Bottom sediment as a source of organic contaminants in Lake Mead, Nevada, USA

ABSTRACT

Treated wastewater effluent from Las Vegas, Nevada and surrounding communities' flow through Las Vegas Wash (LVW) into the Lake Mead National Recreational Area at Las Vegas Bay (LVB). Lake sediment is a likely sink for many hydrophobic synthetic organic compounds (SOCs); however, partitioning between the sediment and the overlying water could result in the sediment acting as a secondary contaminant source. Locating the chemical plumes may be important to understanding possible chemical stressors to aquatic organisms. Passive sampling devices (SPMDs and POCIS) were suspended in LVB at depths of 3.0, 4.7, and 6.7 (lake bottom) meters in June of 2008 to determine the vertical distribution of SOCs in the water column. A custom sediment probe was used to also bury the samplers in the sediment at depths of 0-10, 10-20, and 20-30 cm. The greatest number of detections in samplers buried in the sediment was at the 0-10 cm depth. Concentrations of many hydrophobic SOCs were twice as high at the sediment-water interface than in the mid and upper water column. Many SOCs related to wastewater effluents, including fragrances, insect repellants, sun block agents, and phosphate flame retardants, were found at highest concentrations in the middle and upper water column. There was evidence to suggest that the water infiltrated into the sediment had a different chemical composition than the rest of the water column and could be a potential risk exposure to bottom-dwelling aquatic organisms.

1. Introduction

In recent years, there has been an abundance of research determining the presence of synthetic organic compounds (SOCs) in environmental waters, especially those receiving treated effluents from municipal wastewater treatment plants (WWTPs). These studies generally focus on point source impacts and the lateral distribution of SOCs downstream of known point sources. Although the hydrodynamics within a flowing body of water (i.e., a stream or river) can be complex, it is generally intuitive that SOCs will continue to move downstream until they are removed by attenuation processes, such as sorption or degradation.

Less is known about the vertical distribution of SOCs in deeper large bodies of water (lakes) which receive WWTP effluents. Dilution of WWTP effluent streams and the lack of sufficiently sensitive analytical detection methods can limit the ability of researchers to determine the presence of SOCs in the water column. Lake sediment is a likely sink for many SOCs; however, partitioning between the sediment and the overlying water could result in the sediment acting as a secondary contaminant source.

The cities of Las Vegas, North Las Vegas, Henderson, and metropolitan Clark County, Nevada, discharge treated wastewater effluent from three WWTPs into Las Vegas Wash (LVW) and subsequently into the Lake Mead National Recreation Area at Las Vegas Bay (LVB, Fig. 1). Lake Mead is the largest man-made reservoir by volume in the United States and was created in 1935 by the construction of Hoover Dam on the Lower Colorado River. Although the treated effluent in LVW only accounts for a historical average of 1.4% of the total water flow into Lake Mead, the presence of the SOCs in this effluent may be biologically important (Benotti et al.,

2010). Evidence of endocrine disruption in common carp (*Cyprinus carpio*) sampled from both LVW and LVB provides a potential link between SOCs present in the WWTP effluents and declining health of aquatic species in LVB (Bevans et al., 1996; Patiño et al., 2003).

Rosen et al. (2010) studied the lateral and vertical gradients of SOCs throughout Lake Mead in March of 2006 using passive sampling devices. Semipermeable membrane devices (SPMDs) and polar organic chemical integrative samplers (POCIS) were deployed in LVB to determine the vertical distribution of SOCs entering Lake Mead from LVW. Their study found that the highest concentrations of hydrophobic SOCs were present nearest the lake bottom. This finding along with data showing elevated water temperatures and higher total dissolved solids concentrations along the lake bottom indicated that the effluent plume from LVW was moving along the lower portion of the water column.

LaBounty and Burns (2005) determined that the water from LVW will move through LVB and into Lake Mead at different vertical positions at different times of the year. During the winter months, water from LVW moves across the bottom of the lake. As water temperatures increase, the LVW plume goes through an unstable period in the spring and then moves across the lake's surface in the summer.

The potential of lake sediments acting as a source of bioavailable contaminants has implications on the health of bottom-dwelling aquatic organisms. In order to distinguish between contaminants originating from the LVW plume and the contaminants associated with the sediment infiltrated water, two criteria had to be met: 1) the LVW plume needed to be near the

surface of the lake and 2) monitoring techniques which could distinguish between the available contaminants in the infiltrated water and sediment-bound contaminants needed to be used.

The use of passive samplers for measuring loosely bound organic chemicals in sediments and sediment infiltrated water has been widely reported (De Jonge and Rothenberg, 2005; Namieśnik et al., 2005; Huckins et al., 2006; Ouyang and Pawliszyn, 2006). SPMDs have been buried in direct contact with sediments to measure the fraction of bioavailable SOCs (Rantalainen et al., 2000; Ya-xian et al., 2001; Williamson et al., 2002) and have been used in groundwater monitoring studies deployed in wells (Vrana et al., 2005). In each of these cases, legacy contaminants such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) were targeted. This work is the first reporting of using SPMDs or POCIS to measure emerging contaminants such as fragrances, pharmaceuticals, alternative flame retardants, industrial and residential chemicals, in sediments and the first use of POCIS to measure SOCs in sediment infiltrated water.

All of the passive sampler/sediment studies mentioned previously had the limitation of needing direct access to the sediment in order to bury the passive samplers. Those approaches are not suited for lakes and other deep bodies of water where the sediment is inaccessible without specialized equipment. To overcome this limitation, a sediment probe was constructed which could be lowered from the surface and would insert the passive samplers into the sediment bed at defined depth intervals. The sediment probe described herein was capable of exposing SPMDs and POCIS to the sediment infiltrated water at three depth intervals.

2. Experimental

2.1 Chemicals of interest

A suite of 141 anthropogenic organic chemicals, not including the 140+ PCB congeners measured to estimate the total PCB value, covering a range of hydrophobicities were targeted in this work. Tables 1 and S1 list the chemicals sampled by the SPMD including legacy organochlorine pesticides, PCBs, PAHs, and polybrominated diphenyl ether (PBDE) flame retardants (Alvarez et al., 2008a; Petty et al., 2000). Tables 2 and S1 list the chemicals measured in POCIS extracts including organic wastewater chemicals (OWCs, including fragrances, flame retardants, plasticizers, personal care products, and industrial and consumer chemicals), pharmaceuticals and illicit drugs (Alvarez et al., 2008b; Jones-Lepp et al., 2004). Extracts from both SPMDs and POCIS were screened for estrogens and estrogen-mimicking chemicals using the yeast estrogen screen (YES) (Alvarez et al., 2008a).

2.2 Sampling location

The study location was selected at the site of a USGS water quality platform located in LVB (37°06’59.8”, 114°50’51.4”) near where treated WWTP effluent from the LVW enters Lake Mead (Fig. 1). The water depth was 6.7 m during the sampling period (June 10 to July 9, 2008) which was considerably less than the 18 m depth at the same location during a 2006 sampling reported by Rosen et al. (2010) as water levels in Lake Mead have continued to drop over time.

2.3 Sampling methodology

The study design included the sampling of the water column and the sediment infiltrated water, which required different sampling techniques. For both compartments, different configurations

116 of the SPMD and POCIS were used to measure the concentrations of dissolved SOCs. For the
117 water column measurements, SPMDs (460 cm^2 low density polyethylene tube containing 1.0 mL
118 of purified triolein) and POCIS (41 cm^2 polyethersulfone membrane disk containing 200 mg of
119 Oasis HLB) were constructed to meet the standard surface area to sorbent/lipid volume (SA/V)
120 specifications described by Huckins et al. (2006) and Alvarez et al. (2004, 2007). Stainless steel
121 deployment canisters, each containing four SPMDs or six POCIS, were suspended from the
122 water quality platform at depths of 3.0, 4.7, and 6.7 meters.
123
124 Sampling of the sediment infiltrated water required the design and construction of a custom
125 sediment sampling probe to bury the SPMDs and POCIS at depths of 0-10 cm, 10-20 cm, and
126 20-30 cm (Fig. 2). This design consisted of six perforated metal probes (3.8 cm in diameter, 30.5
127 cm long) attached to a 0.64 cm thick aluminum plate. The plate was attached to cables secured
128 to a buoy on the surface and had a location to attach weights as needed to aid in burying the
129 probes into the sediment. Inside each of the metal probes, three mini-SPMDs (77 cm^2, 0.17 mL
130 triolein) or three mini-POCIS (20.5 cm^2, 100 mg Oasis HLB) were contained at specific
131 intervals. The mini-SPMDs and mini-POCIS conformed to the standard SA/V ratios previously
132 defined which allows for established uptake models to be applied when estimating water
133 concentrations (Goodbred et al., 2009). Racks constructed of Teflon spacers and a stainless steel
134 support rod held the mini-SPMDs and mini-POCIS in place while limiting the movement of
135 water between the three sampling chambers.
136
137 *2.4 Processing and analysis*

The passive samplers were processed and analyzed according to published procedures and described in more detail in the Supplementary Materials (Alvarez et al., 2008a, 2008b; Jones-Lepp et al., 2004, 2010; Petty et al, 2000). Briefly, SPMDs were cleaned, dialyzed in hexane to recover sequestered chemicals, filtered, and fractionated using a size exclusion chromatography (SEC) system and gravity column reactive cleanup to isolate the chemicals of interest from other sampled non-target chemicals. Following cleanup, SPMD dialysates designated for analysis of PAHs and performance reference compounds (PRCs) were analyzed using an Agilent 6890 gas chromatograph (GC, Agilent Technologies, Wilmington, DE) with a 5973N mass selective detector (MSD, Agilent Technologies, Palo Alto, CA). Analyses of PCB, PBDE, and chlorinated pesticide were performed using a Hewlett-Packard 5890 GC equipped with an electron capture detector (ECD, Hewlett-Packard, Palo Alto, CA) following cleanup and fractionation of the SPMD dialysates.

The POCIS were cleaned followed by extracting the sampled chemicals from the POCIS sorbent using 25 mL of a 80:20 (v:v) dichloromethane:methyl-*tert*-butyl ether solution for POCIS designated for the analysis of OWCs and 40 mL of methanol for POCIS designated for the analysis of pharmaceuticals or screening by the YES assay. The OWCs were analyzed using the GC/MSD system previously described for the PAH analyses.

