CENTER for BIOLOGICAL DIVERSITY Because life is good.

November 12, 2009

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Re: Request to Add Las Vegas Wash, Las Vegas Bay, and Lake Mead to Nevada's 303(d) List of Impaired Waters Due to Endocrine Disrupting Chemical Pollution

Dear Mr. Heggeness:

The Center for Biological Diversity ("Center") respectfully requests that the Nevada Division of Environmental Protection ("NDEP") include Las Vegas Wash, Las Vegas Bay, and Lake Mead (collectively "waterbodies") on Nevada's list of impaired waters pursuant to section 303(d) of the Clean Water Act, due to pollution from endocrine disrupting chemicals ("EDCs"). The Center also requests the NDEP establish total maximum daily loads ("TMDLs") for these pollutants so that the NDEP can ensure that the water quality and the beneficial uses of the waterbodies are protected. We are presenting you with documentation describing the current water quality conditions of these waterbodies and data pertaining to the physical, chemical, and biological conditions of the waterbodies, sediment, and fish tissue.[1]

I. Introduction

Lake Mead is the largest reservoir in the United States, part of a National Recreation Area, and is the sole supplier of Las Vegas' drinking water. It is also federally designated critical habitat for the endangered razorback sucker and provides refuge for many other imperiled species. Lake Mead is comprised of Boulder Basin, Virgin Basin and Gregg Basin, with Boulder Basin, the western-most basin, fed by a single tributary, Las Vegas Wash. Wastewater effluent comprises about 90 percent of the flow in Las Vegas Wash, with the other 10 percent coming from urban run-off, stormwater, and resurfacing groundwater. Three municipal agencies, the City of Las Vegas, the Clark County Water Reclamation District, and the City of Henderson, treat the

[1] PUBLIC NOTICE – Data request Water Quality Data and Information for the 2008 – 2010 Integrated Report and Surface Water Quality Assessment (303(d)/305(b)), Sept. 15, 2009, http://ndep.nv.gov/admin/public.htm#water_p.

wastewater generated by Las Vegas Valley and discharged more than 150 MGD of effluent directly into Las Vegas Wash, and consequently, Lake Mead. The total effluent discharge from these three agencies is expected to increase to more than 400 MGD by 2050. The outflow of Las Vegas Wash is a mere six miles from the uptake structures for Las Vegas' sole drinking water source.

The Endocrine Society describes EDCs as compounds that alter "the hormonal and homeostatic systems that enable [an] organism to communicate with and respond to its environment."[2] There are myriad studies linking exposure to EDCs to harm to wildlife. While there are no longterm studies on the effects of human exposure to EDCs in drinking water, there is much evidence suggesting such exposure may pose human health threats.

Even highly treated effluent wastewater contains a variety of potentially harmful compounds. It is well recognized that wastewater discharged from treatment plants contain EDCs and that EDCs are contaminants of emerging concern with widespread environmental effects.[3] However, treated wastewater effluent is not the only source of EDC pollution; Urban and agricultural runoff contribute to EDC loading in our Nation's waters.

II. Clean Water Act Background

The overarching goal of the Clean Water Act is to "restore and maintain the chemical, physical, and biological integrity" of our Nation's waters.[4] In furtherance of that goal, the Clean Water Act prohibits the discharge of pollutants into water except where allowed by permit. The Environmental Protection Agency ("EPA") provides oversight of the Clean Water Act and has delegated the NDEP with the authority for the Act's regulatory implementation and enforcement.

Pursuant to these tasks, NDEP must establish water quality standards that take into account each waterbodies' "use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other purposes."[5] Section 303(d) of the Clean Water Act requires NDEP develop a list of waterbodies needing additional work beyond existing controls to achieve or maintain water quality standards. The 303(d) list provides a comprehensive inventory of waterbodies impaired by both point and nonpoint sources of pollution. A waterbody failing to meet any numerical criteria, narrative criteria, waterbody uses, or antidegradation requirements shall be included as a water-quality limited segment on the 303(d) list.[6]

Once a waterbody is listed as impaired, TMDLs must be promulgated to protect water quality. TMDLs are established for pollutants "at a level necessary to implement the applicable water

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[2] Diamanti-Kandarakis, E. *et. al.* 2009, Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement, *Endocrine Reviews*, 30(4):293-342, available at http://www.endo-society.org/journals/ScientificStatements/upload/EDC_Scientific_Statement.pdf.
[3] *See generally* Benotti, M.J., R.A. Trenholm, B.J. Vanderford, J.C. Holady, B.D. Stanford, and S. Snyder, 2009, Pharmaceuticals and Endocrine Disrupting Compounds in U.S. Drinking Water, *Environ. Sci. Technol.* 43, 597-603.
[4] 33 U.S.C. §1251.
[5] 33 U.S.C. §1313(c)(2).
[6] 40 CFR §130.7(b)(3).

quality standards."[7] The TMDL "defines the specified maximum amount of a pollutant which can be discharged or 'loaded' into the water at issue from all combined sources."[8] NDEP is responsible for establishing the 303(d) list and TMDLs, and the EPA retains the authority to review and reject them.

III. Endocrine Disrupting Chemicals Science

There are a number of contaminants that have recently been discovered to have the potential for deleterious effects on aquatic ecosystems. These contaminants include pesticides, pharmaceuticals and personal care products ("PPCPs") such as soaps and shampoos, and other compounds that can evoke hormonal responses in fish and wildlife. These are generally referred to as endocrine disrupting chemicals or compounds, or simply EDCs.[9] The EPA defines an EDC as "an exogenous chemical substance or mixture that alters the structure or function(s) of the endocrine system and causes adverse effects at the level of the organism, its progeny, populations, or subpopulations of organisms…."[10] EDCs can interfere with synthesis, secretion, transport, binding, or elimination of natural hormones in the body. They can compromise normal reproduction, development, growth, and homeostasis. EDCs are known from runoff and wastewater treatment discharges.

A recent USGS Report found that "the most widespread potential impact of pesticides on water quality is adverse effects on aquatic life and fish-eating wildlife, particularly in streams draining watersheds with substantial agricultural and urban areas."[11] The Report noted that "concentrations of pesticides were frequently greater than water-quality benchmarks for aquatic life and fish-eating wildlife."[12] It found that of 186 stream sites sampled nationwide, 83 percent of 30 urban streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year; 42 percent of 65 mixed-land-use streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year.

In urban streams, most concentrations greater than a benchmark involved the insecticides diazinon (73 percent of sites), chlorpyrifos (37 percent), and malathion (30 percent). In agricultural streams, most concentrations greater than a benchmark involved chlorpyrifos

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[7] 33 USC §1313(d)(1)(C).
[8] *Dioxin/Organochlorine Center v. Clarke*, 57 F.3d 1517, 1520 (9th Cir. 1995).
[9] For information on PPCPs, *see generally* Sass, Jennifer, 2008, Testimony of Jennifer Sass, PhD and Senior Scientist for Natural Resources Defense Council, *Pharmaceuticals in the Nation's Water: Assessing Potential Risks and Actions to Address the Issue*, Apr. 15, 2008; Daughton, Christian G., 2007, *PPCPs in the Environment: an Overview of the Science* (PowerPoint); Daughton, Christian G., 2005, "Emerging" Chemicals as Pollutants in the Environment: a 21st Century Perspective, *Renewable Resources Journal* Winter 2005; *see also* Alpert, Mark, 2008, Fighting Toxins in the Home: Everyday materials may pose health and environmental threats, *SciAm* (Jan. 2008), p. 46; Emery, Gene, 2007, Scented oils linked to male breast growth, *The Australian* (Feb. 1, 2007).
[10] USEPA 1997.
[11] Gilliom, R.J., J.E. Barbash, C.G. Crawford, P.A. Hamilton, J.D. Martin, N. Nakagaki, L.H. Nowell, J.C. Scott, P.E. Stackelberg, G.P. Thelin, and D.M. Wolock, 2007, The quality of our nation's waters—pesticides in the nation's streams and ground water, 1992–2001, *U.S. Geological Survey circular 1291*, available at http://pubs.usgs.gov/circ/2005/1291/pdf/circ1291.pdf.
[12] *Id*.

(21 percent of sites), azinphos-methyl (19 percent), atrazine (18 percent), *p,p'*-DDE (16 percent), and alachlor (15 percent). All are known endocrine disruptors.

Municipal wastewater also contains a multitude of EDCs, many of which are derived from the domestic application of active ingredients found in PPCPs. PPCPs are constantly being infused to rivers and groundwater via treated municipal wastewater. Betablockers, antibiotics, antiphlogistics, estrogens, antiepileptics and contrast agents have been detected in many of our Nation's waters. These EDCs are affecting the biological, chemical, and physical integrity of our water, and are likely having profound effects on the flora and fauna that rely on them.

