by developing numeric criteria?

Designated uses, numeric and narrative criteria, and antidegradation comprise standards that are the foundation of all UDWQ programs to protect Utah's water quality. Of these, only numeric criteria are lacking for the Lake. First, developing numeric criteria for the Lake would not only help enhance water quality protection for the ecosystem but would also provide economic benefits for industries that depend on a healthy Lake. Second, numeric criteria would provide certainty to the regulated community. From design to implementation, dischargers would know, with certainty, what level of pollutant loadings will be permitted, which is critical for long-term business planning. Finally, if the Lake is ever determined to be impaired, numeric criteria will be needed to set goals for any restorations efforts.

UDWQ is committed to protecting the ecological and economic value of the Lake's unique ecosystem. Our goal, shared by most of the Lake's recreational, industrial, and commercial users, is that water quality remains sufficiently good to protect and maintain the chemical, physical, and biological integrity of the Lake and its surrounding wetlands.

To meet water quality goals for the Lake, UDWQ intends to develop numeric water quality criteria where appropriate and associated assessment methods for Lake. The development of numeric water quality criteria is intended to improve the precision and clarity of our management decisions, reduce uncertainty for those we regulate, and improve our confidence that the Lake's water quality remains sufficient to support its important designated uses. The initial focus of UDWQ and Component 1 of the Strategy is on aquatic life numeric criteria for EPA toxic priority pollutants (40 Code of Federal Regulations [CFR] Part 423 Appendix A).

3. PROVIDING SITE-SPECIFIC CONTEXT TO GREAT SALT LAKE CRITERIA

Great Salt Lake Aquatic Life Designated Uses

As mentioned previously, the designated uses assigned to the Lake include aquatic wildlife uses, specifically the protection of waterfowl, shorebirds, and other water-oriented wildlife including their necessary food chain. The development of appropriate numeric water quality criteria for the Lake requires a more nuanced understanding of these water quality uses, which includes identifying the specific organisms to be protected.

Waterfowl, shorebirds, and other water-oriented wildlife including the aquatic organisms in their necessary food chain are the protected aquatic life designated uses for the Lake. The national numeric criteria developed for aquatic life uses are based on biological, ecological, and toxicological data and are designed to protect aquatic organisms from adverse effects resulting from exposure to water pollutants. These criteria specify the magnitude (how much), duration (how long), and frequency (how often) of exposure to over 100 potentially toxic compounds. The EPA has established both freshwater and salt water numeric criteria for aquatic life uses because freshwater and ocean water have different chemical compositions and the species for which the criteria were derived rarely can tolerate both fresh and salt water simultaneously.

Over the past 40 years, UDWQ has used the EPA's freshwater numeric criteria as the basis for establishing numeric criteria for all of the state's freshwater lakes and rivers and for many of Utah's wetlands. These freshwater criteria may be appropriate to apply to the Lake estuaries, but consideration must be given to conditions created by the large, naturally occurring fluctuations in Lake level that may cause radical changes in salinity. The EPA's salt water aquatic life criteria guidelines are based on studies of marine and estuarine organisms and may or may not adequately reflect the tolerance limits of organisms that inhabit the Lake. Relevance of both freshwater and saltwater criteria to the Lake's organisms will be evaluated as part of this strategy. Consistent with federal guidance and regulations, numeric criteria for the Lake will be developed for priority pollutants to ensure protection of sensitive life stages of several important taxonomic groups under varying levels of salinity.

For the Lake, a critical first step for defining the aquatic life designated use is identifying the specific organisms currently present and those that would be considered representative of "existing uses" because they occurred on or after November 28, 1975 (UAC R317-2-1). This list, which is expected to vary for the different salinity regimes, will define the **specific** aquatic and aquatic-dependent species for the Lake to be protected. EPA considers species to be resident if they meet any of the following criteria:

a) are present at the site;

b) are present at the site only seasonally due to migration;

c) are present intermittently because they periodically return or extend their ranges into the site;

d) were present at the site in the past, are not currently present at the site due to degraded conditions, and are expected to be present at the site when conditions improve; or

e) are present in nearby bodies of water, are not currently present at the site due to degraded conditions, and are expected to be present at the site when conditions improve (EPA 2013).

In addition, this list of species will help evaluate the extent to which national EPA guidelines are appropriate for the Lake or whether new Lake specific research will be required. A preliminary working list of species has been compiled by UDWQ (2014).

Use Attainability Analyses

As previously discussed, the CWA requires water quality goals that protect for the propagation of fish, shellfish, and wildlife and water quality that supports recreation in and on the water (i.e., the fishable and swimmable goal). The CWA also recognizes that these goals are not universally achievable or appropriate. Utah has the authority to remove a designated use, if it is not an existing use, or establish subcategories of a use that have less stringent water quality requirements if a Use Attainability Analysis (UAA) demonstrates that the designated use is infeasible to achieve (EPA, 2013). The infeasibility of meeting the use must be attributable to at least one of the following factors:

> ***Use Attainability Analysis (UAA)***
>
> *A Use Attainability Analysis is a structured scientific assessment of the factors affecting the attainment of uses specified in Section 101(a)(2) of the CWA (the so-called fishable/swimmable uses). The factors to be considered in such an analysis include the physical, chemical, biological, and economic use removal criteria described in the EPA's water quality standards regulations (40 CFR 131.10(g)(1)-(6))*

1. Naturally occurring pollutant concentrations prevent the attainment of the use.
2. Natural, ephemeral, intermittent, or low-flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating state water conservation requirements to enable uses to be met.
3. Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place.
4. 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.
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 [chemical] water quality, preclude attainment of aquatic life protection uses.
6. Controls more stringent than those required by Sections 301(b)(I)(A) and (B) and 306 of the CWA would result in substantial and widespread economic and social impact.

The hydrology and habitat of the Lake are extensively modified by dikes, impoundments, and diversions. These hydrologic modifications have altered the aquatic habitat, sometimes extensively. Great Salt Lake's impounded wetlands or other hydraulically modified wetlands may be candidates for UAAs. These wetlands provide valuable habitat and contribute to the support of the Lake's beneficial uses, but similar to reservoirs, they are not natural systems and may not be readily comparable to natural systems. The hydrologic modifications will be considered when determining achievable beneficial uses and associated criteria.