Pharmaceuticals and illicit drugs were analyzed by a Varian 500MS (Walnut Creek, CA) ion trap mass spectrometer, configured with an electrospray ion source, and a Varian 212-liquid chromatograph. An external standard calibration was used to nominally quantify the analytes. Due to potentially interfering materials co-extracted with the pharmaceuticals and illicit drugs,

161 the analyses were performed using the collision induced dissociation (CID) mode for both
162 identification and for calculating the concentration of the analytes of interest. Two to three
163 product ions were used for identification and the most abundant product ion was chosen for
164 quantification.
165
166 SPMDs and POCIS were also screened for estrogenicity by the YES assay. None of the SPMDs
167 in the sediment probe sampler were screened by the YES due to insufficient numbers of samplers
168 available. Samples designated for the YES assay were solvent exchanged into histological grade
169 alcohol and screened without any rigorous cleanup, with the exception of the SPMDs, to prevent
170 removal of unknown but bioactive (estrogenic) chemicals. SPMD dialysates required SEC
171 fractionation to remove any estrogenicity due to residual methyl oleate in the triolein used in the
172 SPMD (Lebo et al., 2004; Rastall et al., 2004).
173
174 All SPMDs designated for chemical analyses were fortified with PRCs (1.0 µg each of
175 acenaphthene-d_{10}, acenaphthalene-d_{10}, fluorine-d_{10}, phenanthrene-d_{10}, pyrene-d_{10}, and 20 ng each
176 of PCB congeners 14, 29, and 50) prior to use to provide a measure of the effect of
177 environmental conditions had on the sampler's performance. Dibenz[*a*,*h*]anthracene-d_{14} (1.0 µg)
178 was also added to each SPMD to serve as a photolysis surrogate to indicate if photolysis of
179 sequestered PAHs had occurred (Table S10).
180
181 Quality control measures used in this study included field and laboratory blanks, surrogate
182 recovery spikes of target chemicals in both the SPMD and POCIS matrices, multi-point
183 calibration curves with the instrumental analyses, and positive and negative controls for the YES

184 assay. Mean recoveries of the test chemicals were 71%±40% (Tables S11-S12). The blanks had
185 few chemicals present at detectable levels. With the exception of diethylhexylphthalate and
186 cholesterol, most blank detections were below 20 ng/sample (Tables S13-S15).
187
188 **3. Results and Discussion**
189 In the current study, it was difficult to determine a clear gradient as the lake depth at this location
190 had dropped to 6.7 m from the 18 m depth two years prior by Rosen et al. (2010). Temperature
191 and specific conductance readings taken by the remote water quality station at least once per day
192 at depths of 1.0, 3.0, and 5.0 m showed no significant variation in measurements between each
193 depth. Temperature readings ranged from an average of 27.5°C±2.2 to 26.5°C±2.0 and the
194 specific conductance ranged from 1669 µS/cm±104 to 1718 µS/cm±100 for the 1.0 and 5.0 m
195 depths respectively. Rosen et al. (2010) determined that the SOCs were confined to a 6 m region
196 of the water column nearest the lake bottom. As the total depth of the water column was 6.7 m
197 in the current study, mixing within the water column appears to be occurring resulting in less
198 defined gradient of SOCs and water quality parameters.
199
200 Most of the chemicals which are commonly associated with WWTP effluents and have greater
201 water solubilities were measured at elevated concentrations in the upper water column (Tables 1-
202 2, S7, S9). Chemicals commonly associated with WWTP effluents, including the fragrance
203 galaxolide (HHCB), the phosphate-based flame retardants, and the surfactant *p-tert*-octylphenol
204 were all measured at the greatest concentrations in the upper water column. HHCB was present
205 at 48 ng/L near the lake surface compared to a previous study reporting HHCB levels in LVW at
206 33 to 44 ng/L during June and July of 2004 (Osemwengie and Gerstenberger, 2004). In the same

study, they measured HHCB at 0.12 and 0.22 ng/L in Lake Mead, but at a location downstream of LVB which would have resulted in considerable dilution of any effluents entering Lake Mead from LVW. Reiner and Kannan (2011) reported HHCB concentrations ranging from 3.95 to 25.8 ng/L in the Hudson River which received treated effluents from numerous communities. Hydrocodone (120 ng/L), a narcotic analgesic and cough suppressant, and the illicit drug methamphetamine (12 ng/L) were detected only in the upper water column. The estimated concentrations for these drugs are considered nominal values as no surrogate standards were used in the LC/MS analyses. Although a true measure of ion suppression of the pharmaceuticals and illicit drugs could not be determined, the effect due to co-extracted chemicals is expected to be minimal as large potentially interfering chemicals are not sampled by the POCIS. Jones-Lepp et al. (2004) previously measured methamphetamine in LVW (referred to as an unnamed site in Nevada in the publication) at concentrations of 1.3 and 0.8 ng/L during the summer and winter months of 2002 and 2003, respectively. Clindamycin, a lincosamide antibiotic widely used as a topical treatment for acne, was measured at trace concentrations at the 3.0 m depth and at 37 ng/L at the 6.7 m depth. Phenol and *para*-cresol, chemicals which can originate from multiple sources including WWTP effluents, were only present at the bottom of the water column.

The more hydrophobic chemicals such as PAHs were present at the highest concentrations at the lake bottom and in the upper 20 cm of the sediment infiltrated water (Tables 1, S3-S4). The distribution of PAHs moves from the water column for PAHs with log octanol-water partition coefficients (K_{ow}s) <5.5 (naphthalene to pyrene) to the sediment infiltrated water for PAHs with log K_{ow}s>5.5 (benz[*a*]anthracene to benzo[*g,h,i*]perylene). Rosen et al. (2010) reported finding the greatest concentrations of PAHs in the upper layer (4 m) of LVB water; however, that study

230 focused solely on PAHs and substituted PAHs ranging from naphthalene to pyrene excluding the
231 ones with higher log K_{ow}s. The data from this study are consistent with previous studies where
232 the lower molecular weight, lower K_{ow}, PAHs are present near the surface of the lake (Lico and
233 Johnson, 2007; Rosen et al., 2010). Many of the PAHs detected are characteristic of petrogenic
234 sources and may be present from recreational boat use in the area as suggested by Lico and
235 Johnson (2007).
236
237 Few chlorinated pesticides and PCBs were identified in either the water column or sediment
238 infiltrated water with little variation in their water concentrations at any sampling depth (Tables
239 1, S5-S6). Endosulfan and its degradation product, endosulfan-II, were found at the greatest
240 concentrations at the 3.0 and 4.7 m depths in the water column. Endosulfan is an acutely toxic
241 insecticide reported as a known endocrine disruptor (Soto et al., 1994; Crisp et al., 1998). The
242 former BMI Complex in southeastern Las Vegas Valley housed different pesticide
243 manufacturers, some of which are suspected to have produced endosulfan (Sahu, 2006). The
244 BMI Complex historically dumped wastes into LVW leading to the direct input of numerous
245 contaminants into Lake Mead. Endosulfan has also been shown to be amenable to long distance
246 atmospheric transport leading to measurable concentrations of the pesticide in water bodies
247 hundreds of kilometers away from the location of initial use (LeNoir et al., 1999; Muir et al.,
248 2004). Concentrations of endosulfan at LVB were within a factor of 2 or 3 to reported
249 concentrations in the Sierra Nevada mountain lakes due to atmospheric deposition (LeNoir et al.,
250 1999).
251

The chemical found at the greatest concentrations in the upper portions of the water column, was the industrial plasticizer *N*-butyl benzenesulfonamide (NBBS) at concentrations of 1600 ng/L and 1100 ng/L at the 3.0 and 4.9 m depths, respectively (Tables 2, S7). NBBS is a precursor in the production of nylon and other polyamide polymers (Strong et al., 1991). NBBS is a neurotoxin reported to cause dose-dependent motor dysfunction in rabbits and rats but is rapidly eliminated from the body requiring a prolonged exposure to high concentrations (>1 mg/kg) to produce a neurotoxic effect (Strong et al., 1991; Kumar et al., 2007). No experimental data exists on the acute, reproductive, or developmental toxicity of NBBS to fish; however, the US Environmental Protection Agency used predictive models to estimate that the risk to aquatic species was relatively low (US EPA, 2003). With its low log K_{ow} of 2.17, NBBS can be found in the water column and tends not to bioaccumulate in aquatic organisms (US EPA, 2003; Kumar et al., 2007). It is unknown if any polymer manufacturers using NBBS were located within the LVW/LVB drainage area.

Phenol, *para*-cresol, and indole were at the highest concentrations in the top 0-10 cm of the sediment and also greatest in the water column at the 6.7 m (lake bottom) depth possibly indicating that the sediment is acting as a contaminant source to the overlying water (Table 2, Fig. 3). *Para*-cresol was previously measured in sediments collected from LVB in 1992, 1995, and 1998 (Bevans et al., 1996, Covay and Beck, 2001). Phenol was also measured in the sediment collected in 1998. A source reconnaissance study in Ohio found *para*-cresol present in 100% of sediment samples and 67% of water samples regardless of their spatial relation to WWTPs (Tertuliani et al., 2008). This along with evidence suggesting that the LVW plume is moving across the surface of the lake suggests that WWTP effluents from LVW are not the sole

source of all chemicals in LVB as surface runoff, shallow ground water, atmospheric inputs, and irrigation are all potential inputs into Lake Mead (Rosen et al., 2010).

A measurable level of estrogenicity from sequestered SOCs was present in POCIS extracts at each sampling depth in the water column and the sediment infiltrated water. In the water column, the estimated estrogenicity was 5 to 9-fold greater at the 3.0 and 4.7 m depths which correlates with the greater occurrence of many SOCs related to WWTP effluents at these depths (Table 3). Although not directly measured in this study, it is assumed that many of the steroidal hormones originating in WWTP effluents would follow the effluent plume. From the SPMDs, an estrogenic response was detected in only the 6.7 m sampler. Since the SPMD samples only nonpolar, nonionic organic chemicals, it is not surprising that the greatest estrogenic response was at the sediment-water interface where hydrophobic chemicals were at the greatest concentrations.

Higher concentrations of some SOCs in the upper layer of the sediment infiltrated water and at the sediment-water interface suggests that the sediment may be acting as a secondary source for some chemicals. This could be a concern to the ecosystem health as SOCs associated with the sediment could impact bottom-dwelling organisms and have repercussions throughout the food chain. Water quality criteria and toxicity data is limited for many of the chemicals identified at the sediment-water interface. What data was available suggested that the concentrations measured in this study were significantly below any acute toxicity levels.

297 The design of the sediment probe device provided a means of successively deploying SPMDs
298 and POCIS at fixed depths in the sediment. The concept of using perforated tubes containing the
299 sampling media has been explored before by De Jonge and Rothenberg (2005) who used
300 perforated tubes containing a solid adsorbent material to measure the flux of PAHs and
301 pesticides in soils. The Peepers sampling device for infiltrated water measurements also has a
302 similar design with the exception that a diffusion membrane is in direct contact with the
303 sediment (Hesslein, 1976). In our study, only minimal sediment was found in each sampling
304 chamber indicating free exchange of water between the passive samplers and the surrounding
305 sediment. Comparing the PRC loss rates (Table S10) from the SPMDs in the sediment probes to
306 that of the water column samplers, it can be qualitatively determined that water exchange
307 between the water in the sampling chambers and the infiltrated water in the sediment did occur,
308 albeit at a reduced rate.
309
310 The use of a sediment probe device as described in this work is advantageous only when the bed
311 sediment is relatively soft allowing the probes to bury themselves. This system would not work
312 in rocky areas. Some disruption of the bed sediment will likely occur as the probes are inserted,
313 however, effects from this disruption should be minimized as the samplers are providing a
314 measure of the average chemical composition of the infiltrated water over weeks to months.
315
316 **4. Conclusions**
317 Lake sediment is a sink for many SOCs; however, partitioning between the sediment and the
318 overlying water could result in the sediment acting as a secondary contaminant source. Using a
319 combination of passive samplers in the water column as well as a custom sediment probe device

to bury passive samplers in the sediment, it was determined that the water at the sediment-water interface had a distinct profile from the rest of the water column. Measurement of the direct risk to sediment-dwelling organisms was beyond the scope of this project, but there is evidence to suggest that the whole water column should be considered when determining the health of a body of water.

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Figure 1. Sampling location in Las Vegas Bay, Lake Mead National Recreation Area, Nevada. The markers labeled 1, 2, and 3 refer to the City of Las Vegas wastewater treatment plant (WWTP), the Clark County WWTP, and the Henderson WWTP, respectively.

Figure 2. Diagram of the sediment probe device. The device contained six probes, each capable of holding three POCIS or three SPMDs at depth intervals of 0-10, 10-20, and 20-30 cm.

