KETCHIKAN PUBLIC UTILITIES
KETCHIKAN LAKES AND SILVIS LAKES
ROCKSLIDE POTENTIAL
AND SLOPE STABILITY
GEOTECHNICAL REVIEW

Prepared for:

KETCHIKAN PUBLIC UTILITIES
2930 Tongass Avenue
Ketchikan, Alaska 99901

Prepared by:

R&M ENGINEERING - KETCHIKAN INC.
P.O. Box 9592
Ketchikan, Alaska 99901

R&M Project No. 952116

November 13, 1995

TABLE OF CONTENTS

KETCHIKAN PUBLIC UTILITIES
KETCHIKAN LAKES AND SILVIS LAKES
ROCKSLIDE POTENTIAL AND SLOPE STABILITY
GEOTECHNICAL REVIEW

INTRODUCTION

On November 13, 1995, an on site geotechnical review for Ketchikan and Silvis Lakes was conducted. This work was accomplished at the request of Darrel Pierce, Engineering Division Manager for Ketchikan Public Utilities.

The purpose of the investigation was to review the potential for large rockslides and the potential for slope instability around Ketchikan Lakes and Silvis Lakes that could be a hazard to the dams. This was initiated in response to the 1994 periodic safety inspection reports accomplished by the Seattle firm of R.W. Beck & Associates.

It is the purpose of this report to describe the review methods and interpret the findings in terms of the lake's topography, regional geology, geomorphology and earthquake effects and probability.

GEOTECHNICAL INVESTIGATION

The field investigation was conducted by visually inspecting the lakes from a Hughes 500 helicopter. Darrel Pierce, KPU, accompanied our engineering geologist on this flight. The helicopter was flown around each lake basin to study slope angles, rock types, faults, fractures, weathering, soils, vegetation, existing slides, avalanche tracks, and structural geology. Conditions were described in a field log maintained by the geologist in charge of the review. Photographs were also taken.

Prior to the site study, a literature review was conducted to identify pertinent previous geotechnical studies in the area. Studies were reviewed that included area geology, engineering geology, evaluation of earthquake hazards and geotechnical properties of soils (see reference list).

This investigation was reconnaissance in nature and involved minimum field work. Conditions during the field inspection were less than ideal. Much of the area was snow covered, particularly the Silvis Lakes basins, making observation somewhat uncertain. Therefore, a review of available aerial photography was also conducted.

GEOLOGIC SETTING

Both the Ketchikan Lakes and Silvis Lakes are located in an elongated stock or gabbro that intrudes metamorphosed strata that include slate, phyllite, and metagraywacke intercalated with metatuff. The gabbro is described as massive and not deformed. The southern most end of lower Ketchikan Lake extends into the metasedimentary rocks.

These bedrock assemblages were extensively carved by glaciers during the pleistocene epoch. These glaciers attained altitudes of 3000 to 4000 feet in the area thus even the highest peaks around the lakes were ice covered. The present topography of Ketchikan Lakes characterized by their elongated shape and steep U-shaped valley clearly reflect the effects of glaciation. The Silvis Lakes occupy oblong east facing cirques that formed during deglaciation (which began about 10,000 years ago).

EARTHQUAKES

Rockslides and mass wasting events large enough to threaten the dams would most likely be triggered by an earthquake. Therefore, a discussion of seismicity, faults, and earthquake probability is appropriate.

Southeastern Alaska lies within the techtonically active circum-pacific belt. Alaska is the most seismically active region of the United States. The trends of many linear fjords are controlled by major faults. The most prominent fault system in the Ketchikan region is the Fairweather-Queen Charlotte Islands fault system, 100 miles southwest of Ketchikan. The three most strongly felt earthquakes in Ketchikan had their epicenters along this offshore fault system. (July 30, 1972; November 17, 1956; and August 22, 1949). The 1949 quake caused a 2 foot high seiche wave at Ward Lake, 5 miles northwest of Ketchikan. No evidence of faulting during or since pleistocene time has been found in the immediate Ketchikan area.

