Clean water bill on the President's desk—again

A presidential veto ignored the fact that the bill asks for much less than the $90 billion it would take to expand sewage treatment systems to accommodate economic growth. David Cherry reports.

Large and rambunctious majorities in the House and the Senate have now passed, for the second time, the Water Quality Bill that President Reagan vetoed in November 1986. The President has the option of signing the bill, or, if he vetoes it, facing its passage by an override. The bill passed provides $20 billion in federal funds over seven years, earmarked mostly for the construction and improvement of sewage treatment plants across the country. It would put an end to, for example, the dumping of raw sewage into New York City's Hudson and East Rivers.

In November, Rep. James J. Howard (D-N.J.), chairman of the House Public Works and Transportation Committee, which wrote the bill, vowed, "We are going to send it right back to the President the way it was passed unanimously by the Congress. There has never been a bill of this magnitude with this type of bipartisan support." And Senate cosponsor Robert Stafford, a Vermont Republican, commented, "If he [Reagan] was dissatisfied with the cost, then he should just wait to see what the Democratic Congress comes up with next year."

The House did pass the bill again in mid-January, by a vote of 406-8. In the Senate, Republican Robert Dole (Kan.) introduced a version whittled down to only $12 billion, on behalf of the White House, with the understanding that the President would sign it if it passed. But the Senate passed the original $20 billion bill 93-6 on Jan. 21. The response by White House Chief of Staff Donald Regan has been to recommend that the President veto it anyway.

Transition to local funding

With a general consensus that sewer systems should be funded only on the state and local level—as before 1972—the bill was designed to make the transition possible under depression conditions of shrinking tax bases and voter resistance to bond issues.

That meant an annual rate of expenditure of $2.4 billion in federal funds during the transition, about half of it in the form of a revolving loan fund. States and cities would draw on the loan fund, and as loans are paid off, the money would be made available to other states and cities. The President's original memo of disapproval specifically rejected the loan fund idea.

Without the $2.4 billion for 1987, fallback legislation would have provided only $1.2 billion—the lowest annual level of federal funding since the original Clean Water Act of 1972. At that level of funding, city and state officials say, many projects would suffer slowdown, and others outright cancellation.

Rep. James J. Florio (D-N.J.) highlighted the connection of the bill to employment levels in a statement issued before the President's veto: "Economic development and expansion, with the creation of new jobs, could be stopped if communities do not make mandated improvements in their sewer systems."

Every state in the union, and the District of Columbia, benefits from the bill under an allocation formula. The federal funds pay for one-third to one-half of many projects.

The bill asks for much less than the estimated $90 billion (in 1982 dollars) it would take to expand and improve sewage treatment systems nationwide to accommodate economic growth. That estimate was part of an *EIR* August 1984 study of U.S. infrastructure needs.

U.S. water infrastructure in crisis

Improving the quality of sewage treatment—the main thrust of the bill—is only one aspect of a broad program

badly needed to reverse the decay and collapse of U.S. water infrastructure.

Major additions to the U.S. water supply through dam-building projects were halted in the 1960s by an Eastern Establishment determined to force cuts in population. Interior Secretary Donald Hodel has just reaffirmed the no-growth policy in a Jan. 24 interview with the *New York Times*. The $16 billion Water Resources Development Act signed by President Reagan in November is a small, but important part of what is needed.

Maintenance and capital improvement of public drinking-water treatment systems and water distribution systems were cut back starting in the 1960s, which led to the present increase in the rate and seriousness of breaks in water mains. The Safe Drinking Water Act signed into law last June, empowering the Environmental Protection Agency (EPA) to set new, stricter standards for drinking water safety, is a step in the right direction. It does leave open the question of whether the municipalities have the ability to pay for attaining the new standards.

