CHAPTER II

DRAINAGE SYSTEM

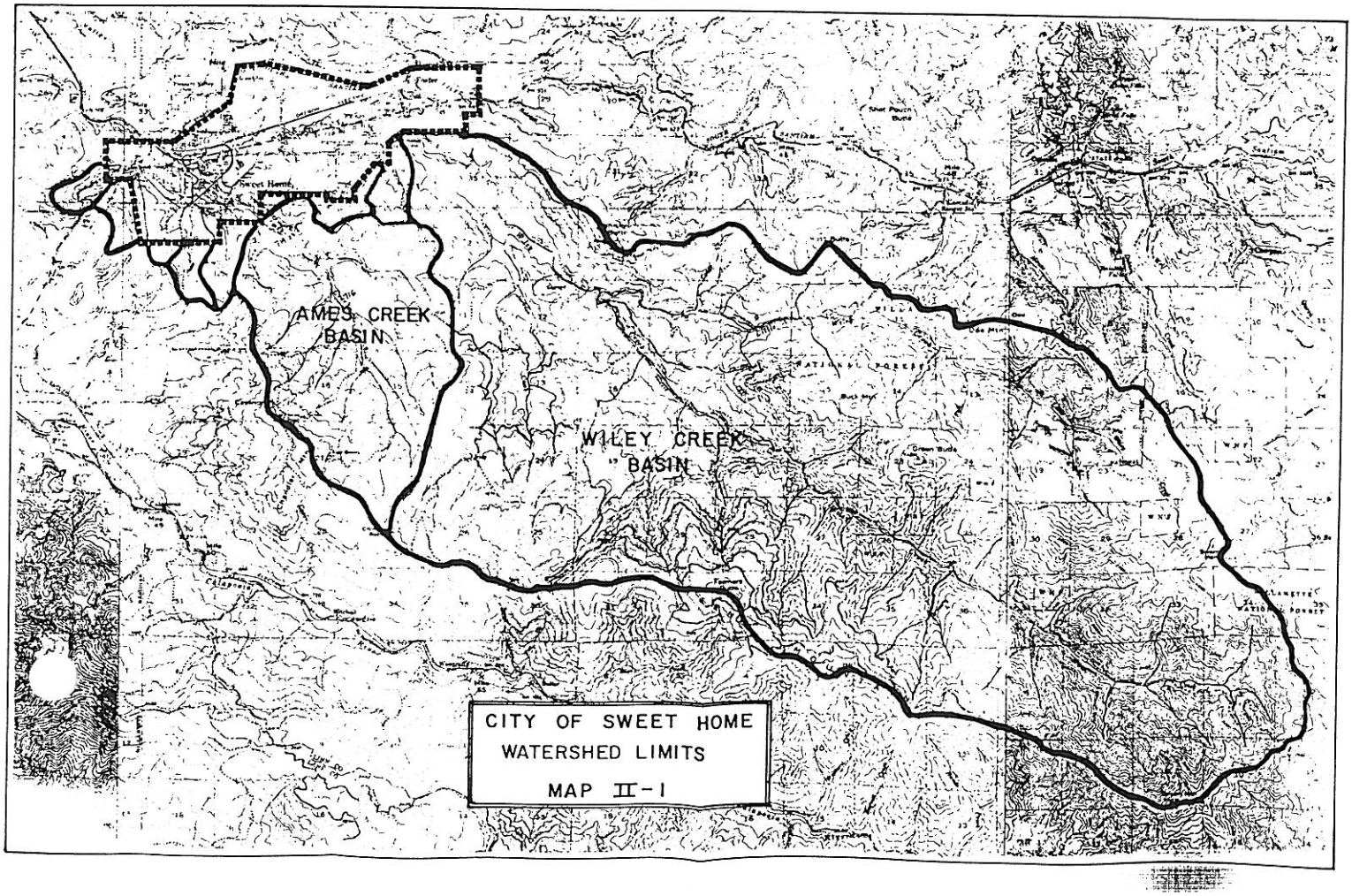
The relationship of the City of Sweet Home to the watershed it intercepts is shown on Map II-1. Although Wiley Creek Basin drains 65 square miles where Wiley Creek passes through the City of Sweet Home it is confined to a deep ravine easily capable of passing design flood peaks. For this reason Wiley Creek Basin and the small area of Foster were not modeled on the computer. All of the City of Sweet Home watershed except Wiley Creek Basin is modeled.

Ames Creek Basin above its point of entry into the proposed urban growth boundary is 9.6 square miles. The break down of Ames Creek Basin above the urban growth boundary into subcatchment is in Appendix B.

The City of Sweet Home watershed excluding Wiley Creek Basin and Ames Creek Basin above the urban growth boundary is shown on Map III-1 (Appendix C). This map shows all existing drainage patterns and assigns computer required numerical identifications to all major pipes, open channels and creeks, as well as all subcatchments.

Steps in the compilation of the existing drainage system included:

1. An initial on-site tour of drainages conducted by Mr. Ozzie Shaw, registered surveyor with considerable experience in the Sweet Home area.
2. Preparation of a 1" = 300' mosaic of all 1" = 100' topographic mapping in the City.
3. For areas beyond this mosaic, 40 foot contour interval U.S. Geologic Survey topography maps were consulted.



