CITY AND BOROUGH OF JUNEAU

MENDENHALL VALLEY DRAINAGE STUDY

Contract No. 89-130

Prepared for:

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1.0 INTRODUCTION

Since the 1960's, Juneau's Mendenhall Valley has become the principal residential area. The population has increased from an estimated 2,000 people in the mid 1960's to 11,000 people at present. As urban development of the Mendenhall Valley proceeded, the drainage characteristics of the area have altered. There has been a loss of tree and other vegetative cover. Large areas have been made impervious due to residential construction and the associated roadways. As the pace of development increased, the City and Borough of Juneau, in 1979, engaged the engineering firm of Engineering Manpower Services (EMPS) to conduct a drainage study of East Mendenhall Valley. Its purpose was to define the apparent drainage problems, to recommend a course of action to alleviate these problems and to provide a framework for further development of East Mendenhall Valley area. This initial study was followed up by a further study in 1983 which provided more detailed standards for the future design and construction of the drainage system.

In the time since the second report there have been some major changes within East Mendenhall Valley. These included construction of major drainage interceptors, paving of subdivision streets and progress toward construction of an underground storm drainage system.

The purpose of this report is to update the previous drainage studies, to assess the adequacy of construction improvements carried out in the past 10 to 15 years, and to evaluate the impact of these construction improvements upon the major surface drainage channels. Recommendations will be made for future action to deal with major problem areas and to prepare for continued expansion of urban areas throughout East Mendenhall Valley.

A description of the hydrology, climate, soils and history of the Mendenhall Valley are included within the original EMPS study. This also includes the vegetation, habitat, fish and wildlife resources. These factors remain essentially the same and have not been further researched as part of this study.

A number of factors have contributed to the present drainage characteristics of the valley. These include:

1. Loss of tree cover and vegetation;
2. Initial development of subdivisions with gravel roads and surface drainage;
3. Obliteration or diversion of many pre-existing natural drainage channels;
4. Subsequent paving of gravel subdivision streets;
5. Installation of major drainage interceptors;
6. Construction of underground storm drainage systems within existing subdivisions;
7. Recent subdivision development that includes underground storm water drainage collection systems and paved streets at the outset;
8. Construction of an areawide domestic water supply system with the removal or closure of wells, resulting in a rise in the general groundwater table;

9. Removal or replacement of certain undersized or dilapidated drainage structures beneath subdivision and arterial streets on the main stream and tributaries of Duck Creek.

The general design of the drainage system of East Mendenhall Valley is ultimately proposed to have underground storm sewers collecting from street inlets and area drains. The collectors discharge directly to the three main surface drainage streams or into interceptor drains which themselves discharge into the streams. The drainage areas can be separated into those which discharge directly into;

- Mendenhall River;
- The tributaries and main channel of Duck Creek;
- and Jordan Creek.

SCOPE OF WORK

The project work scope is highlighted by the following tasks;

1. Define the boundaries of separate drainage areas which outfall into Mendenhall River, Duck Creek and Jordan Creek.

2. Describe the drainage areas in terms of size, runoff characteristics, present and anticipated use, present method of channeling runoff, and an evaluation of the suitability of existing collection and outfall methods.

3. Evaluate the adequacy of existing drainage system and their impact upon the receiving waters of Duck Creek or Jordan Creek.

4. Summarize the permit requirements and concerns of State and Federal agencies.

5. Produce a series of maps depicting the drainage areas, the major interceptors and outfall drains.

6. Identify any additional outfalls needed in the future and proposals for further development of the drainage systems of the area.

STUDY METHODOLOGY

Since CBJ's existing 1974 area topographic mapping was insufficient to adequately determine the optimum drainage paths, existing and recent aerial photography was used to create new topographic mapping. The study area mapping extends from the Dredge Lake area, south to the Juneau Airport and from the base of Thunder Mountain, west to Mendenhall River.

Drainage areas were delineated on topographic mapping using mapping data directly, from field observations and from information gathered by City and Borough of Juneau staff and other local consultants.

