Section 206 Maine

Existing Flood Forecasting Procedures And Flood Hazard Evaluation

Androscoggin River Basin Maine And New Hampshire

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I. INTRODUCTION

The Androscoggin River, with a 3,450 square mile drainage area, flows in Maine and New Hampshire for a distance of 161 miles from the Canadian border to the Atlantic Ocean. The Androscoggin descends a total of 1,245 feet, of which 789 feet have been developed by private interests for hydroelectric power purposes. Steep descents are located at Berlin, New Hampshire with a 240-foot fall in a 2.5-mile stretch and Rumford, Maine with a 180-foot fall in a 1.6-mile reach. The river is fed by numerous tributaries including the Ellis, Swift, Webb, Nezinscot and Little Androscoggin Rivers.

The economic base of the basin is centered in the paper and textile industries. Manufacturing activities are performed in communities throughout the basin. A majority of the large paper mills are located along the Androscoggin River, while textile plants are generally found within the larger communities in the basin. Other industries in the basin include electronic items, printing, and dairy products.

Communities within the Androscoggin River Basin have suffered extensive damage from flooding in the past. Most of the severe floods in the basin have occurred in the spring months of March, April, and May, resulting from heavy rains and melting snow combining to cause large runoffs. Floods due solely to heavy rainfall also occur during November and December. The flood of record for the Androscoggin River Basin is the March 1936 flood which resulted from four storm centers passing over the northeastern part of the United States in a two-week period. There were two distinct flood crests, the first produced by a combination of rainfall and snowmelt, while the second peak was produced by high intensity rainfall preceded by high moisture conditions. This flood caused severe flood damage in both New Hampshire and Maine, with the vast majority sustained in the Maine portion of the basin. Another severe flood in the Androscoggin River Basin occurred in March 1953. A steady stream of moist ocean air flowed over New England producing an almost continuous eight-day period of rain and subsequent flood conditions. Ice jams also create destructive flood problems in areas of the basin where extreme bends or bridges constrict the flow of breaking ice, causing water levels to rise behind the jam. Many of the towns along the main stem have experienced varying degrees of ice jam flooding over the past decade.

The major historical flood damage in the basin has been sustained primarily by the large industrial complexes, paper and textile mills located in the more developed areas of the basin. Most of these mills are in communities in the lower portion of the basin such as Rumford, Mexico, Livermore Falls, Lewiston, Auburn and Brunswick. Exceptions are Berlin and Gorham, New Hampshire, located in the upper area of the basin. Other communities may also suffer some small industrial flood damage, but these are less severe because of their rural nature. Residential neighborhoods sustaining flood damage are scattered throughout the study area, although the majority of the damage is in the lower portion of the basin. The balance of the damage is suffered by highways, railroads, and utilities.

Studies investigating the feasibility of implementing structural measures to reduce flood damages have been conducted for many locations in the

Androscoggin River Basin. These studies have determined that the costs of constructing and maintaining structural flood control projects have been greater than the benefits derived from these projects. Consequently, few flood control dams or local protection projects have been built in the Androscoggin River Basin.

As part of the technical assistance program offered by the Corps of Engineers, this report has been prepared at the request of the Maine Bureau of Civil Emergency Preparedness. The objective of this report is to determine the feasibility of implementing a comprehensive flood forecast, warning, and preparedness plan in the Androscoggin River Basin. The State of Maine expressed a concern about the flood problem that exists in the Androscoggin River Basin and wants to determine the justification of implementing such a system. This report presents the results of an objective analysis to determine areas within the Androscoggin River Basin which could sustain severe flood damage and benefit the most from implementation of a comprehensive system.

Included in this report are specifics pertaining to the existing flood forecast system operated by the National Weather Service (NWS) and a network privately operated by the large paper companies to predict streamflows. The Northeast River Forecast Center of the NWS, currently performing the flood forecasting for the basin, is in the best position to determine the technical requirements of supplementing the existing system with an objective to give flood plain property owners as much warning time as possible. With an increased warning time, property owners will have more time to take actions reducing their susceptibility to flood damage from impending events. The damages prevented by these actions are the benefits accrued from a flood forecast, warning and preparedness plan.

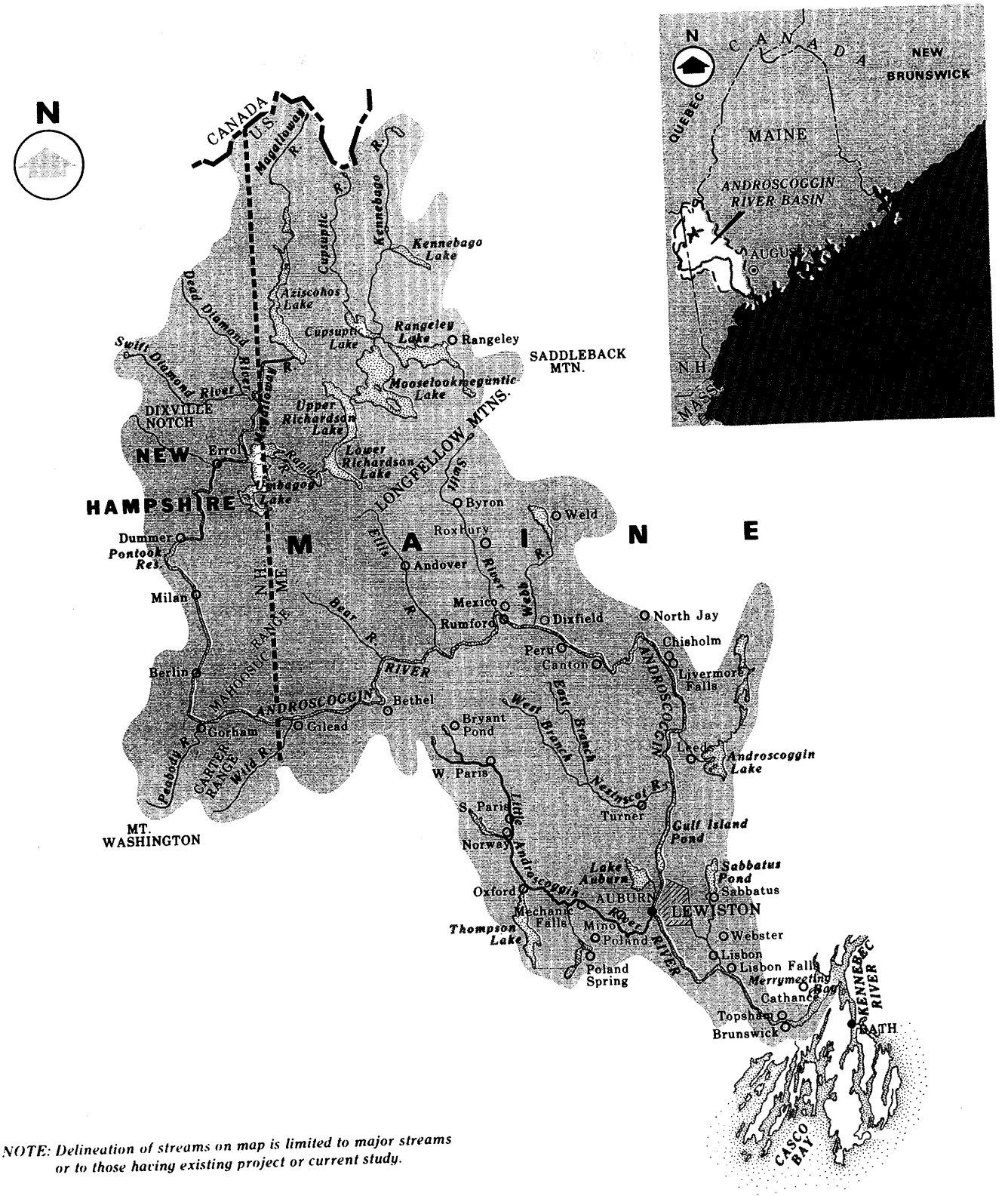
II. PURPOSE AND AUTHORITY

The State of Maine requested assistance from the New England Division, Corps of Engineers in preparing a report determining the feasibility of a comprehensive flood forecast, warning, and preparedness plan for the Androscoggin River Basin. The purpose of this report is to provide the State of Maine with the necessary information to determine if an investment in such a system is warranted.

Authority for Corps of Engineers participation in this effort is contained in Section 206 of the 1960 Flood Control Act (Public Law 86-645) which states

> ". . The Secretary of the Army through the Chief of Engineers, Department of the Army, is hereby authorized to compile and disseminate information on floods and flood damages, including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in the use of flood plain areas and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard. . ."

Other Corps of Engineers programs designed to mitigate flood damages are discussed in a subsequent portion of the report. Programs discussed include Small Projects Authority (Section 205 of the 1948 Flood Control Act), Snagging and Clearing Projects Authority (Section 208 of the 1954 Flood Control Act), and Flood Plain Management Authority (Section 206 of the 1960 Flood Control Act).



NOTE: Delineation of streams on map is limited to major streams or to those having existing project or current study.

ANDROSCOGGIN RIVER BASIN

Maine and New Hampshire

SCALE IN MILES

4 0 4 8 12

PLATE 1

III. SCOPE

This study will identify potential damage areas which would benefit from implementation of a comprehensive Flood Forecast and Warning System in the Androscoggin River Basin. The primary focus of this study will be a determination of the areas which could potentially benefit from such a system, while the NWS would be the lead agency in determining the technical requirements of supplementing the existing system to give flood plain property owners more warning time than currently possible. Determination of the increased lead times from any new system will be made by the NWS. The updated system would attempt to address problems resulting from free flow, ice, and tidal flooding depending on the location of damage centers in the basin.

Included in the report is information pertaining to types of flood forecast and warning procedures available, and a brief discussion of protective measures which can be taken by property owners upon receipt of a flood warning, and also, a synopsis of the present flood forecast systems operating in the Androscoggin River Basin.

The primary objective of this study was to determine those areas in the basin having severe damage potential from free flow, tidal or ice jam flooding. These areas were determined using available hydrologic data, relying most heavily on flood insurance information from the Federal Emergency Management Agency and historical flood data and pictures. An effort was made to assimilate any available topographic mapping regarding developed portions of the basin in order to determine the depth and severity of flooding in these areas. A profile of the flood damage centers in the basin could then be developed. Given the scope of this work, new hydrologic studies or photogrammetric mapping were not needed.

The damage assessment performed was not as intensive as that for Corps of Engineers flood control feasibility studies. Damage survey work of properties in the flood plain and survey field work to determine the depth of flood stages were not conducted. As a result, calculations of expected annual damages for structures in the flood plain was not performed. Therefore, the decision whether any modification of the existing system is warranted must be made based upon the identification of potential areas included in this report.

Coordination among all Federal and State agencies was crucial to the study. A dialogue was maintained to exchange relevant information between the Corps and NWS to exchange information concerning the existing flood forecast and warning system in the basin, while input from local and regional agencies was vital in determining flood prone areas where benefits could be derived from a more comprehensive system.

Federal funding for improvements to the system, including any Corps of Engineers involvement, will be limited. The State of Maine requested this investigation as a means to determine the feasibility of using state expenditures to fund system hardware which could include precipitation gauges, minicomputers and electronic transmission equipment. The NWS, besides setting up any new system, would supply knowledge needed to analyze data coming from the field during periods of heavy rains, ice breakup, or extreme

tidal fluctuation. Included is access to information developed by NWS field offices during periods of flooding. The Corps of Engineers is not authorized to provide funding for any portion of the system. Our involvement is limited to the publication of this report.

IV. FLOOD FORECAST, WARNING AND PREPAREDNESS PROGRAMS

The concept of a flood forecast, warning and preparedness plan is simple. Upstream data, precipitation, and/or stream levels, are measured and the information used to predict downstream flows. If the predicted flows will cause flooding in downstream areas, warnings are then issued to the public in the affected area and to officials responsible for implementation of preplanned protective actions. The activities required to have an effective and comprehensive program can be broken into four major elements. They are:

1. Flood recognition system using upstream data to forecast downstream stages.

2. Warning procedures to disseminate information concerning potential flooding to affected areas.

3. Preparedness plan outlining actions to be taken in order to mitigate the impact of flooding.

4. Maintenance of program capabilities between periods of flooding.

Many local flood forecast, warning, and preparedness programs developed to date work quite effectively. The information made available has been credited with saving lives and preventing much flood damage, while enabling communities to avoid unnecessary evacuation and other inconveniences resulting from over-reactions.

A. Types of Flood Forecast Systems

The first objective of a flood forecast and warning system is to determine when a flood is impending and predict the time and magnitude of its occurrence. The flood forecast portion of the system is vital because all subsequent actions geared to reducing the impacts of flooding are dependent upon a timely and accurate forecast. There are two basic approaches to predicting floods. The most commonly used is a prediction of flooding based on precipitation measured in upstream areas, while an alternative approach is to predict flooding utilizing experienced upstream water levels.

Flood forecasting systems based on measurement of upstream water levels are usually the most accurate, but can only provide a warning period equivalent to the time needed for flood waters to travel from the upstream point to the potential downstream damage area. Systems based on precipitation provide longer warning periods because potential problems are identified before surface runoff reaches the stream. Most flood recognition systems are developed by implementing a combination of these basic approaches. Other characteristics affecting the system's effectiveness include the amount of data collected and the manner of data collection, type of analysis performed, and the extent of automation and computerization employed,

There are five basic types of flood recognition systems available. An analysis must be made to determine which system is most appropriate for a particular situation. Many variables such as the size of the area to be covered, the human and monetary resources available, and the effectiveness desired must be taken into account in designing the most appropriate system. The five systems currently in use can be categorized as:

1. automated upstream water level sensor systems
2. volunteer operated manual crest-stage projection systems
3. automated precipitation systems
4. volunteer operated manual precipitation systems
5. combined systems

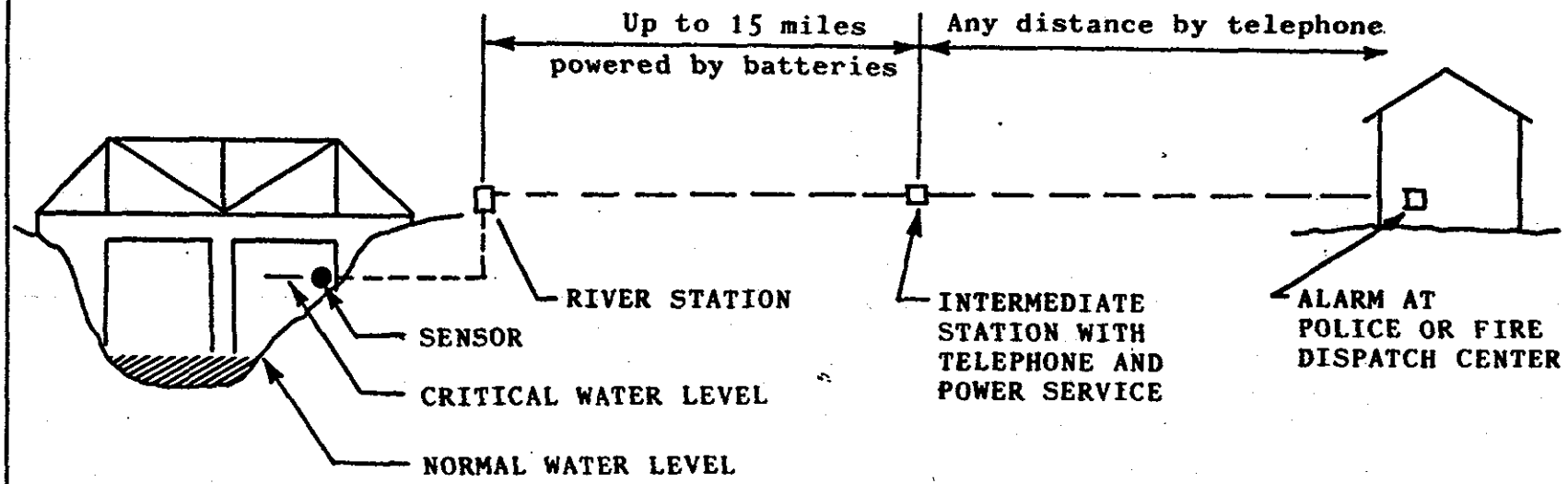
Automated Upstream Water-Level Sensor

Automatic upstream water-level sensor systems employ one or more upstream water level sensors which signal a remote station when a predetermined stream level is exceeded at the sensor location. The system is then activated at the base station and an analysis performed to forecast anticipated downstream water levels. A schematic diagram illustrating the installation of a typical automatic water-level sensor is displayed on the following page.

The problem of flooding caused by ice jams occurs to varying degrees every year along streams in Maine. Forecasting the occurrence of these jams is very difficult because of the localized dynamic conditions which accompany each jam. Automated water-level sensors could play a vital role in forecasting flooding in locations where historical data shows severe flood damage occurs frequently as a result of ice jams. The formation of ice jams usually occurs at two typical locations. One location might be a constriction in the stream channel, at an island or bend, or at manmade features such as dams, bridge abutments and bridge piers. Another typical location is a shallow reach where the ice has frozen to bottom boulders or shoals so the ice cannot be lifted and moved by increased water flow. In each instance the ice acts like a dam increasing stages upstream of the blockage, often resulting in severe flood damage.

The placement of an automatic water-level sensor upstream of locations where ice jams frequently occur could give property owners sufficient warning time to take preventive measures. The sensor could be set at a predetermined stage before flooding occurs to alert residents that river stages are increasing and flooding potential exists.

Several varieties of automatic water-level sensors are available for the purpose. One item of this type is a flood alarm consisting of a float operated switch which can be set at a predetermined stream stage. Transmission of the signal is usually over telephone lines and, for short distances, over battery operated lines. Flood alarms of this type are vulnerable to



Schematic Illustration of Typical Automatic Water-Level Sensor Installation

failure from disruption of telephone and electrical service. To minimize downtime, alarm stations usually include circuitry to automatically signal any disruption in service. Also, these sensors do not indicate the rate of rise of flood waters, the current flood stage, or the duration of flooding.

Another type of automatic water-level sensor, known as the bubbler-type river gauge overcomes some of these deficiencies. This type of gauge is used in rough terrain where access is limited. The structural component of the gauge is fabricated from 12-inch diameter pipe of sufficient height to provide a buried well for shielding on-site electronics and the stabilizing battery. This configuration was chosen on the basis of many years testing equipment under severe storm conditions in the Sierra Nevada Mountains. Transmission of data is performed by an on-site radio transmitter which sends a signal to a base station. Following collection of the data, analysis can be performed to determine downstream stages. These automated gauges are very adaptable to computerization for monitoring and analysis activities. A schematic diagram of a bubbler-type rain gauge is presented on the following page.

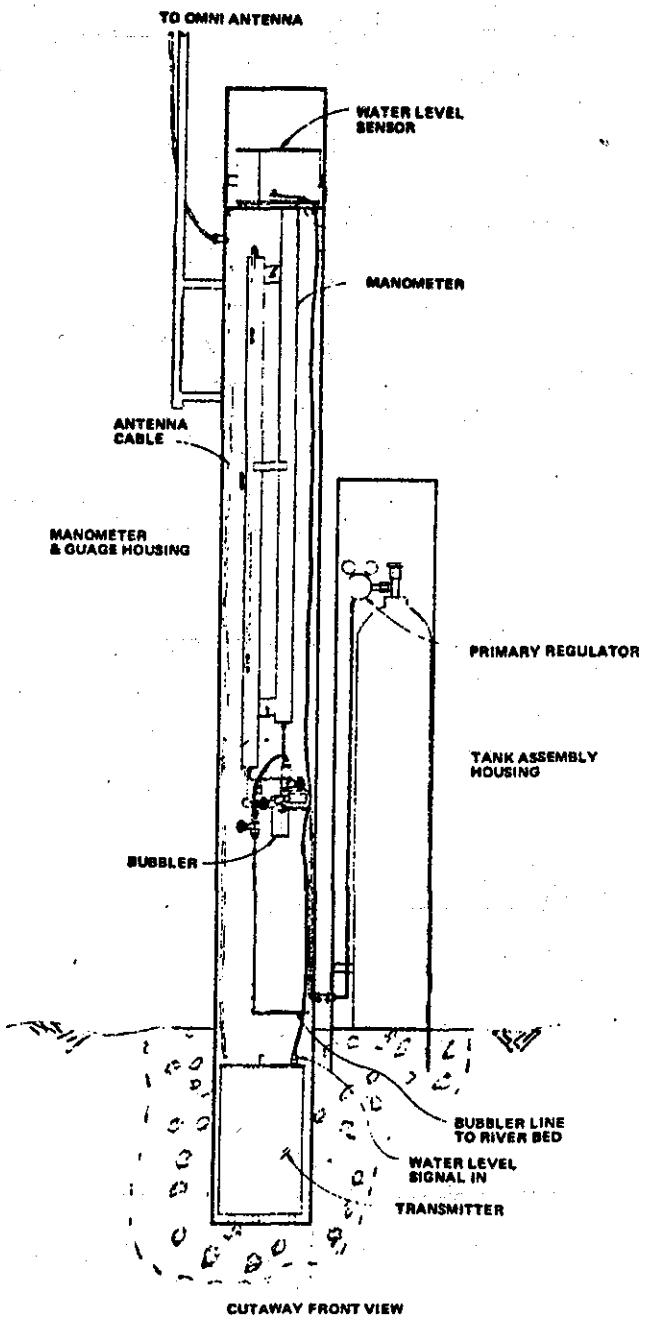
Volunteer Operated Manual Crest-Stage System

The objective of this system is to use water levels already attained at upstream points to predict downstream flood stages. Basic information on travel times also allows predictions of the timing for impending flood stages. The concept of this system is to use volunteer observers, not automated sensors, to determine upstream conditions. These observers are activated by a system coordinator on the basis of pre-established procedures. Observers then determine flood stages from a staff gauge installed at a specific location and report back to the base station where an analysis is performed to forecast downstream flood stages.

Usually only one observation point is needed on each waterway upstream of the area to be protected or a major tributary to a stream flowing through the area. The number of necessary observation points is dependent upon characteristics of the specific area. Of course, the more tributaries that are covered the greater the effectiveness of the system.

Stream gauges commonly used in flood forecast systems are painted on bridge piers and other vertical surfaces near the stream channel or an inexpensive staff gauge mounted on fixed surfaces. Both types of gauges are subject to being obscured or destroyed by debris collection or ice jamming. Proper positioning for the gauges is very important so gauges perform effectively during both low and high flows, when inundation may pose a problem of finding a vantage point.

A system using volunteer observers is dependent upon the availability of the observers during periods of potential flooding. Often a crisis situation develops late at night, the observer may be on vacation or for many other reasons data collection may not be possible. Uncontrollable circumstances could force the system to breakdown totally or function in a less than efficient manner. Also, rural areas and large basins are not particularly suitable for this type of system.



