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

Final Report

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A. INTRODUCTION

The Las Vegas Wash is the sole drainage from the Las Vegas Valley watershed to Lake Mead. The four components of flows in the Las Vegas Wash are tertiary treated municipal wastewater, urban runoff, shallow groundwater, and storm water. Increased urbanization in the valley over the past two decades has resulted in increased flows through the Wash, which has caused significant erosion and wetland destruction.

Since 1998, the Las Vegas Wash Coordination Committee has implemented long-term management strategies for the Las Vegas Wash. A series of projects was undertaken to control erosion, improve water quality, and enhance the ecosystem of the Wash. These projects include construction of several erosion control structures (Zhou *et al*. 2004) and a wetland park. While these projects have provided benefits in terms of water quality improvement and ecosystem enhancement, their potential to change the flow regime of the wash by creating ponds and slowing the flow of the Wash to Lake Mead has created concern regarding the potential for effects on accumulation of contaminants in the Wash. The pools behind the erosion control structures provide habitat for a variety of fish and wildlife, particularly migratory birds. Wetlands have the potential to be contaminant "sinks" or "hot spots" for exposure of fish and wildlife, both resident and migratory, to toxic contaminants including pesticides (Beyer *et al.* 1996).

Other factors might also alter the flow of water in the Las Vegas Wash and affect water quality conditions. Changing lake levels, erosion and formation of deltas, or increasing flows of municipal wastewater treatment plant effluent or diversion of these effluents might result in changes in water quality parameters that affect the cycling, degradation, accumulation, and toxicity of contaminants. For example, fish in newly flooded reservoirs often have elevated concentrations of toxic methylmercury in their tissues. When terrestrial zones are flooded during reservoir filling, enhanced microbial methylation of inorganic mercury in the terrestrial zone occurs, which causes a rapid increase in bioaccumulation of methylmercury in fish (Beyer *et al*. 1996). Any factor that causes the level of the Las Vegas Wash, or pools within it, to suddenly increase to a sustained higher level that inundated surrounding terrestrial areas could cause an increase in methylmercury bioaccumulation in the aquatic food web.

To determine whether factors affecting the flow of the Las Vegas Wash might have potential undesired effects on environmental contaminants in the Wash, an initial monitoring effort was conducted and the results are presented in this report. Additional monitoring has since been conducted, and results will be presented in future reports. If the results of these monitoring events indicate a potential concern related to contaminants, researchers will meet to identify subsequent monitoring needs and to further develop and implement the monitoring plan.

This report describes an assessment of the concentrations of a selected suite of contaminants of potential concern (COPC) in water, sediment, whole fish, and bird eggs collected as part of the 2003 Las Vegas Wash Monitoring and Characterization Study. Contaminant concentrations were assessed to determine whether specific contaminants are cause for concern related to effects on fish and birds of the Las Vegas Wash. This report presents the results of a screening-level assessment rather than a comprehensive risk assessment.

B. CHEMICALS OF POTENTIAL CONCERN

The chemicals of potential concern (COPC) identified for this assessment are presented in Table 1. These chemicals were specified as contaminants of concern in Appendix III of the document entitled "Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries" (December 2001, Las Vegas Wash Coordination Committee). Common synonyms for some of the organic COPC are listed in Appendix A. Additional organic chemicals were analyzed in bird eggs and in whole fish, but these chemicals were not included among those listed as contaminants of concern in the 2001 Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries. The concentrations of the additional organics analyzed in bird eggs and whole fish are presented in Appendices D and G, respectively.

1. Organics

Organochlorine Pesticides

The five major groups of organochlorine pesticides are DDT and its analogs, hexachlorocyclohexane, cyclodienes and related chemicals (including aldrin, dieldrin, and endrin), toxaphene and related chemicals, and the caged structures mirex and chlordecone (Beyer *et al*. 1996, Hoffman *et al*. 2003). Organochlorine pesticides are generally highly soluble in lipids (lipophilic), and so the greatest concentrations are often found in fat deposits in an organism. Many organochlorine pesticides are persistent in the environment as well, but physical and biological factors can influence this property. Organochlorine pesticides are neurotoxic agents with various modes of action. Co-exposure to several organochlorine pesticides is common, and they can interact to produce greater or less exposure or toxicity than would be expected for an individual chemical (Hoffman *et al*. 2003).

DDT and Its Metabolites

Technical DDT, the form that is applied as a pesticide, is a mixture of several compounds. The mixture is altered in the environment by abiotic processes (weathered) and metabolized by organisms, changing the composition in terms of the constituent compounds and their relative concentrations. DDT and its metabolites that are evaluated in this report are presented in Table 2. Of these compounds, p,p'-DDT, p,p'-DDE, and p,p'-DDD are the predominant isomers found in the environment (ATSDR 2002). According to Beyer *et al*. (1996), only the p,p'- isomers have been related to adverse effects. The o,p'- isomers are nearly inactive with regard to pesticidal activity (ATSDR 2002). DDT concentrations reported in environmental samples may refer to the sum of all DDE, DDD, and DDT residues, or they might be reported as total DDT (or ∑DDT).

DDT and its analogs are neurotoxic agents. The major sublethal risks of DDT are the effects of its metabolite DDE, including embryotoxicity, eggshell thinning, and related adverse effects on reproductive success of birds. DDT and DDE have been reported to have estrogenic activity, and DDT in experimental birds induced enzymes that break down the sex hormones that regulate mobilization of calcium. Among the group of DDT-related chemicals, DDE residues generally occur most frequently and at the greatest concentrations in environmental samples. Typically, eggshell thinning of 18 to 20% or more for several years is related to population declines. The brown pelican is believed to be the most sensitive avian species to the effects of DDE on reproduction, with a concentration of 3 µg/g wet-weight (ww) in the egg associated with near total reproductive failure (Hoffman *et al*. 2003, citing Blus 1982).

Benzene Hexachloride (BHC)

Benzene hexachloride (BHC, also known as hexachlorocyclohexane (HCH)) is a neurotoxic synthetic chemical mixture consisting of eight steric isomers (ATSDR 2005a, Hoffman *et al*. 2003). Technical grade BHC, a mixture of five isomers, was once used as an insecticide in the United States but has not been produced or used here for more than 20 years (ATSDR 2005a). The gamma isomer (gamma-BHC, or lindane) was the main insecticidal constituent of technical grade BHC (Hoffman *et al*. 2003). Lindane is one of the few organochlorine pesticides that is still widely used (Hoffman *et al*. 2003). Lindane has not been produced in the United States since 1976, but it can be imported and is available for insecticide use on fruit, vegetables, forest crops, and animals and animal premises, as well as in certain prescription medications to treat scabies and head lice in humans (ATSDR 2005a). Though technical grade BHC is no longer used in the United States, certain BHC constituents persist in the environment, including **alpha-BHC**, **beta-BHC**, **delta-BHC**, and **gamma-BHC (lindane)**. Some isomers occur in air as vapor or attached to airborne particles and can be transported great distances in the environment.

Lindane has various properties that limit its hazards to wildlife, which probably explains its continued use. Following ingestion, lindane is rapidly metabolized to chlorophenols and chlorobenzenes that are easily excreted (Hoffman *et al*. 2003). Lindane is readily metabolized and excreted in birds (Beyer *et al*. 1996), and the half-life of lindane in bird eggs and tissues is less than that for most other organochlorine pesticides (Hoffman *et al*. 2003). It also degrades rapidly following application in the field (Hoffman *et al*. 2003). Though lindane has been used in the United States in seed treatments, lindane residues have rarely been found in tissues or eggs of seed-eating birds and were never found in their predators (Hoffman *et al*. 2003).

Cyclodienes and Related Compounds

Among the cyclodienes and related compounds are **aldrin**, **chlordane, dieldrin**, **endrin**, and **heptachlor.** These are the most acutely toxic organochlorine pesticides (Hoffman *et al*. 2003). Cyclodienes are neurotoxic agents (Hoffman *et al*. 2003) and are highly toxic to fish, insects, birds, and mammals. None of the cyclodienes are known to cause major effects on reproduction at levels well below those causing mortality (Beyer *et al*. 1996). Although a number of cyclodiene metabolites have been identified, the only one that is environmentally important is 12-ketoendrin (Beyer *et al*. 1996). It is important in a few mammals including laboratory rats but is rarely found in birds (Hoffman *et al*. 2003), and it can generally be ignored for wildlife toxicology purposes (Beyer *et al*. 1996).

Aldrin and Dieldrin

Use of aldrin and dieldrin in the United States was canceled, except for limited uses, in 1974, and several other countries also banned these pesticides in the 1970s (Hoffman *et al*. 2003). When aldrin is applied in the field, it rapidly degrades to dieldrin such that aldrin generally is found in biological samples only near application sites (Hoffman *et al*. 2003). Aldrin also is rapidly converted to dieldrin by metabolism in animals. The conversion of aldrin to dieldrin has been documented in birds, fish, and other animals (Beyer *et al*. 1996). However, dieldrin is persistent and retains the toxicity of the parent compound (Hoffman *et al*. 2003). In general, the toxicities of aldrin and dieldrin are similar, so conversion of aldrin to dieldrin in the environment is not expected to alter the toxicity except in fish, to which dieldrin is an order of magnitude more toxic than aldrin (Beyer *et al*. 1996).

Endrin

Endrin is one of the most acutely toxic organochlorine pesticides and more toxic than aldrin or dieldrin. However, endrin has a relatively short half-life, much shorter than dieldrin, in the environment and in organisms (Beyer *et al*. 1996, Hoffman *et al*. 2003).

Chlordane and Related Chemicals and Degradation Products

Technical chlordane is a mixture of chlorinated hydrocarbons that has been used as an insecticide since 1947 (Eisler 2000b). It is an organochlorine pesticide in the cyclodiene group. It was widely used in agriculture until 1978, when its use was restricted to subterranean termite control, nonfood plants, and root dip (Eisler 2000b). Later its use was restricted to termite control only, but significant home and garden use continued (Eisler 2000b). In 1988, the U.S. EPA moved to cancel registration of chlordane and ban its sale and commercial use (Eisler 2000b). All uses have recently been banned (Beyer *et al*. 1996).

Technical chlordane is comprised of approximately 45 components including **cis-chlordane, trans-chlordane, heptachlor, cis-nonachlor,** and **trans-nonachlor** (Beyer *et al*. 1996, Eisler 2000b). Heptachlor occurs as a component of technical chlordane but also is used alone (see discussion of heptachlor and heptachlor epoxide below). Heptachlor epoxide and oxychlordane are toxicologically significant degradation products of chlordane resulting from biological and physical degradation of chlordane in the environment or from metabolism following ingestion. Heptachlor can result from breakdown of cis- and trans-chlordane and then can be oxidized to heptachlor epoxide. Oxychlordane can originate from breakdown of heptachlor, cis- and trans-chlordane, or trans-nonachlor. Heptachlor epoxide in the environment usually occurs as a result of the use of heptachlor rather than chlordane.

Chordane is persistent and lipophilic, *i.e*., it tends to accumulate in fat. It is transported in air and water and is now considered to be ubiquitous in the environment. Chlordane has low water solubility and relatively low vapor pressure, and due to its tendency to sorb to soils and sediments, is transported to aquatic environments in part by erosion of contaminated soils. (Eisler 2000b)

Chlordane is a nerve stimulant that acts by disrupting nerve and muscle membranes (Eisler 2000b). At low chronic doses, it causes hyperexcitability and lack of coordination in animals (Eisler 2000b). High, acute doses cause tremors and convulsions and can cause spasmic muscle twitching and death (Eisler 2000b). Oxychlordane is much more toxic and persistent than its parent compounds. Residues of the two critical compounds in the brains of experimental birds dying from chlordane exposure were heptachlor epoxide and oxychlordane (Hoffman *et al*. 2003).

Heptachlor and Heptachlor Epoxide

Heptachlor, a synthetic cyclodiene insecticide, was formerly used widely as a pesticide for killing insects in homes and other buildings and on food crops, and particularly for control of soil pests including termites, but it was gradually phased out until most of its uses were canceled by 1983 (ATSDR 2005b, Beyer *et al*. 1996, Hoffman *et al.* 2003). Heptachlor is both a breakdown product and a component of chlordane (ATSDR 2005b). Heptachlor was originally purified from technical chlordane and has been used as a pesticide on its own. Technical-grade heptachlor, which was the form of heptachlor most commonly used as a pesticide (ATSDR 2005b), has lesser purity than heptachlor and contains trans-chlordane (U.S. EPA 1980). Heptachlor epoxide was never produced commercially and is not a pesticide but is a metabolite of heptachlor and chlordane. Heptachlor is rapidly converted to heptachlor epoxide in the environment and by bacteria and vertebrates (ATSDR 2005b, Beyer *et al.* 1996), but heptachlor epoxide is persistent and remains as toxic as the parent compound (Hoffman *et al*. 2003). As stated previously, heptachlor epoxide in the environment usually occurs as a result of the use of heptachlor rather than chlordane. Heptachlor is not very soluble in water (ASTDR 2005b).

Mirex

Mirex was used to replace dieldrin and heptachlor in attempts to control fire ants in the southeastern United States and also was used as a fire retardant (Hoffman *et al*. 2003). It was banned for all uses in the United States in 1978 (Hoffman *et al*. 2003). Mirex is slowly and only partially metabolized and is readily stored in the body and thus has the potential to cause chronic toxicity (Hoffman *et al*. 2003). It may accumulate to a high degree in fatty tissues and in eggs (Hoffman *et al*. 2003). Mirex residues have been reported to accumulate at a rate of 25×10^6 from water to bird eggs (Hoffman *et al*. 2003, citing Norstrom *et al.* 1978). Mirex is one of the most stable and persistent of the organochlorines (Beyer *et al*. 1996). Hexachlorobenzene (HCB) and chlordecone are among its metabolites (Beyer *et al*. 1996).

HCB

Hexachlorobenzene (HCB) was widely used as a fungicidal treatment for seeds until 1965 (ATSDR 1997). It also was used to make fireworks, ammunition, and synthetic rubber (ATSDR 1997). There currently are no commercial uses for HCB in the United States, and it does not occur naturally in the environment (ATSDR 1997). It is formed as a by-product in the making of other chemicals (chlorinated solvents and pesticides), in the waste streams of chloralkali (production of chlorine and caustic soda) and wood-preserving plants, and in the burning of municipal waste (ATSDR 1997, Beyer *et al.* 1996). It also is a degradation product of the pesticide mirex (Beyer *et al*. 1996). HCB is persistent in the environment (Beyer *et al.* 1996). It has low water solubility and tends to remain in sediments in aquatic systems or to bind to soil in terrestrial systems (ATSDR 1997). HCB can accumulate to a high degree in fish, birds, and some other organisms. Chronic exposure of animals to HCB can damage the liver, thyroid, nervous system, bones, kidneys, blood, and immune and endocrine systems (ATSDR 1997). Developing organisms can also be affected by maternal exposure (ATSDR 1997). HCB can reasonably be expected to cause cancer in some animals (ATSDR 1997).

PCBs

Polychlorinated biphenyls (PCBs) are a group of synthetic chlorinated aromatic hydrocarbons that have been in general use since the 1930s. PCBs are comprised of a group of monochloro- to decachlorinated compounds with a biphenyl nucleus, with 209 possible congeners, though less than 100 exist in concentrations great enough to have environmental or toxicologic significance (Beyer *et a*l. 1996). PCBs had a wide range of industrial applications because of their properties of resistance to chemical or biological degradation; high thermal stability; and low vapor pressure, flammability, and water solubility (Beyer *et al*. 1996). PCBs were used as heat transfer agents, lubricants, dielectric agents, flame retardants, plasticizers, and waterproofing materials (Beyer *et al*. 1996).

PCBs were produced and released to the environment in large quantities and are now ubiquitous in the environment, including the atmosphere, terrestrial systems, and aquatic systems (Beyer *et al*. 1996). Some of the same properties that made them useful also make them a problem in the environment. PCBs are hydrophobic and have low water solubility, hence they tend to adsorb to sediments, particulate matter, and biota in aquatic systems. Because they resist bacterial and chemical breakdown, they are persistent in the environment. They bioaccumulate to high concentrations in organisms and biomagnify in food webs so that animals at higher trophic levels tend to have the greatest PCB burdens (Beyer *et al*. 1996). PCBs also are subject to long-range atmospheric transport (Beyer *et al*. 1996). Production and use of PCBs were reduced in the 1970s after it was discovered that they occurred and persisted in wildlife, and the manufacture of PCBs was banned in the United States in 1979 (Beyer *et a*l. 1996).

PCBs can cause toxic responses including, but not limited to, thymic atrophy (a "wasting syndrome"), immunotoxic effects, reproductive impairment, and porphyria and related liver damage (Beyer *et al*. 1996). The most sensitive functional endpoint for PCB toxicity in birds appears to be reproductive impairment associated with egg residues (Beyer *et al*. 1996).

2. Metals, Metalloids, and Other Inorganics

Metals and metalloids are naturally-occurring chemicals. Many metals (essential elements) are required in small amounts for proper functioning of biological systems but have toxic effects at greater concentrations. Others are not essential to the body, but organisms have adapted to their presence at concentrations normally encountered in the environment. However, certain natural phenomena and anthropogenic disturbance and activities can result in localized elevated concentrations of metals that are toxic to biota including fish and wildlife.

Aluminum

Aluminum is a naturally abundant metal in the environment. Uses for aluminum include food additives, drugs (antacids), consumer products (cooking utensils, foil), and treatment of drinking water (coagulants). Aluminum also occurs at elevated concentrations in areas where mining and smelting activities take place. Aluminum toxicity varies considerably with chemical species and complexation. Speciation is affected by several factors, most importantly pH (Tuttle and Thodal 1998). Solubility of aluminum and its toxicity to aquatic organisms generally increase with decreasing pH, and dissolved concentrations can reach lethal levels for aquatic species. Under near-neutral to alkaline conditions (pH 6.0 - 8.0), aluminum is not very soluble in water and is nearly biologically inactive (Tuttle and Thodal 1998). Aluminum solubility increases when water pH is greater than 8.0, but the implications to aquatic biota are poorly understood (Tuttle and Thodal 1998). The gills of fish are particularly susceptible to aluminum poisoning.

Antimony

Antimony is a naturally-occurring metal found in small amounts in the earth's crust (ATSDR 1992, USDOE 2006) and is widely distributed in the environment at low levels. Antimony ores are mixed with other metals to form antimony alloys or combined with oxygen to form antimony oxide (USDOE 2006). Most of the antimony used in the United States is imported from other countries for processing (USDOE 2006). Only small amounts are mined in the United States, but antimony is produced in the United States as a by-product of smelting lead and other metals (USDOE 2006). Antimony is used in lead storage batteries, solder, sheet and pipe metal, bearings, castings, and pewter (USDOE 2006). Antimony oxide is added to textiles and plastics as a fire retardant (USDOE 2006) and stabilizer. The most widely used antimony compound is antimony trioxide, the form used as a flame retardant. Antimony also is used in paints, ceramics, and fireworks, and as enamels for plastics, metal, and glass (USDOE 2006).

Antimony can exist in a number of valence states, but the +3 (antimony trioxide) and +5 (antimony pentoxide) states are the most relevant to natural waters (WHO 1996), and the +5 state predominates in unpolluted waters. Most antimony in the environment will eventually find its way into soil or sediment, where it binds strongly to particles that contain iron, manganese, or aluminum (ATSDR 1992). The concentration of antimony found in rivers and lakes is normally less than 5 ppb (ATSDR 1992). Antimony does not appear to accumulate in aquatic animals (ATDSR 1992). The U.S. EPA has not set ambient water quality criteria for antimony.

Arsenic

Arsenic is a metalloid that is ubiquitous in the environment; it is found in air, water, soil, and biota (USDI 1998). It is found naturally in mineral deposits, mineral springs, and volcanic gases (USDI 1998). Arsenic can exist in four oxidation states in the environment: As^{-3}, As^{0}, As^{+3} or As(III), and As^{+5} or As(V), and it can occur in organic or inorganic forms (USDI 1998). Agriculture and industrial activities are responsible for the release of large quantities of materials containing arsenic to the environment. Arsenic is found in coal fly ash and in wastes from production of herbicides, fungicides, algicides, insecticides, and wood preservatives (Newman 2001, USDI 1998). Contamination by mine tailings, smelter wastes, and natural mineralization can result in high concentrations of arsenic in water (USDI 1998).

Inorganic As(V) is the most common species in water, and As(III) converts readily to As(V) under aerobic conditions, though some As(III) might remain (USDI 1998). Arsenic is relatively persistent in aquatic systems, and it is bioaccumulative (particularly in some aquatic species) but does not appear to biomagnify in food webs (USDI 1998). Toxicity and bioavailability of arsenic can vary significantly depending on the chemical form and route of exposure. In general, inorganic arsenic compounds are more toxic than the organic compounds, and As(III) is more toxic than As(V) (USDI 1998). Conversion of As(III) to As(V) is favored in aquatic environments and tends to reduce the toxicity of arsenic in natural waters (USDI 1998). Factors such as water temperature, pH, organic content, phosphate concentration, suspended sediment, the presence of other substances and oxidants, and arsenic speciation influence arsenic toxicity in water (USDI 1998). Higher temperatures increase the uptake of arsenic into biota (USDI 1998).

Normal water concentrations of arsenic are <10 µg/L, and terrestrial biota, birds, and freshwater biota typically contain <1 mg As/kg ww except near sources of arsenic pollution (USDI 1998). An arsenic concentration of 0.27 mg As/kg ww (≈ 1 mg As/kg dry-weight) has been reported to be the 85th percentile concentration of arsenic in freshwater fish (USDI 1998, citing Schmitt and Brumbaugh 1990).

Effects reported in fish exposed to elevated levels of arsenic include liver pathology and deformities of the fins, jaws, head, and eyes (USDI 1998). Turtles exposed to high levels of arsenic exhibited blindness; keratinization (leathery appearance) of the eyelids, nasal areas, and roof of the mouth; and mortalities (USDI 1998). Bird species vary substantially in their tolerance to arsenic. Reported effects in birds exposed to arsenic through a dietary route include reduced growth, reduced liver weight, delayed egg laying, reduced egg weight, eggshell thinning, and mortality (USDI 1998). Although some studies have shown that arsenic injected into eggs is extremely toxic, elevated levels of arsenic rarely occur naturally in bird eggs, even in those collected from areas of high contamination (USDI 1998). Arsenic is reported to be rapidly accumulated and eliminated in mallards (USDI 1998). Arsenic is teratogenic and carcinogenic in many mammals (Newman 2001; USDI 1998, citing Eisler 1988, 1994). It is toxic to the peripheral nervous system, liver, and vascular system. Although it is not considered to be an essential element in most species, arsenic has been reported to have beneficial effects in a variety of animals and plants, and arsenic "deficiencies" are associated with poor growth, reduced survival, and inhibited reproduction (USDI 1998).

Barium

Barium is a metal that occurs in nature as part of many compounds. Barium and barium compounds are used in several industries, and barium is used mostly by the oil and gas industries to make drilling muds, which are lubricants that ease the drilling of rock. Barium sulfate is used to make paints, bricks, tiles, glass, rubber, and other barium compounds. Some barium compounds are used to make ceramics and insect and rat poisons; used as fuel and oil additives; used in treatment of boiler water and in the production of barium greases; used as a component of sealants, in paper manufacturing, and in sugar refining; used in animal and vegetable oil refining; and used to protect limestone objects from deterioration. Barium sulfate also is used in medicine to perform medical tests and to take x-rays of the stomach and intestines. (ATSDR 2005c)

Barium sulfate and barium carbonate are the barium compounds most commonly found in water and soil (ATSDR 2005c). Barium appears to undergo environmental biotransformation as a divalent (2^+) cation (WHO 2001). Background levels of barium in surface water average 0.030 ppm or less but can average as much as 0.30 ppm in some regions of the United States (ATSDR 2005c). Barium adsorbs onto metal oxides in natural waters, and the soluble barium ion concentration in most waters is controlled by the amount of sulfate in the water (WHO 2001). Soluble barium and barium particles can be transported long distances in rivers (WHO 2001).

Barium levels in wildlife have not been documented, but barium has been reported to occur in dairy products and in eggs, indicating that barium uptake can occur in animals (WHO 2001). According to WHO (2001):

> "There is little information on the potential for adverse effects in fish exposed to barium compounds. In the only study located, an LC_{50} value in sheepshead minnows was greater than 500 mg/litre…Based on toxic effects observed in daphnids…mussels…, and other aquatic organisms exposed to barium concentrations that were within the upper range of those concentrations measured in surface waters, it appears that aquatic environments with relatively high barium concentrations may represent a risk to some aquatic populations. However, the paucity of information on environmental effects of exposure to barium compounds precludes a critical evaluation of environmental risk."

Beryllium

Beryllium is a rare chemical element that occurs as a component of certain rocks, coal and oil, soil, and volcanic dust. Beryllium forms compounds that are more covalent than ionic. Beryllium enters air, water, and soil as a result of combustion of coal or oil, release of industrial waste water or dusts, and weathering of rocks and soil. Beryllium typically occurs in freshwater at 0.001 mg/L or less, and, in the absence of a specific source, river waters typically have very low or undetectable levels. Beryllium is a carcinogenic priority pollutant. While all beryllium compounds are potentially harmful or toxic, dissolved beryllium (toxic, bioavailable form) is unlikely to occur at significantly toxic levels in ambient natural waters. Most beryllium in natural waters is bound (sorbed) to suspended matter or to sediment or bound to complexing agents. Beryllium is extremely toxic to warmwater fish in soft water, and toxicity decreases with increasing hardness. The small amount of data available suggest that most organisms bioconcentrate very little beryllium. (Irwin 1997)

Boron

Boron is a metalloid that is widely distributed in the environment at low concentrations. It occurs only in combined forms in nature, and it has an oxidation state of +3 in all of its chemical compounds. Boron compounds are usually degraded or transformed to boric acid and borates, which are the most ecologically significant of the boron compounds. The Mohave Desert of California is among the areas with the greatest natural input of boron in the environment. In North America, boron enters the environment as a result of human activities primarily through the use of boron compounds in laundry products; through irrigation drainage, fertilizers and other agricultural chemicals; during coal combustion; and through mining and processing. Boron compounds are also used as fire retardants, in leather tanning, in rocket fuels, as neutron absorbers in nuclear reactors, and in the production of a whitening agent used by the pulp and paper industry. (USDI 1998)

Boron compounds are water soluble. The chemical form of boron found in water is dependent on pH and other factors, and the predominant species of boron in most freshwater systems (pH <9) is undissociated boric acid. Boric acid and borate ion are stable in the aquatic environment and tend to accumulate and remain bioavailable for long periods of time. Surface water concentrations of boron rarely exceed 1 mg/L, and are usually <0.1 mg/L, in natural freshwater ecosystems. In the United States, boron concentrations in irrigation water typically range from <0.1 to 0.3 mg/L. On the basis of a limited number of field surveys, it appears that whole freshwater fish typically contain <4 mg B/kg. (USDI 1998)

Plants are generally much more susceptible than animals to boron toxicity (USDI 1998). The mechanism for boron toxicity in animals is not fully understood, and the chemical form of boron that is responsible for toxicity is not known (USDI 1998). Aquatic organisms (particularly algae) bioconcentrate boron to varying degrees (USDI 1998), and boron in water may be toxic to aquatic organisms (Tuttle and Thodal 1998). According to USDI (1998), while the database describing the effects of boron on fish is extensive, most of the available studies consider only waterborne exposures and do not address dietary exposure, nor do they relate boron levels in fish tissue to toxic effects. Field and laboratory studies suggest that fish commonly bioaccumulate boron from the diet but do not typically bioconcentrate it from water (USDI 1998), so the available data might not accurately predict effects on fish in the environment. The available data indicate that boron could reduce reproductive potential of sensitive fish species at 0.001 – 0.1 mg/L, and survival of the developmental stages of other species might be impaired at concentrations >0.2 mg/L. Low-level effects reported in laboratory studies might not be predictive of effects observed only at higher levels in natural systems. (USDI 1998)

Boron in the diet of birds can cause decreased hatching success and productivity, reduced body weight of hatchlings, and reduced growth. Boron is readily transferred into eggs and is commonly found at concentrations ranging from 0.05 – 0.6 mg/kg ww in most animal tissues (USDI 1998). Embryos and hatchlings are more susceptible than adult birds to the effects of dietary exposure to boron, and exposure received in the egg appears to be more toxic to ducklings than exposure through diet only (USDI 1998). Mallards are reported to rapidly accumulate and excrete boron (USDI 1998). In the western United States, agricultural irrigation can mobilize boron into aquatic systems at concentrations great enough to pose a risk to waterfowl and other wildlife (USDI 1998). Contradictory evidence suggests that effects of dietary boron might be increased by co-exposure to selenium in the diet under certain conditions (Tuttle and Thodal 1998, USDI 1998).

Cadmium

Cadmium in association with zinc is widely distributed in the earth's crust, and their mixed ores have been smelted since the 1950s. Cadmium is released to the environment when fossil fuels are burned and during zinc ore processing, mining and smelting. Cadmium is used in industrial processes such as plastic production, electroplating, and manufacture of alloys and batteries. Almost all cadmium that is used is eventually released to the environment. Cadmium is not very volatile compared to mercury and lead, but its transport to rivers is probably more important. Cadmium is not an essential element for animals and can be toxic following acute or chronic exposures. Cadmium also is carcinogenic. Acute or chronic exposure to cadmium can induce plants and animals to produce metallohioneins, proteins that sequester certain metals and render them less toxic to the exposed organism. Thus, cadmium can be accumulated in tissues to a great degree without causing a toxic response. Cadmium is bioaccumulative and can, but does not always, biomagnify in food webs. Molluscs can accumulate particularly great concentrations of cadmium, so long-lived birds that feed on molluscs can acquire heavy cadmium burdens, particularly in areas that receive inputs of sewage sludge. (Beyer *et al*. 1996, Newman 2001)

Chromium

Chromium is an abundant, naturally occurring metal that is mobilized into the environment by weathering of rock, but human activities are responsible for the far greater proportion of chromium releases. Chromium can exist as chromium III (Cr(III) or trivalent chromium) or as chromium VI (Cr(VI) or hexavalent chromium) (Newman 2001). Chromium often occurs as the oxyanions CrO_4^{2-} and CrO_7^{2-} (Newman 2001). Chromium is used extensively in domestic and industrial products (Eisler 2000a). It is used in alloys, catalysts, pigments, wood preservatives, and leather tanning processes (Newman 2001). Large amounts of Cr(VI) and Cr(III) enter the environment in sewage and solid wastes from disposal of consumer products containing chromium (Eisler 2000a). Chromium levels in the environment tend to be elevated near electroplating and metal finishing operations, publicly owned municipal wastewater treatment plants, tanneries, oil drilling operations, and cooling towers (Eisler 2000a).

Hexavalent chromium (but not trivalent chromium) is carcinogenic and the more toxic of the two forms (Newman 2001). Cr(III) is an essential nutrient in humans and some species of laboratory animals, but information in this regard is incomplete for other organisms. Little is known about the properties of organochromium compounds, water-soluble species, or their interactions in complex mixtures. Chromium chemistry is poorly understood, and existing analytical methods are inadequate for quantification of chromium species and ionic states. (Eisler 2000a)

Chromium can bioaccumulate to a high degree in organisms at lower trophic levels but does not appear to biomagnify in food webs. Discharge of chromium wastes into surface waters has damaged aquatic ecosystems. According to Eisler (2000c), sensitive freshwater aquatic species show reduced growth, inhibited reproduction, and increased bioaccumulation at approximately 10.0 µg/L of Cr(VI) or greater, and other adverse effects at 30.0 µg/L or greater of Cr(III). More research is needed into the carcinogenic and mutagenic properties of chromium on fish. Tissue levels of chromium >4 mg/kg dry-weight can be considered to be presumptive evidence of chromium contamination, but the significance of chromium concentrations in tissues in not known. (Eisler 2000a)

Copper

Copper occurs widely in the environment and generally is found in seawater and fresh water at 1 – 20 µg/L (USDI 1998, citing Irwin 1996). Copper is used extensively for wiring, electronics, and plumbing and is associated with mining and smelting, coal combustion, leachate from municipal landfills, and municipal sewage sludge (Newman 2001, USDI 1998). Copper is one of the most common contaminants found in urban runoff (USDI 1998), where it occurs, for example, due to wearing of vehicle engine and break parts, fungicide and herbicide application, *etc.* (U.S. EPA 1995). It exists in either +1 (cuprous ion) or +2 (cupric ion) oxidation states, but the latter is more commonly found in natural waters. Dissolved copper in natural waters occurs in several chemical forms and in organic and inorganic complexes (USDI 1998).

Copper is an essential element for all organisms but can be toxic at elevated concentrations associated with contamination (USDI 1998). It generally is more toxic to aquatic organisms than to birds or mammals (USDI 1998), and thus is used as a biocide to control growth of algae, bacteria, and fungi (Newman 2001). The dissolved fraction of copper is believed to be toxic to fish (USDI 1998). Speciation and toxicity of copper are influenced by other factors; low pH, soft water, and higher temperatures increase toxicity of copper (USDI 1998). Likewise, availability and thus toxicity of copper in sediment is affected by acid-volatile sulfide (AVS) and the degree of oxidation of the sediment (USDI 1998). A study of the relationships among copper concentrations in various environmental media indicated that the concentration of copper in water, rather than concentrations in sediment or invertebrates, appears to be the best predictor of copper concentrations in fish (USDI 1998). Synthesis of metallothioneins, proteins that sequester metals such as copper, is induced in most plants and animals exposed to copper and other heavy metals (USDI 1998) so that elevated body burdens of copper are not always indicative of toxicity. Copper toxicity due to excess exposure in the diet is rare in birds and mammals because copper concentrations are tightly regulated in these animals (USDI 1998). Few studies have examined the toxicity of copper to birds, but they appear to be less sensitive than most aquatic organisms (USDI 1998).

Iron

Iron is abundant in the earth's crust and is an important component of many soils (U.S. EPA 1986). It is an essential trace element required by plants and animals and is required for oxygen transport in blood of all vertebrate and some invertebrate animals (U.S. EPA 1986). The ferrous (+2, or bivalent) and ferric (+3, or trivalent) forms are the primary forms of concern in aquatic systems (U.S. EPA 1986). The ferrous form usually originates from pumped groundwater or mine drainage and remains in surface waters with low dissolved oxygen (U.S. EPA 1986). The ferric form is practically insoluble in water (U.S. EPA 1986). Iron can occur in natural organometallic or humic compounds and in colloidal forms (U.S. EPA 1986). In stratified lakes with anaerobic hypolimnia, dissolved ferrous iron can occur in the deep anaerobic waters, but during lake turnover, the iron is oxidized rapidly to insoluble ferric ion that precipitates to bottom sediments (U.S. EPA 1976). When iron precipitates in the presence of oxygen, it can form flocs that remain in suspension, to the detriment of fish and other aquatic life, or settle out on the bottom and smother benthic organisms and fish eggs or cause cementation of the substrate (U.S. EPA 1976). The U.S. EPA (1986) chronic aquatic criterion (CCC) for iron is 1000 µg/L, and there is no acute criterion.

Lead

Lead has been mined and smelted for centuries but has received much greater use since the Industrial Revolution (Beyer *et al*. 1996). Its widespread use in gasoline, batteries, solders, pigments, piping, ammunition, paints, ceramics, caulking, and many other applications has resulted in ubiquitous environmental distribution of lead arising from human activities (Beyer *et al*. 1996, Newman 2001). Consequently, "natural" environmental concentrations no longer exist, but concentrations far from emission sources might be considered "background" levels (Beyer *et al*. 1996).

Lead is a highly toxic heavy metal that acts as a non-specific poison that affects all body systems, resulting in a wide range of sublethal effects in animals (Beyer *et al*. 1996). Effects of chronic exposure include anemia and neurological dysfunction (Newman 2001), and higher concentrations can cause death. Organic compounds of lead such as tetraalkyl-lead were used extensively as anti-knock additives in gasoline. In 1973, the U.S. EPA issued reduction standards for lead in gasoline that resulted in a gradual phasedown, and in 1996, the Clean Air Act banned the sale of the small amount of leaded fuel still available for on-road vehicles (U.S. EPA 1996). Tetraalkyl-lead is metabolized in the liver to trialkyl-lead, which can cause neurological and other health problems (Newman 2001). There is no biological requirement for lead. Even the smallest measurable exposures to lead can affect biological systems, so a "no effect" tissue concentration cannot be defined (Beyer *et al*. 1996). However, the concentrations normally encountered in the environment far from emission sources generally have not been considered to directly affect survival of most wildlife. An exception is waterfowl and other birds that have ingested spent lead gunshot or anglers' weights, which has resulted in widespread mortality (Beyer *et al*. 1996). Lead is bioaccumulative, but whether it biomagnifies in food webs is unclear.

Magnesium

Magnesium, along with calcium, is a major contributor to water hardness. As an abundant intracellular cation, magnesium is a cofactor in enzymatic reactions and is important in the maintenance of cell membrane electric potential. Magnesium generally is not considered to be an environmental concern, but it can modify (typically reduce) the toxicity of co-occurring toxic metals in water. Magnesium salts generally are highly soluble in water. Magnesium commonly occurs at concentrations up to 10 mg/L but rarely exceeds 100 mg/L in natural waters. (UKWIR 2002)

Manganese

Soluble manganese is found in many groundwaters because of reducing conditions that favor the soluble +2 oxidation state (Manahan 2000). Manganese is removed from water by oxidation to a higher oxidation state that is insoluble, *i.e.*, Mn(II) to MnO_2 (or Mn(IV)). Aeration and higher pH favor oxidation (Manahan 2000), and lower pH results in more dissolved manganese (WHO 2004). Relatively high levels of Mn(IV) frequently are found in water as colloidal material (Manahan 2000). Manganese is only weakly bound to dissolved organic carbon (WHO 2004). Manganese may be associated with humic colloids or "peptizing" organic material that binds to colloidal metal oxides, stabilizing the colloid (Manahan 2000). The presence of chlorides, nitrates, and sulfates can increase manganese solubility (WHO 2004). In groundwater, the concentration of manganese is rarely greater than 2 mg/L (Manahan 2000). Concentrations of dissolved manganese in natural waters that are essentially free of anthropogenic sources can range from 10 to >10,000 µg/L. Manganese concentrations in natural surface waters rarely exceed 1000 µg/L and are usually <200 µg/L (WHO 2004).

The U.S. EPA has not set ambient water quality criteria for acute (CMC) or chronic (CCC) exposure of aquatic life to manganese (U.S. EPA 2002a). Relatively few studies have been conducted on the toxicity of manganese to fish (Andersson and Nyberg 1984). Most available aquatic toxicity tests were conducted with ionic manganese, and little is known about the aquatic toxicity of colloidal, particulate, and complexed manganese (WHO 2004). However, the ionic form is the most bioavailable and is assumed to be the most toxic. Manganese is generally bound in inorganic complexes and may be non-toxic despite high total concentrations. High manganese-to-color quotients indicate that a certain fraction of manganese exists as inorganic ions or newly formed precipitates, which may be toxic to fish. Tuttle and Thodal (1998) suggest a concern level of 388 µg Mn/L in water.

Mercury

Mercury is emitted to the environment from a variety of natural sources including volcanic activity and fluxes from the earth and the oceans (Beyer *et al*. 1996, USDI 1998). Mercury also is released by human activities including coal combustion, metal mining and production, waste incineration, chemical production processes, and sewage sludge application (USDI 1998). Mercury is used in electronics, dental amalgams, gold-mining, and paints (Newman 2001). Use of mercury in industrial processes and subsequent discharge in effluents to surface waters has resulted in poisoning of fish and the people and other animals that consume them. Mercury was used extensively as a biocide, *i.e*., as an anti-fungal seed treatment or to inhibit fungal growth in the pulp mill industry (Newman 2001). Humans and birds were poisoned by eating seeds treated with alkylmercury fungicides in the 1960s. Following these incidents, widespread discharge of mercury from industrial processes and use in agriculture declined.

Inorganic mercury is readily dispersed and transported in the environment (Beyer *et al*. 1996). Mercury occurs in natural waters in many forms, including elemental mercury, dissolved and particulate ionic forms, and dissolved and particulate methylmercury (Beyer *et al*. 1996). Methylmercury (organic form) is more toxic and bioaccumulative than the inorganic forms (USDI 1998). Inorganic mercury is methylated in the environment, primarily by microbes (Beyer *et al*. 1996). Methylation in aquatic systems can occur in the sediment and water column. Sediment can be a sink and a source of mercury in the environment and is a source of methylmercury to biota and to the water column (USDI 1998). Mercury levels in water tend to be greatest downstream of wetlands due to the high organic content of the water, and disturbance and re-suspension of wetland sediments can mobilize mercury associated with sediments (USDI 1998). Background concentrations of mercury in fresh water generally are thought to be <10 ng/L, but the use of "background concentrations" for comparison might not be particularly useful due to the global atmospheric transport of mercury (USDI 1998).

Nearly all of the mercury found in fish is methylmercury, even though little of the total mercury found in freshwater and sediments exists as methylmercury (Beyer *et al*. 1996). Inorganic mercury is absorbed less efficiently and excreted more efficiently than methylmercury. Inorganic mercury is not methylated by fish tissue, though it is methylated in the gut. The methylmercury in fish is obtained mostly from the diet and to a smaller extent from the water passing across the gills (Beyer *et al*. 1996, USDI 1998). Thus, concentrations of dissolved organic mercury compounds are more useful than total dissolved mercury concentrations for predicting mercury concentrations in fish (USDI 1998). Uptake of mercury from water into fish is affected by temperature, pH, and water hardness, as well as mercury speciation (USDI 1998). Mercury concentrations in fish tissues generally increase with increasing age or body size, and piscivorous fish and other animals at higher trophic levels (particularly long-lived species) will accumulate more methylmercury than animals at lower trophic levels (Beyer *et al*. 1996). Because methylmercury is bioaccumulative and biomagnifies in aquatic food webs, some water quality criteria or sediment criteria are developed to be protective of animals at higher trophic levels, even though they might not be directly exposed to water or sediment.

Mercury is a toxic heavy metal and is not required by vertebrate organisms (Beyer *et al*. 1996). In animals, inorganic mercury tends to exert its greatest effects on the kidneys (where metallothionein binds and sequesters mercury), while methylmercury is highly toxic to developing embryos and the nervous system (USDI 1998) and particularly to the central nervous system (Beyer *et al*. 1996). Neurotoxicity to the central nervous system is the most likely chronic toxic effect of methylmercury in adult fish and birds (Beyer *et al*. 1996). Chronic exposure of fish to methylmercury can result in lack of coordination, inability to feed, diminished responsiveness, and brain lesions (Beyer *et al*. 1996). Chronic exposure of birds can produce adverse effects such as mortality resulting from chronic diseases, even with low tissue mercury concentrations (USDI 1998). However, reproduction is one of the most sensitive processes that is affected by chronic mercury exposure. Developing embryos are more sensitive than other animal life stages to the effects of mercury (USDI 1998). Transfer of methylmercury from adult female vertebrates (including fish) to their developing offspring probably poses the greatest risk to embryos in aquatic systems (USDI 1998). Likewise, dietary mercury is transferred from the adult female to her eggs, and concentrations in eggs commonly are most useful for predicting effects of mercury on reproduction in birds (USDI 1998). Concentrations of mercury in bird eggs more closely reflect recent maternal dietary uptake of mercury than accumulated stores from maternal tissue (USDI 1998). Effects of mercury on reproduction in birds include: reduced hatching due to early embryo mortality, eggshell thinning, reduced clutch size, increased numbers of eggs laid outside the nest, abnormal behavior of juveniles at low dietary exposures, and possibly impaired hearing in juveniles (USDI 1998). Selenium exposure can counteract the toxic effects of mercury (USDI 1998).

Molybdenum

Molybdenum is widespread in the environment and occurs in nature only as a constituent of compounds including other elements. Molybdenum is used primarily in steel alloys for aircraft and weapons but also is used as an electrode material and as a catalyst in petroleum refining. Human activities that result in molybdenum contamination include combustion of fossil fuels and smelting, mining, and milling for steel, copper, and uranium. Molybdenum is an essential micronutrient for most life forms and is present in all plant and animal tissues. Natural molybdenum concentrations in groundwater and surface water rarely exceed 20 µg/L, and greater concentrations indicate industrial contamination. Background concentrations in the United States are typically in the range of 1.2 – 4.1 µg/L for rivers, and < 1 µg/L in groundwater and 5 – 57 mg/kg dw for river sediments. (USDI 1998)

Toxicological effects reported for molybdenum include lethality in larval fish and amphibians and reduced growth of green algae. However, aquatic organisms generally are resistant to molybdenum toxicity, with the exception of newly fertilized fish eggs. Younger fish tend to be more sensitive than older fish. High bioconcentration of molybdenum by some species of aquatic algae and invertebrates can occur without apparent harm to these organisms, but potential risks to animals that feed on them are uncertain. Few studies have examined the potential for uptake of molybdenum from water into fish tissues, and the toxicological effects of molybdenum in fish tissues are unknown. Dietary dosing studies of domestic birds showed effects on growth and reproduction, but effects appear to be dependent on the ratios of molybdenum, copper, and sulfate in the diet. There are no data that describe the effects of molybdenum on wild birds. Bird eggs normally contain <1 mg Mo/kg dry-weight, with a mean of 0.25 mg Mo/kg. (USDI 1998)

Nickel

Nickel is ubiquitous in the environment and is an essential element for normal growth of many species of microorganisms and plants and several species of vertebrates (Eisler 2000a). At high concentrations, nickel is toxic and carcinogenic (Newman 2001). Nickel in the environment arises from both natural and anthropogenic sources. It enters surface waters from three natural sources: as particulate matter in rainwater, from weathering of bedrock material, and from soil. Nickel is used in alloys like stainless steel, for nickel plating and in production of Ni-Cd batteries, as well as numerous other uses (Newman 2001). Human activities that contribute to nickel loadings in aquatic and terrestrial environments include mining, smelting, refining, alloy processing, scrap metal reprocessing, fossil fuel combustion, and waste incineration (Eisler 2000a). Nickel in aquatic systems occurs as soluble salts associated with or adsorbed to clay particles, organic matter, and other substances (Eisler 2000a). The divalent (+2) ion, as the hydrated ion $(Ni(H_2O)_6)^{2+}$, is the predominant form in natural waters at pH 5 – 9. Nickel forms strong soluble complexes with OH^-, SO_4^{2-}, and HCO_3^-, but these species exist in small concentrations in comparison with hydrated Ni^{2+} in surface water and groundwater. Nickel compounds vary in their water solubility. The fate of nickel in freshwater is affected by pH, redox potential, ionic strength, type and concentration of ligands, and availability of solid surfaces to which nickel can bind (Eisler 2000a). Under anaerobic conditions, nickel precipitates so that dissolved nickel concentrations tend to be low (Eisler 2000a).

The chemical and physical forms of nickel and its salts strongly influence its toxicity and bioavailability. Generally, orally ingested nickel compounds are not very toxic. Nickel is persistent in the environment and tends to bioaccumulate, but there is little evidence that it biomagnifies in food webs. Ionic nickel can be lethal to sensitive aquatic organisms at low µg/L levels, and sublethal effects of nickel to sensitive species also occur in the low µg/L range. Nickel accumulates in fish tissues, and, in the gill, causes damage and alterations in structure. Symptoms of nickel poisoning in fish include surfacing, rapid mouth and opercular movements, and, just prior to death, convulsions and loss of equilibrium. Other signs of nickel poisoning in fish include decreased concentrations of glycogen in muscle tissue and liver with simultaneous increases in lactic acid and glucose in the blood, depressed hydrogen peroxide production in tissues and reduction in superoxide dismutase, and contractions of vascular smooth muscle. Low µg/L levels of nickel in water are lethal to the embryos of fish and toads as well as to daphnids. Nickel is most lethal to fish at pH 8.3 and least lethal at pH 6.3. Sublethal effects include altered immunoregulatory mechanisms in tissues of fish, inhibited reproduction in daphnids, growth inhibition of freshwater and marine algae, and reduced growth in fish. In birds, dietary nickel can accumulate in tissues and in eggs. Reported effects of nickel on birds include inhibited growth and reduced survival. (Eisler 2000a)

Perchlorate

Perchlorate (ClO_4^-) is an anion used as an oxidant in solid rocket fuels, ammunition, and fireworks, as well as for automobile airbag inflators and other uses. It occurs naturally in certain geologic deposits and in fertilizers mined from those deposits. Perchlorate in Lake Mead originates from soils and groundwater contaminated as a result of perchlorate production and disposal near the Las Vegas Wash. Due to its stability and persistence, water solubility, and mobility in the environment, perchlorate tends to contaminate groundwater and fresh surface water environments.

Perchlorate is not very acutely toxic but can cause chronic toxicity. In vertebrate animals, perchlorate acts as a thyroid endocrine disrupter. It interferes with production of thyroid hormones by inhibiting uptake of iodide, which is required for thyroid hormone synthesis, into the thyroid gland (U.S. EPA 2002b). Based on what is currently known about perchlorate occurrence and toxicity, freshwater aquatic species appear to have the greatest potential for exposure and subsequent effects. Organisms in aquatic systems can be exposed by direct uptake of perchlorate from water or by ingestion of dietary items containing perchlorate. Perchlorate does not appear to bioconcentrate in aquatic organisms to levels greater than those that occur in surface water. Based on limited data currently available, bioaccumulation can occur in plants and in animals, but biomagnification in food webs is not expected. When exposure ceases, perchlorate appears to be rapidly eliminated from the bodies of animals. Effects reported in aquatic organisms include changes in thyroid hormone production and thyroid histology, alterations in metamorphosis, and changes in development and population growth (Dean *et al*. 2004).

Selenium

Selenium is a metalloid used in the production of electronics, glass, pigments, alloys, and other materials (Newman 2001). It also is a by-product of gold, copper, and nickel mining and is associated with coal fly ash (Newman 2001). Selenium is nutritionally required in small amounts but is toxic in only slightly greater amounts (Beyer *et al*. 1996). Two major human activities contribute to selenium mobilization and introduction into aquatic systems: (1) procurement, processing, and combustion of fossil fuels, and (2) irrigation of seleniferous soils for crop production in arid and semi-arid regions of the United States (Beyer *et al*. 1996). In aquatic systems, selenium readily enters the food web and can quickly reach concentrations that are toxic to fish and wildlife (*i.e*., it is bioaccumulative). Selenium is efficiently transferred from parents to egg and offspring, resulting in edema, hemorrhaging, spinal deformities, and death (Beyer *et al*. 1996). Reproductive effects occur at smaller selenium doses than do effects on growth and survival of juvenile and adult fish (Beyer *et al*. 1996). Reproductive failure can occur at concentrations that produce few or no other symptoms of selenium toxicity. Selenium in aquatic environments can cause tissue damage, reproductive failure, and elimination of entire fish communities (Beyer *et al*. 1996). Selenium does not biomagnify in food webs. Compared to animals at higher trophic levels, organisms at lower trophic levels can accumulate higher levels of selenium without effect (Beyer *et al*. 1996). While organisms at lower trophic levels are not affected, their body burdens of selenium can be lethal to the more sensitive animals at higher trophic levels that consume them (Beyer *et al*. 1996).

Selenium (Se) can occur in water and in tissues in a variety of forms, but due to constraints of physiological pH range and reduction potential range permitted by water, only Se, SeO_3^{2-}, and $HSeO_3^-$ and SeO_4^{2-} can exist at thermodynamic equilibrium (U.S. EPA 2004). Selenate (SeO_4^{2-}) is usually the dominant form of inorganic selenium in well-aerated surface waters, particularly under alkaline conditions (U.S. EPA 2004). Selenous acid species (SeO_3^{2-} and $HSeO_3^-$) can predominate in solution under moderately oxidizing conditions encountered in oxygenated waters. Selenate salts are usually more soluble than selenite salts (U.S. EPA 2004). Elemental selenium is virtually insoluble in water and presents little risk to birds, but both selenite and selenate are toxic to birds and organic selenides present the greatest risk (Beyer *et a*l. 1996). In particular, selenomethionine is highly toxic to birds and is the form most likely to cause them harm. Other metals can mitigate the toxicity of selenium, including mercury, lead, copper, cadmium, sliver, and arsenic.

Strontium

Strontium is a fairly common alkaline earth metal. It is found in small amounts in most plant tissues but has not been demonstrated to be essential for plant growth or development. Strontium ion levels can be important contributors to water hardness in areas where strontium levels are elevated. A freshwater concentration of 1 mg/L is considered to be high or elevated. Because strontium resembles calcium chemically, it is readily incorporated into bone but, in its non-radioactive form, does not appear to cause harm. The industrial uses of the few organometallic compounds of strontium are few, and their toxicity is considered to be a limited concern. Although pure strontium is not very toxic, many strontium compounds are toxic to fish and wildlife. (Irwin 1997)

Titanium

Titanium is an abundant metal in the earth's crust, but it does not exist in the metallic state. Titanium is used in the pulp and paper industry, and titanium alloys are used in construction materials, particularly for aircraft and spacecraft. Titanium dioxide is the most important of the titanium compounds used in industry. It is used as a white pigment in paints, enamels, and lacquers. Titanium dioxide also is used in the production of plastics. Titanium salts generally exhibit very low toxicity to humans and other animals exposed by the oral route. Based on the small amount of available information describing the aquatic toxicity of titanium salts, they appear to exhibit moderate acute toxicity to aquatic life. (UKWIR 2004)

Vanadium

Vanadium is metal that is ubiquitous in the environment and found at trace levels in most organisms. Vanadium in the environment is usually combined with other elements such as oxygen, sodium, sulfur, or chloride. Vanadium enters the environment naturally in continental dusts and marine aerosols and as a result of volcanic activity. Vanadium is released to the environment by human activities as well, including combustion of fossil fuels and oil refining. The forms of vanadium most likely to be found at waste sites are unknown, but one man-made form, vanadium oxide, is most often used in the steel industry, and less commonly used in the production of rubber, plastics, ceramics, and other chemicals. (Irwin 1997)

Vanadium is not very soluble in water but can be carried in water much like particulate matter or sand. Typical concentrations in surface water are less than 0.001 mg/L. It is difficult to determine the speciation of vanadium in water. In aqueous solution, vanadium in the +5 state exists as various oxoions called "vanadates," the exact nature of which is dependent on pH and concentration. Vanadium also can exist in water in the +4 state, with chemistry centered around the VO^{2+} ion. Vanadium has an affinity for lipids. Animals can take up vanadium from water or food. Limited data suggest that the potential for vanadium to bioaccumulate or bioconcentrate is low for mammals, birds, and fish; high to very high for mollusks, crustacea, and lower animals; and moderate or higher for plants, mosses, lichens, and algae. Vanadium is considered to be an essential element for certain species of algae, but its role in other organisms is debated. Vanadium and its compounds are toxic, and their toxicity increases with increasing valence (*i.e.*, pentavalent vanadium is most toxic). Vanadium also is toxic both as an anion and as a cation. (Irwin 1997)

Zinc

Zinc is a naturally occurring metal and an essential trace element for all organisms (Eisler 2000a). It is a component of more than 200 metalloenzymes and other metabolic compounds and assures stability of biological molecules (*e.g.*, DNA) and structures (*e.g.*, membranes and ribosomes) (Eisler 2000a). Zinc is used extensively in protective coatings, in galvanizing to prevent corrosion, and in alloys (Newman 2001). Major sources of anthropogenic zinc discharges to the environment include electroplating, smelting and ore processing, drainage from mining operations, domestic and industrial sewage, combustion of fossil fuels and wastes, road surface runoff, corrosion of zinc alloys and galvanized surfaces, and erosion of agricultural soils (Eisler 2000a). Most of the zinc released into aquatic environments eventually partitions into sediments, and its release from sediments is enhanced by high dissolved oxygen, low salinity, and low pH (Eisler 2000a). Dissolved zinc usually consists of the toxic aquo ion $(Zn(H_2O)_6)^{2+}$ and various organic and inorganic complexes (Eisler 2000a). Background concentrations of zinc in water seldom exceed 40 µg/L. The toxic zinc species have their greatest effects at low pH, low alkalinity, low dissolved oxygen, and higher temperatures (Eisler 2000a).

