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Commission on Environmental Cooperation

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I am attaching a paper entitled "Serious Environmental and Public Health Impacts of Water Related Diseases and Lack of Sanitation on Adults and Children: A Brief Summary", which is being submitted to the Joint Public Advisory Committee of the Commission for Environmental Cooperation for establishing the written record with respect to the meeting of the Expert Advisory Board on Children's Health and the Environment in North America, which was held on 7 March 2002 in Mexico City.

If you have any questions, please do not hesitate to contact me at the coordinates I have listed below.

Sincerely,  
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# **Serious Environmental and Public Health Impacts of Water Related Diseases and Lack of Sanitation on Adults and Children:**

## **A Brief Summary**

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### **I. Overview:**

#### **A. The Global Picture :**

The lack of clean water resources and sanitation facilities looms as one of the most serious environmental health problems faced today by a large fraction of the world's population, especially those living in developing regions. The World Health Organization (WHO) has estimated that 1.1 billion people globally lack basic access to drinking water resources, while 2.4 billion people have inadequate sanitation facilities, which accounts for many water related acute and chronic diseases. Some 3.4 million people, many of them young children, die each year from water-borne diseases, such as intestinal diarrhea (cholera, typhoid fever and dysentery), caused by microbially-contaminated water supplies that are linked to deficient or non-existent sanitation and sewage disposal facilities. Globally, water-borne diseases are the second leading cause of death in children below the age of five years, while childhood mortality rates from acute respiratory infections ranks first.

Around the world, water supply and sanitation facilities are rapidly deteriorating and currently are operating at a fraction of its installed capacity. This situation is particularly serious in many urban regions of developing countries in Asia, Africa and Latin America where the poor have very limited access to clean water supplies and sanitation facilities, which pose infectious disease risks to the population, especially among infants and young children. This situation is often more pronounced in rural areas, where the problem of water resources and inadequate sanitation facilities still largely remains to be solved.

Added to this is the rapid industrialization of many developing regions, where in the past few decades water contamination by toxic chemicals and hazardous wastes has aggravated an already serious water pollution problem. Many freshwater streams and lakes around the world have been contaminated with industrial discharges and agricultural runoffs that carry a large variety of toxic chemical substances and hazardous wastes. Many contaminated water sources contain a number of heavy metals, pesticides and other agricultural chemicals, along with persistent organic pollutants (POPs), many of which remain in the environment for long periods of time and bioaccumulate in the food web, causing many acute and chronic diseases, ranging from severe skin and liver disorders to developmental abnormalities and human cancer.

#### **B. The Hemispheric Picture :**

In a report based on the Meeting of Environment Ministers of the Americas, held in Montreal, Canada on March 29 - 30, 2001, which represented 33 countries in the Western

Hemisphere, the environmental threats to public health from contaminated drinking water was summarized as follows:

"Although important progress has been made in recent years, approximately 90 million people in the Americas still do not have ready access to water. Many of those who do have the benefit of being connected to a water source, drink water that can make them sick. Threats to water quality can be biological and chemical. About 300 million people in the Americas are at risk of contracting serious diseases such as cholera, typhoid fever, and viral hepatitis. Parasites such as *Giardia* and *Cryptosporidium* are also a serious threat, particularly in developing countries. Biological and chemical contaminants enter source waters mainly through the discharge of human, animal and industrial wastes.

In Latin America and the Caribbean less than 12% of collected wastewater is treated. This means that enormous amounts of raw sewage, along with industrial effluents and run-off water contaminate the ground and surface water sources needed for public water supplies. It is estimated that a reduction in the incidence of certain bacteriological diseases of up to 80% could be achieved through effective water source protection from raw sewage.

Even where most people have access to treated water, there is an ever present risk of outbreak of waterborne diseases or other human illnesses from direct ingestion of, or exposure to, contaminated water or the consumption of any foods so contaminated by water. In Canada, mostly in small towns and villages, many "boil water" advisories are regularly issued over concerns about the microbiological safety of the water. The threat from waterborne disease was highlighted in the spring of 2000, when the spread of *E. Coli* bacteria in the drinking water supply of a small town resulted in several deaths and a large number of ill people.