Schematic Diagram of Installed Bubbler Type River Gauge

Automated Precipitation Systems

This type of system relies upon the transmission of rainfall data, normally by telephone or radio, from upstream locations to a base station. This data is transmitted whenever a specified amount of rainfall has been accumulated by the gauge. Using either simplified charts and tables relating upstream precipitation to stages, or a mini-computer, a forecast of the potential flooding can be made.

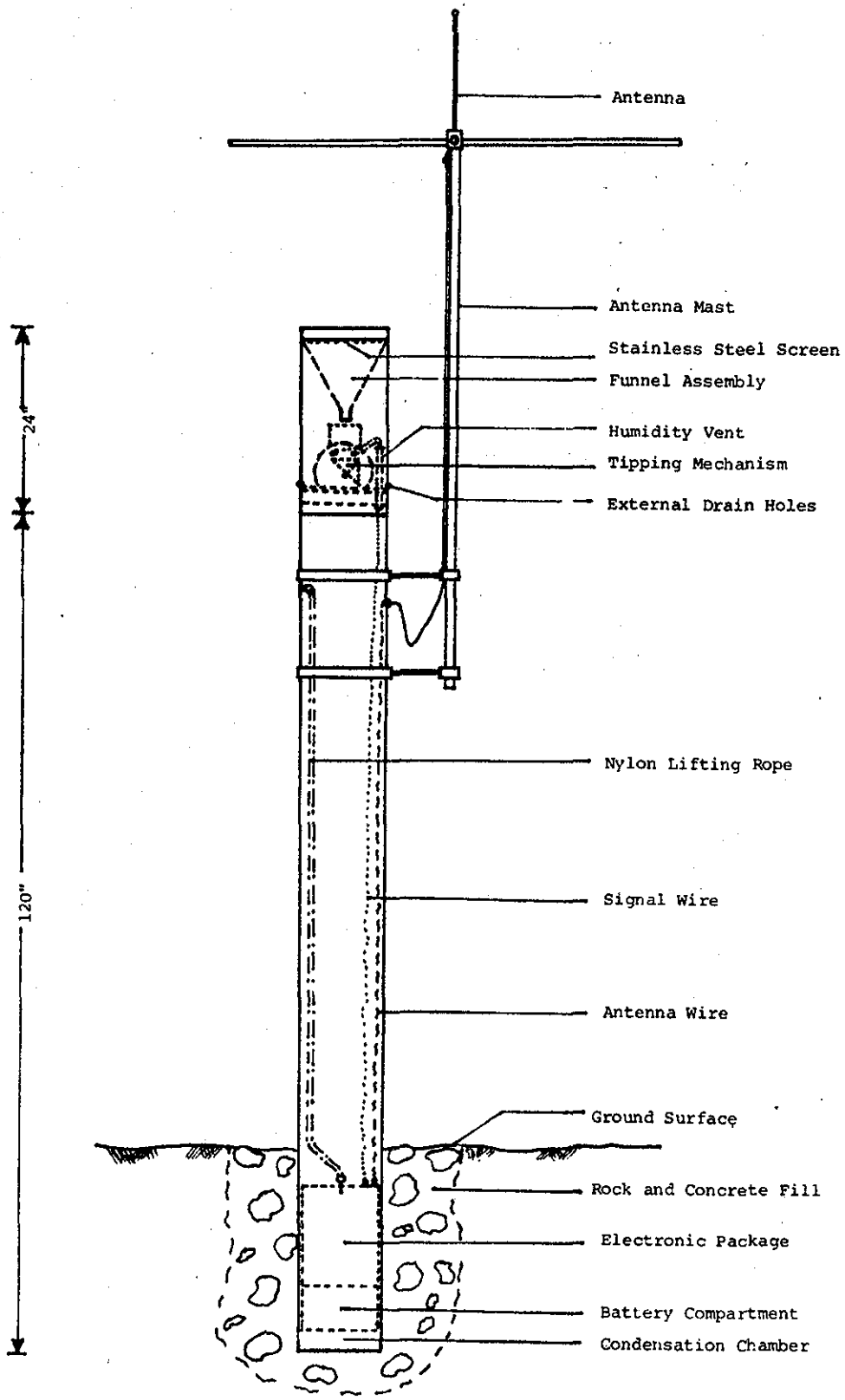
In general, two types of equipment are available for remote collection of precipitation data. One type must be interrogated, usually by telephone, while the other automatically reports by radio or telephone when an increment of precipitation is recieved. Precipitation gauges requiring interrogation must provide for continual communications when conditions favor rain, or some other method for the system operator to acquire data during rainfall periods. Following assembly of the rainfall data from automated gauges, by either telephone or radio, an analysis can be performed to determine downstream flood stages.

In most instances precipitation gauges which adquately measure high intensity rainfall must be positioned at remote locations in the headwaters of basins. Because of this fact, one particular design has been found to be effective and durable in remote locations with severe weather conditions. The construction and appearance of the precipitation gauge are similar to that of the bubbler type water-level gauge. As stated earlier, this design was chosen from years of experience in the Sierra Nevada Mountains.

This type of rain gauge is a modular, self-contained, self-powered reporting unit. Transmissions are made automatically (no interrogation is needed) by radio to the base station. Precipitation is caught in an aluminum funnel assembly and measured by a tipping bucket mechanism. Each 1 mm increment of precipitation causes the radio transmitter contained in the electronic package to transmit a rainfall accumulation value on an appropriate hydrologic radio frequency. A similar gauge appropriate for snow areas uses a modified version of the design which causes incoming precipitation to displace an antifreeze mix through the tipping bucket mechanism. A schematic diagram is shown on page 10.

Volunteer Operated Manual Precipitation Systems

One of the most popular types of flood forecast systems is that employing volunteer rainfall observers equipped with inexpensive rain gauges. Both simplicity and low cost account for this popularity. The system is activated when a predetermined amount of rainfall is exceeded at an observation point. The observer contacts the system coordinator who then activates the entire system by notifying the other volunteer observers. Data from these observers is normally submitted by telephone or radio. In areas where telephone transmissions may be interrupted, systems should be designed to provide a means for data collection by police, public mobile radio units, or amateur radio units. Following assembly of precipitation reports, data is usually analyzed manually to forecast stream stages.



Schematic Diagram of Installed Precipitation Gauge

Again, the effectiveness of this volunteer oriented system is dependent upon the availability and reliability of a few people. Uncontrollable circumstances can interrupt the standard operating procedures, leaving the system ineffective. Also, the adaptability of a volunteer operated manual precipitation system to large basins and rural areas is difficult.

Combined Systems

Many flood forecast, warning and preparedness programs combine a number of methods for data collection. The mix of several methods often enables implementation of a more adaptable system for the particular area being protected. As an example, a water-level sensor located on a stream can develop information which can be used to update earlier forecasts based on information collected by precipitation gauges. Also, the advantages of both can be attained by relying on precipitation information for the earliest warning and measurement of upstream water-levels for more precise forecasts of flood stages and the time of arrival.

B. Flood Warning Arrangements

Determination of Warning Issuance

Flood warning is the critical link between forecast and response. An ideally effective warning process will communicate the current and projected flood threat, reach all persons affected, and account for the activities of the community at the time of the threat (night, day, etc.). The decision to warn must be made by responsible agencies and officials in a competent manner to maintain the credibility of future warnings. The decision-making process regarding the issuance of warnings is usually closely related to the data collection and flood stage prediction network. In cases where data collected through a local flood forecast system is provided to the National Weather Service for hydrologic analysis, that agency normally originates the warning. Warnings are then released over television and radio and given directly to a local official by telephone. Local officials then decide whether to make any further warnings by other means.

Warning disseminations are generally made entirely by local officials when analysis of data is performed on a local level. In this instance, the assignment to issue and disseminate warnings can be made by one person or a chain of command. Moving decisions through a chain of command reduces error and hasty judgements, but may affect the timeliness when warnings are finally made available. This is an important issue because warnings which are received late are of little value. On the other hand, faulty warnings may cause unwarranted complacency or result in overreaction. No single procedure is universally applicable for flood warning arrangements. The appropriate procedure depends on local preference, topographic, hydrologic and other considerations.

Warning arrangements should be carried out according to an established procedure so all personnel are aware of the proper actions to be taken. The procedures must be explicit because the warning arrangements are usually complex, involving a number of people and organizations working in unison to

properly distribute warnings. Detail can be added to warning procedures by providing criteria to assist in determining appropriate actions, including lists of persons to be issued warnings, provision of telephone numbers and addresses, and wording of warning messages to be used in certain situations. Also, the names and telephone numbers of Federal and State disaster offices, listings of potentially useful equipment, maps and plans should be included. It must be noted that because warnings will likely be executed under stressful and trying conditions, nothing should be overlooked.

Warning Systems

After a decision has been made by the local authorities to issue a flood warning, the means must be available to disseminate the information to affected property owners. The actual performance of the warning can be separated into three general types according to the needs of the locality. They are:

1. Mass warning systems

2. Special-recipient warning systems

3. Site-specific warning systems

Mass Warning Systems

This type of system is the most widely used approach to disseminate flood warnings. The message will be available to all parties in the area, with no means to selectively contact people with specific problems not found in the general populace. Mass warning systems use sirens, airhorns, radio, television and other means to cover large numbers of people and a wide area. Selectivity in warning only specific audiences is achieved by the choice of medium, activating only certain airhorns or sirens or making public announcements in particular areas. Also, no special effort is required of the intended recipient to obtain the warning.

Mass warning systems do provide the fastest means to alert large numbers of people and vast areas, but do have several disadvantages. These include:

* Inability of signals to reach the deaf and other special need recipients;

* Unnecessary distribution of warnings to unaffected areas;

* Relatively high cost of making siren systems highly reliable in operation; and

* Limitation in the content of the message which can be conveyed.

Special Recipient Warning System

Warning systems for special recipients are aimed at dissemination of the warning message to selected individuals. This type of system makes use of telephones, private radios, person-to-person contact, and other methods with

a high degree of selectivity in reaching selected individuals. In this manner, confirmation of the receipt and comprehension of the message by recipients to whom warning is critical can be accomplished. The selection of special recipients can depend on criteria such as:

* Responsibility for conduct of other warning activities;

* Need for long warning times;

* Inability to comprehend mass warnings; and

* Located outside the area covered by mass warnings.

The dissemination of warnings in rural areas not covered by a mass warning system is usually a cross between mass warning and warning for special recipients. While the parties to be warned may be individually identified or contacted, the needs of the individuals being contacted may be no greater than in cases where mass warning systems are used. Some of the same techniques used in mass warning systems, such as mobile public address systems, are often employed.

Site-Specific Warning Systems

Site-specific warning systems are designed to contact people in areas where mass warning systems are not heard or people are not familiar with the area. These systems are characterized by their focus on individual buildings, property, or geographical area. Of prime importance are structures such as factories with high noise levels, lacking radios and televisions. Also, site specific warnings are usually given to hotels, motels and other buildings where people unfamiliar with the area congregate. These people often require special instructions not needed by the local population.

Contents of the Flood Warning

The contents of a flood warning should be comprehensive in nature, presenting information relative to the severity of the situation and actions being taken to mitigate the potential problems resulting from flooding. During the flood warning procedure, residents should be given information on:

a. The seriousness of the expected flooding and the locations that might be affected.

b. The actions the city/town is currently taking to reduce damages and the risk to life.

c. The actions that residents of affected areas should take in order to reduce potential flood losses.

d. What the process will be, should evacuation become necessary.

C. Preparedness Planning

The function of a preparedness plan is to coordinate the response to a flood warning. This is an important part of the entire flood forecast, warning and preparedness system because it provides the benefits which justify the expenditure of funds for implementation. The objectives of a preparedness plan address safety, reduction of damage, and reduction of other flood related costs. In most cases, first priority is placed on the reduction of the risk to life, with secondary benefits resulting from the protection of property.

The actions performed in a preparedness plan can be broken into two categories, those performed by governmental agencies attempting to insure public safety, while other actions are carried out by affected property owners reducing their susceptibility to flood damage.

Actions of Local Government

Activities included in preparedness plans for the purpose of public safety are generally performed on a regional level by local government. Actions for protection from direct threats to safety include:

* Temporary evacuation of people and property.
* Dispersal of medical, fire, police and other emergency services.
* A means to maintain vital services.
* Curtailment of electrical and gas service to reduce potential for fire and explosion.
* Control of toxic and other dangerous materials.

Another responsibility of local government is the development of a plan for postflood reoccupation and economic recovery of the flooded area. Activities in the postflood recovery period focus on the reduction of costs other than through the prevention of direct damages. Postflood reoccupation and recovery includes:

* Reestablishment of conditions which will not endanger public health: disease and insect control, safe drinking water, safe sewage disposal, medical supplies.
* Return of other vital services.
* Removal of sediment, debris, flood fighting equipment and materials.
* Repair of damaged structures.
* Establishment of diaster assistance centers for financial and other assistance.

Some activities can be performed quite efficiently by government sectors, while others can be completed more easily with private assistance. For example, evacuation might be more rapidly accomplished if busses from the local transit system were available. Also, schools and public buildings outside the flood area can be used to house evacuees, but the burden of care can be shared by individuals, churches, and service organizations.

Opportunities for more or less governmental involvement exist for many aspects of preparedness plans. Selection of the appropriate level of governmental participation constitutes a major policy decision in plan formulation. The decision must be dictated by the amounts and types of personnel and physical resources available to local governments and the priority assigned to the plan's various objectives.

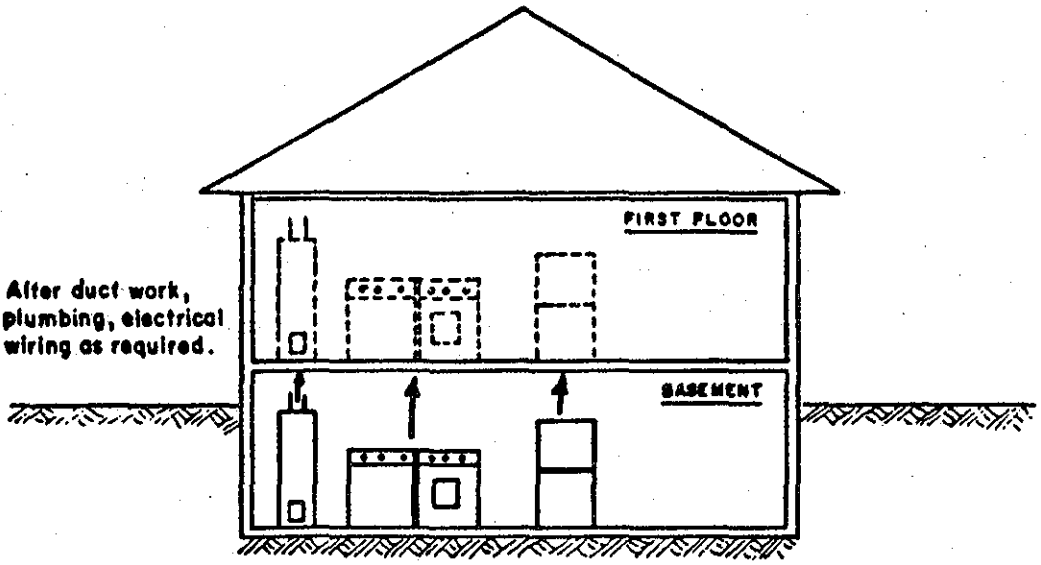
Protective Actions Available to Property Owners

The increased warning time before potential flooding occurs gives property owners time to implement temporary protective measures to reduce their susceptibility to the impacts of flooding. Measures available to property owners include temporary relocation of property and temporary flood proofing. These actions work more effectively when preflood planning is performed to lay out necessary steps to be taken, which items to be moved to higher levels or openings to be closed when a flood warning is received.

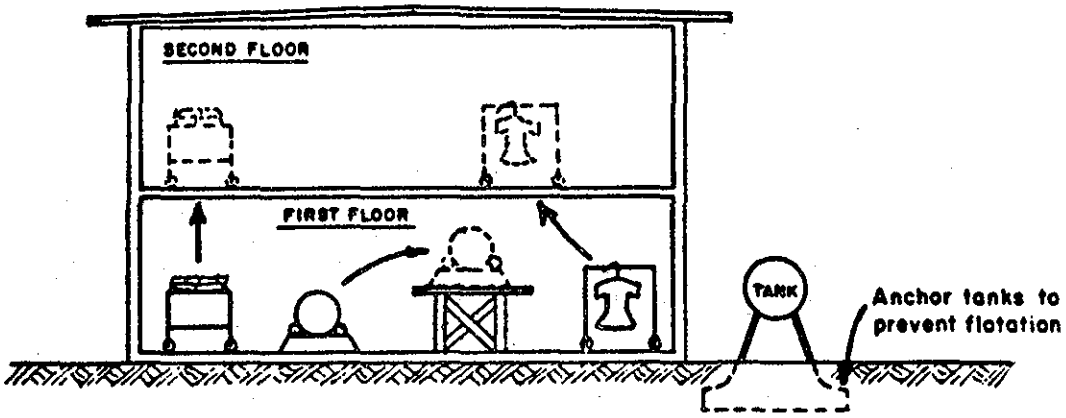
Rearranging or Protecting Property - This method minimizes the degree to which water comes in contact with damageable items. It can involve either minor or major modifications to the structure, selecting specific types of contents, and taking preparatory, emergency and cleanup actions. Many items in this category can be accomplished by the property owner with minimal outside help.

Residential Applications - Some measures can be easily and cheaply implemented by the property owner. The rearrangement or raising in place of contents within a structure is easily accomplished and can result in significant savings should a flood occur. This rearrangement can be permanent or temporary, implemented only when a flood warning is received. Other actions such as utility cells and utility rooms, while effective flood proofing measures, are expensive and require professional expertise. Because of the expense involved, utility cells and rooms are applicable only to those property owners who experience high flood damages.

Commercial/Industrial Applications - The permanent rearrangement or raising in place of equipment is very applicable in commercial/industrial structures because of the high cost of repairing mechanical and electrical machinery. Also, inventory is very adaptable to temporary relocation when flooding is imminent, thereby greatly reducing the potential for flood damage.



Raise Furnace, Water Heater, Washer, Dryer to First Floor



Raise and Relocate Merchandise and Equipment, Anchor Floatable Items.

Rearranging or Protecting Existing Property

Physical Feasibility - The degree to which property can be rearranged and protected is site specific. It depends on the flood hazard, principally depth and frequency of flooding, and the damageable property and its type, value, location and mobility. Shallow flooding allows the use of protective types of measures where appliances, utilities, equipment, and goods can be raised in place, surrounded, or enclosed and protected. Where the hazard is more severe and inundation is to greater depths, property would need to be relocated to prevent damage. In all instances, implementation can be either permanent or temporary, only implemented when flooding is forecast.

Advantages

- Almost every property owner can implement this method to one degree or another.
- It can be done on a per item basis, thus reducing the cost and allowing selective protection of high value contents.
- A structure can continue to be used at its existing site.

Disadvantages

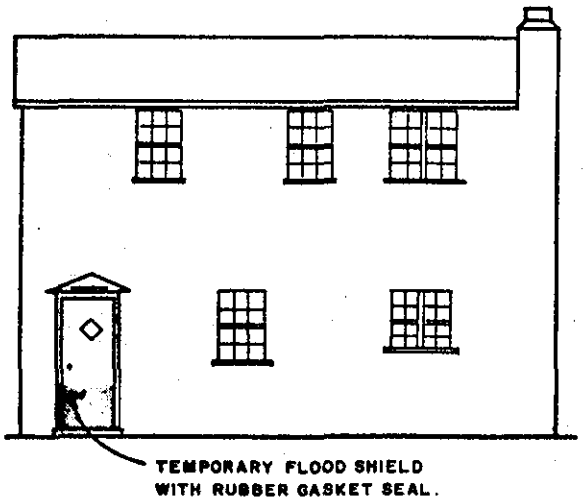
- Damage can be reduced only on those items that can be relocated or protected.

Temporary and/or Permanent Closures

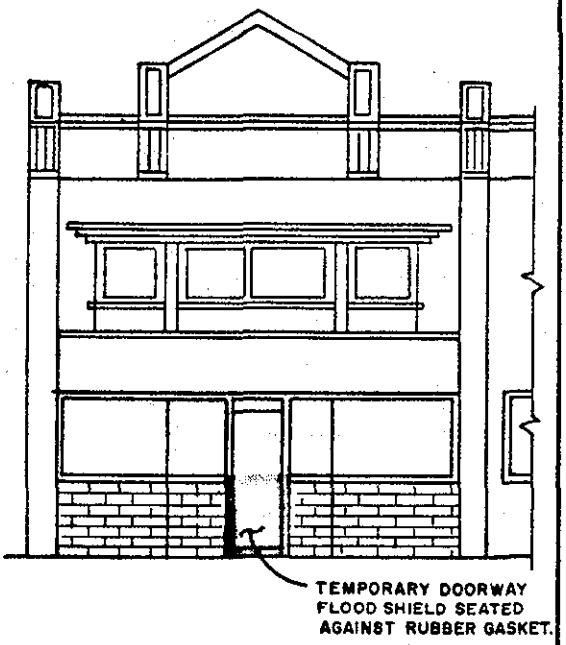
Structures with exteriors relatively impermeable to water can be designed to keep floodwaters out by installing watertight closures to openings such as doorways and windows. Due to the hydrostatic and buoyant pressures floodwaters exert on the building's walls and basement, this method is better suited for commercial and industrial structures that are more structurally sound. While some seepage will probably always occur, it can be reduced by applying sealants to walls and floors and providing check valves and floor drains where practical. Closures may be temporary or permanent. Temporary closures are installed only during a flood threat and therefore need warning time before installation.

Residential Applications - Due to buoyant and hydrostatic pressures, closures are not recommended for most residential structures that are not normally designed to withstand such loads. A second drawback is the possibility of incurring flood damage in the event a closure is neglected or fails to function as intended due to improper placement.

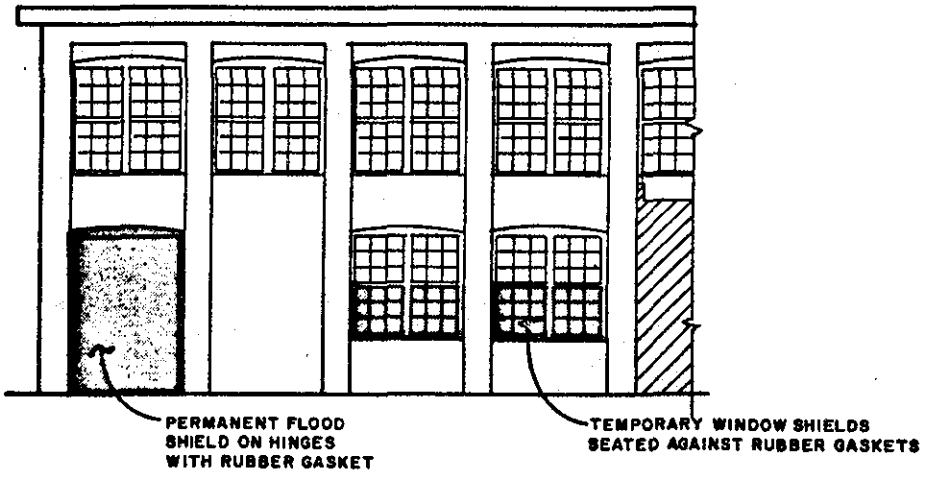
Commercial/Industrial Applications - Generally, closures are better suited to commercial/industrial structures that may be capable of withstanding buoyant and hydrostatic pressures. Permanent masonry closures have been effective in preventing flood damages at many industrial riverine sites in New England. An illustration of this method follows on page 18.