The price: waterborne diseases

All three policy failures—lack of major new water supplies, weakening of our drinking-water treatment and distribution systems, and decline of our sewage collection and treatment systems—are contributing to one of the most alarming, but little-known, tendencies in public health: Outbreaks of waterborne diseases have been on the rise in the United States since the beginning of the 1970s.

Giardia, salmonella, and shigella are the agents responsible for the largest identified categories of illness. Giardia enteritis is an infection of the upper small bowel that can result in chronic diarrhea, abdominal cramps, fatigue, and weight loss. Salmonellosis is an acute bacterial infection accompanied by abdominal pain, chronic diarrhea, nausea, and fever, and can lead to deaths among elderly, young, and debilitated persons. Typhoid fever is one kind of salmonellosis. (Salmonella is not limited to waterborne transmission.) Shigellosis, or bacillary dysentery, is a bacterial disease of the large intestine, which is manifest in diarrhea, fever, and nausea, and produces a significant death rate among infants and children. In addition to these three, cholera and such viruses as hepatitis, polio, and adenovirus, are also waterborne.

Individual outbreaks of these and other waterborne diseases in recent years resulted in 5,000 cases of illness in Sewickley, Pennsylvania, in 1975; 8,000 cases in Georgetown, Tx., in 1980; and 16,000 cases in Riverside, California, in 1965.

Data analyzed by E.C. Lippy and S.C. Waltrip of the EPA's Breidenbach Environmental Research Center in Cincinnati, show a clear upward trend in the number of outbreaks from 1971 through 1980, and the same upward trend in the number of cases of resulting illness (**Figure 1**). Lippy and Waltrip conclude, "Outbreaks were under control for the 1951-70 period, whereas the opposite may be said about the outbreaks for 1971-80." (E.C. Lippy and S.C. Waltrip, "Waterborne Disease Outbreaks—1946-1980: A Thirty-Five-Year Perspective," *J. American Water Works Ass'n.*, February 1984, p. 61)

In the five-year period 1981-85, the number of outbreaks and number of resulting cases of illness decreased. The number of outbreaks reported for 1981-85 totals 178, or an average 35.6 per year, compared to 196 outbreaks for 1976-80, an average of 39.1 per year. The number of cases of illness for 1981-85 totals 32,837 (average 6,567 per year), compared to the 1976-80 figure of 50,085 (average 10,017 per year). These figures all underestimate actual outbreaks and cases by about a factor of four, due to underreporting.

Specialists at the Breidenbach Center, aware that there has been no turnaround in the deterioration of our water infrastructure, do not believe that the decrease in outbreaks and cases in the 1981-85 period represents a reversal of the upward trend. "The level of outbreaks in 1981-1985," Steven Waltrip points out, "is still the second-highest since the 1941-1945 period."

The statistics on waterborne disease must not be seen isolated from the reappearance and resurgence nationally of such non-waterborne diseases as tuberculosis, measles, and mumps, or from the AIDS pandemic. Our public health system generally—not just its water system—is failing.

The Village of Delhi case

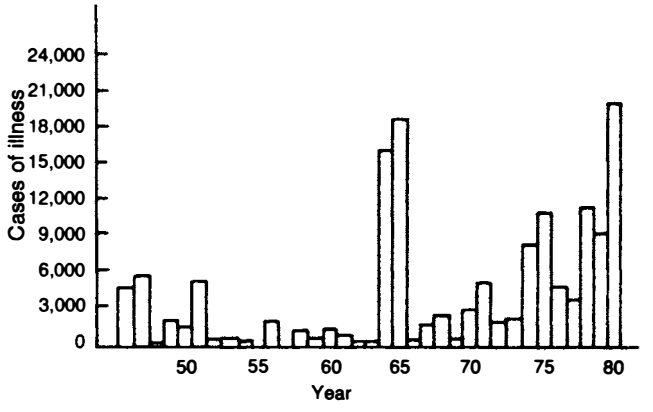
The case of the Village of Delhi, New York, scheduled to be decided as this issue is printed, illustrates with special clarity the seriousness of the public health crisis we face. Delhi, whose treated sewage is discharged into waters that form part of New York City's water supply, is seeking authority to cease disinfection of this wastewater, to cease monitoring the level of fecal coliform bacteria contained in it, and to relax the level of permissible remaining suspended particles. Delhi has a population of about 5,000.