In addition to providing the rationale for not being able to achieve the default uses required by the CWA, the UAA process is intended to identify the best attainable condition of a water body and may include interim goals (EPA, 2013). Currently, Utah's water quality standards do not have tiered aquatic life uses or wetlands-specific designated uses. In the absence of applicable tiered aquatic life uses or alternative designated uses, any changes to the current designated uses would be site-specific.). UAAs may be important tools for establishing statewide water quality goals and critical for defining the appropriate beneficial uses to be protected for some of the Lake's habitats.

Salinity

The waters of the Lake exhibit a continuum of salt concentrations from freshwater up to salt saturation. The health of the Lake ecosystem depends on these variations in salinity that fluctuates greatly from place to place and over time (GSLAC 2012). Specific salt concentrations, at a specific place and time, control what specific organisms survive and reproduce and, therefore, which organisms should be protected. The response of Lake biota to changing salinity can be abrupt, such as for mayflies that generally are not tolerant of increases in salinity, or gradational, such as for many algae species that tolerate a wide range of salinities (EPA, 2010; Belovsky et al., 2011). Similarly, different organisms are expected to vary in their sensitivity to pollutants, which will require the Lake to be partitioned into classes based on specifically defined ranges in salinity.

While salinity is an important determinant of the species present, other factors including sediment and physical habitat also affect the specific organisms supported. For instance, fresh water may cross saline sediment in the transitional waters between 4,208 feet and the open waters (Use Class 5E), resulting in an ecosystem more representative of a saline ecosystem than a freshwater ecosystem. Substrate and plant community can also influence which species are supported. These additional influences must be considered when defining ecosystem communities based on salinities.

Several causeways have been constructed on the Lake that affect circulation within the Lake and the salinity found within the major bays of the Lake. Bridge openings and culverts in the causeways allow for limited exchange flow between the bays. Differences in density and the water surface elevation between the bays results in bidirectional flow of a deep dense brine layer overlaid by a less dense clearer brine layer. Specifically, the denser brine layer flows in one direction while the less dense layer flows in the opposite direction. Brine flowing to a bay of less salinity tends to resist initial mixing with the fresher water and remains in a fairly coherent underflow which can extend some distance into a fresher bay. This forms a stratified brine condition (a deep brine layer overlaid by a shallow brine layer) within the central, deeper portions of Gilbert, Bear River, and Farmington Bays (Gwynn, 1998). The deep brine layer in Gilbert Bay is characterized by extremely high salinity and anoxic conditions, and thus few organisms can survive. The dense brine layer also affects the fate and transport of pollutants when this layer creates reducing conditions that alter the cycling of phosphorous, nitrogen, and metals. Mixing of the deep brine and shallower, less salty layers occurs during large wind events or by diffusion.

For criteria development purposes, three ranges or classes of salinity will initially be evaluated: fresh water, marine, and hypersaline. Salinity has relatively little influence on the Lake's birds but does affect the aquatic organisms that are their primary food source. To warrant protection at a given salinity, the aquatic organisms observed under these conditions should reproduce and thrive and not just survive. For instance, brine shrimp tolerate a wide range of salinity, but they successfully reproduce and thrive in a narrower range, and this narrower range would determine the appropriate salinity class.

Currently, no comprehensive list of organisms inhabiting the Lake has been compiled, and filling this data gap is a critical first step in criteria development (UDWQ, 2014 is a preliminary species list). In addition, the lifecycle of each organism found within the Lake will be summarized to help ascertain conditions where each species may be particularly sensitive to Lake pollutants. For each species it will also be important to establish the specific salinity tolerances and saline conditions to which they are best adapted so that this information can be related back to specific conditions found within the Lake. Definitive salinity levels to support three classes of salinity have yet to be determined. Determining appropriate demarcation points for the proposed salinity classes is complex and will require consultation with wildlife officials, scientists, and other knowledgeable stakeholders. Conceptually, the three classes and associated preliminary salinity ranges are as follows:

Freshwater—Freshwater refers to salinities up to 0.05 percent based on the low salt concentrations where freshwater organisms thrive. Aquatic organisms in the Lake are expected to include freshwater fish, invertebrates, and algae similar to other freshwaters in the state.

Marine—Marine refers to salinities similar to the oceans (approximately 3.5 percent). Conceptually, marine waters (including estuaries) may range from 0.05 to 4.0 percent. However, the aquatic organisms in the Lake are very different from oceans and estuaries. The most obvious differences are the limited number of species and an absence of fish (to be verified) in the Lake's waters with marine salinity.

Hypersaline—In general, hypersaline refers to salinities higher than the oceans (4.0 percent). For the purposes of developing Lake numeric criteria, conceptually, hypersaline refers to the salinities that will support the growth, survival, and reproduction of brine shrimp, brine flies, and algae. The starting point for defining this salinity class are salinities between 4.0 to 12.0 percent based on optimum salinities for brine shrimp (Belovsky and Larson; 2002). The optimum salinity for brine flies, and algae that feeds brine flies and brine shrimp, has yet to be determined but this class will include these organisms.

The preliminary upper bound salinity of 12.0 percent for the hypersaline salinity class is lower than the salinities currently observed in Gunnison Bay (27 percent) and observed in Gilbert Bay since 1995 (19 percent) (USGS, 2014). Any numeric criteria developed for the hypersaline class would not apply to these higher salinity waters. The development of numeric criteria for resident species representative of salinities exceeding the hypersaline salinity class are deferred pending additional characterization of the ecosystem. Currently, halophilic bacteria have been identified as the most abundant organisms for these salinities (Baxter, 2014).

Major Salinity Characteristics of Great Salt Lake

Each class of salinity previously described (freshwater, marine, and hypersaline) exists in different areas of the Lake and can vary with time at a given location dependent on Lake levels, freshwater inputs, and the causeways that divide the Lake (Figure 1).

