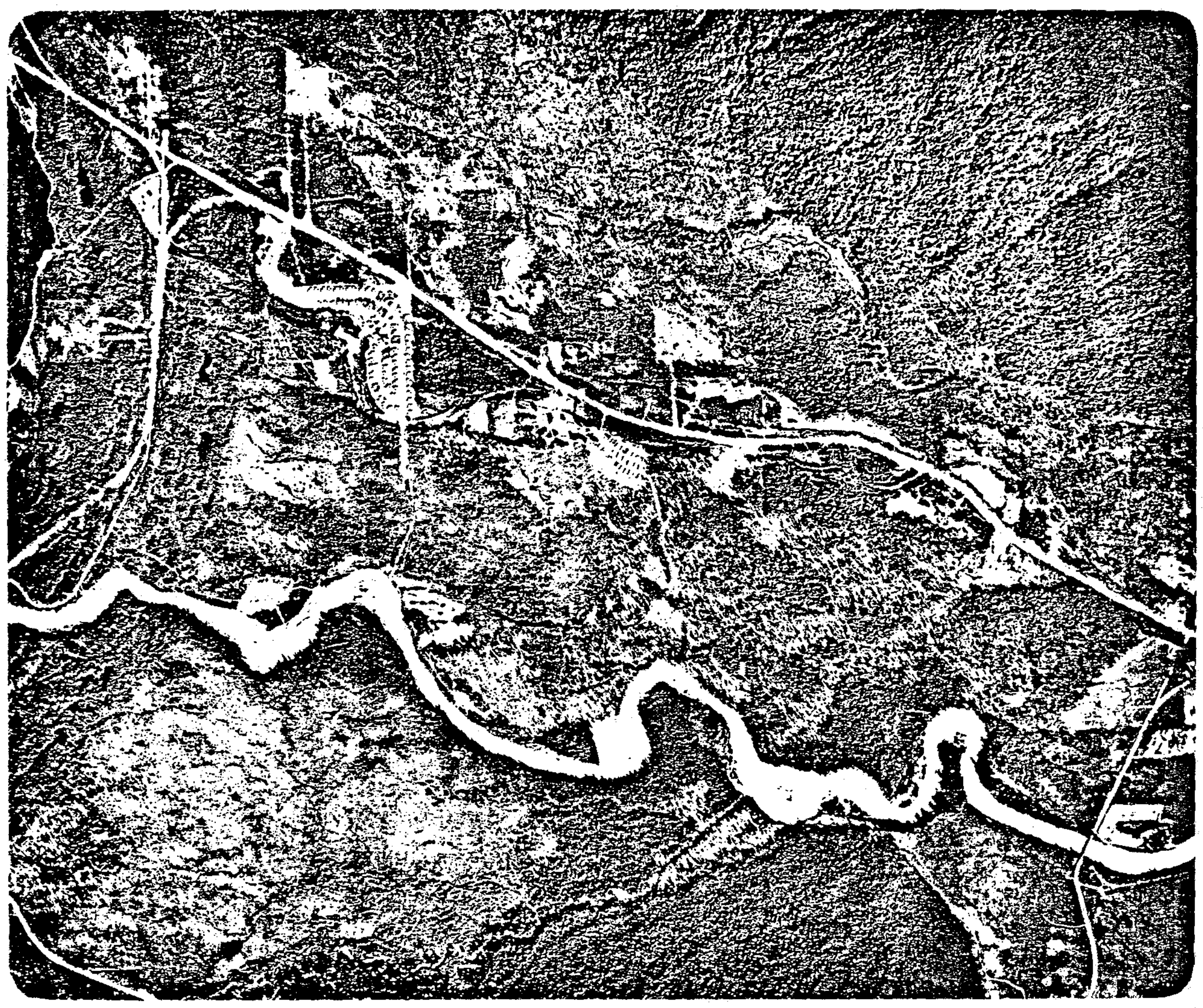
MENDENHALL VALLEY DRAINAGE STUDY



engineering
man
power
services

Prepared for
City & Borough
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1979

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INTRODUCTION

The Mendenhall Valley is rapidly being developed as Juneau's principal "bedroom" area. Present population of the valley is estimated to exceed 7000 people; an increase of some 5000 since 1967. This development has resulted in increased drainage problems, due in part, to new subdivisions being platted on poorly drained areas, or in active drainage channels. Other factors causing, or adding to drainage problems, are more rapid and increased runoff due to the loss of tree and vegetative cover and the creation of more and larger impervious areas. Isolated instances of blockage or reduction of natural drainage sources have also occurred, resulting in localized flooding. Road and drainage design have been inadequate in some instances, causing runoff to flood adjacent or downstream properties. Paving of subdivision streets and arterials increase the rate of runoff.

These factors have all contributed to the "drainage problem" and clearly indicated the need for a drainage plan based upon uniform application of standards for design and construction.

The City and Borough of Juneau, in recognition of this, engaged Engineering Man Power Services to conduct a drainage study for the Mendenhall Valley. The study is to provide the following information:

1. Proposed drainage plans for the area with alternatives as required.

2. An assessment of the impacts of these alternative plans on the environment.

3. A means of financing these improvements.

4. Recommendations as to regulations to implement these plans.

CHAPTER I

STUDY AREA DESCRIPTION

A. Location and Topography

The Mendenhall Valley, comprising the study area, lies about 8 miles northwest of the Juneau business district. The study area is shown on figure 1, being bounded on the north and east by the Tongass National Forest, the west by the drainage divide between the Mendenhall River and Auke Lake, and by the Municipal Airport on the south. The major streams in the valley are the Mendenhall River, Duck Creek, Jordan Creek and Montana Creek. Adjacent areas that contribute to the drainage in the study area have also been studied.

The study area consists of approximately 7.3 square miles or 320,000 acres, of which only a fraction is considered developable. This developable area is gently sloping to the north (upstream), being about 3 miles long and about 1 mile wide. The steep westerly slope of Heintzleman Ridge, rising to an elevation of 2900 feet, comprises the headwaters of Duck and Jordan Creeks, while the wooded ridge between Auke Lake and the Mendenhall River contributes to the flows of Montana Creek and the Mendenhall River.

640
7.3
1920
4480
4672.0

B. Population

The population of the Mendenhall Valley is estimated to be about 7200 persons. This has increased from an estimated 2300 persons in 1967, being an annual increase of about 10%. Nearly all the current population is in the East Mendenhall Valley.

The Mendenhall Valley comprehensive plan adopted in 1973 forecasts a population of 18,673 persons east of the Mendenhall

River. This contemplates full utilization of all buildable land with reservation for schools, gravel extraction, parks and greenbelts.

The ultimate population of the area west of the river is estimated to be 9,612 persons. The total of these two is 28,285 persons in the study area as saturation population.

This would represent more than a three-fold increase over the current population level.

C. Man-Made Development

The history of development in the Mendenhall Valley is comparatively short, with most of the early development related to the lower portion of the Valley. There undoubtedly were some early day homesteads or miner's camps but they were isolated and left few lasting remains.

Pre-World War II development consisted of several dairy farms near the mouth of Duck Creek and Jordan Creek, some fur farms on Duck Creek utilized the salmon runs for animal food, and a few commercial vegetable gardens were in existence. The A-J Mine had constructed a hydro-electric plant on Nugget Creek with a road and power line to it. This road permitted visitors to see the Mendenhall Glacier and it continued around the Mendenhall Loop, following the same route as it does today. A few residents were scattered along its length.

These activities probably had little effect on the character of drainage and flows, though they undoubtedly impacted some of the fish runs.

World War II brought an army camp into the Duck Creek drainage and also caused construction of the Juneau Airport. The character of dairying operations changed and fur farming had ceased. Airport construction was particulary impacting on Jordan and Duck Creeks because the mouths of these streams came increasingly under both horizontal and vertical control. This was particularly true for Jordan Creek. Part of the stream entered groundwater flow above the airport. In lower flow periods only a fraction of the stream passed through the 375 foot corrugated culvert under the runway.

During the post-war years into the early 1960's, several factors had large and long-standing influence on the character and health of both Duck and Jordan Creeks.

a. Parts of middle Jordan Creek drainage were logged or hi-graded for timber, with little control over logging slash disposal in or near the stream.

b. Portions of the Loop Road were widened, using alluvial material from dredged ponds near the Loop Road.

c. The Duck Creek drainage, particularly near its headwaters began to be urbanized with the first tract home construction - Mendenhaven, 1961. Roadside reaches of Duck Creek also became increasingly open to the sun and to proliferation of aquatic vegetation.

During the past decade, urban development in the eastern Mendenhall Valley has proceeded at an increasing pace. This is particularly true since 1973, when the valley sewer system was constructed. Home construction extended to the west bank of Jordan Creek over an extensive portion of this stream's length up-stream from USS 1194. Construction of Egan Drive during this period established the present major culvert control locations and levels for both Duck and Jordan Creeks, passing under the highway.

The Mendenhall Valley sewer presently handles a peak flow of about 3.5 m.g.p.d. of which a significant volume is believed to be from stormflow leakage. Most, if not all, of the domestic water supplies thru-out the Mendenhall Valley draw upon ground water supplies. If 7000 residents in the Mendenhall Valley use about 135 g.p.d/person, then domestic water withdrawals total about 945,000 g.p.d.

D. Soils

The nearly level flood plain of the valley is composed of soils formed in water-laid sandy and silty sediments underlain by coarse sandy and gravelly materials. The depth to gravel ranges from only a few inches to many feet. Many of the soils have high seasonal water tables and are subject to flooding. The depth and frequency of flooding varies with the elevation and location of the soils in the valley.

On the uplands most of the soils are formed in glacial stony till that ranges from a few inches to many feet in thickness over bedrock. Generally, the steeper soils are very shallow and areas of these soils usually include rock outcrops. On benches and footslopes, where deposits of till are commonly thicker, many of the soils are poorly drained. The wet conditions are caused primarily by firm, compact, slowly permeable or impervious subsoil and substratum materials, which impede adequate percolation of water added to the soil by rains and by seepage or runoff from higher areas. There are tracts ~~of well~~ drained soils.

Areas of very poorly drained peat soils occur both on the uplands and in the valleys. These soils have high water tables and are from about two feet to many feet thick over mineral materials. The peat materials, which are in various stages of decomposition, are derived from sedges, mosses, and woody vegetation.

E. Climate

Juneau lies well within the area of maritime influences which prevail over the coastal areas of Southeastern Alaska, and is in the path of most storms that cross the Gulf of Alaska. Consequently, the area has little sunshine, generally moderate temperatures, and abundant precipitation.

The months of February to June mark the period of lightest precipitation, with monthly averages of about 3 inches. After June the monthly amounts increase gradually, reaching a maximum during October when the monthly fall averages over 7 inches.

Monthly averages of precipitation then tend to decline from November until February. Due to the rugged topography, precipitation through-out the year tends to vary greatly in different localities, even in adjacent areas. Juneau Airport has about 65 percent of the total precipitation realized in the City though the rain gages are only 8 miles apart. The maximum yearly amount received in the City is almost double the maximum received at the Juneau Airport.

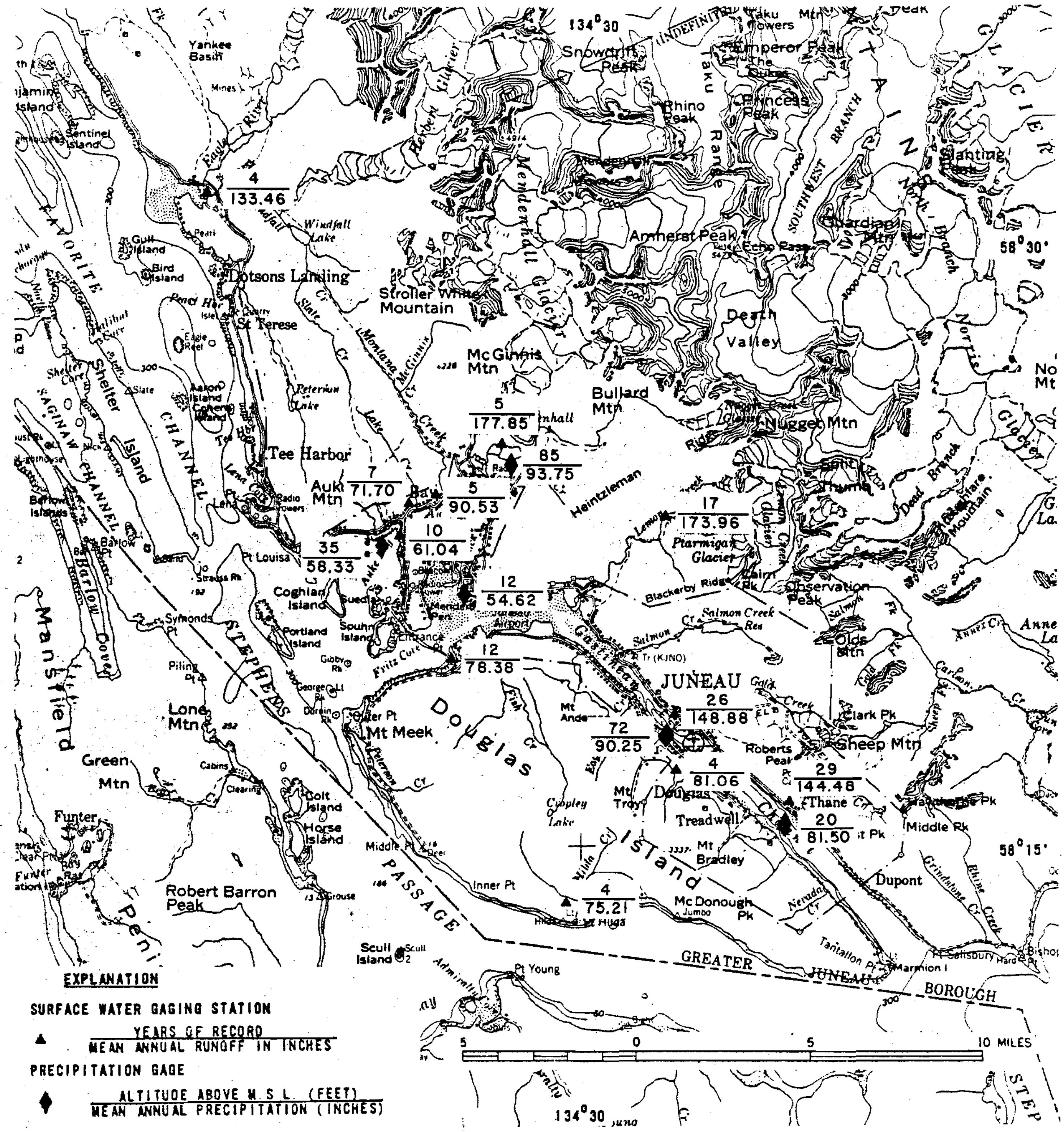
Although it varies widely, the highest average monthly precipitation occurs in the fall when regional storms dominate, and the lowest occurs in late spring when local storms are more prevalent. The maximum monthly precipitation recorded in Juneau was 25.87 inches in November 1936 in contrast to the minimum monthly precipitation of 0.25 inches in July 1915. The maximum monthly precipitation recorded at Juneau Airport was 15.25 inches in October 1974, and the minimum monthly precipitation was 0.27 inches in April 1948.

During October 1978 the measured precipitation nearly exceeded these records, being 13.00 inches at the airport station and 26.68 inches downtown. (Downtown records are not consistent due to station relocation.)

Figure 2 shows that the mean-annual precipitation for stations below 90 feet altitude ranges from 54.62 inches to 93.75 inches. Fragmentary data from high-altitude stations indicate that precipitation increases rapidly with increased altitude as an air mass rises over the initial mountain front; precipitation then declines as the air mass moves over the ice field. Researchers measured approximately 285 inches of precipitation a year at an altitude of 3,400 feet on Mount Juneau, whereas, others indicate that precipitation at an altitude of 4,000 feet on the ice cap is about 100 inches a year.

The effect of this increase in precipitation with altitude must be considered in estimating runoff in the Mendenhall Valley.

Airport data is valid at that location only and as the distance from it is increased, the less reliable it becomes.



Base from USGS 1:250,000 Topographic series - Juneau 1962

Figure 2 - Locations of stream gages and weather stations showing variation of precipitation, runoff, and length of records.
Source: Water Resources of the City and Borough of Juneau.

Other stations, however, do not keep hourly precipitation records which are used to determine storm intensities resulting in flood discharges.

Snow fall and ice accumulation in the area must also be considered in runoff calculations.

Although a trace of snow has fallen as early as September 9, first falls usually occur in the latter part of October, and sometimes not until the first part of December. On the average there is very little accumulation on the ground at low levels until the last of November, although at higher elevations, and particularly on mountain tops, a cover is usually established in early October. Snow accumulation usually reaches its greatest depth during the middle of February when it averages around 10 inches at the airport. December, January, February, and March have the largest amounts of snowfall, averaging from 18 to around 26 inches per month. Individual storms may produce heavy falls as late as the first part of April and light falls as late as the first half of May. However, snow cover is usually gone before the middle of April. During some winters, when temperatures are above normal, there is a great deal of thawing which causes slush that later freezes; and there are occasional intervals of rain which freezes into glaze ice on contact with the ground.

F. Hydrology

The runoff in the study area resulting from the precipitation is determined by topographic, geologic and vegetative factors as these affect the surface streams.

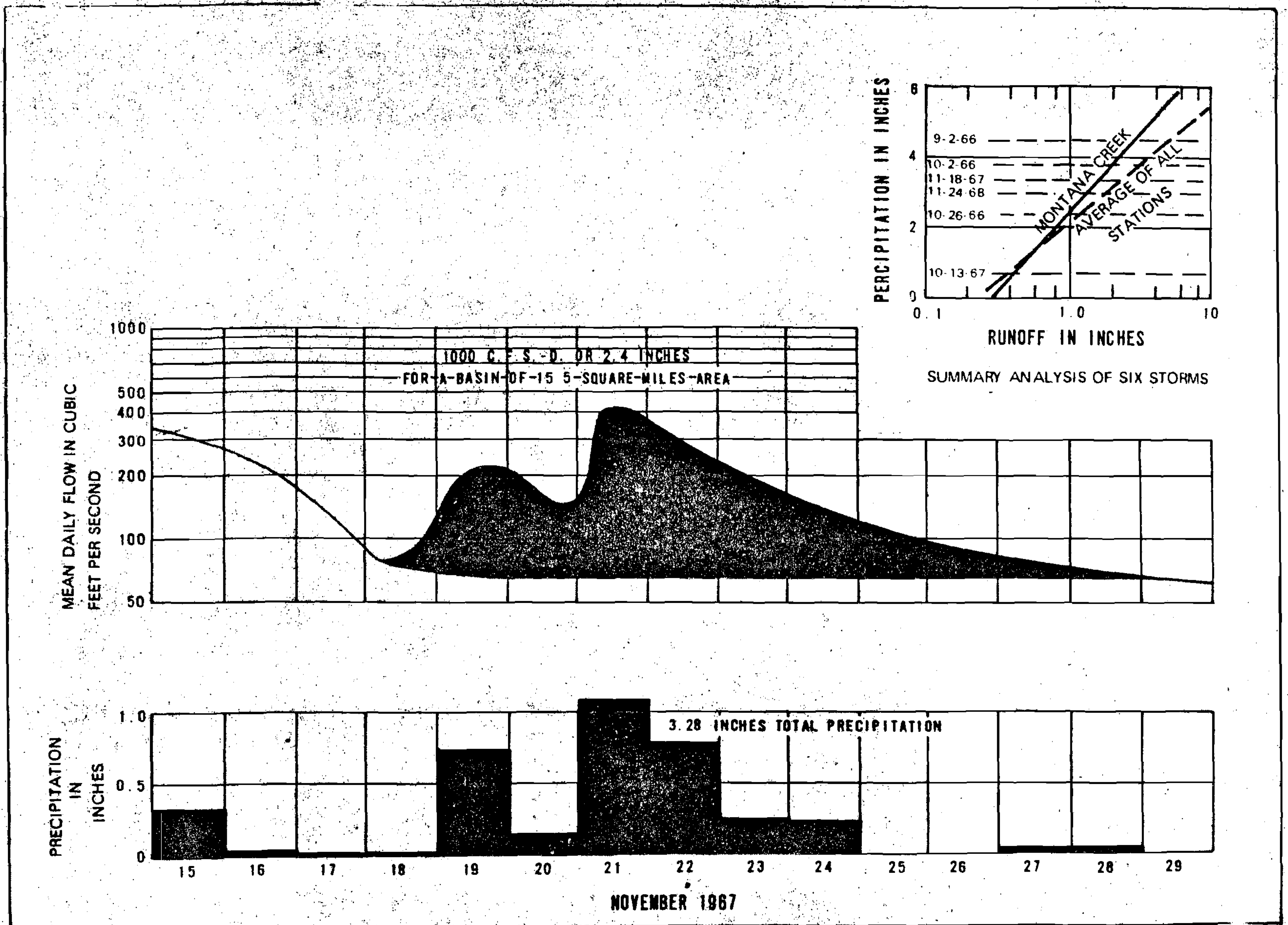
Some of the precipitation is lost through evapotranspiration. This term refers to all the natural processes by which water on and beneath the land surface is returned to the atmosphere as water vapor. Sufficient data are not available in the Juneau area to evaluate directly evapotranspiration of precipitation with a high degree of accuracy. However, Patric and Black (1968) developed empirical estimates based mainly on National Weather Service data. Their estimates of annual potential evapotranspiration in the Juneau area ranged from 17.79 inches to 21.89 inches and averaged 20.35

inches. Patric (1966) determined also that 25 percent of the total precipitation in areas of mature coniferous forest never reached the ground. Patric's potential evaporation was water loss from fully vegetated land surfaces always abundantly supplied with soil moisture. During the 6 months that Patric collected data, only 72.5 percent of gross rainfall reached the ground under the forest.

