CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 9

YUKON RIVER DRAINAGE BASIN
DAM SITE INVESTIGATION

SITE NO. 3

HOOTALINQUA DAM SITE

(MAP AND PRELIMINARY REPORT)

BY

E. B. OWEN

OTTAWA
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HOOTALINQUA DAM SITE

General Description

The Hootalinqua dam site is located at the junction of Teslin and Yukon Rivers about 58 miles north of Whitehorse. At this point Yukon River enters the Teslin River Valley through a narrow preglacial gap in the Hutshi group of volcanic rocks to join the Teslin. The proposed dam crosses the present courses of both rivers. The left abutment consists of a steep rock bluff which rises abruptly from Yukon River (approximate elevation 1, 950 above sea level) to an elevation of 2, 300 feet. Behind the abutment is a bedrock terrace, 500 feet in width, with an approximate elevation of 2, 220 feet. West of the terrace the ground slopes gradually upwards with bedrock exposed at elevation 2, 310.

The right abutment is a smaller bluff consisting chiefly of overburden with a few bedrock exposures. Here the ground surface rises abruptly from the river to an elevation of 2, 020 and then continues eastward as a series of terraces which extend to a rock ridge some two thousand feet away. This ridge constitutes the east side of Teslin Valley.

At the proposed site it is possible both Teslin and Yukon Rivers are flowing over shallow valleys eroded into the underlying bedrock surface before the existence of the last ice sheet. This is suggested by the excessive depths to bedrock indicated by seismic line no. 1 located on the point of land separating the two rivers. The greater part of the material filling Teslin and Yukon River Valleys would probably be glacio-fluvial sand and gravel. It is unlikely a buried valley exists beneath the terraces between the river and the rock ridge along the east side of Teslin Valley.

Unconsolidated Deposits

Five main types of soils have been identified at the proposed Hootalinqua dam site. These are as follows:

1. Recent Alluvium: This material consists chiefly of a fine-grained, dense, grey, silty sand overlain in places by a coarse, graded gravel. It is exposed along the edges of both Yukon and Teslin Rivers and also on the point of land between the two rivers downstream from the centre line.

2. Post-Lacustrine Alluvium (sand): This material consists of a loose, graded, medium- to coarse-grained sand with a few scattered pebbles up to two inches in diameter. It is an extensive deposit thought to have been laid down during the early formation of Teslin River. In some parts the silt content is high. This material should be considered as a potential source of fine aggregate.

3. Post-Lacustrine Alluvium (gravel): This material underlies the post-lacustrine alluvial sand and in some places grades up into it. It consists of a loose, graded, sandy gravel with boulders up to 14 inches in diameter. It appears to be similar to the glacio-fluvial sandy gravel occurring in the left abutment at the Northwest Power Industries site. It is possible this alluvial gravel was originally derived from glacio-fluvial material.

4. Glacio-Lacustrine Silt: This material is similar to that in the right abutment at the Swift River site. It has a low to medium density with a negligible clay content. It occurs only in the vicinity of the left abutment as irregular areas not covered by alluvial sand and gravel. It is probably a shallow deposit of limited extent.

5. Glacio-Lacustrine Clay: This material consists of a soft, grey, medium-plastic clay which in the right abutment area becomes sandy with a honey-comb texture. The deposits occur adjacent to rock outcrops and it is possible their presence is indicative of bedrock at shallow depths. The thickness of the clay

was not determined but it is thought to be relatively thin especially in the areas close to the centre line of the dam. It should be investigated as a potential source of impervious material for the main earth dam.

Bedrock

General Description

Bedrock exposed in the high rock bluff which constitutes the left abutment consists almost entirely of massive, brown-weathering, grey andesite containing greenish phenocrysts of hornblende or pyroxene in a fine-grained groundmass. The permeability of the rock is probably low. It is not vesicular and open joint planes are not common. A few irregular stringers of calcite up to one inch in width are scattered throughout the rock. These rocks frequently form high hills with steep slopes indicating they are resistant to erosion. Their durability is relatively high.

Scattered outcrops of two rock types occur in the right abutment area. At the centre line of the proposed dam a buff-coloured, porphyritic intrusive rock is exposed along the edge of the river for about five hundred feet. It is weathered and thickly jointed but its mere presence at the water's edge is indicative of its durability. Between 600 and 800 feet east of the river, conglomerate is exposed both upstream and downstream from the centre line. The rock is massive but badly weathered. Many of the surface cobbles are loose. The matrix is a friable, quartz sandstone. Most of the pebbles range from 1/4 to 3/4 of an inch in diameter with some up to 3 inches. Many of the pebbles are a fine-grained, black limestone. A narrow bed of fine-grained greywacke occurs along the lower part of the conglomerate.