While Delhi argued that chlorine residues are harmful to fish in the Delaware River, its real motivation was purely financial. Fish appreciate raw sewage—or an approximation thereof—even less than chlorine residues. Delhi provided data purporting to show that it was far enough upstream from New York City for the natural self-purification process in streams to be effective, based upon the specious assumption that average conditions always prevail.

The case shows the depth of irrationality to which public authorities can sink in response to unbearable fiscal pressures.

What is remarkable, is that the state Department of Environmental Conservation sided with Delhi, signaling the existence of political pressures throughout rural New York State to allow small towns to save money by curtailing the treatment and fecal coliform monitoring of their sewage.

FIGURE 1
Cases of illness in waterborne disease outbreaks



Source: USEPA, Lippy and Waltrip, February 1987.

There are at least 73 small town sewage plants operating within New York City's watersheds alone, many of them, including Delhi, already in violation—or intermittent violation—of the terms of their existing permits.

The Delhi case dramatically demonstrates that there is much more to the water infrastructure crisis than can be remedied by the $18 billion allocation for sewage treatment plants in the Water Quality Bill now before the President. Delhi does not say that it lacks capital equipment. *Delhi cannot find sufficient operating budget to use even what capital equipment it has!* And there are tens of thousands of Delhis all across the country.

The Delhi application set off alarm bells well beyond the limits of New York City. Supporting New York City's opposition to the Delhi application are the New York State Department of Health, the Environmental Defense Fund, and the American Water Works Association. Among those testifying for New York City are Dr. Abel Wolman, perhaps the world's most eminent specialist and pioneer in sanitary engineering, and Dr. Edwin Geldreich, a senior research microbiologist at the Breidenbach Center. The public health experts have repeatedly emphasized in their testimony that wastewater disinfection is "the first line of defense," and that safe drinking water depends upon erecting multiple barriers to infection. To dismantle one barrier is to play Russian roulette.

If Delhi and the New York State Department of Environmental Conservation prevail, a national wave of similar actions will likely follow. But their defeat will be no cause for comfort either. The seriousness of the small towns' fiscal difficulties will continue to manifest itself in poorer compliance with existing standards, while the state authorities will increasingly lack the funds to monitor and enforce compliance. Only a return to economic prosperity can provide the remedy.

Decline in waterborne disease surveillance

The decline in surveillance of disease outbreaks must be taken very seriously. At the federal level, the Centers for Disease Control report they are getting out of the business of waterborne disease intelligence, and will drop annual publication of statistics reported in this field. That puts the burden on EPA's Breidenbach Center. But Breidenbach has already eliminated its field investigation function.

It may also be that waterborne disease surveillance has been relaxed, in most of the states, since the 1976-80 period. That is suggested by comparing the trend in Pennsylvania and New York, which have active intelligence systems, with the trend in the other 48 states. In the 1976-80 period, a rising trend can be seen in 48 states, parallel to a rising trend in New York and Pennsylvania. But in the 1981-84 period, the level of cases for the 48 drops by 45%, while the level of cases for the other two rises by 75% (**Figure 4**).