A recent study by Jenkins et. al. (2009) investigated the impacts of effluents from wastewater treatment plants using the western mosquitofish as a surrogate fish model.[13] Fifteen organic wastewater compounds and EDCs were detected, and the site showing compounds having the highest influence on sex steroid hormone activities was the point source for the wastewater effluent. The study found that male mosquitofish sex steroid hormone levels, secondary sex characteristics, organosomatic indices, and sperm quality parameters indicating impairment of endocrine and reproductive function were worse off closer to the wastewater treatment plants' effluent discharges. It found that exposure to EDCs and consequent impairment showed most significant effects at the wastewater treatment point sources, with gradually lesser effects further away from the point sources. This is just one of many studies that identify a connection between wastewater effluent, EDCs, and environmental harm.[14]

IV. Endocrine Disrupting Chemicals in Las Vegas Wash, Las Vegas Bay, and Lake Mead

Past monitoring of Las Vegas Wash, Las Vegas Bay, and Lake Mead have detected EDCs including pesticides, organochlorine compounds ("OCs"), dioxins, furans, polycyclic aromatic hydrocarbons ("PAHs"), phthalates, polychlorinated biphenyls (PCBs), phenolic compounds and "emerging contaminants" such as fragrances/musks, flame retardants, triclosan and its breakdown products, and PPCPs.[15] These environmental conditions are not conducive to healthy populations of fish and wildlife, nor do they support the beneficial uses of these waterbodies.[16]

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[13] Jenkins, J.A., S.L. Goodbred, S.A. Sobiech, H.M. Olivier, R.O. Draugelis-Dale, and D.A. Alvarez, 2009, Effects of Wastewater Discharges on Endocrine and Reproductive Function of Western Mosquitofish (*Gambusia spp.*) and Implications for the Threatened Santa Ana Sucker (*Catostomus santaanae*), *U.S. Geological Survey Open-File Report 2009-1097*, 46p. (Revised May 2009), available at http://pubs.usgs.gov/of/2009/1097/pdf/OF2009-1097.pdf.

[14] *See* Fent, K., A.A. Weston, and D. Caminada, 2006, Ecotoxicology of human pharmaceuticals, *Aquatic Toxicology* 76, 122-159.

[15] Bevans, H.E., S.L. Goodbred, J.F. Miesner, S.A. Watkins, T.S. Gross, N.D. Denslow, and T. Schoeb, 1996, Synthetic organic compounds and carp endocrinology and histology in Las Vegas Wash and Las Vegas and Callville Bays of Lake Mead, Nevada, 1992 and 1995, *Water-Resources Investigations Report* 96-4266, Nevada Basin and Range Study Unit, National Water-Quality Assessment Program, U.S. Geological Survey; Boyd, R.A. and E.T. Furlong, 2002, Human-Health Pharmaceutical Compounds in Lake Mead, Nevada and Arizona, and Las Vegas Wash, Nevada, October 2000-August 2001, *Open-File Report 02-385*, available at http://pubs.usgs.gov/of/2002/ofr02385/ofr02385.pdf; Goodbred, S.L., T.J. Leiker, R. Patiño, J.A. Jenkins, N.D. Denslow, E. Orsak, and M.R. Rosen, 2007, Organic chemical concentrations and reproductive biomarkers in common carp (*Cyprinus carpio*) collected from two areas in Lake Mead, Nevada, May 1999 through May 2000, *U.S. Geological Survey Data Series Report 286*, 18 p. http://pubs.usgs.gov/ds/2007/286/; Rosen et. al., 2009, Lake Mead Endocrine Disruption Studies: Environmental Assessment of Chemical Stressors and Effects on Fish Health within Lake Mead National Recreation Area (PowerPoint), available at http://nevada.usgs.gov/water/projects/mead_endocrine.htm; USFWS, Nevada Office letter to Mr. Alan Biaggi,

Many of these chemicals are known to disrupt the endocrine systems of animals in laboratory studies, and compelling evidence has accumulated that endocrine systems of certain fish and wildlife in the wild have been affected by chemical contaminants, resulting in developmental abnormalities and reproductive impairment. A presentation by Southern Nevada Water Authority (SNWA) to the Wash Coordination Committee entitled "Xenobiotics in Lake Mead" determined there was "significant estrogenic activity" in Las Vegas Wash and Las Vegas Bay, and a suite of natural and synthetic compounds, including PCBs, DDT, alkylphenols, and pharmaceutical compounds like codeine, phenobarbitol, and primidone.[17] A study by Lange et. al. (2000) revealed that the human estrogen 17-beta-estradiol (E2) and a synthetic estrogen used in oral contraceptives, ethynylestradiol (EE2), were in the waterbodies at concentrations of up to 2.7 ng/L and 0.5 ng/L, respectively. As a reference, the no-observed-adverse-effect concentration for EE2 to the fathead minnow (*Pimephales promelas*) is considered to be 1.0 ng/L.[18]

There is also evidence of a higher number and higher concentrations of environmental contaminants in lake sediment, water, and fish tissue from Las Vegas Bay and Las Vegas Wash, relative to other parts of Lake Mead.[19] Contaminants include OCs, PAHs, furans, phthalates, phenols, and PCBs. Dioxins and furans, and twice as many organic contaminants, pesticides, and PCBs have been found in sediment from Las Vegas Bay (compared to Overton Arm).[20] Water samples collected from Las Vegas Wash and Las Vegas Bay contained feminizing compounds such as EE2, nonylphenol, octylphenol, and E2 while samples from reference sites tested negative for these compounds.[21] Significantly higher concentrations of OC compounds and tetrachlorodibenzo-*p*-dioxins and tetrachlorodibenzofurans have been detected at Las Vegas Wash and Las Vegas Bay compared to sites below the Hoover Dam.[22] Other compounds

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Administrator of the Nevada Division of Environmental Protection, Aug. 15, 2001, Subject: Issuance of Permits Allowing the Increased Discharge of Municipal Effluent into Las Vegas Wash, Clark County, Nevada.

[16] U.S. Geological Survey, 2001, Presentation to SNWA by Dr. Tim Gross, Dr. Steve Goodbred, and Dr. Tom Leiker on the preliminary results ongoing contaminant studies on the fishes of Lake Mead; Bevans, H.E., M.S. Lico, and S.J. Lawrence, 1998, Water quality in the Las Vegas Valley area and the Carson and Truckee River basins, Nevada and California, 1992-96, *U.S. Geological Survey Circular 1170*, p. 47, available at http://pubs.usgs.gov/circ/circ1170/nvbr.book.pdf; Covay, K.J., and T.J. Leiker, 1998, Synthetic organic compounds in water and bottom sediment from streams, detention basins, and sewage-treatment plant outfalls in Las Vegas Valley, Nevada, 1997, *U.S. Geological Survey Open-File Report 98-633*, p. 15; LaBounty, J.F., and M.J. Horn, 1997, The influence of drainage from Las Vegas Valley on the limnology of Boulder Basin, Lake Mead, Arizona-Nevada, *Journal of Lakes and Reservoir Management* 13(2):95-108.

[17] Southern Nevada Water Authority, 2000, Presentation by Dr. Shane Snyder on xenobiotics in Lake Mead to the Las Vegas Wash Coordination Committee.

[18] Lange, R., T.H. Hutchinson, C.P. Croudace, F. Siegmund, H. Schweinfurth, P. Hampe, G.H. Panter, and J.P. Sumpter, 2000, Effects of the synthetic estrogen 17 -ethinylestradiol on the life-cycle of the fathead minnow (*Pimephales Promelas*), *Environ Toxicol Chem* 20:1216-1227.

[19] Rosen, M.R., Goodbred, S.L., and Leiker, T.J., 2007, Use of passive samplers for detecting vertical gradients of organic contaminants in Lake Mead, *Nevada Water Resources Association 2007 annual conference, Reno, Nev.* Feb. 20-22, abstracts, unpaginated, available at http://www.nvwra.org/annual_conf/2007/docs/FINAL%20NWRA%202007%20Conference%20program%20and%20abstracts.pdf.

[20] Covay, K.J. and D.A. Beck, 2001, Sediment-deposition rates and organic compounds in bottom sediment at four sites in Lake Mead, Nevada, May 1998, *U.S. Geological Survey Open-File Report 01-282*, p. 34, available at http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA445148&Location=U2&doc=GetTRDoc.pdf.

