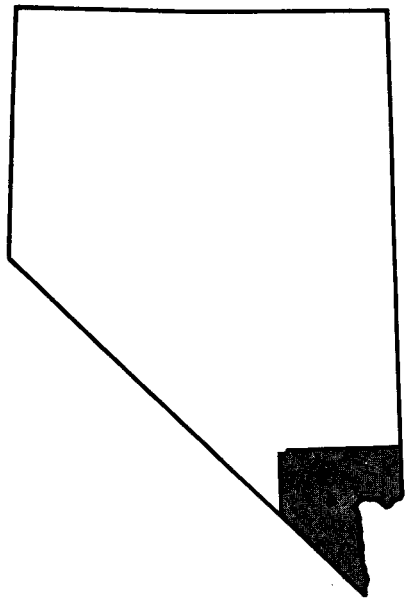
FLOOD INSURANCE STUDY

CITY OF NORTH LAS VEGAS, NEVADA
CLARK COUNTY



REVISED: DECEMBER 15, 1983

Federal Emergency Management Agency

COMMUNITY NUMBER - 320007

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PUBLISHED SEPARATELY:

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study report has been prepared to revise and update a previous Flood Insurance Study/Flood Insurance Rate Map for the City of North Las Vegas, Clark County, Nevada which was published on January 16, 1981. This information will be used by North Las Vegas to update existing flood plain regulations as part of the regular program of flood insurance by the Federal Emergency Management Agency. The information will also be used by local and regional planners to further promote sound land use and flood plain development.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

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

The original hydrologic and hydraulic analyses for this study were performed by the U.S. Soil Conservation Service, for the Federal Emergency Management Agency, under Inter-Agency Agreement IAA-H-8-77, Project Order No. 1. This work, which was completed in November 1978, covered all significant flooding sources affecting the City of North Las Vegas.

Additional hydrologic and hydraulic analyses were performed for the City of North Las Vegas by James M. Montgomery, Consulting Engineers, Inc. This additional work was completed in November 1982 and supersedes the work performed by the U.S. Soil Conservation Service in those areas studied by James M. Montgomery Engineers, Inc.

1.3 Coordination

Detailed and approximate areas were identified at a meeting attended by representatives of the original study contractor (U.S. Soil

Conservation Service), the Federal Emergency Management Agency, and the City of North Las Vegas on January 8, 1976. A meeting of the study contractor and city representatives was held in July 1977 to inform the city of the study progress. An interagency hydrology coordination meeting was held in December 1977 with representatives of the U.S. Army Corps of Engineers, the U.S. Geological Survey, the U.S. Bureau of Reclamation, the Federal Emergency Management Agency, and the study contractor. Discharge values were coordinated in April 1978 with the U.S. Army Corps of Engineers, the U.S. Geological Survey, the Bureau of Reclamation, and the Federal Emergency Management Agency.

On July 19, 1978, the preliminary results of the study were reviewed at an intermediate meeting attended by representatives of the study contractor, the Federal Emergency Management Agency, and the city.

The results of this study were reviewed at a final community coordination meeting held on June 12, 1979. Attending the meeting were representatives of the Federal Emergency Managmeent Agency, the study contractor, and the city. This study incorporates all appropriate comments.

After initial adoption of the study, the City of North Las Vegas submitted additional technical data relating to hydrologic and hydraulic analyses and topographic information. Changes to the flood plain mapping and water-surface profiles resulting from this additional technical data have been incorporated into this Flood Insurance Study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of North Las Vegas, Clark County, Nevada. A portion of Clark County within the corporate limits was not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

Las Vegas Wash, Unnamed Tributary to Las Vegas Wash, and the Union Pacific Railroad Overflow were studied in detail. Las Vegas Wash was studied from approximately 200 feet downstream of Lake Mead Boulevard to approximately 2,720 feet north of Craig Road. Unnamed Tributary to Las Vegas Wash was studied northwesterly from its confluence with Las Vegas Wash to approximately 1,000 feet south of Lone Mountain Road. The Union Pacific Railroad Overflow was studied from its confluence with the Unnamed Tributary to Las Vegas Wash to its confluence with Las Vegas Wash.

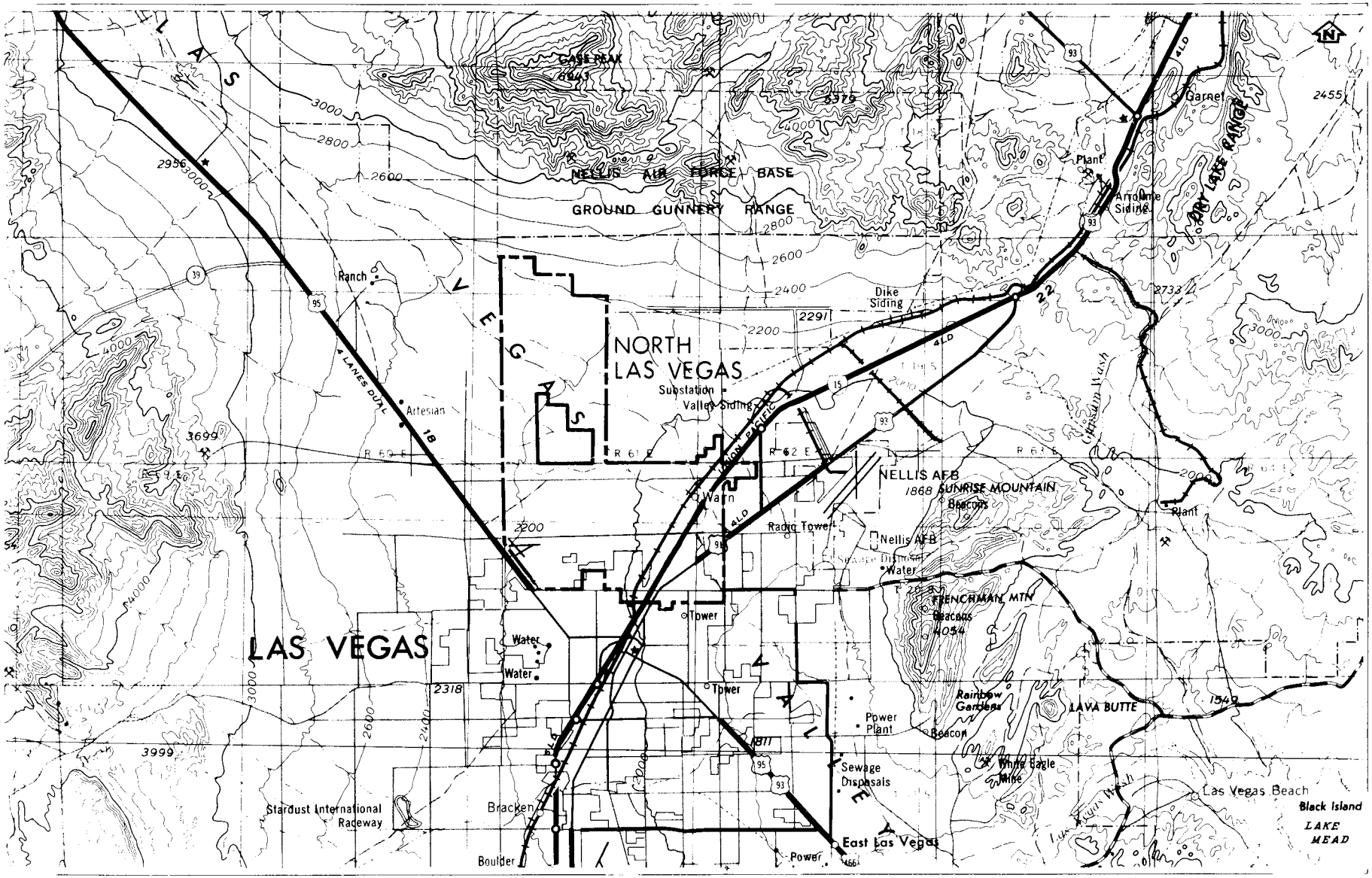


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. All of the detailed and approximate study areas noted above were studied by James M. Montgomery Engineers, Inc. These areas are shown on Flood Insurance Rate Map Panels 0003, 0004, 0005, and 0006. Several unnamed flooding sources were studied by the original study contractor, the U.S. Soil Conservation Service, and were not restudied by James M. Montgomery Engineers, Inc. These areas are shown on Flood Insurance Rate Map Panels 0001 and 0002.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1987.

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 Federal Emergency Management Agency and the City of North Las Vegas.

2.2 Community Description

The City of North Las Vegas is located in central Clark County, in southeastern Nevada, and occupies the central part of a broad, open desert basin. North Las Vegas is bounded by the City of Las Vegas on the south and west and Clark County on the east and north. Henderson and Boulder City, Nevada, are approximately 15 miles and 25 miles, respectively, southeast from North Las Vegas. Interstate Highway 15 passes through the city. Boulder Dam is approximately 32 miles southeast of North Las Vegas.