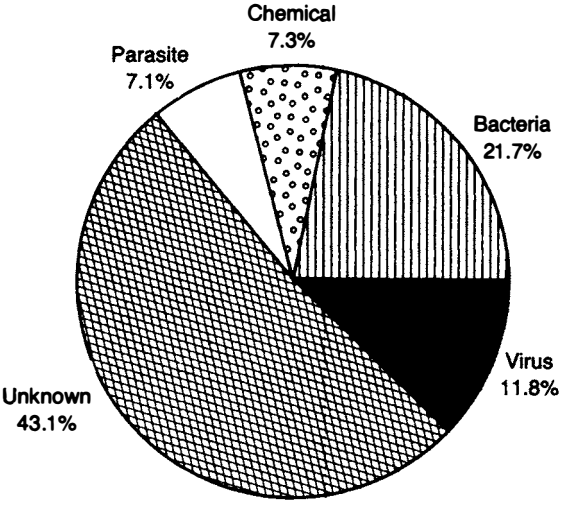
Infrastructure survey

Below is a survey of the distressed condition of the nation's water treatment and water distribution systems, and of its sewage collection and treatment facilities.

Cincinnati as a touchstone

Perhaps the touchstone for assessing our infrastructure is the condition of one of the best of the older cities, Cincinnati.

FIGURE 2
Waterborne disease outbreaks by causative agent



Source: USEPA. Lippy and Waltrip, op. cit.

The Urban Institute's 1979 study of Cincinnati's infrastructure praised the city as

> among the first in the nation to systematically direct its capital planning toward preservation, maintenance, and improvement of existing facilities, accepting the necessity for cutting back on new capital projects if it was to operate within its budgetary limitations. As a result of these measures, Cincinnati's capital plant is in generally good condition compared to those of other older cities. (Nan Humphrey, et al., *The Future of Cincinnati's Capital Plant*. Urban Institute, 1979, p. xv.)

In a nation that should be providing abundantly for a growing population while planning ventures into space, the Institute's very praise constitutes the measure of failure!

If we take the rate of main breaks and leaks as a measure, Cincinnati would appear to be losing some ground (**Figure 5**). A replacement cycle for water pipes of 20-30 years is desirable, but Cincinnati is on a cycle longer than 100 years. (Other older cities are on replacement cycles closer to 1,000 years!) But equally indicative is that Cincinnati's water engineers wish to build a new filtration system, using the leading edge of the technology for drinking-water systems, and cannot do so because there is no money. They have planned a granular activated-carbon filtration system for removing manmade organic compounds. Do we have a future as a nation if we retreat from the frontiers of science and technology?

Shortcomings of drinking water treatment

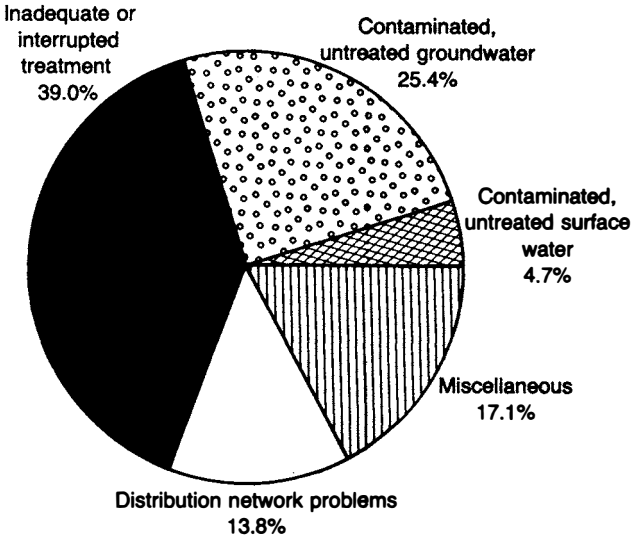
Outbreaks of infection are often traced to the breakdown of equipment or the overloading of one of the processes involved. Outdated or wornout equipment, or equipment insufficient to meet the currently required volumes, is often the problem. There is also the increasing need to build filtration equipment in surface water systems that never needed it before, because of the rising threat posed by the Giardia amoeba. Giardia can survive normal chlorination in cyst form, but filtration eliminates the cysts.

