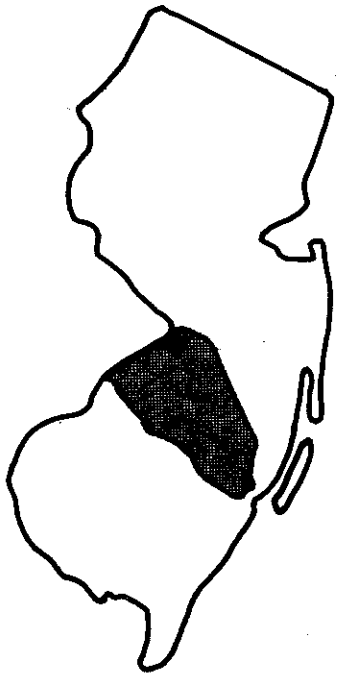
# FLOOD INSURANCE STUDY

## BOROUGH OF PALMYRA, NEW JERSERY
### BURLINGTON COUNTY



REVISED:
MAY 4, 1992

Federal Emergency Management Agency

COMMUNITY NUMBER - **340110**

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial FIS Effective Date: FIS report - December 1977/
Flood Insurance Rate Map - June 1, 1978

Revised FIS Date: May 4, 1992

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

FLOOD INSURANCE STUDY
BOROUGH OF PALMYRA, BURLINGTON COUNTY, NEW JERSEY

# 1.0 INTRODUCTION

## 1.1 Purpose of Study

This Flood Insurance Study revises and updates a previous Flood Insurance Study/Flood Insurance Rate Map for the Borough of Palmyra, Burlington County, New Jersey. This information will be used by the Borough of Palmyra to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP). The information will also be used by local and regional planners to further promote sound land use and floodplain development.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

## 1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses in this study represent a revision of the original analyses, which were prepared by the Philadelphia District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-H-7-76, Project Order No. 11. That work was completed in January 1977.

The hydrologic and hydraulic analyses in this revision were prepared by the COE for FEMA as part of the Limited Map Maintenance Program, under Inter-Agency Agreement No. EMW-89-E-2994, Project Order No. 1, Task Letter No. 2. The work for this revision was completed in May 1990.

## 1.3 Coordination

On May 30, 1975, an initial Consultation Coordination Officer's (CCO) meeting was held with representatives of the borough, FEMA, and the COE (the study contractor) to discuss the content and extent of the original study.

On April 15, 1977, the results of the original study were reviewed at a final Consultation and Coordination Officer's meeting attended by representatives of FEMA, the COE and the Borough of Palmyra.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Borough of Palmyra, Burlington County, New Jersey. The area of study is shown on the Vicinity Map (Figure 1).

All or portions of the following streams were studied by detailed methods: Delaware River and Pennsauken Creek. The effects of tides from the Delaware River on Pennsauken Creek were also studied in detail. Limits of detailed study are indicated on the Flood Insurance Rate Map (Exhibit 1).

This revision was performed in order to incorporate updated hydrologic and hydraulic analyses for Pennsauken Creek and the Delaware River. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Borough of Palmyra.

### 2.2 Community Description

The Borough of Palmyra is located in the northwestern portion of Burlington County in south central New Jersey. It is bordered by the Delaware River to the north and west; the Township of Pennsauken to the south; and the Township of Cinnaminson and the Borough of Riverton to the east.

The Borough of Palmyra is comprised mainly of single-family residential dwellings in the eastern portion of the borough, with tidal wetlands in the west.

The Borough of Palmyra was officially organized and created in 1894. The area consisted mainly of farms with a small cluster of businesses and a population of approximately 2,000 residents. This has increased to the present figure of approximately 7,000 residents with approximately 2,000 homes.

The 100-year floodplain consists mainly of tidal wetlands, with marshgrass overgrowing the area. The topography varies from an elevation of approximately 60 feet southeast of Charles Street and Highland Avenue to only a few feet at the western tidal flats.

The climate is characterized by cool winters with temperatures averaging a little above freezing and moderate summers with average temperatures above 73 degrees Fahrenheit. Average annual precipitation is 44 inches and is fairly uniformly distributed throughout the year.