TWO STORY BRICK
RESIDENTIAL STRUCTURE



ROW STRUCTURE



COMMERCIAL / INDUSTRIAL STRUCTURE

Temporary and Permanent Closures

Physical Feasibility - Most structures, whether residential, commercial or industrial, are not designed to withstand hydrostatic pressure on the exterior walls. Therefore, when discussing physical feasibility, the principal considerations are that: 1) the exterior walls are impermeable or can be made so, 2) all openings below the design level can be closed, and 3) the structure can withstand the anticipated hydrostatic pressures.

When water is prevented from entering a structure, the walls become subject to hydrostatic forces that may cause failure, and the basement floor is subject to uplift forces that may cause buckling or flotation. Most structures are not designed to carry these forces and consequently are in danger of failure if floodwaters rise too high. It is particularly difficult to analyze the capability of existing structures to resist these forces because of the general lack of knowledge about workmanship and materials used during construction and the present condition of these materials. As a result, it is recommended that the property owner seek advice from an engineer or architect regarding the feasibility of these measures before implementation.

Advantages

- May be done on a selective basis to only those openings through which water enters and only to the height desired.
- Easy and quick to implement.

Disadvantages

- In the case of residential structures, is applicable only to those with brick or masonry type walls, without basements, which can structurally withstand the hydrostatic and uplift pressure of the design flood, and which are generally watertight. This disadvantage also applies to commercial and industrial structures, except that the walls and basements may be capable of withstanding greater pressures.
- Reduced likelihood of effective implementation at night, and during vacations and off-business hours.
- May create a false sense of security and induce people to stay in the structure longer than they should.

D. Maintenance of the Flood Forecast, Warning and Preparedness Plan

The actions composing a flood forecast, warning and preparedness plan can easily be forgotten during long periods between floods. A conscious effort should be made to maintain the public awareness of the potential for

flooding. To meet this end, arrangements should be made for continual testing and updating of components within the flood forecast, warning and preparedness plan.

Updating

Updating is primarily a planning activity aimed at identifying and making modifications in the plan because of particular changes which have taken place. The portions of plans most likely to require updating are items such as names, telephone numbers and contacts. However, other needs for updating may also arise which are more complex. For example, changes in land use in the watershed above a protected area or installation of upstream water control structures may change the timing or extent of the flood risk. Likewise, community growth or new development in the protected area may modify the flood hazard. The frequency of updating depends upon the importance of the item requiring alteration.

Testing

Testing refers mainly to equipment and supplies needed during a flood episode. Examples of things to be tested are communication links, generators, pumps, and sirens. The system components should be tested with appropriate frequency to insure proper operation during flooding episodes. The amount of testing performed is dependent upon the item's use during regular activities, vulnerability to failure and importance to the success of the flood forecast, warning and preparedness plan.

V. BENEFITS OF FLOOD FORECAST, WARNING AND PREPAREDNESS PROGRAMS

The principal benefits derived from implementation of a flood forecast, warning, and preparedness program can be broken into three categories. The impact of flooding can be mitigated by improving public safety, reducing losses from property damage, and reducing economic losses not directly related to property damage. The amount of benefits attributed to the program depends largely on the length of warning time and the effectiveness of preplanned response activities. The following two tables list ways a flood forecast, warning and preparedness program contributes to public safety and damage reduction.

TABLE 1

POTENTIAL BENEFITS FOR SAFETY

* Evacuation of hazardous areas prior to flooding;

* Provision of needed assistance to individuals and organizations which require more than the normal amount of time to evacuate;

* Provision for deciding the opening and closing of schools and work to minimize exposure to danger;

TABLE 1 (continued)

* Institution of traffic controls to prevent travel into hazardous areas and facilitate evacuation;

* Utilization of personnel and equipment to assure medical, fire and police services are continued;

* Management of gas and electric services to avoid fire and explosion.

TABLE 2

POTENTIAL BENEFITS FOR
REDUCTION OF PROPERTY DAMAGE

* Movement to a safe elevation of automobiles, furniture, valuable documents, and other damageable items.

* Protection of mechanical and electrical equipment by movement to a higher elevation.

* Protection of structures by sandbagging, anchoring, and implementation of semipermanent flood proofing measures.

Any area with a significant flood problem can benefit from the availability of adequate flood warning and preparedness arrangements, Even areas for which some level of protection has already been provided can benefit from supplementing existing protective measures with a warning and preparedness program. Local flood warning and preparedness programs are likely to be advantageous in a wide variety of cases due to their many potential benefits and relatively low cost.

VI. EXISTING FLOOD FORECAST SYSTEMS

The Androscoggin River Basin is monitored by the National Weather Service in order to disseminate flood forecasts, while the paper industry in the basin accumulates hydrologic data primarily to efficiently monitor hydropower generation. The large paper companies also use meteorological data for other purposes related to forestry. The details of each system are presented to give interested parties an understanding of existing flood forecasting capabilities. The National Weather Service System contains components of many systems outlined in the previous section, while the private system relies upon manual collection of precipitation data.

In each instance, the flood forecasting systems are not capable of addressing the flood problem attributable to ice jamming. In many communities, ice jams cause severe flooding much more often than flooding from free flow conditions. However, the ability to forecast ice jams is very difficult because of the many variables involved in their formation. These variables include: the strength of the ice present, the flow beneath the ice, and the cross section of the river in the vicinity. The localized dynamic conditions of ice jams rule out any regional approach to the forecasting resultant flooding.

A. Public Flood Forecast System

The National Weather Service (NWS), Northeast River Forecast Center (NERFC), located in Bloomfield, Connecticut, has the responsibility for preparing river and flood forecasts for the Androscoggin River Basin. This office performs the hydrologic analysis using the available information and issues the actual flood forecasts. The National Weather Service has an office in Portland, Maine which is primarily concerned with gathering hydrologic data to be used by the NERFC in development of the flood forecasts. The Portland office can make any necessary adjustments to the forecast issued by the NERFC based upon actual occurrences within the basin.

Hydrologic data is collected from three sources by the National Weather Service. The first source is Federally operated gauges within the basin, usually property of the United States Geological Survey (USGS), along with rainfall observers paid to report precipitation amounts. The remaining hydrologic data is generated by two private organizations and made available to the National Weather Service. Central Maine Power and James River Corporato obtain streamflow and precipitation data to regulate hydropower and paper production activities more efficiently.

The only USGS gauge within the Androscoggin River Basin used by the National Weather Service is located in Auburn. The gauge can be interrogated through a terminal at any time to determine instantaneous stream flow and precipitation data. This is quite important because data can be collected seconds after the actual occurrence. The only rainfall observer in the basin working solely for the National Weather Service is located in Rumford and reports precipitation amounts four times daily at 7 a.m., 1 p.m., 7 p.m. and 1 a.m.

Central Maine Power Company monitors occurrences within the Androscoggin River Basin for hydropower generation. The power company makes data available to the National Weather Service at two locations, Rumford and Gulf Island Dam. Streamflow data at Rumford is available four times a day during normal operations at 6 a.m., 12 p.m., 6 p.m., and 12 a.m. Also, instantaneous readings can be collected simply by making a telephone call. The Gulf Island Dam provides streamflow data at the same time as the Rumford station, but instantaneous readings are not obtainable from this site.

The James River Corporation has a number of mills located within the basin, most being in the upper reaches of the river in Berlin and Gorham, New Hampshire. For that reason, the James River Corporation has a series of gauging sites located upstream of Gorham in the northern portions of the basin. Precipitation measurements are taken at six locations, while streamflow data is available from two of these same sites. The six locations are Errol Dam, Aziscoos Lake, Upper Dam, Middle Dam, Berlin and Gorham, with only Errol Dam and Gorham providing flow data. A summary of hydrologic data used by the National Weather Service is presented in the following table.

TABLE 3

NATIONAL WEATHER SERVICE
EXISTING FLOOD FORECASTING SYSTEM
ANDROSCOGGIN RIVER BASIN

Source	Location	Data Collected	Reporting Times
NWS	Rumford	precipitation	7 a.m., 1 p.m., 7 p.m., 1 a.m.
USGS	Auburn	flow/stage	anytime
Central Maine Power	Rumford	flow	6 a.m., 12 p.m., 6 p.m., 12 a.m., (normal operations)
			anytime (flood situations)
	Gulf Island Dam	flow	6 a.m., 12 p.m., 6 p.m., 12 a.m.
James River Corporation	Errol Dam	flow/precipitation	8:20 a.m.
	Aziscoos Lake	precipitation	8:20 a.m.
	Upper Dam	precipitation	8:20 a.m.
	Middle Dam	precipitation	8:20 a.m.
	Berlin	precipitation	8:20 a.m.
	Gorham	flow/precipitation	8:20 a.m.

The hydrologic information is collected from the above sources and an analysis is performed to predict stages on the Androscoggin River. The National Weather Service issues flood forecasts for two locations within the Androscoggin River Basin, Rumford and Auburn, Maine. Flood forecasts issued at Rumford give a 24-hour warning time before peak conditions, while a 36-hour warning time before peak can be issued at Auburn.

A problem with the existing flood forecast system is the unavailability of real-time data; i.e., information received seconds after the actual occurrence. At most locations information is collected at predetermined times, ranging from once to four times a day, with no provision for data collection during the flood episode. Also, data sources which can be interrogated at any time, can be activated only after reception of collected readings at the predetermined times show flood potential exists. This results in flood forecasts which could be improved significantly with instantaneous upstream precipitation, flow and stage readings.

B. Private Flood Forecast System

The Boise Cascade Paper Group - Rumford Mill has a network of precipitation observers located in the upper portion of the basin above Rumford. The pur-

pose of this network is to monitor streamflows and to reduce flood damages at the mill during a flood emergency on any future occasion. The mill has a preparedness plan on file outlining actions to be taken during a flood. Making accurate predictions of flood peaks at the mill is vital. Incorrect flood forecasts on the low side would result in unnecessarily severe flood damages because actions such as moving equipment and inventory would not be implemented. On the other hand, flood forecasts predicting flood heights more severe than actually occur result in the needless dismantling of plant operations in low areas of the mill.

The precipitation network is comprised of six locations between Gorham and Rumford. The readings are received from the Mt. Washington Observatory, Pinkham Notch, and Gorham, New Hampshire; and Andover, Bethel, and Roxbury, Maine. At each site a person is paid to report precipitation amounts to the Boise Cascade Mill. During periods of normal meteorological activity, each individual records the amount of rainfall and mails it to the mill on a daily basis. There is a special procedure to be followed when a flood threat exists, whereby these individuals report precipitation amounts each hour over the telephone. Payment is made to these people per report, assuring their willingness to participate during crisis periods.

A hydrologic analysis is then performed to predict flows at the mill. This analysis is accomplished using tables based upon historical precipitation-flow and flow-stage relationships developed for this part of the basin from years of experience. The six precipitation readings are incorporated into the process and resulting flows and stages are predicted. In the spring, floods usually result from a combination of heavy precipitation and snowmelt. To take the excess runoff from snowmelt into account, temperature readings and snow depth measurements are incorporated into the analysis during the spring months. These temperature readings are necessary to make accurate predictions of flows because the amount of runoff from snowmelt is dependent upon the amount of precipitation and the current temperature in upstream areas. The precipitation and temperature readings are then included in the analysis to calculate predicted runoff. The flood forecasts attained with the system give warning times at the Rumford Mill of 16 hours until peak conditions, with predicted streamflows within 2,000 cfs of actual flows. This correlates into predicted stages within a foot of actual experienced stages.

The warning procedures built into the flood forecast system call for alerts to be given to several key personnel within Boise Cascade, Diamond International Corporation in Peru, the Rumford Police Department, and the Oxford County Civil Defense Office in South Paris. These companies and public agencies can then take appropriate actions to mitigate physical damages and ensure public safety from flooding.

The present users of this flood forecasting system are all located in the Rumford-Mexico area. For that reason, the system does not at the present time address flooding along the Androscoggin River upstream or downstream areas. Therefore, the information generated in this system for upper areas in the basin could be incorporated into a comprehensive forecasting system covering the entire Androscoggin River Basin. Currently, all available hydrologic information collected in the Androscoggin River Basin is not incorporated into a flood forecast system. The data generated by Boise Cascade has not

been used by the National Weather Service to date, but discussions with the paper company have shown a willingness to share this data with agencies involved in river flood forecasting, both on a State and Federal level. The effectiveness of a flood forecast system using all available data should be determined, subsequently to be compared against the effectiveness of any alternative systems using broader data collection networks or automated gauges.

VII. LOCATIONS OF POTENTIAL INDUSTRIAL FLOOD DAMAGE

The economic stability of the Androscoggin River Basin is heavily dependent upon the paper and textile industries. Many of these factories and mills are located adjacent to the main stem of the Androscoggin River and along some of its larger tributaries, mainly the Little Androscoggin and Sabattus Rivers. The majority of these plants are located in the southern third of the basin, although paper companies are situated in the flood plain as far north as Berlin, New Hampshire. The remaining buildings are located throughout the basin, generally centered near the larger communities within the basin. Any flood damages sustained by these mills cause particular financial hardships because of the economic impact on many residents of the area. Closure of the mills for any length of time would place a financial burden on many families, located both within and outside of the inundated area. An effective flood forecast system and a well conceived preparedness plan could mitigate impacts of flooding by allowing industrial plants time to implement protective measures.

The determination of which industrial buildings were located in the flood plain was made using available hydrologic data, namely flood insurance studies, flood plain information reports, and records of past flooding. Also, a series of on-site surveys were made to determine names and locations of industries in the flood plain. These firms identified in the report could benefit from an effective flood forecast and warning system by implementing measures to protect damageable property and/or to prevent floodwaters from entering the structure.

It must be noted that although these firms have been identified in flood plain areas, some may suffer actual flooding very infrequently. As an example, structures located near the outer limits of the 100-year flood plain have a 1 percent chance of being flooded in any given year. Those structures located outside the 100-year flood plain have even a smaller probability of sustaining flood damage in any given year. This list of industrial structures will include some that suffer flooding very infrequently. This will prove to be an important point in determining the usefulness of a Flood Forecast and Warning System for a particular site.

To accurately determine the flood severity at a location two types of information are needed: the flood stages and ground elevations. For communities where hydrologic information has already been developed, the flood stages have been included for the industrial sites. It was beyond the scope of this study to determine the ground elevation for each industrial structure located in the flood plain within the Androscoggin River Basin. However, each firm can reduce flood damages by utilization of an accurate flood forecast in conjunction with predicted flood stages. The flood forecast will allow property owners sufficient time to take protective measures, while the predicted flood stages tell property owners the level of protection required.

Contacts made with paper and textile mills in the basin have shown that some firms take definitive preplanned actions to combat flooding. Upon receiving notification that flooding is imminent or realization that water levels are rising rapidly, employees are mobilized to protect areas of the plants most susceptible to flood damages. The amount of damage which can be prevented is predicated on the timely receipt of the flood warning notice. It is imperative that regardless of the type of flood forecast system operational in the Androscoggin River Basin, these firms be promptly informed when it has been determined that a flood warning is appropriate. In this manner the paper and textile industries, the economic heart of the basin, can take protective measures.

This analysis was not all inclusive and may have overlooked some smaller industries located in the flood plain. The results of this analysis can be used as a guide for the development of a preparedness plan to respond to flood threats. Of course, any warning arrangements should include other industrial firms known by local interests to be located in flood-prone areas, but not included in this evaluation. The entire industrial community will then have an equal opportunity to mitigate potential flood damages. The following discussion identifies industrial plants in the flood plain. The locations are listed by community starting at the extreme downstream point of the basin and working upstream towards the northern headwaters of the basin. For many of the industrial buildings, a location map and predicted flood stages are included.

Brunswick

The City of Brunswick is located in the extreme southern portion of the Androscoggin River Basin. The community is situated in such a manner that flood damage can result from riverine and tidal high water conditions. The business and economic center of the community is located in the northern portion of town near the main stem of the Androscoggin River, far away from any potential for coastal flood damage. Due to the topography of the area characterized by high, steep riverbanks, the flood stages calculated for the Androscoggin River in this reach show most of the downtown area to be above any expected flooding. However, two industrial operations are located in flood-prone areas. Also because the city is in the extreme southern portion of the basin, the flood forecasts for the Brunswick area would result in longer lead times than possible for communities located in more upstream areas of the basin.

A large mill structure located adjacent to the Androscoggin River on the southerly bank is susceptible to flooding. This mill, just west of the Route 201 bridge over the Androscoggin, is a five-story brick structure used in the manufacture and warehousing of textile products. Firms located in the building include Miller Shoe Company and Thom McAn Factory outlet. Also, the Bath Iron Works uses part of the structure for storage. Being a multi-story structure, companies would be able to protect damageable property by moving machinery and inventory to upper floors, upon receipt of a flood warning message.

Another smaller industrial firm may be located in a flood-prone area. The Keena Corporation occupies a relatively small one-story structure on Water Street, approximately one-half mile downstream of the Brunswick-Topsham Hydroelectric Station currently under construction. Due to the type of construction, moving damageable property to a different location upon receipt of a flood warning may be the only method to substantially reduce flood damage.

The flood stages included in the following table were determined using preliminary information contained in the (yet unpublished) Brunswick Flood Insurance Study.

TABLE 4

FLOOD ELEVATIONS FOR
INDUSTRIAL LOCATIONS IN BRUNSWICK

Structure	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Large Mill	15	18	20	24
Keena Corp.	13	16	17	20

Topsham

The Town of Topsham is located on the northern side of the Androscoggin River directly across from Brunswick. Although located near Brunswick, Topsham is subject to flooding only from the Androscoggin River, with no direct flooding due to tidal high water or wave action. The town is relatively small with residential areas predominating the developed portions and no identifiable large business or commercial district. As in most small communities, there is a town center serving as the economic and governmental focal point, but this area and most of the residential development is above any expected flooding. However, a large paper mill is located adjacent to the river and appears to be a candidate to sustain flood damage.

This mill, located just east of the Route 201 bridge over the Androscoggin River, is owned and operated by the Pejebscot Paper Company. The stone foundation of the building directly abuts the river, with three floors being above normal river stages. Being a multi-story structure, much flood damage could be prevented by moving damageable property such as inventory and machinery to upper floors when flooding is imminent. Also, Topsham is located in the extreme southern portion of the basin and would have a long warning time before the actual flooding occurs, allowing sufficient time to implement protective measures.

Flood stages for the area near this structure were taken from preliminary flood profiles of the unpublished Brunswick Flood Insurance Study. The 10-year, 50-year, 100-year and 500-year flood stages are approximately 13 feet, 16 feet, 17 feet and 19 feet above national geodetic vertical datum

respectively. It must be noted that although openings where water could enter the upper floors may be above flood stages, damage could start earlier due to openings such as sewer outlets entering the mill. This is particularly true in this instance with the foundation totally exposed to the flood waters.

Lisbon

The Town of Lisbon is located in the southern portion of the Androscoggin River Basin just northwest of Topsham. The main stem of the Androscoggin River serves as the southern corporate boundary of the town, while the Sabattus River flows in a southerly direction through Lisbon Center until its confluence with the Androscoggin. The two developed areas within Lisbon, Lisbon Center and Lisbon Falls, are situated near these streams with portions of each subject to flooding.

Lisbon Falls is located in the extreme southern area of the community on the northern side of the Androscoggin River. Two large industrial plants, adjacent to the Androscoggin River in this reach, are located in the flood plain and are candidates to sustain severe flood damage. The United States Gypsum Company plant is located approximately 400 feet upstream of the Lisbon-Topsham corporate boundary. The complex is comprised of a series of structures, most being one story with only small areas above the first floor level. Some older parts of the firm are of brick construction, while newer portions of the plant are constructed with corrugated metal. This firm stores finished products and logs on the riverbank approximately 10-12 feet above normal water level. With sufficient warning time, much of this inventory and machinery in the plant could be saved by relocation to another property for the duration of the flood episode. The second industrial plant located within the flood plain is the Worumbo Manufacturing Company plant, approximately 2,500 feet upstream of the Lisbon-Topsham corporate boundary. The plant is comprised of multi-story brick structures directly abutting the Androscoggin River. During periods of flooding, much of the inventory and machinery could be moved above any expected flood stages by relocating items to the upper floors.

Several industrial firms in Lisbon are located in areas prone to flooding from the Sabattus River, a relatively small tributary of the Androscoggin River, having a drainage area of 74 square miles. Juliet Mills has two plants located near the Sabattus River. The first plant is located on Mill Street approximately 4,000 feet upstream of the Sabattus River-Androscoggin River confluence. The multi-story brick structure directly abuts the river, definitely susceptible to flood damages. Another area of concern for Juliet Mills is the plant located in Lisbon on a parcel of land between State Route 196 and the Sabattus River. The flood plain delineation for this area (included in Flood Hazard Analyses, Sabattus River, Lisbon, Maine completed by the Soil Conservation Service in May 1975), shows this plant above any flooding. However, due to its proximity to the river, damage may still result from backups in sewer interceptors or other lines. Therefore, any warning arrangements within the town of Lisbon should include provisions for alerting this Juliet Mills plant when flooding is forecasted.