[21] Snyder, S.A., D.L. Villeneuve, E.M. Snyder, and J.P. Giesy, 2001, Identification and quantification of estrogen receptor agonists in wastewater effluents, *Environmental Science and Technology*, vol. 35, p. 3620-3625.

[22] FWS 2001.

detected included hexachlorobenzene, cis-chlordane, trans-chlordane, trans-nonachlor, dieldrin, *p,p'*-DDD, *p,p'*-DDE, and PCBs, DDT metabolites DDD and DDE, and PCBs.

Historically, the most frequently detected EDCs in samples from Las Vegas Wash have been caffeine, carbamazepine (used to treat epilepsy), cotinine (a metabolite of nicotine), and dehydronifedipine (a metabolite of the antianginal Procardia).[23] Less frequently detected EDCs have been antibiotics (clarithromycin, erythromycin, sulfamethoxazole, and trimethoprim), acetaminophen (an analgesic and anti-inflammatory), cimetidine (used to treat ulcers), codeine (a narcotic and analgesic), diltiazem (an antihypertensive), and 1,7-dimethylxanthine (a metabolite of caffeine). In general, fewer compounds were detected in samples collected from Lake Mead than from Las Vegas Wash. However, caffeine was detected in all samples collected from Lake Mead, and acetaminophen, carbamazepine, cotinine, 1,7-dimethylxanthine, and sulfamethoxazole were also detected in samples from Lake Mead.

A recent study by Rosen et. al. (2009) was the first to delineate synthetic organic compound ("SOC") sources to Las Vegas Bay.[24] It found that water downstream of the wastewater treatment plants generally have higher concentrations of EDCs, including benzophenone, galaxolide, indole, phosphate Tris (2-butoxyethyl), tributylphosphate, triclosan, triphenyl phosphate, methyl-1*H*-benzotriazole, lindane, and chlorpyrifos, than sites upstream of the wastewater treatment plants.[25] This study discovered that some hydrophobic SOCs entering Lake Mead from the Las Vegas Wash distribute laterally across 10 km of Lake Mead from Las Vegas Wash to Boulder Basin.

Evidence of endocrine disruption in common carp[26]

Not only have OC compounds, PAHs, phthalates, phenols, dioxins, synthetic musks, and furans been found in water, sediment and carp tissue from Las Vegas Wash and Las Vegas Bay, these

[23] Boyd, R.A. and E.T. Furlong, 2002, Human-Health Pharmaceutical Compounds in Lake Mead, Nevada and Arizona, and Las Vegas Wash, Nevada, October 2000-August 2001, *Open-File Report 02-385*, available at http://pubs.usgs.gov/of/2002/ofr02385/ofr02385.pdf.

[24] Rosen, M.R., D.A. Alvarez, S.L. Goodbred, T.J. Leiker, and R. Patiño, 2009, Sources and distribution of organic compounds using passive samplers in Lake Mead National Recreation Area, Nevada and Arizona, and their implications for potential effects on aquatic biota, *Journal of Environmental Quality*; see also Vermeirssen, E.L.M., O. Korner, R. Schonenberger, M.J. Suter, and P. Burkhardt-Holm, 2005, Characterization of Environmental Estrogens in River Water Using a Three Pronged Approach: Active and Passive Water Sampling and the Analysis of Accumulated Estrogens in the Bile of Caged Fish, *Environ. Sci. Technol.*, 39, 8191-8198.

[25] Additional potential sources of chemicals measured in the passive samplers at Las Vegas Wash and Bay include. 4-dichlorophenyl isocyanate, *tert*-octylphenol, Acetophenone, BDEs, Dacthal, Fipronil, Hexachlorobenzene (HCB), Isophorone, Isoquinoline, Lindane, Methyl salicylate, *para*-cresol, PCBs, Pentachloroanisole (PCA), Tonalide (AHTN), and Trifluralin.

[26] *See also* Patino, R., 2008, Preliminary Assessment of Field Endocrine and Gonadal Condition of Male Common Carp from Lake Mead National Recreation Area (2007-2008); Patino, R., 2008, Preliminary Assessment of Field Endocrine and Gonadal Condition of Male Largemouth Bass from Lake Mead National Recreation Area (2007-2008); Patino, R., J.A. Jenkins, S.L. Goodbred, M.R. Rosen, and E. Orsak, 2007, Indices of endocrine disruption and reproductive dysfunction in common carp of Lake Mead, Nevada (PowerPoint); Bevans, H.E., S.L. Goodbred, J.F. Miesner, S.A. Satkins, T.S. Gross, N.D. Denslow, and T. Schoeb, 1996, Synthetic organic compounds and carp endocrinology and histology in Las Vegas Wash and Las Vegas and Callville Bays and Lake Mead, Nevada, 1992 and 1995, *U.S. Department of the Interior, U.S. Geological Survey, Water Resources Investigations Report 96-4266, Carson City, NV.*

carp exhibit endocrine disruption relative to fish from other areas of Lake Mead.[27] Results of a study by Linder and Little (2009) indicate that the reproductive condition of fish at Las Vegas Bay are markedly reduced compared to other fish farther away from Las Vegas Wash and the influx of EDCs.[28]

Studies have also shown that male carp from Las Vegas Bay have significantly lower levels of the sex steroid hormone 11-ketotestosterone (11KT), a major androgen responsible for testicular function and sperm production in fishes.[29] They have smaller testes (gonadosomatic index) and higher levels of testicular macrophage aggregates (biomarkers of contaminant exposure).[30] Degradation products of triclosan, a commonly used antimicrobial compound, have been found in these carp, but not in male fish from the reference site in Overton Arm.[31]

A study by Leiker (2009) identified methyl triclosan and four halogenated analogues in male carp collected from Las Vegas Bay as well as from semipermeable devices deployed in Las Vegas Wash.[32] Methyl triclosan is a microbially methylated product of triclosan. Triclosan is an antibacterial and antimicrobial agent used in liquid detergents, hand soaps, deodorants, cosmetics, creams, lotions, mouthwash and toothpaste and is impregnated in many fabrics, plastics, carpets, plastic kitchenware, and toys. Studies suggest a variety of effects of triclosan including the inhibition of fatty acid and lipid biosynthesis, the resistance of some bacteria to triclosan, altered activity of kinase enzymes, reduced membrane stability of immune cells, interference with redox balance in organs, endocrine disruption of the thyroid system, augmented estrogenic and androgenic activity, and effects as a nonspecific depressant on the central nervous system

[27] Rosen, M.R., S.L. Goodbred, R. Patino, T.A. Leiker, and E. Orsak, 2006, Investigations of the Effects of Synthetic Chemicals on the Endocrine System of Common Carp in Lake Mead, Nevada and Arizona, Fact Sheet 2006-3131, available at http://pubs.usgs.gov/fs/2006/3131/; Osemwengie, L.I. and S.L. Gerstenberger, 2004, Levels of synthetic musk compounds in municipal wastewater for potential estimation of biota exposure in receiving waters, *J. Environ. Monit.* 6, 1-8.

[28] Linder, G. and E.E. Little, 2009, Competing risks and the development of adaptive management plans for water resources: field reconnaissance investigation of risks to fishes and other aquatic biota exposed to endocrine disrupting chemicals (EDCs) in Lake Mead, Nevada USA, *EWRI 2009 World Environmental & Water Resources Congress*, Kansas City, Missouri May 17-21, 2009.

[29] Schulz, R.W. and T. Miura, 2002, Spermatogenesis and its endocrine regulation: Fish Physiology and Biochemistry, vol. 26, p 43-56.

[30] Patino, R., S.L. Goodbred, R. Draugelis-Dale, C.E. Barry, J.S. Foott, M.R. Wainscott, T.S. Gross, and K.J. Covay, 2003, Morphometric and histopathological parameters of gonadal development in adult common carp from contaminated and reference sites in Lake Mead, Nevada, *Journal of Aquatic Animal Health*, vol. 15, p. 55-68.

[31] Goodbred et al. 2007.

[32] Leiker, T.J., S.R. Abney, S.L. Goodbred, M.R. Rosen, 2009, Identification of methyl triclosan and halogenated analogues in male common carp (*Cyprinus carpio*) from Las Vegas Bay and semipermeable membrane devices from Las Vegas Wash, Nevada, *Science of the Total Environment* 407, 2102-2114.

