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96th Congress
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COMMITTEE PRINT

COMBINED SEWER FLOODING AND POLLUTION—A NATIONAL PROBLEM

SEARCH FOR SOLUTIONS IN CHICAGO

COMMITTEE ON GOVERNMENTAL AFFAIRS

UNITED STATES SENATE

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LETTER OF TRANSMITTAL

U.S. SENATE,
COMMITTEE ON GOVERNMENTAL AFFAIRS,
Washington, D.C., March 19, 1979.

Hon. ABRAHAM RIBICOFF,
Chairman, Committee on Governmental Affairs,
Washington, D.C.

DEAR ABE: Many of America's large, older cities are today faced with a serious problem involving their deteriorating sewerage systems, and the Federal Government response, to date, has been inadequate. Urban centers such as Boston, New York, San Francisco, and Chicago have combined sewer systems—one pipe for both rainwater and human waste. As the cities have grown and aged, sewer systems have become antiquated and inadequate, resulting in sewer backups and overflow, and widespread pollution.

Metropolitan Chicago's problem—one of the most severe in the country—has become something of a national prototype, and has been treated accordingly by the Federal Government. To remedy its situation, the Metropolitan Sanitary District of Greater Chicago has devised a system of tunnels and reservoirs to be built under the city. The project, known as the tunnel and reservoir plan (TARP), was designed as a two-phase operation which would literally "bottle a rainstorm" and thus relieve the flooding and increased pollution which normally occur during a rainstorm.

But problems have plagued TARP from the start. Although construction began in 1975, only 37 percent of the contracts have been awarded. The project's estimated cost rose from an original $1.2 billion figure to $7.8 billion in 1977, and current projections indicate that the project may cost well over $11 billion by the time it is completed. Cost overruns of 40 percent are common, and the Corps of Engineers has indicated that it will not fund TARP's flood control portion. And, even if the project were completed, it would not be operational until the 1990's.

Cities around the country, including several in the Northeast, are looking to Chicago's cost solution as a guide to dealing with their own combined sewer problems. Some Federal officials have estimated that TARP-like projects in affected cities could cost the Nation hundreds of billions of dollars. Obviously neither the Federal nor the local governments have the resources to fund such operations.

At my request, the U.S. General Accounting Office has been looking at the Chicago situation. This review is consistent with our committee's mandate to inquire into areas of possible mismanagement and waste, and into affairs involving intergovernmental actions. In its soon-to-be-released report, a six-volume study entitled "Combined Sewer Flooding and Pollution—A National Problem: The Search for Solutions in Chicago," the GAO concludes that massive projects such as TARP are simply not worth the cost. In the absence of large-scale

solutions, the study describes small-scale technologies which are available as alternatives to affected communities and to individual homeowners. The report also delineates funding problems faced by communities and offers suggestions for obtaining limited relief.

The Comptroller General, Elmer Staats, who has taken a personal interest in this GAO study, believes that the report—scheduled for mid-April release—will be of national significance. Because of the widespread interest in the topic and in anticipation of great demand for copies of the study, Mr. Staats suggested to me that three of the study's volumes be printed as a Governmental Affairs Committee print; specifically, the report's Executive Summary, the section on "funding problems" faced by communities, and the chapter on "What the Community and the Homeowner Can Do Now" will be of considerable interest and use to communities and individuals across the country. I concur in this excellent recommendation, and hope that you agree, too. Because of the relatively short time we have before release, we need to make appropriate arrangements as soon as possible.

In view of the potential intergovernmental impact of this matter, and in view of the critical need to promote better management of Federal, State, and local resources, I believe that our contributions in reproducing these reports for widespread distribution will assuredly be in the public interest.

Warm personal regards,

CHARLES H. PERCY.

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REPORT BY THE

Comptroller General

OF THE UNITED STATES

Combined Sewer Flooding And Pollution -- A National Problem. The Search For Solutions In Chicago: An Executive Summary

Volume 1 Of Six Volumes

In older cities, like metropolitan Chicago, where storm and sanitary sewers are combined, heavy rains cause sewage to back up in basements and pollute waterways. To alleviate the problem in Chicago, an improvement plan has been developed which could cost as much as $11 billion. The pollution control phase is under construction at a cost of $2 billion. Funding has not been found for flood control, local sewer improvements, and most associated projects.

Illinois officials and the Environmental Protection Agency disagree on whether the pollution control phase will meet the State's lowest water quality goal. GAO recommends that the Environmental Protection Agency suspend funding of the pollution control phase until it can be reassessed.

Whether the plan is completed or not, many local communities need to upgrade their sewers. Yet they are frequently unable to find the funds, either locally or from Federal or State agencies. GAO has identified a number of less expensive measures that communities or homeowners can take to alleviate flooding.



FOR RELEASE

THURSDAY MAY 17 1979 PM

CED-79-77

MAY 15, 1979

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-166506

The Honorable Charles H. Percy
United States Senate

Dear Senator Percy:

This report, prepared in response to your request of March 9, 1978, discusses the combined sewer pollution and flooding problems in the Chicago metropolitan area.

The report highlights the current status and impact of the Chicago Tunnel and Reservoir Plan; profiles the extent and location of flooding and damage in the Chicago metropolitan area; summarizes the limited availability of funds to correct the problems; and, in the absence of such funding, describes several alternatives for local communities and individual citizens to consider.

As arranged with your office, the report is being issued in six volumes. Volume 1 contains an executive summary of the entire report, including our conclusions and recommendations to the Environmental Protection Agency and the Corps of Engineers.

Also as agreed with your office, after you publicly announce its contents, we will furnish copies of this report to the Chairmen, House Committee on Government Operations, House and Senate Committees on Appropriations, House Committee on Public Works and Transportation, and Senate Committee on Environment and Public Works. Copies will also be sent to interested Members of Congress and the Federal agencies concerned with the matters discussed in this report.

The Chairman of the Senate Committee on Governmental Affairs, of which you are the Ranking Minority Member, has agreed to publish as Committee Prints Volume 1--executive summary, Volume 4--funding for local flooding problems, and Volume 5--what can be done to minimize or eliminate urban flooding, for subsequent distribution to interested parties.

B-166506

Appropriate sections of the report were discussed with the agencies involved and their comments were considered in the preparation of the final report.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

PREFACE

At the request of Senator Charles H. Percy, GAO has reviewed the pollution and flooding problems in the Chicago metropolitan area served by combined sewers. This volume, the Executive Summary, includes an introductory section on the flooding and pollution problem in the Chicago metropolitan area and background information on the Tunnel and Reservoir Plan; synopsizes information in the other volumes; and contains our conclusions and recommendations.

In addition to this volume, our report includes five other volumes which address the following areas:

Volume	Description
2	The Tunnel and Reservoir Plan: Its Status and Impact--describes the plan's current construction and funding status; its impact on pollution and flooding in the combined sewer area; and the environmental concerns expressed about the plan.
3	A Profile of Urban Flooding in the Chicago Metropolitan Area--describes the flooding problem in the combined sewer area, including the extent of the problem (flooding of basements, streets, viaducts, etc.); estimated flood damages; and injuries, deaths, and health problems.
4	Funding for Local Flooding Problems is Extremely Limited--summarizes the availability of Federal, State, and local funds for projects to alleviate flooding.
5	What Can Be Done to Minimize or Eliminate Urban Flooding?--describes the actions local communities and homeowners can take to prevent flooding.
6	A Synopsis of the Flooding Problems for Each of the 54 Chicago Area Communities--contains 54 summaries and descriptive maps of the flooding experienced; actions planned or taken by the communities and residents to alleviate or mitigate the problems; and anticipated impact of the Tunnel and Reservoir Plan.

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ABBREVIATIONS

Corps	Army Corps of Engineers
EDA	Economic Development Administration
EPA	Environmental Protection Agency
GAO	General Accounting Office
HUD	Department of Housing and Urban Development
MSD	The Metropolitan Sanitary District of Greater Chicago
TARP	Tunnel and Reservoir Plan

GLOSSARY

Catchbasin	A chamber or well, usually built at the curbline of a street, for the admission of surface water to a sewer or subdrain, having at its base a pit designed to retain grit and debris below the point of overflow. The entrance to the catchbasin is through a grate and/or a curb opening. The purpose is to prevent sewer clogging by trapping coarse debris and to prevent odor emanations from the sewers by providing a water seal.
Check valve	A device installed in the sewer line between the house and street or in the house sewer line under the basement to prevent water from backing into the basement. Some valves close automatically when the flow through the sewer line reverses. Some are mechanically operated by control devices and some are manually operated.
Combined sewers	A sewer system composed of sewers which receive both municipal sewage and stormwater runoff from roofs, streets, ground, etc.
Drain plug	A device installed in floor drains to prevent water from backing up from the drain.
Infiltration	The water entering a sewer system and service connections from the ground, through such means as defective pipes, pipe joints, connections, or manhole walls.
Instream aeration	The circulation of oxygen in water to aid in purification.
Interceptor sewers	The collection system that connects main and trunk sewers with wastewater treatment plants.
Overbank flooding	Flooding that occurs when a river, stream, etc., overflows its banks.

Overhead sewers	A system in which all wastewater from above the street level in the house flows by gravity to the street sewer, but all wastewater and seepage collected in the basement is pumped up to the overhead sewer. The force of gravity and, ultimately, a check valve between the basement and the sewer system prevent backup from the street sewer system.
Outfall	The place where an effluent is discharged into receiving water.
Restrictor	A device placed in catchbasins to limit the rate of flow of water into the sewer system.
Separate sewers	A sewer system composed of sanitary sewers which carry only domestic and industrial sewage and storm sewers which carry only storm runoff.
Sludge	The solid matter removed from wastewater through treatment. Sludge handling involves the processes that remove solids and make them ready for disposal.
Standpipe	An open-ended pipe inserted tightly into a drain which serves as a reservoir to capture minor backups.
Sump pump	A device which pumps out water that accumulates in a basement sump pit.

SECTION 1

INTRODUCTION

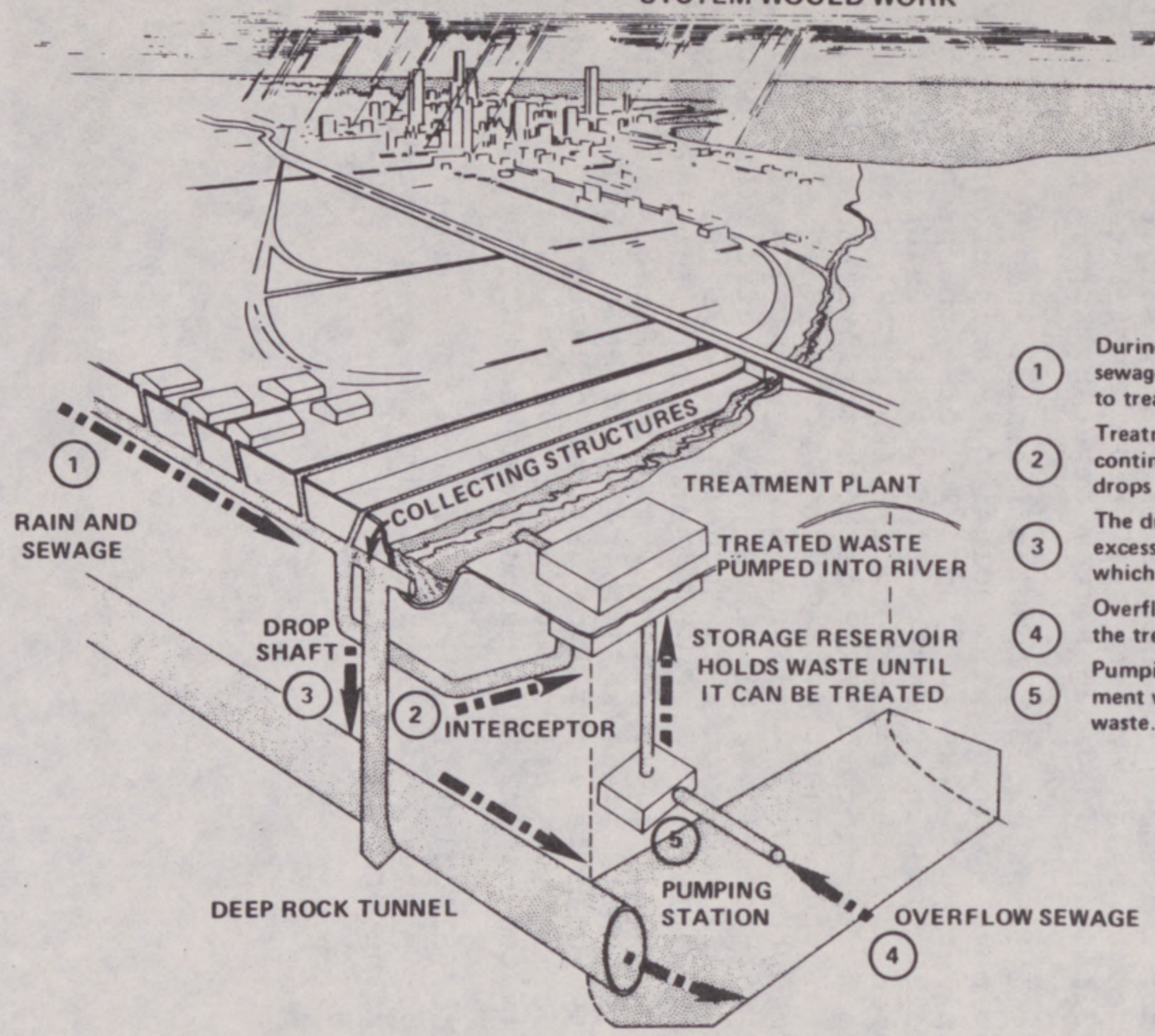
When heavy rains hit cities where storm and sanitary sewers are combined, residents may find their basements, streets, and waterways flooded with raw sewage. This flooding causes millions of dollars of damage each year--and untold pollution, inconvenience, and disgust.

Among the hardest hit areas in the United States is metropolitan Chicago. In the last 5 years, single-family homes in the combined sewer area suffered an estimated $71 million to $102 million in damages from sewer backups.

Citizens groups, local officials, and the Federal Government have long sought a solution to this problem. But remedies are not easy to find. To solve the problem the Metropolitan Sanitary District of Greater Chicago (MSD) has developed a Tunnel and Reservoir Plan (TARP) to literally "bottle a rainstorm." TARP is both massive and expensive. It is one of the largest public works projects in the Nation and its projected costs will probably exceed the $9.2 billion expended for the Alaska pipeline. If completed, TARP would comprise 131 miles of rock tunnels, 9 to 36 feet in diameter, and ranging 150 to 290 feet below ground. In addition, drop shafts, collecting structures, pumping stations, and three open-pit-type storage reservoirs would be constructed. Total capacity would be 44 billion gallons of water, or enough to fill 4.4 million railroad tank cars which would stretch approximately 1-1/2 times around the earth.

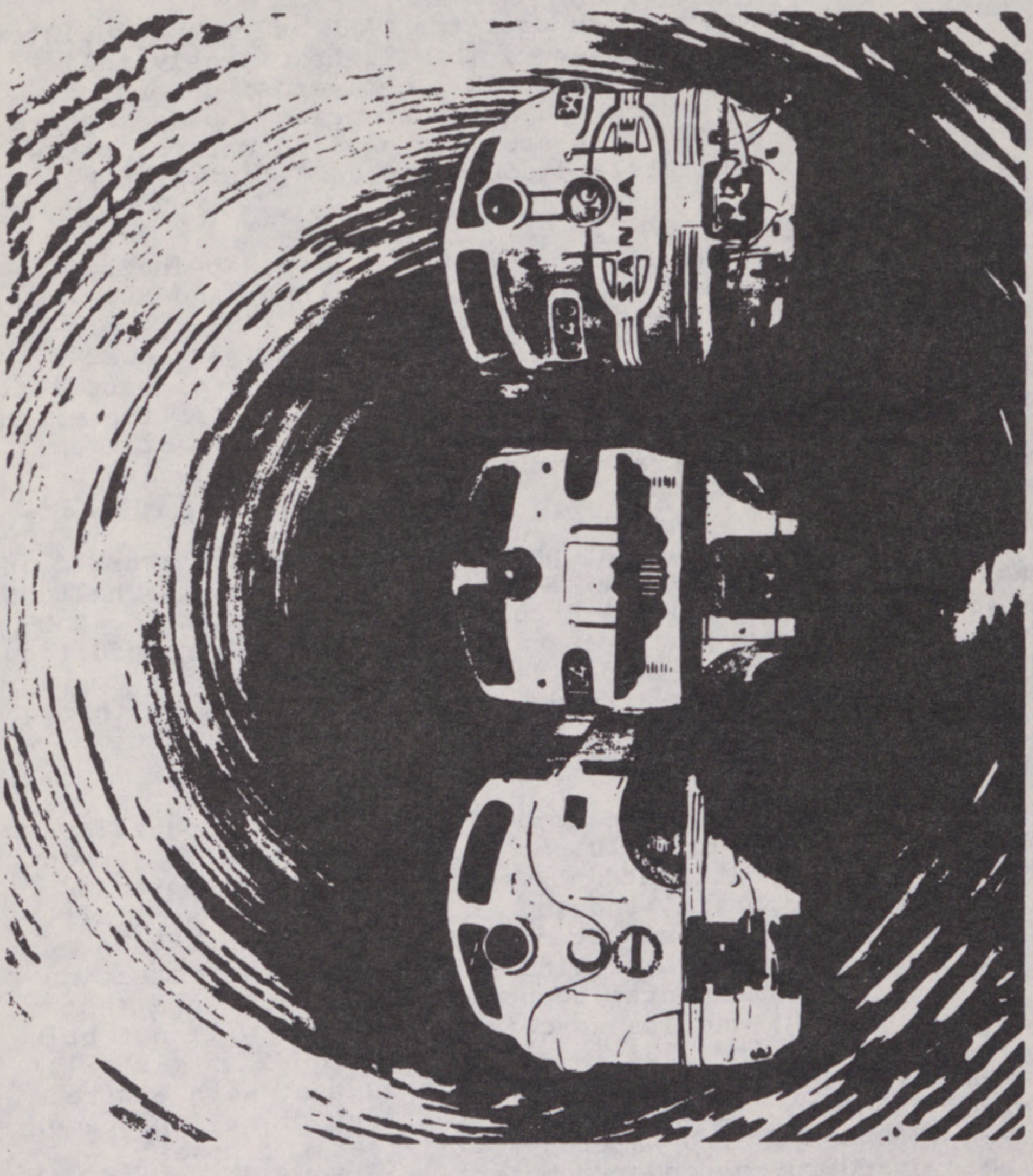
The following illustrations show how such a tunnel and reservoir system would work and gives a perspective on the size of the project.

HOW A TUNNEL AND RESERVOIR SYSTEM WOULD WORK



1. During heavy storm, rainwater runoff and sewage mix and Sanitary District is unable to treat all the waste.
2. Treatment plant, fed by interceptor pipe, continues to treat sewage, while overflow drops to tunnel.
3. The drop shaft funnels the mixture of excess runoff and sewage to tunnel system which conveys it to the reservoir.
4. Overflow sewage is held in reservoir until the treatment plant can process waste.
5. Pumping station draws sewage for treatment when facilities can handle the waste.

SOURCE: THE CHICAGO DAILY NEWS, CHICAGO, ILLINOIS



SOURCE: THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

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TARP alone will not be enough to solve the pollution and flooding problem. Other associated projects must be implemented. These include upgrading treatment plants, instream aeration, widening the Chicago Sanitary and Ship Canal, and extensive upgrading of the sewer collection systems in many of the 54 combined sewer communities.

Determining the precise cost for TARP and the associated projects is difficult. However, it will be expensive--$4 billion to $8 billion (December 1977 estimates) depending on what estimates are used and which associated projects are included in the total. If history is any indication, costs will continue to escalate and could exceed $11 billion by 1983.

TARP is a two phase project. Phase I, now being built with U.S. Environmental Protection Agency (EPA) and MSD funds and expected to be operational by June 1987, is primarily intended to solve water pollution problems caused by combined sewer overflows with limited flood control benefits. Phase I is currently estimated to cost about $2 billion with EPA funding around $1.5 billion and MSD about $0.5 billion. As of January 1979 contracts covering $0.7 billion have been awarded.

EPA officials said that phase I contracts are awarded in somewhat complete segments. Thus, if the project was halted for any reason it would not become a "white elephant." However, to make the segments operational would require additional expenditures. If it were decided to award no further contracts other than those already awarded ($735 million through January 1979), approximately $400 million more would be needed to make these segments operational.

Phase I is expected to reduce combined sewer overflows from approximately 100 to 10 per year and capture 75 percent of the untreated pollutants now entering the area waterways. There is some confusion, though, as to whether phase I will meet water quality goals. It depends on which goals and whom you are talking to. EPA, Illinois Environmental Protection Agency (State environmental agency) and MSD all agree that TARP (both phases) and its associated projects will not bring area waterways to the 1983 interim Federal goal of fishable/swimmable waters. EPA, however, believes that with instream aeration (funded by Illinois) and treatment plant improvements (as yet unfunded), area waterways will meet the lowest Illinois standard--secondary contact 1/ only. The State

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1/See page 13 for definition of secondary contact.

environmental agency disagrees with EPA and believes that the entire program, including phase II, must be implemented if the minimum Illinois water quality goals are to be met.

Phase II is expected to reduce flood damage costs by 65 percent, decrease combined sewer overflows from 10 per year to 4 in 25 years, and eliminate backflows into Lake Michigan. Local sewer improvements--if the communities could afford them--are expected to alleviate the remainder of flooding problems. However, phase II has not yet been funded. Likewise, money for local sewer upgrading, estimated in 1977 to cost $1.6 billion, is extremely hard to come by, as is funding for some of the associated projects. The question arises, can the country afford to spend $11 billion in one city, when other cities also have serious combined sewer problems requiring large expenditures. The nationwide problems caused by combined sewer systems will be further addressed in an upcoming report. At that time we will discuss in greater depth the economic issues involved.

The following table synopsizes the project, its cost, and anticipated benefits.

TARP I, II, and Associated Projects--Basic Information

Item	Estimated Cost	Performances
TARP I - PHASE I		
109.6 miles of tunnels, pump stations, drop shafts, and collecting structures. Capacity 2 billion gallons.	a/$1.999 billion	Reduces combined sewer overflows from 100 to 10 per year, captures 75 percent of pollutants entering waterways. Little impact on flooding or frequency of backflows into Lake Michigan.
TARP - PHASE II		
21.5 miles of tunnels, increased pump capacity, and open storage reservoirs. Capacity 42 billion gallons.	b/898 million	Reduces combined sewer overflows from 10 per year to 4 in 25 years. Eliminates backflows into Lake Michigan. Reduces flood damage about 65 percent.
ASSOCIATED PROJECTS		
Treatment plant expansions and improvments		
Constructing one new treatment plant, increase capacity at two others and upgraded processes at all plants.	a/1.091 billion	Treatment capacity expanded. Water quality ammonia standard violations would be significantly reduced.
Instream aeration		
Will provide 165,300 pounds of oxygen a day.	c/32 million	Artificial addition of oxygen allow Illinois' dissolved oxygen standard to be substantially met.
Upgrading local sewers	d/1.583 billion	Local combined sewer upgrading needed to ease the 35% flooding damage not relieved by TARP I or II.
Solids utilization	d/156 million	Increased sludge processing capacity.
Dredging, channel widening, and associated works	d/248 million	Needed to insure proper operation of TARP.
ENGINEERING, DESIGN, SUPERVISION AND REVIEW	d/640 million	Estimated for TARP and associated projects.
INTEREST DURING CONSTRUCTION	d/1.892 billion	Represents cost of funds provided during construction for all projects.
All phases - total	$8.539 billion	

a/MSD Estimate January 1979.
b/MSD Estimate 1976.
c/MSD Estimate December 1977.
d/Corps Estimate December 1977.

While EPA and the State environmental agency disagree on whether phase I, when it is completed in 1987, will meet the Illinois water use goals, they do agree that phase I will have only limited impact on flooding and backflow frequency. Phase I, however, should reduce the pollutants in the backflows. Citizens with water in their basements want something done now--not sometime in the 1990s.

Fortunately, the situation is not hopeless. Although massive expenditures may not be cost effective, communities and homeowners have at their disposal less expensive options to relieve flooding. These range from "home remedies," such as disconnecting downspouts and installing drainplugs or standpipes, to preventive measures, such as regular maintenance of sewer systems. While such procedures will not provide a total solution to urban flooding, they could go a long way towards easing it.

SECTION 2

WHAT CAUSES FLOODING

Urban flooding occurs when rain falls so rapidly that the conveyance systems (sewers, rivers, drainage ditches, etc.) are unable to carry it away. The water must go somewhere, so it overflows onto streets, viaducts, and lowlands; spills into rivers and streams; and--where storm and sanitary sewers are connected--backs up the wrong way into basement drains, toilets, and laundry tubs. Rivers and drainage ditches in turn may brim over into the community.

Unfortunately, it is inefficient to build a sewer system that will handle the heaviest storm imaginable, so some flooding is inevitable. When designing a sewer system, a community must decide how often it is willing to put up with floods. Generally, the most benefit per dollar is derived from a system that protects against the 5 to 10 year storm. 1/ For example, a recent study to upgrade Evanston's sewers projected the following cost/benefit relationships.

Protection against average storm (years)	Estimated project cost (millions)	Cost per dollar of benefit
1	$35.7	$1.94
5	43.6	.74
10	45.7	.71
25	50.0	.74
100	54.3	.79

The consulting firm recommended protection against the 10-year storm as most cost beneficial. Naturally, storms do not occur with predictable regularity, so a 10-year storm might occur three times in 10 years or never in half a century. Most sewer systems in the Chicago area have been designed to handle a 5-year storm which amounts to 1.8 inches of rain per hour. If an area receives heavier storms, flooding is inevitable.

1/A storm of an intensity that normally occurs once every 5 to 10 years.

COMBINED SYSTEMS AGGREVATE THE PROBLEM

In older cities like Chicago, rain from the streets and sewage from homes and businesses flow into the same conduits. Thus, the sewers are already 10 to 15 percent full when rain starts, whereas under separate sewer systems the storm sewers would be empty until rain begins. When the heavy rains fall, the mixture of storm water and raw sewage can back up into basements and overflow into local waterways.

Since modern sewer systems separate street and sanitary sewers, flooding, when it does occur, usually involves storm water and not sewage.

TIME TAKES ITS TOLL ON SEWERS

Many combined sewer systems were built in the early 1900s. The population has grown since then, increasing the flow of sewage, and much once-open ground has been paved, slowing the absorption of rain. Sewer construction has not kept pace, and systems that were designed to handle a 5-year storm cannot now do so.

Not only have communities failed to build new sewers, but many have not maintained the original ones. Regular clearing of tree roots, silt, and other obstructions has been neglected. Pipes have deteriorated and broken.

Of the 54 communities in MSD's combined sewer area, 30 have sewer systems that are considered fair, poor, or inadequate. Evanston's is a prime example of an inadequate system. According to an Evanston official, "Everytime it rains, it floods somewhere in Evanston's system."

SOME HAVE PROBLEMS, OTHERS DO NOT

Basement backup problems are indiscriminate. Within the same area, some residences may experience basement backup whereas others may not. Why? There are various reasons why this occurs, including:

--The condition of the sewer system in a specific area of the community. For example, one area may have a system that has deteriorated substantially and thus is unable to convey even a fraction of its designed capacity.

--The topography of an individual's property. One person's house may be elevated or the land may slope in a manner that prevents basement backups.

--The condition of the sewer lines between residences and the community's sewer lines. Individual lines, particularly if they are clay tile, are susceptible to blockage from tree roots and general deterioration.

--The adequacy of the resident's basement construction. Some basements have not been properly constructed to prevent seepage from wall and floor cracks.

--The protective devices installed by the resident. Some residents have installed devices, such as standpipes, check valves, and overhead sewers, which prevent water from entering their basements.

HOME SYSTEMS ALSO CAUSE BACKUPS

Inadequate public sewers cannot be entirely blamed for basement flooding. Often, the problem is in the individual building, where flooding can result from

--obstructions in the lines to public sewers,

--seepage through cracks in poorly constructed walls and floors,

--leakage through window wells and doors,

--malfunctioning of flood control devices installed by residents,

--burst pipes or defective water heaters, or

--power failures which prevent flood control devices from functioning.

SECTION 3

THE TUNNEL AND RESERVOIR PROJECT--AN UPDATE

TARP phase I is designed to primarily solve the area's waterway pollution problem; phase II, the flooding problem. The project has been controversial from the start. MSD believes it is the most cost-effective solution to the area's problem. Critics claim it is a grandiose project, of such expense that the country cannot afford it. Opinions vary on how well it will work.

WHEN TARP WILL BE COMPLETED

The planning and construction of phase I is progressing with EPA funding about 75 percent of the cost. By January 1979, approximately 14 miles of the 109 miles of tunnels had been excavated. Contracts covering 37 percent of the project's estimated $2 billion cost have been awarded.

As with most large projects, delays have occurred. MSD currently estimates that phase I will be fully operational in June 1987. This represents a 6-month slippage since September 1978.

Whether phase II will ever be built is questionable. MSD originally looked to the Army Corps of Engineers (Corps) to include this phase on its list of projects for congressional approval. The Corps concluded in February 1977 that it could build certain portions of TARP, primarily phase II. However, in January 1978 the Department of the Army and the Office of Management and Budget concluded that the Corps cannot build structures that convey sanitary sewage or storm runoff, or a combination of sanitary and storm sewage, to a treatment facility.

Subsequently, the Congress, in Public Law 95-482 approved October 18, 1978, appropriated $1 million for the Corps to begin studying the flood damage reduction portion of TARP. By September 1979, the Corps expects to have a plan of what should be studied. While the study has not yet been fully defined, the Corps plans to use the proposed TARP phase II tunnels and reservoirs as a basis of comparison with other alternatives. The study itself would be performed next and would require additional appropriations. The Corps estimates that the study will cost $8 million to $12 million and that it could take 5 years to complete.