The Safe Drinking Water Act signed into law last June empowers the EPA to set new, stricter standards for drinking water safety, requiring filtration, and not just chlorination. Many municipalities will simply be unable to afford them under current economic conditions. Some 20% of the community water-supply systems in the country are having consistent problems meeting the existing EPA microbial standards for drinking water, according to Jack Sullivan, deputy executive director of the American Water Works Association in Washington, D.C. Almost all of them, he says, are small towns of fewer than 500 people.

The Giardia problem. Giardia is most serious in parts of the country which derive their drinking water largely from surface sources. The Northwest is more vulnerable,

FIGURE 3

Cases of illness by deficiency in public water systems (community and noncommunity only)



Source: USEPA. Lippy and Waltrip, op. cit.

for example, than the arid areas of the Southwest which rely on wells. Almost all cities of any size have had filtration for years, so it is the smaller communities—for whom filtration is an expensive proposition—which are vulnerable.

In Oregon, where 64 community systems have no filtration, several small towns have suffered giardiasis outbreaks, such as Corbett, population 200, in early 1985. A similar pattern of increased outbreaks over the past decade exists in Washington state, in California from San Francisco northward, Idaho, and elsewhere.

Colorado had outbreaks in ski resort areas even 12-15 years ago. Then, after some severe outbreaks two or three years ago, the state imposed a blanket requirement for filtration. There were outbreaks in Massachusetts, only a year ago, in Pittsfield and a small town near Boston.

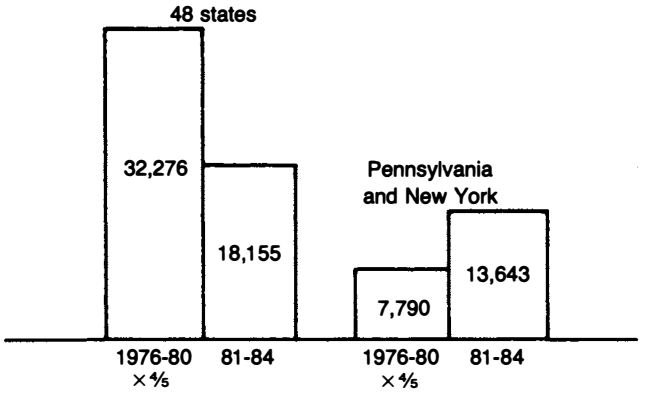
Jim Boydston of the Oregon State Health Division sees the rise in giardiasis outbreaks as a result of the increasing numbers of campers, hunters, and fishermen who are penetrating to the watersheds, since humans are hosts. He also sees the rise as a result of logging operations, since another host, the beaver, flourishes in their wake.

The case of Oregon. Boydston estimates it will take over $100 million to provide filtration for 63 of the 64 Oregon communities lacking it. The 64th is Portland, which has the largest surface water supply in the country that lacks any treatment other than chlorination. Filtration for Portland would require perhaps another $150 million.

These figures must be seen as additional to $200 million

FIGURE 4

Are the states relaxing their surveillance of waterborne disease?



With no relief in sight in the causes of waterborne diseases, the reported number of illnesses dropped 45% for the 48 states. In the two states with active intelligence systems, however, the number of illnesses jumped by 75%. (Tentative figures for Pennsylvania and New York for 1985 were avoided.)

needed over 15 years for the general upgrading of older water supply and distribution systems around the state—reservoirs, transmission pipelines, and treatment plants—according to a 1984 study. Yet more money—amount undetermined—would be necessary to meet all the requirements of the 1986 Safe Drinking Water Act.

The total requirement for Oregon's safe drinking water needs today is clearly over the half-billion-dollar mark. The federal government has never entered significantly into the field of funding safe drinking water. The state itself is in no position to help shoulder these burdens, and they fall squarely upon the communities themselves, many of them too small to even float a bond issue. In Oregon, 60% of the water supply systems serve less than 200 people. Yet the new law requires compliance within five years.

"Our [state] advisory committee has worked on this and has no really good answers," says Boydston. "It's going to be hard."