The city has experienced considerable growth in population. In 1950, the population was 3,875 compared to 18,422 in 1960, 46,067 in 1970, and 42,739 in 1980 (Reference 1).

The corporate limits encompass an area of approximately 22.75 square miles, of which 50 percent is developed. The development consists mainly of single-family residences, with some multiple-family residence complexes and some small businesses. The majority of the development is located in the area bounded by Owens Avenue on the south, Pecos Road on the east, Revere Street on the west, and Gowan Road on the north.

Las Vegas Wash runs through the eastern portion of the city. Unnamed Tributary to Las Vegas Wash joins it from the west. At Las Vegas Boulevard, Las Vegas Wash has a drainage area of 880 square miles and a channel length of 38 miles from its headwaters.

The climate in the North Las Vegas area has four well-defined seasons. Summers have maximum temperatures usually greater than 100°F. The proximity of the mountains accounts for the relatively cool summer nights, with the majority of the minimum temperatures

ranging between 70°F and 75°F. Winters are usually mild and pleasant. Daytime temperatures average near 60°F, with mostly clear skies and warm sunshine. Humidity ranges from 10 to 35 percent during the summer and from 25 to 60 percent during the winter. The average annual precipitation is 3.94 inches, and the average annual temperature is 66°F (Reference 2).

North Las Vegas is predominantly a residential community. There is a small gaming industry from two casinos and a growing warehouse development mixed with light industry. Many of the businesses support the large gaming and tourism industry of Las Vegas and the adjacent metropolitan area.

Las Vegas Wash originates in the Desert and Sheep Mountain ranges located north of the City of North Las Vegas and continues southeastward for more than 50 miles, where it terminates at Lake Mead on the Colorado River. An alluvial apron formed by numerous coalesced alluvial fans skirt the mountains and are located within the northern portion of the city. The southern portion of the city is dissected by many small channels, which do not have the capacity to contain the larger, more infrequent storms that occur.

2.3 Principal Flood Problems

Several types of storms occur in the North Las Vegas area, ranging from general winter storms of low intensity and broad aerial extent to localized summer thunderstorms of high intensity. Most severe flood events on Las Vegas Wash result from intense, short-duration thunderstorms.

The largest and most recently recorded flood on Las Vegas Wash in North Las Vegas was 12,010 cubic feet per second (cfs) on July 3, 1975. The next largest measured events occurred on May 31, 1973, and September 25, 1967, when 1,640 cfs and 1,170 cfs, respectively, were measured. These three floods have return periods of approximately 150, 4, and 3 years, respectively.

The potential for sediment damage is high. Some of the soils in the drainage areas are high erosive. Floodflows are turbid due to the sediment load. Channel banks of the washes are generally unstable and unprotected relative to the erosive forces of the infrequent, large stormflows. Cinder block walls and a few homes constructed close to the channel banks are subject to possible foundation undermining.

2.4 Flood Protection Measures

There are no floodwater-retarding structures within the corporate limits or in the upstream watershed. However, there are several reaches where channel improvements have been made. The main stem of Las Vegas Wash consists of an unimproved, open-earth channel

from the northern corporate limits southward to Carey Avenue. From Carey Avenue to Lake Mead Boulevard, Las Vegas Wash has been excavated as a straight, unlined channel with cinder block fences on each bank. The Unnamed Tributary to Las Vegas Wash is an unimproved open channel from the northern corporate limits southward to a point approximately 2,000 feet upstream of Losee Street. Between this point and Interstate Highway 15, the tributary has been improved as a large, uniform, generally unlined channel with a capacity exceeding the 500-year peak flow. The tributary channel returns to natural conditions between Interstate Highway 15 and Cheyenne Avenue, below which it has been excavated and widened.

A concrete diversion channel was constructed along the west side of Interstate Highway 15. This collects and conveys runoff from the western portion of North Las Vegas northward to an outlet into the Unnamed Tributary to Las Vegas Wash at Interstate Highway 15. The capacity of the diversion channel has a return period of approximately 25 years. Many streets within the city have inverted crowns which allow them to convey surface runoff. An example is King Charles Street, located northwest of the Gowan Road crossing of Las Vegas Wash. This street acts as an extension of an unnamed channel originating at Losee Street, and conveys water through a subdivision and into Las Vegas Wash below Gowan Road. The flow capacities of these streets with inverted crowns are generally small compared with the peak flows of the selected frequencies.

The Union Pacific Railroad, located northwest of Interstate Highway 15, acts as a long dike which diverts Las Vegas Wash overflows into the Unnamed Tributary to Las Vegas Wash. This acts to significantly reduce Las Vegas Wash flows downstream of the railroad and minimize flooding between the railroad and the confluence with the Unnamed Tributary to Las Vegas Wash.

Several additional flood protection measures are being considered by the city for future implementation. These include a system of detention basins and channel, bridge, and culvert improvements. Of particular importance is a large proposed detention basin on Las Vegas Wash north of the corporate limits, which would reduce the 100-year peak discharge at the Union Pacific Railroad by nearly 50 percent. These proposed flood protection measures would have a significant impact in mitigating existing flooding conditions in the community.

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 flooding source studied in detail affecting the community.

The hydrologic characteristics of the Las Vegas Wash watershed, from which both Las Vegas Wash and the Unnamed Tributary to Las Vegas Wash originate, were modeled using the U.S. Soil Conservation Service Technical Release No. 20 rainfall-runoff model (Reference 3). A review of historical data and previous publications (References 4 and 5) indicated that the type of storm most likely to result in a severe runoff events is a cloudburst storm with 3-hour duration and 200-square-mile aerial extent. Because the selected storm area is significantly smaller than the total watershed area (200 square miles versus 880 square miles), several potential storm locations were investigated to determine the storm location causing the greatest peak runoff rates in the study area. For Las Vegas Wash, it was found that 10- and 50-year peak flows are generated by storms centered near Sheep Mountain, while 100-year peak flows result from storms centered near Spring Mountain. For the Unnamed Tributary to Las Vegas Wash, all peak flows are caused by storms centered near the La Madra Mountains. Rainfall depths for 3-hour storms centered in the selected locations were determined from isopluvial maps in the National Oceanic and Atmospheric Administration precipitation-frequency atlas for the State of Nevada (Reference 6). The distribution of rainfall over the 3-hour storm period was determined on the basis of regional and historical information.

The Las Vegas Wash watershed was divided into 78 subbasins to model the rainfall-runoff process. Subbasin areas varied from 1.1 to 32.7 square miles, while times of concentration ranged from 0.37 to 6.52 hours. Soil type and land-use impacts on runoff were modeled using the U.S. Soil Conservation Service Curve Number; subbasin curve numbers varied from 77 to 93.

The TR-20 model for Las Vegas Wash was roughly calibrated using historical rainfall and runoff data gathered during the July 3, 1975, flood, which is the largest recorded flood event in the study area. Peak runoff rates for 10-, 50-, and 100-year storm events were determined using the TR-20 model; 500-year flows were estimated by extrapolating frequency curves developed from the TR-20 results.

Peak discharges corresponding to the selected frequencies were computed at key locations in the watershed, including Las Vegas Wash at the Union Pacific Railroad and the Unnamed Tributary to Las Vegas Wash at the Union Pacific Railroad. Flows at these two points were routed downstream to their confluence above Las Vegas Boulevard. Below the confluence, peak discharges were determined by adding peak flows in Las Vegas Wash to concurrent flows in the Unnamed Tributary to Las Vegas Wash.

Channel overflows occurring at bridges, culverts, and other locations of reduced channel capacity were computed based on hydraulic rating curves developed using the HEC-2 Water-Surface Profiles computer program (Reference 7).

Flood discharges for areas of approximate study were based on rainfall-runoff relationships developed from the TR-20 model results.

Peak discharge-drainage area relationships for Las Vegas Wash, the Unnamed Tributary to Las Vegas Wash, and the Union Pacific Railroad Overflow are shown in Table 1.

3.2 Hydraulic Analyses

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

Water-surface elevations of the 10-, 50-, 100-, and 500-year floods were computed through use of the U.S. Army Corps of Engineers HEC-2 step-backwater computer program (Reference 7).