HOW MUCH TARP WILL COST

No one knows how much TARP will cost, except that it will be expensive. In our previous report 1/ the Corps, as of December 1977, estimated capital costs for TARP and associated projects at $7.9 billion. 2/ MSD disagreed and estimated it at $4.0 billion.

The difference is primarily caused by whether certain associated projects and interest during construction are included. MSD's estimate did not include those factors. The Corps included the associated projects since TARP will not meet its goals unless they are completed.

Even these figures are probably understated because of inflation. Inflation by itself could drive the cost of TARP and associated projects beyond $11 billion by 1983. Yet, this may be low since we assumed that phase I projects not under contract could be completed for current estimates. Further, we found that large construction projects are often underestimated. 3/

Not only are TARP and associated projects capital intensive, but also they will be expensive to operate and maintain. In 1975 the Corps estimated additional annual operating and maintenance costs at $56.0 million for TARP and associated projects. This estimate included $17.5 million annually to operate phase I and II tunnels and reservoirs. The remaining $38.5 million would be costs associated with operating treatment plants and sewer and conveyance systems and disposing of sludge. MSD did not estimate operating and maintenance costs for associated projects; however, it feels that operating both phases of TARP would cost about $14 million, or $3.5 million less than the Corps estimate.

1/"Metropolitan Chicago's Combined Water Cleanup and Flood Control Program: Status and Problems" (PSAD-78-94, May 24, 1978).

2/In October 1978 the Corps revised its estimate to $8.2 billion for capital costs of TARP and associated projects.

3/"Lessons Learned From Constructing the Trans-Alaska Oil Pipeline" (EMD-78-52, June 15, 1978).

WHETHER WATER QUALITY GOALS WILL BE MET IS QUESTIONABLE

Whether phase I, currently under construction, will enable the area waterways to meet the Nation's water quality goals depends on which goals are referred to and whom you are talking to. The two goals involved are:

--The Federal goal contained in the Federal Water Pollution Control Act, as amended, which provides for an interim national goal, wherever attainable, of water quality that provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water (fishable/swimmable).

--Illinois less stringent water use goal provides that, as a minimum, all waterways should permit secondary human contact and permit indigenous aquatic life to exist. Secondary contact water use is one in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal. This water use would not allow swimming but would protect indigenous aquatic life and allow recreational uses such as boating, fishing, and shoreline activities.

All agencies involved agree that even with both phases of TARP, most area waterways cannot meet the 1983 national goal of fishable/swimmable waters. They do agree that with phase II, the Illinois secondary contact standard would be met at all times. Disagreement exists, however, on whether phase I will meet the Illinois standard. EPA says it will if certain associated projects are done, whereas MSD says it will not. The State environmental agency agrees with MSD.

According to EPA environmental impact statements, the first phase tunnels will significantly reduce combined sewer overflows and capture 75 percent of the pollutant load that now enters the area waterways untreated. The ammonia standard violations, however, will continue, and the dissolved oxygen levels will remain below Illinois standards along 70 percent of the waterways. With the first phase tunnels alone, the waterways would still not meet the lowest Illinois water use standard--secondary contact and indigenous aquatic life.

Instream aeration to artificially add oxygen to the waterways is being installed with State environmental agency funding assistance. This measure will allow the Illinois dissolved oxygen standard to be substantially met in all the waterways. MSD also plans some treatment plant upgrading, with EPA funding assistance 1/ which, if completed, should allow the ammonia standard to be met at all times except during overflow episodes.

The EPA environmental impact statements on the TARP systems included a chart which showed that, even with the first phase tunnels, the instream aeration, and the treatment plant upgrading, the lowest Illinois water use standard would not be met. However, in a January 5, 1979, letter the Regional Administrator for EPA region V informed us that EPA now believes that TARP phase I and the other improvements (instream aeration and treatment plant upgrading)

> "will allow for the attainment of the secondary contact uses and thereby, provide for the protection of indigenous aquatic life and a variety of recreational uses such as boating, fishing and shoreline activities."

An EPA regional official stated that EPA did not really change its mind; rather the environmental impact statement charts were in error and that the occasional violations of standards that would occur will not significantly restrict achievement of the secondary contact water uses. MSD officials state that without the phase II reservoirs it is impossible for phase I, even with instream aeration and treatment plant upgrading, to meet the Illinois standard. The State environmental agency does not agree with EPA. The Acting Director of the State environmental agency noted on February 14, 1979,

> "The State of Illinois supports the findings of the [Environmental Impact Statement] that the entire program, including phase II TARP, must be implemented if minimum water quality goals are to be achieved."

In explaining occasional violations, EPA said the standards would be achieved 95 to 100 percent of the time except for a segment of one stream where the dissolved oxygen standard would be met only 85 percent of the time. EPA further stated that construction of phase II will not significantly improve the water quality beyond that expected from phase I.

1/EPA officials are not sure whether EPA will be able to provide its full share of funds needed to complete treatment plant upgrading.

OTHER ENVIRONMENTAL CONCERNS EXIST

Other environmental concerns include

--potential contamination of the ground water supply,

--the disposal of excavated rock material, and

--the disposal of wastewater treatment residue (sludge).

Potential contamination of ground water supply

The potential contamination of the ground water supply has probably caused the most concern of the environmental issues surrounding TARP. Ground water is an important source of water for many Chicago suburbs. Contamination would result in serious problems. Although environmentalists feel TARP may well contaminate the ground water, EPA and MSD believe safeguards are adequate.

Hypothetically, the tunnel systems could harm the ground water supply in two ways. During dry weather, when the tunnels are empty, the difference in water pressure between them and the aquifers (natural underground reservoirs) could cause ground water to infiltrate the tunnels, depleting the water supply. Conversely, during major storms, the pressure inside the tunnels could exceed that inside the aquifer, causing sewage water to seep out of the tunnels and contaminate the ground water.

TARP includes several measures to limit the interaction between the tunnels and the aquifers. Most of the tunnels are being constructed deep underground in extremely hard rock. These tunnels will be unlined, because the tightness and soundness of the rock formation is expected to preclude interaction. Tunnel segments through softer rock formations will be lined with concrete. As the tunneling progresses, grouting 1/ will be used to seal sources of seepage in the rock structure, such as open joints and faults. EPA believes these measures will protect the ground water supply.

1/A mixture of cement and water that is injected under pressure into a drilled hole that intersects a source of seepage. Chemical and epoxy grouts may be required in addition to cement grouts.

However, for insurance EPA is requiring observation wells to monitor the quality of ground water.

As part of the grant agreements, EPA required that MSD submit a plan for a ground water monitoring system with sampling parameters and frequencies mutually agreeable to the State environmental agency and EPA. Any changes in ground water quality resulting from tunnel construction or operation must be detected. MSD also was required to develop an emergency ground water recharge program to be used if contamination is discovered.

MSD consulted with EPA, the State environmental agency, and the Illinois Geological Survey before preparing these plans, which were submitted for their review in late January 1979.

Other environmental issues

The status of the remaining environmental issues varies. EPA believes that disposal of excavated rock material is being accomplished in an environmentally acceptable manner.

Disposal of sludge produced by treatment plants is a growing and expensive problem. TARP, when completed, would increase the volume of sludge by 15 percent since more rainwater will be captured and treated.

Sludge disposal is not a problem that TARP causes, but rather one that TARP exacerbates. MSD officials believe that sludge disposal is the most pressing problem associated with wastewater treatment. In a previous report 1/ we pointed out that until better solutions are found, the sludge disposal problem will get progressively worse and more controversial.

Additional concerns

Subsequent to the environmental impact statement, concern has been raised about potential damage to buildings from blasting for the tunnels. We were unable to review the concern about blasting since at this time there is little information available. Further, indications are strong that this issue will likely become involved in litigation.

1/"Sewage Sludge--How Do We Cope With It?" (CED-78-152, Sept. 25, 1978).

In this period of energy conservation and Presidential concern over energy usage, TARP will be energy intensive. Much electricity is needed--enough to supply the annual requirement of approximately 27,000 residential customers--to pump an estimated 74 billion gallons of water from reservoirs to treatment plants. While electrical requirements are small compared to the area utility capability, a serious question exists concerning the Federal funding of an energy intensive project while at the same time encouraging conservation.

SECTION 4

BACKFLOWS TO LAKE MICHIGAN

TARP (both phases) was designed to meet the following water management goals:

--Prevent backflows from the rivers into Lake Michigan.

--Reduce waterway pollution caused by combined sewer overflows.

--Reduce flooding in the combined sewer and downstream areas.

The backflows occur when the river levels rise to a height which threatens widespread flooding in the combined sewer area. When the rivers reach predetermined levels, MSD opens controlling locks to release impounded river water into the lake. Phase II is the portion of TARP specifically designed to eliminate backflows. Backflows of polluted river water into Lake Michigan have occurred 19 times from 1959 through 1978, with 12 of those in the last 10 years.

When MSD was considering various alternatives to TARP, it rejected any approach that would not satisfy all three objectives. In commenting on various control measures proposed since TARP was planned, MSD has taken the position that unless they meet all three goals, they cannot be considered as alternatives to TARP. Given that position, a large-scale TARP-type solution is virtually dictated.

Backflows thus become a critical issue. Are the impacts of the backflows so detrimental to the environment that they must be totally eliminated? The evidence does not support that contention. Backflows do not violate Federal or State environmental protection laws, or appear to seriously impair public health, the drinking water supply, or the use of public beaches. Government agencies, while unable to demonstrate serious adverse environmental harm, feel that backflows are undesirable and would like to see their impact minimized.

POLLUTION

The State environmental agency prohibits untreated combined sewer overflows into rivers, but has no specific law or regulation governing the backflows of the Chicago area rivers into Lake Michigan. State officials feel that if the combined sewer overflows are contained, backflows to

the lake will be less of a problem. EPA views the backflows as being similar to nonpoint sources of pollution, which are not controlled under EPA's pollutant discharge permit system. Further, if TARP phase I projects are completed, it is expected that 75 percent of the combined sewer pollutants now overflowing into area rivers would be captured. Thus, the quality of water that would be discharged into Lake Michigan would be considerably less polluted than at present.

PUBLIC HEALTH

According to officials from the Cook County and Evanston-North Shore health departments, no documented public health hazards have been associated with the backflows to Lake Michigan. The impact of the backflows, if any, is unknown because the kinds of reportable diseases or infections that could result from backflows could just as easily be caused by some other contamination source.

BEACH CLOSINGS

If Lake Michigan is contaminated, public beaches may have to be closed. Park district officials from Chicago, Wilmette, and Kenilworth provided the following information on closings:

Community	Number of days beaches closed	Period (years)	Caused by backflows
Chicago	16-1/2	9	3
Wilmette	8	6	4
Kenilworth	12	10	(a)

a/Closed 10 days for high bacterial count, but source not identified. High bacteria count can be caused by backflows; however, it can also come from other factors.

The remaining park districts--Winnetka, Evanston, Glencoe, Lake Forest, and Waukegan did not have specific information on beach closings.

As shown above, backflows account only for a portion of beach closings. There are varied reasons for the remaining beach closings. In Chicago, for example, beaches have been closed 16-1/2 days in the last 9 years for the reasons shown below:

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Reason	Total days closed
Oil spills in the lake	9
Backflows of river water when controlling locks opened	3
Overflows at 95th Street pumping station	3
Seiche warnings (note a)	1-1/2

a/Seiche--a sudden rhythmical movement from side to side of the water of a lake or other landlocked body, occasioning fluctuation of the water level from inches to several feet due to sudden variations in atmospheric pressures, wind, or small earthquakes.

WATER SUPPLY

The Chicago water department has two water purification plants that process Lake Michigan water for use in the city and 74 neighboring communities. The plants can draw lake water either from the shore area or from a crib area about 2-1/2 miles out in the lake. The water intakes are constantly monitored, and the purification plants can switch sources when the other source shows contamination.

A water department official said the area's water supply has never been restricted due to backflows to the lake. The water department has always been able to compensate either by switching water intakes or by increasing chemical treatment. Another official said, however, that the carbon application required for about one-fifth of the backflows caused the water to have a septic or hydrocarbon odor.

Officials from the Waukegan and Wilmette water departments noted backflows have not curtailed their water supplies and have only minimally affected their water treatment operations.

Although area water supplies have not been affected, community officials pointed out that backflows are undesirable and should be averted if possible.

SECTION 5

TARP'S IMPACT ON FLOODING

MSD says that phase I will have little impact on flooding. The addition of phase II tunnels and reservoirs would reduce flood damage cost in the communities by about 65 percent. MSD officials feel that the remaining 35 percent would require local sewer upgrading, estimated by the Corps to cost $1.6 billion, before flood damage could be alleviated.

Why will 35 percent of the flood damage remain? Flooding in many communities is not caused by the inadequacy of MSD's interceptors, but rather the inability of the local sewer system to handle the load within the community. Since TARP is designed to relieve interceptor overloading, it will be of little benefit to those communities that cannot get sewage to the interceptors--unless they upgrade their local sewers.

We asked local officials for their perceptions of TARP's impact on their flooding problems. The perceptions varied. In the 28 communities where more than 15 percent of the respondents to our questionnaire 1/ reported basement flooding from sewer backups, local officials in 9 of the communities felt that TARP will have no impact or only minimal impact on the problem unless sewers are upgraded. Also, 6 of the 28 communities felt that TARP would reduce flooding to some extent, but the community needs some sewer upgrading to receive the full benefit.

1/Detailed questionnaire asking about their experience with flooding were mailed to a randomly selected sample of 6,973 area residents. Responses were received from 5,073, or approximately 73 percent.

SECTION 6

HOW BAD IS FLOODING

How bad is flooding? It is hard to say. That a problem exists is undeniable; however, the problem is hard to characterize because its severity varies widely among the 54 communities, 375 square miles, and over 4 million people that make up the combined sewer area of MSD. In some communities, a sprinkle brings problems; in others a downpour causes little difficulty.

Community officials consider basement backup flooding to be the most serious problem. While approximately half the communities have serious street and viaduct flooding, they do not consider this to be as serious as basement backups. Overbank flooding is not considered a big problem since 80 percent occurs on forest preserve land.

We estimate damages from flooding to single-family dwellings at $71 million to $102 million over the last 5 years. Illness and injuries have been negligible; four, possibly six deaths have been attributed to flooding.

About 25 percent of the respondents to our questionnaire reported basement backup flooding through unobstructed home sewer lines. Of those who have had flooding, about four out of five suffered only during extreme rainfall. The following table illustrates, by community, the percentage of residents responding to our questionnaire that had basement backup flooding at least once during the last 5 years.

Community	Area	Percent of basement flooding
Cicero	West	43.8
Kenilworth	North	35.0
Elmwood Pk.	West	31.1
River Forest	West	30.8
Stickney	West	30.2
Forest Pk.	West	28.2
Evanston	North	27.2
N. Riverside	West	27.1
Wilmette	North	26.9
Skokie	North	26.8
Broadview	West	26.5
Chicago	-	26.3
Riverside	West	22.5
Park Ridge	Northwest	20.8
Forest View	West	20.5
Brookfield	West	19.6
Morton Grove	North	18.7
La Grange Pk.	West	18.6
Lincolnwood	North	18.6
Summit	Southwest	18.4
Blue Island	South	18.2
Berwyn	West	16.5
Western Sprgs.	West	16.3
Riverdale	South	16.2
River Grove	West	16.2
Franklin Pk.	West	15.8
Melrose Pk.	West	15.6
Lansing	South	15.2
Calumet Pk.	South	15.0
La Grange	West	14.3
Harwood Hts.	West	13.5
Calumet City	South	12.7
Norridge	West	12.2
Maywood	West	12.2
Burnham	South	11.8
Golf	North	10.0
Oak Park	West	9.9
Schiller Pk.	West	9.8
Harvey	South	9.3
Lemont	Southwest	9.1
Des Plaines	Northwest	8.8
Niles	North	8.7
Arlington Hts.	Northwest	7.2
Markham	South	6.9
Palatine	Northwest	6.6
Mt. Prospect	Northwest	6.1
Dixmoor	South	5.9
S. Holland	South	4.1
Dolton	South	3.3
Phoenix	South	3.3
Posen	South	3.3
Bedford Pk.	Southwest	2.6
Lyons	West	2.6
Hometown	South	2.3

DEATHS, INJURIES, AND HEALTH PROBLEMS

Chicago health officials stated that their records show no deaths from either overbank flooding or sewer backups from 1964 to 1977. Officials in three communities noted the following deaths.

--In Arlington Heights, at least three deaths have been attributed to electrocution in flooded basements since 1967.

--Skokie officials noted one death due to a gas explosion in a flooded basement.

--Lincolnwood officials vaguely recalled that one person was electrocuted in a flooded basement at least 15 years ago.

In Chicago, one respondent to our questionnaire said that her infant drowned in a basement flood.

Community officials do not have information on injuries caused by basement flooding, since these generally are not reported. Regarding health problems, a health official noted that illnesses normally associated with contact with polluted water (viral hepatitis, intestinal infections, etc.) could go unreported if cases were widely scattered.

Forty residents in eight communities responding to our questionnaire reported injuries and illnesses. Typical responses included

--back problems after cleanup,

--a broken toe,

--a cold from wading in standing water, and

--rashes from contact with the polluted water.

SECTION 7

LOCAL NEEDS ARE EXTENSIVE

If flood relief is to be obtained, regardless of what happens to TARP, many communities must extensively modify, rebuild, or construct new sewer systems. Without such upgrading, TARP's impact on flooding will be lessened. According to a December 1977 Corps estimate, such local sewer work will cost about $1.6 billion.

Of 54 communities, 26 have estimated the cost of sewer upgrading. The others have not made studies or simply do not know. The following table shows the estimated amount for the 26 communities.

Community	Amount	Date of estimate
	(millions)	
Arlington Hts.	$ 15.0	1979
Blue Island	4.0	1974
Brookfield	4.8	1976
Burnham	3.0	1975
Calumet City	13.0	1974
Chicago	500.0	1978
Elmwood Pk.	10.0	1979
Evanston	45.7	1977
Forest Pk.	1.0	1979
Forest View	.5	1979
Franklin Pk.	11.5	1979
Golf	a/.4	1979
Kenilworth	a/1.6	1978
La Grange	a/5.8	1978
La Grange Pk.	10.0	1979
Lemont	5.0	1979
Maywood	a/5.5	1958
Mount Prospect	2.0	1979
Norridge	6.5	1979
Park Ridge	20.0	1979
Riverdale	1.0	1978
River Forest	8.8	1973
Schiller Pk.	a/5.1	1979
Skokie	a/65.4	current
Summit	3.5	1973
Western Springs	5.2	current
Total	$754.3	

a/The midpoint of a range estimate (e.g. $300,000 to $500,000).

Whether the overburdened local taxpayer will agree to such large expenditures is questionable. In our discussions with representatives from 54 communities, we found mixed views on approval of flood control projects. For example:

--In 1974 Blue Island voters turned down a $4 million bond issue to construct relief sewers. These sewers were planned to alleviate flooding in specific areas of the community.

--In 1977 Brookfield abandoned a plan to construct storm sewers in a 50 block area in the southern section. This $4.8 million flood relief project was cancelled when residents vigorously protested the special assessment.

--In 1974 Calumet City voters turned down a $13 million referendum for flooding relief.

Some communities, though, have approved projects. These include:

--In 1967 Oak Park approved a $7.5 million bond issue to install relief sewers; these have eliminated sewer backup problems.

--About 7 years ago Melrose Park approved a $180,000 bond issue to construct a storm sewer lift station. This station alleviated flooding in the central area of the community.

--In 1973 Mount Prospect voters approved a $2 million bond issue for various flood control projects.

To further understand the difficulty faced by communities, we asked Evanston officials to estimate the impact of local sewer upgrading on their residents. They noted that on a $100,000 home (average market value of a home in Evanston) it would cost the homeowner about $16 per month for 40 years if the upgrading was financed through property taxes. If the upgrading was financed through sewer charges, it would cost the average resident about $8 per month. Evanston officials said such costs would cause an extreme burden on their citizens. When one adds to this the cost of MSD's portion of TARP phase I (25 percent of phase I's $2 billion cost), which must also be funded by some of the same taxpayers, one can quickly see the problem.

SECTION 8

WHAT FEDERAL AND STATE GOVERNMENTS ARE DOING

Little Federal or State money is available to help local authorities deal with flooding. Sewer backups are considered a local problem; unfortunately, many local governments cannot afford to correct them.

One reason the Federal Government tends to leave flooding problems to local authorities is that there is no single agency to fund sewer projects. Those agencies that might provide funds are EPA, the Corps, the Department of Housing and Urban Development (HUD), the Economic Development Administration (EDA), and the Soil Conservation Service. For some reason, however, not one of these agencies specifically finances projects to remedy basement backups, the principal problem that plagues local sewer authorities. The situation at the State level is similarly bleak.

EPA

EPA can fund up to 75 percent of local sewer projects, but only if their primary purpose is to combat pollution. Thus MSD was able to acquire EPA funds for TARP only by splitting it into two phases--a pollution control phase and a flooding control phase. Phase I, estimated to cost approximately $2 billion, is being funded 75 percent by EPA and 25 percent by MSD. Further, it was agreed as a grant condition between EPA and MSD that the funding of TARP specifically precludes any EPA funding for enlarging combined sewers leading to the tunnels. Thus, local sewer projects in the MSD combined sewer area are not eligible for EPA construction funding.

EPA does have funds available (referred to as step 1 grants) that will permit local communities to study their sewer problems, but not to design or construct sewer systems whose primary purpose is to control flooding. As of January 1979, 38 of the 54 combined sewer communities have either received funds under this program or have applied for grants. According to EPA, the remaining 16 communties have not applied because they do not feel they have a problem, cannot afford the 25-percent local share, or just do not want to get involved with Federal funds.

After completing the step 1 study, EPA provides funds for design and construction of a project (steps 2 and 3). Only 1 (Summit) of the 54 communities has applied for these

grants and it was turned down on the grounds that the proposed project was primarily for flood relief and was not intended to improve water quality.

THE CORPS

The Corps was the chief Federal agency concerned with flood control. Thus, it was to the Corps that MSD looked to fund TARP phase II. However, it was decided that the Corps could not construct TARP. Why? While the Federal Government assumed responsibiity for flood control (Flood Control Act of 1936) it has not assumed responsibility for urban drainage projects. The key is whether TARP is considered a flood control project or an urban drainage project. In January 1978, the Department of the Army and the Office of Management and Budget agreed to criteria used in defining urban drainage and flood control. One provision is that sanitary sewage or storm runoff being conveyed in manmade structures would not be classified as flood control if it goes to a treatment facility.

The Congress has since appropriated in fiscal year 1977 $1 million to the Corps to begin a study of TARP's flood damage reduction provisions. If the Congress approves the cost of a full study, estimated at $8 million to $12 million, the Corps will ultimately report on whether TARP or some other plan would be the most cost beneficial way to deal with flooding in the Chicago area.

HUD

HUD has two programs that could be of some assistance. One provides funds for public works projects and the other provides relief through flood insurance for flood-damaged property. 1/ Characteristically, however, neither program applies to the specific flood problems of metropolitan Chicago.

The Community Development Block Grant program is primarily to finance housing and community development for the poor. Public works projects (e.g. sewers) that are incidental to such community development could be eligible. Some MSD communities have used these grants for sewer projects; for example, Chicago replaced 17,500 feet of brick sewers and Phoenix has filed three proposals with HUD for sewer improvement projects costing $300,000.

1/The flood insurance program is administered by the Federal Insurance Administration (FIA). On April 1, 1979, a reorganization moved FIA from HUD to the Federal Emergency Management Agency.

The national flood insurance program offers communities and homeowners insurance against flood damage. However, only when rivers or other bodies of water flood are losses covered. Damage from basement backups caused by inadequate sewers would seldom be covered. Officials feel that most of the basement backup problems in the Chicago metropolitan area would not be covered by national flood insurance.

OTHER FEDERAL AGENCIES

EDA has a program similar to HUD's in that it funds development projects (including public works) in economically hard-pressed areas. Residential sewer projects may qualify, but only if local industries or businesses are threatened by an inadequate sewage system. The city of Chicago has received $7.5 million under this program for sewer construction and replacement. Only two other communities in MSD's combined sewer area, Evanston and Cicero, have received funds from this program. EDA officials state that this program is unlikely to help local communities with flooding problems.

The Soil Conservation Service funds projects to prevent river flooding. Such projects are underway in three Chicago area watersheds. These are expected primarily to provide some relief for overbank flooding, although some basement backup problems might be solved.

STATE AGENCIES

The State of Illinois has practically no funds available for sewer improvements. The State Department of Transportation gets involved with projects that are directed at controlling overbank flooding or sewer flooding projects that are incidental to roadway improvements. In regard to the latter projects, the local community must pay the cost for any sewer improvement over and above that necessary for proper road drainage. The State environmental agency had a pollution control construction program similar to EPA's, but its funds for new projects are virtually exhausted. Agency officials pointed out that local flooding and sewer upgrading are the responsibility of individual communities.

SECTION 9

WHAT LOCAL AUTHORITIES CAN DO

The burden of alleviating basement flooding rests with local authorities. But many of the community officials told us that their communities do not have the means to support massive sewer projects. Further, they said that without strong Federal or State support, local communities will have to reconcile themselves to the inadequacies of their sewage systems. Thus, local officials must seek less expensive answers. Fortunately, there is much they can do, short of massive system overhauls, to better the systems. Some communities have had success with such relatively inexpensive measures as ordinances requiring the disconnection of downspouts, various actions to slow the flow of water into sewers, and regular street and sewer cleaning. Other communities have taken only limited corrective action.

Niles is an example of a community that has taken extensive action on its own to relieve flooding. According to community officials, this northwestern suburb, of which 60 percent is served by combined sewers, has serious street flooding in several sections and severe basement flooding throughout, due to inadequate local sewer capacity and outfall submergence. This community has taken the following actions:

--Its regular sewer maintenance program includes cleaning about 20 percent of its sewers and catchbasins each year. Sewers are inspected weekly for obstructions and proper water flow.

--It uses restrictors to limit the water flowing into the main sewers. This measure relieves basement sewer backup problems by ponding water in the streets and parking lots.

--The community has a program to separate existing sewers wherever possible. Street drains are sealed off so that combined sewers only convey sanitary flow, then storm sewers are added.

--In 1957, the community passed an ordinance requiring homeowners in flood-prone areas to disconnect their downspouts from the combined sewer system, and prohibiting such connection in all new construction thereafter. Additionally, officials recommend that all residents disconnect their downspouts from the combined sewers. They believe, however, that a general

requirement for existing homes to disconnect would be hard to enforce, costly for the homeowner, and politically unpopular.

According to a Niles official, these actions have been effective in reducing flooding problems. Overall, flooding has been reduced by an estimated 50 percent and complaints from residents have decreased drastically.

An effective community program to relieve flooding should normally involve:

--A study of the existing system to identify problems and solutions. EPA will fund such studies; however, it will not fund any project relating to flooding that might be proposed as a result of the study.

--Educating the public on how to deal with basement flooding.

--Regular maintenance and cleaning. Many communities neglect this, allowing debris to accumulate and pipes to deteriorate and excessive infiltration of water to occur.

--Passing and enforcing ordinances that aid in flood control. For example, an ordinance requiring downspout disconnection can be quite helpful.

--Reviewing and adopting low-cost techniques, such as restrictors, to slow the flow of water into sewers.

These steps will not by themselves solve the problem. Yet, when viewed in light of the scarcity of existing Federal and State funds, taxpayers' reluctance to support sewer improvement projects, and the possibility that TARP phase II may not be approved, they become quite attractive. This approach offers an opportunity to do something now, rather than waiting for funds or for a massive project that, even if it is authorized, might not be completed until the 1990s.

SECTION 10

WHAT HOMEOWNERS CAN DO

Homeowners, whether they live in a community with well-maintained sewers or cracked and clogged ones, or one that acts vigorously to ease flooding or ignores the problem, can on their own initiative keep water out of their basements. In many cases, it is only the homeowner who can act, because the problem is in their own sewer lines or house. Several measures are available to the individual who wants relief from backups. These range from $5,000 corrective systems to $15 drainplugs or standpipes.

FLOOD CONTROL DEVICES

Drainplugs and standpipes are devices that can be inserted in basement drains to stop minor backups. They cost from $15 to $60. Their drawback is that during major floods, they may cause pressure to build up and crack basement floors.

A check valve can be installed in a house sewer line that will allow water to flow out but not in. Manually operated check valves are priced from $300, while automatic ones cost up to $3,000. Check valves must be cleaned periodically or they may clog. Further, debris can jam them open during a storm, rendering them ineffective.

Sump pumps, ranging from $50 to $800, pump water out that accumulates in a basement sump pit. They depend on electricity, however, so when a power failure accompanies a rainstorm they are useless.

SYSTEM CHANGES

If homeowners want to spend $1,500 or more, they can virtually be guaranteed a backup-free basement. Two types of systems are available: the flood control system and the overhead sewer. The former combines pumps, check valves, and ejectors to block and remove water from basements, while the overhead sewer installed near the basement ceiling reduces the incidence of backups. Recently built homes usually have overhead sewers. Both systems partly depend on electricity, but backups are unlikely even during a power failure.

DOWNSPOUT DISCONNECTION

One of the easiest ways to reduce basement backups is to break the connection between the downspout and the sewer

line. Downspouts carry water rapidly down from the roof, which tends to overload the sewer system. For about $15 per downspout, homeowners can redirect their downspouts away from their houses. In some cases, however, this procedure may create problems for a neighbor or be prohibited by local ordinances.

SEWER LINE MAINTENANCE

A high percentage of basement backups result from obstructed lines between the home and the street, particularly in areas with large trees. Periodically rodding out these lines can often eliminate flooding.

STRUCTURAL IMPROVEMENTS

Sometimes flooding is not caused by backups at all, but by cracks in walls, floors, and window wells. Sealing these cracks can correct the problem.