Gunnison Bay (also called the North Arm) is extremely saline when compared with other areas of the Lake. This is due to the limited freshwater inputs to the bay coupled with limited salt exchange with the rest of the Lake that resulted from the 1959 construction of the Union Pacific Railroad (UPPR) Causeway that separates this bay from Gilbert Bay (the South Arm). With limited freshwater inflows to Gunnison Bay, the average salinity is 27 percent, near saturation. At this level, relatively few species can survive, and Gunnison Bay supports mainly halophilic bacteria that give the bay its red hue (Baxter, 2014). Gunnison Bay is the lowest priority of all of the bays for developing numeric criteria because of the limited ecosystem supported and a single permitted discharge (the Behrens Trench concentrated Gunnison Bay water). The upper salinity of the hypersaline class is proposed to be based on brine shrimp and brine fly reproduction, which is exceeded by the salinity in Gunnison Bay. Gunnison Bay will continue to be protected by the narrative standards.

Gilbert Bay (South Arm) is considered hypersaline with salinity levels ranging from 7 to 15 percent from 1995 to 2014 (USGS, 2014). The primary productivity is higher in this bay compared with Gunnison Bay due to lower salinities and Gilbert Bay supports an assemblage of algae and bacteria that are the food source for brine flies and brine shrimp.

On <u>average</u>, the salinity of both Bear River and Farmington Bay is similar to the ocean, but there is also significant variation from place to place within these bays due to significant freshwater inputs.

The majority of freshwater inflow to the Lake is from the Bear River to Bear River Bay. Bear River Bay has limited exchange flow with the rest of the Lake due to the UPRR Causeway and is the freshest of the bays. Salinity within Bear River Bay varies from 1 to 6 percent depending on location within the bay and underlying lake level. Similarly, Farmington Bay has limited exchange flow with the rest of the Lake due to the Antelope Island Causeway. Farmington Bay also has several significant freshwater inputs from the Jordan River, numerous smaller creeks, and treated wastewater. Salinity within Farmington Bay varies from 2 to 7 percent. The lower salt concentrations found within these bays support more invertebrate diversity than Gunnison Bay and Gilbert Bay. During the spring runoff period, fish are carried out into Bear River and Farmington Bays from the freshwater wetlands and rivers. While fish could potentially survive and even thrive near these freshwater inputs, very little is understood about fish inhabiting the Lake but some portions of the Lake are known to have fish (UDWR, 2012).

4. NUMERIC CRITERIA FOR PRIORITY POLLUTANTS

UDWQ will consider developing numeric criteria for all EPA priority pollutants (40 CFR, 423) with the potential to adversely affect the Lake's water quality and designated uses. This potential will be determined in accordance with the requirements of 40 CFR 131.11(2). The approach outlined below focuses on priority pollutants and provides an adaptive process that allows UDWQ to continually improve numeric criteria as our knowledge of the effects of pollutants on the Lake's designated uses continues to improve. This process allows UDWQ to capitalize, to the greatest extent possible, on previously conducted scientific investigations by outlining a process for ensuring that interpretation of existing data is appropriate for the Lake's unique conditions. The process also provides UDWQ with tools to improve the scientific underpinnings of regulatory decisions over the short and long term through a clearly defined process for prioritizing ongoing research needs.

Given that there are over 100 priority pollutants, many of which are likely to exist within the Lake, criteria development is not tractable without a defined process for prioritizing the pollutants. UDWQ proposes an iterative process for prioritizing pollutants for development of numeric criteria (Figure 2) based on information gathered as follows:

1. Compile a list of species inhabiting the Lake and their life cycles.
2. Determine what priority pollutants are known to be present in the Lake or in discharges to the Lake.

3. Compile available EPA freshwater and marine criteria and toxicity data relevant to the Lake species for all CWA Section 304(a) pollutants.

4. Prioritize pollutants of concern by comparing existing Lake concentrations with criteria and the Lake species toxicity data.

After compiling the list of the Lake species, available data will be reviewed for priority pollutant concentrations within the Lake or present in point source discharges or from nonpoint sources to the Lake. If not found in the Lake or sources, the pollutants will be designated as lowest priority. EPA numeric criteria and toxicity data for the Lake relevant species will be compiled for the remaining pollutants.

For each pollutant, Lake concentrations will be divided by freshwater or salt water numeric criteria (and/or other relevant toxicity data) to calculate a hazard quotient. The pollutants will then be ranked from highest to lowest hazard quotient. The rankings may be further modified by consideration of available toxicity data relevant to Lake species. Other factors, such as the relative loading of the pollutant to the Lake will also be considered. This process began in 2013 with the prioritization of pollutants for bioassay method development for Gilbert Bay (UDWQ, 2013).