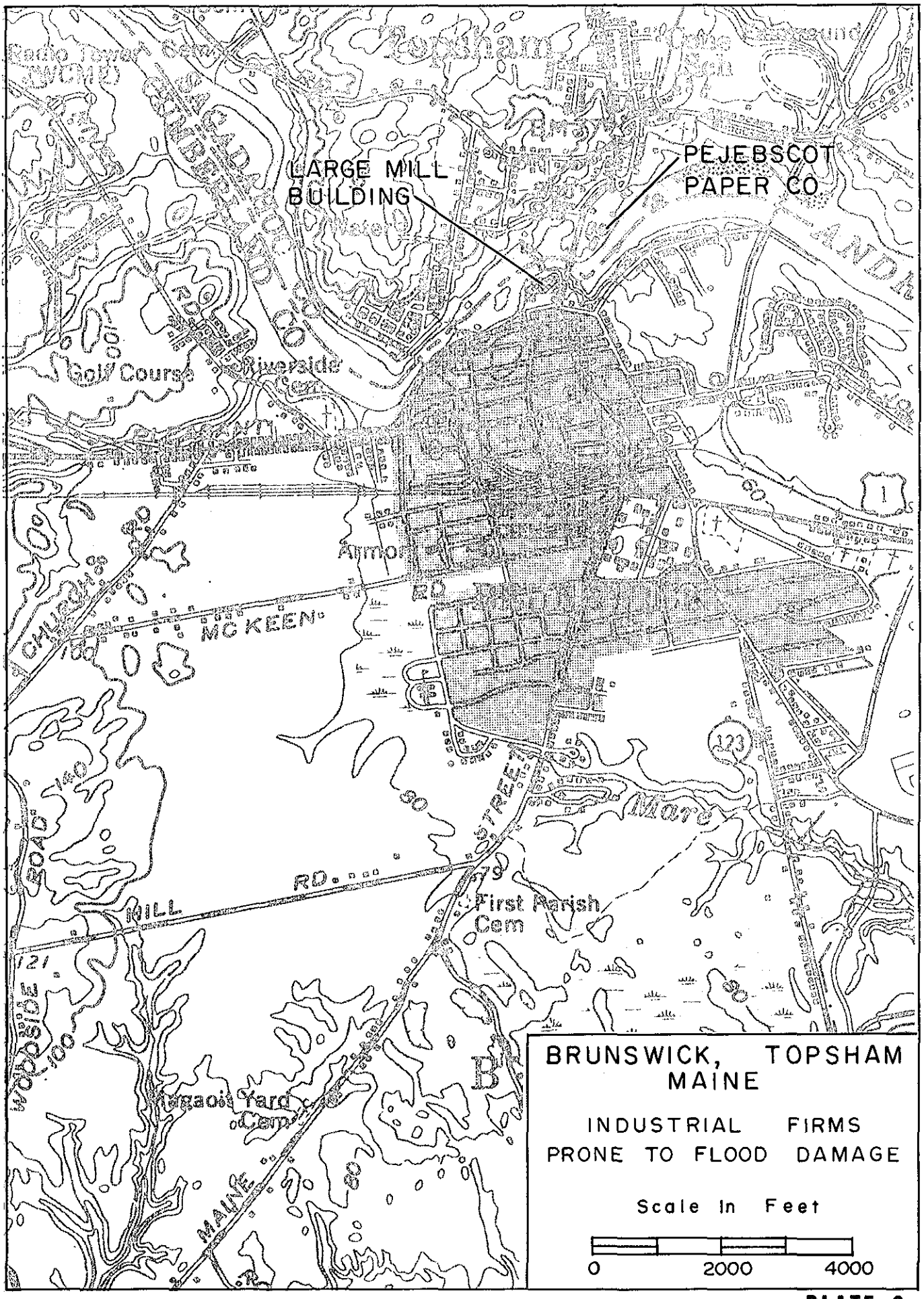

LARGE MILL BUILDING
PEJEBSCOT PAPER CO.
Golf Course
Riverside
Armory
MC KEEN
RD
CHURCH
ROAD
MILL
RD.
STREET
First Parish Cem
Mare
WOODSIDE
MAINE
Magaoia Yard Cem
BRUNSWICK, TOPSHAM MAINE
INDUSTRIAL FIRMS PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000

PLATE 2

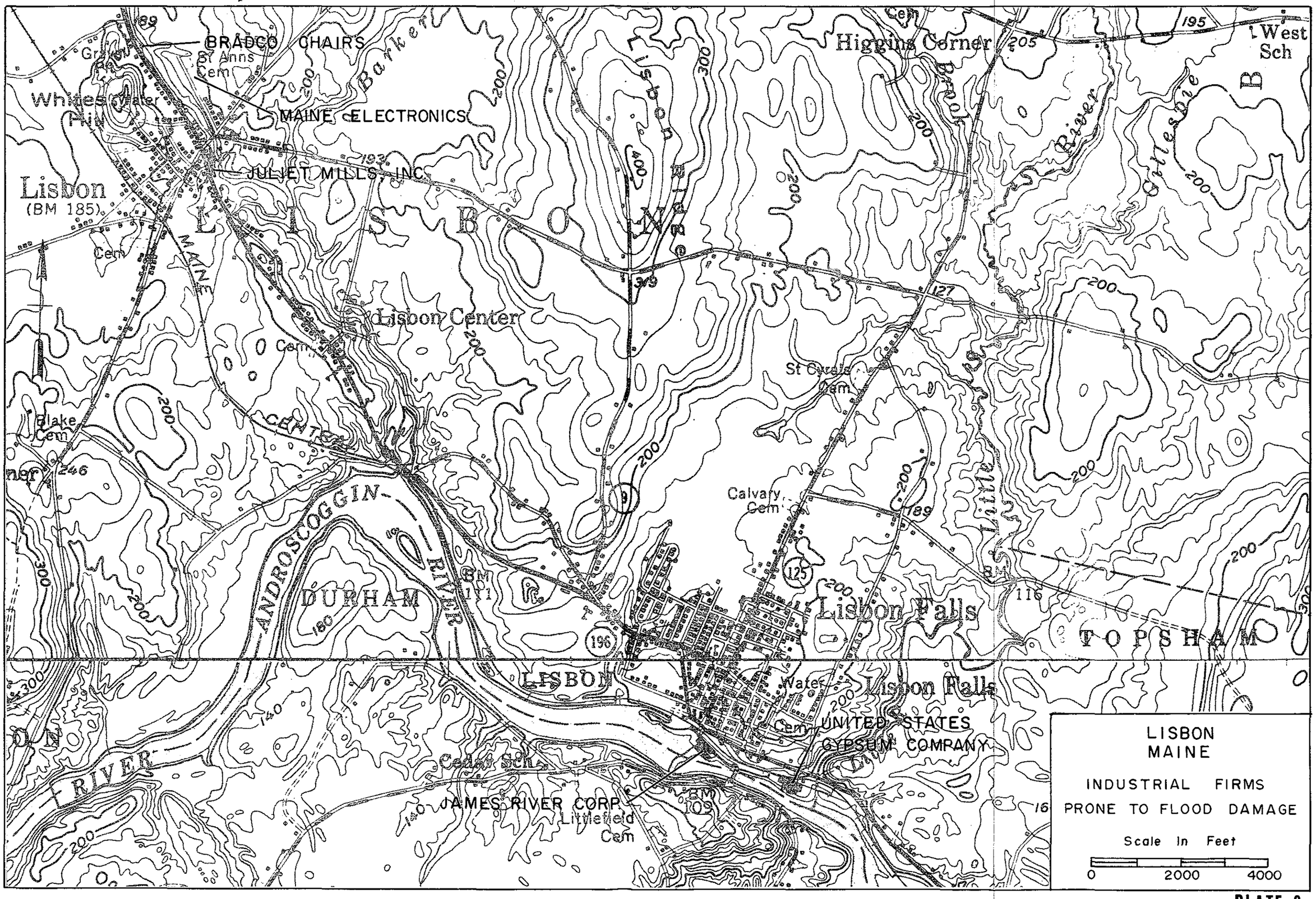

BRADCO CHAIRS
MAINE ELECTRONICS
JULIET MILLS, INC.
Lisbon
(BM 185)
Lisbon Center
Higgins Corner
West Sch
St Cyrals Cem
Calvary Cem
Lisbon Falls
TOPSHAM
DURHAM
LISBON
UNITED STATES GYPSUM COMPANY
JAMES RIVER CORP
Littlefield Cem
Cedar Sch
Blake Cem
ANDROSCOGGIN RIVER
MAINE CENTRAL
Barker
Brook
Gillespie
Little
Water
LISBON
MAINE
INDUSTRIAL FIRMS
PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000

PLATE 3

The Bradco Chair Company is located between State Route 196 and the Sabattus River just downstream of No Name Brook-Sabattus River confluence. This firm inhabits a small structure and appears to employ only a few people. Despite this, flood damages to equipment and inventory could be greatly reduced by receipt of a timely flood warning. The Maine Electronics Company, located on River Street, is outside the flood plain as delineated in the previously discussed study of the Sabattus River in Lisbon. This industrial firm should be alerted to potential flooding. A summary of the flood stages for the four industrial firms located in or near the flood plains of the Androscoggin and Sabattus River is shown in the following table.

TABLE 5

FLOOD ELEVATIONS FOR
INDUSTRIAL LOCATIONS IN LISBON

Structure	River	10-Year	100-Year	500-Year
U.S. Gypsum	Androscoggin	-	84	90
Worumbo Mfg.	Androscoggin	-	97	103
Bradco Chair Co.	Sabattus	184	186	187
Maine Electronics	Sabattus	183	185	186
Juliet Mills (Route 196)	Sabattus	173	175	176
Juliet Mills (Mill Street)	Sabattus	153	154	155

Lewiston

The City of Lewiston is the economic and social center for Androscoggin County. Located in the southern part of the Androscoggin River Basin, the city suffers severe flooding resulting from peak flows in the main stem of the Androscoggin River. These floods, usually occurring during the spring from a combination of heavy rain and snow melt, affect many textile mills and other industries situated near the Androscoggin River in the extreme western portion of the city. The majority of these firms are involved in the shoe manufacturing industry. Although much of this industrial area in Lewiston is subject to flooding from only infrequent events, the potential for severe flood damage does exist.

Pineland Lumber Company is situated on Avon Street adjacent to the river. This complex is comprised of large wood-frame buildings used mainly to store inventory. Large amounts of lumber are stored on the premises, both inside and outside the buildings, on the riverbank only feet above normal water levels. Relocation of this inventory to nearby higher ground is recommended when a flood forecast is issued.

Several large mill buildings are located in the flood plain in an area between the North and South Bridges over the Androscoggin River. The Continental Corporation Building on Cedar Street is a large, five-story brick structure with many small industrial firms as occupants. The firms include: Dori Shoe Company, Falcon Shoe Manufacturing Company, Hana Shoe Corporation, LY-DA Corporation, New England Counter Co., Inc., and Creative Machine Company. This building would sustain flood damage only from very infrequent events, being outside the 100-year flood plain but within the area delineated as the 500-year flood plain, according to the completed Flood Insurance Rate Maps for the City of Lewiston. The Crest Shoe Company occupies a four-story brick building on Chestnut Street just upstream of the Continental Corporation Building. This structure is also situated outside the 100-year flood plain, but subject to flooding from less frequent events. In each instance, first floor contents could be moved to the upper floors during a flood episode.

Bates Fabrics, Inc. has a large complex between Canal Street and the Maine Central Railroad tracks. Although this area is outside the flood plain as delineated on the Flood Insurance Rate Maps, this firm may be interested in obtaining information pertinent to the flood forecast due to the plant's proximity to the canals.

The third area in Lewiston where industrial firms could sustain flood damage is that part of Lincoln Street running along the Androscoggin River in a southerly direction from the South Bridge. Snow's Retreading Plant, located near the intersection of Lincoln Street and Locust Street, occupies a two-story structure with a large, bubble-shaped storage tank on the site. The Mill Fabric Outlet and W.S. Libbey Company occupy adjacent buildings on Lincoln Street approximately 600 feet south from Snow's Retreading Plant. All three firms are located near the fringe of the 100-year flood plain, but in each instance damageable items could be relocated to upper floors. The following table presents the flood stages for industrial locations within the City of Lewiston.

TABLE 6

FLOOD ELEVATIONS FOR
INDUSTRIAL LOCATIONS IN LEWISTON

Structure	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Pineland Lumber	173	175	176	179
Bates Fabric Inc.	129	135	137	145
Continental Corp.	128	134	136	143
Crest Shoe Co.	128	134	136	143
Snow's Retreading Plant	128	133	136	142
Mill Fabric Outlet	128	133	136	141
W.S. Libbey Company	128	133	136	141

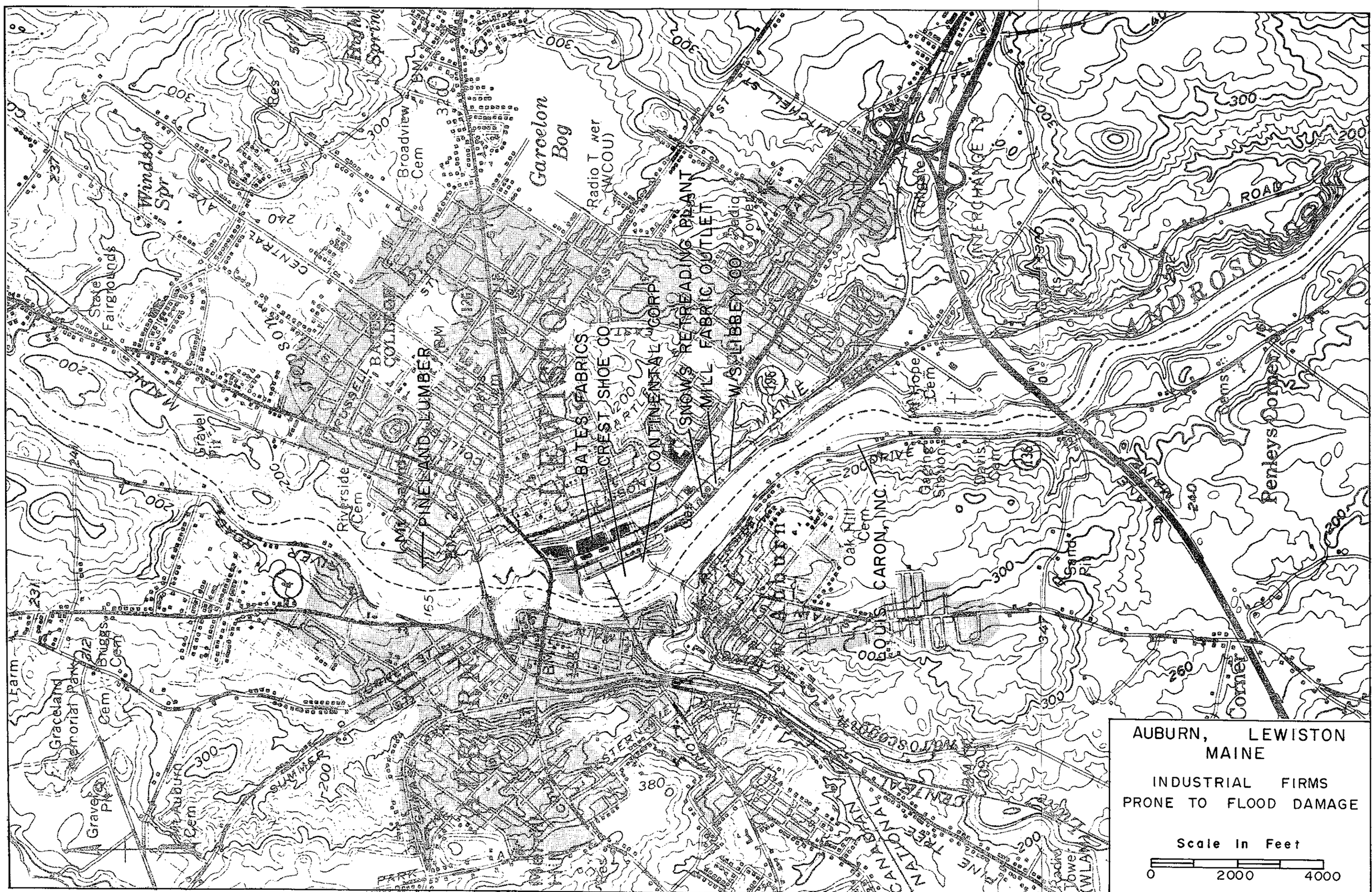

AUBURN, LEWISTON
MAINE
INDUSTRIAL FIRMS
PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000
Garcelon Bog
Broadview Cem
Windsor Spr
State Fairgrounds
Gravel Pit
Riverside Cem
Graceland Memorial Park
Briggs Cem
Auburn Cem
Radio Tower (WCOU)
BATES FABRICS
CREST SHOE CO
CONTINENTAL CORP
SNOWS RETREADING PLANT
MILL FABRIC OUTLET
W.S. LIBBEY CO
PINELAND LUMBER
LOUIS CARON, INC.
Oak Hill Cem
Penleys Corner
Corner
INTERCHANGE 13
ROAD
MAINE
CENTRAL
SUMMER
PINE TREE
CANADIAN NATIONAL
Radio Tower (WLAM)

PLATE 4

Auburn

The City of Auburn is located in the southern portion of the basin directly across the Androscoggin River from Lewiston. The Androscoggin River is the common boundary between the cities of Auburn and Lewiston. The Little Androscoggin River flows in an easterly direction through the southern portion of Auburn. Flood stages on both waterways can cause significant damages within the community. The main industry is the manufacturing of shoes, although all the large textile mills appear to be situated outside the flood plain areas. The extent of industrial flood damage in Auburn is limited to three small firms. Two of these firms, Maine Die Co. and Maxam Inc., are located on North River Road approximately a half mile north of the North River Road-Center Street intersection. These firms occupy one-story structures with no areas for on site elevation of damageable items. Therefore, protection of valuable items would have to be accomplished by relocation to another site or by some other means. The third industrial firm located in the flood plain is Louis Caron, Inc., a manufacturer of bricks and concrete products. Although located on the riverbank adjacent to the main stem of the Androscoggin River, the flood damages sustained by this firm should be minimal due to the nature of the business. The approximate flood stages at the industrial locations for various frequency events are given in Table 7.

TABLE 7

FLOOD ELEVATIONS FOR
INDUSTRIAL LOCATIONS IN AUBURN

Structure	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Maine Die Co.	173	176	177	180
Maxam Inc.	173	176	177	180
Louis Caron, Inc.	128	133	135	141

Mechanic Falls

Mechanic Falls is a small community located approximately seven miles west of Lewiston. The primary source of flooding within the community is the Little Androscoggin River, one of the largest tributaries of the Androscoggin River. The Little Androscoggin River with a drainage area of 353 square miles originates at Bryant Pond in Woodstock, Maine and flows in a southerly direction for its 46-mile length to its confluence with the Androscoggin River. The primary developed section of Mechanic Falls is bisected by the Little Androscoggin River with roughly equal development on each side of the river. The Town of Mechanic Falls has experienced flooding in the recent past, most notably March 1936, March 1953 and April 1969.

The Marcal Paper Company has a plant located adjacent to the Little Androscoggin River on a parcel of land abutting State Routes 11 and 121. The complex is made up of a series of masonry constructed buildings. Much of

this plant has been determined to be above any expected flooding according to the most accurate available flood plain delineations for Mechanic Falls. However, a portion of the plant appears to be flood-prone, potentially capable of sustaining severe flood damages. Therefore, flood damage can be reduced by moving damageable property to other places within the complex.

The 100-year and 500-year flood stages in the vicinity of this plant are approximately 252 and 254 feet above national geodetic vertical datum, respectively. These flood stages were taken from the Flood Plain Information Report, Little Androscoggin River, Auburn, Poland, Mechanic Falls and Minot, Maine published by the Corps of Engineers in February 1974.

Jay

The Town of Jay is located in the central portion of the Androscoggin River Basin. The Androscoggin River flows through Jay for only a short distance in the southwestern section of town. The most heavily developed region within the town is near the river, but most of this area is well above any expected flood stages. However, there is a large paper mill in the flood plain just north of the Jay-Livermore Falls corporate boundary. This plant, owned and operated by the James River Corporation, is situated between State Route 4 and the Androscoggin River with the back wall directly abutting the river. Also, there is a small dam just upstream of the main segment of the plant. Many buildings in the plant have two stories, readily available to temporarily house damageable items.

A large paper mill operated by the International Paper Company is located near the Androscoggin River approximately 2,000 feet downstream of Bean Island.

Flood profiles of the Androscoggin River in this reach have not been calculated, but an inspection of high water marks from past floods shows that this complex is probably above any expected flood stages. Although this plant appears to be situated outside the flood plain, the International Paper Company should be alerted to any flood forecasts issued for the basin so measures can be implemented to reduce flood damages at this plant and other properties within the basin owned by the same company.

Peru

Peru is a community located in the central portion of the Rumford-Mexico area. The town has two sources of potential future flood damage, the Androscoggin River serving as the northern corporate boundary of the town and Spears Stream which flows from south to north through West Peru to its confluence with the main stem of the Androscoggin. Although the vast majority of the town is undeveloped with mountainous terrain being predominate, property along State Route 108 adjacent to the Androscoggin River in the northern portion of town is the most developed area. Most of this area is above any expected flood stages, but one large industrial firm is located in the flood plain.

