

IMPLEMENTATION OF THE CALIFORNIA ENVIRONMENTAL  
CONTAMINANT BIOMONITORING PROGRAM: 2010-2012

**Appendix D**

**Biomonitoring California Designated and Priority Chemical Lists**

California Department of Public Health  
in collaboration with  
California Environmental Protection Agency's  
Office of Environmental Health Hazard Assessment and  
Department of Toxic Substances Control

January 2013



---

Edmund G. Brown, Jr.  
Governor  
State of California

Diana Dooley  
Secretary  
California Health and Human  
Services Agency

Ron Chapman, MD, MPH  
Director & State Health Officer  
California Department of Public Health



**Biomonitoring California  
Designated Chemicals  
February 2011**

The designated chemicals for Biomonitoring California<sup>a</sup> are provided in this list. Designated chemicals consist of those substances that are included in the Centers for Disease Control and Prevention's (CDC's) biomonitoring studies<sup>b</sup> and additional chemicals that are recommended by the Scientific Guidance Panel (SGP) for Biomonitoring California. Designated chemicals are the pool of chemicals from which the SGP can recommend priority chemicals for biomonitoring.

Targets for measurement in biomonitoring studies could include the parent chemical, metabolites and other chemical products formed in the body or the environment (e.g., hemoglobin adduct; environmental degradation product). The approach for biomonitoring a chemical may change as methods development proceeds. The parent chemical is provided in the list below, with other targets for biomonitoring shown indented underneath for some parent chemicals. Biomonitoring California determines the chemicals that are actually biomonitored and the appropriate targets for measurement.

<p><b>Acrylamide</b> Acrylamide hemoglobin adducts Glycidamide hemoglobin adducts</p>	<p>Tetrabromobisphenol A bis(2,3-dibromopropyl) ether Tetrabromobisphenol A bis(2-hydroxyethyl) ether Tetrabromophthalic anhydride Tetrakis(2-chloroethyl)dichloroisopentyl diphosphate 2,4,6-Tribromophenol Tris(2-chloroethyl)phosphate (TCEP) Tris(1-chloro-2-propyl)phosphate (TCPP) Tris(1,3-dichloro-2-propyl)phosphate (TDCPP) Tris(2,3-dichloro-1-propyl)phosphate</p>
<p><b>Antimicrobials used in Food Production<sup>1</sup></b></p>	<p><b><u>Polybrominated diphenyl ethers (PBDEs)</u></b> 2,2',4-Tribromodiphenyl ether (BDE 17) 2,4,4'-Tribromodiphenyl ether (BDE 28) 2,2',4,4'-Tetrabromodiphenyl ether (BDE 47) 2,3',4,4'-Tetrabromodiphenyl ether (BDE 66) 2,2',3,4,4'-Pentabromodiphenyl ether (BDE 85) 2,2',4,4',5-Pentabromodiphenyl ether (BDE 99) 2,2',4,4',6-Pentabromodiphenyl ether (BDE 100) 2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE 153) 2,2',4,4',5,6'-Hexabromodiphenyl ether (BDE 154) 2,2',3,4,4',5',6-Heptabromodiphenyl ether (BDE 183) 2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (BDE 209)</p>
<p><b>Brominated and Chlorinated Organic Compounds used as Flame Retardants<sup>1</sup></b> 2,2-Bis(bromomethyl)-1,3-propanediol 2,2-Bis(chloromethyl)trimethylene bis[bis(2-chloroethyl)phosphate] Bis(2-ethyl-1-hexyl)tetrabromophthalate (TBPH) Bis(hexachlorocyclopentadieno)cyclooctane (Dechlorane Plus) 1,2-Bis(2,4,6-tribromophenoxy)ethane (BTBPE) 1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane 2,3-Dibromopropyl-2,4,6-tribromophenyl ether (DPTE) 2-Ethyl-1-hexyl-2,3,4,5-tetrabromobenzoate (TBB) Chlorendic acid Decabromodiphenylethane (DBDPE) Hexabromobenzene 2,2',4,4',5,5'-Hexabromobiphenyl (BB 153) Hexabromocyclododecane (HBCD) Hexachlorocyclopentadienyl-dibromocyclooctane N,N'-Ethylenebis(tetrabromophthalimide) Pentabromoethylbenzene Pentabromotoluene Short-chain chlorinated paraffins Tetrabromobisphenol A (TBBPA)</p>	<p><b>Cyclosiloxanes<sup>1</sup></b> Decamethylcyclopentasiloxane (D5) Dodecamethylcyclohexasiloxane (D6) Octamethylcyclotetrasiloxane (D4)</p>
	<p><b>Diesel Exhaust<sup>2</sup></b></p>

- California Environmental Contaminant Biomonitoring Program (also known as Biomonitoring California), codified at Health and Safety Code section 105440 et seq.
- Known collectively as the National Reports on Human Exposure to Environmental Chemicals program.