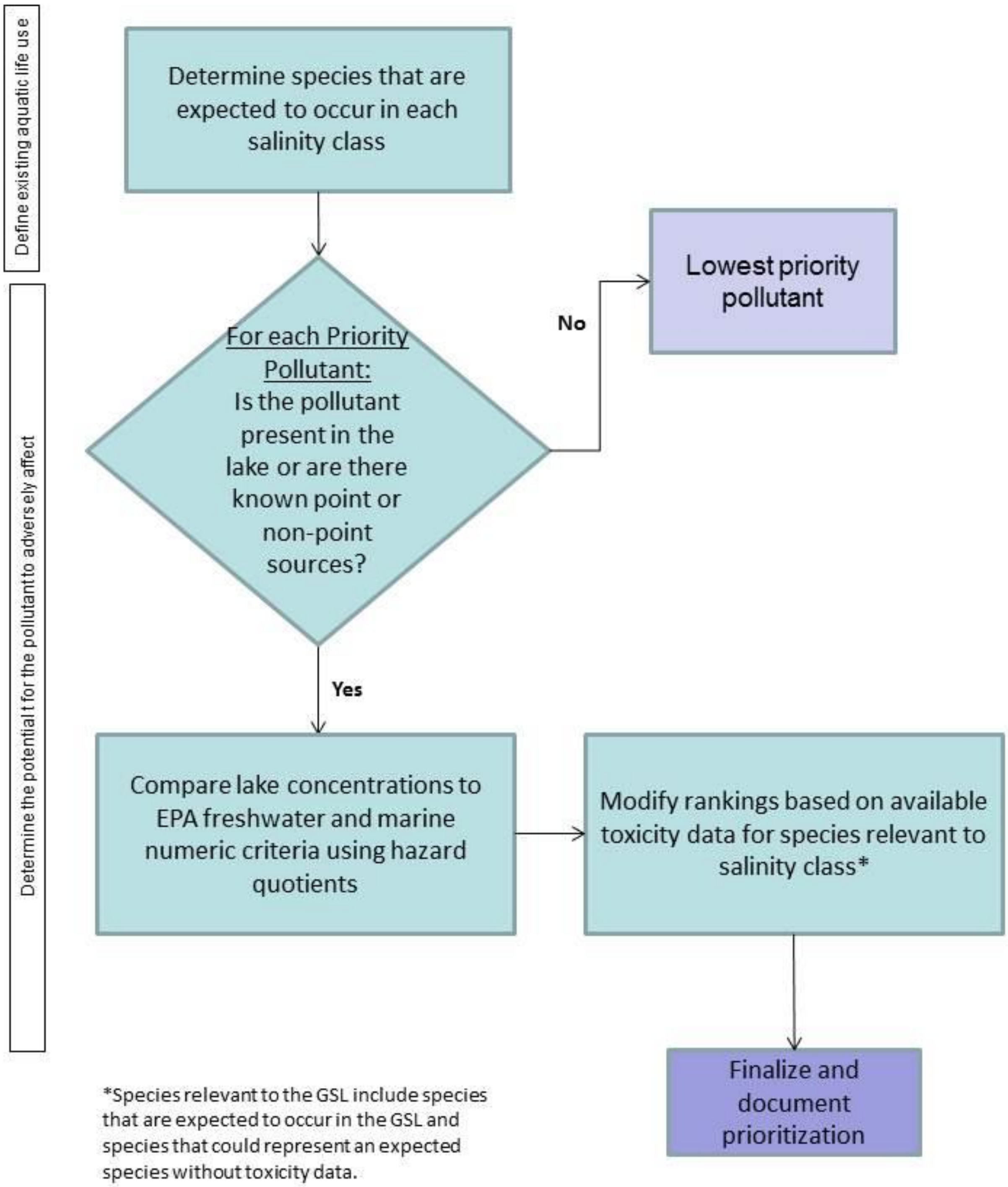

FIGURE 2. PROCESS FOR PRIORITIZING POLLUTANTS FOR DERIVATION OF AQUATIC LIFE NUMERIC CRITERIA

DEVELOPMENT OF NUMERIC CRITERIA

Under CWA regulations, when waters are protected for more than one designated use, the water quality criteria necessary to protect the most sensitive use are applied. UDWQ is initially focusing on numeric criteria for the protection of the aquatic life uses because aquatic life numeric criteria for most pollutants are more stringent than numeric criteria to protect human health-based uses such as contact recreation or drinking water (see UAC R317-2-14).

When national criteria are developed to protect aquatic life, all toxicological studies are evaluated, but the criteria are ultimately intended to protect 95 percent of tested genera unless a commercially or recreationally important species is more sensitive. At a minimum, toxicity data from at least 8 different taxonomic families are required to develop numeric criteria (EPA, 1985). The more saline portions of the Lake are unlikely to support this level of diversity and therefore modifications to the EPA approach will be necessary. Applying the EPA approach to the development of criteria for the Lake requires a clear understanding of how all Lake associated biota use Lake resources. This knowledge will help define the weight given to previously conducted research and will help prioritize specific research needed to generate scientifically defensible criteria.

Figure 3 shows the process for deriving numeric criteria for each pollutant and salinity class. The critical initial step in prioritization and criteria development is identifying the composition (i.e., species) and abundance of the expected biological organisms within each of the three salinity classes: hypersaline, marine, and freshwater. While transition zones certainly exist, these salinity classes roughly determine the composition and abundance of species at different locations around the Lake. In general, the biological composition of the Lake defines the Lake's aquatic life use because these organisms are explicitly protected: waterfowl, shorebirds, and other water-oriented wildlife including their necessary food chain. Subsequent research will focus on a more detailed understanding of how each species uses the Lake and its surrounding wetlands, which provides insight into exposure pathways and highlights areas where sensitivity to a pollutant is likely to be greatest.

Next, UDWQ will compile a comprehensive review of previously conducted toxicity studies for each pollutant and the Lake relevant species to supplement the data compiled for prioritizing the pollutants. As discussed in more detail below, the toxicity data will be reviewed to determine if upper trophic levels (i.e., birds) are more sensitive to the pollutant than lower trophic levels (e.g., brine shrimp). If birds are more sensitive, then the criterion will be based on protecting birds. Otherwise, the criterion will be based on other aquatic life in the bird's necessary food chain. If the outcome of this determination is uncertain, then both bird- and aquatic life-based criteria will be developed. The most protective of these criteria will be recommended for adoption as a numeric criterion for each salinity class.