Cross sections for the backwater analysis of Las Vegas Wash and the Unnamed Tributary to Las Vegas Wash were obtained from aerial photographs flown on September 26, 1981, which were compiled to produce topographic mapping at a scale of 1:2,400 with a contour interval of 2 feet (Reference 8), and from field reconnaissance

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
Las Vegas Wash					
At Losee Road	568	3,960	7,300	8,820	17,000
Below Union Pacific Railroad	--[1]	2,100	2,330	2,440	2,700
Below Interstate Highway 15	--[1]	2,100	2,330	2,370	3,150
Below Confluence with Middle Overflow Area	--[1]	2,720	3,040	3,120	4,500
Below East Cheyenne Avenue	--[1]	2,300	2,560	2,610	3,500
Below Confluence with Unnamed Tributary	--[1]	3,940	7,580	9,220	17,200
Below Las Vegas Boulevard	--[1]	3,940	6,400	6,660	9,300
Below Cutoff Channel	--[1]	3,940	6,530	6,860	10,700
Below Carey Avenue	--[1]	3,940	6,530	6,860	9,700
Below Lake Mead Boulevard	--[1]	3,940	5,500	5,710	7,250
Unnamed Tributary to Las Vegas Wash					
At Lone Mountain Road	126	2,120	4,060	4,890	7,850
At Craig Road	--[1]	1,560	3,500	4,330	6,550
Below Interstate Highway 15	177	3,000	5,720	6,870	9,100
Below Civic Center Drive	--[1]	3,000	5,720	5,970	7,100
Union Pacific Railroad Overflow					
At Las Vegas Wash	--[1]	1,860	4,970	6,380	11,100
At Middle Tributary to Las Vegas Wash	--[1]	1,240	4,260	5,300	8,600

[1]Flow Affected by Upstream Overflows, Diversions, or Obstructions; Drainage Area Does Not Apply

of the study area. Additional topographic data in the overflow area parallel to the Union Pacific Railroad were obtained from 1:480 topographic maps provided by the City of North Las Vegas, based on aerial photography from February and March 1980 (Reference 9). Topographic information required to extend cross sections beyond the corporate limits for the shallow flooding analysis between Lake Mead Boulevard and Las Vegas Boulevard was obtained from the most current U.S. Geological Survey topographic mapping for the study area (Reference 10). All bridge and culvert data were obtained by field measurement and from as-built drawings of Interstate Highway 15.

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).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Roughness values for the main channels of both Las Vegas Wash and the Unnamed Tributary to Las Vegas Wash ranged from 0.025 to 0.040, while flood plain roughness values ranged from 0.035 to 0.080 for all floods. Roughness values in the Union Pacific Railroad overflow area ranged from 0.030 to 0.065.

Starting water-surface elevations for Las Vegas Wash, the Unnamed Tributary to Las Vegas Wash, and the Union Pacific Railroad overflow were calculated using the slope-area method.

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).

Shallow flooding in the flood plain of Las Vegas Wash and the Unnamed Tributary to Las Vegas Wash occurs in the following locations: west of the Unnamed Tributary to Las Vegas Wash near Tillman Drive; east of the Unnamed Tributary to Las Vegas Wash upstream of the entrance to the improved channel beginning above Losee Road; east of the Unnamed Tributary to Las Vegas Wash downstream of Civic Center Drive; in the area bounded by Las Vegas Wash and the Unnamed Tributary to Las Vegas Wash and by Interstate Highway 15 and the Union Pacific Railroad; in the small unnamed channel between Las Vegas Wash and the Unnamed Tributary to Las Vegas Wash, between Interstate Highway 15 and the confluence with Las Vegas Wash; east of Las Vegas Wash between East Cheyenne Avenue, Pecos Road, and the channel; and west of Pecos Road between Lake Mead Boulevard and Owens Avenue. Shallow flooding is a result of overflows caused by reduced channel capacities frequently related to undersized bridge or culvert openings. Average depths and flow paths in

these areas were estimated using normal depth calculations and accounts of historical flooding.

Shallow flooding is often characterized by highly unpredictable flow directions caused by low relief or shifting channels and high debris loads. Where such conditions exist, the entire area susceptible to this unpredictable flow was delineated as a zone of equal risk. Small scale topographic variations were averaged across inundated areas to determine flood depths.

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

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

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study 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 Emergency Management Agency 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 topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (Reference 8).

For the streams studied by approximate methods, the boundary of the 100-year flood was developed from normal depth calculations and topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (Reference 8), and topographic maps at a scale of 1:24,000, with a contour interval of 20 feet (Reference 10). Shallow flooding areas were delineated using normal depth calculations and topographic maps at a scale of 1:2,400, with a contour interval of 2 feet (Reference 8).

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

the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown. 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, increases the flood heights of streams, and increases 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 may be carried without substantial increases in flood heights. Minimum standards of the Federal Emergency Management Agency limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

Floodways were computed for Las Vegas Wash from Las Vegas Boulevard to the northern corporate limits, for the Unnamed Tributary to Las Vegas Wash from the confluence to the upstream detailed study limit, and for the overflow parallel to the Union Pacific Railroad between Las Vegas Wash and the Unnamed Tributary to Las Vegas Wash. A floodway was not applicable downstream of Las Vegas Boulevard because the total 100-year flow (channel flow plus upstream overflows occurring for natural conditions) could not be conveyed within the primary 100-year flood plain with less than a 1.0 foot rise in the water-surface elevation.

The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

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

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

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	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Las Vegas Wash A-H[2]								
I	6,185	418	1,271	7.3	1,849.1	1,849.1	1,849.7	0.6
J	6,485	201	908	10.2	1,851.0	1,851.0	1,851.0	0.0
K	6,865	107	819	11.3	1,852.9	1,852.9	1,853.0	0.1
L	7,255	65	267	11.7	1,852.9	1,852.9	1,853.2	0.3
M	7,875	58	309	10.1	1,858.3	1,858.3	1,859.0	0.7
N	8,425	53	318	9.8	1,861.7	1,861.7	1,862.3	0.6
O	8,890	90	639	4.9	1,865.3	1,865.3	1,865.9	0.6
P	9,510	91	618	5.0	1,865.9	1,865.9	1,866.5	0.6
Q	9,870	54	251	12.4	1,866.2	1,866.2	1,866.2	0.0
R	10,240	92	619	5.0	1,869.4	1,869.4	1,869.4	0.0
S	10,640	74	453	6.9	1,869.9	1,869.9	1,869.9	0.0
T	11,100	58	385	6.2	1,871.1	1,871.1	1,871.1	0.0
U	11,480	71	268	8.8	1,872.0	1,872.0	1,872.0	0.0
V	11,770	135	456	5.2	1,873.3	1,873.3	1,873.3	0.0
W	12,010	194	621	3.8	1,873.4	1,873.4	1,873.6	0.2
X	12,490	426[3]	1,171	2.0	1,873.7	1,873.7	1,874.2	0.5
Y	13,130	130[3]	274	8.6	1,875.3	1,875.3	1,876.0	0.7
Z	13,660	129[3]	362	6.5	1,879.8	1,879.8	1,880.6	0.8
AA	14,100	80	318	7.4	1,882.4	1,882.4	1,882.9	0.5
AB	14,570	72[3]	231	10.3	1,887.2	1,887.2	1,887.2	0.0
AC	15,050	132[3]	344	6.9	1,892.2	1,892.2	1,892.2	0.0
AD	15,560	61	224	10.6	1,895.7	1,895.7	1,895.8	0.1
AE	16,275	77	328	7.4	1,904.8	1,904.8	1,904.9	0.1
AF	16,585	130	598	4.1	1,906.0	1,906.0	1,906.1	0.1
AG	17,435	335	2,062	1.2	1,915.9	1,915.9	1,915.9	0.0
AH	17,825	284	1,166	7.6	1,915.8	1,915.8	1,915.8	0.0

[1]Feet Upstream of Lake Mead Boulevard [2]Floodway Not Applicable [3]Width Includes Islands

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

FLOODWAY DATA

LAS VEGAS WASH

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	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Las Vegas Wash (Cont'd)								
AI	18,045	252	1,406	6.3	1,916.2	1,916.2	1,916.7	0.5
AJ	18,385	305[2]	974	9.1	1,919.5	1,919.5	1,919.6	0.1
AK	18,575	306[2]	928	9.5	1,920.6	1,920.6	1,920.9	0.3
AL	18,945	317[2]	1,857	4.7	1,922.2	1,922.2	1,923.0	0.8
AM	19,355	425[2]	879	10.0	1,923.1	1,923.1	1,923.6	0.5
AN	19,775	356[2]	875	10.1	1,927.6	1,927.6	1,928.4	0.8
AO	20,225	227	847	10.4	1,932.6	1,932.6	1,932.8	0.2
AP	20,755	150	708	12.5	1,938.1	1,938.1	1,938.1	0.0
AQ	21,125	204/120[3]	1,002	8.8	1,941.3	1,941.3	1,941.8	0.5

[1]Feet Upstream of Lake Mead Boulevard [2]Width Includes Islands [3]Width/Width Within Corporate Limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

