Health and Environmental Contaminants in Washington State: What We Know and What We Need to Know

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About This Document….

This document summarizes the preliminary findings of a study on the nature, types and 'comprehensiveness' of information on health and environmental contaminants in Washington State. As well as outlining the available scientific information on the levels of contaminants in the environment, human exposures, and the associated health effects, it also contains estimated rates of several environmentally-related diseases and disabilities in Washington State based on national rates, a report card on the 'comprehensiveness' of the information base in Washington State and an estimate of the economic costs of childhood cancer that can be attributed to environmental exposures.

This document will be updated and expanded once or twice a year, as we find out about additional sources of information. We also intend to make it available on the web over the next few months. If you are aware of relevant information on health and environmental contaminants in Washington State that is not mentioned in this document, or if you have any comments and suggestions, please contact Kate Davies at: kdavies@antiochsea.edu.

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Contents

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1. Introduction and Objectives

Introduction

The emerging science of environmental public health indicates that increasing chemical contamination of the environment is linked with many chronic diseases and disabilities, including asthma, birth defects, developmental problems, and cancer. Since World War II, more than 85,000 synthetic chemicals have been registered for use in the US and approximately 2,000 new ones are added each year. These chemicals include pesticides, chemicals used, manufactured, emitted and released by industries, chemicals in consumer products, and pharmaceuticals, and they are now widespread in our air, water, soil, food, homes, schools, and workplaces, and also in our bodies. At the same time, chronic diseases and disabilities have reached epidemic proportions in the US, affecting more than 100 million men, women and children.

Given this situation, it is important to improve our understanding of how chemical contaminants in the environment cause chronic diseases and disabilities.

Objectives

This document summarizes the findings of a study on the nature, types and 'comprehensiveness' of information on levels of chemicals in the environment, human exposures to these contaminants, and their related health effects in Washington State. Its objectives are:

- To collect and summarize the available scientific information;
- To evaluate the 'comprehensiveness' of the information base;
- To assess its strengths and weaknesses; and
- To identify information gaps and research needs.

2. Approach and Study Limitations

Approach

This study collected and summarized information on:

- Health outcomes associated with environmental contaminants, including:
    - Asthma, cardiovascular disease;
    - Cancers;
    - Reproductive effects;
    - Birth defects;
    - Developmental and neurobehavioral effects; and
    - 'Pesticide incidents';
- Body burdens of environmental contaminants; and
- Levels of environmental contaminants associated with health outcomes, including:
    - Air, drinking water, food and soil quality; and
    - The built environment.

This document organizes information on Washington State under each of these categories.

Health effects associated with environmental contaminants were identified using the Collaborative for Health and Environment's database on 'Chemical Contaminants and Human Disease'[1], as well as the current state of scientific knowledge. This database identifies over 200 health outcomes associated with chemical contaminants in the environment. It was prepared by reviewing three major textbooks on environmental medicine and toxicology, supplemented and updated with literature searches for epidemiological studies and reviews of disease topics. The textbooks and the additional manuscripts are referenced in the database.

The database categorizes the 'strength of the evidence' for the association between the specific health effects and environmental contaminants into three classes:

- "Strong evidence" - where a causal association between exposure to the environmental contaminant and disease has been verified and is generally accepted by the scientific community. This includes the International Agency for Research on Cancer's Group 1 of human carcinogens;
- "Good evidence"- where associations of chemicals and disease are drawn from smaller epidemiological studies or for chemicals with some human evidence and strong corroborating animal evidence of an association. This includes the

[1] This spreadsheet summarizes information on chemical contaminants and about 200 adverse health outcomes. It is available at: http://www.protectingourhealth.org/corethemes/links/2004-0203spreadsheet.htm

International Agency for Research on Cancer's Group 2A chemicals, those with limited evidence for causing cancer in humans and sufficient evidence in experimental animals; and

- "Limited/conflicting evidence" - where chemicals that have been weakly associated with human disease in case reports, or in conflicting human epidemiological studies with mixed or equivocal results. . This includes the International Agency for Research on Cancer's Group 2B chemicals and EPA Group B2 chemicals. These chemicals show limited or inadequate evidence of causing cancer in humans and limited animal evidence of causing cancer. The majority of the chemicals in the database fall into this limited evidence category.

In this study, we **only** chose health effects with "strong" or "good" evidence of association/causality with environmental contaminants. Effects with "limited/conflicting evidence" were not included. Thus, there is "strong" or "good" evidence of a relationship between exposure to environmental contaminants and health for **all** of the health effects described in this study.

We were unable to find information on the prevalence or incidence of many of the health effects in Washington State, including some reproductive effects, specific birth defects, and many developmental and neurobehavioral effects. In these cases and where national data were available, we have estimated rates in Washington State. Specifically, we have estimated Washington State rates for ADHD, cardiac congenital defects, cerebral palsy, developmental delay, endometriosis, hypospadias, learning disabilities, limb reduction, neural tube/CNS defects, Parkinson's Disease, and seizures.

This document organizes information on Washington State by the type of organization (national, state[2,3,4,5,6] or local) that collected, or displays it on a website. However, in some cases there is extensive coordination between national and State organizations in the collection, display and use of health and environmental information.

The following types of information were collected and summarized:

- Environmental monitoring studies;
- Risk assessments;
- Epidemiological studies;

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[2] Washington State publishes a databook that includes some information on the environment (see http://www.ofm.wa.gov/databook/index.htm#environment

[3] Washington State's Department of Ecology has an extensive Environmental Information System – EIM (see http://www.ecy.wa.gov/eim/). This study incorporates some information from EIM and other sources.

[4] In 2000, the Department of Ecology published a report on Washington's Environmental Health (see http://www.ecy.wa.gov/pubs/0001003/index.html). The report summarizes information on water, air, toxics, nuclear, waste, and spills.

[5] Information on environmental monitoring of toxic contaminants in Washington State is described at: www.ecy.wa.gov/programs/eap/toxics/index.html

[6] The Department of Health publishes a monthly epidemiological bulletin of reports of Notifiable Conditions in Washington State, including lead poisoning and pesticide incidents (see http://www.doh.wa.gov/Publicat/publications.htm)

- Health surveillance information; and
- Published studies and the 'grey literature'7.

All websites referenced were accessed between July 1 and November 30, 2004.

This research is the first phase in a two-phase study. The second phase will examine the economic costs of environmentally-attributable disease in Washington State. A preliminary estimate of the economic costs of childhood cancer attributable to environmental exposures is presented in section 5.3.

Study Limitations

The Collaborative on Health and the Environment's database has several limitations[8]:

First, the list of chemical contaminants in the database is not exhaustive or comprehensive. Other chemicals that are not listed may also be causally associated with disease or disability.

Second, the database does not address the route, timing, duration, or amount of exposure required to result in a particular health effect. Some chemicals may only be toxic if inhaled, whereas others need to be ingested in order to be toxic. Some diseases result from only high dose exposures whereas low-level exposures may be less important. Moreover, variations in the susceptibility to toxic effects, depending on the timing and duration of exposure, are not addressed. For example, a fetus or developing child is often more susceptible to a given exposure than an adult.

Third, the database does not quantify the proportion of the individual diseases that are caused or contributed to by specific environmental factors. For example, mesothelioma, a rare form of cancer, is almost entirely due to exposure to asbestos. In contrast, the proportion of more common kinds of lung cancer cases caused by asbestos exposure is relatively small compared to the number of cases caused by tobacco smoking or radon.

To keep the study manageable, it was necessary to focus on public exposures and to exclude occupational exposures.

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[7] The 'grey' literature refers to studies that have not been formally published, such as databases, studies by consultants, unpublished studies by government departments and agencies, and researchers, etc.

[8] See: http://www.protectingourhealth.org/corethemes/links/2004-0203spreadsheet.htm#limitations

3. Asthma

There is growing scientific evidence that poor air quality is a factor in several respiratory diseases, including asthma.

National Organizations

The national Behavioral Risk Factor Surveillance System (BRFSS) provides information on asthma in Washington State, compared with other States[9]. The database shows that in 2003 the lifetime prevalence of asthma in Washington State was 13.8%, compared with a national average of 11.7%. Washington State had the fifth highest lifetime prevalence rate in the US. In terms of current asthma prevalence, Washington had a rate of 9.1%, compared with a national median of 7.6%. Washington State had the seventh highest current prevalence in the US.

The Asthma and Allergy Foundation of America has estimated the direct and indirect costs of asthma in Washington State at $217 million in 1998[10].