CITY OF SWEET HOME
WATERSHED LIMITS

MAP II-1

INDEX TO MAP II-3

Hydrologic soil groups are used to estimate runoff from rainfall. Soils properties are considered that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting. These properties are: depth of seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The influence of ground cover is treated independently - not in hydrologic soil groups.

The soils are classified into four groups, A, B, C, and D with A having the lowest runoff potential and D having the highest runoff potential.

Groups A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravel. These soils have a high rate of water transmission.

Group B soils have moderately low runoff potential and moderate infiltration rates when thoroughly wetted. They consist chiefly of moderately deep to deep, moderately to well drained soils with moderately fine to moderately coarse textures and moderately slow to moderately rapid permeability. These soils have a moderate rate of water transmission.

Group C soils have moderately high runoff potential and slow infiltration rates when thoroughly wetted. They consist chiefly of soils with a layer that impedes downward movement of water, soils with moderately fine to fine texture, soils with slow infiltration due to salts or alkali, or soils with moderate seasonal water tables. These soils may be somewhat poorly drained. They include well drained soils with slowly and very slowly permeable layers such as fragipans, hardpans, hard bedrock and the like at depths of 20 to 40 inches. These soils have a slow rate of water transmission.

Group D soils have high runoff potential and very slow infiltration rates when thoroughly wetted. They consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, soils with very slow infiltration due to salts or alkali, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

4. Field surveys conducted to clarify drainage questions, measure culverts, and obtain SWMM input data.

5. Oregon State Highway Department drawings for U.S. Hwy 20 through Sweet Home were researched.

6. The drainages were then overlaid onto a 1" = 800' scale drawing of the City which is the background for Map III-1.

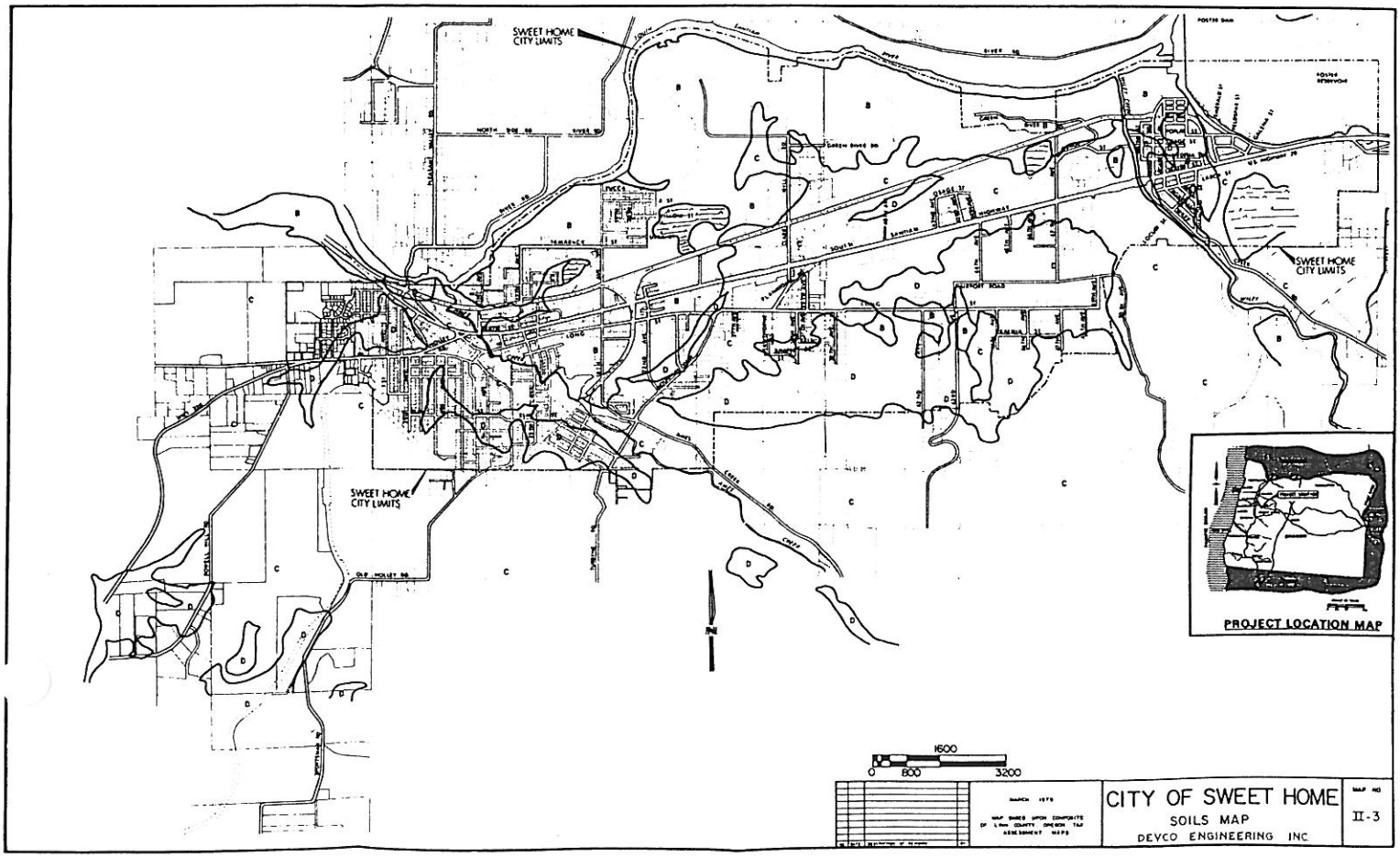
SOILS

The U.S. Department of Agriculture, Soil Conservation Service (SCS) has categorized all soils within the City's watershed. They also provide data sheets for each soil type giving such useful information as hydrologic runoff potential and the range of saturated permeability of the near surface soil horizons.