The primary metabolic effect of zinc occurs at the zinc-dependent enzymes that regulate RNA and DNA. Production of metallothioneins is strongly induced by zinc; these proteins play an important role in zinc homeostasis and can bind to zinc and render it less toxic to the exposed organism. The pancreas appears to be the primary target of the toxic effects of zinc in birds and mammals, followed by bone. Zinc is transferred into bird eggs; transfer into eggs constitutes a major loss of zinc in the laying hen. Reported effects of zinc on birds include reduced survival, inhibited chick growth, effects on pancreas histology, and a variety of other effects. (Eisler 2000a)

The gill epithelium in fish is physically damaged by high concentrations of zinc. Fish might avoid zinc and exhibit other behavioral effects at concentrations as low as 5.6 µg/L. Other symptoms of zinc poisoning in fish include surfacing, lethargy and loss of coordination, hemorrhaging at the gills and the base of the fins, shed scales, and excess mucus production on skin and gills. Aquatic populations are frequently decimated by zinc pollution. Significant adverse effects of zinc occur at low µg/L levels in sensitive aquatic organisms and include effects on growth, survival, and reproduction. Concentrations of zinc in tissues of aquatic organisms usually are far greater than those required for normal metabolism, and much of the zinc is bound to macromolecules or occurs as insoluble metal inclusions in tissues. Aquatic organisms including fish can accumulate zinc to varying degrees from the water and from the diet, but the diet is the most important route of exposure. Fish embryos and larvae are the most sensitive developmental stages. (Eisler 2000a)

Because zinc levels are homeostatically regulated, diagnostic levels for toxicity are not well established in any animal tissues (USDI 1998).

C. METHODS

This report presents the results of a screening-level evaluation of the concentrations of selected COPC in water and sediment samples, bird eggs, and whole fish collected from various locations in the Las Vegas Wash and its tributaries. Samples also were collected at a regional reference site, Pahranagat National Wildlife Refuge (PNWR), for comparison purposes. PNWR is located approximately ninety miles north of Las Vegas and is believed to be less affected by anthropogenic activity and various forms of pollution than the Las Vegas Valley. For the purposes of this study, samples from the regional reference site provided the ability for enhanced data interpretation, primarily the comparison of concentrations of COPC between urban impacted sites and the reference site.

Sample sizes used in this monitoring program are small, so the data do not lend themselves to statistical analysis. Evaluations consist of comparisons between concentrations of individual COPC measured in these environmental samples as part of the 2003 Las Vegas Wash Monitoring and Characterization Study with published levels of concern for individual contaminants. Comparisons are also made between concentrations of COPC in whole fish and bird eggs from PNWR (regional reference location) and those from locations along the Wash. Evaluation of the toxicity of mixtures of contaminants requires more complicated and time-consuming methods and is not within the scope of this project.

1. Selection of Levels of Concern and Literature Search Strategies

The term “level of concern” in the tables of this report encompasses results of individual toxicity tests or studies as well as criteria for protection of fish and wildlife and threshold effect benchmarks and probable effect benchmarks. Benchmarks or criteria commonly are based on more than one toxicity study or on a weight-of-evidence approach rather than relying on a single study. Attempts were made, within the limited scope and time frame of this analysis, to determine whether identified levels of concern (LOC) indicate a threshold for effects or indicate that effects are likely or probable. Threshold effect benchmarks or LOC generally are concentrations that, when exceeded, indicate that concern is warranted, but effects might or might not appear. Threshold effect benchmarks might be designed to be protective of the most sensitive species or only a certain percentile or other subset of species. In the latter case, a finding that the LOC was not exceeded might not ensure that sensitive species of interest in the Las Vegas Wash are adequately protected. Furthermore, benchmarks or criteria might have been developed for a specific location or set of biotic or abiotic parameters or a suite of species that is not representative of conditions or species of the Las Vegas Wash. For similar reasons, contaminant concentrations that exceed probable effect benchmarks or criteria do not guarantee that adverse effects will occur, but indicate a greater degree of concern for adverse effects associated with the contaminant of interest than would those that exceed only a threshold benchmark or criterion. Concentrations less than a probable effect benchmark or LOC should not be construed “safe” levels.

Endpoints derived from individual laboratory or field studies also were recorded in some cases, particularly when these were the only data that were available for screening. Results derived from individual chronic toxicity tests or studies often are reported as lowest observed adverse effect level or concentration (LOAEL or LOAEC), lowest observed effect level or concentration (LOEL or LOEC), or lowest effect level or concentration (LEL or LEC). These cannot be considered to be “safe” levels, even for the species with which they were determined, as these might simply represent the least dose or concentration that was tested. If a lower concentration or dose was tested, it is possible that effects would have been observed at that lower level. Also commonly reported are no observed adverse effect level or concentration (NOAEL or NOAEC), no observed effect level or concentration (NOEL or NOEC), or no effect level or concentration (NEL or NEC). A concentration or dose that exceeds a NOAEL, NOEL, or NEL will not necessarily result in a toxic effect because it is possible that a higher dose or concentration, if tested, would not have resulted in an effect. Likewise, many factors (*e.g.*, water hardness) can modify toxicity such that effects might occur at greater or lesser levels than would be anticipated on the basis of a single toxicity value. Other toxicity values also will be considered when they are judged to be appropriate for screening. In general, toxicity values that are selected to indicate that an effect is likely will be based on effects that are judged to be adverse at the organism, population, or community levels of biological organization.

Individual toxicity tests or studies might be representative primarily of the species tested and the physical/chemical conditions under which the study was conducted. Thus, benchmark levels or criteria, which are commonly based on more than one toxicity study, on effects that are judged to be adverse, or on a weight-of-evidence approach, may be more reliable indicators of potential for adverse effects. Threshold criteria or benchmarks, where available, probably are most useful for screening purposes as they ideally represent the lower range of toxic levels. In general, this report considers tissue-residue guidelines for bird eggs and fish, but not for organisms at higher trophic levels. Due to time constraints, bioaccumulation-based criteria were not specifically targeted or considered in this assessment. However, certain selected benchmarks or criteria for fish tissue, sediment, and water consider bioaccumulation, including fish tissue criteria that are intended for protection of piscivorous wildlife that eat the fish rather than for protection of the contaminated fish.

One of the main problems in establishing which pollutant is responsible for an effect observed in the field is that several chemicals are usually present in samples, and their concentrations are often strongly inter-correlated (Beyer *et al*. 1996). Organochlorine pesticides and other contaminants frequently occur together in biological samples taken from the field or from wild animals. In general, the contaminant of greatest concentration in field samples is DDE (Beyer *et al*. 1996). In many studies of contaminant concentrations in bird eggs, DDE might have masked the effects of other contaminants (Beyer *et al*. 1996). Some co-occurring contaminants can interact, further complicating risk screening. Interacting effects of different organochlorines can influence accumulation of residues in tissues. For example, DDT can stimulate dieldrin metabolism in animals (Beyer *et al*. 1996). The toxic effects of organochlorine pesticides also can interact. For these reasons, data from field studies that relate a single contaminant to an effect might not be as conclusive with regard to cause-and-effect relationship as a laboratory study in which the exposure conditions and the contaminants to which the animals are exposed are under greater control by the investigators. Emphasis is placed on searching for and selecting LOC that are not based solely on associations between contaminant concentrations from field studies and effects that might have resulted from contaminants other than the one of interest.

2. Sources of Levels of Concern for COPC

Toxicity data were taken from selected standard literature compilations and databases. This assessment should not be construed to represent a critical review of those data sources, as such a task was outside of the limited scope of the current effort. Given the nature of the literature searches conducted for this assessment, it is acknowledged that some sources containing potentially relevant information might have been overlooked and that some toxicity values that are not entirely applicable might have been used. Sources of LOC are cited in the notes associated with the tables that present the LOC for each sample type. Books and reports that were used as source references were not reviewed in detail but were briefly reviewed or skimmed for relevant LOC. For example, handbooks by Eisler (2000 a,b,c) were checked only for proposed criteria for protection of natural resources and not for levels associated with adverse effects in individual studies cited in the effects tables. The handbooks by Eisler (2000 a,b,c) were checked only for fish tissue and bird egg criteria and not for sediment or water quality criteria.

The initial search to identify levels of concern (or sediment quality guidelines, SQG) for COPC in sediments focused on values reported by MacDonald *et al*. (2000). MacDonald *et al*. developed and evaluated consensus-based sediment quality guidelines (SQG) for freshwater ecosystems for 28 chemicals. For each contaminant, two consensus-based SQG were developed: a threshold effect concentration (TEC, below which adverse effects are not expected to occur) and a probable effect concentration (PEC, above which adverse effects are expected to occur more often than not). During this process, the authors reviewed and compiled sediment quality criteria published by other investigators and determined to be suitable to form the basis of their TEC and PEC. These criteria were used in the current assessment along with the TEC and PEC. Criteria that were expressed on an organic carbon-normalized basis were converted to dry weight-normalized values at 1% organic carbon because previous studies have shown that they predicted toxicity as well or better than organic carbon-normalized sediment quality criteria in field-collected sediments (MacDonald *et al.* 2000). Consensus-based TECs or PECs were calculated by determining the geometric mean of the suitable sediment quality criteria published by other investigators, but only if three or more published criteria were available for a contaminant. The authors reported that "the consensus-based SQGs provide a unifying synthesis of the existing SQGs, reflect causal rather than correlative effects, and account for the effects of contaminant mixtures" (MacDonald *et al*. 2000). The consensus-based SQG (TEC) do not consider the potential for bioaccumulation in aquatic organism (*i.e.*, they do not incorporate bioaccumulation-based criteria), nor associated hazards to animals that consume them. MacDonald *et al*. (2000) recommend that the consensus-based SQG be used with bioaccumulation-based criteria and tissue residue guidelines.

The review article by MacDonald *et al*. (2000) did not include all of the COPC in the current assessment, so the references cited in that article were collected and reviewed for criteria for the remaining COPC. When no LOC was identified in those references for a COPC, the Risk Assessment Information System (RAIS) Ecological Benchmark Values database (USDOE 2006) was searched for SQG for that COPC.

3. Locations of Interest

This assessment was limited to COPC concentration data related to the specific sampling locations described in Table 3 and shown in the map in Appendix B. Although the Nature Preserve (NP) is not intended to convey storm flows, the adjacent Monson Channel has overflowed into the NP on a number of occasions, so the possible presence of constituents in stormflows cannot be ruled out (Erik Orsak, U.S. Fish and Wildlife Service (USFWS), personal communication, 2006). At the time the NP samples were taken in 2003, the inflows consisted entirely of urban runoff from Monson Channel. In April 2004, after sampling for this report was completed, flows were a mix of blended municipal wastewater effluent and Monson Channel flows, and more recently (November 2005) the flows became 100% effluent to reduce waterborne selenium levels for protection of wildlife.

4. Sources of Chemical Concentration Data and Descriptions of Sampling Methods

Sources of COPC concentration data for each of the environmental media of interest are described below.

Water

All of the water quality data considered in the current study were taken from the report by Zhou *et al*. (2004), entitled “Las Vegas Wash Monitoring and Characterization Study: Results for Water Quality in the Wash and Tributaries.” Data for additional water sampling locations were provided in the report, but the current study focused on sampling locations that corresponded to those used for collection of sediment, bird eggs, and fish. Because the report by Zhou *et al*. drew upon water quality data that were gathered for other purposes, organic contaminants data were available only for tributaries and seeps that contribute to the Las Vegas Wash and were not available for locations in the mainstream Wash. Most of the organic COPC in the current report were not included among the analytes, and those that were included were not detected at DC.

Sediment

Sediment concentrations of COPC were taken from Papelis (2004), “Sediment Quality Sampling for the Las Vegas Wash and Tributaries.” That report describes sediment sampling and analysis procedures, as well as a discussion of the potential sources of contaminants and a limited discussion of the ecological implications. Sediments from PNWR were not sampled for this project and are not included in this analysis. Binding of metals and other contaminants with sediments is a function of surface area, which is greater in finer particle size fractions. Sediment sampling methods were designed to allow sampling of a large range of particle size fractions, including finer material (Papelis, 2004). Although Papelis (2004) reports concentrations of a wider range of contaminants, this report addresses only the COPC identified in Table 1.

Fish

The methodology used to sample fish is described in the document entitled “Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries” (December 2001, Las Vegas Wash Coordination Committee). According to the Las Vegas Wash Coordination Committee web page (http://www.lvwash.org/being_done/progress/fish.html), “A total of 7 [fish] species have been observed in the Wash; they are the green sunfish (*Lepomis cyanellus*), mosquitofish (*Gambusia afinnis*), common carp (*Cyprinus carpio*), black bullhead (*Ameiurus melas*), red shiner (*Cyprinella lutrensis*), fathead minnow (*Pimephales promelas*) and the aquarium fish, suckermouth catfish (Family Laricariidae: *Hypostomus plecostomus*).” Species of fish that were sampled for whole-body residue analysis are presented in Table 4.

Bird Eggs

The methodology used to sample bird eggs is described in the document entitled “Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries” (December 2001, Las Vegas Wash Coordination Committee). Additional organic chemicals not specified as contaminants of concern in the 2001 Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries were analyzed in bird eggs, and the results are presented in Appendix D. After sampling was completed, it was determined that two bird egg samples were collected from a location outside the original study design. Contaminant concentrations in those egg samples are presented in

Appendices E and F. Species that were sampled and associated information are presented in Table 5.

D. RESULTS AND DISCUSSION

Smaller sample sizes are expected to be less representative of the full range of exposures than are larger sample sizes. Because the sample sizes are small and because this is a screening-level assessment, recommendations that contaminants deserve further attention are somewhat biased toward including COPC in future efforts rather than excluding them.

1. Water

COPC concentrations for the sampling sites of interest in the current analysis are summarized in Table 6, and some relevant basic water quality parameters are summarized in Table 7. All water quality data were taken from the report by Zhou *et al*. (2004).

Organics

Organic contaminants were analyzed only in tributaries and seeps that contribute to the flow of the Las Vegas Wash. The only location that was sampled by Zhou *et al*. (2004) and that also is considered in this report is Duck Creek (DC). None of the organic COPC for this analysis were detected in water samples from DC. Detection limits are provided in Table 6. LOC (water quality criteria, or WQC) for organic COPC in water are presented in Table 8.

Inorganics

Beryllium and cadmium were not detected, and analytical limits of detection were not provided for comparison to LOC. Antimony, boron, molybdenum, strontium, titanium, and vanadium were not analyzed. LOC (water quality criteria, or WQC) for inorganic COPC are presented in Table 9. Average and maximum nickel concentrations at all locations exceeded a protective level for marine life, but did not exceed the U.S. EPA acute or chronic aquatic criteria for nickel. Nickel probably is not a concern based on the available information on water concentrations. Average magnesium concentrations in water at LW10.75 and DC and maximum concentrations at these locations and PB (Las Vegas Wash location LW 6.05) were greater than 100 mg/L, a concentration that is rarely exceeded in natural waters. However, magnesium generally is not considered to be an environmental concern. Based on information presented below, the concentrations of the following inorganic chemicals in water should be considered in greater detail than was feasible for this report.

The concentration of aluminum in water at all locations exceeded levels of concern and effect (Tuttle and Thodal 1998) that indicate that minor effects and substantial effects, respectively, are expected. Concentrations at all locations exceeded the U.S. EPA's chronic aquatic criterion (CCC), and maximum concentrations at LW10.75, PB, and LW0.8 exceeded the U.S. EPA's acute aquatic criterion as well. Furthermore, average water pH > 8.0 at LW10.75 and DC might indicate that aluminum at those locations would be more bioavailable than at the other locations where average water pH was less than 8.0 and within the pH range at which aluminum is relatively biologically inactive.

Arsenic concentrations in water at DC exceeded an effect level indicating that substantial effects are expected (Tuttle and Thodal 1998) as well as a lowest chronic value (based on As(V)) for aquatic plants (USDI 1998). Maximum arsenic concentrations at all locations and average arsenic concentrations at LW10.75, DC, and LW0.8 exceeded the normal water concentration of 10 µg/L identified by USDI (1998).

Although LOC were not identified for barium concentrations in water, according to ATSDR (2005c), the maximum (but not the average) barium concentration at LW10.75 was greater than the highest average background level for surface waters in the United States. Maximum and average concentrations of barium in water at all other locations were within the range of background levels.

Chromium concentrations in water at LW10.75 exceeded a level of concern (Tuttle and Thodal 1998) suggesting that minor effects are expected but did not exceed the level indicating substantial effects.

Average copper concentrations at all locations exceeded a lowest chronic value for aquatic organisms of 0.23 µg/L (USDI 1998). Average copper concentrations at all locations sampled also exceeded a level of concern suggesting minor effects but did not exceed a level indicating substantial effects, according to Tuttle and Thodal (1998). Maximum concentrations, but not average concentrations, at all locations exceeded the U.S. EPA's chronic aquatic criterion, and the maximum concentration at DC exceeded the U.S. EPA's acute aquatic criterion as well. Average copper concentrations at all locations exceeded the maximum acceptable toxicant concentration (MATC) of total recoverable copper for protection of aquatic life

Maximum, but not average, iron concentrations at PB were substantially greater than the U.S. EPA's chronic aquatic criterion for iron, and at LW10.75, both average and maximum iron levels exceeded the U.S. EPA's chronic aquatic criterion.

Maximum concentrations of lead at all locations other than DC exceeded a level of concern suggesting minor effects could occur as well as the U.S. EPA's chronic aquatic criterion. However, the average concentration of lead exceeded the U.S. EPA's chronic aquatic criterion only at LW10.75. Maximum, but not average, lead concentrations at LW10.75 also exceeded a 4-day average concentration that should not be exceeded more than once every 3 years, but more data would be required to determine whether a 4-day average exceedance had occurred.

Maximum manganese concentration at LW10.75 exceeded a level of concern suggestive of minor effects (Tuttle and Thodal 1998). However, manganese concentrations at all locations fell within the range that is found in natural waters.

Mercury was detected only at PB, and the average and maximum concentration exceeded a level indicating substantial effects as well as a criterion for protection of piscivorous wildlife (USDI 1998) and a 24-hour average concentration not to be exceeded at any time.

Average and maximum selenium concentrations at all locations exceeded a freshwater background range, threshold for toxicity to fish and wildlife via bioaccumulation, and concentration at which impaired fish reproduction has been noted (USDI 1998). Average concentrations at all locations also exceeded a level of concern suggesting substantial effects (Tuttle and Thodal 1998). Average concentrations at LW10.75 and maximum concentration at PB exceeded the U.S. EPA's current chronic aquatic criterion and Nevada DEP's 96-hour average criterion value for aquatic life (NDEP 2003). Average concentrations at DC and maximum concentration at LW10.75 exceeded Nevada DEP's 1-hr average concentration (NDEP 2003). Available information (total selenium concentration) is insufficient to determine whether the U.S. EPA's acute criterion for selenium was exceeded. Data describing the fraction of total selenium as selenite and selenate are required.

The U.S. EPA (2004) has released updated draft aquatic criteria for selenium that include a criterion maximum concentration (CMC, acute criterion) based on selenite and selenate (and sulfate), and a criterion continuous concentration (CCC, chronic criterion) based on fish tissue selenium residues rather than on a water concentration (see Fish Tissue, Inorganics). According to the draft selenium criteria document (U.S. EPA 2004):

> "…except possibly where an unusually sensitive species is important at a site, freshwater aquatic life should be protected if the following conditions are satisfied. A. The concentration of selenium in whole-body fish tissue does not exceed 7.91 µg/g dw (dry weight). This is the chronic exposure criterion. In addition, if whole-body fish tissue concentrations exceed 5.85 µg/g dw during summer or fall, fish tissue should be monitored during the winter to determine whether selenium concentration exceeds 7.91 µg/g dw. B. The 24-hour average concentration of total recoverable selenium in water seldom (*e.g.*, not more than once in three years) exceeds 258 µg/L for selenite, and likewise seldom exceeds the numerical value given by exp(0.5812[ln(sulfate)]+3.357) for selenate. These are the acute exposure criteria."

Average zinc concentrations in water at all locations fell within the range of concentrations (5 – 51 µg/L) that can cause significant adverse effects on aquatic organisms. Average concentrations at PB and LW0.8 and maximum concentration at DC and LW10.75 exceeded an effect concentration suggesting substantial effects (Tuttle and Thodal 1998). Neither of the U.S. EPA criteria for protection of aquatic life was exceeded. Average zinc concentrations at PB and LW0.8 and maximum concentrations at all locations fell with LOC identified by USDI (1998). Maximum zinc concentrations at all locations and average zinc concentration at PB exceeded the normal background concentration of 40 µg/L typically observed in water.

The references used in this screening did not produce LOC for perchlorate, but LOC including criteria or benchmarks have been proposed. U.S. EPA (2002b) presented a draft toxicological review and risk characterization for perchlorate that contains a screening-level ecological risk assessment for perchlorate. According to Bruce Rodan (U.S. EPA, personal communication, 01/02/2006), "The 2002 ecotoxicological section remains unfinalized in an external review draft form. Given this draft status and the additional information that has been published in the interim, the 2002 ERD [External Review Draft] ecotoxicological section should not be sourced as an Agency conclusion on the ecological risks of perchlorate. Of course, it can be a valuable source of information up to that time." U.S. EPA calculated Tier II values, which are derived when data are not sufficient for deriving National Ambient Water Quality Criteria (AWQC). These values are intended to be protective of 95% of species and account for missing information with approximately 80% confidence. The 2002 report proposed a Secondary Acute Value (SAV) of 5 mg/L (as ClO_4^-) for short-term exposures and a Secondary Chronic Value (SCV) of 0.6 mg/L (as ClO_4^-) for long-term exposures. Dean *et al*. (2004) proposed freshwater water quality criteria developed to meet U.S. EPA requirements for setting AWQC, including a CMC (acute criterion) of 20 mg/L and a CCC (chronic criterion) of 9.3 mg/L. U.S. EPA has not reviewed or approved these criteria. The maximum, but not the average, concentration of perchlorate at LW0.8 exceeded the SCV for perchlorate, indicating that this contaminant deserves greater attention as a potential chronic risk. This is particularly true given that recent research has provided more information about the potential effects of perchlorate on aquatic organisms, particularly fish.

2. Sediment

Concentrations of COPC in sediments from the Las Vegas Wash and its confluence with the Las Vegas Bay are presented in Table 10.

Organics

LOC (or sediment quality criteria, SQC) for organic COPC in sediments are provided in Table 11. Mirex was not detected in sediments of Las Vegas Bay delta (LVB – delta as of April 2003) and did not exceed its minimum LOC, but sediments at other locations were not analyzed. Total PCBs did not exceed their minimum LOC for sediment at any sampling location. Heptachlor did not exceed its minimum LOC in sediments at any of the locations.

Sediment benchmarks were not identified for the following contaminants: delta-BHC, alpha-chlordane, gamma-chlordane, oxychlordane, cis-nonachlor, and trans-nonachlor. Although the following organic COPC were not detected in sediments, analytical detection limits were not sufficiently low to identify concentrations less than their minimum LOC identified for sediment: aldrin; gamma-BHC; chlordane; dieldrin; HCB; heptachlor epoxide; o,p'-DDT (dw); and p,p'-DDT. Although o,p'-DDT was not detected in any sediment samples, because a LOC was not identified for o,p'-DDT (ww) and limit of detection on a dry-weight basis was higher than its minimum LOC, it was not possible to conduct the screening-level evaluation of the potential risk posed by this COPC in sediment.

Endrin exceeded its minimum LOC for sediment at LVB. Endrin was not analyzed with sufficient detection limits at the other locations to determine whether it might exceed LOC. Only the threshold effect benchmarks, and not the probable effect benchmarks, were exceeded. However, endrin concentrations in sediment should be evaluated further.

The sediment concentrations of o,p'-DDE; o,p'-DDD; p,p'-DDE; and p,p'-DDD exceeded their minimum LOC at LVB. The concentrations of the o,p-DDTs were not analyzed in sediments at sites other than LVB. NEL detection limits were not sufficient to detect any of the p,p'-DDTs, and MSCL did not analyze sediments from any sites other than LVB (see footnotes in Table 10). Total DDT was not detected in LVB sediments at levels that exceed the minimum LOC, but other sediments from other locations were not analyzed for total DDT. Further investigation will be required to determine whether the DDTs might pose a risk to benthic organisms in the Las Vegas Wash.

Concentrations of alpha- and beta-BHC did not exceed their LOC for sediment. The limit of detection was insufficient to evaluate gamma-BHC concentrations, and no LOC were identified for delta-BHC. The sum of the BHC isomers exceeded a lowest effect level (threshold effects benchmark) at which the majority of benthic-dwelling organisms would not be affected but did not exceed the severe effect level that would indicate that effects are likely. Further evaluation of BHC in sediments of the Las Vegas Wash is suggested.

Because benchmarks (LOC) are lacking for the chlordane isomers and most of its related chemicals and the limits of detection for chlordane in sediment are insufficient to screen it, chlordane concentrations in sediment should be evaluated more closely.

Inorganics

LOC (or sediment quality criteria, SQC) for inorganic COPC in sediments are reviewed in Table 12. Cadmium, chromium, copper, iron, manganese, nickel, and zinc did not exceed their minimum LOC in sediment and thus are not likely to pose a risk to benthic organisms. The minimum sediment benchmark identified for aluminum in the RAIS database was 58,000 mg/kg dw, which is a probable effect level. Sediment concentrations of aluminum in this study did not exceed that benchmark and also did not exceed the no-effect benchmark of 73,200 mg/kg dw. It is not clear why the no-effect benchmark was greater than the probable effect benchmark, but regardless, neither was exceeded, so aluminum in sediment is not expected to present a risk. Although no sediment criteria were identified for these COPC, the NOAA Screening Quick Reference Tables (SQuiRTS) identified background levels (mg/kg dw) for the following: barium (0.7), strontium (49), vanadium (50) (Buchman 1999). Other sources of information have not yet been investigated to identify expected background levels. Vanadium concentrations in sediments at all sampling locations were less than background levels.

Barium and strontium were detected at much greater concentrations than "background" levels (Buchman 1999) at all sites sampled. These chemicals should be investigated further to determine whether their levels in sediment are cause for concern. Beryllium, boron, magnesium, molybdenum, and titanium were detected in sediments, but neither sediment criteria nor background concentrations for these chemicals were identified in this search, so it is not clear at this time whether the concentrations measured in sediments in this study are a potential risk. Perchlorate was not detected (< 0.04 mg/kg dw) in sediments at any of the sampling locations. However, sediment benchmarks were not found for perchlorate, so further investigation is needed to determine whether the detection limits were sufficient to identify levels of concern in sediments. Sediment lead concentration at LVB exceeded the minimum LOC of 31 mg/kg, which is a threshold effect benchmark, but it did not exceed the probable effect benchmarks. Mercury was not detected in any sediment samples, but the limit of detection at LVB was greater than the minimum LOC for mercury.

Selenium was detected only in sediment from LVB, and the detected concentration was greater than both the minimum LOC (associated only rarely with adverse effects) and a toxicity threshold of 4 mg/kg dw (associated with adverse effects on some fish and wildlife species) (USDI 1998). The detection limit for sediment (5 mg/kg dw) was not sufficiently low to detect concentrations below the minimum LOC.

3. Fish

Individual whole fish samples are identified by species and location in Appendix C.

Organics

Concentrations of organic COPC in whole fish are provided in Table 13, and LOC for the COPC in fish are presented in Table 14. Additional organic chemicals not specified as contaminants of concern in the 2001 Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries were analyzed in whole fish, and the results are presented in Appendix G.

No fish tissue LOC were identified for aldrin, the BHC isomers, dieldrin, endrin, HCB, or DDT and related compounds. LOC were identified for chlordane but none were identified for its individual constituents (related chemicals) or degradation products. No LOC were identified for heptachlor or heptachlor epoxide. Chlordane and mirex concentrations in fish tissue did not exceed their minimum LOC, but at least for mirex, the LOC was not a benchmark or criterion. Endrin was not detected in any fish from any of the sampling locations. Analytical detection limits were appropriate for the few inorganic COPC for which LOC were identified.

Though no LOC were identified for DDT or related compounds in whole fish, it is interesting that DDT and DDE concentrations in fish appear to increase in a downstream direction. The presence of the parent compound DDT in greater concentrations than its metabolite DDE indicates that exposure is not occurring from historical use, but rather that there is an active and continuing source of DDT to the Las Vegas Wash. The source(s) and the potential for DDT and DDE to cause adverse to fish and wildlife should be investigated in greater detail.

Though no LOC were identified for BHC isomers in whole fish, it is worth noting that BHC concentrations in fish tissue also appear to increase at PB and LVB relative to the upstream sites. A similar, though less pronounced, trend was observed for bird eggs. The pattern of BHC isomers should be examined in greater detail in future reports to determine whether they might indicate an ongoing, active source or a weathered source.

The maximum total PCB concentration in one whole fish exceeded a proposed criterion for protection of fish (0.4 mg/kg ww) as well as a criterion for protection of piscivorous wildlife (0.1 mg/kg ww maximum allowable level). The concentration of PCBs in at least one fish each from DC, PB, and LVB exceeded the criterion, and concentrations in some fish from all locations other than the reference site (PNWR) exceeded the criterion for protection of piscivorous wildlife. Further consideration should be given to the potential risks posed by PCBs in whole fish in the Las Vegas Wash.

Inorganics

Concentrations of inorganic COPC in whole fish are provided in Table 15, and LOC for the COPC in fish are presented in Table 14. LOC for whole fish residues were not identified for aluminum, antimony, barium, beryllium, boron, iron, magnesium, manganese, molybdenum, nickel, perchlorate, strontium, titanium, and vanadium. Boron was not analyzed in fish. Antimony was not detected in any of the fish taken from any of the sampling locations. The concentration of chromium in fish did not exceed the minimum LOC identified. Though fish samples were collected for perchlorate analysis, the data were not available at the time of release of this report. However, these data probably will be available for future reports.

The maximum wet-weight and dry-weight based arsenic concentrations detected in fish exceeded their minimum LOC based on comparison to the 85th percentile of concentrations measured in whole fish; these LOC were considered to be levels of concern indicating a relatively minor effect or no-effect levels. Nearly all fish that were analyzed, including those sampled from the reference site PNWR, contained arsenic at concentrations exceeding these LOC. However, none of the concentrations in fish exceeded the toxicity thresholds or effect concentrations that would indicate a greater probability of adverse effects, and none of the fish tissue concentrations exceeded the limit of 1 mg As/kg ww that would constitute presumptive evidence of arsenic pollution. Regardless, further effort should be directed toward assessing the potential for arsenic to exert toxic effects on fish in the Las Vegas Wash.

Cadmium was detected in only two fish, one from LVB and one from PNWR. The cadmium concentration in the fish from LVB exceeded the minimum LOC of 0.05 mg/kg ww, which is a concern concentration indicating a relatively minor effect. More attention should be given to determining whether cadmium concentrations in the fish might cause adverse effects.

Concentrations of copper in several fish, including at least one fish from each sampling location other than NP, exceeded the minimum LOC of 0.9 mg/kg ww, which is a concern concentration indicating a relatively minor effect. Copper concentrations in fish tissue should be examined more closely to determine whether there is a potential for adverse effects.

A few fish collected from PB and LVB contained concentrations of lead that exceeded its LOC in whole fish. The LOC is a concern concentration that indicates potential for relatively minor effects. More attention should be given to estimating the potential risk of lead to fish in the Las Vegas Wash.

Nearly all fish sampled from all locations, including the reference site PNWR, contained zinc concentrations that exceeded the minimum LOC of 20 mg/kg. Further review of the literature, including the primary source for the LOC used here, should aid in determining whether zinc concentrations that were detected in fish are truly cause for concern.

Mercury concentrations detected in fish did not exceed the minimum LOC for relatively minor effects. Beyer *et al*. (1996) stated that the primary effect of methylmercury on fish populations, if such an effect exists at current exposure levels, probably would be reduced reproductive success occurring through effects of methylmercury received by developing fish via maternal transfer. Because fish embryos appear to be more sensitive than adults, levels of concern for adults might not be protective of the more sensitive life stages. However, the fish tissue concentrations currently in hand indicate that mercury is not likely to pose a risk to fish in the Las Vegas Wash.

Selenium concentrations for all of the fish collected from the Las Vegas Wash fell within the range of, or exceeded, minimum LOC for whole fish. Most of the fish sampled at DC and all of the fish sampled at NP contained selenium concentrations that surpass the threshold for reproductive impairment of sensitive species. According to the draft freshwater chronic criterion for selenium, if whole-body fish tissue samples exceed 5.85 µg/g dw (or mg/kg dw) in summer or fall, fish should be monitored in winter to determine if the criterion of 7.91 µg/g dw is exceeded in winter (U.S. EPA 2004). Fish included in the current study were collected in the fall. Most fish at NP, DC, and PB exceeded the summer/fall standard that triggers winter monitoring, and many also exceeded the draft criterion itself. Selenium concentrations in two fish collected at NP fell within the range that would indicate that “catastrophic impacts are highly likely.” Clearly, selenium concentrations in tissues of fish collected from the Las Vegas Wash deserve a more detailed assessment of the potential risk to fish populations in the Wash and possibly to fish in the inner Las Vegas Bay as well.

4. Bird Eggs

Individual bird egg samples are identified by species and location in Appendix C. After sampling was completed, it was determined that two bird egg samples were collected from a location outside the original study design for the Las Vegas Wash Monitoring and Characterization Study. Organic and inorganic COPC concentrations in those egg samples are presented in Appendix D.

Organics

Concentrations of organic COPC in bird eggs are presented in Table 16, and LOC for COPC in bird eggs are provided in Table 17. Additional organic chemicals not specified as contaminants of concern in the 2001 Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries were analyzed in bird eggs, and the results are presented in Appendices E and F.

No LOC were identified for aldrin or any of the BHC isomers. No threshold LOC was identified for lindane (gamma-BHC). Lindane had no effect on hatchability of ring-necked pheasants at 10 mg/kg ww, which is much greater than the maximum detected concentration of lindane in bird eggs in this study, but this value does not represent an adverse effect or a threshold for adverse effects. One study (Hoffman *et al*. 2003, citing Sauter and Steele 1972) reported that lindane in the low mg/kg range in the diet of domestic chickens reduced hatchability and egg production, increased embryonic mortality, and induced eggshell thinning of 8 to 18%. Although lindane seed treatments have been suspected to be hazardous to birds, lindane has not been implicated in any problems for bird populations in the field (Hoffman *et al*. 2003). Though lindane has been used in the United States in seed treatments, lindane residues have rarely been found in tissues or eggs of seed-eating birds (Hoffman *et al*. 2003).

No LOC were identified for chlordane or heptachlor or any of their related compounds. Heptachlor and alpha-BHC were not detected in bird eggs from any of the sampling locations, and since no LOC were identified for these contaminants, the sufficiency of the analytical detection limit could not be assessed for these contaminants individually. For chemicals for which LOC are available, the analytical detection limits appear to be appropriate. Aldrin was detected only in one red-winged blackbird egg at LW10.75, and gamma-chlordane was detected only in eggs from two birds at NP.

LOC were identified for heptachlor epoxide, which is a degradation product of both chlordane and heptachlor. The maximum concentration of heptachlor epoxide detected in bird eggs exceeded the least LOC of 0.04 mg/kg ww and 1-2 mg/kg dw, but the applicability of the value and the degree of adversity associated with the first LOC cannot be determined without reviewing the original article, and the LOC for dry-weight concentration is a no-effect concentration for reproduction in prairie falcon and merlin rather than a threshold effect concentration. The minimum LOC that represents a threshold for adverse effects (1.50 mg/kg ww) or a demonstrated adverse effect (1.5 mg/kg ww) was not exceeded. It appears unlikely that heptachlor epoxide concentrations in bird eggs are currently cause for concern.

Dieldrin concentrations exceeded the minimum LOC of 0.15 mg/kg ww, but did not exceed the minimum reliable threshold LOC that is based on adverse effects (0.7 mg/kg ww). The reproductive processes of mammals and birds are not considered to be particularly sensitive to dieldrin. It seems unlikely that dieldrin concentrations in bird eggs are cause for concern based on currently available data. Endrin, HCB, and mirex concentrations did not exceed their minimum LOC for bird eggs. As stated previously, none of the cyclodienes are known to cause major effects on reproduction at levels well below those causing mortality (Beyer *et al*. 1996).

The maximum concentration of total DDT reported for birds exceeded the LOC identified for total DDT, but the reliability of the LOC is questionable without further review of the literature. LOC were not located for the o,p'- isomers of DDT, DDD, or DDE. The maximum concentration of p,p'-DDD in eggs did not exceed the minimum LOC, but no benchmark value or criterion was identified for this chemical; only results for individual studies were available. Because the p,p'-isomers predominate in the environment and because benchmarks for DDT and related compounds commonly refer to the p,p'- isomers, the LOC for DDE (regardless of whether they were clearly designated for the p,p'- isomer or the isomer was not specified) were compared only to p,p'-DDE concentrations measured in eggs. The maximum concentration of p,p'-DDE exceeded several LOC, including some that represent adverse effects. This contaminant and total DDT should be given closer examination to determine whether adverse effects are likely for birds in the Las Vegas Wash. USFWS pointed out that a black-crowned night heron egg from the regional reference location PNWR had residues of DDE at 1.87 ppm ww, which would have resulted in an estimated 5% - 6.5% eggshell thinning (citing Findholt and Trost 1985).

DDT can affect the reproductive success of birds, primarily through its major metabolite DDE, by more than one toxic mode of action. Eggshell thinning is one of the major ways in which DDT can adversely affect reproductive success of birds. While there is evidence that some other contaminants and physiological conditions can induce eggshell thinning, the burden of proof overwhelmingly indicates that DDE is the major cause of eggshell thinning (Beyer *et al*. 1996). When assessing the potential for a chemical to cause adverse effects in fish and wildlife, concern is generally for effects that might ultimately cause population declines rather than those that affect only individuals. With few exceptions, most scientists who have studied eggshell thinning believe that 18% thinning is an accurate indicator of potential population declines (Beyer *et al*. 1996). Accordingly, in the current analysis, concentrations of DDE or related chemicals that were associated with eggshell thinning of 18% or greater were considered to be benchmarks of adverse effects. Both eggshell thickness and eggshell thickness index are considered to be accurate indicators of eggshell thinning, though thickness is usually the measure of choice (Beyer *et al*. 1996). LOC based on both endpoints were considered, though neither of these endpoints was examined for bird eggs collected in this study.

Studies of the relationships between DDE and eggshell thickness or eggshell thickness index have revealed marked interspecific and intraspecific differences in sensitivity (Beyer *et al*. 1996, and Table 17). The brown pelican seems to be the most sensitive bird species, with eggshell thinning and depressed productivity occurring at 3.0 mg/kg ww DDE in the egg, and total reproductive failure at concentrations greater than 3.7 mg/kg (Beyer *et al*. 1996). Peregrine falcons appear to experience adverse reproductive effects at concentrations about 10-fold greater, or 30 mg/kg ww (Beyer *et al*. 1996). Refinement of the screening-level risk assessment for DDT and DDE in bird eggs will yield a better estimate of the potential for adverse effects. The USFWS provided references describing LOC for DDT and DDE. These will be reviewed and included in future reports.

Total PCB data were erroneously not included in the data set provided to SNWA for data interpretation and report writing. Subsequent to the release of the initial draft report, the missing data were provided to SNWA for inclusion in the final report. Since PCB concentrations initially were not available for bird eggs, LOC for PCBs were not investigated. However, Beyer *et al*. (1996) reviewed the toxicologic significance of PCB residues in bird eggs, and other references are also readily available. These will be reviewed in subsequent reports.

Percent lipid data also were erroneously not included in the data set provided to SNWA for data interpretation and report writing. Subsequent to the release of the initial draft report, the missing data were provided to SNWA (see Appendix H). These data and lipid-adjusted chemical concentrations in bird eggs will be reviewed in subsequent reports.

Inorganics

Concentrations of inorganic COPC in bird eggs are presented in Table 18, and LOC for COPC in bird eggs are provided in Table 17. No LOC for bird egg residues were identified for aluminum, antimony, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, strontium, titanium, or vanadium. Cadmium levels accumulated in bird eggs are negligible and are not expected to cause embryotoxic effects (Beyer *et al*. 1996). Antimony, perchlorate, and titanium concentrations were not reported for bird eggs assessed in this report. Boron and mercury concentrations in eggs did not exceed their minimum LOC for adverse effects. Molybdenum was not detected in bird eggs at any of the sampling locations, and the analytical detection limit was sufficient to detect concentrations below the minimum LOC. Beryllium and vanadium also were not detected in any eggs, and since no LOC were identified, the sufficiency of the analytical detection limit could not be assessed. Detection limits for the other inorganic COPC are appropriate for this project. The maximum concentrations of arsenic and zinc in eggs did not exceed their minimum LOC, but the original data sources for those LOC should be reviewed to determine whether they are appropriate, applicable, and protective for the Las Vegas Wash.

Selenium concentrations in some bird eggs from all locations including PNWR exceeded the minimum LOC, including a threshold for reproductive problems (deformed embryos and hatching failure) at 3 mg/kg ww and a concern level (4 mg/kg dw) that suggests a potential for minor effects on the mallard duck. Selenium concentrations in some of the eggs from NP and DC also exceed an effect level of 10 mg/kg dw that indicates a potential for substantial toxic effects and a threshold concern level (13 mg/kg dw) for embryotoxic and teratogenic effects. Selenium concentrations in bird eggs are great enough to be cause for concern and should be subjected to a risk assessment of greater depth, particularly given the appropriateness of selenium concentrations in eggs as a measure of potential for effects of selenium on bird populations. The developing embryo is the most sensitive avian life stage to the toxic effects of selenium. Because selenium in the egg, rather than that in the parent, causes developmental deformities and death of embryos, selenium in the eggs is the most sensitive measure of potential for selenium effects in birds (Beyer *et al*. 1996). Because selenium is accumulated and lost rapidly in birds, selenium concentrations in eggs are also most representative of contamination in the local environment (Beyer *et al*. 1996). Other advantages of egg sampling are that eggs are often easier to collect than adult birds, the loss of one egg from the nest probably will have little impact on the population, and the egg concentrations integrate maternal exposure over time (Beyer *et al*. 1996).

5. PNWR - Regional Reference Location

The selection of PNWR as the regional reference location was based on the premise that the Pahranagat Valley is believed to be less affected by anthropogenic activity and various forms of pollution compared to the Las Vegas Valley. The results of the 2003 study appear to support this assumption. Chemical residues in wildlife collected from PNWR were, with few exceptions, detected less often and at lower concentrations when compared to samples from the Las Vegas Valley. This held true for both whole fish and bird egg samples, regardless of the species considered. There were exceptions, such as when persistent organochlorines (*e.g*., DDE) in eggs from birds in higher trophic levels at PNWR (*e.g*., black-crowned night heron) were compared with eggs from birds lower in the food chain from the Las Vegas Wash (*e.g*., marsh wren or killdeer). Elevated DDE in raptors and piscivorous birds is not surprising, as it is widely known that organisms in the upper trophic levels tend to accumulate persistent contaminants like mercury, DDE, and PCBs, due to greater dietary exposures.

E. CONCLUSIONS AND RECOMMENDATIONS

The limited analysis of organic contaminants in water samples collected from Duck Creek did not suggest that these are likely to pose a risk to the Las Vegas Wash. However, other significant sources of organic contaminants to the Las Vegas Wash might exist. Based on toxicity and concentration data obtained in this analysis, potential risks associated with water concentrations of aluminum, arsenic, chromium, copper, iron, lead, manganese, mercury, perchlorate, selenium, and zinc should be considered in greater detail.

Based on toxicity and sediment concentration data gathered in this report, concentrations of endrin, DDT and related chemicals, BHC and lead in sediment should be evaluated more closely. Also, further effort should be directed at determining whether elevated barium and strontium concentrations in sediment might be a concern. If possible, methods should be identified or developed that can detect mercury, aldrin, gamma-BHC, chlordane, dieldrin, HCB, heptachlor epoxide, and DDT in sediments to concentrations less than their minimum LOC, unless it is determined that these LOC are not the most suitable for screening.

No LOC were identified for many of the organic and inorganic contaminants analyzed in fish. Based on toxicity and concentration data gathered in the current report, concentrations of the following contaminants in fish should be examined more closely: PCBs, DDT and related compounds, arsenic, cadmium, copper, lead, zinc, and selenium. Perchlorate concentrations in fish tissue collected in 2003 should be included in the next report. Likewise, toxicity information and egg concentration data, as well as the pattern of increasing concentrations of DDT and DDE at downstream locations, indicate that potential risks to birds from DDT and DDE and particularly selenium should be analyzed in greater detail.

Certain contaminants were identified in screens of more than one type of environmental sample. Screening of water, sediment, and fish samples indicates that arsenic and lead might be a concern. Screening of water and fish suggests that copper and zinc deserve closer attention. Mercury was identified as a potential concern in water and possibly in sediment if detection limits for mercury in sediment were lower. Screening of sediment and bird eggs suggests that DDT, DDE, and related chemicals might pose a risk. Selenium was identified as a potential concern in screening of water and sediment samples, fish, and bird eggs. Among the COPC screened, selenium appears to demonstrate the strongest evidence of potential risk based on the information gathered in this analysis.

Future efforts at bioassessment monitoring and screening-level assessment of COPC would benefit from first identifying available relevant benchmarks and then designing sample collection and analysis plans to accommodate them prior to sampling. For example, whenever feasible, analytical methods should be sufficiently sensitive to produce a detection limit less than the lowest benchmark or level of concern, which should be investigated prior to sampling. If benchmarks or levels of concern depend on speciation of metals or analysis of specific metabolites or degradation products of organic chemicals, efforts should be made to analyze the samples of interest in a manner that will allow for comparison to the most appropriate available benchmarks. In some cases, information regarding modifying factors is required or greatly enhances the ability to interpret contaminant concentration data; sometimes this information can only be collected simultaneously with sampling for chemical concentrations. Knowledge of these modifying factors is required before sampling is conducted. Also, certain benchmarks or criteria require specific monitoring regimens (*e.g.*, frequency, number of samples) to allow for the most appropriate comparison, and prior knowledge of sampling requirements is necessary to meet the objectives of the criterion or benchmark. The sampling plan should be re-considered for each contaminant to determine whether the most suitable tissue has been selected for sampling. For example, according to Beyer *et al*. (1996), cadmium is not accumulated to a significant extent in bird eggs, so sampling of a tissue from adult birds might provide a better measure of exposure.

Different benchmarks and criteria are developed for different purposes and using various methods. Ongoing work might benefit from a more critical review of toxicity benchmarks to determine which are most relevant and appropriate for the Las Vegas Wash. Furthermore, in this report, some LOC might have been used in a manner for which they were not originally intended. For example, a criterion that was meant to be compared to a site mean might have been applied to individual samples for screening purposes. Where they are available, species-specific benchmarks or LOC could be used to screen only the species for which they were developed. Particularly for contaminants that were identified during the screening process as those deserving more attention, a closer review of the supporting literature should identify any benchmarks that would be better applied in a different manner or ignored for the purposes of this effort.

Screening-level benchmarks commonly are not developed to be protective of all species of interest in a particular area, but rather for a certain subset or proportion of species. If sensitive species of particular importance (*e.g.*, endangered or threatened species, commercially or recreationally important species, or keystone species) inhabit the area being assessed, extra consideration for these might be warranted. For example, toxicity and/or exposure data specific to the razorback sucker or largemouth bass might be particularly useful for assessing the potential impacts of contaminants on the Las Vegas Wash and Las Vegas Bay.

Benchmarks for certain sample types were not identified for many of the COPC in this study, possibly due to the limited scope of the search necessitated by the available budget. Further review should aid in either identifying appropriate LOC or in determining that the chemicals are not likely to pose a risk based on what is known about their properties. For example, if a chemical is not likely to be present in sediment at significant concentrations due to its physico-chemical properties, there should be less concern for sediment toxicity, and less effort could be expended on attempts to identify sediment LOC. For the metals and metalloids, further investigation might yield more information regarding normal concentrations in environmental samples, particularly for those that are essential to biological systems. For the COPC for which benchmarks were identified, the sufficiency of those benchmarks for screening should be evaluated. If only severe or probable effects benchmarks are available, the potential for more subtle effects might be missed. Potential combined effects of mixtures of contaminants also were not considered here. More in-depth reviews of references that were considered in this report, searches of additional databases, and reviews of the primary literature might identify levels of concern or background levels that are lacking for some of the COPC. For example, handbooks by Eisler (2000a,b,c) were checked only for proposed criteria for protection of natural resources and not for levels associated with adverse effects in individual studies cited in the effects tables. Also, the Eisler (2000a,b,c) handbooks were checked only for fish tissue and bird egg criteria and not for sediment or water quality criteria. This reference in particular should be reviewed in greater detail. Books by Hoffman *et al*. (2003) and Beyer *et al*. (1996) are other references that contain a wealth of useful information that might be addressed in greater detail.

Recommendations Related to Specific Media

Water

Other research and monitoring work has produced a large body of water quality data for the Las Vegas Wash and Las Vegas Bay. Use of these data in addition to the data collected specifically for the current monitoring program could be considered if the additional data are applicable and useful.

Because the U.S. EPA acute water quality criterion for selenium for protection of aquatic life (current and latest draft) are based on selenite and selenate concentrations, these selenium species should be analyzed in water samples in addition to total selenium. Sulfate concentration data should be collected from the same samples so that selenate toxicity can be corrected for sulfate exposure. Because some criteria or benchmarks for chromium are based on Cr(VI) or Cr(III) rather than total chromium, analysis of these species in water and possibly in other media should be considered.

In future reports, more effort will be directed at describing the LOC used for waterborne contaminants. For example, some criteria are based on dissolved concentrations (filtered samples), while others are based on total concentrations (unfiltered samples). Also, the toxicity of some metals is modified by water hardness, and certain water quality criteria for these metals can be adjusted for hardness. Generally, adjustments allow for less stringent criteria as water hardness increases. Hardness adjustments were not applied in this report but should be considered for future efforts because the elevated water hardness in the Las Vegas Wash could significantly reduce the toxicity of some of these metals. Criteria adjusted for hardness have been calculated and will be included in future reports. However, while acute toxicity to in-stream biota decreases for certain metals as hardness increases, most metals are persistent and some may bioaccumulate in food webs. Although short-term toxicity may be avoided in waters with high hardness, chronic sublethal exposures may still pose a risk to wildlife, particularly at the upper trophic levels.

Sediment

It is recommended that some changes in sediment sampling and assessment be considered. Perchlorate in sediment samples was analyzed by ion chromatrography. This method is subject to analytical interferences from other anions in the samples and is not the most reliable or sensitive method currently available for analysis of perchlorate in biological samples. Characterization of all sediment samples, or a representative subset of them, should include factors known to control the availability of contaminants, including pH, organic carbon, inorganic carbon, acid volatile sulfides (AVS), percent water, and grain size (*e.g.*, percent sand, silt, and clay) (Ingersoll, 1995). Sulfides (or acid-volatile sulfide, AVS) in sediment can bind a portion of some metals, including Cd, Cu, Ni, Pb, and Zn, and render them unavailable to biota (USDI 1998, p. 44). The detection limit for selenium in sediment (5 mg/kg dw) is not sufficiently low to determine whether the concentrations of selenium at sites other than LVB might exceed the threshold for toxicity (4 mg/kg dw). Bioaccumulation-based criteria generally were not considered, or at least were not specifically searched, for sediments in the current analysis. Use of bioaccumulation-based criteria for future assessments will improve the assessment for bioaccumulative COPC. USDI (1998) recommends that metal concentrations in sediments be compared to local background metal levels whenever possible, so local data on sediment, or on soil if sediment data are not available, should be gathered and evaluated in future efforts.

Fish

Lipid content data were provided for individual fish analyzed in this study. In future efforts, comparisons of contamination levels among locations should focus on dry-weight concentrations and, for lipophilic contaminants, on lipid-normalized fish tissue concentrations because fish of certain species and at certain locations might be fattier than others.

Weight, standard and total length, and sex of fish that are collected for analysis should be recorded, as body size and sex can influence the concentrations of some contaminants in fish. For example, female fish may eliminate some lipophilic contaminants via their eggs, resulting in lesser whole-body concentrations of these contaminants than are found in males. Methylmercury is typically found at greater concentrations in larger, older fish than in smaller, younger fish. Particularly with the small sample sizes used in this study, it is possible that fish of just one sex might be sampled at a single location, skewing the results. Also, fish of different sizes or sexes might use different locations or habitats within locations in the Las Vegas Wash, and collection of a limited number of fish could easily result in selection of different size ranges or sexes from different locations. Some data that are necessary to assess the effects of these factors were provided subsequent to the release of the initial draft report and will be discussed in later reports.

If a goal of a monitoring plan is to evaluate site-related differences in contamination on the basis of contaminants in fish, the specific locations selected for sampling should be separated by barriers that prevent upstream-downstream fish movement or movement among sampling locations, unless the species selected are territorial or otherwise limited in their movements. An assessment of the mobility of fish among sites must be made prior to drawing conclusions about differences in contaminant levels among locations based on fish tissue concentrations. Elevated concentrations of a contaminant in different environmental media from the same location lend credibility to an assertion that body burdens of the contaminant in animals are location-related.

Bird Eggs

The moisture and lipid contents of bird eggs can vary with the stage of incubation and other factors (Beyer *et al.* 1996). Comparison of individual egg concentrations of COPC to benchmark concentrations based on wet-weight is appropriate as a screening exercise to determine whether residues in individual eggs are cause for concern, but in future efforts comparisons of contamination levels among sampling locations are probably best accomplished using dry-weight concentrations and, for lipophilic COPC, lipid-adjusted concentrations. Percent lipid data were erroneously not included in the data set provided to SNWA for data interpretation and report writing. Subsequent to the release of the initial draft report, the missing data were provided to SNWA (see Appendix H). These data and lipid-adjusted chemical concentrations in bird eggs will be reviewed in subsequent reports.

Most birds sampled in 2003 are believed to be resident species, with the possible exception of the mallard duck (n=3). Because birds are inherently mobile, one cannot rule out the possibility that contaminants detected in tissue were accumulated from areas outside the Las Vegas Wash. However, given the warm climate in the sampling area, most bird species are considered year-round residents. Migrating individuals would be considered the exception. According to USDI (1998), concentrations of mercury in bird eggs more closely reflect recent maternal dietary uptake [*i.e.*, from local sources] of mercury than accumulated stores from maternal tissue (USDI 1998). Likewise, selenium concentrations in bird eggs generally are considered to be from local sources due to the 6-8 weeks required by breeding birds to pair, court, mate, and nest (Joe Skorupa, USFWS, personal communication).

There can be significant intra-clutch variation in egg mercury concentrations. In one study, the first egg laid in a clutch contained as much as 39% more mercury than the second or third eggs laid (USDI 1998, p. 103). This should be considered in sampling and interpretation of results of mercury analysis in bird eggs. Bird egg samples were collected randomly by removing the egg nearest the collector from the direction the nest was first approached. In addition, hens rotate eggs within the nest throughout gestation. Therefore, no attempt was made (nor would it be possible) to collect first-laid eggs. It also should be noted that residues of COPC in bird eggs (including mercury) are expected to reveal accurate averages over time as sample numbers increase, regardless of the sequence the eggs were laid.