State Organizations

Information on asthma prevalence, hospitalization and mortality for different age groups in Washington State is available from the American Lung Association website[11]. The most recent data available are for 1998. The data show that the prevalence of asthma in children increased with age:

Table 1: Prevalence of Asthma in Children in Washington State in 1998

Age (y)	*Prevalence (%)*
0-4	7.2
5-12	10.2
13-17	14.5

Other data on asthma hospitalization show that rates were higher in the very young and the elderly[12]:

[9] See: http://www.cdc.gov/brfss/index.htm
[10] See: http://www.aafa.org/states/display.cfm?State=wa
[11] See: http://www.alaw.org/asthma/washington_asthma_initiative/data_website/prevalence.html . These data are taken from the BRFSS.
[12] See: http://www.alaw.org/asthma/washington_asthma_initiative/data_website/hospitalizations.html

Table 2: Asthma Hospitalization Rates in Washington State for 1998

Age Group (y)	*Rates per 100,000*
0-4	293.9
5-17	86.6
18-34	48.6
35-64	64.9
65+	106.5

Data on asthma mortality suggest that rates were higher in the early 1990s than either in the 1980s or the late 1990s.

Local Organizations

A study conducted in 2000 by the Public Health – Seattle and King County found that the youngest children and the poorest communities had the highest rates of asthma hospitalization[13].

In Spokane, there is a 7-year, time-series, epidemiologic study under way that is examining the associations between ambient particulate constituents or sources and health outcomes such as emergency department visits for asthma or respiratory problems[14].

A 1999 study of emergency department visits for asthma in children and levels of fine particulate matter and carbon monoxide in Seattle found significant associations[15].

Other studies on asthma and air quality are being conducted at the Northwest Center for Particulate Matter and Health at the University of Washington[16].

4. Cardiovascular Disease

Recent scientific studies have shown that fine particulates and poor air quality are associated with cardiovascular disease.

National Organizations

Information from the Centers for Disease Control (CDC) shows that the death rate from cardiovascular disease in Washington State for the total population over 35 years of age was 432 per 100,000 population for 1996-2000, compared to a national rate of 536 per 100,000. Counties with the highest rates included Adams, Cowlitz, Lewis, Pacific, and Pierce[17].

[13] See: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4941a1.htm
[14] See: http://ehp.niehs.nih.gov/members/2002/suppl-4/547-552claiborn/claiborn-full.html
[15] See: http://ehp.niehs.nih.gov/docs/1999/107p489-493norris/abstract.html
[16] See: http://depts.washington.edu/pmcenter/index.html
[17] See: http://apps.nccd.cdc.gov/giscvh/(xtsb0nqqp11mvlyi2fx2mx55)/default.aspx

A 2003 study conducted by the Natural Resources Defense Council estimated that approximately 1,400 people die each year in Washington State from cardiopulmonary diseases associated with air particulates[18].

State Organizations

The Washington State Department of Health has prepared a report (2004) on the 'Burden of Cardiovascular Disease'[19]. The Report discusses the risk factors for cardiovascular disease in Washington State, but it does not include particulates or air quality.

5. Cancer

The American Cancer Society has estimated that 75% of all cancers are caused by environmental factors, including smoking, diet, infectious agents, radiation and chemicals[20]. Moreover, it has been known for many years that some environmental contaminants, such as the organochlorines, can cause cancer. The Trust for America's Health has estimated the overall costs of cancer in Washington State at $3.4 billion in 2002, based on information from the American Cancer Society[21].

5.1 Adult Cancer

We looked at information on 22 types of cancer in adults in Washington State, with "strong" or "good" evidence of environmental causes, as stated in the database prepared by the Collaborative for Health and the Environment[22], including: bladder cancer, bone cancer, brain cancer, breast cancer, cervical cancer, esophageal cancer, laryngeal cancer, leukemia, liver cancer and angiosarcoma, lung cancer, multiple myeloma, lymphoma (Hodgkins and non-Hodgkins), oral cancer, pancreatic cancer, renal (kidney) cancer, salivary gland cancer, skin cancer (melanoma and non-melanoma), scrotal cancer, thyroid cancer.

National Organizations

The CDC makes available information on cancer incidence rates nationally and at a State level. For example, in 2001 Washington State's overall cancer incidence rate for females was 446.1 per 100,000 population[23]. This was the 3rd highest in the country and significantly higher than the national rate of 404.9 per 100,000. The incidence rate for males was 571.7 per 100,000. This was 12th in the country and slightly higher than the national rate of 544.8 per 100,000.

State Organizations

According to the 'Washington State Comprehensive Cancer Control Plan (2004-2008)', cancer is the second leading cause of death in Washington and the leading cause of death

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[18] See: http://www.nrdc.org/air/pollution/bt/WA.asp
[19] Department of Health. 2004. Washington State Burden of Cardiovascular Disease Report, 2004. Available from Marilyn Sitaker, Dept. of Health
[20] See: www.cancer.org/downloads/STT/CAFF_finalPWSecured.pdf
[21] See: http://healthyamericans.org/state/cancergrade/print.php?StateID=WA
[22] See: : http://www.protectingourhealth.org/corethemes/links/2004-0203spreadsheet.htm
[23] See: http://www.cdc.gov/cancer/npcr/uscs/2000/index.htm

among adults ages 45 to 74 years. Approximately 1 of every 4 deaths each year in the State is due to cancer[24].

Washington State has an excellent cancer registry with information from 1993 – 2001 currently available[25]. In 2003, the Washington State Cancer Registry received an "A" grade from the Trust for America's Health[26].

The web version of the Cancer Registry allows researchers to look at cancer rates (mortality or incidence) for any year from 1994-2001, by county, gender, race or ethnicity for a range of different types of cancer, with comparisons to national rates[27]. Using the Registry, Table 3 shows information on the five cancers with the highest incidences rates in Washington State with strong or good evidence of links with environmental contaminants.

Table 3: Types of Cancer with Highest Incidence Rates and Links with Environmental Contaminants in Washington State

Type	*Incidence in WA 2001 per 100,000*	*WA Rank Nationally*	*County with Highest Incidence*
Breast	181.7	1st female	San Juan
Lung	70.1	9th female 30th male	Mason
Melanoma	37.6	1st female 5th male	Pend Oreille
Bladder	23.7	24th female 8th male	Pend Oreille
Non-Hodgkins lymphoma	21.1	6th female 4th male	Walla Walla

This Table shows that Washington State has the highest rates of female breast cancer and melanoma in the country.

5.2 Childhood Cancer

National Organizations

National information on the incidence of childhood cancer is available for different types of cancer, age ranges, and race[28], however, the data cannot be analysed on a State basis.

State Organizations

The Washington State Cancer Registry contains information on different age groups, including children. Two of the most common types of childhood cancer with links to environmental contaminants are brain cancer and leukemia. Table 4 shows the incidence of these two types of cancer in children in Washington State:

[24] See: http://www.doh.wa.gov/CCC/pdf/WSCCC_plan.pdf
[25] See: http://www3.doh.wa.gov/WSCR/
[26] See http://healthyamericans.org/state/cancergrade/display.php?StateID=WA
[27] See: http://www3.doh.wa.gov/wscr/default.htm
[28] See: http://www.cdc.gov/cancer/npcr/uscs/2000/cancer_incidence.htm

Table 4: Incidence of Two Childhood (0-19 years) Cancers in Washington State per 100,000 (2001)[29]

	WA Incidence Rate	*National Incidence Rate*
Brain	3.1	2.7
Leukemia	4.2	4.2

5.3 Costs of Childhood Cancer

One of the major needs identified in this study is the need for information on the economic costs of environmentally-attributable illnesses in Washington State (see section 13.2). Recognizing this need, this study includes an estimate of the economic costs of environmentally-attributable childhood cancers in Washington State. The second phase of this study will generate cost estimates for other environmentally-attributable health effects.

The costs of childhood cancer in Washington State can be estimated using information on the Washington State Cancer Registry[30], and the costs estimates and 'environmentally attributable factors' generated by Landrigan et al.[31], who published a study in 2002 on the national costs of environmentally-attributable childhood illnesses. The methods and assumptions used by Landrigan et al. were also used in a study of the costs of environmentally-attributable childhood illness in Massachusetts by Massey and Ackerman[32].

Number of Children Diagnosed with Cancer:

Landrigan et al. calculated the number of new cases of childhood cancer each year in the US using the number of children in the US under 15 years of age and the annual overall incidence rate of childhood cancer, estimating a total of 7,722 new cases a year. Massey and Ackerman used actual data on the number of new cases of childhood cancer diagnosed in Massachusetts in 1999 from the Massachusetts Community Health Information Profile database.

Data from the Washington State Cancer Registry show that in 2001 (the most recent year for which data are available) 308 children aged 0-19 years were diagnosed with cancer. Of these children, 185 were diagnosed with brain cancer or leukaemia and 123 were diagnosed with cancer at other sites.