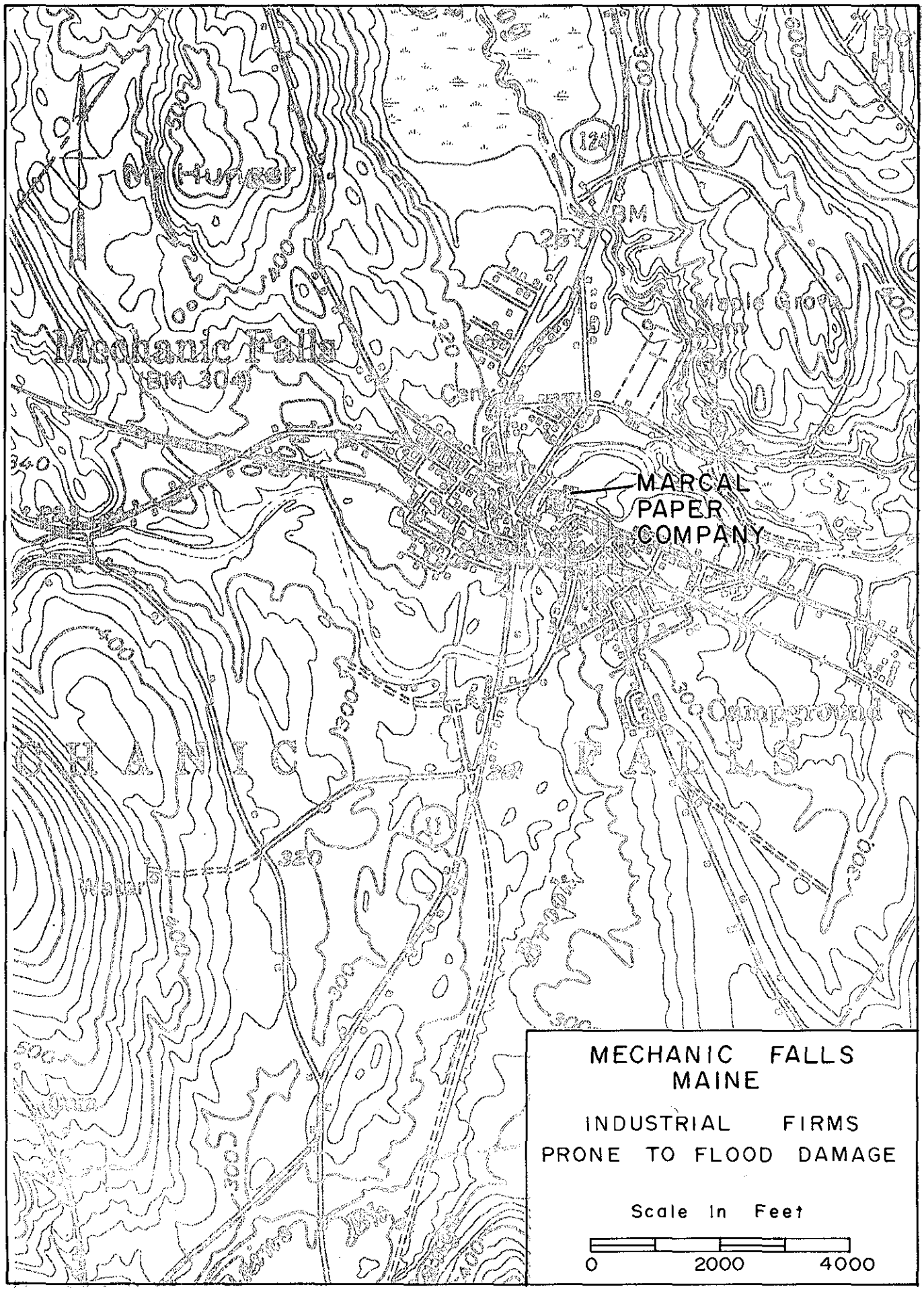

MARCAL
PAPER
COMPANY
Mechanic Falls
(BM 304)
Campground
MECHANIC FALLS
MAINE
INDUSTRIAL FIRMS
PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000

PLATE 5

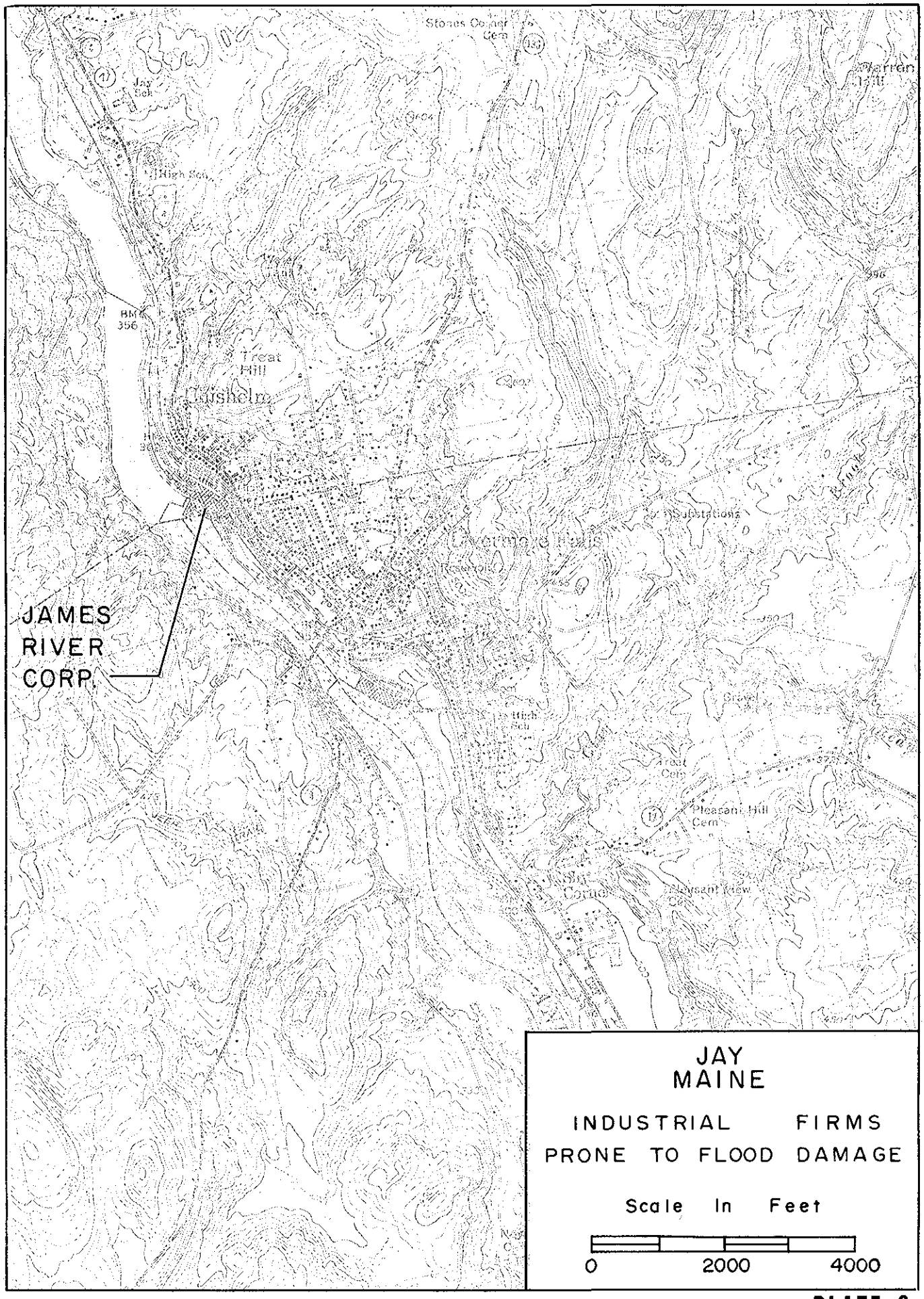

Stones Corner Cem
Jay Sch
High Sch
BM 356
Treat Hill
Gushelm
Substations
JAMES RIVER CORP.
Pleasant Hill Cem
JAY
MAINE
INDUSTRIAL FIRMS
PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000

PLATE 6

The Diamond International Corporation plant is located just upstream of the Spears Stream confluence with the Androscoggin River. This company is accessible only by an access road running next to the river, meaning evacuation of personnel involved in flood fighting activities is vital. The plant is a two-story brick structure with large amounts of wood stored on the premises. It must be noted that this firm receives flood forecast information from the privately operated flood forecast system of Boise Cascade. The amount of flood damage prevented by this early warning procedure is unknown, but much machinery and inventory could be saved by movement to the upper floor upon receipt of a flood warning. Flood profiles for streams in Peru have not been calculated, but flood profiles along the Androscoggin River of the 1936 flood, the flood of record in the basin, show this area to be prone to flooding.

Rumford

The Town of Rumford is located in the central portion of the Androscoggin River Basin, approximately 75 miles north of Portland and 15 miles east of the Maine-New Hampshire state line. The principal source of income in Rumford is pulp and paper manufacturing, namely the Boise Cascade-Rumford Mill. Three potential sources of flood damage exist within Rumford. The Androscoggin River flows from the Rumford-Hanover corporate limit downstream to Rumford Falls located between Upper Dam and Middle Dam, which provide hydroelectric power for the paper mill complex. This complex and the downtown business district are located at a sharp bend in the river. Downstream from this point, the river bank is steep with flooding seldom occurring. The Swift River, with a drainage area of 124 square miles, is characterized by steep slopes. Near Rumford, the Swift River widens and flood plain areas are used for agricultural purposes with few structures near the river. The Ellis River, with a drainage area of 164 square miles, has a gently sloping gradient with low stream velocities. The river meanders through farmland during its course through Rumford.

Flooding in Rumford is generally limited to the areas along the banks of the Androscoggin River above the Upper Dam and the mouth of the Swift River. Major flooding has occurred in the following years: April 1895, March 1936, March 1953, and October 1959. The March 1936 is the flood of record on the Androscoggin River at Rumford.

A huge paper mill, owned and operated by Boise Cascade, is located in the flood plain of the Androscoggin River directly across from the mouth of the Swift River. The complex is comprised of many multi-story structures situated on a point where the river makes a severe change of direction. This firm is aware of the flood problem and has set up a system to collect precipitation data to be used in predicting streamflows. This information is used to monitor hydropower activities and forecast flood stages. Having developed a forecast of potential flooding, the company has a preparedness plan outlining procedures and actions geared to reducing flood damages. Of prime importance to the company is protecting machinery and equipment such as electrical motors. Although this was the only plant where a detailed preparedness plan was discovered, it is quite likely that other industrial firms have implemented similar preparedness plans.

A second industrial firm in Rumford which may sustain flood damage is G.H. Bass & Co., located on U.S. Route 2 approximately 2 miles east of Rumford Center. This company, a manufacturer of shoes, occupies a one-story brick structure on the fringe of the flood plain. It is possible that many valuable items could be protected by temporary raising within the existing structure even though the building is only one story. This is possible because of the shallow depths of flooding generally found at the fringe of the flood plain. A summary of the flood stages at these two locations is presented in the following table.

TABLE 8

FLOOD ELEVATIONS FOR
INDUSTRIAL LOCATIONS IN RUMFORD

Structure	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Boise Cascade (Conf. w/Swift River)	435	439	441	445
G.H. Bass & Co.	613	617	619	623

Gorham

The Town of Gorham is situated in the upper portion of the Androscoggin River Basin approximately 100 miles north of the City of Concord, New Hampshire and 50 miles west of the Town of Rumford, Maine. The total land area of Gorham is 35.3 square miles, of which only five percent is developed. Flooding within Gorham can originate from three sources. The Androscoggin River flows in a southeasterly direction through town with development in the flood plain consisting mainly of residential structures and one large paper mill. The Peabody and Moose Rivers are tributaries of the Androscoggin which flow east through Gorham. These two rivers have drainage areas of 46.6 and 23.9 square miles, respectively. Severe floods have occurred along the Androscoggin River within the Town of Gorham in 1869, 1896, 1927 and 1936. The greatest flood at the Gorham gauging station was the flood of March 1936, having a recurrence interval of 50 years at this location in the basin.

A pulp and paper mill subject to flooding is located on the west bank of the Androscoggin River just south of the Gorham-Berlin corporate limits. The plant, operated by the James River Corporation, is a large brick structure situated just downstream of a small dam. This plant is subject to flooding based on an inspection of the Flood Insurance Rate Maps for Gorham. The James River Corporation, with a number of mills within the Androscoggin River Basin, has a network of precipitation and streamflow gauging sites in the upper portion of the basin above Gorham. Although direct contact with the James River Corporation was not made, it is entirely possible that this information is utilized in forecasting of flood stages. Also, this information is provided to the National Weather Service to be used in development of their flood forecasts. If the company uses the precipitation

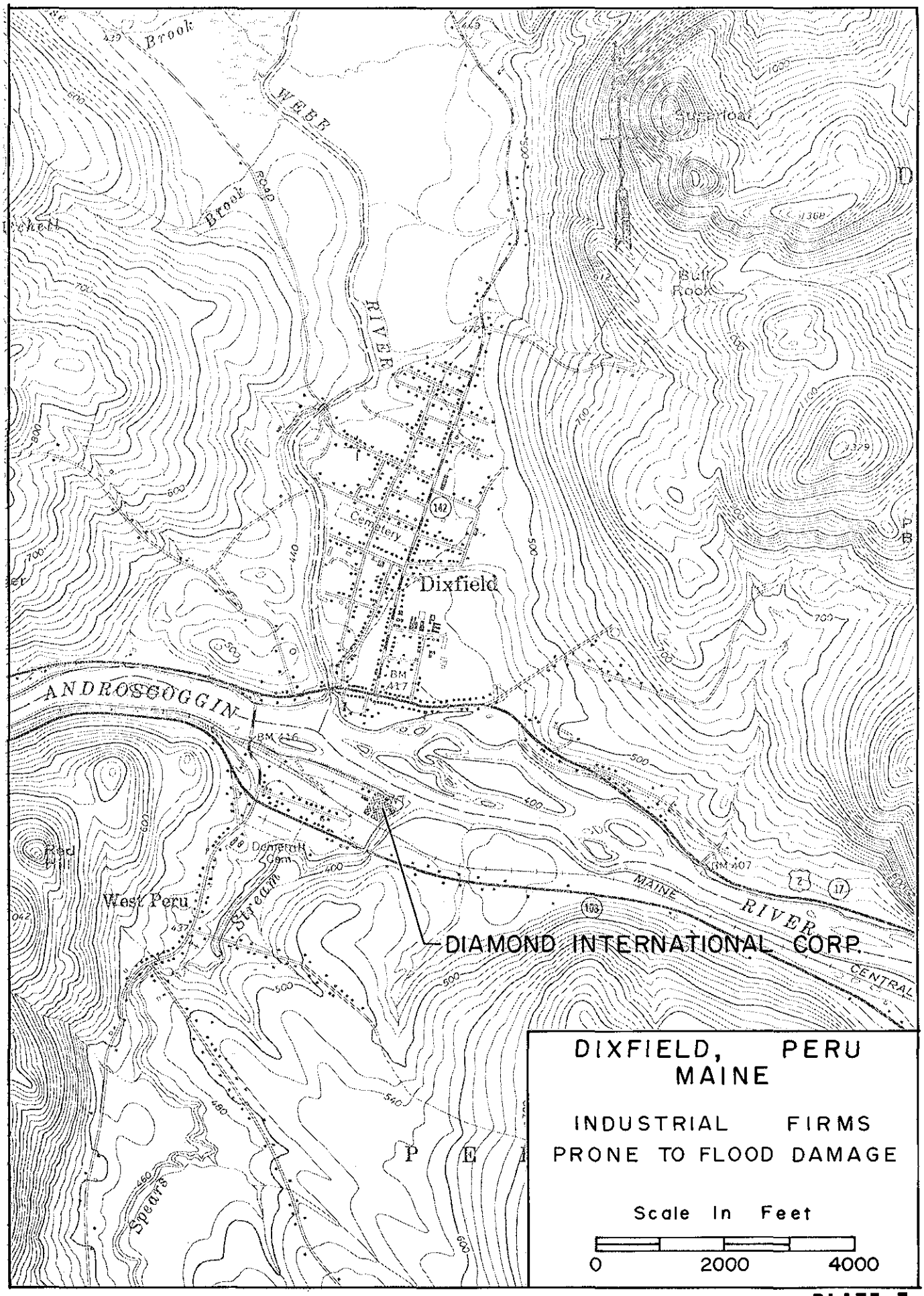

Brook
WEBB
Brook
ROAD
RIVER
Superloaf
Bull Rock
Cemetery
Dixfield
BM 417
ANDROSCOGGIN
BM 416
Red Hill
West Peru
Stream
Dementhill Cem
MAINE
RIVER
CENTRAL
BM 407
DIAMOND INTERNATIONAL CORP.
Spears
DIXFIELD, PERU
MAINE
INDUSTRIAL FIRMS
PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000

PLATE 7

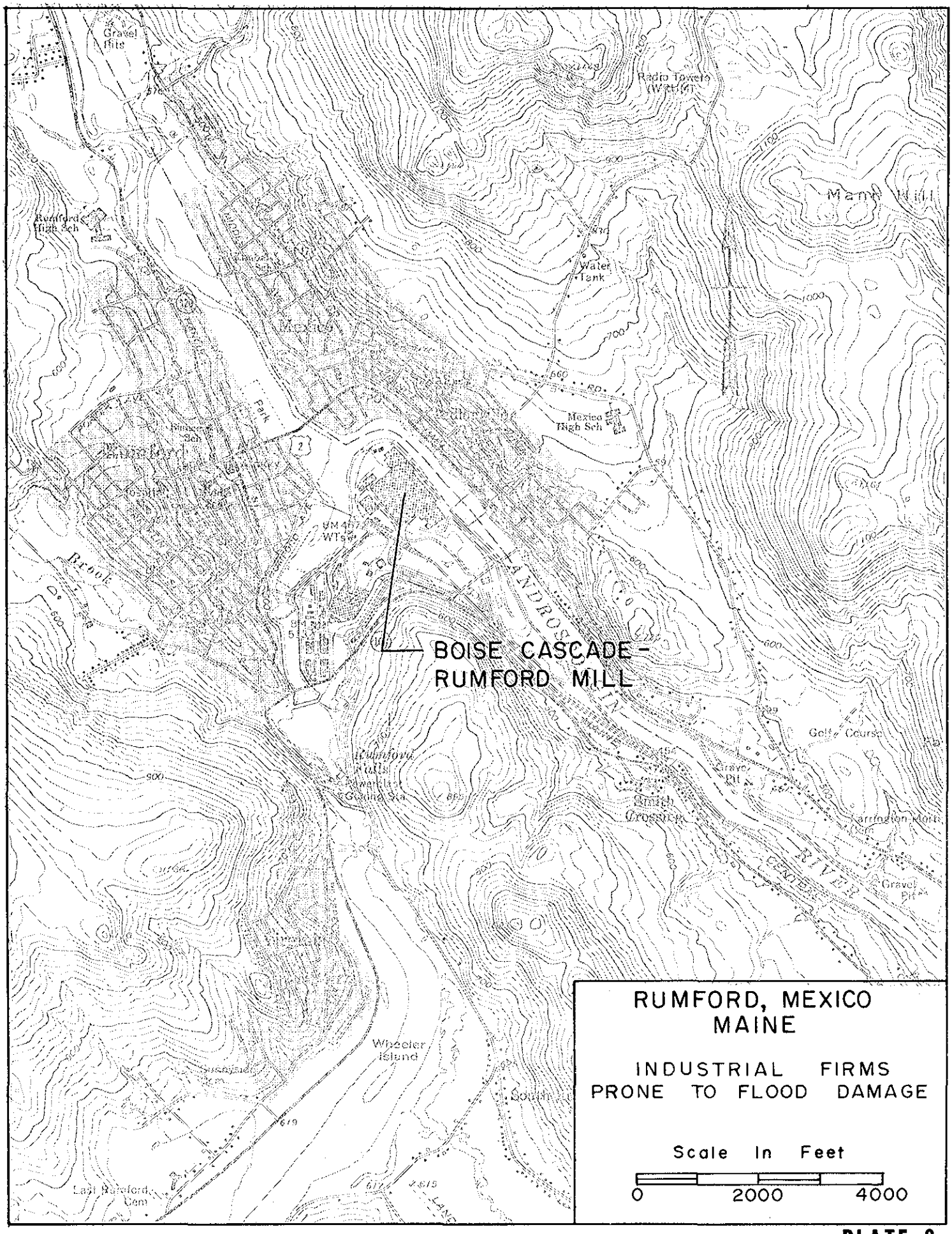

BOISE CASCADE -
RUMFORD MILL
RUMFORD, MEXICO
MAINE
INDUSTRIAL FIRMS
PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000
Gravel Pits
Radio Towers
Mann Hill
Water Tank
Rumford High Sch
Mexico High Sch
Park
Brook
ANDROSCOGGIN
RIVER
Golf Course
Gravel Pit
Smith Crossing
Rumford Falls
Wheeler Island
South
Last Rumford Dam

PLATE 8

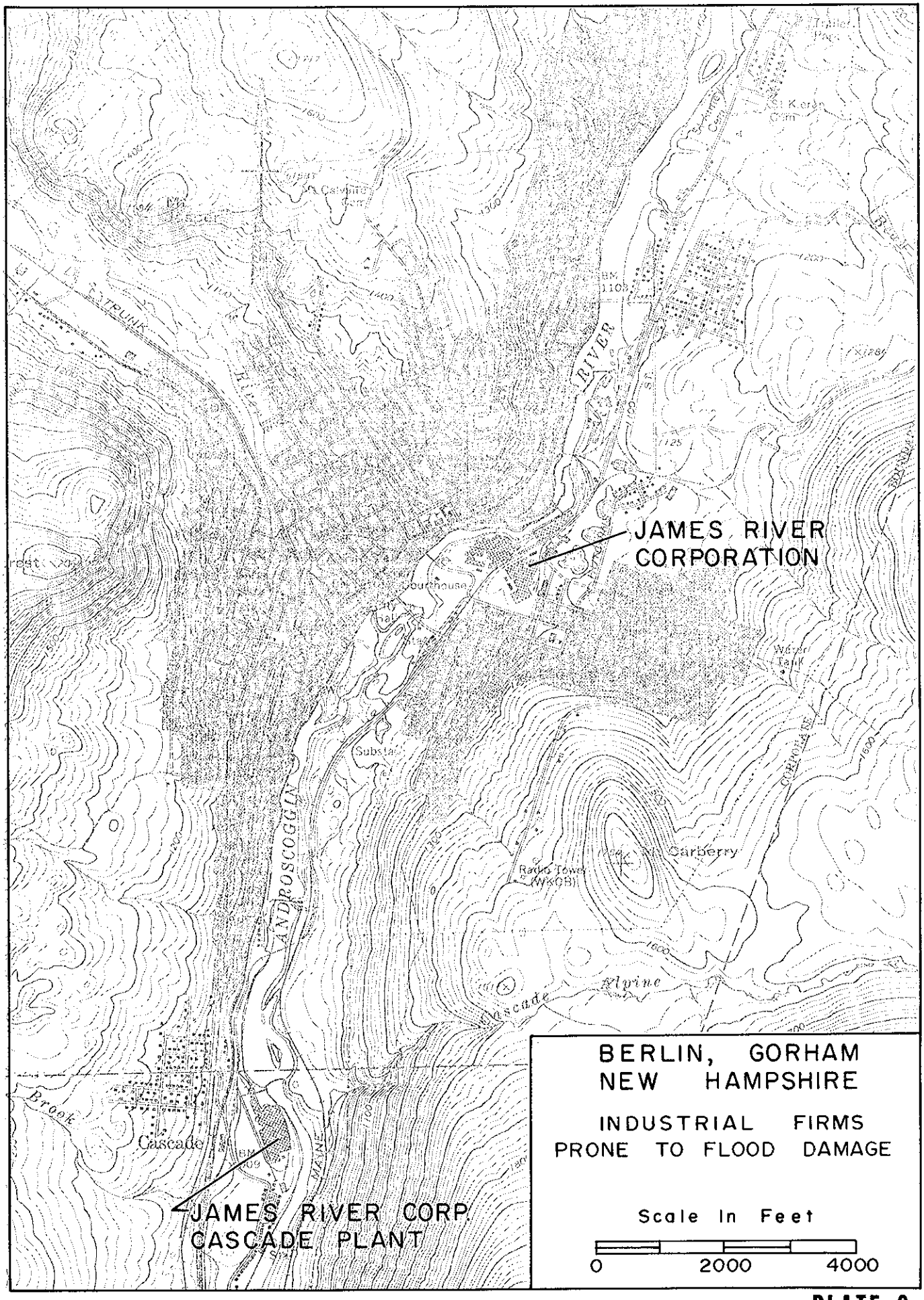

JAMES RIVER CORPORATION
JAMES RIVER CORP. CASCADE PLANT
RIVER
ANDROSCOGGIN
Courthouse
Substa
Carberry
Radio Tower (WKCB)
Cascade
Alpine
Brook
Water Tank
St Kieran Cem
Mt Calvaire Cem
BERLIN, GORHAM
NEW HAMPSHIRE
INDUSTRIAL FIRMS
PRONE TO FLOOD DAMAGE
Scale In Feet
0
2000
4000

PLATE 9

and flow data for flood forecasting, the James River Corporation may have a preparedness plan ready to mitigate flood damages.