If one of the purposes of a monitoring plan is to determine whether there are differences in contamination levels among locations, the sampling locations should be sufficiently separated that movement of birds among them is restricted. Even for resident species, potential movements of birds within the Las Vegas Wash area should be considered before making any judgments about site-related differences in egg contamination.

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WHO. 1996. *Guidelines for Drinking Water Quality. 2nd ed. Volume 2. Health Criteria and Other Supporting Information*. World Health Organisation (WHO). Geneva, Switzerland.

Zhou X, Roefer P, Zikmund K. 2004. *Las Vegas Wash Monitoring and Characterization Study: Results for Water Quality in the Wash and Tributaries. Final Report*. January. Southern Nevada Water Authority. Las Vegas, NV, USA.

Table 1. Chemicals of Potential Concern (COPC)

Organics	Metals, Metalloids, and Other Inorganics
Aldrin	Aluminum
Benzene hexachloride-Total (BHC-Total)	Antimony
alpha-BHC	Arsenic
beta-BHC	Barium
delta- BHC	Beryllium
gamma-BHC	Boron
Chlordane	Cadmium
alpha-Chlordane	Chromium
gamma-Chlordane	Copper
Oxychlordane	Iron
cis-Nonachlor	Lead
trans-Nonachlor	Magnesium
Heptachlor	Manganese
Heptachlor epoxide	Mercury
Dieldrin	Molybdenum
Endrin	Nickel
Hexachlorobenze (HCB)	Perchlorate
Mirex	Selenium
DDT-Total	Strontium
o,p'-DDD	Titanium
o,p'-DDE	Vanadium
o,p'-DDT	Zinc
p,p'-DDD	
p,p'-DDE	
p,p'-DDT	
Polychlorinated biphenyls-Total (PCB-Total)	

Additional organic chemicals were analyzed in bird eggs and whole fish, but these chemicals were not included among those listed as contaminants of concern in the 2001 Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries. The concentrations of the additional organics analyzed in bird eggs and whole fish are presented in Appendices D and G, respectively.

Table 2. DDT and Its Metabolites

Chemical Abbreviation	Chemical Name
o,p'-DDT	o,p'-dichlorodiphenyltrichloroethane
o,p'-DDE	o,p'-dichlorodiphenyldichloroethene
o,p'-DDD	o,p'- dichlorodiphenyldichloroethane
p,p'-DDT	p,p'- dichlorodiphenyltrichloroethane
p,p'-DDE	p,p'- dichlorodiphenyldichloroethene
p,p'-DDD	p,p'- dichlorodiphenyldichloroethane

Table 3. Descriptions of Sampling Locations Used During the Las Vegas Wash Monitoring and Characterization Study, 2000 - 2003

Location	Description	Distance Along Wash (miles)	Flow Constituents: Municipal Waste Water	Shallow Ground Water	Storm Water	Urban Runoff
LW10.75	Las Vegas Wash below confluence of Flamingo Wash, Las Vegas Creek historic channel, and Sloan Channel. Upstream of all municipal WWTP.	10.75	(a)	X	X	X
NP	Nature Preserve at Clark County Wetlands Park.	tributary	X (b)	X	X	X
DC	Duck Creek (DC 1) below Broadbent Road. Catches surface runoff from southwest side of Las Vegas, mainly Henderson.	tributary		X	X	X
PB	Las Vegas Wash (LW 6.05). Pool upstream of Pabco Road erosion control structure and downstream of all municipal WWTP.	6.05	X	X	X	X
LW0.8	Las Vegas Wash (LW0.8). Under bridge over Northshore Road, downstream of Lake Las Vegas. Represents the end of the Las Vegas Wash.	0.8	X	X	X	X
LVB	Las Vegas Bay delta (as of April 2003).	0	X	X	X	X
PNWR	Pahranagat National Wildlife Refuge. Regional reference site with no urban influence. Potential contaminants arise from agriculture and livestock.	NA	NA	NA	NA	NA

NA, not applicable; WWTP; wastewater treatment plant.
(a) Due to the close proximity of this site to the water reclamation plant for the City of Las Vegas, bird egg and fish samples collected in the area cannot be presumed to be unaffected by wastewater constituents, but this site is upstream of the discharges of the municipal WWTP.

Table 3. Descriptions of Sampling Locations Used During the Las Vegas Wash Monitoring and Characterization Study, 2000 – 2003 (continued)

(b) According to the USFWS (personal communication, August 23, 2006), to their knowledge the Nature Preserve (NP) did not receive municipal wastewater flows until after 2003, with the possible exception of flood events (*i.e.*, the Las Vegas Wash overflowing its banks). Thus, this site differs from the other sites that have received municipal wastewater under normal, dry conditions.

Table 4. Fish Species Sampled for Whole-body Residue Analysis, Fall 2003

Common Name	Family Name	Scientific Name
Common carp	Cyprinidae	*Cyprinus carpio*
Green sunfish	Centrarchidae	*Lepomis cyanellus*
Bluegill sunfish	Centrarchidae	*Lepomis macrochirus*
Black bullhead	Ictaluridae	*Ameiurus melas*
Channel catfish	Ictaluridae	*Ictalurus punctatus*

Fish samples were collected in September, October, and November of 2003.

Table 5. Bird Species From Which Eggs Were Sampled, 2003

Common Name	Family Name	Scientific Name	Status	Abundance
Red-winged blackbird	Blackbirds/Icteridae	*Agelaius phoeniceus*	Resident	Abundant
Yellow-headed blackbird	Blackbirds/Icteridae	*Xanthocephalus xanthocephalus*	Summer visitant	Common
American coot	Rails, Gallinules & Coots/Rallidae	*Fulica americana*	Resident	Abundant
Killdeer	Plovers/Charadriidae	*Charadrius vociferus*	Resident	Common
Mallard	Waterfowl/Anatidae	*Anas platyrhynchos*	Resident	Common
Marsh wren	Wrens/Troglodytidae	*Cistothorus palustris*	Resident	Common
Black-crowned night-heron	Bitterns & Herons/Ardeidae	*Nycticorax nycticorax*	Resident	Uncommon
Western grebe	Grebes/Podicipedidae	*Aechmophorus occidentalis*	Winter visitant	Rare

Information regarding the species of birds was taken from the Red Rock Audubon Society Bird List of the Las Vegas Wash (Titus, 2004). Abundant – always found in suitable habitat, Common – usually found in suitable habitat, Uncommon – occasionally found in suitable habitat

Table 6. Concentrations of Chemicals of Potential Concern in Water, 2000-2003

				Sampling Location and Distance Along the Wash (miles)					
Chemical	Units	Detection Limit	Statistic	LW 10.75 (10.75)	DC	PB (6.05)	LW 0.8 (0.8)	Grand Maximum	Minimum LOC
Organics[1]									
Aldrin	µg/L	0.01	Average	na	ND	na	na		
			Maximum	na	ND	na	na		
alpha-BHC	µg/L	0.01	Average	na	na	na	na		
			Maximum	na	na	na	na		
beta-BHC	µg/L	0.01	Average	na	ND	na	na		
			Maximum	na	ND	na	na		
delta-BHC	µg/L	ND[5]	Average	na	ND	na	na		
			Maximum	na	ND	na	na		
gamma-BHC (Lindane)[4]	µg/L	0.01	Average	na	ND	na	na		
			Maximum	na	ND	na	na		
Chlordane	µg/L	0.10	Average	na	na	na	na		
			Maximum	na	na	na	na		
Oxychlordane	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
Dieldrin	µg/L	0.01	Average	na	ND	na	na		
			Maximum	na	ND	na	na		
Endrin	µg/L	0.01	Average	na	na	na	na		
			Maximum	na	na	na	na		
HCB	µg/L	0.05	Average	na	na	na	na		
			Maximum	na	na	na	na		
Heptachlor	µg/L	0.01	Average	na	na	na	na		
			Maximum	na	na	na	na		
Heptachlor epoxide	µg/L	0.01	Average	na	na	na	na		
			Maximum	na	na	na	na		
cis-Nonachlor	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
trans-Nonachlor	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
Mirex	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
o,p'-DDD	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
o,p'-DDE	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
o,p'-DDT	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
p,p'-DDD	µg/L	0.01	Average	na	na	na	na		
			Maximum	na	na	na	na		
p,p'-DDE	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na		
p,p'-DDT	µg/L	0.01	Average	na	na	na	na		
			Maximum	na	na	na	na		
PCB-Total	µg/L	0.10	Average	na	na	na	na		
			Maximum	na	na	na	na		
Metals & Metalloids[2]									
Aluminum	µg/L	---	Average	142	168	383	633		
			Maximum	790	360	6000	2200	**6000**	**87**
Antimony	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na	na	na
Arsenic	µg/L	---	Average	12.8	50.5	7.61	10.5		
			Maximum	30.0	59.0	15.0	14.0	**59.0**	**40.0**
Barium	µg/L	---	Average	48.5	29.0	43.0	53.6		
			Maximum	420	36.0	130	115	420	na
Beryllium	µg/L	ND[6]	Average	ND	na	ND	ND		
			Maximum	ND	na	ND	ND	ND	na
Boron	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na	na	200
Cadmium	µg/L	ND[6]	Average	ND	na	ND	ND		
			Maximum	ND	na	ND	ND	ND	0.051 - 6.3
Chromium	µg/L	---	Average	4.2	2.0	2.4	2.6		
			Maximum	41	2.8	9.7	4.3	**41**	**21.5**
Copper	µg/L	---	Average	7.59	10.8	6.02	6.23		
			Maximum	12.0	17.0	12.0	11.0	**17.0**	**0.23**
Iron	µg/L	---	Average	1360	308	510	840		
			Maximum	20000	610	6100	4200	**20000**	**1000**
Lead	µg/L	---	Average	4.2	0.6	1.1	1.8		
			Maximum	57	0.6	4.7	5.9	**57**	**1**

Table 6. Concentrations of Chemicals of Potential Concern in Water, 2000-2003

				Sampling Location and Distance Along the Wash (miles)					
Chemical	**Units**	**Detection Limit**	**Statistic**	**LW 10.75 (10.75)**	**DC**	**PB (6.05)**	**LW 0.8 (0.8)**	**Grand Maximum**	**Minimum LOC**
Magnesium	mg/L	---	Average	239	287	73	73		
			Maximum	270	310	110	87	310	na
Manganese	µg/L	---	Average	36.4	31.7	43.9	71.3		
			Maximum	660	52.0	140	165	**660**	**388**
Mercury	µg/L	---	Average	ND	na	0.20	ND		
			Maximum	ND	na	0.20	ND	**0.20**	**< 0.00057**
Molybdenum	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na	na	19
Nickel	µg/L	---	Average	14.0	21.1	9.73	11.0		
			Maximum	49.0	30.0	15.0	16.0	**49.0**	**7.1**
Selenium	µg/L	---	Average	14.0	23.3	3.27	3.03		
			Maximum	20.0	27.0	5.18	6.70	**27.0**	**1 - 2**
Selenium[3]	µg/L	---	Average	13.8	22.8	3.42	2.87		
			Maximum	16.5	23.5	5.75	3.31	**23.5**	**1 - 2**
Strontium	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na	na	na
Titanium	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na	na	na
Vanadium	µg/L	na	Average	na	na	na	na		
			Maximum	na	na	na	na	na	9
Zinc	µg/L	---	Average	29	15	44	39		
			Maximum	350	32	74	70	**350**	**5 - 51**
Other Inorganics									
Perchlorate[7]	µg/L		Average	13	20	69	425		
			Maximum	21	26	376	663	663	na

Notes

Data were taken from the report by Zhou et al. 2004. Data for additional water sampling locations are provided in that report, but the current analysis focuses on sampling locations that correspond to those used for collection of sediment, bird eggs, and fish. Except as otherwise noted, averages for the mainstream Las Vegas Wash locations (LW 10.75, PB, and LW 0.8) are averages for monthly samples collected August 2000 to June 2003, and averages for the tributaries and seeps (DC) are averages of quarterly samples collected October 2000 to April 2003.

ND, not detected; na, not analyzed or not available; LOC, level of concern taken from Table 9.

Bold font is used to designate a maximum water concentration of a COPC that exceeded the minimum LOC for that contaminant. Because organic COPC were either not detected or not analyzed, grand maximum values were not calculated, but LOC for organics can be found in Table 8.

[1] Organics were analyzed only in tributaries and seeps that contribute to the flow of the Las Vegas Wash. The only tributary or seep that was sampled by Zhou et al. 2004 and that is also considered in the current analysis is Duck Creek (DC). Organics were analyzed in unfiltered water samples.

[2] Zhou et al. 2004 did not provide detection limits for inorganics (metals, metalloids, perchlorate). Metal and metalloid concentrations are dissolved metals or metalloids; water samples were filtered prior to analysis. Water samples were not filtered prior to perchlorate analysis.

[3] As a supplement to regular water sampling for selenium, these samples for selenium analysis were collected monthly for approximately nine months (1/23/2002 to 9/25/2002) in the mainstream Las Vegas Wash and quarterly (seven samples from 1/23/2002 to 4/23/2003) in the tributaries. Average concentrations were similar to those resulting from regular sampling.

[4] Neither 'Lindane (gamma-BHC)' nor 'Lindane' (presumably total BHC) were detected. Zhou et al. 2004 did not list 'Lindane' among the analytes in Appendix I of their report, and no detection limit is provided. However, 'Lindane' is listed among the analytes (non-detect) in Appendix Ve of that report.

[5] The report by Zhou et al. 2004 did not list delta-BHC as an analyte in Appendix I, and no detection limit is provided. However, delta-BHC is listed as an analyte (non-detect) in Appendix Ve of that report.

[6] Beryllium and cadmium were analyzed at certain sites, but no detection limit is reported by Zhou et al. 2004.

[7] Perchlorate at Duck Creek (DC) was analyzed quarterly from 7/30/2001 to 4/23/2003.

References

Zhou X, Roefer P, Zikmund K. 2004. Las Vegas Wash Monitoring and Characterization Study: Results for Water Quality in the Wash and Tributaries. Final Report. January. Southern Nevada Water Authority. Las Vegas, NV.

Table 7. Some Basic Water Quality Parameters for Sampling Locations in the Las Vegas Wash, 2003

Water Quality Parameter	Units	Location and Distance Along the Wash (miles)					
		LW 10.75 (10.75)	NP	DC	PB (6.05)	LW 0.8 (0.8)	LVB (0)
Temperature	°C	21.32	NA	16.8	23.55	20.95	NA
Dissolved Oxygen (DO)	mg/L	10.83	NA	10.16	8.73	8.75	
pH	---	8.22	NA	8.16	7.69	7.88	NA
Calcium	mg/L	299	NA	505	140	154	NA
Magnesium	mg/L	239	NA	287	73	73	NA
Total Hardness as $CaCO_3$ (calc.)[1]	mg/L	1731	NA	2443	650	685	NA
Total Organic Carbon (TOC)	mg/L	NA	NA	2.7	NA	NA	NA
Total Dissolved Solids (TDS)	mg/L	3132	NA	5048	1567	1633	NA
Conductivity (EC)[2]	µS/cm	3757	NA	5875	2269	2411	NA

Notes

NA, not available.

[1] Hardness was determined by calculation, as described by APHA 1995, using the following equation: Hardness (mg/L equivalent as CaCO3) = 2.497 [Ca, mg/L] + 4.118 [Mg, mg/L]. Hardness estimates were based on averages of monthly (LW 10.75, PB, LW 0.8) or quarterly (DC) concentrations of calcium and magnesium reported by Zhou et al. 2004.

[2] Specific electrical conductivity.

References

APHA. 1995. Method 2340 B. Hardness by calculation. In: AD Eaton, LS Clesceri, and AE Greenberg (eds.), Standard Methods for the Examination of Water and Wastewater. American Public Health Association; American Water Works Association; Water Environment Federation. Washington, DC.

Zhou X, Roefer P, Zikmund K. 2004. Las Vegas Wash Monitoring and Characterization Study: Results for Water Quality in the Wash and Tributaries. Final Report. January. Southern Nevada Water Authority. Las Vegas, NV, USA.

Table 8. Water Quality Criteria for Organic Chemicals of Potential Concern (µg/L)

Chemical Class	Chemical	CASRN	USEPA WQC[1] CMC (acute)	USEPA WQC[1] CCC (chronic)	Contaminant Hazard Reviews[2]	Handbook of Chemical Risk Assessment[3]	USDI 1998[4]	NDEP 2003 Aquatic Life[5]
Organics	Aldrin	309-00-2	3	na	na	na	na	3[a]
	alpha-BHC	319-84-6	na	na	na	na	na	na
	beta-BHC	319-85-7	na	na	na	na	na	na
	delta-BHC	319-86-8	na	na	na	na	na	na
	gamma-BHC	58-89-9	0.95	na	na	na	na	2.0[a], 0.08 (24-hr average)[a]
	Chlordane	57749	2.4	0.0043	na	0.0043 (24-hr average), not to exceed 2.4 at any	na	2.4[a], 0.0043 (24-hr average)[a]
	alpha-Chlordane	5103-71-9	See chlordane	See chlordane	na	na	na	na
	gamma-Chlordane	5566-34-7	See chlordane	See chlordane	na	na	na	na
	Oxychlordane	27304-13-8	See chlordane	See chlordane	na	na	na	na
	Dieldrin	60-57-1	0.24	0.056	na	na	na	2.5[a], 0.0019 (24-hr average)[a]
	Endrin	72-20-8	0.086	0.036	na	na	na	0.18[a], 0.0023 (24-hr average)[a]
	HCB	118-74-1	na	na	na	na	na	na
	Heptachlor	76-44-8	0.52	0.0038	na	na	na	0.52[a], 0.0038 (24-hr average)[a]
	Heptachlor epoxide	1024-57-3	0.52	0.0038	na	na	na	na
	cis-Nonachlor	5103-73-1	na	na	na	na	na	na
	trans-Nonachlor	39765-80-5	na	na	na	na	na	na
	Mirex	2385-85-5	na	0.001	2 - 3	2-3 (significant damage in susceptible aquatic organisms)	na	0.001[a]
	DDT-Total		1.1	0.001	na	na	NA	1.1[a], 0.001 (24-hr average)[a]
	o,p'-DDE	3424-82-6	See DDT-Total	See DDT-Total	na	na	4,400	See DDT-Total
	o,p'-DDD	53-19-0	See DDT-Total	See DDT-Total	na	na	1.69 - 3.99	See DDT-Total
	o,p'-DDT	789-02-6	See DDT-Total	See DDT-Total	na	na	0.013 - 0.2	See DDT-Total
	p,p'-DDE	72-55-9	See DDT-Total	See DDT-Total	na	na	4,400	See DDT-Total
	p,p'-DDD	72-54-8	See DDT-Total	See DDT-Total	na	na	1.69 - 3.99	See DDT-Total
	p,p'-DDT	50-29-3	See DDT-Total	See DDT-Total	na	na	0.013 - 0.2	See DDT-Total
	PCB-Total	---	na	0.014	<0.014, 2.0	<0.014 (acute), <2.0 (chronic)	na	NG

Table 8. Water Quality Criteria for Organic Chemicals of Potential Concern (µg/L)

Notes

na - Chemical name does not appear in given reference
NG - Chemical name is listed in the reference, but no value is reported

References

1 USEPA WQC: U.S. Environmental Protection Agency (USEPA) Water Quality Criteria (WQC). Both of the following references were searched for these criteria.

USEPA. 2004. National Recommended Water Quality Criteria. U.S. Environmnental Protection Agency (USEPA), Office of Water, Office of Science and Technology. Washington, DC. 23 p. http://epa.gov/waterscience/criteria/nrwqc-2004.pdf or http://epa.gov/waterscience/criteria/wqcriteria.html#A2.

USEPA. 2005. Water Quality Standards Database. March. U.S. Environmental Protection Agency (USEPA). Last updated June 16, 2005. Accessed September 29, 2005. http://www.epa.gov/wqsdatabase/.

PCB-Total: CCC applies to total PCBs, e.g., the sum of all congeners or all isomers or homologs or Aroclor analyses.

CMC: Criterion Maximum Concentration, an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect

CCC: Criterion Continuous Concentration, an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect

2 Contaminant Hazard Reviews. Eisler 1985, 1986. http://www.pwrc.usgs.gov/infobase/eisler/reviews.cfm

Eisler, R. 1985. Mirex hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85(1.1).
Maximum acceptable toxicant concentration (MATC) values provided for various freshwater species including: <2.4 for amphipods, 2-3 ppb for fathead minnow, 34 ppb for fathead minnow based on impaired reproduction, >34 for daphnids and midges.

Eisler, R. 1986. Polychlorinated biphenyl hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85(1.7).
alues are for chronic and acute exposure per Eisler 1986 and EPA 1992.

3 Handbook of Chemical Risk Assessment. This reference includes three volumes. Due to time constraints, this reference was checked only for proposed criteria for protection of natural resources.
Eisler, Ronald. 2000a. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 1. Metals. Lewis Publishers. New York, NY, USA. p. 1-738.
Eisler, Ronald. 2000b. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 2. Organics. Lewis Publishers. New York, NY, USA. p. 739-1500.
Eisler, Ronald. 2000c. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 3. Metalloids, Radiation, Cumulative Index to Chemicals and Species. Lewis Publishers. New York, NY, USA. p. 1501-1903.

Table 8. Water Quality Criteria for Organic Chemicals of Potential Concern (µg/L)

4 USDI 1998. U.S. Department of the Interior (USDI). 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, Bureau of Indian Affairs.

DDT - Toxicity threshold values: 0.013 - for FW organisms, 0.36 - for daphnia, 0.2 for fish
DDE - fathead minnow acute LC50 from EPA 1984, value for p,p-DDE
DDD - range encompassing level of concern for fish

5 NDEP 2003 Aquatic Life. NDEP. 2003. Nevada Administrative Code - Chapter 445A - NAC 445A.118 to 445A.225 - Codification as of February 2003. Nevada Division of Environmental Protection (NDEP), Bureau of Water Quality Planning, Water Quality Standards Branch. Carson City, Nevada, USA. Accessed February 23, 2006. 116 p. http://ndep.nv.gov/nac/445a-118.pdf.

General notes

a U.S. Environmental Protection Agency, Pub. No. EPA 440/5-86-001, Quality Criteria for Water (Gold Book) (1986)
b This standard applies to the dissolved fraction.

Table 9. Water Quality Criteria for Inorganic Chemicals of Potential Concern (µg/L)

Chemical Class	Chemical	CASRN	USEPA WQC[1] CMC (acute)	USEPA WQC[1] CCC (chronic)	Contaminant Hazard Reviews[2]	Handbook of Chemical Risk Assessment[3]	Tuttle and Thodal 1998 (Concern)[4]	Tuttle and Thodal 1998 (Effect)[4]	USDI 1998[5]	NDEP 2003 Aquatic Life[6]
Metals & Metalloids	Aluminum	7429-90-5	750 (pH 6.5-9.0)	87	na	na	87	100	na	na
	Antimony	7440-36-0	na	na	na	na	na	na	na	na
	Arsenic	7440-38-2	340	150	see notes	yes	NG	40	48 - 190	342 (1-hr average), 180 (96-hr average)[a,b]
	Barium	7440-39-3	na	na	na	na	na	na	na	na
	Beryllium	7440-41-7	na	na	na	na	na	na	na	na
	Boron	7440-42-8	Narrative Statement - Gold Book	Narrative Statement - Gold Book	1000	yes	200	52,200	5,000 - 25,000	NG
	Cadmium	7440-43-9	2.0	0.25	0.051 - 6.3	yes	NG	1	na	NG[a,b]
	Chromium	7440-43-9	na	na	na	yes	21.5	190	na	NG (total)
	Chromium III	1606-583-1	570	74	<2,200 - <9,900	na	na	na	na	NG[a,b]
	Chromium VI	1854-029-9	16	11	<0.29	na	na	na	na	15 (1-hr average), 10 (96-hr average)[a,b]
	Copper	7440-50-8	13	9	<5.6 - 43, see notes	yes	3.4	110	0.23 - 12	NG[a,b]
	Iron	7439-89-6	na	1000	na	na	NG	NG	na	1000[a]
	Lead	7439-92-1	65	2.5	7.7 - 200, see notes	yes	1	3.5	na	NG[a,b]
	Magnesium	7439-95-4	na	na	na	na	na	na	na	na
	Manganese	7439-96-5	na	na	na	na	388	NG	na	na
	Mercury	7439-97-6	1.4	0.77	<0.00057	yes	NG	0.1	0.00064	2 (1-hr average)[a,b], 0.012 (96-hr average)[a]
	Molybdenum	7439-98-7	na	na	>790 - >70,000, see notes	yes	28	790	20 - 120	19[c]
	Nickel	7440-02-0	470	52	7.1, 140, see notes	yes	NG	NG	NA	NG[a,b]
	Selenium	7782-49-2	See footnote	5	35	yes	1.5	3	1 - 2	20 (1-hr average)[a], 5 (96-hr average)[a]
	Strontium	7440-24-6	na	na	na	na	na	na	na	na
	Titanium	7440-32-6	na	na	na	na	na	na	na	na
	Vanadium	7440-62-2	na	na	na	na	9	170	na	na
	Zinc	7440-66-6	120	120	5 - 51, see notes	yes	NG	32	30 - 110	NG[a,b]
Others	Perchlorate	14797-73-0	na	na	na	na	na	na		na

Table 9. Water Quality Criteria for Inorganic Chemicals of Potential Concern (µg/L)

Notes

na - Chemical name does not appear in given reference
NG - Chemical name is listed in the reference, but no value is reported

References

1 USEPA WQC: U.S. Environmental Protection Agency (USEPA) Water Quality Criteria (WQC). Both of the following references were searched for these criteria.

USEPA. 2004. National Recommended Water Quality Criteria. U.S. Environmnental Protection Agency (USEPA), Office of Water, Office of Science and Technology. Washington, DC. 23 p. http://epa.gov/waterscience/criteria/nrwqc-2004.pdf or http://epa.gov/waterscience/criteria/wqcriteria.html#A2.

USEPA. 2005. Water Quality Standards Database. March. U.S. Environmental Protection Agency (USEPA). Last updated June 16, 2005. Accessed September 29, 2005. http://www.epa.gov/wqsdatabase/.

CMC: Criterion Maximum Concentration, an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect
CCC: Criterion Continuous Concentration, an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect

Boron (excerpted from the Gold Book): The maximum concentration of boron found in 1,546 samples of river and lake waters from various parts of the United States was 5.0 mg/L; the mean value was 0.1 mg/L. Ground waters could contain substantially higher concentrations in certain places. Naturally occurring concentrations of boron should have no effects on aquatic life. The minimum lethal dose for minnows exposed to boric acid at 20 °C for 6 hours was 19,000 to 19,500 mg/L in hard water.
Selenium: CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/l and 12.82 µg/l, respectively. To determine whether this criterion was exceeded, data describing the fractions of selenite and selenate are required; this information was not provided.

2 Contaminant Hazard Reviews: Eisler 1985, 1986, 1987, 1988, 1990, 1993, 1998. (Date and report number vary by chemical). Available at: http://www.pwrc.usgs.gov/infobase/eisler/reviews.cfm
Arsenic (Eisler 1988, Report 85(1.12)) - Four-day mean water concentration not to exceed 190 µg total recoverable inorganic As^{+3}/L more than once every 3 years; 1-h mean not to exceed 360 ug inorganic As^{+3}/L more than once every 3 years. Insufficient data for criteria formulation for inorganic As^{+5}, or for any organoarsenical (EPA 1985). Eisler, R. 1988. Arsenic hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.12).
Boron (Eisler 1990, Report 85(1.20)) - Values: 1 mg/L is for protection of aquatic life based on nonhazardous levels for fish and oysters; adverse effects for sensitive aquatic spp reported at 10-12 mg/L
Eisler, R. 1990. Boron hazards to fish, wildlife, and invertebrates: a synoptic review. U. S. Fish Wildl. Serv., Biol. Rep. 85(1.20).
Cadmium (Eisler 1985, Report 85(1.2))- current upper limit of 10.0 ppb of cadmium in drinking water for human health protection is not sufficient to protect many species of freshwater biota against the biocidal properties of cadmium or again sublethal effects, such as reduced growth and inhibited reproduction. Ambient water quality criteria formulated for protection of freshwater aquatic life state that, for total recoverable cadmium, the criterion, in µg/L, is the numerical value given by e to the power (1.05 (ln (hardness))-8.53) as a 24-h average and the concentration, in ppb, should never exceed the numerical value given by e to the power (1.05 (ln (hardness)) -3.73). Thus, at water hardnesses of 50, 100, and 200 mg/L as $CaCO_3$, the criteria are 0.012, 0.025, and 0.051 ppb, respectively, and the concentration of total recoverable cadmium should never exceed 1.5, 3.0, and 6.3 ppb, respectively.
Chromium (Eisler 1986, Report 85(1.6)) - Numerous values are provided. For Cr^{+6}, freshwater values are for aquatic life protection in USA (per EPA 1980): <0.29 Cr^{+6} as 24 h average; not to exceed 21 Cr^{+6} at any time. For Cr^{+3}, values are hardness dependent as follows: at 50 mg $CaCO_3$/L - <2200 µg/L, at 100 mg $CaCO_3$/L - <4,700 µg/L, at 200 mg $CaCO_3$/L - <9,900 µg/L. Adverse effects of Cr to sensitive species documented at 10.0 µg/L (ppb) of Cr^{+6} (reduced growth, inhibited reproduction, and increased bioaccumulation) and 30.0 µg/L of Cr^{+3} in freshwater. Cr^{+6} is more toxic to freshwater daphnids and teleosts in water of comparatively low alkalinity, low pH, and low total hardness (per Muller 1980).
Copper - Multiple criteria presented for aquatic life. MATC for aquatic life fresh water (spp unspecified) are 12 µg/l @50 mg $CaCO_3$/L, 22 µg/L @ 22 $CaCO_3$/L, 43 mg $CaCO_3$/L. Eisler R. 1998. Copper hazards to fish, wildlife, and invertebrates: a synoptic review. <5.6 µg/L is safe concentration 24-hr average for total recoverable copper. U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR--1998-0002.
Lead - Toxicity varies depending on hardness: i.e., at 50 = 1.3 - 34, at 100 = 3.2 - 82, at 200 = 7.7 - 200. First value is four-day average; second value is a one-hour average, neither is to be exceeded more than once every 3 years. Eisler R. 1988. Lead hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.14).
Mercury (Eisler 1987, Report 85(1.10)) - <0.00057 (24 h average), not to exceed 0.0017 at any time. <0.012, 4-day average (not to be exceeded more than once every 3 years; <2.4, one-hour average (not to be exceeded more than once every 3 years). Eisler R. 1987. Mercury hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85(1.10).
Molybdenum - Range of advserse effect concentrations is >0.79 mg/L (adverse effects on newly fertilized fish eggs) to >70 mg/L (reduced survival of adult fish).
Nickel - values are for marine aquatic life. 7.1 µg/L is for 24-hr average of total recoverable Ni; maximum concentration not to exceed 140 µg/L at any time
Selenium (Eisler 1985, Report 85(1.5)) - Value (as inorganic selenite) for protection of aquatic organisms; range of 47 to 53 ppb associated with growth inhibition of freshwater algae, anemia and reduced hatching in trout, and shifts in species composition of freshwater algae communities. Acute exposure value is 260 µg/L. Chronic value for inorganic selenate is <760 ppb. Selenium chemistry is complex (Rosenfeld and Beath 1964; Harr 1978; Wilber 1983). In nature, selenium exists as six stable isotopes (Se-74,-76,-77,-78,-80, and -82), of which Se-80 and -78 are the most common, accounting for 50 and 23.5%, respectively. Eisler R. 1985. Selenium hazards to fish, wildlife and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85 (1.5).
Zinc (Eisler 1993, Report 85(1.26)) - criteria for protection of aquatic life (freshwater). Results of recent studies, however, show significant adverse effects on a growing number of freshwater organisms in the range of 5 to 51 µg/L. Zinc interacts with numerous chemicals. The patterns of accumulation, metabolism, and toxicity from these interactions sometimes greatly differ from those produced by zinc alone. Recognition of these interactions is essential to the understanding of zinc kinetics in the environment. Many factors modify the lethal properties of zinc to fish. Zinc is more toxic under conditions of comparatively low dissolved oxygen concentrations, high sodium concentrations, decreased loadings of organic complexing agents (Spear 1981), and low pH (NAS 1979). Adverse effects, most sensitive species Brown trout, Salmo trutta, embryos 4.9-19.6 µg/L and fry...To protect about 95% of freshwater animal genera, EPA recommends water concentrations that average <47 µg total recoverable zinc per liter, not to exceed 180 µg/L at any time in soft water (i.e., <50 mg $CaCO_3$/L), or a mean concentration of 59 µg acid soluable zinc per liter, not to exceed 65 µg/L at any time in soft water (Table 9). These criteria are unsatisfactory because lower ambient zinc concentrations between 5 and 51 µg/L clearly have significant negative effects on growth, survival, and reproduction of important species of freshwater fisl amphibians, insects, sponges, and crustaceans (Table 9). 1993 Report

3 Handbook of Chemical Risk Assessment: This reference includes three volumes. Due to time constraints, this reference was checked only to determine whether it contained a record for each contaminant, for future reference.
Eisler, Ronald. 2000a. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 1. Metals. Lewis Publishers. New York, NY, USA. p. 1-738.
Eisler, Ronald. 2000b. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 2. Organics. Lewis Publishers. New York, NY, USA. p. 739-1500.
Eisler, Ronald. 2000c. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants, and Animals. Volume 3. Metalloids, Radiation, Cumulative Index to Chemicals and Species. Lewis Publishers. New York, NY, USA. p. 1501-1903.

4 Tuttle and Thodal 1998: Tuttle PL, Thodal CE. 1998. Field Screening of Water Quality, Bottom Sediments, and Biota Associated With Irrigation In and Near the Indian Lakes Areas, Stillwater Wildlife Management Area, Churchill County, West-Central Nevada, 1995. U. S. Geological Survey Water-Resources Investigations Report 97-4250. United States Geological Survey. Carson City, NV. 57 p.

5 USDI 1998. United States Department of the Interior (USDI). 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, Bureau of Indian Affairs.
Chemical specific notes:
Arsenic - 48 µg/L is lowest chronic value for As (V) in aquatic plants; 190 µg/L is NAWQ chronic criterion for As (III). Per Suter and Mabrey (1994).
Boron - Values are for fish. 5 mg/L = NEL; 25 mg/L = toxicity threshold For fish (viz., catfish and trout embryos; Birge and Black 1977; Perry et al. 1994)
Copper - Hardness-dependent criteria: 0.23 µg/L is lowest chronic value for aquatic organisms; 12 µg/L is NAWQ [National Ambient Water Quality] chronic criterion at hardness of 100 mg/L (as CaCO3) (See Suter and Mabrey 1994). Sensitive species may be affected in the "level of concern range" [specified in table above] (depending partly on effects of pH, temperature, and dissolved oxygen).
Mercury - value based on total mercury from wildlife criterion for protection of piscivorous spp, = 0.00005 µ/L methylmercury; additional criterion for protection of bald eagles = 0.000082 µg/L methylmercury. Values cited as EPA criteria. Concentrations greater than 30 µg/L (toxicity threshold) seem to cause adverse effects, including reproductive impairment and sublethal impacts.
Molybdenum - Presented in Table 26 as "levels for fish" at 0.02 mg/L (or 20 µg/L)= No effect level for fish, or upper limit of natural background (per Eisler 1989), 0.12 mg/L (or 120 µg/L) = LC10 for larval trout (per Birge et al. 1980).
Selenium - No effect associated with <1 µg/L and toxicity threshold for fish and wildlife via bioaccumulation reported as >2 µg/L (Table 32). Impaired fish reproduction noted at 2.0 µg/L (Table 33). "freshwater background" range given as 0 - 0.4 µg/L
Zinc - values are hardness dependent. At hardness of 50 mg/L $CaCO_3$ - 59 ug/L for chronic exposure, 65 µg/L for acute exposure; at hardness of 100 mg/L $CaCO_3$ - 110 µg/L for chronic exposure, 120 ug/L for acute exposure; at hardness of 200 mg/L $CaCO_3$ - 190 µg/L for chronic exposure, 210 µg/L for acute exposure [per table 38]. Per summary table 34: <30 = lowest chronic value for aquatic life (per Suter and Mabery, 1994), 110 = toxicity threshold value assuming hardness of 100 mg/L as $CaCO_3$. Zinc is most harmful to aquatic life during early life stages, in soft water, under conditions of low pH, low alkalinity, low dissolved oxygen and elevated temperatures (per Eisler 1993)

6 NDEP 2003 Aquatic Life. NDEP. 2003. Nevada Administrative Code - Chapter 445A - NAC 445A.118 to 445A.225 - Codification as of February 2003. Nevada Division of Environmental Protection (NDEP), Bureau of Water Quality Plannin Water Quality Standards Branch. Carson City, Nevada, USA. Accessed February 23, 2006. 116 p. http://ndep.nv.gov/nac/445a-118.pdf.
General Notes
a Primary source: U.S. Environmental Protection Agency, Pub. No. EPA 440/5-86-001, Quality Criteria for Water (Gold Book, 1986)
b This standard applies to the dissolved fraction.
c California State Water Resources Control Board, Regulation of Agricultural Drainage to the San Joaquin River: Appendix D, Water Quality Criteria (March 1988 revision).
Chemical-specific notes
As - value is for (As(III))
Cd - Exponential equations presented: For 1-hr average: 0.85exp{1.128 ln(H)-3.828}, for 24-hr average: 0.85exp{0.7852 ln(H)-3.490}
Cr - for Cr(III) exponential equations are presented: for 1-hr average: 0.85exp{0.8190 ln(H)+3.688}, for 24-hr average: 0.85exp{0.8190 ln(H)+1.561}
Cu - Exponential equations presented: For 1-hr average: 0.85exp{0.9422 ln(H)-1.464} for 96-hr average: 0.85exp{0.8545 ln(H)-1.465}
Pb - Exponential equations presented. For 1-hr average: 0.50exp{1.273 ln(H)-1.460}, for 96-hr average: 0.25exp{1.273 ln(H)-4.705}a,g
Ni - Exponential equations presented: For 1-hr average: 0.85exp{0.8460 ln(H)+3.3612} for 96-hr average: 0.85exp{0.8460 ln(H)+1.1645}
Zn - Exponential equations presented: For 1-hr average: 0.85exp{0.8473 ln(H)+0.8604} for 96-hr average: 0.85exp{0.8473 ln(H)+0.7614}

Table 10. Concentrations (mg/kg) of Chemicals of Potential Concern in Sediment Samples, March, 2003

			Sampling Location and Distance Along the Wash (miles)							
			LW 10.75	NP	DC	PB	LW 0.8	LVB		
Chemical Class	Chemical	Reporting Limit	(10.75)			(6.05)	(0.8)	(0)	Maximium Conc.	Minimum LOC
Organics	Organic Matter	5	2200	12000	7400	3700	3000	10000	12000	na
	Aldrin	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.0020
	Benzene hexachloride (BHC)[a]	0.0050			0.0090				**0.0090**	0.0030
	alpha-BHC	0.0050	ND	ND	ND	ND	ND	ND	< 0.0050	0.0060
	beta-BHC	0.0050	ND	ND	ND	ND	ND	ND	< 0.0050	0.0050
	delta-BHC	0.0050	ND	ND	0.0090	ND	ND	ND	0.0090	na
	gamma-BHC (Lindane)	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.00094
	Chlordane	0.0200	ND	ND	ND	ND	ND	ND	**<0.020**	0.0005
	alpha-Chlordane (or cis-)	0.0050	ND	ND	ND	ND	ND	ND	< 0.0050	na
	gamma-Chlordane	0.0050	ND	ND	0.020	ND	ND	ND	0.020	na
	Oxychlordane*	0.002 (ww)	na	na	na	na	na	ND	< 0.002 (ww)	na
	Oxychlordane*	0.003	na	na	na	na	na	ND	< 0.003	na
	Dieldrin	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.00002
	Endrin	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.00002
	Endrin	0.002 (ww)*	na	na	na	na	na	0.0081	0.0081 (ww)	na
	Endrin	0.003*	na	na	na	na	na	0.014	**0.014**	0.00002
	HCB	0.330	ND	ND	ND	ND	ND	ND	**< 0.330**	0.00002
	Heptachlor	0.0050	ND	ND	0.0060	ND	ND	ND	0.0060	0.01
	Heptachlor epoxide	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.0006
	cis-Nonachlor*	0.002 (ww)	na	na	na	na	na	ND	< 0.002 (ww)	na
	cis-Nonachlor*	0.003	na	na	na	na	na	ND	< 0.003	na
	trans-Nonachlor*	0.002 (ww)	na	na	na	na	na	ND	< 0.002 (ww)	na
	trans-Nonachlor*	0.003	na	na	na	na	na	ND	< 0.003	na
	Mirex*	0.002 (ww)	na	na	na	na	na	ND	< 0.002 (ww)	na
	Mirex*	0.003	na	na	na	na	na	ND	< 0.003	0.007
	DDT-Total	na						ND	0.074	0.003
	DDE (sum o,p'- and p,p'-DDE)	na						0.047	0.047	
	DDD (sum o,p'- and p,p'-DDD)	na						0.027	0.027	
	o,p'-DDE*	0.002 (ww)	na	na	na	na	na	0.012	0.012 (ww)	na
	o,p'-DDE*	0.003	na	na	na	na	na	0.020	**0.020**	0.001
	o,p'-DDD*	0.002 (ww)	na	na	na	na	na	0.0076	0.0076 (ww)	na
	o,p'-DDD*	0.003	na	na	na	na	na	0.013	**0.013**	0.002
	o,p'-DDT*	0.002 (ww)	na	na	na	na	na	ND	< 0.002 (ww)	na
	o,p'-DDT*	0.003	na	na	na	na	na	ND	**< 0.003**	0.002
	p,p'-DDE	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.001
	p,p'-DDE	0.002 (ww)*	na	na	na	na	na	0.016	0.016 (ww)	na
	p,p'-DDE	0.003*	na	na	na	na	na	0.027	**0.027**	0.001
	p,p'-DDD	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.002
	p,p'-DDD	0.002 (ww)*	na	na	na	na	na	0.0083	0.0083 (ww)	na
	p,p'-DDD	0.003*	na	na	na	na	na	0.014	**0.0140**	0.002
	p,p'-DDT	0.0050	ND	ND	ND	ND	ND	ND	**< 0.0050**	0.002
	PCB - Total	0.0200	ND	ND	ND	ND	ND	ND	< 0.0200	0.032

Table 10. Concentrations (mg/kg) of Chemicals of Potential Concern in Sediment Samples, March, 2003

Chemical Class	Chemical	Reporting Limit	Sampling Location and Distance Along the Wash (miles)						Maximium Conc.	Minimum LOC
			LW 10.75	NP	DC	PB	LW 0.8	LVB		
			(10.75)			(6.05)	(0.8)	(0)		
Metals	Aluminum	2.5	4000	6800	3800	4500	4400	7200	7200	58,000
	Arsenic	5.0	9.4	13	12	12	10	24	**24**	5.9
	Antimony	2.5	ND	ND	ND	ND	7.2	ND	7.2	25
	Barium	0.25	69	110	63	68	88	150	150	na
	Beryllium	0.25	0.29	0.43	0.28	0.30	0.31	0.50	0.50	na
	Boron	5.0	12	23	13	13	7.9	16	23	na
	Cadmium	0.25	0.27	ND	ND	ND	ND	ND	0.27	0.58
	Chromium	0.50	7.1	11	8.3	8.7	9.4	14	14	26
	Copper	0.25	5.1	14	14	7.9	7.2	14	14	16
	Iron	5.0	4700	7400	5400	5600	6600	10000	10000	20000
	Lead	2.5	7.1	17	5.5	7.8	16	41	**41**	31
	Magnesium	25	25000	23000	11000	17000	11000	16000	25000	na
	Manganese	0.25	110	180	100	120	180	450	450	460
	Mercury	Varies[b]	<0.10	<0.10	<0.095	<0.10	<0.10	<1.1	**<1.1**	0.15
	Molybdenum	0.50	1.2	0.78	0.85	1.1	0.93	2.0	**2.0**	na
	Nickel	2.0	5.5	8.3	5.9	6.5	7.1	12	12	16.0
	Selenium	5.0	ND	ND	ND	ND	ND	6.7	**6.7**	1
	Strontium	0.50	1100	440	370	320	260	520	1100	na
	Titanium	0.25	150	220	300	240	320	430	430	na
	Vanadium	0.25	11	15	14	13	16	21	21	na
	Zinc	5.0	23	73	40	33	27	48	73	98
Other	Perchlorate	0.04	ND	ND	ND	ND	ND	ND	< 0.04	na

Table 10. Concentrations (mg/kg) of Chemicals of Potential Concern in Sediment Samples, March, 2003

Notes

[a] Also called Hexachlorocyclohexane (HCH). For screening purposes, BHC is the sum of all BHC isomers. Non-detects are included as 1/2 of the reported detection limit (in italics) unless the non-detects represent the majority of samples.
[b] Because reporting limits varied by sample for mercury, the sample reporting limit is provided as a sample concentration less than the individual reporting limit for the sample.

Data were taken from Papelis 2004. Samples were collected March 24, 2003. Concentrations are listed in units of mg/kg (equivalent to ppm, or µg/g). Concentrations are reported as mass of chemical (or total metal or metalloid) per dry mass of solid, unless otherwise specified (ww, wet-weight). Sampling locations are listed in order of distance (miles) along the Las Vegas Wash upstream from the Las Vegas Bay (0 mileage). NP and DC are tributaries to the Las Vegas Wash. ND, not detected; na, not analyzed; LOC, level of concern. LOC were taken from Tables 11 and 12. Non-detects (ND) are concentrations below the reporting limit.

Most samples and chemical concentrations were analyzed by Nevada Environmental Laboratories (NEL), but a subset of split samples from LVB were also analyzed by the Mississippi State Chemical Lab (MSCL) for the same suite of analytes. A few of the analytes in the LVB samples were determined only by MSCL. Where samples were analyzed by both MSCL and NEL and all samples analyzed for the same chemical had concentrations below the reporting limit, results for that chemical were combined and the greater of the two labs' reporting limits is presented for that chemical. An asterisk (*) on the chemical name or reporting limit designates a sample analyzed by MSCL and not by NEL. MSCL reported concentrations on a wet-weight basis. Percent moisture (40.4%) was reported for only one sample (designated LV00.001-6422 in the MSCL lab report), so concentrations taken from the MSCL report are averages for that sample. The following equation was used to convert wet-weight based concentrations to dry-weight based concentrations: $Conc._{dw} = Conc._{ww} / (1 - 0.404)$; where Conc.dw is the dry-weight based concentration, Conc.ww is the wet-weight based concentration, and 0.404 is the fraction of sample mass due to moisture. Data presented in Table 9 of the report by Papelis 2004 were ignored unless they could be verified by raw data presented in the appendices of that report.

Chemical concentrations in bold exceed the minimum level of concern (LOC) for that chemical.

References

Papelis, Charalambos. 2004. Sediment Quality Sampling for the Las Vegas Wash and Tributaries. June. Division of Hydrologic Sciences, Desert Research Institute (DRI), University and Community College System of Nevada. DRI Publication No. 41199. 128 p.

Table 11. Sediment Quality Criteria for Organic Chemicals of Potential Concern (µg/kg dry-weight)

Chemical	TEC[e]	TEL[e]	LEL[e]	MET[e]	ERL[e]	TEL-HA28[e]	SQAL[e]	PEL[f]	SEL[f]	TET[f]	ERM[f]	PEL-HA28[f]	Consensus Based PEC[f]
Aldrin	NA	NA	2	2	NG	NA	NG	NA	80 240 µg/kg dw[a], 8 µg/g oc	40 (for 1% TOC)	NG	NA	
BHC													
alpha-BHC	NA	NA	6	10	NA	NA	NG	NA	240 µg/kg dwa, 10 µg/g oc	80 (for 1% TOC)	NA	NA	
beta-BHC	NA	NA	5	30	NA	NA	NG	NA	210 240 µg/kg dw[b], 21 µg/g oc	200 (for 1% TOC)	NA	NA	
delta-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
gamma-BHC	NA	0.94	3	3	NG	NA	3.7 µg/kg dw, 0.37 µg/g oc	1.38	10 ug/kg dw[a], 1 µg/g oc	9 (for 1% TOC)	NG	NA	4.99
Chlordane	3.24	4.5	7	7	0.5	NA	NG	8.9	60 µg/kg dw[a], 6 µg/g oc	30 (for 1% TOC)	6	NA	17.6
alpha-Chlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
gamma-Chlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Oxychlordane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Dieldrin	1.9	2.85	2	2	0.02	NA	110 µg/kg dw, 11 µg/g oc	6.67	910 µg/kg dw[a], 91 µg/g oc	30 (for 1% TOC)	8	NA	61.8
Endrin	NA	2.67	3	8	0.02	NA	42 µg/kg dw, 4.2 µg/g oc	62.4	1300 µg/kg dw[a], 130 µg/g oc	500 (for 1% TOC)	45	NA	207
Hexachlorobenzene (HCB)	NA	NA	0.02	30	NA	NA	NG	NA	240 µg/kg dw[b], 24 µg/g oc	100 (for 1% TOC)		NA	
Heptachlor	NA	NA	NG	300	NG	NA	NG	NA	NG	10 (for 1% TOC)	NG	NA	16
Heptachlor epoxide	NA	0.6	5	5	NG	NA	NG	NA	NG	30 (for 1% TOC)	NA	NA	
cis-Nonachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
trans-Nonachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Mirex	NA	NA	7	11	NG	NA	NA	NA	1300 240 µg/kg dw[b], 130 µg/g oc	800 (for 1% TOC)	NG	NA	
DDT-Total	5.28	7	7	NA	3	NA	NG	4450	120 µg/kg dw[a], 12 µg/g ocd	NA	350	NA	572 ug/kg dw (total DDTs)
o,p'-DDT	4.16 (sum DDT)	7 (Total)	8 (sum op+pp)	9 (Total)	1 (sum DDT)	NA	NG	8.51 (sum DDD)	710 µg/kg dw (o,p- + o,o-)[b], 71 µg/g oc	50 (Total for 1% TOC)	7 (sum DDT)	NA	62.9 ug/kg dw (sum DDT)
o,p'-DDE	3.16 (sum DDE)	1.42 (p,p'-DDE)	5 (sum DDE)	7 (p,p-DDE)	2 (sum DDE)	NA	NG	6.75 (sum DDE)	190 µg/kg dw (p,p- DDE)[a], 19 µg/g oc (p,p-)	50 (p,p-DDE; for 1% TOC)	15 (sum DDE)	NA	31.3 ug/kg dw (sum DDE)
o,p'-DDD	4.88 (sum DDD)	3.54 (p,p'-DDD)	8 (sum DDD)	10 (DDD and p,p-DDD)	2 (sum DDD)	NA	NG	NG (sum DDT)	60 µg/kg dw (p,p- DDD)[a], 6 µg/g oc (p,p-)	60 (DDD and p,p-DDD; for 1% TOC)	20 (sum DDD)	NA	28 ug/kg dw (sum DDD)
p,p'-DDT	4.16 (sum DDT)	7 (Total)	7 (sum op+pp)	9 (Total)	1 (sum DDT)	NA	NG	8.51 (sum DDD)	710 µg/kg dw (o,p- + o,o-)[b], 71 µg/g oc	50 (Total for 1% TOC)	7 (sum DDT)	NA	62.9 ug/kg dw (sum DDT)
p,p'-DDE	3.16 (sum DDE)	1.42	5 (sum DDE)	7 (p,p-DDE)	2 (sum DDE)	NA	NG	6.75 (sum DDE)	190 µg/kg dw (sum DDE)[a], 19 µg/g oc (p,p-)	50 (p,p-DDE; for 1% TOC)	15 (sum DDE)	NA	31.3 ug/kg dw (sum DDE)
p,p'-DDD	4.88 (sum DDD)	3.54	8 (sum DDD)	10 (DDD and p,p-DDD)	2 (sum DDD)	NA	NG	NG (sum DDT)	60 µg/kg dw (sum DDD)[a], 6 µg/g oc (p,p-)	60 (DDD and p,p-DDD; for 1% TOC)	20 (sum DDD)	NA	28 ug/kg dw (sum DDD)
PCB-total	59.8	34.1	70	200	50	32	NA	277	5300 µg/kg dw[a], 530 µg/g oc	1000 (for 1% TOC)	400	240	676

Table 11. Sediment Quality Criteria for Organic Chemicals of Potential Concern (µg/kg dry-weight)

Chemical	USDI 1998	USDOE RAIS 2006	Lowest LOC	Lowest LOC
Aldrin	NA		2	0.002
BHC		3, LEL[c]; 120 SEL[d]; per Persaud et al.	3	0.003, LEL
alpha-BHC	NA		6	0.006
beta-BHC	NA		5	0.005
delta-BHC	NA	NA	NA	NA
gamma-BHC	NA		0.94	0.00094
Chlordane	NA		0.5	0.0005
alpha-Chlordane	NA	NA	NA	NA
gamma-Chlordane	NA	NA	NA	NA
Oxychlordane	NA	NA	NA	NA
Dieldrin	NA		0.02	0.00002
Endrin	NA		0.02	0.00002
Hexachlorobenzene (HCB)	NA		0.02	0.00002
Heptachlor	NA		10	0.01
Heptachlor epoxide	NA		0.6	0.0006
cis-Nonachlor	NA	NA	NA	NA
trans-Nonachlor	NA	NA	NA	NA
Mirex	NA		7	0.007
DDT-Total	1.5 - 46 (LEL); 12000 (severe)		3	0.003
o,p'-DDT			1.5	0.0015
o,p'-DDE			2	0.002
o,p'-DDD			2	0.002
p,p'-DDT			1	0.001
p,p'-DDE	2.2 - 27 , 19000 (severe)		1.42	0.00142
p,p'-DDD	8 - 110 (LEL); 6000 (severe)		2	0.002
PCB-total	NA		32	0.032

Table 11. Sediment Quality Criteria for Organic Chemicals of Potential Concern (µg/kg dry-weight)

Notes

NA - Chemical name does not appear in given reference
NG - Chemical name is listed in the reference, but no value is reported

a dry-weight (dw) value converted by MacDonald et al. 2000; original value expressed in µg/g organic carbon (oc)
b dw value based on conversion used by MacDonald et al. 2000
c Lowest Effect Level indicates a level of contamination which has no effect on the majority of the sediment-dwelling organisms (Persaud et al. 2003)
d Severe Effect Level indicates that sediment is considered heavily polluted and likely to affect the health of sediment-dwelling organisms (Persaud et al. 2003)
e Threshold Effect Level
f Probable Effect Level

References

The following acronyms identify values taken from:
MacDonald DD, Ingersoll CG, and Berger TA. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology 39(1): 20-31.