EXPERT ADVICE

Before deciding on any of the above actions, the homeowner would be wise to consult a reputable plumber. The plumber can diagnose the problem and suggest the most appropriate solution. For example, if flooding results from cracked walls, a drainplug will not help. The plumber can also provide guidance on proper installation and maintenance, which are, of course, necessary for a device to work. With the above information, the homeowner can evaluate the plumber's recommendation. A plumber's diagnosis costs about $50 to $125.

HOW WELL THESE DEVICES WORK

The devices's capability depends on which device is used and how bad the problem is. Plumbers have told us that overhead sewers and flood control systems, if properly installed and maintained, offer virtually 100-percent protection. Others will offer varying protection depending on the seriousness of the problem. For example, if water only enters a few inches, an inexpensive plug will probably do the job.

If a resident cannot afford these devices or the advice of an expert consultant, disconnecting the downspouts and rodding out the lines should be considered. The latter action is particularly important if the resident lives in an area with lots of trees. Again, this approach does not offer an overall solution to the problem, but rather a means to protect the resident.

SECTION 11

CONCLUSION

The Chicago metropolitan area suffers heavily from waterway pollution and, more importantly to the residents, from flooding. MSD has proposed a massive and innovative project to reduce pollution and flooding in the Chicago metropolitan area. TARP and its associated projects will undoubtedly reduce pollution, flooding, and backflows.

Yet, when TARP and associated projects are judged by what it will cost, the taxpayer must stop and think. As of October 1978 TARP and associated projects are estimated at $8.2 billion. Costs are continuing to escalate. If history is a good indicator, this amount could ultimately increase by several billion dollars. Inflation alone could cause TARP and associated projects to exceed $11 billion by 1983.

Both phases of TARP and associated projects offer a promising solution to the problem. But, can the country afford it? Our upcoming report will address in more detail the economic issues, particularly whether the Nation can afford to spend so much for one problem when Federal funds for control of water pollution and flooding are limited as are other elements of the Federal budget. If the Federal Government spends the billions of dollars necessary to complete TARP, should not other hard hit cities also be entitled to their share? In February 1979 EPA estimated that it would take more than $25 billion just to solve the pollution problems of combined sewer communities. If the cost of solving flooding problems associated with combined sewers is included, it could ultimately run more than $100 billion. Thus, the time may have come to reexamine the project.

EPA and the State environmental agency disagree whether phase I of TARP will meet water quality standards. We do not know who is right, since predicting the quality of a waterway can be difficult. However, $2 billion or more will be spent on a pollution project with a high degree of uncertainty as to whether it will accomplish its goal.

There are several options to this problem, including:

--Halting Federal funding of phase I and completing only that portion for which contracts have been awarded--$735 million as of January 1979. This alternative would result in a project that still would provide some pollution and flood control benefits--how much is hard to say without a study. It would save an estimated $0.9 billion in Federal and local funds.

--Halting Federal funding of phase I and attempting to terminate contracts awarded. This could result in savings, but pollution and flood control benefits would be questionable, since some sections already constructed might be inoperable.

--Continuing Federal funding of phase I, recognizing that the expenditure of $2 billion may not result in a project that will meet Illinois lowest water quality standards.

Halting TARP construction would likely require the State and EPA to reexamine the area's water quality goals. What might be required is the recognition that it is simply too expensive for certain streams in MSD's service area to reach water quality goals.

In previous reports we have taken the position that in attempting to achieve water quality goals, the Nation must consider costs, and that in the interest of economy, it may be necessary to permit flexibility in the Nation's water quality goals. More specifically:

--In our previous report on TARP 1/ we concluded that:

> "Funds for control of water pollution and flood control, as with other elements of the Federal budget, are limited. It is not clear to what extent this Nation can afford to fund individual projects, such as Chicago's tunnel and reservoir project that would cost $8 billion. Consideration should be given to some lesser and/or flexible goals in the interest of economy."

--In our report on "16 Air and Water Pollution Issues Facing the Nation," (CED-78-148B, October 11, 1978), we questioned whether TARP should be funded. Specifically:

> " * * * it is unlikely that the entire project will be funded; the goal to improve use of the waterways will not be met. From a cost standpoint it is very

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1/"Metropolitan Chicago's Combined Water Cleanup and Flood Control Program: Status and Problems" (PSAD-78-94, May 24, 1978).

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questionable whether the project should continue to be federally funded.

* * * * *

"The 'wherever attainable' provision of the 1983 interim goal should be used to exclude from the goal waterways that are seriously affected by natural conditions, nonpoint sources, or immense control costs."

We believe our previously stated position concerning TARP and need for the Congress to determine the extent of Federal assistance to urban areas for this type of program are still valid. As costs continue to increase, it becomes even more critical that TARP be reexamined to see if less costly solutions are available. Such solutions can range from adopting lower cost alternative technology to changing the goals or a combination of the two.

Whether phase II will ever be authorized is questionable. Like phase I, it is also costly. Further it is estimated that the project by itself will only solve 65 percent of flooding. Solving the remainder will require extensive expenditures for local sewer upgrading and other projects.

The problems and difficulties are little solace to those residents who have problems, and many do. Help is needed now--not in 1987 when TARP I will be completed or in the 1990s at the earliest if TARP II is authorized. Communities and individuals, however, can take actions to alleviate the problem. Granted, such actions will not accomplish what TARP and associated projects are designed to do. They also will be far less costly.

TARP and associated projects are designed to solve three basic problems--reduce flooding, pollution, and backflows to Lake Michigan. The goals are admirable but given the cost of more than $11 billion can the country afford it? Especially when it involves only one city and other citiies have similar problems.

SECTION 12

RECOMMENDATIONS

We recommend that the Administrator, Environmental Protection Agency, halt funding of TARP phase I except for those portions already under contract until EPA reassesses the project. In its reassessment EPA should

--reevaluate whether it wants to support a $2 billion dollar project that the State believes will not meet Illinois lowest water quality goals.

--in the interest of reducing costs, adopt more flexible water quality goals for the waterways affected by TARP, and

--carefully review the reasons for the project's cost escalation and make changes necessary to control spiraling costs.

We further recommend that the Administrator determine what treatment plant upgrading is necessary to achieve the benefits of phase I and whether funds will be available.

In carrying out the congressional mandate for the Corps of Engineers study of TARP II we recommend that the Secretary of the Army direct the Corps to

--incorporate analyses of less costly alternatives to TARP phase II and associated projects and

--prepare a cost/benefit analysis of the various alternatives to TARP phase II and associated projects as well as the currently proposed project.

We also recommend that each of the 54 communities in MSD's service area consider adopting the technology and procedures discussed in Volume 5 of this report.

SECTION 13

SCOPE OF REVIEW

We obtained the information in this report by reviewing TARP project documents, research publications, engineering studies, correspondence, and by interviewing officials at

--each of the 54 communities with combined or partially combined sewers;

--The Metropolitan Sanitary District of Greater Chicago;

--U.S. Army Corps of Engineers, North Central Division, Chicago, Illinois, Chicago District Office;

--U.S. Environmental Protection Agency, Headquarters, Washington, D.C., and region V, Chicago, Illinois;

--Environment Research Information Center, Cincinnati, Ohio;

--Municipal Environmental Research Laboratory, Cincinnati, Ohio, and Edison, New Jersey;

--U.S. Department of Housing and Urban Development, Headquarters, Washington, D.C., and Chicago, Illinois;

--Federal Insurance Administration, Headquarters, Washington, D.C., and Chicago, Illinois;

--U.S. Department of Commerce;

--Economic Development Administration, Headquarters, Washington, D.C.;

--Illinois Environmental Protection Agency, Division of Water Pollution Control, Springfield, Illinois;

--Illinois Department of Transportation, Chicago and Springfield, Illinois;

--Cook County Department of Highways, La Grange Park, Illinois;

--Cook County Forest Preserve District, River Forest, Illinois; and

--Northeastern Illinois Planning Commission, Chicago, Illinois.

To expedite issuance of this report, formal written agency comments were not obtained; however, the report was discussed with cognizant agency officials and their comments are included where appropriate.

We also met with various plumbing contractors and engineering firms. The following consultants assisted us by providing background information on combined sewer problems, suggesting and evaluating the feasibility of alternative technology to solve pollution and flooding problems, and reviewing and commenting on our draft report.

--Mr. Jerome Horowitz, a consultant with extensive experience in water pollution policies and pollution monitoring and abatement. He has worked with various Federal agencies, including EPA, the National Science Foundation, and the Office of Management and Budget.

--Dr. Floyd D. Peterson, a consulting engineer with extensive knowledge and experience in planning water pollution abatement programs. He is a past Chairman and Commissioner of the Washington Suburban Sanitary Commission.

--Mr. Frank J. Drehwing, Vice President, O'Brien & Gere Engineers, Incorporated. Mr. Drehwing has extensive experience with combined sewer overflow programs and problems.

--Center for the Environment and Man, Incorporated. This firm has significant experience in overall water quality and water resources management planning, including planning for combined sewer overflow and other nonpoint source pollution control. Specifically, the center has conducted studies for the National Commission on Water Quality; the Corps; New England River Basins Commission, and other Federal, State, and local agencies.

To determine the extent of flooding from combined sewers in the Chicago metropolitan area, we developed the following questionnaires:

--A newspaper questionnaire printed in numerous local publications throughout the Chicago area to solicit flooding information from residents.

--A detailed questionnaire distributed on a random sampling basis to about 7,000 residents in MSD's service area.

(087190)

REPORT BY THE

Comptroller General

OF THE UNITED STATES

Combined Sewer Flooding And Pollution -- A National Problem. The Search For Solutions In Chicago: Funding For Local Flooding Problems Is Extremely Limited

Volume 4 Of Six Volumes

Many of the local sewer systems in metropolitan Chicago need major expensive repairs and improvements to reduce basement and street flooding. Yet, community officials contend that they do not have sufficient funds to upgrade the systems. Community attempts to get voter approval of bond issues and special assessments for sewer improvements have had mixed results.

Moreover, little help is available from Federal or State governments. These governments view basement and street flooding as a community problem; thus, they have virtually no programs aimed at urban flooding.

FOR RELEASE

THURSDAY MAY 17 1979 PM

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MAY 15, 1979

PREFACE

At the request of Senator Charles H. Percy, GAO has reviewed the pollution and flooding problems in the Chicago metropolitan area served by combined sewers. This volume discusses the general unavailability of Federal, State, and local funds for projects to alleviate flooding.

In addition to this volume, our report includes five other volumes which address the following areas:

Volume	Description
1	An Executive Summary--includes an introductory section on the flooding and pollution problem in the Chicago metropolitan area and background information on the Tunnel and Reservoir Plan; synopsizes information in the other volumes; and contains our conclusions and recommendations.
2	The Tunnel and Reservoir Plan: Its Status and Impact--describes the plan's current construction and funding status; its impact on pollution and flooding in the combined sewer area; and the environmental concerns expressed about the plan.
3	A Profile of Urban Flooding in the Chicago Metropolitan Area--describes the flooding problem in the combined sewer area, including the extent of the problem (flooding of basements, streets, viaducts, etc.); estimated flood damages; and injuries, deaths, and health problems.
5	What Can Be Done to Minimize or Eliminate Urban Flooding?--describes the actions local communities and homeowners can take to prevent flooding.
6	A Synopsis of the Flooding Problems for Each of the 54 Chicago Area Communities--contains 54 summaries and descriptive maps of the flooding experienced; actions planned or taken by the communities and residents to alleviate or mitigate the problems; and anticipated impact of the Tunnel and Reservoir Plan.

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ABBREVIATIONS

Corps	Army Corps of Engineers
EDA	Economic Development Administration
EPA	U.S. Environmental Protection Agency
FIA	Federal Insurance Administration
HUD	Department of Housing and Urban Development
MSD	The Metropolitan Sanitary District of Greater Chicago
SCS	Soil Conservation Service
TARP	Tunnel and Reservoir Plan

GLOSSARY

Catchbasin	A chamber or well, usually built at the curbline of a street, for the admission of surface water to a sewer or subdrain, having at its base a pit designed to retain grit and debris below the point of overflow. The entrance to the catchbasin is through a grate and/or a curb opening. The purpose is to prevent sewer clogging by trapping coarse debris and to prevent odor emanations from the sewers by providing a water seal.
Check valve	A device installed in the sewer line between the house and street or in the house sewer line under the basement to prevent water from backing into the basement. Some valves close automatically when the flow through the sewer line reverses. Some are mechanically operated by control devices and some are manually operated.
Combined sewers	A sewer system composed of sewers which receive both municipal sewage and stormwater runoff from roofs, streets, ground, etc.
Drain plug	A device installed in floor drains to prevent water from backing up from the drain.
Infiltration	The water entering a sewer system and service connections from the ground, through such means as defective pipes, pipe joints, connections, or manhole walls.
Instream aeration	The circulation of oxygen in water to aid in purification.
Interceptor sewers	The collection system that connects main and trunk sewers with wastewater treatment plants.
Overbank flooding	Flooding that occurs when a river, stream, etc., overflows its banks.

Overhead sewers	A system in which all wastewater from above the street level in the house flows by gravity to the street sewer, but all wastewater and seepage collected in the basement is pumped up to the overhead sewer. The force of gravity and, ultimately, a check valve between the basement and the sewer system prevent backup from the street sewer system.
Outfall	The place where an effluent is discharged into receiving water.
Restrictor	A device placed in catchbasins to limit the rate of flow of water into the sewer system.
Separate sewers	A sewer system composed of sanitary sewers which carry only domestic and industrial sewage and storm sewers which carry only storm runoff.
Sludge	The solid matter removed from wastewater through treatment. Sludge handling involves the processes that remove solids and make them ready for disposal.
Standpipe	An open-ended pipe inserted tightly into a drain which serves as a reservoir to capture minor backups.
Sump pump	A device which pumps out water that accumulates in a basement sump pit.

SECTION 1

INTRODUCTION

Little Federal or State money is available to the 54 communities to alleviate flooding caused by inadequate sewer systems. Alone, many communities cannot finance the extensive sewer work that needs to be done.

No one Federal agency is responsible for urban flooding and no Federal programs have been designed to solve urban flood problems. Essentially, each community is responsible for financing solutions. Such solutions can be costly. In Evanston, for example, if financed through the property tax the owner of a $100,000 home would have to pay an estimated $16 per month for 40 years to finance the community's needed sewer improvements.

SECTION 2

LIMITED FEDERAL OR STATE FUNDING

A number of Federal agencies--the Environmental Protection Agency (EPA); the Department of Housing and Urban Development (HUD); the Economic Development Administration (EDA), Department of Commerce; the Soil Conservation Service (SCS), Department of Agriculture; and two Illinois agencies, the Environmental Protection Agency and the Department of Transportation--can help fund local flood control. Because of various restrictions, however, Chicago-area communities are unlikely to receive these funds to reduce basement and street flooding.

Another form of assistance is National Flood Insurance. However, it only protects homeowners who suffer basement flooding damages that accompany general surface flooding.

Further, the Army Corps of Engineers (Corps) has traditionally been involved in flood control projects. In January 1978, however, the Department of the Army and the Office of Management and Budget agreed to criteria for Corps participation in flood control projects in urban areas. Corps regulations now state that artificial structures that convey sanitary sewage or storm runoff to a treatment facility will not be classified as flood control works. As for local sewer upgrading, the Corps has taken the position that this should be the responsibility of the communities in the combined sewer area.

SECTION 3

FEDERAL AGENCIES

EPA

Local improvements for combined sewers are unlikely to qualify for EPA funding for three reasons:

--Illinois places such projects far down on its priority list submitted to EPA.

--EPA will fund only pollution control projects and, therefore, most local sewer upgrading projects are not eligible.

--In funding the pollution control portion of the Tunnel and Reservoir Plan (TARP), EPA decided it would not fund the expansion of the local sewers because TARP was expected to take care of all pollution problems.

EPA has, however, provided funds for local communities to study their problems.

Under Public Law 92-500, EPA may grant up to 75 percent for the pollution control portion of sewer projects. Eligible projects include sewage treatment plants, interceptor sewers, sewage collection systems, and combined sewer overflow control systems. If the major purpose of a sewer project is to control flooding, it is not eligible for EPA funding. Flood control is covered only if incidental to pollution control.

EPA funds projects from the top of each State's priority list, which includes pollution control projects throughout the State. These lists are revised annually based on population, severity of problems, and Federal and State criteria. Priority is given to sewage treatment facilities and other critical elements of a treatment system, rather than combined sewer overflow projects and collection sewers.

The cost of projects greatly exceeds the amount of funds available. For example, about 1,000 projects are on the Illinois priority list for fiscal year 1979. EPA anticipates funding approximately 175 of these at a cost of about $183 million.

EPA's grant process is divided into three segments.

--Step 1 is the preparation of a facility plan. Planners evaluate alternatives for achieving their pollution goals. EPA will fund 75 percent of planning costs; the local community must raise the rest. Under a step 1 grant, a community can study ways to reduce basement flooding, although it cannot spend EPA money to implement them unless they are principally to control pollution. Each of the 54 communities in the Metropolitan Sanitary District of Greater Chicago's (MSD's) combined sewer area is eligible for a step 1 grant. As of January 1979, 26 of the 54 communities have received grants and 12 others have applied. (See vol. V for specifics.) The 16 communities that have not applied do not believe they have a problem, can not afford the 25 percent local share, or do not want to get involved with Federal funds.

--Step 2 is the design stage. The grant under this section is used to prepare detailed engineering plans and specifications for the approved facility plan. Only 1 of the 54 communities, Summit, has submitted a step 2 application--for a $3.5 million project to upgrade sewers and eliminate the combined sewer backup problem in streets and basements. EPA rejected the application, saying the project was ineligible for grant funds because it provides no pollution abatement benefits (for example, making receiving waters cleaner) as specified under Public Law 92-500.

--Step 3 is the actual construction phase of the approved project.

HUD

Under the Community Development Block Grant Program, HUD can provide funding for various public works projects, including collector sewers and flood and drainage facilities. However, the program's basic purpose is to foster community development activities principally benefiting lower-income persons. Public works projects may be carried out when they support the community development and housing strategies designed by grant recipients.

Cities of over 50,000 and urban counties of over 200,000 are assigned "entitlement" funds annually. Suburbs of less than 50,000 may apply to their participating urban county for a share of its entitlement, or they may apply directly to HUD for "discretionary" grants under the small cities program.

About 80 percent of community development block grant funds are allocated to metropolitan areas; the rest go to nonmetropolitan areas. Funding levels for entitlement cities are determined by a formula that includes such factors as population, poverty, and degree of overcrowding.

HUD entitlement grants

To receive its preset entitlement grants, a community must apply to HUD each year. Funds that are not applied for are reallocated elsewhere in the State on a competitive basis, usually during the same year.

Nine communities in MSD's combined sewer area, as well as Cook County, were eligible for entitlement grants in fiscal year 1978. The following table shows those eligible, the grant amounts made available, and the application status for each.

Community	Grant amount	Application status
	(000 omitted)	
Arlington Hts.	$ 438	Approved
Berwyn	1,530	Did not apply
Chicago	114,279	Approved
Cicero	2,010	Did not apply
Des Plaines	474	Did not apply
Evanston	1,873	Approved
Mount Prospect	341	Approved
Oak Pk.	1,733	Approved
Skokie	449	Approved
Cook County (note a)	15,166	Approved
	$ 138,293	

a/ Includes 44 combined sewer communities

The fiscal year 1978 grant amounts made available to the three communities that did not apply--Berwyn, Cicero, and Des Plaines--total $4,014,000. According to HUD officials, these three communities have never applied for these funds since the program began in fiscal year 1975.

The $4 million unapplied-for funds were made available according to established HUD priorities. Since these funds came from a metropolitan area, they had to be used for urban projects. HUD distributed them as discretionary funds under its competitive small cities program of 1979. A portion of these entitlement grants is being spent on sewer improvements. Chicago has used some of its grants for sewer

projects. Under Cook County's program, three communities, Summit, Dixmoor, and Phoenix, have proposed using some of their money for sewer projects, such as repairs, new construction of relief sewers, and other maintenance to solve flooding problems. Phoenix considers sewer development its highest priority for HUD funding. Other Cook County communities have used their funds for housing rehabilitation, neighborhood improvements, etc.

HUD discretionary grants

HUD's small cities program has no predetermined grant amounts, so eligible communities must compete for funds. The demand for funds far exceeds the amounts available, so the competition is great. No communities in MSD's combined sewer area applied for discretionary funds under the small cities program in fiscal year 1978. Maywood had applied in previous years, but now is included under Cook County's entitlement grant program, so it is no longer eligible.

HUD officials commented that communities prefer to be included under Cook County because the county is entitled to a grant every year and they feel they will have a better chance competing within Cook County than within the entire State. However, there is still no guarantee they will receive anything.

EDA

The Public Works and Economic Development Act of 1965 (Public Law 89-136), as amended, authorizes EDA to award grants and direct loans to help build public facilities needed to encourage economic growth. These funds are distributed to areas where economic growth is behind the national average.

To qualify, projects must fulfill a pressing need of the area and must (1) encourage establishment or expansion of industrial or commercial facilities, (2) create long-term employment opportunities, or (3) benefit the long-term unemployed and members of low-income families.

The maximum grant funding rate is between 50 and 80 percent of total eligible project costs, depending on the area's degree of economic depression. Projects located on Indian reservations are eligible for 100-percent assistance. The grant rates change about every 6 months. Both Cook County and Chicago became eligible for 50-percent funding in 1978.

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EDA officials stressed that their objective is to attract new industry and encourage business expansion in economically hard-pressed areas. Thus, it would not normally pay for rehabilitating or constructing sewer systems in existing residential areas, unless local industry or business would be stifled without an adequate local system. EDA officials feel communities in MSD's service area would not be eligible for funding for upgrading local sewers.

However, in 1976 a special one-time Local Public Works Program was authorized. Under this program, $6 billion was authorized nationally, which provided 100-percent funding for economic stimulus in areas with high unemployment rates. Of this $6 billion, Chicago received about $60 million, $7.5 million of which was used for sewer construction and replacement. Two other communities in MSD's combined sewer area--Evanston and Cicero--received about $1.1 million but used it to replace bridges, construct parking lots, and improve streets. The authorization expired September 30, 1977, and all funds have been expended.

SCS

SCS provides technical and financial assistance to local sponsors of projects aimed at controlling overbank flooding. Local sponsors can include cities, counties, or sanitary districts.

SCS funding is available for

--structural projects, such as floodwater retention structures;

--nonstructural projects, including the acquisition of flood plain lands; and

--landscaping projects, such as development of diversion ditches and grassy wetlands.

Projects are designed to protect flood plain areas from overbank flooding resulting from a storm of 100-year frequency. They include such measures as channel modification, wetland designation, and reservoir facilities--including multipurpose retention basins (which may provide for boating, fishing, picnicking, biking, and hiking).

SCS is currently involved in three watershed plans in the Chicago area. It has no plans for work in the other three watersheds--Calumet-Sag, North Branch Chicago River, and Poplar Creek.

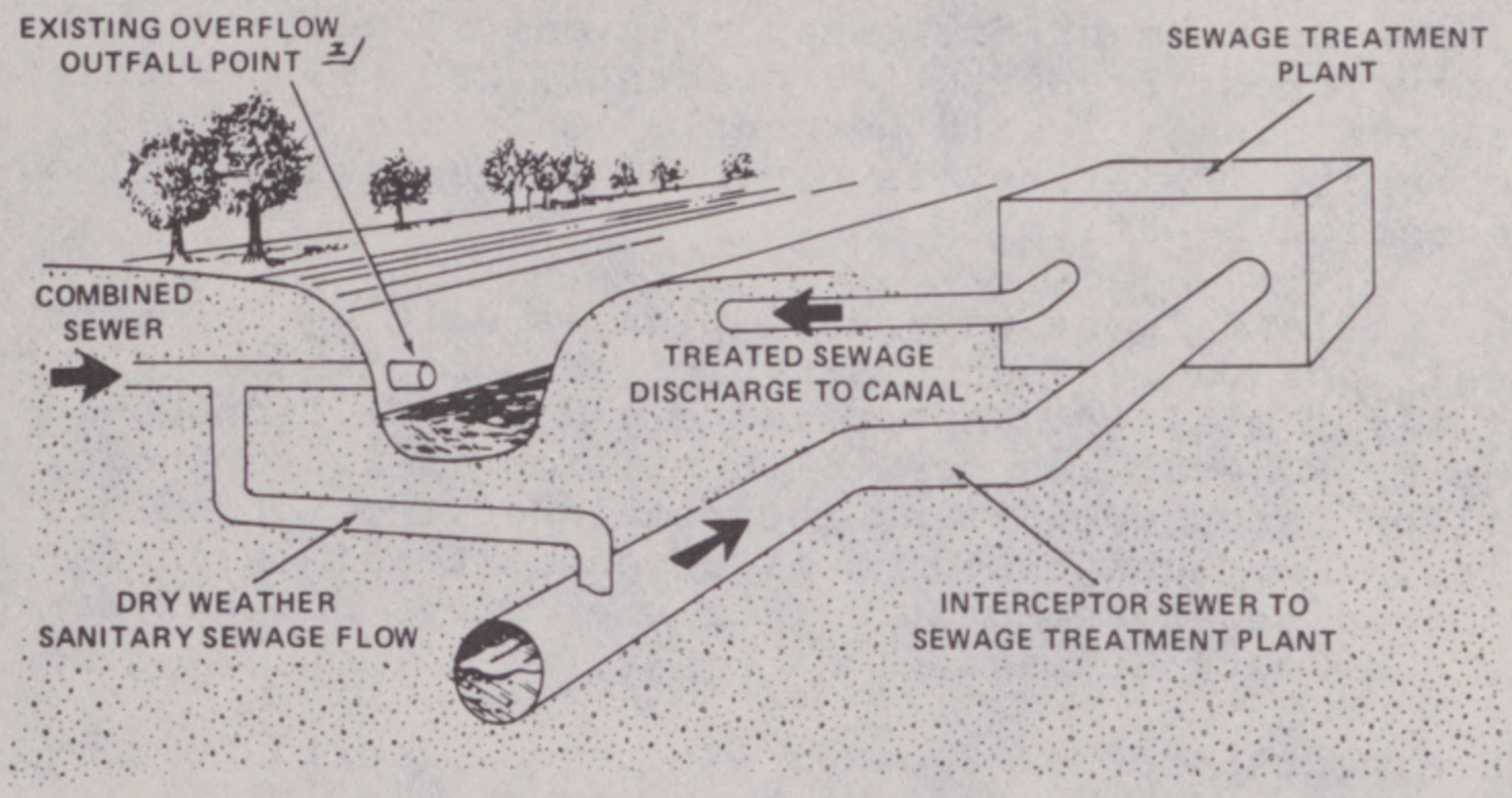
The Upper Salt Creek watershed project includes five detention reservoirs, one multipurpose reservoir, and channel improvements and flood plain regulation. Costs total about $43.3 million and construction is to be completed in the spring of 1981. The plan is being funded by SCS (32 percent), the Illinois Department of Transportation (32 percent), the Cook County Forest Preserve (10 percent), MSD (18 percent), and local municipalities (8 percent). Only one combined sewer community, Palatine, is expected to receive any floodwater reduction benefits.

The Little Calumet watershed plan is waiting for congressional approval. Four reservoirs are proposed at a cost of about $43.1 million. Approximately $31.7 million would be funded by Federal sources, $1.6 million in State funds, $7.4 million through MSD; and the remainder from local municipalities. Overbank flooding is expected to diminish in five combined sewer communities: Calumet City, Dolton, Harvey, Lansing, and South Holland.

SCS expects the Des Plaines watershed plan to be completed in 1980 and submitted to the Congress in 1981. Total costs are estimated at $61.4 million, including $37.3 million in Federal funding. The plan involves building reservoirs, purchasing flood plains, and modifying channels. Eight combined sewer communities are expected to receive less flooding: Brookfield, Chicago, Des Plaines, Franklin Park, La Grange Park, Lyons, Melrose Park, and Schiller Park.

Although SCS projects deal primarily with overbank flooding, they may alleviate sewer backup into basements caused by submerged overflow outfall points (see following diagram) or floodwater entering the sanitary sewer system through street sewers.

EXISTING OVERFLOW OUTFALL POINT
IN RELATION TO COMBINED SEWER SYSTEM



SOURCE: THE CITY OF EVANSTON, ILLINOIS

1/Overflow outfall point becomes submerged when the river rises and water backs up into the combined sewer pipe. This may cause sewer backup in basements.

No estimates of the amount of basement sewer backup flooding which SCS projects will eliminate are available. Overbank flooding is not viewed as a serious problem in the 54 combined sewer communities, because 80 percent of it occurs on forest preserve land. Only in the five communities of Franklin Park, Lemont, Markham, Mount Prospect, and Riverside is overbank flooding considered a problem.

FEDERAL INSURANCE ADMINISTRATION (FIA)

The national flood insurance program was established in 1968 to provide low-cost flood insurance for property owners in flood-prone areas. FIA, which is part of HUD, administers the program. 1/

1/Due to a reorganization, effective April 1, 1979, FIA is part of the Federal Emergency Management Agency.

A community qualifies for the program in two separate phases--emergency and regular. Under the emergency phase, limited amounts of flood insurance is made available even if only preliminary flood data is available and if the community adopts minimum flood plain management ordinances. The regular phase provides the greater coverage when a community adopts comprehensive flood plain management measures and completes a detailed flood study. Also, communities that are minimally flood prone or do not have areas of special flood hazard, may elect to enroll in FIA's regular program, without having to do any studies and by adopting minimal flood plain ordinances.

The insurance is available to any property owner or tenant living in a community or county enrolled in FIA's program. Coverage can be obtained for any building, including mobile homes on permanent sites, and/or their contents. Piers, land, livestock, motor vehicles, etc., are not insurable. Policies may be bought from any licensed property insurance agent or broker. The agent or broker contacts FIA's insurance servicing agency, Electronic Data Systems, for applications and policy processing. The minimum annual premium is $25. Coverage is limited to $35,000 for structures and $10,000 on contents for a single-family residence, under the emergency program. Also, for single-family residences the maximum contents coverage is $60,000 and structural coverage is $185,000 under the regular program. The subsidized rates vary from 25 cents per $100 of coverage for a single-family home to 75 cents per $100 for contents coverage in a non-residential structure. Actuarial rates under the regular program range from 1 cent to $50 per $100 based on the location of a new structure's exposure to flood damage.