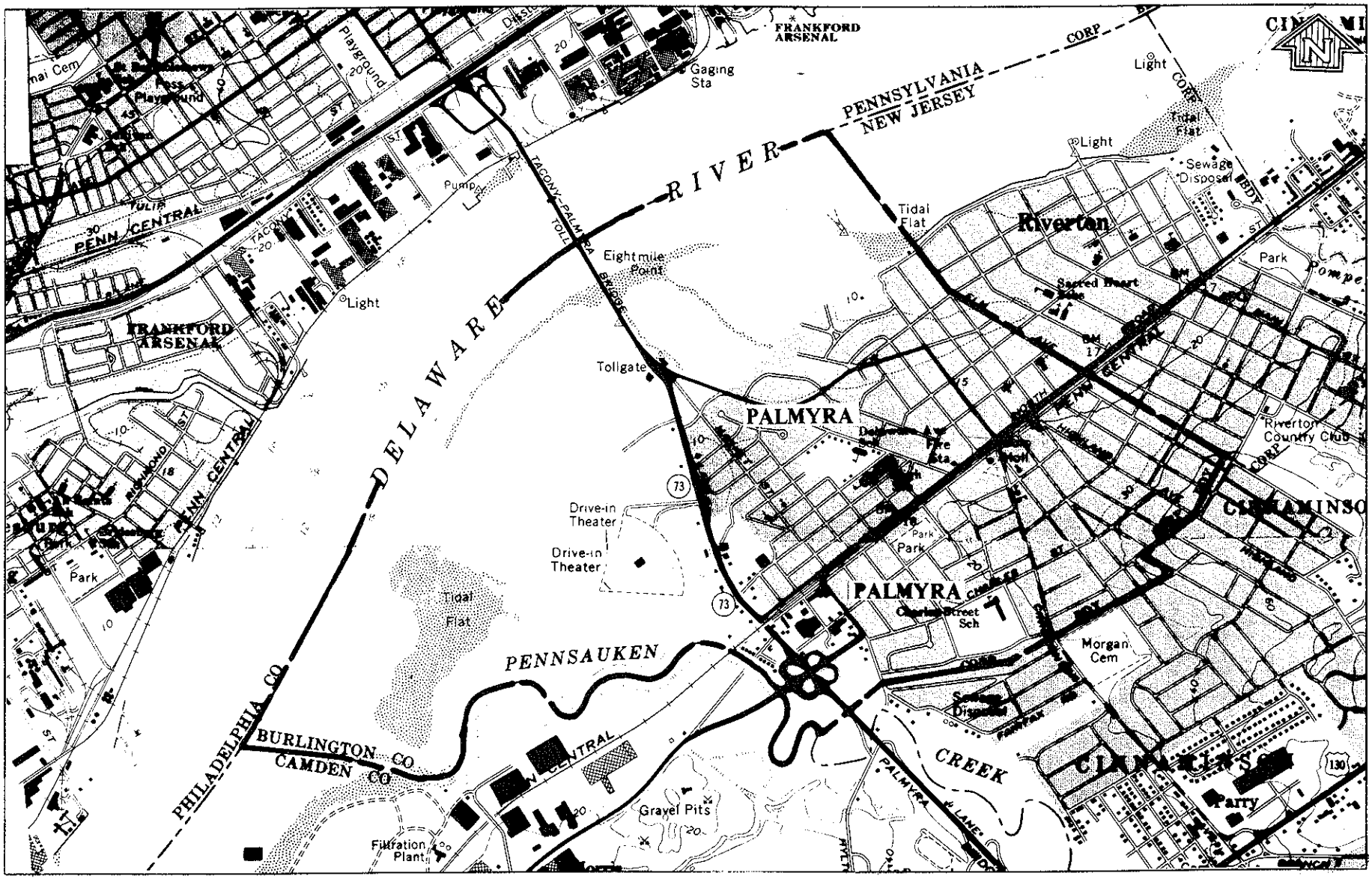



FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

# BOROUGH OF PALMYRA, NJ

(BURLINGTON CO.)

APPROXIMATE SCALE

2000 0 2000 4000 6000 FEET

## VICINITY MAP

## 2.3 Principal Flood Problems

The major sources of flooding within the Borough of Palmyra are the Delaware River and Pennsauken Creek. The Delaware River flows through tidal flatlands within the borough and Pennsauken Creek flows westerly from New Jersey Route 73 to the confluence with the Delaware River. Both the Delaware River and Pennsauken Creek are affected by tidal flooding. The tidal flood of record occurred during the hurricane of August 1933 when the tide in the Delaware River at the mouth of Pennsauken Creek reached an elevation of approximately 9.0 feet. The tidal elevation has an approximate recurrence interval of 50 years. More recently, the 1955 flood reached an elevation of approximately 8.4 feet along the Delaware River in the vicinity of Palmyra (Reference 1).