Figure 3. Distribution of total organic wastewater chemicals measured by polar organic chemical integrative samplers (POCIS) suspended in the water column and buried in sediment. The number above each bar is the total concentration (ng/L) of chemicals.

Supplementary Material

Bottom sediment as a source of organic contaminants in Lake Mead, USA

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1. Processing and analysis of passive samplers

The passive samplers were processed and analyzed according to published procedures (Alvarez et al., 2008a, 2008b; Jones-Lepp et al., 2004, 2010; Petty et al, 2000).

1.1 SPMDs – Briefly, SPMDs were cleaned to remove any films or salts on the membrane surfaces and then the sequestered chemicals were recovered using a standard two-stage dialysis with hexane. Following dialysis, the dialysates were concentrated and filtered prior to fractionation on a size exclusion chromatography (SEC) system to isolate the chemicals of interest from other sampled non-target chemicals. Following SEC, dialysates designated for PAH analyses were applied to a tri-adsorbent column consisting of phosphoric acid silica gel, potassium hydroxide impregnated silica gel, and silica gel to clean-up the dialysates prior to analysis. The enriched samples were then analyzed for PAHs and performance reference compounds (PRCs) using an Agilent 6890 gas chromatograph (GC, Agilent Technologies, Wilmington, DE) with a 5973N mass selective detector (MSD, Agilent Technologies, Palo Alto, CA) with an HP-5MS (30 m, 0.25 mm ID, 0.25 um film thickness) capillary column (Agilent Technologies, Wilmington, DE). Samples were at a volume of 1 mL with 1 µL injected using a cool-on-column inlet.

SPMDs designated for PCB, PBDE, and chlorinated pesticide analyses underwent additional cleanup following SEC by applying the samples to Florisil columns followed by fractionation on silica gel columns. The PCB and chlorinated pesticide/PBDE fractions generated from the silica gel step were analyzed by a Hewlett-Packard 5890 GC equipped with an electron capture detector (ECD, Hewlett-Packard, Palo Alto, CA) and a DB-35MS (30 m, 0.25 mm ID, 0.25 um film thickness) capillary column (J&W Scientific, Folsom, CA). Samples were at a volume of 1 mL with 1 µL injected using a cool-on-column inlet.

1.2 POCIS - The POCIS were gently rinsed with deionized (DI) water to remove any loose materials on the surface of the samplers prior to extractions. Each POCIS was individually extracted by transferring the sorbent from inside the POCIS with DI water into a pre-cleaned empty 25 mL solid-phase extraction (SPE) tube fitted with a polyethylene frit. A second frit was placed on top of the sorbent bed and then the residual water was removed by pulling air through the cartridges for approximately 10 minutes. To recover the sampled chemicals from the POCIS sorbent, 25 mL of a 80:20 (v:v) dichloromethane:methyl-*tert*-butyl ether solution was used for POCIS designated for the analysis of OWCs and 40 mL of methanol was used for POCIS designated for the analysis of pharmaceuticals or screening by the YES assay. Following extraction, the samples were concentrated using a rotary evaporation system and high purity nitrogen blowdown, filtered, and transferred into autosampler vials for analysis. The wastewater indicator chemicals were analyzed using the GC/MSD system previously described for the PAH analyses.

Pharmaceuticals and illicit drugs were analyzed by a Varian 500MS (Walnut Creek, CA) ion trap mass spectrometer, configured with an electrospray ion source, and a Varian 212-liquid chromatograph, was used for all analyses. Mid-range calibration standards (0.5 and 1 ng/µL) were analyzed at the beginning and end of each analytical day. A volume of 5 µL was injected for each standard. Linearity and precision of the daily calibration standards were measured from an initial 3-pt calibration curve prepared and analyzed weekly. A volume of 10 µL was injected for each sample extract. An external standard calibration, along with POCIS rate uptake information, was used to nominally quantify the analytes.

The 500MS was run in the positive ionization mode under the following conditions: ES needle, 5 kV; drying gas, 20 psi and 350° C; housing chamber, 50^{o} C; nebulizer gas, 40 psi; spray shield, 600 V; capillary voltages were set dependent upon the optimized response of the product ions of interest.

Due to potentially interfering materials co-extracted with the pharmaceuticals and illicit drugs, the analyses were performed using the collision induced dissociation (CID) mode for both identification and for calculating the concentration of the analytes of interest. Two to three product ions were used for identification and the most abundant product ion was chosen for quantification. The precursor ion and most abundant product ion that were used to identify and quantify the pharmaceuticals and illicit drugs, and their limits-of-detection (LOD, on-column) are shown in Table S2. Liquid chromatographic separations were performed using an Ascentis Express C18 (Supelco-Aldrich, Bellefonte, PA) 2.7 µm particle size, 3 cm x 2.1 mm column, coupled with a Varian guard column (MetaGuard 2.0 mm Pursuit XRs 3µm C18). The flow rate through the column was 200 µL/min, with the following gradient elution conditions: initial conditions mobile phase A 100%, hold for 2 min; 3 min gradient to 30% A:70% B, hold for 5 min; 3 min gradient to 100% A, hold for 2 min; end run, 5 min equilibration time between analyses. Compositions of the mobile phases were as follows: (A) deionized water/0.5% formic acid, and (B): 82% methanol/18% acetonitrile/0.5% formic acid.

1.3 Estrogenicity Screening - POCIS designated for the YES assay were solvent exchanged into 1 mL of histological grade alcohol and 100 µL of each sample was serially diluted and screened without any rigorous cleanup to prevent removal of unknown but bioactive (estrogenic) chemicals. The YES assay uses a yeast cell transfected with an estrogen receptor. Upon binding with estrogen or an estrogen mimic, a series of reactions occurs resulting in a color change which can be measured spectrophotometrically (Rastall et al., 2004; Alvarez et al., 2008a).

SPMDs deployed in the water column were also screened for estrogenicity by the YES assay. Prior to screening with the YES assay, SPMD dialysates required SEC fractionation to remove any estrogenicity due to residual methyl oleate in the triolein used in the SPMD (Lebo et al., 2004). Following SEC, the SPMD fractions were solvent exchanged into 1 mL of histological grade alcohol and 100 µL of each sample was serially diluted on the YES plate. None of the SPMDs in the sediment probe sampler were screened by the YES due to insufficient numbers of samplers available.

2. Estimation of time-weighted average water concentrations

The estimation of time-weighted average water concentrations of chemicals sequestered by the SPMD and POCIS requires knowledge of the sampling rate for each chemical along with the sampling duration. Using models previously developed (Alvarez et al., 2007; Huckins et al., 2006), data from the analysis of the PRCs added to the SPMDs, and experimentally-derived or theoretically-estimated sampling rates, the bioavailable (i.e., via respiration from the dissolved phase) concentrations of SOCs in the SPMD and POCIS can be estimated.

PRCs are analytically non-interfering organic compounds with moderate to high fugacity from SPMDs that are added to the lipid prior to membrane enclosure and field deployment (Huckins et al., 2006). By applying the amount of PRCs lost during field exposures to a third-order regression model, a site-specific sampling rate can be determined to increase the accuracy of the water concentration estimates. The models describing the uptake and the use of online calculators to calculate water concentrations from SPMD data have been discussed in detail (Alvarez et al., 2010; Huckins et al., 2006). Due to the strong sorptive properties of the adsorbents used in the POCIS, attempts to incorporate PRCs to cover a wide range of analytes into the POCIS have failed (Alvarez et al., 2007). Without PRCs, the estimation of water concentrations from POCIS data requires availability of sampling rates, potentially limiting the number of compounds which can be determined (Alvarez et al., 2007; 2010).

Uptake of chemicals into passive samplers generally follows linear, curvilinear and equilibrium phases of sampling. Integrative (or linear) sampling is the predominant phase for compounds with log K_{OW} values ≥ 5.0 and exposure periods of up to one month in SPMDs and for most of the chemicals tested in the POCIS. During the linear uptake phase, the ambient chemical concentration (C_w) is determined by

$$C_w = N/R_s t \quad (1)$$

where N is the amount of the chemical accumulated by the sampler (typically ng), R_s is the sampling rate (L/d), and t is the exposure time (d). Previous data indicates that many chemicals of interest sampled by the POCIS remain in the linear phase of sampling for at least 56 d (Alvarez et al., 2007; 2010), therefore, the use of a linear uptake model (Eqn. 1) for the calculation of ambient water concentrations was justified.

For the POCIS, the availability of R_s values can limit which chemicals it is possible to estimate water concentrations. For this work, a series of R_s values were used which originated from published and unpublished sources (Alvarez, unpublished work; Alvarez et al., 2007; Bartlet-Hunt et al., 2011; Harman et al., 2008; MacLeod et al., 2007). Water concentrations were performed only for chemicals which had at least one detection.

For SPMDs, regression models have been created which estimate a chemical's site specific R_s and its C_w based on the log K_{OW} of the chemical, the PRCs release rate constant (k_e) and SPMD-water partition coefficient (K_{sw}) (Huckins et al., 2006). A PRCs k_e is determined from the amount of PRC initially added to the SPMD (N_o) and the amount remaining (N) as shown in Equation 2. The log K_{sw} is determined from a regression model of the PRCs log K_{OW} as shown in Equation 3 where a_0 is the intercept determined to be -2.61 for PCBs,

PAHs, nonpolar pesticides and -3.20 for polar pesticides. The $R_{s\text{-}PRC}$ can then be calculated as shown in Equation 4 where V_s is the volume of the SPMD.

$$k_e = - [\ln(N/N_o)]/t \quad (2)$$

$$\log K_{sw} = a_0 + 2.321 \log K_{ow} - 0.1618 (\log K_{ow})^2 \quad (3)$$

$$R_{s\text{-}PRC} = V_s K_{sw} k_e \quad (4)$$

The extrapolation of C_w from measured values of N requires knowledge of a chemical's site-specific sampling rate (R_{si}) which is determined from a third-order polynomial (Eqn. 5) where $\alpha_{(i/PRC)}$ is the compound-specific effect on the sampling rate and the relationship between the $R_{s\text{-}PRC}$ and R_{si} (Eqn. 6).

$$\log \alpha_{(i/PRC)} = 0.0130 \log K_{OW}^3 - 0.3173 \log K_{OW}^2 + 2.244 \log K_{OW} \quad (5)$$

$$R_{si} = R_{s\text{-}PRC}(\alpha_i / \alpha_{PRC}) \quad (6)$$

The C_w of a chemical in the water can then be calculated by

$$C_w = N/(V_s K_{sw}[1-\exp(-R_s t/V_s K_{sw})]) \quad (7)$$

Rates of diffusion of SOCs between the sediment and a passive sampler in the sediment probe device are controlled by a number of variables including the organic carbon content of the sediment, the log K_{ow} of the chemical, the length of the diffusion pathway, and the hydraulic permeability of the sediment (Huckins et al., 2006). Most of these variables are difficult to measure in situ and may require complicated transport models to describe the uptake into SPMDs. For this work, the concentration gradient in relation to the sediment depth was of greater importance than the actual infiltrated water concentration. Therefore, two assumptions were made to simplify the estimation of the ambient water concentrations: 1) PRC losses would adjust the chemical sampling rates to account for water movement and resistance to chemical transport; and 2) using standard first-order uptake models along with the PRCs would provide a reasonable approximation of the chemical concentrations in the infiltrated water.