The flood stages for the Androscoggin River directly upstream of the plant are 861 feet NGVD, 863 feet NGVD, 864 feet NGVD, and 865 feet NGVD for the 10-year, 50-year, 100-year, and 500-year floods respectively. These flood elevations do not take into account any turbulence resulting from flood waters rushing over the dam directly upstream from the plant. Therefore, the actual extent of flood damages may be more severe than indicated by the flood elevation.

Berlin

The City of Berlin is located just north of Gorham in the southeastern portion of Coos County in northern New Hampshire. The city is the northernmost industrialized area within the Androscoggin River Basin. The total land area of Berlin is 57.1 square miles, of which only six percent is developed with the remainder of the land undeveloped and wooded. The city is the home of a huge manufacturer of paper products, the chief source of employment in the area. Agriculture is limited by the topography of the area, steep and broken with ledges and rock outcroppings in many places. Two streams, the Androscoggin and Dead Rivers, are sources of flood damage in Berlin. The Androscoggin River enters Berlin in a rather wide valley and travels through the community for about 5.5 miles. The Dead River, having a drainage area of 15.9 square miles, is a short stream flowing four miles southeast through Berlin to join the Androscoggin River. Because the Dead River has caused considerable flood damage in Berlin, a small upstream flood control reservoir combined with a channelization project in the business section effectively control flooding.

The one source of potential severe industrial flood damage is the huge James River Corporation plant located on the easterly bank of the Androscoggin River. The complex is comprised of a number of structures located near the river. The extent of the flood problem at this site is difficult to assess because the plant area is fenced off and the stream drops approximately 70 feet between the upper and lower limits of the complex. As previously mentioned, this corporation collects precipitation and streamflow data for that portion of the basin above Gorham, New Hampshire. Therefore, this company must possess a working knowledge of the hydrologic characteristics of the upper part of the basin. This includes knowledge pertaining to the flood problem and resulting damage at the Berlin plant.

VIII. LOCATIONS OF POTENTIAL RESIDENTIAL/COMMERCIAL FLOOD DAMAGE

The Androscoggin River Basin is primarily undeveloped and rural in nature, possessing a small population density over most of the 3,450-square mile area comprising the basin. Although most of the basin is undeveloped, residential and commercial areas are located in the flood plain in some of the larger communities along the main stem and major tributaries. The majority of these flood plain areas are in the lower two-thirds of the basin where the effect of the large upstream storage reservoirs is not as great. Also, the large paper companies own large portions of the upstream areas for harvesting trees to be used in the production of paper products.

The flooding in these residential and commercial areas can result from free flow or ice jam conditions. An effective flood forecast and warning system can increase the warning time before flooding occurs, thereby allowing residential property owners time to implement temporary flood damage reduction measures. The flood forecast system can accurately predict the magnitude and severity of flooding occurring under free flow conditions, but flooding resulting from ice jamming remains difficult because of the dynamic conditions. In each instance, the residential areas identified in the following pages should be included in any preparedness plan developed to mitigate the flood problems.

The identification of residential areas located in the flood plain was performed utilizing available hydrologic information. *In many communities flood insurance studies or flood plain information reports have been completed containing water surface profiles for the 100-year and 500-year flooding events. Also, flood plain maps delineating the areas of inundation caused by these floods were available. In other areas where flood profiles have not been developed, high water marks and profiles of the March 1936 flood, the flood of record for the Androscoggin River Basin, were used to determine areas prone to flooding. An initial screening of the basin was made by the Maine Civil Emergency Preparedness Office and the Regional Planning Commission utilizing flood records and knowledge of past flooding. The outcome of this screening was a list of communities having experienced past residential and commercial flood damages and logical choices to sustain similar or worse flood damages in the future. Included in this data was an estimate of the number of structures located in the flood plain within each community.

A visit was made to each of the communities identified to determine the location of these residential and commercial areas, the extent of any new development, and the type of structures flooded (1-story, 2-story, apartments, etc.). In areas where flood profiles have been developed, flood elevations for various frequency events have been included for locations within the town near these groups of structures in the flood plain. This information can be used in conjunction with ground elevations to determine the flood depths at each location. Because the acquisition of accurate ground elevations for individual commercial and residential structures was beyond the scope of this study, the number of structures in the flood plain at each identified location was roughly estimated from the best available information.

In a flood preparedness plan, each residential and commercial structure cannot be alerted individually to the potential for flooding. Therefore, the responsibility of preparing a plan to warn property owners that flooding is imminent rests with local authorities, generally carried out by the local police and/or fire department. Other local entities must also perform tasks efficiently in order to reduce the hardships of flooding. These tasks include evacuation of inundated areas and maintenance of vital services.

A main concern within the Androscoggin River Basin is the isolation which occurs in many areas of the basin due to the steep mountainous terrain present in the basin. Also, most of the major roadways parallel the rivers become inundated and impassable during a major flood. Local authorities, possessing

knowledge of the local transportation system, are in the best position to find workable solutions to this problem before major flooding strikes.

The areas identified in this report have been determined using available publications. It is possible that residential areas located in some communities may have inadvertently escaped this evaluation. Also, this effort was focused on areas containing groups of residential and commercial structures, not on locating individual residences prone to flooding. Many residential structures susceptible to flooding and located in rural settings throughout the basin are not mentioned in this report, but may be known to local officials. However, any local preparedness plan should contain instructions concerning the evacuation and protection of families facing that predicament. The following section provides a picture of the potential for residential and commercial flood damage within the Androscoggin River Basin. Information is presented by community starting at the extreme downstream part of the basin and then proceeding upstream.

Brunswick

The topography of the riverbank near the Androscoggin River in Brunswick is steep, with the vast majority of the residential and commercial development above any expected flooding. This includes the central business district, the Brunswick Naval Air Station, and Bowdoin College. An inspection of the Flood Hazard Boundary Maps for Brunswick, rough estimates of the flood plain areas within a community published by the Federal Emergency Management Agency before a detailed hydrologic analysis is completed, shows the Androscoggin River during flood periods within its banks or just barely out of its banks in developed areas of the town. However, an inspection of areas near the river yielded two residential neighborhoods that are located in fairly low areas near the river. Although flooding may not be severe in these neighborhoods, when a flood warning is issued precautionary measures should be taken to insure public safety.

The first residential area identified as potentially prone to flooding is along Water Street between the United States Route 201 and Maine Central Railroad bridges over the Androscoggin River. Approximately 20 single family residential structures are located on both sides of Water Street in a low area between Industry Road and Stone Street. These homes are situated in the lowest part of the area, with homes farther east on Water Street, Industry Road and Stone Street at higher elevations. Flood elevations for the Androscoggin River in this vicinity, taken from preliminary flood profiles from the as yet unpublished Brunswick Flood Insurance Study are 13 feet NGVD, 16 feet NGVD, 17 feet NGVD, and 20 feet NGVD for the 10-year, 50-year, 100-year and 500-year floods, respectively. Accurate ground elevations in this area were unobtainable with the scales of the available photogrammetric mapping.

Another residential area which may be prone to flooding is along Merrymeeting Road, west of the Maine Central Railroad and south of United States Route 1. According to the Flood Hazard Boundary Maps for Brunswick, expected flood stages will only reach as far as Route 1. Preliminary flood elevations in this area are 12 feet NGVD, 15 feet NGVD, 16 feet NGVD, and 18 feet NGVD for the 10-year, 50-year, 100-year and 500-year events, respectively. To

determine more accurately the severity of potential flooding, ground elevations for this neighborhood must be compared to corresponding flood elevations.

Topsham

The Town of Topsham, located directly across the Androscoggin River from Brunswick, has steep riverbanks and terrain such that flooding is limited to a small strip of land adjacent to the river, This results in flooding being limited to the ends of streets running perpendicular to the river or small areas of streets running parallel to the river. Three areas of potential residential or commercial flood damage were found in Topsham. These areas were initially identified using the Flood Hazard Boundary Maps for Topsham published by the Federal Emergency Management Agency. A field inspection was then made to determine the extent of development in these areas.

The first potential damage center is at the southerly end of Green Street with approximately 5 homes and a fire station appearing to be located in a flood prone area. This area is just north of the Pejebscot Paper Company mill along United States Route 201, The other two areas of residential development are located between Foreside Road and the Androscoggin River. An area of 1-family residential structures is located off Foreside Road approximately 1,400 feet east from the State Route 24 interchange. These fairly new homes are on Pinewood Drive, the southern portion of which was identified as a flood hazard area. Twin Pond is a street running from Foreside Road towards the Androscoggin River which has large, new homes located in a flood hazard area.

The following table presents flood elevations of various frequency events for each of the three areas. In order to accurately assess the severity of flooding, the ground elevations in these areas must be determined and then compared to the flood elevations.

TABLE 9

FLOOD ELEVATIONS FOR RESIDENTIAL/COMMERCIAL FLOOD PLAIN AREAS WITHIN TOPSHAM

Area	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Green Street	13	16	17	19
Pinewood Drive	12	14	15	18
Twin Pond Road	11	13	14	16

Lisbon

Lisbon Falls is located in the southern part of Lisbon near the Androscoggin River just northwest of the Lisbon-Topsham corporate limit. The best available flood plain delineation of this area, the Flood Plain Information Report for

the Androscoggin River in Lisbon and Durham published by the Corps of Engineers, shows a portion of Lisbon Falls subject to flooding. This area is outside the 100-year flood plain, but within the boundaries of the 500-year flood plain. It must be noted that these areas have been delineated on topographic mapping having 20-foot contour intervals, resulting in maps presenting a general picture of flood severity, but some inaccuracies could exist. Within the area identified as flood plain are about 12 one-family residential structures, 40 mobile homes, and small commercial establishments such as a gas station, fish market, etc. This development is located for the most part on Davis and Lisbon Streets.

The Sabattus River flows through Lisbon Center approximately 2 miles upstream of its confluence with the Androscoggin River. The flood plain for this area has been delineated on aerial photography by the U.S. Department of Agriculture, Soil Conservation Service. The east bank of the Sabattus River in Lisbon is primarily undeveloped with wooded land predominating. The one exception is River Street where 7 residential structures and 4 mobile homes are located on the east side of the street, above any expected flooding. The west side of the Sabattus River on State Route 196, particularly the area between Webster Road and Littlefield Road, is developed with residential and small commercial structures. On the east side of State Route 196, approximately 5 residential structures and 10 small commercial establishments are within the 100-year flood plain. Flood stages from a 500-year flooding event would go over the roadway affecting residential and commercial structures on the west side of State Route 196.

The flood elevations at these locations for various frequency events are presented in Table 10. The flood severity at these points was not determined because accurate ground elevations were unobtainable using available topographic mapping.

TABLE 10

FLOOD ELEVATIONS FOR RESIDENTIAL/COMMERCIAL FLOOD PLAIN AREAS WITHIN LISBON

Stream	Location	10-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Androscoggin	Dam 1300' upstream of Rt. 9 bridge	-	108	111
	1700' upstream of dam	-	109	112
Sabattus	Webster Road	174	175	176
	Upper Dam	183	184	185
	No Name Brook Confluence	184	186	187

Lewiston

The City of Lewiston has experienced residential and commercial damages from the Androscoggin River in the past, most notably the flood of March 1936. The primary area of residential and commercial flood damage is located in an area extending south from Cedar Street along Lincoln Street for a distance of approximately one mile. Flood damages from Locust Street south, the southern part of this area, are confined to those structures located on or just off Lincoln Street. About 25-30 residential structures and a few small commercial firms are located in the flood plain in this neighborhood. These structures are situated within the 100-year flood plain, with the additional area inundated by a 500-year flood limited due to the steep slope east of Lincoln Street. Timely warning is needed here because the only possible route of exodus is along Lincoln Street. No roads in this reach lead easterly away from Lincoln Street towards higher ground above the flood stages.

The northern part of this area stretches from Cedar Street south to Locust Street and from the Androscoggin River west to Lincoln Street. The 100-year flood plain in this area encompasses the extreme western part of Locust Street, Lincoln Drive, and Lincoln Street. Approximately 55 structures would be affected by an occurrence of a 100-year frequency flood. A total of about 50 structures on Lincoln Street, Oxford Street, and River Street are outside the 100-year flood plain, but within the area inundated by the 500-year frequency flood. The development in this reach is dominated by two and three story residential structures with both single and multi-unit buildings present. Also, many multi-story structures with commercial firms on the first floor and what appear to be apartments on the upper floors are located in this area.

A second large flood prone area with mostly commercial development and some residential apartment buildings is the portion of Oxford Street and Lincoln Street running north from Chestnut Street. This area would be inundated only by severe flooding events, those more infrequent than a 100-year event. Approximately 35 structures are located within the boundary of the 500-year flood plain.

The majority of the commercial and residential development within the City of Lewiston is located such that inundation would only occur from infrequent flooding events with flood depths not severe, certainly not deep enough to reach upper floors. With a sufficient warning time much flood damage can be prevented by moving damageable items to higher elevations. The following table presents flood elevations for various frequency events at locations within the City of Lewiston.

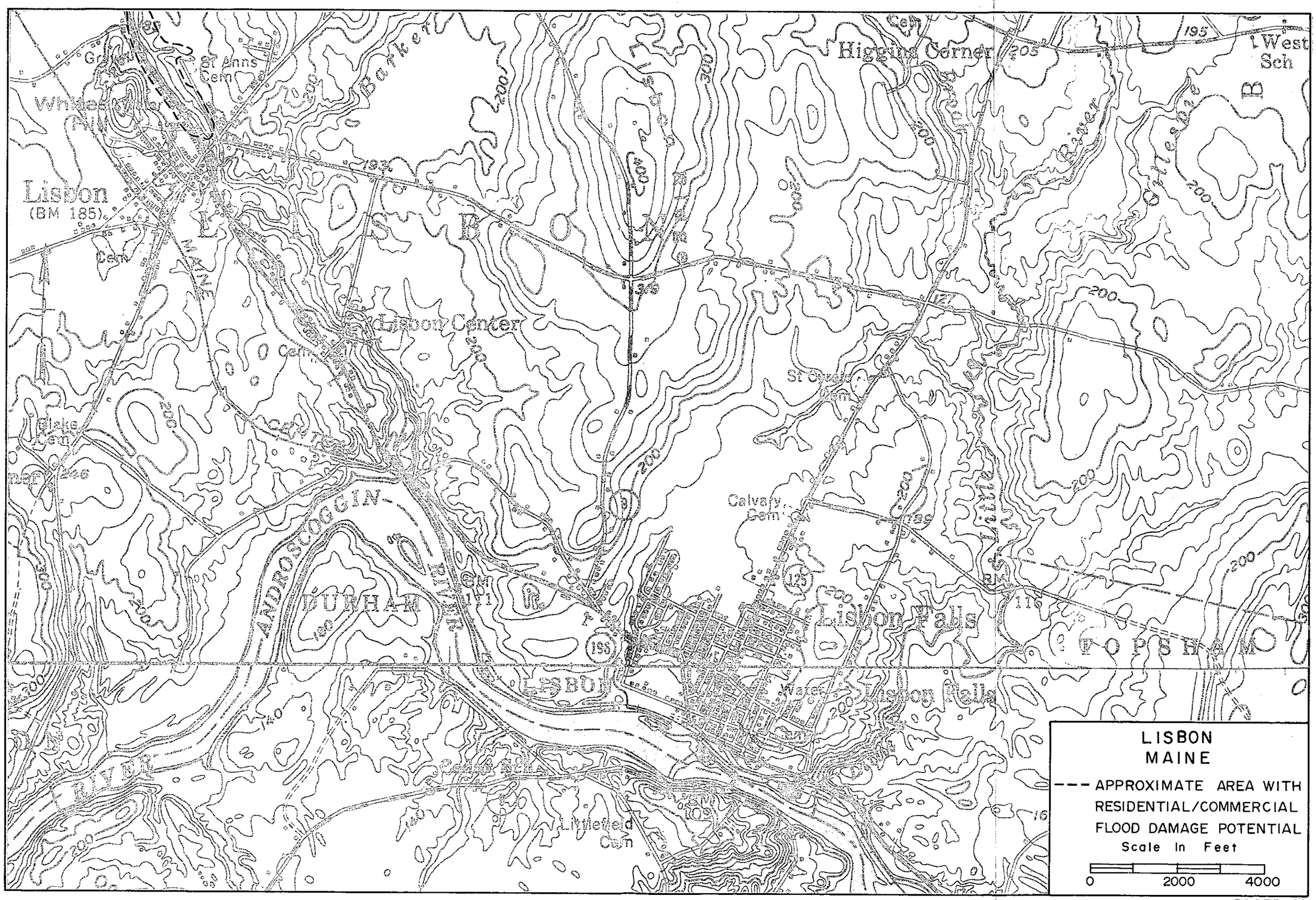

LISBON
MAINE
APPROXIMATE AREA WITH RESIDENTIAL/COMMERCIAL FLOOD DAMAGE POTENTIAL
Scale In Feet
0
2000
4000
Lisbon
(BM 185)
Lisbon Center
Lisbon Falls
Higgins Corner
St Anns Cem
Calvary Cem
Littlefield Cem
DURHAM
ANDROSCOGGIN
RIVER
MAINE
Barker
Little
Gillespie
West Sch
Blake Cem
Cedar Sch
Water
Cem

PLATE 10

TABLE 11

FLOOD ELEVATIONS FOR RESIDENTIAL/COMMERCIAL FLOOD PLAIN AREAS WITHIN LEWISTON

Location	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Maine Turnpike Bridge	126	131	133	139
U.S.G.S. Gaging Station	126	132	134	139
South Bridge	129	134	136	142
Canadian National Railroad Bridge	129	134	137	143
North Bridge	129	135	137	145

Auburn

The City of Auburn, located across the Androscoggin River from Lewiston, is subject to flood damage from high stages on both the Androscoggin and Little Androscoggin Rivers. Like many communities within the Androscoggin River Basin, the area of the community inundated by flooding is limited to a narrow strip of land adjacent to the river. This is due to the topography of the city which results in narrow flood plains rather than large widespread natural valley storage areas.

Riverside Drive runs in a southerly direction along the Androscoggin River from Broad Street to the southern corporate limit. The entire length of Riverside Drive between Broad Street and the Maine Turnpike overpass is subject to flooding. Structures on the east side of the road are within the area inundated by the 100-year flood, while structures on the west side of the road in some areas are outside the 100-year flood plain, but within the 500-year flood plain. A total of 56 structures on Riverside Drive are prone to flood damage. Based upon a delineation of the 100 and 500-year flood stages on topographic mapping of the area, 39 structures are within the 100-year flood plain and 17 structures are within the 500-year flood plain. The vast majority of these structures are residential with only 2 commercial establishments on the east side of Riverside Drive. Timely and accurate flood warnings are necessary for this location, particularly for the area south of Truman Avenue where the only evacuation route is along Riverside Drive. No side roads lead away from Riverside Drive toward higher elevations from Truman Avenue to the corporate limit. Also, many homes in this reach are above predicted flood stages, but should be evacuated because the only access road (Riverside Drive) would be cut off during flood episodes.

Another location of potential severe flood damage is the area near the confluence of the Little Androscoggin River and Androscoggin River. On the

southern side of the confluence, portions of Pulsifer Street, Second Street, Broad Street and Riverside Drive are within the 100-year flood plain. A total of 17 structures are situated in this area, primarily consisting of large multi-family dwellings and commercial firms (bakery, bowling alley, etc.). The portion of Mill Street from Pulsifer Street to Riverside Drive would be affected by the occurrence of a 500-year flood. Approximately 15 additional structures, utilized mainly for commercial purposes, would sustain flood damage.

Development in the flood plain on the northern side of the Little Androscoggin near the confluence consists mainly of residential structures. Approximately 20 structures on Main Street and Newbury Street are within the 100-year flood plain, while additional structures affected by the 500-year are limited due to the topography in this area. It must be noted that the March 1936 flood reached the second floors of many structures in this area, both on the north and south sides of the confluence. The March 1936 flood, the flood of record in the basin, is estimated to be the equivalent of a 100-year flood in this part of the basin.

A large portion of Main Street would sustain flood damage from severe flooding events. Structures on the east side of the street are particularly prone to basement flood damage because the back of the buildings face the Androscoggin River and the land slopes down towards the river. A total of 10 commercial structures on the east side of Main Street between Vine Street and Court Street are prone to flooding. The west side of Main Street is above any flooding according to the Flood Insurance Rate Maps for Auburn published by the Federal Emergency Management Agency. However, a delineation of the flood stages included in the Auburn Flood Insurance Study on 5-foot contour interval topographic mapping provided by the city shows the large commercial building on the west corner of Court Street and Main Street subject to flooding. In any event, the commercial firms on Main Street identified above should be warned when the possibility of flooding exists.

An area of concern is a large apartment building located off Cushing Street. The seven-story brick structure is located in the 500-year flood plain as delineated on the Flood Insurance Rate Maps. Although flooding will cause actual physical flood damage only to the lowest floor, proper actions must be taken to insure the safety of occupants inhabiting the 70-unit building for the entirety of the flood episode.

The final area within Auburn where severe flood damages could occur is the Center Street and North River Road junction. The area is commercially developed with no concentration of residential structures within the flood plain. A total of 7 commercial structures would sustain damage from the occurrence of a 100-year flood. Included in these structures are a sports center, auto parts store, and an auto body shop. Within the 500-year flood boundaries, 8 commercial structures would sustain flood damage. These include two fast food restaurants, a tire store, and a shopping center with 10 or more small firms. Despite many of these buildings sustaining flood damage from only infrequent flooding events, much damage could be prevented by an accurate and timely flood forecast and warning.