Streams flowing to the sea represent another major element of fresh-water discharge from the hydrologic system in the study area. Analysis of streamflow records gives reliable information on floods, total flow, maximum flow, minimum flow, and time duration of flow. Estimates of flow characteristics of ungaged streams can be made also by making statistical comparisons with long-term records on comparable streams, checked by spot-discharge measurements on the ungaged streams. Long-term streamflow records from a network of gaging stations are fundamental to such studies. Continuous streamflow records, ranging from about 3 to 28 years, are available for the 13 streams shown in Table A. Stations on these streams were established at points sufficiently upstream from the ocean so that the records would not be affected by tidal fluctuations.

Discharge of many streams in the City-Borough is related directly to precipitation. The increased streamflow caused by a storm is logically called direct runoff, and can be estimated from a stream hydrograph (Figure 3). This figure also summarizes the relation between precipitation and direct runoff in the 13 gaged streams in the Borough during 6 selected storms. The data indicate that direct runoff increases from about 50 percent of the precipitation recorded at altitudes below 90 feet during a 1-inch storm to about 125 percent during a 5-inch storm. This seeming excess of 25 percent reflects lack of precipitation records at altitudes higher than 90 feet.

For the major streams in the study area, monthly flows are normally greatest in early summer and least in late winter. This is portrayed in figures 4 & 5 which are graphs of monthly dis-



Same source as Figure 2.

Figure 3.--Relation of precipitation to direct runoff for selected storms recorded at Juneau airport

Table A Basin description of gaged streams.

Name of stream	Number (fig. 8)	Latitude	Longitude	Drainage area (square miles)	Mean basin altitude (feet above mean sea level)	Gage altitude (feet above mean sea level)	Stream length (miles)	Main channel slope (feet per mile)
Herbert River	A	58°31'26"	134°47'40"	56.9	2,790	5	16.2	393.4
Lake Creek	B	58°23'40"	134°37'50"	2.50	1,170	75	3.6	555
Montana Creek	C	58°23'53"	134°36'34"	15.5	1,500	75	7.6	264
Mendenhall River	D	58°25'05"	134°32'40"	85.1	3,260	60	18.3	291.5
Auke Creek	E	58°22'56"	134°38'10"	3.96	1,200	69.1	3.6	536
Lemon Creek	F	58°23'30"	134°25'15"	12.1	3,430	650	5.3	500
Fish Creek	G	58°19'50"	134°35'20"	13.6	1,600	17	6.9	289
Gold Creek	H	58°18'25"	134°24'05"	9.76	2,400	245	4.9	541
Lawson Creek	I	58°17'05"	134°24'40"	2.98	1,530	75	3.7	556
Sheep Creek	J	58°16'30"	134°18'50"	4.57	1,900	629.8	3.4	232
Hilda Creek	K	58°13'38"	134°29'50"	2.62	1,580	30	4.3	500
Carlson Creek	-	58°19'00"	134°10'15"	24.3	2,200	130	8.5	219
Dorothy Creek	-	58°13'40"	134°02'25"	15.2	3,100	350	8.5	234

Name of stream	Lake area (percent)	Forest area (percent)	Glacier area (percent)	Record high discharge (cubic feet per second)	Record low discharge (cubic feet per second)	Years of record	Average discharge (cubic feet per second)	Runoff (inches)
Herbert River	1.8	36.9	58	6,280	15	4	523	133.41
Lake Creek	.0	70.0	.0	980	0	7	13.2	71.70
Montane Creek	.0	64.5	3.2	1,920	5	5	101.3	88.75
Mendenhall River	3.5	9.4	66	9,020	25	6	1,114	177.77
Auke Creek	.0	48	.0	348	.02	10	17.8	61.04
Lemon Creek	.0	4	67	2,800	--	16	155	173.96
Fish Creek	.0	72	.0	2,120	1.0	12	78.5	78.38
Gold Creek	.0	29	8	2,650	.0	17	107	148.88
Lawson Creek	.0	81.9	.0	565	.27	4	17.9	81.57
Sheep Creek	.0	44	2.0	840	.0	31	48.6	144.42
Hilda Creek	.0	59.5	.0	400	.60	4	14.5	75.16
Carlson Creek	.0	68	10	5,100	--	10	340	190.01
Dorothy Creek	15	13	16	1,780	6	38	143	127.76

Source: Water Resources of the City and Borough of Juneau, Prepared by the United States Geological Survey. (1971)

EXPLANATION

Location.--Lat 58°23'53", long 134°36'34", in E½SW¼ sec 13, T. 40 S., R. 65 E., on right bank 80 ft upstream from highway bridge, 1.4 miles upstream from mouth at Mendenhall River, 1.5 miles northeast of Auke Bay, and 3.9 miles downstream from McGinnis Creek.

Drainage area.--15.5 sq mi.

Records available.--August 1965 to present. Miscellaneous measurements collected in 1948, 1950, 1952, 1961, 1963-65.

Gage.--Water-stage recorder. Altitude of gage is 75 ft (from topographic map).

Remarks.--Records good except those for winter months, which are poor.

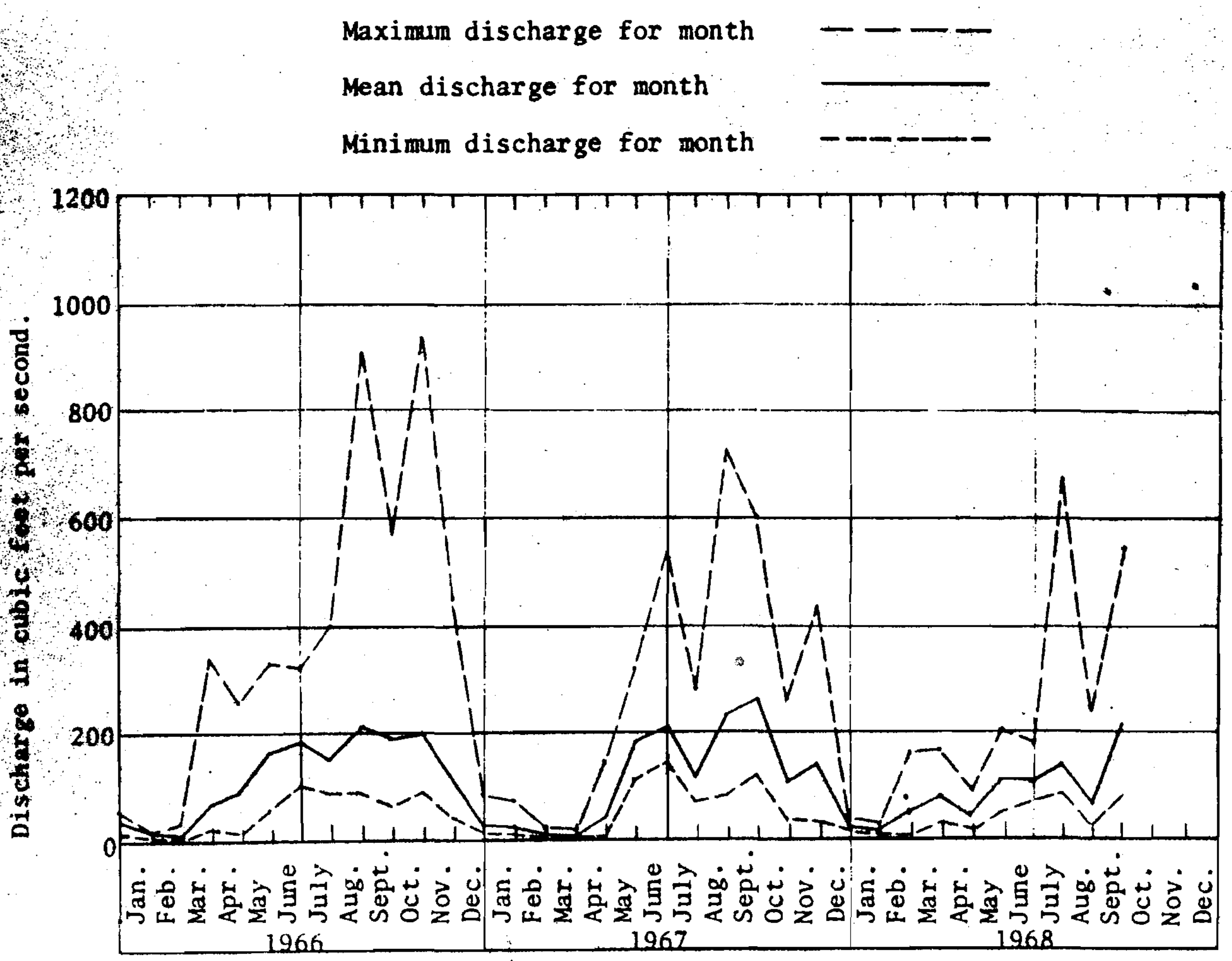


Figure 4.--Graph of monthly discharge and summary of records for gaging station 15-0528: Montana Creek near Auke Bay, Alaska.
From hydrologic data of the Juneau Borough prepared by the United States Geological Survey, 1969.

EXPLANATION

Location.--Lat 58°25'05", long 134°32'40", in $SW\frac{1}{4}NE\frac{1}{4}$ sec 8, T. 40 S., R. 66 E., at east end of Mendenhall Lake, 250 ft northwest of Mendenhall Visitors Center, 7 miles upstream from mouth at Fritz Cove, and 4.2 miles northeast of Auke Bay.

Drainage area.--85.1 sq mi.

Records available.--May 1965 to present.

Gage.--Water-stage recorder. Altitude of gage is about 60 ft (from topographic map).

Remarks.--Records fair except those for periods of no gage-height record and those for winter months, which are poor.

Maximum discharge for month

Mean discharge for month

Minimum discharge for month

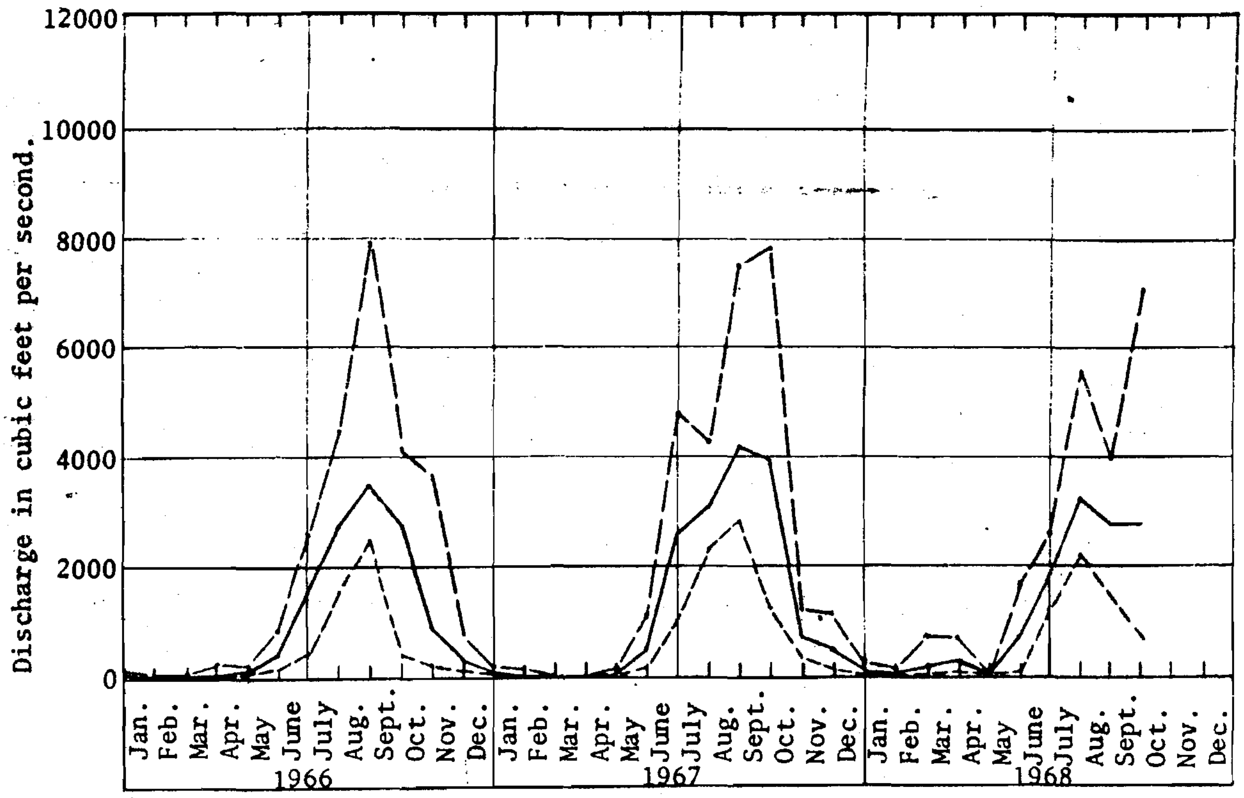


Figure 5.--Graph of monthly discharge and summary of records for gaging station 15-0525: Mendenhall River near Auke Bay, Alaska. Same source as figure 4.

charge and summary of records for Montana Creek and Mendenhall River. Data indicate that the total outflow of fresh water during the month of greatest flow averages about 15 times the total during the month of least flow. The long-term monthly flow characteristics of selected streams are shown in Figure 6. Basic data on these and other gaged-stream basins are included in Table A.

Discharge of any stream depends primarily on the size of its basin, although other factors are undoubtedly influential. Figure 7 shows the relation of stream discharge to basin size. The regression curves show high-, average-, and low-discharge relation. High flow is generally proportional to average flow regardless of basin size. But low flow of small basins is disproportionately low because such basins generally lack the ground-water reservoirs, which provide the base flow of larger streams.

The low flow of many streams is derived from drainage of ground water; but when flow in the streams is high, surface water generally recharges the aquifer. The aquifers are also recharged by infiltration of precipitation. Sufficient data are not available to estimate directly the quantity of ground-water recharge in the study area; however, indirect estimates of ground-water recharge indicate that under natural conditions, recharge might be 25 percent of total precipitation in the larger basins. Duck Creek in particular appears to lose a sizable portion of its flow to recharge of the aquifer.

G. Water Quality

The hydrologic characteristics of the Mendenhall Valley drainages are seen from the discussion above to vary from dominantly glacial melt-water to predominantly surface water sources, and also including heavy contributions of ground water to at least two streams. These naturally varying hydrologic characteristics produce variable water quality as shown in Table B.

Note:
Table A and Figures 2, 3, 6, and 7 from Water Resources of the City and Borough of Juneau.

Figures 4 and 5 from Hydrologic Data of the Juneau Borough. Both prepared by the United States Geological Survey.