Bedrock Structures

The contact between the volcanic rocks on the left abutment and the sedimentary rocks on the right probably occurs beneath Teslin River. The

contact may be a fault although it is more likely to be an unconformity with the volcanic rocks lying unconformably upon the sedimentary beds. It is an important structure and the area should be thoroughly investigated to determine if broken or weathered zones exist in the bedrock. Such zones are capable of transmitting large quantities of water. The same contact may occur on the east side of Teslin Valley about three-quarters of a mile upstream from the site. Here volcanic rocks on the south are separated from sedimentary rocks on the north by a narrow, steep-walled valley. A large exposure of aplite occurs along the north side of this valley. Immediately north of the aplite and a half mile east of the east abutment is a large hill composed entirely of conglomerate. These conglomerate beds extend along the east side of Teslin Valley at least one mile north of the site. They constitute the right abutment of a potential dam site about one-half mile below the present site.

The contact also occurs along a second, steep-walled valley which intersects the west side of Teslin Valley about nine thousand feet below the proposed site. Here greywacke and conglomerate beds occur on the north side and volcanic rocks on the south.

A fault zone occurring in the left abutment should be investigated further. This fault zone is about ten feet in width. It strikes approximately parallel to the proposed centre line and dips downstream at about 60 degrees.

Engineering Considerations

Depth of Overburden

Accurate information regarding the thickness of the overburden in the vicinity of the proposed site was not available. Areas where bedrock was thought to be ten feet or less from ground surface have been identified on the accompanying plan.

It is possible at the proposed site the two rivers are presently flowing over a considerable thickness of alluvium and glacio-fluvial materials deposited in the valleys by melt waters following the last glaciation. Consequently the thickness of overburden beneath the two rivers is probably too great to warrant excavation to bedrock for the main dam structure. Further seismic investigations accompanied by test borings would be required to contour bedrock surface in the site area. Borings along the proposed centre line should be designed to take samples of the soil, to conduct permeability tests and to penetrate at least 15 feet of bedrock.

Overburden on the left bank of Yukon River is a relatively thin deposit of alluvial sands and gravels overlying one or more bedrock terraces. Much of it is less than 10 feet in thickness. The bulk of the material exposed on the right bank is also alluvium. It is concentrated along two terraces which roughly parallel Teslin River. The lack of large bedrock exposures in this area suggests the thickness of these deposits is greater than those on the left bank of Yukon River.

There is little information available concerning the types of overburden existing beneath the two rivers. It is thought the main mass of material will consist of permeable, glacio-fluvial sands and gravels overlying bedrock. Till may exist between the glacio-fluvial material and bedrock but there is nothing on surface to indicate its presence. A cut-off trench would have to be incorporated into the design of the earth-fill dam to control seepage through the underlying permeable sands and gravel and prevent piping. Considerable seepage through these same permeable materials should be expected beneath the two proposed cofferdams. The presence of large boulders which would prevent steel sheet piling from being driven to useful depths could only be ascertained by test borings.

Foundations and Abutments

The volcanic rocks constituting the left abutment are satisfactory. They are massive, durable and only superficially weathered. There are indications that quantities of ground water will be encountered during construction of the

two diversion tunnels due to minor faulting and the presence of vertical joint planes. It is suggested two or three test borings be put down along the proposed line of the tunnel to test the quality and permeability of the rock. There are no indications in the surface exposures that large zones of broken rock will be encountered during construction of the tunnels.

Bedrock on the right abutment is not as massive as that on the left but should make satisfactory foundation material for the intake and spillway structures. The presence of considerable overburden, of intrusive rocks and the possibility of a fault or unconformity beneath Teslin River indicates the need of several test borings in this area to determine the depth of overburden and the quality of the underlying bedrock.