**Disinfection By-Products  
(Trihalomethanes)<sup>3</sup>**

Bromodichloromethane  
Dibromochloromethane  
Tribromomethane (Bromoform)  
Trichloromethane (Chloroform)

**Environmental Phenols<sup>3</sup>**

Benzophenone-3  
Bisphenol A  
4-*tert*-Octylphenol  
Triclocarban<sup>4</sup>  
Triclosan

**Parabens<sup>3</sup>**

Butylparaben<sup>5</sup>  
Ethylparaben  
Methylparaben  
n-Propylparaben

**Metals<sup>3</sup>**

Antimony  
Arsenic  
    Arsenic (V) acid  
    Arsenobetaine  
    Arsenocholine  
    Arsenous (III) acid  
    Dimethylarsinic acid  
    Monomethylarsonic acid  
    Trimethylarsine oxide  
Barium  
Beryllium  
Cadmium  
Cesium  
Cobalt  
Lead  
Manganese  
Mercury  
Molybdenum  
Platinum  
Thallium  
Tungsten  
Uranium

**Perchlorate**

**Perfluorochemicals<sup>3</sup>**

2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid  
2-(N-Methyl-perfluorooctane sulfonamido) acetic acid  
Perfluorobutane sulfonic acid

Perfluorodecanoic acid  
Perfluorododecanoic acid  
Perfluoroheptanoic acid  
Perfluorohexane sulfonic acid  
Perfluorononanoic acid  
Perfluorooctane sulfonamide  
Perfluorooctane sulfonic acid (PFOS)  
Perfluorooctanoic acid (PFOA)  
Perfluoroundecanoic acid

**Pesticides<sup>3,6</sup>**

**Carbamate Insecticides<sup>3</sup>**

Benfuracarb  
    Carbofuranphenol  
Carbaryl  
    1-Hydroxynaphthalene<sup>7</sup>  
    2-Hydroxynaphthalene<sup>7</sup>  
Carbofuran  
    Carbofuranphenol  
Carbosulfan  
    Carbofuranphenol  
Furathiocarb  
    Carbofuranphenol  
Propoxur  
    2-Isopropoxyphenol

**Fungicides<sup>3</sup>**

Captafol  
    Tetrahydrophthalimide  
Captan  
    Phthalimide  
    Tetrahydrophthalimide  
Chlorothalonil  
Dichloran  
Folpet  
    Phthalimide  
Iprodione  
Mancozeb  
    Ethylene thiourea  
Maneb  
    Ethylene thiourea  
Metalaxyl  
Metiram  
    Ethylene thiourea  
Nabam  
    Ethylene thiourea  
Pentachlorophenol  
o-Phenylphenol  
Propineb  
    Propylene thiourea  
Thiram  
    Ethylene thiourea

<p>Ziram Ethylene thiourea</p>	<p>Methoxychlor Dihydroxy methoxychlor Monohydroxy methoxychlor Mirex 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol <b>Organophosphate Insecticides<sup>3</sup></b> Acephate Azinphos methyl Dimethyldithiophosphate Dimethylphosphate Dimethylthiophosphate Chlorethoxyphos Diethylphosphate Diethylthiophosphate Chlorpyrifos Diethylphosphate Diethylthiophosphate 3,5,6-Trichloro-2-pyridinol Chlorpyrifos methyl Dimethylphosphate Dimethylthiophosphate 3,5,6-Trichloro-2-pyridinol Coumaphos 3-Chloro-7-hydroxy-4-methyl-2H-chromen-2-one/ol Diethylphosphate Diethylthiophosphate Diazinon Diethylphosphate Diethylthiophosphate 2-Isopropyl-4-methyl-6-hydroxypyrimidine Dichlorvos (DDVP) Dimethylphosphate Dicrotophos Dimethylphosphate Dimethoate Dimethyldithiophosphate Dimethylphosphate Dimethylthiophosphate Disulfoton Diethyldithiophosphate Diethylphosphate Diethylthiophosphate Ethion Diethyldithiophosphate Diethylphosphate Diethylthiophosphate Fenitrothion Dimethylphosphate Dimethylthiophosphate Fenthion Dimethylphosphate Dimethylthiophosphate Isazophos-methyl</p>
<p><b>Herbicides - Substituted Ureas<sup>3</sup></b> Bensulfuron-methyl Chlorimuron-ethyl Chlorsulfuron Diuron Ethametsulfuron-methyl Foramsulfuron Halosulfuron Iodosulfuron Linuron Metsulfuron-methyl Nicosulfuron Primisulfuron-methyl Prosulfuron Rimsulfuron Sulfometuron-methyl Sulfosulfuron Thifensulfuron-methyl Triasulfuron Triflusulfuron-methyl Non-specific metabolites Dimethoxy pyrimidine Dimethyl pyrimidine Methyl methoxytriazine <b>Organochlorine Pesticides<sup>3</sup></b> Aldrin Dieldrin Chlordane <i>trans</i>-Nonachlor Oxychlordane Dichlorodiphenyltrichloroethane (DDT) (including p,p'-DDT and o,p'-DDT) <i>p,p'</i>-Dichlorodiphenyldichloroethene (DDE) Dieldrin Endosulfan Endosulfan-ether Endosulfan-lactone Endosulfan-sulfate Endrin Heptachlor Heptachlor epoxide Hexachlorobenzene Pentachlorophenol 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol Hexachlorocyclohexanes (HCH) (including beta-HCH and gamma-HCH [lindane]) Pentachlorophenol 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol</p>	