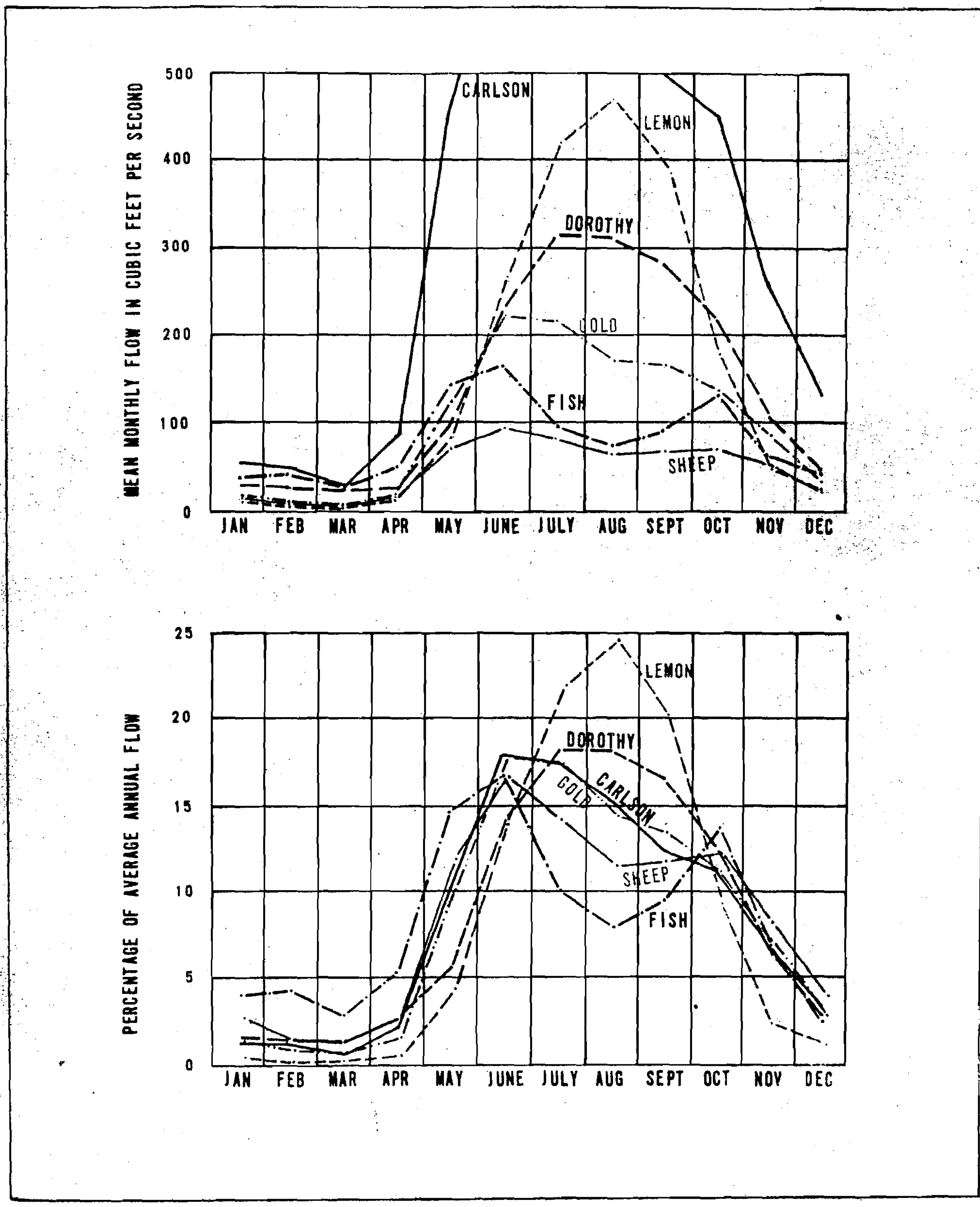


Figure 6 - Long-term monthly flow characteristics of selected streams in the City-Borough
Same source as Figure 2

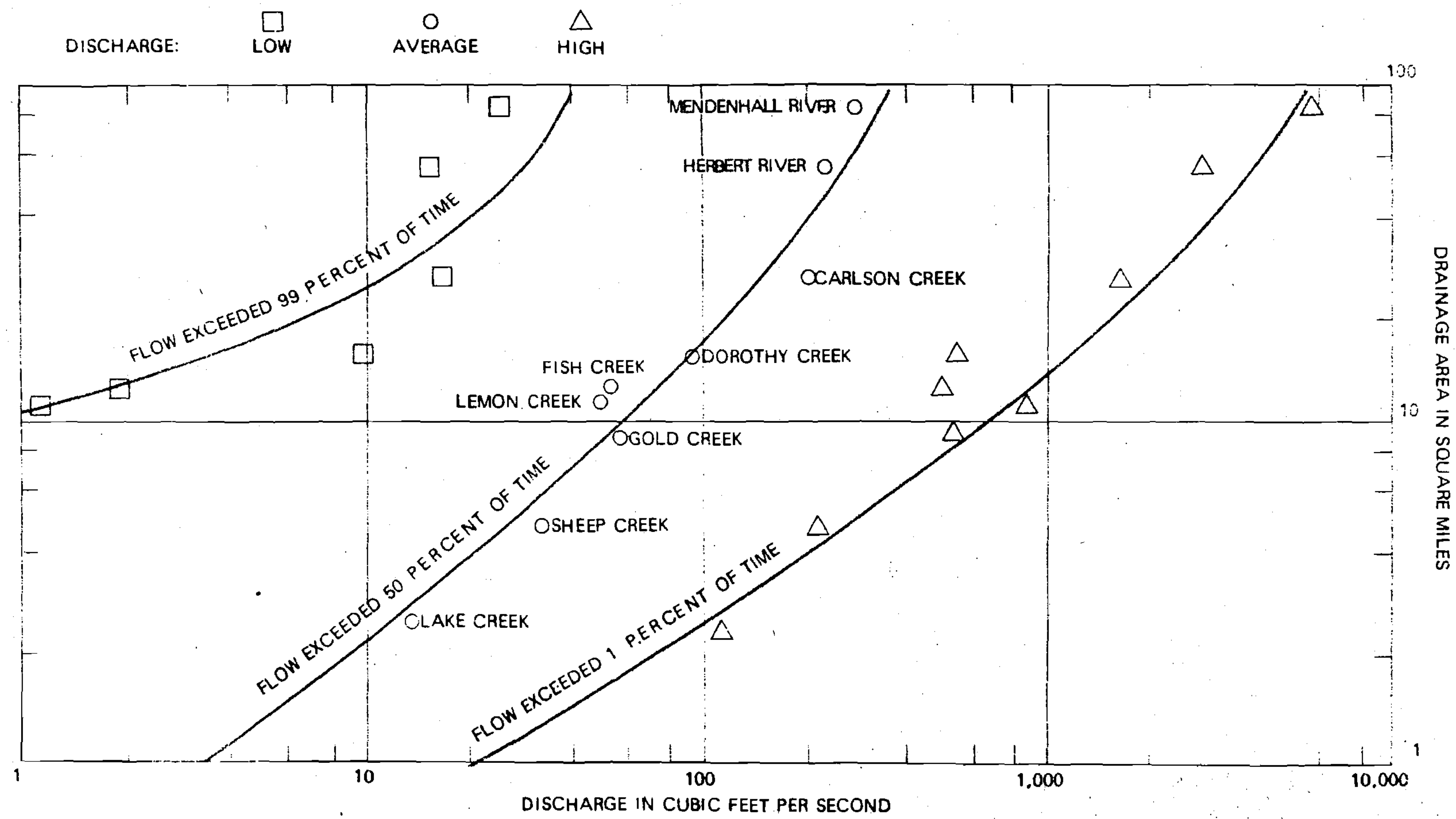


Figure 7.--Relation of streamflow to basin size.
Same source as figure 2.

Table B

Generalized Water Quality
Characteristics of Mendenhall Valley

Parameter	Source of Waters		
	Glacial	Surface	Groundwater
temperature	winter: approach 32°	winter: approach 32°	winter: elevated well above 32°
	summer: 55°	summer: variable, up to 80° in areas open to sun during low stream flow.	summer: warming from around 42° 45° emergence temperature.
sediment	winter: decrease to 10 mg/L	winter: normally 0 - 10 mg/L	undisturbed flows generally 0-5 mg/L
	summer-fall 1000 mg/L Bed-load sediment of sand-gravel size.	summer-fall variable 0-100 mg/L from road washings gravel removal operations & land excavations. Bed-load sediments: favor sand-fine gravel.	disturbed flows 100 mg/L from road washings, gravel removal operations & land excavations, Bed-load sediments: favor sand.
iron	Total iron variable; can exceed 2 mg/L. Deposition near river-banks where ground waters emerge.	Total iron variable: 1 mg/L; occasional iron deposition.	Total iron variable usually 1 mg/L; frequent iron deposition at up-welling areas.
pH	Usually 7.0	Variable: in mid-valley and near old glacial out-wash is 7.0	Variable; similar pattern to that for surface water; Mendenhall sediments evidently favor elevated pH
sewage effluent	No current information identified.		

H. Water Supply

Ground water in the Mendenhall Valley contains iron and manganese in excess of the Public Health Standards. Its total hardness averages 90 to 100 parts per million and the temperature ranges in the lower 40's. Relatively iron free water enters the valley by precipitation and flows in the streams. Iron content increases slightly in the surface streams as water passes through the valley. The iron content greatly increases when water infiltrates and moves through the aquifier.

The valley does not have a central water supply system. Instead, water is obtained from wells, small surface catchment systems and precipitation. Some of the larger tract developments, and trailer parks in the area have installed ground water supply systems for a limited number of units. The three major Shopping Centers have pump reservoir ponds and system which meet a fire demand and thereby allow a reduction in insurance rates.

There are an increasing number of problems due to iron concentration and hardness. Whether this is due to the additional number of wells, or other factors, is not known. The construction of the sanitary sewer system reduces replenishment of the aquifer by the amount of the domestic water usage plus the inflow into the sewer system.

I. Vegetation

The east side of the Mendenhall River Valley bottom has been partially logged (hi-graded for spruce) over the years since World War II while less logging occurred on the west side of the river. Logging extended onto the toe slopes of Thunder Mountain and included extensive areas of the Jordan

Creek drainage, some areas of the Duck Creek drainage, and portions along the lower Mendenhall River. Urban development has been accompanied by extensive clearing. The tree cover remaining along the streams of the eastern valley are dominantly spruce with varied age classes and stand densities. Some portions of the stream channels are overgrown with grasses and sedges which tolerate or thrive where the stream has been slowed and clogged by logs, debris, or garbage. Devil's Club, Sitka Alder, willow and Stink Currant occur under the spruce margins of Valley streams, while willow continues along the banks of open streambeds near the intertidal areas.

An extensive drainage area between lower Montana Creek (below Loop Road Bridge) and the Mendenhall River is covered with grasses, sedges and other water loving plants. Willow and alder are also common on slightly raised surfaces and open grown spruce appear on a bit higher ground. Beaver use the hardwoods and the slow-moving tributaries to Montana Creek. Moving across this open area from Montana Creek to the Mendenhall River, the land becomes well drained near the lower water level of the river, where gravel deposits are evidently extensive. Accordingly, the vegetation near the river becomes favorable for excellent stands of Sitka spruce, as well as large cottonwood. Youthful stands of hardwoods - primarily alder - grow on recently abandoned river shoreline. The riverside alder stands also support dispersed stems of well-established, younger spruce, which may one day replace the alder overstory.

The inter-tidal and wetlands near the mouth of Duck and Jordan Creeks and the Mendenhall River are vegetated by grasses, sedges, and other low-growing perennials. These lands and their vegetation have been extensively used as horse grazing areas, and as berry-producing and flowering areas used by residents. Dispersed groves of youthful spruce occupy the occasional area which is more elevated or which has especially good drainage characteristics, and such developing groves serve as habitat for a diversity of bird species.

J. Fish and Wildlife

Taken together, the waters of the Mendenhall Valley are estimated by ADF&G to support the following magnitude of fish and water-dependent wildlife:

Summary of Fishes and Water-Dependent Wildlife of Mendenhall Valley Drainages

Species	Residents	Catch by Fishermen	Escapement to Stream or Lake
Sockeye Salmon		?	600 - 1,000
Chum Salmon		?	1 - 20,000
Pink Salmon		?	1,000
Coho Salmon		4,500	1,500
Cutthroat Trout	Present	?	
Sea Run Cutthroat		?	?
Rainbow Trout	Few	? - few	
Steelhead		? - few	
Dolly Varden		Many	about 20,000
Beaver	Fair population being trapped		
Muskrat	Fair population being trapped		
Mink	A few being trapped		

Sport or subsistence fishing, primarily for Coho or Dolly Varden, occurs both in the main stem of the Mendenhall River, and in some of the more accessible fishable pools of lower Montana Creek and Jordan Creek.

The Sockeye and most of the Chum salmon production depends on safe passage up the Mendenhall River and/or Montana Creek to spawning areas within the National Forest.

About 20,000 Dolly Varden migrate up-river in the fall to winter in Mendenhall Lake. Safe passage upstream to Mendenhall Lake requires adequate streamflows of sufficient quality.

Salmonoids using the Mendenhall system also require a reliable migratory route for fry from spawning areas to the sea or to dispersed areas of residence within the fresh water system. This migration season extends from about mid-April to mid-summer.

The mainstream channel of the Mendenhall River may also receive winter spawning. This has not been identified in this river, but is fairly likely during the clear-water periods in spring-fed gravel areas. Such winter spawning has been documented in similar streams.

The waters and water margins in the Mendenhall Valley provide important habitats for both resident and migrating birds. Nesting habitats in particular are summarized in Table C.

Table C

Birds That Depend on the Water-Related Habitat for Nesting in the Mendenhall Valley

Nesting Species	Habitat	Specific Nesting Locations where Known
Red-Throated Loon	Nests on shore or island	Ponds at the Mendenhall
Great-blue Heron	Nests in trees. Feeds on fish in fresh and saltwater areas.	
Canada Goose	Fresh and saltwater of the Mendenhall Valley	Float plane basin area
Mallard	Lakes, ponds, intertidal areas of Mendenhall Valley.	Float plane basin area
Gadwall	" " "	" " "
Green-winged Teal	" " "	" " "
Blue-winged Teal	" " "	" " "
Northern Shoveler	" " "	" " "
Harlequin	Streams, lakes, saltwater nests on ground or in willow trees near streams.	Near Visitors Center
Common Merganser	" " "	
Simipalmated Plover	Shores of freshwater ponds, lakes and intertidal areas.	Float plane Basin
Killdeer	" " "	" " "
Spotted Sandpiper	" " "	" " "
Least Sandpiper	" " "	" " "

1/ Provided with the assistance of Robert Armstrong, Juneau.

Table C cont.

Nesting Species	Habitat	Specific Nesting Locations where Known
Common Snipe	Muskeg, grassy meadows.	Brotherhood Park
Arctic Tern	Lakes, sloughs, ponds, intertidal	Mendenhall Lake, Float-plane basin
Kingfisher	" " "	Banks of Mendenhall River, Brotherhood Park
Bank Swallow	Cut Banks	" " "
Dipper	Streams	Most streams

Several other species nest along the stream and lake margins in the Mendenhall Valley. These include Rufous Hummingbirds, Northwestern Crows, American Robins, Hermit Thrushes, Ruby-crowned Kinglets, Orange-crowned Warblers, Yellow Warblers, Yellow-rumped Warblers, Wilson Warblers, Red-Winged Black-birds, Savannah Sparrows, Lincoln's Sparrow and Song Sparrows.

In addition to the nesting habitat provided, the shore-line vegetation and margins of the streams, sloughs, ponds and lakes of the Mendenhall Valley provide food for many species of birds which stop in the area during migration. Over 100 species of birds have been found in the Mendenhall Valley.

CHAPTER II

DRAINAGES WITHIN STUDY AREA

A. Mendenhall River

The Mendenhall River is the major drainage in the Valley being fed by Mendenhall Glacier at its headwaters. Floods have occurred in 1927, 1946 and 1961. The Corps of Engineers has prepared a flood plain study of the river and flood limits have been established. The flood boundaries are overlaid on the Borough zoning maps and constitute a flood plain district. Within this district certain standards for structures must be adhered to.

The floodway of the river is thus established and development and drainage plans need to be in accord with this.

The tributaries of the Mendenhall River are small and numerous, starting at tidewater and continuing upstream to Mendenhall Lake. The principal ones are Duck Creek and Montana Creek which are discussed separately. Other tributaries are essentially subdivision drainage ditches which will be considered as individual drainage plans.

B. Montana Creek

This stream has had little development adjacent to it, and its banks and channel are essentially in the natural state, except for deadfalls resulting from World War II logging. The drainage area of 15.5 square miles originates at Windfall Lake and flows into the Mendenhall River 1.4 miles upstream from its mouth.

The portion of the lower Montana Creek drainage bounded by the stream, the Loop Road, and the Mendenhall River may sometime be developed for residential housing. The land is privately owned and nearly level. The water table is at or near the ground surface at most times of the year and there are few defined drainage courses. A slow moving tributary of Montana Creek and a small drainage course entering the Mendenhall River approximately 0.6 mile upstream from the mouth of Montana Creek drain this area.

The remaining portions of the Montana Creek drainage within the study area consist of wooded slope between the stream and the Auke Lake drainage divide and the area above the Loop Road. Drainage courses for these areas are not well defined.

C. Jordan Creek

Jordan Creek originates at the summit of Heintzelman Ridge, draining the westerly slope of this mountain. Elevations in the 2.8 square mile drainage area range from sea level to about 2,800 feet.

The stream flows through residential and commercial districts in its lower reaches and has several structures (both bridge and culverts) spanning it. Some of these are in poor repair and contribute to the flooding problem. Due to the numerous obstructions to flow in the stream bed, the channel has spread and become shallower.

D. Duck Creek

Duck Creek flows through the developed residential area of the Valley originating near the forest boundary at the head of the Valley. One tributary brings water to Duck Creek from the slope of Heintzelman Ridge.

The stream has numerous crossings at both public and private roads and driveways. Nearly all pass the flow through culverts with sizes ranging from 12 inches up to 6 feet. Many of these impede flow and create backwaters and flooding. The tributaries are poorly defined in many instances and as a result have suffered from encroachment and diversions by development and from a lack of maintenance. The main channel of Duck Creek is generally well defined and stable.

Established tributaries which carry significant flow and for which provision is made in the drainage plan are identified and described as follows:

1. North Branch - Taku Blvd. to Glacier Spur Road. This is the headwaters of one part of Duck Creek. This is poorly defined above the crossing of Mendenhall Loop Road.

2. East Branch - Taku Blvd. to Trafalgar Avenue. This branch crosses under Loop Road and continues easterly to the slope of Thunder Mountain.

3. East Fork - Nancy Avenue to Delta Avenue. This fork passes through gravel pit ponds thence northerly to its source near Delta and Valley Avenues.

4. East Fork - LuReCo to Thunder Mountain Road. This fork joins Duck Creek near El Camino Street after passing under Loop Road.

5. Tributary from Glacier Highway through Airport Acres. This tributary joins Duck Creek opposite the intersection of Glacier Highway, draining an area to the north of this point.

6. Branch through Mendenhaven to Poplar Avenue. This is a small drainage, essentially a storm drain.

7. Other drainages enter Duck Creek and will be considered as part of the subdivision drainage plans.

E. Other Small Drainages

These include three small tributaries to the lower Mendenhall River, which drain the flat lands below the Glacier Highway and west of Brotherhood Bridge. Tributaries B-1 and B-2 drain the lands in the vicinity of Epperly's Stable, while tributary B-3 drains the lands below Abel's Lumber yard and nearer to the River. These are almost entirely in the intertidal zone with sinuous paths and shallow banks.

Another small drainage crosses Egan Drive, passing through Field Meadows Subdivision and draining commercial land on the way to tidelands. It is identified in this study as Field Meadows Drainage.

CHAPTER III

STUDY METHODS

A. Study Objective

The basic purpose of any drainage plan is to protect the property adjacent to and downstream of the area of concern. The health and safety of the residents of the community must also be considered. The effect upon domestic water supply systems is an essential factor in this consideration.

Along with these basic considerations of health, safety and property protection, there are the environmental values to be safeguarded. Such factors as fisheries, stream bank aesthetics, bird and animal habitat, and water quality and quantity should be considered and evaluated to determine the effects of various plans upon them.

A satisfactory drainage plan will hopefully satisfy all of these concerns and still be economically attainable. In addition, it would be easily and equitably administered and be responsive to change as future conditions warrant.

This study will determine the drainage plan that best satisfies these requirements.

B. Design Criteria

1. Storm Frequency.--Storms are generally classified by "frequency" or "return period", such as a 2-year storm, a 25-year storm, etc. A 10-year storm, for example, is that intensity of storm which will occur on the average of once in every 10-year period as computed from available data. It might occur this year, but will have a long-term average occurrence of once in 10 years. The greater the return period, the greater will be the intensity of rainfall.

It is usual municipal practice to design storm drainage facilities for a return period such that the improvement cost can be justified by the amount of the prevented damage. This means that some flooding must be expected in periods of time longer than the design return period. For this study, a return period of 10 years was used for the design of all drainage facilities.

2. Rainfall Intensity-Duration.--Climatological data prepared by the National Weather Service for Juneau was utilized. These rainfall-intensity duration curves were correlated with 6-hour storm intensities derived from Juneau Airport records.

3. Snow Melt.--Runoff from melting snow onto frozen ground was considered in sizing culverts and ditches.

4. Drainage Standards.-- Drainage standards and practices in use by the City and Borough were applied. Minimum size culvert is 12" diameter. Maximum depth of roadside ditch is 3 feet with a 1-1/2:1 maximum foreslope and a minimum grade of 0.5%. For drainage ditches not adjacent to the roadway a minimum bottom width of 4 feet and a minimum grade of 0.3% is used. Other design standards used are those consistent with good practice.

5. Environmental Considerations. Full consideration was given to the effects of each plan on the environmental features. Each plan was analyzed for its effect on the values identified.

6. Future Development.--Assumptions were made that the Valley would be developed to its full potential as a residential community. Arterials and collector streets would be paved.

C. Design Procedure

1. Runoff Determination.--Runoff determination for the drainage areas within the study area utilized the best information available. The study area was divided first into major drainage areas which contribute to the flow into the Mendenhall River, Montana Creek, Duck Creek and Jordan Creek respectively. These major areas were then further divided into sub-areas, grouping areas of similar terrain and development, and setting the boundaries so as to determine flows at desired locations. City-Borough topographical maps (1" = 100' with 2' contours), supplemented by Corps of Engineers topographic maps and U.S. quadrangle maps were used to determine drainage boundary lines. Field investigation and checking were done to verify the map information.