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[29] Data taken from: http://www3.doh.wa.gov/WSCR/

[30] See: http://www3.doh.wa.gov/WSCR/

[31] See: Landrigan, P., Schechter, C., Lipton, J., Fahs, M., and Scwartz, J. Environmental Pollutants and Disease in American Children: Estimates of Morbidity, Mortality, and Costs for Lead Poisoning, Asthma, Cancer, and Developmental Disabilities. Environmental Health Perspectives 110(7): 721-728 (2002)

[32] See: Massey R., and Ackerman, F. Costs of Preventable Childhood Illness: The Price We Pay for Pollution. Global Development and Environment Institute, Tufts University. Available at: http://ase.tufts.edu/gdae/publications/articles_reports/Childhood_Illness.PDF

Costs per Child:
Landrigan et al. estimated the national average economic costs per child to be approximately $623,000 in 1998 dollars. This estimate is comprised of the following costs:

Treatment Costs	
Physician fees	$ 35,900
In patient services	$189,600
Out patient services	$ 20,400
Laboratory services	$263,200
Total Treatment Costs	$509,000
Indirect Costs:	
Lost parental wages[33]	$ 13,500
Lost future income due to loss of IQ[34]	$ 60,500
Costs of treating a second primary cancer[35]	$ 40,000
Total Indirect Costs	$114,000
Total Cost per Child	$623,000

Landrigan et al. then multiplied this cost by the estimated number of new childhood cancer cases in the US each year (7,722) to yield an estimate of $4.8 billion. They then added $1.8 billion for the costs of premature death to produce a total cost of $6.6 billion.

Massey and Ackerman used Landrigan's approach, but revised it slightly. Specifically, Massey and Ackerman's estimates excluded costs for lost future income due to effects on IQ. They also excluded the costs for premature death that were included in Landrigan et al. Massey and Ackerman's estimates are therefore more conservative than those used by Landrigan et al.

To estimate the costs of childhood cancer in Washington State in 2004 dollars, we used the US Department of Labor Consumer Price Index Inflation Calculator[36] to convert Landrigan's estimates of the total cost per child, shown above, from 1998 dollars to 2004 dollars. This generated cost estimates of $723,032 per child in 2004 dollars, including the loss of future income due to loss of IQ, but excluding costs for premature death, and $591,752 excluding the loss of future income due to loss of IQ and costs for premature death.

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[33] Loss of parental income estimated assuming 5 lost wage days per 7 child hospital days.
[34] Loss of IQ estimated assuming that cranial irradiation used to treat brain cancer will reduce IQ an average of 2.8 points in each child treated, corresponding to a loss of lifetime earnings of $60,471 (references provided in Landrigan et al.)
[35] Subsequent primary cancers are more common in children that have had one primary cancer. The costs of treating subsequent primary cancers was estimated using the same costs as the first primary cancer, adding in the present value of those future costs at 7.46% (as explained in Landrigan et al.)
[36] See: http://www.bls.gov/cpi/home.htm

We recognize that both the original estimates generated by Landrigan et al., and the conversion to 2004 dollars are based on national estimates that may not reflect costs in Washington State completely accurately.

Environmentally-Attributable Fractions:
Landrigan et al. and Massey and Ackerman used an 'environmentally-attributable fraction' (EAF) model as the basis for developing their cost estimates. This approach is described in detail in Landrigan et al. and has been used to estimate the costs in Washington State.

To estimate the EAF for childhood cancer, Landrigan et al., convened an expert panel. Based on the available scientific evidence, the panel concluded that the EAF for childhood cancer is at least 5-10% and less than 80-90%. In the face of this uncertainty, Landrigan et al. based their costs estimates on EAFs of 2%, 5% and 10%, respectively. All of these estimates are at the lower and more conservative end of this range. This study uses the same approach.

Results for Washington State:
Table 5 shows the estimated costs of childhood cancer in Washington State for children diagnosed in 2001. Conservatively assuming that 5-10% of childhood cancers can be attributed to environmental factors, the annualized costs are estimated to be approximately $11-22 million, if loss of future income is included and $9-18 million if it is excluded. Both sets of estimates exclude costs of premature death.

Table 5: Costs of Childhood Cancer in Washington State for Children Diagnosed in 2001, Excluding Costs of Premature Death

	# Diagnosed in 2001	*Cost per Child (2004 $)*	*Total Cost (2004 $)*	*EAF*	*Cost of EAF (2004 $)*
Including loss of future income	308	723,817	222,935,636	2%	4,458,713
				5%	**11,146,782**
				10%	**22,293,564**
				80%	178,348,509
				90%	200,642,072
Excluding loss of future income	308	591,752	182,259,616	2%	3,645,192
				5%	**9,112,981**
				10%	**18,225,962**
				80%	145,807,693
				90%	164,033,654

These estimates are significantly less than the estimates of Landrigan et al. because they exclude costs for premature death. Using Landrigan et al's. approach to calculate the costs of premature death of $1.8 billion nationally in 1997 $, pro-rating the costs for the number of children diagnosed in Washington State only (308), using the US Department of Labor Consumer Price Index Inflation Calculator to estimate the costs in 2004 $, and applying EAFs of 5% and 10%, the costs of premature death in Washington State can be estimated at

$4.28 million and $8.56 million, respectively. Including these figures in the cost estimates shown in Table 5 results in the considerable higher overall estimates shown in Table 6:

Table 6: Costs of Childhood Cancer in Washington State for Children Diagnosed in 2001, Including Costs of Premature Death

	EAF	*Cost of EAF*	*Including Costs for Premature Death (2004 $)*
Including loss of future income	5% 10%	11,146,782 22,293,564	**15,426,782** **30,853,564**
Excluding loss of future income	5% 10%	9,112,981 18,225,962	**13,392,981** **26,785,962**

This Table shows that the costs of childhood cancer in Washington State, including costs for premature death range from $15-30 million (assuming EAFs of 5%-10%) including the loss of future income, to $13-26 million (assuming EAFs of 5%-10%) excluding the loss of future income.

Whether one views the estimates including or excluding costs for premature death and including or excluding the loss of future income as more valid, all of these costs are largely preventable.

6. Non-Cancer Health Effects

It is now becoming apparent that many environmental contaminants are associated with non-cancer health effects, including reproductive effects, birth defects, developmental disabilities and neurobehavioral defects. These effects are often manifest at lower exposures than those associated with other acute and chronic conditions, such as cancer.

This study looked for Washington State specific data on 24 non-cancer health outcomes, including reproductive, birth, developmental, and/or neurobehavioral effects. These effects were: ADD/ADHD/hyperactivity, altered time to sexual maturation, autism, behavioral problems, cardiac congenital defects, cerebral palsy, cognitive impairment, congenital malformations, decreased coordination, decreased IQ/retardation, delayed growth, developmental delay, endometriosis, fetotoxocity (includes miscarriage, spontaneous abortion, stillbirth), genito-urinary malformations (includes hypospadias and cryptotorchidism), low birth weight, Minamata disease, neural tube/CNS defects,Parkinson's disease, pre-term delivery, reduced fertility - female and male, skeletal malformations, and seizures. Most of these diseases and disabilities have strong associations with exposure to environmental contaminants, according to the Collaborative on Health and Environment's database[37].

[37] See: http://www.protectingourhealth.org/corethemes/links/2004-0203spreadsheet.htm

6.1 Reproductive Effects

For the purposes of this study, reproductive effects include altered time to sexual maturation, reduced fertility in men and women, endometriosis, fetotoxicty (fetal death), preterm births, low birth weight, and infant mortality.

National Organizations

Preterm Birth, Low Birth Weight and Infant Mortality

National data on births, birth rates, and fertility rates are available from the CDC. This includes data from Washington State[38]. The March of Dimes also has information on pre-term birth and low birth weight in the State. This information shows that between 1992 – 2002, the proportion of preterm births in Washington increased from 8.3% to 9.6%. Similarly, the proportion of low birth weight babies increased over the same time period from 5.3% to 5.9%[39]. During 2000-2002, the preterm birth rate was highest for Native American infants (14.0%), followed by African-Americans (13.3%), Hispanics (10.2%), Asians (9.8%) and whites (9.2%) in Washington State.

Endometriosis

Nationally, 2-4% of all females and 10-15% of all women in their reproductive years are estimated to have endometriosis[40]. Using these proportions and demographic information in the Washington State Databook[41], it can be estimated that approximately 61,222 – 122,444 of all women in Washington State have endometriosis and 306,100 – 459,164 women in their reproductive years have endometriosis.

State Organizations

Fetotoxicity, Perterm Birth, Low Birth Weight and Infant Mortality

The Washington State Department of Health has data on fetal death, preterm birth, low birth weight and infant mortality. For example, the prevalence of fetal death was 5.5 per 1,000 live births in 2002[42]. The prevalence of low birth weight in Washington State increased from 5.3% in 1990 to 5.8% in 2001 (low birth weight is defined as less than 2,500 grams or 5lbs 8oz)[43]. The State rate for infant mortality was 5.8 per 1,000 in 1998-2000, compared to a national rate of 6.9 per 1,000[44]. Infant mortality rates were highest among Blacks, and American Indians / Alaska Natives.