5-Chloro-1,2-dihydro-1-isopropyl-[3H]-1,2,4-triazol-3-one	Bifenthrin
Dimethylphosphate	Cyfluthrin
Dimethylthiophosphate	<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Malathion	<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Dimethyldithiophosphate	4-Fluoro-3-phenoxybenzoic acid
Dimethylphosphate	Cyhalothrin (including <i>lambda</i> - and <i>gamma</i> -)
Dimethylthiophosphate	3-Phenoxybenzoic acid
Malathion dicarboxylic acid	Cypermethrin (including <i>cis</i> - and <i>trans</i> -)
Methamidophos	<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Methidathion	<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Dimethyldithiophosphate	3-Phenoxybenzoic acid
Dimethylphosphate	Cyphenothrin
Dimethylthiophosphate	Deltamethrin
Methyl parathion	<i>cis</i> -3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid
Dimethylphosphate	3-Phenoxybenzoic acid
Dimethylthiophosphate	Esbiothrin
<i>p</i> -Nitrophenol	Esfenvalerate
Naled	Etofenprox
Dimethylphosphate	Fenpropathrin
Oxydemeton-methyl	3-Phenoxybenzoic acid
Dimethylphosphate	Fenvalerate
Dimethylthiophosphate	Imiprothrin
Parathion (Ethyl parathion)	Metofluthrin
Diethylphosphate	Permethrin (including <i>cis</i> - and <i>trans</i> -)
Diethylthiophosphate	<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
<i>p</i> -Nitrophenol	<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid
Phorate	3-Phenoxybenzoic acid
Diethyldithiophosphate	Phenothrin (sumithrin)
Diethylphosphate	Prallethrin
Diethylthiophosphate	Pyrethrin 1
Phosmet (Imidan)	<i>cis/trans</i> -Dimethylvinylcyclopropane carboxylic diacid
Dimethyldithiophosphate	Resmethrin
Dimethylphosphate	<i>cis/trans</i> -Dimethylvinylcyclopropane carboxylic diacid
Dimethylthiophosphate	Tetramethrin
Pirimiphos-methyl	Tralomethrin
2-(Diethylamino)-6-methylpyrimidin-4-ol/one	3-Phenoxybenzoic acid
Dimethylphosphate	
Dimethylthiophosphate	<b>Other Herbicides</b>
Sulfotep	Acetochlor
Diethylphosphate	Acetochlor mercapturate
Diethylthiophosphate	Alachlor
Temephos	Alachlor mercapturate
Dimethylphosphate	
Dimethylthiophosphate	
Terbufos	
Diethyldithiophosphate	
Diethylphosphate	
Diethylthiophosphate	
Tetrachlorvinphos	
Dimethylphosphate	
<b>Pyrethroid Pesticides<sup>1</sup></b>	
Allethrin	
<i>cis/trans</i> -Dimethylvinylcyclopropane carboxylic diacid	

Atrazine  
Atrazine mercapturate  
Diaminochlorotriazine  
Desethylatrazine  
Desisopropylatrazine  
Hydroxyatrazine  
Dacthal  
2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters  
2,4-Dichlorophenoxyacetic acid  
2,4-Dichlorophenol  
Metolachlor  
Metolachlor mercapturate  
Pendimethalin  
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T), salts and esters  
2,4,5-Trichlorophenoxyacetic acid  
Trifluralin