FLOODWAY DATA

LAS VEGAS WASH

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	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Unnamed Tributary to Las Vegas Wash								
B	810	104	597	11.5	1,855.7	1,855.7	1,856.3	0.6
C	1,490	87	830	8.3	1,859.8	1,859.8	1,860.5	0.7
D	2,915	78	483	14.2	1,870.5	1,870.5	1,871.0	0.5
E	3,500	200	837	8.2	1,877.0	1,877.0	1,877.7	0.7
F	3,950	85	518	13.3	1,879.4	1,879.4	1,879.9	0.5
G	4,550	150	1,050	6.5	1,884.4	1,884.4	1,885.2	0.8
H	4,720	106	643	10.7	1,884.7	1,884.7	1,885.4	0.7
I	5,395	100	575	12.0	1,889.6	1,889.6	1,890.1	0.5
J	6,345	99	472	12.5	1,897.5	1,897.5	1,897.6	0.1
K	7,025	110	614	8.0	1,901.3	1,901.3	1,901.8	0.5
L	7,995	99	455	10.8	1,904.0	1,904.0	1,904.0	0.0
M	8,345	191	519	9.1	1,913.7	1,913.7	1,914.1	0.4
N	8,745	365	1,179	4.1	1,916.8	1,916.8	1,917.6	0.8
O	9,425	130	506	9.7	1,923.2	1,923.2	1,923.4	0.2
P	9,665	130	746	6.6	1,925.6	1,925.6	1,926.0	0.4
Q	10,265	320	848	5.8	1,927.3	1,927.3	1,928.1	0.8
R	10,645	287	619	7.9	1,931.5	1,931.5	1,932.2	0.7
S	10,950	332	715	6.8	1,935.4	1,935.4	1,936.2	0.8
T	11,440	437	744	6.6	1,040.5	1,940.5	1,941.2	0.7
U	11,780	425	828	5.9	1,944.7	1,944.7	1,945.7	1.0
V	12,340	193	625	7.8	1,952.4	1,952.4	1,952.7	0.3
W	12,680	289	664	7.4	1,955.9	1,955.9	1,956.9	1.0
X	13,135	128	469	10.4	1,961.9	1,961.9	1,962.4	0.5
Y	14,005	86	398	12.3	1,973.2	1,973.2	1,973.6	0.4
Z	14,150	190	516	9.5	1,978.8	1,978.8	1,979.0	0.2

[1]Feet Upstream of Confluence With Las Vegas Wash

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

FLOODWAY DATA

UNNAMED TRIBUTARY TO LAS VEGAS WASH

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	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Unnamed Tributary to Las Vegas Wash (Cont'd)								
AA	14,310	88	397	12.3	1,982.0	1,982.0	1,982.0	0.0
AB	14,990	143	484	10.1	1,992.0	1,992.0	1,992.5	0.5
AC	15,725	163	522	9.4	2,001.6	2,001.6	2,001.8	0.2
AD	15,855	134	528	9.3	2,002.9	2,002.9	2,003.4	0.5
AE	16,015	171	585	8.4	2,004.8	2,004.8	2,005.4	0.6
AF	16,100	302	742	6.6	2,006.3	2,006.3	2,006.8	0.5
AG	16,320	260	677	7.2	2,008.7	2,008.7	2,009.0	0.3
AH	16,590	223	659	7.4	2,010.5	2,010.5	2,011.3	0.8
AI	16,800	304	753	6.5	2,012.6	2,012.6	2,013.3	0.7
AJ	17,700	119	490	10.0	2,021.0	2,021.0	2,021.2	0.2

[1] Feet Upstream of Confluence With Las Vegas Wash

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

FLOODWAY DATA

UNNAMED TRIBUTARY TO LAS VEGAS WASH

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	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Union Pacific Railroad Overflow								
A	510	160	918	5.8	1,903.3	1,903.3	1,903.4	0.1
B	1,030	174	855	6.2	1,904.2	1,904.2	1,904.2	0.0
C	1,270	279	1,353	3.9	1,904.7	1,904.7	1,905.2	0.5
D	1,640	249	1,095	4.8	1,905.8	1,905.8	1,906.6	0.8
E	1,970	150	639	8.3	1,907.6	1,907.6	1,908.3	0.7
F	2,420	419	2,613	2.4	1,909.0	1,909.0	1,909.8	0.8
G	2,640	404	2,251	2.8	1,909.0	1,909.0	1,909.8	0.8
H	2,875	210	919	6.9	1,909.0	1,909.0	1,909.8	0.8
I	3,505	152	671	9.5	1,911.0	1,911.0	1,911.5	0.5
J	4,030	149	695	9.2	1,913.5	1,913.5	1,914.4	0.9
K	4,325	161	972	6.6	1,914.9	1,914.9	1,915.9	1.0
L	4,665	224	1,375	4.6	1,915.7	1,915.7	1,916.7	1.0

[1]Feet Upstream of Unnamed Tributary to Las Vegas Wash

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

FLOODWAY DATA

UNION PACIFIC RAILROAD OVERFLOW

obstructed without increasing the water-surface elevation of the 100-year flood more than 1 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.

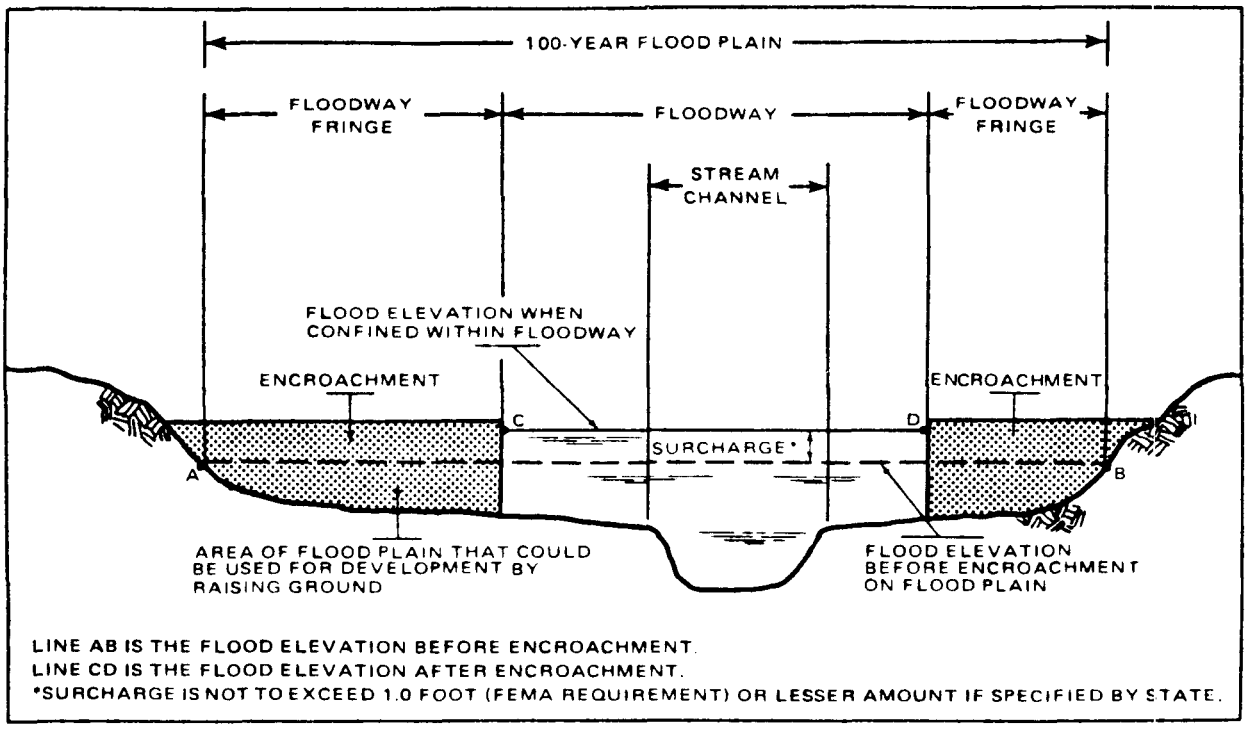


Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Emergency Management Agency 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 North Las Vegas.

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
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the City of North Las Vegas are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors (FHFs)

The FHF is the Federal Emergency Management Agency 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 FHFs, the entire incorporated area of the City of North Las Vegas 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 FHFs determined.

Zone A0: Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.

Zone AH: Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Las Vegas Wash							
Reach 1	0006	-2.19	-0.26	1.46	020	A4	Varies - See Map
Reach 2	0003,0006	-0.52	-0.13	1.12	005	A1	Varies - See Map
Reach 3	0003	-1.64	-0.49	1.68	015	A3	Varies - See Map
Shallow Flooding	0006	N/A	N/A	N/A	N/A	A0	1
Unnamed Tributary to Las Vegas Wash							
Reach 1	0001,0002 0004,0005 0006	-2.05	-0.32	0.89	020	A4	Varies - See Map
Shallow Flooding	0004,0005	N/A	N/A	N/A	N/A	A0	1
Union Pacific Railroad Overflow							
Reach 1	0003,0004	-2.61	-0.54	1.30	025	A5	Varies - See Map
Shallow Flooding	0003,0004	N/A	N/A	N/A	N/A	AH	Varies - See Map

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

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

FLOOD INSURANCE ZONE DATA

LAS VEGAS WASH-UNNAMED TRIBUTARY TO LAS VEGAS WASH-
UNION PACIFIC RAILROAD OVERFLOW

Zones A1, and A3-A5:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
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, FHFs, 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 North Las Vegas 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 Emergency Management Agency.