For these drainage areas runoff determinations ~~was~~ were made utilizing the Corps of Engineers Hydraulic Engineering Center (HEC) computer program "STORM". This program provides a means for analysis of the quantity and quality of runoff from urban or non-urban watersheds. The program is designed for period of record analysis using continuous hourly precipitation data. It is, therefore, a continuous simulation model. A certain fraction of the rainfall will run off each hour dependent upon the runoff coefficient for the area. The formula utilizing this runoff coefficient takes into consideration land use and type and gives resultant runoff figures considering storm intensity, duration, spacing and the storage capacity of the system.

The Corps of Engineers has published a flood plain study of the streams in the Borough including the study area. The runoff determinations and resultant discharge figures determined by the Corps were utilized to verify calculations from the aforementioned computer program. Some inaccuracies were found in the Corps' work and additional study near the headwaters of Duck Creek had to be performed. Generally, however, good agreement with the Corps' values was obtained.

In order to determine runoff from small, individual drainage areas, the rational formula was used. This is:

$$Q = AIC$$

Where: A = Area in acres

I = Intensity of rainfall for the time of concentration

C = Coefficient of imperviousness

For this study coefficients of 0.6 for commercial and industrial areas, 0.4 for residential areas, 0.2 for undeveloped land, and 0.5 for the steep slopes of Heintzelman Ridge were used. The intensity used was taken from the National Weather Service's rainfall-intensity-duration curves for the Juneau area.

By employing more than one method the validity of results could be checked. In addition, known floods in Duck Creek and Jordan Creek were estimated to further verify the results. The relationship of the drainage areas is shown on the schematic diagrams for each drainage course, Figures 8, 9, and 10. The flows for Duck Creek and Jordan Creek are also tabulated in Table D.

2. Sizing of Drainage Structures.--Sizing of drainage structures was in accordance with the U.S. Department of Commerce, Bureau of Public Roads, Hydraulic Engineering Circular No. 5, "Hydraulic Charts

Table D

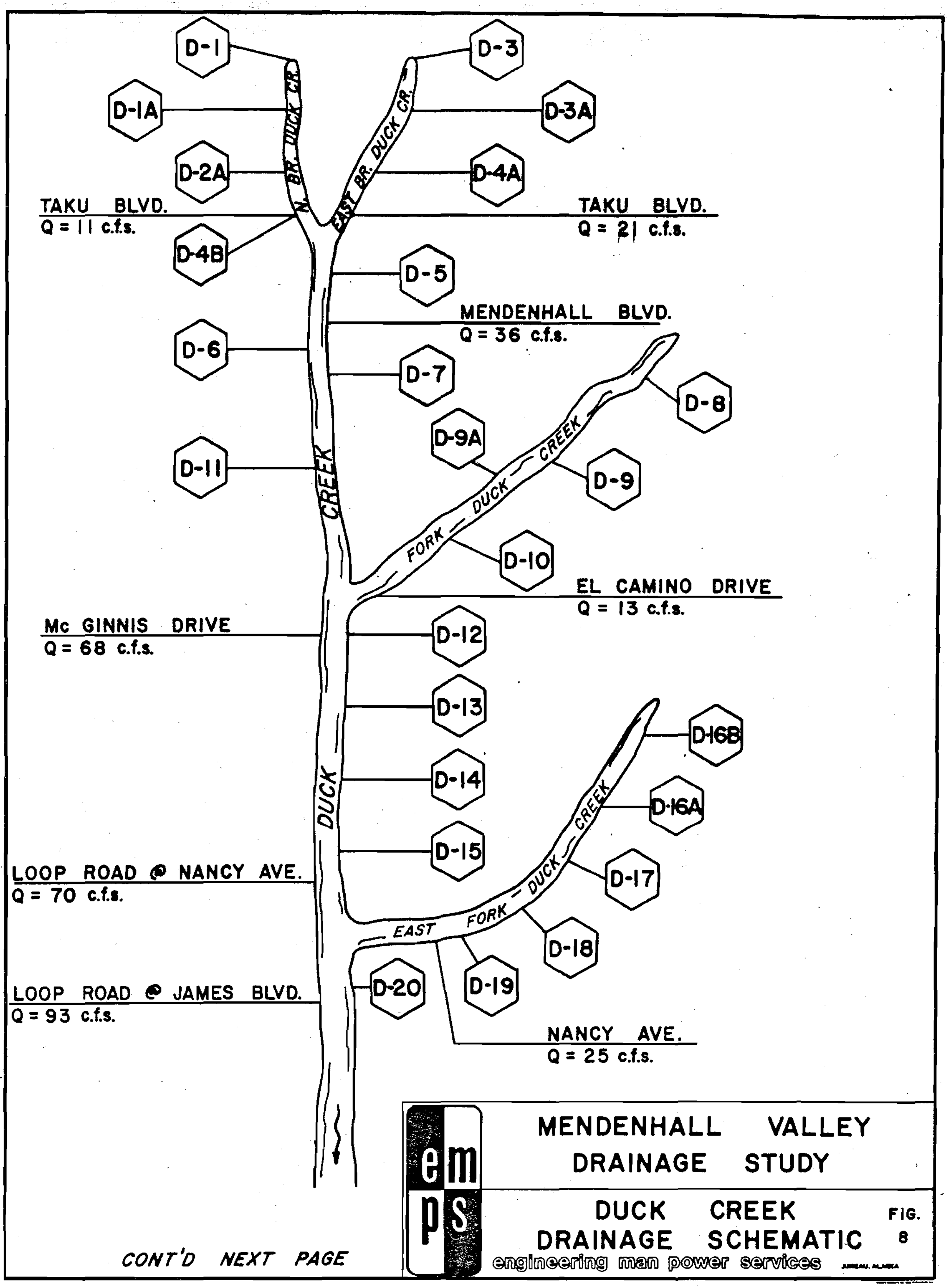
RESULTS OF STORM SIMULATION

Basin EMPS	Basin HJE	Area	Simulation Conditions	Land Use Percentage SFR	MFR	CA	CB	CE	IA	IB	Other	10 year Flow (CFS)	Date Y M D	Hour
D-4B	DUCK I	76	Current	22							78	10.5	621208	23
			Projected	69							31	12.2	621208	23
D-4A	DUCK II	146	Current	32							68	20.9	621208	23
			Projected	39							61	21.4	621208	23
D-5	DUCK III	247	Current	35							65	35.9	520817	17
			Projected	54							46	38.2	520817	17
D-10	DUCK IV	87	Current	52							48	13.4	520817	17
			Projected	96							4	15.2	520817	17
D-12	DUCK V	433	Current	48							52	67.6	520817	18
			Projected	69							31	72.1	520817	18
D-15	DUCK VI	479	Current	45							55	70.1	750913	23
			Projected	64	3						33	75.3	750913	23
D-19	DUCK VII	165	Current	39		5					56	24.9	750913	23
			Projected	50	3	16					31	26.7	750913	23
D-20	DUCK VIII	659	Current	43		1					56	93.1	750913	23
			Projected	59	3	4					34	99.7	750913	23
D-21	DUCK IX	720	Current	43		1					56	101.7	750913	23
			Projected	60	4	4					32	108.0	750913	23
D-28	DUCK X	773	Current	41		1			1		57	107.4	520817	18
			Projected	59	5	4			1		31	115.4	520817	18
D-30	DUCK XI	844	Current	42		1		1	1		55	114.5	740825	22
			Projected	60	5	5			1		29	123.5	740825	22
D-33	DUCK XII	964	Current	37	1	1	0.2	0.4	0.4	7	53	129.2	740823	22
			Projected	53	6	5				9	27	140.1	740823	22
J-14	JORD IV	2157	Current	5				1			94	225.4		

KEY:

Current - Present land use.
Projected - Fully developed land use.
HJE - Computer symbol.

SFR - Single Family residential
MFR - Multi family residential
CA, CB, CE - Commercial
IA, IB - Industrial



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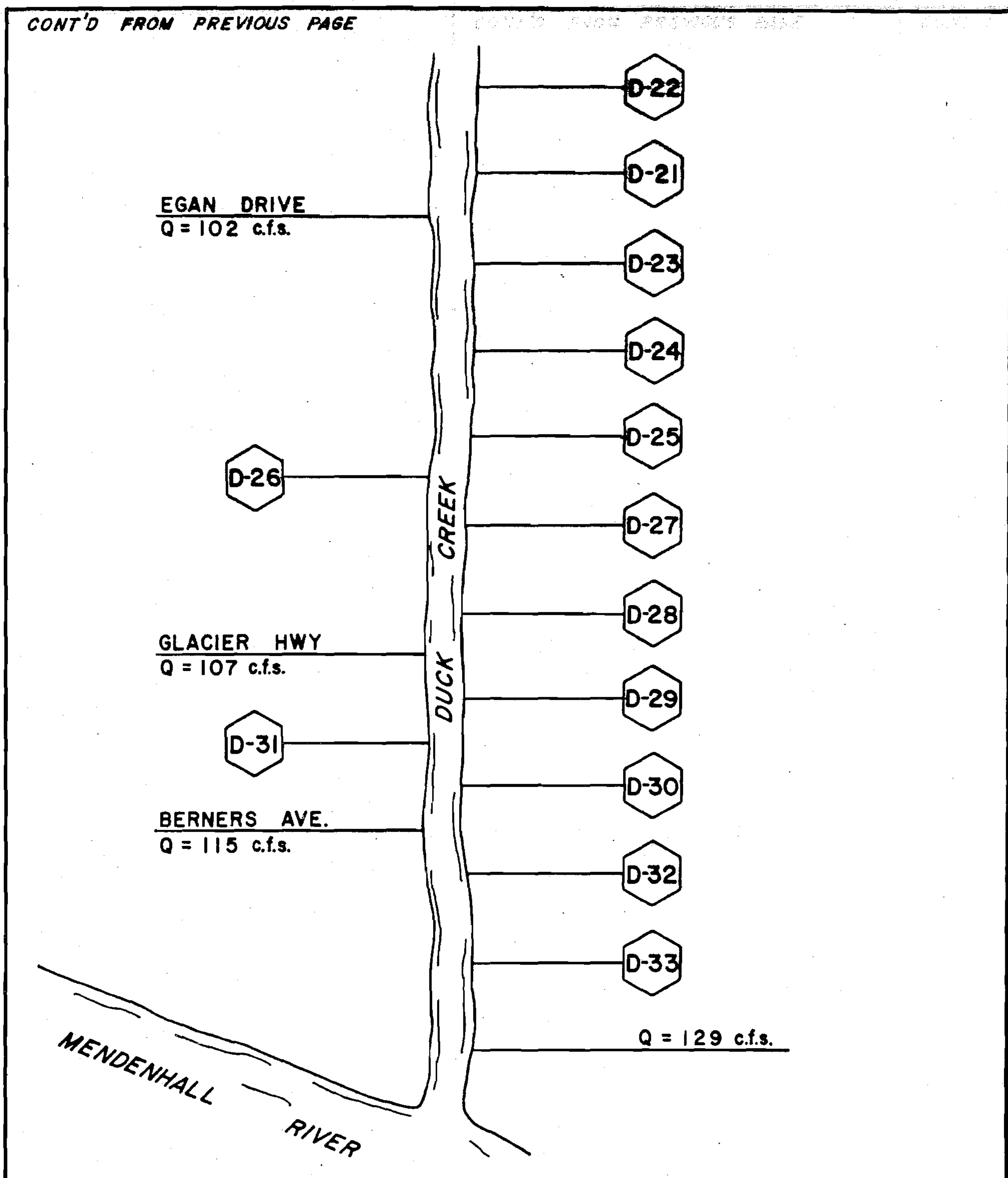

MENDENHALL VALLEY DRAINAGE STUDY

DUCK CREEK DRAINAGE SCHEMATIC

FIG. 9

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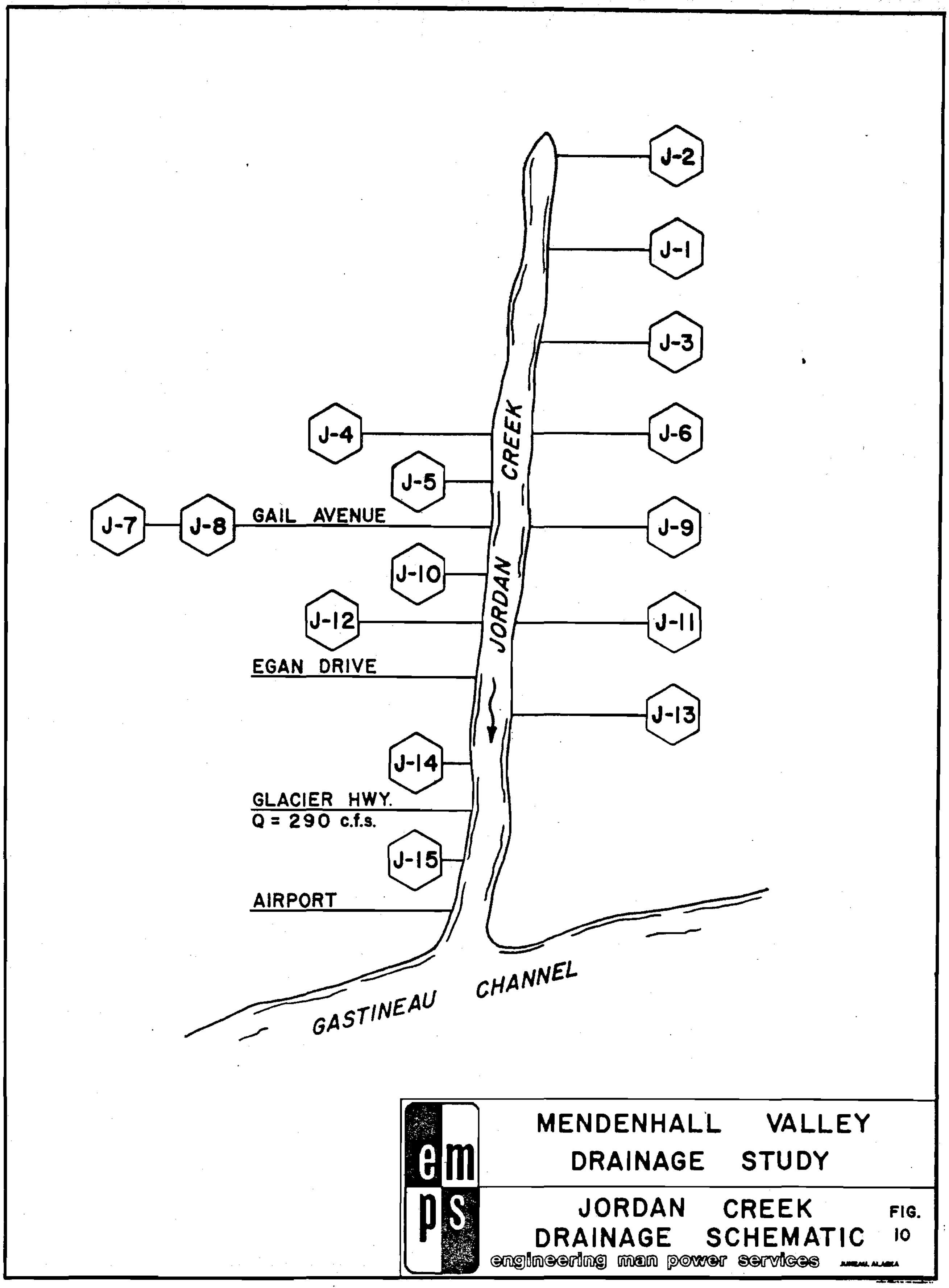

J-2
J-1
J-3
J-4
J-6
J-5
CREEK
J-7
J-8
GAIL AVENUE
J-9
J-10
JORDAN
J-12
J-11
EGAN DRIVE
J-13
J-14
GLACIER HWY.
Q = 290 c.f.s.
J-15
AIRPORT
GASTINEAU CHANNEL
MENDENHALL VALLEY
DRAINAGE STUDY
JORDAN CREEK
DRAINAGE SCHEMATIC
FIG. 10
emps
engineering man power services

for the Selection of Highway Culverts". The channels and drainage ditches were sized by solving Manning's equation by means of nomographs developed by the Bureau of Public Roads.

D. Levels of Improvement

In order to provide an orderly plan for development, as well as options determined by financing capability, the drainage plan for each drainage area is presented as levels of improvement. A brief discussion of each of these levels follows.

Level I - Leave as is

This is the "do-nothing" alternative. Unfortunately, this alternative will not stop the drainage problems from continuing and probably becoming worse as development continues. Additionally, the financial burden of maintaining Borough roads and protecting property will increase. Where little property damage is liable to occur and improvements can be forestalled, this alternative can be followed.

Level 2 - Initial Plan

This is the first stage of improvement, directed toward relief of trouble spots first. Areas of known flooding, and areas which are developing rapidly, are attended to under this level of improvement. Such items as replacement of inadequate culverts, obtaining easements, establishing ditches or storm drains within those easements, and removal of obstructions and debris from stream channels would be accomplished under this program. Effective ordinances to provide control over filling and building within these drainage paths will also be necessary so that the problem does not continue to worsen.

Level 3 - Ultimate Plan

This is the ultimate plan recognizing that the Valley will become more urbanized resulting in a demand for paved streets, more paved areas and improved drainage. The likelihood of a municipal water system is also considered.

Most of the subdivision streets in the Valley have comparatively flat grades making drainage difficult. Surface ditches are difficult to maintain, are unsightly and not effective in the winter. On the other hand, an underground pipe drain system is expensive and requires maintenance to keep open and operational.

This level of plan establishes a system of drainage ways, mostly open channels, of a capacity and grade suitable to receive flows from the adjacent subdivisions or commercial areas. Feeding into these established channels are storm drain systems, usually underground, except in the scattered or less developed areas where side ditches are used.

Each major drainage way has a specified width, within which improvements and activities such as filling, clearing, or excavating are controlled. The drainage way will be maintained by the City-Borough and the property owners will be required to provide easements along the drainage course for this purpose.

E. Subdivision Drainage

The initial and ultimate drainage plans just discussed have dealt primarily with the improvement of drainage courses or established streams. A major component of an ultimate drainage plan is the means used to capture and direct the runoff water to these established streams. This is an integral part of future subdivision improvement that may include paving, sidewalks and a water system.

Several possible means of controlling water are available. The method in ~~common use~~ in the Valley at present is the V-shaped ditch alongside the street, whether the street is gravel surfaced or paved. Another method in use (Mendenhaven Subdivision) has a rolled or mountable gutter to catch the water from the paved street and direct it to the drains and storm sewer. Still another system (e.g. Totem Park) uses drainage inlets (field inlets) set in a shallow, grassed ditch to receive the water and convey it to storm drains.

Each system has its advantages and disadvantages. Open ditches are cheaper to construct and the grades can be easily modified to accept more water or to drain lower areas. Driveway culverts and the ditches require considerable maintenance to keep open and they are unsightly.

Mountable curb and gutter is expensive and the street grade must be set low so that the gutter can receive the water from adjoining property as there is no variation in grade possible between the pavement and gutter.

It may be difficult and expensive to regrade the street to match the required gutter grades. Many of the existing streets are level or slightly higher than the adjacent property and would have to be lowered in order to drain the yards and driveways. This could also affect the sanitary sewers in place in some instances.

The field inlet system set in a shallow, variable depth ditch provides for some variation between street and drainage grades, thus it can be "fitted" to adjacent property to some extent. It is more expensive than the open ditch system, but less so than the curb and gutter design.

