ORDINANCE NO. 88- 515-0

AN ORDINANCE ESTABLISHING AND IMPOSING REGULATIONS TO PREVENT FLOOD DAMAGE AND DECLARING AN EMERGENCY.

1.0 STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND OBJECTIVES.

1.1 The legislature of the State of Oregon has delegated the responsibility to local governmental units to adopt regulations designed to promote the public health, safety, and general welfare of its citizenry. Therefore, the City Council of Troutdale, Oregon does ordain as follows:

1.2 FINDINGS OF FACT

(1) The flood hazard areas of the City of Troutdale are subject to periodic inundation which results in loss of life and property, health, and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.

(2) These flood losses are caused by the cumulative effect of obstructions in areas of special flood hazards which increase flood heights and velocities, and when inadequately anchored, damage uses in other areas. Uses that are inadequately floodproofed, elevated, or otherwise protected from flood damage also contribute to the flood loss.

1.3 STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed:

(1) To protect human life and health;
(2) To minimize expenditure of public money and costly flood control projects;
(3) To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
(4) To minimize prolonged business interruptions;
(5) To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets, and bridges located in areas of special flood hazard;

(6) To help maintain a stable tax base by providing for the sound use and development of areas of special flood hazard so as to minimize future flood blight areas;
(7) To ensure that potential buyers are notified that property is in an area of special flood hazard; and,
(8) To ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

1.4 METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purpose, this ordinance includes methods and provisions for:

(1) Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;
(2) Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
(3) Controlling the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;
(4) Controlling filling, grading, dredging, and other development which may increase flood damage; and
(5) Preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or may increase flood hazards in other areas.

2.0 DEFINITIONS

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give the meaning they have in common usage and to give this ordinance its most reasonable application.

"APPEAL" means request for a review of the City of Troutdale's interpretation of any provision of this ordinance or a request for a variance.

"AREA OF SHALLOW FLOODING" means a designated AO or AH Zone on the flood Insurance Rate Map (FIRM). The base flood depths range from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and, velocity flow may be evident. AO is characterized as sheet flow and AH indicates ponding.

"AREA OF SPECIAL FLOOD HAZARD" means the land in the flood plain within a community subject to a one percent or greater chance of flooding in any given year. Designation on maps always includes the letters A or V.

"BASE FLOOD" means the flood having a one percent chance of being equaled or exceeded in any given year. Also referred to as the "100-year flood". Designation on maps always includes the letter A or V.

"DEVELOPMENT" means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations located within the area of special flood hazard.

"FLOOD" or" FLOODING" means a general and temporary condition of partial or complete inundation of normally dry land areas from:

(1) The overflow of inland or tidal waters and/or
(2) The unusual and rapid accumulation of runoff of surface waters from any source.

"FLOOD INSURANCE RATE MAP (FIRM)" means the official map on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

"FLOOD INSURANCE STUDY" means the official report provided by the Federal Insurance Administration that includes flood profiles, the Flood Boundary-Floodway Map, and the water surface elevation of the base flood.

"FLOODWAY" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

"LOWEST FLOOR" means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of this ordinance found at Section 5.2-1(2).

"MANUFACTURED HOME" means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. For flood plain management purposes the term "manufactured home" also includes park trailers, travel trailers, and other similar vehicles placed on a site for greater than 180 consecutive days. For insurance purposes the term "manufactured home" does not include park trailers, travel trailers, and other similar vehicles.

"MANUFACTURED HOME PARK OR SUBDIVISION" means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"NEW CONSTRUCTION" means structures for which the "start of construction" commenced on or after the effective date of this ordinance.

"START OF CONSTRUCTION" includes substantial improvement, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundation or the erection of temporary forms nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure.

"STRUCTURE" means a walled and roofed building including a gas or liquid storage tank that is principally above ground.

"SUBSTANTIAL IMPROVEMENT" means any repair, reconstruction, or improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure either:

(1) before the improvement or repair is started, or
(2) if the structure has been damaged and is being restored, before the damage occurred. For the

purpose of this definition "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure.

The term does not, however, include either:

(1) any project for improvement of a structure to comply with existing state or local health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions, or
(2) any alteration of a structure listed on the National Register of Historic Places or a State Inventory of Historic Places.

"VARIANCE" means a grant of relief from the requirements of this ordinance which permits construction in a manner that would otherwise be prohibited by this ordinance.

3.0 GENERAL PROVISIONS

3.1 LAND TO WHICH THIS ORDINANCE APPLIES

This ordinance shall apply to all areas of special flood hazards within the jurisdiction of the City of Troutdale.

3.2 BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard identified by the Federal Insurance Administration in a scientific and engineering report entitled "The Flood Insurance Study for the City of Troutdale dated September 30, 1988, with accompanying Flood Insurance Maps is hereby adopted by reference and declared to be part of this ordinance. The Flood Insurance Study is on file at the City Recorder's Office, City of Troutdale.

3.3 PENALTIES FOR NONCOMPLIANCE

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates

this ordinance or fails to comply with any of its requirements shall upon conviction therefore be fined not less than $500.00 nor more than $1000.00 or imprisoned for not more than five days, or both, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the City of Troutdale from taking such other lawful action as is necessary to prevent or remedy any violation.

3.4 ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and another ordinance, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

3.5 INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

(1) Considered as minimum requirements;
(2) Liberally construed in favor of the governing body; and,
(3) Deemed neither to limit nor repeal any other powers granted under State statutes.

3.6 WARNING AND DISCLAIMER OF LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the areas of special flood hazards or uses permitted within such areas will be free from flooding or flood damage. This ordinance shall not create liability on the part of the City of Troutdale, any officer or employee thereof, or the Federal Insurance Administration, for any damages that result from reliance on this ordinance or any administrative decision lawfully made hereunder.

4.0 ADMINISTRATION

4.1 ESTABLISHMENT OF DEVELOPMENT PERMIT

4.1-1 Development Permit Required

A development permit shall be obtained before construction or development begins within any area of special flood hazard established in Section 3.2. The permit shall be for all structures including manufactured homes, as set forth in the "DEFINITIONS", and for all development including fill and other activities, also as set forth in the "DEFINITIONS".

4.1-2 Application for Development Permit

Application for a development permit shall be made on forms furnished by the City of Troutdale and may include but not limited to; plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities, and the location of the foregoing. Specifically, the following information is required:

(1) Elevation in relation to mean sea level, of the lowest floor (including basement) of all structures;
(2) Elevation in relation to mean sea level to which any structure has been floodproofed:
(3) Certification by a registered professional engineer or architect that the floodproofing methods for any nonresidential structure meet the floodproofing criteria in Section 5.2-2; and
(4) Description of the extent to which a watercourse will be altered or relocated as a result of proposed development.

4.2 DESIGNATION OF THE CITY OF TROUTDALE

The City of Troutdale is hereby appointed to administer this ordinance by granting or denying development permit applications in accordance with its provisions.

4.3 DUTIES AND RESPONSIBILITIES OF THE CITY OF TROUTDALE

Duties of the City of Troutdale shall include, but not be limited to:

4.3-1 Permit Review

(1) Review all development permits to determine that the permit requirements of this ordinance have been satisfied.
(2) Review all development permits to determine that all necessary permits have been obtained from

those Federal, State, or local governmental agencies from which prior approval is required.

(3) Review all development permits to determine if the proposed development is located in the Floodway. If located in the Floodway, assure that the encroachment provisions of Section 5.3-(1) are met.

4.3-2 Use of Other Base Flood Data

When base flood elevation data has not been provided in accordance with Section 3.2, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD, the City of Troutdale may obtain, review, and reasonably utilize any base flood elevation and floodway data available from a federal, State or other source, in order to administer Sections 5.2 SPECIFIC STANDARDS, and 5.3 FLOODWAYS.

4.3-3 Information to be Obtained and Maintained

(1) Where base flood elevation data is provided through the Flood Insurance Study or required as in Section 4.3-2, obtain and record the actual elevation (in relation to mean sea level) of the lowest floor (including basement) of all new or substantially improved structures, and whether or not the structure contains a basement.

(2) For all new or substantially improved floodproofed structures:

(i) verify and record the actual elevation (in relation to mean sea level) and

(ii) maintain the floodproofing certifications required in Section 4.1(3).

(3) Maintain for public inspection all records pertaining to the provisions of this ordinance.

4.3-4 Alteration of Watercourses

(1) Notify adjacent communities and the U.S. Army Corp of Engineers and other affected agencies prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Insurance Administration.