For each of the drainage areas identified, runoff computations were made using the *rational method* based upon a 25 year storm intensity. Runoff coefficients were established at 0.4 for developed residential and commercial areas, 0.2 for undeveloped land within the valley floor, and 0.6 for the steep slopes of Heintzleman Ridge. The intensity used was for the 25 year storm as shown on the National Weather Service rainfall-intensity-duration curves for the Juneau area.

Runoff computations were made for individual drainage areas and for larger combined drainage areas which cumulatively make up the flow of the major streams.

From field observations it is known that during times of lower flows, portions of the Duck Creek stream bed dry out completely while other sections continue with some flow. This indicates that a significant portion of the stream flow occurs within the sands and gravels of the stream bed and elsewhere within the Valley. Runoff computations were revised to allow for this portion of subsurface flow. The peak flows, which are the critical flows for sizing of culverts and major drainage structures, are further adjusted to account for storage retention areas within the major streams.

SIZING OF DRAINAGE STRUCTURES

Drainage structures were sized in accordance with the State of Alaska Department of Transportation & Public Facilities (DOT/PF) Hydraulic Manual. This document uses criteria, charts and nomographs developed by the U.S. Department of Commerce, Federal Highway Administration (FHWA). Open channel flows were computed by using Manning's equation with roughness coefficients from FHWA design charts for open channel flow. The computed stream flows could be compared with the runoff and discharge quantities determined by the Corps of Engineers in the 1977 flood plain study and computations made by EMPS in the earlier Mendenhall Valley drainage studies. Flows computed by this study were higher than those noted in EMPS' work since the storm intensity used was for the 25 year storm as opposed to the 10 year storm in the earlier study.

An additional data source on the stream flow for Duck Creek has recent become available. The U.S. Geologic Survey (U.S.G.S.) has established gauging points at five locations on Duck Creek and in one location on Jordan Creek. The usefulness of this data is limited due to the fact that only two years of data are available and that, except in some specific instances, the peak flows during storms have not been recorded. It is these peak flows, which by definition occur only very infrequently, which are of concern when evaluating the likelihood of flood damage.

On September 25, 1996 a severe rainstorm occurred which provided a useful comparison of theoretical runoff to observed stream flows. Examination of National Weather Service precipitation data indicated

that there was a maximum 1 hour rainfall intensity of 0.31", a 6 hour precipitation amount of 1.49" and precipitation measuring 3.8" within a 24 hour period. This equates to *about* a 10 year storm intensity. A 25 year storm would be expected to be approximately 20% higher.

CONSTRUCTION IMPROVEMENTS WITHIN EAST MENDENHALL VALLEY

Since the 1979 and 1983 drainage studies were completed by EMPS, the City and Borough of Juneau has carried out a considerable number of significant construction improvements to the drainage system. Details of various construction projects are shown in Appendix C. The major underground collectors and interceptors are shown on the mapping exhibits within Appendix A. The Capital Improvement Projects (C.I.P.) which have had major impact upon drainage flows within East Mendenhall Valley are:

1. A 54" diameter interceptor drain south of the Alaska Memorial Park discharging into the Mendenhall River.

2. 24" to 54" interceptor drains within Portage, Gee and lower Julep Street discharging into the outfall noted above.

3. A 36" interceptor from lower Julep Street, across Melvin Park, with an outfall in the Mendenhall River.

4. An 18" to 24" diameter collector/interceptor from the northern end of Tongass Boulevard, collecting from Dudley Street, Forest Lane, Jennifer Drive and neighboring areas, with an outfall into the lakes on the Duck Creek fork.

5. Improvements to the Duck Creek channel which include;

   A. A 17' open arch crossing at Stephen Richards Memorial Drive.

   B. Rechanneling of flow from Brother's Avenue through a 36" culvert beneath the Mendenhall Loop Road and reconstructing the channel of the upper portion of Duck Creek.

6. A 30" interceptor was constructed on Berner's Avenue and Radcliffe Road draining collectors from Totem Park and other neighboring areas and discharging to an outfall in the Mendenhall River.

7. Improvements in the drainage of Riverside Drive from Vintage Park to the Rotary Park have provided 24" collectors gathering water from Parkwood Drive, to James Blvd., discharging to the Mendenhall River behind the post office and via a new 36" outfall across Dimond Park.