Soil permeability as reported by the SCS is the source data for the SWMM infiltration parameters.

Saturated winter soil conditions were simulated by (1) equating the minimum infiltration to the SCS minimum saturated permeability regardless of soil horizon below the surface and (2) by inputting five hours of antecedent precipitation before the 'peak' of the synthetic design storm. The SWMM response to these measures is to treat the soil as saturated.

Hydrologic grouping of soils as reported by the SCS is shown in Map II-3.


SWEET HOME CITY LIMITS
SWEET HOME CITY LIMITS
SWEET HOME CITY LIMITS
PROJECT LOCATION MAP
1600
0
800
3200
CITY OF SWEET HOME
SOILS MAP
DEVCO ENGINEERING INC
II-3

PRECIPITATION

Rainfall intensity - frequency - duration (I-F-D) curves recommended for the City of Sweet Home are shown as Figure II-5. This chart is largely constructed from NOAA Atlas 2, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, "Precipitation - frequency Atlas of the Western United States, Vol. XI, Oregon". Discussions with Mr. Ralph Fredericks[1] of NOAA, resulted in some changes to the procedures of NOAA Atlas 2 in the durations less than one hour which increased the rainfall for these durations and the results are shown in Figure II-5.

In the course of developing the I-F-D curves for the City of Sweet Home, NOAA Atlas 2 data was compared with I-F-D curves in use by the cities of Portland, Salem, Corvallis and Eugene and with I-F-D curves in the Oregon State Highway Division Hydraulics manual. On the whole, the comparisons were good to very good for durations greater than one hour and poor to good for durations less than one hour. Sources and derivation methods for the I-F-D curves in use by these other cities are quite diverse as are their curve data for durations less than one hour. NOAA Atlas 2 supersedes National Weather Service Technical Publications TP#24, 25 and 40 which were used to prepare at least two of these other Willamette Valley I-F-D curves.

The nearest U.S. National Weater Service (NWS) precipitation recording stations are located at Foster Dam and at Cascadia. The length of record at Foster Dam is only five (5) years and, therefore provided minimum support data for this study. Cascadia, on the other hand, has