TEC: consensus-based threshold effect concentration, i.e., concentration below which harmful effects are unlikely to be observed (MacDonald et al., 2003)
TEL: threshold effect level, dry weight (Smith et al. 1996).
LEL: lowest effect level, dry weight (Persaud et al. 1993).
MET: minimal effect threshold, dry weight (EC and MENVIQ 1992)
ERL: effect range-low, dry weight (Long and Morgan 1992).
TEL-HA28: threshold effect level for *Hyalella azteca*, 28-day test, dry weight (US EPA 1996, Ingersoll et al. 1996)
SQAL: sediment quality advisory levels, dry weight at 1% OC (US EPA 1997)
PEL: probable effect level, dry weight (Smith et al. 1996)
SEL: severe effect level, dry weight (Persaud et al. 1993)
TET: toxic effect threshold, dry weight (EC and MENVIQ 1992)
ERM: effect range-median, dry weight (Long and Morgan 1991)
PEL-HA28: probable effect level for *Hyalella azteca*, 28-day test, dry weight (US EPA 1996)
PEC: consensus-based probable effect concentration, i.e., concentration above which harmful effects are likely to be observed (MacDonald et al. 2003)

Other References

USDI 1998: United States Department of the Interior (USDI). 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, Bureau of Indian Affairs. Concentrations are presented as ranges. Generally, the lower number indicates a "no effect" level, and the higher number is a "toxicity threshold." Adverse effects should be rare at concentrations less than the no effect level, but may occur at concentrations between the no effect level and the toxicity threshold, and are very likely above the threshold. In some cases, the lower number is a low effect level (LEL) and the higher number is a severe effect level (severe).

USDOE RAIS 2006: United States Department of Energy (USDOE) Risk Assessment Information System (RAIS) Database. http://risk.lsd.ornl.gov/. This database includes a compilation of Ecological Benchmark Values from various sources. This database was searched only when suitable criteria were not identified from the other references or were sparse, because the sources used in the database were generally similar to the ones that were searched previously.

The following references were checked but did not contain relevant criteria for organic contaminants.

Tuttle and Thodal 1998: Tuttle PL, Thodal CE. 1998. Field Screening of Water Quality, Bottom Sediments, and Biota Associated With Irrigation In and Near the Indian Lakes Areas, Stillwater Wildlife Management Area, Churchill County, West-Central Nevada, 1995. U. S. Geological Survey Water-Resources Investigations Report 97-4250. United States Geological Survey. Carson City, NV. 57 p.

Contaminant Hazard Reviews: Eisler R. (Date and report number vary by chemical). Contaminant Hazard Reviews. http://www.pwrc.usgs.gov/infobase/eisler/reviews.cfm-
Safe values for the Great Lakes.

Table 12. Sediment Quality Criteria for Inorganic Chemicals of Potential Concern (mg/kg dry-weight)

Chemical	CASRN	TEC[a]	TEL[a]	LEL[a]	MET[a]	ERL[a]	TEL-HA28[a]	SQAL[a]	PEL[b]	SEL[b]
Aluminum	7429-90-5	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	7440-36-0	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	9.79	5.9	6	7.0	33	11	NA	17	33
Barium	7440-39-3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	7440-41-7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Boron	7440-42-8	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	7440-43-9	0.99	0.596	0.6	0.9	5	0.58	NA	3.53	10
Chromium	7440-43-9	43.4	37.3	26	55	80	36	NG	90	110
Copper	7440-50-8	31.6	35.7	16	28	70	28	NA	197	110
Iron	7439-89-6	NA	NA	20,000	NA	NA	NA	NA	NA	NA
Lead	7439-92-1	35.8	35	31	42	35	37	NA	91.3	250
Magnesium	7439-95-4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	7439-96-5	NA	NA	460	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	0.18	0.174	0.2	0.2	0.15	NA	NG	0.486	2
Molybdenum	7439-98-7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	7440-02-0	22.7	18	16	35	30	20	NG	36	75
Selenium	7782-49-2	121	NA	NA	NA	NA	NA	NA	NA	NA
Strontium	7440-24-6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Titanium	7440-32-6	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	7440-62-2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	7440-66-6	121	123	120	150	120	98	NG	315	820
Perchlorate	14797-73-0	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 12. Sediment Quality Criteria for Inorganic Chemicals of Potential Concern (mg/kg dry-weight)

Chemical	TET[b]	ERM[b]	PEL-HA28[b]	Consensus Based PEC[b]	Contaminant Hazard Reviews	USDI 1998	Tuttle and Thodal 1998 (Concern)
Aluminum	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	25	NA	NA	NA	NA	NA
Arsenic	17	85	48	33	NG	8.2 - 70	33
Barium	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA
Boron	NA	NA	NA	NA	NA	NA	NA
Cadmium	3	9	3.2	4.98	NG	NA	5
Chromium	100	145	120	111	NG	NA	80
Copper	86	390	100	149	NG	34 - 270	70
Iron	NA	NA	25,000	NA	NA	NA	21200
Lead	170	110	82	128	NG	NA	35
Magnesium	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	635	1,200	NA	NA	NA	460
Mercury	1.0	1.3	NA	1.06	NG	>0.15 - 0.2	0.15
Molybdenum	NA	NA	NA	NA	NG	NA	NA
Nickel	61	50	33	48.6	< 20	NA	30
Selenium	NA	NA	NA	NA	NA	1 - 4	1
Strontium	NA	NA	NA	NA	NA	NA	NA
Titanium	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA
Zinc	540	270	540	459	< 90	150 - 410	120
Perchlorate	NA	NA	NA	NA	NA		NA

Table 12. Sediment Quality Criteria for Inorganic Chemicals of Potential Concern (mg/kg dry-weight)

Notes

NA - Chemical name does not appear in given reference
NG - Chemical name is listed in the reference, but no value is provided
a Threshold Effect Level
b Probable Effect Level

References

The following acronyms identify values taken from:
MacDonald DD, Ingersoll CG, and Berger TA. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology 39(1): 20-31.

TEC: consensus-based threshold effect concentration, i.e., concentration below which harmful effects are unlikely to be observed (MacDonald et al., 2003)
TEL: threshold effect level, dry weight (Smith et al. 1996).
LEL: lowest effect level, dry weight (Persaud et al. 1993).
MET: minimal effect threshold, dry weight (EC and MENVIQ 1992)
ERL: effect range-low, dry weight (Long and Morgan 1992)
TEL-HA28: threshold effect level for *Hyalella azteca*, 28-day test, dry weight (US EPA 1996, Ingersoll et al. 1996)
SQAL: sediment quality advisory levels, dry weight at 1% OC (US EPA 1997)
PEL: probable effect level, dry weight (Smith et al. 1996)
SEL: severe effect level, dry weight (Persaud et al. 1993)
TET: toxic effect threshold, dry weight (EC and MENVIQ 1992)
ERM: effect range-median, dry weight (Long and Morgan 1991)
PEL-HA28: probable effect level for *Hyalella azteca*, 28-day test, dry weight (US EPA 1996)

Other References

Contaminant Hazard Reviews: Eisler R. (Date and report number vary by chemical). Contaminant Hazard Reviews. http://www.pwrc.usgs.gov/infobase/eisler/reviews.cfm-
Safe values for the Great Lakes.

USDI 1998: United States Department of the Interior (USDI). 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, Bureau of Indian Affairs.
Concentrations are presented as ranges. Generally, the lower number indicates a "no effect" level, and the higher number is a "toxicity threshold." In some cases, the lower number is a low effect level (LEL) and the higher number is a severe effect level (severe).

Chemical-specific notes
Mercury: Concentrations less than the no effect level (0.065 mg/kg dw) are close to background and are not known to cause adverse effects. Concentrations >LOC 0.15 mg/kg dw (ERL) rarely cause adverse effects. Toxicity threshold to protect the clapper rail is 0.2 mg/kg dw (Schwarzbach et al. 1993).

USDOE RAIS 2006: United States Department of Energy (USDOE) Risk Assessment Information System (RAIS) Database.
http://risk.lsd.ornl.gov/. This database includes a compilation of Ecological Benchmark Values from various sources. This database was searched only when suitable criteria were not identified from the other references or were sparse, because the sources used in the database were generally similar to the ones that were searched previously

Tuttle and Thodal 1998: Tuttle PL, Thodal CE. 1998. Field Screening of Water Quality, Bottom Sediments, and Biota Associated With Irrigation In and Near the Indian Lakes Areas, Stillwater Wildlife Management Area, Churchill County, West-Central Nevada, 1995. U. S. Geological Survey Water-Resources Investigations Report 97-4250. United States Geological Survey. Carson City, NV. 57 p.
Ranges are provided for each chemical. The lower number is a concern concentration assigned to a value noted in the literature or to a value associated with relatively minor effects (e.g., LC1 or decreased growth rate for a limited period of time). The higher number is an effect concentration assigned to values noted as such in the literature or to values that cause substantial effects (e.g., LC50, reduced survival or reproduction, or teratogenesis).

Benchmarks for arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc were taken from Long and Morgan 1991; concern concentration represents and Effect Range-Low (lower 10th percentile) and effect concentration represents and Effect Range-Median (median) for sediment-based assays.

Benchmarks for manganese and iron were taken from Persaud et al. 1993; lower effect level guideline (lower 5th percentile of sediment-based bioassays causing effect).

Benchmarks for selenium were taken from Skorupa et al. 1996; 1 µg/g in sediment was the minimum concentration associated with effects on avian reproduction whereas 3 µg/g in sediment was the minimum concentration associated with effects on fish; EC_{100} > 4.0 µg/g in sediment for fish and birds in freshwater systems. See also Lemly and Smith 1987.

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Aldrin Res Dry	Aldrin DL Dry	Aldrin Res Wet	Aldrin DL Wet	BHC-Total Res Dry	BHC-Total DL Dry	BHC-Total Res Wet	BHC-Total DL Wet
03NPCC01	NP	ND	0.000375	ND	0.0000990	ND	0.00291	ND	0.000765
03NPCC02	NP	ND	0.000518	ND	0.0000960	ND	0.00402	ND	0.000744
03NPGS03	NP	ND	0.000609	ND	0.000157	ND	0.00473	ND	0.00122
Maximum:		**na, 0.000609**		**na, 0.000157**		**na, 0.00473**		**na, 0.00122**	
Median:		**ND**		**ND**		**ND**		**ND**	
03DCBB02	DC	ND	0.000456	ND	0.000099	ND	0.00354	ND	0.000770
03DCBB05	DC	ND	0.000495	ND	0.000103	ND	0.00384	ND	0.000796
03DCCC01	DC	ND	0.000382	ND	0.000102	0.00769	0.00297	0.00205	0.000789
03DCCC03	DC	ND	0.000377	ND	0.0000980	0.00415	0.00293	0.00108	0.000761
03DCCC04	DC	ND	0.000423	ND	0.000100	0.00407	0.00328	0.000967	0.000779
Maximum:		**na, 0.000495**		**na, 0.000103**		**0.00769**		**0.00205**	
Median:		**ND**		**ND**		**0.00415**		**0.00108**	
03PabBG04	PB	ND	0.000376	ND	0.000103	0.0495	0.00292	0.0135	0.000796
03PabCC01	PB	ND	0.000349	ND	0.0000990	0.0665	0.00271	0.0188	0.000765
03PabCC02	PB	ND	0.000341	ND	0.000104	0.0616	0.00265	0.0188	0.000805
03PabCC03	PB	ND	0.000414	ND	0.000104	0.0426	0.00321	0.0106	0.000804
03PabCC05	PB	ND	0.000353	ND	0.000102	0.0833	0.00274	0.0240	0.000789
03PabCC06	PB	ND	0.000384	ND	0.000103	0.0475	0.00298	0.0127	0.000796
03PabCC07	PB	ND	0.000530	ND	0.000102	0.0376	0.00411	0.00724	0.000793
03PabCC08	PB	ND	0.000333	ND	0.000103	0.0645	0.00259	0.0199	0.000796
03PabCC09	PB	ND	0.000312	ND	0.0000980	0.0769	0.00242	0.0241	0.000758
03PabCC10	PB	0.000811	0.000423	0.000194	0.000101	0.0289	0.00328	0.00693	0.000786
Maximum:		**0.000811**		**0.000194**		**0.0833**		**0.0241**	
Median:		**0.000811**		**0.000194**		**0.0556**		**0.0162**	
03LVBCAT04	LVB	ND	0.000411	ND	0.000103	0.0212	0.00319	0.00534	0.000802
03LVBCC01	LVB	0.000588	0.000328	0.000183	0.000102	0.0432	0.00254	0.0135	0.000794
03LVBCC02	LVB	ND	0.000419	ND	0.000104	0.00854	0.00325	0.00212	0.000805
03LVBCC03	LVB	0.000412	0.000364	0.000117	0.000103	0.0143	0.00282	0.00405	0.000800
Maximum:		**0.000588**		**0.000183**		**0.0432**		**0.0135**	
Median:		**0.000500**		**0.000150**		**0.0178**		**0.00470**	
03BBPahr05	PNWR	ND	0.000504	ND	0.0000890	ND	0.00391	ND	0.000691
03BBPahr06	PNWR	ND	0.000544	ND	0.000100	ND	0.00422	ND	0.000774
03CCPahr01	PNWR	ND	0.000526	ND	0.000104	ND	0.00408	ND	0.000804
03CCPahr02	PNWR	ND	0.000455	ND	0.000103	ND	0.00353	ND	0.000796
03CCPahr03	PNWR	ND	0.000436	ND	0.000102	ND	0.00338	ND	0.000789
03GSPahr04	PNWR	ND	0.000472	ND	0.000104	ND	0.00366	ND	0.000804
Maximum:		**na, 0.000544**		**na, 0.000104**		**na, 0.00422**		**na, 0.000804**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.000811**		**0.000194**		**0.0833**		**0.0241**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	alpha-BHC Res Dry	alpha-BHC DL Dry	alpha-BHC Res Wet	alpha-BHC DL Wet	beta-BHC Res Dry	beta-BHC DL Dry	beta-BHC Res Wet	beta-BHC DL Wet
03NPCC01	NP	ND	0.00102	ND	0.000268	0.00142	0.000936	0.000372	0.000246
03NPCC02	NP	ND	0.00140	ND	0.000260	ND	0.00129	ND	0.000239
03NPGS03	NP	ND	0.00165	ND	0.000426	ND	0.00152	ND	0.000392
Maximum:		**na, 0.00165**		**na, 0.000426**		**0.00142**		**0.000372**	
Median:		**ND**		**ND**		**0.00142**		**0.000372**	
03DCBB02	DC	ND	0.00124	ND	0.000269	ND	0.00114	ND	0.000247
03DCBB05	DC	ND	0.00134	ND	0.000278	ND	0.00123	ND	0.000256
03DCCC01	DC	ND	0.00104	ND	0.000276	ND	0.000954	ND	0.000254
03DCCC03	DC	ND	0.00102	ND	0.000266	0.00109	0.000942	0.000283	0.000245
03DCCC04	DC	ND	0.00115	ND	0.000272	ND	0.00106	ND	0.000250
Maximum:		**na, 0.00134**		**na, 0.000278**		**0.00109**		**0.000283**	
Median:		**ND**		**ND**		**0.00109**		**0.000283**	
03PabBG04	PB	0.00300	0.00102	0.000819	0.000278	0.0355	0.000938	0.00967	0.000256
03PabCC01	PB	0.00396	0.000947	0.00112	0.000268	0.0465	0.000871	0.0131	0.000246
03PabCC02	PB	0.00507	0.000925	0.00154	0.000281	0.0422	0.000851	0.0129	0.000259
03PabCC03	PB	0.00319	0.00112	0.000797	0.000281	0.0289	0.00103	0.00722	0.000258
03PabCC05	PB	0.00486	0.000958	0.00140	0.000276	0.0573	0.000881	0.0165	0.000254
03PabCC06	PB	0.00270	0.00104	0.000722	0.000278	0.0329	0.000957	0.00880	0.000256
03PabCC07	PB	0.00160	0.00144	0.000308	0.000277	0.0257	0.00132	0.00495	0.000255
03PabCC08	PB	0.00347	0.000904	0.00107	0.000278	0.0447	0.000831	0.0138	0.000256
03PabCC09	PB	0.00404	0.000847	0.00126	0.000265	0.0548	0.000779	0.0172	0.000244
03PabCC10	PB	0.00223	0.00115	0.000534	0.000275	0.0198	0.00106	0.00474	0.000253
Maximum:		**0.00507**		**0.00154**		**0.0573**		**0.0172**	
Median:		**0.00333**		**0.0009445**		**0.0389**		**0.0113**	
03LVBCAT04	LVB	0.00137	0.00111	0.000344	0.000280	0.0138	0.00102	0.00348	0.000258
03LVBCC01	LVB	0.00474	0.000890	0.00148	0.000278	0.0266	0.000818	0.00829	0.000255
03LVBCC02	LVB	ND	0.00114	ND	0.000281	0.00689	0.00104	0.00171	0.000259
03LVBCC03	LVB	0.00152	0.000986	0.000432	0.000280	0.00935	0.000907	0.00265	0.000257
Maximum:		**0.00474**		**0.00148**		**0.0266**		**0.00829**	
Median:		**0.00152**		**0.000432**		**0.0116**		**0.00307**	
03BBPahr05	PNWR	ND	0.00137	ND	0.000241	ND	0.00126	ND	0.000222
03BBPahr06	PNWR	ND	0.00148	ND	0.000271	ND	0.00136	ND	0.000249
03CCPahr01	PNWR	ND	0.00143	ND	0.000281	ND	0.00131	ND	0.000258
03CCPahr02	PNWR	ND	0.00124	ND	0.000278	ND	0.00114	ND	0.000256
03CCPahr03	PNWR	ND	0.00118	ND	0.000276	ND	0.00109	ND	0.000254
03GSPahr04	PNWR	ND	0.00128	ND	0.000281	ND	0.00118	ND	0.000258
Maximum:		**na, 0.00148**		**na, 0.000281**		**na, 0.00136**		**na, 0.000258**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.00507**		**0.00154**		**0.0573**		**0.0172**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	delta-BHC Res Dry	delta-BHC DL Dry	delta-BHC Res Wet	delta-BHC DL Wet	gamma-BHC Res Dry	gamma-BHC DL Dry	gamma-BHC Res Wet	gamma-BHC DL Wet
03NPCC01	NP	ND	0.00104	ND	0.000272	0.000768	0.000503	0.000202	0.000132
03NPCC02	NP	ND	0.00143	ND	0.000264	ND	0.000694	ND	0.000129
03NPGS03	NP	ND	0.00168	ND	0.000433	ND	0.000816	ND	0.000210
Maximum:		**na, 0.00168**		**na, 0.000433**		**0.000768**		**0.000202**	
Median:		**ND**		**ND**		**0.000768**		**0.000202**	
03DCBB02	DC	ND	0.00126	ND	0.000273	0.00129	0.000611	0.000281	0.000133
03DCBB05	DC	ND	0.00136	ND	0.000283	ND	0.000663	ND	0.000137
03DCCC01	DC	ND	0.00105	ND	0.000280	0.00720	0.000512	0.00192	0.000136
03DCCC03	DC	ND	0.00104	ND	0.000270	0.00306	0.000506	0.000795	0.000131
03DCCC04	DC	ND	0.00116	ND	0.000277	0.00382	0.000566	0.000907	0.000134
Maximum:		**na, 0.00136**		**na, 0.000283**		**0.00720**		**0.00192**	
Median:		**ND**		**ND**		**0.00344**		**0.000851**	
03PabBG04	PB	0.00239	0.00104	0.000652	0.000283	0.00863	0.000504	0.00235	0.000137
03PabCC01	PB	0.00661	0.000963	0.00187	0.000272	0.00939	0.000468	0.00265	0.000132
03PabCC02	PB	0.00622	0.00094	0.00189	0.000286	0.00812	0.000457	0.00247	0.000139
03PabCC03	PB	0.00324	0.00114	0.000809	0.000285	0.00728	0.000555	0.00182	0.000139
03PabCC05	PB	0.00801	0.000974	0.00231	0.000280	0.0131	0.000473	0.00378	0.000136
03PabCC06	PB	0.00446	0.00106	0.00119	0.000283	0.00743	0.000514	0.00198	0.000137
03PabCC07	PB	0.00326	0.00146	0.000627	0.000282	0.00706	0.000710	0.00136	0.000137
03PabCC08	PB	0.00634	0.000919	0.00195	0.000283	0.00999	0.000446	0.00307	0.000137
03PabCC09	PB	0.00707	0.000861	0.00221	0.000269	0.0110	0.000418	0.00344	0.000131
03PabCC10	PB	0.00294	0.00117	0.000704	0.000279	0.00395	0.000567	0.000946	0.000136
Maximum:		**0.00801**		**0.00231**		**0.0131**		**0.00378**	
Median:		**0.00534**		**0.00153**		**0.00838**		**0.00241**	
03LVBCAT04	LVB	0.00293	0.00113	0.000737	0.000285	0.00312	0.000550	0.000786	0.000138
03LVBCC01	LVB	0.00614	0.000904	0.00192	0.000282	0.00577	0.000439	0.00180	0.000137
03LVBCC02	LVB	ND	0.00115	ND	0.000286	0.00146	0.000561	0.000363	0.000139
03LVBCC03	LVB	0.00173	0.00100	0.000490	0.000284	0.00169	0.000487	0.000479	0.000138
Maximum:		**0.00614**		**0.00192**		**0.00577**		**0.00180**	
Median:		**0.00293**		**0.000737**		**0.00241**		**0.0006325**	
03BBPahr05	PNWR	ND	0.00139	ND	0.000245	ND	0.000676	ND	0.000119
03BBPahr06	PNWR	ND	0.00150	ND	0.000275	ND	0.000729	ND	0.000134
03CCPahr01	PNWR	ND	0.00145	ND	0.000285	ND	0.000705	ND	0.000139
03CCPahr02	PNWR	ND	0.00126	ND	0.000283	ND	0.000610	ND	0.000137
03CCPahr03	PNWR	ND	0.00120	ND	0.000280	ND	0.000584	ND	0.000136
03GSPahr04	PNWR	ND	0.00130	ND	0.000285	ND	0.000633	ND	0.000139
Maximum:		**na, 0.00150**		**na, 0.000285**		**na, 0.000729**		**na, 0.000139**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.00801**		**0.00231**		**0.0131**		**0.00378**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Chlordane[1] Res Dry	Chlordane[2] Res Wet	Chlordane[3] Lipid-adjusted	alpha-Chlordane Res Dry	alpha-Chlordane DL Dry	alpha-Chlordane Res Wet	alpha-Chlordane DL Wet
03NPCC01	NP	0.1174	0.0308	0.464	0.0407	0.000357	0.0107	0.0000940
03NPCC02	NP	0.0403	0.0075	0.612	0.0113	0.000493	0.00209	0.0000910
03NPGS03	NP	0.0788	0.0203	1.08	0.0116	0.000580	0.00298	0.000149
Maximum:		**0.117**	**0.0308**	**1.08**	**0.0407**		**0.0107**	
Median:		**0.0788**	**0.0203**	**0.612**	**0.0116**		**0.00298**	
03DCBB02	DC	0.1339	0.0291	0.738	0.0357	0.000434	0.00777	0.0000940
03DCBB05	DC	0.0619	0.0129	1.16	0.0151	0.000471	0.00313	0.0000980
03DCCC01	DC	0.1296	0.0345	0.664	0.0317	0.000364	0.00842	0.0000970
03DCCC03	DC	0.1682	0.0437	0.603	0.0475	0.000359	0.0123	0.0000930
03DCCC04	DC	0.0626	0.0149	0.437	0.0154	0.000402	0.00366	0.0000950
Maximum:		**0.168**	**0.0437**	**1.16**	**0.0475**		**0.0123**	
Median:		**0.130**	**0.0291**	**0.664**	**0.0317**		**0.00777**	
03PabBG04	PB	0.1953	0.0533	0.833	0.0245	0.000358	0.00668	0.0000980
03PabCC01	PB	0.2171	0.0614	0.752	0.0537	0.000332	0.0152	0.0000940
03PabCC02	PB	0.1866	0.0568	0.672	0.0466	0.000324	0.0142	0.0000990
03PabCC03	PB	0.1353	0.0338	0.586	0.0355	0.000394	0.00887	0.0000990
03PabCC05	PB	0.1696	0.0488	0.409	0.0299	0.000336	0.00861	0.0000970
03PabCC06	PB	0.0687	0.0183	0.272	0.0178	0.000365	0.00475	0.0000980
03PabCC07	PB	0.1240	0.0239	0.605	0.0149	0.000504	0.00288	0.0000970
03PabCC08	PB	0.1202	0.0370	0.360	0.0238	0.000317	0.00732	0.0000980
03PabCC09	PB	0.1810	0.0567	0.512	0.0322	0.000297	0.0101	0.0000930
03PabCC10	PB	0.0921	0.0221	0.598	0.0158	0.000403	0.00378	0.0000960
Maximum:		**0.217**	**0.061**	**0.833**	**0.0537**		**0.0152**	
Median:		**0.152**	**0.043**	**0.592**	**0.0272**		**0.00797**	
03LVBCAT04	LVB	0.1320	0.0332	0.617	0.0240	0.000391	0.00604	0.0000980
03LVBCC01	LVB	0.1492	0.0466	0.374	0.0261	0.000312	0.00813	0.0000970
03LVBCC02	LVB	0.0667	0.0166	0.339	0.00401	0.000398	0.000994	0.0000990
03LVBCC03	LVB	0.0958	0.0272	0.294	0.0188	0.000346	0.00534	0.0000980
Maximum:		**0.149**	**0.0466**	**0.617**	**0.0261**		**0.00813**	
Median:		**0.114**	**0.0302**	**0.356**	**0.0214**		**0.00569**	
03BBPahr05	PNWR	ND	ND	ND	ND	0.000480	ND	0.0000850
03BBPahr06	PNWR	ND	ND	ND	ND	0.000518	ND	0.0000950
03CCPahr01	PNWR	ND	ND	ND	ND	0.000501	ND	0.0000990
03CCPahr02	PNWR	ND	ND	ND	ND	0.000433	ND	0.0000980
03CCPahr03	PNWR	0.0011	0.0003	0.00992	0.000428	0.000414	0.000100	0.0000970
03GSPahr04	PNWR	ND	ND	ND	ND	0.000449	ND	0.0000990
Maximum:		**0.0011**	**0.0003**	**0.00992**	**0.000428**		**0.000100**	
Median:		**0.0011**	**0.0003**	**0.00992**	**0.000428**		**0.000100**	
Grand Maximum:		**0.217**	**0.0614**	**1.1578**	**0.0537**		**0.0152**	
Minimum LOC:		**na**	**0.1**	**300**	**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	gamma-Chlordane Res Dry	gamma-Chlordane DL Dry	gamma-Chlordane Res Wet	gamma-Chlordane DL Wet	Oxychlordane Res Dry	Oxychlordane DL Dry	Oxychlordane Res Wet	Oxychlordane DL Wet
03NPCC01	NP	0.0268	0.000410	0.00703	0.000108	0.00546	0.000533	0.00143	0.000140
03NPCC02	NP	0.00610	0.000566	0.00113	0.000105	0.000976	0.000736	0.000181	0.000136
03NPGS03	NP	ND	0.000665	ND	0.000171	0.00578	0.000865	0.00149	0.000223
Maximum:		**0.0268**		**0.00703**		**0.00578**		**0.00149**	
Median:		**0.0165**		**0.00408**		**0.00546**		**0.00143**	
03DCBB02	DC	0.0335	0.000498	0.00728	0.000108	0.00922	0.000647	0.00201	0.000141
03DCBB05	DC	0.00949	0.000540	0.00197	0.000112	0.00344	0.000702	0.000712	0.000146
03DCCC01	DC	0.0305	0.000417	0.00810	0.000111	0.00676	0.000543	0.00180	0.000144
03DCCC03	DC	0.0466	0.000412	0.0121	0.000107	0.00902	0.000536	0.00234	0.000139
03DCCC04	DC	0.0164	0.000462	0.00389	0.000110	0.00267	0.000600	0.000633	0.000143
Maximum:		**0.0466**		**0.0121**		**0.00922**		**0.00234**	
Median:		**0.0305**		**0.00728**		**0.00676**		**0.00180**	
03PabBG04	PB	0.0137	0.000411	0.00375	0.000112	0.0158	0.000534	0.00431	0.000146
03PabCC01	PB	0.0513	0.000381	0.0145	0.000108	0.0108	0.000496	0.00305	0.000140
03PabCC02	PB	0.0438	0.000372	0.0133	0.000113	0.0112	0.000484	0.00342	0.000147
03PabCC03	PB	0.0361	0.000452	0.00903	0.000113	0.00923	0.000588	0.00231	0.000147
03PabCC05	PB	0.0320	0.000386	0.00922	0.000111	0.00319	0.000502	0.000918	0.000144
03PabCC06	PB	0.0198	0.000419	0.00529	0.000112	0.00243	0.000545	0.000649	0.000146
03PabCC07	PB	0.0165	0.000579	0.00317	0.000112	0.00313	0.000753	0.000604	0.000145
03PabCC08	PB	0.0284	0.000364	0.00875	0.000112	0.00576	0.000473	0.00177	0.000146
03PabCC09	PB	0.0351	0.000341	0.0110	0.000107	0.00381	0.000443	0.00119	0.000139
03PabCC10	PB	0.0163	0.000462	0.00389	0.000111	0.00147	0.000601	0.000352	0.000144
Maximum:		**0.0513**		**0.0145**		**0.0158**		**0.00431**	
Median:		**0.0302**		**0.00889**		**0.00479**		**0.00148**	
03LVBCAT04	LVB	0.0220	0.000449	0.00553	0.000113	0.00649	0.000583	0.00163	0.000147
03LVBCC01	LVB	0.0204	0.000358	0.00637	0.000112	0.00217	0.000466	0.000677	0.000145
03LVBCC02	LVB	0.00222	0.000457	0.00055	0.000113	ND	0.000594	ND	0.000147
03LVBCC03	LVB	0.0146	0.000397	0.00413	0.000113	0.00292	0.000517	0.000829	0.000146
Maximum:		**0.0220**		**0.00637**		**0.00649**		**0.00163**	
Median:		**0.0175**		**0.00483**		**0.00292**		**0.000829**	
03BBPahr05	PNWR	ND	0.000551	ND	0.0000970	ND	0.000716	ND	0.000126
03BBPahr06	PNWR	ND	0.000594	ND	0.000109	ND	0.000773	ND	0.000142
03CCPahr01	PNWR	ND	0.000575	ND	0.000113	ND	0.000748	ND	0.000147
03CCPahr02	PNWR	ND	0.000497	ND	0.000112	ND	0.000647	ND	0.000146
03CCPahr03	PNWR	ND	0.000476	ND	0.000111	ND	0.000619	ND	0.000144
03GSPahr04	PNWR	ND	0.000516	ND	0.000113	ND	0.000671	ND	0.000147
Maximum:		**na, 0.000594**		**na, 0.000113**		**na, 0.000773**		**na, 0.000147**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.0513**		**0.0145**		**0.0158**		**0.00431**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	cis-Nonachlor Res Dry	cis-Nonachlor DL Dry	cis-Nonachlor Res Wet	cis-Nonachlor DL Wet	trans-Nonachlor Res Dry	trans-Nonachlor DL Dry	trans-Nonachlor Res Wet	trans-Nonachlor DL Wet
03NPCC01	NP	0.0114	0.000492	0.00300	0.000129	0.0330	0.000393	0.00868	0.000103
03NPCC02	NP	0.00604	0.000679	0.00112	0.000126	0.0159	0.000542	0.00295	0.000100
03NPGS03	NP	0.0140	0.000798	0.00360	0.000206	0.0474	0.000638	0.0122	0.000164
Maximum:		**0.0140**		**0.00360**		**0.0474**		**0.0122**	
Median:		**0.0114**		**0.00300**		**0.0330**		**0.00868**	
03DCBB02	DC	0.0128	0.000597	0.00279	0.000130	0.0427	0.000477	0.00929	0.000104
03DCBB05	DC	0.00961	0.000648	0.00199	0.000134	0.0243	0.000518	0.00505	0.000107
03DCCC01	DC	0.0189	0.000501	0.00503	0.000133	0.0417	0.000400	0.0111	0.000106
03DCCC03	DC	0.0162	0.000495	0.00422	0.000129	0.0489	0.000395	0.0127	0.000103
03DCCC04	DC	0.00971	0.000554	0.00230	0.000132	0.0184	0.000442	0.00437	0.000105
Maximum:		**0.0189**		**0.00503**		**0.0489**		**0.0127**	
Median:		**0.0128**		**0.00279**		**0.0417**		**0.00929**	
03PabBG04	PB	0.0383	0.000493	0.0104	0.000134	0.103	0.000394	0.0282	0.000107
03PabCC01	PB	0.0315	0.000458	0.00890	0.000129	0.0698	0.000366	0.0197	0.000103
03PabCC02	PB	0.0304	0.000447	0.00926	0.000136	0.0546	0.000357	0.0166	0.000109
03PabCC03	PB	0.0161	0.000543	0.00402	0.000136	0.0384	0.000434	0.00959	0.000108
03PabCC05	PB	0.0326	0.000463	0.00940	0.000133	0.0719	0.000370	0.0207	0.000106
03PabCC06	PB	0.00869	0.000503	0.00232	0.000134	0.0200	0.000402	0.00534	0.000107
03PabCC07	PB	0.0617	0.000694	0.0119	0.000134	0.0278	0.000555	0.00535	0.000107
03PabCC08	PB	0.0171	0.000437	0.00527	0.000134	0.0451	0.000349	0.0139	0.000107
03PabCC09	PB	0.0310	0.000409	0.00970	0.000128	0.0789	0.000327	0.0247	0.000102
03PabCC10	PB	0.0127	0.000555	0.00304	0.000133	0.0458	0.000443	0.0110	0.000106
Maximum:		**0.0617**		**0.0119**		**0.103**		**0.0282**	
Median:		**0.0307**		**0.00908**		**0.0502**		**0.0153**	
03LVBCAT04	LVB	0.0387	0.000538	0.00974	0.000135	0.0408	0.000430	0.0103	0.000108
03LVBCC01	LVB	0.0631	0.000430	0.0197	0.000134	0.0374	0.000343	0.0117	0.000107
03LVBCC02	LVB	0.0471	0.000548	0.0117	0.000136	0.0134	0.000438	0.00332	0.000109
03LVBCC03	LVB	0.0451	0.000477	0.0128	0.000135	0.0144	0.000381	0.00408	0.000108
Maximum:		**0.0631**		**0.0197**		**0.0408**		**0.0117**	
Median:		**0.0461**		**0.0123**		**0.0259**		**0.00719**	
03BBPahr05	PNWR	ND	0.000661	ND	0.000117	ND	0.000528	ND	0.0000930
03BBPahr06	PNWR	ND	0.000713	ND	0.000131	ND	0.000570	ND	0.000104
03CCPahr01	PNWR	ND	0.000690	ND	0.000136	ND	0.000551	ND	0.000108
03CCPahr02	PNWR	ND	0.000597	ND	0.000134	ND	0.000477	ND	0.000107
03CCPahr03	PNWR	ND	0.000571	ND	0.000133	0.000642	0.000456	0.000150	0.000106
03GSPahr04	PNWR	ND	0.000619	ND	0.000136	ND	0.000494	ND	0.000108
Maximum:		**na, 0.000713**		**na, 0.000136**		**0.000642**		**0.000150**	
Median:		**ND**		**ND**		**0.000642**		**0.000150**	
Grand Maximum:		**0.0631**		**0.0197**		**0.103**		**0.0282**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Heptachlor Res Dry	Heptachlor DL Dry	Heptachlor Res Wet	Heptachlor DL Wet	Heptachlor epoxide Res Dry	Heptachlor epoxide DL Dry	Heptachlor epoxide Res Wet	Heptachlor epoxide DL Wet
03NPCC01	NP	ND	0.000309	ND	0.0000810	0.0119	0.00109	0.00312	0.000287
03NPCC02	NP	ND	0.000426	ND	0.0000790	0.00274	0.00151	0.000508	0.000279
03NPGS03	NP	ND	0.000501	ND	0.000129	0.00456	0.00177	0.00118	0.000457
Maximum:		**na, 0.000501**		**na, 0.000129**		**0.0119**		**0.00312**	
Median:		**ND**		**ND**		**0.00456**		**0.00118**	
03DCBB02	DC	ND	0.000375	ND	0.0000820	0.0223	0.00133	0.00486	0.000289
03DCBB05	DC	ND	0.000407	ND	0.0000840	0.0111	0.00144	0.00229	0.000298
03DCCC01	DC	ND	0.000314	ND	0.0000840	0.0222	0.00111	0.00592	0.000296
03DCCC03	DC	ND	0.000310	ND	0.0000810	0.0189	0.00110	0.00492	0.000285
03DCCC04	DC	ND	0.000348	ND	0.0000830	0.0171	0.00123	0.00406	0.000292
Maximum:		**na, 0.000407**		**na, 0.0000840**		**0.0223**		**0.00592**	
Median:		**ND**		**ND**		**0.0189**		**0.00486**	
03PabBG04	PB	ND	0.000309	ND	0.0000840	0.0365	0.00109	0.00996	0.000298
03PabCC01	PB	ND	0.000287	ND	0.0000810	0.0552	0.00102	0.0156	0.000287
03PabCC02	PB	ND	0.000280	ND	0.0000850	0.0454	0.000992	0.0138	0.000302
03PabCC03	PB	0.00166	0.000341	0.000416	0.0000850	0.0260	0.00120	0.00650	0.000301
03PabCC05	PB	ND	0.000290	ND	0.0000840	0.0188	0.00103	0.00543	0.000296
03PabCC06	PB	ND	0.000316	ND	0.0000840	0.00963	0.00112	0.00257	0.000298
03PabCC07	PB	ND	0.000436	ND	0.0000840	0.0588	0.00154	0.0113	0.000297
03PabCC08	PB	ND	0.000274	ND	0.0000840	0.0537	0.000969	0.0165	0.000298
03PabCC09	PB	ND	0.000257	ND	0.0000800	0.0402	0.000908	0.0126	0.000284
03PabCC10	PB	ND	0.000348	ND	0.0000830	0.0111	0.00123	0.00266	0.000295
Maximum:		**0.00166**		**0.000416**		**0.0588**		**0.0165**	
Median:		**0.00166**		**0.000416**		**0.0384**		**0.0106**	
03LVBCAT04	LVB	ND	0.000338	ND	0.0000850	0.0937	0.00120	0.0236	0.000301
03LVBCC01	LVB	0.000735	0.000270	0.000229	0.0000840	0.0585	0.000954	0.0183	0.000298
03LVBCC02	LVB	ND	0.000344	ND	0.0000850	0.0131	0.00122	0.00324	0.000302
03LVBCC03	LVB	ND	0.000299	ND	0.0000850	0.0570	0.00106	0.0162	0.000300
Maximum:		**0.000735**		**0.000229**		**0.0937**		**0.0236**	
Median:		**0.000735**		**0.000229**		**0.0578**		**0.0173**	
03BBPahr05	PNWR	ND	0.000415	ND	0.0000730	ND	0.00147	ND	0.000259
03BBPahr06	PNWR	ND	0.000448	ND	0.0000820	ND	0.00158	ND	0.000290
03CCPahr01	PNWR	ND	0.000433	ND	0.0000850	ND	0.00153	ND	0.000301
03CCPahr02	PNWR	ND	0.000374	ND	0.0000840	ND	0.00132	ND	0.000298
03CCPahr03	PNWR	ND	0.000358	ND	0.0000840	ND	0.00127	ND	0.000296
03GSPahr04	PNWR	ND	0.000388	ND	0.0000850	ND	0.00137	ND	0.000301
Maximum:		**na, 0.000448**		**na, 0.0000850**		**na, 0.00158**		**na, 0.000301**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.00166**		**0.000416**		**0.0937**		**0.0236**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Dieldrin Res Dry	Dieldrin DL Dry	Dieldrin Res Wet	Dieldrin DL Wet	Endrin Res Dry	Endrin DL Dry	Endrin Res Wet	Endrin DL Wet
03NPCC01	NP	0.0306	0.00137	0.00805	0.000360	ND	0.00167	ND	0.000439
03NPCC02	NP	0.00451	0.00189	0.000836	0.000350	ND	0.00230	ND	0.000426
03NPGS03	NP	0.0140	0.00223	0.00362	0.000574	ND	0.00271	ND	0.000698
Maximum:		**0.0306**		**0.00805**		**na, 0.00271**		**na, 0.000698**	
Median:		**0.0140**		**0.00362**		**ND**		**ND**	
03DCBB02	DC	0.0505	0.00166	0.0110	0.000362	ND	0.00203	ND	0.000441
03DCBB05	DC	0.0147	0.00181	0.00305	0.000375	ND	0.00220	ND	0.000456
03DCCC01	DC	0.0694	0.00140	0.0185	0.000372	ND	0.00170	ND	0.000452
03DCCC03	DC	0.0407	0.00138	0.0106	0.000358	ND	0.00168	ND	0.000436
03DCCC04	DC	0.0410	0.00154	0.00974	0.000367	ND	0.00188	ND	0.000446
Maximum:		**0.0694**		**0.0185**		**na, 0.00220**		**na, 0.000456**	
Median:		**0.0410**		**0.0106**		**ND**		**ND**	
03PabBG04	PB	0.0233	0.00137	0.00636	0.000375	ND	0.00167	ND	0.000456
03PabCC01	PB	0.117	0.00128	0.0331	0.000360	ND	0.00155	ND	0.000439
03PabCC02	PB	0.0399	0.00125	0.0121	0.000379	ND	0.00152	ND	0.000461
03PabCC03	PB	0.0327	0.00151	0.00818	0.000378	ND	0.00184	ND	0.000460
03PabCC05	PB	0.0356	0.00129	0.0102	0.000372	ND	0.00157	ND	0.000452
03PabCC06	PB	0.0200	0.00140	0.00535	0.000375	ND	0.00171	ND	0.000456
03PabCC07	PB	0.0236	0.00194	0.00454	0.000373	ND	0.00236	ND	0.000454
03PabCC08	PB	0.0419	0.00122	0.0129	0.000375	ND	0.00148	ND	0.000456
03PabCC09	PB	0.0392	0.00114	0.0123	0.000357	ND	0.00139	ND	0.000434
03PabCC10	PB	0.0178	0.00155	0.00426	0.000370	ND	0.00188	ND	0.000451
Maximum:		**0.117**		**0.0331**		**na, 0.00236**		**na, 0.000461**	
Median:		**0.0342**		**0.00919**		**ND**		**ND**	
03LVBCAT04	LVB	0.0110	0.00150	0.00276	0.000378	ND	0.00183	ND	0.000459
03LVBCC01	LVB	0.0136	0.00120	0.00423	0.000374	ND	0.00146	ND	0.000455
03LVBCC02	LVB	0.00424	0.00153	0.00105	0.000379	ND	0.00186	ND	0.000461
03LVBCC03	LVB	0.00563	0.00133	0.00160	0.000377	ND	0.00162	ND	0.000459
Maximum:		**0.0136**		**0.00423**		**na, 0.00186**		**na, 0.000461**	
Median:		**0.00832**		**0.00218**		**ND**		**ND**	
03BBPahr05	PNWR	ND	0.00184	ND	0.000325	ND	0.00224	ND	0.000396
03BBPahr06	PNWR	ND	0.00199	ND	0.000365	ND	0.00242	ND	0.000444
03CCPahr01	PNWR	ND	0.00192	ND	0.000378	ND	0.00234	ND	0.000460
03CCPahr02	PNWR	ND	0.00166	ND	0.000375	ND	0.00202	ND	0.000456
03CCPahr03	PNWR	ND	0.00159	ND	0.000372	ND	0.00194	ND	0.000452
03GSPahr04	PNWR	ND	0.00172	ND	0.000378	ND	0.00210	ND	0.000460
Maximum:		**na, 0.00199**		**na, 0.000378**		**na, 0.00242**		**na, 0.000460**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.117**		**0.0331**		**ND, 0.00271**		**ND, 0.000698**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	HCB Res Dry	HCB DL Dry	HCB Res Wet	HCB DL Wet	Mirex Res Dry	Mirex DL Dry	Mirex Res Wet	Mirex DL Wet
03NPCC01	NP	0.00752	0.000956	0.00198	0.000251	ND	0.000353	ND	0.0000930
03NPCC02	NP	0.00232	0.00132	0.000429	0.000244	ND	0.000487	ND	0.0000900
03NPGS03	NP	0.00185	0.00155	0.000477	0.000400	0.000632	0.000572	0.000163	0.000148
Maximum:		**0.00752**		**0.00198**		**0.000632**		**0.000163**	
Median:		**0.00232**		**0.000477**		**0.000632**		**0.000163**	
03DCBB02	DC	0.0170	0.00116	0.00369	0.000253	ND	0.000428	ND	0.0000930
03DCBB05	DC	0.00408	0.00126	0.000845	0.000261	ND	0.000465	ND	0.0000960
03DCCC01	DC	0.0189	0.000973	0.00502	0.000259	0.00351	0.000359	0.000935	0.0000960
03DCCC03	DC	0.0257	0.000961	0.00668	0.000250	0.00202	0.000355	0.000525	0.0000920
03DCCC04	DC	0.0120	0.00108	0.00284	0.000256	0.00126	0.000397	0.000298	0.0000940
Maximum:		**0.0257**		**0.00668**		**0.00351**		**0.000935**	
Median:		**0.017**		**0.00369**		**0.00202**		**0.000525**	
03PabBG04	PB	0.0288	0.000957	0.00784	0.000261	ND	0.000353	ND	0.0000960
03PabCC01	PB	0.0555	0.000889	0.0157	0.000251	0.00409	0.000328	0.00116	0.0000930
03PabCC02	PB	0.0439	0.000868	0.0134	0.000264	0.00202	0.000320	0.000614	0.0000970
03PabCC03	PB	0.0333	0.00106	0.00832	0.000264	0.000904	0.000389	0.000226	0.0000970
03PabCC05	PB	0.0267	0.000899	0.0077	0.000259	0.000695	0.000332	0.000200	0.0000960
03PabCC06	PB	0.0162	0.000977	0.00433	0.000261	0.000630	0.000361	0.000168	0.0000960
03PabCC07	PB	0.0167	0.00135	0.00322	0.000260	0.00178	0.000498	0.000343	0.0000960
03PabCC08	PB	0.0243	0.000848	0.00748	0.000261	0.00118	0.000313	0.000364	0.0000960
03PabCC09	PB	0.0347	0.000795	0.0109	0.000249	0.000551	0.000293	0.000172	0.0000920
03PabCC10	PB	0.0124	0.00108	0.00296	0.000258	0.000456	0.000398	0.000109	0.0000950
Maximum:		**0.0555**		**0.0157**		**0.00409**		**0.00116**	
Median:		**0.0278**		**0.00777**		**0.000904**		**0.000226**	
03LVBCAT04	LVB	0.0116	0.00105	0.00291	0.000263	0.000781	0.000386	0.000196	0.0000970
03LVBCC01	LVB	0.0103	0.000835	0.00322	0.000261	0.00107	0.000308	0.000333	0.0000960
03LVBCC02	LVB	ND	0.00107	ND	0.000264	0.00198	0.000393	0.000491	0.0000970
03LVBCC03	LVB	0.00688	0.000926	0.00195	0.000263	0.000659	0.000342	0.000187	0.0000970
Maximum:		**0.0116**		**0.00322**		**0.00198**		**0.000491**	
Median:		**0.0103**		**0.00291**		**0.000926**		**0.000265**	
03BBPahr05	PNWR	ND	0.00128	ND	0.000227	ND	0.000474	ND	0.0000840
03BBPahr06	PNWR	ND	0.00139	ND	0.000254	ND	0.000511	ND	0.0000940
03CCPahr01	PNWR	ND	0.00134	ND	0.000264	ND	0.000495	ND	0.0000970
03CCPahr02	PNWR	ND	0.00116	ND	0.000261	ND	0.000428	ND	0.0000960
03CCPahr03	PNWR	ND	0.00111	ND	0.000259	ND	0.000409	ND	0.0000960
03GSPahr04	PNWR	ND	0.00120	ND	0.000264	ND	0.000444	ND	0.0000970
Maximum:		**na, 0.00139**		**na, 0.000264**		**na, 0.000511**		**na, 0.0000970**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.0555**		**0.0157**		**0.00409**		**0.00116**	
Minimum LOC:		**na**		**na**		**na**		**6.3**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	DDT-Total Res Dry	DDT-Total DL Dry	DDT-Total Res Wet	DDT-Total DL Wet	o,p'-DDD Res Dry	o,p'-DDD DL Dry	o,p'-DDD Res Wet	o,p'-DDD DL Wet
03NPCC01	NP	0.0298	0.00276	0.00783	0.000724	0.000930	0.000706	0.000244	0.000185
03NPCC02	NP	0.0222	0.00380	0.00411	0.000704	ND	0.000973	ND	0.000180
03NPGS03	NP	0.0440	0.00447	0.0113	0.00115	ND	0.00114	ND	0.000295
Maximum:		**0.0440**		**0.0113**		**0.000930**		**0.000244**	
Median:		**0.0298**		**0.00783**		**0.000930**		**0.000244**	
03DCBB02	DC	0.0948	0.00334	0.0206	0.000728	ND	0.000857	ND	0.000186
03DCBB05	DC	0.112	0.00363	0.0232	0.000752	ND	0.000930	ND	0.000193
03DCCC01	DC	0.204	0.00281	0.0542	0.000747	0.00916	0.000719	0.00244	0.000191
03DCCC03	DC	0.128	0.00277	0.0332	0.000720	0.00969	0.000710	0.00252	0.000184
03DCCC04	DC	0.173	0.00310	0.0411	0.000737	0.00337	0.000795	0.000800	0.000189
Maximum:		**0.204**		**0.0542**		**0.00969**		**0.00252**	
Median:		**0.128**		**0.0332**		**0.00916**		**0.00244**	
03PabBG04	PB	0.238	0.00276	0.0649	0.000752	0.00713	0.000707	0.00194	0.000193
03PabCC01	PB	0.520	0.00256	0.147	0.000724	0.0394	0.000657	0.0111	0.000185
03PabCC02	PB	0.361	0.00250	0.110	0.000761	0.0348	0.000641	0.0106	0.000195
03PabCC03	PB	0.189	0.00304	0.0472	0.000760	0.0139	0.000779	0.00347	0.000195
03PabCC05	PB	0.201	0.00259	0.0578	0.000747	0.0226	0.000664	0.00652	0.000191
03PabCC06	PB	0.106	0.00282	0.0282	0.000752	0.0125	0.000721	0.00333	0.000193
03PabCC07	PB	0.449	0.00389	0.0865	0.000750	0.0252	0.000996	0.00485	0.000192
03PabCC08	PB	0.294	0.00245	0.0904	0.000752	0.0253	0.000626	0.00779	0.000193
03PabCC09	PB	0.307	0.00229	0.0961	0.000717	0.0408	0.000587	0.0128	0.000184
03PabCC10	PB	0.132	0.00311	0.0316	0.000744	0.0139	0.000796	0.00332	0.000190
Maximum:		**0.520**		**0.147**		**0.0408**		**0.0128**	
Median:		**0.266**		**0.0757**		**0.0239**		**0.00569**	
03LVBCAT04	LVB	1.22	0.00302	0.308	0.000758	0.100	0.000772	0.0252	0.000194
03LVBCC01	LVB	1.07	0.00241	0.334	0.000751	0.111	0.000616	0.0346	0.000192
03LVBCC02	LVB	0.464	0.00307	0.115	0.000761	0.0163	0.000787	0.00405	0.000195
03LVBCC03	LVB	0.992	0.00267	0.281	0.000757	0.0747	0.000684	0.0212	0.000194
Maximum:		**1.22**		**0.334**		**0.111**		**0.0346**	
Median:		**1.03**		**0.295**		**0.0874**		**0.0232**	
03BBPahr05	PNWR	ND	0.00370	ND	0.000653	ND	0.000948	ND	0.000167
03BBPahr06	PNWR	0.00503	0.00400	0.000922	0.000732	ND	0.00102	ND	0.000188
03CCPahr01	PNWR	0.00574	0.00386	0.00113	0.000760	ND	0.000990	ND	0.000195
03CCPahr02	PNWR	0.00816	0.00334	0.00184	0.000752	ND	0.000856	ND	0.000193
03CCPahr03	PNWR	0.0185	0.00320	0.00431	0.000747	ND	0.000819	ND	0.000191
03GSPahr04	PNWR	0.00699	0.00346	0.00153	0.000760	ND	0.000888	ND	0.000195
Maximum:		**0.0185**		**0.00431**		**na, 0.00102**		**na, 0.000195**	
Median:		**0.00699**		**0.00153**		**ND**		**ND**	
Grand Maximum:		**1.22**		**0.334**		**0.111**		**0.0346**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	o,p'-DDE Res Dry	o,p'-DDE DL Dry	o,p'-DDE Res Wet	o,p'-DDE DL Wet	o,p'-DDT Res Dry	o,p'-DDT DL Dry	o,p'-DDT Res Wet	o,p'-DDT DL Wet
03NPCC01	NP	0.00263	0.000334	0.000691	0.0000880	ND	0.000526	ND	0.000138
03NPCC02	NP	0.000549	0.000462	0.000102	0.0000850	0.000732	0.000726	0.000136	0.000135
03NPGS03	NP	0.000858	0.000543	0.000221	0.000140	ND	0.000854	ND	0.000220
Maximum:		**0.00263**		**0.000691**		**0.000732**		**0.000136**	
Median:		**0.000858**		**0.000221**		**0.000732**		**0.000136**	
03DCBB02	DC	0.00548	0.000406	0.00119	0.0000880	ND	0.000639	ND	0.000139
03DCBB05	DC	0.00338	0.000441	0.000700	0.0000910	ND	0.000694	ND	0.000144
03DCCC01	DC	0.00316	0.000341	0.000840	0.0000910	ND	0.000536	ND	0.000143
03DCCC03	DC	0.00223	0.000336	0.000579	0.0000870	ND	0.000530	ND	0.000138
03DCCC04	DC	0.0137	0.000377	0.00325	0.0000890	ND	0.000593	ND	0.000141
Maximum:		**0.0137**		**0.00325**		**na, 0.000694**		**na, 0.000144**	
Median:		**0.00338**		**0.000840**		**ND**		**ND**	
03PabBG04	PB	0.0162	0.000335	0.00441	0.0000910	ND	0.000527	ND	0.000144
03PabCC01	PB	0.0488	0.000311	0.0138	0.0000880	ND	0.000490	ND	0.000138
03PabCC02	PB	0.0317	0.000304	0.00964	0.0000920	ND	0.000478	ND	0.000146
03PabCC03	PB	0.00693	0.000369	0.00173	0.0000920	ND	0.000581	ND	0.000145
03PabCC05	PB	0.0252	0.000315	0.00725	0.0000910	ND	0.000495	ND	0.000143
03PabCC06	PB	0.00788	0.000342	0.00210	0.0000910	ND	0.000538	ND	0.000144
03PabCC07	PB	0.0343	0.000472	0.00662	0.0000910	ND	0.000743	ND	0.000143
03PabCC08	PB	0.0212	0.000297	0.00651	0.0000910	ND	0.000467	ND	0.000144
03PabCC09	PB	0.0371	0.000278	0.0116	0.0000870	ND	0.000438	ND	0.000137
03PabCC10	PB	0.0111	0.000377	0.00266	0.0000900	ND	0.000594	ND	0.000142
Maximum:		**0.0488**		**0.0138**		**na, 0.000743**		**na, 0.000146**	
Median:		**0.0232**		**0.00657**		**ND**		**ND**	
03LVBCAT04	LVB	0.218	0.000366	0.0548	0.0000920	0.0159	0.000576	0.00399	0.000145
03LVBCC01	LVB	0.167	0.000292	0.0522	0.0000910	0.0166	0.000460	0.00517	0.000144
03LVBCC02	LVB	0.00660	0.000373	0.00164	0.0000920	0.00443	0.000587	0.00110	0.000146
03LVBCC03	LVB	0.153	0.000324	0.0434	0.0000920	0.00490	0.000510	0.00139	0.000145
Maximum:		**0.218**		**0.0548**		**0.0166**		**0.00517**	
Median:		**0.160**		**0.0478**		**0.0104**		**0.00269**	
03BBPahr05	PNWR	ND	0.000449	ND	0.0000790	ND	0.000707	ND	0.000125
03BBPahr06	PNWR	ND	0.000485	ND	0.0000890	ND	0.000763	ND	0.000140
03CCPahr01	PNWR	ND	0.000469	ND	0.0000920	ND	0.000738	ND	0.000145
03CCPahr02	PNWR	ND	0.000406	ND	0.0000910	ND	0.000639	ND	0.000144
03CCPahr03	PNWR	ND	0.000388	ND	0.0000910	ND	0.000611	ND	0.000143
03GSPahr04	PNWR	ND	0.000421	ND	0.0000920	ND	0.000662	ND	0.000145
Maximum:		**na, 0.000485**		**na, 0.0000920**		**na, 0.000763**		**na, 0.000145**	
Median:		**ND**		**ND**		**ND**		**ND**	
Grand Maximum:		**0.218**		**0.0548**		**0.0166**		**0.00517**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	p,p'-DDD Res Dry	p,p'-DDD DL Dry	p,p'-DDD Res Wet	p,p'-DDD DL Wet	p,p'-DDE Res Dry	p,p'-DDE DL Dry	p,p'-DDE Res Wet	p,p'-DDE DL Wet
03NPCC01	NP	0.00627	0.000708	0.00165	0.000186	0.0194	0.000351	0.00511	0.0000920
03NPCC02	NP	0.00232	0.000977	0.000429	0.000181	0.0186	0.000484	0.00344	0.0000900
03NPGS03	NP	0.00388	0.00115	0.00100	0.000296	0.0377	0.000569	0.00972	0.000147
Maximum:		**0.00627**		**0.00165**		**0.0377**		**0.00972**	
Median:		**0.00388**		**0.00100**		**0.0194**		**0.00511**	
03DCBB02	DC	0.00619	0.000859	0.00135	0.000187	0.0798	0.000426	0.0174	0.0000930
03DCBB05	DC	0.00384	0.000933	0.000797	0.000193	0.102	0.000462	0.0212	0.0000960
03DCCC01	DC	0.0108	0.000721	0.00286	0.000192	0.179	0.000357	0.0476	0.0000950
03DCCC03	DC	0.00793	0.000712	0.00206	0.000185	0.105	0.000353	0.0274	0.0000920
03DCCC04	DC	0.00548	0.000797	0.00130	0.000189	0.149	0.000395	0.0354	0.0000940
Maximum:		**0.0108**		**0.00286**		**0.179**		**0.0476**	
Median:		**0.00619**		**0.00135**		**0.105**		**0.0274**	
03PabBG04	PB	0.0183	0.000709	0.00500	0.000193	0.196	0.000351	0.0535	0.0000960
03PabCC01	PB	0.0435	0.000659	0.0123	0.000186	0.383	0.000326	0.108	0.0000920
03PabCC02	PB	0.0290	0.000643	0.00883	0.000196	0.262	0.000319	0.0798	0.0000970
03PabCC03	PB	0.00909	0.000781	0.00227	0.000195	0.156	0.000387	0.0391	0.0000970
03PabCC05	PB	0.0253	0.000666	0.00729	0.000192	0.124	0.000330	0.0356	0.0000950
03PabCC06	PB	0.0148	0.000724	0.00396	0.000193	0.0657	0.000359	0.0176	0.0000960
03PabCC07	PB	0.0281	0.00100	0.00542	0.000193	0.356	0.000495	0.0685	0.0000950
03PabCC08	PB	0.0366	0.000628	0.0113	0.000193	0.209	0.000311	0.0643	0.0000960
03PabCC09	PB	0.0452	0.000589	0.0142	0.000184	0.180	0.000292	0.0564	0.0000910
03PabCC10	PB	0.0144	0.000798	0.00346	0.000191	0.0914	0.000396	0.0219	0.0000950
Maximum:		**0.0452**		**0.0142**		**0.383**		**0.108**	
Median:		**0.0267**		**0.00636**		**0.188**		**0.0550**	
03LVBCAT04	LVB	0.191	0.000775	0.0481	0.000195	0.696	0.000384	0.175	0.0000970
03LVBCC01	LVB	0.148	0.000619	0.0462	0.000193	0.627	0.000306	0.196	0.0000960
03LVBCC02	LVB	0.0216	0.000789	0.00537	0.000196	0.415	0.000391	0.103	0.0000970
03LVBCC03	LVB	0.146	0.000686	0.0413	0.000195	0.614	0.000340	0.174	0.0000960
Maximum:		**0.191**		**0.0481**		**0.696**		**0.196**	
Median:		**0.147**		**0.0438**		**0.621**		**0.175**	
03BBPahr05	PNWR	ND	0.000951	ND	0.000168	0.00336	0.000471	0.000593	0.0000830
03BBPahr06	PNWR	ND	0.00103	ND	0.000188	0.00503	0.000509	0.000922	0.0000930
03CCPahr01	PNWR	ND	0.000993	ND	0.000195	0.00574	0.000492	0.00113	0.0000970
03CCPahr02	PNWR	ND	0.000859	ND	0.000193	0.00767	0.000425	0.00173	0.0000960
03CCPahr03	PNWR	ND	0.000822	ND	0.000192	0.0176	0.000407	0.00412	0.0000950
03GSPahr04	PNWR	ND	0.000891	ND	0.000195	0.00622	0.000441	0.00136	0.0000970
Maximum:		**na, 0.00103**		**na, 0.000195**		**0.0176**		**0.00412**	
Median:		**ND**		**ND**		**0.00598**		**0.00125**	
Grand Maximum:		**0.191**		**0.0481**		**0.696**		**0.196**	
Minimum LOC:		**na**		**na**		**na**		**na**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	PCB-Total Res Dry	PCB-Total DL Dry	PCB-Total Res Wet	PCB-Total DL Wet
03NPCC01	NP	0.289	0.0130	0.0760	0.00342
03NPCC02	NP	0.289	0.0180	0.0535	0.00333
03NPGS03	NP	0.576	0.0211	0.149	0.00545
Maximum:		**0.576**		**0.149**	
Median:		**0.289**		**0.0760**	
03DCBB02	DC	0.658	0.0158	0.143	0.00344
03DCBB05	DC	0.610	0.0172	0.126	0.00356
03DCCC01	DC	2.09	0.0133	0.557	0.00353
03DCCC03	DC	1.22	0.0131	0.318	0.00340
03DCCC04	DC	0.803	0.0147	0.191	0.00348
Maximum:		**2.09**		**0.557**	
Median:		**0.803**		**0.191**	
03PabBG04	PB	1.26	0.0130	0.343	0.00356
03PabCC01	PB	2.65	0.0121	0.747	0.00342
03PabCC02	PB	2.19	0.0118	0.667	0.00360
03PabCC03	PB	1.04	0.0144	0.260	0.00359
03PabCC05	PB	0.668	0.0122	0.192	0.00353
03PabCC06	PB	0.536	0.0133	0.143	0.00356
03PabCC07	PB	2.19	0.0184	0.421	0.00354
03PabCC08	PB	1.04	0.0116	0.319	0.00356
03PabCC09	PB	0.831	0.0108	0.260	0.00339
03PabCC10	PB	0.551	0.0147	0.132	0.00351
Maximum:		**2.65**		**0.747**	
Median:		**1.04**		**0.290**	
03LVBCAT04	LVB	1.05	0.0142	0.264	0.00358
03LVBCC01	LVB	1.90	0.0114	0.592	0.00355
03LVBCC02	LVB	1.14	0.0145	0.283	0.00360
03LVBCC03	LVB	0.955	0.0126	0.271	0.00358
Maximum:		**1.90**		**0.592**	
Median:		**1.10**		**0.277**	
03BBPahr05	PNWR	0.0284	0.0175	0.00501	0.00309
03BBPahr06	PNWR	0.0262	0.0189	0.00480	0.00346
03CCPahr01	PNWR	0.0260	0.0183	0.00512	0.00359
03CCPahr02	PNWR	0.0231	0.0158	0.00519	0.00356
03CCPahr03	PNWR	0.0288	0.0151	0.00672	0.00353
03GSPahr04	PNWR	0.0211	0.0164	0.00463	0.00359
Maximum:		**0.0288**		**0.00672**	
Median:		**0.0261**		**0.00507**	
Grand Maximum:		**2.65**		**0.747**	
Minimum LOC:		**na**		**0.4**	