Both of the latter require maintenance, although not to the extent that the open ditch plan does.

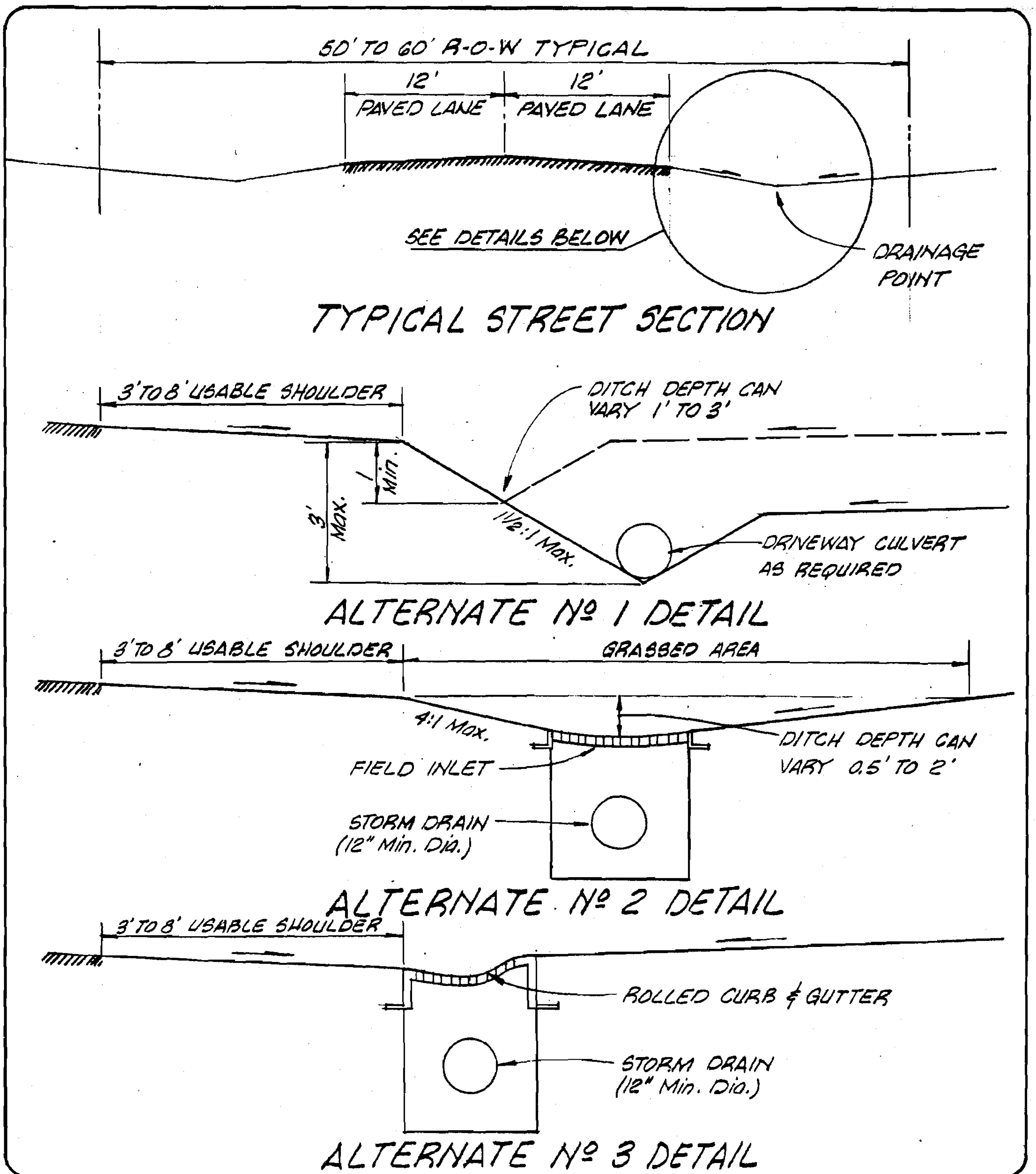
None seem to work well in the wintertime, during time of thawing after heavy snowfall. Ditches and inlets become ice-clogged and the runoff water flows in the street. Additional maintenance effort is required to clear blocked ditches, culverts and drains to alleviate this. Increasing the size of the components at the time of initial construction aids in reducing wintertime problems. Also thaw pipes and marker posts can aid winter maintenance.

Three possible drainage designs for typical paved subdivision streets are shown in Figure 11. There are others that may be applicable. For the purpose of this study these represent three concepts and other designs can be considered as variations to these.

A drainage plan must be designed for each area or subdivision. Factors such as amount of water, slope of streets, height of streets above or below adjacent property and fall available to the nearest drainage course, determine the design most suitable for a particular area. In order to form a basis for cost comparison an inlet system has been shown. This could be either the field inlet or curb and gutter system. Additional costs would be involved in the curb and gutter system.

F. Effect on Water supply.

The domestic water supply of the Valley is from wells usually from 50 to 100 feet deep. These wells tap the underlying aquifer which, as stated under Water Supply, Chapter I, contains excess iron and manganese and hardness. As yet there appears to be ample water for domestic use, although increased development and channeling the runoff to a storm drain system will result in lowering of the water table and likely result in some areas of water shortage. To what extent this will occur is speculative until a program of monitoring wells and supplies is undertaken.



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emps engineering consultants juneau alaska

TYPICAL ALTERNATE STREET SECTIONS

MENDENHALL VALLEY DRAINAGE STUDY

JUNEAU ALASKA

FIG. 11

CHAPTER IV

DRAINAGE PLANS

The various drainages in the study area have been divided into convenient sections in order to describe planned drainage improvements. It is contemplated that the drainage improvements will either be part of the initial improvement or the ultimate plan. Each of the drainages, then, are covered and an initial and an ultimate plan is presented.

The existing drainage courses; Jordan Creek, Duck Creek and its branches, Mendenhall River drainages, and Montana Creek are treated in this manner. This overall drainage system of streams or drainage courses will then be used to accept subdivision stormwater.

Preliminary designs for draining the various subdivisions are shown and these become a part of the ultimate plan. These subdivision drainage systems will outlet into the drainage courses that are established.

A. Jordan Creek

The plan for Jordan Creek is to retain its capacity as a fishery stream. To do this, it will be necessary to control subdivision stormwater entering it. Efforts should be made to clear the channel of obstructions so that it can carry a greater volume of floodwater. This would be done in accordance with the requirements of the Department of Fish and Game so that adverse effects on the aquatic population would be minimized and possibilities for enhancement maximized.

Initial Plan

Jordan Creek, as has been stated, is essentially intact insofar as the banks and gradient are concerned. There are a few substandard crossing structures that should be corrected.

1. From the Airport to Glacier Highway.

The culverts under the airport runway and one recently installed under an access road are 72" diameter and 6' x 9' arch culvert, respectively. The runway culvert is to high and lowering would benefit the stream flow and fish passage. The old bridges to the aircraft tiedown area should be removed. If replacement is required, culverts of 84" diameter (or hydraulic equivalent) should bo installed.

The channel is constricted in several locations as one proceeds upstream. These restrictions should be removed and a channel with an effective bottom width of 20 feet established. Cost estimate for this is $15,000, not including the airport culverts.

2. From Glacier Highway to Egan Drive.

The channel width of 20 feet should be established. The fill and structure to the new Chapman Building encroach on the stream and they should be removed or corrected. Proceeding upstream, the submerged logs and trees in the stream should be removed. The old bridge just downstream of Egan Drive should be removed. Estimated cost is $9,000 (exclusive of the Chapman "problem").

3. From Egan Drive to Tall Timbers Subdivision.

Judicious cleaning of the stream channel should be undertaken. Care must be taken not to breakdown the banks or remove a significant amount of the vegetative canopy. Logs and sunken trees should be removed. At least one old bridge in this reach should be removed. Cost estimated to be $40,000.

4. From Tall Timbers to Thunder Mountain Trailer Park.

Continue with the removal of stream obstructions. Encroachments to the stream channels such as fill or structures should be removed or satisfactorily bypassed. The outlet flow from the gravel pit (Reid's) should be routed away from the active stream and other means taken to minimize water-quality degradation. Cost of this is estimated at $20,000.

5. From Thunder Mountain Trailer Park to the Headwaters.

Safeguard this spawning area by clearing of debris. Establish a buffer area with stable vegetative cover.

Ultimate Plan

As a follow up program to the work accomplished initially to clear the channel of obstructions, it is recommended that a maintenance program be undertaken. This would involve removal of windfalls, surveillance to prevent unauthorized work in the stream or alongside it and other efforts deemed necessary to enhance the stream. A prescribed width of 50 feet as a buffer area between the stream and future development should be established.

A lesser width of 25' between the stream and presently developed land will be satisfactory, provided that this strip is carefully managed.

For much of its length the stream lies within the National Forest. However, a tract of land adjacent to the forest boundary is available for selection by the State and the Borough. This strip of land is about 1500 feet wide and extends to the headwaters of the stream. Tentatively, the Borough has selected the portion lying north and east of Glacier Valley School (approximately), leaving the remainder of this tract as State's selected land. The Borough land will presumably be available for development. Crossings of the stream to develop land on the east or mountain side could be constructed. There is only a limited area available for development, and avalanche hazards and stream safeguards may further restrict development.

B. Duck Creek

The plan for Duck Creek is to utilize to the fullest extent possible the main creek and its tributaries to carry the stormwater down the valley. These natural channels are generally well defined and development and improvements have been built so as to keep them open. Some encroachments and diversions have occurred. The problems related to diverting flow from one tributary to another preclude this unless there are overwhelming reasons for doing so.

Each section of Duck Creek and its tributaries will be considered in turn and the initial and ultimate plan for each will be discussed. Sufficient drainage capacity will be included in the various sections so that storm drainage from adjacent subdivisions can be handled.

Duck Creek within the Airport Boundary.

Initial Plan

The culverts at Robertson Avenue should be replaced as they are totally inadequate. Two 48" diameter culverts or one large culvert should be installed at about the same elevation. Cost is estimated to be $20,000. Any channel obstructions on Airport property should be removed.

Ultimate Plan

The culverts under the access road to the tie down area (F&WS) are adequate but should be lowered and extended. The channel of Duck Creek upstream to Berners Avenue should be lowered a maximum of 2 feet. This would result in a more efficient channel, better able to pass flood waters. This would require careful work so as not to damage banks and adjoining vegetation, and should be approved by the Department of Fish and Game. Initial review of this by them seemed to be favorable.

Duck Creek - Airport Boundary to Glacier Highway.

Initial Plan

Improve drainage in Duck Creek by removing inadequate culverts at driveways. The determination as to who bears the cost of this is not being made, as the property owner may be responsible. To be uniform in this study, it is assumed that where improvements are required, that they will be paid for with public funds.

The culverts under the driveways crossing Duck Creek should be replaced with 2 - 48" diameter pipes. The cost of this is in the order of $20,000.

Ultimate Plan

The lowering of the channel extending below Berners Avenue (described above) should be continued through this section. This would involve deepening the channel by as much as 2 feet at Berners Avenue.

Duck Creek from Glacier Highway to the crossing of Loop Road near Nancy Avenue.

Initial Plan

The culvert at Glacier Highway is inadequate and should be replaced with 2 - 48" diameter culverts. Cost is estimated at $25,000. The initial work will also involve clearing of debris or obstructions in the stream.

The two private driveway crossings of Duck Creek just below Nancy Avenue are positioned such that the channel is poorly aligned. The inadequate culverts should be replaced and the channel properly aligned and graded. The cost of this work is estimated to be $16,000.

Steps should be taken to establish definite channel and pond boundary lines to insure the integrity of the stream and ponds.

Ultimate Plan

The stream should be studied for possible enhancement as habitat area, other than that little has to be done except to maintain the present channel and ponds intact.

Duck Creek from Loop Road crossing to Taku Boulevard.

Initial Plan

Debris and obstructions should be cleared from the channel. Selectively clear any vegetation that may inhibit flows.

The following culverts are inadequate and should be replaced:

Road opposite Trinity Drive ... install 2 - 36" CMP's

Trailer Court Entrance ... . install 2 - 36" CMP's

McGinnis Drive ... ... install 2 - 36" CMP's

Aspen Avenue . ... install 2 - 36" CMP's

Mendenhall Blvd. . ... install 2 - 36" CMP's

The cost of this work is estimated to be $20,000.

Ultimate Plan

Steps should be taken to establish definite limits of the stream to protect the stream and its banks. Planned landscaping and revegetating should be undertaken through this stretch as it passes through subdivisions.

Duck Creek-North Branch - Taku Blvd. to Glacier Spur Road.

Initial Plan

This is a poorly defined branch of Duck Creek, at least above the point where it crosses under Loop Road. Through Glacier Valley Subdivision the existing culverts and ditches are inadequate. Between Dredge Lake Road and the Glacier Spur Road the channel needs to be defined, cleared and graded. The culverts (24") under the Loop Road and Glacier Spur are the only ones of adequate size. The following culverts should be replaced with single 24" or 2 - 18" pipes:

Valley Avenue, Lake Avenue & Dredge Lake Avenue.

Easements should be obtained between Dredge Lake Road and Glacier Spur Road. The drainage channel should be excavated to a bottom width of 4 feet. The cost of this work is estimated to be $15,000.

Ultimate Plan

This will require a storm drain system at such time the subdivision is paved. At that time the 24" culvert under Loop Road will have to be lowered. The storm drain should follow the ditch established in the initial plan.

Duck Creek-East Branch - Taku Blvd.to Trafalgar Avenue.

Initial Plan

This section of Duck Creek is not well defined after it crosses under Loop Road near Taku Boulevard. It runs along the east side of Loop Road to Threadneedle thence easterly along Threadneedle, crossing under Trafalger Avenue about 200' north of Threadneedle. The source of the water at the upper end of this branch is the slope of Thunder Mountain, the only portion of Duck Creek originating there. The road construction has diverted the flow away from its original channel and houses have been built in the original channel, thus obstructing it.

The initial work to be done is to establish a defined channel - Trafalgar Avenue to Threadneedle - within an easement, then carry the flow down Threadneedle in a side ditch to Loop Road. At this point this flow could be joined with the north branch of the stream, described previously. However, this should not be done unless adequate provisions can be made for the increased flow down stream. Hence, initially it is recommended to continue it in its present course along the east side of Loop Road.

The existing culverts throughout the length of this drainage are inadequate and should be replaced. The side drainage ditch along Threadneedle will need to be approximately 2' deep to accommodate the flow and all the driveway culverts will have to be replaced; 29" x 18" pipe arches are recommended for these culverts to better fit the ditch and take the water. Cost of this work is estimated to be $20,000.

Ultimate Plan

The ultimate plan would involve the additional work required to enclose the drainage along Threadneedle at such time as it is paved. This drainage system will have to be buried alongside Loop Road to Taku Boulevard.

Duck Creek-East Fork - Nancy Avenue to Delta Avenue.

Initial Plan

The ponds between the starting point and Trinity Drive have been created by gravel extraction. They have some value in the drainage scheme as reservoirs or holding ponds to level out downstream flows. Above Trinity Drive the drainage channel is fairly well defined but is shallow with many obstructions and inadequate culverts. The initial work should consist of establishing a channel and culverts adequate for the flow with provision for sufficient depth as required to drain the area in the future.

The work will consist of replacing the inadequate culverts under Dudley, Tongass, Short Court driveways, Junior High entrance road, Amalga and Nugget Avenues. Cost of this is estimated to be $40,000.

There is an easement from Trinity south to the pond. This channel should have an easement north of Trinity, all the way to its starting point at Delta Avenue. The channel is not well defined and encroachments are numerous.

Ultimate Plan

The ultimate plan for this tributary contemplates utilizing this drainage channel to pick up adjacent subdivision drains. As such, the drain will have to be sufficently deep to accommodate storm drain outfalls. It may not be possible to leave this as an open ditch except near the Junior High School, where it is not adjacent to a road, and across some of the lots between Tongass and Trinity.

As an alternative to leaving the channel in its present location, it is recommended that it be relocated so as to be within dedicated rights-of-way as much as possible. This is possible and feasible by following Tongass Blvd., Short Court, Nugget Drive, Steep Place, Slate Drive and Valley Boulevard. This would eliminate several existing "tight spots" where the drainage course is close to improvements and would permit hooking up laterals more readily. Easier access for maintenance purposes would also be a benefit.

The status of the gravel pit ponds between Nancy and Trinity Avenues should be reviewed. Public ownership or control would be desirable to preclude filling with stumps and debris and thus continuing an eyesore. The ponds have value as a storage area for storm water if the outflow could be controlled. This could be done by installing an overflow pipe or structure at Nancy Avenue and gating the present pipe. The overflow pipe would be set at about elevation 31. This would amount to about 27 acre feet of storage in the system. This would relieve downstream peak flow for a short time, but not enough to regulate downstream flow. This storage would assist in maintaining minimal flow in Duck Creek below this point. Additional information on flows and foundation soils at the possible damsite (Nancy Avenue) will be needed in order to determine feasibility of this.

Duck Creek-East Fork - LuReCo to Thunder Mountain Road.

Initial Plan

This drainage tributary of Duck Creek is well defined throughout the LuReCo Subdivision and across Loop Road. From there on it is not so well defined nor maintained. Flooding occurs around Deborah Drive and Valley Boulevard. The initial work proposed is to relieve this flooding by establishing the channel and putting adequate culverts in at Nugget, Valley, Diane, Deborah, and Kimberley Drives. These should be single 24" or double 18" pipes. The drainage course should be established by easement. The cost of this work is estimated to be $15,000.

Ultimate Plan

This system would be expanded and deepened with the Loop Road culvert lowered. The culverts through LuReCo (2 crossings of El Camino Street) will need to be lowered and increased in size. This is necessary in order to carry the upstream flow at such time a storm sewer system is constructed there. An alternative location to Duck Creek along the north boundary of Villa de Vista Subdivision should be considered. This would eliminate a deeper ditch or storm drain through the subdivision.

Tributary of Duck Creek from Glacier Highway thru Airport Acres

Initial Plan

This drainage crosses under the Glacier Highway near the junction of Berner's Avenue and proceeds northerly, crossing Lee Smith Drive, Miner Drive, and the yet-to-be developed Ka-See-An Drive. The course is poorly defined and flooding has occurred. The initial work is planned to eliminate this. The culverts under the above streets should be replaced with either a single 24" or 2 - 18" pipes. The culvert under the Glacier Highway will have to be lowered to elevation 18. This can be done only after Duck Creek is lowered through this section as was discussed under the work for that section.

The existing drainage way is obstructed by improvements where it runs from Lee Smith Drive to the Glacier Highway. A portion of this section should be abandoned and the water carried south along Lee Smith Drive in a pipe system to a point between lots 4 and 5, Airport Acres, thence southwesterly to rejoin the original course just north of the Glacier Highway. The drainage should be established throughout its length, and easement obtained. Kendler Street has apparently been vacated, and since the drainage flows through there, it will now require an easement. Cost estimate for this work is at $31,000.

Ultimate Plan

This is a low, flat area and will require extensive lateral drainage ditches or drains to minimize ponding and localized flooding.

The future of the unplatted portion of U.S. Survey 1194 east of this area bears on drainage plans. It doesn't appear possible to drain much of this area into Jordan Creek, thus it will have to be handled through this system, (via Sheiye Way), contributing to the flow and requiring a lower grade line.

Branch of Duck Creek Thru Mendenhaven to Poplar.

Initial Plan

This system is essentially in place, although not particularly well located in respect to improvements. Drainage way should be defined and easements obtained.

Ultimate Plan

As conditions warrant, the culverts and inlets should be replaced with maintainable standard items, and the remaining open ditch system put into pipe.