---

[1] Co-author of NOAA Atlas 2

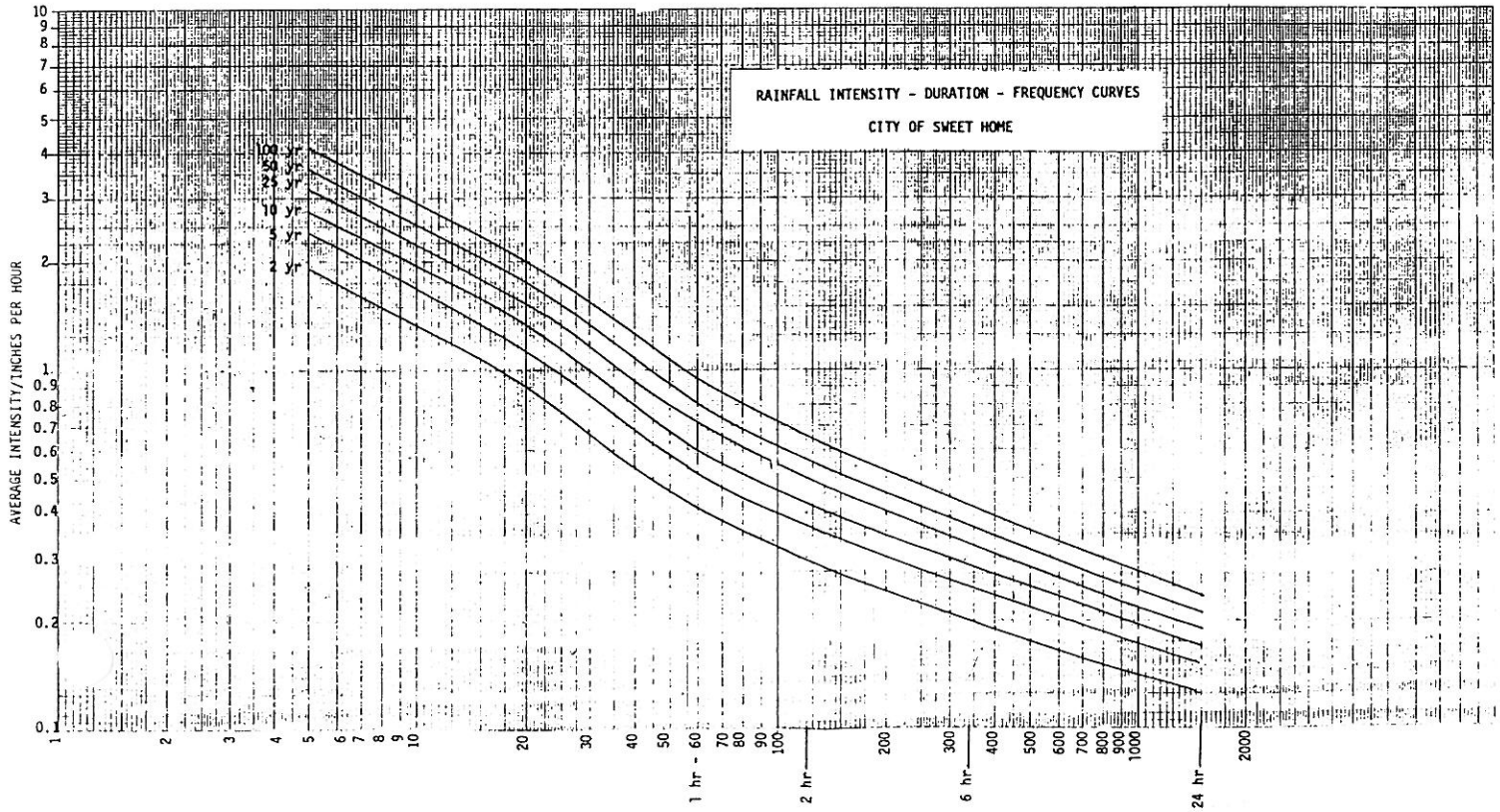

RAINFALL INTENSITY - DURATION - FREQUENCY CURVES
CITY OF SWEET HOME
100 yr
50 yr
25 yr
10 yr
5 yr
2 yr
AVERAGE INTENSITY/INCHES PER HOUR
10
9
8
7
6
5
4
3
2
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
200
300
400
500
600
700
800
900
1000
2000
1 hr
2 hr
6 hr
24 hr
TIME/MINUTES

FIGURE II-5

a good fifty-four (54) year record with the last thirty-one (31) years readily available on magnetic tape records at NWS in Silver Springs, Maryland. A NOAA prepared I-F-D analysis of Cascadia for the years 1948-1973 was compared against the I-F-D curve prepared for the City of Sweet Home and the correlation was good.[2]

DESIGN FREQUENCY

Development within the South Santiam and Ames Creek 100 year flood plains will be controlled by local regulations stimulated by the National Flood Insurance Program administered by the U.S. Department of Housing and Urban Development through its Federal Insurance Agency (FIA). Flood Insurance Rate Maps for the South Santiam and Ames Creek flood ways are nearing completion now. Final conversion of Sweet Home to the 'Regular Program' of the National Flood Insurance Program is expected about December 1980.

All state and county bridges, culverts and storm drains within the city limits of Sweet Home will likely be constructed or improved to design frequencies outlined in Page 1-2 of the Oregon Department of Transportation's Hydraulics Manual. (Appendix A)

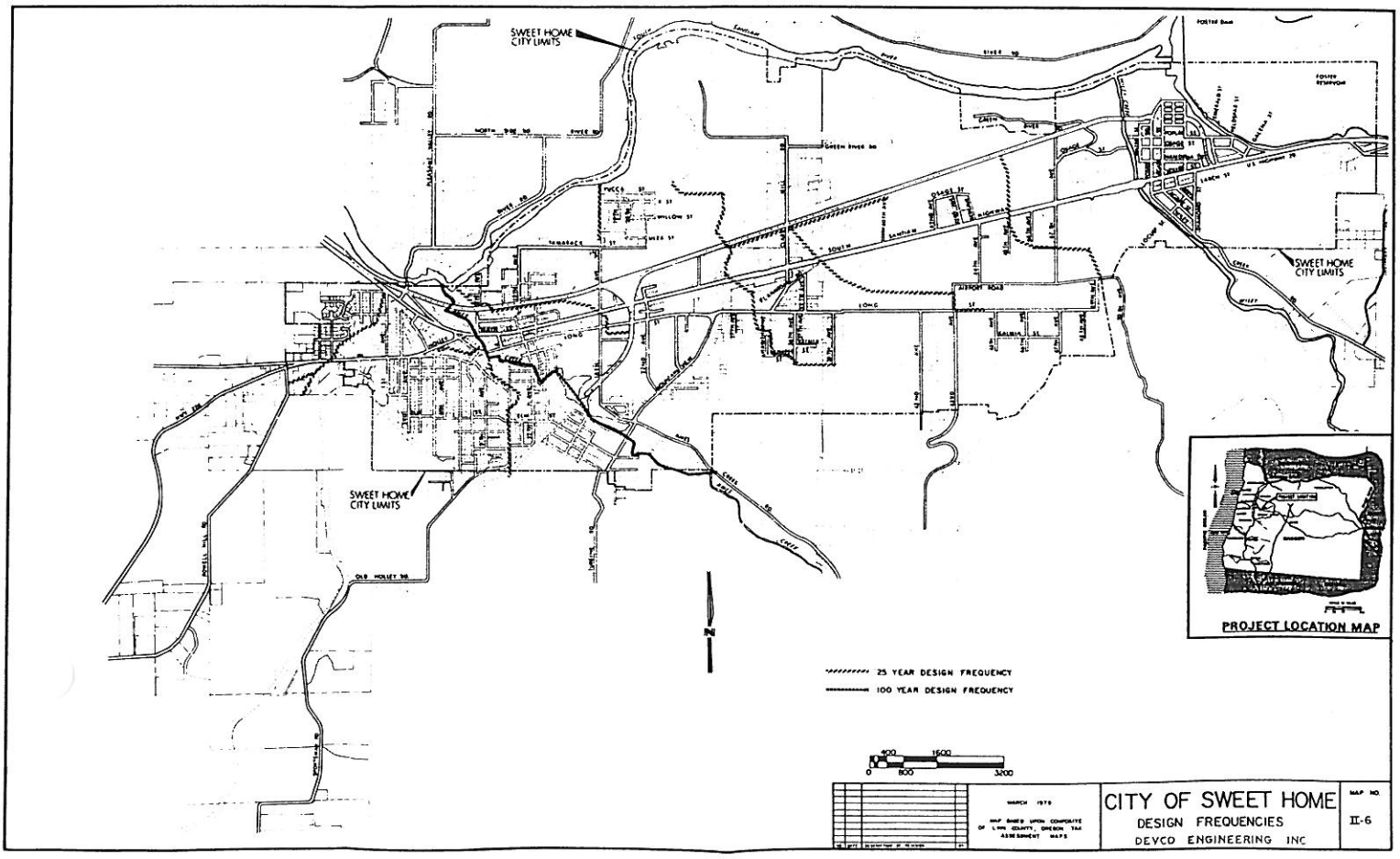
The City's design frequency criteria shall be compatible with State and Federal guidelines. Setting mandatory design frequencies for urban and suburban areas requires recognition of the existence of both 'convenience' and 'overflow or flood' drainage systems. 'Convenience' systems are the