In addition to these interceptors, numerous local drainage systems have been upgraded to current standards. As older subdivisions were improved during the 1980's by paving of gravel roads, the drainage in a number of these subdivisions was changed to underground systems. Newer subdivisions have been constructed with paved streets and underground drainage from the outset. The upgraded drainage system for the Valley has proved generally adequate for the actual storm flows experienced within recent years.

Creek, as a resource for fisheries and wildlife habitat, while at the same time meeting the need to provide adequate drainage for the residents of the Mendenhall Valley.

There are a number of areas where constrictions in the flow of Duck Creek and its tributaries result in flooding upstream. North of the Back Loop Road, ditches have inadequate grade to cope with maximum storm flows. The area would benefit from a comprehensive underground storm collection system. This system could only be installed if the existing 24" culvert crossing below the Back Loop Road was lowered. The main channel of Duck Creek flows with little restriction beneath Taku Boulevard, but is constricted by a series of culverts at Mendenhall Boulevard. This causes backing up of the creek above that point. This localized floodway has not, to date reached the adjoining residences.

The culverts at Aspen Street cause backing up during high flows with some flooding of properties in the low lying portion of Birch Lane. The area around Duck Creek's crossing of McGinnis Street is generally low lying. This results in localized flooding and a danger of overtopping of the road during floods exists. Downstream, at the back of the Glacier View Mobile Home park is a private driveway which has small culverts unable to carry the 10 year design flow. This has resulted in overtopping of the road and partial undermining of the paved surface. This constriction also results in back water at the McGinnis Street crossing contributing to flooding there. This driveway is not presently in use and has been fenced off at the trailer park.

The new 17' wide arch culvert installed at Stephen Richards Memorial Drive is more than adequate for design flows up to a 25 year flood.

One of the main tributaries for Duck Creek gathers runoff from Kiowa Drive, Valley Blvd., Delta Drive, Deborah and Diane Streets. Construction of deeper ditches and installation of 24" culverts within this area have improved the flows and prevented recurrence of earlier flooding in much of this area. However, there are localized areas of flooding remaining. Thence, a 36" crossing of the Mendenhall Loop Road carries this water adequately. However, from Glacier Valley Baptist Church to the confluence with the main channel of Duck Creek, low lying areas of Spruce Lane and El Camino Street flood significantly on a regular basis. The situation could be improved by installation of larger culverts set at a lower elevation on the eastern portion of El Camino Street and Spruce Lane. Installation in 1995 of a 48" culvert at the western side of El Camino Street has resulted in relieving of the flow constriction which had been present at that point.

The lower sections of Duck Creek, which include several old gravel pits as storm retention pond areas, have culverts sized adequately to pass a 25 year storm. However, a number of culverts are "perched" with the invert/outlet levels too high to allow the creek to cut the bed to its natural slope. This results in restrictions to high flows, excessive accumulation of silts and in places drying up of the creek bed at times of low flow. Culverts which presently cause significant constriction of upstream flows are the 48" located beneath a driveway south of Nancy Street and the twin 60" pipe conduits at Egan Drive. However, prior to lowering the culverts at Egan Drive, all downstream culverts need to be lowered and have minimum 2x48" culverts installed. The increased peak flow at Egan Drive could cause flooding downstream unless the whole channel was improved to beyond Berners Avenue.

MENDENHALL RIVER

At the western limits of the study area, construction improvements since 1985, are detailed in Appendix C. These improvements have successfully channeled storm water runoff via collectors and interceptors into Mendenhall River. There remain some isolated areas where the drainage flow is poor to marginal.

EXISTING DRAINAGE PROBLEMS

The construction improvements detailed above have adequately dealt with the most widespread areas of flooding and those areas which could be upgraded by direct upgrading of portions of the existing system. However, there still remain certain areas where flooding is a concern. These drainage areas can be put into a number of categories.

A. Areas towards the eastern margin of East Mendenhall Valley which are susceptible to cross over water from Jordan Creek to Duck Creek's drainages during periods of high flow. (eg., Trafalgar Street, Nancy/Tongass Blvd.).

B. Damaged inlets or blocked culverts, (eg., west of Amerigas on Loop Road, Chelsea Ct.).

C. Areas which require significant portions of the downstream drainage system to be lowered to enable adequate underground drainage to be installed. (eg., Valley Avenue, Dredge Lake Ave.).