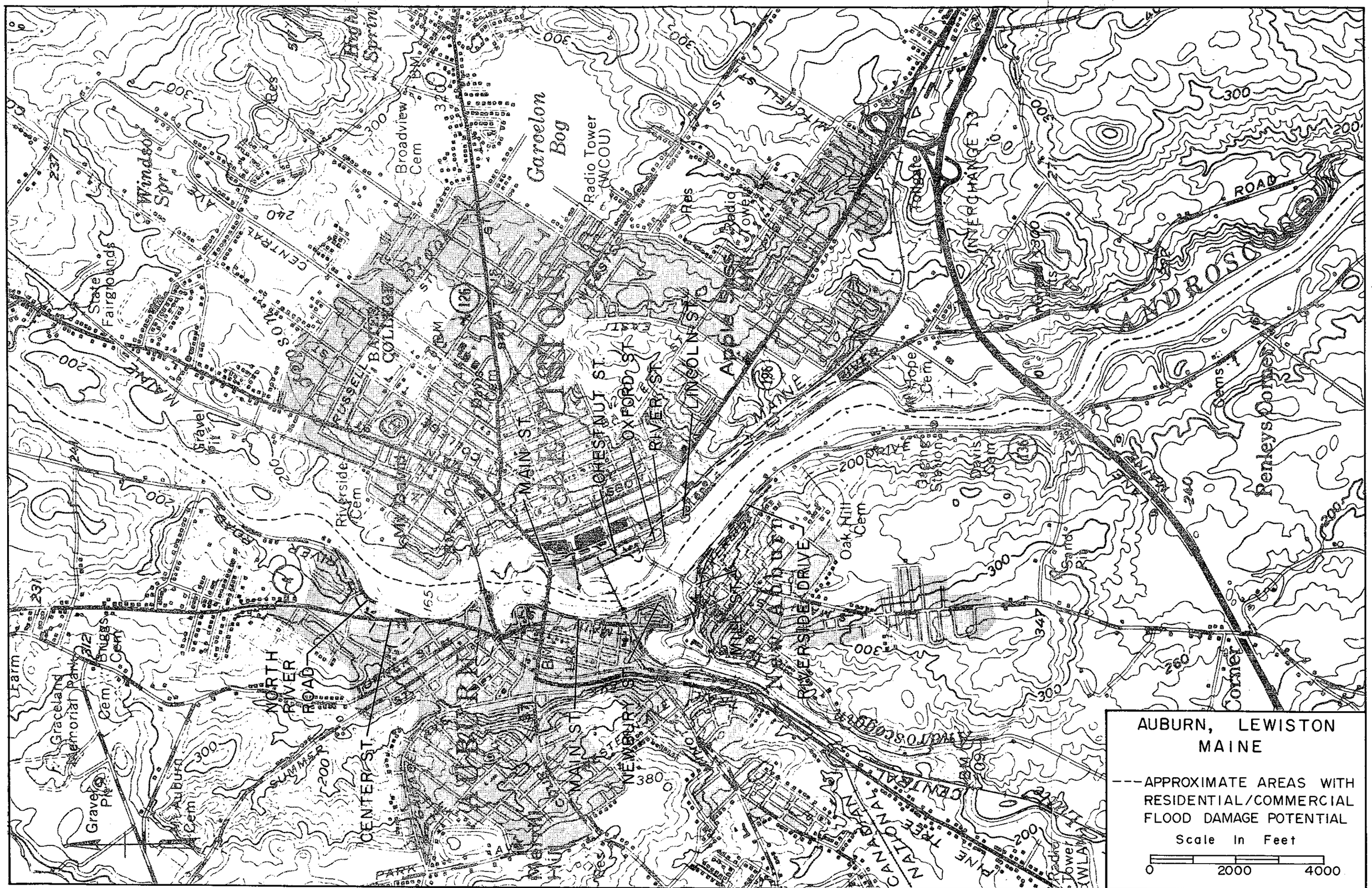

AUBURN, LEWISTON
MAINE
---APPROXIMATE AREAS WITH RESIDENTIAL/COMMERCIAL FLOOD DAMAGE POTENTIAL
Scale In Feet
0
2000
4000
Garcelon Bog
Radio Tower (WCOU)
Broadview Cem
State Fairgrounds
Windsor Spr
CENTRAL AVE
MAINE
RUSSELL
BATES COLLEGE
MAIN ST
CHESTNUT ST
OXFORD ST
RIVER ST
LINCOLN ST
Apple Sass
Hope Cem
INTERCHANGE 13
ANDROSCOGGIN
ROAD
Penleys Corner
Riverside Cem
Davis Cem
Oak Hill Cem
RIVERSIDE DRIVE
NORTH RIVER ROAD
CENTER ST
MAIN ST
NEWBURY ST
Graceland Memorial Park
Briggs Cem
Mt Auburn Cem
Gravel Pit
Farm
CANADIAN NATIONAL
PINE TREE
Radio Tower (WLAM)
Corner

PLATE 11

The following table summarizes flood elevations for various locations where flood damage is most likely to occur.

TABLE 12

FLOOD ELEVATIONS FOR RESIDENTIAL/COMMERCIAL FLOOD PLAIN AREAS WITHIN AUBURN

Location	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Maine Turnpike Bridge	126	131	133	139
USGS Gaging Station	126	132	134	139
South Bridge	129	134	136	142
Canadian National Railroad Bridge	129	134	137	143
North Bridge	129	135	137	145
Jct. Center Street-North River Road	172	175	176	179

Canton

The Town of Canton is a small community in the central portion of the basin which is bisected by the Androscoggin River. Flood profiles and delineations of the flood plain have not been completed. Estimates of flood prone areas in Canton were taken from Flood Hazard Boundary Maps published by the Federal Emergency Management Agency and a Corps of Engineers report published in October 1980, "Historical Ice Jam Flooding in Maine, New Hampshire, and Vermont." Therefore, the severity of flood damage potential and the number of structures in flood plain locations are approximations.

The first group of structures identified as candidates to sustain future floods are in an area known as Canton Point, on the northern side of the Androscoggin River near State Route 140. Approximately 10 residential structures in this vicinity may sustain flood damage. Also, evacuation of this entire area may be necessary during periods of flooding because isolation could easily occur when State Route 140 is inundated and impassable.

In instances of ice jam flooding, which affects this area, measures are taken by emergency teams from the towns of Dixfield and Jay to alert and assist residents of Canton Point who are isolated. However, during a basin-wide flooding episode this system may be inoperable because Dixfield and Jay will be taking measures to protect individuals in their own communities.

The second area where numerous structures are in the flood plain is along State Route 140 on the south side of the Androscoggin River. Approximately 40 residential structures and a wood-frame school in the Whitney

Brook area from the State Route 140 bridge over Whitney Brook upstream for about one mile are situated such that flood damages could be sustained in the future. In this area evacuation is much easier on roadways leading in a southerly direction away from flooded regions. This area also sustains flooding resulting from jamming ice, but protective measures to insure public safety during ice jams is more easily implemented in the southern areas of the community.

Dixfield

The Town of Dixfield is situated on the northern side of the Androscoggin River just downstream of Mexico. The most developed portion of town is located in the vicinity of the U.S. Route 2 and State Route 142 junction, just downstream of the Webb River confluence with the Androscoggin River. According to the Flood Hazard Boundary Maps for Dixfield, a number of structures on the south side of U.S. Route 2 are located in a flood hazard area. These maps are only estimates of the flood plain area so the severity of flooding in this area could not be determined in detail. However, only a slight increase in flood elevations will result in a significant number of additional structures sustaining flood damage. While the exact extent of the flood problem is not known, evacuation of flood plain occupants in Dixfield can be accomplished by using State Route 142 which runs north away from the Androscoggin River.

Mexico

Mexico is located in the central portion of the basin, directly across the Androscoggin River from Rumford. Flood damages can result from high water on both the Androscoggin River and Swift River. The part of Mexico with the greatest potential for sustaining severe flood damage is the area near the Swift River confluence with the Androscoggin River. The entire lengths of Carlton Avenue, Ford Street, Dix Avenue, and Holman Area will be inundated by a 100-year flood. The portions of Main Street from the Swift River to Roxbury Road and Osgood Avenue from Main Street to Fort Street are also within the 100-year flood plain. Within this area are approximately 50 residential structures, many containing more than one housing unit, and numerous small commercial firms. A shopping center located in a very low area east of Holman Avenue would be severely impacted by flooding. This shopping center contains a supermarket, a drug store, a liquor store, a laundromat, and a gas station. In response to a flood forecast, a preparedness plan should be implemented to prevent as much damage as possible and insure public safety for inhabitants of this large area.

Other smaller groups of structures in Mexico subject to flooding were identified at two locations. The development along Main Street from Roxbury Road to the Ridlonville Bridge is in a flood-prone area. A general statement can be made that structures on the west side of Main Street are within the 100-year flood plain, while buildings on the east side would be affected only by more infrequent flooding events. Located in this stretch is an ambulance service on the west side of Main Street, definitely within the 100-year flood plain. The second small area identified is subject to

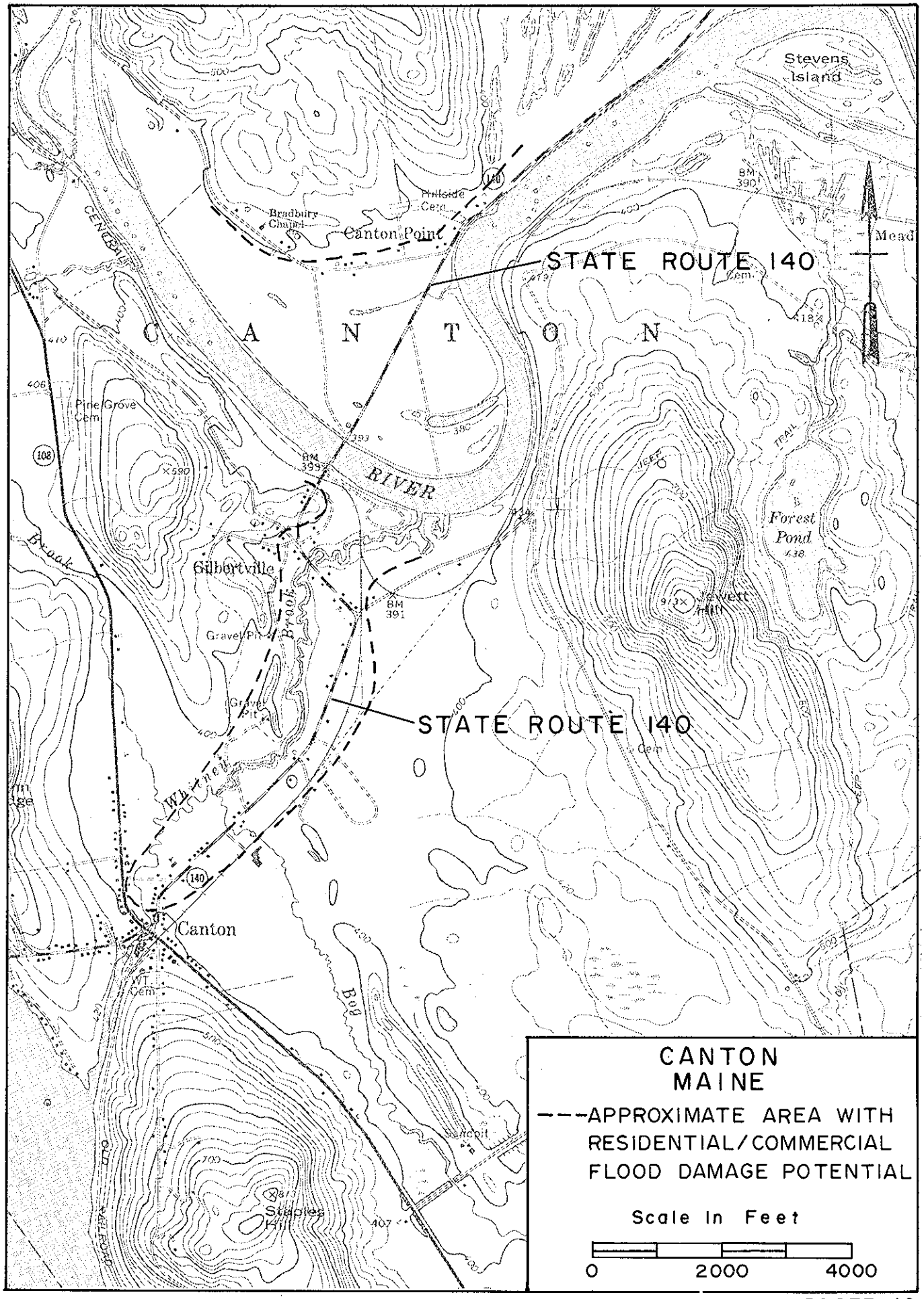
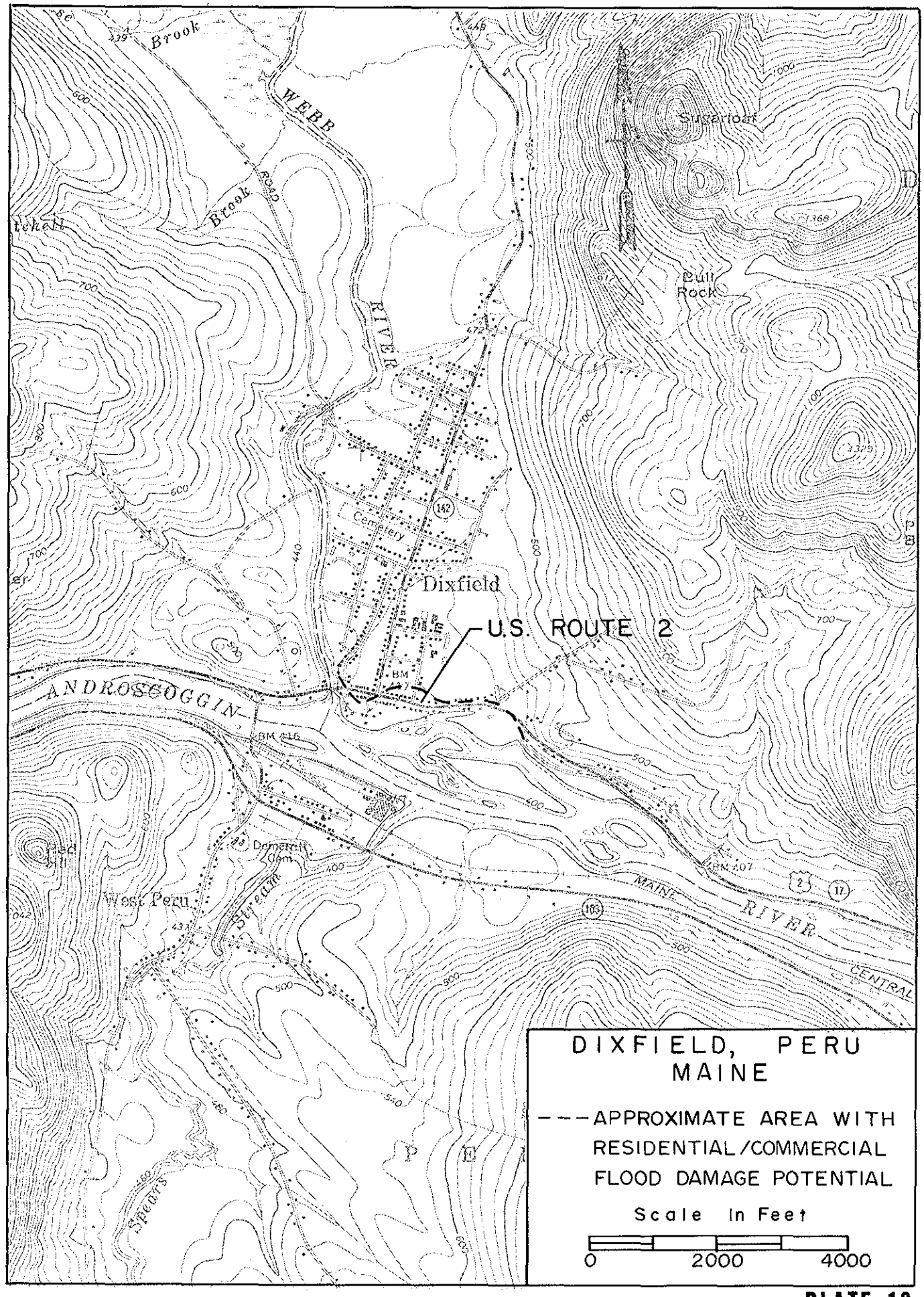

Stevens Island
Canton Point
Bradbury Chapel
Hillside Cem
STATE ROUTE 140
C A N T O N
RIVER
Pine Grove Cem
Gilbertville
Brook
Gravel Pit
Whitney
Forest Pond
Jewett Hill
Canton
Bog
Staples Hill
Sandpit
CANTON
MAINE
---APPROXIMATE AREA WITH RESIDENTIAL/COMMERCIAL FLOOD DAMAGE POTENTIAL
Scale In Feet
0
2000
4000

PLATE 12



Brook
WEBB
Brook
ROAD
RIVER
Sugarloaf
Bull Rock
Cemetery
Dixfield
U.S. ROUTE 2
ANDROSCOGGIN
West Peru
Stream
MAINE
RIVER
CENTRAL
Spears
DIXFIELD, PERU
MAINE
APPROXIMATE AREA WITH
RESIDENTIAL/COMMERCIAL
FLOOD DAMAGE POTENTIAL
Scale In Feet
0
2000
4000

PLATE 13

flooding from the Swift River. Approximately 10 residential structures on Interval Avenue are candidates to sustain flood damages at some future date.

Flood elevations for locations near potential high damage areas are given in the following table.

TABLE 13

FLOOD ELEVATIONS FOR RESIDENTIAL/COMMERCIAL FLOOD PLAIN AREAS IN MEXICO

Location	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Androscoggin River Confluence with Swift River	435	438	440	445
Footbridge	433	436	438	443
Ridlonville Bridge	431	434	436	438
Swift River 400' upstream of Androscoggin Confluence	439	444	445	448

Rumford

Rumford is a fairly large community located at approximately the midpoint of the basin. Fortunately, the major business district and largest residential area within the town are above any expected flooding from the Androscoggin River or its main tributary in Rumford, the Swift River. A major roadway, U.S. Route 2, parallels the Androscoggin River from the Hanover-Rumford corporate limit to the Swift River which serves as the Rumford-Mexico corporate limit. A large number of structures are not consolidated in one location, but spread out over the length of the road in Rumford. Once again an early flood forecast is necessary because U.S. Route 2 is the only evacuation route for most of the properties in this area.

Rumford Center, located on U.S. Route 2 near the Split Brook confluence with the Androscoggin River, is a small neighborhood consisting of about 25 residential structures and 4 commercial firms. Based on an inspection of the Flood Insurance Rate Maps for Rumford, structures on the southern side of the road are subject to flooding, but a conclusion cannot be made exactly which structures on the north side of the road are in the flood plain. In any event, all property owners in Rumford Center should be alerted when the potential for flooding exists. This area does have an evacuation route (Andover Road) leading away from the flooded area which is easily accessible to all inhabitants of Rumford Center.

A large motor inn is adjacent to the Androscoggin River on the south side of U.S. Route 2 approximately 1 mile east of Rumford Center. The motor inn, occupying large two-story wood frame buildings, is totally within the 500-year flood plain. Proper warning and evacuation procedures are needed for the motor inn because overnight guests will more than likely not be familiar with the surrounding area. Also, the nearest road leading away from flooding to safe areas is the previously mentioned Andover Road, about a mile to the west. Farther east on U.S. Route 2 near Joes Pond Outlet, a very small stream which runs into the Androscoggin River, a group of four commercial buildings are in the flood plain. These buildings contain two restaurants, a gas station, and a bowling alley.

A commercial and residential area located off U.S. Route 2 just south of the Virginia section of Rumford is prone to flooding from the Androscoggin River. This area consists of about 20 residential structures and commercial firms which include a motel, restaurant, and lounge. Portions of Prospect Avenue, Eaton Hill Road, and Sunnyside Road would be inundated by a 100-year flood, with the increased area inundated by greater events limited. Another area just off U.S. Route 2 having commercial and residential development in the flood plain is just upstream of the South Rumford Road bridge. The extent of flooding encompasses parts of Prospect Avenue, Virginia Street, Chaplin Street, Hall Street, and Free Street. Approximately 30 residential structures and 15 commercial firms (variety stores, gas stations, sandwich shops, etc.) could potentially sustain some form of flood damage in the future.

The final area of development identified as being in the flood plain is on the south side of the Androscoggin River. This area is comprised of about 50 single-family residential structures located on South Rumford Road and Franklin Avenue. The structures are near the confluence of Logans Brook with the Androscoggin River. The following table gives flood elevations for various frequency events at spots near potential damage centers in Rumford.

TABLE 14

FLOOD ELEVATIONS FOR RESIDENTIAL/COMMERCIAL FLOOD PLAIN AREAS WITHIN RUMFORD

Location	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Split Brook Confluence	616	620	622	626
Zircon Brook Confluence	612	615	617	621
Logan Brook Confluence	610	614	616	620
300' upstream South Rumford Road	610	614	615	619

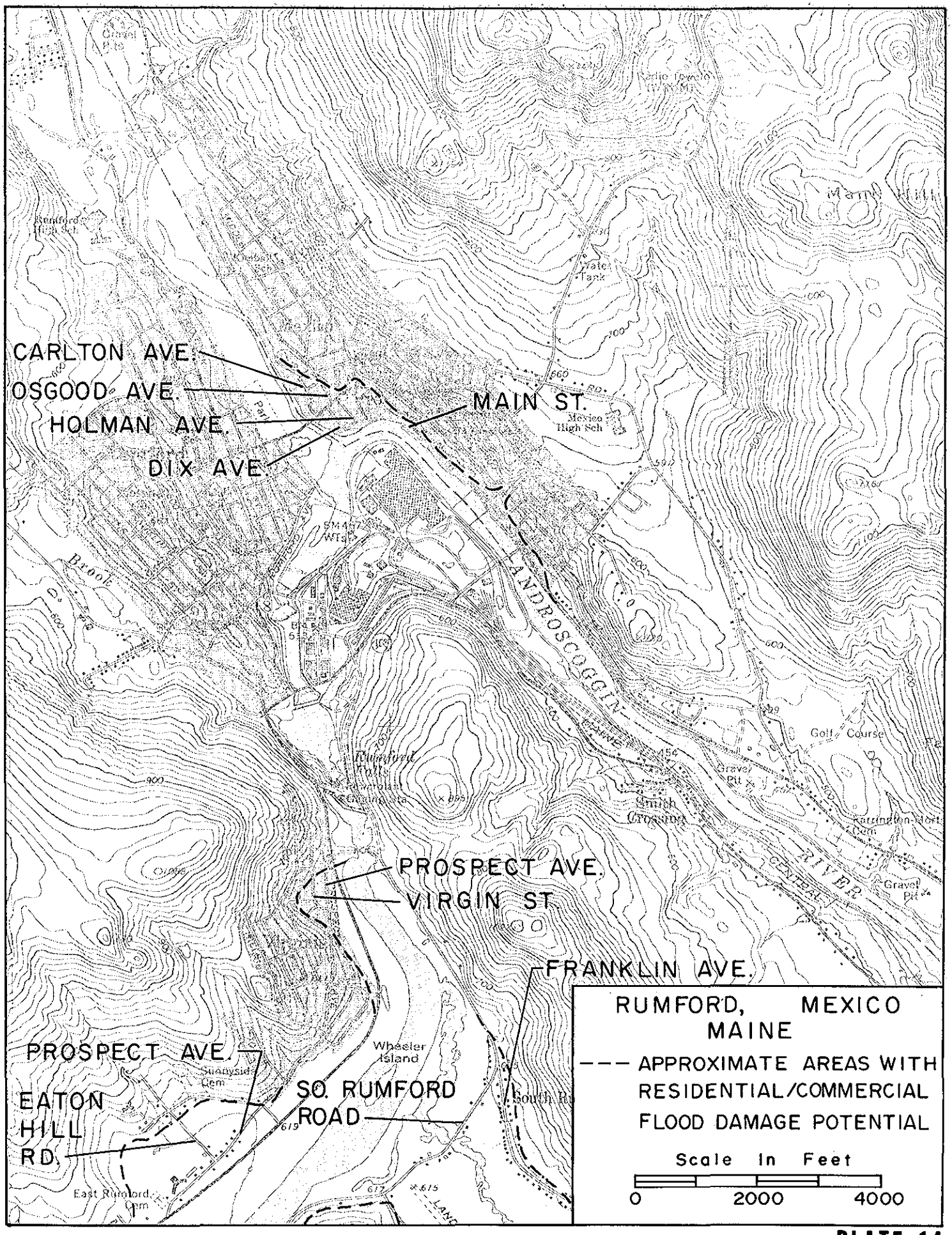

CARLTON AVE.
OSGOOD AVE.
HOLMAN AVE.
DIX AVE.
MAIN ST.
PROSPECT AVE.
VIRGIN ST.
FRANKLIN AVE.
PROSPECT AVE.
EATON HILL RD.
SO. RUMFORD ROAD
Mexico High Sch
Golf Course
Wheeler Island
Smith Crossing
RIVER
RUMFORD, MEXICO
MAINE
APPROXIMATE AREAS WITH RESIDENTIAL/COMMERCIAL FLOOD DAMAGE POTENTIAL
Scale In Feet
0
2000
4000

PLATE 14

Bethel

The community of Bethel is in the upper portion of the Androscoggin River Basin approximately midway between Rumford, Maine and Berlin, New Hampshire. Areas of potential commercial and residential flood damage were identified using the rough estimate of the flood plain included in the Flood Hazard Boundary Maps published by FEMA for Bethel. Also, areas affected by ice jam flooding were outlined in a previous Corps of Engineers report, "Historical Ice Jam Flooding in Maine, New Hampshire and Vermont" published in October 1980. This was necessary because flood profiles and subsequent delineation of the flood plain on accurate topographic mapping have not been completed for Bethel.