---

[2] Cascadia I-F-D analysis is included in Appendix B.

catch basins, manhole, ditches, pipes, etc. that most people are familar with. 'Overflow or flood' drainage systems - whether planned or not - become apparent when the capacity of 'convenience' systems is exceeded. What distinguishes 'convenience' drainage from flooding, ponding, surcharging and the like is the selection of a design frequency. Design frequencies adopted by other Willamette Valley municipalities range from five (5) years to twenty-five (25) years for 'convenience' systems. The basic minimum design frequency recommended for the City of Sweet Home is ten (10) years. (A ten (10) year storm has a 10% chance of occurring in any one year.) Federal agencies such as the Department of Housing and Urban Development have established ten (10)years as the minimum storm drain design criteria for participation in their myriad assortment of financial assistance programs. The Oregon Department of Transportation is another agency which has set a minimum ten (10) year design frequency.

Outfall from 'convenience' storm drainage is accumulated in major drainages throughout the City and then routed to the South Santiam River. As the flow and velocity in these major drainages increased, the potential hazard and the degree of risk also increases. When these high and fast flows pass through areas of high occupancy density and/or areas of high property values the degree of risk is high enough to warrant additional protection which is provided by increasing the design frequency for these select reaches of major drainages.


SWEET HOME CITY LIMITS
SWEET HOME CITY LIMITS
SWEET HOME CITY LIMITS
PROJECT LOCATION MAP
25 YEAR DESIGN FREQUENCY
100 YEAR DESIGN FREQUENCY
N
0 800 1600 3200
MARCH 1979
MAP BASED UPON COMPOSITE OF LINN COUNTY, OREGON TAX ASSESSMENT MAPS
CITY OF SWEET HOME
DESIGN FREQUENCIES
DEVCO ENGINEERING INC
MAP NO.
II-6

A twenty-five (25) year design frequency is recommended for these selected reaches, Map II-6 identifies their locations.

It is possible that future development may propose to take advantage of land within the Ames Creek flood plain shown on FIA Flood Insurance Rate Maps through measures including realignment of Ames Creek. For this eventuality, it is recommended that any improvements, realignments, etc. to Ames Creek be based on a 100 year design frequency which is consistent with the National Flood Insurance Program.

Table IV-2, Peak Design Flows, tabulates the 'full development' design discharge for each reach of each major drainage investigated within the City of Sweet Home. Dependence on Table IV-1 will assure that all the design frequency criteria discussed above is being adhered to.

DETENTION WITH NEW DEVELOPMENT

What is detention?

> "The water falling on a given site should, in an ideal "detention" solution, be absorbed or retained on site to the extent that after development the quantity and rate of water leaving the site would not be significantly different than if the site had remained undeveloped.[3] This approach to storm drainage runoff says that temporary ponding is a solution and not a problem which in may respects is an 'about-face' from traditional design solutions which aim to remove runoff quickly.

---

[3] Residential Storm Water Management, ULI, ASCE, NAHB, 1975.

What are detentions 'Advantages' and 'Disadvantages':

'Advantages' include:

1. Peak discharges are reduced, thereby decreasing the necessary size of channels and pipes downstream. Lower peak flows also suggest less risk of water-related damage, less erosion, and higher water quality.

2. If downstream restrictions exist, detention design techniques may still permit upstream development which otherwise might not have been possible.

3. Key phrases in the use of detention are 'natural engineering', 'blue-green concepts', and 'economic environmental benefit'. Detention sites might double as tennis courts, picnic areas, paved parking lots, planned lakes, etc., thereby maximizing land use.