3. Method detection limits and method quantitation limits

The method detection limit (MDL) and method quantification limit (MQL) for analysis of POCIS and SPMD samples were determined for each analyte by measuring the values of coincident instrumental chromatographic peaks in all field blank samples for each analyte (Tables S3-S8). Determination of MDL and MQL values have been described by Keith (1991). The MDL was operationally defined as the mean of field blanks plus three standard deviations. The MQL was operationally defined as the mean of field blanks plus ten-standard deviations. For individual analytes having no coincident chromatographic peak, an assumed value equal to the low sample reject for the instrumental method (operationally defined as

20% of the concentration of the lowest standard concentration used for the calibration curve) was used to calculate the mean. In the cases where the calculated values of the MQLs were below the level of the calibration curve employed in the analysis, the MQLs were set at the value of the lowest level of the calibration curve employed in quantifying concentrations of an analyte.

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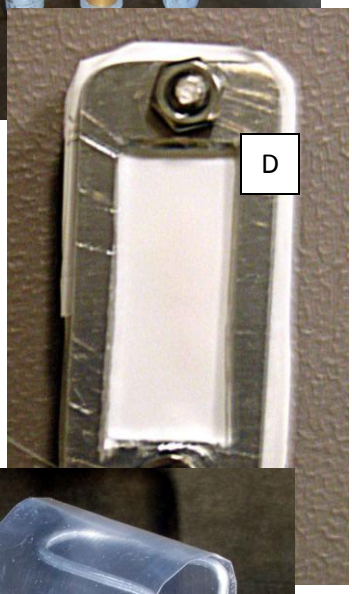
Figure S1. Photographs of the sediment probe device and the miniature semipermeable membrane devices (SPMDs) and polar organic chemical integrative samplers (POCIS) used in the sediment probes. A – sediment probe device; B – sediment probe device during retrieval; C – mini-POCIS unit; D – side view of two mini-POCIS units; E – mini-SPMD.

A

B

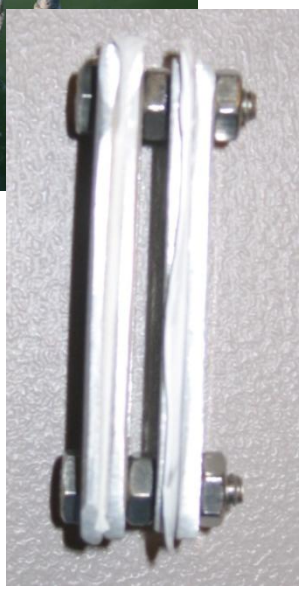
349

C



D

E



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352 Table S1. Chemicals selected for analysis in passive samplers deployed in Lake Mead.

Waste Indicator Chemicals[a]		Polycyclic aromatic hydrocarbons[b]	Chlorinated Pesticides / PCBs / PBDEs[b]
Tetrachloroethylene	Anthracene	Naphthalene	Trifluralin
Bromoform	Diazinon	Acenaphthylene	Hexachlorobenzene (HCB)
Isopropylbenzene (cumene)	Musk Ambrette	Acenaphthene	Pentachloroanisole (PCA)
Phenol	Carbazole	Fluorene	Tefluthrin
1,4-Dichlorobenzene	Caffeine	Phenanthrene	alpha-Benzenehexachloride (a-BHC)
d-Limonene	Traseolide (ATII)	Anthracene	Diazinon
Acetophenone	Galaxolide (HHCB)	Fluoranthene	Lindane
para-Cresol	Tonalide (AHTN)	Pyrene	beta-Benzenehexachloride (b-BHC)
Isophorone	Musk Xylene	Benz[*a*]anthracene	Heptachlor
Camphor	Carbaryl	Chrysene	delta-Benzenehexachloride (d-BHC)
Menthol	Metalaxyl	Benzo[*b*]fluoranthene	Dacthal
Naphthalene	Bromacil	Benzo[*k*]fluoranthene	Chlorpyrifos
Methyl salicylate	Anthraquinone	Benzo[*a*]pyrene	Oxychlordane
Dichlorvos	Musk Ketone	Indeno[1,2,3-*c*,*d*]pyrene	Heptachlor Epoxide
Isoquinoline	Chlorpyrifos	Dibenz[*a*,*h*]anthracene	trans-Chlordane
Indole	Fluoranthene	Benzo[*g*,*h*,*i*]perylene	trans-Nonachlor
2-Methyl naphthalene	Pyrene	Benzo[*b*]thiophene	o,p'-DDE
1-Methyl naphthalene	Tri(dichloroisopropyl) phosphate	2-methylnaphthalene	cis-Chlordane
2,6-Dimethylnaphthalene	Tri(butoxyethyl) phosphate	1-methylnaphthalene	Endosulfan
Cashmeran (DPMI)	Triphenyl phosphate	Biphenyl	p,p'-DDE
N,N-diethyltoluamide (DEET)	Diethylhexylphthalate (DEHP)	1-ethylnaphthalene	Dieldrin
Diethyl phthalate	Benzo[a]pyrene	1,2-dimethylnaphthalene	o,p'-DDD
p-tert-Octylphenol	Cholesterol	4-methylbiphenyl	Endrin
Benzophenone		2,3,5-trimethylnaphthalene	cis-Nonachlor
Tributyl phosphate	**Pharmaceuticals[a]**	1-methylfluorene	o,p'-DDT
Ethyl citrate	Azithromycin	Dibenzothiophene	p,p'-DDD
Cotinine	Clarithromycin	2-methylphenanthrene	Endosulfan-II
Celestolide (ADBI)	Clindamycin	9-methylanthracene	p,p'-DDT
Prometon	Hydrocodone	3,6-dimethylphenanthrene	Endosulfan Sulfate
Atrazine	MDMA (Ecstasy)	2-methylfluoranthene	p,p'-Methoxychlor
Phantolide (AHMI)	Methamphetamine	Benzo[*b*]naphtho[2,1-*d*]thiophene	Mirex
4-Octylphenol	N,N-DMPEA	Benzo[*e*]pyrene	cis-Permethrin
Tri(2-chloroethyl) phosphate	Pseudoephredrine	Perylene	trans-Permethrin
N-butyl benzenesulfonamide	Roxithromycin	3-methylcholanthrene	Total PCBs
Phenanthrene	Urobilin		PBDE congeners 28, 27, 99, 100, and 153

353 [a] Chemicals under this general chemical classification were measured in polar organic chemical integrative sampler
354 (POCIS) extracts.
355 [b] Chemicals under this general chemical classification were measured in semipermeable membrane device (SPMD)
356 extracts.
357

358

359 Table S2. Monitoring ions and limits of detection (LOD) used for the LC/MS/MS analyses of
360 pharmaceuticals and illicit drugs.

Compound	Precursor ion	Product ion	LOD[a]
Urobilin hydrochloride	591.3 $(M + H - HCl)^+$	343.3 $[M+H- HCl - 2(C_7H_{10}NO)]^+$	0.4
Azithromycin	749.5 $(M+H)^+$	591.4 $(M+H-C_8H_{16}O_2N)^+$	0.5
Roxithromycin	859.5 $(M+Na)^+$	755.4 $(M+Na-C_4H_9O_3)^+$	1
Clarithromycin	748.4 $(M+H)^+$	590.1 $(M+H-C_8H_{16}O_2N)^+$	1
Clindamycin	425.2 $(M+H)^+$	377.2 $(M+H-SH-CH_3)^+$	1
Methamphetamine	150 $(M+H)^+$	119 $(M+H-CH_3NH_2)^+$	2
MDMA(Ecstasy)	194 $(M+H)^+$	163.0 $(M-CH_3NH_2+H)^+$	1
Pseudoephedrine	166 $(M+H)^+$	148.2 $(M+H-H_2O)^+$	3
Hydrocodone	300 $(M+H)^+$	199 $(M+H-C_5H_{11}NO)+$	2

361 [a] as determined using MacDougall et al., guidelines (MacDougall and Crummett 1980), ng on-column.

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Table S3. Water concentrations of polycyclic aromatic hydrocarbons (PAHs) estimated from residues in semipermeable membrane devices deployed in the water column in Las Vegas Bay, Lake Mead, NV.

	MDL	MQL	Sampler Depth in Water Column		
			3.0 m	4.7 m	6.7 m
	pg/L	pg/L	pg/L	pg/L	pg/L
Naphthalene	140	680	**680**	**680**	**1400**
Acenaphthylene	28	140	<28	<28	<28
Acenaphthene	20	100	<20	<20	**110**
Fluorene	14	72	**74**	**73**	**400**
Phenanthrene	190	440	*260*	*250*	*420*
Anthracene	11	53	**56**	**55**	**63**
Fluoranthene	48	140	**330**	**380**	**320**
Pyrene	4.3	22	**290**	**360**	**410**
Benz[*a*]anthracene	3.7	19	**24**	**21**	**34**
Chrysene	3.8	19	**140**	**150**	**160**
Benzo[*b*]fluoranthene	3.7	19	**47**	**43**	**66**
Benzo[*k*]fluoranthene	3.9	19	**51**	**45**	**36**
Benzo[*a*]pyrene	4.1	20	**27**	**24**	**77**
Indeno[1,2,3-*c*,*d*]pyrene	4.8	24	**65**	**29**	**94**
Dibenz[*a*,*h*]anthracene	4.3	22	<4.3	<4.3	<4.3
Benzo[*g*,*h*,*i*]perylene	5.2	26	**71**	**62**	**100**
Benzo[*b*]thiophene	530	2600	<530	<530	<530
2-methylnaphthalene	560	1500	<560	<560	*940*
1-methylnaphthalene	47	230	**230**	**230**	**700**
Biphenyl	42	210	<42	**210**	**210**
1-ethylnaphthalene	14	71	<14	<14	**160**
1,2-dimethylnaphthalene	18	92	<18	<18	**300**
4-methylbiphenyl	17	85	<17	<17	<17
2,3,5-trimethylnaphthalene	6.2	31	**70**	**99**	**340**
1-methylfluorene	97	210	*130*	*120*	**280**
Dibenzothiophene	14	72	<14	**73**	**160**
2-methylphenanthrene	6.3	31	**70**	**67**	**43**
9-methylanthracene	5.1	26	<5.1	<5.1	<5.1
3,6-dimethylphenanthrene	4.0	20	**50**	**45**	**33**
2-methylfluoranthene	3.9	20	**25**	**22**	**33**
Benzo[*b*]naphtho[2,1-*d*]thiophene	4.2	21	<4.2	<4.2	<4.2
Benzo[*e*]pyrene	4.1	21	**110**	**120**	**200**
Perylene	3.8	19	**75**	**89**	**140**
3-methylcholanthrene	5.9	30	<5.9	<5.9	<5.9

MDL – method detection limit; MQL – method quantitation limit

Less than (<) values are results below the method detection limit.

Results in *italic* type are estimated values greater than the method detection limit but less than the method quantitation limit. These values have a greater amount of uncertainty in the absolute value.

Results in **bold** type are reportable values greater than the method quantitation limit.

Table S4. Water concentrations of polycyclic aromatic hydrocarbons (PAHs) estimated from residues in semipermeable membrane devices buried in the sediment in Las Vegas Bay, Lake Mead, NV.