FIA officials said that damage caused by sewer backup or basement seepage would seldom be covered. Only losses caused by a general flooding condition are covered under the policy. Water seepage, sewer backup, and street flooding are only covered if rivers or other bodies of water into which the community's sewage system empties are at flood stage. The policy does not cover damages resulting only from conditions such as inadequate sewers or blockage or breakage of water mains. For example, if a sudden heavy rain fills gutters and overloads sewer systems, but does not flood waterways, damage is not covered.

Forty-seven of the 54 combined sewer communities are enrolled in FIA's flood insurance program. The other seven communities are:

Bedford Pk.
Berwyn
Cicero
Harwood Hts.
Hometown
Lincolnwood
Oak Pk.

Although these seven communities are not prone to overbank flooding, they can enroll in the flood insurance program. Skokie is one community considered not prone to overbank flooding, yet decided to enroll. However, since the type of flooding normally experienced in these communities would not be covered, there is not much purpose in enrolling.

SECTION 4

STATE FUNDING

Only two State agencies--the Illinois Environmental Protection Agency and the Illinois Department of Transportation--provide funds for sewer construction or other flood control projects. These funds are limited both in amount and in application.

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

In 1970, the State of Illinois issued $750 million in bonds (the Anti-Pollution Bond Act) to help communities in planning, financing, and constructing municipal sewage works. The Illinois Environmental Protection Agency makes these funds available to communities for pollution and health hazard projects. The agency's program is patterned after the Federal grant program; that is, about 75 percent of the eligible project cost is funded by the State, and the rest by the local community.

Through August 1978, about $529 million has been spent. MSD has received about $18 million for design work on TARP; $14 million for instream aeration, and $49 million for minor treatment plant improvements and sewer rehabilitation. The $221 million left is available only for funding ongoing projects and providing a few health risk grants. The health risk grants are usually awarded to unsewered communities with a severe health risk, such as exposed sewage from septic tanks that can cause gastrointestinal illness. The Illinois Department of Public Health identifies the projects with health risks, and the State legislature selects some for funding.

Agency officials do not foresee any further State bond issues for antipollution projects and know of no other sources of funding other than U.S. EPA. The Illinois Department of Transportation may provide funding for flood control projects. State environmental protection officials pointed out, however, that local flood control and sewer upgrading is considered the responsibility of the individual communities.

ILLINOIS DEPARTMENT OF TRANSPORTATION

The Illinois Department of Transportation has two divisions that are involved in flood-related projects: the Division of Water Resources and the Division of Highways.

Division of Water Resources

The Division of Water Resources has an annual capital improvements budget of about $10 million, 90 percent of which is used for projects to control waterway overbank flooding. (The rest is used for navigation or water supply projects.) Officials anticipate continuing annual appropriations at about the same level, but emphasized that these funds are for overbank flooding projects, not sewer backup or street flooding correction, although these problems might lessen as a result.

In the past, the division emphasized individual local projects constructed in cooperation with local governments. It paid for construction, and the local governments provided rights-of-way and project maintenance. Most of the projects were located in the Chicago metropolitan area and included such things as cleaning and widening streams or building dikes and levees.

In the last 7 years, however, the emphasis has shifted to participating with the Corps and SCS in areawide watershed plans. Currently the division is involved in two flood control projects in MSD's service area aimed at reducing overbank flooding: the Addison Creek project, financed by the division and local communities, and the Upper Salt Creek watershed plan, in cooperation with SCS.

The Addison Creek project is located west of Chicago. Two of the eight communities to benefit, Melrose Park and Broadview, are in MSD's combined sewer area. The plan includes reservoirs, a storm sewer, and channel modifications. The division is funding about 95 percent of the $15 million total project cost.

The Upper Salt Creek watershed plan is one of the six watershed plans for the Chicago Area River Basin. (See p 8.) Through fiscal year 1978, the division had spent about $12 million of its $14 million share.

Division of Highways

The Division of Highways may get involved in street flooding projects that are incidental to highway improvements. It will provide drainage for its own projects only. If the project happens to be located in an area that has bad street flooding, local officials can arrange to have it benefit their community. For example, the division was improving a road adjacent to a Morton Grove area with a street flooding problem. A storm sewer had to be installed

to provide drainage for the road, so Morton Grove officials arranged to pay the additional cost for putting in a larger sewer to handle the community's excess water. The total cost to Morton Grove, including an additional sewer line, was about $1.1 million. Not all the street flooding problems have been solved, however, because part of the problem is caused by two other communities sewage that overloads Morton Grove's sewer system.

SECTION 5

COMMUNITY NEEDS ARE EXTENSIVE, BUT FUNDS ARE LIMITED

Many communities in the combined sewer area need to extensively modify, rebuild, or construct sewer systems, yet community officials contend they cannot come up with funds. As discussed in volume V, improved maintenance, optimization of local systems, and the adoption of flood control alternatives could reduce the need for such a large expenditure. Unfortunately, sewer systems are so inadequate in some communities that measures, such as alternative technology, maintenance improvements, and ordinances, while perhaps diminishing local flooding somewhat, still wo. . not be enough. Ultimately, communities with inadequate systems will have to spend large amounts on sewer upgrading or tolerate frequent backups.

The following table shows estimated expenditures required to improve sewer systems in 26 of the 54 communities that were able to provide estimates. Some of these estimates resulted from engineering studies; others are local officials' guesses.

Community	Amount	Date of estimate
	(millions)	
Arlington Hts.	$ 15.0	current
Blue Island	4.0	1974
Brookfield	4.8	1976
Burnham	3.0	1975
Calumet City	13.0	1974
Chicago	500.0	1978
Elmwood Pk.	10.0	current
Evanston	45.7	1977
Forest Pk.	1.0	current
Forest View	.5	current
Franklin Pk.	11.5	current
Golf	a/ .4	current
Kenilworth	a/ 1.6	1978
La Grange	a/ 5.8	1978
La Grange Pk.	10.0	current
Lemont	a/ 5.0	current
Maywood	5.5	1958
Mount Prospect	2.0	current
Norridge	6.5	current
Park Ridge	20.0	current
Riverdale	1.0	1978
River Forest	8.8	1973
Schiller Pk.	a/ 5.1	current
Skokie	a/65.4	current
Summit	3.5	1973
Western Sprgs.	a/ 5.2	current
	$754.3	

a/ The midpoint of a range estimate (e.g., $300,000 to $500,000).

Raising the needed funds locally may be difficult, community officials commented, because many taxpayers already feel overburdened. What funds are available are committed to projects with higher priority.

Bond issues and special assessments proposed for projects to solve flooding and basement backup problems have been met with mixed results:

--In 1974, Calumet City residents defeated a $13 million bond referendum to build sewers and lift stations.

--Blue Island residents defeated a $4 million 1974 bond issue to fund the construction of relief sewers.

--In 1976, Brookfield residents protested a $4.8 million special assessment for construction of storm sewers.

--Arlington Heights funded a $14.5 million project with three general obligation bonds for floodwater detention basins and sewers.

--Oak Park passed a $7.5 million bond issue in 1967 to install relief sewers; these have eliminated sewer backup problems.

--Park Ridge has spent $5.5 million since 1961 for four relief sewer projects, funded by general obligation bonds.

In addition to the $754 million approximated by 26 combined sewer communities, two other estimates have been made of the capital costs needed to upgrade local sewers to achieve TARP's benefits. In December 1977, the Corps estimated that $1.6 billion would be needed to upgrade local sewers; MSD estimated about $786 million. How much it will actually cost has yet to be proven.

What is apparent, however, is that local communities will need to finance both the local sewer system upgrading, needed to solve sewer backup and flooding problems, and TARP.

Upgrading the local systems would require substantial tax or sewer service charge (based on water consumption) increases for property owners. For example, Evanston estimated costs at $45.7 million for sewer improvements necessary to benefit from TARP. If the project is financed through general obligation bonds with 40-year serial maturity at 6-1/2 percent interest, Evanston officials estimate the annual property tax rate would increase about 8 percent. For a $100,000 home (average market value of a home in Evanston) this would mean an additional $196 per year or about $16 monthly for 40 years. If the project is financed through sewer service charges, an average Evanston homeowner would pay an additional $98 per year.

According to Evanston officials, without Federal funding increased taxes or charges of this magnitude will cause an extreme burden on Evanston citizens.

In addition to the increase in local taxes for sewer upgrading, TARP must be financed. MSD's January 1979 estimate for phase I construction costs is about $2 billion. Approximately 25 percent of this must be financed by MSD, or ultimately, area residents.

TARP construction, along with other MSD operations, is financed from a general-use fund supported through the sale of general obligation bonds. There is no separate bond issue. Funds used to finance TARP construction costs are repaid to the general-use fund by levying taxes on real property in MSD's taxing district, which includes the 54 communities in the combined sewer area and about 70 outside the combined sewer area. Bonds are sold based on anticipated cash flow and taxes are levied at the time the bonds are sold. According to MSD, TARP construction costs will not affect the water rates charged to homeowners.

(087190)

REPORT BY THE

Comptroller General

OF THE UNITED STATES

Combined Sewer Flooding And Pollution -- A National Problem. The Search For Solutions In Chicago: What Can Be Done To Minimize Or Eliminate Urban Flooding?

Volume 5 of Six Volumes

Local communities and homeowners can reduce basement flooding with a number of measures that are much less expensive than extensive sewer improvements. This volume discusses such techniques, which include regular maintenance of sewer lines, actions to slow the flow of water into sewers, and various devices that can be installed in the home.

FOR RELEASE

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PREFACE

At the request of Senator Charles H. Percy, GAO has reviewed the pollution and flooding problem in the Chicago metropolitan area served by combined sewers. This volume summarizes the actions local communities and homeowners can take to minimize basement flooding.

In addition to this volume, our report includes five other volumes which address the following areas:

Volume	Description
1	An Executive Summary--includes an introductory section on the flooding and pollution problems in the Chicago metropolitan area and background information on the Tunnel and Reservoir Plan; synopsizes information in the other volumes; and contains our conclusion and recommendations.
2	The Tunnel and Reservoir Plan: Its Status and Impact--describes the plan's current construction and funding status; its impact on pollution and flooding in the combined sewer area; and the environmental concerns expressed about the plan.
3	A Profile of Urban Flooding in the Chicago Metropolitan Area--describes the flooding problem in the combined sewer area including the extent of the problem (flooding of basements, streets, viaducts, etc.); estimated flood damages; and injuries, deaths, and health problems.
4	Funding for Local Flooding Problems is Extremely Limited--summarizes the availability of Federal, State, and local funds for projects to alleviate flooding.
6	A Synopsis of the Flooding Problems for Each of the 54 Chicago area communities--contains 54 summaries and descriptive maps of the flooding experienced; actions planned or taken by the communities and residents to alleviate or mitigate the problems; and anticipated impact of the Tunnel and Reservoir Plan.

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ABBREVIATIONS

GAO	General Accounting Office
MSD	The Metropolitan Sanitary District of Greater Chicago
TARP	Tunnel and Reservoir Plan

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GLOSSARY

Catchbasin	A chamber or well, usually built at the curbline of a street, for the admission of surface water to a sewer or subdrain, having at its base a pit designed to retain grit and debris below the point of overflow. The entrance to the catchbasin is through a grate and/or a curb opening. The purpose is to prevent sewer clogging by trapping coarse debris and to prevent odor emanations from the sewers by providing a water seal.
Check valve	A device installed in the sewer line between the house and street or in the house sewer line under the basement to prevent water from backing into the basement. Some valves close automatically when the flow through the sewer line reverses. Some are mechanically operated by control devices and some are manually operated.
Combined sewers	A sewer system composed of sewers which receive both municipal sewage and stormwater runoff from roofs, streets, ground, etc.
Drain plug	A device installed in floor drains to prevent water from backing up from the drain.
Infiltration	The water entering a sewer system and service connections from the ground, through such means as defective pipes, pipe joints, connections, or manhole walls.
Instream aeration	The circulation of oxygen in water to aid in purification.
Interceptor sewers	The collection system that connects main and trunk sewers with wastewater treatment plants.
Overbank flooding	Flooding that occurs when a river, stream, etc., overflows its banks.

Overhead sewers	A system in which all wastewater from above the street level in the house flows by gravity to the street sewer, but all wastewater and seepage collected in the basement is pumped up to the overhead sewer. The force of gravity and, ultimately, a check valve between the basement and the sewer system prevent backup from the street sewer system.
Outfall	The place where an effluent is discharged into receiving water.
Restrictor	A device placed in catchbasins to limit the rate of flow of water into the sewer system.
Separate sewers	A sewer system composed of sanitary sewers which carry only domestic and industrial sewage and storm sewers which carry only storm runoff.
Sludge	The solid matter removed from wastewater through treatment. Sludge handling involves the processes that remove solids and make them ready for disposal.
Standpipe	An open-ended pipe inserted tightly into a drain which serves as a reservoir to capture minor backups.
Sump pump	A device which pumps out water that accumulates in a basement sump pit.

SECTION 1

INTRODUCTION

Local communities and residents can play an important part in either eliminating or mitigating flood damages. There are techniques--some at low cost--that will reduce or eliminate sewer backup problems.

Community flood control measures could include improving sewer system maintenance, educating citizens on flood control techniques, and passing and enforcing flood control ordinaces. The resident can, among other things, use drain plugs, check valves, flood control systems, and overhead sewers.

SECTION 2

LOCAL COMMUNITIES CAN DO MORE

Local communities could do more to alleviate flooding. While community officials are responsible for ensuring an adequate sewage system and protecting residents against flooding, some have taken extensive flood control measures, whereas others have done little.

Many local officials feel they do not have the resources for extensive sewer rebuilding, which often is needed to solve the problem completely. Further, as discussed in volume 4 of this report, Federal and State funding for this purpose is not readily available. Lacking the funds for a total solution, some community officials seem to have given up in frustration.

Although the funding situation makes it difficult to provide total relief, low-cost, small-scale steps are available to alleviate the problem; for example, disconnecting downspouts, restricting the flow of water from streets to sewers, or retaining water in parking lots. Many communities have had success with these techniques.

WHAT IS A COMMUNITY'S RESPONSIBILITY?

Communities in the Metropolitan Sanitary District of Greater Chicago (MSD) service area are required to adopt and enforce MSD requirements regarding the design and construction of sewers and sewer systems. Typically, communities implement these requirements through ordinances. In addition, communities are responsible for

--adopting their own ordinances and rules for flood control;

--taking actions (such as restrictors, ponding, etc.) that may help to alleviate flooding; and

--building, operating, and maintaining their local sewer system.

COMMUNITY ACTIONS VARY

Actions by the 54 communities to alleviate local flooding conditions varied widely. Some communities have done an outstanding job, while others have done little.

There are many reasons why some communities do not take more action.

--Some do not consider flooding a problem in their community.

--Some have very limited resources to devote to sewage and flooding problems.

--Some are almost fully developed, making certain flood control measures such as, above ground reservoirs and retention ponds, difficult to institute.

--Some have not completed engineering studies of sewer systems and do not know what action to take.

--Some officials stated they had not tried certain techniques because they do not work or would not completely solve the problem.

Following are examples of how communities have dealt with severe flooding problems.

Park Ridge

This northwest suburb, 99 percent of which is served by combined sewers, has severe basement and street flooding in several sections, due to inadequate local sewer capacity. It has taken the following actions:

--Since 1961, the city has spent $5.5 million funded by general obligation bonds, for four relief sewer projects.

--In 1974, it published a booklet entitled "Basic Information on Basement Flooding," recommending flood control measures to residents. The booklets were made available at the city hall.

--It has a regular sewer maintenance program. Each year, it cleans one-third of its 2,800 catchbasins, flushes one-fourth of its sewer lines, inspects 4,000 feet of sewers through television monitoring, and monitors additional sewers as needed.

--A 1968 ordinance requires downspout disconnection on new construction in certain areas. A 1977 study of over 10,000 homes in these areas showed that a third of downspouts are still connected. City officials believe downspout disconnection is not enforceable on

older structures because of drainage problems and cost to residents.

--Other ordinances require plaza ponding, overhead plumbing, and sump pumps on all new construction. An additional ordinance sets standards for construction on flood plains.

--The city attempted to use restrictors to create street or parking lot ponding; however, this action was frustrated by clogged restrictors and maintenance problems.

Community officials did not comment on the effectiveness of these flood-control measures.

Niles

This northwest suburb, of which 60 percent is served by combined sewers, has serious street flooding in several sections and severe basement flooding throughout, due to inadequate local sewer capacity and submerged outfall points. This community has taken the following actions:

--Its regular sewer maintenance program includes cleaning about 20 percent of its sewers and catchbasins each year. Sewers are inspected weekly for proper water flow and obstructions.

--It uses restrictors to limit the water flowing into main sewers. This measure relieves basement sewer backup problems by ponding water in the streets and parking lots.

--The community has a program to separate existing sewers wherever possible. Street drains are sealed off so that combined sewers only carry sanitary flow, then storm sewers are added.

--It passed an ordinance in 1957 requiring homeowners in flood-prone areas to disconnect their downspouts from the combined sewer system, and prohibiting such connection in all new construction thereafter. Additionally, officials recommend that all residents disconnect their downspouts from the combined sewers. They feel, however, a general requirement for existing homes to disconnect would be hard to enforce, costly for the homeowner, and politically unpopular.

According to a Niles official, these actions have been very effective in reducing flood problems. Overall, flooding has been reduced by an estimated 50 percent and complaints from residents have decreased drastically.

Arlington Heights

This northwest suburb, 50 percent of which is served by combined sewers, has severe basement backups and street flooding throughout the community. This flooding is caused by inadequate local sewers and extensive development on low, level terrain. Arlington Heights has taken the following actions to alleviate flooding problems:

--It funded three engineering studies from 1973 to 1975 at a total cost of $40,000. The studies recommended constructing a number of detention basins and sewer projects. To implement these recommendations, the village board issued three general obligation bonds totaling $14.5 million, which it funded by increasing individual property taxes by $40 per year. As of August 1978, $5.3 million has been spent.

--The use of retention basins has been emphasized. About 28 basins have been completed or proposed by the village or private developers. According to a village official, these basins are effective in reducing flooding--problems and complaints have decreased since their construction. In addition, many of the basins provide recreational benefits, such as boating and fishing, or are part of multiuse facilities including tennis courts and football fields.

--The village design manual for new construction requires storm water facilities, such as separate sewers, and storage facilities to compensate for flood plain construction and 100-year-frequency storm runoff, as well as ground water drainage.

--Arlington Heights passed a flood control ordinance in 1963, requiring downspout disconnection for all new construction. In addition, the village requires downspout disconnection for all structures in problem areas identified by village inspections.

--The village has a routine maintenance program to clean 30 percent of its 4,500 catchbasins and 50 percent of its sewer lines (combined and sanitary) annually. Television monitoring is also done as needed.

According to a village official, sewer maintenance activities have helped alleviate flooding problems.

--Streets are cleaned throughout the city every 30 days and every 6 days in the business district.

According to an Arlington Heights official, the community has not experienced a severe enough rainstorm to test the overall effects of its flood control measures. However, one official said that there was a noticeable decrease in flooding problems and complaints after retention basins were constructed. Further, increased sewer maintenance and repair has helped to alleviate flooding.

Wilmette

This northern suburb, about 50 percent of which is served by combined sewers, has serious basement and street flooding throughout, due to inadequate local and MSD interceptor sewers. The community has taken the following actions to alleviate flooding problems:

--It requires that all new parking lots and the roofs of all new apartment buildings be constructed to retain storm water.

--It passed an ordinance which prohibits connecting downspouts on new construction and requires sump pumps and ejector pumps in new remodeled buildings. Downspouts on all public buildings have been disconnected.

--It has promoted downspout disconnection and installation of flood control devices through articles in the village newsletter.

--In 1976, village contractors constructed a storm relief sewer in the separate sewer area to reduce street and basement flooding.

--Over the past 10 years, Wilmette has increased the capacity of a pumping station which discharges storm water into the north branch of the Chicago River.

--The village has installed restrictors in sewers on 5 to 10 percent of the streets and is sealing lift holes in all sanitary sewer covers to reduce storm water infiltration.

--In 1978 Wilmette completed a 2-year program to jetclean both sewer systems, and all catchbasins were cleaned

during fiscal year 1977. The village is continuing an annual program of jetcleaning both sewer systems.

--Sewer inspections and repairs are done as needed.

--All streets are cleaned each month, weather permitting.

--Between June 1968 and September 1969, the village used smoke detection techniques to identify 400 illegal connections in the separate sewer area. To date, community actions have resulted in homeowners' compliance in all but three of these cases.

--During 1957-77, Wilmette funded three engineering studies of the adequacy of the sewer system and the Tunnel and Reservoir Plan's (TARP's) effect on the community.

A village official stated the above actions were effective in reducing flooding. He estimated that storm water runoff has been reduced or delayed by about 15 to 20 percent.

SECTION 3

WHAT A COMMUNITY SHOULD DO

A total solution to community flooding problems is not in sight. Many local communities lack the funds needed to rebuild or renovate their sewer systems. Further, it is still uncertain whether TARP phase II, needed for flood damage control, will ever be completed. Even if phase II is built, it would probably be in the 1990s and even then many communities with severe flooding may not be helped.

Thus, communities need to take the initiative and implement those actions they can afford. Each community should recognize that small-scale measures offer some relief without vast expenditures.

A structured approach is necessary if basement backups are to be effectively stemmed. A worthwhile program usually involves

--an initial study of the existing system, in which problems are identified and possible solutions are discussed;

--educating of residents;

--regular maintenance and cleaning;

--passing and enforcing flood control ordinances such as downspout disconnection; and

--reviewing and adopting low-cost techniques.

INITIAL STUDY

The key to profitable action is for the community to learn as much as it can about the existing sewage system and the causes of local flooding. Without such a study, a community is severely handicapped in seeking solutions. Under Public Law 92-500, the Environmental Protection Agency will provide 75-percent funding--in a step 1 grant--for such a study. The objective is to provide information on various alternatives to a community's water pollution problems and identify the most cost-effective solutions. In addition, the study may analyze the flow of storm water into combined sewers through such means as cracked sewer lines. If inflow is excessive, a detailed evaluation identifies specific sections of the sewer which need renovation. These studies often suggest various solutions; however, they tend to

recommend large, costly construction projects, with little emphasis on low-cost approaches.

Of the 54 communities in the combined sewer area, 26 have received step 1 grants and another 12 have applied as of January 1979. Federal officials in the State said every one of the 54 communities is eligible for such a grant and funds are available. The following table shows the step 1 grant status for each of the 54 communities.

Community	Grant received Amount	Date
Arlington Hts.	$ (a)	-
Bedford Pk.	(b)	-
Berwyn	(a)	-
Blue Island	15,000	4/14/78
Broadview	46,725	7/22/78
Brookfield	57,750	2/ 6/78
Burnham	(a)	-
Calumet City	39,750	7/26/77
Calumet Pk.	(b)	-
Cicero	(b)	-
Chicago	(a)	-
Des Plaines	(a)	-
Dixmoor	(b)	-
Dolton	20,475	4/14/78
Elmwood Pk.	57,375	6/17/77
Evanston	21,000	1/25/77
Forest Pk.	(a)	-
Forest View	(b)	-
Franklin Pk.	323,100	10/29/76
Golf	6,900	7/22/77
Harvey	(b)	-
Harwood Hts.	(b)	-
Hometown	(b)	-
Kenilworth	48,825	9/28/77
La Grange	47,625	11/30/76
La Grange Pk.	25,275	6/16/77
Lansing	56,100	6/17/77
Lemont	$ (a)	-
Lincolnwood	(b)	-
Lyons	(a)	-
Markham	(b)	-
Maywood	30,000	6/13/77
Melrose Pk.	45,450	1/26/78
Morton Grove	(a)	-
Mount Prospect	306,750	7/22/77
Niles	100,650	7/21/77
Norridge	120,300	10/26/76
North Riverside	(a)	-
Oak Pk.	(b)	-
Palatine	393,525	10/31/77
Park Ridge	45,075	6/13/77
Phoenix	(b)	-
Posen	(b)	-
Riverdale	(b)	-
River Forest	(a)	-
River Grove	(b)	-
Riverside	(b)	-
Schiller Pk.	25,875	6/30/77
Skokie	151,650	2/28/77
South Holland	44,025	4/19/77
Stickney	(a)	-
Summit	15,000	11/15/77
Western Sprgs.	26,250	8/09/77
Wilmette	82,650	9/29/78

a/The community has applied for, but not yet received its grant.

b/The community has not applied for a grant.

EDUCATION

Educating the public on how to deal with basement flooding can help people understand the problem and related damages. Several communities (Skokie, Evanston, Des Plaines, and Park Ridge, among others) have published excellent pamphlets on their situations. (See app. I for a sample.)

Every community with a flooding problem should seriously consider publishing a pamphlet that could be made available to each resident, including newcomers. Such a pamphlet should explain the problem and its causes, actions the resident should consider, and actions the community is taking. The need to publish this type of pamphlet can perhaps be best illustrated by the following comments from an irate homeowner:

> "I just moved into this house July 7 and right at this moment water is pouring into the basement for the 2nd time since July (and) I'm so discouraged I don't know what to do or where to begin."

SEWER MAINTENANCE AND STREET CLEANING

Routine maintenance, including preventive measures, is essential for a system to operate efficiently. According to several consultants and community officials, sewer maintenance is frequently performed only on an emergency basis. For example, rather than routinely cleaning the system, the community will clean it only when blockage occurs.

According to our consultants, most communities neglect maintenance since it is the action not evident to the citizenry.

Most experts feel that regular cleaning of a community's streets helps to keep debris out of the system. Many streets accumulate debris and silt over a period of time. (For example, in 1977, Chicago, in cleaning 200,000 curbmiles of streets, removed 19,000 tons of dirt and debris.) When it rains, this debris is swept into the sewage system, thus cutting down on the system's flow.

According to local officials in one Chicago community, the frequent flooding of an underpass on a State-controlled road in the community partly results from the State's failure to properly clean the street. Debris accumulates in the underpass and rain sweeps it into the drain openings, clogging the drain and pumps.

Deterioration causes problems

A poor local sewer system is one of the primary causes of basement flooding. The following shows the condition of sewers in the 54 communities, as characterized by local officials.

Condition (note a)	Number of communities
Poor	4
Fair	8
Inadequate	18
Adequate	6
Good	14
Unknown	3
Mixed	1

a/Description varies because it was based on community officials' perceptions.

Generally, those communities with systems classified as good or adequate had less severe basement flooding than those whose systems were classified as poor, fair, or inadequate.

Troublesome sewers result from various causes, including

--the growth of the community beyond sewer system capacity,

--the loss of recharge areas as communities pave ground or cover it with buildings, and

--inadequate maintenance.

The results of communities developing beyond their sewer capacity and omitting preventive maintenance on aging sewer lines is illustrated by engineering consultants' comments on sewer systems in Evanston and Golf.

Evanston has severe, widespread basement and street flooding, partly because local sewers are unable to convey even minor storm runoffs. According to engineers, this community's sewer system is antiquated, badly deteriorating, and composed of a disproportionate amount of small pipes. More specifically, engineering studies show that

--sewer lines have been infiltrated by tree roots and suffer serious leakages from 90 percent of pipe joints,

--4,000 of the 5,000 catchbasins need repair, and

--many brick basins are caving in.

Severe basement and street flooding due to an inadequate sewer system is experienced in certain sections of Golf. According to engineers, the sewer system suffers from root infiltration, deposits, and structural failure. The engineers concluded that the entire system should be cleaned and investigated for areas needing structural rehabilitation.

Our consultants have said that money spent on routine and preventive maintenance will pay dividends in increased system efficiency. When maintenance is neglected and the system has infiltration, deposits, etc., it may not be able to handle its design capacity. When that happens the potential for water backing up into basements is sharply increased. For example, in one community engineers recommended that maintenance and rehabilitation programs be accelerated to arrest rapid deterioration of sewers and to improve system efficiency.

ORDINANCES

Local ordinances, if enforced, can help prevent flooding. Ordinances can be used to prevent building in flood plain areas, require disconnection of downspouts, require ponding and detention facilities in commercial areas, and require water conservation.

MSD requires each community in its service area to adopt certain rules, contained in a manual of procedures governing the issuance of required sewer permits. Some of the provisions are:

--Since December 1970, basements, floors, rooms, or occupancy areas below ground level in all new buildings have been required to have overhead plumbing.

--Since January 1972, most new construction projects located in unsewered or separate sewered areas have been required to have storm water runoff detention. MSD has no detention requirements for the combined sewer areas, but local governments may establish their own.

--Connection of downspouts to separate sanitary sewers is prohibited, but not to storm or combined sewers. Local governments may prohibit connection to combined sewers if they wish.

Some local communities have adopted flood control ordinances or rules beyond MSD's requirements. For example, some communities have passed ordinances requiring that all downspouts be disconnected from the sewer system.

INEXPENSIVE MEASURES

What are the alternatives to large-scale construction projects or to extensive rebuilding of local systems? A community can do many things to provide relief, realizing that these approaches may not totally solve the problem. Many communities in the Chicago metropolitan area, across the Nation and in countries overseas have had success with the various methods discussed below. (Each of the following methods will be discussed in greater detail in our upcoming report on nationwide combined sewer problems.)

Basically, alternative approaches involve

--retaining the water in above-ground storage areas,

--slowing the flow of water into the system to reduce peak loads,

--educating the public on devices which can be installed in individual basements to prevent flooding (see p. 11),

--upgrading sewer maintenance and cleaning (see pp. 11 to 13) and street cleaning,

--using on-line or off-line storage devices in the system, and

--constructing relief projects in limited areas.