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[38] See: http://www.cdc.gov/nchs/data/nvsr/nvsr52/nvsr52_19.pdf
[39] See: http://www.marchofdimes.com/peristats/prematurity.aspx?reg=53&stop=60
[40] See: Eskenazi, B. and Warner, M. Epidemiology of Endometriosis. Obstet Gynecol Clin North America 24(2): 235-258 (1997)
[41] See: http://www.ofm.wa.gov/databook/population/pt04.htm
[42] See: http://www.doh.wa.gov/ehsphl/chs/chs-data/fetdeath/2002/2002g1.htm
[43] See: http://www.doh.wa.gov/cfh/mchas/mchdatareport/LBWSingleton99_01F.pdf
[44] See: http://www.doh.wa.gov/cfh/mchas/mchdatareport/Infant_mortality99_01F.pdf

Local Organizations

Male Fertility

A 1996 study of male fertility in Seattle found that there has been no decline in sperm quality in healthy adult men over the previous 21 years[45]. This finding contrasts with the results of other studies in Sweden and Europe[46].

We were unable to find any information relevant to altered time to sexual maturation and female fertility in Washington State.

6.2 Birth Defects

For the purposes of this study, birth defects include abnormalities of structure, function or metabolism (body chemistry) present at birth that result in physical or mental disability, or are fatal. Several thousand different birth defects have been identified, but the causes of about 60 to 70 percent of birth defects are currently unknown. Birth defects that have been associated with exposure to environmental contaminants include congenital malformations, neural tube/CNS defects, genito-urinary defects (including hypospadias and cryptotorchidism), cardiac congenital defects, and skeletal malformations.

National Organizations

Birth Defects/Congenital Malformations

Birth defects are the leading cause of death in the first year of life[47]. About 150,000 babies are born each year in the US with birth defects. This is equivalent to 1 in 28 babies. Using this information and the number of live births in Washington State annually[48], it can be estimated that about 2,821 babies are born with birth defects every year in Washington State. This is consistent with the Department of Health estimate shown below.

The Trust for America's Health estimated the total lifetime cost of selected birth defects in Washington State in 2001 at $158 million[49].

Neural Tube/CNS Defects

It has been estimated that neural tube defects occur in 1-2 babies per 1,000 live births[50]. Assuming that there are about 79,000 live births a year in Washington State, it can be estimated that there are 79-158 babies born with neural tube defects in Washington State each year.

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[45] See: Paulsen, C.A., Berman, N.G., and Wang, C. Is Male Reproductive Health At Risk? Longitudinal Semen Analysis Studies. Advances in Contraception 13 (2/3): 119-121 (1997) and Paulsen, C.A., Berman, N.G., and Wang, C. Data from Men in Greater Seattle Area Reveals no Downward Trend in Semen Quality. Fertility and Sterility 65(5): 1015-1020 (1996).

[46] See for example: Carlsen, E. Giwercman, A., Keiding, N., and Skakkebaek, N. 1992. Evidence for Decreasing Quality of Semen During the Past 50 Years. Brit. Med. J. 305: 609-613

[47] See: http://www.modimes.org/professionals/681_1206.asp

[48] In 2002 there were about 79,000 live births in Washington State. See http://www.marchofdimes.com/peristats/

[49] See: http://healthyamericans.org/state/birthdefects/print.php?StateID=WA

[50] Fact sheet on Neural Tube Defects. Available from Birth Defects Research for Children Inc. at: http://www.birthdefects.org/information/parents3.asp

Genito-urinary Defects

Hypospadias, an abnormality of the penis in which the urinary tract opening is not at the tip, has been associated with exposure to estrogen and estrogen-disrupting substances. Historically, the condition occurred in about 1 per 300-500 live male births. Over the past 25 years, the incidence and severity has reportedly doubled in the US and Europe, so that the incidence is now believed to be about 1 in 100 male babies[51]. Using this information and the number of male live births in Washington State annually, it can be estimated that about 400 male babies are born with hypospadias every year in Washington State.

Cardiac Congenital Defects

Approximately 30,000 – 40,000 (or 1 in 100) babies are born each year with heart defects[52]. About 44,000 are born with congenital heart disease[53]. Using this information and the number of live births in Washington State annually, it can be estimated that about 800 babies are born with heart defects or congenital heart disease every year in Washington State.

Skeletal malformations

Nationally, limb reduction defects occur in about 1 in every 2,000 live births[54]. Using this information and the number of live births in Washington State annually, it can be estimated that about 40 babies are born with limb reduction defects every year in Washington State.

State Organizations

Birth Defects/Congenital Malformations

Washington State does not have a comprehensive, operational, publicly accessible Birth Defects Registry. In 2003, the State was awarded a "D" for its Birth Defects Registry by the Trust for America's Health[55]. Only eight States got a worse rating. The Department of Health is now establishing a better Registry. For example, in 2002, only 58% of births were in a facility that reported defects to the Department. In 2003, this proportion had risen to 80%.

Washington State has around 79,000 live births every year with an estimated 2,400 to 3,200 children diagnosed with birth defects based on annual prevalence rate of 2-4 per 100 live births per year[56]. According to Washington State Vital Statistics, 92 of 423 deaths to children under one year of age occurred among children with birth defects in 2000.

We unable to find any information relevant to cryptotorchidism in Washington State.

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[51] Fact sheet on Hypospadias. Available from Birth Defects Research for Children Inc. at: http://www.birthdefects.org/information/parents3.asp

[52] Fact sheet on Heart Defects. Available from Birth Defects Research for Children Inc. at: http://www.birthdefects.org/information/parents3.asp

[53] See: http://www.heartcenteronline.com/Congenital_Heart_Disease.html

[54] Fact sheet on Limb Reduction. Available from Birth Defects Research for Children Inc. at: http://www.birthdefects.org/information/parents3.asp

[55] See: http://healthyamericans.org/state/birthdefects/print.php?StateID=WA

[56] See: http://www.doh.wa.gov/Notify/nc/birthd.htm

6.3 Developmental Disabilities and Neurobehavioral Defects

For the purposes of this study, developmental and neurobehavioral effects include ADD/ADHD/hyperactivity, autism, developmental delay and cognitive impairment, decreased IQ/retardation, cerebral palsy, Parkinson's Disease, seizures, behavioral problems, decreased coordination, delayed growth, and Minamata disease.

National Organizations

ADD/ADHD/hyperactivity

According to the CDC, about 3-7% of children in the US suffer from ADHD and some studies have estimated higher prevalence rates in community samples[57]. Using demographic information from the Washington State Databook and an estimated prevalence range of 3-7%, it can be calculated that approximately 51,000- 119,000 children in Washington State have ADHD.

Autism

Data from the CDC suggest that the incidence of autism in Washington State is increasing. For example, in 1993, there were 51 new cases in people aged 6-22 years and in 2003 there were 2,824 new cases[58].

Developmental Delay and Cognitive Impairment

About 17% of children in the US under 18 years of age have a developmental disability and approximately 2% of school aged children have a serious developmental disability, such as mental retardation or cerebral palsy and require special educational services or support[59]. State and federal education departments spend about $36 billion each year on special education programs for individuals with developmental disabilities who are 3-21 years old.

Using demographic information from the Washington State Databook and an estimated prevalence rate of 17%, it can be calculated that approximately 268,000 children in Washington State have a developmental disability.

Nationally, nearly 12 million children under 18 years of age suffer from deafness, blindness, epilepsy, speech deficits, cerebral palsy, delays in growth and development, emotional or behavioural problems or learning disabilities[60]. Learning disabilities affect 5-10% of children in public schools[61] and there was an increase of 191% in the number of children requiring special education between 1974 –94. Using this information and information in the Washington State Databook, it can estimated that about 58,000 – 116,000 children aged 5 - 18 years have a learning disability.

There are national data on children with special health care needs (includes child's functional status) in Washington State (the National Survey of Children with Special Health Care

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[57] See: http://www.cdc.gov/ncbddd/adhd/what.htm
[58] See: http://www.fightingautism.org/idea/autism.php?s=WA&z=m
[59] See http://www.cdc.gov/ncbddd/dd/default.htm
[60] See: Boyle C, Decouffle P, Yeargin-Allsopp M. 1994**.** Prevalence and health impact of developmental disabilities in US children. Pediatrics 93(3):399-403.
[61] See: Parrill M. 1996**.** Research implications for health and human services**.** In: Learning Disabilities, Lifelong Issues (Cramer S, Ellis W, eds). Baltimore, MD: Paul W. Brookes Publishing.

Needs)[62],[63]. Specifically, results from the 2001 Survey indicate that approximately 14% or 211,000 children ages 0-17 years in Washington State have special needs compared to the national average of 13%. It has been estimated that children with special health care needs account for about 60% of the total medical costs for all children.

Decreased IQ/Retardation

In 1993, an estimated 1.5 million people aged 6 –64 years suffered from mental retardation in the US. The prevalence in Washington State was 8.3 per 1,000 children aged 6 –17 years, ranking 31st of 50 in the US. The adult prevalence rate was 5.0 per 1,000, ranking 36th out of 50 in the US[64].