			Sampler Depth in Sediment		
	MDL	MQL	0-10 cm	10-20 cm	20-30 cm
	pg/L	pg/L	pg/L	pg/L	pg/L
Naphthalene	11000	28000	<11000	<11000	<11000
Acenaphthylene	180	910	<180	<180	<180
Acenaphthene	140	670	<140	<140	<140
Fluorene	99	500	**510**	**500**	*490*
Phenanthrene	430	1300	*450*	*440*	<430
Anthracene	76	380	<76	<76	<76
Fluoranthene	410	1200	<410	<410	<410
Pyrene	38	190	**220**	**200**	**190**
Benz[*a*]anthracene	36	180	**210**	**190**	*170*
Chrysene	36	180	**210**	**180**	*170*
Benzo[*b*]fluoranthene	35	180	**210**	**180**	<35
Benzo[*k*]fluoranthene	39	190	**230**	**200**	*190*
Benzo[*a*]pyrene	41	200	**240**	<41	<41
Indeno[1,2,3-*c*,*d*]pyrene	49	250	**290**	<49	<49
Dibenz[*a*,*h*]anthracene	44	220	**260**	<44	<44
Benzo[*g*,*h*,*i*]perylene	54	270	**320**	**280**	<54
Benzo[*b*]thiophene	3400	17000	<3400	<3400	<3400
2-methylnaphthalene	3200	9300	<3200	<3200	<3200
1-methylnaphthalene	300	1500	**1500**	<300	<300
Biphenyl	280	1400	<280	<280	<280
1-ethylnaphthalene	97	490	<97	<97	<97
1,2-dimethylnaphthalene	120	620	<120	<120	<120
4-methylbiphenyl	120	570	<120	<120	<120
2,3,5-trimethylnaphthalene	49	250	<49	<49	<49
1-methylfluorene	490	1400	<490	<490	<490
Dibenzothiophene	99	500	<99	<99	<99
2-methylphenanthrene	50	250	<50	<50	<50
9-methylanthracene	43	210	<43	<43	<43
3,6-dimethylphenanthrene	36	180	<36	<36	<36
2-methylfluoranthene	36	180	<36	<36	<36
Benzo[*b*]naphtho[2,1-*d*]thiophene	37	190	<37	<37	<37
Benzo[*e*]pyrene	42	210	<42	<42	<42
Perylene	38	190	<38	<38	<38
3-methylcholanthrene	61	310	<61	<61	<61

MDL – method detection limit; MQL – method quantitation limit

Less than (<) values are results below the method detection limit.

Results in *italic* type are estimated values greater than the method detection limit but less than the method quantitation limit. These values have a greater amount of uncertainty in the absolute value.

Results in **bold** type are reportable values greater than the method quantitation limit.

Table S5. Water concentrations of chlorinated pesticides, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) estimated from residues in semipermeable membrane devices deployed in the water column in Las Vegas Bay, Lake Mead, NV.

			Sampler Depth in Water Column		
	MDL	MQL	3.0 m	4.7 m	6.7 m
	pg/L	pg/L	pg/L	pg/L	pg/L
Trifluralin	12	16	**25**	*15*	*13*
Hexachlorobenzene (HCB)	0.89	2.2	**25**	**26**	**13**
Pentachloroanisole (PCA)	19	52	<19	<19	<19
Tefluthrin	64	150	<64	<64	<64
alpha-Benzenehexachloride (a-BHC)	150	200	<150	<150	<150
Diazinon	16000	20000	<1600	<1600	<1600
Lindane	240	270	<240	<240	<240
beta-Benzenehexachloride (b-BHC)	60	110	**180**	**220**	**110**
Heptachlor	10	26	<10	<10	<10
delta-Benzenehexachloride (d-BHC)	86	250	<86	<86	<86
Dacthal	17	45	<17	<17	<17
Chlorpyrifos	28	74	<28	<28	<28
Oxychlordane	0.39	2.0	<0.4	<0.4	<0.4
Heptachlor Epoxide	28	74	<48	<48	<48
trans-Chlordane	3.0	7.6	*4.5*	*5.8*	*5.5*
trans-Nonachlor	5.1	12	<5.1	<5.1	<5.1
o,p'-DDE	9.3	24	**62**	**94**	**65**
cis-Chlordane	0.43	2.1	**14**	**19**	**13**
Endosulfan	22	110	**61**	**51**	<22
p,p'-DDE	16	27	**100**	**140**	**160**
Dieldrin	20	53	*28*	*40*	<20
o,p'-DDD	12	33	**35**	**39**	*21*
Endrin	10	29	<10	<10	<10
cis-Nonachlor	3.6	10	<3.6	<3.6	<3.6
o,p'-DDT	6.1	18	<6.1	<6.1	<6.1
p,p'-DDD	0.37	1.9	**39**	**47**	**33**
Endosulfan-II	46	230	**210**	**290**	*160*
p,p'-DDT	34	68	<34	<34	<34
Endosulfan Sulfate	120	320	<120	<120	<120
p,p'-Methoxychlor	9.4	47	**11**	<9.4	<9.4
Mirex	0.52	2.6	<0.5	<0.5	<0.5
cis-Permethrin	62	180	<62	<62	<62
trans-Permethrin	1.1	5.5	<1.2	<1.2	<1.2
Total PCBs	110	310	*170*	*200*	**310**
PBDE-28	6.0	10	<6.0	<6.0	**11**
PBDE-47	21	49	*28*	*28*	*23*
PBDE-99	13	27	<13	<13	<13
PBDE-100	1.7	4.1	<1.7	<1.7	<1.7
PBDE-153	1.3	2.2	<1.3	<1.3	<1.3

MDL – method detection limit; MQL – method quantitation limit

Less than (<) values are results below the method detection limit.

Results in *italic* type are estimated values greater than the method detection limit but less than the method quantitation limit. These values have a greater amount of uncertainty in the absolute value.

Results in **bold** type are reportable values greater than the method quantitation limit.

Table S6. Water concentrations of chlorinated pesticides, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) estimated from residues in semipermeable membrane devices buried in the sediment in Las Vegas Bay, Lake Mead, NV.

			Sampler Depth in Sediment		
	MDL	MQL	0-10 cm	10-20 cm	20-30 cm
	pg/L	pg/L	pg/L	pg/L	pg/L
Trifluralin	55	65	*59*	*58*	<55
Hexachlorobenzene (HCB)	3.5	18	*6.2*	*5.6*	*6.9*
Pentachloroanisole (PCA)	18	49	<18	<18	<18
Tefluthrin	200	240	*210*	<200	<200
alpha-Benzenehexachloride (a-BHC)	470	490	<470	<470	<470
Diazinon	97000	190000	<97000	<97000	<97000
Lindane	840	1100	<840	<840	<840
beta-Benzenehexachloride (b-BHC)	160	210	*180*	**220**	*170*
Heptachlor	11	20	<11	<11	<11
delta-Benzenehexachloride (d-BHC)	280	830	<280	<280	<280
Dacthal	70	180	<70	<70	<70
Chlorpyrifos	41	91	<41	<41	<41
Oxychlordane	3.6	18	<3.6	<3.6	<3.6
Heptachlor Epoxide	76	230	<76	<76	<76
trans-Chlordane	41	110	<41	<41	<41
trans-Nonachlor	94	260	<94	<94	<94
o,p'-DDE	54	150	<54	<54	*71*
cis-Chlordane	28	84	<28	<28	<28
Endosulfan	140	720	<140	<140	<140
p,p'-DDE	77	140	*88*	**160**	**250**
Dieldrin	68	140	<68	<68	<68
o,p'-DDD	31	83	<31	<31	<31
Endrin	54	91	*57*	<54	<54
cis-Nonachlor	3.9	19	*6.3*	<3.9	<3.9
o,p'-DDT	15	43	<15	<15	<15
p,p'-DDD	3.5	18	**21**	**29**	**40**
Endosulfan-II	300	1500	<300	<300	<300
p,p'-DDT	110	180	<110	<110	<110
Endosulfan Sulfate	500	1400	<500	<500	<500
p,p'-Methoxychlor	69	340	<69	<69	<69
Mirex	5.3	27	<5.3	<5.3	<5.3
cis-Permethrin	27	133	<27	<27	<27
trans-Permethrin	11	57	<11	<11	<11
Total PCBs	120	220	*180*	*200*	**260**
PBDE-28	23	360	<23	<23	<23
PBDE-47	110	270	<110	<110	<110
PBDE-99	6.1	12	<6.1	<6.1	<6.1
PBDE-100	33	54	<33	<33	<33
PBDE-153	26	64	<26	<26	*38*

MDL – method detection limit; MQL – method quantitation limit

Less than (<) values are results below the method detection limit.

Results in *italic* type are estimated values greater than the method detection limit but less than the method quantitation limit. These values have a greater amount of uncertainty in the absolute value.

Results in **bold** type are reportable values greater than the method quantitation limit.

399 Table S7. Concentrations of waste indicator chemicals in polar organic chemical integrative
400 samplers (POCIS) deployed in the water column in Las Vegas Bay, Lake Mead, NV.

	Sampling Rate (R_s)			Sampler Depth in Water Column		
	MDL	MQL	3.0 m	4.7 m	6.7 m
	L/d	ng/POCIS	ng/POCIS	ng/POCIS	ng/POCIS	ng/POCIS
Tetrachloroethylene	NA	2.0	10	<2.0	<2.0	<2.0
Bromoform	NA	2.0	10	<2.0	<2.0	<2.0
Isopropylbenzene (cumene)	NA	2.0	10	<2.0	<2.0	<2.0
Phenol	0.097 [a]	10	50	<10	<10	**110**
1,4-Dichlorobenzene	NA	2.0	10	<2.0	<2.0	<2.0
d-Limonene	NA	2.0	10	<2.0	<2.0	<2.0
Acetophenone	0.082 [a]	2.0	10	<2.0	<2.0	<2.0
para-Cresol	0.087 [a]	20	100	<20	<20	**13000**
Isophorone	0.266 [a]	2.0	10	<2.0	<2.0	*5.0*
Camphor	NA	2.0	10	<2.0	<2.0	<2.0
Menthol	NA	10	50	<10	<10	<10
Naphthalene	NA	2.0	10	<2.0	<2.0	<2.0
Methyl salicylate	0.079 [a]	10	50	<10	<10	<10
Dichlorvos	NA	10	50	<10	<10	<10
Isoquinoline	NA	10	50	<10	<10	<10
Indole	0.085 [a]	10	50	<10	<10	**680**
2-Methyl naphthalene	NA	2.0	10	<2.0	<2.0	<2.0
1-Methyl naphthalene	NA	2.0	10	<2.0	<2.0	<2.0
2,6-Dimethylnaphthalene	NA	2.0	10	<2.0	<2.0	<2.0
Cashmeran (DPMI)	NA	2.0	10	<2.0	<2.0	<2.0
N,N-diethyltoluamide (DEET)	0.192 [a, b]	10	50	**290**	**160**	<10
Diethyl phthalate	0.061 [a]	2.0	10	**110**	**100**	**55**
p-tert-Octylphenol	0.058 [c]	10	50	**95**	**65**	<10
Benzophenone	0.067 [a]	2.0	10	**10**	<2.0	<2.0
Tributyl phosphate	0.150 [a]	2.0	10	**65**	**40**	<2.0
Ethyl citrate	0.265 [a]	10	50	**50**	*35*	<10
Cotinine	NA	10	50	<10	<10	<10
Celestolide (ADBI)	NA	2.0	10	<2.0	<2.0	<2.0
Prometon	NA	10	50	<10	<10	<10
Atrazine	NA	20	100	<20	<20	<20
Phantolide (AHMI)	NA	2.0	10	<2.0	<2.0	<2.0
4-Octylphenol	NA	20	100	<20	<20	<20
Tri(2-chloroethyl) phosphate	0.309 [a]	10	50	**640**	**350**	<10
N-butyl benzenesulfonamide	0.065 [a]	20	100	**3100**	**2000**	<20
Phenanthrene	NA	2.0	10	<2.0	<2.0	<2.0
Anthracene	NA	2.0	10	<2.0	<2.0	<2.0
Diazinon	NA	2.0	10	<2.0	<2.0	<2.0
Musk Ambrette	NA	2.0	10	<2.0	<2.0	<2.0
Carbazole	NA	2.0	10	<2.0	<2.0	<2.0
Caffeine	NA	10	50	<10	<10	<10
Traseolide (ATII)	NA	2.0	10	<2.0	<2.0	<2.0
Galaxolide (HHCB)	0.216 [a]	2.0	10	**300**	**190**	**55**
Tonalide (AHTN)	0.222 [a]	2.0	10	**35**	**20**	**10**
Musk Xylene	NA	2.0	10	<2.0	<2.0	<2.0

Carbaryl	NA	10	50	<10	<10	<10
Metalaxyl	NA	10	50	<10	<10	<10
Bromacil	NA	20	100	<20	<20	<20
Anthraquinone	NA	10	50	<10	<10	<10
Musk Ketone	NA	2.0	10	<2.0	<2.0	<2.0
Chlorpyrifos	NA	10	50	<10	<10	<10
Fluoranthene	NA	2.0	10	<2.0	<2.0	<2.0
Pyrene	NA	2.0	10	<2.0	<2.0	<2.0
Tri(dichloroisopropyl) phosphate	0.050 [a]	10	50	**550**	**270**	*25*
Tri(butoxyethyl) phosphate	NA	20	100	<20	<20	<20
Triphenyl phosphate	NA	2.0	10	<2.0	<2.0	<2.0
Diethylhexylphthalate (DEHP)	0.041 [a]	230	480	<230	<230	*390*
Benzo[a]pyrene	NA	2.0	10	<2.0	<2.0	<2.0
Cholesterol	NA	1000	2900	<1000	<1000	<1000

MDL – method detection limit; MQL – method quantitation limit
Less than (<) values are results below the method detection limit.
Results in *italic* type are estimated values greater than the method detection limit but less than the method quantitation limit. These values have a greater amount of uncertainty in the absolute value.
Results in **bold** type are reportable values greater than the method quantitation limit.