(2) require that maintenance is provided within the altered or relocated portion of said watercourse so that the flood carrying capacity is not diminished.

4.3-5 Interpretation of FIRM Boundaries

Make interpretations where needed, as to exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual field conditions). The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation as provided in Section 4.4.

4.4 VARIANCE PROCEDURE

4.4-1 Appeal Board

(1) The Planning Commission as established by the City of Troutdale shall hear and decide appeals and requests for variances from the requirements of this ordinance.
(2) The Planning Commission shall hear and decide appeals when it is alleged there is an error in any requirement, decision, or determination made by the City of Troutdale in the enforcement or administration of this ordinance.
(3) Those aggrieved by the decision of the Planning Commission, or any taxpayer, may appeal such decision to the City Council, as provided in Section 10 of the Development Ordinance.
(4) In passing upon such applications, the Planning Commission shall consider all technical evaluations, all relevant factors, standards specified in other sections of this ordinance, and:

(i) the danger that materials may be swept onto other lands to the injury of others;
(ii) the danger to life and property due to flooding or erosion damage;
(iii) the susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
(iv) the importance of the services provided by the proposed facility to the community;
(v) the necessity to the facility of a waterfront location, where applicable;
(vi) the availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;
(vii) the compatibility of the proposed use with existing and anticipated development;

(viii) the relationship of the proposed use to the Comprehensive Plan and flood plain management program for that area;

(ix) the safety of access to the property in times of flood for ordinary and emergency vehicles;

(x) the expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site; and

(xi) the costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water systems, and streets and bridges.

(5) Upon consideration of the factors of Section 4.4-1(4) and the purpose of this ordinance, the Planning Commission may attach such conditions to the granting of variances as it deems necessary to further the purpose of this ordinance.

(6) The City of Troutdale shall maintain the records of all appeal actions and report any variances to the Federal Insurance Administration upon request.

4.4-2 Conditions for Variances

(1) Generally, the only condition under which a variance from the elevation standard may be issued is for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing items (i-xi) in Section 4.4-1(4) have been fully considered. As the lot size increases the technical justification required for issuing the variance increases.

(2) Variance may be issued for the reconstruction, rehabilitation, or restoration of structures listed on the National Register of Historic Places or the State Inventory of Historic Places, without regard to the procedures set forth in this section.

(3) Variances shall not be issued within a designated floodway if any increase in flood levels during the base flood discharge would result.

(4) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

(5) Variances shall only be issued upon:

(i) a showing of good and sufficient cause;
(ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant;

(iii) a determination that the granting of a variance will not allow result in increasedflood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public as identified in Section 4.1-4(4), or conflict with existing local laws or ordinance.

(6) Variances as interpreted in the National Flood Insurance Program are based on the general zoning law principle that they pertain to a physical piece of property; they are not personal in nature and do not pertain to the structure, its inhabitants, economic or financial circumstances. They primarily address small lots in densely populated residential neighborhoods. As such, variances from the flood elevations should be quite rare.

(7) Variances may be issued for nonresidential buildings in very limited circumstances to allow a lesser degree of floodproofing than watertight or dry-floodproofing, where it can be determined that such action will have low damage potential, complies with all other variance criteria except 4.4-2(1), and otherwise complies with Sections 5.1-1 and 5.1-2 of the GENERAL STANDARDS.

(8) Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

5.0 PROVISIONS FOR FLOOD HAZARD REDUCTION

5.1 GENERAL STANDARDS

In all areas of special flood hazards, the following standards are required:

5.1-1 Anchoring

(1) All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.

(2) All manufactured homes must likewise be anchored to prevent flotation, collapse or lateral movement, and shall be installed using methods and

practices that minimize flood damage. Anchoring methods may include, but are not limited to, use of over-the-top or frame ties to ground anchors (Reference FEMA's "Manufactured Home Installation in Flood Hazard Areas" guidebook for additional techniques).

5.1-2 Construction Materials and Methods

(1) All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.
(2) All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.
(3) Electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities shall be designed and/or otherwise elevated or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

5.1-3 Utilities

(1) All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;
(2) New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters; and,
(3) On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

5.1-4 Subdivision Proposals

(1) All subdivision proposals shall be consistent with the need to minimize flood damage;
(2) All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage;
(3) All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage; and,
(4) Where base flood elevation data has not been provided or is not available from another authoritative source, it shall be generated for subdivision proposals and other proposed developments which contain at least 50 lots or 5 acres (whichever is less).

5.1-5 Review of Building Permits

Where elevation data is not available either though Flood Insurance Study or from another authoritative source (Section 4.3-2), applications for building permits shall be reviewed to assure that proposed construction will reasonably safe from flooding. The test of reasonableness is a local judgment and includes use of historical data, high water marks, photographs of past flooding, etc., where available. Failure to elevate at least two feet above grade in these zones may result in higher insurance rates.

5.2 SPECIFIC STANDARDS

In all areas of special flood hazards where base flood elevation data has been provided as set forth in Section 3.2, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD or Section 4.3-2, Use of Other Flood Data, the following provisions are required:

5.2-1 Residential Construction

(1) New construction and substantial improvements of any residential structure shall have the lowest floor, including basement, elevated to or above base flood elevation.

(2) Fully enclosed areas below the lowest floor that are subject to flooding are prohibited, or shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria:

(i) A minimum of two openings having a total net area of not less than one square inch for every square square foot of enclosed area subject to flooding shall be provided.

(ii) The bottom of all openings shall be no higher than one foot above grade.

(iii) Openings may be equipped with screens, louvers, or other devices provided that they permit the automatic entry and exit of floodwaters.

5.2-2 Nonresidential Construction

New construction and substantial improvement of any commercial, industrial or other nonresidential

structure shall either have the lowest floor, including basement, elevated to the level of the base flood elevations; or together with attendant utility and sanitary facilities, shall:

(1) be floodproofed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water
(2) have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy;
(3) be certified by a registered professional engineer or architect that the design and methods of construction are in accordance with accepted standards of practice for meeting provisions of this subsection based on their development and/or review of the structural design, specifications and plans. Such certifications shall be provided to the official as set forth in Section 4.3-3(2)
(4) Nonresidential structures that are elevated, not floodproofed, must meet same standards for space below the lowest floor as described in section 5.2-1(2).
(5) Applicants floodproofing nonresidential buildings shall be notified that flood insurance premiums will be based on rates that are one foot below the floodproofed level (e.g. a building constructed to the base flood level will be rated as one foot below that level).

5.2-3 Manufactured Homes

All manufactured homes to be placed or substantially improved within Zones A1-30, AH, and AE shall be elevated on a permanent foundation such that the lowest floor of the manufactured home is at or above the base flood elevation and be securely anchored to an adequately anchored foundation system in accordance with the provisions of subsection 5.1-1(2).

5.3 FLOODWAYS

Located within areas of special flood hazard established in Section 3.2 are areas designated as FLOODWAYS. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

(1) Prohibit encroachment, including fill, new construction, substantial improvements, and other developments unless certification by a registered

professional engineer or architect is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.

(2) If Section 5.3(1) is satisfied, all new construction and substantial improvements shall comply with all applicable flood reduction provisions of Section 5.0 PROVISIONS FOR FLOOD HAZARD REDUCTION.

NOTE: Where base flood elevations have been provided but floodways have not, Section 5.3 should read as follows:

5.3 ENCROACHMENTS

The cumulative effect of any proposed development, when combined with all other existing and anticipated development, shall not increase the water surface elevation of the base flood more than one foot at any point.

6.0 EMERGENCY CLAUSE

Since additional delay in establishing rules and regulations will create a potential hazard to the community and the citizens of Troutdale, AN EMERGENCY IS HEREBY DECLARED TO EXIST and these regulations will become effective September 13, 1988.

PASSED BY THE COMMON COUNCIL OF THE CITY OF TROUTDALE THIS 13TH DAY OF SEPTEMBER, 1988.