**Other Pesticides**  
1,4-Dichlorobenzene (*p*-Dichlorobenzene)  
2,5 Dichlorophenol  
N,N-Diethyl-3-methylbenzamide (DEET)  
Fipronil  
Octhilinone

**Phytoestrogens<sup>3</sup>**

Daidzein  
O-Desmethylangolensin  
Enterodiol  
Enterolactone  
Equol  
Genistein

**Polychlorinated Biphenyls (PCBs),  
Dioxin-Like<sup>3</sup>**

Coplanar PCBs<sup>3</sup>

3,4,4',5-Tetrachlorobiphenyl (PCB 81)  
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)  
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)

Mono-ortho-Substituted PCBs<sup>3</sup>

2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)  
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)  
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)  
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)  
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)  
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)

**Phthalates<sup>3</sup>**

Benzylbutyl phthalate (BzBP)  
Mono-benzyl phthalate  
Mono-*n*-butyl phthalate  
Dibutyl phthalate (DBP)<sup>8</sup>  
Mono-*n*-butyl phthalate  
Mono-isobutyl phthalate  
Dicyclohexyl phthalate (DCHP)  
Mono-cyclohexyl phthalate  
Diethyl phthalate (DEP)  
Mono-ethyl phthalate  
Di-2-ethylhexyl phthalate (DEHP)  
Mono-(2-ethyl-5-carboxypentyl) phthalate  
Mono-2-ethylhexyl phthalate  
Mono-(2-ethyl-5-hydroxyhexyl) phthalate  
Mono-(2-ethyl-5-oxohexyl) phthalate  
Di-isodecyl phthalate (DiDP)  
Mono-(carboxynonyl) phthalate  
Di-isononyl phthalate (DiNP)  
Mono-(carboxyisooctyl) phthalate  
Mono-(hydroxyisononyl) phthalate  
Mono-isononyl phthalate  
Mono-(oxoisonyl) phthalate  
Dimethyl phthalate (DMP)  
Mono-methyl phthalate  
Di-*n*-octyl phthalate (DOP)  
Mono-(3-carboxypropyl) phthalate  
Mono-*n*-octyl phthalate

**Polychlorinated Biphenyls (PCBs),  
Non-Dioxin-Like<sup>3</sup>**

2,2',5-Trichlorobiphenyl (PCB 18)  
2,4,4'-Trichlorobiphenyl (PCB 28)  
2,2',3,5'-Tetrachlorobiphenyl (PCB 44)  
2,2',4,5'-Tetrachlorobiphenyl (PCB 49)  
2,2',5,5'-Tetrachlorobiphenyl (PCB 52)  
2,3',4,4'-Tetrachlorobiphenyl (PCB 66)  
2,4,4',5-Tetrachlorobiphenyl (PCB 74)  
2,2',3,4,5'-Pentachlorobiphenyl (PCB 87)  
2,2',4,4',5-Pentachlorobiphenyl (PCB 99)  
2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)  
2,3,3',4',6-Pentachlorobiphenyl (PCB 110)  
2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)  
2,2',3,4,4',5' and 2,3,3',4,4',6-Hexachlorobiphenyl (PCB 138 & 158)  
2,2',3,4',5,5'-Hexachlorobiphenyl (PCB 146)  
2,2',3,4',5,6-Hexachlorobiphenyl (PCB 149)  
2,2',3,5,5',6-Hexachlorobiphenyl (PCB 151)  
2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)  
2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)  
2,2',3,3',4,5,5'-Heptachlorobiphenyl (PCB 172)  
2,2',3,3',4,5,6'-Heptachlorobiphenyl (PCB 177)  
2,2',3,3',5,5',6-Heptachlorobiphenyl (PCB 178)  
2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)  
2,2',3,4,4',5,6-Heptachlorobiphenyl (PCB 183)  
2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187)  
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (PCB 194)

2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB 195)  
2,2',3,3',4,4',5,6' and 2,2',3,4,4',5,5',6-Octa-  
chlorobiphenyl (PCB 196 & 203)  
2,2',3,3',4,5,5',6-Octachlorobiphenyl (PCB 199)  
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (PCB 206)  
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (PCB  
209)

**Polychlorinated Dibenzo-*p*-dioxins<sup>3</sup>**

1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin  
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin  
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin  
1,2,3,7,8-Hexachlorodibenzo-*p*-dioxin  
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin  
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin  
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)