6.0 OTHER STUDIES

A Flood Insurance Study has been completed for the City of Las Vegas (Reference 11). A Flood Insurance Study is being conducted for the unincorporated areas of Clark County adjacent to the City of North Las Vegas (Reference 12). The results of the Clark County study will be in general agreement with this study.

A Flood Plain Information report for Lower Las Vegas Wash was prepared by the U.S. Army Corps of Engineers in 1967 (Reference 13). The limits of the report did not extend to the City of North Las Vegas. Peak discharge values were calculated for Las Vegas Wash that did not correspond to values used by the U.S. Army Corps of Engineers for their Flood Plain

Information report. However, these differences were resolved during earlier coordination meetings.

A Flood Hazard Boundary Map for the City of North Las Vegas has been published (Reference 14). This Flood Insurance Study is more detailed and, thus, supersedes that map.

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

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Building 105, Presidio of San Francisco, San Francisco, California 94129.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of Commerce, Bureau of the Census, Characteristics of the Population, Nevada, Volume 1, Part 30, 1981

2. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Climatological Summary, prepared in cooperation with the University of Nevada, 1973

3. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 20, Computer Program for Project Formulation - Hydrology, 1965

4. U.S. Department of Agriculture, Soil Conservation Service, Flood Flow Frequency Analyses, Supplement to Las Vegas Wash and Tributaries, Flood Hazard Analyses, Clark County, Nevada, Reno, Nevada, July 1978

5. Clark County Flood Control Division, "A Brief Hydrologic Appraisal of the July 3-4, 1975, Flash Flood in Las Vegas Valley, Nevada," in cooperation with the U.S. Department of Interior, Geological Survey, 1976

6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Precipitation Frequency Atlas of the Western United States, Atlas 2, Volume VII, 1973

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

8. Aero-Graphics, Inc., Photogrammetric Maps, Scale 1:2400, Contour Interval 2 feet: North Las Vegas, Nevada, (September 26, 1981)

9. Cooper Aerial Survey Co., Photogrammetric Maps, North Las Vegas, Nevada, Scale 1:480, February and March 1980

10. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 feet: Las Vegas NE, Nevada (1976), Photorevised (1973); Las Vegas NW, Nevada (1967), Photorevised (1973); Gass Peak SW, Nevada (1974)

11. Federal Emergency Management Agency, Flood Insurance Study, City of Las Vegas, Clark County, Nevada, September 1980

12. Federal Emergency Management Agency, Flood Insurance Study, Clark County, Nevada (Unincorporated Areas), unpublished

13. U.S. Department of the Army, Corps of Engineers, Los Angeles District, Flood Plain Information, Lower Las Vegas Wash, Clark County, Nevada, December 1967

14. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of North Las Vegas, Clark County, Nevada, Scale 1:9600, February 15, 1974, Revised February 4, 1977

FLOOD PROFILES

LAS VEGAS WASH

REACH 1
ZONE A4

LIMIT OF FLOODING AFFECTING CITY OF NORTH LAS VEGAS

CORPORATE LIMITS

LAKE MEAD BOULEVARD NORTH/ PECOS ROAD

CAREY AVENUE

LAS VEGAS BOULEVARD NORTH

50 AND 100-YEAR FLOODS COINCIDE

ELEVATION (FEET NGVD)

1850
1840
1830
1820
1810

-500 0 1000 2000 3000 4000 5000 6000

STREAM DISTANCE IN FEET ABOVE LAKE MEAD BOULEVARD/PECOS STREET

A B C D E F G H

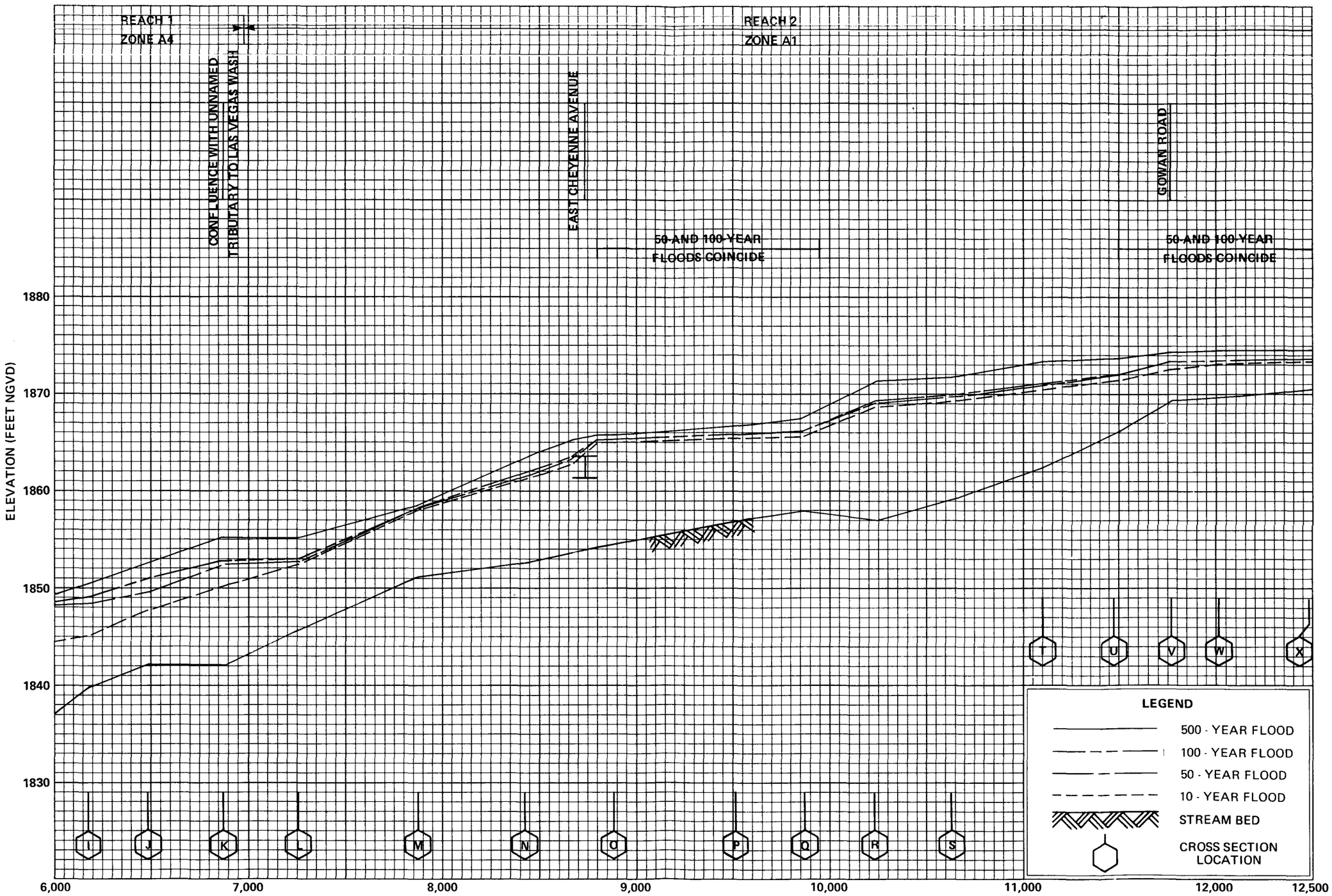
LEGEND

- 500 - YEAR FLOOD
- 100 - YEAR FLOOD
- 50 - YEAR FLOOD
- 10 - YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