'Disadvantages' include:

1. Volume of runoff is not measurably reduced.

2. Initial development cost are usually higher, which in turn, increases the price of lots to the builders and eventually to the home buyers.

3. Appearance and/or maintenance of numerous small fully enclosed subsurface or numerous surface detention facilities may be difficult to keep up. Provision must be made for long-term operation of these facilities.

4. Detention is generally not economical where the land is already well drained and the drainage has a close outfall.

5. In the absence of mandatory basin-wide use of detention principles, a development incorporating detention to control its own runoff must still design for and be prepared to pass the increased runoff from ultimate development of sites upstream.

A comparison of existing runoff rates with projected 'full development' runoff rates which result from no detention are shown below for random locations.

Model[4] Identification	Storm Frequency (Years)	Location	Existing (cfs)	'Full Development' (cfs)
102	25	Nandina St. to Main St. west of 1st Ave.	292	308
504	10	12th Ave. just north of railroad	18	40
506	25	12th Ave. just south of railroad	128	149
530	25	18th Ave. north of Tamarack	61	126
556	25	Long St. to Main St. north of Ashbrook Subdivision	16	156
576	25	West of Clark Mill Rd. and south of railroad	189	359
586	25	43rd St. to U.S. Hwy 20 at approx. 36th Ave.	148	291
802	10	U.S. Highway 20 @ 40th Avenue	13	35
806	25	U.S. Highway 20 @ 45th Avenue	94	116

Increased runoff rates are the direct result of more streets, roofs with downspouts connected to street gutters, sidewalks, parking lots, etc. Infiltration into the soil is stopped and the surface and near-surface storage capacity of a natural surface is vastly reduced. 'Full development' runoff rates can be reduced if new development incorporates detention.

Most of the City of Sweet Home has good drainage slope. However, factors within the proposed urban growth boundary that favor the use of detention storage include:

---

[4] See Map IV-1

1. Midway bench south of Main Street and east of Mountain View Road can be characterized as flat.

2. Existing restrictions within downtown Sweet Home.

3. New growth will concentrate above existing drainage restrictions. Specific large new developments may substantially raise runoff before downstream improvements are made.

It is concluded that: (1) detention is an available tool which the City may use when downstream conditions warrant its application. (2) Each subdivision application be reviewed by the City Engineer for its impact on downstream properties. Where downstream problems are obvious, the Planning Commission Staff Report shall require that storm drainage be designed in accordance with the City's detention criteria.

Recommended detention criteria for the City of Sweet Home are:

3.4

1. Detention required for sites equal to or greater than four acres.

2. Sites less than four acres are exempt from detention requirements.

3. Hold runoff release rate from developed land equal to peak runoff from 10 year storm on undeveloped land.

4. Provide storage resulting from the difference between the 10 year release rate (item 3 above) and the 10 year storm runoff after development.

Acceptable detention calculations for low risk applications may utilize the Rational Method. Example calculations of this method for Berdell's Addition Subdivision are included in Appendix B. This method utilizes Figure II-5, Rainfall-Intensity-Frequency Curves. For larger

detentions and reservoirs, it is desirable to study the routing of storm runoff inflow through the detention area in greater detail. Continuity equations will be employed and the hydrographs in Appendix C and D may be specified as design criteria.

The results of a telephone survey on the use of detention by Willamette Valley cities is given below:

Municipality Greater 10,000 Population	Is On-Site Detention Currently Required?	Is Mandatory On-Site Detention Being Considered
Portland	Depends on downstream conditions	No
Salem	Yes	--
Roseburg	No	?
Corvallis	No	Yes
Oregon City	No	No
Beaverton	Yes	--
McMinnville	Yes	--
Dallas	No	No

HYDROLOGY AND HYDRAULICS

The Storm Water Management Model of the U.S. Environmental Protection Agency is one of the most comprehensive mathematical models for the simulation of storms and combined sanitary systems. This study uses but a small part of the model. Briefly, the portion of the program that is used is a step by step accounting of rainfall, infiltration detention, overland flow and gutter flow. In so doing

the fundamental mathematics are Horten's equation for infiltration, Mannings kinematic equation for overland and gutter flows and continuity equations to account for detention and time lag.[5]

Users manuals for SWMM have been given to the City. SWMM data input requirements and the primary source for each input parameter are shown below.

Input Parameter	Source
For channels or pipes:	
diameter or width	field survey
length	topographic maps
slope	topographic maps
side slopes	field survey
resistance	field survey
depth of overflow	field survey
For subcatchments:	
width	topographic maps
area	planimeter topographic maps
per cent impervious	topographic maps and City's Comprehensive Plan
slope	topographic maps
resistance, impervious	default value = .013
resistance, pervious	User's Manual
surface storage, impervious	default value = .062
surface storage, pervious	default value = .184 then adjusted for slope

[5] Bibliography items 15 through 23

Input Parameter	Source
infiltration, maximum	Soil Conservation Service
infiltration, minimum	Soil Conservation Service
decay rate	default value = .00115

Culvert capacities are calculated using the U.S. Department of Commerce, Bureau of Public Roads, HEC 5 and HEC 10, culvert capacity charts.

Where manual calculations were required, the Manning equation was used.