YEAS: 6

NAYS: 0

ABSTAINED: 0

Sam K. Cox

Sam K. Cox, Mayor

Date Signed: September 14, 1988

ATTEST:

Valerie J. Raglione

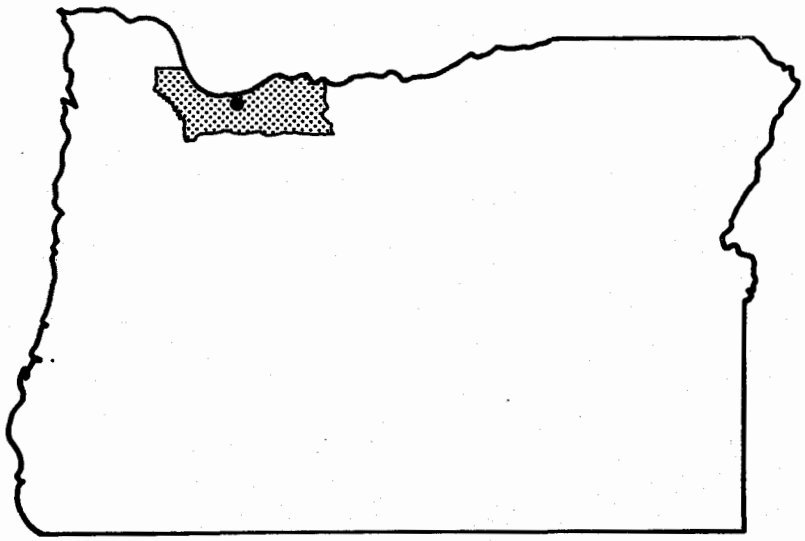
Valerie J. Raglione
City Recorder

PL1|6

A MAP THAT IS TOO LARGE TO SCAN IS INCLUDED IN ORDINANCE # 515-0. TO VIEW THIS MAP, PLEASE REFER TO THE MICROFILM.

FLOOD INSURANCE STUDY

CITY OF TROUTDALE, OREGON
MULTNOMAH COUNTY



SEPTEMBER 30, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 410184

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. Please contact the community repository for any additional data.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

FLOOD INSURANCE STUDY
CITY OF TROUTDALE, OREGON

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Troutdale, Multnomah County, Oregon, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

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

1.2 Authority and Acknowledgments

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

The hydrologic and hydraulic analyses of Sandy River and the lower reach of Beaver Creek for this study were performed by U.S. Army Corps of Engineers (COE), Portland District, for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-EMW-E-1153, Project Order No. 1, Amendment No. 21. The analyses for the two upper reaches of Beaver Creek were performed by the COE for the Flood Insurance Study for the City of Gresham, Oregon (Reference 1). This study was completed in November 1985. Hydrologic and hydraulic analyses for Sandy River and Beaver Creek that were performed by the U.S. Soil Conservation Service (SCS) in October 1977 (Reference 2), were adjusted by the COE to produce this study.

1.3 Coordination

The initial coordination for this study was accomplished by telephone conversations between FEMA and the COE in September 1982. Streams requiring detailed and approximate study were identified. Coordination with the SCS regarding its flood hazard analysis on Sandy River and Beaver Creek continued throughout the study. Topographic maps and elevation reference marks were furnished by the City of Troutdale and the SCS.

An intermediate community coordination meeting was held on November 24, 1986, and was attended by representatives of the City of Troutdale, FEMA, and the COE. At that meeting, work maps showing water-surface profiles, floodway limits, and flooded areas were presented by the study contractor for review by City officials. FEMA representatives discussed the status of participation of the City of Troutdale during conversion from the emergency phase to the regular phase of the NFIP.

A final community coordination meeting was held on November 24, 1987 to review results of the work. It was attended by representatives of the City of Troutdale, FEMA and the COE.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Troutdale, Multnomah County, Oregon. The area of study is shown on the Vicinity Map (Figure 1).

Sandy River, between River Mile (RM) 0.7 and RM 4.2, and three reaches of Beaver Creek were studied by detailed methods. The reaches of Beaver Creek are: (1) from its mouth to a point about 300 feet upstream of Jackson Park Road; (2) from S.E. Stark Street upstream to the corporate limits; and (3) from the corporate limits upstream to Sweet Briar Road. Arata Creek was studied by approximate methods between the downstream corporate limits at Marine Drive and the upstream corporate limits (western edge) southwest of the County Farm and Home, including a short loop into the City of Wood Village at Halsey Street.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through November 1990.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, the City of Troutdale and FEMA.

2.2 Community Description

The City of Troutdale is located near the confluence of the Sandy and Columbia Rivers in Multnomah County, Oregon, approximately 15 miles east of Portland, at the mouth of the Columbia River Gorge, and 19 miles southeast of Vancouver, Washington.

The unincorporated areas north and east of Troutdale are included in the Multnomah County, Oregon, Flood Insurance Study (FIS) (Reference 3). A FIS for the City of Gresham, which borders Troutdale on the southwest, has also been published (Reference 1).

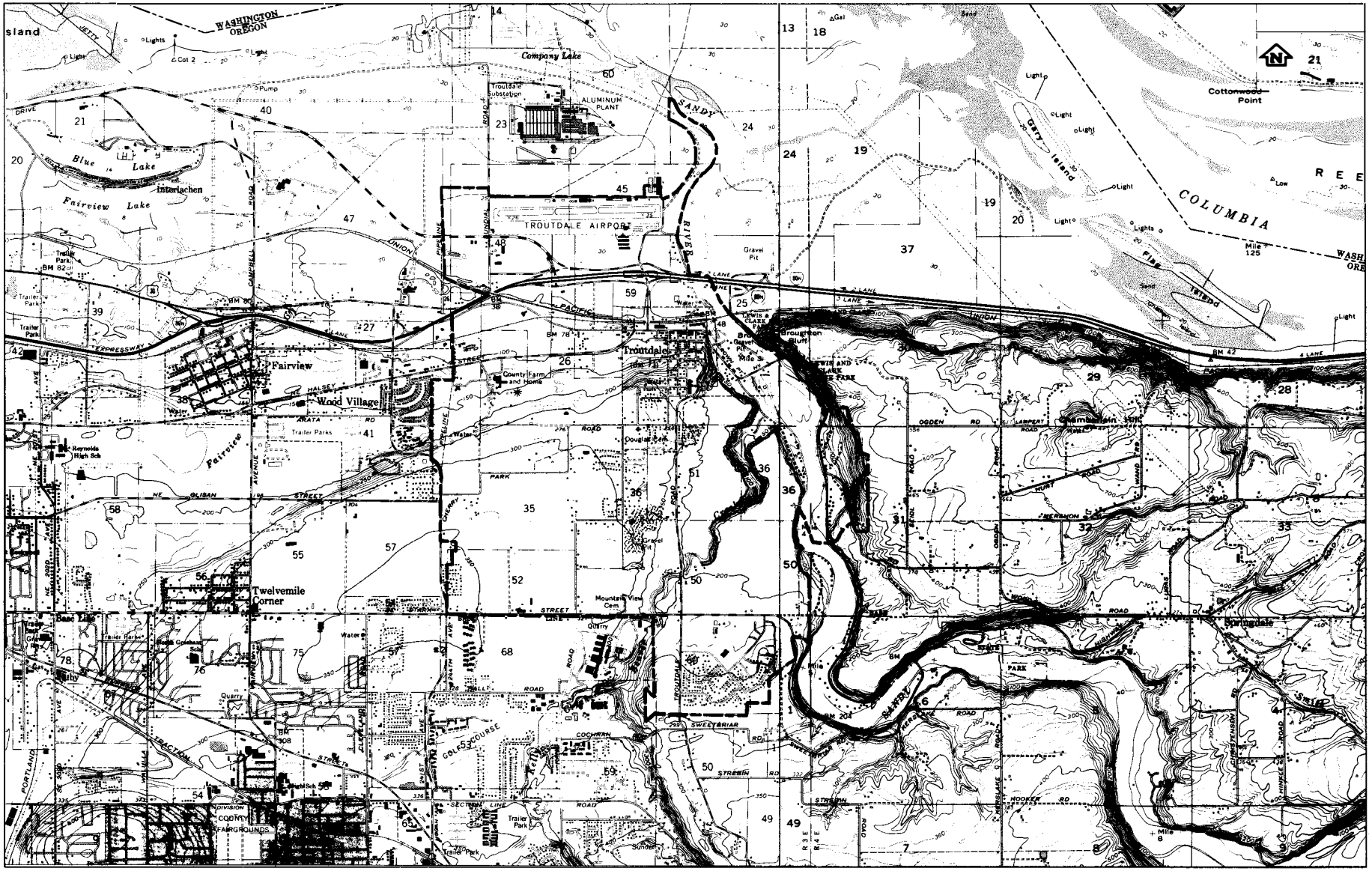


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TROUTDALE, OR
(MULTNOMAH CO.)

APPROXIMATE SCALE

.8 0 .8 1.6 2.4 MILES

VICINITY MAP

A Flood Hazard Boundary Map (FHBM) has been produced for the City of Wood Village (Reference 4), which borders Troutdale on the west.