NA – not applicable, sampling rate not needed as there were no detection for this chemical
[a] Alvarez, Unpublished Data
[b] Bartlet-Hunt et al., 2011
[c] Harman et al., 2008

413 Table S8. Concentrations of waste indicator chemicals in polar organic chemical integrative
414 samplers (POCIS) buried in the sediment in Las Vegas Bay, Lake Mead, NV.

	Sampling Rate (R_s) L/d	MDL ng/POCIS	MQL ng/POCIS	Sampler Depth in Sediment 0-10 cm ng/POCIS	10-20 cm ng/POCIS	20-30 cm ng/POCIS
Tetrachloroethylene	NA	2.0	10	<2.0	<2.0	<2.0
Bromoform	NA	2.0	10	<2.0	<2.0	<2.0
Isopropylbenzene (cumene)	NA	2.0	10	<2.0	<2.0	<2.0
Phenol	0.097 [a]	10	50	**1300**	**640**	<10
1,4-Dichlorobenzene	NA	2.0	10	<2.0	<2.0	<2.0
d-Limonene	NA	2.0	10	<2.0	<2.0	<2.0
Acetophenone	0.082 [a]	2.0	10	**30**	**60**	<2.0
para-Cresol	0.087 [a]	20	100	**11000**	**6900**	<20
Isophorone	0.266 [a]	2.0	10	**40**	**70**	<2.0
Camphor	NA	2.0	10	<2.0	<2.0	<2.0
Menthol	NA	10	50	<10	<10	<10
Naphthalene	NA	2.0	10	<2.0	<2.0	<2.0
Methyl salicylate	0.079 [a]	10	50	*20*	*40*	<10
Dichlorvos	NA	10	50	<10	<10	<10
Isoquinoline	NA	10	50	<10	<10	<10
Indole	0.085 [a]	10	50	**950**	**760**	<10
2-Methyl naphthalene	NA	2.0	10	<2.0	<2.0	<2.0
1-Methyl naphthalene	NA	2.0	10	<2.0	<2.0	<2.0
2,6-Dimethylnaphthalene	NA	2.0	10	<2.0	<2.0	<2.0
Cashmeran (DPMI)	NA	2.0	10	<2.0	<2.0	<2.0
N,N-diethyltoluamide (DEET)	0.192 [a, b]	10	50	**200**	<10	<10
Diethyl phthalate	0.061 [a]	2.0	10	**490**	**240**	<2.0
p-tert-Octylphenol	0.058 [c]	10	50	<10	<10	<10
Benzophenone	0.067 [a]	2.0	10	<2.0	<2.0	<2.0
Tributyl phosphate	0.150 [a]	2.0	10	<2.0	**20**	<2.0
Ethyl citrate	0.265 [a]	10	50	<10	<10	<10
Cotinine	NA	10	50	<10	<10	<10
Celestolide (ADBI)	NA	2.0	10	<2.0	<2.0	<2.0
Prometon	NA	10	50	<10	<10	<10
Atrazine	NA	20	100	<20	<20	<20
Phantolide (AHMI)	NA	2.0	10	<2.0	<2.0	<2.0
4-Octylphenol	NA	20	100	<20	<20	<20
Tri(2-chloroethyl) phosphate	0.309 [a]	10	50	<10	<10	<10
N-butyl benzenesulfonamide	0.065 [a]	20	100	<20	<20	<20
Phenanthrene	NA	2.0	10	<2.0	<2.0	<2.0
Anthracene	NA	2.0	10	<2.0	<2.0	<2.0
Diazinon	NA	2.0	10	<2.0	<2.0	<2.0
Musk Ambrette	NA	2.0	10	<2.0	<2.0	<2.0
Carbazole	NA	2.0	10	<2.0	<2.0	<2.0
Caffeine	NA	10	50	<10	<10	<10
Traseolide (ATII)	NA	2.0	10	<2.0	<2.0	<2.0
Galaxolide (HHCB)	0.216 [a]	2.0	10	**130**	**170**	<2.0
Tonalide (AHTN)	0.222 [a]	2.0	10	**30**	**20**	<2.0
Musk Xylene	NA	2.0	10	<2.0	<2.0	<2.0

Carbaryl	NA	10	50	<10	<10	<10
Metalaxyl	NA	10	50	<10	<10	<10
Bromacil	NA	20	100	<20	<20	<20
Anthraquinone	NA	10	50	<10	<10	<10
Musk Ketone	NA	2.0	10	<2.0	<2.0	<2.0
Chlorpyrifos	NA	10	50	<10	<10	<10
Fluoranthene	NA	2.0	10	<2.0	<2.0	<2.0
Pyrene	NA	2.0	10	<2.0	<2.0	<2.0
Tri(dichloroisopropyl) phosphate	0.050 [a]	10	50	**50**	<10	<10
Tri(butoxyethyl) phosphate	NA	20	100	<20	<20	<20
Triphenyl phosphate	NA	2.0	10	<2.0	<2.0	<2.0
Diethylhexylphthalate (DEHP)	0.041 [a]	1000	2400	<1000	<1000	<1000
Benzo[a]pyrene	NA	2.0	10	<2.0	<2.0	<2.0
Cholesterol	NA	1200	2200	<1200	<1200	<1200

MDL – method detection limit; MQL – method quantitation limit

Less than (<) values are results below the method detection limit.

Results in *italic* type are estimated values greater than the method detection limit but less than the method quantitation limit. These values have a greater amount of uncertainty in the absolute value.

Results in **bold** type are reportable values greater than the method quantitation limit.

NA – not applicable, sampling rate not needed as there were no detection for this chemical

[a] Alvarez, Unpublished Data

[b] Bartlet-Hunt et al., 2011

[c] Harman et al., 2008

Table S9. Nominal concentrations of pharmaceuticals and illicit drugs in polar organic chemical integrative samplers (POCIS) deployed in the water column and buried in the sediment in Las Vegas Bay, Lake Mead, NV.

	Sampling Rate (R_s) L/d	Sampler Depth in Water Column			Sampler Depth in Sediment		
		3.0 m ng/POCIS	4.7 m ng/POCIS	6.7 m ng/POCIS	0-10 cm ng/POCIS	10-20 cm ng/POCIS	20-30 cm ng/POCIS
Azithromycin	NA	ND	ND	ND	ND	ND	ND
Clarithromycin	0.668 [a]	**trace**	ND	**47**	ND	ND	ND
Clindamycin	NA	ND	ND	ND	ND	ND	ND
Hydrocodone	0.050 [b]	**170**	ND	ND	ND	ND	ND
MDMA (Ecstasy)	NA	ND	ND	ND	ND	ND	ND
Methamphetamine	0.089 [b]	**32**	ND	ND	ND	ND	ND
N,N-DMPEA	NA	ND	ND	ND	ND	ND	ND
Pseudoephredrine	NA	ND	ND	ND	ND	ND	ND
Roxithromycin	NA	ND	ND	ND	ND	ND	ND
Urobilin	NA	ND	ND	ND	ND	ND	ND

ND – not detected.

Trace – identity of the clindamycin was confirmed by LC/MS/MS but the concentration was too low for quantitation.

Results in **bold** type are reportable values greater than the method quantitation limit.

NA – not applicable, sampling rate not needed as there were no detection for this chemical

[a] MacLeod et al., 2007

[b] Alvarez, Unpublished Data

Table S10. Concentrations of performance reference compounds (PRCs) recovered from semipermeable membrane devices (SPMDs) deployed in the water column and buried in the sediment in Las Vegas Bay, Lake Mead, NV.

		Acenaphthylene-d_{10} ng/SPMD	Acenaphthene-d_{10} ng/SPMD	Fluorene-d_{10} ng/SPMD	Phenanthrene-d_{10} ng/SPMD	Pyrene-d_{10} ng/SPMD	Dibenz[*a*,*h*]anthracene-d_{14} [a] ng/SPMD
Water Column	Fabrication Blank	730	790	880	1030	1250	1060
	Field Blank	680	750	887	1070	1240	1050
	Blank Average [b]	**705**	**770**	**884**	**1050**	**1245**	**1055**
	3.0 m	0	0	0	60	550	930
	4.7 m	0	0	0	40	490	950
	6.7 m	160	350	400	630	1070	1160
Sediment Depth	Fabrication Blank	270	300	340	430	590	670
	Field Blank	270	320	370	430	460	560
	Blank Average [b]	**270**	**310**	**355**	**430**	**525**	**615**
	0-10 cm	150	330	370	460	600	650
	10-20 cm	100	210	260	400	550	630
	20-30 cm	90	210	250	360	540	600

[a] Dibenz[*a*,*h*]anthracene-d_{14} was used as a photolysis marker.

[b] The average of the PRC values from the blanks was used to determine the initial PRC concentrations (N_o).

443 Table S11. Recovery of priority pollutant polycyclic aromatic hydrocarbons (PAHs) from
444 semipermeable membrane devices (SPMDs) processed concurrently with field SPMDs deployed
445 in the water column and buried in the sediment in Las Vegas Bay, Lake Mead, NV.

	Water Column % Recovery	Sediment Depth % Recovery
Naphthalene	41	28
Acenaphthylene	67	51
Acenaphthene	70	55
Fluorene	79	63
Phenanthrene	87	73
Anthracene	85	73
Fluoranthene	92	84
Pyrene	93	84
Benz[*a*]anthracene	94	91
Chrysene	94	90
Benzo[*b*]fluoranthene	94	89
Benzo[*k*]fluoranthene	92	87
Benzo[*a*]pyrene	93	87
Indeno[1,2,3-*c,d*]pyrene	96	85
Dibenz[*a,h*]anthracene	94	79
Benzo[*g,h,i*]perylene	91	83

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Table S12. Recovery of chlorinated pesticides, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) from semipermeable membrane devices (SPMDs) processed concurrently with field SPMDs deployed in the water column and buried in the sediment in Las Vegas Bay, Lake Mead, NV.