Retaining storm water

Various means can be used at ground level or above to store the storm water before it enters the sewage system, thus reducing the peak load. Some of the more popular methods involve:

--Rooftop reservoir. Building code regulations often require that flat-roofed structures be able to support at least 6 inches of standing water. Flow regulators installed in downspouts could retain water on rooftops during storms and release the accumulation slowly after storms have subsided.

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--Parking lot ponding. Temporary storage on remote sections of parking lots can be accomplished by reducing the size of storm drain inlets or by increasing the space between inlets.

--Plaza ponding. Large shopping centers or office building plazas can install depressed sodded areas. These could be aesthetically attractive for fair weather enjoyment. During a storm, these depressed areas would fill with water that would slowly seep into the planted area after the storm.

--Berms and swales. These are slight mounds and depressions around residential and park areas intended to prevent excess storm waters from running off lots and entering storm sewers.

--Temporary flooding of natural and recreational areas. These areas can be used for temporarily storing runoff from adjacent areas. Because of grass cover, recreational areas retard the flow of water.

Delaying inflow

Aside from methods of trapping water, certain measures can be taken to delay the flow of water into sewers during storms.

--Disconnecting downspouts. Through this approach, storm water is directed onto yards or pavement to slow the rate of flow into the sewer system and provide for some absorption into the ground.

--Porous pavement. This type of pavement allows water to penetrate through it and be temporarily stored in the underlying layers of ordinary gravel. The water slowly filters from the gravel into natural soil.

--Using restrictors. Communities have installed restrictors in sewer inlets or catch basins to reduce runoff to the sewers. This approach causes storm water to drain slowly or at a predetermined rate into the sewers.

Disconnecting downspouts deserves further discussion, since it is a very inexpensive way to achieve some flood relief. The experience of the Springfield Sanitary District in Springfield, Illinois, demonstrates the benefits of disconnection. Because of persistent sewage backup complaints, as many as 300

in a day, the Springfield Sanitary District instituted a downspout disconnection program, which included improved sewer maintenance and additional sewer construction. Subsequently, Springfield, Illinois, officials initiated a similar program for areas within the corporate limits of the city. Both of these disconnection programs have substantially reduced basement flooding.

Storing storm water

Storage is available for reducing pollution from combined sewer overflows and for managing urban storm water runoff. Storage within sewer lines can be activated by automatically monitoring flows in the sewer system. Off-line storage can be achieved by such devices as tanks, tunnels, and holding basins. Inherent in many of these storage schemes is the pumping of stored water to treatment plants during off-peak hours.

Relief sewer projects

If sources of flooding can be identified, constructing relief sewers may eliminate problems. For example, constructing a storm relief sewer line in an area of severe street flooding may provide sufficient sewer capacity to absorb the excess storm water.

MSD COMMENTS

According to MSD officials, several of the approaches discussed in this volume to solve flooding problems merit consideration and can possibly be used to help certain local drainage problems. However, these officials conclude that the methods, either individually or in combination, do not meet the following water management goals in the combined sewer area and, therefore, cannot be used as a replacement for TARP:

--Prevent backflows into Lake Michigan.

--Eliminate waterway pollution caused by combined sewer overflows.

--Provide an outlet for flood waters.

--Comply with Federal and State environmental laws.

--Accomplish results in the most cost-effective manner.

We agree that the various alternatives discussed in this volume will not provide the extent of flood control which TARP is designed to supply. However, the questionable funding status of TARP phase II and the fact that TARP phase I will not be completed until 1987 raises serious doubts as to whether its flood control benefits will ever be derived. Given this situation, communities must try alternative approaches if some measure of flood relief is to be attained in the near future.

SECTION 4

WHAT THE HOMEOWNER CAN DO

Homeowners can take certain actions--some at low cost--to reduce or eliminate problems caused by sewer backups. Unfortunately, some backup problems are so severe that they leave homeowners little recourse unless they can or are willing to spend several thousand dollars. Even then, problems from flooding may not completely be solved. The causes of basement backup are complex and the solutions are just as elusive. Because basement flooding is caused by various factors (see figures 1 and 2 below), generalized solutions are difficult to recommend. Those which succeed under one set of circumstances may fail under others.

Before deciding on any flood control measures, a homeowner should seek expert advice, normally from a reputable plumbing contractor. This diagnostic help will allow the homeowner to weigh the cost, the effectiveness, and the possible side effects of various flood control measures.

FLOOD CONTROL DEVICES

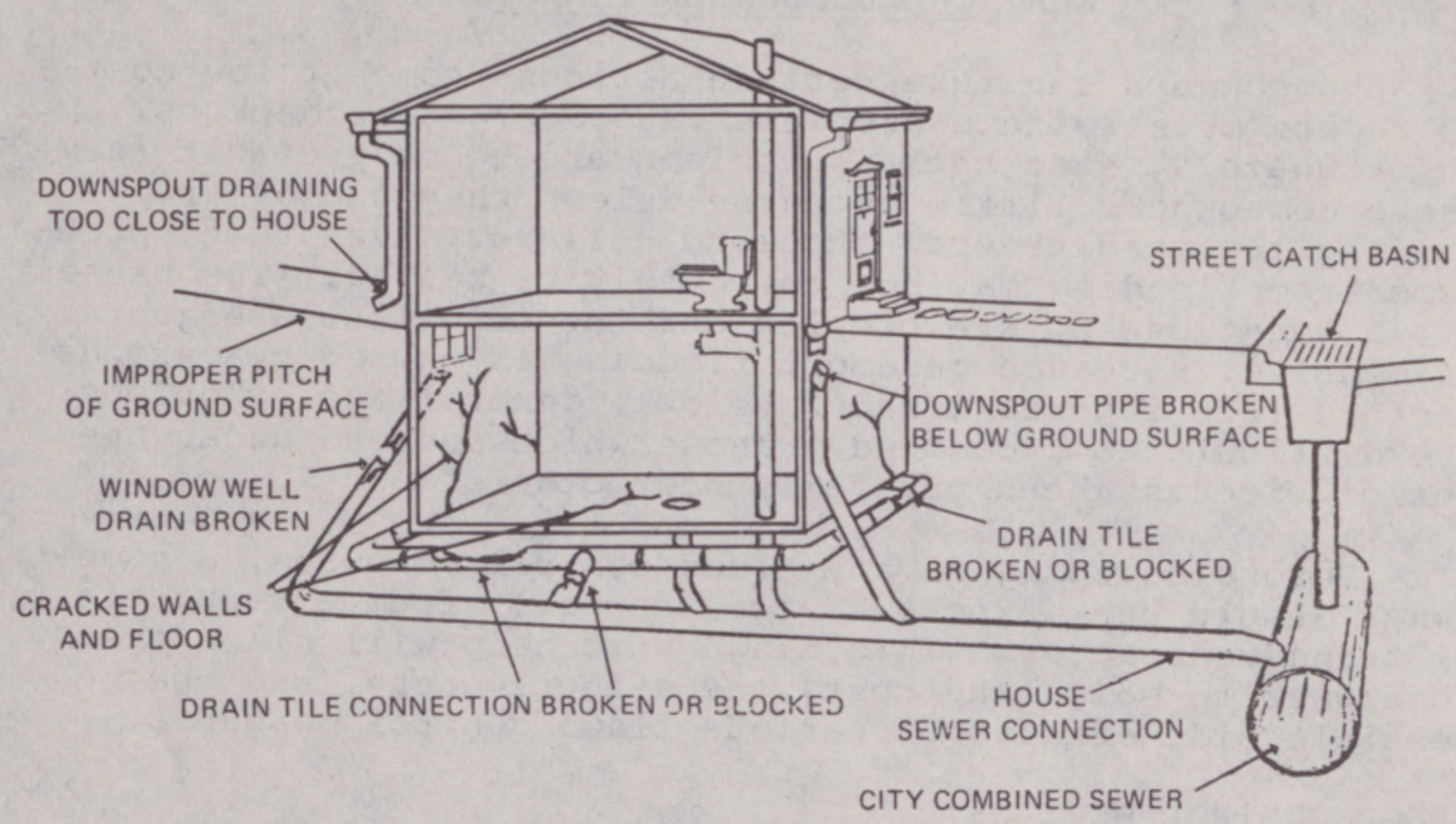
Some homeowners have successfully emphasized devices that either prevent water from entering the basement or provide a means of drawing water away from basement floors and walls. Unfortunately, others have had little success with these devices.

Such devices and their effectiveness are discussed below.

Plugs

Plugs can be inserted into floor drains to cap the drain. (See figure 3.) If properly installed, they will keep water from backing up from the floor drain. However, if the water level keeps rising, it can back up through other basement openings such as toilets, showers, and laundry tubs. If this happens, plugs can be installed in these drains. While drain plugs work for some homeowners, they can cause problems for others by putting pressure on the sewer line. If sewer pipes are deteriorated, water can leak out of loose joints and cracks, accumulate under the floor, and create pressure that may buckle the floor. According to plumbing contractors, where water normally backs up just around the drain or only a few inches deep, pressure caused by inserting a plug would probably be insignificant.

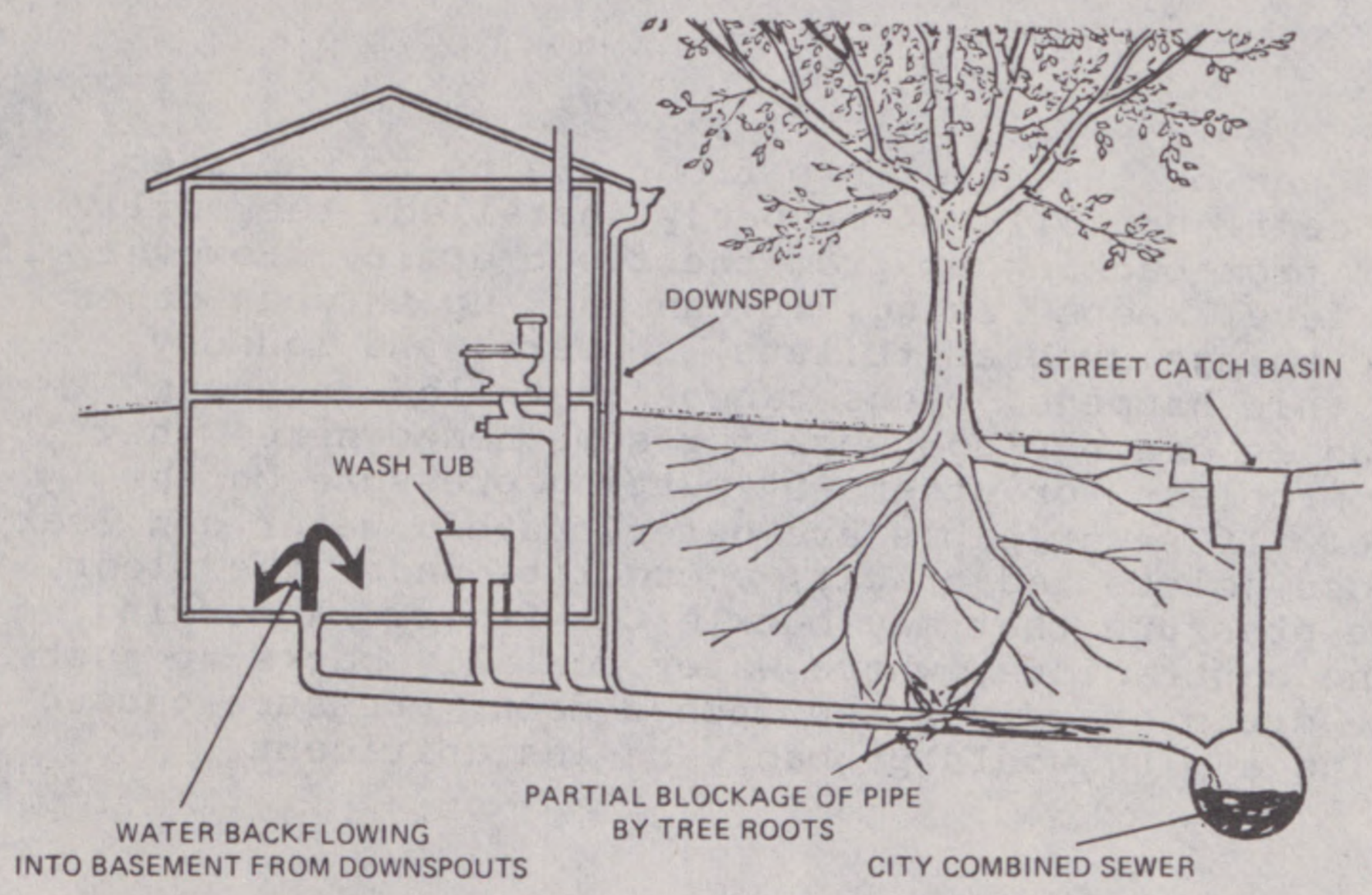
FIGURE 1



WATER SEEPAGE THROUGH FLOORS AND WALLS

SOURCE: CITY OF EVANSTON, ILLINOIS

FIGURE 2

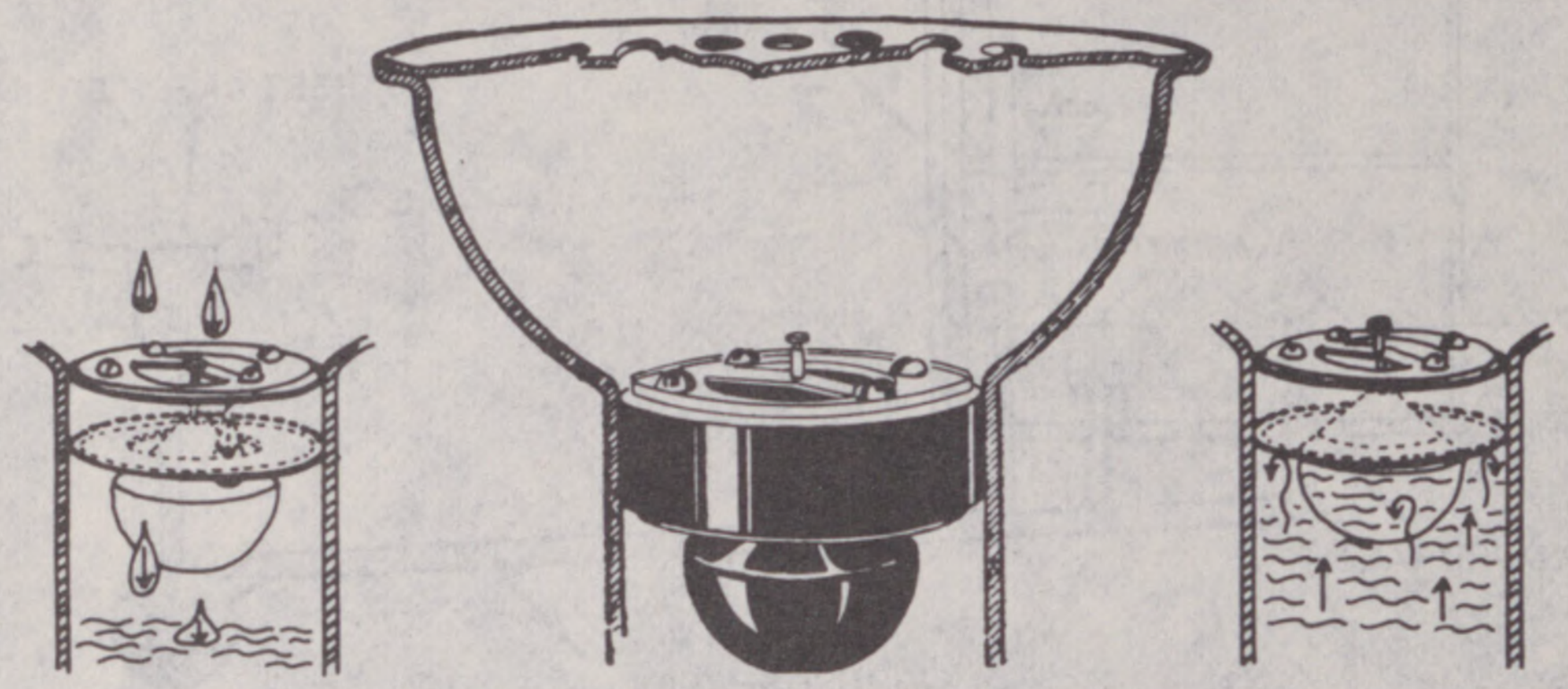


TREE ROOTS PARTIALLY BLOCKING PIPE

SOURCE: THE CITY OF EVANSTON, ILLINOIS

A plug will cost from $15 to $60, depending on the type and whether it is installed by the homeowner or a plumber.

FIGURE 3



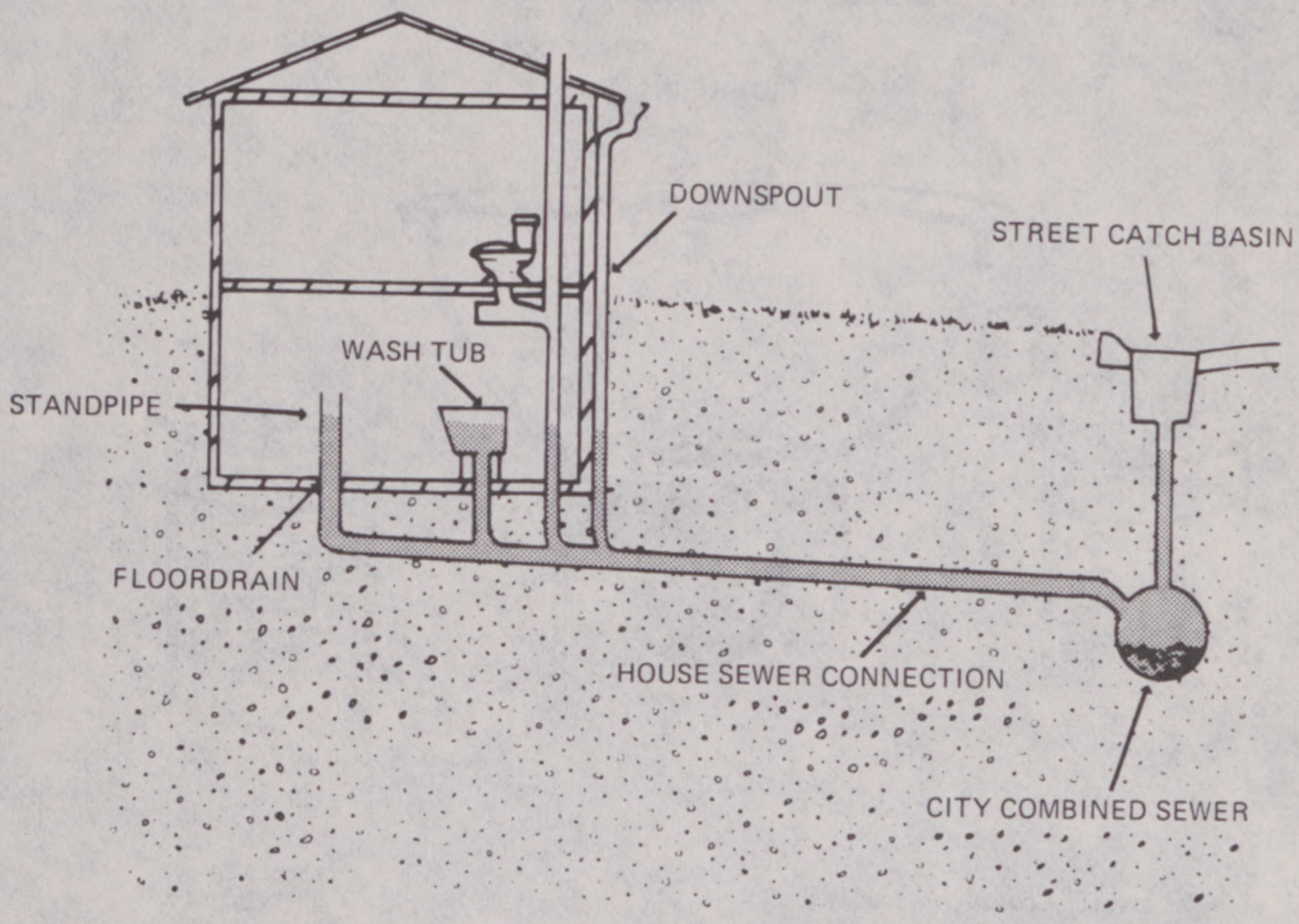
DRAIN PLUG

SOURCE: SINDELL LTD., MILWAUKEE, WISC.

Standpipes

A standpipe is an open-ended pipe inserted tightly into a drain and is similar to a plug in function and cost. (See figure 4.) The major difference is that the standpipe will stick up (from a few inches to 30 inches) above the drain. A standpipe serves as a reservoir for minor backups. However, if the water exceeds the height of the pipe, it will overflow onto the basement floor. Properly installed standpipes will prevent minor sewer backups, but like drain plugs, may cause basement floor cracking from water pressure.

FIGURE 4



STANDPIPE INSTALLED IN A
COMBINED SEWER SYSTEM

SOURCE: THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

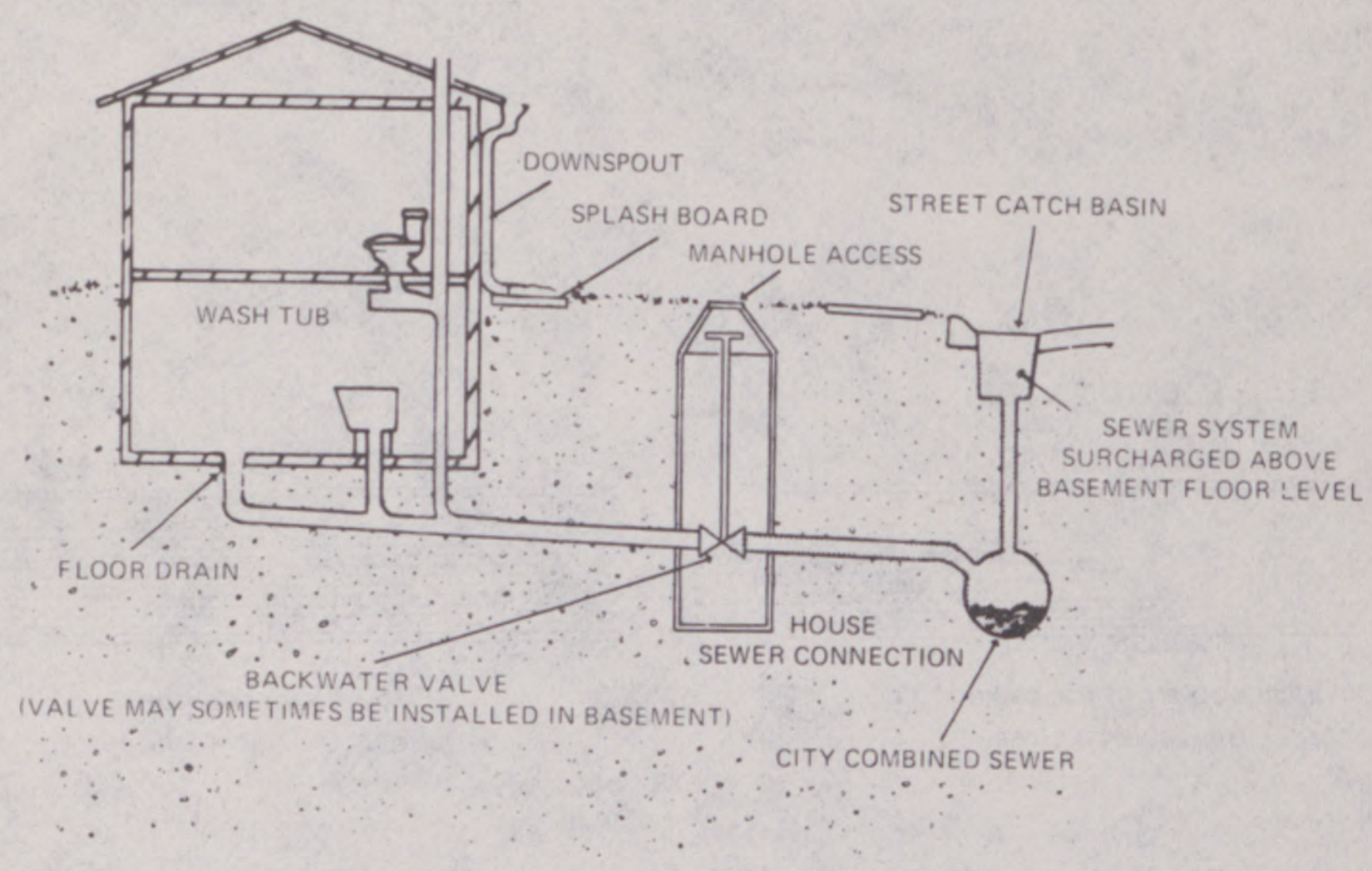
Check valves

Various types of valves are available which prevent water from backing up into the basement. Some close automatically when the flow through the sewer line reverses. Some are mechanically operated by control devices and some are manually operated. A disadvantage of manually operated valves is that they must be closed whenever there is a storm that could cause flooding. Check valves are normally installed in the house sewer line under the basement or between the house and street sewer. (See figures 5 and 6.)

Since valves have moving parts, they require periodic maintenance. Unless they are periodically maintained and cleaned, valves may not provide homeowners with reliable flood protection. Also, debris in sewer lines may prevent the valve from closing. When a valve is tightly closed to prevent sewage backup into the house, it could, depending on its location, prevent outflow of household sewage unless a bypass and pump are installed. Thus, the homeowner may not be able to use the house plumbing.

Valves normally range from $300 to $3,000, depending on the one selected and the installation method chosen.

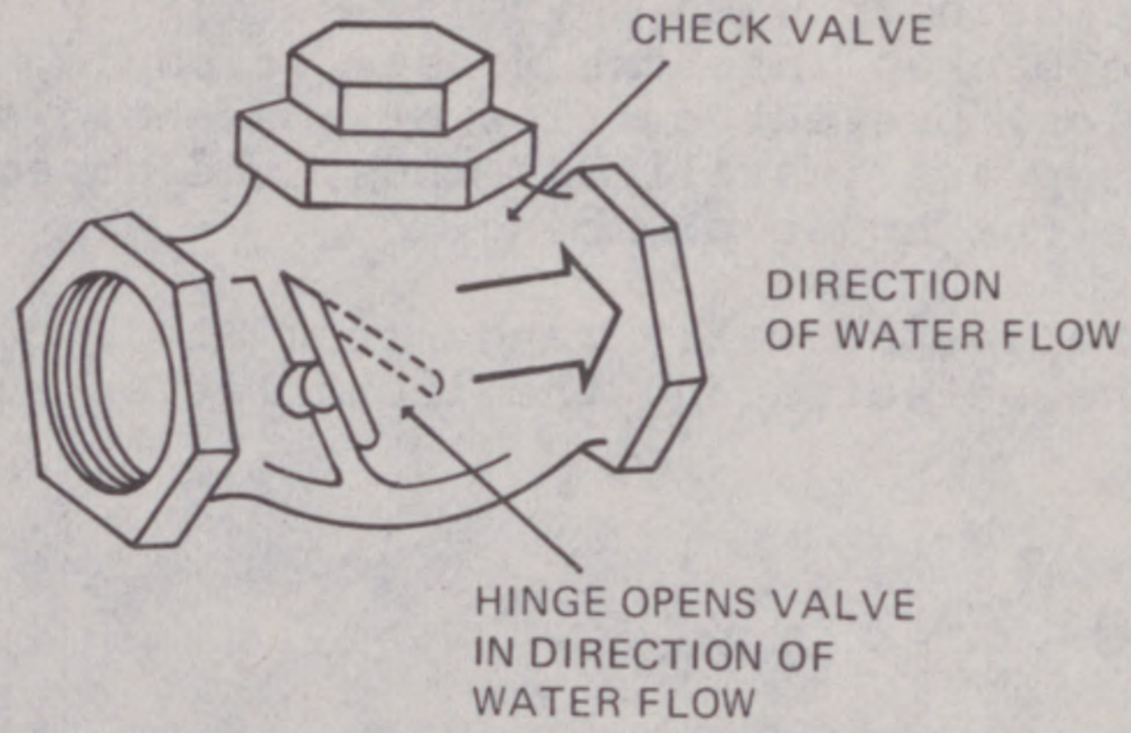
FIGURE 5



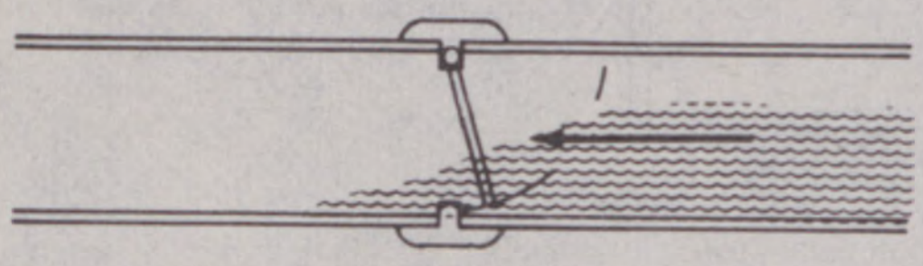
CHECK VALVES INSTALLED IN
A COMBINED SEWER SYSTEM

SOURCE: THE CITY OF EVANSTON, ILLINOIS

FIGURE 6

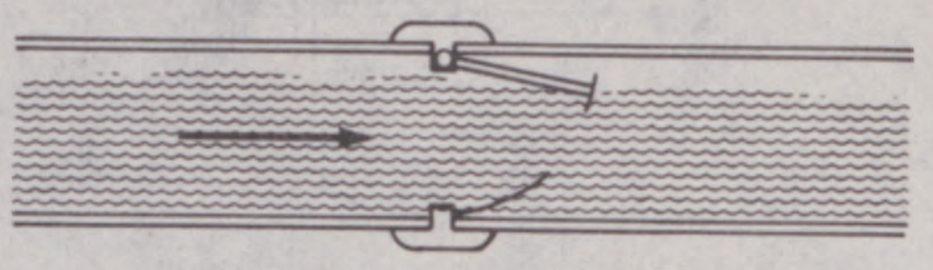


CROSS SECTION VIEW



any backup from the sewer
causes the valve to close

CROSS SECTION VIEW



flow from the house
allows the valve to open

ILLUSTRATIONS OF A CHECK VALVE

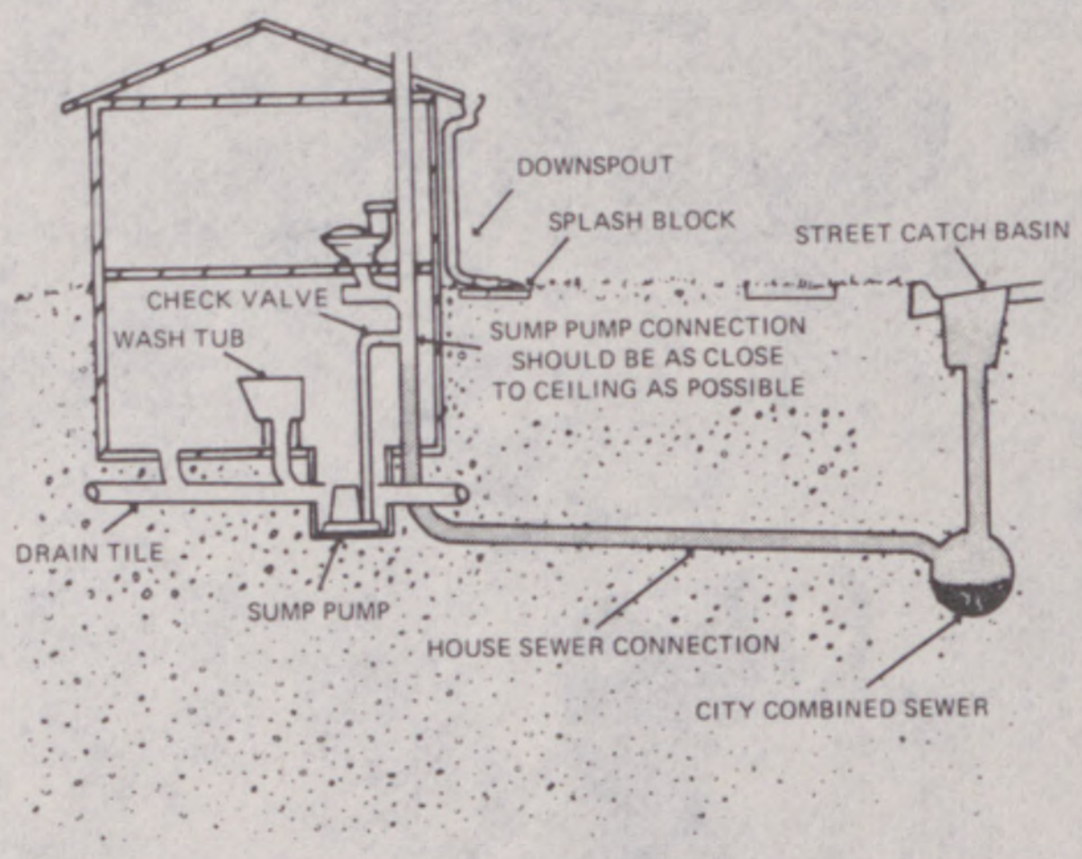
SOURCE: CITY OF PARK RIDGE, ILLINOIS

Sump pump

This device does not directly prevent sewage backups, but rather pumps out water that accumulates in a basement sump pit. (See figures 7 and 8.) It is often used in connection with other actions to improve the chances of eliminating basement water. A sump pump can, for example, relieve pressure on walls and control seepage. In a combined sewer area, a sump pump can be set up to collect water from drain tiles, sinks, washing machines, and floor drains. The direct connection between the floor drain and the sewer system could thus be eliminated. Unfortunately, sump pumps depend on electricity, which sometimes fails during a rainstorm. For example, over 100 respondents to our questionnaire said pumps were very effective until the power failed.