The city was founded in 1890 and incorporated in 1907. Troutdale's location at the western gateway of the Columbia River Gorge influenced its development as a river and railroad commerce center. Shipping, railroading and logging remained the primary commercial industries of Troutdale until the late 1940s. The economic character of Troutdale has changed dramatically since 1960. Troutdale is currently classified as a bedroom community in the greater Portland metropolitan area. As a result, its economic base is now very similar to the highly diversified economic base of Portland. The three largest employers in the urban service area of Troutdale are the Reynolds Aluminum Company, the Portland-Troutdale Airport, and the school district.

The population of Troutdale remained relatively stable from the date of founding (300 people) through 1960 (520 people). However, the population has increased significantly in the last 27 years. The census estimates for 1970 and 1980 are 1,661 and 6,546, respectively.

These increases have resulted from large numbers of people establishing residence in Troutdale and from population increases associated with annexations to the city. The projected population for Troutdale in the year 2000 varies from 12,000 to 15,000 (References 5 and 6).

The climate of Troutdale is characterized by mild, wet winters and dry, pleasant summers. However, due to its proximity to the Columbia River Gorge and the Cascade Mountains, winter wind speeds and precipitation are higher than in Portland. Troutdale averages 45 inches of yearly precipitation compared to 39 inches in Portland. The Troutdale Uniform Building Code provides protection from a 33.5 lb/sq.ft wind load factor compared to the 17.0 lb/sq.ft wind load factor in Portland's ordinance.

Sandy River, the third largest river in Multnomah County, drains an area of 502.3 square miles. Its origin is the Reed, Zigzag and Palmer Glaciers on Mt. Hood. The Mt. Hood Wilderness Area, the Mt. Hood National Forest and the Bull Run Watershed Preserve comprise approximately 70 percent of the watershed area (Reference 2). Beaver Creek is a tributary of Sandy River and drains an area of approximately 13 square miles.

Both Sandy River and Beaver Creek are characterized by deeply entrenched river valleys. The elevation variation of the Sandy River Basin is 10 to 11,245 feet mean sea level (msl). The elevation range is 15 to 600 feet msl for the Beaver Creek Basin. The steep slopes of Beaver Creek preclude any significant development within its floodplain except in the lower one-half mile. A similar condition exists for all but the first six miles of the Sandy River.

Demand for recreation usage along the lower portion of the Sandy River is high. For example, Dabney and Lewis and Clark State Parks received 346,000 and 319,000 visitor days of use, respectively, in 1975 (Reference 2).

Arata Creek flows into Troutdale from Wood Village several times along their common boundary along the western edge of Troutdale. From Halsey Street upstream the drainage area is less than one square mile. At both the northwestern corporate limits and Marine Drive where Arata Creek leaves the city for the final time, the drainage area is about 1.5 square miles.

2.3 Principal Flood Problems

Sandy River flooding in Troutdale can occur as a result of spring snowmelt runoff from the Mt. Hood watershed. However, intense winter rainstorms are the primary cause of flooding.

Recent significant floods occurred in December 1964, January 1965 and January 1972. These floods have recurrence intervals of 300, 10 and 30 years, respectively (Reference 3). Flows of 61,400; 23,900; and 36,200 cubic feet per second (cfs), respectively, were recorded at the U.S. Geological Survey (USGS) gaging station No. 14137000 on the Sandy River near Marmot, Oregon. This gage was established in 1911 and measures data from a drainage area of 262 square miles (Reference 7). Because the floodplain was only slightly developed, damage was relatively minor.

Most of the damage consisted of severe bank erosion, because most of the homes along the stream were above the flood levels. Figure 2 shows 1964 flood damage to the Crown Point Road approach to the Sandy River bridge. Downstream of the Troutdale corporate limits at the Interstate Highway (I-84) bridges, Sandy River flood elevations are controlled by Columbia River stages.

The annual Columbia River snowmelt freshet occurs in May or June and has caused flooding in the lower Sandy River reach during high runoff years. The June 1948 and 1956 floods, with recurrence intervals of 48 and 18 years, respectively, were snowmelt freshets. Figure 3 shows flooding on the Sandy River west bank near its confluence with the Columbia River in 1948.

2.4 Flood Protection Measures

There are no flood-control structures on Sandy River, Beaver Creek, or Arata Creek. The National Weather Service in Portland, Oregon, is responsible for flood warning and river forecasting services in Multnomah County. General weather forecasts and precipitation amounts are also available.

The Columbia River flood-control system consists of a series of flood-control storage reservoirs in both the U.S. and Canada. there are 22 major reservoirs in the Columbia River Basin upstream of Sandy River with a total flood-control storage capacity of about

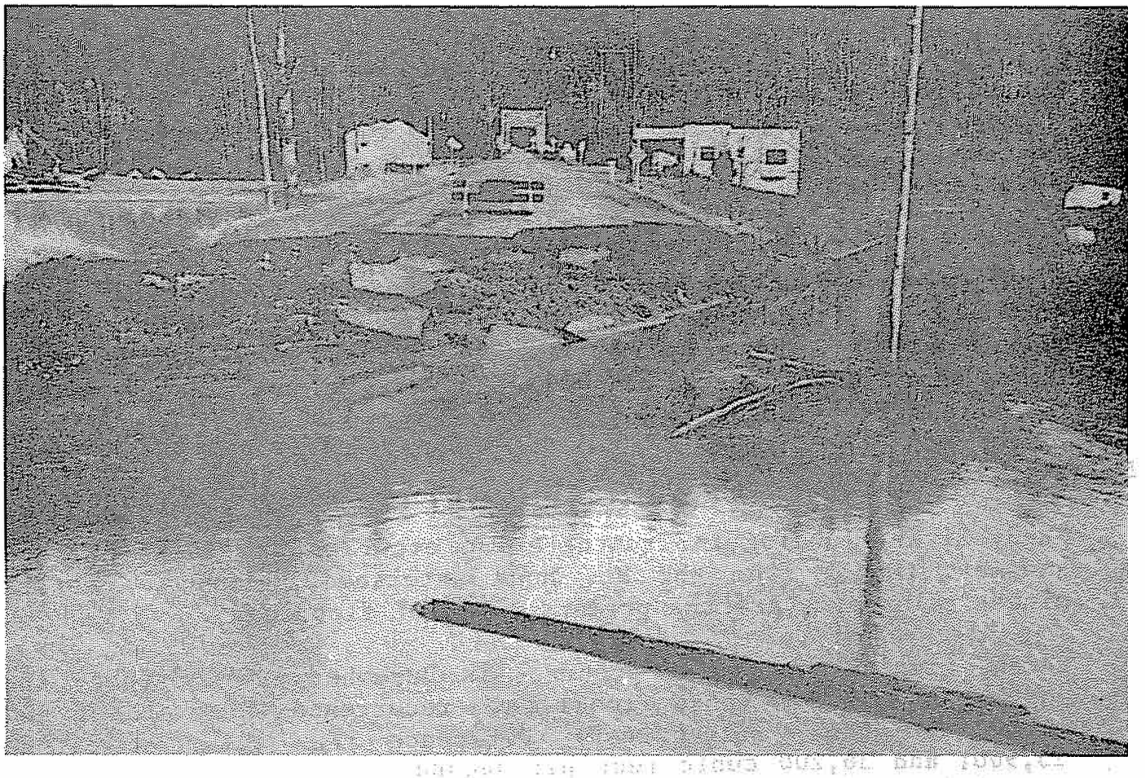


Figure 2. The December 1964 Flood Damage to the Crown Point Highway Grade at the Sandy River Bridge Southeast of Troutdale (looking east)