EDCs are harming endangered and threatened species[33]

Ongoing studies have detected a variety of contaminants in fish and wildlife that rely on Las Vegas Wash and Las Vegas Bay.[34] Imperiled birds using Las Vegas Wash and Las Vegas Bay include the Yuma clapper rail, southwestern willow flycatcher, yellow-billed cuckoo, and over 150 species of migratory birds. Some of the migratory bird species in the area include the great blue heron, great egret, snowy egret, eared grebe, Western grebe, Clark's grebe, gadwall, American wigeon, mallard, blu-winged teal, cinnamon teal, northern shoveler, northern pintail, American coot, red-winged blackbird, brewer's blackbird, yellow-headed blackbird, marsh wren, double-crested cormorant, American avocet, killdeer, and black-necked stilt.

OCs have been detected in grebe eggs collected from Las Vegas Bay and swallow eggs collected from Las Vegas Wash.[35] DDT and its metabolites DDD and DDE accounted for the majority of the total OC burden in eggs from Las Vegas Wash and Las Vegas Bay. DDT is known to cause egg shell thinning resulting in the reduction in reproductive success in birds.

The endangered razorback sucker is also found in Las Vegas Bay and Lake Mead and has federally designated critical habitat throughout these waterbodies. Razorback suckers are long-lived fish that can grow up to three feet long. However, they are struggling to survive and face threats from habitat loss and competition with other fish species. Blackbird Point at Las Vegas Bay is known spawning habitat for the razorback sucker. Distinct differences have been found in razorback suckers from Las Vegas Bay and razorback suckers from other locations.[36] One study found concentrations of E2 were significantly higher, concentrations of 11KT were lower, and the ratio of E2 to 11KT higher in male razorback suckers from Las Vegas Bay than those from Echo Bay.[37] In another study, a razorback sucker from Las Vegas Bay had 9 OC compounds, while none were detected in a razorback sucker from Echo Bay. DDT residues accounted for more than half the detected OC concentrations in the fish, and PCBs accounted for a third of the total detected OC concentrations.

The Endangered Species Act ("ESA") prohibits the "take" of endangered species. The ESA defines take as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" endangered species.[38] The U.S. Fish and Wildlife Service has further defined "harm" to include "significant habitat modification or degradation" that "actually kills or injures wildlife by

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[33] *See generally* Intertox, Inc., 2008, Las Vegas Wash Monitoring and Characterization Study: Ecotoxicologic Screening Assessment of Selected Contaminants of Potential Concern in Sediment, Whole Fish, Bird Eggs, and Water, 2005-2006, *Prepared for: Southern Nevada Water Authority, U.S. Bureau of Reclamation, and U.S. Fish & Wildlife Service*; Intertox, Inc., 2006, Las Vegas Wash Monitoring and Characterization Study: Ecotoxicologic Screening Assessment of Selected Contaminants of Potential Concern in Sediment, Whole Fish, Bird Eggs, and Water, 2000-2003, *Prepared for: Southern Nevada Water Authority, U.S. Bureau of Reclamation, and U.S. Fish & Wildlife Service.*

[34] USFWS 2001; *See generally* Tuttle, P.L. and E.L. Orsak, 2001, Las Vegas Wash Water Quality and Implications to Fish and Wildlife, available at http://www.fws.gov/Pacific/ecoservices/envicon/pim/reports/LasVegas/WaterQuality.htm.

[35] FWS 2001.

[36] FWS 2001.

[37] FWS 2001.

[38] ESA §9(a)(1).

significantly impairing essential behavior patterns, including breeding, feeding, or sheltering."[39] EDCs enter Lake Mead under the delegated authority of NDEP. There is evidence that these EDCs are significantly degrading razorback sucker habitat, including federally designated critical habitat, and are likely injuring wildlife by disrupting behavior patterns such as breeding ability.[40] Therefore, NDEP is likely already engaging in take of razorback suckers, and possibly other endangered species, by failing to protect the water quality of these waterbodies.

EDCs may be harming National Recreation Area resources and contaminating Las Vegas' drinking water

Lake Mead is part of a designated National Recreation Area managed by the National Park Service. With over 157,000 acres of fishable water, and 8 million visitors annually, Lake Mead NRA provides anglers with the opportunity to fish a variety of species including striped and large mouth bass and stocked trout. As a national recreation area, Lake Mead is to be managed to specifically provide for water based recreation including boating, swimming, and fishing in a manner that preserves the scenic, historic, scientific, and other important features of the area. The unregulated introduction of EDCs into Lake Mead NRA is harming these resources and diminishing the integrity of this national treasure.

Not only is Lake Mead an important recreational resource, it is the largest reservoir in the United States. The Bureau of Reclamation manages the Hoover Dam and Lake Mead for water resources for southern Nevada, Arizona, southern California, and Mexico. Lake Mead receives water for about half of southern Nevada's potable water to be returned as highly treated effluent for return flow credit as additional water resource withdrawal. Boulder Basin of Lake Mead is the sole source of drinking water to over 1.2 million Las Vegans and more than 35 million tourists annually. The Saddle Island intake structures for Las Vegas' drinking water is only six short miles downstream of the Las Vegas Wash. Although SWNA is ultimately responsible for treating its customers' water, NDEP has a duty to protect Lake Mead's beneficial uses as municipal and domestic water supplies.

V. Nevada's Las Vegas Wash, Las Vegas Bay, and Lake Mead Are Impaired Waterbodies and Must Be Included on Nevada's 303(d) List

The purpose of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of our Nation's waters. Establishing water quality standards and issuing discharge permits are the primary mechanisms to achieve that goal. Nevada's water quality standards define the water quality goals for waterbodies by designating beneficial uses and setting criteria necessary to protect the beneficial uses.[41] These standards apply to all surface waters of the state and require waters to be free from various pollutants in sufficient levels so as to not interfere with any beneficial uses. Furthermore, the Nevada Administrative Code requires that all waters be free from "deleterious substances attributable to domestic or industrial waste or

[39] 50 CFR §17.3.
[40] Jobling, S., S. Coey, J.G. Whitmore, D.E. Kime, K.J.W. Van Look, B.G. McAllister, N. Beresford, A.C. Henshaw, G. Brighty, C.R. Tyler, and J.P. Sumpter, 2002, Wild Intersex Roach (*Rutilus rutilus*) Have Reduced Fertility, *Biology of Reproduction* 67, 515-524.
[41] NAC 445A.118-445A.225.

other controllable sources at levels or combinations sufficient to be toxic to human, animal, plant or aquatic life or in amounts sufficient to interfere with any beneficial use of the water."[42]

As explained above, and throughout this submittal, the existing water quality of Las Vegas Wash, Las Vegas Bay, and Lake Mead is inadequate to preserve the chemical, physical, and biological integrity of water or provide protection for their beneficial uses.

While the EPA publishes recommended guidelines for water quality criteria under §304 of the Clean Water Act, it is the responsibility of NDEP to ensure that the criteria are appropriately adopted and updated.[43] The State Environmental Commission is required to establish water quality standards "at a level designed to protect and ensure a continuation of the designated beneficial use or uses" applicable to each waterbody.[44] In general, a waterbody should be included on the list when there is adequate documentation that beneficial uses are not being supported and/or beneficial use standards are not being met.[45] Las Vegas Wash, Las Vegas Bay, and Lake Mead each have beneficial uses that are not being met due to pollution from EDCs.

For the area from the confluence of the Las Vegas Wash with Lake Mead to Telephone Line Road, the beneficial uses include: (a) Irrigation; (b) Watering of livestock; (c) Recreation not involving contact with the water; (d) Maintenance of a freshwater marsh; (e) Propagation of wildlife; and (f) Propagation of aquatic life, excluding fish. There is a goal of ensuring that the beneficial uses for this segment will include, without limitation, the propagation of aquatic life, including, without limitation, fish by the next triennial review (i.e. the review currently being undertaken).[46] The highest number and the greatest concentration of EDCs have been detected in this segment (relative to other parts of Lake Mead). The information offered in this submittal indicates that this segment is unable to meet its beneficial uses due to EDCs, namely the propagation of wildlife, and will not meet its goal of being beneficial to the propagation of fish.