**Polychlorinated Dibenzofurans<sup>3</sup>**

1,2,3,4,6,7,8-Heptachlorodibenzofuran  
1,2,3,4,7,8-Heptachlorodibenzofuran  
1,2,3,4,7,8-Hexachlorodibenzofuran  
1,2,3,6,7,8-Hexachlorodibenzofuran  
1,2,3,7,8,9-Hexachlorodibenzofuran  
2,3,4,6,7,8-Hexachlorodibenzofuran  
1,2,3,4,6,7,8,9-Octachlorodibenzofuran  
1,2,3,7,8-Pentachlorodibenzofuran  
2,3,4,7,8-Pentachlorodibenzofuran  
2,3,7,8-Tetrachlorodibenzofuran

**Polycyclic Aromatic Hydrocarbons  
(PAHs)<sup>3</sup>**

Benz[a]anthracene  
1-Hydroxybenz[a]anthracene  
3-Hydroxybenz[a]anthracene  
9-Hydroxybenz[a]anthracene  
Benzo[a]pyrene  
3-Hydroxybenzo[a]pyrene  
Benzo[c]phenanthrene  
1-Hydroxybenzo[c]phenanthrene  
2-Hydroxybenzo[c]phenanthrene  
3-Hydroxybenzo[c]phenanthrene  
Chrysene  
1-Hydroxychrysene  
2-Hydroxychrysene  
3-Hydroxychrysene  
4-Hydroxychrysene  
6-Hydroxychrysene  
Fluoranthene  
3-Hydroxyfluoranthene  
Fluorene  
2-Hydroxyfluorene  
3-Hydroxyfluorene  
9-Hydroxyfluorene

Naphthalene  
1-Hydroxynaphthalene  
2-Hydroxynaphthalene  
Phenanthrene  
1-Hydroxyphenanthrene  
2-Hydroxyphenanthrene  
3-Hydroxyphenanthrene  
4-Hydroxyphenanthrene  
9-Hydroxyphenanthrene  
Pyrene  
1-Hydroxypyrene

**Synthetic Hormones used in Food  
Production<sup>1</sup>**

Melengestrol acetate  
Trenbolone acetate  
Zeranol

**Tobacco Smoke**

Nicotine  
Cotinine

**Volatile Organic Compounds<sup>3</sup>**

Benzene  
Carbon tetrachloride  
Chlorobenzene  
Dibromomethane  
1,2-Dibromo-3-chloropropane (DBCP)  
1,2-Dichlorobenzene (*o*-Dichlorobenzene)  
1,3-Dichlorobenzene (*m*-Dichlorobenzene)  
1,1-Dichloroethane  
1,2-Dichloroethane  
1,1-Dichloroethene  
*cis*-1,2-Dichloroethene  
*trans*-1,2-Dichloroethene  
Dichloromethane (Methylene chloride)  
1,2-Dichloropropane  
2,5-Dimethylfuran  
Ethylbenzene  
Hexachloroethane  
Methyl-*t*-butyl ether (MTBE)  
Nitrobenzene  
Styrene  
1,1,2,2-Tetrachloroethane  
Tetrachloroethylene (Perchloroethylene)  
1,1,1-Trichloroethane  
1,1,2-Trichloroethane  
Trichloroethylene  
Toluene  
*m*-Xylene  
*o*-Xylene  
*p*-Xylene

**Notes**

<sup>1</sup> All members of the chemical class are designated chemicals, including, but not limited to, the chemicals shown.

<sup>2</sup> Diesel exhaust is a complex mixture that contains many components, one or more of which may be useful as an indicator for biomonitoring.

<sup>3</sup> All members of the chemical class are not designated chemicals; only the specific chemicals listed are designated chemicals.

<sup>4</sup> Triclocarban is not a phenol but can be analytically measured with environmental phenols. When it is released into the environment, it is commonly found in the same environmental media as triclosan.

<sup>5</sup> Includes n-butylparaben and isobutylparaben.

<sup>6</sup> Fungicides, herbicides, and insecticides are grouped under the general heading of "Pesticides."

<sup>7</sup> 1-Hydroxynaphthalene is the metabolite of both carbaryl and naphthalene. To determine the percent of 1-hydroxynaphthalene attributable to carbaryl alone, 2-hydroxynaphthalene (which is only a metabolite of naphthalene) must also be measured.

<sup>8</sup> Includes di-n-butyl phthalate and di-isobutyl phthalate.

**Biomonitoring California  
Priority Chemicals  
February 2011**

The following is a list of priority chemicals for Biomonitoring California.<sup>a</sup> The Scientific Guidance Panel (SGP) recommends priority chemicals from the designated chemical list. Targets for measurement in biomonitoring studies could include the parent chemical, metabolites and other chemical products formed in the body or the environment (e.g., hemoglobin adduct; environmental degradation product). The approach for biomonitoring a chemical may change as methods development proceeds. The parent chemical is provided in the list below and, for some parent chemicals, other targets for biomonitoring are shown indented underneath. Biomonitoring California determines the chemicals that are actually biomonitored and the appropriate targets for measurement.