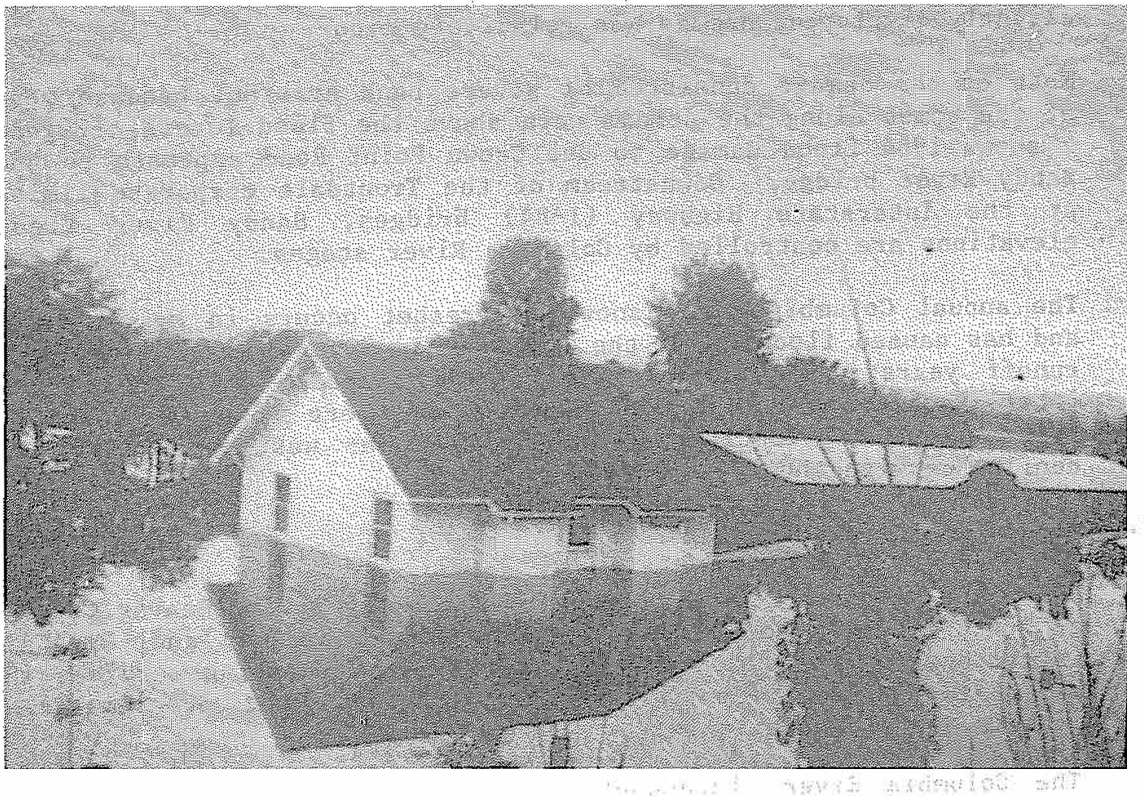


Figure 3. The June 1948 Flood at the James Graham Residence Located on the Sandy River West Bank Near the Columbia River Confluence

40 million acre-feet (Reference 8). This flood control volume would have reduced the 1948 flood from an observed stage of 32.8 feet to stage of 23.3 feet (or 9.5 feet) at the Vancouver, Washington, gage about 14 miles downstream of Sandy River.

The part of the city north of the northern branch of the Union Pacific Railroad (UPRR) is in the Columbia River lowlands protected by the levees of the Sandy Drainage District. Those levees provide protection from the 100-year flood on the Columbia River.

3.0 ENGINEERING METHODS

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

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Peak discharge-drainage area relationships for the Sandy River and Beaver Creek are shown in Table 1.

TABLE 1. SUMMARY OF DISCHARGES

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Sandy River					
at Mouth	502	48,000	72,000	82,800	129,200
at Dabney Park	483	46,500	69,700	80,100	125,000

TABLE 1. SUMMARY OF DISCHARGES (cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Beaver Creek					
at Crown Point Road	13	1,200	1,800	2,100	3,300
at SE Stark Street	11.7	551	871	1,038	1,485
at Kelly Creek	6.6	329	520	620	887

The hydrologic analysis for Sandy River was performed by the SCS, Oregon State Office. Their analysis used the standard log-Pearson Type III methods as outlined by the U.S. Water Resources Council (Reference 9). The SCS analysis was based on records for USGS gaging station No. 1414500 on the Little Sandy River near Bull Run, Oregon. That gage has a drainage area of 440 square miles and was maintained from 1929 to 1966. Flows computed at the gage were adjusted to compensate for the increase in drainage area between the gage and the study area.

Discharges for the 100-year flood were determined at several locations on Arata Creek by using formulas in the USGS document, "Magnitude and Frequency of Floods in Western Oregon" (Reference 16). Those discharges were reduced at several of the downstream locations due to impoundment at restrictive culverts and diversion away from the creek due to overland flow.

3.2 Hydraulic Analyses

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

Hydraulic analyses performed by the SCS, using their Water Surface Profile Computer Program (WSP2), were regenerated using the COE's HEC-2 program (Reference 11). The WSP2 program used elevation-discharge-velocity information to plot rating curves for each cross section. The rating curves were used with peak flow-frequency information from the hydrologic studies and with historic high water information to obtain water-surface elevations for the 10-, 50-, 100-, and 500-year floods at each cross section. Flood profiles on Sandy River and Beaver Creek were prepared by the SCS for their published report (Reference 2). Some adjustments in the computed water-surface elevations (CWSEL) occurred as a result of conversion from the WSP2 to the HEC-2 program. Primarily, CWSELS were lowered in the vicinity upstream of the bridges. In the beginning downstream reach, the 500-year flood CWSEL was higher in the HEC-2 data due to a different starting technique. The SCS used the same starting water-surface elevation (SWSEL) for both the 100-year and 500-year floods (elevation of December 1964 flood) while the COE used the slope-area method. However, both the WSP2 and the HEC-2 500-year flood SWSEL were submerged by the backwater from the

Columbia River combined probability flood profiles up to the I-84 bridges.

Cross sections, stream channel profiles, and highwater mark elevations on Sandy River and Beaver Creek were field surveyed by the SCS in 1973 and 1974.

Roughness factors (Manning's "n") used in detailed hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. The highwater marks were used to calibrate the computer model and determine the accuracy of the friction factor chosen. Where the computed elevation did not adequately reflect the actual experiences, the chosen factor was adjusted. Ranges of roughness factors used for Sandy River within the corporate limits were from .028 to .05 for the channel and from .05 to .10 for the overbanks. The factors used for Beaver Creek were from .035 to .05. for the channel and from .06 to .07 for the overbanks.

The SWSELs for Sandy River were based on a slope-area method with a starting slope of approximately .00029 to .00025. There is overflow from Sandy River and interflow with Beaver Creek from Crown Point Highway downstream to their confluence, and Beaver Creek CWSELs reflect the increase in discharge because it was assumed that the two streams will peak together. A split-flow analysis was made to determine the quantity of overflow into Beaver Creek for the 50- and 100-year floods. The 500-year flow was so great that the cross sections were extended to include Beaver Creek in the Sandy River floodplain.

Backwater from Columbia River controls flood crests in the reach of the Sandy River downstream of I-84 bridges for the 100- and 500-year floods and for the reach downstream of the UPRR trestle for the 10- and 50-year floods. Columbia River flood elevations were determined from combined probability stage-frequency profiles prepared for the Multnomah County, Oregon, Clark County, Washington, FISs, as well as others (Reference 12).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

The approximate analysis on Arata Creek was based upon existing topographic maps (Reference 12), culvert analyses, and normal depth computations.

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

All elevations are referenced to the National Geodetic Vertical Datum (NGVD) of 1929. Elevation reference marks used in the study are shown on the maps; the description of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

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

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:200, with a contour interval of 2 feet (References 13 and 14).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and lack of detailed topographic data.

For Arata Creek, studied by approximate methods, only the 100-year floodplain boundary was determined and delineated on the previously mentioned topographic maps (References 13, 14, and 15).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe.

The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown. The floodway widths for Sandy River Cross Sections A through G extend beyond the corporate limits. The surcharge for Sandy River ranges from 0.4 to 0.9 feet. The floodway width for Beaver Creek at Cross Section K is entirely outside the corporate limits. The surcharge for Beaver Creek ranges from 0.2 to 1.0 feet.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

5.0 INSURANCE APPLICATION

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

Zone A

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

Zone AE

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

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Beaver Creek								
A	633	150	2,080	2.3	34.6	34.6	35.1	0.5
B	1,373	150	2,000	2.4	35.9	35.9	36.2	0.3
C	1,848	128	1,720	2.6	36.1	36.1	36.3	0.2
D	2,006	44	690	6.8	36.1	36.1	36.3	0.2
E	2,270	115	1,130	1.8	39.5	39.5	39.8	0.3
F	2,798	110	2,050	1.0	39.6	39.6	39.8	0.2
G	3,115	94	680	2.9	39.7	39.7	39.9	0.2
H	3,379	90	1,660	1.2	39.8	39.8	40.1	0.3
I	12,778	10	133	7.8	210.7	210.7	211.7	1.0
J	12,988	136	1,520	0.7	212.0	212.0	212.8	0.8
K	13,593	152[2]	955	1.1	212.1	212.1	212.8	0.7
L	17,477	40	167	6.2	242.6	242.6	243.0	0.4