01P



FLOOD PROFILES

LAS VEGAS WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

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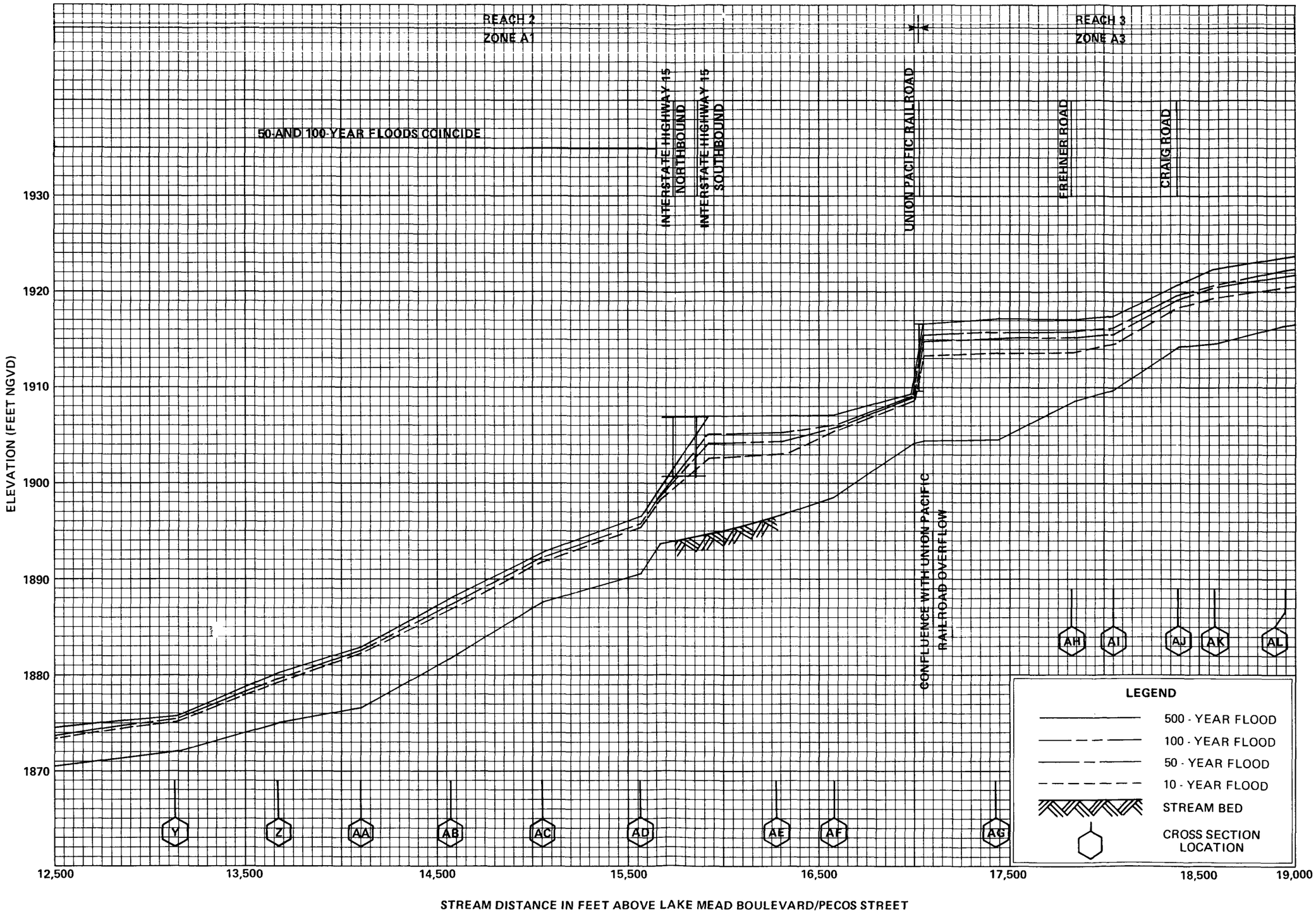

FLOOD PROFILES

LAS VEGAS WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

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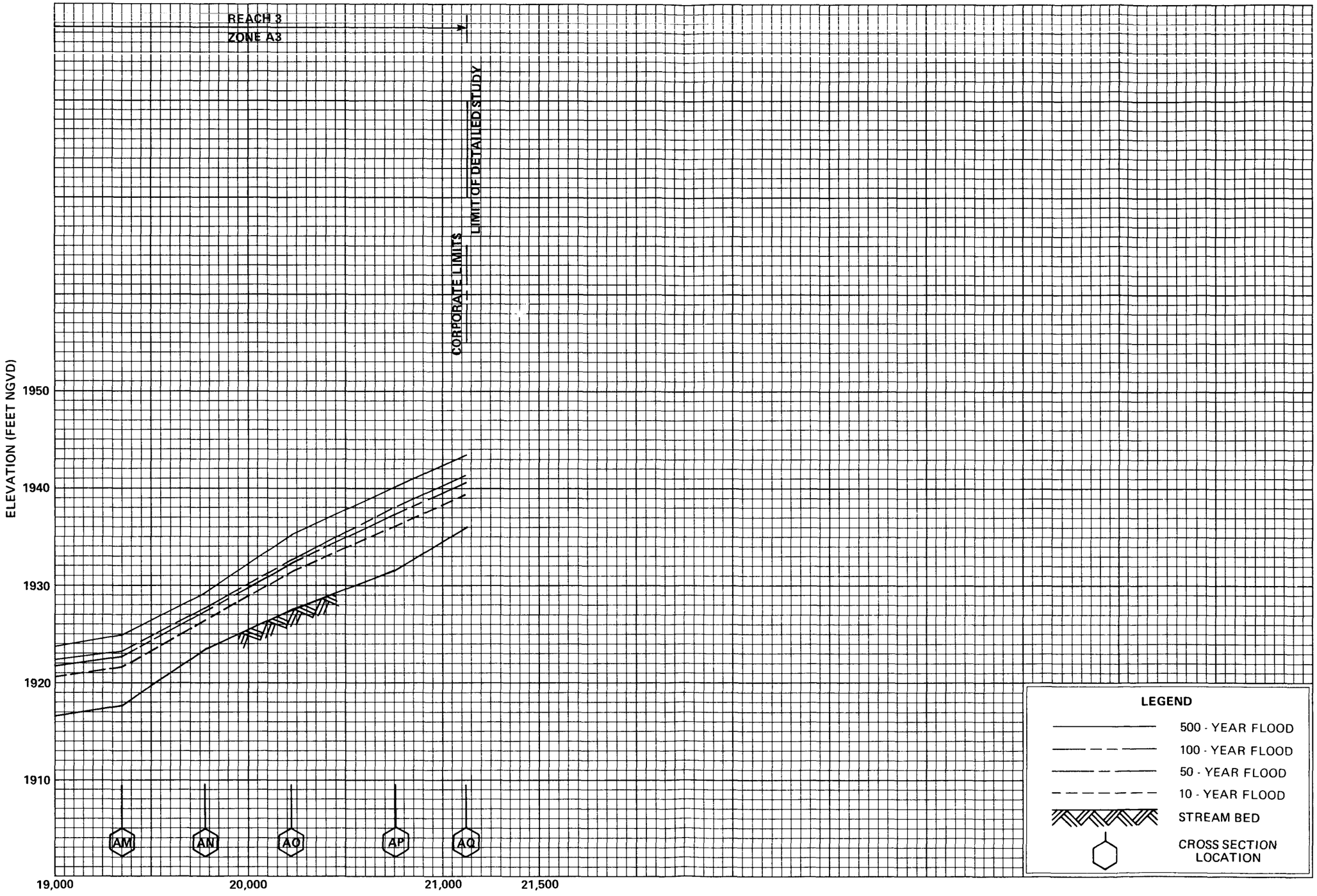

FLOOD PROFILES

LAS VEGAS WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

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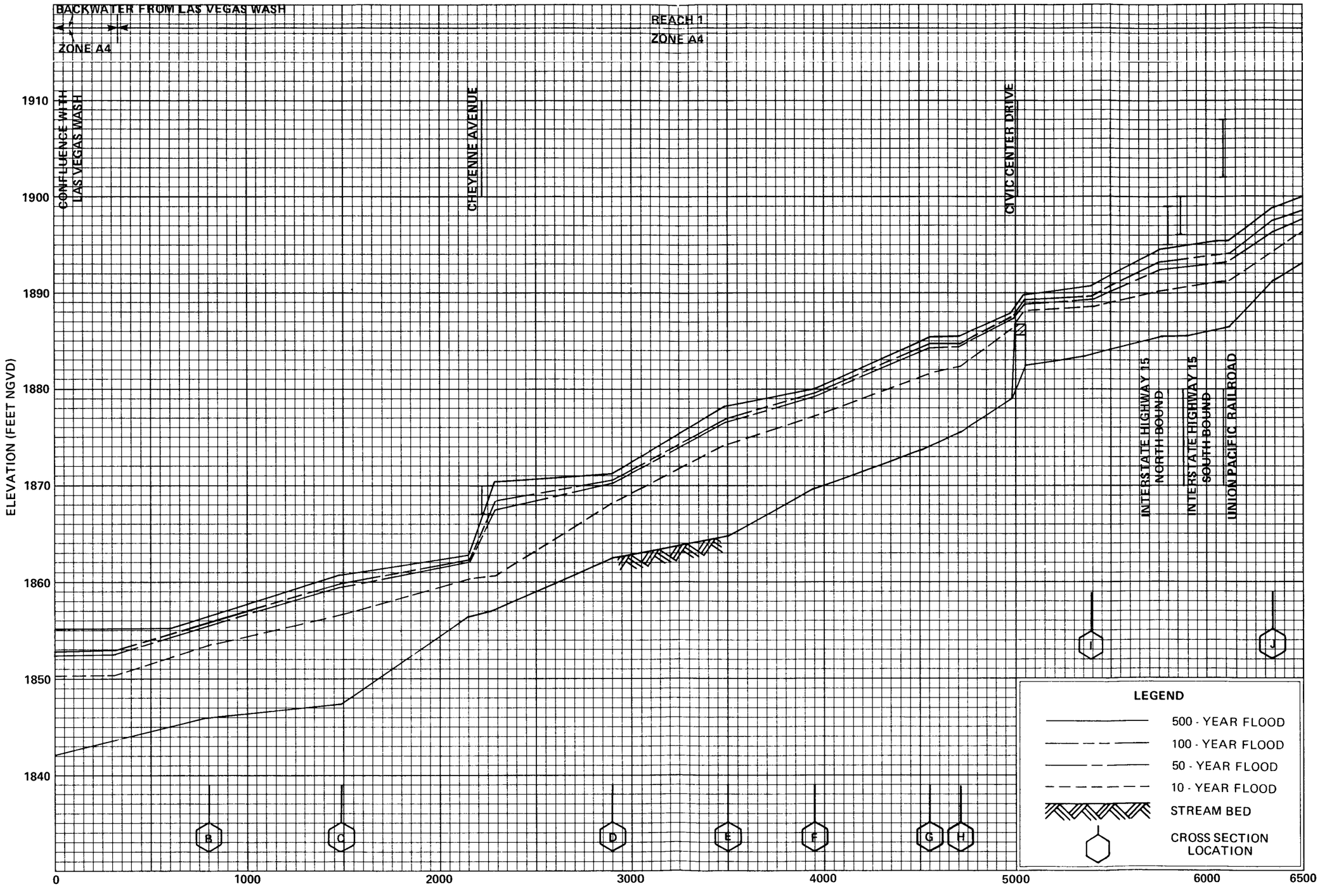