The beneficial uses for the area of Lake Mead from a distance of 1.2 miles into Las Vegas Bay from the confluence of the Las Vegas Wash with Lake Mead include: (a) Irrigation; (b) Watering of livestock; (c) Recreation not involving contact with the water; (d) Industrial supply; (e) Propagation of wildlife; and (f) Propagation of aquatic life, including without limitation, a warm-water fishery.[47] This segment has the second greatest number and highest concentration of

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[42] NAC 445A.121(4) Standards applicable to all surface waters.
[43] 33 U.S.C. §1313(c).
[44] NRS 445A.520(1) Standards of water quality. http://www.leg.state.nv.us/NRS/NRS-445A.html#NRS445ASec520.
[45] NAC 445A.119-445A.225.
[46] NAC 445A.200 Requirements to maintain existing higher quality for area from confluence of Las Vegas Wash with Lake Mead to Telephone Line Road; standards for beneficial uses; goal of requirements and standards.
[47] NAC 445A.196(2) Requirements to maintain existing higher quality for area of Lake Mead from distance of 1.2 miles into Las Vegas Bay from confluence of Las Vegas Wash with Lake Mead; standards for beneficial uses; goal of requirements and standards. For (a) Watering of livestock. The water must be suitable for the watering of livestock without treatment; (b) Irrigation. The water must be suitable for irrigation without treatment; (e) Recreation not involving contact with the water. The water must be free from: (1) Visible floating, suspended or settled solids arising from man's activities; (2) Sludge banks; (3) Slime infestation; (4) Heavy growth of attached plants, blooms or high concentrations of plankton, discoloration or excessive acidity or alkalinity that leads to corrosion of boats and docks; (5) Surfactants that foam when the water is agitated or aerated; and (6) excessive water temperatures; (g) Industrial supply. The water must be treatable to provide a quality of water which is suitable

EDCs. The information provided in this submittal indicates that water quality standards are not being met as EDCs are currently impairing the beneficial uses of the propagation of wildlife and aquatic life.

For all other areas of Lake Mead, the beneficial uses include: (a) Irrigation; (b) Watering of livestock; (c) Recreation involving contact with the water; (d) Recreation not involving contact with the water; (e) Industrial supply; (f) Municipal or domestic supply, or both; (g) Propagation of wildlife; and (h) Propagation of aquatic life, including, without limitation, a warmwater fishery.[48] Lake Mead is receiving EDCs from runoff and wastewater effluent discharged through Las Vegas Wash. The introduction of these EDCs is preventing the beneficial uses of this waterbody as the EDCs are impairing fish and wildlife and infiltrating Las Vegas' drinking water supply.

Additionally, the Clean Water Act and Nevada Administrative Code have an anti-degradation standard based on the "Requirement to Maintain Existing Higher Water Quality." Where existing water quality is higher than the standards required for beneficial uses, such as with Lake Mead, NDEP must ensure these standards continue to be met. Meeting anti-degradation standards is necessary to maintain high quality recreation experiences, viable fish and wildlife populations, and protect the source drinking water supplies.

In addition to the waterbodies not meeting their beneficial uses or their requirements to maintain existing higher water quality, they are in violation of the standards applicable to all surface waters.[49] All surface waters must be free from biocides, toxics, and other deleterious substances at levels or combinations sufficient to be toxic to human, animal, plant or aquatic life. The pollutants at issue in this submittal are all known EDCs. These EDCs are deleterious substances that are currently at levels or combinations sufficient to have such adverse effects on all living organisms.

Specific EDCs affect Las Vegas Wash, Las Vegas Bay, and Lake Mead waters and aquatic life

Infinitesimally small levels of EDC exposure, in fact any level of exposure at all – may cause endocrine or reproductive abnormalities.[50] The EPA recognizes that EDCs discharged from wastewater treatment plants and found in runoff are contaminants of emerging concern with

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for the intended use. (h) Propagation of wildlife. The water must be suitable for the propagation of wildlife and waterfowl without treatment. *See* NAC 445A.122 Standards applicable to beneficial uses.

[48] NAC 445A.194 Requirements to maintain existing higher quality for area of Lake Mead not covered by NAC 445A.197; standards for beneficial uses. (c) Aquatic life. The water must be suitable as a habitat for fish and other aquatic life existing in a body of water. This does not preclude the reestablishment of other fish or aquatic life. (d) Recreation involving contact with the water. There must be no evidence of man-made pollution, floating debris, sludge accumulation or similar pollutants. (f) Municipal or domestic supply. The water must be capable of bring treated by conventional methods of water treatment in order to comply with Nevada's drinking water standards. NRS 445A.425, 445A.520; NAC 445A.122 Standards applicable to beneficial uses.

[49] NAC 445A.121.

[50] Sheehan, D.M., E.J. Willingam, J.M. Bergeron, C.T. Osborn, D. Crews, 1999, No threshold dose for estradiol-induced sex reversal of turtle embryos: how little is too much? *Environ Health Perspect* 107:155-159, available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566346/pdf/envhper00507-0101.pdf; National Institute of Environmental Health Sciences, 2006, Endocrine Disruptor Fact Sheet June 2006.

potentially widespread environmental effects.[51] A variety of pollutants are entering these waterbodies from both effluent and agricultural and urban runoff. They can each independently have adverse affects to water quality and fish and wildlife, and though the extent is not fully understood, are likely interacting in ways that degrade water quality and prevent the beneficial uses of these waterbodies.[52] In creating its 303(d) list, NDEP must "assemble and evaluate all existing and readily available water quality-related data and information."[53]

The enclosed peer-reviewed scientific literature meets data quality standards. The peer-reviewed scientific information and data supporting this request meets all data assurances and data quality objectives. The data and information is of high quality and credibility using methods and parameters to control for errors. Moreover, EPA's guidance states that the "[l]ack of a state-approved QAPP should not, however, be used as the basis for summarily rejecting data and information submitted by such organizations, or assuming it is of low quality, regardless of the actual QA/QC protocols employed during the gathering, storage, and analysis of these data."[54]

EPA's guidance for listing of impaired waters emphasizes that states should evaluate all data, and that listings may be based on small data sets, data other than site specific monitoring, and data from the public.[55] Recognizing the limited monitoring data available, EPA encourages states to consider a more expansive versus cautious approach to monitoring data.[56] Site-specific monitoring data is not required for impaired water listing. EPA regulations require that "reports from dilution calculations and predictive modeling" be included in the data and information that a state considers in its assessment process for section 303(d) listing purposes.[57] EPA guides states to consider even very small sample sets to ascertain the attainment status of waters. Moreover, states should use information about observed effects, predictive modeling, and knowledge about pollutant sources and loadings when making its listing determinations.[58] Furthermore, EPA regulations and guidance require states to seek public participation in the impaired waters listing process. EPA regulations require that states actively solicit data and information from organizations and individuals, including conservation organizations.[59] Here, the Center presents well-documented and highly credible scientific evidence that Las Vegas Wash, Las Vegas Bay, and Lake Mead are impaired from EDC pollution.

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[51] OW/ORD Emerging Contaminants Workgroup, 2008, Aquatic Life Criteria for Contaminants of Emerging Concern, Part I, General Challenges and Recommendations, June 3, 2008, available at http://www.epa.gov/waterscience/criteria/library/sab-emergingconcerns.pdf.

[52] Sumpter, J.P. and A.C. Johnson, 2005, Lessons from Endocrine Disruption and Their Application to Other Issues Concerning Trace Organics in the Aquatic Environment, *Environmental Science & Technology* 4321-4332; Brian, J.V., Harris, C.A., Scholze, M., Backhaus, T., Booy, P., Lamoree, M., Pojana, G., Jonkers, N., Runnalls, T., Bonfa, A., Marcomini, A., and Sumpter, J.P., 2005, Accurate Prediction of the Response of Freshwater Fish to a Mixture of Estrogenic Chemicals, *Environmental Health Perspective*, v. 113, N. 6, June 2005.

[53] 40 CFR §130.7(b)(5); *see also Sierra Club v. Leavitt*, 488 F.3d 904 (11th Cir. 2007).

[54] EPA 2006.

[55] EPA, Guidance for 2006 Assessment, Listing and Reporting requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act at 33-35, 38 (2004); EPA 2006, EPA advised states to use the 2006 Guidance for their 2008 303(d) listings. See Memo from Diane Regas: Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions (Oct. 12, 2006).

[56] EPA 2006.

[57] 40 C.F.R. §130.7(b)(5)(ii).

[58] EPA 2006.

[59] 40 C.F.R. §130.7(b)(5)(iii); EPA 2006.

NDEP has set standards for some of these pollutants, including chlordane, endrin, HCB, heptachlorepoxide, lindane, and PCBs,.[60] However, these standards are either being exceeded or are not stringent enough as they are being detected in both the waterbodies and in fish and wildlife and are preventing the beneficial uses of the waterbodies. Therefore, NDEP must include the waterbodies on the 303(d) list due to impairment from the following EDCs:

Chlordane Chlordane is a persistent organochlorine pesticide made up of a mixture of related chemicals, including heptachlor. It bioaccumulates readily in fish and wildlife and is highly toxic to freshwater invertebrates and fish. Its use is banned in the U.S. but it is still manufactured for export. The EPA has recognized that longterm exposure to this pollutant can result in adverse health effects at .002 mg/L and has established a public health goal of zero exposure.[61] NDEP has established aquatic life criteria at 2.4 ppb and human health consumption criteria at .00059 ppb (for organism only). It has been found in common carp in Las Vegas Bay at 13 micrograms per kilogram (approximately .0013 ppb, well over the NDEP limit).[62] Bioaccumulating components of chlordane include trans-chlordane, cis-nonachlor and trans-nonachlor and are also known endocrine disruptors.

