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Project Summary

Nationwide Assessment of Receiving Water Impacts from Urban Stormwater Pollution

Volume I. Summary

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Results of this nationwide search for documented case studies of impacts of urban runoff on receiving waters indicate that well-documented cases are scarce. Impacts previously attributed to urban stormwater runoff may be point-source impacts to disguise, or they may be masked by greater contributions from other sources. In some cases they are offset by hydrological, biological, or geological attributes of the receiving water body.

The lack of documentation and clear definition of urban stormwater impacts makes the task of assessing the importance of this pollution source even more difficult. Efforts to address this aspect include relating sources of pollutants and pollutant types to the characteristics of the receiving water and the effects on desired water uses. Characteristics such as stream or lake bed hydraulics, present and potential water uses, established stream standards, ecological data, and water quality information have been summarized for 248 urbanized areas. Results of these analyses have been summarized by the quantity of urban runoff, the available dilution capacity in the primary receiving water, the number of times the urban areas were cited as having a "problem," the type of receiving waters, the impaired beneficial uses, and the problem pollutants.

The results indicate that numerous definitions of "problems" are being used. Relatively little substantive data to document impacts have been collected. Impacts are most noticeable in small receiving waters. Impacts from urban runoff are difficult to isolate from other sources such as municipal and industrial wastes. Also, accidental or deliberate discharges from point sources under wet-weather conditions are sometimes the primary cause of wet-weather impacts. The findings suggest the need to intensify monitoring programs so that receiving water impacts can be more realistically evaluated. The present data base is poor.

This Project Summary was developed by EPA's Municipal Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Urban stormwater runoff has been recognized as a potentially significant source of pollution. Studies have shown

urban stormwater runoff constituents comparable in concentration to secondarily treated sewage and often comprise a majority of constituent loads to some receiving waters. Nationwide estimates of the cost of controlling urban stormwater run into the billions of dollars.

The prohibitive costs of treating all stormwater outflows have made it necessary to take a more in-depth look at the receiving waters on a case-by-case basis. What *are* the impacts of stormwater runoff?

Concentrations and loads are high, but what actual impairments of beneficial use occur? What documentation exists? These questions have been the impetus for undertaking this nationwide assessment

A previous nationwide assessment indicated urban runoff and combined sewer overflows can be viewed as causing problems since, on a nationwide average, the quantity (13.4 *in./yr*) is approximately equal to the quantity of sewage (12.8 in /yr), and the annual BOD_5 per acre from a sewage treatment plant with a removal efficiency of 90% is 59.4 lb as compared to 43.6 lb from urban runoff and combined sewer overflows. Loads per acre from combined sewer overflows are approximately four times as large as loads per acre from urban runoff. Furthermore, the cost of controlling these wet-weather flows appears to be competitive with the cost of additional removal of pollutants in sewage. If further reductions in pollutant loads are needed, then wet-weather controls as well as further waste treatment should be evaluated carefully The anticipated high price tag for such control programs has prompted decision makers to take a harder look at the seriousness of the problem

Approach

This report represents the results of a search through published and unpublished literature, project documents relating to sections 201 and 208 of the Federal Water Pollution Control Act of 1972 (PL 92-500), EPA-furnished fish kill data, Nationwide Urban Runoff Program proposals and project materials, agency data and permit files, and other miscellaneous data sources to characterize urban wet-weather impacts on receiving waters Information is presented for each of the 248 urbanized areas in the United States.

The results of the literature review were analyzed and organized in terms of the following characteristics of the urban area as it related to types and quantities of pollutants, characteristics and types of receiving waters; uses of receiving waters and water quality standards; kind of impact whether ecological or public health, characteristics of impact (e.g., short-term dissolved oxygen sags versus longer term benthic effects); and key pollutant or pollutants causing the impact.

Data for each urban area were partitioned into the following categories:

- Demographic data
- Hydrologic background
- Waste sources
- Receiving waters
  - — Classification
  - — Dilution ratio
  - — Special studies
  - — References to "Other studies" category
  - — 1:500,000 USGS State Hydrologic Map for Urban Area and environs
  - — Ten years of monthly and annual flow data for primary receiving water(s).

An area was viewed as having an actual or potential urban runoff "problem" if any of the following conditions applied:

1. The local or state 208 agency viewed urban runoff as a priority problem.
2. Runoff-related fish kills had been reported during 1970-79
3. A runoff related beach closing was reported.
4. It is a National Urban Runoff Program (NURP) study area.
5. The urbanized area was identified in EPA-funded projects as having a potential dissolved oxygen problem.
6. The urbanized area was listed in the 1978 Report to Congress on Control of Combined Sewer Overflow
7. The urbanized area was studied by the National Commission on Water Quality Studies
8. The urbanized area was mentioned in the National Eutrophication Survey.
9. The urbanized area was mentioned in the 1974 National Water Quality Inventory.
10. The urbanized area was mentioned in the 1979 Congressional Hearings.
11. The urbanized area has combined sewers.
12. The urbanized area was mentioned in other studies.

Thus, any urbanized area may have a "problem" as defined by these 12 conditions some of which are interrelated.