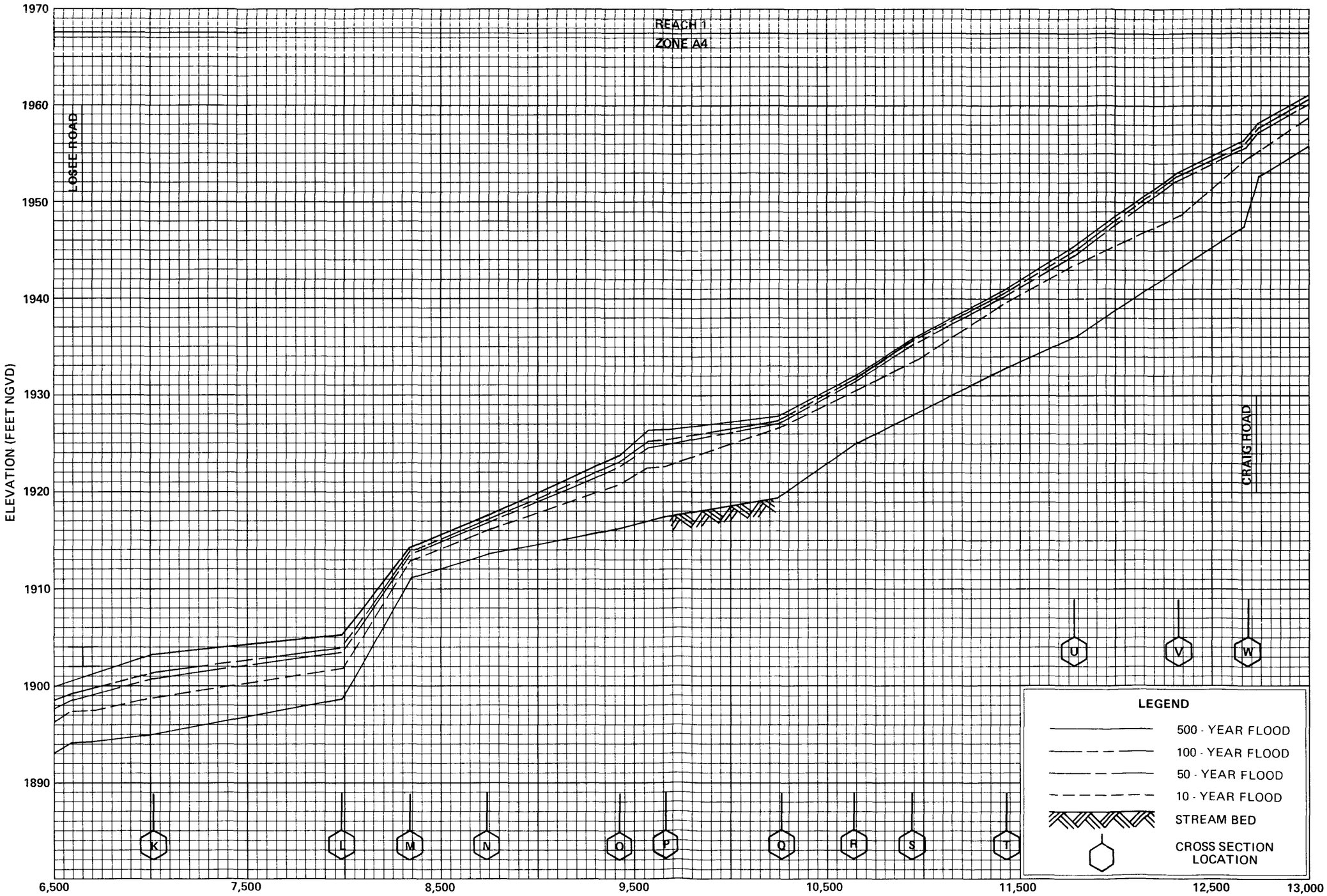
FLOOD PROFILES

UNNAMED TRIBUTARY TO LAS VEGAS WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

05P



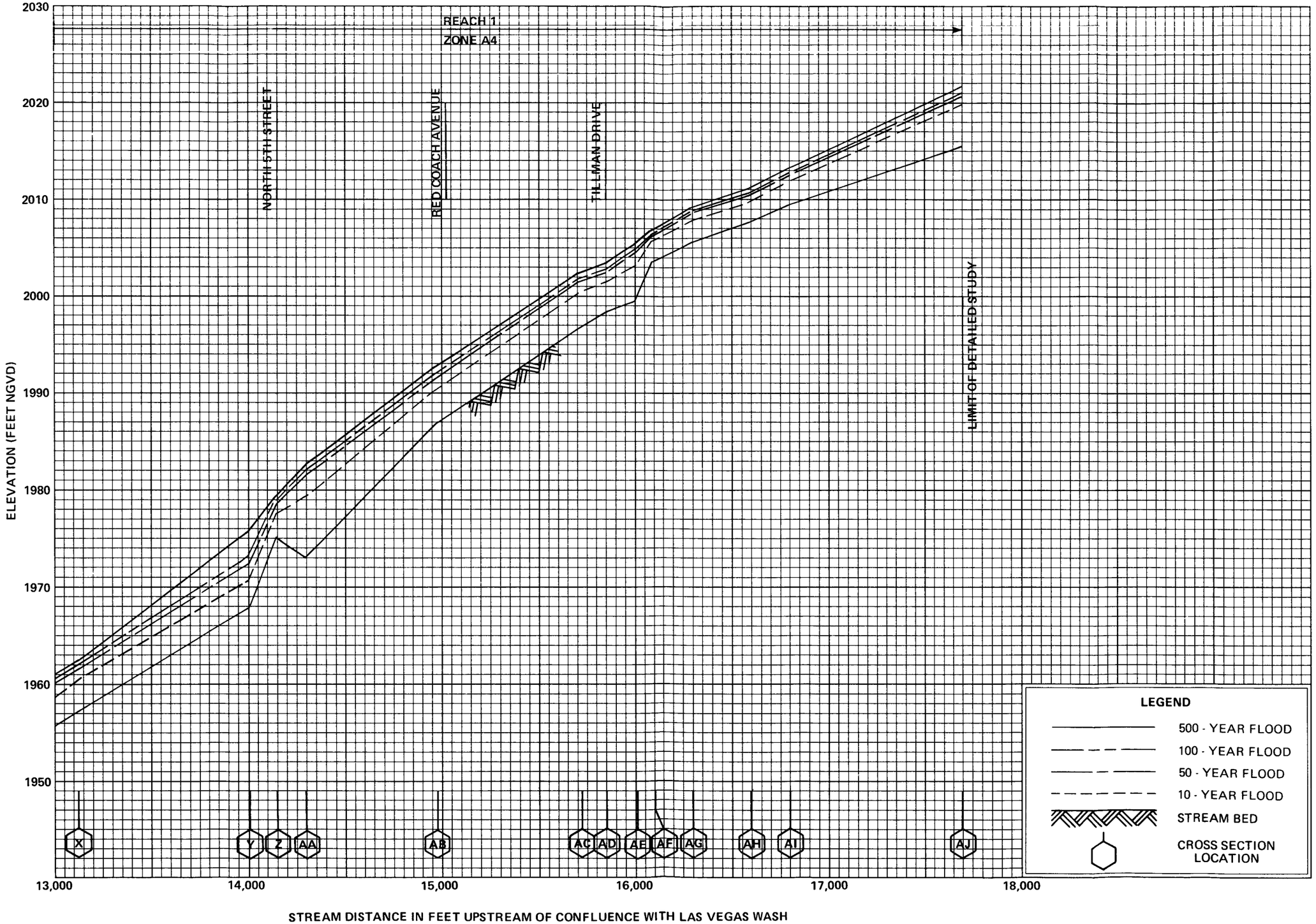
FLOOD PROFILES

UNNAMED TRIBUTARY TO LAS VEGAS WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

