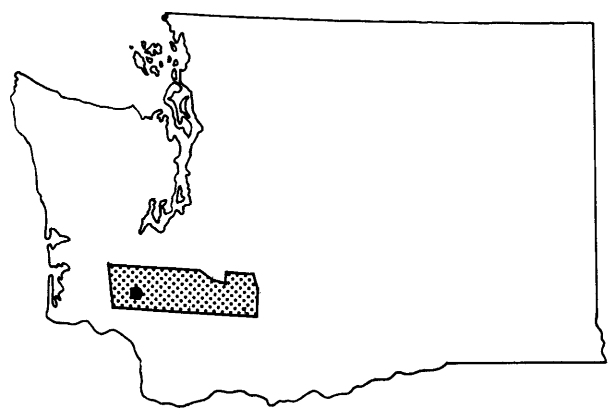
FLOOD INSURANCE STUDY

CITY OF WINLOCK, WASHINGTON
LEWIS COUNTY



MARCH 1979

U.S. DEPARTMENT of HOUSING & URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

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1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Winlock, Lewis County, Washington, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Winlock to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

On April 14, 1976, streams selected for detailed analysis were identified in a meeting attended by representatives of the community; a study contractor formerly identified to perform the study, but not subsequently brought under contract; and the Federal Insurance Administration.

A later meeting was attended by representatives of the county, Tudor Engineering (the study contractor), and the Federal Insurance Administration on July 6, 1976.

During the course of the work, numerous informal contacts were made by the study contractor with the community for the purpose of obtaining data and acquiring base map material.

On April 10, 1975, the results of the work were reviewed at an interim technical meeting attended by representatives of the study contractor, the Federal Insurance Administration, and the City of Winlock.

The results of this study were reviewed at a final community coordination meeting held on September 11, 1978. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the city. No problems were raised at the meeting.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering, for the Federal Insurance Administration, under Contract No. H-4025. This work, which was completed in April 1978, covered all significant flooding sources affecting the Town of Winlock.

2.0 AREA STUDIED

2.1 Scope of Study

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

Floods caused by overflow of Olequa Creek were studied in detail. In addition, King Creek was studied by approximate methods.

Flood elevations and determination of flood hazard factors for Olequa Creek and approximate flood boundaries for King Creek outside of the Winlock corporate limits are included in the Flood Insurance Study for Lewis County (Reference 1).

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

2.2 Community Description

Winlock is located in southwestern Lewis County, in the southwestern corner of Washington. Wildwood lies approximately 10 miles to the southwest of Winlock, Chehalis lies approximately 13 miles to the south, and Napavine lies approximately 5 miles to the north.

Winlock was incorporated in 1890, the third municipality to be incorporated in Lewis County. The city's population reached a high of 1140 in 1910; by 1968, it had declined to 850. In 1975, the estimated population of Winlock was 974. It is currently the fourth largest city in Lewis County (References 2 and 3).

The economy of Winlock (and Lewis County, in general), depends heavily on the lumber and wood products industry, which comprised 75 percent of the total manufacturing employment of the county in 1976. Three manufacturing plants are located in Winlock. These are Colorshake, Shakertown Corporation, and Winlock Veneer Company (Reference 4).

Winlock has a mid-latitude, west coast marine type climate, typified by dry, cool summers and mild, wet, and cloudy winters. The average annual precipitation is approximately 50 inches; however, less than 1 inch normally falls in each of the months of July and August. Average afternoon wintertime temperatures range from a low near 25°F