[1]Feet Upstream from Confluence with Sandy River
[2]This Width is Entirely Outside Corporate Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TROUTDALE, OR
(MULTNOMAH COUNTY)

FLOODWAY DATA

BEAVER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Sandy River								
A	2.40	750/160[2]	13,950	5.9	32.1	32.1	33.0	0.9
B	2.42	894/289	15,920	5.2	32.3	32.3	33.1	0.8
C	2.57	559/100	9,210	9.0	32.2	32.2	33.0	0.8
D	2.61	519/24	9,350	8.9	32.6	32.6	33.4	0.8
E	2.62	603/93	10,060	8.2	32.9	32.9	33.6	0.7
F	2.83	352/72	6,190	12.8	34.0	34.0	34.4	0.4
G	2.95	330/80	6,910	11.4	36.7	36.7	37.2	0.5
H	2.98	340	6,880	11.5	37.3	37.3	37.9	0.6
I	3.02	630	12,260	6.6	39.4	39.4	39.9	0.5
J	3.22	988	14,060	5.7	40.0	40.0	40.4	0.4
K	3.56	358	7,750	10.4	40.4	40.4	41.2	0.8
L	4.06	465	10,880	7.4	43.2	43.2	43.9	0.7

[1]Miles Upstream from Confluence with Columbia River
[2]Width/Width Within Corporate Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TROUTDALE, OR
(MULTNOMAH COUNTY)

FLOODWAY DATA

SANDY RIVER

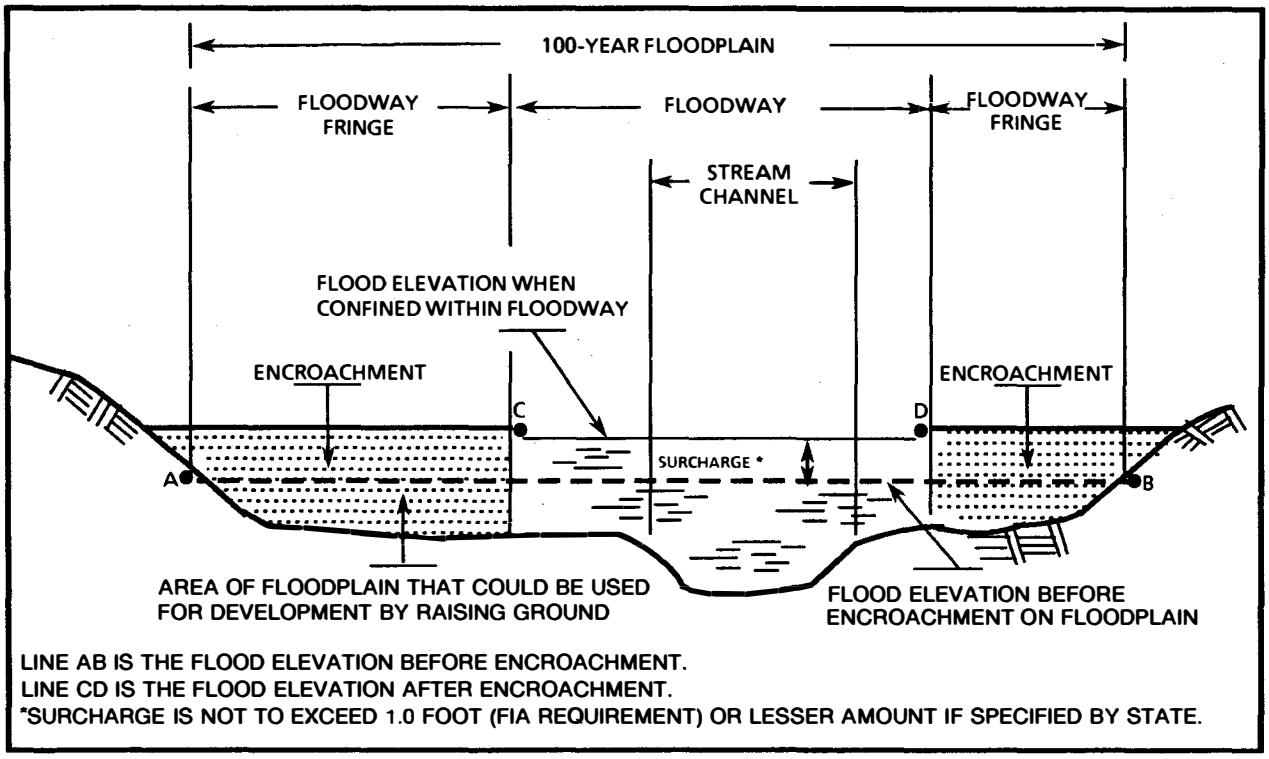


Figure 2. Floodway Schematic

Zone X

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

6.0 FLOOD INSURANCE RATE MAP

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

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

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

The SCS prepared a Flood Hazard Analysis, Lower Sandy River and Beaver Creek, dated October 1977, for the City of Troutdale and Multnomah County (Reference 2). Much of the basic data from that study was used in this study.

The study area for this study is adjacent to that of the Multnomah County, Oregon, Flood Insurance Study dated December 15, 1981 (Reference 3) and the City of Gresham, Oregon, Flood Insurance Study dated June 17, 1986 (Reference 1). The portions of Sandy River flood profiles in the Multnomah County Flood Insurance Study adjacent to the City of Troutdale which came from the SCS Flood Hazard Analysis for Sandy River (Reference 2) vary from the water-surface elevations computed by the COE HEC-2 computer program. The differences are greatest in the area from the UPRR trestle upstream to the Crown Point Road bridge and result from internal differences in how the computer programs handle bridges. The Multnomah County FIS will be revised at a later date to match the profiles in this study. The City of Wood Village FHBM (Reference 4) is being revised to remove Arata Creek flood boundaries. It will be in agreement with this Flood Insurance Study.

A FHBM was prepared for the City of Troutdale, but as this study represents a more detailed analysis, it supersedes it (Reference 17).

This Flood Insurance Study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130 228th Street, S.W., Bothell, Washington 98021-9796.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Study, City of Gresham, Oregon, June 1986.

2. U.S. Department of Agriculture, Soil Conservation Service, Flood Hazard Analysis, Lower Sandy River and Beaver Creek, City of Troutdale, Multnomah County, Oregon, October 1977.

3. Federal Emergency Management Agency, Flood Insurance Study, Multnomah County, December 15, 1981.

4. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Wood Village, Oregon, Scale 1:9,600, October 31, 1975.

5. City of Troutdale, Department of Community Development, Comprehensive Plan Inventory, August 1977.

6. Personal Communication, City Planner, City of Troutdale, 1983.

7. U.S. Department of the Interior, Geological Survey, Water Supply Paper 2135, Part 15, 1966-1970.

8. U.S. Department of the Army, Corps of Engineers, Rivergate-North Portland Area, Flood Control Study, Feasibility Report, January 1976.

9. U.S. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin 17, March 1976.

10. U.S. Department of the Interior, Geological Survey, Open File Report 79-553, Magnitude and Frequency of Floods in Western Oregon, D.D. Harris, L.L. Hubbard, L.E. Hubbard, Portland, Oregon, 1979.

11. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, November 1976, updated March 1982.

12. U.S. Department of the Army, Corps of Engineers, Columbia River Combined Probability Flood Frequency Profiles, Mouth to Bonneville Dam, October 1979.