Results

Major findings as a result of the literature search and assessment of wet-weather impacts on receiving waters are summarized below:

1. Impacts are not clearly defined. Rather they are a composite of the perspectives of professionals from several branches of engineering and science, environmental interest groups, citizens committees, etc The prevailing philosophical definition of impacts during the past decade was based on a broad-based ecological framework. However, the past year has witnessed a shift back towards the more traditional public health perspective with more interest in cost effectiveness. Against this rather fuzzy backdrop, impacts were tabulated in this report in several ways as viewed by these different groups. From a technical point of view, impacts should be more severe if the dilution capacity of the receiving water is not too large. Thus, dilution ratios were calculated for each of the 248 urbanized areas in the United States. Otherwise, "impacts" were estimated by the number of times the urbanized area was cited in any of 12 categories of special studies, e.g., the urbanized

area listed urban runoff as a high priority problem in its 208 planning study Admittedly, this approach is subjective but it appears to be reasonable due to the paucity of available information

2 Receiving waters are not well defined. The literature contains studies of receiving waters ranging from the smallest ponds and creeks to major rivers, estuaries, and the ocean. Lacking a clear definition of receiving waters, 1:500,000 USGS Hydrologic Maps were used for all urbanized areas. A dilution ratio calculation was performed for the primary receiving water(s) that is contiguous to the urbanized area. In many cases, receiving waters of notoriety in the literature, e.g., Lake Eola in Orlando, Florida, do not even appear on these maps

3 Almost 85% of the primary receiving waters contiguous to urbanized areas are rivers The majority of these rivers have an average flow of less than 10,000 cfs. Lakes comprise 5% of the receiving waters and the remaining 10% are estuaries or oceans.

4 Over 10,000 fish kill reports for 1970-1979 were reviewed Less than 3% of these fish kills listed urban runoff as the direct cause.

5. Water quality problems exist at 449 out of a total of 3521 beaches throughout the United States Although urban runoff was not listed as a separate category in this study, it may be a significant factor since almost 50% of the closings were due to undefined sewage contamination or unknown causes

6. Studies of continuous dissolved oxygen (DO) records downstream of urbanized areas indicate that worst-case circumstances occur after storms in approximately one-third of the cases studied This lowered DO is probably due to combined sewer overflows, urban runoff, and storm-caused resuspension of benthal materials.

7 Thirty cities are presently conducting intensive studies of urban runoff under joint sponsorship of the city and EPA's Nationwide Urban Runoff Program. Several of these studies will try to document the deleterious receiving water impacts that are caused by urban runoff. There is little *direct* evidence at this time to document this cause-effect relationship.

8. The National Water Quality Inventory studies indicated that 12 out of 26 water quality constituents have higher concentrations during higher flow periods. These studies were done for major (>10,000 cfs) rivers that comprise only 19% of the primary receiving waters for urbanized areas.

9. Urban runoff was listed as a high priority problem in 88 urbanized areas. However, this prioritization was done with relatively little scientific/technical information.

10. The 1978 NEEDS Survey proposed water quality criteria for wet-weather flows and compared these criteria to the results of computer simulations However, these criteria are admittedly arbitrary and the model does not include the capability to incorporate the resuspension of benthal deposits. Based on the evaluations of DO data described in summary item 6, this factor is very important

11. The 1979 Congressional Hearings related to urban runoff discussed the disturbing fact that existing treatment plants are being operated poorly In many of these cases, the results of plant breakdowns, spills, etc., are manifest as urban runoff problems because the discharges are made during wet-weather periods.

12. A total of 120 urbanized areas have combined sewers. Most of these cities are located in the eastern United States. In these areas, the combined sewer overflow problem is more significant than direct urban runoff.

13 The most popular theme of other studies of urban runoff quality was to predict water quality changes in stormwater detention ponds. The primary purpose of these ponds is drainage control. Concern exists that these ponds may have serious water quality problems and act as mosquito breeding areas.

14. On the national level, about 150 million people live in urban areas in the United States The average annual precipitation in these areas is 33 4 in The annual volume of urban runoff is 4% larger than the annual volume of sewage. The median receiving water has an annual flow of approximately 15 times the sum of the urban runoff and sewage. The median number of the 12 conditions that define this existence of an urban runoff problem per urbanized area is 1.6.

15. Unexpectedly, the number of problem citations per urbanized area increases as the dilution ratio increases. One would expect the opposite to occur since increased dilution should reduce the number of problem citations per urbanized area. Overall, no obvious regional trends in dilution ratio were apparent.

16. Omitting those states not having at least three urban areas, the following seven states do not have a dilution ratio greater than 10:

Connecticut (3.0)
North Carolina (3.5)
Colorado (3.5)
California (3.7)
Utah (5.1)
Massachusetts (6.2)
Ohio (7 2)

At the other extreme, the following three states have dilution ratios greater than 1000:

Arkansas (1040)
West Virginia (1525)
Kentucky (2409)

17. The following 19 cities have four to six problem citations:

Citations per Urbanized Area	Urbanized Area(s)
6	Philadelphia, PA
5	Boston, MA, Chicago, IL,

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	Detroit, MI, Lansing, MI, Milwaukee, WI, New York, NY, Seattle, WA, and Washington, DC
4	Atlanta, GA, Baltimore, MD, Cleveland, OH, Denver, CO, Des Moines, IA, Mobile, AL, Richmond, VA, Savannah, GA, Syracuse, NY, and Youngstown, OH

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The complete report, entitled "Nationwide Assessment of Receiving Water Impacts from Urban Stormwater Pollution: Volume I. Summary," (Order No. PB 81-161 812; Cost: $14.00, subject to change) will be available only from:
National Technical Information Service
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