Table 13. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Whole Fish, 2003

Notes

ND - not detected; na - not analyzed or not available; Res Dry - dry-weight residue; DL Dry - dry-weight detection limit; Res Wet - wet-weight residue; DL Wet - wet-weight detection limit; LOC - level of concern. Location medians are reported for detectable concentrations, i.e., they exclude non-detects.

Method detection limits vary by sample. Where all concentrations for a site were below detection limts, the maximum is reported as 'na,[maximum detection limit]'.

[1]Chlordane Res Dry is the sum of the concentrations of the dry-weight residues of alpha-chlordane, gamma-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane, and heptachlor.
Non-detect values for the concentrations of individual constituents were ignored. Detection limits were not determined for the chlordane mixture.

[2]Chlordane Res Dry is the sum of the concentrations of the dry-weight residues of alpha-chlordane, gamma-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane, and heptachlor.
Non-detect values for the concentrations of individual constituents were ignored. Detection limits were not determined for the chlordane mixture.

[3]Chlordane Lipid-adjusted is the sum of the concentrations of the lipid-adjusted wet-weight residues of alpha-chlordane, gamma-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane, and heptachlor.
Non-detect values for the concentrations of individual constituents were ignored. Detection limits were not determined for the chlordane mixture. For comparison to the lipid-adjusted LOC identified in the literature search, wet-weight residues were adjusted for lipid content for each fish using the following equation.
Res Lipid-adjusted = Res Wet/(% Lipid/100)

LOC were taken from Table 14.

Table 14. Levels of Concern for Chemicals of Potential Concern in Whole Fish (mg/kg)

Chemical Class	Chemical	Species	Level of Concern (in units listed in reference)	Level of Concern (mg/kg)[1]	Endpoint Description	Source, Reference	Notes
Organics	Aldrin	NA	NA	NA	NA	NA	
	BHC	NA	NA	NA	NA	NA	
	alpha-BHC	NA	NA	NA	NA	NA	
	beta-BHC	NA	NA	NA	NA	NA	
	delta-BHC	NA	NA	NA	NA	NA	
	gamma-BHC	NA	NA	NA	NA	NA	
	Chlordane	NA	< 0.1 mg/kg ww tissue	<0.1	NOEL	Eiser 2000, citing Arruda et al. 1987	Did not check original reference. This value might refer to whole-body or muscle tissue.
	Chlordane	NA	> 300 mg/kg, lipid weight	No data on ww basis	Reduced survival	Eisler 2000, citing Zitko 1978	Did not check original reference. Original reference might contain information that could allow conversion to wet weight basis. Chlordane concentration was adjusted to a lipid basis in Table 13 for comparison to this benchmark.
	alpha-Chlordane	NA	NA	NA	NA	NA	
	gamma-Chlordane	NA	NA	NA	NA	NA	
	Oxychlordane	NA	NA	NA	NA	NA	
	Dieldrin	NA	NA	NA	NA	NA	
	Endrin	NA	NA	NA	NA	NA	
	Hexachlorobenzene (HCB)	NA	NA	NA	NA	NA	
	Heptachlor	NA	NA	NA	NA	NA	
	Heptachlor epoxide	NA	NA	NA	NA	NA	
	cis-Nonachlor	NA	NA	NA	NA	NA	
	trans-Nonachlor	NA	NA	NA	NA	NA	
	Mirex	Brook trout (*Salvelinus fontinalis*)	6.3 mg/kg ww whole-body NOAEL	6.3	NOAEL	Eisler 2000, citing Skea et al. 1981	In lab studies with brook trout, 6.3 mg/kg whole-body residues were not associated with adverse effects on growth or survival
	DDT - Total	NA	NA	NA	NA	NA	
	o,p' - DDD	NA	NA	NA	NA	NA	
	o,p' - DDE	NA	NA	NA	NA	NA	
	o,p' - DDT	NA	NA	NA	NA	NA	
	p,p' - DDD	NA	NA	NA	NA	NA	
	p,p' - DDE	NA	NA	NA	NA	NA	
	p,p' - DDT	NA	NA	NA	NA	NA	
	PCB – Total	Unspecified	< 400 µ/kg ww whole body	< 0.4	Proposed criterion for protection of fish	Eisler 1986, citing EPA 1980; Eisler 2000, citing Eisler 1986	
	PCB – Total	Unspecified	> 50 mg/kg ww whole body	> 50	Proposed criterion for protection of fish from adverse effects	Eisler 2000, citing Niimi 1996	
	PCB – Total	Unspecified	> 50 mg/kg	> 50	Reduced growth and survival of progeny	Beyer et al. 1996	
	PCB – Total	Unspecified	> 100 mg/kg	> 100	Lethal concentration or concentration that can affect reproduction in females	Beyer et al. 1996	
	PCB – Total	Unspecified	0.5 mg/kg	0.5	Fish tissue concentration protective of fish and aquatic life	USDOE RAIS 2006, citing Swain and Holms 1985	Original reference states a criterion of 500 ng/g wet weight maximum in fish muscle (Swain and Holms 1985) and thus is not a criterion for whole-body concentrations.

Table 14. Levels of Concern for Chemicals of Potential Concern in Whole Fish (mg/kg)

Chemical Class	Chemical	Species	Level of Concern (in units listed in reference)	Level of Concern (mg/kg)[1]	Endpoint Description	Source, Reference	Notes
	PCB – Total	Unspecified	0.1 mg/kg	0.1	Maximum allowable level in fish tissue for protection of piscivorous wildlife	USDOE RAIS 2006, citing BCMOELP 1988	This criterion is intended to be protective of animals other than fish and so is not consistent with the other criteria.
Metals & Metalloids	Aluminum	NA	NA	NA	NA	NA	
	Antimony	NA	NA	NA	NA	NA	
	Arsenic	Unspecified	0.22 µg/g ww*	0.22	85th percentile of whole fish; described as a concern concentration	Tuttle and Thodal 1998, citing Schmitt and Brumbaugh 1990	Concern concentration was either designated as such in the primary source cited by these authors or indicates a relatively minor effect
	Arsenic	Bluegill sunfish (*Lepomis macrochirus*)	2.1 µg/g ww	2.1	Effect concentration; decreased growth and survival of juveniles	Tuttle and Thodal 1998, citing Gilderhus 1966	
	Arsenic	Unspecified	1 mg/kg dw*	1 dw	85th percentile of whole fish, described as an NEL	USDI 1998, citing Schmitt and Brumbaugh 1980	From Table 1 in original reference
	Arsenic	Unspecified	12 mg/kg dw	12 dw	Toxicity threshold (unspecified effects)	USDI 1998, citing Sandhu 1978	From Table 1 in original reference
	Barium	NA	NA	NA	NA	NA	
	Beryllium	NA	NA	NA	NA	NA	
	Boron	NA	NA	NA	NA	NA	
	Cadmium	Unspecified	0.05 µg/g ww*	0.05	Concern concentration	Tuttle and Thodal 1998, citing Schmitt and Brumbaugh 1990	85th percentile of whole fish in the National Contaminant Monitoring Program; concern concentration was either designated as such in the primary source cited by these authors or indicates a relatively minor effect
	Chromium	Unspecified	4.0 µg/g ww*	4.0	Concern concentration; concentration that suggests chromium contamination	Tuttle and Thodal 1998, citing Eisler 1986	Concern concentration was either designated as such in the primary source cited by these authors or indicates a relatively minor effect
	Copper	Unspecified	0.9 µg/g ww*	0.9	Concern concentration	Tuttle and Thodal 1998, citing Schmitt and Brumbaugh 1990	85th percentile of whole fish in the National Contaminant Monitoring Program; concern concentration was either designated as such in the primary source cited by these authors or indicates a relatively minor effect
	Iron	NA	NA	NA	NA	NA	
	Lead	Unspecified	0.22 µg/g ww*	0.22	Concern concentration	Tuttle and Thodal 1998, citing Schmitt and Brumbaugh 1990	85th percentile of whole fish in the National Contaminant Monitoring Program; concern concentration was either designated as such in the primary source cited by these authors or indicates a relatively minor effect
	Magnesium	NA	NA	NA	NA	NA	
	Manganese	NA	NA	NA	NA	NA	
	Mercury	Unspecified	0.17 µg/g ww*	0.17	Concern concentration	Tuttle and Thodal 1998, citing Schmitt and Brumbaugh 1990	85th percentile of whole fish in the National Contaminant Monitoring Program; concern concentration was either designated as such in the primary source cited by these authors or indicates a relatively minor effect

Table 14. Levels of Concern for Chemicals of Potential Concern in Whole Fish (mg/kg)

Chemical Class	Chemical	Species	Level of Concern (in units listed in reference)	Level of Concern (mg/kg)[1]	Endpoint Description	Source, Reference	Notes
	Mercury	Nonmarine birds	0.5 - 2.0 mg/kg ww	0.5 - 2.0	Concentrations sufficient to impair reproductive success, as measured by reduced egg production, egg viability and hatchability, embryo survival, and chick survival	Beyer et al. 1996	
	Mercury	Fathead minnows (*Pimephales promelas*)	0.62 µg/g dw	0.62 dw	Reduced reproduction	Tuttle and Thodal 1998, citing Snarski and Olson 1982	
	Mercury	Mosquitofish (*Gambusia affinis*)	0.7 µg/g ww	0.7	Diminished predator-avoidance behavior	Tuttle and Thodal 1998, citing Kania and O'Hara 1974	
	Mercury	Rainbow trout (*Oncorhynchus mykiss*)	1000 - 5000 µg/kg ww	1 - 5	Adverse effects probable	Eisler 2000, citing Niimi and Kissoon 1994	
	Mercury	Unspecified	0.3 mg/kg	3	Whole body screening benchmark	USDOE RAIS 2006, citing Beyer et al. 1996	The purpose of this criterion (protection of fish or other species) and the basis for the concentration (ww vs. dw, whole-body vs. tissue) is not clear without reviewing the original reference.
	Mercury	Various species; freshwater; adults	>3000 µg/kg ww	>3	Adverse effects expected	Eisler 2000, citing Wiener and Spry 1996	
	Mercury	Salmonids	3 µg/g ww	3	Estimated no-observed-effect concentration for	Beyer et al. 1996	
	Mercury	Brook trout (*Salvelinus fontinalis*)	5 µg/g ww	5	Whole-body concentration associated with sublethal or lethal toxic effects	Beyer et al. 1996	
	Mercury	Rainbow trout (*Oncorhynchus mykiss*)	10 µg/g ww	10	Whole-body concentration associated with sublethal or lethal toxic effects	Beyer et al. 1996	
	Mercury	Rainbow trout (*Oncorhynchus mykiss*)	10,000 - 20,000 µg/kg ww	10 - 20	Lethal whole body concentration	Eisler 2000, citing Niimi and Kissoon 1994	
	Molybdenum	NA	NA	NA	NA	NA	
	Nickel	NA	NA	NA	NA	NA	
	Selenium	Unspecified	1 - 4 mg/kg dw*	1 - 4 dw	Background levels	USDI 1998	

Table 14. Levels of Concern for Chemicals of Potential Concern in Whole Fish (mg/kg)

Chemical Class	Chemical	Species	Level of Concern (in units listed in reference)	Level of Concern (mg/kg)[1]	Endpoint Description	Source, Reference	Notes
	Selenium	"Cold water spp"	2 - 4 mg/kg dw*	2 - 4 dw	Level of concern; effects are rare, but concentrations are elevated above backgroun	USDI 1998, citing Lemly 1996	
	Selenium	Fish and aquatic birds	3 µg/g dw	3 dw	Concentration in food chain organisms that is potentially lethal to fish and aquatic birds	Beyer et al. 1996	
	Selenium	"Warm water spp"	3 - 4 mg/kg dw*	3 - 4 dw	Level of concern; effects are rare, but concentrations are elevated above backgroun	USDI 1998, citing Lemly 1996	
	Selenium	Freshwater or anadromous fishes	4 µg/g dw	4 dw	Threshold for tissue concentrations that affect health and reproductive status	Beyer et al. 1996	
	Selenium	Unspecified sensitive species	4 - 10 µg/g dw	4 dw	Concern concentration; estimated true threshold for reproductive impairment of sensitive species	Tuttle and Thodal 1998; citing Skorupa et al. 1996, Lillebo and et al. 1988, and Lemly 1996	Concern concentration was either designated as such in the primary source cited by these authors or indicates a relatively minor effect. Concentrations above this value appear to produce adverse effects in some species.
	Selenium	Freshwater or anadromous fishes	< 4,000 µg/kg dw	< 4 dw	Acceptable tissue residues, whole body	Eisler 2000; citing Lemly 1993 and Lemly 1996	
	Selenium	Freshwater fish	5.85 - 7.91 µg/g dw	5.85 - 7.91	U.S. EPA 2004 Draft Selenium Aquatic Life Criterion	U.S. EPA 2004	The draft freshwater chronic criterion is expressed as a concentration in whole-body fish tissue of 7.91 µg/g dw. If samples exceed 5.85 µg/g dw in summer or fall, fish should be monitored in winter to determine if the criterion is exceeded.
	Selenium	Unspecified sensitive species	10 µg/g dw	10 dw	Effect concentration; estimated true threshold for reproductive impairment of sensitive species	Tuttle and Thodal 1998; citing Skorupa et al. 1996, Lillebo and et al. 1988, and Lemly 1996	Effect concentration designation was either designated as such in the primary source cited by these authors or indicates values that cause substantial effects
	Selenium	Unspecified	10 - 20 mg/kg dw	10 - 20 dw	"Threshold for toxicity for sensitive and moderately sensitive taxa"; teratogenesis	USDI 1998, citing Lemly 1995, 1996	Values associated with whole body concentration after poisoning event at Bellows Lake, NC, see Table 33
	Selenium	Unspecified	< 12,000 µg/kg dw	< 12 dw	Acceptable tissue residues, whole body	Eisler 2000; citing Waddell and May 1995, Lemly 1993a,b	
	Selenium	Unspecified	50 - 100 mg/kg dw	50 - 100 dw	"Catastrophic impacts are highly likely"	USDI 1998, citing Lemly 1995, 1997	
	Strontium	NA	NA	NA	NA	NA	
	Titanium	NA	NA	NA	NA	NA	

Table 14. Levels of Concern for Chemicals of Potential Concern in Whole Fish (mg/kg)

Chemical Class	Chemical	Species	Level of Concern (in units listed in reference)	Level of Concern (mg/kg)[1]	Endpoint Description	Source, Reference	Notes
	Vanadium	NA	NA	NA	NA	NA	
	Zinc	White sucker	20 mg/kg*	20	Unspecified	USDI 1998, citing Munkittrick et al. 1991	This is lower than the normal background reported in a study by Schmitt and Brumnbaugh 1990. Assuming ww., but did not confirm.
	Zinc	Unspecified	21.7 mg/kg ww*	21.7	Geometric mean for US fish nationwide measured in 1984	Eisler 1993, citing Schmitt and Brumbaugh 1990	85th percentile = 34.2 mg/kg fw, max = 118.4 mg/kg fw
	Zinc	Unspecified	34.2 µg/g ww	34.2	Mortality and malformation of fish and amphibian embryos and larvae	Tuttle and Thodal 1998, citing USEPA 1985	
	Zinc	Common carp (*Cyprinus carpio*)	70 - 168 mg/kg*	70 - 168	Unspecified	Eisler 1993, citing Lowe et al. 1985	This range represents the "highest zinc concentrations measured in whole freshwater fish in the conterminous United States in 1978-79"; values were measured in Utah; the reference range from another area was reported to be 63 mg/kg (per Lowe et al. 1985); ww is assumed but not confirmed.
	Zinc	Various species within a "metals contaminated lake" in Indiana	See notes*	See notes	Unspecified	Eisler 1993, citing Murphy et al. 1978	Lake concentration of 636 µg dissolved Zn/L; fish tissue concentration in mg/kg dw Bowfin (*Amia calva*) - 93, White sucker (*Catostomus commersoni*) - 102, Brown bullhead (*Ictalurus nebulosus*) - 127, Warmouth (*Lepomis gulosus*) - 140, Orangespot sunfish (*Lepomis humilis*) - 140 Redear sunfish (*Lepomis microlophus)* - 477, Largemouth bass (*Micropterus salmoides*) - 119, Golden shiner (*Notemigonus crysoleucas*) - 160, Yellow perch (*Perca flavescens*) - 160, Black crappie (*Pomoxis nigromaculatus*) - 123
Other	Perchlorate[2]	NA	NA	NA	NA	NA	

Notes

* No specific effect was described in association with the bird egg concentration reported. Since only a summary of the study was reviewed, it is possible that effects were evaluated and reported in the primary source.

NEL - No Effect Level

1 Reported on a wet-weight (ww) basis, unless otherwise noted (e.g., dw, dry-weight).

2 When results of tissue analyses are available, perchlorate LOC will be presented in Appendix B. However, no benchmarks or criteria have been identified to date.

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Tuttle and Thodal 1998: Tuttle PL, and Thodal CE. 1998. Field Screening of Water Quality, Bottom Sediment, and Biota Associated With Irrigation in and Near the Indian Lakes Area, Stillwater Wildlife Management Area, Churchill County, West-Central Nevada, 1995. U.S. GEOLOGICAL SURVEY. Water-Resources Investigations Report 97-4250.
Benchmark ranges are provided for each chemical. The lower number is a concern concentration assigned to a value noted in the literature or to a value associated with relatively minor effects (e.g., LC1 or decreased growth rate for a limited period of time). The higher number is an effect concentration assigned to values noted as such in the literature or to values that cause substantial effects (e.g., LC50, reduced survival or reproduction, or teratogenesis).

USDI 1998: United States Department of the Interior (USDI), 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, Bureau of Indian Affairs.

USDOE RAIS 2006: United States Department of Energy (USDOE) Risk Assessment Information System (RAIS) Database.
http://risk.lsd.ornl.gov/. This database includes a compilation of Ecological Benchmark Values from various sources. This database was searched only when suitable criteria were not identified from the other references or were sparse.

U.S. EPA 2004: U.S. EPA. 2004. Draft Aquatic Life Water Quality Criteria for Selenium - 2004. November. U.S. Environmental Protection Agency (U.S. EPA), Office of Water. Washington, DC. 334 p. http://www.epa.gov/seleniumcriteria/.

Table 15. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Antimony Res Dry 0.2	Antimony Res Wet 0.20	Arsenic Res Dry 0.2	Arsenic Res Wet 0.20	Barium Res Dry 0.2	Barium Res Wet 0.20	Cadmium Res Dry 0.2	Cadmium Res Wet 0.20	Chromium Res Dry 0.2	Chromium Res Wet 0.20
03NPCC01	NP	ND	ND	2.00	0.519	1.46	0.378	ND	ND	1.05	0.272
03NPCC02	NP	ND	ND	3.35	0.684	1.65	0.336	ND	ND	0.882	0.180
03NPGS03	NP	ND	ND	1.37	0.332	0.810	0.196	ND	ND	1.31	0.316
	Maximum:	**na, 0.200**	**na, 0.08**	**3.35**	**0.684**	**1.65**	**0.378**	**na, 0.200**	**na, 0.050**	**1.31**	**0.316**
	Median:	**ND**	**ND**	**2.00**	**0.519**	**1.46**	**0.336**	**ND**	**ND**	**1.05**	**0.272**
03DCBB02	DC	ND	ND	ND	ND	1.58	0.400	ND	ND	1.11	0.282
03DCBB05	DC	ND	ND	2.55	0.558	3.13	0.686	ND	ND	1.25	0.273
03DCCC01	DC	ND	ND	ND	ND	2.56	0.777	ND	ND	0.984	0.298
03DCCC03	DC	ND	ND	1.32	0.386	2.30	0.673	ND	ND	0.935	0.274
03DCCC04	DC	ND	ND	ND	ND	2.34	0.626	ND	ND	0.819	0.220
	Maximum:	**na, 0.200**	**na, 0.08**	**2.55**	**0.558**	**3.13**	**0.777**	**na, 0.200**	**na, 0.060**	**1.25**	**0.298**
	Median:	**ND**	**ND**	**1.93**	**0.472**	**2.34**	**0.673**	**ND**	**ND**	**0.984**	**0.274**
03PABBG04	PB	ND	ND	ND	ND	1.33	0.360	ND	ND	0.842	0.227
03PABCC01	PB	ND	ND	1.48	0.459	2.71	0.841	ND	ND	0.774	0.240
03PABCC02	PB	ND	ND	1.63	0.519	8.47	2.69	ND	ND	2.42	0.770
03PABCC03	PB	ND	ND	0.994	0.266	2.40	0.642	ND	ND	1.01	0.270
03PABCC05	PB	ND	ND	ND	ND	6.78	2.18	ND	ND	0.822	0.265
03PABCC06	PB	ND	ND	ND	ND	2.25	0.635	ND	ND	0.765	0.216
03PABCC07	PB	ND	ND	ND	ND	19.4	5.12	ND	ND	1.44	0.379
03PABCC08	PB	ND	ND	ND	ND	10.51	3.30	ND	ND	0.892	0.280
03PABCC09	PB	ND	ND	ND	ND	3.10	1.05	ND	ND	0.750	0.254
03PABCC10	PB	ND	ND	ND	ND	19.18	5.64	ND	ND	1.45	0.427
	Maximum:	**na, 0.200**	**na, 0.08**	**1.63**	**0.519**	**19.4**	**5.64**	**na, 0.200**	**na, 0.070**	**2.42**	**0.770**
	Median:	**ND**	**ND**	**1.48**	**0.459**	**4.94**	**1.62**	**ND**	**ND**	**0.867**	**0.267**
03LVBCAT04	LVB	ND	ND	ND	ND	5.39	1.48	ND	ND	0.988	0.271
03LVBCC01	LVB	ND	ND	ND	ND	4.85	1.96	ND	ND	2.02	0.816
03LVBCC02	LVB	ND	ND	ND	ND	15.0	4.13	0.64	0.177	0.760	0.210
03LVBCC03	LVB	ND	ND	ND	ND	8.55	2.66	ND	ND	0.853	0.265
	Maximum:	**na, 0.200**	**na, 0.08**	**na, 0.200**	**na, 0.800**	**15.0**	**4.13**	**0.641**	**0.177**	**2.02**	**0.816**
	Median:	**ND**	**ND**	**ND**	**ND**	**6.97**	**2.31**	**0.641**	**0.177**	**0.921**	**0.268**
03BBPAHR05	PNWR	ND	ND	1.44	0.285	34.8	6.89	ND	ND	0.939	0.186
03BBPAHR06	PNWR	ND	ND	1.89	0.340	34.6	6.22	0.214	0.039	0.889	0.160
03CCPAHR01	PNWR	ND	ND	1.04	0.240	7.90	1.82	ND	ND	0.794	0.183
03CCPAHR02	PNWR	ND	ND	ND	ND	5.74	1.53	ND	ND	0.911	0.242
03CCPAHR03	PNWR	ND	ND	ND	ND	9.34	2.35	ND	ND	1.04	0.262
03GSPAHR04	PNWR	ND	ND	ND	ND	5.29	1.23	ND	ND	2.95	0.683
	Maximum:	**na, 0.200**	**na, 0.08**	**1.89**	**0.340**	**34.8**	**6.89**	**0.214**	**0.039**	**2.95**	**0.683**
	Median:	**ND**	**ND**	**1.44**	**0.285**	**8.62**	**2.09**	**0.214**	**0.039**	**0.925**	**0.214**
	Grand Maximum:	**ND, 0.200**	**na, 0.08**	**3.35**	**0.684**	**34.8**	**6.89**	**0.641**	**0.177**	**2.95**	**0.816**
	Minimum LOC:	**na**	**na**	**na**	**0.22**	**na**	**na**	**na**	**0.05**	**na**	**4**

Table 15. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Copper Res Dry 0.8	Copper Res Wet 0.80	Iron Res Dry 4	Iron Res Wet 4.00	Lead Res Dry 0.2	Lead Res Wet 0.20	Manganese Res Dry 0.4	Manganese Res Wet 0.40	Mercury Res Dry 0.02	Mercury Res Wet 0.02
03NPCC01	NP	3.14	0.817	150	39.0	ND	ND	2.14	0.555	ND	ND
03NPCC02	NP	1.61	0.328	308	62.9	0.201	0.041	4.05	0.825	ND	ND
03NPGS03	NP	ND	0.194	352	85.2	ND	ND	10.2	2.47	0.048	0.012
	Maximum:	**3.14**	**0.817**	**352**	**85.2**	**0.201**	**0.041**	**10.2**	**2.47**	**0.048**	**0.012**
	Median:	**2.38**	**0.328**	**308**	**62.9**	**0.201**	**0.041**	**4.05**	**0.825**	**0.048**	**0.012**
03DCBB02	DC	7.24	1.84	320	81.2	0.286	0.073	24.2	6.15	0.055	0.014
03DCBB05	DC	8.10	1.77	451	98.7	0.396	0.087	26.6	5.82	0.048	0.011
03DCCC01	DC	2.71	0.822	359	108.8	0.314	0.095	45.2	13.7	0.067	0.020
03DCCC03	DC	3.15	0.924	303	88.7	0.248	0.073	22.7	6.65	0.045	0.013
03DCCC04	DC	3.13	0.840	364	97.6	0.306	0.082	19.3	5.17	0.103	0.027
	Maximum:	**8.10**	**1.84**	**451**	**109**	**0.396**	**0.095**	**45.2**	**13.7**	**0.103**	**0.027**
	Median:	**3.15**	**0.924**	**359**	**97.6**	**0.306**	**0.082**	**24.2**	**6.15**	**0.055**	**0.014**
03PABBG04	PB	ND	0.216	249	67.1	ND	ND	16.7	4.51	0.062	0.017
03PABCC01	PB	1.70	0.526	385	119	0.276	0.085	11.6	3.60	0.045	0.014
03PABCC02	PB	2.61	0.828	430	137	0.404	0.128	30.9	9.84	0.023	0.007
03PABCC03	PB	3.48	0.933	239	64.0	ND	ND	8.52	2.28	0.035	0.009
03PABCC05	PB	3.02	0.972	193	62.0	0.423	0.136	6.31	2.03	0.032	0.010
03PABCC06	PB	3.65	1.03	254	71.7	0.893	0.252	6.18	1.74	0.037	0.011
03PABCC07	PB	5.05	1.33	528	139	0.720	0.190	19.1	5.05	0.101	0.027
03PABCC08	PB	4.83	1.52	285	89.6	1.91	0.601	9.87	3.10	0.061	0.019
03PABCC09	PB	2.01	0.681	274	92.4	0.357	0.121	12.3	4.16	0.030	0.010
03PABCC10	PB	3.48	1.02	589	173	0.738	0.217	26.9	7.89	0.033	0.010
	Maximum:	**5.05**	**1.52**	**589**	**173**	**1.91**	**0.601**	**30.9**	**9.84**	**0.101**	**0.027**
	Median:	**3.48**	**0.953**	**279**	**91.0**	**0.572**	**0.163**	**12.0**	**3.88**	**0.036**	**0.010**
03LVBCAT04	LVB	ND	0.219	371	102	1.82	0.498	24.4	6.68	0.061	0.017
03LVBCC01	LVB	ND	0.322	266	107	0.595	0.240	13.7	5.53	0.118	0.048
03LVBCC02	LVB	3.43	0.945	653	180	1.38	0.380	11.4	3.15	0.037	0.010
03LVBCC03	LVB	1.83	0.569	261	81.3	0.627	0.195	6.84	2.13	0.059	0.018
	Maximum:	**3.43**	**0.945**	**653**	**180**	**1.82**	**0.498**	**24.4**	**6.68**	**0.118**	**0.048**
	Median:	**2.63**	**0.446**	**318**	**104**	**1.00**	**0.310**	**12.6**	**4.34**	**0.060**	**0.018**
03BBPAHR05	PNWR	1.07	0.212	493	97.6	0.236	0.047	19.5	3.86	0.329	0.065
03BBPAHR06	PNWR	1.16	0.209	523	94.2	0.246	0.044	26.6	4.80	0.445	0.080
03CCPAHR01	PNWR	ND	0.185	362	83.6	ND	ND	7.65	1.77	0.025	0.006
03CCPAHR02	PNWR	2.18	0.579	260	69.1	ND	ND	5.28	1.40	0.022	0.006
03CCPAHR03	PNWR	1.06	0.267	367	92.6	ND	ND	9.42	2.37	0.031	0.008
03GSPAHR04	PNWR	32.2	7.46	339	78.7	ND	ND	19.1	4.43	0.239	0.055
	Maximum:	**32.2**	**7.46**	**523**	**97.6**	**0.246**	**0.047**	**26.6**	**4.80**	**0.445**	**0.080**
	Median:	**1.16**	**0.239**	**365**	**88.1**	**0.241**	**0.046**	**14.3**	**3.12**	**0.135**	**0.032**
	Grand Maximum:	**32.2**	**7.46**	**653**	**180**	**1.91**	**0.601**	**45.2**	**13.7**	**0.445**	**0.080**
	Minimum LOC:	**na**	**0.9**	**na**	**na**	**na**	**0.22**	**na**	**na**	**na**	**0.170**

Table 15. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Molybdenum Res Dry 0.2	Molybdenum Res Wet 0.20	Nickel Res Dry 0.8	Nickel Res Wet 0.80	Selenium Res Dry 0.2	Selenium Res Wet 0.20	Strontium Res Dry 4	Strontium Res Wet 4.00	Titanium Res Dry 0.4	Titanium Res Wet 0.40
03NPCC01	NP	ND	ND	ND	ND	63.6	16.5	208	54.1	15.2	3.94
03NPCC02	NP	0.248	0.051	ND	ND	106	21.6	432	88.1	30.2	6.16
03NPGS03	NP	ND	ND	ND	ND	40.2	9.72	437	106	34.5	8.35
	Maximum:	**0.248**	**0.051**	**na, 0.800**	**na, 0.200**	**106**	**21.6**	**437**	**106**	**34.5**	**8.35**
	Median:	**0.248**	**0.051**	**ND**	**ND**	**63.6**	**16.5**	**432**	**88.1**	**30.2**	**6.16**
03DCBB02	DC	ND	ND	ND	ND	5.10	1.30	295	74.9	28.1	7.13
03DCBB05	DC	ND	ND	ND	ND	13.73	3.01	275	60.2	31.9	6.99
03DCCC01	DC	ND	ND	ND	ND	10.25	3.11	396	120	30.7	9.31
03DCCC03	DC	ND	ND	ND	ND	10.81	3.17	293	85.9	25.1	7.35
03DCCC04	DC	ND	ND	ND	ND	11.72	3.14	394	106	29.1	7.79
	Maximum:	**na, 0.200**	**na, 0.060**	**na, 0.800**	**na, 0.200**	**13.73**	**3.17**	**396**	**120**	**31.9**	**9.31**
	Median:	**ND**	**ND**	**ND**	**ND**	**10.81**	**3.11**	**295**	**85.9**	**29.1**	**7.35**
03PABBG04	PB	ND	ND	ND	ND	13.7	3.71	240	64.8	23.2	6.25
03PABCC01	PB	ND	ND	ND	ND	7.71	2.39	423	131	29.4	9.12
03PABCC02	PB	ND	ND	ND	ND	6.50	2.07	326	104	27.3	8.68
03PABCC03	PB	ND	ND	ND	ND	9.79	2.62	246	65.9	20.9	5.60
03PABCC05	PB	ND	ND	ND	ND	4.12	1.33	188	60.7	15.1	4.87
03PABCC06	PB	ND	ND	ND	ND	9.21	2.60	249	70.1	20.9	5.88
03PABCC07	PB	ND	ND	ND	ND	7.46	1.97	332	87.6	31.4	8.30
03PABCC08	PB	ND	ND	ND	ND	4.99	1.57	255	80.1	21.0	6.58
03PABCC09	PB	ND	ND	ND	ND	3.93	1.33	308	104	24.2	8.18
03PABCC10	PB	ND	ND	ND	ND	3.47	1.02	390	115	38.2	11.2
	Maximum:	**na, 0.200**	**na, 0.070**	**na, 0.800**	**na, 0.300**	**13.7**	**3.71**	**423**	**131**	**38.2**	**11.2**
	Median:	**ND**	**ND**	**ND**	**ND**	**6.98**	**2.02**	**281**	**83.8**	**23.7**	**7.38**
03LVBCAT04	LVB	ND	ND	ND	ND	2.57	0.704	291	79.7	31.8	8.71
03LVBCC01	LVB	ND	ND	ND	ND	3.85	1.55	231	93.0	20.3	8.17
03LVBCC02	LVB	ND	ND	ND	ND	6.87	1.90	330	90.9	31.6	8.73
03LVBCC03	LVB	ND	ND	ND	ND	4.72	1.47	329	102	21.9	6.80
	Maximum:	**na, 0.200**	**na, 0.080**	**na, 0.800**	**na, 0.300**	**6.87**	**1.90**	**330**	**102**	**31.8**	**8.73**
	Median:	**ND**	**ND**	**ND**	**ND**	**4.29**	**1.51**	**310**	**92.0**	**26.8**	**8.44**
03BBPAHR05	PNWR	ND	ND	ND	ND	1.48	0.293	627	124	47.3	9.36
03BBPAHR06	PNWR	ND	ND	ND	ND	1.22	0.220	499	89.8	43.3	7.80
03CCPAHR01	PNWR	ND	ND	ND	ND	0.991	0.229	548	127	37.9	8.74
03CCPAHR02	PNWR	ND	ND	ND	ND	1.47	0.392	337	89.5	23.3	6.19
03CCPAHR03	PNWR	ND	ND	ND	ND	0.965	0.243	471	119	31.5	7.94
03GSPAHR04	PNWR	0.403	0.093	1.07	0.25	1.57	0.365	671	156	32.0	7.43
	Maximum:	**0.403**	**0.093**	**1.07**	**na, 0.300**	**1.57**	**0.392**	**671**	**156**	**47.3**	**9.36**
	Median:	**0.403**	**0.093**	**1.07**	**ND**	**1.35**	**0.268**	**523**	**121**	**34.9**	**7.87**
	Grand Maximum:	**0.403**	**0.093**	**1.07**	**na, 0.300**	**106**	**21.6**	**671**	**156**	**47.3**	**11.2**
	Minimum LOC:	**na**	**na**	**na**	**na**	**na**	**2**	**na**	**na**	**na**	**na**

Table 15. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Whole Fish, 2003

Sample	Location	Vanadium Res Dry 0.2	Vanadium Res Wet 0.20	Zinc Res Dry 4	Zinc Res Wet 4.00
03NPCC01	NP	0.438	0.114	203	52.8
03NPCC02	NP	0.904	0.184	274	55.9
03NPGS03	NP	0.331	0.080	131	31.8
	Maximum:	**0.904**	**0.184**	**274**	**55.9**
	Median:	**0.438**	**0.114**	**203**	**52.8**
03DCBB02	DC	1.00	0.253	91.3	23.2
03DCBB05	DC	1.15	0.251	111	24.4
03DCCC01	DC	0.375	0.114	310	94.0
03DCCC03	DC	0.425	0.125	267	78.3
03DCCC04	DC	0.425	0.114	364	97.5
	Maximum:	**1.15**	**0.253**	**364**	**97.5**
	Median:	**0.425**	**0.125**	**267**	**78.3**
03PABBG04	PB	ND	0.054	86.9	23.5
03PABCC01	PB	0.223	0.069	305	94.7
03PABCC02	PB	0.485	0.154	258	81.9
03PABCC03	PB	0.265	0.071	285	76.2
03PABCC05	PB	0.226	0.073	205	66.0
03PABCC06	PB	ND	0.056	294	82.9
03PABCC07	PB	0.720	0.190	306	80.8
03PABCC08	PB	0.285	0.089	251	78.7
03PABCC09	PB	0.316	0.107	283	95.5
03PABCC10	PB	0.673	0.198	213	62.6
	Maximum:	**0.720**	**0.198**	**306**	**95.5**
	Median:	**0.300**	**0.081**	**270**	**79.7**
03LVBCAT04	LVB	3.46	0.947	99.5	27.3
03LVBCC01	LVB	0.456	0.184	236	95.1
03LVBCC02	LVB	1.13	0.313	212	58.6
03LVBCC03	LVB	0.597	0.186	231	71.8
	Maximum:	**3.46**	**0.947**	**236**	**95.1**
	Median:	**0.865**	**0.249**	**222**	**65.2**
03BBPAHR05	PNWR	0.627	0.124	93.5	18.5
03BBPAHR06	PNWR	0.749	0.135	111	20.0
03CCPAHR01	PNWR	0.244	0.056	240	55.3
03CCPAHR02	PNWR	0.245	0.065	298	79.2
03CCPAHR03	PNWR	ND	0.050	149	37.5
03GSPAHR04	PNWR	ND	0.046	127	29.4
	Maximum:	**0.749**	**0.135**	**298**	**79.2**
	Median:	**0.436**	**0.061**	**138**	**33.4**
	Grand Maximum:	**3.46**	**0.947**	**364**	**97.5**
	Minimum LOC:	**na**	**na**	**na**	**20**

Table 15. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Whole Fish, 2003

Notes

ND - not detected; na - not analyzed or not available; Res Dry - dry-weight residue; DL Dry - dry-weight detection limit; Res Wet - wet-weight residue; DL Wet - wet-weight detection limit; LOC - level of concern.
Location medians are reported for detectable concentrations, i.e., they exclude non-detects.

Method Reporting Limits are provided for each chemical in the header of the table. Wet-weight based concentrations are calcuated from moisture content of individual samples, so method reporting limits vary for the wet-weight based concentrations. Where all concentrations for a site were below method reporting limts, the maximum is reported as 'na,[maximum method reporting limit]'.

LOC were taken from Table 14.

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Aldrin Res Dry	Aldrin DL Dry	Aldrin Res Wet	Aldrin DL Wet	BHC-Total Res Dry	BHC-Total DL Dry	BHC-Total Res Wet	BHC-Total DL Wet	alpha-BHC Res Dry	alpha-BHC DL Dry	alpha-BHC Res Wet	alpha-BHC DL Wet
KD-5A	LW 10.75	ND	0.00124	ND	0.000310	ND	0.00616	ND	0.00154	ND	0.00179	ND	0.000448
RWB-2	LW 10.75	ND	0.00252	ND	0.000413	0.0181	0.0125	0.00296	0.00205	ND	0.00363	ND	0.000595
RWB-3	LW 10.75	0.00672	0.00297	0.000960	0.000424	0.125	0.0147	0.0179	0.00210	ND	0.00428	ND	0.000612
RWB-4	LW 10.75	ND	0.00245	ND	0.000313	0.0397	0.0121	0.00507	0.00155	ND	0.00353	ND	0.000451
RWB-5	LW 10.75	ND	0.00417	ND	0.000477	0.0254	0.0207	0.00291	0.00236	ND	0.00602	ND	0.000687
Maximum:		**0.00672**		**0.000960**		**0.125**		**0.0179**		**na, 0.00602**		**na, 0.000687**	
Median:		**0.00672**		**0.000960**		**0.0326**		**0.00402**		**ND**		**ND**	
AC-3A	NP	ND	0.000891	ND	0.000231	ND	0.00442	ND	0.00115	ND	0.00128	ND	0.000333
MW-1	NP	ND	0.00247	ND	0.000432	ND	0.0122	ND	0.00214	ND	0.00356	ND	0.000623
AC-14	NP	ND	0.000873	ND	0.000218	ND	0.00433	ND	0.00108	ND	0.00126	ND	0.000315
AC-1A	NP	ND	0.000958	ND	0.000235	ND	0.00475	ND	0.00116	ND	0.00138	ND	0.000338
MW-2	NP	na	na	ND	0.000746	na	na	ND	0.00370	na	na	ND	0.00108
Maximum:		**na, 0.00247**		**na, 0.000746**		**na, 0.0122**		**na, 0.00370**		**na, 0.00356**		**na, 0.00108**	
Median:		**ND**		**ND**		**ND**		**ND**		**ND**		**ND**	
KD-2	DC	ND	0.00129	ND	0.000310	0.00942	0.00639	0.00227	0.00154	ND	0.00186	ND	0.000448
KD-4	DC	ND	0.00110	ND	0.000289	0.00657	0.00546	0.00172	0.00143	ND	0.00159	ND	0.000417
KD-8	DC	ND	0.00139	ND	0.000340	0.00783	0.00690	0.00191	0.00169	ND	0.00201	ND	0.000490
Maximum:		**na, 0.00139**		**na, 0.000340**		**0.00942**		**0.00227**		**na, 0.00201**		**na, 0.000490**	
Median:		**ND**		**ND**		**0.00783**		**0.00191**		**ND**		**ND**	
AC-5A	PB	ND	0.000953	ND	0.000215	0.0965	0.00472	0.0218	0.00107	ND	0.00137	ND	0.000310
KD-6A	PB	ND	0.00168	ND	0.000449	0.0689	0.00835	0.0184	0.00223	ND	0.00243	ND	0.000647
M-2A	PB	ND	0.000735	ND	0.000236	0.195	0.00364	0.0625	0.00117	ND	0.00106	ND	0.000340
MW-4	PB	na	na	ND	0.000477	na	na	0.0167	0.00236	na	na	ND	0.000687
RWB-1	PB	ND	0.00234	ND	0.000340	0.114	0.0116	0.0165	0.00169	ND	0.00338	ND	0.000490
Maximum:		**na, 0.00234**		**na, 0.000477**		**0.195**		**0.0625**		**na, 0.00338**		**na, 0.000687**	
Median:		**ND**		**ND**		**0.105**		**0.0184**		**ND**		**ND**	
KD-3	LVB	ND	0.00143	ND	0.000385	0.200	0.00707	0.0540	0.00191	ND	0.00206	ND	0.000556
M-1	LVB	ND	0.000776	ND	0.000231	0.0283	0.00385	0.00842	0.00115	ND	0.00112	ND	0.000333
M-1B	LVB	ND	0.000716	ND	0.000243	0.0165	0.00355	0.00560	0.00121	ND	0.00103	ND	0.000351
Maximum:		**na, 0.00143**		**na, 0.000385**		**0.200**		**0.0540**		**na, 0.00206**		**na, 0.000556**	
Median:		**ND**		**ND**		**0.0283**		**0.00842**		**ND**		**ND**	
AC-11	PNWR	ND	0.000897	ND	0.000230	ND	0.00445	ND	0.00114	ND	0.00129	ND	0.000332
AC-12	PNWR	ND	0.00105	ND	0.000266	ND	0.00521	ND	0.00132	ND	0.00151	ND	0.000383
AC-7	PNWR	ND	0.00102	ND	0.000232	ND	0.00506	ND	0.00115	ND	0.00147	ND	0.000335
MW-3	PNWR	na	na	ND	0.000482	na	na	ND	0.00239	na	na	ND	0.000695
NH-1	PNWR	ND	0.00125	ND	0.000229	0.00833	0.00621	0.00152	0.00114	ND	0.00180	ND	0.000330
WG-1	PNWR	ND	0.00107	ND	0.000207	0.0306	0.00529	0.00596	0.00103	ND	0.00154	ND	0.000299
YBB-1	PNWR	ND	0.00174	ND	0.000286	ND	0.00865	ND	0.00142	ND	0.00252	ND	0.000412
Maximum:		**na, 0.00174**		**na, 0.000482**		**0.0306**		**0.00596**		**na, 0.00252**		**na, 0.000695**	
Median:		**ND**		**ND**		**0.0195**		**0.00374**		**ND**		**ND**	
Grand Maximum:		**0.00672**		**0.000960**		**0.200**		**0.0625**		**0.00602**		**0.00108**	
Minimum LOC:		**na**		**na**		**na**		**na**		**na**		**na**	

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	beta-BHC Res Dry	beta-BHC DL Dry	beta-BHC Res Wet	beta-BHC DL Wet	delta-BHC Res Dry	delta-BHC DL Dry	delta-BHC Res Wet	delta-BHC DL Wet	gamma-BHC Res Dry	gamma-BHC DL Dry	gamma-BHC Res Wet	gamma-BHC DL Wet
KD-5A	LW 10.75	0.00209	0.00176	0.000522	0.000439	ND	0.00194	ND	0.000485	ND	0.00174	ND	0.000435
RWB-2	LW 10.75	0.0147	0.00356	0.00241	0.000584	ND	0.00394	ND	0.000645	ND	0.00353	ND	0.000579
RWB-3	LW 10.75	0.116	0.00420	0.0166	0.000600	ND	0.00464	ND	0.000663	0.00876	0.00416	0.00125	0.000595
RWB-4	LW 10.75	0.0191	0.00346	0.00244	0.000442	ND	0.00382	ND	0.000488	0.0206	0.00343	0.00264	0.000438
RWB-5	LW 10.75	0.00865	0.00590	0.000988	0.000674	ND	0.00652	ND	0.000745	0.0168	0.00585	0.00192	0.000668
Maximum:		**0.116**		**0.0166**		**na, 0.00652**		**na, 0.000745**		**0.0206**		**0.00264**	
Median:		**0.0147**		**0.00241**		**ND**		**ND**		**0.0168**		**0.00192**	
AC-3A	NP	0.00410	0.00126	0.00106	0.000327	ND	0.00139	ND	0.000361	ND	0.00125	ND	0.000324
MW-1	NP	0.00512	0.00349	0.000896	0.000611	ND	0.00386	ND	0.000675	ND	0.00346	ND	0.000606
AC-14	NP	0.00147	0.00123	0.000368	0.000308	ND	0.00136	ND	0.000341	ND	0.00122	ND	0.000306
AC-1A	NP	0.00140	0.00135	0.000343	0.000332	ND	0.00150	ND	0.000367	ND	0.00134	ND	0.000329
MW-2	NP	na	na	0.00115	0.00105	na	na	ND	0.00116	na	na	ND	0.00104
Maximum:		**0.00512**		**0.00115**		**na, 0.00386**		**na, 0.00116**		**na, 0.00346**		**na, 0.00104**	
Median:		**0.00279**		**0.000632**		**ND**		**ND**		**ND**		**ND**	
KD-2	DC	0.00892	0.00182	0.00215	0.000439	ND	0.00201	ND	0.000485	ND	0.00181	ND	0.000435
KD-4	DC	0.00611	0.00156	0.00160	0.000408	ND	0.00172	ND	0.000452	ND	0.00154	ND	0.000405
KD-8	DC	0.00734	0.00197	0.00179	0.000481	ND	0.00217	ND	0.000531	ND	0.00195	ND	0.000477
Maximum:		**0.00892**		**0.00215**		**na, 0.00217**		**na, 0.000531**		**na, 0.00195**		**na, 0.000477**	
Median:		**0.00734**		**0.00179**		**ND**		**ND**		**ND**		**ND**	
AC-5A	PB	0.0906	0.00135	0.0205	0.000304	0.00564	0.00149	0.00127	0.000336	ND	0.00134	ND	0.000301
KD-6A	PB	0.0627	0.00238	0.0167	0.000635	ND	0.00263	ND	0.000702	0.00466	0.00236	0.00124	0.000629
M-2A	PB	0.192	0.00104	0.0618	0.000333	0.00121	0.00115	0.000387	0.000369	0.00111	0.00103	0.000356	0.000331
MW-4	PB	na	na	0.0164	0.000674	na	na	ND	0.000745	na	na	ND	0.000668
RWB-1	PB	0.108	0.00331	0.0157	0.000481	ND	0.00366	ND	0.000531	0.00439	0.00328	0.000637	0.000477
Maximum:		**0.192**		**0.0618**		**0.00564**		**0.00127**		**0.00466**		**0.00124**	
Median:		**0.0993**		**0.0167**		**0.00343**		**0.000829**		**0.00439**		**0.000637**	
KD-3	LVB	0.185	0.00202	0.0501	0.000545	0.00394	0.00223	0.00106	0.000602	0.0107	0.00200	0.00290	0.000540
M-1	LVB	0.0276	0.00110	0.00823	0.000327	ND	0.00121	ND	0.000361	ND	0.00109	ND	0.000324
M-1B	LVB	0.0160	0.00101	0.00544	0.000344	ND	0.00112	ND	0.000380	ND	0.00100	ND	0.000341
Maximum:		**0.185**		**0.0501**		**0.00394**		**0.00106**		**0.0107**		**0.00290**	
Median:		**0.0276**		**0.00823**		**0.00394**		**0.00106**		**0.0107**		**0.00290**	
AC-11	PNWR	ND	0.00127	ND	0.000325	ND	0.00140	ND	0.000360	ND	0.00126	ND	0.000322
AC-12	PNWR	ND	0.00148	ND	0.000376	ND	0.00164	ND	0.000415	ND	0.00147	ND	0.000372
AC-7	PNWR	ND	0.00144	ND	0.000328	ND	0.00159	ND	0.000363	ND	0.00143	ND	0.000326
MW-3	PNWR	na	na	ND	0.000681	na	na	0.000753	0.000753	na	na	ND	0.000675
NH-1	PNWR	0.00775	0.00177	0.00142	0.000324	ND	0.00196	ND	0.000358	ND	0.00175	ND	0.000321
WG-1	PNWR	0.0301	0.00151	0.00586	0.000293	ND	0.00167	ND	0.000324	ND	0.00150	ND	0.000291
YBB-1	PNWR	ND	0.00246	ND	0.000403	ND	0.00273	ND	0.000446	0.00301	0.00244	0.000492	0.000400
Maximum:		**0.0301**		**0.00586**		**na. 0.00273**		**0.000753**		**0.00301**		**0.000492**	
Median:		**0.0189**		**0.00364**		**ND**		**0.000753**		**0.00301**		**0.000492**	
Grand Maximum:		**0.192**		**0.0618**		**0.00652**		**0.00127**		**0.0206**		**0.00290**	
Minimum LOC:		**na**		**na**		**na**		**na**		**na**		**na**	