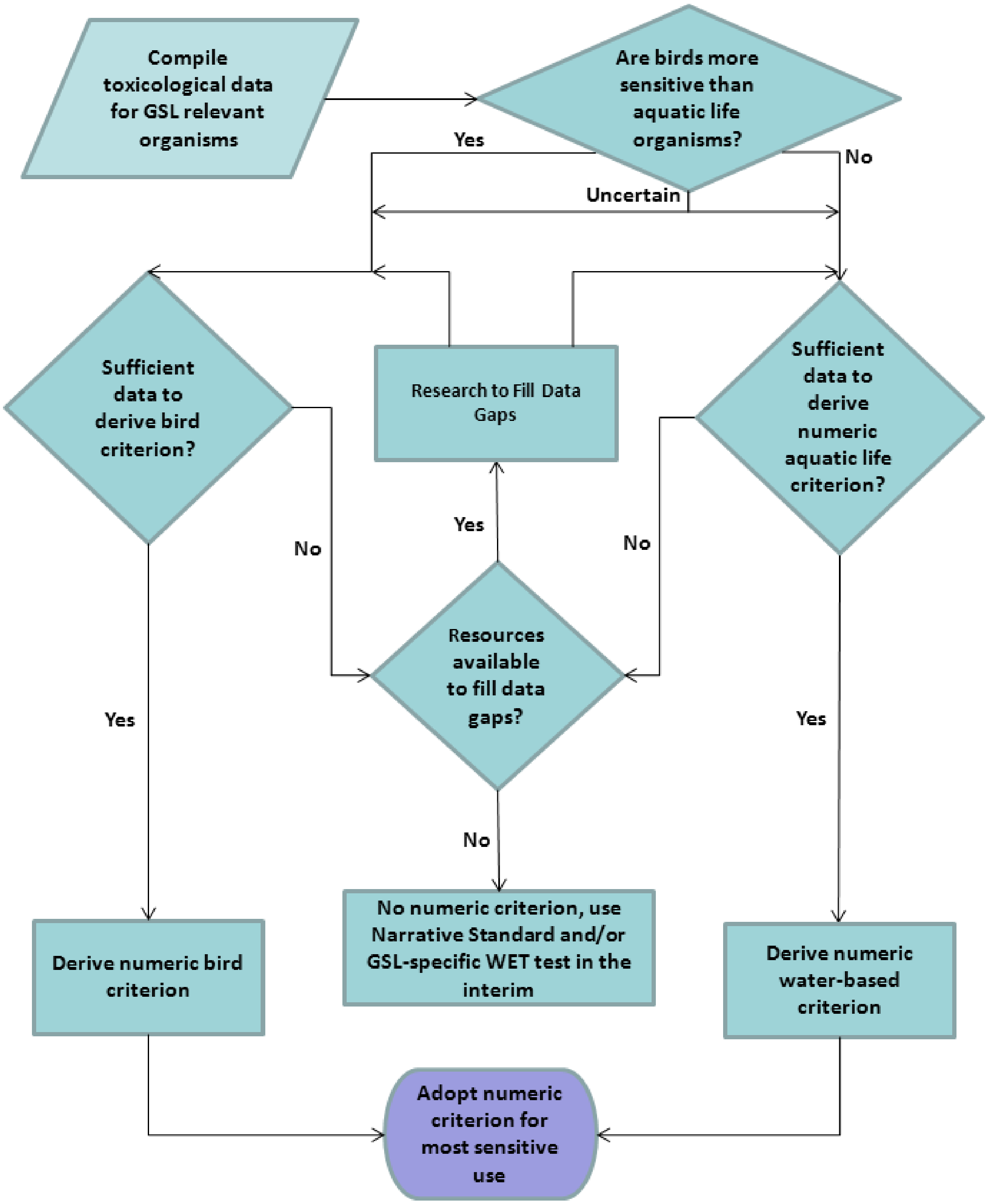

FIGURE 3. PROCESS FOR DERIVING AQUATIC LIFE NUMERIC CRITERIA FOR GREAT SALT LAKE

UDWQ may propose that newly adopted numeric criteria for the Lake have delayed implementation. The purpose of delaying implementation is to provide time for permittees to comply with the new criteria or to collect additional data that could be used to modify the criteria. The delayed implementation will be codified in R317-2, which requires adoption by the Water Quality Board and additional public comment solicitations.

Bird-based Criteria

If birds are more sensitive than aquatic life organisms or the data is inadequate to make this determination, the available toxicity data for birds and the pollutant will be compiled. The increased sensitivity can be from higher exposures because the pollutant biomagnifies or because the higher trophic levels are toxicologically more sensitive. When the higher trophic levels are more sensitive to a pollutant, the numeric criteria can be based on a tissue concentration (e.g., bird eggs, invertebrate tissue) or a water column concentration when there is sufficient information to translate the tissue concentration. The available toxicological studies will be reviewed and a tissue or concentration or dose that is equivalent to a no-observed-adverse effects level will be derived, if the data are adequate. If adequate data are not available, the critical data gaps will be identified and filled through primary research depending on pollutant prioritization and available resources. If resources are currently unavailable, water quality will remain protected by the existing narrative standard. WET testing used by the UPDES program to monitor the toxicity of effluents using standardized protocols is generally not applicable for evaluating potential effects to higher trophic levels because the standard WET testing organisms are not representative of higher trophic levels.

Prior to the adoption of a tissue-based criterion, UDWQ will be based on a similar approach as recommended by EPA's (2010) *Guidance for Implementing the 2001 Methylmercury Water Quality Criterion* to develop a detailed plan that describes how the criterion will be applied to decision making in key water quality programs. Specifically, these implementation plans will determine how compliance with the tissue-based criterion will be monitored, assessed, and interpreted in the context of water quality programs such as setting UDPES permit effluent limits (Section V). Such implementation plans are critical because it is difficult to apply tissue-based criteria to UDWQ's UPDES permits and other water quality programs that are intrinsically based on direct measures of water column concentrations. The implementation plan may also identify alternative monitoring or compliance points for the numeric criterion. For instance, for the selenium tissue-based egg criterion for Gilbert Bay, potential alternative measurement points are selenium in water or waterfowl food (e.g., brine flies). Alternative measurement endpoints may that the relationships between selenium in water, food, and egg be adequately characterized and predictable.

Water-based Criteria

When members of higher trophic levels are not the most sensitive to a pollutant, the methods outlined by the EPA (1985) will be modified for application to the Lake (Figure 3). A review of the toxicological studies used to derive EPA's existing freshwater numeric criteria and any new data available in the literature will determine if they can be directly adopted for the freshwater salinity class. For instance, many of these existing criteria were initially derived to protect species that are more sensitive than those that inhabit freshwater environments within the Lake. Similarly, criteria intended to protect early life stages of fish would not be appropriate if a given fish species resides in but does not reproduce in the Lake. Wherever possible, criteria for the Lake will be calculated using the existing freshwater toxicity base modified using the EPA (2013) deletion process.