Cerebral Palsy

Approximately, 500,000 – 700,000 Americans have some degree of cerebral palsy. This is about 2-3 cases per 1,000 births[65]. Using this range and estimates of Washington State's population, about 96,000 – 138,000 people in Washington State are estimated to have some degree of cerebral palsy.

Parkinson's Disease

It has been estimated that approximately 1- 1.5 million people in the US have Parkinson's Disease[66]. Using this range and estimates of Washington State's population, about 20,000 – 30,000 people in Washington State are estimated to have Parkinson's Disease. Internationally, the prevalence of Parkinson's Disease has been estimated at 4.5 – 21 per 100,000[67].

Seizures

Approximately 2 million Americans are affected by some type of seizure disorder[68]. Using this number and information in the Washington State Databook, it can estimated that about 39,600 people in Washington State experience some type of seizure disorder.

State Organizations

Developmental Delay

In 1999, an estimated 2.5% of children under 3 years of age were reported to have developmental delays or disabilities in Washington State[69]. Moreover, a total of 5,520 infants and toddlers under three years of age were found to be enrolled in public early intervention services for developmental delays, disabilities, or special health care needs as of December 1, 2000. The 2000 rate of enrollment in services in Washington State (2.3%) exceeded the rate

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[62] See: http://www.doh.wa.gov/cfh/mchas/mchdatareport/CSHCN_F.pdf

[63] See: 2001 National CSHCN Survey, Department of Health and Human Services, CDC, National Center for Health Statistics, Hyattsville, Maryland, April 28,2003.

[64] See: http://www.cdc.gov/mmwr/preview/mmwrhtml/00040023.htm

[65] Fact sheet on Cerebral Palsy. Available from Birth Defects Research for Children Inc. at: http://www.birthdefects.org/information/parents3.asp

[66] See: http://www.pdf.org and http://www.parkinson.org/site/pp.asp?c=9dJFJLPwB&b=71125

[67] See Gorell, J.M., and Checkoway, H. Epidemiological Studies: Risk factors. Session IV Summary and Research Needs. NeuroToxicology 22: 837-844 (2001

[68] Fact sheet on Seizures. . Available from Birth Defects Research for Children Inc. at: http://www.birthdefects.org/information/parents3.asp

[69] See: http://www1.dshs.wa.gov/rda/research/7/79/h.shtm

found in the National Health Interview Survey for children with limitations in some daily activity (2.0%). Over the previous six years (1993-99) the *number* of children served increased by 37% from 4,055 to 5,557, and the *proportion* of children enrolled has risen from 1.6% to 2.3%[70].

We have been unable to find any relevant information on behavioural problems, decreased coordination, delayed growth, and Minamata disease in Washington State

6.4 'Pesticide Incidents'

State Organizations

In Washington State, the Pesticide Incident Reporting and Tracking (PIRT) system maintains records of pesticide incidents reported to State agencies[71]. In 2001, the Department of Health investigated 200 incidents involving 250 people and the Washington Poison Center received 2,100 calls about pesticides.

The State Department of Agriculture maintains a list of pesticide-sensitive individuals[72].

7. Body Burden

Many persistent bioaccumulative toxic substances are present in human tissues, including blood, bone, breast milk, fatty tissue, hair, and urine. The 'Second National Report on Human Exposure to Environmental Contaminants'[73] contains data on the presence of over 100 environmental contaminants in a variety of human tissues in the US. Unfortunately, these data cannot be analysed on a State basis.

State Organizations

The most recent report of the Adult Blood Lead Registry (2003) shows that the proportion of adults in Washington State with high blood levels has dropped[74]. For 1993-2003, 1.18% of adults had blood lead levels of 40 micrograms per decilitre (_g/dL) or greater. For 2003 on its own, this percentage was 0.4%.

There is also a report that summarises the results of blood lead surveys done in Washington State and the Childhood Blood Lead Registry[75]. A high prevalence of elevated blood lead levels was found in children in Yakima (8.4%), but the prevalence of elevated levels in four other cities (Bellingham, Seattle, Spokane and Tacoma) was only 1.2%. A 1999 State-wide study of one and two year olds estimated the prevalence of elevated blood lead levels to be 0.9%.

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[70] See: http://www1.dshs.wa.gov/rda/research/7/79/g.shtm
[71] See: www.doh.wa.gov/ehp/ts/PIRT.HTM
[72] See: http://agr.wa.gov/PestFert/Pesticides/SensitivityRegistry.htm
[73] See: http://www.cdc.gov/exposurereport/2nd/
[74] See: http://www.lni.wa.gov/Safety/Research/files/LeadUpdt2004.pdf
[75] See: www.doh.wa.gov/Topics/WALeadScreenRecommend.doc

Local Organizations
'Studies on Pesticide Exposures Among Preschool Children', conducted at the University of Washington, found that nearly all children in Seattle are likely to have measurable levels of organophosphate pesticides in their urine[76].

Another study on 'Organophosphorus Pesticide Exposure of Urban and Suburban Pre-school Children with Organic and Conventional Diets' looked at levels of organophosphate pesticides in children's urine after consuming a diet of organic foods. It found that consumption of organic foods reduced children's exposure from above to below the EPA's current guidelines[77].

The same researchers studied children's exposure to the pesticides chlorpyrifos and parathion in an agricultural community in central Washington by measuring levels in urine[78].

Other studies conducted by non-governmental organizations have looked at levels of PBDEs in breast milk in the Pacific Northwest[79]. The reports shows that levels in this region are higher than levels in breast milk from Japan, Sweden, Canada and Texas, however, they are lower than national US levels.

8. Air Quality

There is strong evidence that air quality can cause or worsen lung-related diseases such as asthma, cardiovascular disease, emphysema, and chronic bronchitis.

National Organizations
The EPA has information on levels and trends of the six criteria pollutants (carbon monoxide, ground-level ozone, lead, nitrogen dioxide, particulate matter, and sulfur dioxide) in metropolitan statistical areas (MSAs) in the US, including those in Washington State[80].

The EPA's National Air Toxics Assessment (1996) provided information on levels of 34 hazardous air pollutants and the website can be used to generate maps of ambient levels of contaminants, estimated human exposures, and estimated health (cancer and non-cancer) health risks for Washington State[81]. According to the Assessment, King County ranked among the dirtiest/worst 10% of all counties in the US in terms of the number of people living in areas with respect to the non-cancer risk from hazardous air pollutants. Also, an estimated 1,730,356 people in King County faced a cancer risk more than 100 times the goal set by the Clean Air Act, because of their exposures to hazardous air pollutants.

[76] See: http://www.nutrition4health.org/NOHAnews/NNSp02PesticideExpChildren.htm and http://ehp.niehs.nih.gov/members/2001/109p299-303lu/lu-full.html
[77] See: http://www.ewg.org/pdf/20021122_UWstudy.pdf
[78] See: http://ehp.niehs.nih.gov/members/2002/110p549-553fenske/fenske-full.html
[79] See: http://www.northwestwatch.org/toxics/PBDEs_in_NW.pdf
[80] See: http://www.epa.gov/airtrends/metro.html
[81] See: www.epa.gov/ttn/atw/nata/nata1.html

State Organizations

As judged by levels of the six criteria pollutants with national ambient air quality standards, air quality in Washington State has been improving over the past 15 years. Data on trends in air quality are available[82]. Major sources of air pollution in Washington State include:

- Motor vehicles (57%);
- Industrial emissions (17%);
- Wood stoves (11%); and
- Outdoor burning (5%).

In the '2000-2002 Air Quality Trends Report', the Department of Ecology stated that 14 areas of the State had been designated as violating the national ambient air quality standards and over 3 million people lived in these areas[83]. Studies also showed the potential for violations in new areas such as Colville and parts of the Columbia plateau.

Table 7 shows the number of days where air quality was "unsafe for sensitive groups" and "unsafe for all" in different regions of the State[84]:

Table 7: "Safety" of Air Quality in Different Regions of Washington State

2003	**West WA**	**SW WA**	**SE WA**	**NE WA**
Unsafe for Sensitive Groups	16 days	0 days	10 days	3 days
Unsafe for All	0 days	0 days	3 days	3 days

Local Organizations

Air Watch Northwest provides a portal to Northwest air quality agencies. These agencies provide air quality data for the geographical areas they serve[85].

In 2003, the Puget Sound Clean Air Agency released its final report on 'Puget Sound Air Toxics Evaluation'. The report identified chemicals and air emission sources that pose the greatest risks to health in the region, including estimates of cancer and non-cancer risks[86]. The Puget Sound Clean Air Agency has also completed a study (2002) of public views and behaviours that affect air quality in Puget Sound[87].

Public Health Seattle and King County have conducted a series of studies on a cancer cluster near SeaTac airport[88].

