

Economic Impacts of Polluting Lake Michigan

Since Industry has existed in Chicago and the cities surrounding Lake Michigan pollutants have been carelessly spilled and in turn contaminated most of the lake. This particular lake has an ecosystem that is very fragile and contains one the largest supplies of freshwater on the Earth. Lake Michigan is a vital resource for the Americas as well as Canada and as long as pollutants are continually thrown into the water it will change the ecosystem and prevent the healthy lifestyle of not only the wildlife but communities surrounding the lake as well. Lakes act very differently than a river when it comes to washing out contaminants. Lake Michigan is a fairly enclosed system that acts as a pollutant swamp that encapsulates water that could remain in the system for more than 100 years before escaping out. This means pollutants that have entered the system from the past and that are still entering in today will effect the ecological system for many years to come if not treated. Studies completed by the United States Food and Drug Administration have shown unsafe levels of toxins have entered communities of fish. These will in turn harm future profits that fisheries will receive as well as contribute to the cost of the recreational fishers and users of the lake. The EPA is

currently working on a materials balance solution to the pollution and must take into account the cost and benefits associated with cleaning it up. (www.EPA.gov)

Currently the EPA is concentrating on four particular toxins that have been entering Lake Michigan to see how these chemicals are effecting the ecosystem and if it would be useful to take a material balance approach to the problem. These four were chosen in order to receive a representative sample of the lake that currently contains 29 pollutants. The four pollutants are polychlorinated biphenyl's (PCBs), mercury, trans-nonachlor, and atrazine. PCBs are human-produced industrial chemicals that are most commonly seen in electrical transformers and capacitors as coolants. This chemical has also been used in dye carriers in carbonless copy paper, paints, adhesives, sealents, and road coverings to control dust. In 1979 the EPA banned the manufacturing of PCBs which cause cancer and kidney damage however they still exist in the environment at sites that have not been properly cleaned up. The second contaminant Mercury is a naturally occurring toxin that can be released into the environment by natural processes or by human activity such as the combustion of certain fuels and the burning of materials that contain mercury. The release of this toxin into the environment is quit harmful due to the fact that it is stored for long periods of time in fat tissue and adds up rapidly in

fish stock, wildlife, and humans over time. Mercury is a human carcinogen that can also cause brain, lung, and kidney damage as well as fetus damage to females. Trans-Nonachlor was a chemical component of a pesticide for termite control used between 1948 and 1988 yet despite being banned in the U.S. in 1987 it was still produced for exportation until 1997. Seepage into the environment can occur through the run-off of soil or by atmospheric transport that can contaminate water local and distant. Trans-Nonachlor contributes to endocrine system problems and causes neurological disorders if digested or inhaled. The last toxin to be studied by the EPA in Lake Michigan is Atrazine that was used in corn and sorghum herbicide. The half-life of this chemical in soil is sixty days however it is much longer in water. Presently Atrazine is a use restricted pesticide and can only be used by trained applicators. The annual maximum contaminant level in drinking water is rarely exceeded however after rainfall the peak values exceed the amount set by the EPA. Atrazine is a possible human carcinogen and has caused tumors in mammary glands in lab animals. (www.EPA.gov)

The Lake Michigan Mass Balance Project began in 1994 and will conclude late December 1999. The EPA biologists are using the principle of conservation of mass: the amount of pollutant entering the lake should equal the amount of pollutant leaving,

trapped in, or chemically changed in the lake. This theory is used as a very effective way to enable biologist to find quick strategies to reduce toxic loads and minimize the health risks involved to humans and the wildlife. On the other hand economists use the theory of materials balance to look at the same problem. We think of it as how industry removes things from the environment to create production and consumption which in turn recycles the end emissions back into the Earth. The total amount of what goes in must equal the amount that comes out. When industry produces their materials nothing is lost they simply change the form of what they started with and most often make it into a form more useful to us as a society. People who want zero pollution don't understand that zero emissions aren't the optimal amount of pollution needed. No pollution means no production or consumption by society, so zero emissions is not optimal. Society can reduce the amount of pollution in Lake Michigan by simply reducing the amount of production and consumption, but do they really want to do this? One possible solution the EPA has is to look at the unemployed labor and capital and allocate that to change the pollution to a less harmful form, emissions would stay at the same rate however there would be a change in consumption. The EPA needs to see the whole picture and realize that the issue of Lake Michigan isn't on getting rid of all the pollution and spending billions

of dollars on it but rather to create the correct combination of pollution and emissions that society likes the best. We must see that there are only three places that pollution can go, water, air, and land, in this case it ended up in water. Would society feel more comfortable to have it go into the air or land, maybe but this is not the proper way to solve the problem. Emissions and pollution can't be looked at in separation because they are different combinations of the exact same thing. They can't be managed in segregation.