For the marine salinity class, toxicity data used to develop the EPA saltwater criteria will be reviewed for organisms relevant to the Lake and supplemented by any more recent studies. UDWQ will identify from the literature review those studies that are directly relevant to the Lake's biota. Assuming that the marine organisms are taxonomically similar to the Lake's organisms, the EPA (2013) deletion process will be used. Data gaps will be identified and numeric criteria calculated when the database is sufficiently robust.

For the hypersaline waters, a literature search will be conducted for the species that are expected to occur (e.g., brine shrimp, brine flies, algae) and if toxicity data are adequate, numeric criteria will be calculated. UDWQ anticipates that limited toxicity data for the hypersaline class will be available. For some pollutants, no data may be available. For others, test results for an incomplete number of species representative of hypersaline waters will be available. When the database is not representative of all species, the primary concern is that the untested species could be more sensitive to the pollutant than the tested species, resulting in an inadequately protective criterion. In other words, a criterion based on an incomplete toxicity database should never be more protective than a criterion based on a complete toxicity database but may be less protective. The specific methodology for deriving criteria will be developed after the existing toxicity database is complete for the highest priority pollutants.

Filling data gaps in the toxicity database for the Lake's organisms is anticipated to require substantial resources to conduct the bioassays (laboratory toxicity tests). An appropriate suite of tests will need to be developed for the Lake's highest priority pollutants. Resources required to conduct these tests are dependent on how many tests need to be run, which is currently unknown. If the resources to fill these data gaps are not available, in the interim, the pollutant will continue to be evaluated using the existing narrative standard as outlined in the interim UDPES permitting approach currently under development.

5. APPLYING NUMERIC CRITERIA TO WATER QUALITY PROGRAMS

Water quality criteria (both numeric and narrative) are the foundation for UDWQ's water quality protection programs. The criteria are used to determine effluent permit limits for point source dischargers, to assess the status of waters (fully supporting or impaired) for protection of designated uses, and to implement antidegradation to prevent unnecessary increases in pollution. Following is a brief description of our water quality programs and how criteria are applied to the Lake.

Monitoring

Component 2 of the Strategy provides details for UDWQ's monitoring programs for the Lake to support the development of numeric criteria. The following is a brief overview of the Monitoring Program for the Lake that is described in much greater detail in Component 2 of the Strategy. UDWQ has been monitoring Lake water quality since the early 1990s. Field measurements such as pH, specific conductance, water temperature, and dissolved oxygen levels have been collected, as well as water quality samples of nutrients and metals. However, for some metals and nutrients, the salinity of the water has been shown to interfere with chemical analysis, and, consequently, there are concerns about the validity of historical data. As sampling techniques and laboratory instrumentation have been refined, so has the program for monitoring Lake water quality.

The baseline sampling plan in Component 2 incorporates updated sampling protocols and includes quality assurance and quality protection measures to ensure accurate data. The baseline sampling plan is designed to address overall condition of water quality by identifying the potential contaminants of concern, the concentration of those contaminants in the water, and the variability of concentrations spatially, seasonally, and annually. The plan specifies pollutants that will be measured in several media (e.g., water, tissue).

Total selenium and total mercury will be measured from water brine shrimp and bird eggs, whereas other trace metals (i.e., arsenic, lead, zinc and thallium) will be measured in the water but not in eggs until evidence exists that a specific metal potentially threatens birds. Nutrients and other chemical constituents will be measured in concert with other physical field measures in the water column, including: dissolved oxygen, pH, temperature, conductivity, Secchi depth (water clarity), water depth, and depth to the deep brine layer. UDWQ will continue to develop the chemical and biological techniques that are precise, accurate, representative, complete, and comparable for saline waters. The numeric criteria developed through this strategy will be compared with both historical and present data for applicability to the Lake.

Assessment (305(b) and 303(d))

Both state and federal regulations require UDWQ to assess support of the Lake's designated uses every other year in the *305(b) Integrated Report*. These assessments involve compilation of all existing and readily available data to develop a report to congress that identifies waters that are impaired or not meeting their designated use criteria (sometimes referred to as the 303(d) list). Assessments are typically done by either comparing water quality data against numeric criteria or with other tools that quantify biological health (i.e., biological assessments or Trophic State Index). For the Lake, UDWQ's strategy is to create assessment frameworks based on biological, physical, and chemical parameters and use the frameworks to document if the beneficial uses are attained when compared with the narrative standard. These efforts are documented in the 2008, 2010, and 2014 Integrated Reports.

To date, the Lake has been placed in Integrated Report Assessment Category 3C (2008, 2010, and 2012/2014), which includes waters where data and information are insufficient to determine an assessment status. The available data to determine if the Lake is supporting its beneficial uses are inconclusive for the reasons documented in the *Integrated Reports*.

Numeric criteria, and the additional understanding of Lake processes that will result from their development, will provide a concise way to assess the Lake and ensure protection of beneficial uses by comparing the criteria to water quality data. However, adoption of numeric criteria by salinity class will require development of unique assessment and implementation methods. As previously discussed, the salinity at a given location can vary with time as the salinity-specific numeric criteria presumably will. Determining criteria to apply is critical to avoid erroneous conclusions regarding designated use support, which could result in inadequate protection of the Lake's water quality or substantial unnecessary costs to UPDES permittees.

Total Maximum Daily Load Program

Waterbodies that are determined to be impaired are required to have a total maximum daily load (TMDL) analysis conducted for the pollutant causing the impairment. The TMDL identifies and quantifies all sources of the pollutant. For a watershed like the Lake's, this process would take many years and require substantial staff and monitoring resources. The research needs presented in

Component 2 anticipate some of the monitoring needed to support TMDL development in the event that the Lake is found to be impaired during a future assessment cycle.

Once the pollutant loading is characterized, the TMDL calculates the reduction in load necessary to reduce the pollutant concentrations to meet numeric criteria and subsequently protect the uses. This reduction is allocated among all pollutant sources. These required reductions sometimes result in additional treatment requirements for UPDES permittees and/or may limit the growth potential of these discharges. Given the costs of additional treatment, UPDES permittees to the Lake demand that conclusions be based on technically rigorous methods. Clearly, erroneous conclusions regarding designated use support are highly undesirable because they may result in inadequate protection of the Lake's water quality or substantial unnecessary costs.