Disparity in water supply is also an issue. Poor people are less likely to be connected to regular sources of water supply and often are forced to purchase highly priced poor quality water from vendors. The high cost of water and lack of quality are generally responsible for the low level of personal hygiene and associated spread of communicable diseases, and high prevalence of water related diseases. Inequities are also visible between water supply coverage in urban and rural populations. A recent global assessment carried out by WHO-PAHO-UNICEF indicates that in most developing countries the best-served rural dweller is much worse off than the worst-served urban dweller. Insufficient and ineffective management of surface and coastal waters also has important detrimental impacts on the potential for rivers and beaches to be used for bathing, swimming and other recreational activities. Not only does this cause

problems to public health, but it can also be responsible for the loss of revenue from tourism."

## II. Summary of Water-Related Diseases Worldwide:

- Bacterial Diseases: According to WHO and the US Centers for Disease Control and Prevention (CDC), over 2 billion people, mostly living in developing countries, are at elevated risk to water related bacterial diseases. While there are many illnesses that may be identified in this category, the major water related diseases include acute dehydrating diarrhea (*cholera*), abdominal illness (*typhoid fever*), acute diarrhea (*dysentery*) and chronic diarrhea (*Brainerd diarrhea*).
- Cryptosporidiosis: In the past two decades, in many regions of the world, including the United States, a common water related diarrheal disease that is increasingly been recognized as a major public health problem is *cryptosporidiosis*, caused by a microscopic parasite (*Cryptosporidium*). It is generally found in drinking water, swimming pools and recreational streams that have been accidentally contaminated by human fecal wastes.
- Giardia: Another increasingly common water related diarrheal disease around the world, including the United States, is *giardiasis*, which is caused by a one-celled microscopic parasite (*Giardia*). Similar to the spread of *cryptosporidium* in the environment, *giardia* is transmitted by discharges of fecal wastes into water, food, soil and other surfaces, and therefore the preventative hygienic measures that are being recommended to lower the overall incidence of the former disease applies here equally well.
- Malaria: One of the most serious vector-borne diseases in the world today is malaria. It occurs in many tropical regions of the world, such as Central and South Africa, Hispaniola, the sub-Saharan region of Africa (where the largest incidences are annually reported), Indian subcontinent, Southeast Asia, Middle East and Oceania. It is a water related disease, since it is caused by four subspecies of microscopic parasites (*Plasmodium*) carried by female *Anopheles* mosquitoes that breed its larvae in stagnant waters and storage reservoirs in warm climates.
- Malarial Incidence: Each year, 300 to 500 million people contract malaria worldwide, of which 1.5 to 2.7 million people die from the disease, the overwhelming majority (90%) of them children below the age of 5 years. Since the 1970s, there has been a resurgence of malaria in different regions of the world, partially due to the rapid formation of resistant parasites to malaria preventing drugs, such as chloroquine and other quinoline products. In addition, significant increases in the incidence of malaria in recent years have been caused by the construction of dams, intensified irrigation systems and other water related projects, which have become new mosquito breeding sites in many developing regions.
- Schistosomiasis: It is estimated that 200 million people worldwide are infected with schistosomiasis, with another 2 billion people in some 74 countries are at elevated risk from this debilitating water-borne disease. Schistosomiasis (sometimes known as bilharzia) is caused by parasitic worms (*Schistosoma*) when human beings come into contact with certain types of snails that harbor these parasites in contaminated fresh

water. The main factor in the proliferation of this disease is when human fecal wastes are dumped in fresh water sources.

