

DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES

PROVINCE OF BRITISH COLUMBIA

WATER RIGHTS BRANCH

KELOWNA, B.C.

PRELIMINARY REPORT ON  
CONTROL OF SURFACE LEVELS ON  
TWIN (NIPIT) LAKES

File No. ID-80  
TWIN

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Technician.

SYNOPSIS

The high water level in Lower Twin Lake during a wet weather cycle in the 1950's caused flood damage and resulted in the construction of a gate controlled overflow pipe and ditch to divert excess inflow to Park Rill. These works were used for irrigation, but operated so that the surface level in Lower Twin Lake was reduced without adding to the flood potential of Park Rill.

The Lower Nipit Improvement District was formed to acquire and operate such control works but were distracted from this purpose by a dry weather cycle during the 1960's. The irrigator had to move his pump to the lake as the surface level subsided, and the outlet channel was partially filled.

Heavy inflow during 1972 caused renewed concern that another wet cycle would result in flood damage to private land and to an increasing number of private structures along the lower lake shore. The trustees of the Lower Nipit Improvement District requested the Comptroller of Water Rights to prepare a report concerning control of the high water level and the possible re-establishment of the outlet works.

This report examined the flood potential on Lower Twin Lake and considered various systems to control high water levels. It was concluded that re-establishment and extension of the former system would provide reasonable protection and best economy at an estimated cost of \$1,500.00 per annum. This cost is preliminary in nature and a more detailed investigation and design should precede any firm commitment by the District Trustees.

It should be noted that the diversion of water from Twin Lakes to Park Rill through any system would be contingent on the conclusion of an agreement which would protect the landowners downstream on Park Rill from any increased flood potential.

# SOUTH EASTERN BRITISH COLUMBIA

SCALE—10 Miles to 1 Inch

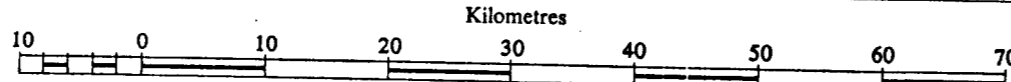
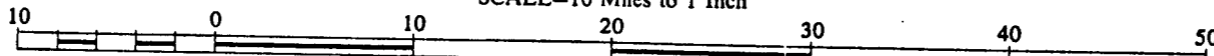


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PRELIMINARY REPORT ON  
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INTRODUCTION

During the winter of 1971-72, precipitation in the southern portion of British Columbia was exceptionally heavy. As a result, by the spring of 1972 the water content of the mountain snowpack was at record or near-record level for that time of year. In the Okanagan and Similkameen watersheds, the snow-packs on April 1st, May 1st, and May 15th were the heaviest ever measured. Warm weather occurred during the second half of May and caused a rapid runoff. One result was a substantial rise in the water level of the Nipit (Twin) Lakes, in particular the lower lake, which had no outlet.

The trustees of the Lower Nipit Improvement District wrote to the Comptroller of Water Rights, British Columbia Water Resources Service, on October 27th, 1972, to express their concern that another year of heavy inflow could result in serious flooding to cottages near the lower lake, further pollution of the lake, and loss of the use of some private land. The trustees requested that a report be prepared concerning the re-establishment of outlet works and the control of the lake level. In response to that request, the Comptroller of Water Rights authorized the preparation of this report, for the purpose of establishing controlled maximum and minimum water levels and comparing alternative schemes by which to achieve this control.

The cost estimates contained herein were developed for comparative purposes, and are based on a minimum of superficial site examination. A more detailed soil investigation should precede the final design and estimate of the selected scheme.

DESCRIPTION OF AREA

Twin Lakes are located some fifteen miles southwest of the City of Penticton in the South Okanagan Valley of British Columbia. Access is by two miles of good gravel secondary road south from B.C. High 3, near the summit between Keremeos and Kaleden Junction. The two lakes are similar in size with the south or upper lake just under 80 acres and the north or lower lake just over 80 acres in surface area at their usual high water levels.

For many years the primary local industry was raising beef cattle, with one ranch on Lot 427, another on Lots 280 and 281 and a combined ranch - "dude ranch" operation on Lot 192<sup>S</sup> and the Fractional West  $\frac{1}{2}$  of Northeast  $\frac{1}{4}$  Section 36, Township 89 S.D.Y.D. (See Drawing No.1). During the 1960's recreational use increased as subdivision took place around the lower lake, and camping, boating, fishing, hiking, and trail riding became popular during the summer, while ice fishing and snowmobiling became common in the winter. In 1970 a land development company acquired the upper two ranches for the purpose of developing an extensive recreational project.

The climate of the area, while similar to nearby Keremeos, was considered to be influenced by an elevation of 2,600 feet above mean sea level (A.M.S.L.). The extreme temperatures were estimated to range between 95°F and - 30°F while the June - September daily mean temperature would likely vary between 55°F and 70°F. Annual average precipitation is some 12 inches of which about one-third occurs as snow.