06P



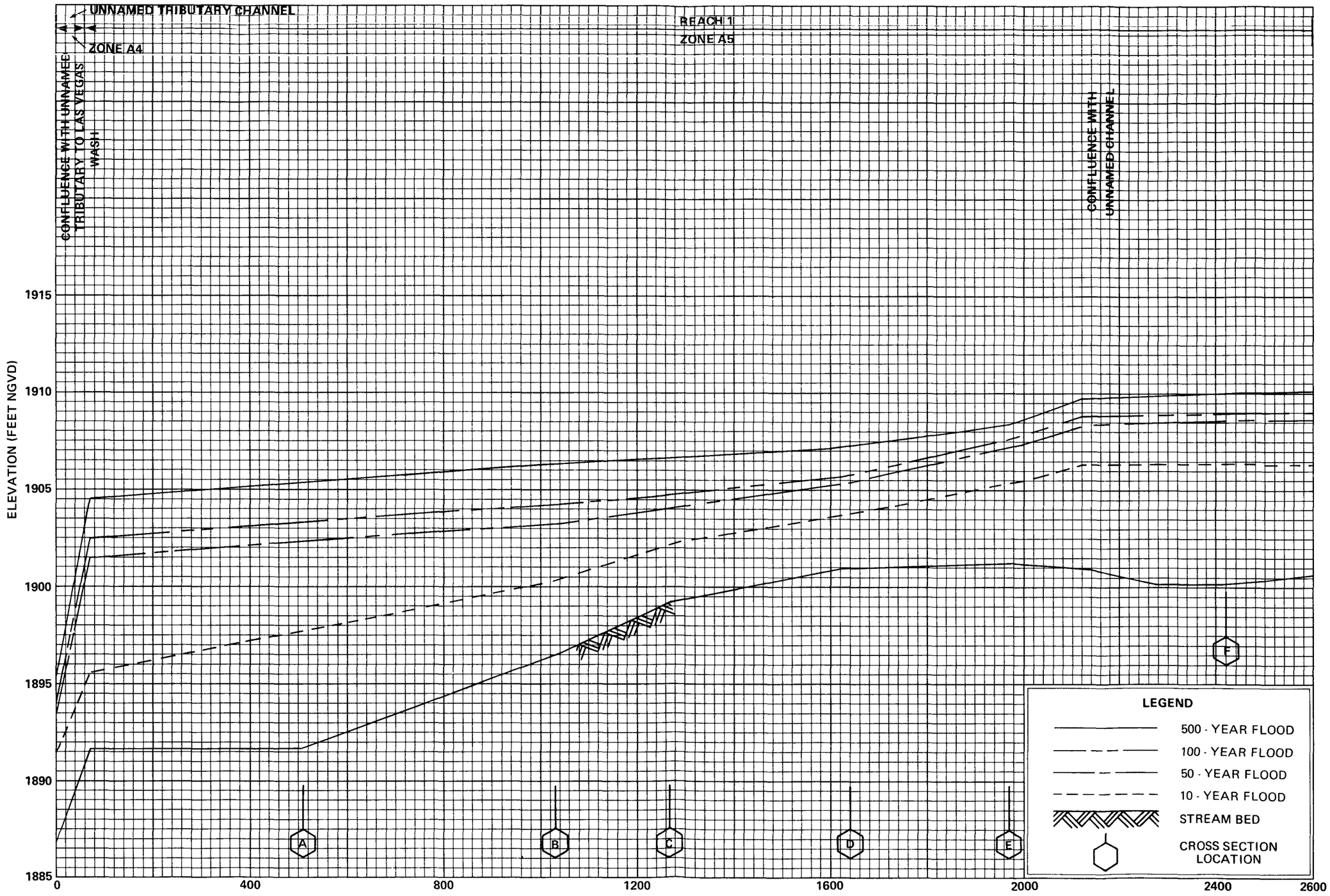
FLOOD PROFILES

UNNAMED TRIBUTARY TO LAS VEGAS WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

07P



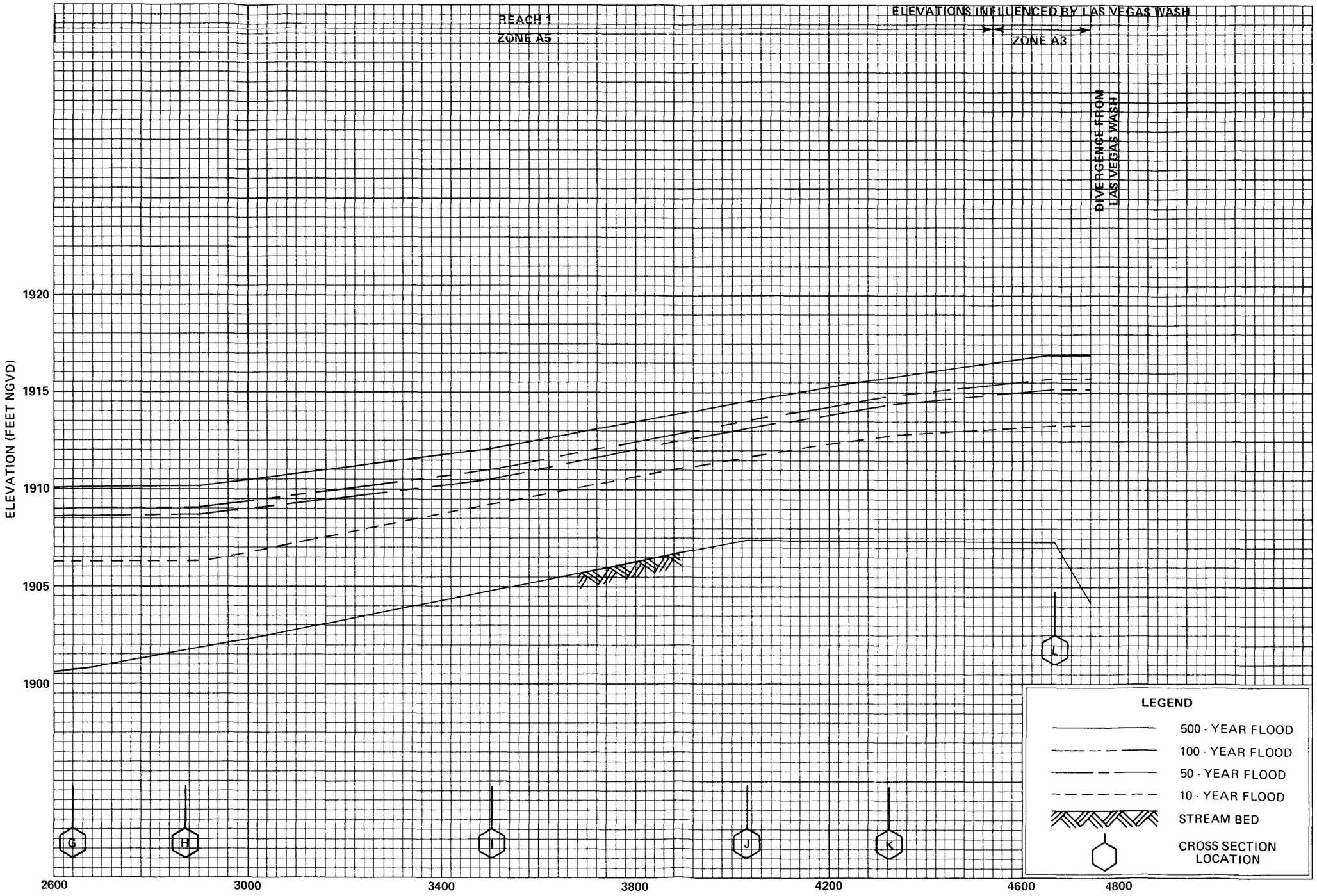
FLOOD PROFILES

UNION PACIFIC RAILROAD OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

08P



FLOOD PROFILES

UNION PACIFIC RAILROAD OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF NORTH LAS VEGAS, NV
(CLARK CO.)

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