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[82] See: https://fortress.wa.gov/ecy/aqp/Public/aqn.shtml and http://www.pscleanair.org/airq/reports.shtml
[83] See: http://www.ecy.wa.gov/pubs/0302008.pdf
[84] See: www.alaw.org/air_quality/outdoor_air_quality/state_of_the_air.html
[85] See: http://www.airwatchnorthwest.org/
[86] See: http://www.pscleanair.org/news/other/psate_final.pdf
[87] See: http://www.pscleanair.org/news/other/2002_survey.pdf
[88] See http://www.metrokc.gov/HEALTH/seatac/index.htm

9. Drinking Water

Chemical contaminants in drinking water can cause cancer, birth defects and neurobehavioral effects.

National Organizations
Annual drinking water quality reports on each of 17 public water systems in Washington State are available from the EPA[89].

A national study conducted by the Natural Resources Defense Council in 2003 included the City of Seattle. It found that Seattle's watershed controls were among the best in the country, however, in 1997/98 14% of homes tested exceeded the national action level for lead of 15 parts per billion[90]. The City has entered into an agreement with the State to correct this by 2004. Also, in 2000 the levels of haloacetic acids (chlorination by-products) exceeded the new national standard of 60 parts per billion and levels of trihalomethanes (also chlorination by-products) approached the national standard of 80 parts per billion. A new treatment plant has now reduced these levels.

Two studies have examined levels of pesticides in well water[91]. One State-wide study found that pesticides were detected in 6% of the wells tested and that 21 of the 27 pesticides analysed for, were detected. Frequently detected pesticides included atrazine, simazine, dicamba, 2,4,5-TP, 2,4-DB, picloram and metribuzin. The second study had lower detection levels and was conducted by the US Geological Survey (USGS). It found pesticides in 30% of the wells tested. Frequently detected pesticides included atrazine, simazine, prometon, DDE, tebuthiuron and metribuzin.

State Organizations
In 2001, more than 5 million of the State's 5.9 million residents were served by public water systems that are mostly privately owned[92].

There is a Department of Health database (SADIE) containing data on drinking water quality of public systems[93]. Registration is required to access and use the database.

In 2006, large water systems in the State will have to comply with the new federal standard for arsenic in drinking water of 10 parts per billion. Approximately 155 large water systems in the State may have to take action to reduce levels of arsenic[94].

Portions of Adams, Benton, Clark, Franklin, Grant, Thurston, Walla Walla, and Whatcom Counties have nitrate concentrations in ground water that exceed 10 micrograms per litre (mg/l) – the EPA's Maximum Contaminant Level[95].

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[89] See: http://yosemite.epa.gov/ogwdw/ccr.nsf/Washington!OpenView&Start=1
[90] See: http://www2.nrdc.org/water/drinking/uscities/pdf/seattle.pdf
[91] See: http://wa.water.usgs.gov/pubs/fs/fs122-96/
[92] See: http://www.doh.wa.gov/ehp/dw/Word_Docs/Overview.doc
[93] See: http://ww3.doh.wa.gov/sadie/asp/default.asp
[94] See: http://www.doh.wa.gov/ehp/dw/our_main_pages/Arsenic.pdf

Local Organizations
Studies have shown that many schools in the Seattle are have drinking water that exceeds the EPA's maximum Contaminant Level of 20 parts per billion [96].

10. Chemical Contaminants in Food

10.1 Contaminants in Food
There are many chemical contaminants in food. Approximately 80-99% of human exposure to persistent organic pollutants occurs via food.

National Organizations
The US Total Diet Study (TDS) has analysed food samples from across the country for residues of pesticides, metals and metalloids for many years[97]. More food samples have been collected and analysed from Washington State than from any other State. Specifically, samples from Washington State were collected in 1993 (Spokane), 1994 (Seattle), 1995 (Tacoma), and 2001 (Spokane).

One analysis of the TDS data found that an average 'western US diet' is associated with approximately 66 exposures per day[98].

There is also information on pesticide use on food crops in Washington State available from the National Agricultural Statistics Service. Information is available on field crops, vegetables, winter wheat, fruit, and potatoes, including information from 1999, 2001, 2002, and 2003[99].

10.2 Fish Contaminants and Consumption[100]
National Organizations
A 1996/97 risk assessment of tribal high fish consumers conducted by the EPA and the Columbia River Inter-tribal Fish Commission showed that this subpopulation may face 50 times the cancer risk of the general public[101]. This assumes a 70 year lifetime and 48 fish meals a month, compared with the general public's consumption of once a month.

State Organizations
In 2003, there were 13 site-specific fish and shellfish consumption advisories in Washington State. These advisories were mainly for mercury, PCBs, dioxins, and PAHs. The species affected included walleye, smallmouth bass, bottom fish, shellfish, crab, and rockfish. The

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[95] See: http://www.doh.wa.gov/ehp/dw/fact_sheets/npp.htm#aff
[96] See: http://www.seattleschools.org/area/facilities/WaterQuality/water_quality_reports.htm
[97] See: http://vm.cfsan.fda.gov/~comm/tds-toc.html
[98] See: http://www.panna.org/resources/documents/nowhereToHide.pdf
[99] See: http://www.nass.usda.gov/wa/rlsetoc.htm#chemuse
[100] This document does not cover recreational shellfish beach closures, as most are closed because of biotoxins, rather than chemical contaminants.
[101] See: http://yosemite.epa.gov/r10/oea.nsf/0/C3A9164ED269353788256C09005D36B7?OpenDocument

consumption advisories contain recommendations include limiting consumption by women of child-bearing age, pregnant and breast feeding women and children under 6 years, and no consumption by anyone[102]. There is also a State-wide advisory for mercury[103].

In 2004, a study of PCB levels in fish from Lake Washington resulted in a new advisory for the Lake[104].

In 2001, the Washington State Toxics Monitoring Program (now cancelled) analysed 147 samples of fish from 5 species and 14 sites (13 lakes and one river) and found that PCBs in all samples exceeded the national Toxics Rule criterion and that mercury was present in all samples[105].

11. Soil Quality

Human exposure to chemical contaminants via soil is important, especially for children. There is information on several issues related to soil quality, including:

- Ambient or background contamination levels;
- Point sources;
- Waste sites; and
- Environmental justice and equity.

11.1 Ambient Contamination

State Organizations

In 2003, a State-wide risk assessment estimated levels of arsenic and lead in soils, related to the operation of smelters in Tacoma, Everett, Harbor Island, Northport, and Trail, as well as orchard land treated with pesticides containing arsenic and/or lead[106] (the 'Area-Wide Soil Contamination Task Force Report', June 30, 2003). The study found that approximately 487,000 acres has been affected by the smelters and 187,500 acres has been affected by the application of these pesticides. Approximately one million residents live in areas likely to have more than 20 parts per billion of arsenic in the soil (the Department of Ecology's health-based hazardous waste clean-up level. There is no information available on soil lead levels attributable to the use of leaded gasoline.

In 1994, the State Department of Ecology conducted a study of 'Natural Background Soil Metal Concentrations in Washington State'[107]. The study found that levels of metals were slightly higher in western Washington, than in eastern portions of the State.

Local Organizations

[102] See: www.doh.wa.gov/ehp/oehas/eha_fish_adv.htm
[103] See: www.doh.wa.gov/fish/FishAdvMercury.htm
[104] See: http://www.doh.wa.gov/Publicat/2004_news/04-101.htm
[105] See: http://www.ecy.wa.gov/biblio/0303012.html
[106] See: http://www.ecy.wa.gov/programs/tcp/area_wide/Final-Report/PDF/TF-Report-final.pdf
[107] See: http://www.ecy.wa.gov/pubs/94115.pdf.

Following up on the risk assessment study, a series of studies called "Dirt Alert" have been launched in King, Kitsap, Pierce, and Thurston Counties[108]. These studies have conducted soil and dust sampling, especially in areas frequented by children. A series of studies on Vashon/Maury Island (VMI) examined soil quality and mortality from cancers associated with arsenic[109]. The studies found no "statistically significant differences" between rates in VMI and King County or the State as a whole.

Other studies include:

- A study of arsenic levels in soils from the City of University Place[110];
- An assessment of surface soil contamination at Soil and Crop Inc., Othello[111]; and
- Levels of contaminants in soil from the Little Squalicum Creek[112].

11.2 Point Sources

National Organizations

The EPA published a report on 'Measuring Progress 1991-2001: The Priority Chemicals Trend Report'[113]. This report data on the amounts of the EPA's Priority Chemicals in hazardous waste, including information on Washington State. The data used in the Trends Report are taken primarily from EPA's Toxics Release Inventory, a national inventory of toxic chemical emissions and releases managed by the EPA. In 2001, Washington State ranked 13th in the country, in terms of the quantities of priority chemicals generated as hazardous waste, quantities combusted for energy recovery, quantities transferred to treatment facilities, and quantities transferred to land disposal facilities.

State Organizations

The Department of Ecology has summarized data from the EPA's Toxic Release Inventory for Washington State, and data from the Emergency Planning and Community Right to Know Act Tier Two[114]. The report, 'Chemicals In Washington State: Summary Report 2002', states that nearly 3,500 facilities reported storage of one or more hazardous chemicals that year.