C. Mendenhall River - Drainages

Meadow Grove - Riverside Park

Initial Plan

Easements are required (if not already obtained) at the foot of Eagle Street to the river from the Block J cul-de-sac to the river, from Kevin Court to Scott Drive, and where the ditch on west side of Radcliffe is on private property. The culverts along Radcliffe Road appear to be adequate, however additional development and/or paving of the area may overload them. Little cost except for easements.

Ultimate Plan

Radcliffe Road will likely be improved to arterial standards and paved. At that time the drainage system along it should be converted to an underground system. Similar treatment will apply to Stikine, Eagle and Meadow Grove Lane. Laterals to pick up the cul-de-sacs may be either a pipe system or an open ditch, depending upon grade.

Egan Drive to Steven Richards Drive

Initial Plan

This area is presently being subdivided and drainage is being routed to the river via gravel pits. Little work is needed except to establish easement lines for drainage courses as required.

Ultimate Plan

Riverwood has paved streets with no curb and gutter. Ditches are shallow and maintenance is likely to be expensive. In the event that future improvements are made,a storm drain plan should be provided. The drainage courses presently being established to the river should be checked for adequacy.

Steven Richards Drive

Initial Plan

The drainage along this drive is carried west to the river in a ditch within an easement. Paving of North Riverside Drive is expected in 1979. Little needs to be done here immediately.

Ultimate Plan

In the event future improvements are made, such as widening of Steven Richards Drive, or paving of the trailer courts, a storm drainage plan should be provided.

Long Run Drive

Initial Plan

This is one of the "trouble" spots due to adjacent development with inadequate provision for runoff. The Borough has a sewer lift station at the NW corner of Long Run and Riverside Drive which further limits area available for ditching. An additional 24" diameter culvert should be installed across Riverside Drive just north of Long Run Drive. This will then require a storm drain on the north side of Long Run Drive running west for about 600 feet to the natural drainage course. This natural drainage course should be improved to where it joins the main course about 200 feet further on. Cost is estimated at $28,000. This will relieve the immediate problem in the vicinity of the intersection. Remaining area drainage should be considered in the ultimate plan.

Ultimate Plan

This would involve collecting water from adjacent property and bringing it to this system. This is considered along with other subdivision drainage.

Mountain View area along Riverside Drive

Initial Plan

It is understood that the developer of Mt. View will construct a drainage ditch along the south side of the cemetery property to the river. This will relieve the natural drainage course in this area and should assist in draining all the land downstream to the river. No cost is attached to this work insofar as the Borough is concerned, except to furnish culverts.

Ultimate Plan

This area will eventually be developed and subdivision drainage to the above drainage ditch is possible.

North Riverside at Melvin Park

Initial Plan

The culvert under Riverside is inadequate and should be replaced. A 24" pipe or a 29" x 18" pipe arch should be used. Ditching to the river should be improved. Cost of this work is estimated at $2,000.

Ultimate Plan

This area will be developed further and subdivision drainage to the river is practical.

North Riverside at Marion and Pinedale

Initial Plan

These culverts appear to be adequate. Easements should, if not already, be obtained.

Ultimate Plan

Subdivision drainage can be accomplished by going to the river, via these routes.

North Riverside Drive at Tournure Street

Initial Plan

The existing culvert is inadequate and should be replaced. The other culverts under Glendale (2), Mint, Julep, and Rosedale are also inadequate. An easement along this route should be obtained. Cost of this work is estimated at $15,000.

Ultimate Plan

The drainage from the fully paved subdivision can be carried to the river via this route.

Nunatak Terrace on the west side of river.

Initial

This subdivision is in rolling terrain and should experience few problems if culverts of proper size are installed.

Ultimate Plan

The existing ditch drainage can be improved or converted to an underground pipe system if paving is contemplated. Either system is feasible.

D. Montana Creek

Initial

Little development has occurred adjacent to Montana Creek, although one area in U.S. Survey 1796 has been subdivided. The large, flat area lying below Loop Road requires an extensive drainage system in order to be economically developed.

The initial work required consists of establishing a drainage plan so that development when it does occur can proceed in an orderly manner.

Ultimate

The ultimate plan for Montana Creek drainage consists of a drainage plan for the area below Loop Road which may soon be developed. The remaining areas above Loop Road and between Montana Creek and Auke Lake should adhere to requirements imposed to keep the stream corridor clear of development. This anadromous stream would be protected by the requirements of ADF&G and the Coastal Zone Management Program.

The area below Loop Road is shown on the map in the pocket. A system of drainage ditches such as are shown should be established. These ditches will likely have an adverse effect on the tributary streams that now exist. These tributaries may support Dolly Varden and Coho salmon. These streams would be completely changed or done away with by the ditches proposed. Whether the fish would use the ditches for spawning and rearing is unknown.

The ditching plan will require a coordinated, drainage area approach for implementation. That is, an owner at the upper or northern end of the area will need the downstream

E. Other Small Drainages

1. Streams B-1, B-2 and B-3.--These drainages include the tidal streams west of the Mendenhall River and below the Glacier Highway. Streams B-1 and B-2 lie on the fringe of the present commercial development, the nearest structures being a stable and a wrecking lot. Stream B-3 is routed along Industrial Drive which is building up with light commercial buildings.

Initial Plan

These small streams drain a fairly large area, and therefore should be maintained in order to pass the runoff. No immediate work is seen as being necessary to accomplish this.

Ultimate Plan

Streams B-1 and B-2 should be protected from encroachment as they are reputed to support a run of salmon. No filling, crossing or relocation should be made unless the requirements of the Department of Fish and Game are met.

Stream B-3 does not have any fishery value and is used to drain a developing area. Relocations and crossings should not be made unless adequate provisions are made for the storm flow.

2. Field Meadows Drainage

Initial Plan

This drainage should be established within an easement following property lines. Ditch improvement and a larger (24") culvert are needed at the crossing of Airport Boulevard. Cost of this work is estimated to be $14,000.

Ultimate Plan

This drainage would be contained in a pipe system so that full utilization of the property may be made. The adjacent commercial area will be drained to this system.

F. Subdivision Drainage

As discussed in Chapter III, STUDY METHODS, improvement of subdivision drainage may be accomplished by one of several methods. The particular type of design used must be adapted to the particular subdivision. For this study an inlet system draining into a properly sized storm drain is used in the street rights-of-way and open channel drainage is used through open areas or for well defined streams.

Initial Plan

The initial plan for subdivision drainage consists of improvement of the existing open ditches. These ditches are led to drainage courses which have to be improved to carry the water away. This is discussed under the plans for Jordan and Duck Creeks and the Mendenhall River Tributaries. Generally, the immediate subdivision drainage problems have been considered in the discussion of these particular streams and their tributaries. Thus, the Initial Plan for the various subdivisions have already been discussed.

Ultimate Plan

The various subdivision drainage plans are shown on the maps made a part of this report. The systems shown are designed to handle a storm of 10-year frequency. Generally, the ultimate system directs the drainage to the same stream or tributary where it presently is going. Exceptions to this are subdivisions bordering Jordan Creek where an effort is made to direct stormwater away from Jordan Creek to minimize possible pollution of this salmon stream. Nearly all presently developed subdivisions have an ultimate drainage plan shown. Exceptions are Mendenhaven which has an underground system which is functional and Nunatak Terrace, Glacier Park, Forest Estates, and McGinnis. These have not been included due to their rolling terrain which favors a surface system with short runs of ditches rather than an extensive underground system.

A brief description of each system, its location, where it drains, and its cost is tabulated on Table B.

Table E

Subdivision	Description	Drainage Course	Cost*
Riverdale Heights	Along Tournure Street from Mint Way to Riverside Drive.	To Mendenhall River via easement.	$ 56,700
Riverdale Heights	Along Riverside Drive, Cloverdale, Pinedale, & Firndale	To Mendenhall River via easement.	$ 73,200
North Riverside Drive	On Nagoon Lane & Fireweed Lane.	To Mendenhall River via easement.	$ 108,800
North Riverside Drive	On Ptarmigan, Lupine, Marion & Riverside Drive.	To Mendenhall River via easement.	$ 64,500
Sleepy Hollow	On Julep, Birch Lane, & Ichabod Lane, & adjacent to Melvin Park.	To Mendenhall River via easement.	$ 136,000
Sleepy Hollow	On Aspen, Portage Avenues & McGinnis.	East to Duck Creek at Aspen.	$ 47,200
Cedar Court & Mendenhaven	On Columbia Boulevard, Poplar & Birch Lane.	To Duck Creek at Birch Lane.	$ 94,800
Lengthy Acres & Smith Park	On Long Run Drive, Gee Street & Richards Drive.	Into Long Run Tributary of the Mendenhall River.	$ 86,500
Lengthy Acres	On Long Run Drive from Portage West.	Into Long Run Tributary of the Mendenhall River.	$ 88,900
Smith Park & Mt. View	On Gee Street from Portage West.	Into Long Run Tributary of the Mendenhall River.	$ 115,500
Mt. View	On Tanis, Trio, Portage, Julep, & Melrose.	Via easement & open ditch to Mendenhall River.	$ 199,500
Sprucewood Park	Along Steven Richards Drive.	To Mendenhall River via easement.	$ 41,500
Green Acres	On Jerry, Marsha, James Blvd.	Via easement to Duck Creek.	$ 79,400

*1979 dollars.

1262200

Table E (cont)

Subdivision	Description	Drainage Course	Cost
Riverside Park	On Radcliffe, Eagle.	To Mendenhall River via easement.	$ 147,500
Meadow Grove	On Meadow Lane, Stikine, Scott, and Eagle St.	To Mendenhall River at Stikine, and Eagle.	$ 88,600
		Total	$4,360,100

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Table E (cont)

Subdivision	Description	Drainage Course	Cost
LuReCo	On McGinnis and Sanders.	To Duck Creek at McGinnis.	$ 69,700
Evergreen Park, Forest Grove & Field Acres.	On Tongass, Evergreen Park, Jennifer, Forest Lane, Crest, Dudley, & Short Court.	To East Fork of Duck Creek (pond) near Trinity.	$ 399,900
Evergreen Park	On Tongass, Hayes, & Rainbow.	To East Fork Duck Creek (pond) at Hayes.	$ 119,200
Tall Timbers	On Tongass, Gail, Marilyn & Bresee Street.	To East Fork Duck Creek (pond) at Gail Avenue.	$ 115,200
Tongass Park	On Atlin Avenue.	To Duck Creek at Egan Drive	$ 46,100
Valley Centre	On Mallard & Jordan.	To Jordan Creek at Jordan Avenue.	$ 89,800
Valley Centre	On Crest Avenue.	To Jordan Creek at Crest Avenue.	$ 46,100
Field Meadows	From Egan Drive to Airport Boulevard.	To Gastineau Channel via easement.	$ 67,200
Cascade Manor & Airport Acres	Cascade Street & Glacier Hwy.	To Jordan Creek at Glacier Highway.	$ 82,000
Tongass Park	On Hurlock Avenue & O'Day Dr.	To Duck Creek at Egan Drive.	$ 38,000
Tongass Park & Airport Acres	On Lee Smith, O'Day, Miner, & Sheiye.	To Duck Creek at Berners Ave. via easement.	$ 207,700
Sunset Park & Dales	On Sunset Dr. & Del Rae Road.	To Duck Creek at Del Rae.	$ 57,000
Totem Park	On Muir, Herbert, Brady, Norris & Berners.	To Mendenhall River via easement.	$ 126,400

Table E (cont)

Subdivision	Description	Drainage Course	Cost
Riverside Park	On Radcliffe, Eagle.	To Mendenhall River via easement.	$ 147,500
Meadow Grove	On Meadow Lane, Stikine, Scott, and Eagle St.	To Mendenhall River at Stikine, and Eagle.	$ 88,600
		Total	$4,360,100

CHAPTER V

RECOMMENDATIONS

A. Recommended Plan

The recommended drainage plan for the study area proposes utilizing presently established drainage courses to the fullest extent possible. Where there are not platted drainage courses existing at the present time, these would be established by easement.

The initial work planned is that necessary to relieve present flooding problems or to prevent flooding that appears to be imminent. The ultimate plan provides for a drainage system for the remaining undeveloped areas and also an underground system that will be compatible with a paving program for the presently developed areas. The individual elements of the drainage plan have been discussed in detail and these will not be repeated as recommendations.

The major components of the recommended plan are as follows:

1. Jordan Creek and Montana Creek should be managed so as to retain their present unspoiled condition. Little additional stormwater would be routed to them and channel enhancement will be attempted on Jordan Creek. Green belt strips bordering these streams should be established. A width of 50 feet in undeveloped areas and a width of 25 feet in developed areas each side of the stream are recommended. Within these limits, activities would be controlled in a manner similar to that proposed under the Coastal Zone Management Program.

2. <u>Duck Creek and Tributaries</u> should be utilized fully as channels to carry stormwater from the subdivision. Tributary drainage channels would be rerouted to public right-of-way in some instances, and in other instances, easements would need to be obtained. Easement widths of 20 feet for construction and maintenance purposes would be required. Duck Creek in its lower reaches would be deepened slightly and culverts that obstruct flow would be replaced.

3. <u>Mendenhall River Drainages</u> would be established (if not already) by easement. This would include presently developed areas on the east side of the river and also areas near Montana Creek on the west side of the river, coordinating this with a proposed footpath.

4. <u>Other small drainages</u> near the mouth of the Mendenhall River would be preserved in their present condition or as described under the specific stream plan.

5. <u>Subdivision drainage</u> would be handled by an underground storm drain system. This would be installed at the time the subdivision paving is accomplished. The various systems are shown on the maps attached.

6. <u>Municipal Water system</u> should be installed or provided for at the same time as subdivision drainage and paving. A program of monitoring existing supplies for quality and quantity should be undertaken.

B. <u>Implementation</u>

Implementation of the plan encompasses establishment of the drainage plan as part of the Borough's comprehensive plan, promulgating regulations to control development as it affects drainage, and determining means of financing, and setting priorities and a timetable for the improvements.

1. Adoption.--The first part of the implementation plan requires adoption of the drainage plan by the Assembly. This plan would be sufficiently detailed to indicate location and width of all required easements or green belts along stream and channels. It would also contain the criteria that must be adhered to in preparing drainage plans for subdivisions.

2. Regulations.--The present platting regulations require that "The plat shall clearly indicate the method by which the subdivider proposes to handle surface and subsurface drainage for the subdivision and its effect on the adjacent areas;" (Sec. 49.35.130) And Sec. 49.35.250 IMPROVEMENTS, (d) Surface Drainage, requires that "The subdivider shall be responsible for a total surface drainage plan subject to approval of the City and Borough Engineer." And also this section states: "Access shall be provided to all public water bodies and easements or dedications shall be assured along creeks or rivers for protection, improvements to maintenance."

It appears that an additional provision is needed in the platting regulations requiring that the drainage plan for each subdivision be compatible with and comply with the requirements of the master drainage plan. This would ensure orderly, planned subdivision development in respect to drainage. This provision would contain or refer to criteria that the drainage plan would have to meet.

3. Financing.--Local financing of drainage improvements will be burdensome to the property owner. However, benefits to the owners and increased valuation of the property will likely occur.

At the present time, there is no federal program to storm drainage financing comparable to the sewerage treatment and water supply programs. These are financed, in part, by the federal government under the Clean Water Act of 1977. This act authorizes studies for treatment of storm drainage, but no money has been appropriated for this purpose.

Other sources of federal funds such as HUD Block grants or EDA grants may or may not be available. At the present time there is not money available for these grants.

Local funding for drainage improvements could be either area-wide or by local improvement district. The work necessary to improve the major drainage courses and to correct present flooding problems would appear to be properly funded by means of area-wide levies. This is the work identified as "Initial" in this report plus the long-term improvements to the major drainage courses.

The subdivision drainage systems could be funded by local improvement districts (LID's). Ideally, drainage improvements would be made at the same time as paving and water system improvements, so that all the work remaining in the subdivisions could be financed and constructed at the same time. Benefiting subdivisions could share in trunk storm drains where the system covers more than one subdivision.

4. Priorities and Timetable for Improvements--The following are suggested priorities necessary to undertake the improvements that have been proposed herein. The timetable for these improvements depends upon the time of adoption of this plan and accompanying ordinances by the Assembly and also the amount of money made available to finance the work.

Priority 1. Following adoption of plan, identify required easements and green belt-buffer areas to be acquired. These should be acquired through exchange of land wherever possible, rather than purchase.

Priority 2. Perform work under the Initial Plan for Jordan Creek starting at Airport Boundary and working upstream. Cost is estimated at $84,000 to perform stream cleanup as described.

Priority 3. Perform work under the Initial Plan for Duck Creek and tributaries. Cost is estimated at $222,000. Specific order of the segments of this work should be assigned so that downstream problems are not created by making upstream improvements first.

Priority 4. Perform work under the Initial Plan for the other tributary streams in the study area.

Priority 5. Perform work under the Ultimate Plan for areas and subdivisions as the specific need arises and as funds are available.

C. Criteria for Drainage Plans

Drainage plans shall be based upon an engineering analysis. A plat of the area shall be submitted showing the limits of the area affected and any off site drainage contributing to the flow. The drainage structures shall be adequate to pass the runoff from a 10-year storm (or a 50-year storm for bridges). Computations to support the sizing of the pipes and drainage courses, will be submitted.

Ditches adjacent to roadways shall:

1. Be no deeper than 3 feet
2. Have side slopes of 1 1/2:1 or flatter
3. Have desirable minimum grade of 0.5%.

Ditches not adjacent to roadways shall:

1. Have a 4 foot minimum bottom width
2. Have a minimum grade of 0.3%

Culverts shall:

1. Be a minimum 12" diameter
2. Have a minimum of 2 feet of cover

Easements of minimum 10 feet width for pipe systems - and 30 feet plus the width of the ditch will be provided for construction and maintenance.