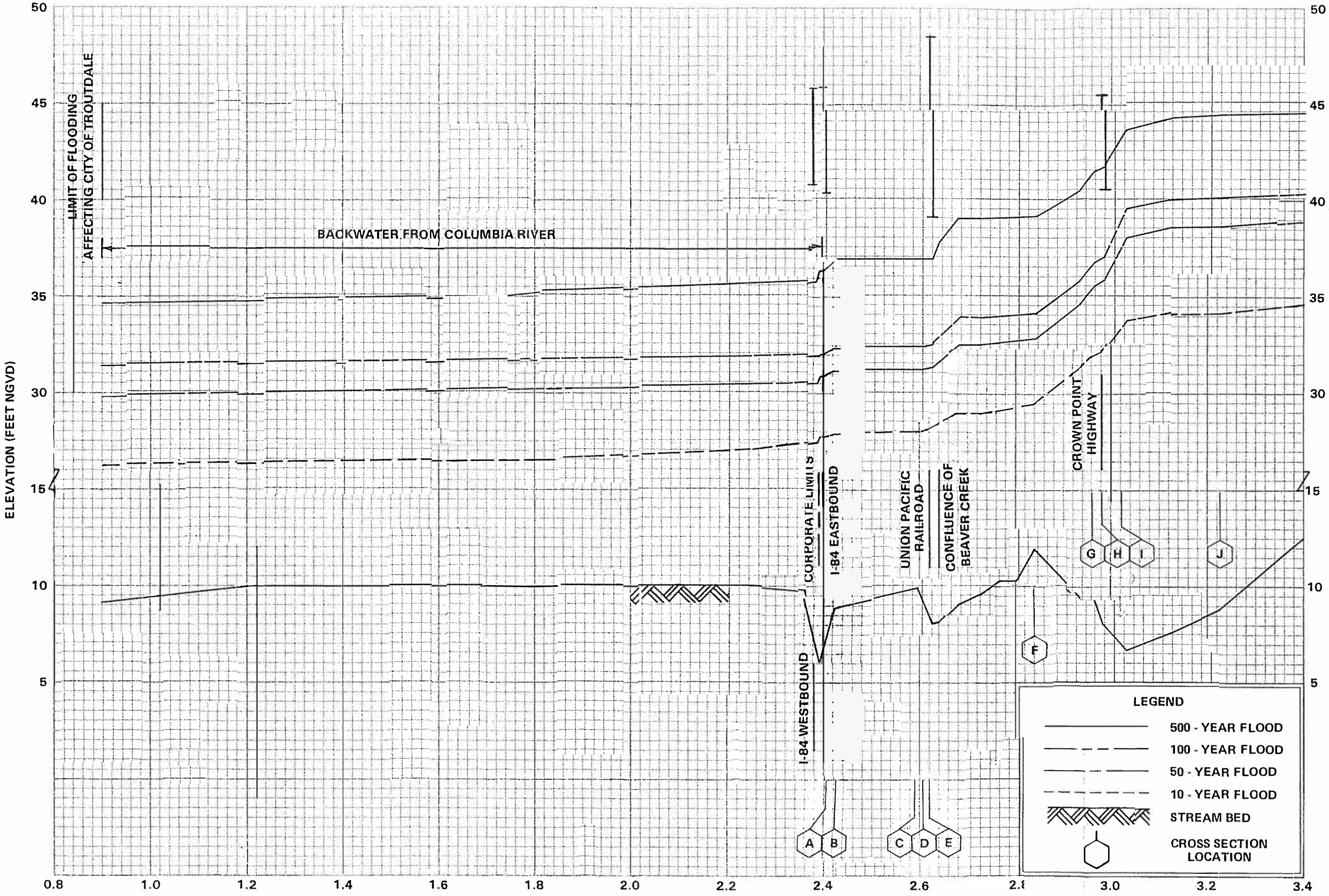
13. Multnomah County Aerial Survey of 1968, Planimetric Topographic Maps, Scale 1:200; Contour Interval 2 feet

14. City of Troutdale, Orthophoto Topographic Maps, Scale 1:200; Contour Interval: 2 feet, From Aerial Survey of 1983.

15. U.S. Department of the Army, Corps of Engineers, Portland District, Topographic Survey, Columbia River, Vancouver to the Dalles, Oregon-Washington, sheets 41 through 46, May 1972.

16. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Camas, Washington-Oregon 1961, Photorevised 1972; Contour Interval 20 Feet: Washougal, Washington-Oregon (1961), Photorevised 1975.

17. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Troutdale, Oregon, Scale 1:9,600, March 20, 1979



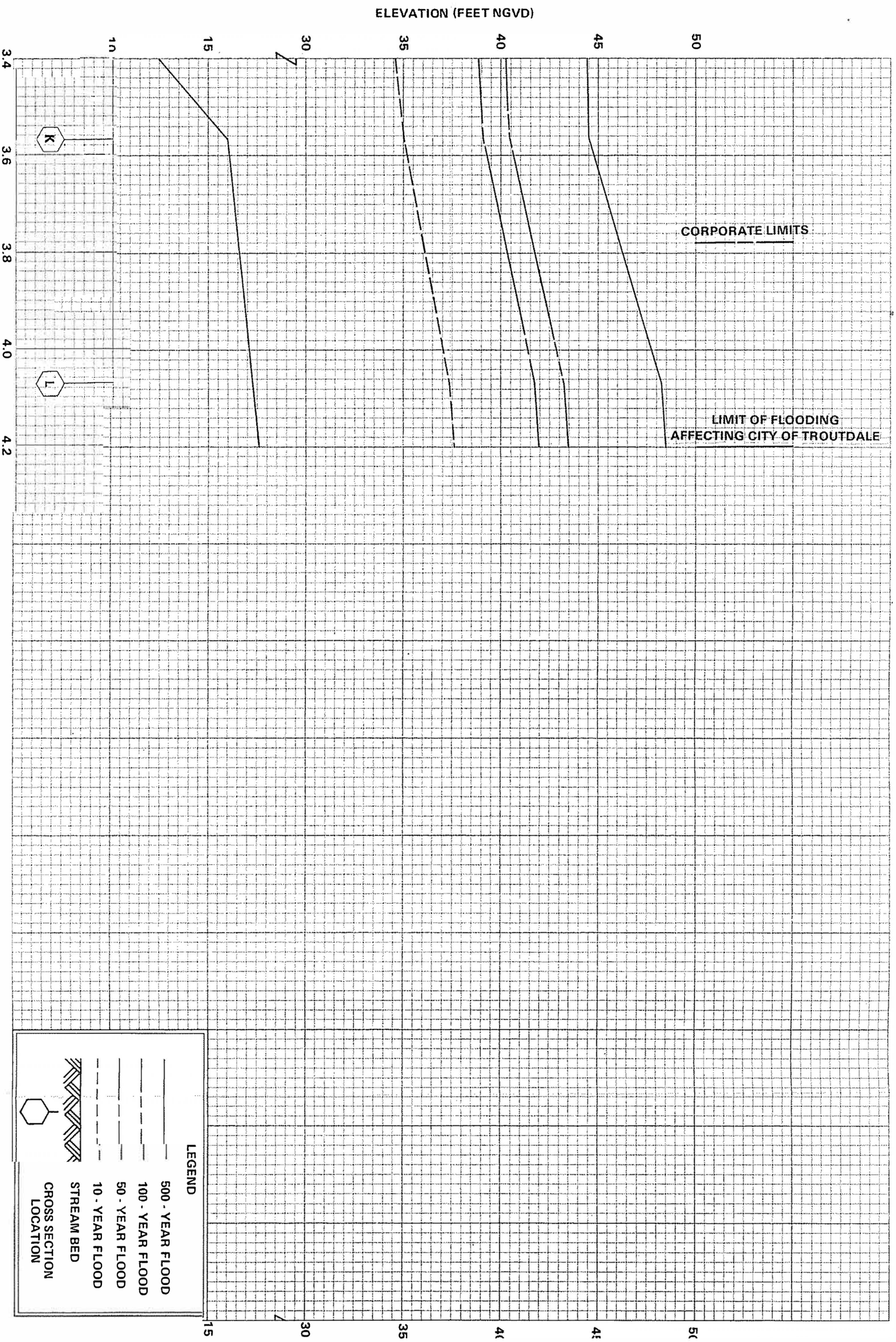
FLOOD PROFILES

SANDY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TROUTDALE, OR
(MULTNOMAH CO.)