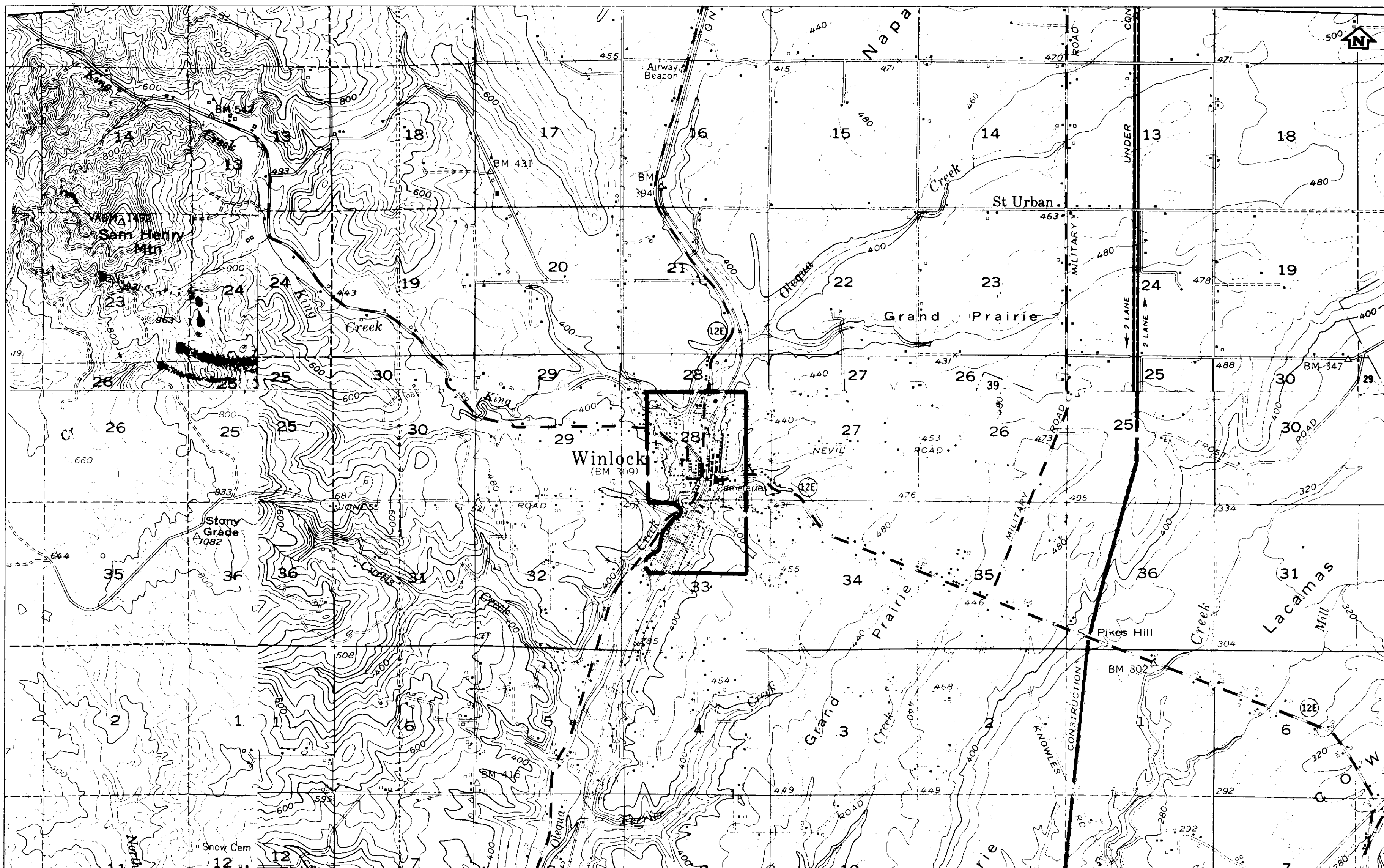

FIGURE 1

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF WINLOCK, WA
(LEWIS CO.)

APPROXIMATE SCALE

1 0 1 2 3 MILES

VICINITY MAP

to approximately 45°F. Normal summertime temperatures range from 70°F to 80°F reaching 90°F or higher on from 5 to 15 days and 100°F or higher in 1 out of 4 summers. Minimum summertime temperatures range from the mid 40's to the mid 50's. The average annual snowfall is light and seldom remains on the ground longer than 1 week or reaches a depth in excess of 8 to 12 inches (Reference 5).

The section of Olequa Creek that flows through Winlock drains an area of approximately 26 square miles. It originates in the area known as Jackson Prairie, runs southwestward through Winlock, and eventually empties into the Cowlitz River. Elevations range from approximately 500 feet on Jackson Prairie to approximately 260 feet in Winlock to approximately 80 feet at the confluence of the Cowlitz River and Olequa Creek.