- Trachoma: Improved water sanitation and hygienic conditions could also reduce the worldwide incidence of trachoma, a serious chronic eye disease, which is caused by an infectious bacterial agent (*Chlamydia trachomatis*) that is spread by person-to-person contacts and by insect vectors such as houseflies. At present, it is estimated that 500 million people are at risk to this disease and 146 million people are threatened by irreversible blindness. WHO estimates that trachoma results in 6 million cases of blindness each year, and that the prevalence of this disease in children is 10 - 40% in some African countries.
- Arsenic Poisoning: An environmental health problem of enormous proportion has arisen in a number of regions of the world where naturally occurring arsenic found in subsoil layers have contaminated underground drinking water sources. The most severe cases of arsenic poisoning have occurred in Bangladesh, where it is estimated that between 35 and 77 million people (in a country of 125 million people) has been exposed to this toxic substance by ingesting drinking water drawn from underground aquifers. Other countries where excessive arsenic in drinking water from underground sources (and in some cases from surface mine tailings and agricultural runoffs) has also been identified as an environmental health risk include Argentina, Chile, China, India, Mexico, Thailand and the United States.
- Fluorosis: In some regions of the world, unsafe levels of naturally occurring fluoride, which is present abundantly in the earth's crust, are found in drinking water. Excessive level of fluoride ingestion causes a chronic disease known as fluorosis, which is a serious bone disease that discolors teeth (dental fluorosis), causes stiffness of joints and other skeletal deformations.
- Incidence of Fluorosis: According to UNICEF, fluorosis is endemic in at least 25 countries across the globe, whereas WHO estimates that in China alone some 30 million people suffer from chronic fluorosis. In 1993, fluorosis was reported to be endemic in 15 out of 32 states in India, while an estimated 5 million people in Mexico are affected by high levels of fluoride from exposure to underground drinking water.
- Fluoride in Drinking Water: In many developed countries, fluoride is added intentionally in drinking water (generally at a presumed safe concentration level of 1 part per million (ppm) as a preventative measure against dental decay. However, WHO has recommended that in warmer climates, fluoride in drinking water be kept below the 1 ppm concentration level, since individuals in hot weather ingests greater quantities of water daily than those living in more temperature regions.
- Toxic Substances and Hazardous Wastes: Increasingly, many surface and underground drinking water sources around the world have become severely polluted by a variety of toxic chemical substances and hazardous wastes. These sources of water contamination include manufacturing, refinery and municipal effluent discharges, leachates from landfills and hazardous waste sites, agricultural runoffs, mining operations, and other commercial and recreational activities.
- Types of Toxic Substances: Among the more common toxic substances found in drinking water are *heavy metals* (such as beryllium, cadmium, chromium, lead, mercury, nickel), *toxic organic compounds* (such as benzene, dichloroethylene, dioxin, ethylene dibromide, MTBE, phthalates, PCBs, toluene, xylenes), *pesticides* (such as

alachlor, atrazine, DDT, dalapron, hexachlorobenzene, lindane, permethrin, 2,4-D), and *disinfection by-products* (such as bromates, chlorophenols, chloroform, bromoform, halogenated acetic acids and acetonitriles).

- Sources of Heavy Metals: The major "point" sources of heavy metal contamination of waterways are from the mining, metal smelting, electroplating and chemical manufacturing industries, whereas "non-point" sources of heavy metals are from agricultural runoffs (containing mineral fertilizers, sewage sludge and certain types of pesticides) and from urban/suburban runoffs and atmospheric fallouts that are linked to road traffic and emissions from power plants and waste incinerators.
- Sources of Synthetic Organic Pollutants: Major sources of toxic organic compounds in surface and ground water are from chemical, pharmaceutical, synthetic polymer (plastic/rubber) and fossil fuel refining industries, whereas most pesticide contamination of drinking water originate from agricultural and domestic uses.
- Disinfectant By-products: These organic compounds are formed in waterways and reservoirs when chlorine, used as a bactericidal agent in many water treatment plants, chemically reacts with naturally occurring organic compounds (e.g., soil-bearing humic acids) to form a number of halogenated organic compounds, such as chloroform and bromoform, which cause liver and kidney diseases and are potential cancer causing substances.
- Agricultural Runoffs: In addition, agricultural runoffs of nitrogen fertilizers in many rural areas of the world contaminate rivers, lakes and underground aquifers leading to excessive levels of dissolved nitrates and nitrites in drinking water that may cause "blue baby syndrome", an acute and serious life threatening disease among infants and young children.
- Health Effects of Toxic Substances: The presence of toxic chemical substances and hazardous waste materials in drinking water pose a large spectrum of human health risks to the general population. They range from simple ailments such as short-term skin rashes, nose and eye irritations, gastrointestinal distress, numbness in fingers and toes, to a variety of serious acute and chronic diseases. For instance, a number of heavy metals cause long-term liver and kidney damage, nervous system disorders, loss of fingernails and hair, blood pressure changes and circulatory problems.
- Persistent Organic Pollutants: Many persistent organic pollutants (POPs) found in drinking water (that do not breakdown in the environment for weeks, months and years), such as aromatic and halogenated hydrocarbons, cause developmental and nervous system disorders, reproductive difficulties, liver and kidney problems, several types of cardiovascular disorders, increased risks of a variety of childhood and adult cancers and potential genetic damages to future generations.