Construction Materials

Aggregate

Considerable potential, fine and coarse, natural aggregate occurs within the dam site area. These deposits consist of post-lacustrine alluvial sand and gravels located on the terraces adjacent to the two abutments. There is a possibility the materials occur in places only as a thin veneer overlying bedrock. The silt content is frequently high. A program of test pitting and sampling is recommended to determine the quality and quantity of these materials. An investigation of the valleys of several, small streams tributary to Yukon and Teslin Rivers failed to disclose a large deposit of suitable, natural aggregate. One deeply entrenched creek which joins the Yukon about nine thousand feet downstream from the site is bordered on its left side by a high terrace made up of sand and gravel with some silt. The terrace starts at the creek and extends downstream and parallel to Yukon River for about six hundred feet. The quantity of material available is large. The heterogenous nature of the material, however, makes it more suitable for fill than aggregate.

There is a possibility the volcanic rocks on the left abutment could be crushed to make satisfactory aggregate. This would be a relatively expensive method and should only be considered as a last resort.

Impervious Material

It is believed the clayey material located at both abutments would be satisfactory for the impervious core of the main dam. The quantity of material available is not large and test pitting would be necessary to determine if there is sufficient to satisfy the requirements of the dam. In places the post-lacustrine sands have a relatively high silt content. It might be possible to sufficiently compact these silty sands to use them as impermeable material.

The material forming the bluff along the east side of the river, 3,000 to 11,000 feet downstream from the site, is a sandy clay with occasional beds of fine sand or clay. This is also a potential source of impervious material.

Pervious Material

The material for the pervious shell of the dam could be obtained from the post-lacustrine sand and gravel covering the terraces on both sides of the two rivers.

Riprap

The volcanic rocks excavated from the two diversion tunnels in the left abutment and the porphyry exposed along the right bank of Teslin River should both provide satisfactory riprap and rock fill for the main dam. These rocks are massive and durable and have a relatively high specific gravity.

Ground Water

Little is known regarding the ground-water table in the vicinity of the site. It is thought to be low at both abutments which may introduce a leakage hazard following construction of the dam. However, none of the rocks involved are of the soluble type and there should be no major leakage problems. Accurate

information regarding the water table can be obtained only by an expensive drilling program involving the installation of many ground-water observation holes.

Further Investigations

It should be remembered the present geological investigation of the proposed dam site at Hootalinqua is a preliminary one designed to furnish the engineers with as much information as possible before any money is spent on an expensive subsurface investigation. If it is decided more information is required at this site, the following test borings are suggested as part of this program:

Location	Approximate Elevation	Depth	Remarks
1. East abutment on centre line, 100 feet east of Teslin River	2,035	15 feet below grade of spillway channel excavation	Soil samples taken every 5 feet or where there is a change in material, permeability tests conducted, ground-water observation hole established
2. Small island, on centre line, at Teslin River's edge	1,955	15 feet into bedrock	"
3. Small island, on centre line, at centre of island	1,975	"	"
4. Small island, on centre line, at Yukon River's edge	1,955	"	"
5. West abutment, on centre line, 120 feet west of Yukon River, at east diversion tunnel	2,130	30 feet below east diversion tunnel	"

Location	Approximate Elevation	Depth	Remarks
6. East diversion tunnel, on centre line, 170 feet south of hole no. 5	2,065	30 feet below east diversion tunnel	Soil samples taken every 5 feet or where there is a change in material, permeability tests conducted, ground-water observation hole established
7. East diversion tunnel, on centre line, 170 feet north of hole no. 5.	2,070	"	"
8. East abutment, 750 feet east of hole no. 1	2,135	15 feet below grade of spill-way channel excavation	"

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LEGEND

CENOZOIC — QUATERNARY

- 8 — ALLUVIUM : dense, fine grained, silty sand; some coarse gravel
- 7 — ALLUVIUM : fine to coarse grained sand, with scattered pebbles up to 2 inches
- 6 — ALLUVIUM : fine to coarse grained gravel.
- 5 — GLACIO-LACUSTRINE : silt, with some very fine grained sand
- 4 — GLACIO-LACUSTRINE : sandy clay to clay, honeycomb texture in part

MESOZOIC — TRIASSIC AND/OR JURASSIC

- 3 — PORPHYRY
- 2 — ANDESITE AND BASALT
- 1 — CONGLOMERATE

N (APPROX)

YUKON RIVER

TESLIN RIVER

River Elev 1951.0' June 23, 1956

River Elev 1950.0 June 28, 1956

Seismic Line No. 1

Fault zone, shear zone

Jointing

Edge of outcrop

Geological boundary (approx.)

Areas where overburden is thought to be < 10 feet

Proposed bore-hole P.B.H. 8

SCALE IN FEET
200 100 0 200

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TESLIN & YUKON RIVERS

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