McKeesport: aging and outdated equipment. The case of McKeesport, Pennsylvania is a warning that aging and outdated filtration systems may also break down. McKeesport, a declining town of 30,000 just outside Pittsburgh, suffered an giardiasis outbreak in 1984. A team from the Army Corps of Engineers had to be brought in to set up an emergency water supply.

Then, in January 1986, a single Giardia cyst was found in the bimonthly test of the treated water. When a larger sample was taken, a few more cysts were found. Since it has not been possible to find what is wrong with the system—which includes filtration—the Water Authority has been adding three times the usual amount of chlorine, 3 mg. per liter, since January. It is enough to deactivate any cyst, but creates taste and odor problems and dries the skin when used for bathing.

Sam Scarfone, the Water Authority's chemist, says the real problem is that the water treatment plant was built in 1907 and is out of date and undependable. "Our settling basins and mixing facilities aren't the best," he says.

The Water Authority has never been able to finance a replacement. Now, the McKeesport system has been bought out by the private Westmoreland Water Authority, which plans to build a new treatment plant.

But McKeesport is not alone. In Cleveland, the Division Avenue water treatment plant built in 1915 was characterized in 1980 as "in very poor and hazardous condition and in urgent need of replacement." The Urban Institute's study of Cleveland's infrastructure went on to say,

> Settling has severely stressed its structural components, causing mechanical failures, leaks, and a partial roof collapse. Since the plant provides 31 percent of the system's treatment capacity, the other three plants could not accommodate current or projected water demand if it were shut down. A new plant will cost a staggering $141 million. (Nan Humphrey, et al., *The Future of Cleveland's Capital Plant,* Urban Institute, 1979, p. 16.)

How many more McKeesports and Division Avenue plants are there across the country today?

Failure of water distribution

The water distribution system extends from the water treatment plant to the household or commercial user. Failures in the distribution system take the form of pipe leakage, constriction of flow, main breaks, stuck valves, and defective or absent meters. Leakage and constriction of flow have serious implications for a city's fire protection, since they reduce water pressure and flow capacity.

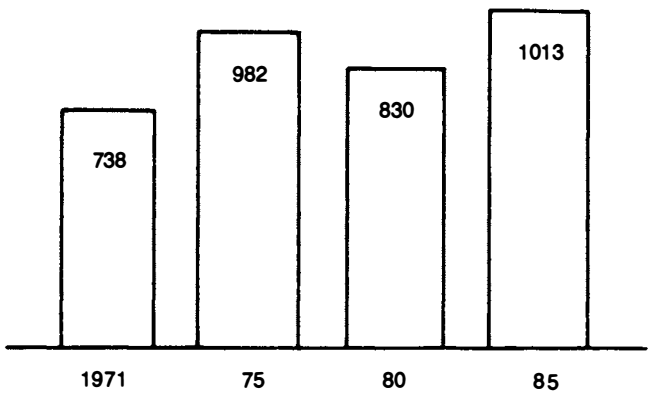
Leakage. The difference between the volume of treated water released into the distribution system, and the volume of metered consumption, constitutes the volume unaccounted for, whether lost through pipe leakage or unmetered consumption. Boston suffers from the worst leakage problem in the country, with a loss of at least 18% of its water between treatment plant and user. But Cleveland, St. Louis, Pittsburgh, and Tulsa suffer losses of 15% or more, by conservative estimate.

Even where water is abundant, the loss of such great percentages of treated water constitutes an effectual reduction in treatment capacity, and an additional treatment cost per delivered gallon.

Leakage is the result of pipe joint deterioration, corrosion, poor construction, shifting of pipes from soil movement, and excessive water pressure, and can be controlled through repair and maintenance.

FIGURE 5

Cincinnati Water Works breaks and leaks repaired, 1971-85



The Cincinnati Water Works serves the city of Cincinnati and about 90% of Hamilton County. The figures indicate a rising rate of breaks and leaks. The year 1971 was used instead of 1970—a strike year.