Endrin Endrin was once a registered pesticide in the U.S. and is a highly toxic persistent organic pollutant that bioaccumulates. The EPA has recognized that longterm exposure to this pollutant can result in adverse health effects at .002mg/L.[63] NDEP has established aquatic life criteria at .18 ppb, criteria for human health consumption at .81 ppb (for organism only), and standards for water supply at .2 ppb. Endrin has been detected at Meadows Detention Basin at .053 *m*g/L.[64]

HCB: Hexachlorobenzene is a well studied persistent organic pollutant fungicide that was banned in the U.S. in 1966 and is a suspected carcinogen.[65] The EPA has recognized that longterm exposure to this pollutant can result in adverse health effects at .001 mg/L and has established a public health goal of zero exposure.[66] NDEP has established aquatic life criteria at .0038 ppb, human health consumption criteria at .00075 ppb (for water plus organism) and .00078 ppb (for organism only). However, it has been found in common carp in Las Vegas Bay at 3.8 micrograms per kilogram (approximately .0038 ppb, well over NDEP's standard).[67]

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[60] Please refer to the *State Numeric Criteria vs. EPA Numeric Criteria Report for Nevada* for Nevada water criteria values.
[61] EPA, 2009, National Primary Drinking Water Regulations, available at http://www.epa.gov/safewater/consumer/pdf/mcl.pdf.
[62] Goodbred 2007, Table 3; Intertox 2008, Table 15.
[63] EPA 2009.
[64] Intertox 2008, Table 6.
[65] ATSDR, 1997, Toxicological Profile for Hexachlorobenzene, available at http://www.atsdr.cdc.gov/toxprofiles/tp90.html.
[66] EPA 2009.
[67] Goodbred 2007, Table 3; Intertox, Table 15.

Heptachlorepoxide Heptachlorepoxide is the degradate of heptachlor, a manufactured chemical used to make mothballs. The EPA has recognized that longterm exposure to this pollutant can result in adverse health effects at .0002 mg/L and has established a public health goal of zero exposure.[68] NDEP has established human health consumption criteria at .001 ppb (for water plus organism) and .00011 ppb (for organism only). It has been detected in common carp in Las Vegas at .62 micrograms per kilogram (approximately .0062 ppb).[69]

Lindane and related compounds This chlorinated hydrocarbon (y hexachlorocyclohexane – HCH) is banned for agricultural uses but is still allowed as a pharmaceutical. It may accumulate in sediment and can be toxic to fish at high concentrations and at lower concentrations can affect growth, hormones, and the immune system. The EPA has recognized that longterm exposure to this pollutant can result in adverse health effects at .0002 mg/L,[70] and has placed alpha-hexachlorocyclohexane on the Contaminant Candidate List.[71] NDEP has established aquatic life criteria at 2 ppb, criteria for human health consumption at .019 ppb (for water plus organism), and 4 ppb for water supply. These compounds have been found throughout the waterbodies and in common carp in Las Vegas Bay at 9.9 micrograms per kilogram.[72]

PCBs Polychlorinated biphenyls (PCBs) do not degrade readily or dissolve in water, and therefore bioaccumulate in body fat and biomagnify up the food chain. They were once widely used as insulators and cooling compounds in electrical equipment, and have been incorporated into a variety of consumer products including lubricants, paints, varnishes, and inks. PCBs come in 209 forms, or congeners. Though the U.S. banned the manufacture of PCBs in 1979, they are still used in closed electrical equipment. One EPA study shows that gulls from areas with high-PCB exposures have altered thyroid function which compromises their ability to respond to changing environmental conditions.[73] The EPA has recognized that longterm exposure to this pollutant can result in adverse health effects at levels greater than .0005 mg/L and has established a public health goal of zero exposure.[74] NDEP has established aquatic life criteria at .014 ppb, human health consumption criteria at .0007 ppb (for organism only), and zero for water supply. PCBs have been found

[68] EPA 2009.
[69] Goodbred 2007, Table 3; Intertox 2008, Table 15.
[70] EPA 2009.
[71] EPA, 2009, Fact Sheet: Final Third Drinking Water Contaminant Candidate List (CCL3), available at http://www.epa.gov/ogwdw000/ccl/pdfs/ccl3_docs/fs_cc3_final.pdf.
[72] Rosen 2009, Table 2, Table 3, Table 4; Goodbred 2007, Table 3.
[73] EPA, Final Report: Field and Laboratory Studies of the Effects of Polychlorinated Biphenyls and Other Persistent Organic Pollutants on Thyroid Function During Avian Development, 2003, available at http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractDetail/abstract/444/report/F.
[74] EPA 2009.

throughout the waterbodies and in common carp in Las Vegas Bay at 1.25 micrograms per kilogram (approximately .00125 ppb, well over NDEP's limit).[75]

Selenium Selenium bioaccumulates and causes reproductive effects at very low concentrations. Waterborne selenium in the Las Vegas Wash is currently between 3-4 ppb, a level of concern for wildlife. Selenium concentrations in the Las Vegas Wash exceed minimum levels of concern, as well as EPA's chronic criterion and NDEP's chronic criterion for protection of aquatic life. Elevated levels of selenium pose a concern for razorback suckers because adults readily bioaccumulate selenium in various tissues, including egg tissues. Fish collected in Las Vegas Wash exhibited selenium in whole body tissue ranging from 3.5-13.7 ppm, and 2.5-6.9 from the Bay.[76] By comparison, the majority of selenium literature supports a whole-body toxicity threshold of 4 ppm dry weight.[77]

Other EDCs are present for which the NDEP has not adopted the standards, but for which the EPA has established recommended water quality standards.[78] NDEP must place the waterbodies on the 303(d) list due to water quality standards not being met.

Chlorpyrifos Chlorpyrifos is an organophosphate pesticide that has been linked to neurological effects and birth defects.[79] The EPA has identified it in its Endocrine Disruptor Screening Program, Tier I Screening List.[80] It has been detected throughout the waterbodies and in common carp from Las Vegas Bay at 8.65 micrograms per kilogram.[81]

DDT, DDE, DDD DDT is an organochlorine pesticide.[82] Though it was banned in the U.S. in 1972, it and its breakdown products DDE and DDD, are highly persistent and can stay in soil and sediment. They bioaccumulate and biomagnify up the food chain. They are known to have acute and longterm effects on microorganisms, invertebrates, amphibians, fish, mammals, and birds.

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[75] Rosen 2009, Table 2, Table 3; Goodbred 2007, Table 3; Intertox 2008 Table 15.
[76] USFWS, 2007, Biological Opinion for Systems Conveyance and Operations Program for the Discharge of Municipal Wastewater into Lake Mead, Clark County, Nevada.
[77] *See* Hamilton, S.J., K.M. Holley, and K.J. Buhl, 2002, Hazard assessment of selenium to endangered razorback suckers (*Xyrauchen texanus*), *The Science of the Total Environment e Science of the Total Environment* 291, 111-121; Hamilton, S., 2003, Review of residue-based selenium toxicity thresholds for freshwater fish, *Ecotoxicology and Environmental Safety* 65, 201-210; Intertox 2008, Table 21, Table 22.
[78] EPA, 2009, National Recommended Water Quality Criteria, available at http://www.epa.gov/ost/criteria/wqctable/.
[79] ATSDR, 1997, Toxicological Profile for Chlorpyrifos, available at http://www.atsdr.cdc.gov/toxprofiles/tp84.html.
[80] EPA, 2009, Final List of Initial Pesticide Active Ingredients and Pesticide Inert Ingredients to be Screened Under the Federal Food, Drug, and Cosmetic Act, 74 *Federal Register* 17579 (Apr. 15, 2009).
[81] Rosen 2009, Table 2, Table 3; Goodbred 2007, Table 3.
[82] *See* ATSDR, 2002, Toxicological Profile for DDT, DDE, and DDD, available at http://www.atsdr.cdc.gov/toxprofiles/tp35.html.