### **III. Water-Borne Diseases and Drinking Water Contaminants in United States, Canada and Mexico:**

A. United States and Canada: The problems of water pollution and drinking water contamination in the two North America countries tend to be similar in nature, since the types of industrial and municipal discharges, disposal of hazardous wastes and agricultural runoffs

are not markedly different. The chemical and biological contaminants in drinking water that have serious potential impacts on human health are as follow:

- Heavy metals and synthetic organic compounds are found in detectable levels in a number of surface and ground water sources in different regions of both countries. The presence of these toxic substances in drinking water originates from industrial effluents into waterways, leaking petroleum storage tanks, municipal landfills and hazardous waste disposal sites and from accidental spills. In the past two decades, the detection of unsafe levels of these toxic chemical substances in underground drinking water sources have led to extensive remedial cleanups of aquifers in many regions of North America.
- In rural areas, leakages from defective septic waste systems have seriously contaminated groundwater sources with bacteria, viruses and toxic chemicals found in household detergents and cleaning products. Often such contamination of drinking water sources are poorly monitored and the full extent of the problem are largely unknown.
- In urban communities and inner cities areas, excessive levels of lead in drinking water have been detected which arises from the heavy metal leaching from plumbing that had been installed in older building that were generally built before the 1930s. Pregnant women and young children are among the most vulnerable members of the population to the adverse health impacts of lead in drinking water.
- In some regions of the United States, especially in the Western states, excessive levels of arsenic (above the current EPA and WHO guidelines of 10 parts per billion) have been widely found in groundwater that arise from the natural sources in the soil. Long time exposure to arsenic in drinking water can cause skin damages, diabetes, circulatory system disorders and pose a potential cancer risk.
- The problem of identifying the health impacts of naturally occurring fluoride in drinking water leading to dental fluorosis is made more complicated because in many communities fluoride is added as a preventative measure against childhood dental decay and it is also present in many foods. A National Academy of Sciences study in 1993 stated that “the prevalence of dental fluorosis reported in optimally fluoridated areas (both natural and added) in recent years ranged from 8% to 51%, compared with 3% to 26% in nonfluoridated areas.” -- indicating a public health problem that has not been fully recognized.
- Agricultural runoffs and aerial spraying can cause severe water pollution problems in many farming regions of United States and Canada. These range from contamination of groundwater sources with excessive levels of nitrates and nitrites from synthetic fertilizers and animal manure from large feedlots to the use of a variety of insecticides and herbicides that enter into rivers, lakes and drinking water reservoirs.
- In recent years, several water-borne infectious diseases outbreaks have occurred in United States and Canada that were caused by parasites found in contaminated rivers and lakes. These include *Cryptosporidium* and *Giardia*, which enter surface waters through improper sewage disposal and animal wastes.
- The extensive chlorination in United States and Canada to destroy pathogenic bacteria in drinking water supplies has lead to the formation of disinfectant by-products, such as halogenated hydrocarbons. One class of these halogen-containing organic