Sump pumps cost from $75 to $800, depending on the type and installation method.

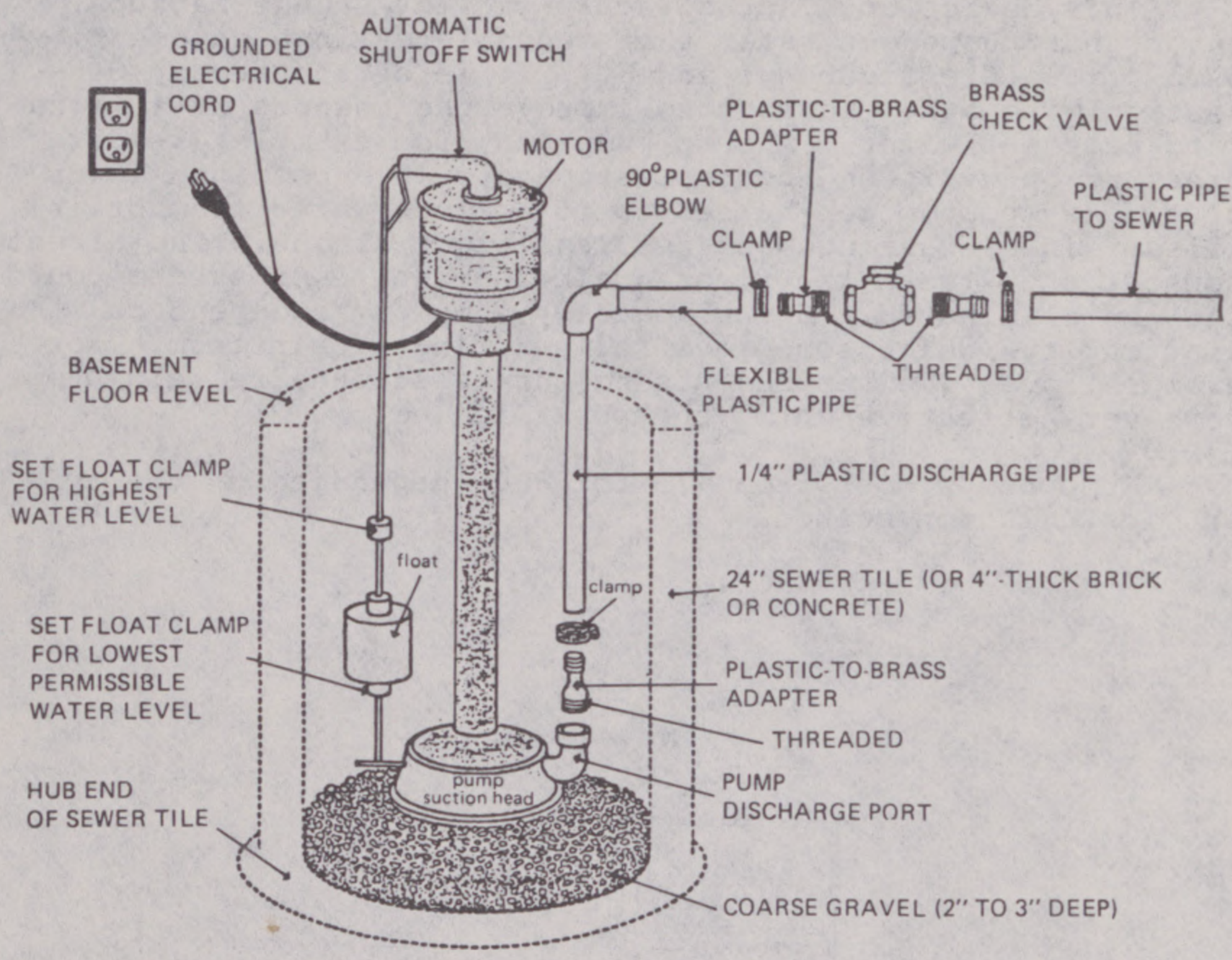
FIGURE 7



SUMP PUMP INSTALLED IN A COMBINED SEWER SYSTEM

SOURCE: THE CITY OF EVANSTON, ILLIONIS

FIGURE 8





PEDESTAL-TYPE SUMP PUMP

SOURCE: THE AMERICAN CRUCIBLE PRODUCTS COMPANY, LORAIN, OHIO

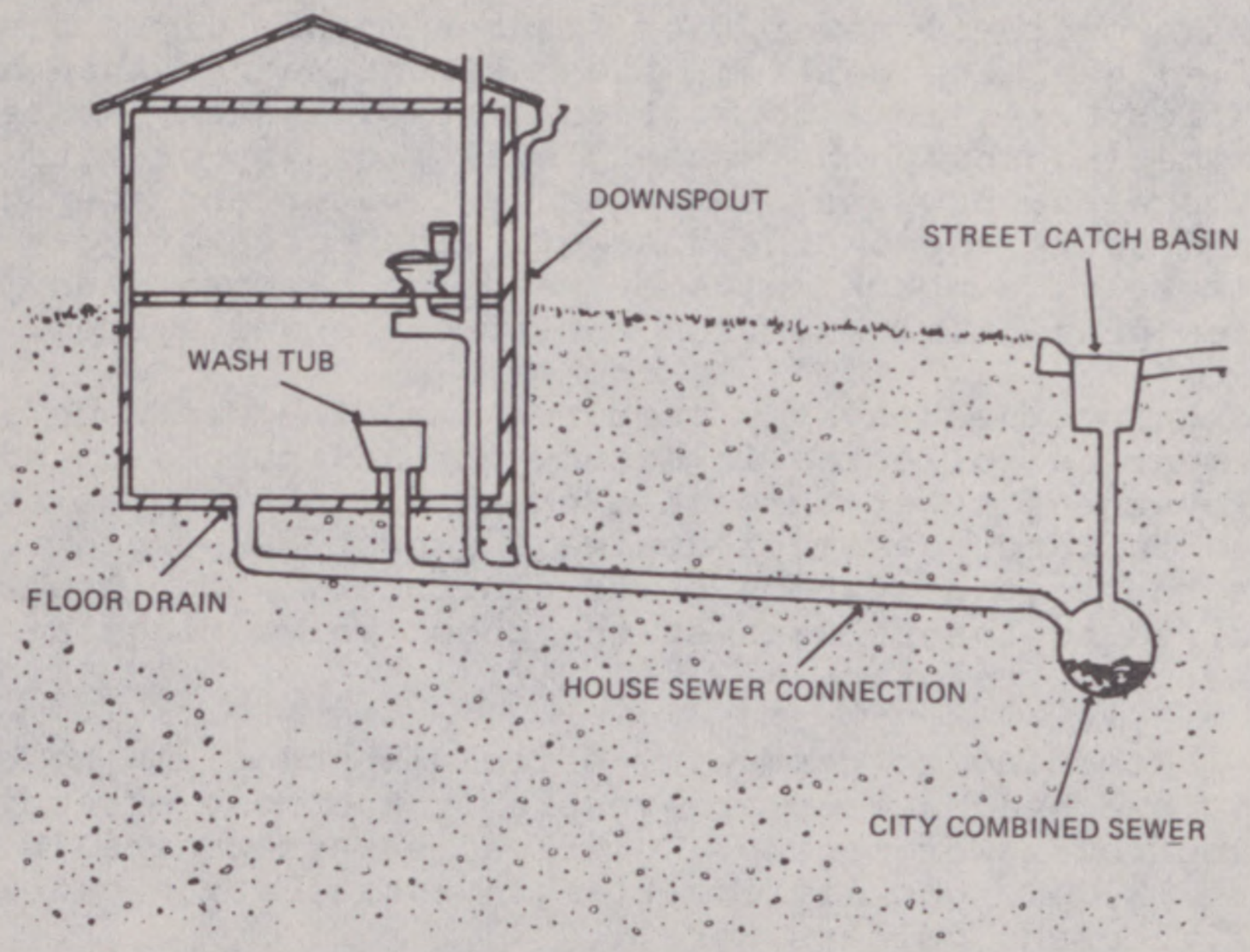
Overhead sewers

An overhead sewer (see figures 9 and 10) is a system installed near the ceiling of a basement rather than beneath the floor. As in a conventional sewer system, wastewater originating above the street level flows by gravity into the city sewers; however, basement wastewater and seepage is pumped up to the overhead sewer. The force of gravity, and ultimately, a check valve between the basement and the sewer system prevent backup from the street sewer system.

An overhead system requires that the drainage in the basement be collected in a sump pit and pumped up and into the overhead sewer through a check valve. In the event of power failure, basement drainage cannot be pumped out, unless there is a standby power generator. Maintenance is required to insure against the check valve clogging or mechanical failure.

According to community officials and plumbing contractors, overhead sewers are generally the most effective device to control sewer backup. Overhead sewers generally cost about $2,000, but difficulties in installation can add several thousand dollars more.

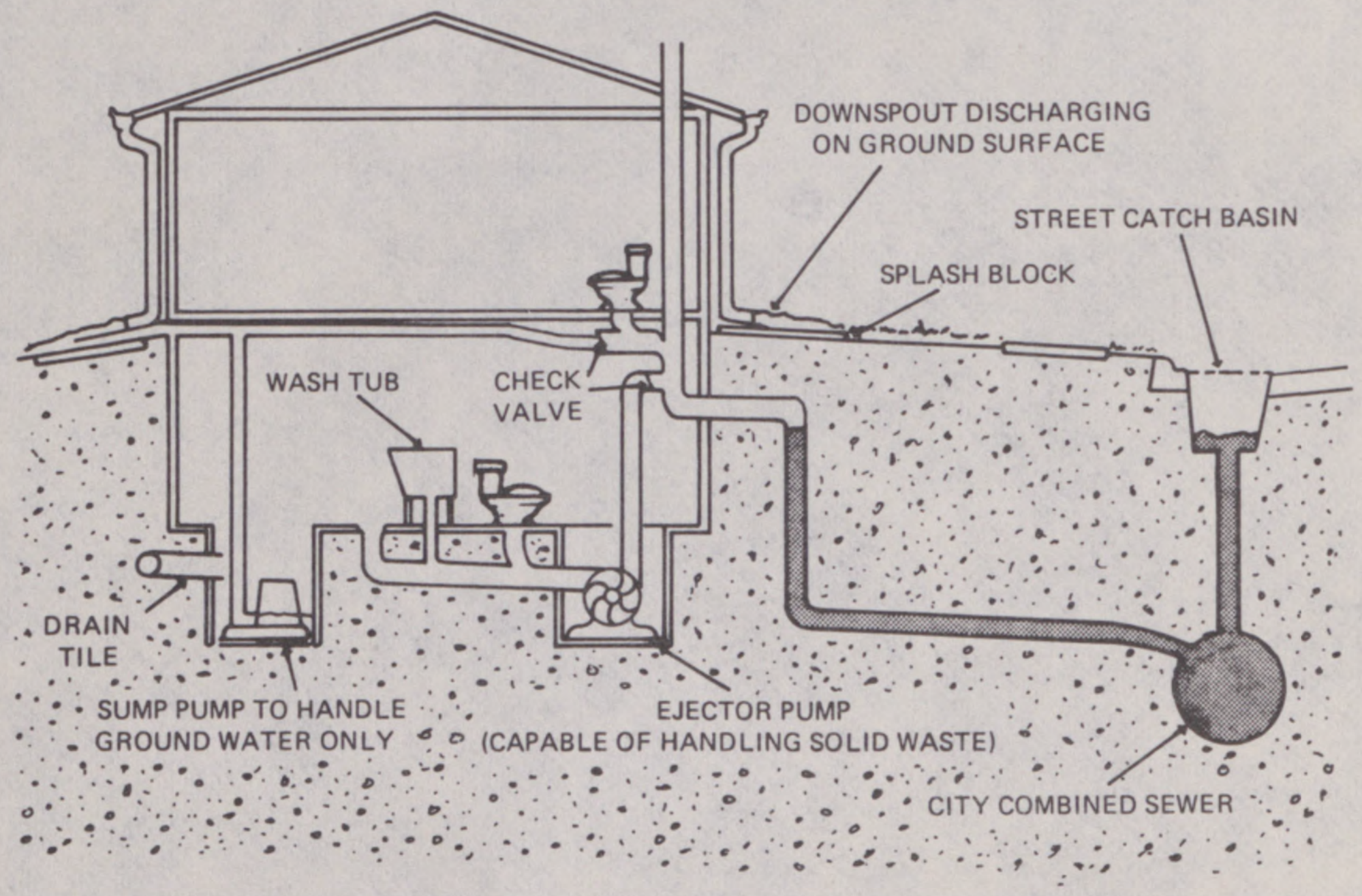
FIGURE 9



CONVENTIONAL COMBINED SEWER SYSTEM

SOURCE: THE CITY OF EVANSTON, ILLINOIS

FIGURE 10



OVERHEAD PLUMBING INSTALLED IN A
COMBINED SEWER SYSTEM

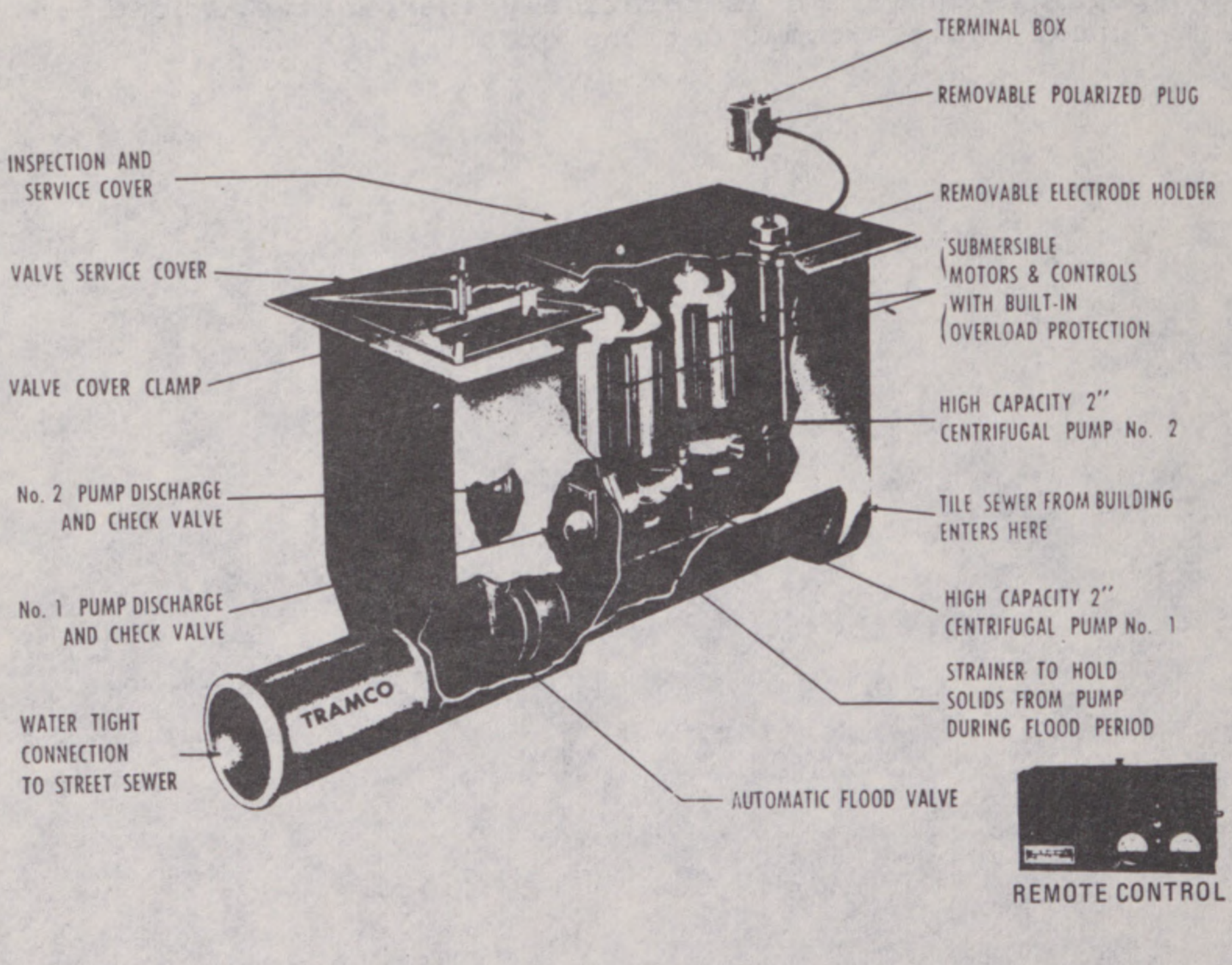
SOURCE: CITY OF EVANSTON, ILLINOIS

Flood control systems

Many homeowners have installed systems popularly termed "flood control systems." These combine pumps, check valves, and ejector systems. Typically, all drainage systems below street level load into a basin, where the water is ejected from the basement. These systems have been described by plumbers as very effective, though they do require some maintenance.

Flood control systems range from $1,500 to $5,000.

FIGURE 11



FLOOD CONTROL SYSTEM

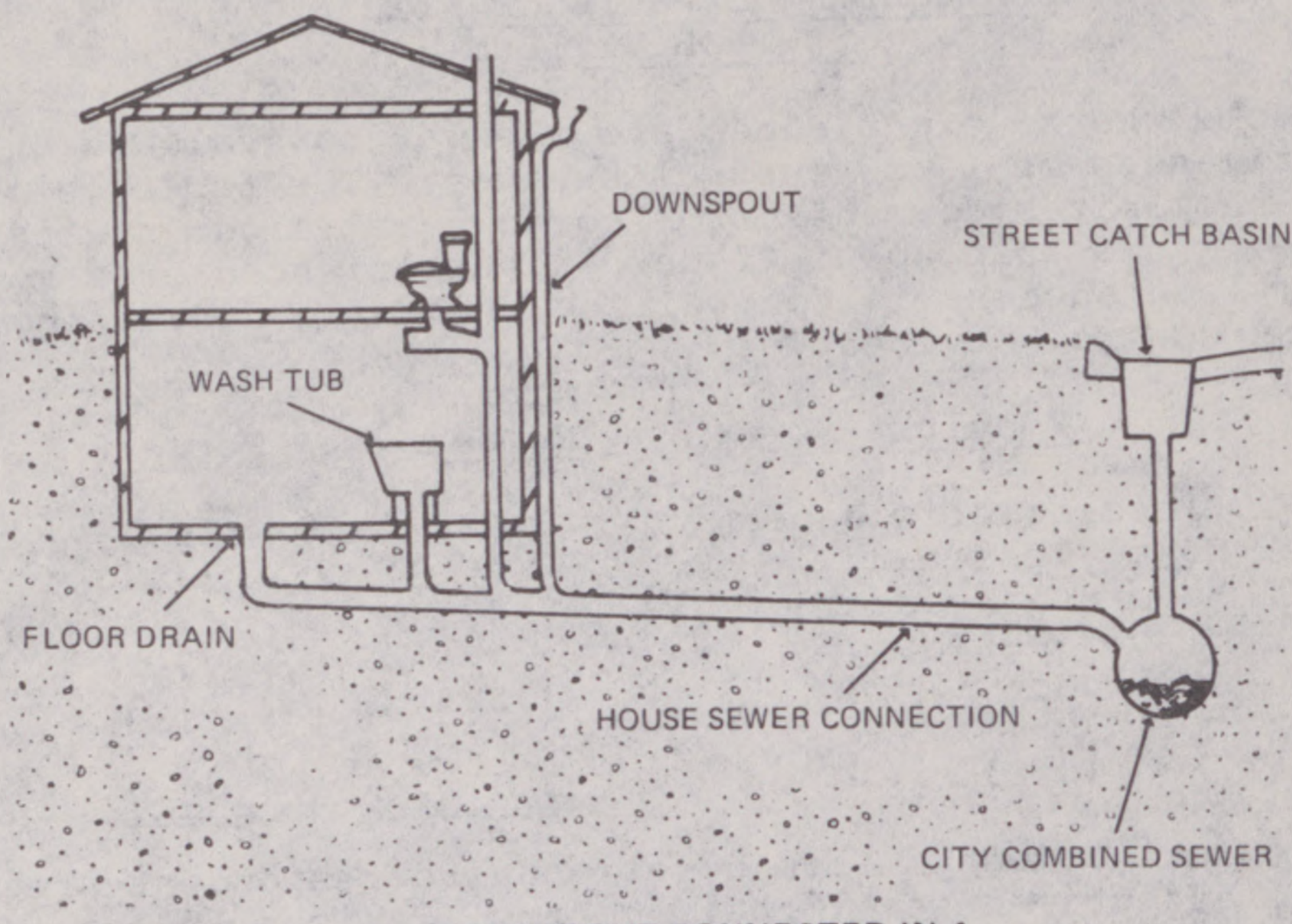
SOURCE: TRAMCO PUMP COMPANY, CHICAGO, ILLINOIS

Disconnecting downspouts

Rainwater which falls on the roof is normally collected in gutters at the roof's edges and runs through downspouts either directly to the sewer system or into the drain tiles and then to the sewer system. (See figure 12.) Either way, the downspout causes the water to flow rapidly from the roof to the sewer system, which greatly increases the possibility for basement backup. When the water empties into the drain tiles, the chance for basement seepage problems are increased.

Homeowners can disconnect their downspouts from the sewer system if local ordinances permit such actions. The simple procedure of disconnecting downspouts and discharging the water to splashblocks away from the building can substantially reduce water in basements. (See figure 13.) Downspout disconnection is relatively inexpensive, about $15 a downspout, unless complications exist.

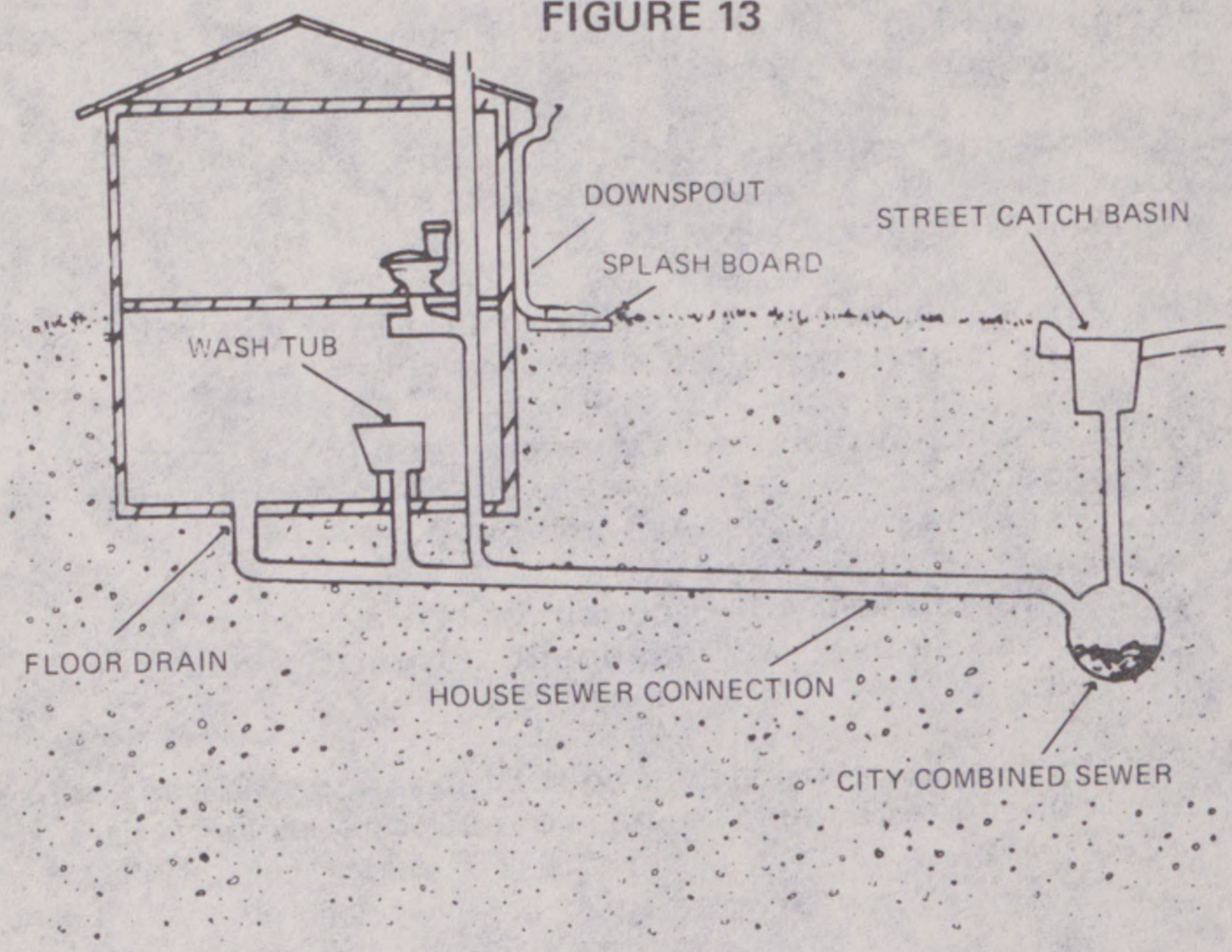
FIGURE 12



DOWNSPOUT CONNECTED IN A
COMBINED SEWER SYSTEM

SOURCE: THE CITY OF EVANSTON, ILLINOIS

FIGURE 13



DOWNSPOUT DISCONNECTED IN A
COMBINED SEWER SYSTEM

SOURCE: CITY OF EVANSTON, ILLINOIS

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SECTION 5

HOMEOWNERS' EXPERIENCE WITH FLOOD CONTROL DEVICES

Homeowners' experiences are one way to evaluate the effectiveness of flood control devices. The table below, which summarizes comments from homeowners in our statistical sample, shows that about 47 percent experienced from moderate to complete success in controlling their flooding using various control devices.

Results	Number	Percent
Flooding eliminated	930	26.1
Major lessening	40[illegible]	11.3
Moderate lessening	327	9.1
Minor lessening	328	9.2
No impact	1,582	44.3
Total	3,570	100.0

Typical comments from questionnaire respondents regarding the effectiveness of their control devices follow:

--"Converting to overhead sewers has solved my problem, except during power failure."

--"Since we installed our flood control in 1971, we have had no problems."