Flooding within the Pennsauken Creek watershed occurs during all seasons of the year with the main flood seasons being summer and fall. Summer floods are generally the result of intense local thunderstorms. However, the highest flood elevations in the study reach have resulted from tidal conditions due to hurricane activity.

## 2.4 Flood Protection Measures

Presently there are no flood protection measures within the study area. Residents depend on the usual warnings issued through radio, television, and local newspapers for information concerning possible flood conditions. Flood watches and flood warnings are issued by the National Weather Service (NWS) Flood Forecasting Center located in Philadelphia, Pennsylvania.

# 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

## 3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the community.

In this revision, discharges for Pennsauken Creek were developed using methods described in U. S. Geological Survey (USGS) Special Report 38 (Reference 2). Peak discharges were calculated at the confluence with the Delaware River. Located upstream of the township within the Pennsauken Creek watershed are two current USGS stream gages. Gage No. 01467081 is on South Branch Pennsauken Creek in Cherry Hill, with a drainage area of 8.98 square miles. Gage No. 01467069 is on North Branch Pennsauken Creek in Moorestown, with a drainage area of 12.8 square miles. Peak frequency discharges were determined for each gage in accordance with USGS bulletin No. 17B (Reference 3). The discharge-frequency relationships of the study area are consistent with the upstream gage records.

A summary of the drainage area-peak discharge relationships for the portion of Pennsauken Creek studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| PENNSAUKEN CREEK | | | | | |
| Upstream of confluence with Delaware River | 35.7 | 1,580 | 2,460 | 2,930 | 4,000 |

In this restudy, the tidal flood elevations calculated for the Delaware River were based on a COE study of the Delaware River Basin (Reference 4). The stillwater elevations for the 10-, 50-, 100-, 500-year floods have been determined for the Delaware River and are summarized in Table 2, "Summary of Stillwater Elevations."

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

| FLOODING SOURCE AND LOCATION | ELEVATION (feet) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|
| DELAWARE RIVER | | | | |
| At the mouth of Pennsauken Creek | 7.8 | 9.3 | 10.1 | 12.3 |

## 3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

In this revision, cross sections were obtained by photogrammetry using recent aerial photography (Reference 5). The ground control for the photogrammetry was acquired using conventional surveying techniques. Bridges and culverts were field-surveyed (Reference 6). Cross sections were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures.

For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are shown on the Flood Insurance Rate Map (Exhibit 2).

In the original study, water-surface elevations of floods of the selected recurrence intervals were computed by manual methods. In this revision, water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 7). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

In this revision, the starting water-surface elevation was the one year tide -- 6.0 feet at the mouth of Pennsauken Creek. The backwater effect of the Delaware River was compared to the fluvial flood elevations. Along the study reach of Pennsauken Creek for all recurrence intervals, the backwater effect of the Delaware River produced tidal flood elevations in excess of fluvial flood elevations. For this reason, no flood profiles were calculated as part of this revision.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen based on engineering judgment. **Channel roughess factors were updated for the Delaware River using the information in Reference 4.** The channel "n" value used for Pennsauken Creek in this revision was 0.040 and the overbank "n" value was 0.070 (Reference 6).

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study, and their descriptions, are shown on the maps.

## 4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist in developing floodplain management measures.

### 4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 10 feet in the original study (Reference 8). In this revision, boundaries were interpolated using topographic maps developed by aerial photogrammetric techniques at a scale of 1"=400' with a contour interval of 4 feet (Reference 5).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 1). On this map, the 100-year floodplain boundaries correspond to the boundaries of the areas of special flood hazards (Zone AE), and the 500-year floodplain boundaries correspond to the boundaries of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundaries have been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 1).

### 4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the

100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this study.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 3). The computed floodways are shown on the Flood Insurance Rate Map (Exhibit 1). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway for Pennsauken Creek extend beyond the corporate limits.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 3 for certain downstream cross sections of Pennsauken Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 0.2 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

## 5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH[2] (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| | | | | | (FEET NGVD) | | | |
| Pennsauken Creek | | | | | | | | |
| A | 885 | 623 | 8,583 | 0.3 | 10.1 | 6.0[3] | 6.0 | 0.0 |
| B | 3,405 | 281 | 3,597 | 0.8 | 10.1 | 6.0[3] | 6.0 | 0.0 |
| C | 5,850 | 267 | 3,230 | 0.9 | 10.1 | 6.1[3] | 6.1 | 0.0 |
| D | 7,540 | 228 | 2,388 | 1.2 | 10.1 | 6.1[3] | 6.1 | 0.0 |
| E | 8,530 | 291 | 3,459 | 0.8 | 10.1 | 6.2[3] | 6.2 | 0.0 |