Assessment of earthquake probability is very uncertain. Ketchikan was placed in seismic zone 2 by Lemke, 1975, where magnitudes of the largest expected earthquake is between 4.5 to 6.0 and moderate damage could be expected. At the present there is no reliable method of predicting when an earthquake will occur.

KETCHIKAN LAKES SITE CONDITIONS

Ketchikan Lakes occupy a gently arching north-south trending trough that was scoured out by glaciers. The trough is U-shaped and the canyon walls are nearly vertical in most areas. These vertical walls are composed of massive gabbro. This bedrock is only slightly weathered and unjointed. No evidence of exfoliation or frost fracturing were found that might cause rockfalls into the lake. However, on the northwest side of the lake is a deep break in the cliff that is partially filled with large boulders. A recent rockfall off the north side of this fracture contributed a large volume rock to the boulder pile. On the western shore of the lower lake is an avalanche chute with a runout zone that stops just short of the lake. There are also avalanche tracks on the east side of the lower lake that reach the water.

SILVIS LAKES SITE CONDITIONS

Silvis Lakes occupy two cirques that open to the east. Cirques are formed by Alpine glacier rock plucking and frost action. While these lakes are cut into the same gabbro bedrock as Ketchikan Lakes, it is more fractured in the Silvis Lakes area. Upper Silvis Lake has moderately steep to steep sideslopes with zones of fractured bedrock and boulder that might be subject to sliding. Fortunately there is a large bench that rings much of the upper lake that should lessen the effects of slides by catching or slowing the slide material. Lower Silvis Lake has very steep sideslopes but the bedrock is less fractured than at the upper lake. There is a large avalanche zone at the west end of the lake but the runout zone is adequate to prevent most slides from reaching the water. No scars of previous debris or mass wasting slides were seen in either lake. However the ground during the site visit was snow covered making observations uncertain.

CONCLUSIONS AND RECOMMENDATIONS

Both Ketchikan and Silvis Lakes are in steep sided troughs and basins that have some potential for rockfalls or slides. Putting a qualitative or probability value on that potential is very difficult. It does not appear that any of the dam structures would be directly impacted by rockfalls or slides, so the major danger from these events would likely be from waves generated by materials falling into the lakes or waves generated by earthquake ground motion or displacement. Damage to the dams would be either directly from impact forces or the effects of waves overtopping the dam.

Fortunately both lake systems are in gabbro bedrock that exhibits good engineering properties. The rock is massive and generally unjointed. Areas of fractured or loose rock poised to fall were not found. The few forested slopes did not appear to have sufficient thickness of soil to generate a large wave, if soil was to slide into the lake.

The most likely trigger for such an event would be an earthquake of magnitude 6 or greater. There is no historic record of Ketchikan experiencing earthquakes of this magnitude. It is not now possible to predict if or when a strong seismic event would strike the Ketchikan area. However, being close to the Fairweather Queen Charlotte fault system and being in seismic Zone 2 indicate that at some unknown time in the future such an event is likely to occur.

Conducting a more detailed geologic investigation of site hazards does not seem warranted at this time. However, periodic inspection of the lake basins for developing rockfall or slide conditions is recommended.

Should there be questions, or if we may be of further assistance, please do not hesitate to contact us at your convenience.

Sincerely,

R & M ENGINEERING, INC.

STATE OF ALASKA
M.A. Menzies
No. 1410-S

Ralph Swedell
Engineering Geologist

Malcolm A. Menzies, P.E.
Civil Engineer

ysh

LIST OF REFERENCES

"Reconnaissance Engineering Geology of the Ketchikan Area, Alaska, with Emphasis on Evaluation of Earthquake and Other Geologic Hazards" Richard W. Lemke, U.S.G.S. Open File Report 75-250, 1975.

"Regional and Other General Factors Bearing on Evaluation of Earthquake and Other Geologic Hazards to Coastal Communities of Southeastern Alaska". R.W. Lemke and L.A. Yehle, U.S.G.C. Open File Report, 1972.

"Geotechnical Properties of Southeast Alaska Forest Soils". W.L. Schroeder, Oregon State University, 1983.

Geologic Map of the Ketchikan and Prince Rupert Quadrangles, Southeastern Alaska. H.C. Berg, R.L. Elliott and R.D. Koch, 1988.