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	alpha-Chlordane Res Dry	alpha-Chlordane DL Dry	alpha-Chlordane Res Wet	alpha-Chlordane DL Wet	gamma-Chlordane Res Dry	gamma-Chlordane DL Dry	gamma-Chlordane Res Wet	gamma-Chlordane DL Wet	Oxychlordane Res Dry	Oxychlordane DL Dry	Oxychlordane Res Wet	Oxychlordane DL Wet
KD-5A	LW 10.75	0.0134	0.00150	0.00335	0.000375	ND	0.00156	ND	0.000391	0.0528	0.00213	0.0132	0.000533
RWB-2	LW 10.75	ND	0.00304	ND	0.000499	ND	0.00317	ND	0.000520	0.0470	0.00432	0.00770	0.000709
RWB-3	LW 10.75	ND	0.00359	ND	0.000513	ND	0.00374	ND	0.000534	0.0562	0.00510	0.00803	0.000729
RWB-4	LW 10.75	ND	0.00296	ND	0.000378	ND	0.00308	ND	0.000393	0.0784	0.00420	0.0100	0.000537
RWB-5	LW 10.75	ND	0.00504	ND	0.000576	ND	0.00525	ND	0.000600	0.0586	0.00716	0.00670	0.000819
Maximum:		**0.0134**		**0.00335**		**na, 0.00525**		**na, 0.000600**		**0.0784**		**0.0132**	
Median:		**0.0134**		**0.00335**		**ND**		**ND**		**0.0562**		**0.00803**	
AC-3A	NP	ND	0.00108	ND	0.000280	ND	0.00112	ND	0.000291	0.0223	0.00153	0.00579	0.000397
MW-1	NP	ND	0.00298	ND	0.000522	0.00700	0.00311	0.00122	0.000544	0.102	0.00424	0.0178	0.000742
AC-14	NP	ND	0.00106	ND	0.000264	0.0496	0.00110	0.0124	0.000275	0.0268	0.00150	0.00670	0.000375
AC-1A	NP	ND	0.00116	ND	0.000284	ND	0.00121	ND	0.000296	0.0535	0.00164	0.0131	0.000403
MW-2	NP	na	na	0.00507	0.000902	na	na	ND	0.000939	na	na	0.00683	0.00128
Maximum:		**na, 0.00298**		**0.00507**		**0.0496**		**0.0124**		**0.102**		**0.0178**	
Median:		**ND**		**0.00507**		**0.0283**		**0.00681**		**0.0402**		**0.00683**	
KD-2	DC	ND	0.00156	ND	0.000375	ND	0.00162	ND	0.000391	0.0209	0.00221	0.00502	0.000533
KD-4	DC	0.00317	0.00133	0.000832	0.000349	ND	0.00139	ND	0.000364	0.0129	0.00189	0.00338	0.000496
KD-8	DC	ND	0.00168	ND	0.000411	ND	0.00175	ND	0.000428	0.0247	0.00239	0.00603	0.000584
Maximum:		**0.00317**		**0.000832**		**na, 0.00175**		**na, 0.000428**		**0.0247**		**0.00603**	
Median:		**0.00317**		**0.000832**		**ND**		**ND**		**0.0209**		**0.00502**	
AC-5A	PB	ND	0.00115	ND	0.000260	ND	0.00120	ND	0.000271	0.0253	0.00164	0.00572	0.000369
KD-6A	PB	ND	0.00204	ND	0.000543	ND	0.00212	ND	0.000565	0.00730	0.00289	0.00195	0.000771
M-2A	PB	ND	0.000888	ND	0.000285	ND	0.000925	ND	0.000297	0.0504	0.00126	0.0162	0.000405
MW-4	PB	na	na	ND	0.000576	na	na	ND	0.000600	na	na	0.00258	0.000819
RWB-1	PB	ND	0.00283	ND	0.000411	ND	0.00295	ND	0.000428	ND	0.00402	ND	0.000584
Maximum:		**na, 0.00283**		**na, 0.000576**		**na, 0.00295**		**na, 0.000600**		**0.0504**		**0.0162**	
Median:		**ND**		**ND**		**ND**		**ND**		**0.0253**		**0.00415**	
KD-3	LVB	ND	0.00172	ND	0.000466	ND	0.00180	ND	0.000485	0.0113	0.00245	0.00306	0.000662
M-1	LVB	0.00133	0.000938	0.000396	0.000280	ND	0.000976	ND	0.000291	0.00904	0.00133	0.00269	0.000397
M-1B	LVB	0.00238	0.000865	0.000810	0.000294	ND	0.000901	ND	0.000306	0.00656	0.00123	0.00223	0.000418
Maximum:		**0.00238**		**0.000810**		**na, 0.00180**		**na, 0.000485**		**0.0113**		**0.00306**	
Median:		**0.00186**		**0.000603**		**ND**		**ND**		**0.00904**		**0.00269**	
AC-11	PNWR	ND	0.00108	ND	0.000278	ND	0.00113	ND	0.000290	ND	0.00154	ND	0.000395
AC-12	PNWR	ND	0.00127	ND	0.000321	ND	0.00132	ND	0.000335	0.00580	0.00180	0.00147	0.000456
AC-7	PNWR	ND	0.00123	ND	0.000281	ND	0.00128	ND	0.000293	ND	0.00175	ND	0.000399
MW-3	PNWR	na	na	ND	0.000582	na	na	ND	0.000606	na	na	ND	0.000827
NH-1	PNWR	ND	0.00151	ND	0.000277	ND	0.00158	ND	0.000288	0.0223	0.00215	0.00407	0.000393
WG-1	PNWR	ND	0.00129	ND	0.000251	ND	0.00134	ND	0.000261	0.0241	0.00183	0.00468	0.000356
YBB-1	PNWR	ND	0.00211	ND	0.000345	ND	0.00220	ND	0.000359	ND	0.00300	ND	0.000490
Maximum:		**na, 0.00211**		**na, 0.000582**		**na, 0.00220**		**na, 0.000606**		**0.0241**		**0.00468**	
Median:		**ND**		**ND**		**ND**		**ND**		**0.0223**		**0.00407**	
Grand Maximum:		**0.0134**		**0.00507**		**0.0496**		**0.0124**		**0.102**		**0.0178**	
Minimum LOC:		**na**		**na**		**na**		**na**		**na**		**na**	

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	cis-Nonachlor Res Dry	cis-Nonachlor DL Dry	cis-Nonachlor Res Wet	cis-Nonachlor DL Wet	trans-Nonachlor Res Dry	trans-Nonachlor DL Dry	trans-Nonachlor Res Wet	trans-Nonachlor DL Wet	Heptachlor Res Dry	Heptachlor DL Dry	Heptachlor Res Wet	Heptachlor DL Wet
KD-5A	LW 10.75	0.0672	0.00153	0.0168	0.000383	0.532	0.00163	0.133	0.000407	ND	0.00220	ND	0.000550
RWB-2	LW 10.75	0.00671	0.00311	0.00110	0.000510	0.0383	0.00330	0.00627	0.000542	ND	0.00446	ND	0.000731
RWB-3	LW 10.75	0.00513	0.00367	0.000733	0.000524	0.0362	0.00390	0.00518	0.000556	ND	0.00526	ND	0.000752
RWB-4	LW 10.75	0.0116	0.00302	0.00148	0.000386	0.0571	0.00321	0.00729	0.000410	ND	0.00434	ND	0.000554
RWB-5	LW 10.75	0.00734	0.00515	0.000839	0.000589	0.0364	0.00547	0.00416	0.000625	ND	0.00739	ND	0.000845
Maximum:		**0.0672**		**0.0168**		**0.532**		**0.133**		**na, 0.00739**		**na, 0.000845**	
Median:		**0.00734**		**0.00110**		**0.0383**		**0.00627**		**ND**		**ND**	
AC-3A	NP	ND	0.00110	ND	0.000286	ND	0.00117	ND	0.000303	ND	0.00158	ND	0.000410
MW-1	NP	0.00879	0.00305	0.00154	0.000534	0.00836	0.00324	0.00146	0.000567	ND	0.00438	ND	0.000766
AC-14	NP	0.00531	0.00108	0.00133	0.000269	0.0094	0.00114	0.00235	0.000286	ND	0.00155	ND	0.000386
AC-1A	NP	0.00149	0.00118	0.000365	0.000290	0.0014	0.00126	0.000343	0.000308	ND	0.00170	ND	0.000416
MW-2	NP	na	na	ND	0.000921	na	na	ND	0.000978	na	na	ND	0.00132
Maximum:		**0.00879**		**0.00154**		**0.00940**		**0.00235**		**na, 0.00438**		**na, 0.00132**	
Median:		**0.00531**		**0.00133**		**0.00836**		**0.00146**		**ND**		**ND**	
KD-2	DC	ND	0.00159	ND	0.000383	0.0260	0.00169	0.00626	0.000407	ND	0.00228	ND	0.000550
KD-4	DC	ND	0.00136	ND	0.000357	0.0157	0.00144	0.00411	0.000379	ND	0.00195	ND	0.000512
KD-8	DC	ND	0.00172	ND	0.000420	0.0152	0.00182	0.00372	0.000446	ND	0.00246	ND	0.000602
Maximum:		**na, 0.00172**		**na, 0.000420**		**0.0260**		**0.00626**		**na, 0.00246**		**na, 0.000602**	
Median:		**ND**		**ND**		**0.0157**		**0.00411**		**ND**		**ND**	
AC-5A	PB	ND	0.00118	ND	0.000266	ND	0.00125	ND	0.000282	ND	0.00169	ND	0.000381
KD-6A	PB	0.00604	0.00208	0.00161	0.000555	0.0207	0.00221	0.00553	0.000589	ND	0.00298	ND	0.000795
M-2A	PB	0.0112	0.000908	0.00359	0.000291	0.0292	0.000964	0.00938	0.000309	ND	0.00130	ND	0.000418
MW-4	PB	na	na	ND	ND	na	na	ND	0.000625	na	na	ND	0.000845
RWB-1	PB	0.00663	0.00289	0.000962	0.000420	0.0116	0.00307	0.00168	0.000446	ND	0.00415	ND	0.000602
Maximum:		**0.0112**		**0.00359**		**0.0292**		**0.00938**		**na, 0.00415**		**na, 0.000845**	
Median:		**0.00663**		**0.00161**		**0.0207**		**0.00553**		**ND**		**ND**	
KD-3	LVB	0.0293	0.00176	0.00792	0.000476	0.0130	0.00187	0.00351	0.000505	ND	0.00253	ND	0.000683
M-1	LVB	0.00588	0.000958	0.00175	0.000286	0.0165	0.00102	0.00493	0.000303	ND	0.00137	ND	0.000410
M-1B	LVB	0.00813	0.000884	0.00276	0.000301	0.0179	0.000939	0.00610	0.000319	ND	0.00127	ND	0.000431
Maximum:		**0.0293**		**0.00792**		**0.0179**		**0.00610**		**na, 0.00253**		**na, 0.000683**	
Median:		**0.00813**		**0.00276**		**0.0165**		**0.00493**		**ND**		**ND**	
AC-11	PNWR	ND	0.00111	ND	0.000284	ND	0.00118	ND	0.000302	ND	0.00159	ND	0.000408
AC-12	PNWR	ND	0.00130	ND	0.000328	ND	0.00138	ND	0.000349	ND	0.00186	ND	0.000471
AC-7	PNWR	ND	0.00126	ND	0.000287	ND	0.00134	ND	0.000305	ND	0.00181	ND	0.000412
MW-3	PNWR	na	na	ND	0.000595	na	na	ND	0.000632	na	na	ND	0.000853
NH-1	PNWR	0.00955	0.00155	0.00175	0.000283	0.0118	0.00164	0.00215	0.000300	ND	0.00222	ND	0.000406
WG-1	PNWR	0.115	0.00132	0.0224	0.000256	0.149	0.00140	0.0290	0.000272	ND	0.00189	ND	0.000367
YBB-1	PNWR	ND	0.00216	ND	0.000353	ND	0.00229	ND	0.000374	ND	0.00309	ND	0.000506
Maximum:		**0.115**		**0.0224**		**0.149**		**0.0290**		**na, 0.00309**		**na, 0.000853**	
Median:		**0.0623**		**0.0121**		**0.0804**		**0.0156**		**ND**		**ND**	
Grand Maximum:		**0.115**		**0.0224**		**0.532**		**0.133**		**0.00739**		**0.00132**	
Minimum LOC:		**na**		**na**		**na**		**na**		**na**		**na**	

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Heptachlor epoxide Res Dry	Heptachlor epoxide DL Dry	Heptachlor epoxide Res Wet	Heptachlor epoxide DL Wet	Dieldrin Res Dry	Dieldrin DL Dry	Dieldrin Res Wet	Dieldrin DL Wet	Endrin Res Dry	Endrin DL Dry	Endrin Res Wet	Endrin DL Wet
KD-5A	LW 10.75	0.0794	0.00186	0.0199	0.000464	0.201	0.00178	0.0503	0.000445	ND	0.00213	ND	0.000532
RWB-2	LW 10.75	0.0942	0.00377	0.0154	0.000618	0.0425	0.00361	0.00697	0.000591	ND	0.00431	ND	0.000707
RWB-3	LW 10.75	1.93	0.00444	0.276	0.000635	0.120	0.00425	0.0171	0.000608	ND	0.00509	ND	0.000727
RWB-4	LW 10.75	0.161	0.00366	0.0206	0.000468	0.141	0.00351	0.0180	0.000448	ND	0.00419	ND	0.000535
RWB-5	LW 10.75	0.0788	0.00624	0.00901	0.000713	0.0668	0.00598	0.00763	0.000683	ND	0.00714	ND	0.000817
Maximum:		**1.93**		**0.276**		**0.201**		**0.0503**		**na, 0.00714**		**na, 0.000817**	
Median:		**0.0942**		**0.0199**		**0.120**		**0.0171**		**ND**		**ND**	
AC-3A	NP	0.0358	0.00133	0.00929	0.000346	0.0174	0.00128	0.00452	0.000331	ND	0.00153	ND	0.000396
MW-1	NP	0.0574	0.00370	0.0100	0.000647	0.0111	0.00354	0.00194	0.000619	ND	0.00423	ND	0.000740
AC-14	NP	0.0114	0.00131	0.00286	0.000326	0.0350	0.00125	0.00875	0.000312	ND	0.00150	ND	0.000374
AC-1A	NP	0.0206	0.00143	0.00506	0.000351	0.0280	0.00137	0.00685	0.000336	ND	0.00164	ND	0.000402
MW-2	NP	na	na	0.00528	0.00112	na	na	0.00118	0.00107	na	na	ND	0.00128
Maximum:		**0.0574**		**0.0100**		**0.0350**		**0.00875**		**na, 0.00423**		**na, 0.00128**	
Median:		**0.0282**		**0.00528**		**0.0227**		**0.00452**		**ND**		**ND**	
KD-2	DC	0.0191	0.00193	0.00460	0.000464	0.0138	0.00185	0.00332	0.000445	ND	0.00221	ND	0.000532
KD-4	DC	0.0143	0.00165	0.00376	0.000432	ND	0.00158	ND	0.000414	ND	0.00189	ND	0.000495
KD-8	DC	0.00766	0.00208	0.00187	0.000509	0.00587	0.00199	0.00144	0.000487	ND	0.00238	ND	0.000582
Maximum:		**0.0191**		**0.00460**		**0.0138**		**0.00332**		**na, 0.00238**		**na, 0.000582**	
Median:		**0.0143**		**0.00376**		**0.00984**		**0.00238**		**ND**		**ND**	
AC-5A	PB	0.182	0.00142	0.0412	0.000322	0.00979	0.00136	0.00221	0.000308	ND	0.00163	ND	0.000368
KD-6A	PB	0.0134	0.00252	0.00357	0.000672	0.0122	0.00241	0.00325	0.000643	ND	0.00288	ND	0.000769
M-2A	PB	0.163	0.00110	0.0524	0.000353	0.0254	0.00105	0.00815	0.000338	ND	0.00126	ND	0.000404
MW-4	PB	na	na	0.0297	0.000713	na	na	ND	0.000683	na	na	ND	0.000817
RWB-1	PB	0.581	0.00350	0.0843	0.000509	0.0129	0.00336	0.00188	0.000487	ND	0.00401	ND	0.000582
Maximum:		**0.581**		**0.0843**		**0.0254**		**0.00815**		**na, 0.00401**		**na, 0.000817**	
Median:		**0.173**		**0.0468**		**0.0126**		**0.00273**		**ND**		**ND**	
KD-3	LVB	0.0225	0.00213	0.00608	0.000577	0.0396	0.00204	0.0107	0.000552	ND	0.00244	ND	0.000660
M-1	LVB	0.0170	0.00116	0.00508	0.000346	0.0133	0.00111	0.00396	0.000331	ND	0.00133	ND	0.000396
M-1B	LVB	0.0626	0.00107	0.0213	0.000364	0.00454	0.00102	0.00154	0.000349	ND	0.00123	ND	0.000417
Maximum:		**0.0626**		**0.0213**		**0.0396**		**0.0107**		**na, 0.00244**		**na, 0.000660**	
Median:		**0.0225**		**0.00608**		**0.0133**		**0.00396**		**ND**		**ND**	
AC-11	PNWR	ND	0.00134	ND	0.000344	ND	0.00128	ND	0.000330	ND	0.00154	ND	0.000394
AC-12	PNWR	ND	0.00157	ND	0.000398	ND	0.00150	ND	0.000381	ND	0.00180	ND	0.000455
AC-7	PNWR	ND	0.00153	ND	0.000348	ND	0.00146	ND	0.000333	ND	0.00175	ND	0.000398
MW-3	PNWR	na	na	ND	0.000721	na	na	ND	0.000690	na	na	ND	0.000825
NH-1	PNWR	0.00390	0.00187	0.000714	0.000343	0.00256	0.00179	0.000469	0.000328	ND	0.00214	ND	0.000392
WG-1	PNWR	0.00917	0.00160	0.00178	0.000310	0.00226	0.00153	0.000440	0.000297	ND	0.00183	ND	0.000355
YBB-1	PNWR	ND	0.00261	ND	0.000427	0.00337	0.00250	0.000552	0.000409	ND	0.00299	ND	0.000489
Maximum:		**0.00917**		**0.00178**		**0.00337**		**0.000552**		**na, 0.00299**		**nd, 0.000825**	
Median:		**0.00654**		**0.00125**		**0.00256**		**0.000469**		**ND**		**ND**	
Grand Maximum:		**1.93**		**0.276**		**0.201**		**0.0503**		**0.00714**		**0.00128**	
Minimum LOC:		**1 - 2**		**0.04**		**na**		**0.15**		**na**		**0.27**	

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	HCB Res Dry	HCB DL Dry	HCB Res Wet	HCB DL Wet	Mirex Res Dry	Mirex DL Dry	Mirex Res Wet	Mirex DL Wet	DDTs-Total Res Dry	DDTs-Total Res Wet
KD-5A	LW 10.75	0.0225	0.00247	0.00563	0.000618	ND	0.00176	ND	0.00044	1.96742	0.491
RWB-2	LW 10.75	0.0626	0.00501	0.0103	0.000822	ND	0.00357	ND	0.000586	3.06805	0.502
RWB-3	LW 10.75	1.18	0.00591	0.168	0.000844	ND	0.00421	ND	0.000602	8.3247	1.194
RWB-4	LW 10.75	0.137	0.00487	0.0174	0.000622	ND	0.00347	ND	0.000443	1.03102	0.132
RWB-5	LW 10.75	0.0983	0.00830	0.0112	0.000949	ND	0.00592	ND	0.000677	1.88747	0.215
Maximum:		**1.18**		**0.168**		**na, 0.00592**		**na, 0.000677**		**8.32**	**1.19**
Median:		**0.0983**		**0.0112**		**ND**		**ND**		**1.97**	**0.491**
AC-3A	NP	0.0389	0.00177	0.0101	0.000460	ND	0.00126	ND	0.000328	0.52139	0.135
MW-1	NP	0.0800	0.00491	0.0140	0.000860	0.00887	0.0035	0.00155	0.000613	0.6536	0.115
AC-14	NP	0.00858	0.00174	0.00214	0.000434	ND	0.00124	ND	0.00031	0.05727	0.0143
AC-1A	NP	0.0138	0.00191	0.00338	0.000467	ND	0.00136	ND	0.000333	0.09585	0.0235
MW-2	NP	na	na	0.00347	0.00148	na	na	0.00116	0.00106	na	0.0449
Maximum:		**0.0800**		**0.0140**		**0.00887**		**0.00155**		**0.654**	**0.135**
Median:		**0.0264**		**0.00347**		**0.00887**		**0.00136**		**0.309**	**0.0449**
KD-2	DC	0.0254	0.00256	0.00612	0.000618	ND	0.00183	ND	0.00044	13.01396	3.13
KD-4	DC	0.0127	0.00219	0.00334	0.000575	0.00555	0.00156	0.00146	0.00041	6.6651	1.75
KD-8	DC	0.00990	0.00277	0.00242	0.000677	ND	0.00197	ND	0.000483	0.78373	0.192
Maximum:		**0.0254**		**0.00612**		**0.00555**		**0.00146**		**13.0**	**3.13**
Median:		**0.0127**		**0.00334**		**0.00555**		**0.00146**		**6.67**	**1.75**
AC-5A	PB	0.383	0.00190	0.0864	0.000428	ND	0.00135	ND	0.000305	1.07	0.241
KD-6A	PB	0.0288	0.00335	0.00768	0.000893	ND	0.00239	ND	0.000637	0.814	0.217
M-2A	PB	0.261	0.00146	0.0839	0.000469	ND	0.00104	ND	0.000335	2.37	0.759
MW-4	PB	na	na	0.00259	0.000949	na	na	ND	0.000677	NA	0.171
RWB-1	PB	0.270	0.00466	0.0391	0.000677	0.00359	0.00332	0.000521	0.000483	2.47	0.359
Maximum:		**0.383**		**0.0864**		**0.00359**		**0.000521**		**2.47**	**0.759**
Median:		**0.266**		**0.0391**		**0.00359**		**0.000521**		**1.72**	**0.241**
KD-3	LVB	0.00771	0.00284	0.00208	0.000767	ND	0.00202	ND	0.000547	2.25	0.608
M-1	LVB	0.0198	0.00154	0.00589	0.000460	ND	0.0011	ND	0.000328	0.721	0.214
M-1B	LVB	0.0202	0.00142	0.00688	0.000484	ND	0.00102	ND	0.000345	1.05	0.358
Maximum:		**0.0202**		**0.00688**		**na, 0.00202**		**na, 0.000547**		**2.25**	**0.608**
Median:		**0.0198**		**0.00589**		**ND**		**ND**		**1.05**	**0.358**
AC-11	PNWR	ND	0.00178	ND	0.000458	ND	0.00127	ND	0.000326	0.0224	0.00575
AC-12	PNWR	0.00345	0.00209	0.000873	0.000529	ND	0.00149	ND	0.000377	0.656	0.166
AC-7	PNWR	ND	0.00203	ND	0.000462	ND	0.00145	ND	0.00033	0.00940	0.00214
MW-3	PNWR	na		0.00116	0.000959	na	na	ND	0.000684	na	0.130
NH-1	PNWR	0.0122	0.00249	0.00223	0.000456	0.0046	0.00178	0.000842	0.000325	10.2	1.88
WG-1	PNWR	0.0290	0.00212	0.00564	0.000413	0.00807	0.00151	0.00157	0.000294	17.0	3.32
YBB-1	PNWR	ND	0.00347	ND	0.000568	ND	0.00248	ND	0.000405	1.42	0.232
Maximum:		**0.0290**		**0.00564**		**0.00807**		**0.00157**		**17.0**	**3.32**
Median:		**0.0122**		**0.00170**		**0.00634**		**0.00121**		**1.04**	**0.166**
Grand Maximum:		**1.18**		**0.168**		**0.00887**		**0.00157**		**17.0**	**3.32**
Minimum LOC:		**na**		**6.2**		**na**		**20**		**na**	**0.2**

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	o,p'-DDD Res Dry	o,p'-DDD DL Dry	o,p'-DDD Res Wet	o,p'-DDD DL Wet	o,p'-DDE Res Dry	o,p'-DDE DL Dry	o,p'-DDE Res Wet	o,p'-DDE DL Wet	o,p'-DDT Res Dry	o,p'-DDT DL Dry	o,p'-DDT Res Wet	o,p'-DDT DL Wet
KD-5A	LW 10.75	ND	0.00227	ND	0.000567	ND	0.00141	ND	0.000352	ND	0.00122	ND	0.000305
RWB-2	LW 10.75	ND	0.0046	ND	0.000755	ND	0.00286	ND	0.000468	0.00417	0.00247	0.000683	0.000405
RWB-3	LW 10.75	0.0128	0.00543	0.00182	0.000775	ND	0.00337	ND	0.000481	ND	0.00291	ND	0.000416
RWB-4	LW 10.75	0.00704	0.00447	0.000898	0.000571	ND	0.00277	ND	0.000354	0.00247	0.0024	0.000315	0.000307
RWB-5	LW 10.75	ND	0.00762	ND	0.000871	0.00533	0.00473	0.000609	0.00054	0.00744	0.00409	0.000851	0.000468
Maximum:		**0.0128**		**0.00182**		**0.00533**		**0.000609**		**0.00744**		**0.000851**	
Median:		**0.00992**		**0.001359**		**0.00533**		**0.000609**		**0.00417**		**0.000683**	
AC-3A	NP	ND	0.00163	ND	0.000423	ND	0.00101	ND	0.000262	0.00215	0.000874	0.000559	0.000227
MW-1	NP	ND	0.00451	ND	0.00079	ND	0.0028	ND	0.00049	0.0127	0.00242	0.00222	0.000424
AC-14	NP	ND	0.0016	ND	0.000399	ND	0.000989	ND	0.000247	0.00168	0.000856	0.000419	0.000214
AC-1A	NP	ND	0.00175	ND	0.000429	ND	0.00109	ND	0.000266	0.00158	0.00094	0.000387	0.00023
MW-2	NP	na	na	ND	0.00136	na	na	ND	0.000845	na	na	0.005	0.000732
Maximum:		**na, 0.00451**		**na, 0.00136**		**na, 0.00280**		**na, 0.000845**		**0.0127**		**0.00500**	
Median:		**ND**		**ND**		**ND**		**ND**		**0.00192**		**0.000559**	
KD-2	DC	ND	0.00236	ND	0.000567	0.00738	0.00146	0.00178	0.000352	0.005	0.00126	0.0012	0.000305
KD-4	DC	ND	0.00201	ND	0.000528	0.00208	0.00125	0.000545	0.000328	0.00302	0.00108	0.000793	0.000284
KD-8	DC	ND	0.00254	ND	0.000621	ND	0.00158	ND	0.000385	0.00587	0.00136	0.00144	0.000334
Maximum:		**na, 0.00254**		**na, 0.000621**		**0.00738**		**0.00178**		**0.00587**		**0.00144**	
Median:		**ND**		**ND**		**0.00473**		**0.00116**		**0.00500**		**0.00120**	
AC-5A	PB	ND	0.00174	ND	0.000393	ND	0.00108	ND	0.000244	0.00167	0.000935	0.000377	0.000211
KD-6A	PB	ND	0.00308	ND	0.00082	ND	0.00191	ND	0.000509	ND	0.00165	ND	0.000441
M-2A	PB	ND	0.00134	ND	0.000431	ND	0.000833	ND	0.000267	0.0108	0.000721	0.00345	0.000232
MW-4	PB	na	na	ND	0.000871	na	na	ND	0.000540	na	na	0.000791	0.000468
RWB-1	PB	0.00694	0.00428	0.00101	0.000621	ND	0.00266	ND	0.000385	0.0291	0.0023	0.00422	0.000334
Maximum:		**0.00694**		**0.00101**		**na, 0.00266**		**na, 0.000540**		**0.0291**		**0.00422**	
Median:		**0.00694**		**0.00101**		**ND**		**ND**		**0.0108**		**0.00212**	
KD-3	LVB	0.00854	0.00261	0.00231	0.000704	0.0221	0.00162	0.00596	0.000437	0.00916	0.0014	0.00248	0.000378
M-1	LVB	ND	0.00142	ND	0.000423	0.00115	0.000879	0.000342	0.000262	0.00466	0.000761	0.00139	0.000227
M-1B	LVB	ND	0.00131	ND	0.000445	0.000979	0.000811	0.000333	0.000276	ND	0.000702	ND	0.000239
Maximum:		**0.00854**		**0.00231**		**0.0221**		**0.00596**		**0.00916**		**0.00248**	
Median:		**0.00854**		**0.00231**		**0.00115**		**0.000342**		**0.00691**		**0.00194**	
AC-11	PNWR	ND	0.00164	ND	0.00042	ND	0.00102	ND	0.000261	ND	0.00088	ND	0.000226
AC-12	PNWR	ND	0.00192	ND	0.000486	ND	0.00119	ND	0.000301	ND	0.00103	ND	0.000261
AC-7	PNWR	ND	0.00186	ND	0.000425	ND	0.00116	ND	0.000263	ND	0.001	ND	0.000228
MW-3	PNWR	na	na	ND	0.00088	na	na	ND	0.000546	na	na	ND	0.000473
NH-1	PNWR	ND	0.00229	ND	0.000418	ND	0.00142	ND	0.000259	0.00169	0.00123	0.000309	0.000225
WG-1	PNWR	0.0528	0.00195	0.0103	0.000379	0.0156	0.00121	0.00304	0.000235	0.0407	0.00105	0.00792	0.000203
YBB-1	PNWR	ND	0.00319	ND	0.000522	ND	0.00198	ND	0.000324	0.00352	0.00171	0.000576	0.00028
Maximum:		**0.0528**		**0.0103**		**0.0156**		**0.00304**		**0.0407**		**0.00792**	
Median:		**0.0528**		**0.0103**		**0.0156**		**0.00304**		**0.00352**		**0.000576**	
Grand Maximum:		**0.0528**		**0.0103**		**0.0221**		**0.00596**		**0.0407**		**0.00792**	
Minimum LOC:		**na**		**na**		**15.7**		**0.25**		**na**		**0.2**	

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	p,p'-DDD Res Dry	p,p'-DDD DL Dry	p,p'-DDD Res Wet	p,p'-DDD DL Wet	p,p'-DDE Res Dry	p,p'-DDE DL Dry	p,p'-DDE Res Wet	p,p'-DDE DL Wet	p,p'-DDT Res Dry	p,p'-DDT DL Dry	p,p'-DDT Res Wet	p,p'-DDT DL Wet
KD-5A	LW 10.75	0.00472	0.00134	0.00118	0.000335	1.93	0.00156	0.482	0.000391	0.0327	0.00174	0.00818	0.000434
RWB-2	LW 10.75	0.00388	0.00272	0.000637	0.000446	3.06	0.00317	0.501	0.00052	ND	0.00352	ND	0.000578
RWB-3	LW 10.75	0.0819	0.00321	0.0117	0.000459	8.23	0.00374	1.18	0.000534	ND	0.00416	ND	0.000594
RWB-4	LW 10.75	0.00767	0.00265	0.00098	0.000338	1.01	0.00308	0.129	0.000394	0.00384	0.00342	0.00049	0.000437
RWB-5	LW 10.75	0.0247	0.00451	0.00283	0.000515	1.85	0.00525	0.211	0.0006	ND	0.00584	ND	0.000667
Maximum:		**0.0819**		**0.0117**		**8.23**		**1.18**		**0.0327**		**0.00818**	
Median:		**0.00767**		**0.00118**		**1.93**		**0.482**		**0.0183**		**0.00434**	
AC-3A	NP	0.00364	0.000963	0.000945	0.00025	0.512	0.00112	0.133	0.000291	0.00360	0.00125	0.000935	0.000324
MW-1	NP	0.0319	0.00267	0.00558	0.000467	0.609	0.00311	0.107	0.000544	ND	0.00346	ND	0.000605
AC-14	NP	0.00139	0.000943	0.000347	0.000236	0.0542	0.0011	0.0135	0.000275	ND	0.00122	ND	0.000305
AC-1A	NP	0.00167	0.00104	0.00041	0.000254	0.0926	0.00121	0.0227	0.000296	ND	0.00134	ND	0.000328
MW-2	NP	na	na	0.00141	0.000806	na	na	0.0385	0.000939	na	na	ND	0.00104
Maximum:		**0.0319**		**0.00558**		**0.609**		**0.133**		**0.00360**		**0.000935**	
Median:		**0.00266**		**0.000945**		**0.302**		**0.0385**		**0.00360**		**0.000935**	
KD-2	DC	0.00158	0.00139	0.000382	0.000335	13.0	0.00162	3.13	0.000391	ND	0.00180	ND	0.000434
KD-4	DC	ND	0.00119	ND	0.000312	6.66	0.00139	1.75	0.000364	ND	0.00154	ND	0.000404
KD-8	DC	ND	0.0015	ND	0.000368	0.768	0.00175	0.188	0.000428	0.00986	0.00195	0.00241	0.000476
Maximum:		**0.00158**		**0.000382**		**13.0**		**3.13**		**0.00986**		**0.00241**	
Median:		**0.00158**		**0.000382**		**6.66**		**1.75**		**0.00986**		**0.00241**	
AC-5A	PB	0.0116	0.00103	0.00262	0.000233	1.04	0.00120	0.235	0.000271	0.0120	0.00133	0.00271	0.000301
KD-6A	PB	0.0044	0.00182	0.00117	0.000485	0.807	0.00212	0.215	0.000565	0.00268	0.00236	0.000714	0.000628
M-2A	PB	0.0131	0.000794	0.00420	0.000255	2.29	0.000925	0.735	0.000297	0.0520	0.00103	0.0167	0.000330
MW-4	PB	na	na	0.00134	0.000515	na	na	0.169	0.000600	na	na	ND	0.000667
RWB-1	PB	0.0249	0.00253	0.00362	0.000368	2.41	0.00295	0.350	0.000428	ND	0.00328	ND	0.000476
Maximum:		**0.0249**		**0.00420**		**2.41**		**0.735**		**0.0520**		**0.0167**	
Median:		**0.0124**		**0.00262**		**1.67**		**0.235**		**0.0120**		**0.00271**	
KD-3	LVB	0.0269	0.00154	0.00728	0.000417	2.18	0.0018	0.590	0.000485	ND	0.002	ND	0.000539
M-1	LVB	0.0131	0.000839	0.00389	0.00025	0.699	0.000977	0.208	0.000291	0.00280	0.00108	0.000834	0.000324
M-1B	LVB	0.0112	0.000774	0.00382	0.000263	1.03	0.000902	0.352	0.000307	0.00486	0.001	0.00165	0.000341
Maximum:		**0.0269**		**0.00728**		**2.18**		**0.590**		**0.00486**		**0.00165**	
Median:		**0.0131**		**0.00389**		**1.03**		**0.352**		**0.00383**		**0.00124**	
AC-11	PNWR	ND	0.00097	ND	0.000249	0.0224	0.00113	0.00575	0.00029	ND	0.00126	ND	0.000322
AC-12	PNWR	ND	0.00114	ND	0.000287	0.656	0.00132	0.166	0.000335	ND	0.00147	ND	0.000372
AC-7	PNWR	ND	0.0011	ND	0.000251	0.0094	0.00128	0.00214	0.000293	ND	0.00143	ND	0.000325
MW-3	PNWR	na	na	ND	0.000521	na	na	0.130	0.000607	na	na	ND	0.000674
NH-1	PNWR	0.0133	0.00135	0.00243	0.000247	10.2	0.00158	1.87	0.000288	0.0195	0.00175	0.00357	0.000320
WG-1	PNWR	0.394	0.00115	0.0765	0.000224	16.5	0.00134	3.22	0.000261	0.0241	0.00149	0.00468	0.000290
YBB-1	PNWR	ND	0.00189	ND	0.000309	1.41	0.0022	0.231	0.00036	0.0055	0.00244	0.00090	0.000399
Maximum:		**0.394**		**0.0765**		**16.5**		**3.22**		**0.0241**		**0.00468**	
Median:		**0.204**		**0.0395**		**1.03**		**0.166**		**0.0195**		**0.00357**	
Grand Maximum:		**0.394**		**0.0765**		**16.5**		**3.22**		**0.0520**		**0.0167**	
Minimum LOC:		**na**		**0.1**		**15.7**		**0.1**		**na**		**0.2**	

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	PCB-Total Res Dry	PCB-Total DL Dry	PCB-Total Res Wet	PCB-Total DL Wet
KD-5A	LW 10.75	2.18	0.184	0.545	0.0460
RWB-2	LW 10.75	2.15	0.373	0.352	0.0612
RWB-3	LW 10.75	4.94	0.440	0.705	0.0628
RWB-4	LW 10.75	2.39	0.363	0.305	0.0463
RWB-5	LW 10.75	5.65	0.618	0.646	0.0706
Maximum:		**5.65**		**0.705**	
Median:		**2.39**		**0.545**	
AC-3A	NP	0.591	0.132	0.153	0.0342
MW-1	NP	3.64	0.366	0.636	0.0640
AC-14	NP	0.615	0.129	0.154	0.0323
AC-1A	NP	0.695	0.142	0.170	0.0348
MW-2	NP	na	na	0.799	0.110
Maximum:		**3.64**		**0.799**	
Median:		**0.655**		**0.170**	
KD-2	DC	1.13	0.191	0.272	0.0460
KD-4	DC	0.643	0.163	0.169	0.0428
KD-8	DC	1.36	0.206	0.333	0.0504
Maximum:		**1.36**		**0.333**	
Median:		**1.13**		**0.272**	
AC-5A	PB	1.34	0.141	0.303	0.0319
KD-6A	PB	1.98	0.249	0.529	0.0665
M-2A	PB	1.26	0.109	0.405	0.0349
MW-4	PB	na	na	0.607	0.0706
RWB-1	PB	5.67	0.347	0.823	0.0504
Maximum:		**5.67**		**0.823**	
Median:		**1.66**		**0.529**	
KD-3	LVB	2.71	0.211	0.732	0.0571
M-1	LVB	0.786	0.115	0.234	0.0342
M-1B	LVB	0.960	0.106	0.327	0.0361
Maximum:		**2.71**		**0.732**	
Median:		**0.960**		**0.327**	
AC-11	PNWR	ND	0.133	ND	0.0341
AC-12	PNWR	0.196	0.156	0.0495	0.0394
AC-7	PNWR	ND	0.151	ND	0.0344
MW-3	PNWR	na	na	ND	0.0714
NH-1	PNWR	0.547	0.185	0.100	0.0339
WG-1	PNWR	10.5	0.158	2.05	0.0307
YBB-1	PNWR	ND	0.258	ND	0.0423
Maximum:		**10.5**		**2.05**	
Median:		**0.547**		**0.1**	
Grand Maximum:		**10.5**		**2.05**	
Minimum LOC:					

Table 16. Concentrations (mg/kg) of Organic Chemicals of Potential Concern in Bird Eggs, 2003

Notes

ND - not detected; na - not analyzed or not available; Res Dry - dry-weight residue; DL Dry - dry-weight detection limit; Res Wet - wet-weight residue; DL Wet - wet-weight detection limit; LOC - level of concern. Location medians are reported for detectable concentrations, i.e., they exclude non-detects.

Three marsh wren samples (MW-2, MW-3, MW-4) were not sufficiently large for complete analysis of organics following analysis of inorganics.

[1]Chlordane Res Dry is the sum of the concentrations of the dry-weight residues of alpha-chlordane, gamma-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane, and heptachlor. Non-detect values for the concentrations of individual constituents were ignored. Detection limits were not determined for the chlordane mixture.

[2]Chlordane Res Dry is the sum of the concentrations of the dry-weight residues of alpha-chlordane, gamma-chlordane, cis-nonachlor, trans-nonachlor, oxychlordane, and heptachlor. Non-detect values for the concentrations of individual constituents were ignored. Detection limits were not determined for the chlordane mixture.

LOC were taken from Table 17.

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
Organics	Aldrin	NA	NA	NA	NA	NA	
	BHC (or HCH)	NA	NA	NA	NA	NA	
	alpha-BHC	NA	NA	NA	NA	NA	
	beta-BHC	NA	NA	NA	NA	NA	
	delta-BHC	NA	NA	NA	NA	NA	
	gamma-BHC (Lindane)	Ring-necked pheasant (*Phasianus colchicus*)	10 ppm, assumed ww	10	Hatchability was unaffected, laboratory dietary exposure of adults	Beyer et al. 1996, citing Ash and Taylor 1964	
	alpha-Chlordane	NA	NA	NA	NA	NA	
	gamma-Chlordane	NA	NA	NA	NA	NA	
	Oxychlordane	NA	NA	NA	NA	NA	
	Dieldrin	American kestrel (*Falco sparverius*)	0.15 µg/g ww	0.15	Eggshell thickness and eggshell thickness index of eggs from treated adults were reduced ~ 5.0%	Cal OEHHA 2006, citing Lowe and Stendell 1991	Degree of adversity cannot be assessed based on information in the database.
	Dieldrin	Double-crested cormorant (*Phalacrocorax auritus*)	0.33 ppm ww	0.33	Eggs lost or broken before hatching; decreased eggshell thickness, mean hatching success and fledging success	Cal OEHHA 2006, citing Weseloh et al. 1983	Degree of adversity cannot be assessed based on information in the database.
	Dieldrin	Peregrine falcon (*Falco peregrinus*)	0.36 ppm ww	0.36	Geometric mean value associated with 15% eggshell thinning compared with pre-1947 reference	Cal OEHHA 2006, citing Johnstone et al. 1996	Not considered an adverse effect based on information available in the database.
	Dieldrin	Unspecified	0.7 mg/kg	0.70	ECW Avian Egg Screening Benchmark, ww assumed; Level associated with population decline	USDOE RAIS 2006	Wet weight is assumed but not verified
	Dieldrin	Peregrine falcon (*Falco peregrinus*)	0.7 µg/g	0.7	LOAEL, critical concentration for a stable population, based on large amount of data on residue levels in eggs; greater levels are associated with population declines	Beyer et al. 1996, citing Newton 1988	Wet weight is assumed but not verified
	Dieldrin	Brown pelican (*Pelecanus occidentalis*)	>1 µg/g	1	No definite critical egg level was established, but it was reported to exceed 1 µg/g; based on a field study in which eggs contained multiple residues	Beyer et al. 1996, citing Blus 1982	Wet weight is assumed but not verified
	Dieldrin	Peregrine falcon (*Falco peregrinus*)	2.0 ppm ww	2	No effect on number of viable eggs	Cal OEHHA 2006, citing Enderson et al. 1968	
	Endrin	Unspecified	0.27 mg/kg	0.27	ECW Avian Egg Screening Benchmark , ww assumed.	USDOE RAIS 2006	Wet weight is assumed but not verified
	Endrin	Screech owl (*Otus asio*)	0.27 ppm	0.27	Level in eggs associated with reproductive impairment in a laboratory dietary exposure study: 0.75 ppm in diet, 57% lower productivity, fewer eggs per day per laying female, fewer eggs hatched per incubated clutch, fewer fledglings per total number of pairs)	Beyer et al. 1996, citing Fleming et al. 1982	Without reviewing original reference, it is impossible to know whether the effects occurred due to endrin residue in eggs or whether effects on adults were partly or totally responsible for observed effects.
	Endrin	Brown pelican (*Pelecanus occidentalis*)	0.5 µg/g	0.5	Rough estimate of the critical egg level based on a field study in which eggs contained multiple residues	Beyer et al. 1996, citing Blus 1982	
	Endrin	Mallard duck (*Anas platyrhynchos*)	2.75 ppm	2.75	Egg concentration associated with effects on embryo survival	Beyer et al. 1996, citing Roylance et al. 1985	Degree of effect not reported by Beyer et al.

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
	Endrin	Mallard duck (*Anas platyrhynchos*)	2.9 ppm	2.9	Egg concentration associated with poorer reproductive performance than controls	Beyer et al. 1996, citing Spann et al. 1986	Questionable study; differences were rarely statistically significant and controls performed poorly. The lowest dose might have performed better than controls.
	Hexachlorobenzene (HCB)	Japanese quail (*Coturnix japonica*)	6.2 ppm ww	6.2	Reduced survival of chicks, but other reproductive parameters were unaffected; dietary eposure of adults in the laboratory	Beyer et al. 1996	
	Hexachlorobenzene (HCB)	Unspecified	100 mg/kg	100.00	ECW Avian Egg Screening Benchmark , ww assumed.	USDOE RAIS 2006	Wet weight is assumed but not verified
	Heptachlor	NA	NA	NA	NA	NA	
	Heptachlor epoxide	Double-crested cormorant (*Phalacrocorax auritus*)	0.04 ppm ww	0.04	Eggs lost or broken before hatching; decreased eggshell thickness, mean hatching success and fledging success	Cal OEHHA 2006, citing Weseloh et al. 1983	Degree of adversity cannot be assessed based on information in database. This species is listed as "uncommon" by the Red Rock Audubon Society of Las Vegas Wash.
	Heptachlor epoxide	Praire falcon (*Falco mexicanus*) and merlin (*Falco columbarius*)	0.2 - 0.4 ppm (or 1 - 2 ppm dw)	0.2 - 0.4 (or 1 - 2 ppm dw)	No effect on reproduction	Beyer et al. 1996, citing Fyfe et al. 1976	
	Heptachlor epoxide	Peregrine falcon (*Falco peregrinus*)	0.2-1.2 ppm ww	1.2	No effect on number of viable eggs	Cal OEHHA 2006, citing Enderson et al. 1968	
	Heptachlor epoxide	Unspecified	1.50 mg/kg	1.50	ECW Avian Egg Screening Benchmark, ww assumed	USDOE RAIS 2006	Wet weight is assumed but not verified
	Heptachlor epoxide	American kestrel (*Falco sparverius*)	1.5 ppm	1.5	Productivity reduced when eggs contained >1.5 ppm in field study	Beyer et al. 1996, citing Henny et al. 1983	
	Heptachlor epoxide	American kestrel (*Falco sparverius*)	< 3 µg/g	< 3	Adverse effect on nest success	Hoffman et al. 2003, citing Henny et al. 1983	Wet weight is assumed but not verified
	Heptachlor epoxide	Gray partridge (*Perdix perdix*)	3 - 7 ppm ww	3 - 7	Slight reduction in chick survival, but normal hatching success; threshold for effects not defined	Beyer et al. 1996, citing Havet 1973	
	Heptachlor epoxide	Canada goose (*Branta canadensis*)	10 µg/g ww	10	Adverse effect on nest success (declined from 73% to 17%) at concentrations exceeding this level	Hoffman et al. 2003 and Beyer et al. 1996, both citing Blus et al. 1984	Some geese died from heptachlor epoxide poisoning at this level. Cause of poor reproductive success is unknow but might have been due to embryotoxicity or nest desertion.
	Heptachlor epoxide	Japanese quail (*Coturnix japonica*)	14 - 17 ppm ww	14 - 17	50% reduction in chick survival, threshold not defined	Beyer et al. 1996, citing Grolleau and Froux 1973	
	cis-Nonachlor	NA	NA	NA	NA		
	trans-Nonachlor	NA	NA	NA	NA		
	Mirex	Unspecified	20.00 mg/kg	20.00	ECW Avian Egg Screening Benchmark, ww assumed	USDOE RAIS 2006	Wet weight is assumed but not verified
	Mirex	Mallard duck (*Anas platyrhynchos*)	277 ppm ww	277	Reduced survival of ducklings, laboratory study of dietary exposure of adults	Beyer et al. 1996, citing Hyde et al. 1973	
	p,p'-DDT	Pelicans and cormorants	0.2 ppm ww	0.2	Decreased eggshell thickness	Cal OEHHA 2006, citing Anderson et al. 1969	Degree of adversity cannot be determined based on information in database. These species are listed as "uncommon" or "accidental" by the Red Rock Audubon Society of Las Vegas Wash

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
	p,p'-DDT	Double-crested cormorant (*Phalacrocorax auritus*)	0.22 ppm ww	0.22	Eggs lost or broken before hatching; decreased eggshell thickness, mean hatching success and fledging success	Cal OEHHA 2006, citing Weseloh et al. 1983	Degree of adversity cannot be determined based on information in database.
	p,p'-DDT	Peregrine falcon (*Falco peregrinus*)	0.9 - 7.2 ppm ww	0.9 - 7.2	No effect on number of viable eggs	Cal OEHHA 2006, citing Enderson et al. 1968	
	p,p'-DDD	Pelicans and cormorants	<0.1 ppm ww	<0.1	Decreased eggshell thickness	Cal OEHHA 2006, citing Anderson et al. 1969	Degree of adversity cannot be determined based on information in database.
	p,p'-DDD	Double-crested cormorant (*Phalacrocorax auritus*)	0.17 ppm ww	0.17	Eggs lost or broken before hatching; decreased eggshell thickness, mean hatching success and fledging success	Cal OEHHA 2006, citing Weseloh et al. 1983	Degree of adversity cannot be determined based on information in database. This species is listed as "uncommon" by the Red Rock Audubon Society of Las Vegas Wash
	p,p'-DDD	Peregrine falcon (*Falco peregrinus*)	0.9 - 3.4 ppm ww	0.9 - 3.4	No effect on number of viable eggs	Cal OEHHA 2006, citing Enderson et al. 1968	
	p,p'-DDD	Western grebe (*Aechmophorus occidentalis*)	1.3 ppm ww	1.3	Decreased eggshell thickness	Cal OEHHA 2006, citing Lindval and Lowe 1979 and Lindval and Lowe 1980	Degree of adversity cannot be determined based on information in database.
	p,p'-DDE	Brown pelican (*Pelicanus occidentalis*)	0.1 µg/g ww	0.1	Calculated no-effect level (NEL) for eggshell thinning	Beyer et al. 1996, citing Blus 1984; USDOE RAIS 2006, citing Beyer et al. 1996	Concentrations lower than threshold value not expected to cause significant adverse effects
	p,p'-DDE	Peregrine falcon (*Falco peregrinus*)	0.2 µg/g ww	0.2	Calculated no-effect level (NEL) for eggshell thinning	Beyer et al. 1996, citing Cade et al. 1971	
	p,p'-DDE	Common goldeneye (*Bucephala clangula*)	0.52 mg/kg ww	0.52	Egg breakage, 15.4% eggshell thinning	USDI 1998, citing Zicus et al. 1988	This species is listed as "common winter visitant" by the Red Rock Audubon Society of Las Vegas Wash
	p,p'-DDE	Hooded merganser (*Lophodytes cucullatus*)	0.62 mg/kg ww	0.62	9.6% eggshell thinning; egg breakage	USDI 1998, citing Zicus et al., 1988	Not considered an adverse effect based on information available in the database.
	p,p'-DDE	Various, see notes	1.2 - 10 mg/kg ww	1.2 - 10	Lowest Effect Level (LEL) for productivity	USDI 1998, citing Noble and Elliot 1990	See table 16 in reference. Values by species (in mg/kg ww) are: American kestrel - 10, bald eagle - 6, golden eagle - 10, falcons - 10, hawks - 10, merlin - 5, northern harrer- 10, owls - 10, osprey - 4, prairie falcon - 1.2
	p,p'-DDE	Osprey (*Pandion haliaetus*)	2 - 8.7 mg/kg ww	2 - 8.7	10 - 20% eggshell thinning	USDI 1998, citing Weimeyer et al. 1988	
	p,p'-DDE	Brown pelican (*Pelicanus occidentalis*)	2.6 - 3.0 mg/kg ww	2.6 - 3.0	29 - 40% decrease in nesting success	USDI 1998, citing Blus 1984	This is the lowest concentration reported; effects at levels up to 8 mg/kg ww are also reported
	p,p'-DDE	White-face ibis (*Plegadis chihi*)	3 mg/kg ww	3	Reduced clutch size, decreased productivity, egg breakage	USDI 1998, citing Henny et al. 1985	
	p,p'-DDE	Brown pelican (*Pelicanus occidentalis*)	3 mg/kg ww	3	Reduced productivity	USDI 1998, citing King 1985	