SYNTHETIC DESIGN STORMS

The only recorded gauging of runoff flows in the Sweet Home watershed is on Wiley Creek at mile station 3.8 for the year 1947 through 1973.[6] (In 1973 the gauge was moved to its present location at mile station 1.4.) However, Wiley Creek is excluded from this study because it poses no serious flood damage risks within the City. Since the remainder of the City's watershed is without gauging, it is impossible at this time to calibrate and verify the SWMM model that is now constructed. If undertaken calibration would involve taking an actual storm precipitation record from the National Weather Service measurement station at Foster Dam, inputting this into the SWMM model of Sweet Home, and comparing the SWMM produced runoff with actual gauged runoffs, if necessary, adjusting the parameters within the model to achieve maximum correlation between the calculated and observed runoffs.

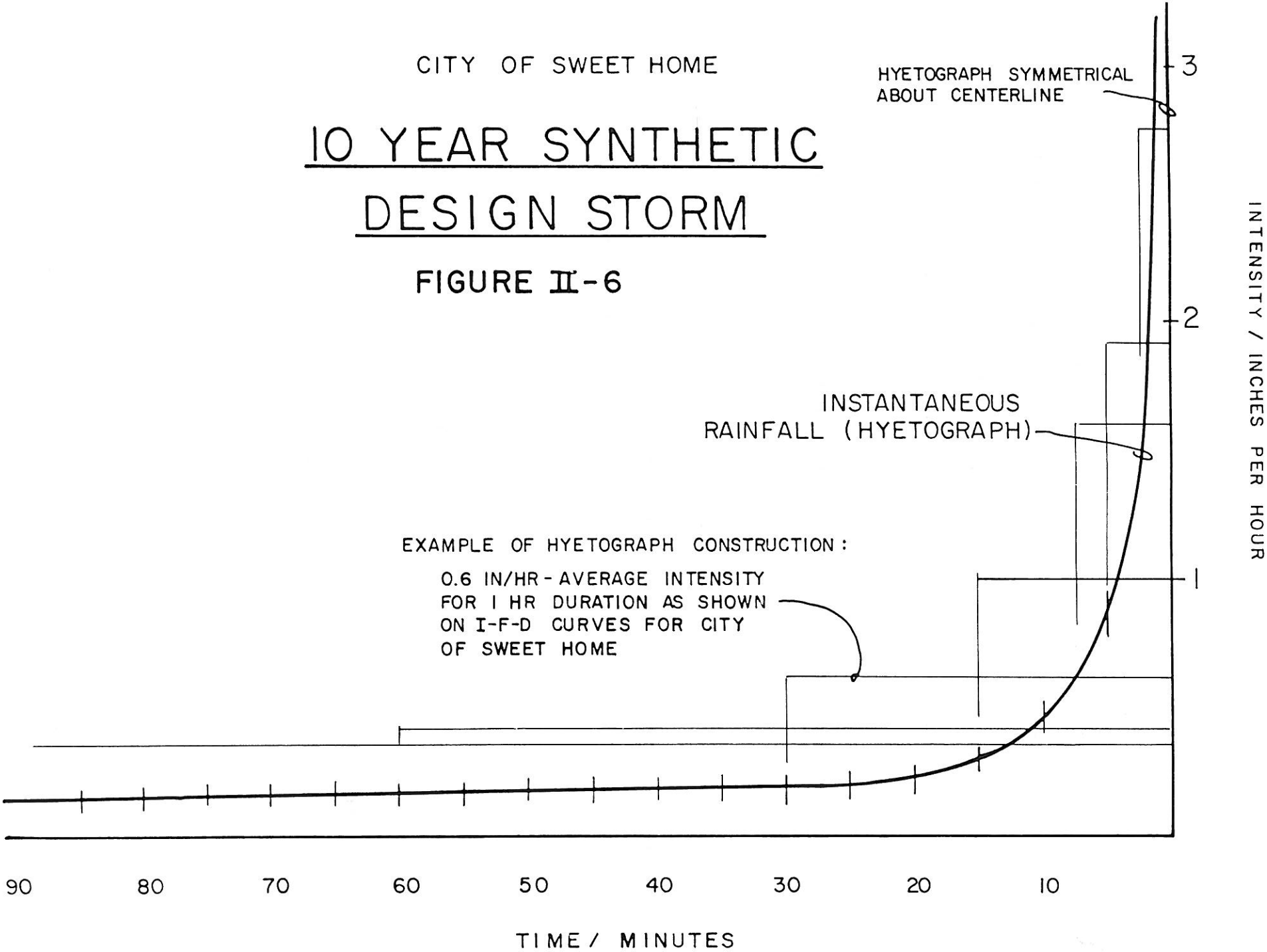
---

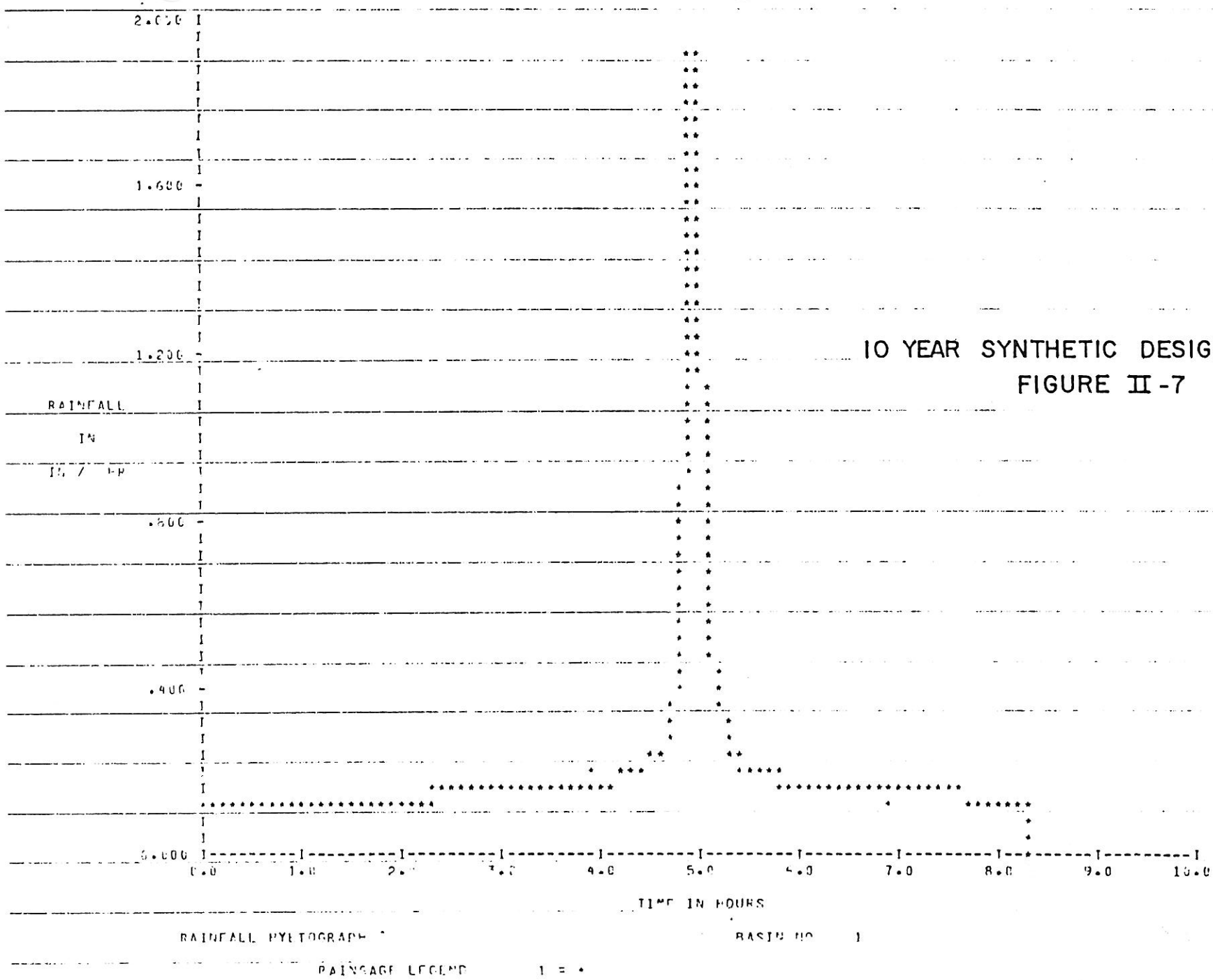
[6] See Notes and Calculations for annual frequency analysis of this data etc.

CITY OF SWEET HOME

10 YEAR SYNTHETIC DESIGN STORM

FIGURE II-6





10 YEAR SYNTHETIC DESIGN RAINFALL
FIGURE II-7

To produce the deterministic model that exists, synthetic design storm rainfalls (instantaneous hyetographs) were prepared based on the intensity-frequency-duration curves previously prepared for the City. Hyetographs were prepared for the 10, 25 and 100 year storms. Figure II-6 shows construction of the 10 year synthetic design storm rainfall (hyetograph). Figure II-7 is the 10 year synthetic design hyetograph. The 25 and 100 year hyetographs are in Appendix C and D.