<p><b>Brominated and Chlorinated Organic Compounds used as Flame Retardants<sup>1</sup></b></p> <p>2,2-Bis(bromomethyl)-1,3-propanediol          2,2-Bis(chloromethyl)trimethylene bis[bis(2-chloroethyl)phosphate]          Bis(2-ethyl-1-hexyl)tetrabromophthalate (TBPH)          Bis(hexachlorocyclopentadieno)cyclooctane (Dechlorane Plus)          1,2-Bis(2,4,6-tribromophenoxy)ethane (BTBPE)          1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane          2,3-Dibromopropyl-2,4,6-tribromophenyl ether (DPTE)          2-Ethyl-1-hexyl-2,3,4,5-tetrabromobenzoate (TBB)          Chlorendic acid          Decabromodiphenylethane (DBDPE)          Hexabromobenzene          2,2',4,4',5,5'-Hexabromobiphenyl (BB 153)          Hexabromocyclododecane (HBCD)          Hexachlorocyclopentadienyl-dibromocyclooctane          N,N'-Ethylenebis(tetrabromophthalimide)          Pentabromoethylbenzene          Pentabromotoluene          Short-chain chlorinated paraffins          Tetrabromobisphenol A (TBBPA)          Tetrabromobisphenol A bis(2,3-dibromopropyl) ether          Tetrabromobisphenol A bis(2-hydroxyethyl) ether          Tetrabromophthalic anhydride          Tetrakis(2-chloroethyl)dichloroisopentyl diphosphate          2,4,6-Tribromophenol          Tris(2-chloroethyl)phosphate (TCEP)          Tris(1-chloro-2-propyl)phosphate (TCPP)          Tris(1,3-dichloro-2-propyl)phosphate (TDCPP)          Tris(2,3-dichloro-1-propyl)phosphate</p> <p><b>Polybrominated diphenyl ethers (PBDEs)</b></p> <p>2,2',4-Tribromodiphenyl ether (BDE 17)          2,4,4'-Tribromodiphenyl ether (BDE 28)          2,2',4,4'-Tetrabromodiphenyl ether (BDE 47)</p>	<p>2,3',4,4'-Tetrabromodiphenyl ether (BDE 66)          2,2',3,4,4'-Pentabromodiphenyl ether (BDE 85)          2,2',4,4',5-Pentabromodiphenyl ether (BDE 99)          2,2',4,4',6-Pentabromodiphenyl ether (BDE 100)          2,2',4,4',5,5'-Hexabromodiphenyl ether (BDE 153)          2,2',4,4',5,6'-Hexabromodiphenyl ether (BDE 154)          2,2',3,4,4',5',6-Heptabromodiphenyl ether (BDE 183)          2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (BDE 209)</p>
	<p><b>Cyclosiloxanes<sup>1</sup></b></p> <p>Decamethylcyclopentasiloxane (D5)          Dodecamethylcyclohexasiloxane (D6)          Octamethylcyclotetrasiloxane (D4)</p>
	<p><b>Diesel Exhaust<sup>2</sup></b></p>
	<p><b>Environmental Phenols<sup>3</sup></b></p> <p>Bisphenol A          Triclosan</p> <p><b>Parabens<sup>3</sup></b></p> <p>Butylparaben<sup>4</sup>          Ethylparaben          Methylparaben          n-Propylparaben</p>
	<p><b>Metals<sup>3</sup></b></p> <p>Arsenic          Arsenic (V) acid          Arsenobetaine          Arsenocholine          Arsenous (III) acid          Dimethylarsinic acid          Monomethylarsonic acid          Trimethylarsine oxide          Cadmium</p>

a. California Environmental Contaminant Biomonitoring Program, codified at Health and Safety Code section 105440 et seq.