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
	p,p'-DDE	Brown pelican (*Pelicanus occidentalis*)	3 µg/g ww	3	Near total reproductive failure	Beyer et al. 1996, Cal OEHHA 2006, Hoffman et al. 2003; all citing Blus 1982	ww specified by Beyer et al. 1996; 4,4'-DDE specified by Cal OEHHA 2006
	p,p'-DDE	Bald eagle (*Haliaeetus leucocephalus*)	3 - 5 mg/kg ww	3 - 5	Depressed productivity and 10% eggshell thining	USDI 1998, citing Weimeyer et al. 1984	15 mg/kg ww associated with "no productivity."
	p,p'-DDE	Brown pelican (*Pelicanus occidentalis*)	3.0 - 66 mg/kg ww	3.0 - 66	18 - 47% eggshell thinning	USDI 1998, citing Jehl 1973	
	p,p'-DDE	Black skimmer (*Rhyncops niger*)	3.2 mg/kg ww	3.2	Decreased hatching and fledging success	USDI 1998, citing Custer and Mitchell 1987	
	p,p'-DDE	Bald eagle (*Haliaeetus leucocephalus*)	3.6 - 6.3 mg/kg ww	3.6 - 6.3	50% reduction in productivity	USDI 1998, citing Weimeyer et al. 1993	75% reduction in productivity at >6.3 mg/kg; 15% eggshell thinning at 16 mg/kg
	p,p'-DDE	Elegant tern (*Sterna elegans*)	3.79 mg/kg ww	3.79	Chick mortality during hatching	USDI 1998, citing Ohlendorf et al. 1985	
	p,p'-DDE	White-face ibis (*Plegadis chihi*)	4 - 8 µg/g ww	4 - 8	Concentration in eggs at which adverse reproductive effects first appear	Beyer et al. 1996, citing Henny and Heron 1989	Threshold level for reproductive effects
	p,p'-DDE	California condor (*Gymnogyps californianus*)	5 µg/g ww	5	Concentration in eggs associated with 20% eggshell thinning, by regression analysis	Beyer et al. 1996, citing Kiff et al. 1979	Regression analysis relating DDE levels to 20% eggshell thinning from various studies; range was 5 µg/g ww for California condor (Kiff et al. 1979) to 60 (fresh eggs) - 110 (failed eggs) µg/g ww for bald eagle (Wiemeyer et al. 1993)
	p,p'-DDE	Snowy egret (*Egretta thula*)	5 mg/kg ww	5	Reduced clutch size, decreased productivity, egg breakage	USDI 1998, citing Henny et al. 1985	
	p,p'-DDE	Green-backed heron (*Butorides striatus*)	5 - 10 mg/kg ww	5 - 10	Reduced hatching success	USDI 1998, citing White et al. 1988	
	p,p'-DDE	Western grebe (*Aechmophorus occidentalis*)	5.4 mg/kg ww	5.4	2.3% eggshell thinning; reduced productivity	USDI 1998, citing Lindvall and Low 1980	
	p,p'-DDE	Mallard duck (*Anas platyrhynchos*)	5.8 ppm ww	5.8	Changes in behavior of ducklings	Cal OEHHA 2006, citing Heinz 1976	Might not be an adverse effect; review of original reference recommended.
	p,p'-DDE	Common tern (*Sterna hirundo*)	6.67 mg/kg ww	6.67	17% thinning; hatching failure; embryo mortality	USDI 1998, citing Fox 1976	
	p,p'-DDE	Red-necked grebe (*Podiceps grisegena*)	6.68 mg/kg ww	6.68	Low egg viability; 6.5% eggshell thinning; reduced fledging success	USDI 1998, citing De Smet 1987	
	p,p'-DDE	Black-crowned night-heron (*Nycticorax nycticorax*)	8 mg/kg ww	8	Reduced clutch size, decreased productivity, egg breakage	USDI 1998, citing Henny et al. 1984, 1985	
	p,p'-DDE	Brown pelican (*Pelicanus occidentalis*)	8 mg/kg ww	8	20% eggshell thinning and impaired reproductive success	Cal OEHHA 2006, citing Blus 1984	
	p,p'-DDE	Black-crowned night-heron (*Nycticorax nycticorax*)	8 - 12 mg/kg ww	8 - 12	27 - 58% decrease in nesting success	USDI 1998, citing Blus 1984	12 mg/kg associated with "critical level for reproductive success"; 25-50 mg/kg with "total reproductive failure"; 36 mg/kg with 18% eggshell thinning; 54 mg/kg with 20% thinning

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
	p,p'-DDE	Black-crowned night-heron (*Nycticorax nycticorax*)	8.62 mg/kg ww	8.62	8-13% eggshell thinning compared with pre-1947 reference population	USDI 1998, citing Ohlendorf and Marois 1990	
	p,p'-DDE	Caspian tern (*Sterna caspia*)	9.3 mg/kg ww	9.3	22% hatching failure; 4.6% died in hatching	USDI 1998, citing Ohlendorf et al. 1985	
	p,p'-DDE	Double crested cormorant (*Phalacrocorax auritus*)	10 mg/kg ww	10	20% eggshell thinning	USDI 1998, citing Pearce et al. 1979	
	p,p'-DDE	Black-crowned night-heron (*Nycticorax nycticorax*)	11 - 12 mg/kg ww	11 - 12	36-39% hatching success, 14-17% eggshell thinning	USDI 1998, citing Price 1977	
	p,p'-DDE	Barn owl (*Tyto alba*)	12 µg/g ww	12	20% eggshell thinning, 75% reduction in hatching and fledging rates; laboratory study of birds dosed with DDE in the diet	Beyer et al. 1996, citing Mendenhall et al. 1983)	No indication of the residues in eggs at which reproductive problems first appear; i.e., this is not a threshold effect concentration
	p,p'-DDE	Leach's storm-petrel (*Oceanodroma leucorho*)	12 mg/kg ww	12	12% eggshell thinning	USDI 1998, citing Noble and Elliot 1990	
	p,p'-DDE	Double-crested cormorant (*Phalacrocorax auritus*)	14.5 ppm ww	14.5	Eggs lost or broken before hatching, decreased eggshell thickness, mean hatching success and fledging success	Cal OEHHA 2006, citing Weseloh et al. 1983	
	p,p'-DDE	Bald eagle (*Haliaeetus leucocephalus*)	15 µg/g ww	15	Concentration at which few or no young are produced	Beyer et al. 1996, citing Wiemeyer et al. 1993	Listed as concentration at which effects on reproduction are first noted
	p,p'-DDE	Peregrine falcon (*Falco peregrinus*)	15 mg/kg ww	15	Depressed productivity	USDI 1998, citing Peakall et al. 1975	
	p,p'-DDE	Peregrine falcon (*Falco peregrinus*)	15 - 20 µg/g ww	15 - 20	Lower critical level that adversely affecting reproductive success	Beyer et al. 1996, citing Peakall 1976	Nest success in Great Britain not affected by DDE, with residues as high as 25 - 31 µg/g (Beyer et al. 1996, citing Ratcliffe 1967). Limited evidence from field studies in Alaska suggests that effects occur only at >30 µg/g ww (Beyer et al. 1996, citing Ambrose et al. 1988).
	p,p'-DDE	White-face ibis (*Plegadis chihi*)	16 - 20 mg/kg ww	16 - 20	27.8% eggshell thinning	USDI 1998, citing Henny and Herron 1989	8 - 16 mg/kg ww associated with 17.4% eggshell thinning
	p,p'-DDE	Peregrine falcon (*Falco peregrinus*)	18 µg/g ww	18	20% eggshell thinning; field study	Beyr et al. 1996, citing Pruett-Jones et al. 1980	Field study in Australia
	p,p'-DDE	Northern gannet (*Sula bassanus*)	18.5 mg/kg ww	18.5	17% eggshell thinning; low reproductive success	USDI 1998, citing Elliot et al. 1988	
	p,p'-DDE	Double-crested cormorant (*Phalacrocorax auritus*)	30 µg/g ww	30	24% eggshell thinning, field study		Field study in Baja California; in the same study, cormorant eggs from the field in California had 11% eggshell thinning at 32 µg/g ww.
	p,p'-DDE	Mallard duck (*Anas platyrhynchos*)	38.8 µg/g ww	38.8	18% decrease in "eggshell index"; 32% decrease in Ca2+-Mg2+ATPase activity; 44% increase in calcium content of eggshell mucosa	Cal OEHHA 2006, citing Lundholm 1982	

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
	p,p'-DDE	Black duck (*Anas rubripes*)	46.3 mg/kg ww	46.3	Eggshell thinning of 18 - 29%, significantly reduced survival of embryonated eggs or hatchlings to 3 weeks posthatch; laboratory study of birds dosed with DDE in the diet	USDI 1998, citing Longcore et al. 1971; Beyer et al. 1996, citing Longcore et al. 1971	144 mg/kg assoicated with eggshell thinning of 24-38%; No indication of the residues in eggs at which reproductive problems first appear; i.e., this is not a threshold effect concentration
	p,p'-DDE	Peregrine falcon (*Falco peregrinus*)	44 µg/g ww	44	22% eggshell thinning; field study	Beyer et al. 1996, citing Cade et al. 1971	Field study in Alaska
	p,p'-DDE	Heron	54 µg/g ww	54	20% eggshell thinning	Blus 1984, citing Klass et al. 1974	
	p,p'-DDE	Brown pelican (*Pelicanus occidentalis*)	59 mg/kg ww	59	44% eggshell thinning	USDI 1998, citing Risebrough 1972	
Metals & Metalloids	Aluminum	NA	NA	NA	NA		
	Antimony	NA	NA	NA	NA		
	Arsenic	Unspecified	1.3 - 2.8 mg/kg ww*	1.3 - 2.8	Unspecified	USDI 1998, citing Skorupra 1996 unpublished data	
	Boron	Domestic chicken (*Gallus domesticus*)	3.2 - 8.0 mg/kg ww	3.2 - 8.0	Developmental abnormalities, malformations of nervous system, eyes, and spinal cord, rumplessness, skeletal deformities, cleft palate, missing toes, eye deformities following embryo yolk injection (55 g egg)	Eisler 1990 citing Birge and Black 1977; Schowing and Cuevas 1975; Schowing et al. 1976; Landauer 1953a; Landauer 1953b; Landauer 1953c; Landauer 1952	
	Boron	Mallard duck (*Anas platyrhynchos*)	13 - 20 mg/kg ww	13 - 20	13 mg/kg listed as no effect level; 20 mg/kg = EC10 for egg viability	USDI 1998, citing Smith and Anders 1989 and Stanley et al. 1996	
	Boron	Mallard duck (*Anas platyrhynchos*)	13 - 49 µg/g dw	13 - 49 dw	13 mg/kg - concern level, reduced weight gain of ducklings and reduced body weight of hatchlings; 49 mg/kg - effect level, reduced hatching success, hatch weight, duckling survival, and duckling	Tuttle and Thodal 1998, citing Smith and Anders 1989	No moisture content given in original study for conversion to wet weight
	Barium	NA	NA	NA	NA		
	Beryllium	NA	NA	NA	NA		
	Cadmium	Unspecified	See notes	NA	NA	Beyer et al. 1996	Cadmium levels accumulated into bird eggs are negligible and are not expected to cause embryotoxic effects
	Chromium	NA	NA	NA	NA		
	Copper	NA	NA	NA	NA		
	Iron	NA	NA	NA	NA		
	Lead	NA	NA	NA	NA		
	Mercury	Osprey (*Pandion haliaetus*)	0.05 - 0.11 mg/kg ww	0.05 - 0.11	No adverse reproductive effects	USDI 1998, citing Audet et al. 1992	
	Mercury	Merlin (*Falco columbarius*)	0.2 - 1.0 mg/kg ww (1 - 5 mg/kg dw)	0.2 - 1.0 dw	Reduced productivity in half of populations	USDI 1998, citing Newton and Haas 1988	
	Mercury	Unspecified	0.50 mg/kg	0.50	ECW Avian Egg Screening Benchmark, ww assumed	USDOE RAIS 2006	

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
	Mercury	Various species	< 500 - < 2000 µg/kg ww	< 0.5 - < 2	Safe level	Eisler 2000, citing Fimreite 1979 and Thompson 1996	
	Mercury	Pheasant	0.5 - 1.5 ww	0.5 - 1.5	Decrease in hatchability	USDI 1998, citing Fimreite 1971	
	Mercury	Mallard duck (*Anas platyrhynchos*)	0.86 mg/kg ww	0.86	Aberrant nesting behavior	USDI 1998, citing Heinz 1979	
	Mercury	Ring-necked pheasant (*Phasianus colchicus*)	< 900 µg/kg ww	< 0.9	Safe level to allow normal reproduction	Eisler 2000, citing Mora 1996	
	Mercury	Common tern (*Sterna hirundo*)	<1000 µg/kg ww	< 1	Safe level	Eisler 2000, citing Spann et al. 1972	
	Mercury	Waterbirds	1000 - 3600 µg/kg ww	1 .0 - 3.6	Level protective against adverse effects	Eisler 2000, Zilloux et al. 1993	
	Mercury	Water birds "generally"	1.0 - 3.6 ww	1.0 - 3.6	"Residue threshold for significant toxic effects"	USDI 1998, citing Zillioux et al. 1993	
	Mercury	Ring-necked pheasant (*Phasianus colchicus*)	< 2000 - 4700 µg/kg ww	< 2 - 4	Safe level to prevent reduced hatching and fledging success	Eisler 2000, citing Mora 1996	
	Mercury	Common tern (*Sterna hirundo*)	3.65 mg/kg ww	3.65	27% hatching success, 10-12% fledging rate; no effects on reproduction reported for 1 mg/kg	USDI 1998, citing Fimreite 1974	
	Mercury	Mallard duck (*Anas platyrhynchos*)	5.0 mg/kg ww	5	Mallard brain lesions	USDI 1998, citing Heinz 1975	
	Mercury	Herring gull (*Larus argentatus*)	16 mg/kg ww	16	No decrease in hatchability	USDI 1998, citing Fimreite 1974	
	Mercury	Osprey (*Pandion haliaetus*)	1.5 - 3.0 dw (0.3 - 0.6 mg/kg ww)	1.5 - 3.0 dw	Decrease in number of young fledged	USDI 1998, citing Odjso 1982	
	Mercury	Mallard duck (*Anas platyrhynchos*)	0.83 µg/g dw	0.83 dw	Effect level; decreased juvenile survival	Tuttle and Thodal 1998, citing Heinz 1979	
	Manganese	NA	NA	NA	NA		
	Molybdenum	Unspecified	16 µg/g dw	16 dw	Embryotoxicity	Tuttle and Thodal 1998, citing Friberg and others (1975)	
	Molybdenum	White rock chicken	23 mg/kg dw	23 dw	No effect on egg viability	USDI 1998, citing Lepore and Miller 1965	
	Molybdenum	White rock chicken	33 mg/kg dw	33 dw	50% of eggs non-viable (i.e., EC50)	USDI 1998, citing Lepore and Miller 1966	
	Nickel	NA	NA	NA	NA		
	Selenium	Unspecified	3.00 mg/kg ww	3.00	ECW Avian Egg Screening Benchmark	USDOE RAIS 2006	
	Selenium	Unspecified	3 mg/kg ww	3	Threshold for reproductive problems, primarily deformities of embryos and hatching failure	Beyer et al. 1996	
	Selenium	Unspecified	10 mg/kg ww	10	Embryo toxicity threshold	USDI 1998, citing Heinz 1996	
	Selenium	Ducks	23 mg/kg ww	23	IC10 for teratogenesis	USDI 1998, citing Skorupa 1998	Wet weight is assumed but not verified
	Selenium	Mallard duck (*Anas platyrhynchos*)	4 - 10 µg/g dw	4 - 10 dw	4 mg/kg - concern level, increased susceptibility of captive mallard hatchlings to duck hepatitis virus; 10 mg/kg - effect level, unspecified LOAEL	Tuttle and Thodal 1998, citing Skorupa et al. 1996	Concern level indicates relatively minor effects; effect level indicates substantial effects
	Selenium	Unspecified	<5 mg/kg dw	< 5 dw	Background level associated with no effects	USDI 1998	

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Chemical Class	Chemical	Species Name	Level of Concern (units listed in reference)[1]	Level of Concern (mg/kg)[2]	Endpoint Description	Source, Reference	Notes
	Selenium	Mallard duck (*Anas platyrhynchos*)	13 - 24 µg/g dw	13 - 24 dw	Critical embryotoxic and teratogenic threshold between 13 - 24 mg/kg dw; concern level is 13 mg/kg dw, effect level is 24 mg/kg dw	Tuttle and Thodal 1998, citing Skorupa and Ohlendorf 1991	Concern level indicates relatively minor effects; effect level indicates substantial effects
	Strontium	NA	NA	NA	NA		
	Titanium	NA	NA	NA	NA		
	Vanadium	NA	NA	NA	NA		
	Zinc	Unspecified	50 mg/kg ww*	50	No effect	USDI 1998, citing Skorupra 1996 unpublished data	Wet weight is assumed but not verified
Other Inorganics	Perchlorate[3]	NA	NA	NA	NA		

Table 17. Levels of Concern (mg/kg) for Chemicals of Potential Concern in Bird Eggs, 2003

Notes

1 Values generally were reported in the literature as either wet weight (ww) or dry weight (dw). Where this information was not provided, ww was assumed.
2 Level of Concern is reported in mg/kg ww unless specified as dry-weight (dw).
3 When data on perchlorate concentrations are available, perchlorate LOC will be discussed in Appendix B. However, no benchmarks or criteria have been identified to date.
* No specific effect was described in association with the bird egg concentration reported. Since only a summary of the study was reviewed it is possible that effects were evaluated and reported on in the primary source.
NA - Information relating to bird egg for this chemical
For DDT and DDE, the designation '(unspecified)' indicates that the specific isomer was not identified.

References

Beyer et al. 1996: Beyer WN, Heinz GH, and Redmon-Norwood AW (eds.). 1996. Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations. SETAC Special Publication Series. CRC Press. Washington, DC. 494 p.

Cal OEHHA 2006: California Office of Environmental Health Hazard Assessment (Cal OEHHA) Database. 2006. The California Wildlife Biology, Exposure Factor, and Toxicity Database (Cal/Ecotox). California. http://www.oehha.ca.gov/scripts/cal_ecotox/chemicaldescription.asp
Outputs for this database provide synopsis of primary literature sources including a description of effects and dose levels. The primary literature sources cited were obtained and reviewed in some cases; however, a comprehensive review of the primary literature cited in the Cal/Ecotox database was not conducted. This database was accessed February 2006.

Eisler 2000:
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Tuttle PL and Thodal CE 1998: Field Screening of Water Quality, Bottom Sediment, and Biota Associated With Irrigation in and Near the Indian Lakes Area, Stillwater Wildlife Management Area, Churchill County, West-Central Nevada, 1995. U.S. GEOLOGICAL SURVEY. Water-Resources Investigations Report 97-4250.
Primary literature sources were searched to determine ww versus dw, but these sources were not comprehensively reviewed.

USDI 1998: United States Department of the Interior (USDI) 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, Bureau of Indian Affairs.
The information presented was originally compiled for use in studies relating to the Department of the Interior's National Irrigation Water Quality Program (NIWQP). These studies were intended to identify and address irrigation-induced water quality and contamination problems associated with water projects in the Western States. This reference focuses on nine constituents or properties commonly identified during NIWQP studies in the Western United States: salinity, DDT, and the trace elements arsenic, boron, copper, mercury, molybdenum, selenium, and zinc.

USDOE RAIS 2006: United States Department of Energy (USDOE) Risk Assessment Information System (RAIS) Database. 2006. http://risk.lsd.ornl.gov/
This database provides access to approximately 80 sets of benchmark values for acute and chronic ecological endpoints. For bird egg concentrations, the Environmental Contaminants in Wildlife (ECW) Avian Egg Screening Benchmark was searched. Specific effects associated with these benchmark values are not provided. This database was accessed February 2006. The primary literature source listed for the ECW Avian Egg Screening Benchmark is:
Beyer, W.N. , G.H. Heinz and A.W. Redmon-Norwood (eds.). 1996. Environmental Contaminants in Wildlife - Interpreting Tissue Concentrations, Special Publication of SETAC, CRC Press, Inc. 494 p.
This reference was reviewed to verify the levels reported within the database and to ascertain toxicological effects associated with these levels. A full comprehensive review of this reference was not conducted.

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Aluminum Res Dry mg/kg	Aluminum DL Dry mg/kg	Aluminum Res Wet mg/kg	Aluminum DL Wet mg/kg	Arsenic Res Dry mg/kg	Arsenic DL Dry mg/kg	Arsenic Res Wet mg/kg	Arsenic DL Wet mg/kg	Barium Res Dry mg/kg	Barium DL Dry mg/kg	Barium Res Wet mg/kg	Barium DL Wet mg/kg
KD-5A	LW 10.75	ND	2.00	ND	0.600	0.200	0.200	0.070	0.060	1.100	0.200	0.320	0.060
RWB-2	LW 10.75	ND	3.00	ND	0.500	ND	0.300	ND	0.050	1.100	0.200	0.190	0.040
RWB-3	LW 10.75	ND	3.00	ND	0.500	ND	0.300	ND	0.050	1.700	0.200	0.300	0.040
RWB-4	LW 10.75	ND	3.00	ND	0.500	ND	0.300	ND	0.050	0.790	0.200	0.140	0.040
RWB-5	LW 10.75	ND	2.00	ND	0.300	ND	0.400	ND	0.060	0.730	0.200	0.110	0.030
	Maximum:	**na, 3.00**		**na, 0.600**		**0.200**		**0.070**		**1.70**		**0.320**	
	Median:	**ND**		**ND**		**0.200**		**0.070**		**1.10**		**0.190**	
AC-14	NP	ND	2.00	ND	0.500	0.500	0.200	0.100	0.050	1.70	0.200	0.400	0.050
AC-1A	NP	ND	2.00	ND	0.500	0.400	0.200	0.090	0.050	0.740	0.200	0.180	0.050
AC-3A	NP	ND	2.00	ND	0.500	0.300	0.200	0.070	0.050	1.500	0.200	0.380	0.050
MW-1	NP	7.00	4.00	1.00	0.800	0.400	0.400	0.080	0.080	0.600	0.200	0.100	0.040
MW-2	NP	10.0	10.0	ND	2.00	ND	1.000	ND	0.200	0.400	0.200	0.060	0.040
	Maximum:	**10.0**		**1.00**		**0.500**		**0.100**		**1.70**		**0.400**	
	Median:	**8.50**		**1.00**		**0.400**		**0.085**		**0.740**		**0.180**	
KD-2	DC	ND	2.00	ND	0.500	ND	0.200	ND	0.050	0.94	0.200	0.250	0.050
KD-4	DC	ND	2.00	ND	0.600	0.200	0.200	0.070	0.060	0.63	0.200	0.200	0.060
KD-8	DC	ND	2.00	ND	0.600	0.300	0.200	0.080	0.060	0.3	0.200	0.080	0.060
	Maximum:	**na, 2.00**		**na, 0.600**		**0.300**		**0.080**		**0.94**		**0.250**	
	Median:	**ND**		**ND**		**0.250**		**0.075**		**0.63**		**0.200**	
AC-5A	PB	ND	2.00	ND	0.400	0.400	0.200	0.090	0.040	5.60	0.200	1.20	0.040
KD-6A	PB	ND	2.00	ND	0.500	0.200	0.200	0.050	0.050	0.90	0.200	0.240	0.050
M-2A	PB	2.00	2.00	0.800	0.700	ND	0.200	ND	0.070	8.80	0.200	2.90	0.070
MW-4	PB	6.00	5.00	1.00	1.00	0.500	0.500	ND	0.100	3.40	0.200	0.720	0.040
RWB-1	PB	ND	2.00	ND	0.300	ND	0.200	ND	0.030	1.00	0.200	0.160	0.030
	Maximum:	**6.00**		**1.00**		**0.500**		**0.090**		**8.80**		**2.90**	
	Median:	**4.00**		**0.900**		**0.400**		**0.070**		**3.40**		**0.720**	
KD-3	LVB	ND	2.00	ND	0.600	ND	0.200	ND	0.060	0.88	0.200	0.250	0.060
M-1	LVB	ND	2.00	ND	0.600	0.300	0.200	0.080	0.060	16.0	0.200	4.90	0.060
M-1B	LVB	ND	2.00	ND	0.600	ND	0.200	ND	0.060	2.10	0.200	0.620	0.060
	Maximum:	**na, 2.00**		**na, 0.600**		**0.300**		**0.080**		**16.0**		**4.90**	
	Median:	**ND**		**ND**		**0.300**		**0.080**		**2.10**		**0.620**	
AC-7	PNWR	ND	2.00	ND	0.500	1.40	0.200	0.360	0.050	5.30	0.200	1.40	0.050
AC-11	PNWR	ND	2.00	ND	0.500	0.630	0.200	0.170	0.050	5.50	0.200	1.50	0.050
AC-12	PNWR	ND	2.00	ND	0.500	1.50	0.200	0.370	0.050	4.60	0.200	1.10	0.050
MW-3	PNWR	ND	3.00	ND	0.600	ND	0.300	ND	0.060	5.00	0.200	0.990	0.040
NH-1	PNWR	ND	2.00	ND	0.400	ND	0.200	ND	0.040	3.60	0.200	0.700	0.040
WG-1	PNWR	ND	2.00	ND	0.400	ND	0.200	ND	0.040	0.67	0.200	0.140	0.040
YBB-1	PNWR	ND	2.00	ND	0.400	0.500	0.200	0.090	0.040	9.00	0.200	1.60	0.040
	Maximum:	**na, 3.00**		**na, 0.600**		**1.50**		**0.370**		**9.00**		**1.60**	
	Median:	**ND**		**ND**		**1.02**		**0.265**		**5.00**		**1.10**	
Grand Maximum:		**10.0**		**1.0**		**1.5**		**0.4**		**16.0**		**4.9**	
Minimum LOC:		**na**		**na**		**na**		**1.3**		**na**		**na**	

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Beryllium Res Dry mg/kg	Beryllium DL Dry mg/kg	Beryllium Res Wet mg/kg	Beryllium DL Wet mg/kg	Boron Res Dry mg/kg	Boron DL Dry mg/kg	Boron Res Wet mg/kg	Boron DL Wet mg/kg	Cadmium Res Dry mg/kg	Cadmium DL Dry mg/kg	Cadmium Res Wet mg/kg	Cadmium DL Wet mg/kg
KD-5A	LW 10.75	ND	0.100	ND	0.030	ND	2.00	0.600	0.600	ND	0.100	ND	0.030
RWB-2	LW 10.75	ND	0.100	ND	0.020	3.00	2.00	0.500	0.400	0.200	0.100	0.030	0.020
RWB-3	LW 10.75	ND	0.100	ND	0.020	2.00	2.00	0.400	0.400	0.200	0.100	0.030	0.020
RWB-4	LW 10.75	ND	0.100	ND	0.020	ND	2.00	0.400	0.400	ND	0.100	ND	0.020
RWB-5	LW 10.75	ND	0.100	ND	0.020	ND	2.00	0.300	0.300	0.100	0.100	0.020	0.020
	Maximum:	**na, 0.1**		**na, 0.03**		**3.00**		**0.60**		**0.200**		**0.0300**	
	Median:	**ND**		**ND**		**2.50**		**0.40**		**0.200**		**0.0300**	
AC-14	NP	ND	0.100	ND	0.020	5.00	2.00	1.00	0.500	ND	0.100	ND	0.020
AC-1A	NP	ND	0.100	ND	0.020	5.00	2.00	1.00	0.500	ND	0.100	ND	0.020
AC-3A	NP	ND	0.100	ND	0.030	4.00	2.00	1.00	0.500	ND	0.100	ND	0.030
MW-1	NP	ND	0.100	ND	0.020	5.00	2.00	1.00	0.400	0.300	0.100	0.050	0.020
MW-2	NP	ND	0.100	ND	0.020	5.00	5.00	0.90	0.900	20.0	0.200	3.50	0.040
	Maximum:	**na, 0.1**		**na, 0.03**		**5.00**		**1.00**		**20.0**		**3.50**	
	Median:	**ND**		**ND**		**5.00**		**1.00**		**10.2**		**1.78**	
KD-2	DC	ND	0.100	ND	0.030	ND	2.00	ND	0.500	ND	0.100	ND	0.030
KD-4	DC	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.100	ND	0.030
KD-8	DC	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.100	ND	0.030
	Maximum:	**na, 0.1**		**na, 0.03**		**na, 2**		**na, 0.6**		**na, 0.1**		**na, 0.03**	
	Median:	**ND**		**ND**		**ND**		**ND**		**ND**		**ND**	
AC-5A	PB	ND	0.100	ND	0.020	4.00	2.00	1.00	0.400	ND	0.100	ND	0.020
KD-6A	PB	ND	0.100	ND	0.030	ND	2.00	ND	0.500	ND	0.100	ND	0.030
M-2A	PB	ND	0.100	ND	0.030	ND	2.00	ND	0.700	ND	0.100	ND	0.030
MW-4	PB	ND	0.100	ND	0.020	ND	2.00	ND	0.400	0.2	0.100	0.04	0.020
RWB-1	PB	ND	0.100	ND	0.020	2.00	2.00	0.30	0.300	ND	0.100	ND	0.020
	Maximum:	**na, 0.1**		**na, 0.03**		**4.00**		**1.00**		**0.200**		**0.040**	
	Median:	**ND**		**ND**		**3.00**		**0.65**		**0.200**		**0.040**	
KD-3	LVB	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.100	ND	0.030
M-1	LVB	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.100	ND	0.030
M-1B	LVB	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.100	ND	0.030
	Maximum:	**na, 0.1**		**na, 0.03**		**na, 2**		**na, 0.6**		**na, 0.1**		**na, 0.03**	
	Median:	**ND**		**ND**		**ND**		**ND**		**ND**		**ND**	
AC-7	PNWR	ND	0.100	ND	0.030	2.00	2.00	0.60	0.500	ND	0.100	ND	0.030
AC-11	PNWR	ND	0.100	ND	0.030	3.00	2.00	0.70	0.500	ND	0.100	ND	0.030
AC-12	PNWR	ND	0.100	ND	0.020	3.00	2.00	0.80	0.500	0.100	0.100	0.030	0.020
MW-3	PNWR	ND	0.100	ND	0.020	ND	2.00	ND	0.400	0.570	0.100	0.110	0.020
NH-1	PNWR	ND	0.100	ND	0.020	ND	2.00	ND	0.400	ND	0.100	ND	0.020
WG-1	PNWR	ND	0.100	ND	0.020	ND	2.00	ND	0.400	ND	0.100	ND	0.020
YBB-1	PNWR	ND	0.100	ND	0.020	ND	2.00	ND	0.400	ND	0.100	ND	0.020
	Maximum:	**na, 0.1**		**na, 0.03**		**3.00**		**0.80**		**0.570**		**0.110**	
	Median:	**ND**		**ND**		**3.00**		**0.70**		**0.335**		**0.070**	
Grand Maximum:		**ND, 0.1**		**ND, 0.03**		**5.0**		**1.0**		**20.0**		**3.5**	
Minimum LOC:		**na**		**na**		**13**		**3.2**		**na**		**na**	

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Chromium Res Dry mg/kg	Chromium DL Dry mg/kg	Chromium Res Wet mg/kg	Chromium DL Wet mg/kg	Copper Res Dry mg/kg	Copper DL Dry mg/kg	Copper Res Wet mg/kg	Copper DL Wet mg/kg	Iron Res Dry mg/kg	Iron DL Dry mg/kg	Iron Res Wet mg/kg	Iron DL Wet mg/kg
KD-5A	LW 10.75	ND	0.500	ND	0.100	4.20	0.300	1.300	0.090	92.0	2.00	27.0	0.600
RWB-2	LW 10.75	2.80	0.500	0.510	0.090	3.20	0.300	0.590	0.050	255	2.00	46.7	0.400
RWB-3	LW 10.75	1.00	0.500	0.200	0.090	2.90	0.300	0.520	0.050	170	2.00	31.0	0.400
RWB-4	LW 10.75	ND	0.500	ND	0.090	3.50	0.300	0.640	0.050	150	2.00	26.0	0.400
RWB-5	LW 10.75	ND	0.500	ND	0.080	3.60	0.300	0.570	0.050	212	2.00	33.5	0.300
	Maximum:	**2.80**		**0.510**		**4.20**		**1.30**		**255**		**46.7**	
	Median:	**1.90**		**0.355**		**3.50**		**0.590**		**170**		**31.0**	
AC-14	NP	2.40	0.500	0.570	0.100	6.40	0.300	1.50	0.070	190	2.00	44.0	0.50
AC-1A	NP	ND	0.500	ND	0.100	3.70	0.300	0.92	0.070	97.0	2.00	24.0	0.50
AC-3A	NP	ND	0.500	ND	0.100	3.50	0.300	0.89	0.080	160	2.00	40.0	0.50
MW-1	NP	2.20	0.500	0.440	0.100	4.30	0.300	0.83	0.060	120	2.00	24.0	0.40
MW-2	NP	1.00	0.500	0.300	0.090	132	0.500	23.5	0.090	110	5.00	19.0	0.90
	Maximum:	**2.40**		**0.570**		**132**		**23.5**		**190**		**44.0**	
	Median:	**2.20**		**0.440**		**4.30**		**0.92**		**120**		**24.0**	
KD-2	DC	ND	0.500	ND	0.100	14.0	0.300	3.90	0.080	130	2.00	36	0.500
KD-4	DC	ND	0.500	ND	0.100	3.30	0.300	0.93	0.090	110	2.00	32	0.600
KD-8	DC	ND	0.500	ND	0.100	3.00	0.300	0.89	0.090	86	2.00	26	0.600
	Maximum:	**na, 0.5**		**na, 0.1**		**14.0**		**3.90**		**130**		**36**	
	Median:	**ND**		**ND**		**3.30**		**0.93**		**110**		**32**	
AC-5A	PB	ND	0.500	ND	0.100	3.60	0.300	0.81	0.070	150	2.00	34	0.400
KD-6A	PB	ND	0.500	ND	0.100	3.90	0.300	1.00	0.080	120	2.00	32	0.500
M-2A	PB	ND	0.500	ND	0.200	3.30	0.300	1.10	0.100	110	2.00	35	0.700
MW-4	PB	ND	0.500	ND	0.100	2.90	0.300	0.62	0.060	130	2.00	28	0.400
RWB-1	PB	ND	0.500	ND	0.080	4.10	0.300	0.66	0.050	150	2.00	24	0.300
	Maximum:	**na, 0.5**		**na, 0.2**		**4.10**		**1.10**		**150**		**35**	
	Median:	**ND**		**ND**		**3.60**		**0.81**		**130**		**32**	
KD-3	LVB	0.60	0.500	0.2	0.100	3.20	0.300	0.92	0.090	130	2.00	37	0.600
M-1	LVB	2.50	0.500	0.75	0.200	18.0	0.300	5.40	0.090	140	2.00	42	0.600
M-1B	LVB	ND	0.500	ND	0.100	4.20	0.300	1.30	0.090	130	2.00	37	0.600
	Maximum:	**2.50**		**0.75**		**18.0**		**5.40**		**140**		**42**	
	Median:	**1.55**		**0.475**		**4.20**		**1.30**		**130**		**37**	
AC-7	PNWR	ND	0.500	ND	0.100	3.40	0.300	0.86	0.080	130	2.00	32	0.500
AC-11	PNWR	1.50	0.500	0.41	0.100	3.70	0.300	0.99	0.080	110	2.00	29	0.500
AC-12	PNWR	8.20	0.500	2	0.100	3.60	0.300	0.88	0.070	204	2.00	50	0.500
MW-3	PNWR	ND	0.500	ND	0.100	8.00	0.300	1.60	0.060	120	2.00	25	0.400
NH-1	PNWR	1.50	0.500	0.3	0.100	6.50	0.300	1.20	0.060	150	2.00	28	0.400
WG-1	PNWR	ND	0.500	ND	0.100	3.60	0.300	0.74	0.060	160	2.00	32	0.400
YBB-1	PNWR	ND	0.500	ND	0.090	1.50	0.300	0.27	0.050	150	2.00	27	0.400
	Maximum:	**8.20**		**2**		**8.00**		**1.60**		**204**		**50**	
	Median:	**1.50**		**0.41**		**3.60**		**0.88**		**150**		**28**	
Grand Maximum:		**8.2**		**2.0**		**132.0**		**23.5**		**255.0**		**50.0**	
Minimum LOC:		**na**		**na**		**na**		**na**		**na**		**na**	

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Lead Res Dry mg/kg	Lead DL Dry mg/kg	Lead Res Wet mg/kg	Lead DL Wet mg/kg	Magnesium Res Dry mg/kg	Magnesium DL Dry mg/kg	Magnesium Res Wet mg/kg	Magnesium DL Wet mg/kg	Manganese Res Dry mg/kg	Manganese DL Dry mg/kg	Manganese Res Wet mg/kg	Manganese DL Wet mg/kg
KD-5A	LW 10.75	ND	0.200	ND	0.0600	377	2.00	111	0.600	1.60	0.500	0.460	0.100
RWB-2	LW 10.75	ND	0.300	ND	0.0500	428	3.00	78.3	0.500	2.90	0.500	0.520	0.0900
RWB-3	LW 10.75	ND	0.300	ND	0.0500	554	3.00	99.1	0.500	1.90	0.500	0.340	0.0900
RWB-4	LW 10.75	ND	0.300	ND	0.0500	362	3.00	65.3	0.500	0.800	0.500	0.100	0.0900
RWB-5	LW 10.75	ND	0.200	ND	0.0300	594	2.00	93.6	0.300	1.00	0.500	0.200	0.0800
	Maximum:	**na, 0.3**		**na, 0.06**		**594**		**111**		**2.90**		**0.520**	
	Median:	**ND**		**ND**		**428**		**93.6**		**1.60**		**0.340**	
AC-14	NP	ND	0.200	ND	0.050	738	2.00	174	0.500	3.50	0.500	0.830	0.100
AC-1A	NP	ND	0.200	ND	0.050	504	2.00	125	0.500	1.80	0.500	0.440	0.100
AC-3A	NP	ND	0.200	ND	0.050	431	2.00	110	0.500	1.90	0.500	0.470	0.100
MW-1	NP	11.0	0.400	2.10	0.080	350	4.00	69	0.800	3.70	0.500	0.710	0.100
MW-2	NP	17.0	1.00	3.00	0.200	310	10.0	55	2.00	2.10	0.500	0.370	0.090
	Maximum:	**17.0**		**3.00**		**738**		**174**		**3.70**		**0.830**	
	Median:	**14.0**		**2.55**		**431**		**110**		**2.10**		**0.470**	
KD-2	DC	ND	0.200	ND	0.050	362	2.00	97.8	0.500	1.00	0.500	0.350	0.100
KD-4	DC	ND	0.200	ND	0.060	378	2.00	107	0.600	1.00	0.500	0.340	0.100
KD-8	DC	ND	0.200	ND	0.060	267	2.00	79.9	0.600	1.00	0.500	0.400	0.100
	Maximum:	**na, 0.2**		**na, 0.06**		**378**		**107**		**1.00**		**0.400**	
	Median:	**ND**		**ND**		**362**		**97.8**		**1.00**		**0.350**	
AC-5A	PB	ND	0.200	ND	0.040	744	2.00	166	0.400	1.00	0.500	0.200	0.100
KD-6A	PB	ND	0.200	ND	0.050	375	2.00	99.5	0.500	1.00	0.500	0.370	0.100
M-2A	PB	ND	0.200	ND	0.070	343	2.00	113	0.700	2.10	0.500	0.690	0.200
MW-4	PB	ND	0.500	ND	0.100	400	5.00	85	1.00	3.00	0.500	0.630	0.100
RWB-1	PB	ND	0.200	ND	0.030	503	2.00	82.3	0.300	2.90	0.500	0.480	0.080
	Maximum:	**na, 0.5**		**na, 0.1**		**744**		**166**		**3.00**		**0.690**	
	Median:	**ND**		**ND**		**400**		**99.5**		**2.10**		**0.480**	
KD-3	LVB	ND	0.200	ND	0.060	446	2.00	127	0.600	1.00	0.500	0.360	0.100
M-1	LVB	ND	0.200	ND	0.060	441	2.00	134	0.600	2.00	0.500	0.620	0.200
M-1B	LVB	ND	0.200	ND	0.060	410	2.00	122	0.600	1.00	0.500	0.330	0.100
	Maximum:	**na, 0.2**		**na, 0.06**		**446**		**134**		**2.00**		**0.620**	
	Median:	**ND**		**ND**		**441**		**127**		**1.00**		**0.360**	
AC-7	PNWR	ND	0.200	ND	0.050	434	2.00	110	0.500	1.70	0.500	0.420	0.100
AC-11	PNWR	ND	0.200	ND	0.050	595	2.00	159	0.500	1.00	0.500	0.300	0.100
AC-12	PNWR	ND	0.200	ND	0.050	547	2.00	134	0.500	1.70	0.500	0.420	0.100
MW-3	PNWR	0.500	0.300	0.090	0.060	290	3.00	56	0.600	2.40	0.500	0.470	0.100
NH-1	PNWR	ND	0.200	ND	0.040	785	2.00	151	0.400	1.90	0.500	0.370	0.100
WG-1	PNWR	ND	0.200	ND	0.040	554	2.00	115	0.400	1.90	0.500	0.400	0.100
YBB-1	PNWR	ND	0.200	ND	0.040	399	2.00	70.7	0.400	3.20	0.500	0.560	0.090
	Maximum:	**0.500**		**0.090**		**785**		**159**		**3.20**		**0.560**	
	Median:	**0.500**		**0.090**		**547**		**115**		**1.90**		**0.420**	
	Grand Maximum:	**17.0**		**3.0**		**785.0**		**174.0**		**3.7**		**0.8**	
	Minimum LOC:	**na**		**na**		**na**		**na**		**na**		**na**	

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Mercury Res Dry mg/kg	Mercury DL Dry mg/kg	Mercury Res Wet mg/kg	Mercury DL Wet mg/kg	Molybdenum Res Dry mg/kg	Molybdenum DL Dry mg/kg	Molybdenum Res Wet mg/kg	Molybdenum DL Wet mg/kg	Nickel Res Dry mg/kg	Nickel DL Dry mg/kg	Nickel Res Wet mg/kg	Nickel DL Wet mg/kg
KD-5A	LW 10.75	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.500	ND	0.100
RWB-2	LW 10.75	ND	0.100	ND	0.020	ND	2.00	ND	0.400	ND	0.500	ND	0.0900
RWB-3	LW 10.75	ND	0.100	ND	0.020	ND	2.00	ND	0.400	ND	0.500	ND	0.0900
RWB-4	LW 10.75	ND	0.100	ND	0.020	ND	2.00	ND	0.400	ND	0.500	ND	0.0900
RWB-5	LW 10.75	ND	0.100	ND	0.020	ND	2.00	ND	0.300	ND	0.500	ND	0.0800
	Maximum:	**na, 0.1**		**na, 0.03**		**na, 2**		**na, 0.6**		**na, 0.5**		**na, 0.1**	
	Median:	**ND**		**ND**		**ND**		**ND**		**ND**		**ND**	
AC-14	NP	ND	0.100	ND	0.020	ND	2.00	ND	0.50	ND	0.500	ND	0.100
AC-1A	NP	ND	0.100	ND	0.020	ND	2.00	ND	0.50	ND	0.500	ND	0.100
AC-3A	NP	0.200	0.100	0.050	0.030	ND	2.00	ND	0.50	ND	0.500	ND	0.100
MW-1	NP	ND	0.200	ND	0.040	ND	2.00	ND	0.40	ND	0.500	ND	0.100
MW-2	NP	ND	0.500	ND	0.090	ND	2.00	ND	0.40	0.9	0.500	0.200	0.090
	Maximum:	**0.200**		**0.050**		**na, 2**		**na, 0.5**		**0.900**		**0.200**	
	Median:	**0.200**		**0.050**		**ND**		**ND**		**0.900**		**0.200**	
KD-2	DC	ND	0.100	ND	0.03	ND	2.00	ND	0.500	0.500	0.500	ND	0.100
KD-4	DC	ND	0.100	ND	0.03	ND	2.00	ND	0.600	0.500	0.500	ND	0.100
KD-8	DC	ND	0.100	ND	0.03	ND	2.00	ND	0.600	0.500	0.500	ND	0.100
	Maximum:	**na, 0.1**		**na, 0.03**		**na, 2**		**na, 0.6**		**0.500**		**na, 0.1**	
	Median:	**ND**		**ND**		**ND**		**ND**		**0.500**		**ND**	
AC-5A	PB	ND	0.100	ND	0.020	ND	2.00	ND	0.400	ND	0.500	ND	0.100
KD-6A	PB	0.200	0.100	0.060	0.030	ND	2.00	ND	0.500	ND	0.500	ND	0.100
M-2A	PB	ND	0.100	ND	0.030	ND	2.00	ND	0.700	ND	0.500	ND	0.200
MW-4	PB	ND	0.200	ND	0.040	ND	2.00	ND	0.400	ND	0.500	ND	0.100
RWB-1	PB	ND	0.100	ND	0.020	ND	2.00	ND	0.300	ND	0.500	ND	0.080
	Maximum:	**0.200**		**0.060**		**na, 2**		**na, 0.7**		**na, 0.5**		**na, 0.2**	
	Median:	**0.200**		**0.060**		**ND**		**ND**		**ND**		**ND**	
KD-3	LVB	0.200	0.100	0.060	0.030	ND	2.00	ND	0.600	ND	0.500	ND	0.100
M-1	LVB	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.500	ND	0.200
M-1B	LVB	ND	0.100	ND	0.030	ND	2.00	ND	0.600	ND	0.500	ND	0.100
	Maximum:	**0.200**		**0.060**		**na, 2**		**na, 0.6**		**na, 0.5**		**na, 0.2**	
	Median:	**0.200**		**0.060**		**ND**		**ND**		**ND**		**ND**	
AC-7	PNWR	0.100	0.100	0.040	0.030	ND	2.00	ND	0.500	ND	0.500	ND	0.100
AC-11	PNWR	0.200	0.100	0.060	0.030	ND	2.00	ND	0.500	ND	0.500	ND	0.100
AC-12	PNWR	0.200	0.100	0.050	0.020	ND	2.00	ND	0.500	ND	0.500	ND	0.100
MW-3	PNWR	0.300	0.200	0.060	0.040	ND	2.00	ND	0.400	0.500	0.500	0.100	0.100
NH-1	PNWR	0.350	0.100	0.067	0.020	ND	2.00	ND	0.400	ND	0.500	ND	0.100
WG-1	PNWR	0.340	0.100	0.071	0.020	ND	2.00	ND	0.400	ND	0.500	ND	0.100
YBB-1	PNWR	0.100	0.100	0.020	0.020	ND	2.00	ND	0.400	ND	0.500	ND	0.090
	Maximum:	**0.350**		**0.071**		**na, 2**		**na, 0.5**		**0.500**		**0.100**	
	Median:	**0.200**		**0.060**		**ND**		**ND**		**0.500**		**0.100**	
	Grand Maximum:	**0.4**		**0.1**		**ND, 2**		**ND, 0.7**		**0.9**		**0.2**	
	Minimum LOC:	**0.2**		**0.05**		**16**		**na**		**na**		**na**	

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Selenium Res Dry mg/kg	Selenium DL Dry mg/kg	Selenium Res Wet mg/kg	Selenium DL Wet mg/kg	Strontium Res Dry mg/kg	Strontium DL Dry mg/kg	Strontium Res Wet mg/kg	Strontium DL Wet mg/kg	Vanadium Res Dry mg/kg	Vanadium DL Dry mg/kg	Vanadium Res Wet mg/kg	Vanadium DL Wet mg/kg
KD-5A	LW 10.75	5.80	0.300	1.70	0.090	29.2	0.200	8.61	0.060	ND	0.500	ND	0.100
RWB-2	LW 10.75	6.30	0.400	1.10	0.070	37.1	0.200	6.79	0.040	ND	0.500	ND	0.090
RWB-3	LW 10.75	5.30	0.400	0.95	0.070	48.5	0.200	8.67	0.040	ND	0.500	ND	0.090
RWB-4	LW 10.75	3.90	0.400	0.700	0.070	20.0	0.200	3.60	0.040	ND	0.500	ND	0.090
RWB-5	LW 10.75	6.60	0.600	1.00	0.090	48.4	0.200	7.64	0.030	ND	0.500	ND	0.080
	Maximum:	**6.60**		**1.70**		**48.5**		**8.67**		**na, 0.5**		**na, 0.1**	
	Median:	**5.80**		**1.00**		**37.1**		**7.64**		**ND**		**ND**	
AC-14	NP	15.0	0.600	3.60	0.100	55.8	0.200	13.1	0.050	ND	0.500	ND	0.100
AC-1A	NP	23.0	1.00	5.70	0.200	22.7	0.200	5.64	0.050	ND	0.500	ND	0.100
AC-3A	NP	21.0	1.00	5.50	0.300	24.1	0.200	6.13	0.050	ND	0.500	ND	0.100
MW-1	NP	13.0	0.600	2.50	0.100	26.5	0.200	5.16	0.040	ND	0.500	ND	0.100
MW-2	NP	15.0	2.00	2.60	0.400	27.2	0.200	4.82	0.040	ND	0.500	ND	0.090
	Maximum:	**23.0**		**5.70**		**55.8**		**13.1**		**na, 0.5**		**na, 0.1**	
	Median:	**15.0**		**3.60**		**26.5**		**5.64**		**ND**		**ND**	
KD-2	DC	12.0	0.600	3.30	0.200	19.0	0.200	5.18	0.050	ND	0.500	ND	0.100
KD-4	DC	15.0	0.600	4.10	0.200	19.0	0.200	5.40	0.060	ND	0.500	ND	0.100
KD-8	DC	3.80	0.300	1.10	0.090	6.90	0.200	2.10	0.060	ND	0.500	ND	0.100
	Maximum:	**15.0**		**4.10**		**19.0**		**5.40**		**na, 0.5**		**na, 0.1**	
	Median:	**12.0**		**3.30**		**19.0**		**5.18**		**ND**		**ND**	
AC-5A	PB	3.10	0.300	0.68	0.070	44.6	0.200	9.94	0.040	ND	0.500	ND	0.100
KD-6A	PB	3.90	0.300	1.00	0.080	16.0	0.200	4.20	0.050	ND	0.500	ND	0.100
M-2A	PB	3.20	0.300	1.10	0.100	16.0	0.200	5.30	0.070	ND	0.500	ND	0.200
MW-4	PB	5.60	0.700	1.20	0.100	35.3	0.200	7.48	0.040	ND	0.500	ND	0.100
RWB-1	PB	4.30	0.300	0.71	0.050	12.0	0.200	2.00	0.030	ND	0.500	ND	0.080
	Maximum:	**5.60**		**1.20**		**44.6**		**9.94**		**na, 0.5**		**na, 0.2**	
	Median:	**3.90**		**1.00**		**16.0**		**5.30**		**ND**		**ND**	
KD-3	LVB	5.20	0.300	1.50	0.090	22.6	0.200	6.43	0.060	ND	0.500	ND	0.100
M-1	LVB	4.50	0.300	1.40	0.090	33.3	0.200	10.2	0.060	ND	0.500	ND	0.200
M-1B	LVB	2.80	0.300	0.83	0.090	8.30	0.200	2.50	0.060	ND	0.500	ND	0.100
	Maximum:	**5.20**		**1.50**		**33.3**		**10.2**		**na, 0.5**		**na, 0.2**	
	Median:	**4.50**		**1.40**		**22.6**		**6.43**		**ND**		**ND**	
AC-7	PNWR	1.40	0.300	0.350	0.080	42.2	0.200	10.7	0.050	ND	0.500	ND	0.100
AC-11	PNWR	1.40	0.300	0.380	0.080	37.1	0.200	9.94	0.050	ND	0.500	ND	0.100
AC-12	PNWR	1.80	0.300	0.430	0.070	50.1	0.200	12.2	0.050	ND	0.500	ND	0.100
MW-3	PNWR	3.20	0.500	0.630	0.100	36.8	0.200	7.22	0.040	ND	0.500	ND	0.100
NH-1	PNWR	4.90	0.300	0.940	0.060	13.0	0.200	2.40	0.040	ND	0.500	ND	0.100
WG-1	PNWR	3.20	0.300	0.650	0.060	9.10	0.200	1.90	0.040	ND	0.500	ND	0.100
YBB-1	PNWR	4.10	0.300	0.720	0.050	60.7	0.200	10.7	0.040	ND	0.500	ND	0.090
	Maximum:	**4.90**		**0.940**		**60.7**		**12.2**		**na, 0.5**		**na, 0.1**	
	Median:	**3.20**		**0.630**		**37.1**		**9.94**		**ND**		**ND**	
Grand Maximum:		**23.0**		**5.7**		**60.7**		**13.1**		**ND, 0.5**		**ND, 0.2**	
Minimum LOC:		**4**		**3.00**		**na**		**na**		**na**		**na**	

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Sample	Location	Zinc Res Dry mg/kg	Zinc DL Dry mg/kg	Zinc Res Wet mg/kg	Zinc DL Wet mg/kg
KD-5A	LW 10.75	49.0	0.500	14.5	0.100
RWB-2	LW 10.75	65.0	0.500	11.9	0.090
RWB-3	LW 10.75	70.2	0.500	12.6	0.090
RWB-4	LW 10.75	60.5	0.500	10.9	0.090
RWB-5	LW 10.75	52.4	0.500	8.3	0.080
	Maximum:	**70.2**		**14.5**	
	Median:	**60.5**		**11.9**	
AC-14	NP	78.6	0.500	18.5	0.100
AC-1A	NP	67.3	0.500	16.7	0.100
AC-3A	NP	68.1	0.500	17.3	0.100
MW-1	NP	57.9	0.500	11.3	0.100
MW-2	NP	47.0	0.500	8.30	0.090
	Maximum:	**78.6**		**18.5**	
	Median:	**67.3**		**16.7**	
KD-2	DC	60.4	0.500	16.3	0.100
KD-4	DC	59.2	0.500	16.8	0.100
KD-8	DC	51.4	0.500	15.4	0.100
	Maximum:	**60.4**		**16.8**	
	Median:	**59.2**		**16.3**	
AC-5A	PB	97.2	0.500	21.7	0.100
KD-6A	PB	61.3	0.500	16.3	0.100
M-2A	PB	65.7	0.500	21.7	0.200
MW-4	PB	67.2	0.500	14.2	0.100
RWB-1	PB	57.6	0.500	9.43	0.080
	Maximum:	**97.2**		**21.7**	
	Median:	**65.7**		**16.3**	
KD-3	LVB	46	0.500	13	0.100
M-1	LVB	65.3	0.500	20	0.200
M-1B	LVB	50.2	0.500	14.9	0.100
	Maximum:	**65.3**		**20**	
	Median:	**50.2**		**14.9**	
AC-7	PNWR	64.7	0.500	16.4	0.100
AC-11	PNWR	63.8	0.500	17.1	0.100
AC-12	PNWR	73.3	0.500	17.9	0.100
MW-3	PNWR	69.5	0.500	13.6	0.100
NH-1	PNWR	53.1	0.500	10.2	0.100
WG-1	PNWR	48	0.500	10	0.100
YBB-1	PNWR	81	0.500	14.3	0.090
	Maximum:	**81**		**17.9**	
	Median:	**64.7**		**14.3**	
Grand Maximum:		**97.2**		**21.7**	
Minimum LOC:		**na**		**50**	

Table 18. Concentrations (mg/kg) of Inorganic Chemicals of Potential Concern in Bird Eggs, 2003

Notes

ND - not detected; na - not analyzed or not available; Res Dry - dry-weight residue; DL Dry - dry-weight detection limit; Res Wet - wet-weight residue; DL Wet - wet-weight detection limit; LOC - level of concern.
Location medians are reported for detectable concentrations, i.e., they exclude non-detects.
Although the review involved a search for benchmarks for antimony and titanium, none were identified, and these chemicals were not analyzed in bird eggs.

Three marsh hen samples (MW-2, MW-3, MW-4) were not sufficiently large for complete analysis of organics following analysis of inorganics.

LOC were taken from Table 17.