The primary area of potential flood damage within Bethel is along U.S. Route 2 which crosses the Androscoggin River approximately 1,000 feet upstream of Hastings Island. This area is often the location of ice jam flooding resulting from ice hanging up on Hastings Island. Flood damages would occur on both sides of the river with a total of approximately 32 residential structures, a twelve unit trailer park, and two commercial firms (gas station, jewelry store) located in the flood plain. Steps to protect property and insure safety of occupants on the north side of the Androscoggin River should be the main focus of any preparedness plan. This is due to the fact that evacuation routes for this area, U.S. Route 2 in a northerly and southerly direction, would be cut off. A plan of action, whereby a fire engine and police cruiser are placed north of the Androscoggin River on U.S. Route 2 to service isolated areas of town, is implemented when ice jam emergencies exist. However, this plan may not be adequate when a major flood hits the Androscoggin River Basin, thereby inundating a much larger area of Bethel.

Gorham

Gorham is located in the upper portion of the Androscoggin River Basin approximately 10 miles west of the New Hampshire-Maine State line. The major development in the community is located in the northeastern section of the community near the Androscoggin River. A group of residential structures is in the flood plain on side streets north of U.S. Route 2 near the Route 16 junction. Approximately 35 single family residential structures are within the flood plain boundaries on Androscoggin Street, Alpine Street, Corbin Avenue, Howland Street, Jewell Street, and Willis Place. Farther upstream near Bucks Island, flood stages would overtop U.S. Route 2 and flood approximately 25 structures in the vicinity of Messenger Brook. A school in this area is above stages from a 100-year flooding event, but would be inundated by 500-year flood stages. The overtopping of U.S. Route 2 and subsequent closure of the only means to get to high elevations necessitates an efficient flood forecast and preparedness plan.

A large area of potential flood damage is the area in Gorham known as Upper village near the Moose Brook confluence with the Androscoggin River. A total number of about 50 structures, the majority being residential, but with some commercial establishments are subject to flooding at this locale. High water from the Androscoggin River would flood portions of Marois Avenue,

Hamlin Avenue, Pine Street, River Street, Frazier Street, and Elm Street, while flood stages from Moose Brook will primarily affect Cross Street and portions of U.S. Route 2. Flood peak forecasts for the Androscoggin River would probably not coincide with periods of maximum flooding on Moose Brook, due to the much smaller drainage area and extremely steep gradient of the stream bed. Also, Moose Brook may flood at times from heavy localized precipitation when flooding is not forecast for the Androscoggin River.

Lastly, predicted flood stages for the Peabody River will inundate portions of Main Street, Dell Street, and Bangor Street. In this area much of the flooding results from a constriction of flow at the Grand Trunk Railroad bridge. More severe floods such as 100-year and 500-year floods in particular are worsened by this blockage of flows. A table summarizing flood elevations for various frequency events at locations near potential flood damage areas follows.

TABLE 15

FLOOD ELEVATIONS FOR RESIDENTIAL/COMMERCIAL FLOOD PLAIN AREAS WITHIN GORHAM

Stream	Location	10-Year (NGVD)	50-Year (NGVD)	100-Year (NGVD)	500-Year (NGVD)
Androscoggin	Cascade Power Station Dam	774	774	775	776
	2000' upstream Cascade Power Station Dam	777	778	779	780
	Confluence of Moose River	785	786	787	788
	Confluence of Moose Brook	792	794	795	796
Peabody River	U.S. Route 2 State Route 116	773	775	776	778
	Grand Trunk Railroad	777	779	780	787
	Footbridge	789	791	793	795
Moose River	U.S. Route 2 State Route 116	799	801	802	804
	Grand Trunk Railroad	803	805	810	812
Moose Brook	State Route 16	798	800	801	803
	Grand Trunk Railroad	803	811	812	816
	Private Road	824	830	831	832

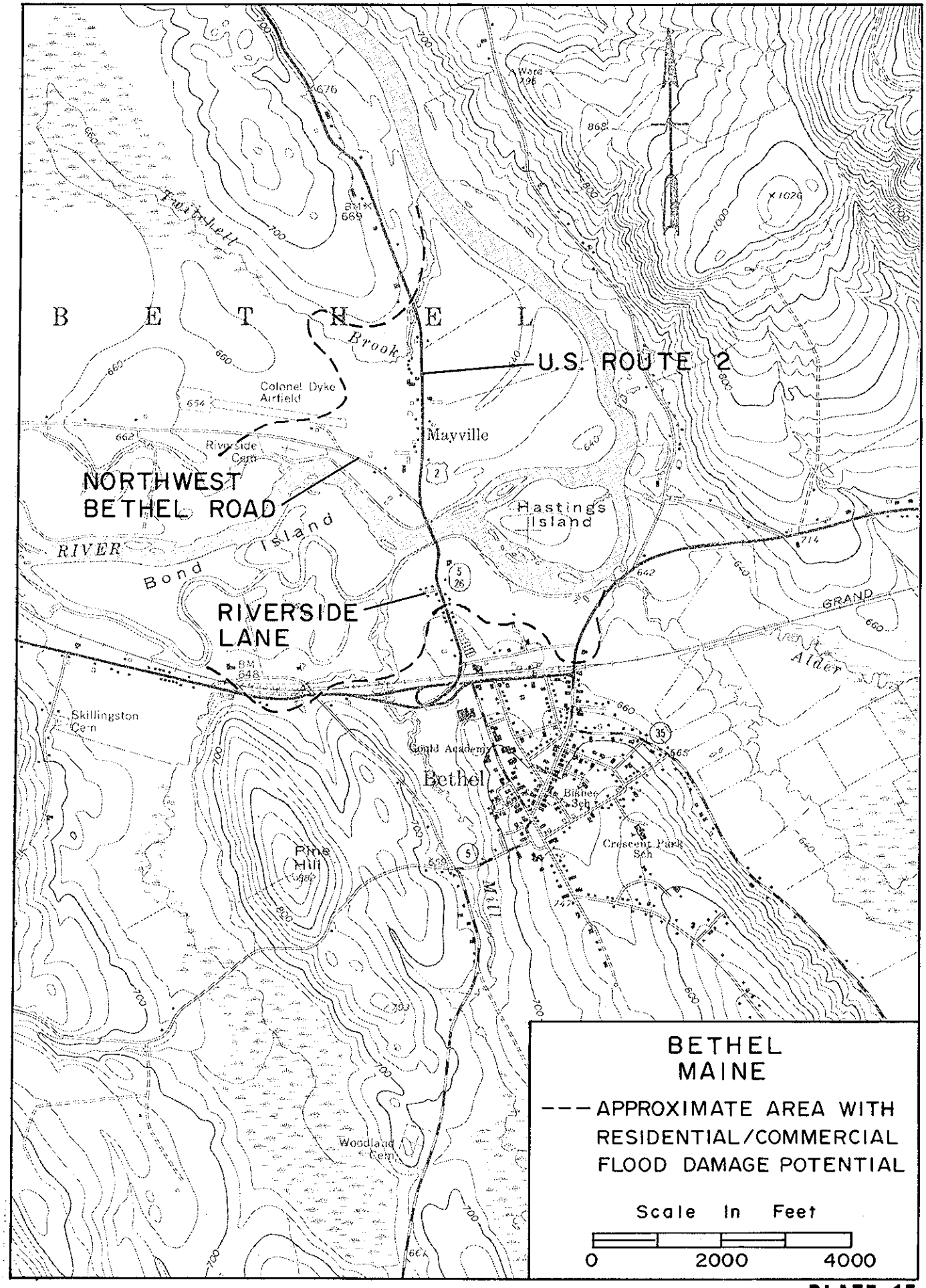

BETHEL
U.S. ROUTE 2
NORTHWEST BETHEL ROAD
RIVERSIDE LANE
Twitchell Brook
Colonel Dyke Airfield
Riverside Cem
Mayville
Hastings Island
Bond Island
RIVER
GRAND
Alder
Skillingston Cem
Gould Academy
Bethel
Bisbee Sch
Crescent Park Sch
Pine Hill
Mill
Woodland Cem
BETHEL
MAINE
--- APPROXIMATE AREA WITH RESIDENTIAL/COMMERCIAL FLOOD DAMAGE POTENTIAL
Scale In Feet
0
2000
4000

PLATE 15

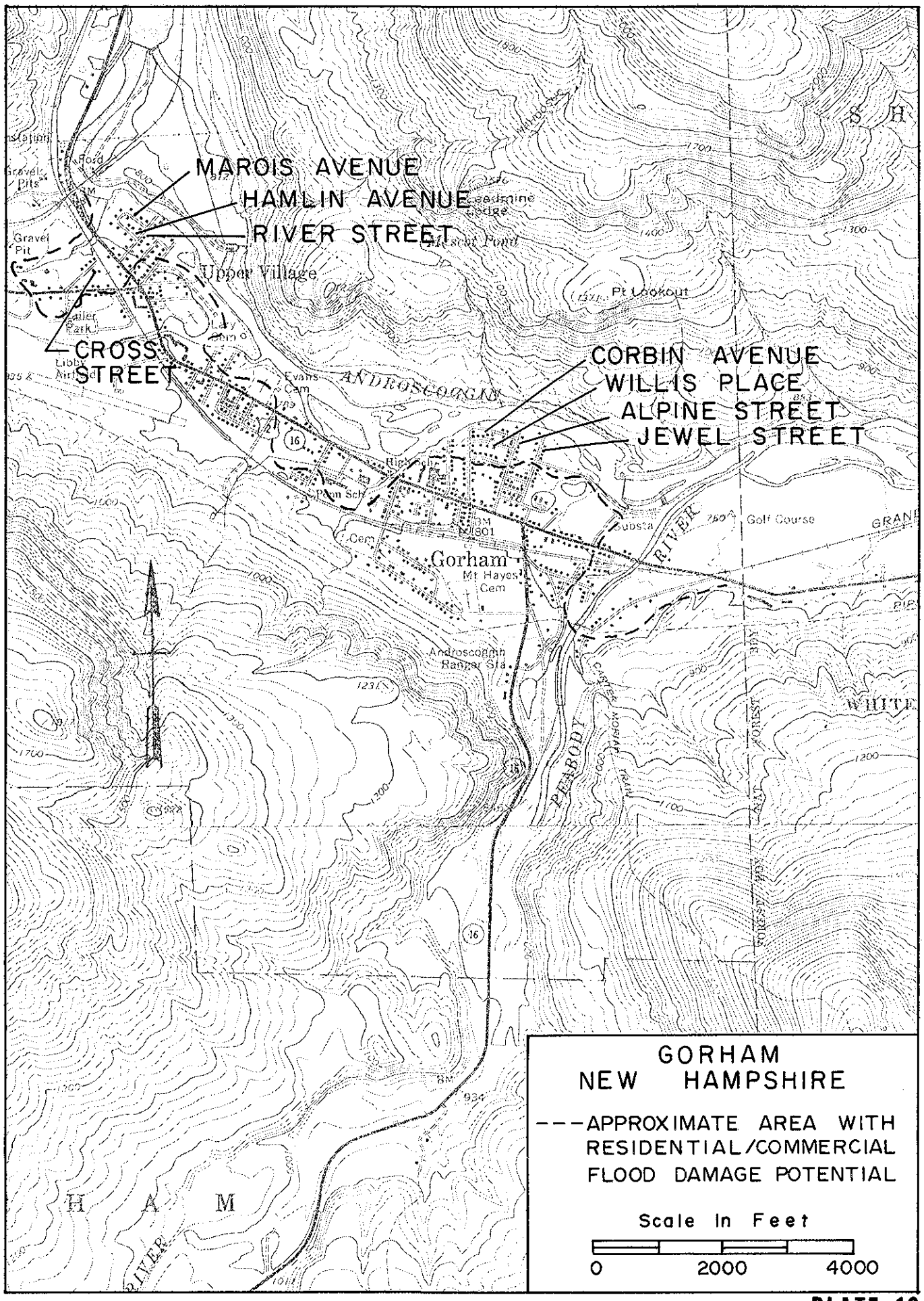

MAROIS AVENUE
HAMLIN AVENUE
RIVER STREET
CROSS STREET
CORBIN AVENUE
WILLIS PLACE
ALPINE STREET
JEWEL STREET
Upper Village
Gravel Pit
Gravel Pits
Pt Lookout
ANDROSCOGGIN
Evans Cem
Gorham
Mt Hayes Cem
Golf Course
Androscoggin Ranger Sta
PEABODY
RIVER
GORHAM
NEW HAMPSHIRE
---APPROXIMATE AREA WITH RESIDENTIAL/COMMERCIAL FLOOD DAMAGE POTENTIAL
Scale In Feet
0
2000
4000

PLATE 16

Other Communities

The analysis to determine residential and commercial areas susceptible to flood damage yielded a number of communities with structures in the flood plain. Structures in these communities are not located in a centralized area, but scattered throughout each town. Communities in this category include Durham, Jay, Livermore, and Wayne along the Androscoggin River and Mechanic Falls on the Little Androscoggin River. When a river forecast shows that the potential for flooding exists, all communities along the main stem of the Androscoggin River and its major tributaries should be alerted, so measures can be taken to ensure public safety and protect valuable property.

IX. CORPS OF ENGINEERS PROGRAMS TO MITIGATE FLOOD HAZARDS

In addition to possible implementation of a comprehensive Flood Forecast, Warning and Preparedness Program for the Androscoggin River Basin, other programs exist to mitigate flood hazards. The Corps of Engineers can carry out small project and technical assistance work under continuing authorities which aid in lessening the impacts of flooding.

A. Small Projects

Section 205 of the 1948 Flood Control Act, as amended by Section 61 of the 1974 Water Resources Development Act provides authority to construct small flood control projects that have not been specifically authorized by Congress. Each project must be economically justified and complete within itself. In addition, each project is limited to a Federal cost of not more than $4 million. This Federal cost limitation includes all project related costs for investigations, inspections, engineering, preparation of plans and specifications, supervision, administration, and construction.

A project planned and implemented under Section 205 is designed to provide the same adequate degree of protection as would be provided under specific Congressional authorization. Flood control projects under Section 205 are not limited to any particular type of improvement and a project may include features for other purposes, such as water supply, when local interests contribute the project cost assigned to that purpose. Flood damage reduction measures undertaken under Section 205 may be structural or nonstructural in nature. Formal assurances of local cooperation similar to those required for regularly authorized projects must be furnished by a local sponsoring agency. The local sponsor must be fully authorized under State laws to give such assurances and financially capable of fulfilling all measures of local cooperation.

A project is adopted under Section 205 only after full detailed investigation and study clearly shows the engineering feasibility and economic justification of the project proposed. An investigation of a prospective small project under Section 205 may be initiated after receipt of a formal request from a prospective sponsoring agency fully empowered under State law to provide all required local cooperation. This request and any further inquiries concerning a small flood control project should be made directly to the Division Engineer.

B. Snagging and Clearing Projects

Section 208 of the 1954 Flood Control Act as amended by Section 26 of the 1974 Water Resources Development Act, authorizes clearing and straightening of stream channels and the removal of accumulated snags and other debris in the interest of flood control. Each project selected must be economically justified with a maximum Federal expenditure limited to $250,000. The local sponsoring agency must agree to provide all lands, easements, rights-of-way, and all required alterations and relocations in utility facilities; maintain the project after completion; assume all project costs in excess of $250,000; and prevent future encroachment which might interfere with proper functioning of the project. A project is adopted under Section 208 only after full detailed investigation and study clearly shows the engineering feasibility and economic justification of the project proposed. An investigation of a prospective project under Section 208 may be initiated after receipt of a formal request from a prospective sponsoring agency fully empowered under State law to provide all required local cooperation. This request and any further inquiries should be made directly to the Division Engineer.

C. Flood Plain Management Service Program

The Flood Plain Management Program is the Corps' means of using its technical expertise in flood plain management matters to help those outside the Corps, both Federal and non-Federal, to deal with floods and flood plain related matters. Section 206 of the Flood Control Act of 1960, as amended, provides the authority for this program. Upon request, the Corps of Engineers will furnish to States, counties, cities, and Federal agencies the flood plain information and technical assistance needed in planning for prudent use of land subject to flooding from streams, lakes, and oceans. Requests are also honored from individuals when the necessary information is readily available.

The objective of the Flood Plain Management Services (FPMS) Programs is to support comprehensive flood plain management planning with technical services and planning guidance at all appropriate governmental levels; and thereby, to encourage and guide them toward prudent use of the Nation's flood plains for the benefit of the national economy and welfare. For other Federal agencies, this is especially important because they meet the requirements of Executive Order 11988, titled "Flood Plain Management." Adjustment of land use based on proper planning and employment of a variety of techniques for reducing flood damages and damage potential constitutes a rational means by which the locational advantages and natural resource values of flood plains can be balanced with the inevitable hazards which floods pose.

X. SUMMARY AND CONCLUSIONS

The initial effort to determine existing conditions within the Androscoggin River Basin showed that two independent flood forecast systems are operational. The National Weather Service, having responsibility for flood forecasting in the Androscoggin River Basin, develops flood forecasts utilizing precipitation, flow, and stage data collected at scattered locations through-

out the basin. However, most of this information is available only at predetermined times, generally four times daily. The availability of real time data could significantly increase the effectiveness of the existing NWS flood forecasting system. The second flood forecast system is privately operated by Boise Cascade to predict flows and stages at their Rumford Mill. This information is used to monitor streamflows and to reduce flood damages at the mill. This system relies upon data collected by manual precipitation observers who are paid to report precipitation amounts at six locations above Rumford, Maine. Precipitation data is mailed daily to the mill by the observers, but hourly readings can be telephoned into the mill during periods of heavy rainfall. This system predicts flow at Rumford within 2,000 cfs of actual flow with a 16-hour lead time until peak. However, this system does not have the capability to forecast river conditions for other areas of the basin.

In many communities ice jam flooding causes flood damage much more frequently than flooding under free flow conditions. The two systems currently forecasting river conditions in the Androscoggin River Basin do not address this problem. Because of the localized dynamic characteristics of ice jams, forecasting their occurrence on a regional basis is not practical. The most effective method to mitigate the impact of ice jam flooding is through a local forecast system. A flood forecast system could be based upon observations of the rate of increase of river stages in the vicinity of the potential flood damage area.

An analysis to determine the severity of flooding within the Androscoggin River Basin showed a number of communities would sustain significant flood damage. Large industrial plants located near the Androscoggin River in Brunswick, Topsham, Lisbon, Lewiston, Jay, Peru, Rumford, Gorham, and Berlin could sustain flood damage at some future date. Also, industrial plants in Mechanic Falls near the Little Androscoggin River and Lisbon near the Sabattus River are subject to flooding. Residential and commercial structures are located in the flood plain throughout the basin, but the most severe damage would occur in larger communities within the basin. Large areas of potential severe residential and commercial flood damages were found in the following communities: Lisbon, Lewiston, Auburn, Rumford, Mexico, and Gorham. Also, smaller areas of residential and commercial development were found subject to flooding in many other communities within the basin.

A major safety hazard existing at many locations in the Androscoggin River Basin is isolation during periods of high river stages. Most major roadways in the basin parallel either the Androscoggin River or one of its main tributaries due to the steep topography of the area. Also, there are very few roads connecting with the major routes which lead away from the flood plain because of the terrain and undeveloped areas which encompass most of the basin. Therefore, the problem of isolation must be addressed by any preparedness plan responding to a flood forecast. These actions are more effective when outlined by local authorities, familiar with transportation routes and resources available during flooding episodes.

During the course of this study, it became apparent that no agency, State or Federal, had a working understanding of the hydrologic data currently available in the basin or knowledge pertaining to operational preparedness plans. It is imperative that the State of Maine coordinate with all involved parties to implement a flood forecast system which effectively uses this existing hydrologic data. The State of New Hampshire, encompassing the extreme upstream portion of the basin, should be included in any discussions pertaining to flood forecasting systems in the Androscoggin River Basin. Upon determination of the capabilities of an effective flood forecast system using available data, the State could then determine the increased lead time derived from a more comprehensive system. An example is the incorporation of automated gauges to collect real time data for developing flood forecasts. By knowing the extent of potential flood damages, an evaluation can be made whether the initial implementation cost of improving the system is justified. Regardless of the type of flood forecast system operational, the industrial firms identified in this report should be directly alerted when a flood forecast is issued. Also, each community in the basin, by priority, should be notified of the flood threat as soon as possible. Close coordination among State, county, and municipal civil preparedness agencies is needed to set up detailed warning arrangements so all affected areas are alerted. Local communities and property owners would then have the most time possible to implement measures to mitigate the severity of flood hazards.

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