#### HYDROLOGY

The upper lake is fed by a northward sloping watershed of 7.1 square miles of which 1.3 square miles is above 5,000 feet in elevation. Additional drainage to the lower lake from about one square mile of low lying land to the west is negligible. The flow between the lakes is controlled by an earth-fill dam which impounds about 380 acre feet of storage water on the upper lake in the 4.9 foot range between the sluice pipe lip and the spillway crest. The lower lake has no natural surface outlet and would not flow over the divide to the east until the lakes had become one lake, about 15 feet deep over the upper lake spillway. A geologists' report, included as Appendix A to this report, states that the lakes are large kettles in outwash, filling old pre-ice drainage and suggests that the lakes discharge by groundwater flow both to the east into Park Rill and to the north and east into the Marron River.

The watershed has not been very productive probably due to a rainshadow effect of the Apex Mountain area. The main tributary, Horn Creek, has been observed in a rising flood stage for several days before reaction occurred in the lake, indicating high groundwater absorption. As a result, during wet and dry weather cycles, the surface levels of the lakes have fluctuated over a wide range.

Water Survey of Canada established stream gauging station 02N149 on Lower Twin Lake at the request of the British Columbia Water Resources Service in May 1968. Regular readings were recorded during the April 1st to September 30th irrigation season for the years 1968 to 1972, inclusive, and these together with irregular earlier readings were plotted graphically (See Drawing No.2). Because of the scarcity of early records, it was assumed for the purposes of this report, that annual inflows to the Twin Lakes System were historically comparable to annual inflows to Okanagan Lake. A table was prepared expressing these inflows as a percentage of the 1921 to 1971 mean inflow. (See Appendix B)

#### HISTORY

The earliest water licence recorded in the Twin Lake area was Conditional Licence No.607 on Horn Creek, with a priority date of September 30th, 1904. A survey in 1923 confirmed water use and Final Licence No.4192 was issued authorizing the diversion of 24.5 acre feet per annum to irrigate 9.8 acres of District Lot 281 (part of the middle ranch). The same licensee, Mr. Gilbert Taylor, acquired Conditional Water Licence No.1047, dated February 20th, 1911, which authorized the irrigation of District Lots 280 and 281 from Twin Lakes. By 1926 Mr. Taylor had not been able to devise a practical system to transport the water to the land, and the licence was abandoned.

The next development took place in 1930, when Conditional Licence No.10471 was issued, authorizing the diversion of thirty acre feet per annum by pump from upper Twin Lake, to irrigate 12 acres of D.L.427 (the upper Ranch). The licensee found pumping to be too expensive, and in 1935 the licence was amended to authorize the construction of an intake and gravity pipeline from Horn Creek, on Lot 1469<sup>S</sup> upstream from Twin Lakes. Beneficial use was established by survey in 1937 and Final Licence No.10377 - Horn Creek, was issued in 1938, authorizing the use of 30 acre feet to irrigate 18 acres of Lot 427.

In 1942 the upper ranch was still owned by the original licensee, Mr. V. De B. Green, while the middle ranch and the lower or "dude" ranch were owned by Mr. D.L. Sutherland.

A heavy runoff that spring caused a rise in the upper lake level which resulted in some flooding on the upper ranch. The lower lake was at a relatively low surface level due to the below average runoff which had occurred during the preceding four years. Mr. Green obtained the approval of Mr. Sutherland to deepen the outlet channel from the upper lake to the lower lake in order to lower the surface level of the upper lake more quickly and thereby reduce flood damage. Below normal runoff occurred in 1943 and 1944 but when an above average inflow in 1945 was followed by a very heavy runoff in 1946, a dispute arose between the two ranchers. Mr. Green registered a complaint that Mr. Sutherland had dammed the outlet from the upper lake, raising the surface level and flooding his land. Mr. Sutherland contended that he had only filled the ditch to the former natural level of the outlet channel in order to reduce flood damage at the Dude Ranch. The Engineer for the Fairview Water District resolved the dispute by the establishment of a maximum high water level for the upper lake and a relative maximum elevation for the outlet channel. 1947 was a low runoff year but in 1948, the maximum recorded runoff occurred and the inflows to the upper lake exceeded the capacity of the outlet channel resulting in further flooding on both lakes. The Sutherland brothers, who had acquired the lower ranches from their father, filed an application for water licences that November and on June 1st, 1949, the following water licences were issued:

Conditional Licence No. 19012, authorizing the construction of a three foot high dam to store 200 acre feet on the upper lake for use as set out in Conditional Licence No. 19011. This licence was subject to the previously established maximum water level.

Conditional Licence No. 19011 authorizing the installation of a pump at the southeast corner of the lower lake, to divert 200 acre feet of water for the irrigation of 100 acres of District Lot 280 by pipe and ditch. A minimum lake level was not specified under this licence.