Utah Pollution Discharge Elimination System (UPDES) Permits

UDWQ issues UPDES permits to all entities that discharge pollutants to surface waters in Utah, including discharges of domestic and industrial wastewater, and more diffuse sources like stormwater. In the case of domestic and industrial dischargers, these permits establish allowable concentrations of pollutants and monitoring requirements for industry to ensure that designated uses are protected and the discharge is consistent with the antidegradation policy (UAC R317-2-3). In the case of stormwater discharges, permits establish best management practices to ensure designated uses are protected. As previously discussed, the development of allowable concentrations (i.e., permit limits) for UPDES discharges to the Lake has been complicated by the lack of numeric criteria.

Permit limits are based on the most stringent of (1) technology-based effluent limits (which includes, but is not limited to, secondary treatment standards for municipal wastewater treatment plants and/or categorical effluent limits prescribed for a given industry), (2) numeric criteria, and (3) application of the narrative standard. Many of the existing permit limits for discharges directly to the Lake are based on technology-based effluent limits, which some believe to be underprotective of the Lake's beneficial uses or fail to comply with the Narrative Standard. This has resulted in repeated appeals of new UPDES permits for discharges to the Lake or permit renewals that are required every 5 years for existing permits. These appeals result in costly uncertainty and delays for UDWQ and the regulated community. Permit limits based on numeric criteria will reduce these uncertainties and delays.

Applying numeric criteria to the Lake's UPDES permits also requires the adoption of implementation methods. Implementation methods are required to ensure that the appropriate salinity-based standard is applied when developing water-quality-based effluent limits. In situations where multiple salinity classes may apply, depending on the season or climatic variation, the most protective criteria will generally be applied and used to determine permit limits and to assess compliance. However, in some situations facilities could be allowed sufficient flexibility to adapt their discharge to varying conditions, which is evaluated on a case-by-case basis. As with assessments (see above), selection of the appropriate salinity class, or classes, is critical to avoid erroneous compliance determinations and permit limits that are too restrictive or not restrictive enough. UDWQ proposes to address the critical issue of establishing methods for assigning the salinity-based classes with significant stakeholder input.

To determine water-quality-based effluent limits for UPDES-permitted discharges directly to the Lake, UDWQ proposes the following:

1. Determine the salinity class(es) of the receiving water
2. Determine the most protective numeric criteria from the applicable salinity classes
3. Conduct a Waste Load Allocation assuming limiting conditions and the most protective numeric criterion

UDWQ initially proposes an approach for assigning salinity classes that is based on the Lake-specific averaging times and limiting conditions. As previously discussed, salinity determines the specific organisms that are present in different areas of the Lake and defines the beneficial uses. Numeric criteria are expected to vary for the different salinity class/beneficial use/organism combinations. Therefore, determination of the correct salinity class is extremely important. Assigning the correct salinity class for a given location in the Lake is complicated by the Lake's dynamic nature with salt concentrations varying over time. Averaging times are intended to make this selection process manageable and are defined as the minimum duration that must exist for a salinity class to apply.

Different averaging times will likely be needed for evaluating acute and chronic effects. The averaging times must be linked to protecting the specific organisms represented by the designated use. For instance, the averaging period for chronic criteria should consider the time necessary for the aquatic organism to thrive and reproduce. The goal is to protect the biological integrity of the waters while avoiding unnecessary regulatory burdens to protect organisms that are transient and not critical to the ecosystem's biological integrity. Averaging times could also be used to support seasonal limits (different effluent limits based on different receiving water conditions) to provide flexibility and potential cost savings to industry while still protecting the Lake.

Limiting conditions are used to develop permit limits for discharges to Utah's rivers and streams in the UPDES program by using the last 10 years of flow data for a stream to estimate worst case, or limiting conditions. The permit limits are reviewed every 5 years, but modifications due to changes in the limiting conditions are generally small and rarely require a significant permit limit change or treatment method. However, the impacts of changing salinity classes for the Lake are potentially much greater. UDWQ proposes to develop alternative methods to determine limiting conditions for the Lake with regard to determining applicable salinity classes. Historical records will be used to predict potential salinity changes for the design life of a treatment system based on past changes over the same time period. This will provide the regulated community with consistent expectations regarding the level of treatment required and to ensure that plausible future uses remain protected.

Ensuring that permit limits are appropriate will also require review of existing UDWQ mixing zone policies. Existing mixing zone policies do not take into consideration the unique characteristics of the Lake. For instance, a fresher-water discharge to the Lake on a calm day is expected to initially disperse as a thin layer on top of the saltier Lake water. This situation is not unique to the Lake. Most coastal discharges in the United States would be similar with the density differences between the effluent and receiving water. Site-specific factors and existing programs in other states will be reviewed and considered when developing Lake-specific mixing zone policies. Any changes to the existing mixing zone policy (UAC R317-2-5) are required to go through the rulemaking process. Lake-specific mixing zone policies will also address discharges to Class 5E transitional waters (between 4,208 feet and the open waters). Discharges to Class 5E waters are often effluent dependent (i.e., effluent is source of all the of flow). These artificially created habitats may not be well described by the ecosystems used to define the salinity classes and will be addressed using the UAA process or by developing new designated use classes.

UDWQ is in the process of developing an interim approach for UDPES permitting for the Lake that will be used until numeric criteria are developed. An interim approach is needed because of the time anticipated to develop and promulgate numeric criteria. A draft of the GSL UPDES Permitting Interim Approach document will be made available to the public for review and comment in 2014.

Antidegradation

Antidegradation (UAC R317-2-3) rules encompass several requirements that are intended to maintain the existing water quality and to prevent unnecessary increases in pollution to the Lake. First, these provisions prohibit permitting any new or expanded discharge to Lake or its inflows if these inputs would impair the Lake. Second, these provisions require a demonstration that any new or expanded discharge is necessary to accommodate social or economic growth and that the least-degrading alternative was selected, provided that it is feasible to implement. If these first two conditions are met, then a new or increased discharge is permissible.