King Creek originates on the slopes of Sam Henry Mountain at an elevation of 1492 feet and flows southeasterly, joining Olequa Creek within Winlock at an elevation of approximately 285 feet. It drains an area of approximately 16.3 square miles.

2.3 Principal Flooding Problems

The City of Winlock has no recorded history of major floods. However, interviews with local residents have determined that minor flooding occurred in December 1974, December 1975, and February 1976. These storms resulted in some flooding of the sewage treatment plant and in the southwest Canyon Loop area.

2.4 Flood Protection Measures

There are no existing flood protection measures in Winlock.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled 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 flood plain management and for flood insurance premium 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 equalled 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 occurrence) 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 here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

No streamflow records are available for either Olequa or King Creeks. Runoffs for the floods of interest were calculated using rainfall-runoff relationships developed for the area and a computerized storm water routing model. The model incorporates the unit hydrograph methodology developed by the U.S. Soil Conservation Service (Reference 6).

The 24-hour duration storm precipitation volumes for the 10-, 50-, and 100-year return storm frequencies were obtained from the National Oceanic and Atmospheric Administration Atlas 2 (Reference 7). Precipitation volume for the 500-year storm was obtained by extending the National Oceanic and Atmospheric Administration Atlas 2 frequency curve on normal distribution probability paper. The intensity distribution was based on rainfall gage records at Castle Rock.

Peak discharge-drainage area relationships for Olequa Creek are shown in Table 1.

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second)			
		10-Year	50-Year	100-Year	500-Year
Olequa Creek					
At Downstream Limit of Study	42.4	1510	2740	3220	4790
At Confluence with King Creek	38.5	1365	2470	2910	4340
At Confluence with North Fork Olequa Creek	22.2	680	1300	1470	2300

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

Water-surface elevations were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 8). Photogrammetric work maps at a scale of 1:4800, with a contour interval of 4 feet and cross section data were provided by Towill, Inc., San Francisco, California (Reference 9), under subcontract to the study contractor. All bridges and culverts were surveyed to obtain elevation data and structural geometry. Starting water surface elevations were computed by slope-area method.

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 is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel and overbank roughness factors (Manning's "n") are based on field inspection and photographs at each cross section location. Values varied from a channel roughness coefficient of 0.030 to overbank coefficients which ranged from 0.050 to 0.100.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Starting water-surface elevations for Olequa Creek was computed by the slope-area method.

King Creek, selected for approximate study, was investigated using discharges developed in a manner similar to the development for detailed analysis but for the 100-year recurrence interval only. Flood elevations were estimated in the field by use of a hand-held programmable calculator using the normal-depth method.

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

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using photogrammetric work maps at scale of 1:4800, with a contour interval of 4 feet (Reference 9).

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2).

Approximate area boundaries were delineated in the field using calculated elevations, a hand-held level, and approximate distances.

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodway for this study was computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WITH FLOODWAY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	DIFFERENCE (FEET NGVD)
Olequa Creek							
A	10.741	147/80[2]	609	5.3	261.8	261.8	0.0
B	10.869	199/20[2]	856	3.8	263.3	263.3	0.0
C	11.214	129/25[2]	518	6.2	269.5	269.5	0.0
D	11.291	111/25[2]	726	4.0	270.9	270.9	0.0
E	11.330	114/25[2]	759	3.8	271.2	271.2	0.0
F	11.584	72	294	9.9	276.2	276.1	0.1
G	11.615	92	397	7.3	278.8	278.8	0.0
H	11.643	110	618	4.7	279.9	279.9	0.0
I	11.723	109	439	6.6	280.8	280.8	0.0
J	11.765	90	486	6.0	281.8	281.8	0.0
K	11.807	102	466	6.2	282.6	282.6	0.0
L	12.020	112	460	6.3	287.0	287.0	0.0
M	12.176	92	291	5.0	290.3	290.3	0.0

[1]Miles Above Mouth [2]Width/Width Within Corporate Limits

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF WINLOCK, WA
(LEWIS CO.)

FLOODWAY DATA

OLEQUA CREEK

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain 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 flood plain development are shown in Figure 2.