	Water Column % Recovery	Sediment Depth % Recovery
Trifluralin	12	13
Hexachlorobenzene (HCB)	91	70
Pentachloroanisole (PCA)	96	70
Tefluthrin	14	11
alpha-Benzenehexachloride (a-BHC)	74	70
Diazinon	22	8.9
Lindane	82	80
beta-Benzenehexachloride (b-BHC)	79	77
Heptachlor	87	86
delta-Benzenehexachloride (d-BHC)	74	74
Dacthal	29	26
Chlorpyrifos	45	22
Oxychlordane	98	91
Heptachlor Epoxide	98	96
trans-Chlordane	88	86
trans-Nonachlor	86	84
o,p'-DDE	97	108
cis-Chlordane	87	94
Endosulfan	85	99
p,p'-DDE	83	87
Dieldrin	86	88
o,p'-DDD	96	90
Endrin	92	94
cis-Nonachlor	77	71
o,p'-DDT	79	85
p,p'-DDD	94	84
Endosulfan-II	83	49
p,p'-DDT	83	79
Endosulfan Sulfate	79	49
p,p'-Methoxychlor	30	44
Mirex	88	83
cis-Permethrin	4.5	5.7
trans-Permethrin	2.0	3.4
Total PCBs	91	89
PBDE-28	88	93

PBDE-47	94	117
PBDE-99	44	57
PBDE-100	39	49
PBDE-153	3.3	11

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Table S13. Concentrations of polycyclic aromatic hydrocarbons (PAHs) from semipermeable membrane device (SPMD) blanks processed concurrently with field SPMDs deployed in the water column and buried in the sediment in Las Vegas Bay, Lake Mead, NV.

	Water Column			Sediment Depth		
	Lab Blank	Fabrication Blank	Field Blank	Lab Blank	Fabrication Blank	Field Blank
	ng/SPMD	ng/SPMD	ng/SPMD	ng/SPMD	ng/SPMD	ng/SPMD
Naphthalene	0	0	0	10	0	10
Acenaphthylene	0	0	0	0	0	0
Acenaphthene	0	0	0	0	0	0
Fluorene	0	0	0	0	0	0
Phenanthrene	20	10	10	10	10	10
Anthracene	0	0	0	0	0	0
Fluoranthene	10	0	0	10	0	0
Pyrene	0	0	0	0	0	0
Benz[*a*]anthracene	0	0	0	0	0	0
Chrysene	0	0	0	0	0	0
Benzo[*b*]fluoranthene	0	0	0	0	0	0
Benzo[*k*]fluoranthene	0	0	0	0	0	0
Benzo[*a*]pyrene	0	0	0	0	0	0
Indeno[1,2,3-*c*,*d*]pyrene	0	0	0	0	0	0
Dibenz[*a*,*h*]anthracene	0	0	0	0	0	0
Benzo[*g*,*h*,*i*]perylene	0	0	0	0	0	0
Benzo[*b*]thiophene	0	0	0	0	0	0
2-methylnaphthalene	10	10	0	10	0	0
1-methylnaphthalene	0	0	0	0	0	0
Biphenyl	0	0	0	0	0	0
1-ethylnaphthalene	0	0	0	0	0	0
1,2-dimethylnaphthalene	0	0	0	0	0	0
4-methylbiphenyl	0	0	0	0	0	0
2,3,5-trimethylnaphthalene	0	0	0	0	0	0
1-methylfluorene	20	10	20	10	0	0
Dibenzothiophene	0	0	0	0	0	0
2-methylphenanthrene	0	0	0	0	0	0
9-methylanthracene	0	0	0	0	0	0
3,6-dimethylphenanthrene	0	0	0	0	0	0
2-methylfluoranthene	0	0	0	0	0	0
Benzo[*b*]naphtho[2,1-*d*]thiophene	0	0	0	0	0	0
Benzo[*e*]pyrene	0	0	0	0	0	0
Perylene	0	0	0	0	0	0
3-methylcholanthrene	0	0	0	0	0	0

Table S14. Concentrations of chlorinated pesticides, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) from semipermeable membrane device (SPMD) blanks processed concurrently with field SPMDs deployed in the water column and buried in the sediment in Las Vegas Bay, Lake Mead, NV.

	Water Column			Sediment Depth		
	Lab Blank	Fabrication Blank	Field Blank	Lab Blank	Fabrication Blank	Field Blank
	ng/SPMD	ng/SPMD	ng/SPMD	ng/SPMD	ng/SPMD	ng/SPMD
Trifluralin	4.5	4.9	4.5	2.6	2.6	2.7
Hexachlorobenzene (HCB)	0.18	0.08	0.28	0.06	0.03	0.05
Pentachloroanisole (PCA)	5.1	1.6	0.54	0.36	0.47	0.00
Tefluthrin	12	10	5.0	5.6	5.9	5.8
alpha-Benzenehexachloride (a-BHC)	5.8	5.7	5.2	3.0	3.0	3.0
Diazinon	36	35	33	17	22	27
Lindane	6.7	6.7	6.9	3.2	3.3	3.5
beta-Benzenehexachloride (b-BHC)	1.9	1.9	1.4	0.99	0.91	0.94
Heptachlor	0.88	1.0	2.6	0.51	0.53	0.53
delta-Benzenehexachloride (d-BHC)	0	0	3.3	1.6	0	0
Dacthal	0.78	0.74	0	0.14	0.26	0.64
Chlorpyrifos	1.1	1.1	0	0.24	0.20	0.40
Oxychlordane	0	0	0	0	0	0
Heptachlor Epoxide	2.0	2.1	0	0	0.93	0
trans-Chlordane	0.32	0.3	0.86	0.17	0.16	1.2
trans-Nonachlor	0.74	0.9	1.6	0.54	0.50	2.5
o,p'-DDE	0.78	0.8	2.7	0.40	0.42	1.7
cis-Chlordane	0	0	0.10	0	0	0.74
Endosulfan	0	0	0	0	0	0
p,p'-DDE	4.7	6.2	6.2	2.3	2.7	3.2
Dieldrin	1.4	0	1.9	0.71	1.0	1.3
o,p'-DDD	0	3.1	1.9	0	0.56	0.78
Endrin	0	1.1	0	1.1	1.3	1.0
cis-Nonachlor	0	0.94	0.40	0.05	0.02	0
o,p'-DDT	0	0	1.6	0	0	0.40
p,p'-DDD	0	0	0	0	0	0
Endosulfan-II	0	0	0	0	0	0
p,p'-DDT	8.4	8.6	13	4.0	4.0	5.0
Endosulfan Sulfate	0.08	0.04	0.38	0	0.12	0.24
p,p'-Methoxychlor	0	0	0	0	0	0
Mirex	0	0	0	0	0	0
cis-Permethrin	2.1	0	85	0	0	0

trans-Permethrin	0	0	0	0	0	0
Total PCBs	7.0	4.5	29	3.6	2.9	4.3
PBDE-28	2.1	2.2	2.6	0.96	0.92	1.1
PBDE-47	2.8	7.0	4.9	3.6	1.6	1.3
PBDE-99	2.0	3.6	3.0	1.1	0.81	0.90
PBDE-100	0.24	0.44	0.18	0.18	0.12	0.13
PBDE-153	0.22	0.28	0.28	0.17	0.44	0.21

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463 Table S15. Concentrations of waste indicator chemicals in polar organic chemical integrative
464 samplers (POCIS) blanks processed concurrently with field SPMDs deployed in the water
465 column and buried in the sediment in Las Vegas Bay, Lake Mead, NV.

	Water Column			Sediment Depth		
	Lab Blank	Fabrication Blank	Field Blank	Lab Blank	Fabrication Blank	Field Blank
	ng/POCIS	ng/POCIS	ng/POCIS	ng/POCIS	ng/POCIS	ng/POCIS
Tetrachloroethylene	0	0	0	0	0	0
Bromoform	0	0	0	0	0	0
Isopropylbenzene (cumene)	0	0	0	0	0	0
Phenol	0	0	0	0	0	0
1,4-Dichlorobenzene	0	0	0	0	0	0
d-Limonene	0	0	0	0	0	0
Acetophenone	0	0	0	0	0	0
para-Cresol	0	0	0	0	0	0
Isophorone	0	0	0	0	0	0
Camphor	0	0	0	0	0	0
Menthol	0	0	0	0	0	0
Naphthalene	0	0	0	0	0	0
Methyl salicylate	0	0	0	0	0	0
Dichlorvos	0	0	0	0	0	0
Isoquinoline	0	0	0	0	0	0
Indole	0	0	0	0	0	0
2-Methyl naphthalene	0	0	0	0	0	0
1-Methyl naphthalene	0	0	0	0	0	0
2,6-Dimethylnaphthalene	0	0	0	0	0	0
Cashmeran (DPMI)	0	0	0	0	0	0
N,N-diethyltoluamide (DEET)	0	0	0	0	0	0
Diethyl phthalate	0	0	0	0	0	0
p-tert-Octylphenol	0	0	0	0	0	0
Benzophenone	0	0	0	0	0	0
Tributyl phosphate	0	0	0	0	0	0
Ethyl citrate	0	0	0	0	0	0
Cotinine	0	0	0	0	0	0
Celestolide (ADBI)	0	0	0	0	0	0
Prometon	0	0	0	0	0	0
Atrazine	0	0	0	0	0	0
Phantolide (AHMI)	0	0	0	0	0	0
4-Octylphenol	0	0	0	0	0	0
Tri(2-chloroethyl) phosphate	0	0	0	0	0	0
N-butyl benzenesulfonamide	0	0	0	0	0	0

Phenanthrene	0	0	0	0	0	0
Anthracene	0	0	0	0	0	0
Diazinon	0	0	0	0	0	0
Musk Ambrette	0	0	0	0	0	0
Carbazole	0	0	0	0	0	0
Caffeine	0	0	0	0	0	0
Traseolide (ATII)	0	0	0	0	0	0
Galaxolide (HHCB)	0	0	0	0	0	0
Tonalide (AHTN)	0	0	0	0	0	0
Musk Xylene	0	0	0	0	0	0
Carbaryl	0	0	0	0	0	0
Metalaxyl	0	0	0	0	0	0
Bromacil	0	0	0	0	0	0
Anthraquinone	0	0	0	0	0	0
Musk Ketone	0	0	0	0	0	0
Chlorpyrifos	0	0	0	0	0	0
Fluoranthene	0	0	0	0	0	0
Pyrene	0	0	0	0	0	0
Tri(dichloroisopropyl) phosphate	0	0	0	0	0	0
Tri(butoxyethyl) phosphate	0	0	0	0	0	0
Triphenyl phosphate	0	0	0	0	0	0
Diethylhexylphthalate (DEHP)	150	130	80	230	610	480
Benzo[a]pyrene	0	0	0	0	0	0
Cholesterol	520	0	190	580	850	790