--"I have not experienced flooding since 1972 (August). That year I had water 6 times. I installed a check valve in October of 1972."

--"No flooding problems since installation of standpipe and rodding out line to street."

--"When backup pressure from the sewer is too great, it forces the water between the floor and side wall--the standpipes are of no use."

--"Since we installed a check valve between the street and house our basement flooding has been eliminated."

We further analyzed the effectiveness of flood control devices by looking at questionnaire responses from 103

residents in 32 communities who eliminated their flooding problem. These residents, who experienced basement flooding during heavy rainstorms, successfully stopped such flooding by using multiple devices and methods as summarized in the following table.

Devices and Methods People Used to Eliminate Their Flooding Problem

Installed removable drain plug	7
Installed standpipe(s)	20
Installed check valve in basement	14
Installed check valve between building and street	16
Installed overhead sewer	22
Installed sump pump connected to sewer	22
Installed sump pump discharging to yard	12
Disconnected downspouts	17
Eliminated basement wall and floor cracks	24
Other (i.e., replaced sewer line to street, sealed sewer line in basement.)	7
Total	161

Plumbing contractors told us that these devices do control flooding, when properly installed and maintained. Flooding control devices will have no impact on flooding if homeowners install inappropriate devices or install them incorrectly. Further, maintenance is critical if the devices are to work effectively. For example, check valves require periodic cleaning to assure that they open and close properly. According to the contractors, properly installed overhead sewers and flood control systems provide virtually 100-percent protection.

MSD COMMENTS

According to MSD, the various flood control measures homeowners can take do not help in solving overall pollution and flood control problems or in solving the basic problem of inadequate sewers. They are merely interim measures to keep sewage backup out of basements and solve the problem for the individual homeowner. These measures are not viable and effective alternatives for TARP.

MSD is correct in stating that homeowner actions will not accomplish the flood and pollution control which TARP is designed to achieve. However, we do not believe homeowners should wait for the flood control phase of TARP which may never be constructed or, which if constructed, may not provide relief in the homeowner's community. The flood control measures described in this volume will provide homeowners with relief now and help them avoid the damages and basement cleanup efforts resulting from flooded basements.

SECTION 6

WHAT SHOULD HOMEOWNERS DO?

Why are some residents successful in eliminating or reducing basement water problems while others are not? Since the causes of flooding vary widely, no universal solutions exist. Each homeowner's basement backup problems should be diagnosed by an expert; once the cause is found, remedies can be planned. Unfortunately, such diagnosis is costly; $50 to $125 according to the plumbing contractors we talked to. However, this diagnosis should provide the homeowner with some suggested solutions.

Since many homeowners are unable or unwilling, to spend $50 to $125 for a professional diagnosis (which might offer a solution costing several thousand dollars), what inexpensive actions can they take? We posed this question to a number of consultants, sewer contractors, and plumbers who suggested that homeowners disconnect downspouts and route them away from the house. We were told many times that this simple step could, for some homeowners, go a long way toward solving or reducing the problem. One expert commented that it does not make sense to keep downspouts connected in an area that has basement flooding. However, in disconnecting downspouts, homeowners have sometimes failed to route them away from the house, thus causing water to drain near foundation walls and, therefore, canceling any benefits from disconnection.

Because of persistent sewage backup complaints--as many as 300 a day--Springfield, Illinois, started a downspout disconnection program. The program also included improved sewer maintenance. According to Springfield officials, basement backups have almost been eliminated. They believe downspout disconnection was a major factor in their success.

If this is such a simple solution, why do people persist in keeping them connected? In some areas, ordinances require that downspouts be connected. In others, because of lot size or topography, disconnection can create problems for neighbors by discharging water onto their property. Frequently, the problem is educational and political in that residents and community officials are not convinced downspout disconnection is important.

Our consultants also suggested that homeowners clean out sewer lines between the residence and the street. Our questionnaire showed that about 14 percent of sewer backup problems were caused by obstructions in the residents' lines, a problem that would not be solved by anything the community

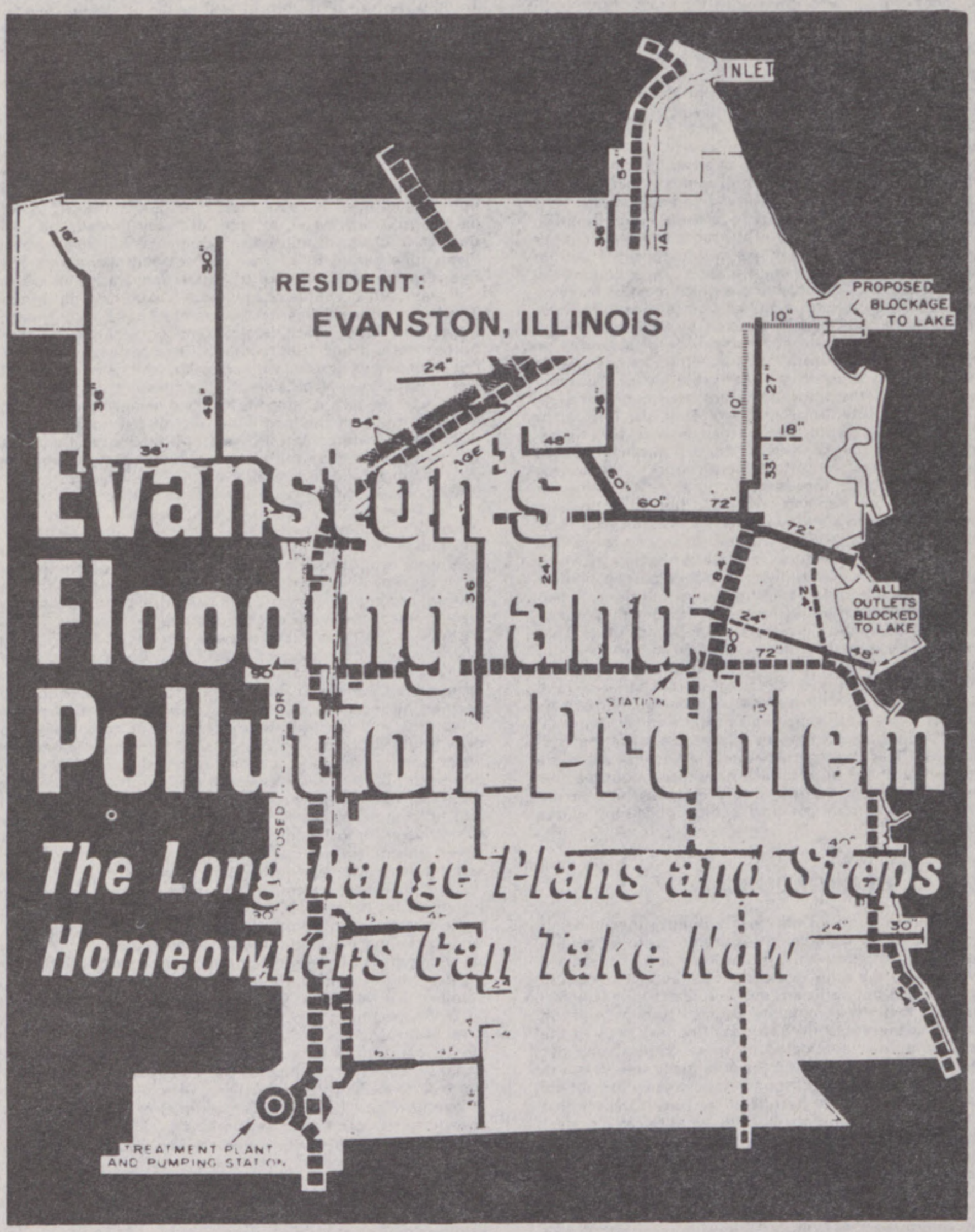
or MSD could do. One plumbing contractor commented that a high percentage of his calls result from clogged lines; his practice was to check for obstructions first, particularly in an area with large trees.

Steps beyond these two measures are more problematic. Drain plugs are probably safe and provide an economical solution when the basement has no more than 1 to 2 inches of backup, though no one can be 100-percent certain that they will not create floor problems. Of course, any device improperly installed or poorly maintained will not work well.

In summary, some homeowners have succeeded in preventing basement backup with various devices, ranging from inexpensive plugs to $5,000 control systems. We also found a number of residents who have done nothing to relieve their problem. Since large projects, such as TARP or the rebuilding of the communities' sewer system, can take years and may not solve individual problems, the homeowner may want to consider doing something now.

APPENDIX I

APPENDIX I



APPENDIX I

1 INTRODUCTION

When you are standing knee-deep in water in your newly-remodeled basement angrily surveying the damage and mess; when you are bringing curses down upon the heads of the Sewer Department personnel, your aldermen, the Mayor, the City Manager, and anyone else you think might have some remote responsibility for your plight, our brochure is not going to be of much immediate help. But, if you remember 1975 was one of the worst years on record for flooding, and you want to take some steps to keep that from happening again, we may be able to offer you some suggestions.

We wish it were possible for Sewer Department personnel to merely turn a valve, clean a few miles of sewers, and make some repairs to take care of everything. Unfortunately, that is not the case. Evanston's sewer problem is very large and complex. The principal purpose of this report is to provide every Evanston household with an understanding of the scope and nature of our sewer problem. More important, we will outline the actions which can be taken to remedy the situation. These actions can be divided into two broad groups: those which must be taken by public agencies responsible for handling sewage and storm water drainage; and those which can be taken by individual homeowners. Because of the scale and complexity of solutions required by government to substantially alter the vast waste water system, the programs which it must carry out are, of necessity, long-range. Although the study phase has been completed, no real relief can be expected for some years. That is an unpleasant fact which is of little comfort to the person with a wet basement. Understanding how our antiquated, periodically modified sewerage system works, (or often doesn't work) and hearing about all of the large-scale, long-range proposals which may eventually help correct our flooding problem is fine, but how does that help the people who are fuming over the water in their basement right now? It doesn't. That's where the second part of the brochure comes into the picture. It explains techniques which individual homeowners could apply to help their particular situation. Most of these are immediate, short-range solutions. A person who has experienced serious basement flooding may not be especially interested in the big picture or long-range plans. That person wants to see something done right now and may want to turn immediately to the second part of this brochure.

We would urge you to read the background material we have put together so that you will have a better understanding of how your home fits into a large and complex system and an appreciation of what actions are going to be required to make that system work better. It is important that people know or are aware of the real nature of the problem and how the responsible governmental agencies intend to deal with it. Expensive and disruptive long-range programs are going to require public support and understanding.

HISTORICAL BACKGROUND

Evanston's sewer problem has been around a long time. If you are wondering why something wasn't done before now, we can't speak for our predecessors, but we can speculate on the reasons. Very likely the estimated cost of corrections seemed so great that there was not sufficient public support for taking action. It appears that the community decided through inaction simply to live with problems. Basement flooding back in the 1940's may have been considered an irritation, but one not worth the cost of correction. Even the potentially serious health hazards created by sewage backing up into basements did not appear to cause sufficient alarm outside of the Health Department to result in any action. While the hazards are not nearly as great compared to sewage contaminating drinking water sources, any time human feces are present, as when a sewer backs up into a house, a serious potential health problem exists.

Some things have changed in recent years to refocus attention on the issue. With still more urban construction, there is even less open ground to help absorb rainwater runoff, thus adding to the incidence of flooding. Perhaps even more important is the change in living styles which have found more and more people expanding their living space by remodeling basements and turning them into family rooms, hobby centers, etc. A flooded basement now becomes a thing of more serious consequence than it was many years ago.

In any case, we can't really deal effectively with why things weren't done years ago; the important point is that something is being done now. Action began when the City commissioned the sewer study which was completed in 1975. It has given us information on the exact nature of the problem and offers some alternative solutions.

Conditions contributing to the chronic flooding of basements have their roots in both historic and physical factors which include the geology of this area, the time in which it was settled and the technology available when our sewer system first began to be installed. One of the basic errors made was in trying to combine both the sanitary sewers, which carry away household wastes, and storm sewers, which carry away storm water runoff, in the same pipes. Because these pipes are connected to individual homes, storm water, at times of heavy rainfall, can back up through the system and enter basements. But there were problems long before that. If we go back and take a look at what this region was like before it was settled, we see an extremely flat area with a couple of low sandy ridges running through it. The flat areas are former lake bottoms of Lake Michigan and the ridges are former beach ridges. Generally, the soils of the lake bottom have a high clay content. The combination of flat terrain and clay soils produced a situation which slowed the natural storm water runoff because the soils were slow to absorb the water and the lack of slope to the land hampered runoff. Consequently, much of the land either side of the ridge was wet and marsh-like. These conditions were of no serious consequence for the first residents of the area, the Potawotomies, who merely used the high land for travel and otherwise adapted to the conditions of the region instead of trying to change them.

So, from the very beginning this was a wet, marshy area, but it wasn't a problem then. As the land began to be settled by the white man, the first parts to be developed were ridges because they were dry. Certain parts of the community were referred to as "Frog Town" for good reason. As the development of what was to become Evanston continued to expand, the wet lands were drained, first with ditches and later with sewers. It is not a particularly difficult feat to drain wet lands and make them available for "more productive use," but it was very difficult to insure that they would always remain dry. When the big rains came nature sometimes reclaimed her own. Although man in his engineering ingenuity was able to prepare the wet lands for development, and successfully utilize them, he began adding to his own future problem. On top of soils sometimes impervious to water and on slopes that didn't help the runoff, he began to build acres of hard surfaces which could not absorb rain. Rooftops, roads and parking lots all further reduced the already limited holding capacity of the land and increased the volume of storm water runoff which would have to be handled by the sewer system. From our check of historical documents, the sewer system has been inadequate since the day the first pipe was laid. There are statements about the inadequacy of the sewer system dating back to 1902. All of this is not to say that we have made a terrible ecological mistake and that we should return the land to the marshes and the Red-Winged Blackbird. It is just to set the context of the problem, perhaps to give us something to ponder while listening to the sump pump or waiting for the plumber to arrive.

Since the time the bulk of our sewer system was built, there have been a number of improvements in design, new environmental concerns, alterations to the sewerage system, and additional problems with which to cope. For example, several of the storm sewers east of Ridge Avenue were, until recently, allowed to overflow into Lake Michigan at times of heavy rainfall. New environmental protection regulations prohibit this and in the 1960's these outfalls were sealed off. The result is less pollution, but more problems in the sewerage system because of this blockage.

In spite of these problems, a community doesn't go about changing sewer systems like somebody buying the latest model automobile. There is a tremendous amount of inertia to change due to the huge fixed capital investment in a sewer system. Major alterations are made infrequently and only at great costs (borne by the taxpayers) to the community. There have to be compelling reasons to launch into such a project.

APPENDIX I

2 STUDY CONCLUSIONS

Evanston's sewerage system was the subject of a major study in 1938. This report called attention to the inadequacy of the existing system and the general seriousness of the situation. A second study in 1975 reaffirmed the conclusions of the earlier work and reported: "The Evanston sewerage system is adequate for handling only the sanitary sewage, leaving the disposal of storm water runoff from rainfall a practically unsolved problem." It went on to detail particular types of inadequacies and location of problem areas. A number of far-reaching recommendations were proposed for correcting present conditions.

Only part of the problem is with the Evanston system, however. The rest lies with the Metropolitan Sanitary District's facilities. The Sanitary District collects sewage from its member communities through a system of large pipes called interceptors. These pipes, in turn, transport the sewage and storm water to the District's treatment plant at Howard Street and McCormick Boulevard. These facilities are able to handle the regular flow of sewage but at times of heavy rains, the capacity of the interceptors becomes inadequate. The Sanitary District cannot provide storage capacity for the incredible volume of storm water that descends in a heavy rainfall until it can be processed by the plant.

The solution to the Evanston flooding problem will, therefore, require parallel efforts between the Sanitary District and the City of Evanston as both improve their inadequate systems. The District has evolved a plan to develop the needed storage capacity for storm water (described in more detail later) and Evanston's improvement plan will be coordinated with the District's.

In the meantime, what happens to all that water that comes down in a heavy rain so rapidly that it can't be absorbed by the areas system? The treatment works can't store it, the interceptors are loaded, the main sewers are full, the smaller ones in the street in front of your house can't accept any more and the water is standing in the streets or backing up your sewer line into your basement. Your basement becomes like a small reservoir, holding a tiny portion of the volume of water until the system can handle it. We can suggest some techniques for keeping that water out of your basement, but we have to face up to a way to get the sewerage system to accept flood-like quantities of storm water more quickly.

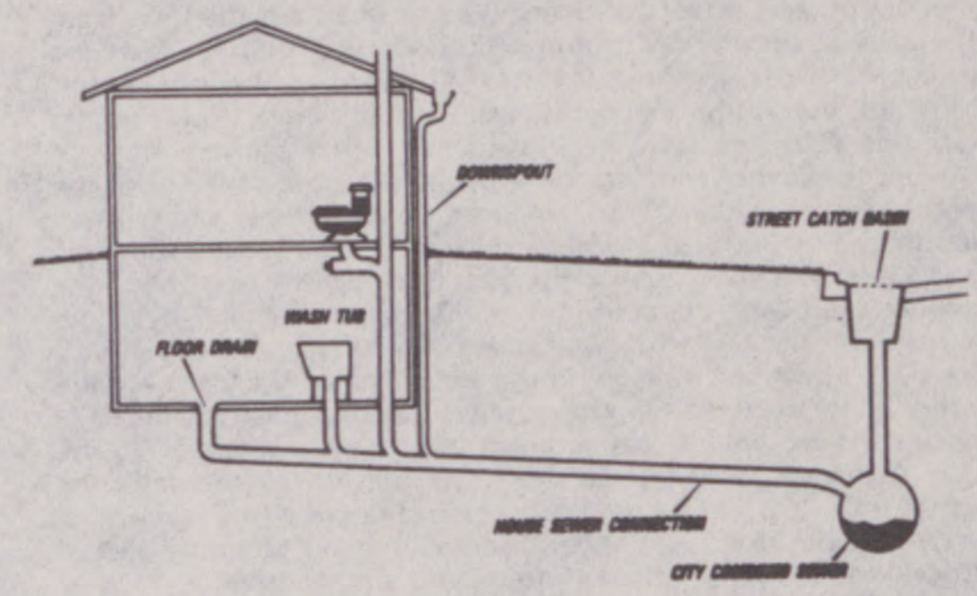
TYPES OF SEWER SYSTEMS AND HOW THEY WORK

There are several basic types of sewer systems in use in various communities. The type of system a community has reflects its problems and attempts to correct them. ı.

Sewers serve two types of functions: (1) They collect and carry off household wastes from the bath, kitchen, floor drains and toilets. This is called "sanitary flow." (2) Sewers also collect and carry storm water run-off resulting from rainfall and distribute it usually to the nearest water body such as a canal, stream or lake.

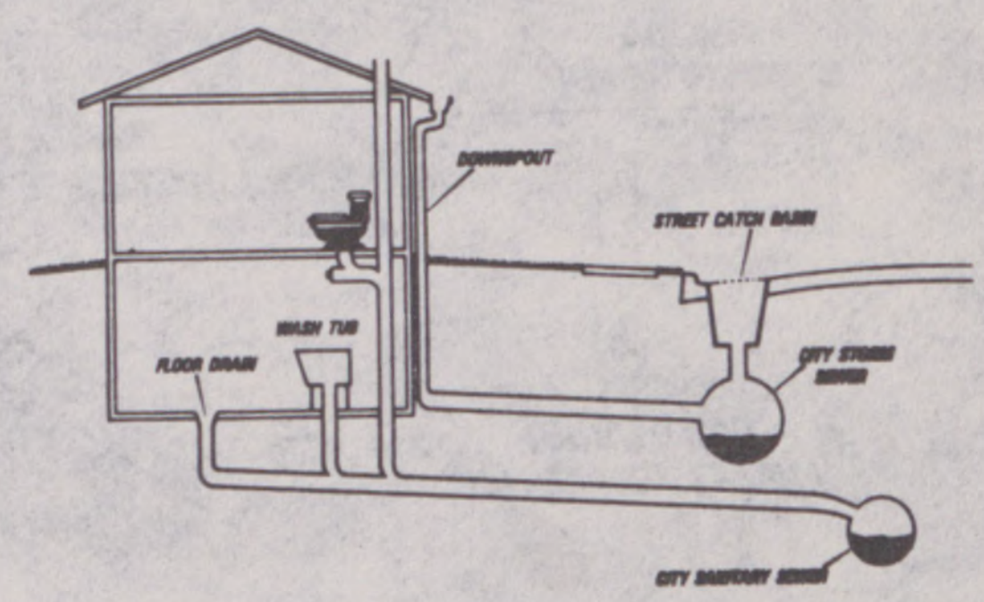
When sewers were first installed before the turn of the century, they were just for the purpose of carrying off storm water. Later, as indoor plumbing became available, sanitary waste lines were connected to the same sewer that was carrying the storm water. While this solved the problem of how to carry sanitary wastes away from the homes, other problems arose from this action. First, the sanitary wastes were carried to the same water bodies as the storm water without treatment. The pollution which resulted caused some very serious health problems which later had to be corrected through the construction of sewerage treatment plants. Another problem resulting from this adaptation of the original system was that a link was created between the sewer carrying large volumes of storm water at times of heavy rain and individual homes. When this one pipe is overloaded by storm water run-off, the water often backs up into basements if steps are not taken to prevent it. An obvious solution for correcting this problem would be to have a second set of sewers constructed to carry the sanitary wastes, but by the time sewage treatment plants were built, the cities were well-developed with miles of paved streets. The installation of a second set of piping under all the streets would have been extremely expensive. Consequently, most older cities such as Evanston simply adapted the original sewer system so that a single pipe handled both storm water and household sanitary flow. This is known as a "combined system." It might also be called a compromise system because that's really what it is – a compromise between costs and results. Figure 1 shows how a combined system works.

FIGURE 1
COMBINED SEWERAGE SYSTEM, most common in older communities and most likely to flood because of small sewer capacity and direct connection through which storm water run-off can back up into basement.



Most newer communities have what is called a *separate system.* As the name implies, there is a separate system for sanitary flow from house connections and a separate system for storm run-off from street inlet connections. The major advantage of the separate system is that there is no connection to the house plumbing, thus eliminating the chance of sewer back-up from storm run-off. The obvious disadvantage of such a system is the tremendous cost involved in building it. Figure 2 shows how a separate system works.

FIGURE 2
SEPARATE SEWERAGE SYSTEM, least likely to flood because the house sewer is not connected to the storm sewer so there is no chance of back-up into the basement



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3 THE EVANSTON SEWER SYSTEM

After construction of the North Shore Channel, sewers were constructed in the western areas of Evanston to discharge the storm water and raw sewage into the Channel. Further improvements were made during the 1920's when the Metropolitan Sanitary District undertook to provide treatment for all sewage. The plant now serving Evanston was constructed at the corner of Howard Street and McCormick Boulevard.

A deep interceptor sewer was constructed to collect the sanitary flow coming from Evanston's sewers and discharging directly into the channel. This interceptor, located adjacent to the channel, took all sewage directly to the new plant for treatment. Only storm water was allowed to overflow into the channel. Figure 3 shows how this system works.

Connections of the old sewers on the east side of the City to new interceptors presented special problems because they were pitched toward the lake, and some areas were too low for the sewage to flow by gravity all the way west to the interceptor. New connecting sewers were installed to intercept the flow from the older sewers, and a pumping station was built to raise the sewage from the low areas to flow westward to the interceptor.

When these improvements were made, "overflow" points were left along the Lake Michigan shore where storm water was allowed to escape from the system whenever the capacity of the sewers was exceeded. Thus, at times of very heavy rainfall and flooding, a mixture of storm water and sewage would still flow into Lake Michigan. In recent years, as pollution of the lake became a growing concern, all of the Lake Michigan overflow points have been blocked, so essentially all storm and sanitary flows are now made to flow to the west. The only exceptions are a few short sections of storm sewer located near to the lake shore carrying only street drainage that now discharges to the lake. Although blocking the overflows was environmentally the right thing to do in helping protect and upgrade the quality of water in Lake Michigan, sewer flooding in areas generally east of Ridge Avenue was greatly compounded by this action.

Evanston's sewerage system has evolved over a long period of time and has undergone a number of changes, some of which have obviously protected the health of the community. After such a series of adaptations, however, we have a rather makeshift system in need of a major overhaul.

Both the Sanitary District and the City of Evanston must undertake programs of substantial magnitude to make any marked improvement, and both are making such plans. Since much of what Evanston might do is dependent upon the kinds of improvements the Sanitary District would make, their plans will be explained first.

THE SANITARY DISTRICT DEEP TUNNEL AND RESERVOIR PLAN

Serious flooding and pollution problems exist throughout most of the metropolitan area, not just in Evanston alone. The Metropolitan Sanitary District has responsibility for collecting and treating the waste water from an area of some 375 square miles. Keeping pace with the tremendous growth of this region and supplying service to it has required some remarkable engineering on a vast scale. Yet, the problem of flooding still remains.

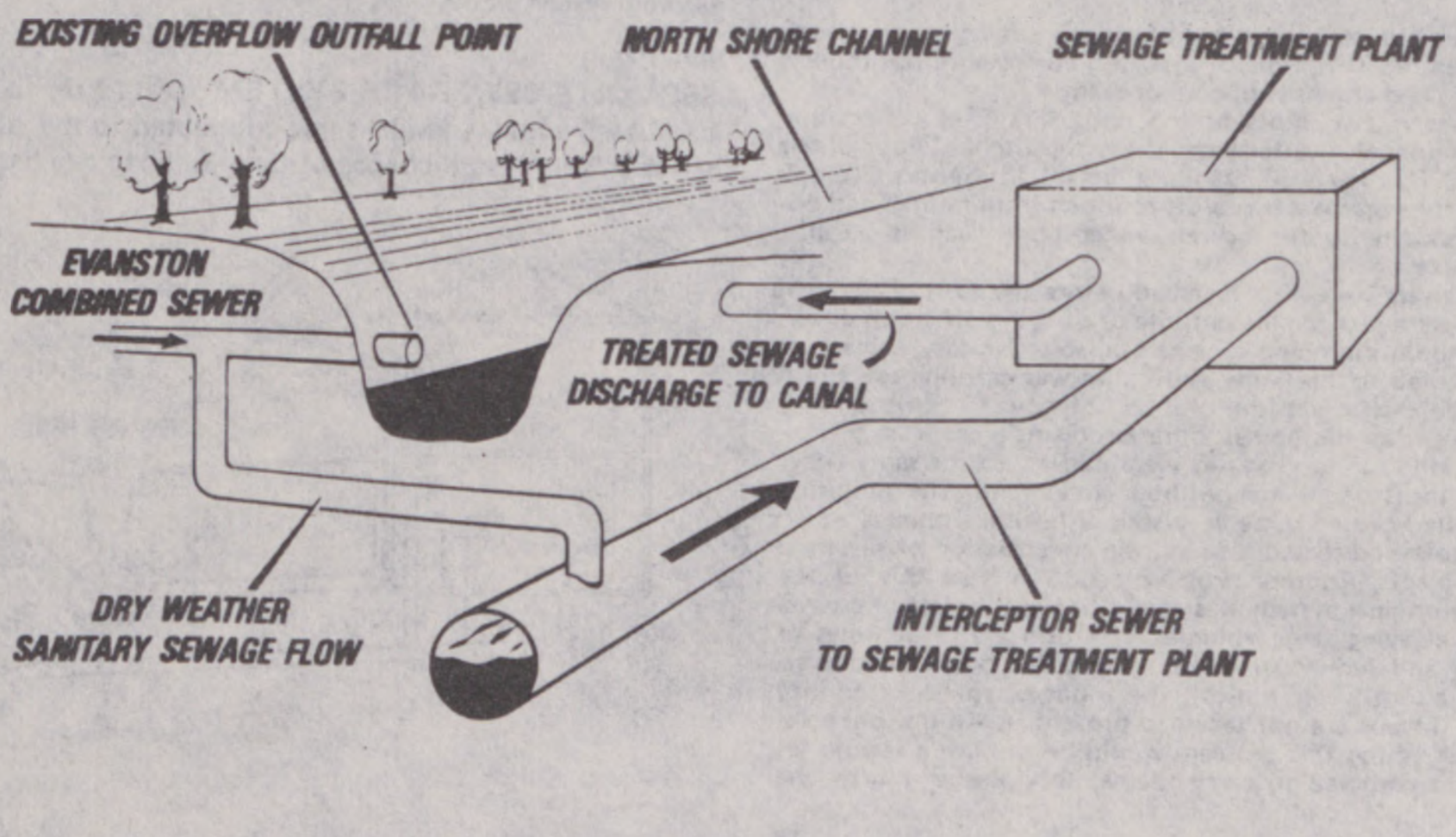
Greater capacity must be built into the District's sewers just as we must enlarge ours. This, in itself, will be an enormous undertaking, complicated by newly-imposed environmental standards to upgrade the water quality of our waterways. In the future, it will not be possible to merely dump polluted storm water into the nearest river and ship it to downstream communities. All waste water will have to pass through a treatment plant before being released into the waterways. Even with enlarged interceptor sewers to help speed up water runoff, there remains the problem of where to hold all this water until it can be processed through the treatment plant.

Sewage treatment is not a rapid process, certainly not rapid enough to accommodate treatment of the vast volumes of storm water which can fall in a short time. With the improvement of the storm water delivery system through increased carrying capacity, the treatment plants could become just another bottleneck in the system.

After years of investigation, the City of Chicago and the Metropolitan Sanitary District have settled on a massive plan to provide a solution to the problem of storing storm water and reducing flooding and pollution. The proposal is to build 125 miles of tunnels deep down in bedrock and three giant reservoirs capable of holding enormous quantities of combined storm water and sewage. The purpose of the Deep Tunnel Plan is to

FIGURE 3

LINK BETWEEN EVANSTON AND THE METROPOLITAN SANITARY DISTRICT SYSTEMS



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capture storm water and sewage before they reach the waterways. This collection will be accomplished through the use of drop shafts and deep rock tunnels to transport the waste water to the reservoirs where it can be stored until treated. Branch tunnels from the reservoirs and pumping stations will then transfer the stored waste water back to the surface treatment plants for gradual processing as plant capacity is available during off-peak hours. The whole Deep Tunnel Plan is one of unprecedented magnitude. Since nothing like it has ever been attempted before, its progress will be watched by cities all over the world. Figure 4) shows how this system will work.