Source: Cincinnati Water Works Annual Reports

Constriction of flow. Constriction of flow in steel pipes usually takes the form of tuberculation, a form of corrosion in which bumps form over the interior surface of the pipe, reducing its effective diameter. The rate at which tuberculation proceeds depends upon the local water chemistry. Lining steel pipes with cement to prevent tuberculation was introduced in the 1950s, and a method of lining pipes which have already been laid has been developed.

Cleveland provides the horror story of what tuberculation can do in unlined steel pipes. J.B. Gilbert and Associates, consulting engineers, reported in 1977 that tuberculation had "drastically" reduced pipe capacity. Capacity loss in one Cleveland suburb, Seven Hills, had fallen to 23-30% of its original level. The consequent loss of water pressure is spelled out in the Urban Institute's Cleveland study:

> [W]ater pressure frequently falls below the American Water Works Association's suggested minimum of 30 pounds per square inch, and during the worst periods of peak demand, about 400 customers are without service. Because of low pressure, Cleveland has refused service to some new developments in the higher elevation service areas, and several parties have charged in a lawsuit that insufficient pressure in fire hydrants contributed to the destruction caused by a major fire. (Nan Humphrey, et al., p. 17.)

In addition to tuberculation, other causes of Cleveland's low pressure and flow capacity problems are inadequate pumps and undersized mains.

Buffalo provides another example of drastic consequences as a result of tuberculation.

Main breaks and stuck valves. Main breaks are on the increase in older sections of systems, in the absence of adequate replacement programs, although statistics are not available to quantify the trend. But high main break rates are also found in portions of systems of relatively recent date, where construction was shoddy. Cincinnati Water Works officials, for example, see an increase in main breaks in the older, city section of their regional system, but the trend is masked in the regional statistics.

To compound the problem of main breaks, the marked deterioration in the condition of valves makes the *consequences* of breaks much more serious. When a stuck valve prevents the engineer from shutting off the flow above the break, the price can be high, as recent events in Salem, Massachusetts and New York City attest.

A 30-inch main supplying Salem broke Nov. 21, 1986. Because the valve that could have diverted the flow to another line was stuck, almost all of the 10.5 million gallons in the city's large reservoir drained away before the flow could be stopped. Paul Niman of the Salem Public Works Department commented, "We try not to create panic in the public, but boy, these older systems are in tough shape, and no city could be in worse shape than Salem."

If Salem is worse than Boston, New York City, and Cleveland, then it is in very bad shape indeed. One month later, on Dec. 19, a 36-inch main in New York City ruptured and flooded six subway stations with five million gallons of water, because the valve above the break was stuck open. It took eight hours to shut off the rupture. At rush hour, 120,000 subway riders were stranded until a fleet of 30 buses began a shuttle service around the affected area.

Sewers and sewage treatment plants

The EPA's biennial sewers and sewage treatment needs survey for 1986 is due to be published at the end of February 1987, and "the numbers are supposed to be pretty traumatic," according to Senior Staff Associate Mark Popovich, at the Council of State Planning Agencies in Washington, D.C. Indeed, if the "numbers" are to reflect the reality that has been emerging over recent years, they must be traumatic.

A National League of Cities survey of 800 cities, summarized in an early 1983 publication, indicates that in almost 35% of these cities, wastewater treatment facilities need major work; in 65%, storm water collection and drainage systems are deteriorating. A significant percentage of cities surveyed indicated that infrastructure facilities needed to be totally replaced.

Inadequate maintenance is one of the primary reasons for violations of sewage treatment standards; aged, obsolete facilities is another cause.

One-half of the nation's wastewater treatment systems are operating at full capacity (80% or more) and cannot sup-

port further economic expansion.

Since at least 1970, a constant 29% of the growing U. S. population continues without the benefit of sewer systems, relying instead on riskier septic tanks (*Statistical Abstract of the United States* 1985, p. 200).