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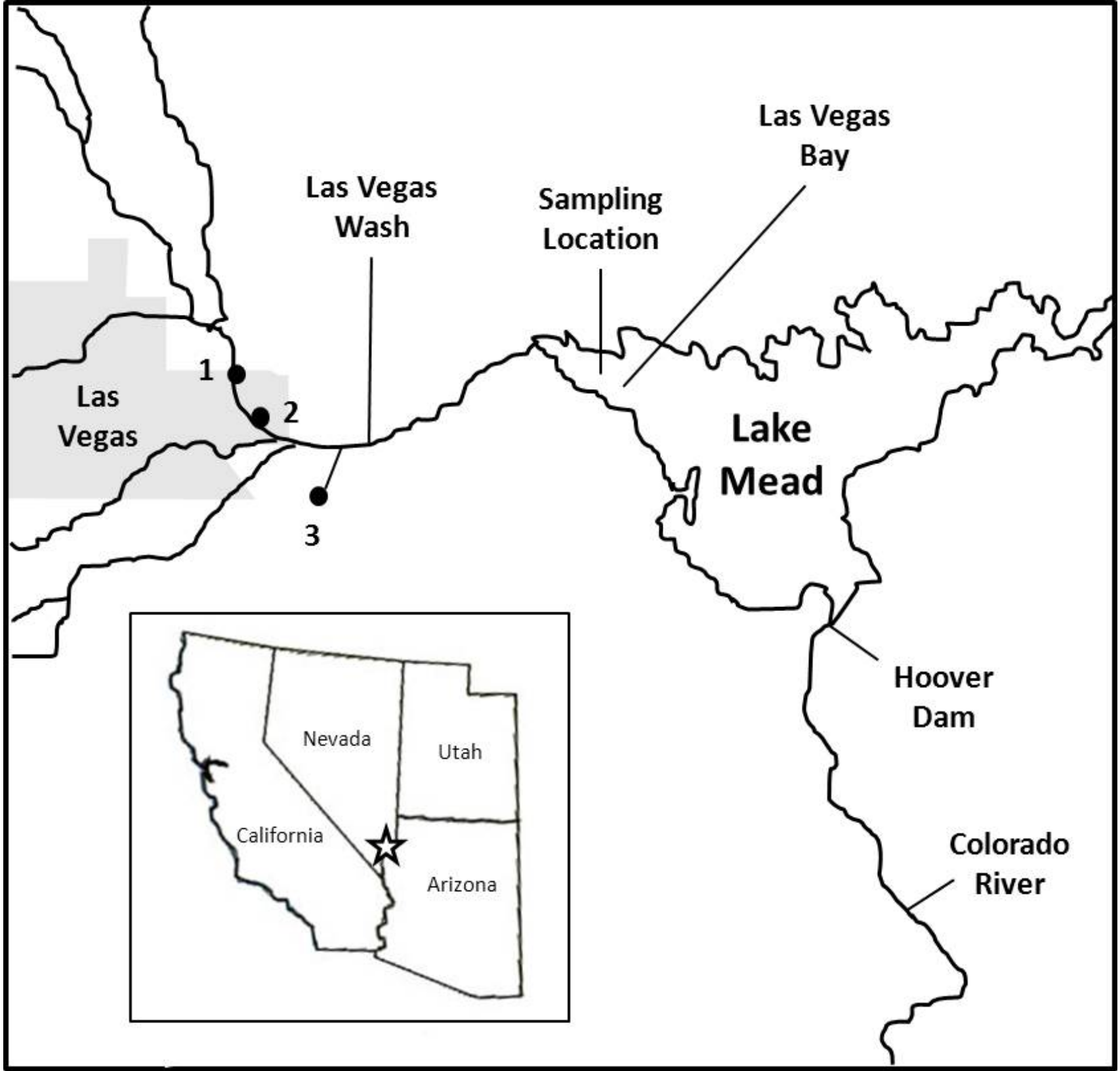
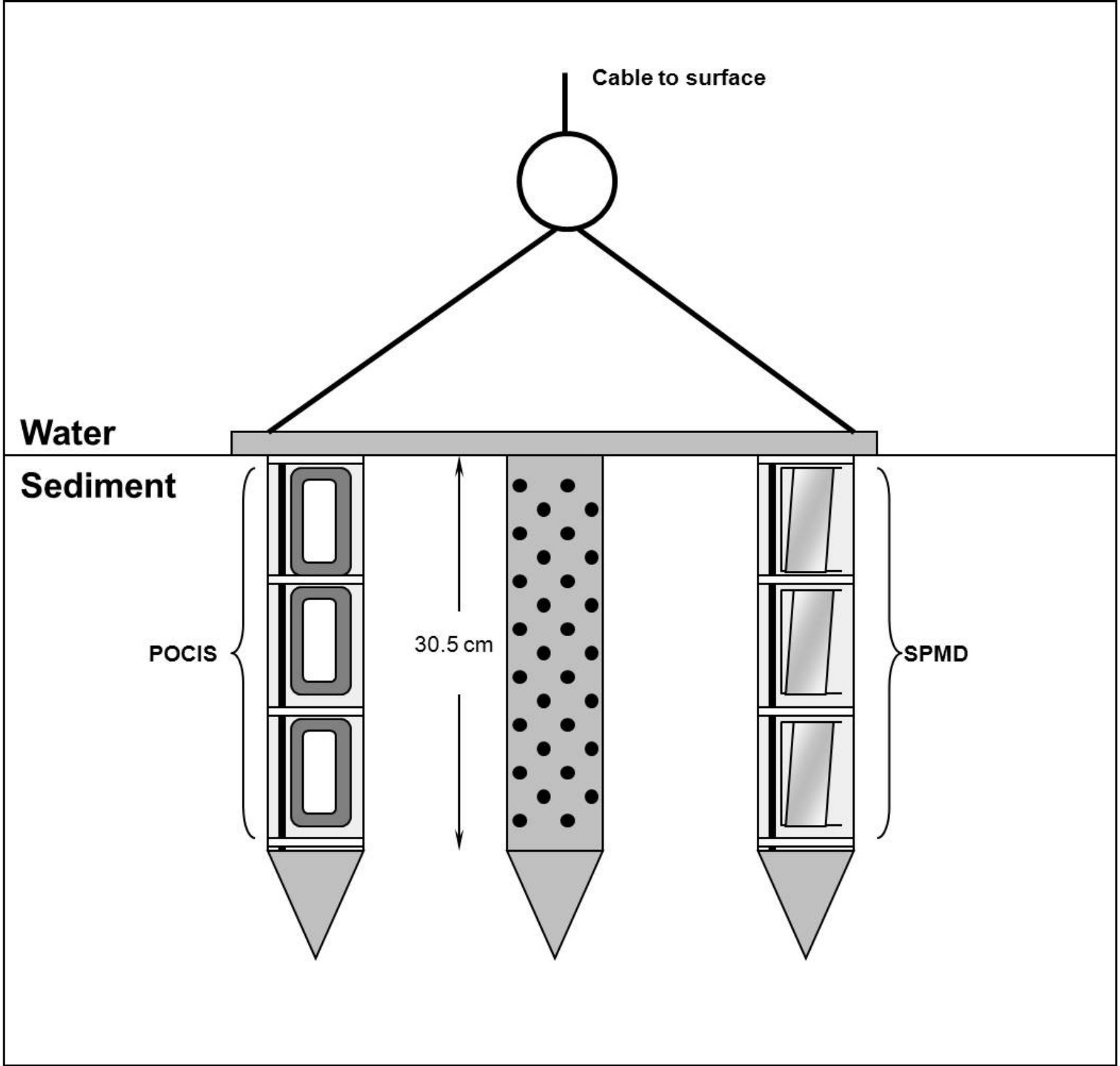

Las Vegas Bay
Las Vegas Wash
Sampling Location
1
2
3
Las Vegas
Lake Mead
Hoover Dam
Colorado River
Nevada
Utah
California
Arizona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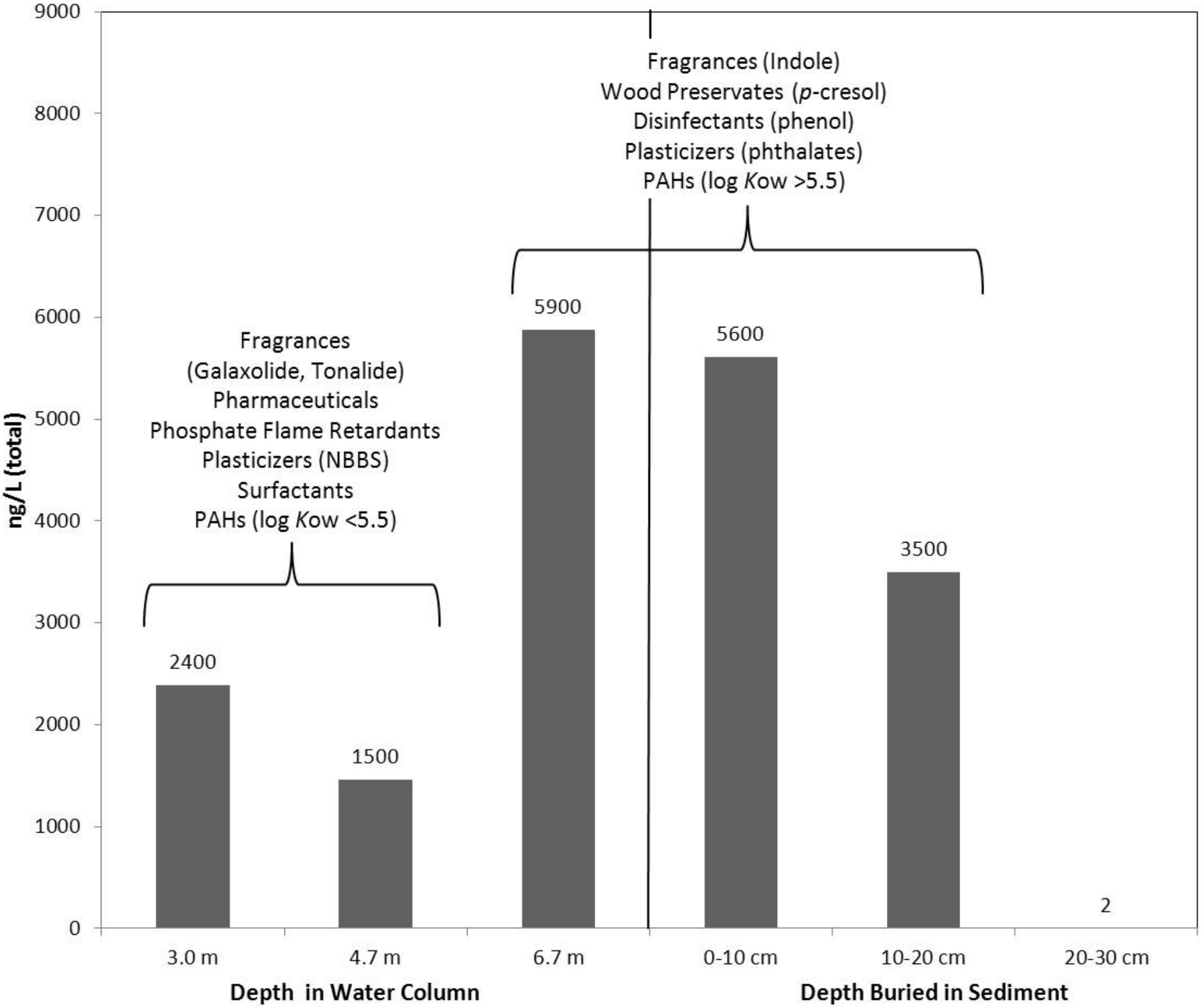
Water
Sediment
POCIS
30.5 cm
SPMD


9000
8000
7000
6000
5000
4000
3000
2000
1000
0
ng/L (total)
Fragrances (Indole)
Wood Preservates (p-cresol)
Disinfectants (phenol)
Plasticizers (phthalates)
PAHs (log Kow >5.5)
Fragrances
(Galaxolide, Tonalide)
Pharmaceuticals
Phosphate Flame Retardants
Plasticizers (NBBS)
Surfactants
PAHs (log Kow <5.5)
2400
1500
5900
5600
3500
2
3.0 m
4.7 m
6.7 m
0-10 cm
10-20 cm
20-30 cm
Depth in Water Column
Depth Buried in Sediment