They have been detected in the waterbodies in both water and fish samples.[83]

Dieldrin Dieldrin is a chlorinated insecticide that was used as an alternative to DDT until it was banned in 1987 because of its toxicity. Dieldrin has low solubility in water, and persists in soil and sediment where it can move to organisms and bioaccumulate. Exposed to sunlight dieldrin can transform into photodieldrin, an even more toxic compound. EPA set a human health consumption limit of .000052 *m*g/L (for water plus organism) and .000054 *m*g/L (for organism only). Dieldrin has been detected in the waterbodies and in common carp from Las Vegas Bay at 3.9 micrograms per kilogram (approximately .0039 *m*g/L, considerably over the EPA recommended standard).[84]

Isophorone Isophorone is used as a solvent in ink, paint, adhesives, and pesticides and can be found in wood preservatives and floor sealants. The EPA has identified it in its Endocrine Disruptor Screening Program, Tier I Screening List.[85] The EPA has recommended 35 *m*g/L CCC; 960 *m*g/L CMC. It has been detected in waterbodies.[86]

Oxychlordane Oxychlordane is the most persistent chlordane metabolite and is highly toxic. It has an EPA water quality standard of 2.4 *m*g/L CMC and .0043 *m*g/L CCC, yet has been detected in common carp at Las Vegas Bay at 1.25 micrograms per kilogram.[87]

Pentachloroanisole Pentachloroanisole is a chlorinated aromatic compound, a degradate of pentachlorophenol and pentachloronitrobenzene, and is toxic to rodents.[88] It is a suspected carcinogen and has been linked to liver lesions. It is a chlorinated aromatic compound and has an EPA water quality standard of .001 *m*g/L CCC, yet has been found all around the waterbodies, and been detected in common carp from Las Vegas Bay at 3.8 micrograms per kilogram.[89]

Pyrene Pyrene is a polycyclic hydro carbon used in dyes and is known to be toxic to the kidneys and liver. EPA has recommended 830 *m*g/L CCC; 4000 *m*g/L CMC. It has been detected in Las Vegas Bay.[90]

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[83] Intertox 2008, Table 6, Table 15, Table 19; Rosen 2009, Table 2.
[84] Intertox 2008, Table 6, Table 19; Goodbred 2007, Table 3.
[85] 74 Fed. Reg. 17579.
[86] Rosen 2009, Table 4.
[87] Goodbred 2007, Table 3.
[88] ATSDR, 1997, Toxicological Profile for Pentachlorophenol, available at http://www.atsdr.cdc.gov/toxprofiles/tp51.html.
[89] Rosen 2009, Table 2, Table 3; Goodbred 2007, Table 3.
[90] Rosen 2009, Table 2.

For other EDCs found in the waterbodies, the EPA has identified them as pollutants, but has not yet established recommended water quality standards. NDEP must list the waterbodies as impaired due to pollution from these EDCs:

Naphthalene Naphthalene is a polycyclic aromatic hydrocarbon and is the primary ingredient in mothballs. It has the ability to damage or destroy red blood cells. It has been detected in the waterbodies at concentrations of at least 1600 pg/L.[91] Similar compounds, 1-methyl-naphthalene and 2-methyl-naphthalene should be considered to act similarly to naphthalene. 1-methyl-naphthalene has been detected in the waterbodies at concentrations up to 1200pg/L. 2-methyl-naphthalene has been detected in the waterbodies at concentrations up to 1200 pg/L.

Perchlorate Perchlorate reduces iodine uptake into the thyroid gland.[92] A 2002 EPA report proposes secondary acute values for short-term and long-term exposure to perchlorate. Perchlorate concentrations substantially exceeded those levels in sampling fro Las Vegas Wash.[93]

Phenanthrene Phenanthrene is a polycyclic aromatic hydrocarbon used in dyes. It targets fat tissues, kidneys and liver. PAHs have caused tumors and reproductive problems in laboratory animals, as well as birth defects and decreased body weight in offspring.[94] It has been detected in the waterbodies at concentrations up to 1300 pg/L.[95]

Other EDCs have been detected in the waterbodies and are impairing water quality standards. NDEP must place the waterbodies on the 303(d) list due to impairment by the following EDCs:

1,7-Dimethylxanthine Also known as paraxanthine, is a dimethyl derivative of xanthine. It is a psychoactive central nervous system stimulant and can act as an inhibitor of adenosine receptors. It has been detected in the waterbodies.[96]

2,6-dimethyl-naphthalene It is a polycyclic aromatic hydrocarbon and has been detected in the waterbodies at concentrations of 860 pg/L.[97]

4-*tert*-octylphenol Chronic exposure to this chemical can interfere with the secretion of luteinizing hormone, follicle-stimulating hormone, prolactin, and testosterone. It has been detected in Las Vegas Bay.[98]

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[91] Rosen 2009, Table 2.
[92] EPA, 2008, Interim Drinking Water Health Advisory for Perchlorate, available at http://www.epa.gov/safewater/contaminants/unregulated/pdfs/healthadvisory_perchlorate_interim.pdf.
[93] Intertox 2008, p. 50; ADEQ, 2004, Perchlorate in Arizona: Occurrence Study of 2004, available at http://www.azdeq.gov/function/about/download/perch1201.pdf.
[94] EPA, Phenanthrene Fact Sheet, available at http://www.epa.gov/waste/hazard/wastemin/minimize/factshts/phenanth.pdf.
[95] Rosen 2009, Table 3.
[96] Rosen 2009.
[97] Rosen 2009, Table 2.

5-methyl-1*H*-benzotriazole	It can be found in aircraft deicing and anti-icing fluid. It bioaccumulates in fish fat. It has been detected in the waterbodies at concentrations up to 20,000 pg/L.[99]
17B-estradiol	Male trout exposed to low levels of 17B-estradiol have reduced semen volume, sperm density, and sperm fertility.[100] Largemouth bass exposed to 17B-estradiol had changes in expression of hapcidins, a highly conserved antimicrobrial peptide and iron-regulatory hormone, reducing hep-1 levels in the liver.[101] It has been detected in the waterbodies.
Acetophenone	Acetophenone is an aromatic ketone used in fragrances, is an excipient used in some pharmaceuticals and is an additive in cigarettes. Oral exposure can cause central nervous system depression and hematologic effects. It has been detected in the waterbodies.[102]
Benzophenone	It is a UV-absorbing chemical. It is considered toxic. It has been detected in the waterbodies.[103]
Caffeine	Effects of caffeine include decreased insulin sensitivity and can have adverse affects on the adrenal glands. It has been detected in the waterbodies.[104]
Dacthal	Dacthal is used to kill weeds. It and its degradates are toxic to the liver, kidneys, and thyroid. Longterm health effects can be expected at .07 mg/L exposure.[105] It has been detected in the waterbodies.[106]
Ethynylestradiol	It is a potent endocrine modulator present in the aquatic environment at biologically active concentrations. Lifelong exposure to 5ng/L EE2 in zebrafish led to a 56% reduction in fecundity and complete population failure with no fertilization.[107] Fathead minnows chronically exposed to

[98] Rosen 2009, Table 2, Table 4.
[99] Rosen 2009, Table 4.
[100] Lahnsteiner, F., B. Berger, M. Kletzl, T. Weismann, 2006, Effect of 17B-estradiol on gamete quality and maturation in two salmonid species, *Aquatic Toxicology* 79 (2006) 124-131.
[101] Robertson, L.S., L.R. Iwanowicz, and J.M. Marranca, 2009, Identification of centrarchid hepcidins and evidence that 17B-estradiol disrupts constitutive expression of hepcidin-1 and inducible expression of hepcidin-2 in largemouth bass (*Micropterus salmoides*), *Fish & Shellfish Immunology* 26 (2009) 898-907.
[102] Rosen 2009, Table 2, Table 4.
[103] Rosen 2009, Table 4.
[104] Rosen 2009, Table 4.
[105] EPA, Summary from the Health Advisory for Dacthal and Dacthal Degradates, Document Number: 822-S-08-002, available at http://www.epa.gov/ogwdw000/ccl/pdfs/reg_determine2/healthadvisory_ccl2-reg2_dacthaldegradates_summary.pdf.
[106] Rosen 2009, Table 2, Table 3.
[107] Nash, J.P., D.E. Kime, L.T.M. Van der Ven, P.W. Wester, F. Brion, G. Maack, P. Stahlschmidt-Allner, and C.R. Tyler, 2004, Long-term Exposure to Environmental Concentrations of the Pharmaceutical Ethynylestradiol Causes

	low concentrations of EE2 led to feminization of males through the production of vitellogenin mRNA and protein, impacts on gonadal development, and near extinction of species form the lake where they were being tested.[108] Trout exposed to EE2 during sexual development had increased levels of aneuploid sperm, leading to decreased embryonic survival and ultimately diminished reproductive success.[109] *Lumbriculus variegatus* exposed to EE2 accumulated high amounts, indicating secondary poisoning of predators might be possible.[110] It is also on the EPA's CCL3 list.[111] It has been detected in the waterbodies.[112]
Indole	Indole is an aromatic heterocyclic organic compound found in fragrances and pharmaceuticals. It has been detected in the waterbodies.[113]
methyl salicylate	Methyl salicylate is a fragrant oil, known as wintergreen. It is found in numerous consumer products including insect repellents, topical treatments for muscle and joint pain, and in suntan lotion. It has been detected in the waterbodies.[114]
Octachlorostyrene	Octachlorostyrene is a halogenated aromatic compound and persistent and bioaccumulative toxicant pesticide. It has been detected in the waterbodies.[115]
para-cresol	Cresols have a variety of uses including disinfectants, fragrances, herbicides, pharmaceuticals, and wood preservatives. Para-cresol has been detected in the waterbodies.[116]
Polybrominated diphenyl ethers	PBDEs are a class of synthetic flame retardants used in plastics, cushions, and clothing. They are similar to PCBs, and like PCBs, they come in 209 different congeners. They bioaccumulate in freshwater and marine fish, and their effects are believed to be similar to that of PCBs. PBDE and a-hexabromocyclododecane (HBCD) are flame retardant additives used in household and commercial applications. Captive American kestrels