The runoff shall be determined by the following formula:

$Q = CIA$

Q = Runoff in cubic feet per second

C = Runoff coefficient

I = Rainfall intensity in inches per hour

A = Contributing area in acres

The runoff coefficients to be used are:

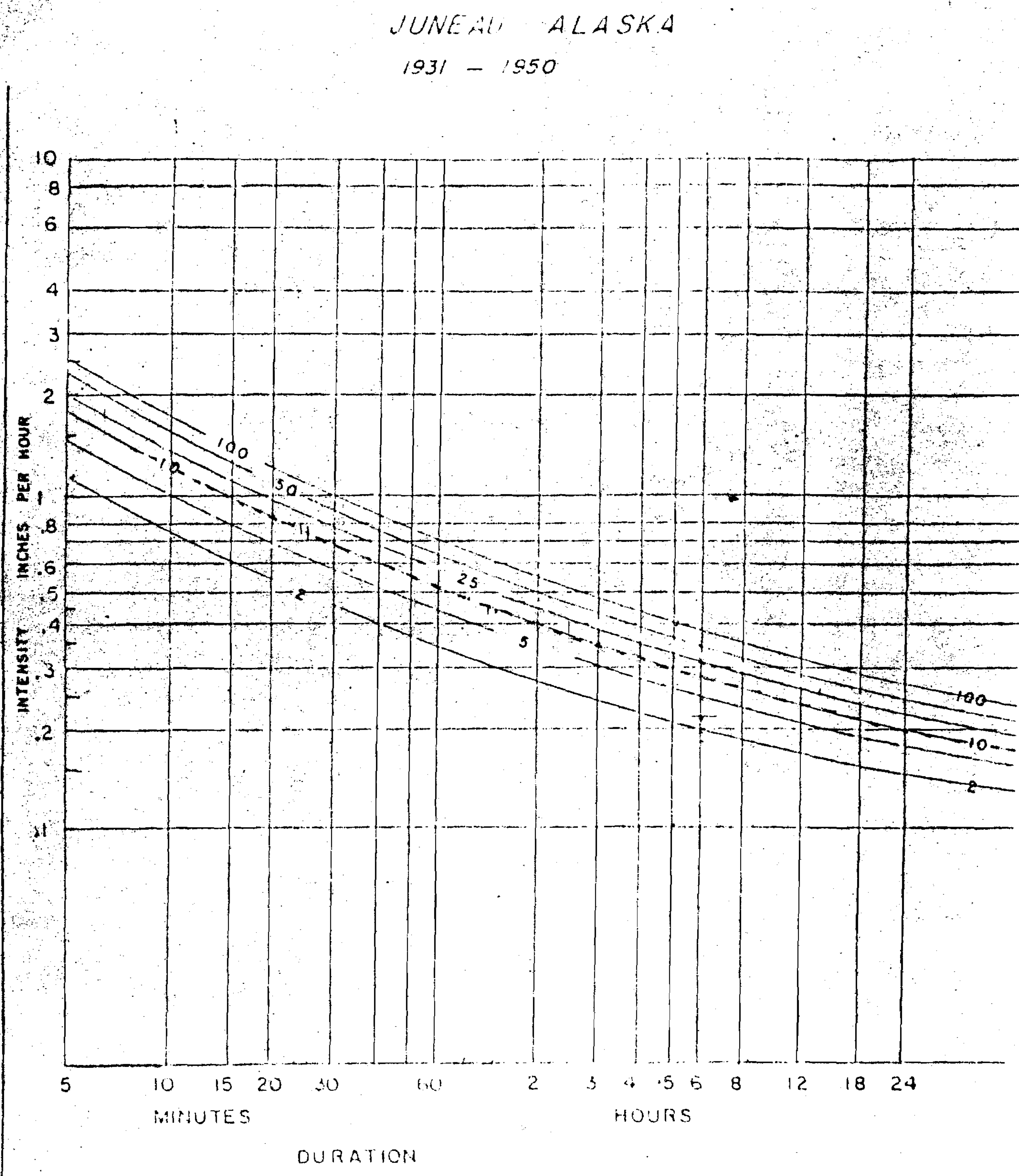
Zone type	Coefficient
Open spaces, undeveloped area	0.2
Single family residential	0.4
Multi family residential	0.4
Light commercial	0.6
School grounds and building	0.4
Industrial	0.6

The rainfall intensity (I) will be the Rainfall-Intensity-Duration curves prepared by the National Weather Service as given in figure 12.

The time of concentration to be used in conjunction with the rainfall-curve can be derived from the nomograph shown in figure 13.

The storm drain pipe sizes can be determined from Manning's Formula. Nomographs solving this formula and instruction for use are given in the State of Alaska Hydraulics Manual.

Culverts for road and driveways placed in drainage courses should be designed using the Hydraulic Engineering Circular No. 5, "Hydraulic Charts for the Selection of Highway Culverts", published by the U.S. Department of Commerce. Culverts should be designed for a headwater depth not greater than 2.0 times the culvert diameter for culverts 18" and under, or 1.5 times the culvert diameter for culverts greater than 18 inches.



RAINFALL INTENSITY - DURATION - FREQUENCY CURVE

SCALE: NTS	DATE: 1-74	CITY AND BOROUGH OF JUNEAU, ALASKA
DRAWN BY:	CHECKED BY:	RAINFALL INTENSITY
APPROVED BY:	REVISED:	FIGURE 12

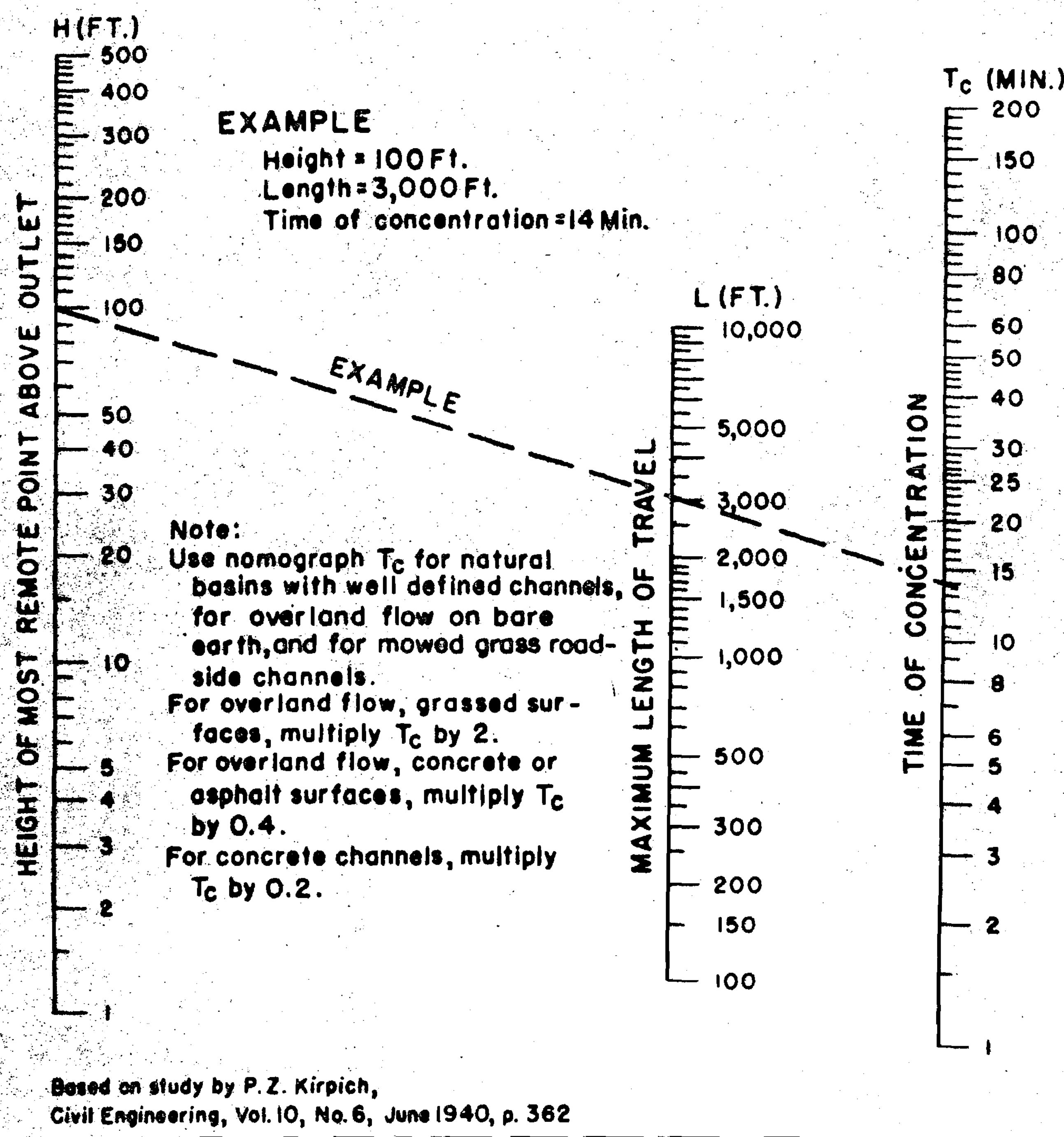


FIGURE 13

TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

CHAPTER VI

SUMMARY OF RECOMMENDATIONS

- A drainage plan for the Valley should be adopted embodying the features of the plans for each individual drainage course as discussed herein.

- Drainage plans for subdivision or developments should comply with the criteria given herein.

- Work necessary to relieve present flooding should be undertaken soon, as the Initial part of this plan.

- Drainage systems compatible with subdivision paving and development should be constructed in accordance with this Ultimate plan.

- Easements for drainage courses should be acquired through presently subdivided lands and should be required to be set aside in future subdivision.

- Buffer strips should be established along streams having high fishery or recreational values, and activity limited within these strips.

- Provisions for coordinated projects for paving, municipal water, and storm drainage should be made whenever possible.

- Financing of drainage improvements through state and/or federal grants should be pursued.

- Local financing should be area wide where benefits are area wide. Such as the improvements to the major drainage courses. Local financing should be by improvement districts where benefits are limited to particular subdivisions or areas.

ATTACHMENT

DRAFT

ENVIRONMENTAL ASSESSMENT

as prepared by

DAN BISHOP

A. <u>Protecting the Stream Environment: Relation to the Public and to the Land Owner</u>

While maintaining and improving the drainage characteristics of the Mendenhall Valley, the plan adopted should in so far as possible, protect and enhance the habitats found both within streams and ponds as well as their margins. These are the habitats of salmonoids, of fur-bearers, and of varied bird species - life which can greatly enhance the quality of living for valley residents. The quality of water banks and margins is also of much concern. This zone is critical not only to the maintenance of living habitat but also provides residents and passers-by with a scenic quality easily lost.

The implementation of a Valley drainage plan which is also sensitive to environmental values will require the support and cooperation of the public, and in particular the land-owner. With the exception of the inter-tidal mouths of Mendenhall River, and Duck and Jordan Creek, the streams and waters of this project area are all contained within blocks of surveyed lands. Thus, while the waters of these streams and lakes belong to the State, their banks and their beds belong to the land holder. The State regulates quantity and quality of natural waters, and is responsible for protecting the freshwater habitats of anadromous fishes (Mendenhall River, Montana Creek, Duck Creek and Jordan Creek are all identified as Anadromous Fish Streams). The Army Corps of Engineers regulates filling in these streams and waters (above influence of Mean Higher High Tide) but has no control over removal of materials. Beyond these controls, the Borough, and the land owner carry responsibility for maintenance of environmental quality in and near waters of the Valley.

Public (Municipal, State) ownership of lands adjacent to waters and water courses may assist drainage planning which includes protection, maintenance or enhancement of environmental values. In some instances, the special cooperation of private land owners of stream or water areas or their margins will also be necessary. Such cooperation may include:

1. Access to stream channels to clear beds of undesireable logs, debris, waste materials, or clogging aquatic vegetation.
2. Easements or trades for areas of particular sensitivity.
3. Stabilized drainage locations.
4. Maintenance of stream banks so as to minimize sediment contribution and bank erosion.
5. Provision for streamside plantings where shade is necessary or desireable.

B. Analysis of Plans on Drainage-by-Drainage Basis

Mendenhall River

Includes the main thread of the river and lands on adjacent banks from the mouth at the airport to Mendenhall Lake. Since significant tributaries are discussed separately, this unit includes only the rather narrow strands of land along either side of the river which are not drained by an identified tributary.

Two alternate drainage plans have been considered: (1) leave the drainage area of concern as is. Utilize roadside ditches and cross drains to remove surface water accumulations as roading and urganization proceeds; and (2) develop a lateral drain distribution pattern, extending from river banks into more poorly drained perched water table areas which lie some distance back from the river, and near to adjoining drainages. Install this pattern as sub-divisions grow.

Environmental impacts of these alternatives are summarized below:

1. Use minimal roadside culverts, and cross drains:

   Much fill material will be required to elevate land surface around residences, and for fill in poorly draining ground. Demand for borrow pits will be increased.

   The portion of poorly drained areas which are un-economical to drain and difficult to use for urban values will be increased over alternative (2). These areas will favor higher populations of water-breeding insects, and will support good bird populations.

   Drowning of spruce trees will occur by filling and limiting of surface water drainage patterns.

2. Develop lateral drainage system, which utilizes the differential elevation between the river and the surface of adjacent nearby lands.

   Less fill and less borrow pit demand, as well as greater percent utilization of land for urban purposes will result.

   Less favorable conditions for water-breeding insects, and more favorable conditions for spruce-hemlock will be created. Conifers may replace willow brush in some locations. To the extent that poorly drained wetlands are included in the drainage pattern these will also be altered, with loss of wetland berries and flowers such as nagoon berries, and Alaska cotton.

Birds which may be displaces or less attracted to the improved drainage of these areas include:

Marsh hawk,
Plover
Short-eared owl and
Swallows.

Habitat of muskrat may be lost, while squirrel population may, in time, increase in the area if conifers are favored.

The points of discharge of laterals into the Mendenhall River may produce bank erosion and un-sightliness if not properly installed and armored.

These created drainage paths may attract a few adult coho salmon and could actually provide a few out-migrating coho smolt. The opportunity for such production is likely to be limited, however.

Passage of lateral drains to the river could have a degrading effect upon remaining natural margins along the river. However, it is felt that such effects can be largely avoided by good design, and could be compatible with a green belt margin along the river, if this is adopted.

It may be anticipated that new borrow pits will be developed in areas between the Mendenhall River and Montana Creek. Such pits, properly located and designed, might be compatible with the drainage plan, and make a small contribution to salmonoid production of the Mendenhall River.

Montana Creek

The area of the Montana Creek drainage which is considered here includes the low lands and their upslope margins which lie below the National Forest boundary to the confluence with the Mendenhall River.

Alternatives evaluated for this stream include:

1. leave as is. Allow the prevailing course of urbanization to proceed within the limits of flood risk, sewer and water quality requirements, road access, etc. Provide for drainage along roadside culverts leading toward natural drainage routes.

2. identify route(s) of drainage flow thru sub-divisions to specific natural drainage ways. Develop easements where necessary to protect or develop drainage paths. Strengthen sub-division and building ordinances with regard to permits for filling and drainage plans. Require drainage plan for any paving or major site work.

3. Incorporate plans for care, protection, and enhancement of Montana Creek and its banks. These plans will attempt to harmonize local suburban runoff with maintenance of fishery and recreation values in so far as can be coordinated with land owners.

Environmental impacts of these alternatives are summarized below:

1. Much fill will be required for subdivisions on low ground with increased demand for borrow pits.

   A significant part of the low ground may not be economical to fill and protect from flooding under any practical alternative. This undeveloped flood-prone land may receive increased concentrated flows from adjacent or nearby suburban areas. Flooding in these areas may actually increase.

   Some of the future subdivisions will be located up-drainage from ponds and slow moving tributaries of Montana Creek. In this manner fine textured sediments washed from subdivision roads, fills, excavations, etc. will carry into probable habitat for coho salmon and dolly varden. To the extent that spawning occurs in these tributary waters, productivity will be damaged by sediment entry.

   This pattern of minimal drainage development may have the least impact, good or bad, on the existing fish and wildlife habitat of Montana Creek, if sediment discharges from roading and suburban development are controlled. This low impact is possible since it may prove un-economic, under such a drainage approach, to utilize the low ground near Montana Creek and its immediate tributaries.

This plan will accommodate the least area for suburban developments, including playing fields, etc. It will also probably not be particularly compatible with maintaining the scenic values of the area, including spruce which may be drowned by filling operations.

2. This alternate, while probably increasing potential areas for subdivision developments, will also be likely to concentrate flows where they have been spread out, and to increase volume of peak flows thru tributaries. These changes of flow pattern toward greater efficiency in handling peak flows will have varied effects upon the present environment.

   a. To the extent that gravels are available for stream working in Montana Creek tributaries, available spawning riffle areas may be increased.
   b. Stream areas for rearing of salmonoids may be stable or reduced, depending upon the manner, and the degree in which tributary channels may be altered to improve flow characteristics.
   c. Fur-bearer habitat will be reduced. This reduction will include beaver, muskrat, and mink. Trapping situations will be reduced.
   d. Bird populations will be markedly changed in the area as drainage develops, with likely reductions in numbers of marsh hawk, plover, short-eared owl, swallows, great blue heron, and perhaps some surface feeding ducks.

The visual quality of the area might fare well under this alternative, since provision would be possible for drainage way easements and presumably associated streamside or pond edge vegetation might receive protection. The likelihood of space suitable for playing fields, etc. would be improved, since more land would be useable.

3. This alternative could be added to either alternatives (1) or (2) above. Protection, maintenance and improvement of Montana Creek's stream channel and stream bank conditions is compatible with either intensity level of drainage planning. This activity would have to be developed cooperatively with the private land owners holding title to parts of Montana Creek's streambed.

   a. Removal of obstructions to flow (primarily logging slash and debris) in the lower reaches of Montana Creek, with the objective of increasing the efficiency of the channel to carry peak flows, will favor channel to carry peak flows, will favor channel de-grading and alteration of the streambed toward coarser sediments - more gravel and less sand. This will favor increase in success of mainstream spawning, in particular of pink salmon. Impact on resident salmonoids, Coho, Dolly Varden, Rainbow, is likely to involve reduction in suitable velocity niches for small fishes, but an increase in size of streambed materials may also favor diversity of aquatic insect production. In sum, such stream clearance might have more beneficial than adverse impacts on fish populations, if selective removal with ADF&G assistance is practiced.

b. Removal of logging residues from the immediate banks of Montana Creek would have the favorable impact of improving streamside access for fishermen and hikers, providing rights of way can be established. Removal would also have the mixed effect of reducing future blockages to flow, while at the same time removing future building materials for sustaining sufficient barriers and hiding places for resident fishes. Clearing of streambank materials may be self-regulating at a desireable level, as a result of difficulty in removing larger logs, stumps, etc.

c. Dredged or dragline gravel operations are a future possibility near or adjacent to Montana Creek. Such operations would be legal if requirements of water quality and fishery habitat protection were met. They would, nevertheless, pose a de-grading threat to the quality of the stream unless plans which anticipate the problem can be formed before operations commence. In this way, it is possible that borrow pits may be turned into productive tributary rearing areas after completion.

Jordan Creek

Includes the entire drainage from the airport to its headwaters on Thunder mountain east of Pleasant Gardens subdivision.

The alternatives considered for this stream refer to respective segments of its length, and are listed below according to these parts of the stream.

Jordan Creek below old Glacier Highway

Alternatives include:

1. Continue to use the same culvert route under the airstrip, and let the future perimeter of the airport continue to determine the location of the streambed. Adjust the stream route elsewhere where needed to conform to the above plan, making sufficient efforts to bring the streambed and stream gradient to a condition sufficient to handle peak flows without overflowing banks:

2. Extend Jordan Creek to the southeast end of the runway, locating the stream channel near the side of the runway. Adjust the stream route to conform to this plan, making minimal efforts to bring the streambed and stream gradient to a condition sufficient to handle peak flows.

3. Expand on plan (1) above, by re-building the culvert, under the airport, and at that time also extending the culvert to provide for a widened strip. Provide for conditions in culvert suitable for salmonoid migration up and downstream. Establish culvert elevation and upstream stream channel conditions so that sediment flow through the system is not interrupted by permanent deposition in flats above the airport. Improve the efficiency of channel, while also providing several protected holding pools for salmonoids.

4. Expand on (2) above, so that maximum sediment carrying capacity of lower Jordan Creek is developed, and estuarine flushing and scouring abilities at the mouth of the stream are developed. Provide several protected holding ponds for salmonoids, and run outflows from Smith-Honsinger dredged pond and the adjacent flow to the N.W. into Jordan Creek near mouth to assist with sediment flushing action.

These alternatives are examined for impacts, to the degree that present information permits.

1. This plan has a limited life-span because of the poor and rusted quality of the culvert under the airstrip. During its remaining life it will favor intermittent flows in the stream channel and thru the culvert. Adult salmon will have restricted access into the stream during many summers, and sea-migrating Coho or Dolly Varden will be largely at the mercy of the outflowing tides.

This plan will have little effect on salmonoids rearing in this section of Jordan Creek - few presently use this section as rearing habitat.

Insofar as the plan continues the existence of the man-made ponds near the discharging culvert under the runway, it will support the continued use by waterfowl of these waters. This is not a major waterfowl use area, however.