D. Localized low lying areas where there is a lack of fall to the existing drainage system - scattered throughout the area.

E. Forest covered areas which are generally low lying and where runoff from neighboring areas has collected and seeped away through subsurface ground water flow. (eg., Teslin Ave., South of Thunder St.).

Sections of Duck Creek and Jordan Creek cause flooding due to;

- Blockages within the drainage channels due to debris, fallen trees and other obstructions.
- Constricted channels with inadequate storm retention areas.
- Undersized or perched culverts which result in backing up of storm flows which extend beyond the available flood retention areas.

FUTURE IMPROVEMENTS/RECOMMENDATIONS

The present use of open ditch collectors results in standing water beside roads during times of sustained rainfall. This system requires considerable annual maintenance in cleaning silt from ditches and from clearing blocked culverts. Above ground drainage is also more susceptible to freezing and snow damming with resultant localized flooding when drainage paths are obstructed.

Where specific site conditions allow, further improvements will be made to the areawide drainage system. It is desirable, insofar as possible, to remove all stormwater drainage ditches and replace with

underground pipes and culverts. Collection can be via curb and gutter with curb inlets or shallow swales with area inlets. However, some type of ditching system should remain to allow for snow storage and melt off.

CBJ Engineering is proposing upgrading the drainage system in the Nancy Street, Lower Tongass Blvd. area. This area will have an underground drainage system discharging into Duck Creek below Nancy Street. The intent is to prevent the flooding of the ditches and low lying areas which presently drain into Jordan Creek.

DUCK CREEK ENHANCEMENTS

All enhancements to the main Duck Creek drainage will need acceptance by the local resource agencies. All enhancements must address the dual purposes of improving peak flow capacity of the stream together with enhancing fish habitat. At present, a project is underway to design and construct a bottomless culvert at Cessna Drive. This project has been delayed due to the complexity of relocating sewer and communication lines discovered during the design process. The following enhancements are proposed:

1. At Aspen Avenue, replace the existing 2 - 24" diameter culverts with a larger pipe arch culvert. Hydraulically, a 50" by 31" pipe arch would have the capacity to pass a 25 year peak storm flow. However, to obtain required permit approvals by the resource agencies, a larger pipe arch or bottomless arch may be required to allow for the stream to develop its own channel within the arch without being constricted in any way by the culvert.

2. The culvert crossings of Spruce Lane and upper El Camino should be replaced with a minimum 36" diameter culvert and the bed of the stream between the culverts should be lowered a minimum of 12".

3. Flooding at McGinnis Street can be alleviated by installation of a pipe arch or bottomless arch culvert. To carry a 25 year storm flow, a minimum 65" by 40" arch culvert is required. Again, to satisfy resource agency concerns, it may be necessary to install a larger pipe arch or bottomless arch as noted above.

4. We propose removing the culverts and roadway at the back of Glacier View Mobile Home Park within the streambed of Duck Creek and providing a foot bridge to allow pedestrian access. This proposal has no detrimental value to Duck Creek either for storm flows or for fish passage, and would be attractive to the concerned resource agencies.

JORDAN CREEK ENHANCEMENTS

Channelize the upper reaches of Jordan Creek by excavating and clearing fallen trees and debris. This action requires the approval of State resource agencies. Due to the build up of silt within the upper reaches, the creek is functioning less effectively to allow fish passage to the spawning grounds and the gravels themselves are becoming choked by the silt. A more detailed study is required to determine the most effective way of improving the stream flow to enhance fish passage and storm flows.

The culverts at Egan Drive are adequately sized to pass a 25 year storm flow but at present the flows are restricted because of considerable back water on the downstream side. The most urgent condition, which results in flooding of the area behind the Jordan Creek Mall, is to control the stream flow

between Egan Drive and Glacier Highway. At present Jordan Creek overflows its bank before the full capacity of the culverts at Glacier Highway has been reached. This condition should be improved by raising the banks of Jordan Creek and creating a controlled flood plain area which is capable of passing the 25 year storm flow. Adjacent to the buildings on the west side of the Jordan Avenue bridge, sheet piling is necessary due to the limited space between the creek and the buildings.