01P



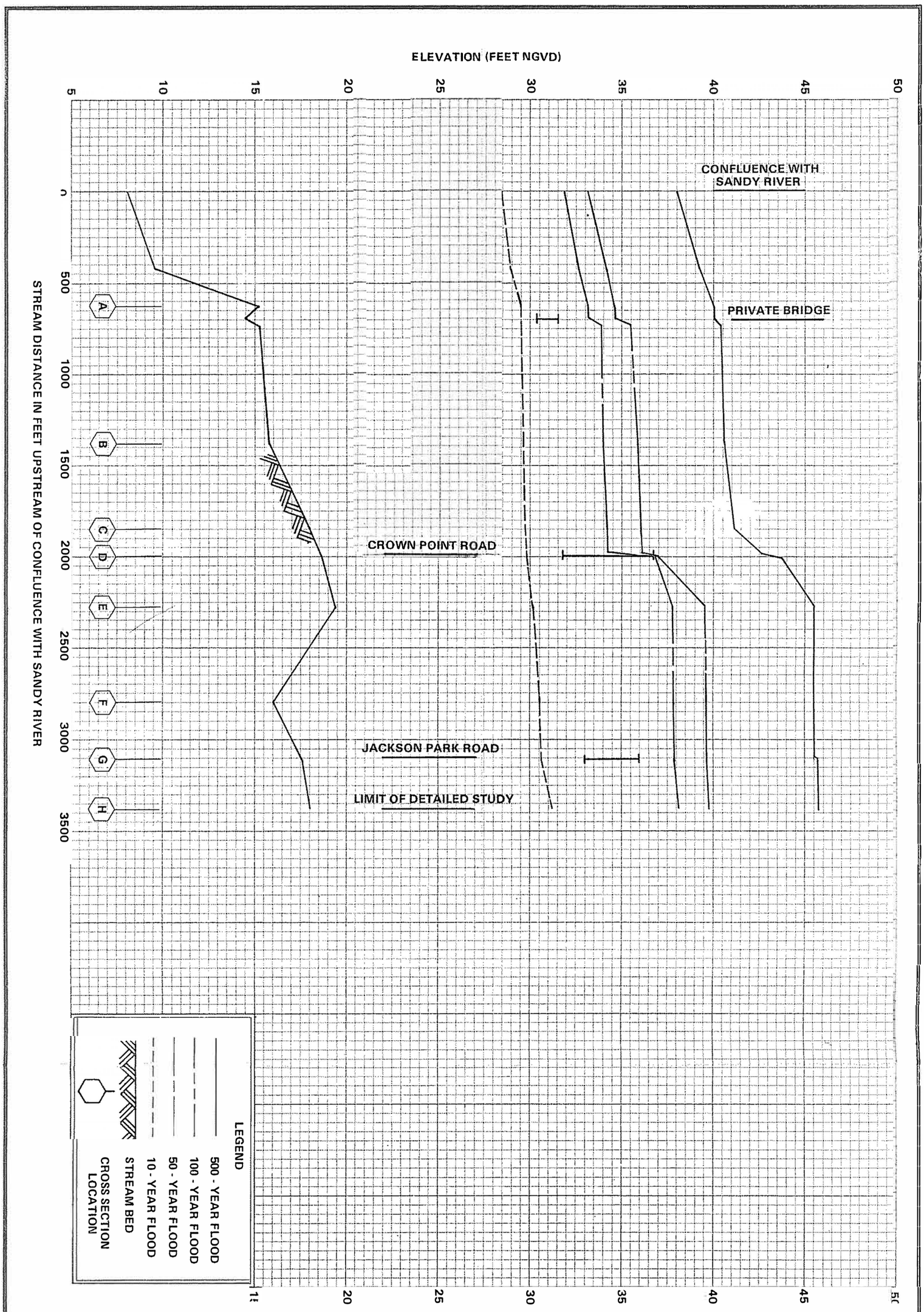
02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TROUTDALE, OR
(MULTNOMAH CO.)

FLOOD PROFILES

SANDY RIVER



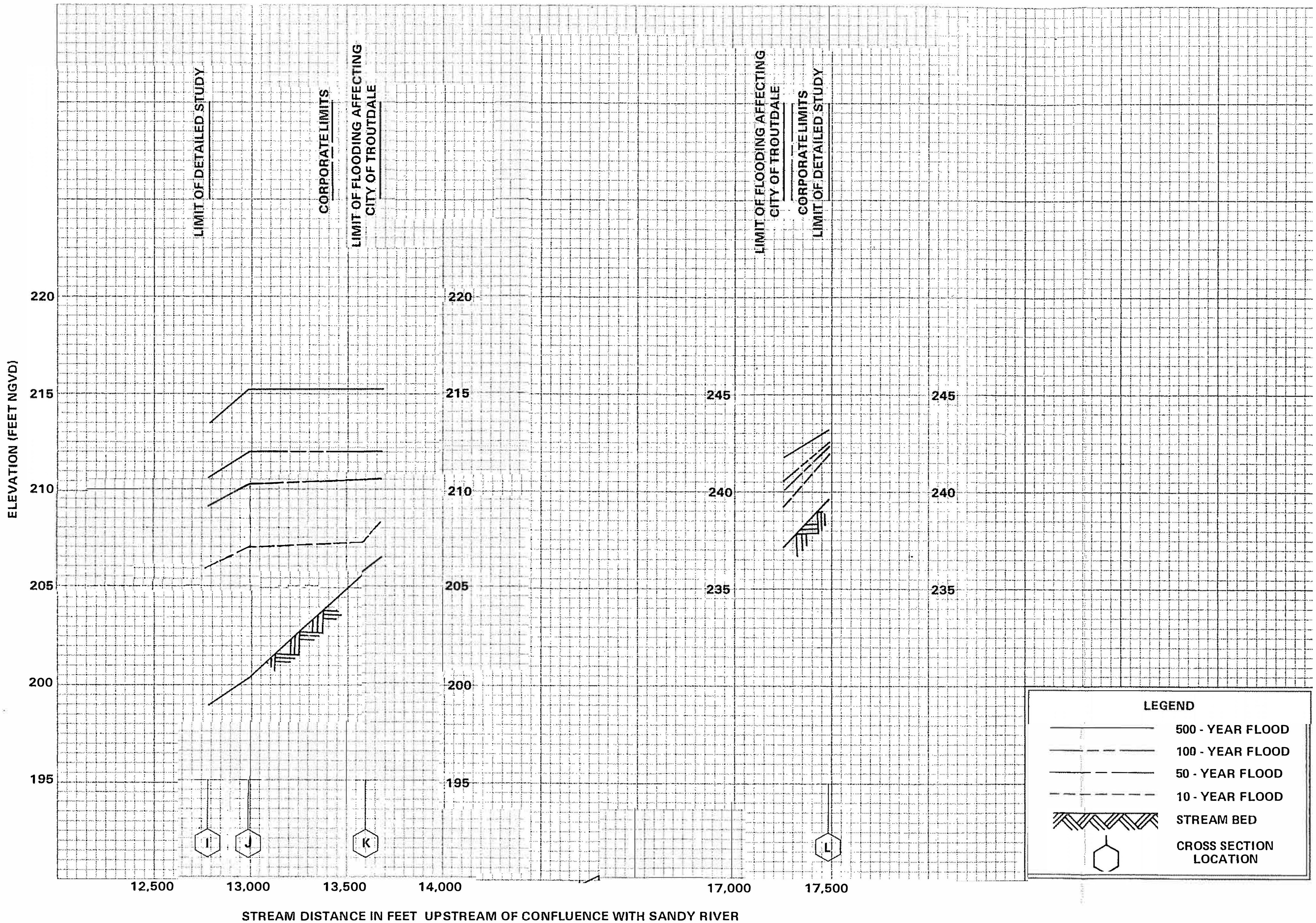
03P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TROUTDALE, OR
(MULTNOMAH CO.)

FLOOD PROFILES

BEAVER CREEK



FLOOD PROFILES

BEAVER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF TROUTDALE, OR
(MULTNOMAH CO.)

04P

EXHIBIT 3 - ELEVATION REFERENCE MARKS
CITY OF TROUTDALE, MULTNOMAH COUNTY, OREGON

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 1	33.99	SCS TBM No. 2, located approximately at the southeastern corner of the northwest quarter of Section 24; Township 1 South, Range 3 East, at the top of the lower hinge-pin on the west gate post on the gravel road. Post is 50 feet southeast of house.
RM 2	45.948	Oregon State Highway Department Bench Mark No. 2, in the northwest corner of the U.S. Highway 30 Sandy River bridge; 3.4 feet southeast of the northwestern corner of the walkway; 16.0 feet north of the centerline of the south lanes; and 0.8 feet north of the south edge of the walk.
RM 3	34.93	SCS TBM No. 4, located at Troutdale, at the southeastern corner of Crown Point Highway intersection with a gravel road to the gravel works. A 16d spike (RR) & shiner (disk) in the north side of Pacific Gas & Electric pole number 109/A 1325.
RM 4	39.15	SCS TBM No. 5, located at the intersection of Crown Point Highway and Jackson Park Road, on the west side of Crown Point Highway. A 16d spike (RR) & shiner (disk) in base of powerpole No. J 622466.
RM 5	36.45	SCS TBM No. 9 located at the southwest corner of the Jackson Park Road bridge over Beaver Creek, a 16d spike (RR) and shiner (disk) in the east side of post at said corner.
RM 6	44.22	SCS TBM No. 13, located on Jackson Park Road 0.3-mile south of Jackson Park Road Bridge over Beaver Creek. West side of road, 16d spike (RR) and shiner (disk) in east face of Pacific Gas and Electric powerpole No. 3455.