Bird populations nesting or relying on the sapling spruce fringe of the stream near the runway will probably lose their habitat when the airport is expanded. This will probably occur for all alternatives.

Perhaps the most notable environmental impact of this minimal alternative plan is that it contributes nothing toward an effort to halt the gradual destruction of the natural habitats of this stream. In the instances of Jordan and Duck Creeks it appears that the ability of the lower stream to carry its sediment load to the sea is particularly critical to maintaining acceptable migration and habitat conditions both in this section and upstream.

2. The possible impacts of this plan are not well understood, since this involves 800 - 1000 feet of additional channel length, along with abandonment of significant portions of the present channel near the airport.

A favorable impact is that it would free the Jordan Creek channel from future alterations and impacts associated with the airport. A stable channel position, if correctly located, would allow for later channel improvements.

It is uncertain at this time whether a stream channel route to tidewater at the end of the runway will increase or decrease the channel gradient, as compared to the present stream gradient to the invert of the upper end of the present culvert under the runway. If the present grade between the old Glacier highway and the invert of the culvert is in the magnitude of .2%, the added 800 - 1000 ft. length of channel to tidewater at the end of the runway would require at least 2 feet additional fall to maintain the existing grade. The significance of this question is in the possible impact of change in stream competence. If the channel change results in greater competence to handle sediment load, then deposition in this section will be reduced, and fishery habitat may benefit. With reduction in gradient and competence, a deposition pattern will develop more severly, and the streambed will tend to spread out. This would be generally detrimental to maintenance of fish habitat or migration routes.

The impact of alternative (2) on waterfowl habitat would not be large. It would probably produce a small reduction because less ponded water would be available.

3. Expand on plan (1) above. This would involve a considerable increase of continuous culvert length under the runway from the present length of about 375 feet. The effect of this increase on upstream migration of salmonoids would require careful examination and possibly special design features such as lighting or resting ponds. ADF&G culvert design standards for swimming capability of migrating salmon in fresh water (1961) recommended horizontal distances between resting pools, as follows, for velocities of water in culvert:

Average Velocity	Spacing
1.5 f.p.s.	680 ft.
2.0 "	410 "
2.5 "	280 "
3.0 "	210 "

A significant increase in culvert length will result in more risk that adult coho will not migrate upstream. However, we know that the present 375 ft. culvert passes adult coho satisfactorily.

A re-built culvert at a lower invert elevation might greatly improve the sediment characteristics of the lower stream and allow the streambed to grade down to a level where it would dry up less frequently during low water periods. Present impact upon migrating Coho and Dolly Varden fingerling of stream de-watering would also be reduced by construction of deepened instream holding areas.

4. Expand on alternative (2); maximize sediment carrying capacity,estuarine flushing....

The potential for further reduction of environmental impacts over plan (2) can not be accurately assessed at this time, since few facts are available. The following evaluation is based upon field examination, without benefit of measured data.

As indicated earlier, the possible environmental impact of sedimentation in the lower channel of Jordan Creek will be consideralby dependent upon additional available grade to tidewater, which will not be much altered by additional channel sophistications. The addition of clear flows into Jordan Creek near its mouth from discharges out of the Smith-Honsinger pond and from the small flow that crosses Egan Drive near the intersection west of the Veterinary Clinic, offers the possibility of increasing the stream's competence near its mouth. This improved sediment-carrying abiliby may provide conditions favorable to fish passing ability of the channel, and to maintenance of streamflows during low flow periods. Incorporation of the Smith-Honsinger pond into the Jordan Creek system might also have a favorable impact on stability of runs of rearing fish capable of occupying the pond.

The configuration of the estuarine area at the end of the runway will bear upon whether and how the sediments discharging from Jordan Creek will be flushed. Incorporation of design sufficient to do this would also reduce potential fishery impacts from upstream sedimentation.

The potential for reduction of fishery impacts by a raised streamside berm with planted conifers and shrubs also applies for this plan, and might be even of greater importance since the channel length would be greater.

Use of instream deepened pools will reduce possible losses of fingerling Coho/Dolly Varden during summer drought periods.

As with alternative (2), this plan might involve loss of waterfowl and bird habitats. Development of a new vegetated stream fringe would later replace lost bird habitat.

Jordan Creek between old Glacier Highway and confluence of tributary from Reed's Dredged Gravel Pond

Alternatives include:

1. Leave the stream channel and stream margin as is. Develop drainage paths for future subdivision in this area when and as the problems occur and,

2. Clear the stream channel of old bridges, logs, debris and garbage, to improve flow efficiency. Use ADF&G guidance to identify features of streambed that should not be removed or altered. Provide recommended drainage paths to be maintained as future subduvisions may be developed. Control periodic sediment discharged from Reed's Gravel Ponds.

3. Provide for maintenance of streambank quality, and for fishing access to points on the streams in so far as possible. Develop easementa and property exchanges to protect and enhance value of the stream.

Environmental impacts of these alternatives:

1. Impacts on sizeable numbers of rearing fish populations using this section would be dependent upon the nature and the quality of subdivision development in the area. Clearing and development to the banks would increase the likelihood of undesireable levels of stream heating and could also reduce availability of protective cover for resident fish.

   A few nesting broods of waterfowl might be displaced. Birds which use the present mix of conifers, hardwoods, and brush adjacent to the stream would be seen less frequently.

2. The immediate impact of stream clearing would likely be the displacement of a significant or large part of the resident fish population. This population would re-occupy the stream over the next several years, and stream capability would return to productive levels similar to or higher than the present condition.

   Stream clearing, coupled with sufficient downstream measures to carry out the sediment, would result in higher flow velocity conditions, favoring maintenance of a cleaner streambed. This would provide potential for spawning salmon to utilize this streambed. Change in aquatic insect population toward those which favor coarser streambed material would be expected, and would alter the feeding habits of resident Coho and Dolly Varden. The potential for local sport fishing would be improved by stream clearance.

Stream clearance is likely to reduce local flooding. To the degree this is successful, less added elevation by trucked-in fill material may be needed, reducing impact from borrow pits.

Control of periodic sedimented water discharges from Reed's Gravel Ponds will reduce sedimentation of streambed and spawning gravels, and improve visual quality of the stream along much of its length.

To the degree this alternative results in a more open streambed, greater potential for heating will develop. This will be countered by higher flow velocities which act to reduce heating for a given parcel of water.

3. This alternative would use the potential of Jordan Creek for being a natural asset, rather than a public nuisance. Favorable impacts from neighborhood fishing use and from educational uses by the nearby elementary and junior high schools can be expected from creation of a quality margin along Jordan Creek by easements, covenants, land exchange, or other means. Property values of lots and residences near the stream are likely to increase as a result of improved stream quality. This favorable impact has been observed near urban streams in Anchorage.

   Improved quality of access to Jordan Creek would also increase the potential for over-fishing or for harassment of spawning fish. To avoid this impact would require both a fisheries management plan and a public education program. Both plan and program are attainable.

Jordan Creek above confluence of tributary from Reed Ponds

Alternatives include:

1. Do nothing with regard to drainage planning

2. Establish drainage routes for possible future subdivision development.

3. Establish a protected headwater spawning area.

Environmental impacts of these alternatives:

1. This area is beyond the limits of present subdivision activity. A considerable portion of this section of Jordan Creek drainage remains un-logged so that future urbanization means impacts of logging, roading and housing developments. This would be occurring in an area where up-welling springflows and/or near-surface flows from tributaries off Thunder Mountain are common.

   Since this area is the most important part of the stream for coho spawning, the potential of significant fisheries losses are large. This small and relatively pristine spawning groudn may also be of special value as a teaching area for local elementary and junior high students. Thus the impacts of its loss or serious disruption by lack of advance planning are large for the Valley community.

2. Impact on headwater spawning from nearby subdivision development might be difficult to avoid because of the nature of the divided headwater flow pattern in this area, and because of extensive springflows and high water table areas. Loss of primary pole-spruce timber stands, now un-common in the Mendenhall Valley would also result.

   Alteration of the natural flow regime in the headwaters of Jordan Creek by filling, and replacing with suburban developments will also change the downstream flow pattern, probably toward a flashier runoff. This change could reduce quality of fish rearing habitat, in some downstream reaches.

3. This alternative would maintain natural flow regulation in the major headwaters of Jordan Creek. In addition to protecting Coho spawning grounds of primary importance to Jordan Creek's fishery, insuring quantity and quality of headwater flows would have a major favorable impact on the health of the entire stream and the life it supports.

   A protected headwater will be compatible with dispersed recreational uses and developments as well as with outdoor education uses. Impacts on the stream environment will be minimal so long as the forest canopy is not sufficiently disrupted to favor windthrow and the ground surface is not significantly altered.

Duck Creek

This drainage adjoins Jordan Creek, but has little direct tributary flow off Thunder Mountain as is incorrectly indicated on the USGS topographic map. The drainage boundary between Duck Creek and the Mendenhall River strand is poorly defined, and has probably been altered by various sub-divisions and road-culvert developments. The headwaters of Duck Creek meet those of the Dredge Lake system at the terminal moraine just up-valley from the Loop Road.

Drainage facility alterations and installations that may be proposed for the Duck Creek watershed have an excellent chance of favorably impacting environmental features. The stream is presently in a generally un-healthy and un-productive condition, although it is not beyond hope for retaining or re-building desireable environmental features, while accomplishing the primary goal of carrying urban runoff without flooding. The drainage subdivisions and the alternatives considered reflect varied degrees of reaching these goals.

Duck Creek below the new I.G.A. Shopping Center

Alternatives considered include:

1. Leave drainage path as is. Provide for surface runoff by ditches and roadside runoff to stream channel.

2. Low level improvement. Replace culverts where they may favor local flooding. Remove major debris from streambed where efficient flows are obstructed. Develop plans and ordinances to provide control over filling, drainage paths to maintain Duck Creek as an effective drainage way.

3. Enlarge upon alternative (2) to provide for environmental features of the stream:
   a. lower the bed of the stream, increasing the gradient and reducing the period when streambed lies above local water table level.
   b. remove phreatic vegetation in and along the side of the stream. Replace with less encroaching trees, and ground cover.
   c. provide one or more holding ponds.
   d. establish a policy for maintenance of borough lands along stream course.
   e. develop easements or other means to assure compatibility in the handling of private lands along this part of the stream.

Impacts of these alternatives are considered below:

1. By itself, this alternative will contribute a gradual, continuing loss of the remaining vestige population of salmonoids in this stream. This will result from continuing mortality to downstream Coho and Dolly Varden migrants through entrapement during low flow conditions and from restrictions to upstream migration, also by low flow conditions.

   Birds which need continuous waterflows remain displaced by this alternative, while other birds, and their predators which use grasses and shrubs as opposed to wetlands may survive well until displaced by airport expansion or commercial land development.

   Visual quality of the stream channel will remain nondescript and with little to commend it.

   Recreational value of the stream margin will remain low. Land residents will derive little value personally or in property value from adjacency of the stream.

2. This alternative might improve up and downstream migration routes of salmonoids if culverts were also installed to minimize impoundment of low flows, and if shaded instream holding ponds were installed and periodically maintained.

   Birds needing continuous waterflows will be marginally benefited by this alternative to the degree that enhancement of flood-flow handling conditions also provide some benefit to low flows. Incorperating one or more shaded instream ponds would enhance bird populations.

   Visual quality of lower Duck Creek might be significantly improved by this alternative.

3. Evaluation of this alternative is based upon limited data on the relative elevation positions of the lower Duck Creek streambed and the adjacent water table. Evaluation of the role of streamside willow brush and other vegetation along or in the streambed is also limited by only general definition regarding water losses, (evapo-transpiration), reduction of waterflow velocities, and deposition-favoring characteristics.

   Lowering the bed of Duck Creek downstream from new I.G.A. may beneficially increase summer streamflows. These flows may be further significantly augmented by reduction in evapo-transpirational losses from instream and streamside phreatic vegetation.

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   The initial impact of this action will be to produce a large resulting flush of sediment downstream into the

Mendenhall River. This would be followed by rapid physical stabilization of the bed into a sand-gravel composition. Additionally, Duck Creek would be more open to sunlight and would be more exposed to stream heating until shading streambank vegetation were developed. Heating tendencies, however, would be counteracted by increase in low flows.

Use of maintained instream holding pond(s) would provide a collection point(s) for sediment moving downstream as well as a protected station(s) for migrating salmonoids during winter or summer drought periods. Such pond(s) could also improve visual quality of the stream.

Greater diversity in bird life would be sustained with more stable flows, particularly after a vegetated stream margin were developed, including spruce as well as hardwoods. A vegetated margin of trees along lower Duck Creek near the airport would also provide a visual curtain between airport activities and adjacent residents. To some extent this would also provide for noise reduction in residential areas.

Duck Creek upstream from the new I.G.A. Shopping Center

Alternatives considered include:

1. Leave drainage essentially as is, providing for surface runoff in ditches with no improvements to the stream channel or to the dredged ponds.

2. Low-level improvement; treat subdivisions which have particularly bad surface drainage, ditching, or in some cases, piping storm runoff into Duck Creek or into tributary dredged ponds. Harmonize culvert sizes and installations to improve drainage efficiency. Establish comprehensive planning and strengthen ordinances and basis for permitting fills or installing drainages.

3. Re-grade, and re-form Duck Creek's channel. Provide, where practical, for selected reaches of the stream to be specially maintained as salmonoid spawning or rearing areas. Utilize existing dredged ponds in Duck Creek drainage as regulatory reservoirs, with installation of controllable, variable-level outlets. Vegetate portions of the stream and pond banks to provide shade to the stream and to improve visual quality.

Impacts of these alternatives are considered below:

1. With the minimal attention of alternative 1, there will be little likelihood that Duck Creek can maintain much fish or wildlife value. Sparse populations of remaining Coho

would be likely to hang on in small numbers until the attrition of high fresh water mortality factors finally wipe out the stock. On years with good populations of salmon entering the Mendenhall River, strays might still enter Duck Creek to attempt to spawn.

Bird populations associated with this section of the stream would remain in considerable numbers so long as the streamside and in-stream vegetation remained. Water breeding insects would do well.

Trees and vegetation along the stream and pond margins would probably be slow to mature or develop into a more pleasing visual form. Reasons for this are three-fold:
a. present natural growth is present but sparse and of poor quality in many instances;
b. new urban developments will mean further attrition, and,
c. there is no streamside vegetative protection provision in Borough regulations. With Alternative 1, visual quality along Duck Creek will either improve marginally, or will deteriorate slowly.

2. Use of Alternative 2 might allow the indefinite continuation of a vestige population of salmon and/or Dolly Varden in Duck Creek, provided the stream conditions below Egan Drive does not deteriorate further. The limited stream area still available and suitable for spawning or for rearing would have to remain useable. Number of returning salmon are un-likely to increase significantly under this plan and would provide little value to the community.

   Bird populations would not be changed much with this alternative, but habitat might be stabilized by regulatory action which is developed.

   Visual quality of Duck Creek and its margins may be improved or at least maintained with this alternative. Recreational and urban property values associated with this section of Duck Creek would probably not be enhanced but possibility of later enhancement would not necessarily be foreclosed.

   Effects on water quality from plan 2 are summarized below:
   a. iron precipitates present in ponds and streams may be somewhat reduced in concentration if rate of pond exchange is periodically increased, and/or if stream velocities and bedload scour is increased where iron precipitation occurs. No chemical changes related to iron precipitation are expected.
   b. quality of streambed sediments would be coarser, to the degree that higher stream velocities are developed during stormflows. The degree of change in stormflow velocity conditions which might be expected is not known at this time.

c. water temperature extremes will be ameliorated to the extent that protective streamside vegetation is encouraged. Little change is expected under this alternative.

3. Use of such measures as described in Alternative 3 would provide for a continuing salmonoid population in Duck Creek. Sufficient spawning habitat for Coho could probably be maintained to provide for a healthy population of resident Coho fry and fingerling. This alternative, however, would offer little chance of improving salmonoid populations in Duck Creek unless the stream below Egan Drive was improved and maintained as a viable migration route for adult and young fishes up and down stream.

   Re-grading sections of Duck Creek by clearing the channel of what appears to be recent decades of debris and sedimentation would provide sustained increases in salmonoid spawning and possibly rearing areas if the new flow conditions carried sediment through the re-conditioned reaches of the stream. Without continuity of sediment flow the favorable impacts would be relatively short-lived.

   Use of Duck Creek's dredged ponds as reservoirs to even out flows is limited by the modest size and draw-down capability of these basins. Likewise, the favorable effect of releasing flows during summer droughts would not have much duration based upon available storage. It is possible, however, that summer draw-down of these dredge ponds would induce significant increases of flow from groundwater reserves, while also providing a more vigorous flushing of iron-rich waters with benefit to water quality.

   Instances of groundwater contributions to ditches or gravel pits were measured in similar alluvium near Valdez by C.R. Mattson, NMFS. His measurements during the peak of snowmelt indicated a drainage ditch was accumulating ground water at about .65 cfs/100 ft. while a ditch near a gravel pit measured at the same period produced about .45 cfs/100ft. Earlier in the year (March) during winter low flow, the first ditch produced about .3cfs/100 ft. of ditch. While these figures are not applicable, they are indicative of a significant contribution potential when a ditch or pond is drained below the local water table in water-bearing alluvium. This potential may, if utilized in Duck Creek, have favorable impact on low flow conditions.

   Vegetating of Duck Creek stream and pond margins will help to reduce stream heating which has been identified as a problem to salmonoids near the inter-tidal mouth of this stream. A tree margin along Duck Creek will also enhance its visual character and improve adjacent residential values, including the bicycle path along much of Duck Creek's length.

Other Small Tributaries

Includes:

A. the drainage winding through Long Run Drive Subdivision to the Mendenhall River; and

B. three small tributaries to the Mendenhall River - B-1 & B-2 drain lands in the vicinity of Epperly's Stable and support Coho populations, while B-3 drains lands near Abel's lumber yard and does not have identified fish and wildlife values.

Tributary A - Long Run Drive

The alternatives which may be developed will not impact fish and wildlife resources in as much as none have been identified. A more efficient flow path, with less opportunity for impoundment or flooding will improve the opportunity for home landscaping and visual enhancement.

An alternative could be developed which would consider the possibility of special handling of the stream as it passes into the River at the Red Samm gravel pit. There may be possibility of adopting the tributary and the gravel pit into an attractive asset to local residents.

Tributaries B-1 & B-2

The drainage alternatives for these two Coho rearing tributaries will concern the degree and the manner in which the habitat can be protected. These partially spring-fed streams are small in size. Taken together, the two tributaries may provide in the magnitude of 10 to 20,000 $ft.^2$ of salmonoid rearing area.

In the absence of actual inventory information on Coho fry-fingerling population, the approximation method shown in Benefit/Cost Salmon Habitat Improvement U.S.F.S. Alaska Region, Juneau, Feb. 1969 was used to estimate Coho smolt production and adult returns that may be expected in this situation.

Good populations of Coho as suggested by a preliminary ADF&G examination of the tributaries last fall, may produce in the magnitude of 30 Coho smolt/ $100ft^2$ of rearing area/year, inferring an annual production from these two tributaries of 300-600 smolt, with 30 to 60 returning adult Coho expected, of which about 7 to 20 may pass through the fishery to spawn in these general waters.

In short, this exercise indicates that the impact of losing these tributaries, on Coho production, is worthy of consideration in designing and approving access and land development in this area.

Tributary B-3

Fish and wildlife resources have not been found in this tributary.

This area is being developed for commercial uses. Risk of industrial pollution of the tributary due to discarded waste products may bear special care in management. The potential impact of undesireable chemical wastes entering this tributary, then flowing into the Mendenhall River and Fritz Cove is of particular importance to both anadromous and marine resources of the entire area.