However, for antidegradation to be effective, it is necessary to prioritize pollutants by identifying those pollutants in a proposed discharge that are most likely to threaten Lake biota or recreation uses. To date, efforts to apply these procedures for the Lake have been hampered by the lack of numeric criteria and understanding of the linkage between water chemistry parameters and the Lake's uses.

The antidegradation policy is intended to preserve assimilative capacity. Assimilative capacity is the difference between existing concentrations and concentrations that would impair the beneficial use. When available, numeric criteria clearly define the available assimilative capacity. Without numeric criteria, it is difficult to determine how much assimilative capacity will be used or how much remains for a given pollutant. Numeric criteria would provide greater confidence that degradation to the Lake is minimized.

6. NEAR TERM ACTIONS

Developing numeric water quality criteria will not be easy or quick. Significant scientific uncertainty exists about the fate and transport of pollutants and the effects that these pollutants have on the designated uses of the Lake. Filling key knowledge gaps will require several years and multidisciplinary expertise. To successfully navigate this long-term program, UDWQ has created a process for prioritizing, implementing, and applying research to meet regulatory needs. Stakeholder input, review, and participation will be sought throughout the process. Partnering with key state and federal agencies to secure and maximize resources will be paramount for success.

Stakeholder Participation and Rule Making Process

UDWQ has previously followed a steering committee and science panel paradigm for the Great Salt Lake Selenium Project and Willard Spur projects. A similar approach will be used when UDWQ encounters complex technical or regulatory problems. Less complex issues may be addressed at the workgroup level. UDWQ has already successfully used workgroups to address complex or controversial issues. Relevant to efforts to derive numeric criteria are the existing Water Quality Standards,[5] Mercury,[6] and Nutrient Workgroups.

At a minimum, all proposed changes to Utah's water quality standards are vetted by the Water Quality Standards Workgroup. After review by the Standards Workgroup, the Utah Water Quality

[5] http://www.waterquality.utah.gov/WQS/workgroup/index.htm#wqsmtgs
[6] http://www.deq.utah.gov/Issues/Mercury/workgroup.htm

Board[7] must formally adopt the changes. This process is governed by the Utah Administrative Procedures Act that provides minimum requirements for public participation during rulemaking and imposes deadlines to completing rulemaking. To successfully adopt changes to the rules within these deadlines, UDWQ understands that stakeholder concerns must be addressed before the commencement of formal rulemaking. UDWQ will add additional opportunities for stakeholder involvement (e.g., outreach meetings, soliciting expert opinion) as necessary depending on the specific situation. UDWQ is proactively committed to an open process to meet its regulatory obligations and to ensure that all stakeholders' concerns are identified and addressed. These outreach efforts will be further developed with stakeholder input and documented in future iterations of the Strategy.

Finally, once the Water Quality Board adopts any changes to Utah's Water Quality Standards, the EPA must review the revisions and take action (approve or disapprove) on the changes.

Schedule

Too many uncertainties currently exist to estimate the resources needed to complete these efforts. In addition to the intrinsic level of effort required, the schedule is directly dependent on the resources available. The following schedule presented in Table 1 assumes that current resource levels are maintained. An increase in available resources will allow the schedule to be accelerated. Note that the following schedule specifically pertains to the development of numeric criteria and does not include other concurrent UDWQ efforts for the Lake. Clearly, significant additional resources will be needed to meet the goals of this strategy within the next 20 years.

TABLE 1. SCHEDULE AND RESOURCE PLAN FOR DEVELOPMENT OF GREAT SALT LAKE NUMERIC CRITERIA

Study Description	Pollutants	Staff Hours	Projected Costs	Recommended Timeline
Develop interim guidance for UPDES permitting for the Great Salt Lake.	Priority Pollutants	60	$60,000	2015
Evaluate whether Utah's existing mixing zone policy continues to be appropriate for the Great Salt Lake.	NA	120	$120,000	2015

[7] http://www.waterquality.utah.gov/WQBoard/index.htm

Study Description	Pollutants	Staff Hours	Projected Costs	Recommended Timeline
Compile the list of Great Salt Lake-relevant organisms including life cycle information.	Priority Pollutants	120	$120,000	2015
Initiate method development for toxicity testing of brine shrimp and brine flies for the hypersaline salinity class and initiate testing of highest priority pollutants.	As, Cu, Pb, Hg	320	$320,000	2015
Establish salinity ranges and specific organisms for each salinity class.	NA	80	$80,000	2018
Prioritize pollutants for development of numeric criteria in each salinity class by determining what pollutants are currently present in the Great Salt Lake, or in discharges to the Lake, and comparing existing Lake concentrations with existing numeric criteria for fresh and open water and relevant toxicity data from the literature.	25	80	$80,000	2018
Criteria recalculation for freshwater salinity class for Bear River Bay	25	120 hrs./pollutant 3,000 hrs. total	$120,000/each	2023
Criteria recalculation for freshwater salinity class for Farmington Bay	25	40 hrs./pollutant 1,000 hrs. total	$40,000/each	2023
Criteria recalculation for marine salinity class for Farmington Bay	25	120 hrs./pollutant 3,000 hrs. total	$120,000/each	2023

Study Description	Pollutants	Staff Hours	Projected Costs	Recommended Timeline
Criteria derivation for hypersaline class for Farmington and Gilbert Bays. Assumes bioassays for brine shrimp, brine flies, and an alga.	25	120 hrs./pollutant 3,000 hrs. total	$120,000/each	2023
Evaluation of avian sensitivity versus sensitivity of aquatic species.	25	20 hrs./pollutant 500 hrs. total	$20,000/each	2023
Criteria derivation and implementation methods for avian species.	5	160 hrs./pollutant 800 hrs. total	$160,000/each	2023
Establish salinity ranges for UPDES discharge locations.	NA	50 hrs	$50,000	2023

Hrs. = hours

NA = Not Applicable

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