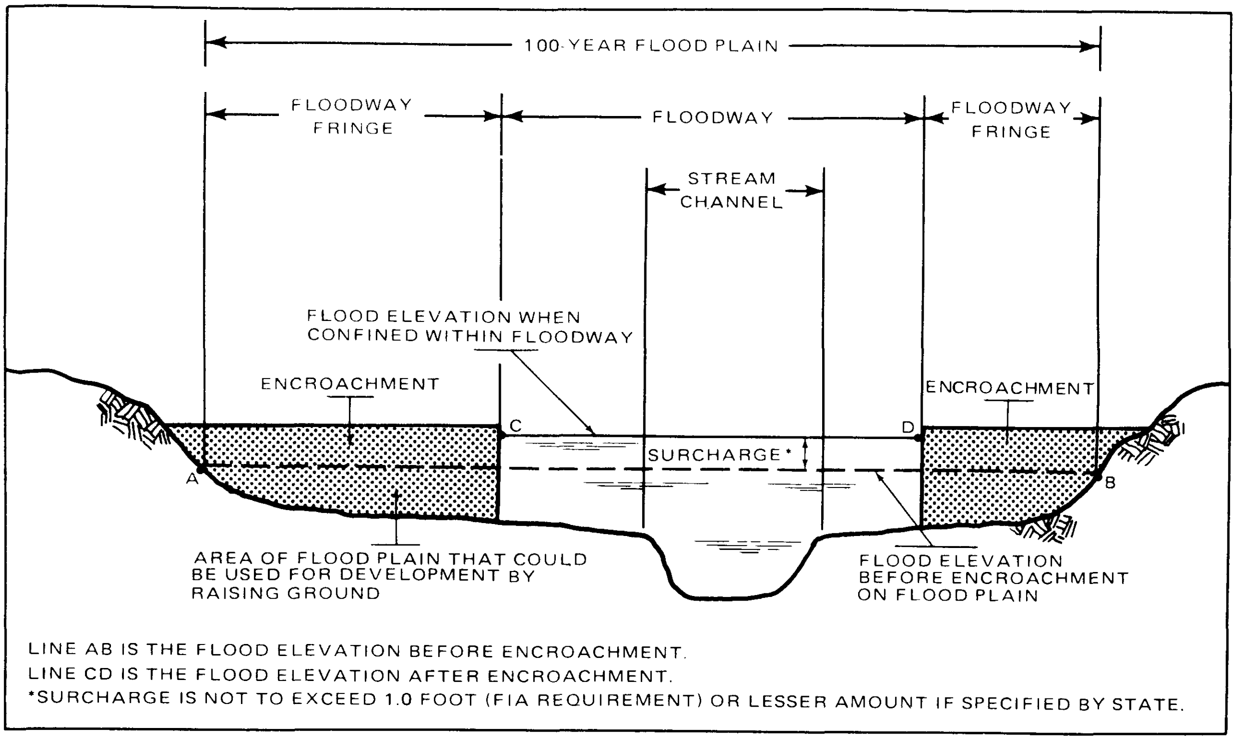

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Winlock.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
2 to 7 feet	1.0 foot

One reach meeting the above criterion was required for the flooding sources of Winlock. This included one on Olequa Creek. The location of the reach is shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of the City of Winlock was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.
Zone A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Winlock is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

No Flood Insurance Studies have been done for communities adjacent to Winlock. A Flood Insurance Study has been done for Lewis County (Reference 1). This study is in agreement with the Lewis County study.

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

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, Arcade Plaza Building, 1321 Second Avenue, Seattle, Washington 98101.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Olequa Creek Reach 1	0001	-2.39	-0.55	1.59	025	A5	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF WINLOCK, WA
(LEWIS CO.)

FLOOD INSURANCE ZONE DATA

OLEQUA CREEK

TABLE 3

8.0 BIBLIOGRAPHY AND REFERENCES

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6. U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, Technical Release No. 20, Computer Program for Project Formulation, Hydrology, May 1975

7. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Atlas 2, Volume IX, Precipitation-Frequency Atlas of the Western United States, 1973

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

9. Towill Inc., Photogrammetric Work Map, Scale 1:4800, Contour Interval 4 feet: Winlock, Washington (1978)

FLOOD PROFILES

OLEQUA CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF WINLOCK, WA
(LEWIS CO.)