The Department of Ecology also has information on facilities and sites of interest[115] and industrial permits issued in the State[116].

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[108] See: http://www.ecy.wa.gov/programs/tcp/sites/tacoma_smelter/ts_hp.htm.
[109] See: http://www.ecy.wa.gov/biblio/0109036.html, http://www.metrokc.gov/health/hazard/soilsamples.htm and http://www.metrokc.gov/health/hazard/vmicancerreport.pdf.
[110] See: http://www.ecy.wa.gov/biblio/0103008.html;
[111] See: http://www.ecy.wa.gov/biblio/88e29.html.
[112] See: http://www.ecy.wa.gov/biblio/0403014.html
[113] See: http://www.epa.gov/epaoswer/hazwaste/minimize/trends.htm#list
[114] See: http://www.ecy.wa.gov/pubs/0404020.pdf
[115] See: http://www.ecy.wa.gov/services/as/iss/fsweb/fshome.html
[116] See: http://apps.ecy.wa.gov/industrial/

11.3 Waste Sites

National and State Organizations

There are 47 current or de-listed Superfund sites in Washington State – with 8 in both King and Spokane Counties, 7 in Kitsap County, and 6 in Pierce County[117]. Of these 47 sites, health assessments have been completed at 23 sites[118]. These assessments are conducted by the State Department of Health, under contract with the federal Agency for Toxic Substances and Disease Registry (ATSDR). Most of them are risk assessments that focus on cancer and 'non-carcinogenic effects'. Three health assessments included an epidemiological component. Twenty-three other health assessments have been completed for sites not listed on the National Priorities List.

The Department of Ecology has a Hazardous Sites List, under the Model Toxics Control Act (MTCA)[119]. Nearly every county in Washington has one or more properties on the hazardous sites list. Most are in the more-populous counties of western Washington, where historically there have been more industrial and manufacturing practices. MTCA requires the identification and ranking of sites, according to their level of hazard. The rankings are on a scale of one to five, with a score of one representing the highest level of concern and five the lowest. The scores are based on analysis of the primary paths through which humans and the environment could be exposed to hazardous substances at a site. The List parallels the list of federal Superfund sites[120].

The Department of Ecology has information on active hazardous waste and used oil facilities in Washington State[121].

11.4 Environmental Justice and Equity

State Organizations

In a 1995 study of 'Environmental Equity in Washington State', the Department of Ecology found there was a disproportionately greater number of 'environmental facilities' in low income and minority areas[122]. Data on releases of toxic chemicals also indicated a disproportionate distribution, although less than the facilities data. The disproportionality was greater within counties than at a state level. We have not been able to locate any epidemiological studies that have followed up on this risk assessment.

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[117] See: http://www.epa.gov/superfund/sites/npl/wa.htm

[118] See: http://www.atsdr.cdc.gov/HAC/PHA/region_10.html#washington for a listing of public health assessments in Washington State, with hyperlinks to the actual assessments

[119] See: http://www.ecy.wa.gov/programs/tcp/mtca_gen/hazsites.html

[120] See: http://www.leg.wa.gov/house/opr/IssuePapers/FEP2.htm

[121] See: www.ecy.wa.gov/programs/hwtr/hwfacilities/index.html

[122] See: http://www.ecy.wa.gov/biblio/95413.html

12. The Built Environment

There are many environmental contaminants in the built environment, including contaminants in house dust, radon, environmental or secondhand smoke, and pesticides.

12.1 House Dust

National Organizations

A national study, conducted by the Environmental Working Group, of levels of PBDEs in ten homes across the US that found a level of 5,912 parts per billion in a house in Seattle. This level was the 3rd highest in the homes studied. The study is called 'In the Dust: Toxic Fire Retardants in American Homes (2003)'[123].

A study by Roberts, J., Budd, W., Chuang, J., and Lewis, R. on 'Chemical Contaminants in House Dust: Occurrence and Sources' looked at eight homes in Seattle and found that levels of PAHs varied from 1 – 100 parts per million[124]. The study was sponsored by EPA.

12.2 Radon

State Organizations

Radon exposure causes lung cancer and acts synergistically with smoking. Ten counties in Washington State "high radon potential" and one – Spokane – has "very high potential". Eastern counties tend to have a higher potential than western ones. An estimated 400,000 Washington State residents live in homes with high or very high potential[125].

12.3 Environmental Tobacco Smoke

State Organizations

Environmental tobacco smoke is an important indoor air pollutant. Approximately 12% of Washington State adults are exposed to environmental tobacco smoke at home and about 7% are exposed at work[126]. An estimated 244,000 youth in Washington State are exposed to environmental tobacco smoke at home[127].

12.4 Pesticides

Local Organizations

The City of Seattle[128] and King County[129] have reported reduced pesticide use in recent years.

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[123] See http://www.ewg.org/reports/inthedust/index.php
[124] See: www.epa.gov/ttn/amtic/ord/00147.txt
[125] See: www.doh.wa.gov/ccc/pdf/wsccc_plan.pdf
[126] See: http://www.doh.wa.gov/Tobacco/fact_sheets/programfactsandfigures.htm
[127] See: http://www.alaw.org/tobacco_control/secondhand_smoke/
[128] See: http://www.seattle.gov/environment/documents/PesticideExecutiveSummary.doc
[129] See: http://www.metrokc.gov/procure/green/bul67.htm

12.5 Other Studies of the Built Environment

Local Organizations

In 2002, the Cle Elum-Roslyn Indoor Air Quality Coalition published a report on indoor air quality at the Cle Elum-Roslyn High School[130].

13. How Comprehensive is Our Information?

13.1 Report Card

This Report Card on the 'comprehensiveness' of the information on health and environmental contaminants in Washington State is based on the following grading system:

A	Excellent
B	Good
C	Fair
D	Poor
F	Fail

Asthma: Grade A

The information available on asthma in Washington State is very good. Moreover, the studies conducted at the Northwest Center for Particulate Matter and Health add considerably to our understanding of the links between asthma and particulate matter.

Cardiovascular Disease: Grade A/B

There is reasonably good information available on cardiovascular disease in Washington State. However, it has not been adequately linked with information on air quality. A large, new study on cardiovascular disease and particulates at the University of Washington[131] will help to address this gap. There is also a need for better morbidity information.

Cancer: Grade A

The information available on cancer in Washington State is very good. As mentioned in section 5, the State's Cancer Registry was awarded an "A" by the Trust for America's Health. It would be helpful if the Registry allowed users to generate maps of cancer rates by county. Also, there is a need for more studies on different types of cancer in relation to exposures to carcinogenic chemicals in the environment.

Reproductive Effects: Grade B/C

The Washington State data on preterm birth, low birth weight and infant mortality are very good. However, better data are needed on male and fertility and the relationship between specific reproductive effects and exposure to environmental contaminants.

[130] See: http://www.co.kittitas.wa.us/health/CE-RIndoorAirQualityFinalReport.pdf).
[131] See: http://www.uwnews.org/article.asp?articleID=5187

Birth Defects: Grade D/F

There is an urgent need for an operational, publicly accessible Washington State Birth Defects Registry. As noted in section 6.2, the State received a "D" for its Birth Defects Registry from the Trust for America's Health. The Department of Health is now building a better database, which ideally should be queryable and allow users to map rates of birth defects by county. There is also an urgent need for studies to link birth with exposure to environmental contaminants.

Developmental Disabilities and Neurobehavioral Defects: Grade F

We were unable to find much information on developmental disabilities or neurobehavioral defects in Washington State. This suggests that there is a need for such information. There is also a need to link information on developmental disabilities and neurobehavioral defects with information on exposures to environmental contaminants, because a growing amount of scientific evidence indicates that these types of exposures can have profound effects on health.

'Pesticide Incidents': Grade A

Washington State is one of only a few states with systems for tracking and reporting 'pesticides incidents' (California has a Pesticide Illness Surveillance Program and Oregon's Pesticide Analytical and Response Center reports 'pesticide incidents').

Body Burden: Grade D

There is an urgent need for a State-wide biomonitoring program to complement the national program on human exposure to environmental contaminants. The Department of Health has plans for such a program, but is currently unable to fund it. There is also a need for biomonitoring studies relevant populations at risk, such as studies on levels of the full range of persistent bioaccumulative toxic chemicals in breast milk and mercury levels in people who eat a lot of fish.

Air Quality: Grade A/B

The Washington State information on air quality is good, but there are no data on ambient levels of pesticides and the most recent data on ambient levels of hazardous air pollutants are for 1996. Also, there has been a decrease in the number of monitoring stations in recent years.

Drinking Water: Grade B/C

Information on drinking water quality in Washington State is good, but there is a need for a publicly accessible, queryable State-wide database, with mapping capacity. It is unclear why the Department of Health's SADIE database requires users to request registration. Also, there is a need for studies on chemicals in drinking water and health outcomes, such as those that have been observed in studies conducted elsewhere in the US and Canada.

