Kinbasket Lake Damsite, Columbia River

By M. S. Hedley.

January 16, 1958

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Accompanied by:

Profile of Kinbasket Lake River Damsite.

British Columbia Department of Mines,
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The essential character of the ground at the outlet of Kinbasket Lake and for some distance downstream was outlined in a brief report written in September, 1957. A site was considered below the lake on the reasoning that the valley was filled with unsorted glacial material, which, being relatively impervious, would perhaps not require treatment or need to be excavated beneath the level of water-sorted surface gravels. The actual site, 7,800 feet below the lake outlet, was chosen largely on the basis of cross-sectional area, and it was not considered that the subsurface materials would be different for a mile or so upstream or downstream from this site.

The drilling of two holes has shown that the valley fill is not impervious, in spite of the fact that it appears to consist largely of unsorted, till-like material. Both holes failed to retain water at depths below river level -- in a wet region. In hole K 1 at and near the bedrock surface at 255 feet the hole was reported dry as soon as the pumps were stopped. In hole K 2 water was lost from a depth of about 70 feet (50 feet below river surface) to bottom of hole at 153 feet. The complete loss of water beneath the bed of a major river in a region of high precipitation is extraordinary.

Examination and screen analysis of samples by Ripley and Associates from hole K 1 indicate partly sorted materials to a depth of about 70 feet and then dominantly unsorted

materials, most with a "till-like appearance", to the deepest sample at 211 feet. A general uniformity of samples was noted from 70 to 211 feet. This checks the drillers log of gravels and sands to about 70 feet, indicating "normal" stream action to that depth. Below 70 feet the drillers log does not in most instances give a very good idea of the materials, except that many boulders were encountered and considerable blasting had to be done. There was no indication of washed sands or fine gravels. Some of the unsorted material was found to be relatively impervious, but water loss in the boulder zones indicated that they constitute some form of openwork gravels.

Samples were not taken from Hole K 2. The drillers log indicates gravels to about 30 feet, below which occur till and boulders and unspecified materials. There was complete loss of water in the boulder zones and only local water return in a very few sections. The hole was exceedingly difficult to drill and was abandoned at a depth of 153 feet.

From the base of sorted or partly sorted gravels in hole K 1 at about 2,330 feet to the bottom of hole K 2 at 2,032 feet is a vertical interval of approximately 300 feet. The material in this interval is very bouldery and appears to consist of unsorted till-like material interspersed with boulder sheets or lenses. The till-like material is apparently relatively impervious, but the boulder runs are not and appear to constitute openwork gravels. The downward, vertical permeability of the entire sequence must be low, but the lateral, horizontal permeability is high. Since water was completely lost at the

bottom of both holes it follows that the water table must lie below 2,032 feet, more than 120 feet below the bed of the river. It is unthinkable that the lowermost part of the channel is dry.

The valley fill, so far as it is known, consists of unsorted "glacial till" with lenses or sheets of open work gravels or boulder beds. The material as a whole appears relatively impervious to downward percolating water, but is well drained internally by the gravels. The fact that the gravel runs or boulder beds are not saturated proves that they do not extend through to the lake and indicates that there is an efficient subsurface seal at the lake outlet. It may be argued that the gravel runs should taper upstream to disappear in the region of the glacial plug of the ancestral valley, and so provide no natural drains, but, while this could be true, an equally or more effective barrier to horizontal percolation may exist in the clay and silt on lake bottom.

It follows that if an effective valley seal exists, it is most probably at the lake outlet, and that is where a dam may best be built to obviate leakage. If the seal is found to be inadequate it may be greatly increased by application of materials readily at hand.

Kinbasket, like any glacial lake is continually receiving large quantities of silts and clays, of which some settles at the head of the lake or at stream mouths, some settles from suspension at all parts of the lake, and some is carried on the bottom by gravity flows. The thickness of

clays and silts in Kinbasket Lake is not known, but there is probably a substantial thickness at the centre of the lake. The condition at the downstream site indicates that there is some sealing, and the small amount of sounding done at the lake end showed some clay and silt, but not its depth.

The outlet of Kinbasket Lake has certain advantages as a damsite, and preliminary investigation should not prove too costly if it is decided that the governing factor is the presence of an effective seal. Rock is exposed at shore on both sides at the outlet, and construction of diversion tunnels on the west side presents no obvious problem. Concern over the possible presence of a major fault was felt down stream, but at the outlet side the placement of the dam could be adapted for greater stability should regional or detailed study indicate the presence of a major disruptive fault. If the layer of clay and silt should be found insufficient it could be increased with millions of yards of such material that exists near the head of the lake and could be pumped the distance of 5 or 6 miles to the outlet. The dam axis can be placed to best advantage relative to the seal without increasing the crest length or creating a serious problem.