OTHER STUDIES

Two studies of significance are currently underway which involve Ames Creek. These are:

1. Federal Flood Insurance study being performed by the Corps of Engineers for the Federal Insurance Agency (FIA) of the Department of Housing and Urban Development.
2. Oregon Department of Transportation preparation of plans and specifications to replace the Mountain View Road bridge on Ames Creek.

The hydrologic investigations of both studies are complete and available for comparison with the Proposed Master Storm Drainage Plan. Agreement between the various studies is acceptable.

	Peak Runoffs (cfs) for 100 year Average Return Period Storm	
	Ames Creek @ Santiam	Ames Creek @ Mt. View Rd.
Proposed Master Drainage Plan	2510[7,8]	1710[7]
FIA Study - Corps of Engineers	2125	-
Oregon Department of Transportation	-	1650[9]
Geological Survey Water Supply Paper #1689[10]	-	1760

Field survey notes of Ames Creek taken by the Corps of Engineers were provided for use in this study and are included in Appendix B.

---

[7] Includes 50 cfs of winter base flow added to SWMM runoff.

[8] Based on 'full development'

[9] Based on Oregon State Highway Division, Hydraulics Manual, Page 3-47.

[10] Provided for additional comparison. Geological Water Supply Paper 1689, Magnitude and Frequency of Floods in the United States, Part 14, Pacific Slope Basins in Oregon and the Lower Columbia River Basin.