[1]Feet above confluence with the Delaware River
[2]This width extends beyond corporate limits
[3]Elevation computed without consideration of backwater effects from the Delaware River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

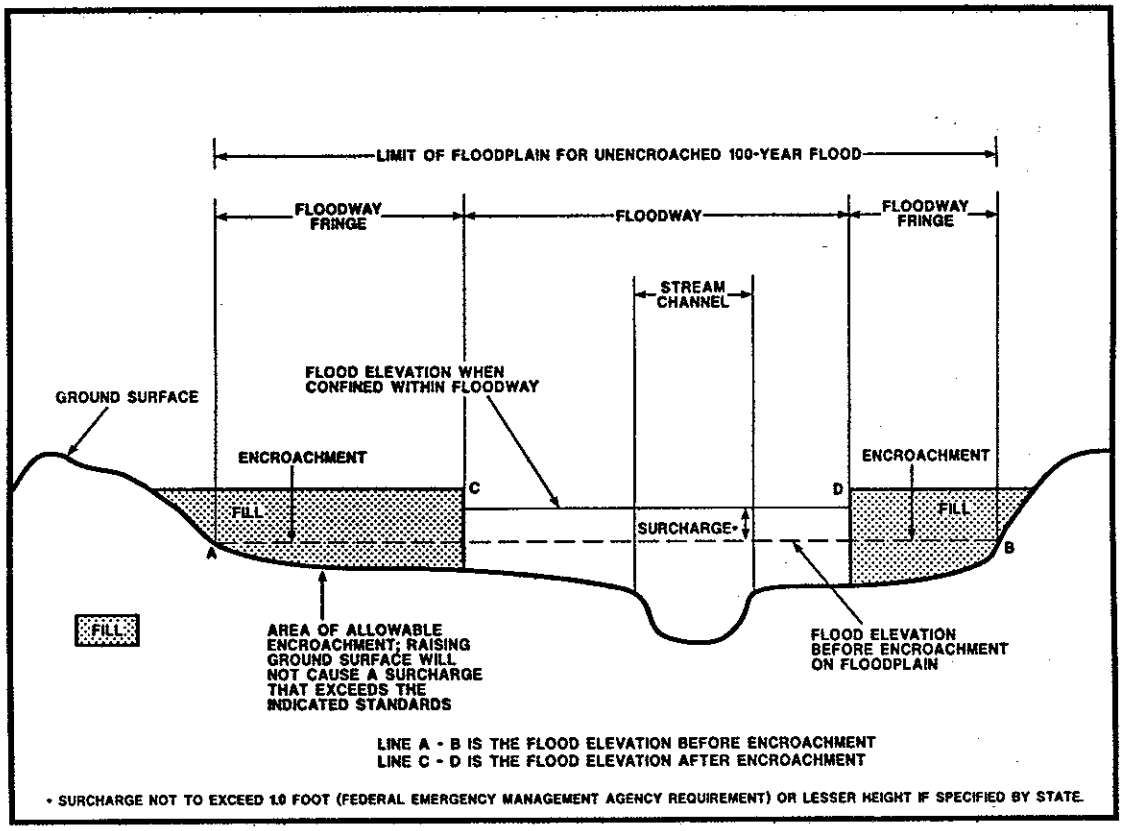
**BOROUGH OF PALMYRA, NJ**
**(BURLINGTON CO.)**

**FLOODWAY DATA**

**PENNSAUKEN CREEK**

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.




**FLOODWAY SCHEMATIC** Figure 2

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the

areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

## 6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map (FIRM) is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable. The FIRM includes flood hazard information that was presented separately on the Flood Boundary and Floodway Map in the previously printed Flood Insurance Study for the Borough of Palmyra.

## 7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Borough of Riverton (Reference 9).

Flood Insurance Studies are currently being prepared for the Townships of Pennsauken and Cinnaminson (References 10 and 11 )

Because it is based on more up-to-date analyses, this study supersedes the previously printed Flood Insurance Study for the Borough of Palmyra (Reference 12).

## 8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, 26 Federal Plaza, Room 1351, New York, New York 10278.

## 9.0 BIBLIOGRAPHY AND REFERENCES

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