Summary:

The drilling done from September to November, 1957, below Kinbasket Lake proves an unsatisfactory condition that may not be insuperable but shows the advisability of selecting some other site.

The valley fill consists of "glacial till" and

boulder concentrations and is relatively impermeable vertically but is highly permeable horizontally. The fill is possibly as much as 600 feet deep (see profile), and is exceptionally difficult to drill. The tasks of determining what might be the effect of a load of 400 feet of water and of finding what steps might be necessary to minimize leakage are judged too expensive, lengthy, and uncertain.

The outlet of the lake was, initially, judged to be a less favourable site because of the greater volume of fill, but the relative ease of assuring satisfactory subsurface conditions there may more than offset that extra cost. Excavation of some material would be necessary at any downstream site, but none may need to be excavated at the outlet.

The valley of the Columbia River is the Rocky Mountain Trench, which is known in many sections to be located along a line of major faulting. The largest or principal fault zone is believed to lie east of Kinbasket Lake and consequently would present no hazard, but a subsidiary fault may lie within the valley. The presence of and magnitude of such a valley fault may be learned only through geological study because the thorough drilling of bedrock on such a cross-section might be prohibitive in cost. Should geological study indicate the presence of a major valley fault, it is highly probable that dam construction at the outlet can be modified to render the site completely safe.

A course of investigation at the lake outlet appears desirable. It should include drilling to bedrock, and

investigation of the thickness and character of clay and silt deposits on the lake bottom.

A structural geological study should be made of the region, from Blackwater Lakes to Canoe River, in an attempt to evaluate the origin and present condition of the Trench and to determine the general stability of the region. This should take a season of four months by a first class geologist with a broad background of experience. He would be available to advise during the course of investigations at the damsite but must not be tied to those investigations.

Respectfully submitted,

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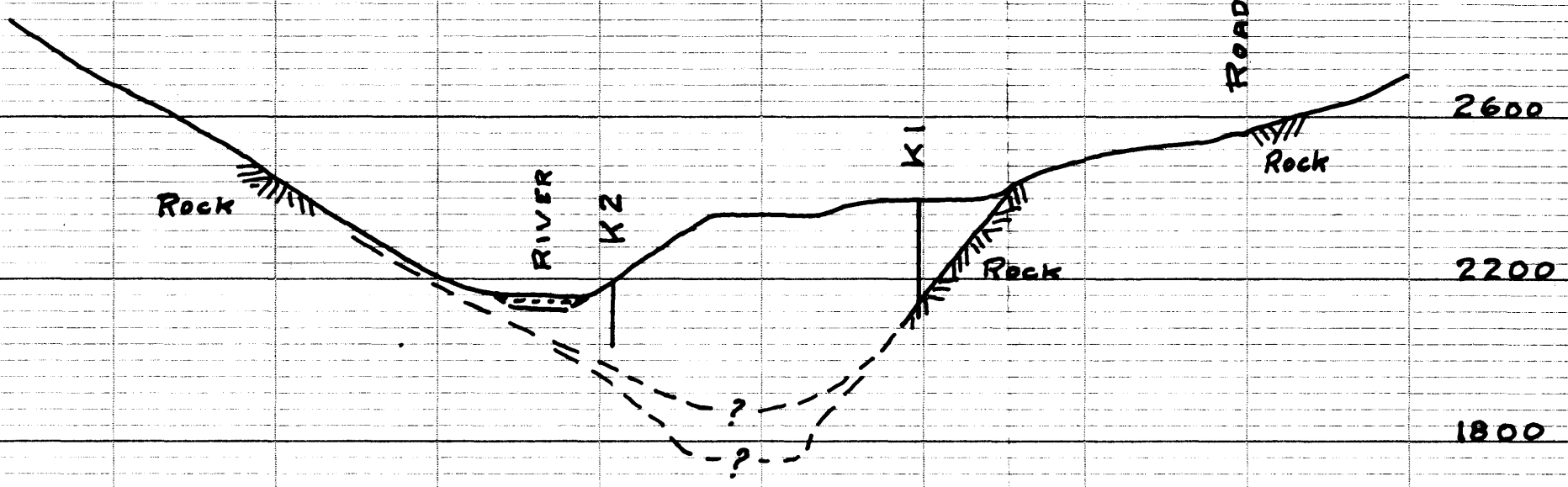

PROFILE
KINBASKET LAKE
RIVER DAMSITE
1" = 400'

M.S.H. 1957-8