

study progressed. This lack of information highlights a need for comprehensive and coordinated programs of research and development in the field of urban hydrology and hydraulics.

The inescapable consequence of decisions regarding storm drainage is the selection of space for the temporary storage of storm water. If nothing is done to convey storm water away, it will occupy space near the place where it falls. If a storm sewer is constructed, storm water will occupy space at the downstream end of the storm sewer. Regardless of what decision is made regarding storm drainage, there results a selection of space for the temporary storage of storm water. This is an important fundamental principle.

In urban areas space has typically high economic values. Complete economic analyses must include the cost of the space selected for the temporary storage of storm water, since the use of that space for other purposes is curtailed. This concept is relatively new to the field of storm-drainage economics, and warrants thoughtful consideration by all persons who make decisions in that field. A subsequent part of this paper further develops this concept.

(b) Services Rendered; Dangers and Damages

The runoff produced in rural areas can cause considerable damage to crops, soil, animals, farm buildings, and roads and highways. At times it may even result in loss of life in both humans and animals. The U.S. Soil Conservation Service works with local rural groups to plan and construct drainage facilities to alleviate such problems. Corrective measures employed in rural areas must be entirely different from those used in urban areas. Such measures normally include contour plowing, selective area and crop farming, reforestation, maintenance of natural ditches and watercourses, and the construction of embankments and levees along with judicious location of buildings, feedlots, pastures, crop-fields, roads, ponds, and impoundments.

The runoff from urban areas, if not properly conveyed to disposal points, can result in very significant losses. Most important of these is the great damage inflicted upon both real and personal property. As a result of discussing such losses with knowledgeable individuals, it is estimated that the total average annual losses in all parts of the United States in recent years is \$1 billion or more. However, this estimate merely indicates the general magnitude of losses since data on the evaluation of losses is not available. Considering the present rate of industrial expansion and population growth in urban areas, it is not difficult to visualize an increase in losses due to such property damage.

Inadequate disposal of runoff often results in widespread loss of valuable time and frequently, causes great inconvenience to urban populations. This is characterized by persons arriving late to places of employment, or perhaps not reporting at all, because of delays in transportation caused by street flooding, or resulting from the need to care for property being endangered by flooding.

Flooding of basements can result from unsatisfactory or nonexistent storm sewer systems. The results may vary, from mere inconvenience and loss of use of basement facilities, upward to very serious threats to health and safety. The extensive use of combined sewers presents a threat of disease to the helpless public in such areas. In commercial areas, where food may be served in basement cafeterias and restau-