- compounds -- trihalomethanes (e.g., chloroform) -- pose long-term health impacts on the general population, such as liver, kidney, central nervous system disorders and may pose an increased risk of contracting cancer.
- The widespread use of the fuel additive MTBE in the United States has led to its increasing presence in many surface and ground water sources in the country. While the long-term toxicity of MBTE has been documented, a drinking water standard for this pervasive contaminant has not been established as yet by the United States Environmental Protection Agency.
  - Drinking water sources may also contain radioactive substances, such as Radium 226/228 and a variety of beta-emitting minerals found in underground aquifers. These contaminants pose cancer risks to individuals who ingest radioactive sources of drinking water over a long period. In addition, radon gas in the soil can dissolve and accumulate in ground water posing health risk to communities that ingest such contaminated sources of water. Radioactive radon has been shown in recent years to be a potential cancer causing substance.

B. Mexico: In the past few decades, while industrialization and urbanization have occurred at a rapid rate in Mexico, in many respects it still shares a variety of water related problems that are commonly found in other developing countries in Latin America:

- Mexico continues to have serious deficiencies of clean water resources in many poor urban and rural communities, along with major lack in sewage system infrastructures and sanitation facilities. In many regions of the country, such as the squatter housing areas of Mexico City, where over seven million people live, there is severe lack of drinking water resources, sanitation facilities and storm water drainage systems, which combined together become a breeding ground of water related acute and chronic diseases among adults and children.
- While water-borne infectious diseases have been reduced in the past few years in Mexico, microbially-contaminated drinking water still remains a serious problem, especially when contrasted with United States and Canada. For instance, there were over 45,582 cases of cholera reported in Mexico between 1991 and 2000, compared with only 245 and 33 reported cases of this water-borne disease during the same period in United States and Canada, respectively.
- Along the border areas of Mexico and United States, the region has been long characterized by a variety of environmental problems, including chronic lack of water resources for drinking, bathing, cooking and washing, along with a widespread absence of basic sewage and storm drainage systems. In addition, dumping of untreated raw sewage and discharge of toxic chemicals and hazardous wastes into waterways, along with pesticide runoffs from agricultural operations, have severely contaminated many rivers and streams in the border region.
- In recent past, it was estimated that 24 million gallons of raw sewage were released daily into the Rio Grande River from Nuevo Laredo, with fecal bacterial counts reaching levels as high as 22,000 bacteria per milliliter in some regions (a 200 bacterial count is considered unsafe for swimming). Similarly, 46 million gallons of raw sewage was discharged daily into the Tijuana River along the California-Mexico border, while 76 million gallon of sewage wastes were dumped each day into



- California's New River. In some US-Mexico border areas, newly built municipal sewage treatment plants have come into operation recently to reduce water related problems in the region.
- One of the most important drinking water sources in the Yucatan peninsula – the extensive karstic aquifer – has become severely contaminated with pathogenic microbial organisms due to seepage of untreated sewage wastes in the region. In many rural areas of the Yucatan peninsula, gastroenteritis, diarrhea and urinary tract infections have become pervasive among its inhabitants. It is now estimated that more than 40% of deaths of children below 6 years of age stem from gastrointestinal diseases caused by microbially-contaminated ground water in the region.
  - Another serious water related problem in Mexico is the potential of dental fluorosis, joint pains and skeletal deformities among inhabitants in certain regions of the country. For example, in the Los Altos de Jalisco region (on the Central-Western coastland), the concentration of naturally occurring fluoride in drinking water range from 0.14 to 12.97 mg/L (the WHO guideline for fluoride being 1.5 mg/L), posing high health risks to a significant fraction of its inhabitants, as much as an estimated third (200,000) of its total population of 600,000. Overall, the WHO has estimated that 5 million people in Mexico are at elevated health risk from ingesting excessive levels of fluoride in their drinking water.
  - In recent years, to address the serious water related problems in Mexico, the Inter-American Development Bank (IDB) embarked on a large scale program of providing financial assistance (in the form of a long-term loan) to improve sanitation, drainage and water supply for the greater Mexico City metropolitan region and Mezquital valleys. The cost of such a massive project is expected to exceed \$ 1 billion, with additional co-financing to be obtained from Japan's Overseas Economic Cooperation Fund and with matching funds from local sources.

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