Chemical Contaminants in Food: Grade B

There is good information available on environmental contaminants in food in Washington State, although there is a need to make information in the Total Diet Study data more accessible and understandable to the public. In addition, there is a need for more frequent sample collection from a larger number of locations in the State.

There is also a need to use data in the Total Diet Study to estimate total daily or weekly ingestion of individual and cumulative environmental contaminants via food and other sources (drinking water, air, soil/dust), and to relevant conduct risk assessments.

Soil Quality: Grade B/C

There is relatively good information available on levels of metals and on the health risks associated with many hazardous waste sites in the State. However, information on ambient levels of persistent organic pollutants is needed, as is information on soil contamination from leaded gasoline.

The Built Environment: Grade C

There is a need for better information on environmental contaminants in the built environment. This includes data on lead, other heavy metals, pesticides, persistent organic pollutants and other environmental contaminants. Data on levels of environmental contaminants in the built environment need to be linked with health information.

Table 8 summarizes this assessment of the information available on health and environmental contaminants in Washington State in a Report Card.

Table 8: Report Card on Information Available on Health and Environmental Contaminants in Washington State

Type of Information	**Grade**	**Comments**
Asthma	A	Very good
Cardiovascular Disease (CVD)	A/B	Need to link CVD with air pollution. Also, need for better morbidity data.
Cancer	A	Very good, but mapping of data would be helpful. Also, need to link cancer information with exposure to environmental carcinogens
Reproductive Effects (effects on male and female fertility, endometriosis, preterm births, low birth weight, and infant mortality)	B/C	Data on preterm birth, low birth weight and infant mortality are very good. Better data needed on male and fertility and the relationship between reproductive effects and exposure to environmental contaminants

Birth Defects	D/F	Need an operational, publicly accessible WA State Birth Defects Registry. Better data on developmental effects in Washington State is needed. Need to link birth and developmental effects with exposure to environmental contaminants
Developmental Disabilities and Neurobehavioral Defects	F	Unable to find much information on Washington State
'Pesticide Incidents'	A	One of only a few states with tracking systems
Body Burden	D	Need a State-wide biomonitoring program. Also, need more information on populations at risk e.g., high fish consumers
Air Quality	A/B	Good, but no data on ambient levels of pesticides. There has been a decrease in the number of monitoring stations in recent years
Drinking Water	B	Good, but a publicly accessible, queryable State-wide database, with mapping capacity, is needed. Also, there is a need for studies on chemicals in drinking water and health outcomes
Food	B	Need to make information in the Total Diet Study data more accessible and understandable
Soil Quality	B/C	Information on contamination from leaded gasoline needed. Also, data on levels of persistent organic pollutants
Built Environment	C	Need more data on lead, other metals, pesticides, and other contaminants

13.2 Key Findings and Needs

Linking Information on Health and Environmental Contaminants in Washington State:

Information on health in Washington State and information on environmental contaminants in the State are not sufficiently linked with each other. Information on environmental contaminants is not usually used to understand information on health, and similarly information on health is not used to understand information on environmental contaminants. Generic health-based standards and guidelines are used to analyze information

on levels of environmental contaminants, for example, information on air quality is interpreted using the national ambient air quality standards. But this is not adequate to gain a comprehensive understanding of environmental public health in Washington State. The need to link these types of information is all the more urgent because of evidence of increasing rates of many diseases and disabilities linked with environmental contaminants and evidence of worsening environmental contamination.

More research is needed to link information on environmental contaminants with specific health outcomes, such as studies on linking information on levels of traffic-related air pollutants and asthma and cardiovascular disease. The work being done under the Washington State Environmental Public Health Tracking System[132] is a start, but more is needed if we are to understand how environmental contaminants affect health in Washington State more fully.

To decide which environmental contaminants and health outcomes to focus on, it is suggested that it would be helpful to use the Department of Ecology's Working List of Persistent Bioaccumulative Toxics[133] as a guide (or any subsequent legislated Washington State list of persistent bioaccumulative toxics), as well as the six criteria air pollutants. The Department of Ecology's Working List includes aldrin/dieldrin, cadmium, chlordane, DDT etc, dicofol, dioxins and furans, endosulphan, heptachlor epoxide, HCB, hexachlorobutadiene, gamma HCH, lead, methoxychlor, mercury, pendimethalin, pentabromodiphenyl ether, pentachlorobenzene, PAHs, PCBs, toxaphene, trifluralin, and 1,2,4,5 tetrachlorobenzene. The criteria air pollutants are carbon monoxide, ozone, particulate matter, sulphur dioxide, nitrogen dioxide, and lead.

Geographical and Temporal Trends:
Related to the need for stronger linkages between health and environmental information in Washington State, there is a need for better information on geographical and temporal trends in health and environmental contaminants. This type of information is needed to understand trends across the State and over time. It would be extremely helpful for planning purposes and to evaluate the effectiveness of risk reduction policies, programs and initiatives. Some trend information is available, such as geographic and temporal trends in levels of the criteria air pollutants. However, this is the exception, rather than the rule.

Information on Exposures:
There is also a need for better data on the exposures of Washington State residents to environmental contaminants, including population exposures to ambient or background levels of environmental contaminants, and exposures of "at risk" populations, such as children and the elderly, First Nations and high fish consumers, and low income groups. Generic information on background levels of environmental contaminants in the environment is unlikely to accurately reflect human exposures.

Information on Cumulative and Aggregate Exposures:
Exposure information usually focuses on individual contaminants, is media specific, i.e., looks at exposure through a specific environmental medium, such as air, drinking water,

[132] See: http://www.cdc.gov/nceh/tracking/EPHTracking/contacts/wa.htm
[133] See: http://www.ecy.wa.gov/biblio/0003002.html and http://www.ecy.wa.gov/biblio/0203030.html

food, etc, and is measured over a specific period of time. Thus, it rarely takes account of combined exposures to all environmental contaminants, total exposures from all pathways, or exposures over an entire lifetime. However, environmental contaminants can act synergistically, exposures from different pathways can affect the same biological systems, and it can take years of exposure to result in health effects.

For this reason, there is an urgent need for multi-contaminant, multi-media approaches to understand total cumulative exposures from all contaminants, all exposures pathways, and aggregate exposures over the human lifetime.

Tools for Communities:
There is a need for much better tools for communities to understand the available environmental and health information. This includes publicly accessible, queryable, and mapable databases that contain information relevant to local communities. For example, EPA's National Air Toxics Assessment has a website database that allows the viewer to request maps, data, and charts on emissions, ambient concentrations, human exposures, and estimated cancer and non-cancer risks down to the county level for the entire country[134].

The Department of Ecology's Environmental Information System contains some mapable environmental information, but it is not linked with any health information. .

Economic Information
There is a lack of information on the economic costs of environmentally-attributable diseases and disabilities in Washington State. Information is available on the total economic costs of cancer and asthma, but information on the environmentally-attributable proportions of these and other diseases and disabilities is not.

This type of information is urgently needed by policy-makers and others so that they can balance estimated costs for environmental protection measures with the estimated health benefits that would result from implementation of health protective measures. This will enable them to make more informed decisions about the costs and benefits of risk reduction strategies.

13.3 Next Steps

Over the next 6-12 months, we plan to continue this study by making progress in the following three main areas:

- Expand the scope of this study to include:
  - The estimated economic costs of the environmentally-attributable proportions of other chronic diseases and disabilities in Washington State, such as asthma, blood lead levels in children, birth defects, and neurobehavioral effects;

[134] See: http://www.epa.gov/ttn/atw/nata/nsata1.html

- Washington State information on the relationship between land use patterns, urban sprawl and health, including obesity and other chronic health conditions;

- Information on climate change and health in Washington State;

- Information on radiation and health in Washington State; and

- A summary of Washington State information on environmental contaminants in food, based on information in the US Total Diet Study.

- Create a website containing the information and references collected for this study, as part of the proposed website for the Collaborative on Health and the Environment Northwest Chapter.

- Continue to update and expand the information and references on the subjects covered in this document.

Comments and suggestions on this document, or on additional sources of information and references are invited.

Appendix A:

List of Acronyms

ADD/ADHD	Attention Deficit Disorder/Attention Deficit and Hyperactivity Disorder
ATSDR	Agency for Toxic Substances and Disease Registry
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control
CNS	Central Nervous System
CVD	Cardiovascular Disease
EAF	Environmentally-attributable Factor
EPA	Environmental Protection Agency
IQ	Intelligence Quotient
MSAs	Metropolitan Statistical Areas
PAHs	Polyaromatic Hydrocarbons
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated biphenyls
PIRT	Pesticide Incident Reporting and Tracking
SADIE	Washington State's Drinking Water Database
TDS	Total Diet Study
US	United States
USGS	US Geological Survey
VMI	Vashon and Maury Island
WA	Washington State