Construction has already begun on part of this new system with three strategically-placed tunnels as part of a pilot program. When completed, these tunnels will form just part of the $594 million first phase of the entire project! Federal funds have been approved for the North Shore section of the project which is now under contract. Construction on the phase affecting Evanston is expected to begin in 1976. However, it will be several years before that work is completed and our flooding problem relieved.

When completed, the Deep Tunnel Project will have several advantages for Evanston residents: 1) the capacity of our sewer system will be improved when sewer outfalls, now dumping storm water into the channel, are instead connected to discharge to the deep tunnel. (Currently during heavy rains, the water level in the channel rises several feet and obstructs the flow from Evanston sewers, thus causing back-ups in the system and slowing down the rate at which flood waters can recede.) 2) Since combinations of sewage and storm water will no longer flow into the channel, its water quality should be greatly improved. The channel can be upgraded from a stinking ditch to a pleasant water body with good potential for recreation. 3) It will no longer be necessary to occasionally open the locks at Wilmette during heavy rainstorms to relieve flood conditions in the channel, thus eliminating that source of Lake Michigan pollution.

EVANSTON'S 1975 SEWER STUDY

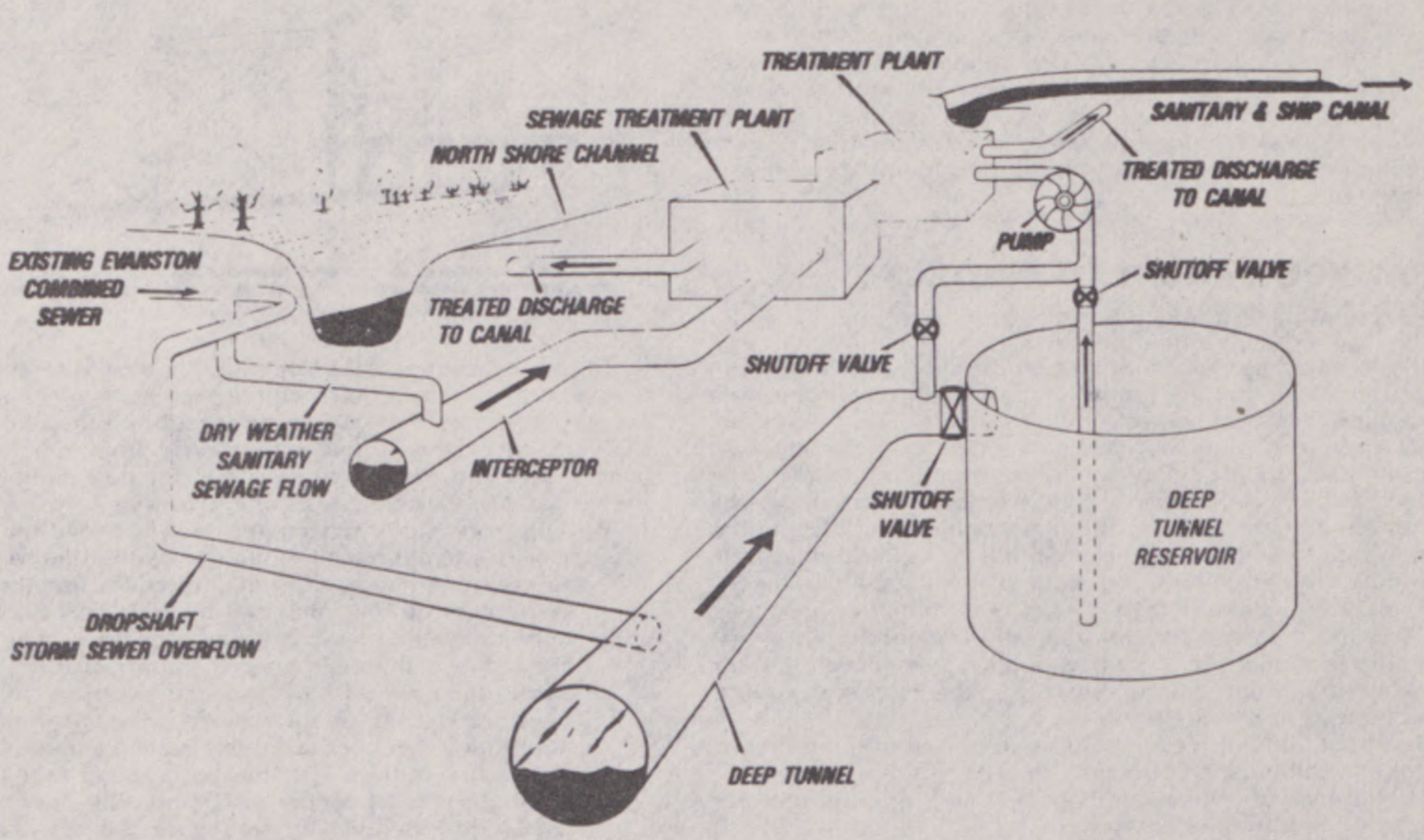
What makes the Deep Tunnel Plan so important for Evanston is that there was little we could do to improve the capacity of our own system until we had some place to deliver our storm water. There was no point in initiating new studies and recommendations until we knew what the Santiray District's long-range plans were. Had the community reacted many years ago, before current environmental protection laws, we might have constructed a separate storm water system to dump directly into the lake and the channel. This system would have been built at great expense and now we would have to be reworking it because such practices would not be permitted.

In view of the opportunity of the Metropolitan Sanitary District's Deep Tunnel and Reservoir proposal, the City of Evanston commissioned a consulting firm of Alvord, Burdick and Howson to make a comprehensive sewer study of the local system to determine the limits of its inadequacy and to recommend the most practical method of rehabilitating the facilities and carrying out improvements. The consultant was also charged with developing a program that would take advantage of the Deep Tunnel and Reservoir Plan proposal by the Metropolitan Sanitary District. Evanston's plans should be compatible with the District's.

During 1974 and 1975, field studies were conducted to determine the extent of "surcharging," a technical term for the back-up of storm water in the sewerage system under pressure. The effects of a storm of moderate to heavy intensity were followed with measuring devices. In many areas surcharging occurred with combined sewage gushing through manhole covers and discharging onto roadways. Under such pressure, diluted sewage also, no doubt, forced its way into many basements.

The most seriously affected parts of the City were the northwest, the northeast, and south central areas. These tests confirmed conclusively the residents' views—that the present combined sewer system is inadequate to handle runoffs from any significant rainstorm. What they would like most to know is, what can be done?

FIGURE 4
LINK BETWEEN EVANSTON AND THE METROPOLITAN SANITARY DISTRICT'S DEEP TUNNEL PLAN



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5 (Evanston's 1975 Sewer Study Cont.)

The report recommendations include an interim five-year development program which calls for (1) additional maintenance (2) inspection (3) rehabilitation and (4) improvements to the existing system. All this interim activity will do is to simply rehabilitate the original system, at an estimated cost of $4,400,000, to make up for the deterioration that has taken place over the years. Though it is important work which must be done, it will by no means solve all our sewerage problems.

A second series of recommendations calls for developing the following long-range improvements, with estimated construction costs of $45,700,000:

1. That the interceptor sewer capacities be increased to handle storms that are apt to occur only once in ten years. (In engineering terms, that's a very heavy storm.)
2. That a system of partial separation be implemented. In selected areas the existing sewer system would be supplemented by separate storm collection systems. Separation of the entire system was considered; however, the estimated cost of $200 million makes such a proposal economically unfeasible. Also under this proposal, relief interceptors would be provided in the form of shallow tunnels connecting the existing interceptors to the North Shore Channel and eventually to the Metropolitan Sanitary District Deep Tunnel when completed.
3. That the City pursue a program of financing through three sources of funding, namely:
   a. Construction grants from the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92.500).
   b. Anti-Pollution Bond Act supervised by the Illinois Environmental Protection Agency, and
   c. City of Evanston financing using Revenue Bonds, and General Obligation Bonds

The project as identified in the consultant's report should, under current regulations, be eligible for an Environmental Protection Agency grant-in-aid which could cover up to 75 per cent of the cost. Obviously, the availability of the federal funds will be critical in the financial planning.

These undertakings proposed by the Sanitary District and the City of Evanston to deal with the flooding problem are going to be very large scale, expensive, and, unfortunately, a long time in finally achieving results. But, for the long-suffering homeowner, we believe we have some good news on some short-term, self-help measures. While these ideas are a few steps up from the finger-in-the-dike technique, they are not the total solution to the flooding problems. We will still have to follow through with the long-range plans.

WHAT YOU CAN DO TO PROTECT YOUR BASEMENT

If you have been following this report straight through from the introduction, you are probably convinced that all basement flooding problems are caused by an inadquate sewerage system. That's a common cause all right, but certainly not the only one. In many instances the flooding may be caused by circumstances found right on your property. In the following section we will explain some of these causes and offer a number of illustrations to show you how their cuase can be determined and what technique might be best to help your particular situation.

The bad news about these solutions is that they are things that you must do and pay for yourself. The good news is that they are techniques which can be applied immediately by the homeowner without waiting years for the large-scale public works projects to bring relief.

Basement flooding is typically caused by one of three circumstances or a combination of them:

1) Blockage of the private "house sewer" or drain between the home and the City sewer.
2) Surface or ground water seeping through walls and floor.
3) Surcharging or back-up of sewage and storm water through the City sewer and into the home where there are no protective devices to keep it out.

PRIVATE SEWER BLOCKAGE

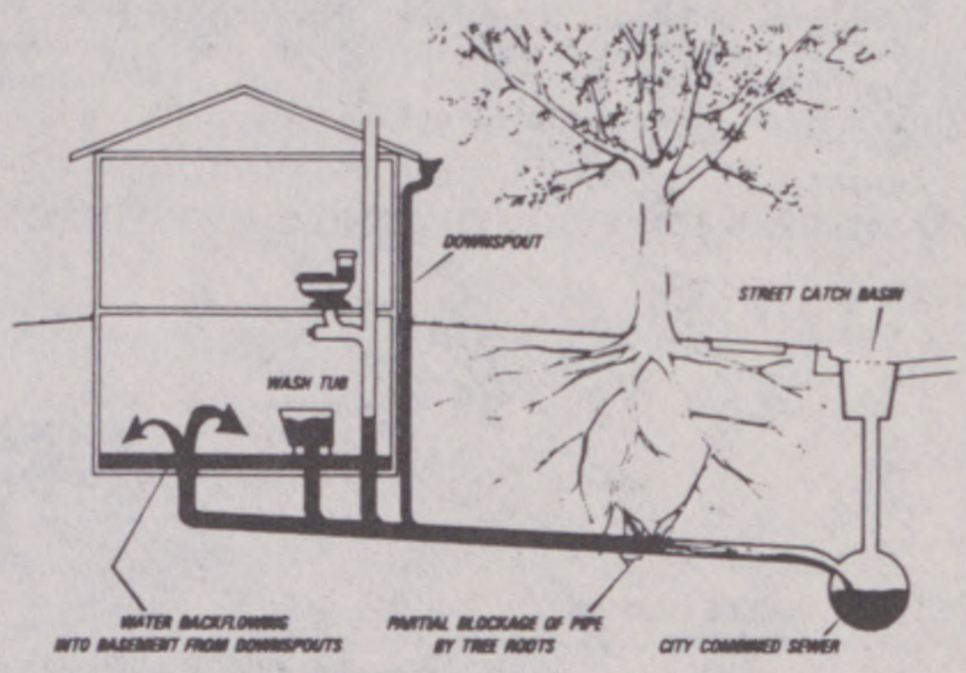
A prevalent problem which often causes flooding in Evanston basements occurs when the roots from trees located near the sewer find their way inside the tile, usually growing through very small cracks in the mortar at the tile joint. Once inside the tile, the roots continue to grow and form large masses that obstruct the pipe opening. (See Figure 5)

If the sewer is used regularly, the roots will usually stop growing at a point that will allow ordinary use. But, a large object flushed down the sewer so that it lodges against the roots, or an excess amount of water from the downspouts will cause a back-up of the sewer into the basement.

The downspouts from most Evanston homes are connected to the house sewer pipe near the basement wall and blockage due to roots usually occurs under the front lawn or parkway. If the sewer is partially obstructed, the water coming from the gutters during a heavy rain cannot pass through, and part of the water will back up into the basement. (See Figure 5)

FIGURE 5

HOW PRIVATE SEWERS CAUSE FLOODING PROBLEMS, partial blockage by tree roots can hold back downspout water and cause basement flooding, backing up clear clean water, not of the sewage type. Periodic sewer rodding and the use of copper sulfate crystals will help prevent this problem.



If your problem is caused by root blockage, it can be relatively easy and inexpensive to correct depending on which alternative action you choose. First, the sewer must be cleaned with an electric rodding machine using a root cutter that will thoroughly remove the roots that have grown into the pipe. Following that, the homeowner may elect to do the following:

1. Periodic rodding – Having the sewer rodded on a regular schedule to cut out all root growth will often be sufficient to keep them under control and reduce the likelihood of sewer back-up. No rules can be given on how often this must be done because it depends on how active the roots are and how thorough a job the contractor is able to do. Some homeowners have found it necessary to have the sewer rodded as often as every six months, and others have found that once every few years is enough.
2. Use of copper sulfate – It has been found that flushing a small quantity of copper sulfate crystals down a sewer at regular intervals will often reduce the activity of root growth without injury to the tree. Although this may not

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6 completely eliminate the growth, it may increase the interval between needed rodding.

3. Sewer pipe replacement – The surest method of permanently correcting the problem is to have the sewer pipe dug up and replaced at the location where the roots are getting in. The new pipe used for replacement has a new type of joint that is tightly sealed to completely eliminate future entrance of roots. This is not, however, an inexpensive solution.

Blockage of house sewers is also occasionally caused by broken or separated tile. This is usually caused by settlement of the soil under the pipe or by poor installation of the pipe. In these cases there is little alternative other than to dig up the pipe at the damaged location and make repairs.

A professional firm specializing in sewer repair can best advise on the type of blockage in a sewer, the location, and the probability that it will reoccur. Before making any decision on how to proceed, we would strongly advise the homeowner to get more than one opinion and estimate on work needed to be done.

SURFACE AND GROUND WATER

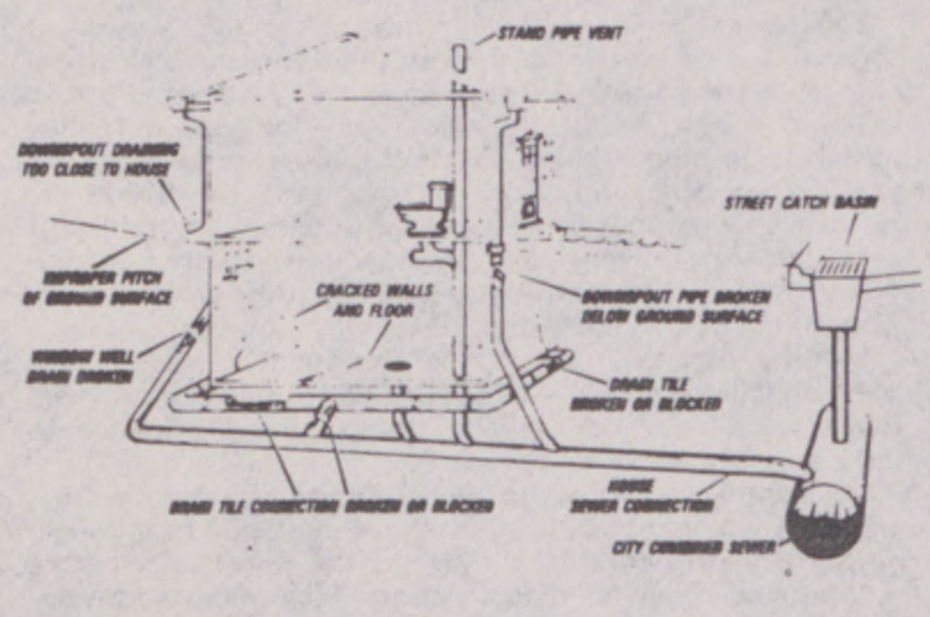
Most basements are constructed with a "footing drain" around the outside walls, intended to collect ground water that is in the soil and keep it from seeping through cracks in the basement floors and walls. The tile is either perforated or laid with open joints to easily pick up the ground water, and in most homes, it is directly connected to the house sewer. (See Figure 6)

If a basement develops leaks in the floor or walls when there previously were none, it is often caused by blockage or breakdown of the footing drains so that they are no longer functioning properly.

Floor and wall leaks can also be caused by excessive surface water getting near to the basement walls. Ground surfaces surrounding the building should pitch away from the foundation for several feet to keep excessive amounts of water from soaking into the soil near to the building.

Downspouts which connect into the house drain or sewer are often a source of problems when their underground connections become broken causing water to seep through the foundation in the vicinity of the break. Or, their emptying into a clogged house sewer can cause back-ups. Under certain circumstances it might be advisable to disconnect your downspouts and let the rain water be absorbed by the ground instead of entering the house sewer. Downspouts that are discharged onto the ground should be terminated on splash blocks or other means to direct the flow well away from the building foundation.

FIGURE 6
SOURCES OF FLOODING PROBLEMS CAUSED BY SURFACE & GROUND WATER



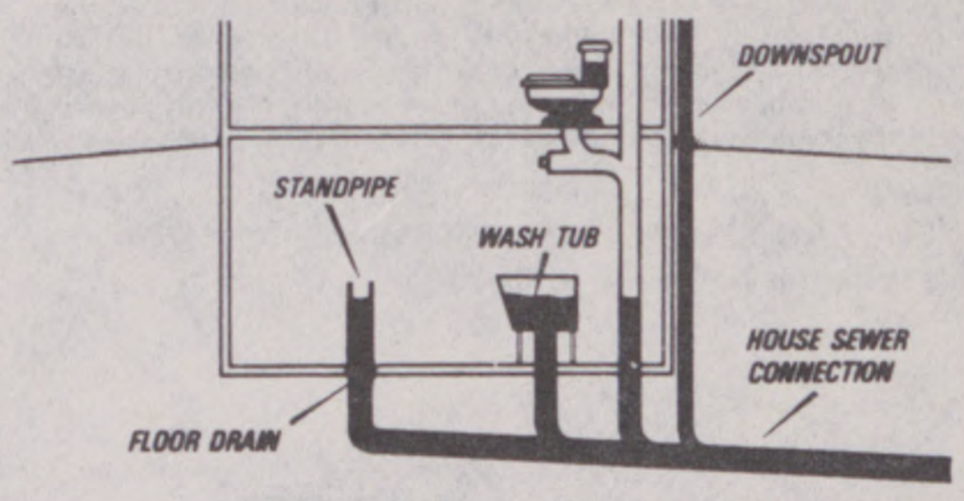
The best method of stopping leaks through basement floors and walls may depend on many factors, and it is recommended that advice of more than one plumber be obtained before spending large amounts for repairs. Careful study of Figure 6 will give you a better understanding of this problem and what might be done to correct it.

BACK UP OF THE CITY SEWERS

When the quantity of storm water exceeds the capacity of a section of the City sewer system, the pressure builds up in the system and water will back up into unprotected basements. When this surcharging occurs, there are several steps that can be taken by the property owner to obtain varying degrees of safety in preventing it from happening again. Among the factors that the property owner must consider when deciding on which method to use is, the frequency at which flooding occurs, how deep the water gets when the basement has flooded in the past, how difficult it is to clean up, the investment in storage, equipment or improvements in the basement that can be damaged by flooding, and, of course, the cost of making improvements.

- *The Floor Drain Standpipe* Except for homes constructed in recent years, the floor drains in most Evanston homes are directly connected to the house sewer. (See Figure 7) When the City sewer surcharges and the flow begins to back up through the basement floor drain, the natural inclination is to place a plug in the drain, but this may create other problems. The piping under the floor in most older homes is clay tile, and the concrete floors were laid with only a thin slab of concrete. Therefore, if the drain is plugged, sufficient pressure could build up in the sewer to break the tile and heave the concrete floor. The alternative to plugging is to insert a short "standpipe" in the floor drain to raise the overflow level. (See Figure 7)

FIGURE 7
THE USE OF THE FLOOR DRAIN STANDPIPE



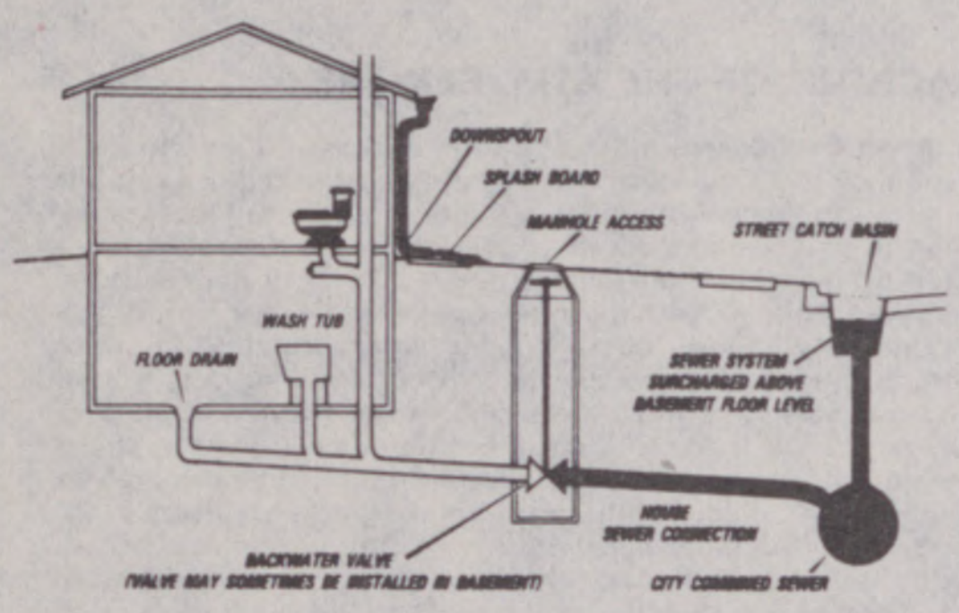
The object is to hold back the water only if it would have flooded several inches deep. If the pressure builds to a higher point, it is better to let some of the water flow in and lay on the floor to equalize the pressure than to take a chance on having the sewer and floor broken. Standpipes may be left in place at all times if the floor drain is not needed.

- *Backwater Valves* – A variety of valves is available that can be installed in house sewer lines to prevent water from backing into the basement. (See Figure 8) Manually operated valves are used by some property owners. The disadvantage of this type is that they must be closed quickly whenever there is a storm that could cause flooding. A type of check valve is made for sewers that closes automatically when flow through the sewer line reverses, and other types of automatic valves are also available. (See the foldout above for a detailed example of how a check valve works.) These valves may be installed either outside the house or inside the basement depending on various factors.

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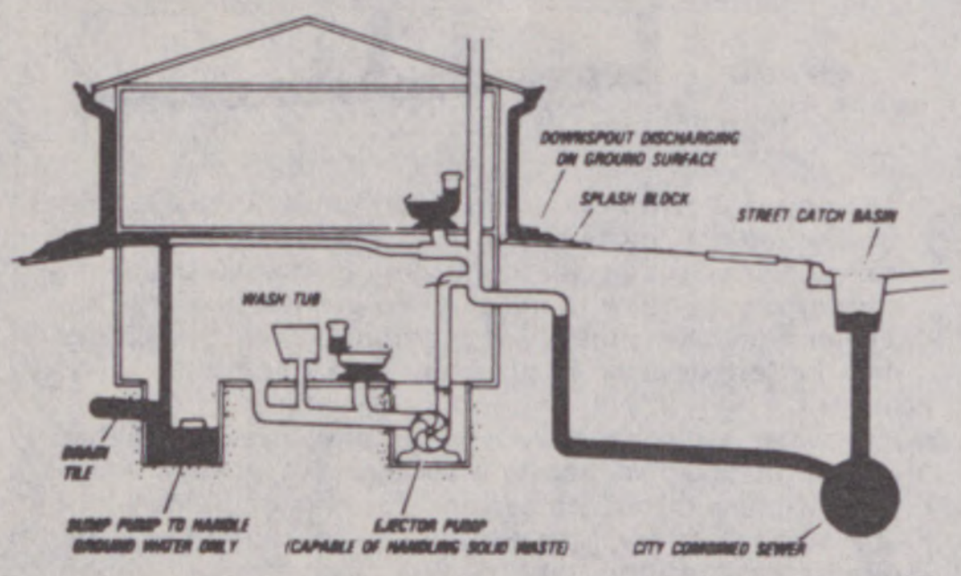
FIGURE 8
BACKWATER VALVE,
Method of Preventing Basement Flooding



Valves installed in sewer lines sometimes become "jammed" with debris and fail to close completely. In this case the valve may slow down the backflow of sewage, but not stop it completely. For this reason, a valve installed on a sewer line should not be depended on for 100 per cent protection, and an access manhole should always be provided for getting to the valve for service and repair (See Figure 8) It should also be kept in mind that when a valve is installed in a house sewer, the house plumbing cannot be used during a storm when the valve is closed.

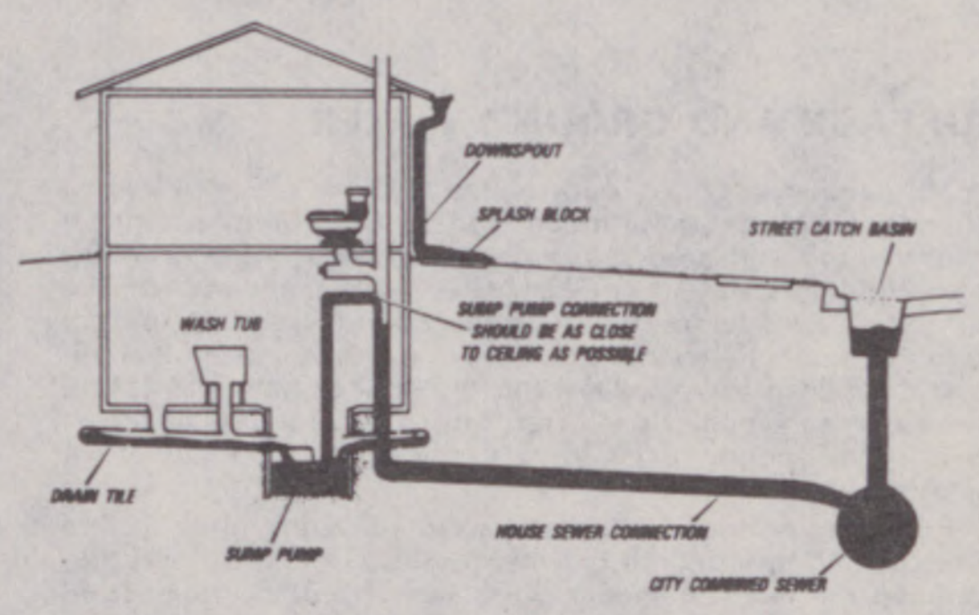
✲ *Overhead Sewer Systems* – The term "overhead sewer" is applied to a system in which all sewage from above the street level flows by gravity to the City sewer, but all sewage and storm water collected in the basement must be pumped up to the house sewer at a connection near to the basement ceiling (See Figure 9). In other words,

FIGURE 9
OVERHEAD SEWERAGE SYSTEM
This system is not likely to flood



there are no direct connections between the sewer system and the basement, so there is no way in which it may back into the basement. The overhead system can be installed in an older home, but can be quite costly if extensive plumbing changes are required. It is often used by property owners who have substantial investments in storage, equipment or improvements in their basement and wish to ensure that sewer backup will not occur. In cases where the house sewer is cast-iron pipe, a modified overhead sewer system may be used. This could result in a considerable savings, compared to the cost of a complete overhead system. (See Figure 10) Otherwise a portion of the old tile sewer must be dug up and replaced with cast-iron pipe for a safe distance from the house. Pressures created in this system are often too great to be handled by the old tile house sewers. One disadvantage of these systems that should be considered is that the pumps used to pump water from the basement level will not operate during a power failure, so some overflow of the sump could occur if the power is off for an extended time. The overhead system is generally the most effective way to prevent basement flooding.

FIGURE 10
MODIFIED OVERHEAD SEWERAGE SYSTEM



All of our illustrations are just that—illustrations. They are plans which can be generally applied to your situation with professional advice. They should prove helpful in understanding the basic principles and analyzing your particular problem. Any of these techniques can be expensive and we again urge that you seek competent help in solving your problem. Get estimates. After all, installation of something like overhead plumbing is a major investment.

AFTER A FLOOD

Never enter a flooded basement unless absolutely necessary, and then only with extreme caution. *The possibility of electrocution is always present.* Always wear rubber boots. When cleaning the basement after water has receded, use caution around electrical outlets and appliances, and disconnect power from electrical equipment as quickly as possible.

If a basement is subject to frequent flooding, appliances should be raised on platforms to keep the motors and electrical parts higher off the floor. Gas appliances that have been flooded should be checked, and if the pilot light has gone out, they should be lit promptly. Wet electric motors should not be turned on. They often will not need repair if dirt is washed from the motor and then it is dried *thoroughly* before an attempt is made to use. A motor may take a week or two to dry out thoroughly by itself, but this can be speeded by using gentle heat or air, or by taking it to a repair shop.

A flooded basement should be thoroughly cleaned with detergent and disinfectant. The sewage which has accompanied the flood water may be a health hazard if not attended to promptly after the water has receded.

In conclusion, we hope this report has helped make a complex problem a little easier to understand, that you have gained from it some appreciation of the size of the task that is before us, and that you have found some ideas which might help your particular basement flooding problem.

APPENDIX I

EVANSTON CITY COUNCIL

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*Harry Von Huben	Water and Sewer Superintendent
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Alfred Tyler	Artist-Draftsman

*Former Staff Member

(087190)