Sewage collection. The problem of breaks in sewer pipes is getting worse in the older cities: New York, the Eastern Seaboard, and the Great Lakes cities, according to Martin Tiemens, Deputy Director of the Municipal Services Division of EPA. Most cities do not have good data on the condition of their sewers. Some do not even have maps of all their pipes.

In older cities, domestic sewage and storm water are carried away in the same pipes, leading to overflows of raw sewage into rivers and bays when heavy rains exceed the capacity of the system. The pipes also frequently release raw sewage when the gates and valves in these old systems become stuck open, and are not detected. There has been dramatic progress in eliminating combined sewers since the Clean Water Act became law in 1972. Yet the EPA Needs Survey for 1984 shows a population of 44 million is still served by combined sewer systems. More than half of the work to be done is concentrated in six states: New York, Illinois, Massachusetts, Pennsylvania, Ohio, and Indiana ($14 of $23 billion).

Adequate sewage collection and treatment is vital for public health. Among the waterborne diseases are cholera, hepatitis, salmonella, and typhoid. Providing sewers in unsewered areas eliminates the most serious threat to public and private underground sources of water. The requirement of secondary treatment for wastewater—i.e., elimination of 85% of conventional pollutants—typically eliminates more than 90% of bacteria.

Crisis management and selective investment

As of now, the infrastructure crisis is being approached only on the basis of crisis management and selective investment. The legislation passed in the last seven months is still within that context, useful though it is. In the name of that approach, the National Council on Public Works Improvement was established in late 1985 under a mandate from Congress, and issued a report, *The Nation's Public Works—Defining the Issues* last September. The Council essentially consists of tax-exempt bond salesmen and government representatives. Executive director Nancy Rutledge explains that the Council has no mandate to gather new information on the condition of infrastructure, and "sees no further value in a call to arms." The Council is instead "seeking a better methodology for appraising needs."

But the bacteria and the parasites and the viruses have no respect for selective investments. Nothing less than the creation of cheap new credit for production—in the manner and scale of our gear-up for World War II—will rebuild America's infrastructure.

Testimony: Dr. Abel Wolman

The importance of a worst-case scenario

The following is an excerpt from the Oct. 17, 1986 testimony of Dr. Abel Wolman, In the Matter of the Application of the Village of Delhi, *before the New York State Department of Environmental Conservation. Dr. Wolman is an internationally distinguished pioneer in sanitary engineering and professor emeritus at Johns Hopkins University, Baltimore, Maryland. The treated sewage of the Village of Delhi, population 5,000, is discharged into waters that form part of New York City's water supply. However, the village is seeking authority to stop disinfecting this wastewater, to stop monitoring the level of fecal coliform bacteria contained in it, and to relax the level of permissible remaining suspended particles. The village has made various arguments on behalf of this desire, but clearly, the motivations are purely financial. Dr. Wolman was asked about the potential public health consequences.*

New York City policy requires that all sewage treatment plants disinfect effluent which enters New York City's water supply. The logic of this requirement is inescapable. Sewage represents one of society's most potent sources of human pathogens, and its disinfection represents a proven prophylactic measure which has saved millions of lives. . . .

New York City's demand for continued disinfection of all sewage plant discharges in its watershed is reasonable. Alternatives to chlorination could be supported where such alternatives are at least as effective, reliable, and enforceable as established chlorination practices. The DEC's [Department of Environmental Conservation] proposal contains no consideration of alternative disinfection methods. Significantly, it also fails to take into consideration the consequences of a worst-case scenario.

Q: What is the rationale for using a worst-case scenario in assessing proposals of this type?

Dr. Wolman: One should never lose sight of the occurrence of unexpected natural and man-made accidents which materially disturb the management success! Dependence upon the "average" conditions is always fraught with danger, since average behavior of a river conceals the high importance of floods and droughts. The consequences of nature's misbe-