<p>Lead Mercury</p>	<p>Diethylphosphate Diethylthiophosphate Diazinon Diethylphosphate Diethylthiophosphate 2-Isopropyl-4-methyl-6-hydroxypyrimidine Dichlorvos (DDVP) Dimethylphosphate Dicrotophos Dimethylphosphate Dimethoate Dimethyldithiophosphate Dimethylphosphate Dimethylthiophosphate Disulfoton Diethyldithiophosphate Diethylphosphate Diethylthiophosphate Ethion Diethyldithiophosphate Diethylphosphate Diethylthiophosphate Fenitrothion Dimethylphosphate Dimethylthiophosphate Fenthion Dimethylphosphate Dimethylthiophosphate Isazophos-methyl 5-Chloro-1,2-dihydro-1-isopropyl-[3H]-1,2,4-triazol-3-one Dimethylphosphate Dimethylthiophosphate Malathion Dimethyldithiophosphate Dimethylphosphate Dimethylthiophosphate Malathion dicarboxylic acid Methamidophos Methidathion Dimethyldithiophosphate Dimethylphosphate Dimethylthiophosphate Methyl parathion Dimethylphosphate Dimethylthiophosphate <i>p</i>-Nitrophenol Naled Dimethylphosphate Oxydemeton-methyl Dimethylphosphate Dimethylthiophosphate Parathion (Ethyl parathion) Diethylphosphate Diethylthiophosphate <i>p</i>-Nitrophenol</p>
<p><b>Perchlorate</b></p>	
<p><b>Perfluorochemicals<sup>3</sup></b> 2-(N-Ethylperfluorooctanesulfonamido) acetic acid 2-(N-Methylperfluorooctanesulfonamido) acetic acid Perfluorobutane sulfonic acid Perfluorodecanoic acid Perfluorododecanoic acid Perfluoroheptanoic acid Perfluorohexane sulfonic acid Perfluorononanoic acid Perfluorooctane sulfonamide Perfluorooctane sulfonic acid (PFOS) Perfluorooctanoic acid (PFOA) Perfluoroundecanoic acid</p>	
<p><b>Pesticides<sup>3, 5</sup></b> <b>Herbicides<sup>3</sup></b> 2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters 2,4-Dichlorophenoxyacetic acid 2,4-Dichlorophenol <b>Organochlorine Pesticides<sup>3</sup></b> Dichlorodiphenyltrichloroethane (DDT) (including <i>p,p'</i>-DDT and <i>o,p'</i>-DDT) <i>p,p'</i>-Dichlorodiphenyldichloroethene (DDE) <b>Organophosphorus Insecticides<sup>3</sup></b> Acephate Azinphos methyl Dimethyldithiophosphate Dimethylphosphate Dimethylthiophosphate Chlorethoxyphos Diethylphosphate Diethylthiophosphate Chlorpyrifos Diethylphosphate Diethylthiophosphate 3,5,6-Trichloro-2-pyridinol Chlorpyrifos methyl Dimethylphosphate Dimethylthiophosphate 3,5,6-Trichloro-2-pyridinol Coumaphos 3-Chloro-7-hydroxy-4-methyl-2H-chromen-2-one/ol</p>	

Phorate  
Diethyldithiophosphate  
Diethylphosphate  
Diethylthiophosphate  
Phosmet (Imidan)  
Dimethyldithiophosphate  
Dimethylphosphate  
Dimethylthiophosphate  
Pirimiphos-methyl  
2-(Diethylamino)-6-methylpyrimidin-4-ol/one  
Dimethylphosphate  
Dimethylthiophosphate  
Sulfotepp  
Diethylphosphate  
Diethylthiophosphate  
Temephos  
Dimethylphosphate  
Dimethylthiophosphate  
Terbufos  
Diethyldithiophosphate  
Diethylphosphate  
Diethylthiophosphate  
Tetrachlorvinphos  
Dimethylphosphate

**Pyrethroid Pesticides<sup>3</sup>**  
Allethrin  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
Cyfluthrin  
*cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
*trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
4-Fluoro-3-phenoxybenzoic acid  
Cyhalothrin (including *lambda*- and *gamma*-)  
3-Phenoxybenzoic acid  
Cypermethrin (including *cis*- and *trans*-)  
*cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
*trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
3-Phenoxybenzoic acid  
Deltamethrin  
*cis*-3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid  
3-Phenoxybenzoic acid  
Fenpropathrin  
3-Phenoxybenzoic acid  
Permethrin (including *cis*- and *trans*-)  
*cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
*trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid  
3-Phenoxybenzoic acid

Pyrethrin 1  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
Resmethrin  
*cis/trans*-Dimethylvinylcyclopropane carboxylic diacid  
Tralomethrin  
3-Phenoxybenzoic acid