How much would the public be willing to pay to help the situation in Lake Michigan and create a recreational area and a recreational fishing zone safe for everyone? The objective of this is to estimate the damages caused from the pollution of Lake Michigan. Economists call this the use value of non-market valuation. We create models to measure the damages that people who use the lake incur, such as commercial fisherman or simply people who like to water-ski or fish recreationally. We can also estimate the damages of the non-use value; those are the damages incurred to the people who don't use the lake but who like to know that it is there and not being polluted. The model I chose to use is the travel-cost method of valuation. This consists of costs you incur if the site is damaged and you decide to take fewer trips to the site. We can see the benefits people receive from the site, which is Lake Michigan by studying

their demand curves. When looking at Lake Michigan we have to notice that it is a very large lake and there are no other lakes to go to, however certain sites of the lake are more polluted than others and thus can change visitors outcomes on which site to visit. Lake Michigan is more polluted in the Northern Waukeegan Harbor near Wisconsin than it is in Lake Forest Harbor where there is less pollution. Visitors and recreational fisherman are then more inclined to visit Lake Forest Harbor when in fact they were once equally as attractive. Since pollution has increased in Waukeegan recreational fisherman have stopped visiting the site because of the toxins contained in the fish that are harmful to humans. When using the travel-cost method for the use value of recreational areas we have to include transportation costs, the value of the person's time, equipment costs, and entrance fees. Taking a trip to Waukeegan could be cheaper or more expensive for one person than it is for another mainly because sites are in different locations and people value their time differently. Once the demand curves have been estimated for recreational purposes of Lake Forest Harbor and Waukeegan Harbor we have to compare the two and see how the curves shift when pollution increases in Waukeegan Harbor. After industry has contaminated the fish stock in Waukeegan Harbor catch rates decreased and contaminates contained in the biomass of the fish stock increased. These

harmful emissions causes the demand curve for Waukeegan Harbor to shift in and the demand curve for Lake Forest Harbor to shift out. After the contamination recreational users of the lake would rather visit a site with less pollution than a site that contained more pollution. Before the harmful contaminants entered Waukeegan harbor the cost of going to the site for example was \$25 and the amount of trips taken by an individual was 10 and the cost of going to Lake Forest was \$30 and the amount of trips taken by an individual was 5. Consequently after the seepage of the toxins into the Waukeegan site the amount of trips taken decreased to 5 and the amount of trips taken to Lake Forest increased to 7. In turn the area under the curves or the willingness to pay to go to a site has changed. The willingness to pay to visit Lake Forest is higher than it would have been without the contaminants and the willingness to pay to take a trip to Waukeegan is lower than it would have been without the pollution (See graph on next page.) One of the most important things to realize with this travel cost model is the power of substitution to effect an individual decision on what site to visit. The closer the two sites are to matching the amenities both of them offer the less damage will be done once the site is damaged. This means the easier it is Lake Forest Harbor to substitute Waukeegan Harbor less damages will occur.

In order to receive the proper data to construct your demand curves you must sample a random set of users of the lake and ones that have potential to use it. We need to calculate the amount of trips an individual will take to either Waukeegan or Lake Forest throughout the year. To complete the curve we also need to calculate the distance, value of an individual's time, and gas costs to find the total cost of taking a trip to each area. We also need data for the amenities of each site such as catch rates for recreational fisherman and cleanliness of water for other users. These data points will come into a curve that will help you show the willingness of an individual to pay for a site. The data we receive here is called observed trip data, we may also want to use stated preference data when we use hypothetical sites and receive hypothetical answers. This method is useful to create different situations not attainable in the real world that would help us with our model. Have people answer questions on how their trip patterns would change with a change in pollution. However sometimes with hypothetical questions people give hypothetical answers.

By looking at the material balance theory and the travel-cost method of valuation we can see a few major affects that pollution has on our society. It even goes beyond causing people to change locations for recreation. But it is important to notice how behavior is affected by industry dumping harmful

waste into the environment. It can go as far as costing commercial fisherman millions of dollars of lost revenue because a company wants billions more. How do we stop these people from harming innocent people? We attempt to use non-market valuation to get back at the companies and material balance to help clean up. These two events are interrelated and must be recognized together. However when the EPA and other companies involve lawyers there is a big dispute over what non-market valuation and non-use values are. Lawyers for big companies who pollute say they don't exist while from a natural resource economics view they do. Material balance can only help so much, more needs to be done to create a balance mix of emissions dumped into Lake Michigan. Government needs to realize that people are effected even if they don't use the areas polluted and hold companies responsible for their wrong doings.