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Reproductive Failure in Fish, *Environ Health Perspective* 112:1725-1733 (2004), available at http://www.ehponline.org/members/2004/7209/7209.pdf.

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exposed to DE-71 and HBCD resulting in the birds laying eggs that contain concentrations currently found in wild herring gulls ad peregrine falcons. It resulted in delayed egg laying and smaller eggs being laid, causing thinner eggshells and differential weight loss during embryonic development, and reduced fertility and reproductive.[117] Another study found that PBDE may reduce reproductive success in ospreys.[118] BDE 47, BDE 99, and BDE 100 have been detected in the waterbodies at varying concentrations.[119]

Synthetic musks Synthetic musks are chemicals used in fragrances. Among the most ubiquitous are Galaxolide and Tonalide. These chemicals bioaccumulate in fish and have been detected in Las Vegas Wash and Lake Mead.[120] Galaxolide and Tonalide have been detected in the waterbodies.[121]

Triphenolphosphate Is a flame retardant added to computer products. It is water resistant and is a neurotoxin in animals. It has been detected in the waterbodies.[122]

Tributyl phosphate Commonly known as TBP, it is an organophosphorus compound used as an extractant and plasticizer. It has been detected in the waterbodies.[123]

Triclosan It is used in soaps and toothpaste and can act as an endocrine disruptor at concentrations found in US streams. More than 55% of streams examined in 2002 had a median concentration of 0.14 ppb. Research indicates .15 ppb is capable of perturbing hormonal signaling mechanisms. It has a similar chemical structure to PBDEs and PCBs and bioaccumulate in fish and can be found in human breast milk.[124] It has been detected in the waterbodies.[125]

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Trifluralin Trifluralin is an herbicide used to control weeds. It can cause liver and kidney damage, decreased fetal weight and size, and increased miscarriages. It is on the EPA's Tier 1 EDSP list.[126] It has been detected in the waterbodies.[127]

Tris(2-chloroethyl) Phosphate It is used as a flame retardant in automobiles and furniture. It has been shown to decrease cell viability, DNA synthesis, and cell numbers. It has been detected in the waterbodies.[128]

Tris(2-butoxyethyl) Phosphate It is a flame retardant used in floor polish and as a plasticizer in rubber and plastics. It has been detected in the waterbodies.[129]

NDEP is also obligated to test these waterbodies for the following pollutants:[130]

Acetaminophen Acetaminophen has the ability to antagonize the effects of E2. It has been detected in the waterbodies.

Atenolol Atenolol is a beta blocker used to treat Cardiovascular diseases. It is considered a human carcinogen and is known for reproductive and development toxicity, neurotoxicity, and acute toxicity.

Atorvasatin Popularly known as Lipitor, atorvasatin is a statin used for lowering blood cholesterol. Statins may lower testosterone levels.

Atrazine Atrazine can cause sub-lethal effects in aquatic organisms and amphibians at .1 *m*/L. it is on the EPA's EDSP Tier 1 screening list,[131] and can cause cardiovascular system and reproductive problems in individuals exposed longterm to .003 mg/L.[132] It has been detected in the waterbodies.

Benfluralin Benfluralin is a pre-emergent dinitroaniline herbicide used to control grass and weeds. It is on the EPA's EDSP tier 1 screening list. It is toxic to the kidneys, liver and thyroid. It has been detected in the waterbodies.

BHA Butylated hydroxyanisole is a food additive and aromatic organic compound. The oxidative characteristics of BHA may contribute to

[126] 74 Fed. Reg. 17579.
[127] Rosen 2009, Table 3.
[128] Rosen 2009, Table 4.
[129] Rosen 2009, Table 4.
[130] NAC 445A.121(5) "If toxic materials are known or suspected by the department to be present in a water, testing for toxicity may be required to determine compliance with the provisions of this section and effluent limitations. The failure to determine the presence of toxic materials by testing does not preclude a determination by the department, on the basis of other criteria or methods, that excessive levels of toxic materials are present."
[131] 74 Fed. Red. 17579.
[132] EPA 2009.

carcinogenicity or tumorigenicity. It is on the EPA's CCL3 list.[133] It has been detected in the waterbodies.

Bisphenol A BPA is a manmade chemical found in plastic products frequently used as food and beverage containers, and in epoxy resins found in dental sealants. Animals exposed to low doses of the natural hormone estradiol or the environmental estrogen BPA during fetal development were more likely to develop a precursor of prostate cancer than those not exposed. There is also evidence that BPA may have effects on obesity and diabetes. It has been detected in the waterbodies.

Carbamazepine Carbamazepine is a mood stabilizing drug used to treat epilepsy and bipolar disorder. It is also a known endocrine disruptor. It has been detected in the waterbodies.

Cimetidine Cimetidine is a histamine used to treat heartburn and peptic ulcers. It also inhibits many isozymes of the cytochrome enzyme system. It can enhance estrogen activity and cause spontaneous lactation in females and gynecomastia in males. It has been detected in the waterbodies.

Clarithromycin Clarithromycin is a macrolide antibiotic. It has been associated with kidney and liver failure. It has been detected in the waterbodies.

Cotinine Cotenine is a metabolite of nicotine. It has been detected in the waterbodies.[134]

Dehydronifedipine It is a by-product of heart medication. It has been detected in the waterbodies.[135]

Diazepam It is a pharmaceutical that may affect male reproductive organs. It has been detected in the waterbodies.

Diltiazem It used to treat heart conditions and has been detected in the waterbodies.[136]

Fluoxetine Fluoxetine can significantly delay metamorphosis in amphibian development.[137] It has been detected in the waterbodies.

Sulfamethoxazole It is commonly used to treat urinary tract infections and sinusitis. It has been detected in the waterbodies.[138]

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[133] EPA 2009 CCL3.
[134] Boyd 2002.
[135] Boyd 2002.
[136] Boyd 2002.
[137] Rogers, E.D. and M.C. Black, 2003, Effect of Fluoxetine on Amphibian Development.
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For each waterbody on the 303(d) list, NDEP must establish total maximum daily loads for pollutants that water can sustain without exceeding water quality standards.[139] NDEP must establish a TMDL for every pollutant that prevents or is expected to prevent a waterbody from attaining applicable water quality standards.[140]

VI. Conclusion

If the NDEP does not revise the current water quality criteria, aquatic ecosystems will be irreparably damaged, recreational uses will be diminished, and commercial uses will be thwarted. Methods for the extraction of EDCs exist and NDEP must establish and enforce limitations. The lake is currently at 1,100 feet, a historic low. As draught conditions persist, elevation is expected to continue to drop. This will make it difficult for NDEP to protect and maintain the water quality of these waterbodies. It must take steps now to ensure that EDCs do not continue to compromise the their water quality.

The materials enclosed with this submittal support the finding that Las Vegas Wash, Las Vegas Bay, and Lake Mead are impaired due to EDCs. The information presented in this submittal is born from peer-reviewed publications using data and information collected and developed in a scientifically sound and defensible manner. I am enclosing a cd of electronic copies of the publications cited in this submittal. Many of these publications contain relevant documentation of quality assurance, numerical data, and maps. If you seek additional information in these regards, or have any other questions about the submittal, please do not hesitate to contact me at jlopez@biologicaldiversity.org or 415-436-9682 x. 305.

Sincerely

Jaclyn Lopez

Enclosed on cd:

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