APPENDIX A

Common Synonyms and CASRN for Organic Chemicals of Potential Concern (COPC)

Chemical	CASRN	Common Synonyms
Aldrin	309-00-2	
alpha-BHC	319-84-6	alpha-benzene hexachloride alpha-HCH alpha-hexachlorocyclohexane alpha-lindane benzene hexachloride-alpha-isomer
beta-BHC	319-85-7	beta-benzene hexachloride beta-HCH beta-hexachlorocyclohexane beta-lindane beta-hexachlorobenzene trans-alpha-benzenehexachloride
delta-BHC	319-86-8	delta-benzene hexachloride delta-HCH delta-hexachlorocyclohexane delta-lindane
gamma-BHC	58-89-9	gamma-benzenehexachloride gamma-HCH gamma-hexachlorocyclohexane BHC (insecticide) benzene hexachloride benzene hexachloride-gamma isomer hexachlorocyclohexane hexachlorocyclohexane, gamma-isomer gamma-hexachlorobenzene lindane
alpha-Chlordane	5103-71-9	cis-chlordane c-chlordane
gamma-Chlordane	5566-34-7	trans-chlordane
Oxychlordane	27304-13-8	octachlor epoxide
Endrin	72-20-8	
HCB	118-74-1	hexachlorobenzene
Heptachlor	76-44-8	
Heptachlor epoxide	1024-57-3	

APPENDIX A

Common Synonyms and CASRN for Organic Chemicals of Potential Concern (continued)

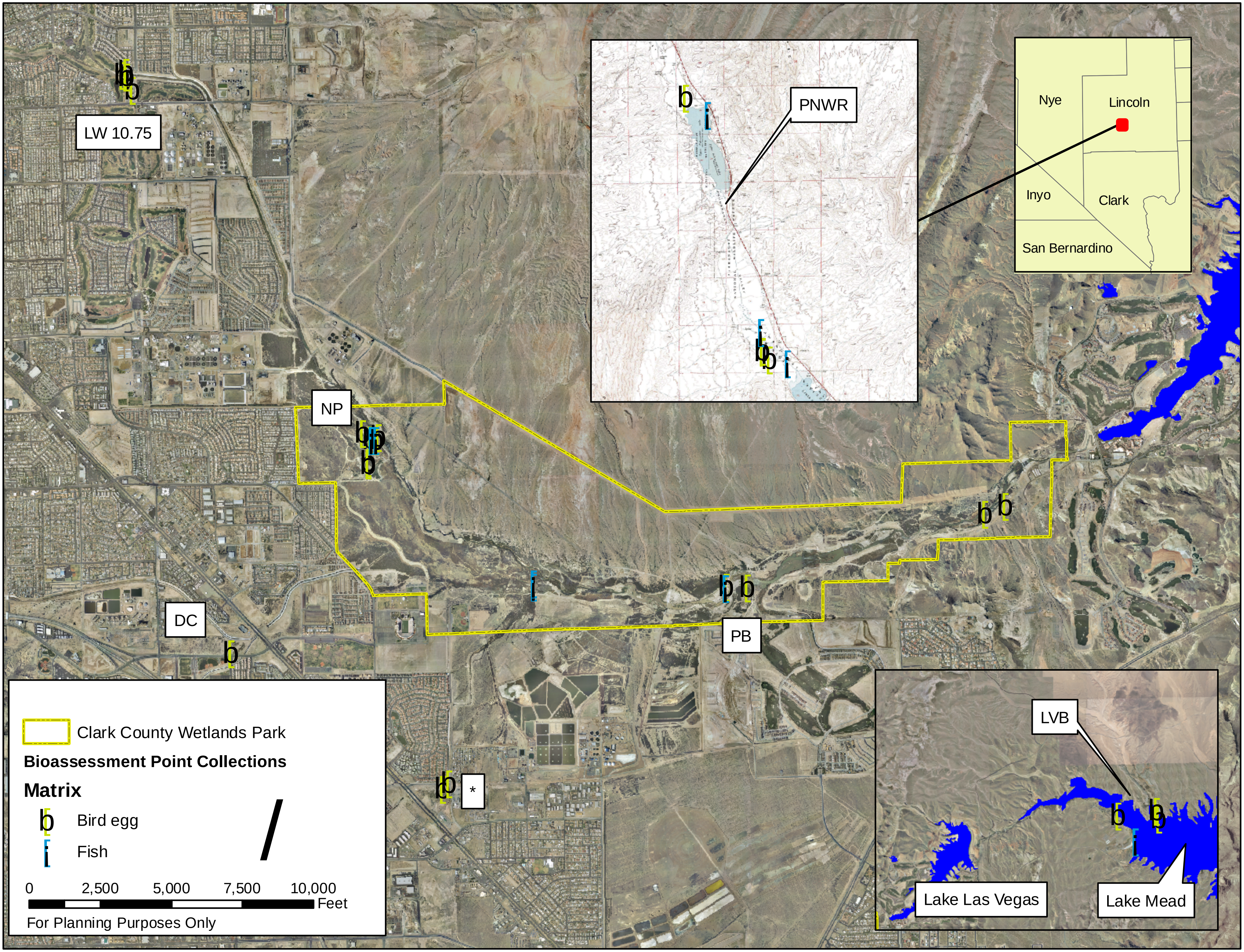
Chemical	CASRN	Common Synonyms
Mirex	2385-85-5	dodecaclor perchlordecone
cis-Nonachlor	5103-73-1	
trans-Nonachlor	39765-80-5	
o,p'-DDD	53-19-0	2,4'-DDD o,p'-dichlorodiphenyldichloroethane 2,4'-dichlorodiphenyldichloroethane 2,4'-dichlorophenyldichlorethane
o,p'-DDE	3424-82-6	2,4'-DDE o,p'-dichlorodiphenyl dichloroethene o,p'-dichlorodiphenyldichloroethylene
o,p'-DDT	789-02-6	2,4'-DDT o,p'-dichlorodiphenyltrichloroethane
p,p'-DDD	72-54-8	4,4'-DDD dichlorodiphenyldichloroethane
p,p'-DDE	72-55-9	4,4'-DDE DDT dehydrochloride dichlorodiphenyl dichloroethene dichlorodiphenyldichloroethylene
p,p'-DDT	50-29-3	4,4'-DDT dichlorodiphenyltrichloroethane 4,4'-dichlorodiphenyltrichloroethane p,p'-dichlorodiphenyltrichloroethane

CASRN, Chemical Abstract Services Registry Number

APPENDIX B

Map of Sampling Locations Used During the Las Vegas Wash Monitoring and Characterization Study, 2000 – 2003

Location codes and location descriptions are provided in Table 3.
*These two killdeer (*Charadrius vociferus*) eggs collected in 2003 in the vicinity of Duck Creek were later determined to have been taken from a location outside the original study design for the Las Vegas Wash Monitoring and Characterization Study.



LW 10.75
PNWR
Nye
Lincoln
Inyo
Clark
San Bernardino
NP
DC
PB
LVB
Lake Las Vegas
Lake Mead
Clark County Wetlands Park
Bioassessment Point Collections
Matrix
Bird egg
Fish
0
2,500
5,000
7,500
10,000
Feet
For Planning Purposes Only

APPENDIX C

Individual Whole Fish Samples and Bird Egg Samples Identified by Species and Location

Whole Fish Samples Identified by Species and Location

Sample	Species Common Name	Location[a]
03CCPahr01	Common carp	PNWR
03CCPahr02	Common carp	PNWR
03CCPahr03	Common carp	PNWR
03BBPahr05	Black bullhead	PNWR
03BBPahr06	Black bullhead	PNWR
03GSPahr04	Green sunfish	PNWR
03DCBB02	Black bullhead	DC
03DCBB05	Black bullhead	DC
03DCCC01	Common carp	DC
03DCCC03	Common carp	DC
03DCCC04	Common carp	DC
03LVBCAT04	Channel catfish	LVB
03LVBCC01	Common carp	LVB
03LVBCC02	Common carp	LVB
03LVBCC03	Common carp	LVB
03NPCC01	Common carp	NP
03NPCC02	Common carp	NP
03NPGS03	Green sunfish	NP
03PabBG04	Bluegill sunfish	PB
03PabCC01	Common carp	PB
03PabCC02	Common carp	PB
03PabCC03	Common carp	PB
03PabCC05	Common carp	PB
03PabCC06	Common carp	PB
03PabCC07	Common carp	PB
03PabCC08	Common carp	PB
03PabCC09	Common carp	PB
03PabCC10	Common carp	PB

[a] Location codes and location descriptions are provided in Table 3.

APPENDIX C

Individual Whole Fish Samples and Bird Egg Samples Identified by Species (continued)

Bird Egg Samples Identified by Species and Location

Sample	Species Common Name	Location[a]
KD-5A	Killdeer	LW10.75
RWB-2	Red-winged blackbird	LW10.75
RWB-3	Red-winged blackbird	LW10.75
RWB-4	Red-winged blackbird	LW10.75
RWB-5	Red-winged blackbird	LW10.75
AC-3A	American coot	NP
MW-1	Marsh wren	NP
AC-14	American coot	NP
AC-1A	American coot	NP
MW-2	Marsh wren	NP
KD-2	Killdeer	DC
KD-4	Killdeer	DC
KD-8	Killdeer	DC
AC-5A	American coot	PB
KD-6A	Killdeer	PB
M-2A	Mallard	PB
MW-4	Marsh wren	PB
RWB-1	Red-winged blackbird	PB
KD-3	Killdeer	LVB
M-1	Mallard	LVB
M-1B	Mallard	LVB
AC-11	American coot	PNWR
AC-12	American coot	PNWR
AC-7	American coot	PNWR
MW-3	Marsh wren	PNWR
NH-1	Black-crowned night-heron	PNWR
WG-1	Western grebe	PNWR
YBB-1	Yellow-headed blackbird	PNWR

[a] Location codes and location descriptions are provided in Table 3.

APPENDIX D

Concentrations (mg/kg) of Additional Organic Chemical Contaminants Measured in Bird Eggs, 2003

This appendix presents concentrations of organic chemical contaminants that were not considered in the current report because they were not among those specified as contaminants of concern in the 2001 Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries. Three marsh wren egg samples (sample codes MW-2, MW-3, and MW-4) did not provide sufficient sample volume for complete analysis of organics.

ND, not detected; na, not analyzed or not available; Res Dry, dry-weight residue; DL Dry, dry-weight detection limit; Res Wet, wet-weight residue; DL Wet, wet-weight detection limit; DDMU (a metabolite of DDT) ,1-di-(p-chlorophenyl)-2-chloroethylene.

Location codes: LW10.75, Las Vegas Wash mile 10.75, upstream of all municipal wastewater treatment plant discharges; NP, Nature Preserve at Clark County Wetlands Park; DC, Duck Creek (DC 1) below Broadbent Road; PB, Las Vegas Wash mile 6.05, upstream of Pabco Road erosion control structure; LVB, Las Vegas Bay delta (as of April 2003); PNWR, Pahranaghat National Wildlife Refuge, regional reference site.

Sample	Location	DDMU Res Dry	DDMU DL Dry	DDMU Res Wet	DDMU DL Wet	Pentachloro-anisole Res Dry	Pentachloro-anisole DL Dry	Pentachloro-anisole Res Wet	Pentachloro-anisole DL Wet
KD-5A	LW 10.75	ND	0.00159	ND	0.000397	ND	0.00215	ND	0.000536
RWB-2	LW 10.75	0.00572	0.00322	0.000938	0.000529	ND	0.00435	ND	0.000714
RWB-3	LW 10.75	0.112	0.00380	0.0159	0.000543	ND	0.00513	ND	0.000733
RWB-4	LW 10.75	0.00777	0.00313	0.000991	0.000400	ND	0.00423	ND	0.000540
RWB-5	LW 10.75	ND	0.00534	ND	0.000610	ND	0.00721	ND	0.000824
AC-3A	NP	0.00451	0.00114	0.00117	0.000296	ND	0.00154	ND	0.000400
MW-1	NP	0.0109	0.00316	0.00191	0.000553	ND	0.00427	ND	0.000747
AC-14	NP	ND	0.00112	ND	0.000279	ND	0.00151	ND	0.000377
AC-1A	NP	ND	0.00123	ND	0.000301	ND	0.00166	ND	0.000406
MW-2	NP	na	na	ND	0.000955	na	na	ND	0.00129
KD-2	DC	0.00542	0.00165	0.00130	0.000397	ND	0.00223	ND	0.000536
KD-4	DC	0.00264	0.00141	0.000693	0.000370	ND	0.00190	ND	0.000500
KD-8	DC	0.00220	0.00178	0.000538	0.000435	ND	0.00240	ND	0.000588
AC-5A	PB	0.0257	0.00122	0.00580	0.000275	ND	0.00165	ND	0.000372
KD-6A	PB	0.00816	0.00216	0.00218	0.000575	ND	0.00291	ND	0.000776
M-2A	PB	0.0111	0.000941	0.00357	0.000302	ND	0.00127	ND	0.000408
MW-4	PB	na	na	0.00287	0.000610	na	na	ND	0.000824
RWB-1	PB	0.0446	0.00300	0.00648	0.000435	ND	0.00405	ND	0.000588
KD-3	LVB	0.112	0.00183	0.0304	0.000493	ND	0.00246	ND	0.000666
M-1	LVB	0.00828	0.000993	0.00247	0.000296	ND	0.00134	ND	0.000400
M-1B	LVB	0.0143	0.000917	0.00487	0.000312	ND	0.00124	ND	0.000421
AC-11	PNWR	ND	0.00115	ND	0.000295	ND	0.00155	ND	0.000398
AC-12	PNWR	0.00214	0.00134	0.000543	0.000340	ND	0.00182	ND	0.000459
AC-7	PNWR	ND	0.00131	ND	0.000298	ND	0.00176	ND	0.000402
MW-3	PNWR	na	na	0.000711	0.000617	na	na	ND	0.000833
NH-1	PNWR	0.0348	0.00160	0.00637	0.000293	ND	0.00216	ND	0.000396
WG-1	PNWR	1.26	0.00136	0.246	0.000265	ND	0.00184	ND	0.000358
YBB-1	PNWR	0.00982	0.00223	0.00161	0.000365	ND	0.00302	ND	0.000493

Sample	Location	Toxaphene Res Dry	Toxaphene DL Dry	Toxaphene Res Wet	Toxaphene DL Wet	Chlorpyrifos Res Dry	Chlorpyrifos DL Dry	Chlorpyrifos Res Wet	Chlorpyrifos DL Wet
KD-5A	LW 10.75	ND	0.134	ND	0.0336	0.0244	0.000757	0.00610	0.000189
RWB-2	LW 10.75	ND	0.272	ND	0.0446	ND	0.00154	ND	0.000252
RWB-3	LW 10.75	ND	0.321	ND	0.0459	ND	0.00181	ND	0.000259
RWB-4	LW 10.75	ND	0.265	ND	0.0338	ND	0.00149	ND	0.000191
RWB-5	LW 10.75	ND	0.451	ND	0.0515	ND	0.00254	ND	0.000291
AC-3A	NP	ND	0.0963	ND	0.0250	0.00426	0.000543	0.00111	0.000141
MW-1	NP	ND	0.267	ND	0.0467	ND	0.00151	ND	0.000264
AC-14	NP	ND	0.0943	ND	0.0236	0.0165	0.000532	0.00414	0.000133
AC-1A	NP	ND	0.104	ND	0.0254	ND	0.000584	ND	0.000143
MW-2	NP	na	na	ND	0.0806	na	na	ND	0.000455
KD-2	DC	ND	0.139	ND	0.0336	0.00425	0.000786	0.00102	0.000189
KD-4	DC	ND	0.119	ND	0.0312	0.00347	0.000672	0.000911	0.000176
KD-8	DC	ND	0.150	ND	0.0368	ND	0.000848	ND	0.000207
AC-5A	PB	ND	0.103	ND	0.0233	0.00105	0.000581	0.000237	0.000131
KD-6A	PB	ND	0.182	ND	0.0485	ND	0.00103	ND	0.000274
M-2A	PB	ND	0.0794	ND	0.0255	0.00108	0.000448	0.000345	0.000144
MW-4	PB	na	na	ND	0.0515	na	na	ND	0.000291
RWB-1	PB	ND	0.253	ND	0.0368	ND	0.00143	ND	0.000207
KD-3	LVB	ND	0.154	ND	0.0417	0.00995	0.000870	0.00269	0.000235
M-1	LVB	ND	0.0839	ND	0.0250	0.00226	0.000473	0.000673	0.000141
M-1B	LVB	ND	0.0774	ND	0.0263	ND	0.000437	ND	0.000148
AC-11	PNWR	ND	0.0970	ND	0.0249	ND	0.000547	ND	0.00014
AC-12	PNWR	ND	0.114	ND	0.0287	ND	0.000640	ND	0.000162
AC-7	PNWR	ND	0.110	ND	0.0251	ND	0.000622	ND	0.000142
MW-3	PNWR	na	na	ND	0.0521	na	na	ND	0.000294
NH-1	PNWR	ND	0.135	ND	0.0248	ND	0.000763	ND	0.00014
WG-1	PNWR	ND	0.115	ND	0.0224	0.00998	0.000650	0.00194	0.000126
YBB-1	PNWR	ND	0.189	ND	0.0309	ND	0.00106	ND	0.000174

APPENDIX D: Concentrations (mg/kg) of Additional Organic Chemical Contaminants Measured in Bird Eggs, 2003 (continued)

Sample	Location	1,2,3,4-Tetrachloro-benzene Res Dry	1,2,3,4-Tetrachloro-benzene DL Dry	1,2,3,4-Tetrachloro-benzene Res Wet	1,2,3,4-Tetrachloro-benzene DL Wet	1,2,4,5-Tetrachloro-benzene Res Dry	1,2,4,5-Tetrachloro-benzene DL Dry	1,2,4,5-Tetrachloro-benzene Res Wet	1,2,4,5-Tetrachloro-benzene DL Wet
KD-5A	LW 10.75	ND	0.00146	ND	0.000366	ND	0.00382	ND	0.000954
RWB-2	LW 10.75	ND	0.00297	ND	0.000487	0.0122	0.00774	0.00200	0.00127
RWB-3	LW 10.75	ND	0.00350	ND	0.000501	0.0166	0.00913	0.00237	0.00130
RWB-4	LW 10.75	0.00530	0.00289	0.000676	0.000369	ND	0.00753	ND	0.000961
RWB-5	LW 10.75	0.00754	0.00492	0.000862	0.000563	0.0156	0.0128	0.00178	0.00147
AC-3A	NP	ND	0.00105	ND	0.000273	ND	0.00274	ND	0.000711
MW-1	NP	ND	0.00292	ND	0.000510	ND	0.00760	ND	0.00133
AC-14	NP	ND	0.00103	ND	0.000257	ND	0.00268	ND	0.000671
AC-1A	NP	ND	0.00113	ND	0.000277	0.00696	0.00294	0.00170	0.000722
MW-2	NP	na	na	ND	0.000880	na	na	ND	0.00229
KD-2	DC	ND	0.00152	ND	0.000366	ND	0.00396	ND	0.000954
KD-4	DC	ND	0.00130	ND	0.000341	ND	0.00339	ND	0.000889
KD-8	DC	ND	0.00164	ND	0.000401	ND	0.00428	ND	0.00105
AC-5A	PB	0.00244	0.00112	0.000550	0.000254	0.0211	0.00293	0.00476	0.000661
KD-6A	PB	0.0214	0.00199	0.00571	0.000530	0.0255	0.00518	0.00679	0.00138
M-2A	PB	0.0308	0.000867	0.00989	0.000278	0.0401	0.00226	0.0129	0.000726
MW-4	PB	na	na	ND	0.000563	na	na	0.00330	0.00147
RWB-1	PB	0.0183	0.00276	0.00265	0.000401	0.0283	0.00720	0.00410	0.00105
KD-3	LVB	ND	0.00168	ND	0.000455	ND	0.00438	ND	0.00118
M-1	LVB	ND	0.000915	ND	0.000273	ND	0.00238	ND	0.000711
M-1B	LVB	0.00127	0.000845	0.000433	0.000287	0.00532	0.00220	0.00181	0.000748
AC-11	PNWR	ND	0.00106	ND	0.000272	ND	0.00276	ND	0.000708
AC-12	PNWR	ND	0.00124	ND	0.000314	ND	0.00323	ND	0.000817
AC-7	PNWR	ND	0.00120	ND	0.000274	ND	0.00314	ND	0.000715
MW-3	PNWR	na	na	ND	0.000568	na	na	0.00252	0.00148
NH-1	PNWR	ND	0.00148	ND	0.000270	ND	0.00385	ND	0.000704
WG-1	PNWR	ND	0.00126	ND	0.000245	0.00760	0.00328	0.00148	0.000638
YBB-1	PNWR	ND	0.00206	ND	0.000337	ND	0.00536	ND	0.000878

Sample	Location	Pentachloro-benzene Res Dry	Pentachloro-benzene DL Dry	Pentachloro-benzene Res Wet	Pentachloro-benzene DL Wet	Endosulfan I Res Dry	Endosulfan I DL Dry	Endosulfan I Res Wet	Endosulfan I DL Wet
KD-5A	LW 10.75	ND	0.00200	ND	0.000501	0.208	0.00243	0.0520	0.000607
RWB-2	LW 10.75	ND	0.00407	ND	0.000667	0.0106	0.00493	0.00174	0.000808
RWB-3	LW 10.75	0.0402	0.00480	0.00575	0.000685	ND	0.00581	ND	0.000830
RWB-4	LW 10.75	0.0163	0.00395	0.00208	0.000505	0.00902	0.00479	0.00115	0.000611
RWB-5	LW 10.75	0.0118	0.00674	0.00134	0.000770	ND	0.00816	ND	0.000933
AC-3A	NP	0.00418	0.00144	0.00108	0.000373	ND	0.00174	ND	0.000452
MW-1	NP	ND	0.00399	ND	0.000698	0.0373	0.00483	0.00653	0.000845
AC-14	NP	ND	0.00141	ND	0.000352	0.0868	0.00171	0.0217	0.000427
AC-1A	NP	0.00208	0.00155	0.000509	0.000379	ND	0.00187	ND	0.000459
MW-2	NP	na	na	0.00244	0.00120	na	na	0.00857	0.00146
KD-2	DC	ND	0.00208	ND	0.000501	0.0211	0.00252	0.00509	0.000607
KD-4	DC	ND	0.00178	ND	0.000467	0.0186	0.00215	0.00488	0.000565
KD-8	DC	ND	0.00225	ND	0.000549	0.0203	0.00272	0.00496	0.000665
AC-5A	PB	0.0416	0.00154	0.00938	0.000347	ND	0.00186	ND	0.000421
KD-6A	PB	ND	0.00272	ND	0.000725	0.0125	0.00329	0.00332	0.000878
M-2A	PB	0.0575	0.00119	0.0185	0.000381	0.0202	0.00144	0.00650	0.000462
MW-4	PB	na	na	ND	0.000770	na	na	ND	0.000933
RWB-1	PB	0.00774	0.00378	0.00112	0.000549	ND	0.00458	ND	0.000665
KD-3	LVB	ND	0.00230	ND	0.000622	0.0174	0.00279	0.00471	0.000754
M-1	LVB	ND	0.00125	ND	0.000373	0.0224	0.00152	0.00668	0.000452
M-1B	LVB	0.00438	0.00116	0.00149	0.000393	0.0128	0.00140	0.00434	0.000476
AC-11	PNWR	ND	0.00145	ND	0.000371	ND	0.00176	ND	0.000450
AC-12	PNWR	ND	0.00170	ND	0.000429	ND	0.00205	ND	0.000520
AC-7	PNWR	ND	0.00165	ND	0.000375	ND	0.00200	ND	0.000455
MW-3	PNWR	na	na	ND	0.000778	na	na	ND	0.000942
NH-1	PNWR	ND	0.00202	ND	0.000370	0.00864	0.00245	0.00158	0.000448
WG-1	PNWR	ND	0.00172	ND	0.000335	ND	0.00209	ND	0.000406
YBB-1	PNWR	ND	0.00282	ND	0.000461	ND	0.00341	ND	0.000558

Sample	Location	Endosulfan II Res Dry	Endosulfan II DL Dry	Endosulfan II Res Wet	Endosulfan II DL Wet	Endosulfan sulfate Res Dry	Endosulfan sulfate DL Dry	Endosulfan sulfate Res Wet	Endosulfan sulfate DL Wet
KD-5A	LW 10.75	ND	0.00243	ND	0.000607	ND	0.000687	ND	0.000172
RWB-2	LW 10.75	ND	0.00493	ND	0.000808	ND	0.00140	ND	0.000229
RWB-3	LW 10.75	ND	0.00581	ND	0.000830	ND	0.00164	ND	0.000235
RWB-4	LW 10.75	ND	0.00479	ND	0.000611	ND	0.00136	ND	0.000173
RWB-5	LW 10.75	ND	0.00816	ND	0.000933	ND	0.00231	ND	0.000264
AC-3A	NP	ND	0.00174	ND	0.000452	ND	0.000493	ND	0.000128
MW-1	NP	ND	0.00483	ND	0.000845	ND	0.00137	ND	0.000239
AC-14	NP	ND	0.00171	ND	0.000427	ND	0.000483	ND	0.000121
AC-1A	NP	0.00303	0.00187	0.000742	0.000459	0.000542	0.000530	ND	0.000130
MW-2	NP	na	na	ND	0.00146	na	na	ND	0.000413
KD-2	DC	0.00517	0.00252	0.00124	0.000607	0.00859	0.000714	0.00207	0.000172
KD-4	DC	ND	0.00215	ND	0.000565	0.00325	0.000610	0.000852	0.000160
KD-8	DC	ND	0.00272	ND	0.000665	ND	0.000770	ND	0.000188
AC-5A	PB	ND	0.00186	ND	0.000421	ND	0.000527	ND	0.000119
KD-6A	PB	ND	0.00329	ND	0.000878	ND	0.000932	ND	0.000249
M-2A	PB	ND	0.00144	ND	0.000462	0.00577	0.000407	0.00185	0.000131
MW-4	PB	na	na	ND	0.000933	na	na	ND	0.000264
RWB-1	PB	ND	0.00458	ND	0.000665	ND	0.00130	ND	0.000188
KD-3	LVB	ND	0.00279	ND	0.000754	ND	0.000790	ND	0.000213
M-1	LVB	ND	0.00152	ND	0.000452	ND	0.000430	ND	0.000128
M-1B	LVB	0.00278	0.00140	0.000944	0.000476	ND	0.000396	ND	0.000135
AC-11	PNWR	ND	0.00176	ND	0.000450	ND	0.000497	ND	0.000127
AC-12	PNWR	ND	0.00205	ND	0.000520	ND	0.000581	ND	0.000147
AC-7	PNWR	ND	0.00200	ND	0.000455	ND	0.000565	ND	0.000129
MW-3	PNWR	na	na	ND	0.000942	na	na	ND	0.000267
NH-1	PNWR	ND	0.00245	ND	0.000448	0.00221	0.000693	0.000405	0.000127
WG-1	PNWR	0.0241	0.00209	0.00469	0.000406	ND	0.000591	ND	0.000115
YBB-1	PNWR	ND	0.00341	ND	0.000558	ND	0.000966	ND	0.000158

APPENDIX E

Concentrations (mg/kg) of Organic Chemical Contaminants in Additional Bird Egg Samples Not Assessed in This Report

Two killdeer (*Charadrius vociferus*) eggs collected in 2003 in the vicinity of Duck Creek were later determined to have been taken from a location outside the original study design for the Las Vegas Wash Monitoring and Characterization Study. Chemical concentration data for these two eggs (samples KD-9 and KD-10B) are presented below.

ND, not detected; DL, detection limit; Dry, dry-weight residue or detection limit; Wet, wet-weight residue or detection limit; DDMU (a metabolite of DDT) ,1-di-(p-chlorophenyl)-2-chloroethylene. Percent moisture: KD-9, 70.5%; KD-10B, 73.3%.

Please Note (USFWS, personal communication, August 23, 2006): p,p'-DDE, lindane, endrin, and total PCB concentrations were elevated in these killdeer egg samples. Concentrations for p,p'-DDE, endrin, and total PCB were higher in sample KD-9 than in any other bird egg sample collected as part of the 2003 data set. The samples were collected in Henderson, Nevada from an area down gradient of a former chemical manufacturing facility.

APPENDIX E

Concentrations (mg/kg) of Organic Chemical Contaminants in Additional Bird Egg Samples Not Assessed in This Report (continued)

Chemical or Parameter		KD-9 Residue	KD-9 DL	KD-10B Residue	KD-10B DL
Aldrin	Dry	ND	0.00108	0.00127	0.00124
	Wet	ND	0.000269	0.000335	0.000328
Benzene hexachloride (BHC-Total)	Dry	2.93	0.00533	0.422	0.00616
	Wet	0.734	0.00133	0.112	0.00163
alpha-BHC	Dry	0.0156	0.00155	ND	0.00179
	Wet	0.00391	0.000388	ND	0.000473
beta-BHC	Dry	2.89	0.00152	0.421	0.00176
	Wet	0.722	0.000380	0.111	0.000464
delta-BHC	Dry	0.0284	0.00168	ND	0.00194
	Wet	0.00709	0.000420	ND	0.000512
gamma-BHC (lindane)	Dry	0.00422	0.00151	ND	0.00174
	Wet	0.00106	0.000377	ND	0.000460
alpha-Chlordane	Dry	ND	0.00130	ND	0.00150
	Wet	ND	0.000325	ND	0.000396
gamma-Chlordane	Dry	ND	0.00135	ND	0.00156
	Wet	ND	0.000338	ND	0.000413
Oxychlordane	Dry	0.203	0.00185	0.0289	0.00213
	Wet	0.0508	0.000462	0.00765	0.000563
cis-Nonachlor	Dry	0.876	0.00133	0.513	0.00153
	Wet	0.219	0.000332	0.136	0.000405
trans-Nonachlor	Dry	0.555	0.00141	0.0670	0.00163
	Wet	0.139	0.000353	0.0177	0.000430
Heptachlor	Dry	0.00308	0.00190	ND	0.00220
	Wet	0.00077	0.000476	ND	0.000581
Heptachor epoxide	Dry	0.230	0.00161	0.127	0.00186
	Wet	0.0576	0.000402	0.0336	0.000491
Dieldrin	Dry	0.0501	0.00154	0.0885	0.00178
	Wet	0.0125	0.000385	0.0234	0.000470
Endrin	Dry	0.618	0.00184	ND	0.00213
	Wet	0.154	0.000461	ND	0.000562

APPENDIX E

Concentrations (mg/kg) of Organic Chemical Contaminants in Additional Bird Egg Samples Not Assessed in This Report (continued)

		Sample			
		KD-9		KD-10B	
Chemical or Parameter		Residue	DL	Residue	DL
Hexachlorobenzene (HCB)	Dry	0.508	0.00214	0.234	0.00247
	Wet	0.127	0.000535	0.0619	0.000653
Mirex	Dry	0.676	0.00153	ND	0.00176
	Wet	0.169	0.000382	ND	0.000465
p,p'-DDT	Dry	0.619	0.00150	ND	0.00174
	Wet	0.155	0.000376	ND	0.000459
p,p-'DDE	Dry	74.0	0.00136	19.6	0.00156
	Wet	18.5	0.000339	5.19	0.000413
p,p'-DDD	Dry	0.364	0.00116	0.279	0.00134
	Wet	0.0909	0.000291	0.0737	0.000355
o,p'-DDT	Dry	0.808	0.00106	0.00965	0.00122
	Wet	0.202	0.000264	0.00255	0.000322
o,p'-DDE	Dry	0.723	0.00122	0.591	0.00141
	Wet	0.181	0.000305	0.156	0.000372
o,p'-DDD	Dry	0.138	0.00196	0.0229	0.00227
	Wet	0.0344	0.000491	0.00604	0.000599
DDMU	Dry	0.390	0.00138	0.171	0.00159
	Wet	0.0975	0.000344	0.0452	0.000420
Endosulfan I	Dry	0.365	0.00210	0.0355	0.00243
	Wet	0.0912	0.000526	0.00938	0.000642
Endosulfan II	Dry	0.379	0.00210	ND	0.00243
	Wet	0.0947	0.000526	ND	0.000642
Endosulfan sulfate	Dry	0.557	0.000596	0.00938	0.000688
	Wet	0.139	0.000149	0.00248	0.000182
Pentachloro-anisole	Dry	0.00512	0.00186	ND	0.00215
	Wet	0.00128	0.000465	ND	0.000567
Toxaphene	Dry	ND	0.116	ND	0.134
	Wet	ND	0.0291	ND	0.0355
Chlorpyrifos	Dry	0.0245	0.000656	0.00421	0.000757
	Wet	0.00614	0.000164	0.00111	0.000200
1,2,3,4-Tetrachlorobenzene	Dry	0.0386	0.00127	ND	0.00146
	Wet	0.00965	0.000317	ND	0.000387
1,2,4,5-Tetrachlorobenzene	Dry	0.0371	0.00331	ND	0.00382
	Wet	0.00927	0.000827	ND	0.00101
Pentachlorobenzene	Dry	0.188	0.00174	0.106	0.00200
	Wet	0.0470	0.000434	0.0279	0.000530
PCB-Total	Dry	11.2	0.159	2.65	0.184
	Wet	2.79	0.0398	0.701	0.0486

APPENDIX F

Concentrations (mg/kg) of Inorganic Chemical Contaminants in Additional Bird Egg Samples Not Assessed in This Report

Two killdeer (*Charadrius vociferus*) eggs collected in 2003 in the vicinity of Duck Creek were later determined to have been taken from a location outside the original study design for the Las Vegas Wash Monitoring and Characterization Study. Chemical concentration data for these two eggs (samples KD-9 and KD-10B) are presented below.

ND, not detected; DL, detection limit; Dry, dry-weight residue or detection limit; Wet, wet-weight residue or detection limit. Percent moisture: KD-9, 75.0%; KD-10B, 73.6%.

APPENDIX F

Concentrations (mg/kg) of Inorganic Chemical Contaminants in Additional Bird Egg Samples Not Assessed in This Report (continued)

Chemical or Parameter		KD-9 Residue	KD-9 DL	KD-10B Residue	KD-10B DL
Aluminum	Dry	ND	2.00	ND	2.00
	Wet	ND	0.600	ND	0.500
Arsenic	Dry	ND	0.200	ND	0.200
	Wet	ND	0.0600	ND	0.0500
Barium	Dry	0.880	0.200	0.920	0.200
	Wet	0.260	0.0600	0.250	0.0500
Beryllium	Dry	ND	0.100	ND	0.100
	Wet	ND	0.0300	ND	0.0300
Boron	Dry	ND	2.00	ND	2.00
	Wet	ND	0.600	ND	0.500
Cadmium	Dry	ND	0.100	0.100	0.100
	Wet	ND	0.0300	0.0300	0.0300
Chromium	Dry	ND	0.500	ND	0.500
	Wet	ND	0.100	ND	0.100
Copper	Dry	3.60	0.300	4.20	0.300
	Wet	1.10	0.0900	1.10	0.0800
Iron	Dry	110	2.00	78.0	2.00
	Wet	33.0	0.600	21.0	0.500
Lead	Dry	ND	0.200	ND	0.200
	Wet	ND	0.0600	ND	0.0500
Magnesium	Dry	370	2.00	398	2.00
	Wet	109	0.600	106	0.500
Manganese	Dry	1.00	0.500	0.900	0.500
	Wet	0.350	0.100	0.200	0.100
Mercury	Dry	0.100	0.100	0.350	0.100
	Wet	0.0400	0.0300	0.0930	0.0300
Molybdenum	Dry	ND	2.00	ND	2.00
	Wet	ND	0.600	ND	0.500
Nickel	Dry	ND	0.500	ND	0.500
	Wet	ND	0.100	ND	0.100
Selenium	Dry	3.90	0.300	3.70	0.300
	Wet	1.10	0.0900	1.00	0.0800
Strontium	Dry	27.5	0.200	21.8	0.200
	Wet	8.11	0.0600	5.82	0.0500
Vanadium	Dry	ND	0.500	ND	0.500
	Wet	ND	0.100	ND	0.100
Zinc	Dry	61.3	0.500	57.9	0.500
	Wet	18.1	0.100	15.5	0.100

APPENDIX G

Concentrations (mg/kg) of Additional Organic Chemical Contaminants Measured in Whole Fish, 2003

This appendix presents concentrations of organic chemical contaminants that were not considered in the current report because they were not among those specified as contaminants of concern in the 2001 Bioassessment Monitoring Plan for Las Vegas Wash and Tributaries.

ND, not detected; Res Dry, dry-weight residue; DL Dry, dry-weight detection limit; Res Wet, wet-weight residue; DL Wet, wet-weight detection limit; DDMU (a metabolite of DDT) ,1-di-(p-chlorophenyl)-2-chloroethylene.

Location codes: NP, Nature Preserve at Clark County Wetlands Park; DC, Duck Creek (DC 1) below Broadbent Road; PB, Las Vegas Wash mile 6.05, upstream of Pabco Road erosion control structure; LVB, Las Vegas Bay delta (as of April 2003); PNWR, Pahranaghat National Wildlife Refuge, regional reference site.

Sample	Location	Chlorpyrifos Res Dry	Chlorpyrifos DL Dry	Chlorpyrifos Res Wet	Chlorpyrifos DL Wet	DDMU Res Dry	DDMU DL Dry	DDMU Res Wet	DDMU DL Wet
03CCPahr01	PNWR	ND	0.00120	ND	0.000236	ND	0.000701	ND	0.000138
03CCPahr02	PNWR	ND	0.00104	ND	0.000233	ND	0.000606	ND	0.000137
03CCPahr03	PNWR	ND	0.000992	ND	0.000232	ND	0.000580	ND	0.000136
03BBPahr05	PNWR	ND	0.00115	ND	0.000203	ND	0.000672	ND	0.000119
03BBPahr06	PNWR	ND	0.00124	ND	0.000227	ND	0.000725	ND	0.000133
03GSPahr04	PNWR	ND	0.00108	ND	0.000236	ND	0.000629	ND	0.000138
03DCBB02	DC	0.00180	0.00104	0.000393	0.000226	0.00367	0.000607	0.000800	0.000132
03DCBB05	DC	ND	0.00113	ND	0.000233	0.00349	0.000659	0.000724	0.000137
03DCCC01	DC	ND	0.000871	ND	0.000232	0.00832	0.000509	0.00221	0.000136
03DCCC03	DC	ND	0.000860	ND	0.000223	0.00430	0.000503	0.00112	0.000131
03DCCC04	DC	ND	0.000963	ND	0.000229	0.00689	0.000563	0.00164	0.000134
03LVBCAT04	LVB	0.00122	0.000935	0.000307	0.000235	0.0817	0.000547	0.0206	0.000138
03LVBCC01	LVB	0.00162	0.000747	0.000505	0.000233	0.0440	0.000437	0.0137	0.000136
03LVBCC02	LVB	ND	0.000953	ND	0.000236	0.00708	0.000558	0.00175	0.000138
03LVBCC03	LVB	ND	0.000828	ND	0.000235	0.0462	0.000484	0.0131	0.000137
03NPCC01	NP	ND	0.000855	ND	0.000225	ND	0.000500	ND	0.000131
03NPCC02	NP	ND	0.00118	ND	0.000218	ND	0.000690	ND	0.000128
03NPGS03	NP	ND	0.00139	ND	0.000358	ND	0.000811	ND	0.000209
03PabBG04	PB	0.00253	0.000856	0.000691	0.000233	0.0135	0.000501	0.00367	0.000137
03PabCC01	PB	ND	0.000795	ND	0.000225	0.0211	0.000465	0.00596	0.000131
03PabCC02	PB	ND	0.000776	ND	0.000236	0.0193	0.000454	0.00588	0.000138
03PabCC03	PB	ND	0.000943	ND	0.000236	0.00718	0.000552	0.00180	0.000138
03PabCC05	PB	0.00335	0.000804	0.000966	0.000232	0.0109	0.000470	0.00313	0.000136
03PabCC06	PB	0.000990	0.000874	0.000265	0.000233	0.00365	0.000511	0.000974	0.000137
03PabCC07	PB	ND	0.00121	ND	0.000233	0.0139	0.000706	0.00269	0.000136
03PabCC08	PB	0.00229	0.000759	0.000705	0.000233	0.0169	0.000444	0.00521	0.000137
03PabCC09	PB	0.00372	0.000711	0.00116	0.000223	0.0120	0.000416	0.00376	0.000130
03PabCC10	PB	ND	0.000964	ND	0.000231	0.00537	0.000564	0.00129	0.000135

Sample	Location	Endosulfan I Res Dry	Endosulfan I DL Dry	Endosulfan I Res Wet	Endosulfan I DL Wet	Endosulfan II Res Dry	Endosulfan II DL Dry	Endosulfan II Res Wet	Endosulfan II DL Wet
03CCPahr01	PNWR	ND	0.00205	ND	0.000403	ND	0.00195	ND	0.000383
03CCPahr02	PNWR	ND	0.00177	ND	0.000399	ND	0.00168	ND	0.000379
03CCPahr03	PNWR	ND	0.00169	ND	0.000396	ND	0.00161	ND	0.000376
03BBPahr05	PNWR	ND	0.00196	ND	0.000346	ND	0.00187	ND	0.000329
03BBPahr06	PNWR	ND	0.00212	ND	0.000388	ND	0.00201	ND	0.000369
03GSPahr04	PNWR	ND	0.00184	ND	0.000403	ND	0.00175	ND	0.000383
03DCBB02	DC	0.0115	0.00177	0.00251	0.000386	ND	0.00169	ND	0.000367
03DCBB05	DC	ND	0.00192	ND	0.000399	ND	0.00183	ND	0.000379
03DCCC01	DC	ND	0.00149	ND	0.000396	ND	0.00142	ND	0.000376
03DCCC03	DC	0.00770	0.00147	0.00200	0.000381	ND	0.00140	ND	0.000363
03DCCC04	DC	0.00453	0.00164	0.00108	0.000390	ND	0.00156	ND	0.000371
03LVBCAT04	LVB	0.0116	0.00160	0.00293	0.000402	0.0162	0.00152	0.00408	0.000382
03LVBCC01	LVB	0.0296	0.00128	0.00923	0.000398	0.0429	0.00121	0.0134	0.000379
03LVBCC02	LVB	ND	0.00163	ND	0.000403	0.0108	0.00155	0.00267	0.000384
03LVBCC03	LVB	0.0207	0.00141	0.00587	0.000401	0.0165	0.00135	0.00467	0.000382
03NPCC01	NP	0.0682	0.00146	0.0179	0.000384	ND	0.00139	ND	0.000365
03NPCC02	NP	0.0101	0.00201	0.00187	0.000373	ND	0.00192	ND	0.000355
03NPGS03	NP	0.0175	0.00237	0.00452	0.000611	0.00294	0.00225	0.000757	0.000581
03PabBG04	PB	0.0271	0.00146	0.00740	0.000399	0.00924	0.00139	0.00252	0.000379
03PabCC01	PB	0.0138	0.00136	0.00391	0.000384	ND	0.00129	ND	0.000365
03PabCC02	PB	0.0421	0.00133	0.0128	0.000403	0.0301	0.00126	0.00917	0.000384
03PabCC03	PB	0.0114	0.00161	0.00286	0.000403	0.0122	0.00153	0.00306	0.000383
03PabCC05	PB	0.0180	0.00137	0.00519	0.000396	0.0186	0.00131	0.00536	0.000376
03PabCC06	PB	0.00493	0.00149	0.00132	0.000399	ND	0.00142	ND	0.000379
03PabCC07	PB	ND	0.00206	ND	0.000397	0.0141	0.00196	0.00272	0.000378
03PabCC08	PB	0.0137	0.00130	0.00422	0.000399	ND	0.00123	ND	0.000379
03PabCC09	PB	0.0207	0.00121	0.00647	0.000380	0.0158	0.00116	0.00496	0.000362
03PabCC10	PB	0.00374	0.00165	0.000896	0.000394	0.00765	0.00157	0.00183	0.000375

Sample	Location	Endosulfan sulfate Res Dry	Endosulfan sulfate DL Dry	Endosulfan sulfate Res Wet	Endosulfan sulfate DL Wet	Pentachloro-anisole Res Dry	Pentachloro-anisole DL Dry	Pentachloro-anisole Res Wet	Pentachloro-anisole DL Wet
03CCPahr01	PNWR	0.00214	0.00214	ND	0.000422	ND	0.000541	ND	0.000106
03CCPahr02	PNWR	ND	0.00186	ND	0.000418	0.00120	0.000467	0.000269	0.000105
03CCPahr03	PNWR	ND	0.00178	ND	0.000415	0.00139	0.000447	0.000325	0.000104
03BBPahr05	PNWR	ND	0.00206	ND	0.000363	ND	0.000518	ND	0.0000910
03BBPahr06	PNWR	ND	0.00222	ND	0.000407	ND	0.000559	ND	0.000102
03GSPahr04	PNWR	ND	0.00192	ND	0.000422	ND	0.000485	ND	0.000106
03DCBB02	DC	ND	0.00186	ND	0.000404	0.00928	0.000468	0.00202	0.000102
03DCBB05	DC	ND	0.00202	ND	0.000418	0.00151	0.000508	0.000314	0.000105
03DCCC01	DC	ND	0.00156	ND	0.000415	0.0111	0.000393	0.00296	0.000104
03DCCC03	DC	ND	0.00154	ND	0.000400	0.0180	0.000388	0.00467	0.000101
03DCCC04	DC	ND	0.00172	ND	0.000409	0.00573	0.000434	0.00136	0.000103
03LVBCAT04	LVB	0.00317	0.00167	0.000798	0.000421	0.00186	0.000422	0.000467	0.000106
03LVBCC01	LVB	ND	0.00134	ND	0.000417	0.00287	0.000337	0.000895	0.000105
03LVBCC02	LVB	ND	0.00171	ND	0.000423	ND	0.000430	ND	0.000107
03LVBCC03	LVB	ND	0.00148	ND	0.000420	0.00156	0.000373	0.000444	0.000106
03NPCC01	NP	ND	0.00153	ND	0.000402	0.00958	0.000385	0.00252	0.000101
03NPCC02	NP	ND	0.00211	ND	0.000391	0.00207	0.000532	0.000384	0.0000980
03NPGS03	NP	ND	0.00248	ND	0.000640	0.00339	0.000625	0.000873	0.000161
03PabBG04	PB	ND	0.00153	ND	0.000418	0.00314	0.000386	0.000857	0.000105
03PabCC01	PB	ND	0.00142	ND	0.000402	0.0144	0.000359	0.00405	0.000101
03PabCC02	PB	ND	0.00139	ND	0.000423	0.0109	0.000350	0.00332	0.000107
03PabCC03	PB	ND	0.00169	ND	0.000422	0.00790	0.000425	0.00197	0.000106
03PabCC05	PB	ND	0.00144	ND	0.000415	0.0105	0.000363	0.00304	0.000104
03PabCC06	PB	ND	0.00156	ND	0.000418	0.00603	0.000394	0.00161	0.000105
03PabCC07	PB	ND	0.00216	ND	0.000416	0.00301	0.000544	0.000580	0.000105
03PabCC08	PB	ND	0.00136	ND	0.000418	0.00745	0.000342	0.00229	0.000105
03PabCC09	PB	ND	0.00127	ND	0.000398	0.00982	0.000321	0.00308	0.000100
03PabCC10	PB	ND	0.00172	ND	0.000413	0.00309	0.000435	0.000740	0.000104

APPENDIX G: Concentrations (mg/kg) of Additional Organic Chemical Contaminants Measured in Whole Fish, 2003 (continued)

Sample	Location	Pentachloro-benzene Res Dry	Pentachloro-benzene DL Dry	Pentachloro-benzene Res Wet	Pentachloro-benzene DL Wet	1,2,3,4-Tetrachloro-benzene Res Dry	1,2,3,4-Tetrachloro-benzene DL Dry	1,2,3,4-Tetrachloro-benzene Res Wet	1,2,3,4-Tetrachloro-benzene DL Wet
03CCPahr01	PNWR	ND	0.000528	ND	0.000104	0.000553	0.000553	ND	0.000109
03CCPahr02	PNWR	ND	0.000457	ND	0.000103	0.000479	0.000479	ND	0.000108
03CCPahr03	PNWR	ND	0.000437	ND	0.000102	0.000458	0.000458	ND	0.000107
03BBPahr05	PNWR	ND	0.000506	ND	0.0000890	ND	0.000530	ND	0.0000940
03BBPahr06	PNWR	ND	0.000546	ND	0.000100	ND	0.000572	ND	0.000105
03GSPahr04	PNWR	ND	0.000474	ND	0.000104	ND	0.000496	ND	0.000109
03DCBB02	DC	ND	0.000457	ND	0.000100	ND	0.000479	ND	0.000104
03DCBB05	DC	ND	0.000496	ND	0.000103	ND	0.000520	ND	0.000108
03DCCC01	DC	ND	0.000384	ND	0.000102	ND	0.000402	ND	0.000107
03DCCC03	DC	ND	0.000379	ND	0.0000980	ND	0.000397	ND	0.000103
03DCCC04	DC	ND	0.000424	ND	0.000101	ND	0.000444	ND	0.000105
03LVBCAT04	LVB	0.000634	0.000412	0.000160	0.000104	ND	0.000432	ND	0.000109
03LVBCC01	LVB	0.00162	0.000329	0.000505	0.000103	0.00132	0.000345	0.000413	0.000108
03LVBCC02	LVB	0.000660	0.000420	0.000164	0.000104	0.000660	0.000440	0.000164	0.000109
03LVBCC03	LVB	0.000947	0.000365	0.000269	0.000103	ND	0.000382	ND	0.000108
03NPCC01	NP	ND	0.000377	ND	0.0000990	ND	0.000395	ND	0.000104
03NPCC02	NP	ND	0.000520	ND	0.0000960	ND	0.000544	ND	0.000101
03NPGS03	NP	ND	0.000611	ND	0.000158	ND	0.000640	ND	0.000165
03PabBG04	PB	0.00160	0.000377	0.000435	0.000103	0.0356	0.000395	0.00972	0.000108
03PabCC01	PB	0.00722	0.000350	0.00204	0.0000990	0.0330	0.000367	0.00931	0.000104
03PabCC02	PB	0.00317	0.000342	0.000964	0.000104	0.0236	0.000358	0.00719	0.000109
03PabCC03	PB	0.00233	0.000416	0.000583	0.000104	0.0229	0.000435	0.00573	0.000109
03PabCC05	PB	0.00425	0.000354	0.00122	0.000102	0.0386	0.000371	0.0111	0.000107
03PabCC06	PB	0.00261	0.000385	0.000698	0.000103	0.0209	0.000403	0.00558	0.000108
03PabCC07	PB	0.00209	0.000532	0.000402	0.000102	0.0182	0.000557	0.00352	0.000107
03PabCC08	PB	0.00218	0.000334	0.000672	0.000103	0.0194	0.000350	0.00597	0.000108
03PabCC09	PB	0.00588	0.000313	0.00184	0.0000980	0.0344	0.000328	0.0108	0.000103
03PabCC10	PB	0.00228	0.000425	0.000546	0.000102	0.0111	0.000445	0.00267	0.000107

APPENDIX G: Concentrations (mg/kg) of Additional Organic Chemical Contaminants Measured in Whole Fish, 2003 (continued)

Sample	Location	1,2,4,5-Tetrachloro-benzene Res Dry	1,2,4,5-Tetrachloro-benzene DL Dry	1,2,4,5-Tetrachloro-benzene Res Wet	1,2,4,5-Tetrachloro-benzene DL Wet	Toxaphene Res Dry	Toxaphene DL Dry	Toxaphene Res Wet	Toxaphene DL Wet
03CCPahr01	PNWR	ND	0.00110	ND	0.000216	ND	0.0506	ND	0.00996
03CCPahr02	PNWR	ND	0.000951	ND	0.000214	ND	0.0438	ND	0.00986
03CCPahr03	PNWR	ND	0.000910	ND	0.000213	ND	0.0419	ND	0.00978
03BBPahr05	PNWR	ND	0.00105	ND	0.000186	ND	0.0485	ND	0.00856
03BBPahr06	PNWR	ND	0.00114	ND	0.000208	ND	0.0524	ND	0.00960
03GSPahr04	PNWR	ND	0.000987	ND	0.000216	ND	0.0454	ND	0.00996
03DCBB02	DC	ND	0.000952	ND	0.000207	ND	0.0438	ND	0.00954
03DCBB05	DC	0.00151	0.00103	0.000314	0.000214	ND	0.0476	ND	0.00986
03DCCC01	DC	ND	0.000799	ND	0.000213	ND	0.0368	ND	0.00978
03DCCC03	DC	ND	0.000789	ND	0.000205	ND	0.0363	ND	0.00943
03DCCC04	DC	ND	0.000883	ND	0.000210	ND	0.0407	ND	0.00965
03LVBCAT04	LVB	0.00171	0.000858	0.000430	0.000216	ND	0.0395	ND	0.00994
03LVBCC01	LVB	0.00279	0.000685	0.000872	0.000214	ND	0.0315	ND	0.00984
03LVBCC02	LVB	ND	0.000875	ND	0.000217	ND	0.0403	ND	0.00998
03LVBCC03	LVB	ND	0.000760	ND	0.000215	ND	0.0350	ND	0.00992
03NPCC01	NP	ND	0.000784	ND	0.000206	ND	0.0361	ND	0.00949
03NPCC02	NP	ND	0.00108	ND	0.000200	ND	0.0498	ND	0.00922
03NPGS03	NP	ND	0.00127	ND	0.000328	ND	0.0586	ND	0.0151
03PabBG04	PB	0.0215	0.000786	0.00586	0.000214	ND	0.0362	ND	0.00986
03PabCC01	PB	0.0418	0.000730	0.0118	0.000206	ND	0.0336	ND	0.00949
03PabCC02	PB	0.0352	0.000712	0.0107	0.000217	ND	0.0328	ND	0.00998
03PabCC03	PB	0.0296	0.000865	0.00741	0.000216	ND	0.0398	ND	0.00996
03PabCC05	PB	0.0223	0.000738	0.00643	0.000213	ND	0.0340	ND	0.00978
03PabCC06	PB	0.0161	0.000802	0.00429	0.000214	ND	0.0369	ND	0.00986
03PabCC07	PB	0.0204	0.00111	0.00393	0.000213	ND	0.0510	ND	0.00982
03PabCC08	PB	0.0173	0.000696	0.00533	0.000214	ND	0.0320	ND	0.00986
03PabCC09	PB	0.0234	0.000652	0.00733	0.000204	ND	0.0300	ND	0.00940
03PabCC10	PB	0.0114	0.000884	0.00273	0.000212	ND	0.0407	ND	0.00975

APPENDIX H

Percent Lipid in Whole Fish and Bird Egg Samples

Percent Lipid in Whole Fish Samples

Sample	% Lipid
03CCPahr01	0.59
03CCPahr02	3.23
03CCPahr03	2.52
03BBPahr05	0.59
03BBPahr06	1.08
03GSPahr04	2.40
03DCBB02	3.95
03DCBB05	1.11
03DCCC01	5.19
03DCCC03	7.24
03DCCC04	3.40
03LVBCAT04	5.39
03LVBCC01	12.5
03LVBCC02	4.89
03LVBCC03	9.26
03NPCC01	6.65
03NPCC02	1.22
03NPGS03	1.88
03PabBG04	6.40
03PabCC01	8.16
03PabCC02	8.45
03PabCC03	5.77
03PabCC05	12.0
03PabCC06	6.74
03PabCC07	3.95
03PabCC08	10.3
03PabCC09	11.1
03PabCC10	3.69

Percent Lipid in Bird Egg Samples

Sample	% Lipid
AC-11	45.53
AC-12	42.86
AC-7	57.20
MW-3	na
NH-1	35.32
WG-1	49.31
YBB-1	33.74
KD-5A	58.68
RWB-2	32.26
RWB-3	43.53
RWB-4	42.40
RWB-5	23.35
AC-14	41.18
AC-1A	55.66
MW-2	na
AC-3A	46.27
MW-1	41.35
KD-10B	47.09
KD-9	69.17
KD-2	64.34
KD-4	54.62
KD-8	72.96
AC-5A	47.26
KD-6A	59.77
M-2A	56.89
MW-4	na
RWB-1	29.94
KD-3	52.83
M-1	64.78
M-1B	49.82

na, not analyzed