**Other Pesticides**  
1,4-Dichlorobenzene (*p*-Dichlorobenzene)  
2,5 Dichlorophenol

**Phthalates<sup>3</sup>**  
Benzylbutyl phthalate (BzBP)  
Mono-benzyl phthalate  
Dibutyl phthalate (DBP)<sup>6</sup>  
Mono-*n*-butyl phthalate  
Mono-isobutyl phthalate  
Dicyclohexyl phthalate (DCHP)  
Mono-cyclohexyl phthalate  
Diethyl phthalate (DEP)  
Mono-ethyl phthalate  
Di-2-ethylhexyl phthalate (DEHP)  
Mono-(2-ethyl-5-carboxypentyl) phthalate  
Mono-2-ethylhexyl phthalate  
Mono-(2-ethyl-5-hydroxyhexyl) phthalate  
Mono-(2-ethyl-5-oxohexyl) phthalate  
Di-isodecyl phthalate (DiDP)  
Mono-(carboxynonyl) phthalate  
Di-isononyl phthalate (DiNP)  
Mono(carboxyisononyl) phthalate  
Mono(hydroxyisononyl) phthalate  
Mono-isononyl phthalate  
Mono(oxoisononyl) phthalate  
Dimethyl phthalate (DMP)  
Mono-methyl phthalate  
Di-*n*-octyl phthalate (DOP)  
Mono-(3-carboxypropyl) phthalate  
Mono-*n*-octyl phthalate

**Polychlorinated Biphenyls (PCBs), Dioxin-Like<sup>3</sup>**  
**Coplanar PCBs<sup>3</sup>**  
3,4,4',5-Tetrachlorobiphenyl (PCB 81)  
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)  
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)

**Mono-ortho-Substituted PCBs<sup>3</sup>**  
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)  
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)  
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)

2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)  
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)  
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)

**Polychlorinated Biphenyls (PCBs),  
Non-Dioxin-Like<sup>3</sup>**

2,2',5-Trichlorobiphenyl (PCB 18)  
2,4,4'-Trichlorobiphenyl (PCB 28)  
2,2',3,5'-Tetrachlorobiphenyl (PCB 44)  
2,2',4,5'-Tetrachlorobiphenyl (PCB 49)  
2,2',5,5'-Tetrachlorobiphenyl (PCB 52)  
2,3',4,4'-Tetrachlorobiphenyl (PCB 66)  
2,4,4',5-Tetrachlorobiphenyl (PCB 74)  
2,2',3,4,5'-Pentachlorobiphenyl (PCB 87)  
2,2',4,4',5-Pentachlorobiphenyl (PCB 99)  
2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)  
2,3,3',4',6-Pentachlorobiphenyl (PCB 110)  
2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)  
2,2',3,4,4',5' and 2,3,3',4,4',6-Hexachlorobiphenyl  
(PCB 138 & 158)  
2,2',3,4',5,5'-Hexachlorobiphenyl (PCB 146)  
2,2',3,4',5',6'-Hexachlorobiphenyl (PCB 149)  
2,2',3,5,5',6-Hexachlorobiphenyl (PCB 151)  
2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)  
2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)  
2,2',3,3',4,5,5'-Heptachlorobiphenyl (PCB 172)  
2,2',3,3',4,5',6'-Heptachlorobiphenyl (PCB 177)  
2,2',3,3',5,5',6-Heptachlorobiphenyl (PCB 178)  
2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)  
2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB 183)  
2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187)  
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (PCB 194)  
2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB 195)  
2,2',3,3',4,4',5,6' and 2,2',3,4,4',5,5',6-Octa-  
chlorobiphenyl (PCB 196 & 203)  
2,2',3,3',4,5,5',6-Octachlorobiphenyl (PCB 199)  
2,2',3,3',4,4',5,5',6'-Nonachlorobiphenyl (PCB 206)  
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (PCB  
209)

**Polycyclic Aromatic Hydrocarbons  
(PAHs)<sup>3,7</sup>**

3-Hydroxybenzo[a]pyrene  
6-Hydroxychrysene  
3-Hydroxyphenanthrene

**Tobacco Smoke**

Nicotine  
Cotinine

**Notes**

<sup>1</sup> All members of the chemical class are priority chemicals, including, but not limited to, the chemicals listed.

<sup>2</sup> Diesel exhaust is a complex mixture that contains many components, one or more of which may be useful as an indicator for biomonitoring.

<sup>3</sup> All members of the chemical class are not priority chemicals; only the specific chemicals listed are priority chemicals.

<sup>4</sup> Includes n-butylparaben and isobutylparaben.

<sup>5</sup> Fungicides, herbicides, and insecticides are grouped under the general heading of "Pesticides."

<sup>6</sup> Includes di-n-butyl phthalate and di-isobutyl phthalate.

<sup>7</sup> The SGP recommended the three hydroxy-PAHs listed as priority chemicals. These three hydroxy-PAHs are metabolites of benzo[a]pyrene, chrysene and phenanthrene, respectively.