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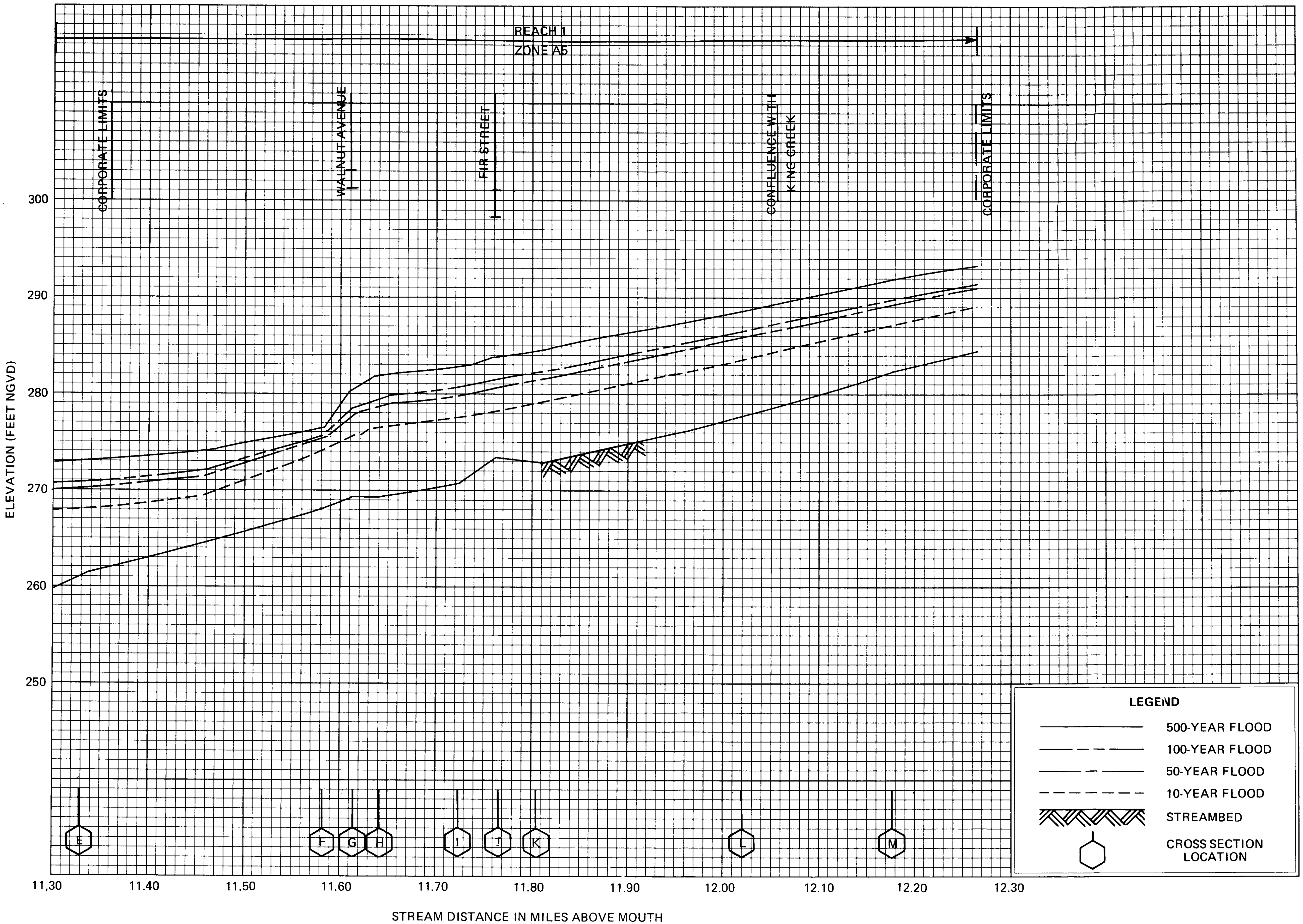

FLOOD PROFILES

OLEQUA CREEK

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
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CITY OF WINLOCK, WA
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