Above average runoff was observed during a wet cycle which extended from 1948 to 1959 (See Appendix B). During the spring of 1951 a sudden snow melt caused another rapid increase in the surface levels of the lakes, and resulted in further flooding, especially at the dude ranch. The Sutherland Brothers installed an additional low-head pump on the lower lake which brought their total pumping capacity to about 15 acre feet per day. On May 17th they commenced pumping from the Lower Twin Lake into Lower Horn Creek, which originated from springs in the middle of Lot 280, and flowed into Myers Creek (Park Rill). On July 18th, 1951, the pumping was stopped due to complaints of flooding downstream on Park Rill. Several lawsuits for flood damage resulted, but the conditions of settlement were not recorded by the Water Rights Branch. That fall the Sutherlands applied for a change of works under Conditional Licence 19011 to authorize drainage works from the lower lake to a sump on Lot 280, and the re-location of their irrigation pump and sprinkler system at this sump. The Park Rill complainants objected because the sump drained into Park Rill, and the proposed works could be used to divert flood waters from Twin Lake into Park Rill. To satisfy these objections, the following clauses were included in Conditional Licence No. 20305, issued on March 1st, 1952 to replace Conditional Licence No. 19011:



- (d) "The purpose for which the water is to be used is irrigation and the use of the works for drainage or any other purpose shall not be permitted without the consent of the District Water Rights Engineer."
- (e) "The maximum quantity of water which may be diverted is 200.0 acre feet per annum and this water shall not be diverted at a rate greater than is approved by the District Water Rights Engineer with such additional quantity as the Engineer may from time to time determine should be allowed for losses."
- (k) "Water shall not be diverted in excess of that authorized in clause (e) without the consent in writing from the District Water Rights Engineer."

C.W.L.19012 was replaced by C.W.L.20606 on the same date.

Spring runoff in 1952 again caused flooding at the Dude Ranch and several cabins were moved to higher ground. The new drainage works had not yet been constructed but John Stewart, the owner of the District Lots 282 and 283, signed an agreement to use all the water the Sutherlands could pump from the lower lake. Weirs were installed at the pump and at Stewarts point of rediversion, on a temporary, unlicensed basis.

During October 1952 the works authorized by C.W.L.20605 were installed, consisting of 500 feet of 15" diameter pipe laid in a ditch excavated through the divide to a maximum depth of about 25 feet, with a concrete headwall and vertical steel control gate at the lake end. The pipe was backfilled and the open portion of the ditch was extended 1,200 feet east to a sump dug in Lower Horn Creek, where the irrigation pump was relocated.

On January 15th, 1953 the Sutherlands were authorized by the District Engineer to divert up to 6 acre feet per day from Twin Lakes through the new works to Park Rill. On May 1st this authority was reduced to the diversion of that quantity which Mr. Stewart re-diverted as measured by the previously installed weirs. This arrangement continued when required for the duration of the wet cycle and was apparently satisfactory to all parties concerned.

By 1960 several properties had changed hands; the Dude Ranch had been acquired by Mr. and Mrs. David Johnson, while the middle ranch on Lots 280 and 281 had been acquired by Mr. R.A. Wassman, with the exception of that portion of the lakeshore, subdivided by the Sutherlands into residential sized lots and sold for recreational use. The upper ranch was still owned by Mr. Green.

The weather entered a dryer cycle in the 1960's resulting in well below average inflow to Twin Lakes during seven of the eleven year-period, 1960 to 1970, inclusive, while only 1964 was substantially above average. This caused a gradual decline in surface level of the lower lake so Mr. Wassman found it necessary to re-establish his pump on the lower lake and later he had to lower the pump intake several times. The open overflow ditch through the centre of the farm became temporarily useless and constituted an inconvenience and hazard to the operation of the ranch. In 1961 Mr. Wassman advised his neighbours that the outlet works were of no benefit to his property; that responsibility for the operation and maintenance should be assumed by the property owners who would benefit from them, otherwise he would apply for a change of works to plug the pipe outlet and fill the deep portion of the ditch. The lakeshore property owners were concerned about future flood levels and circulated a petition to prevent this closure. The petitioners were advised by the Comptroller of Water Rights in June 1961, that nothing in the Water Act could prohibit the licensee from ceasing to operate or abandoning his works and, in fact, that if the licences were abandoned the Water Rights Branch would have to instruct the licensee to permanently plug the pipeline. (See Appendix "C") It was suggested that if they wished

to operate works for controlling the level of Lower Twin Lake, the owners of all lands benefiting from such control should be incorporated into an Improvement District for drainage purposes under the Water Act. The Improvement District could then apply for a licence for land improvement purposes which would give them the power to install and operate control works. They were warned that flooding problems downstream on Park Rill would also have to be resolved. Mr. Wassman agreed to grant an easement for drainage works over his property provided that the existing pipeline was extended 800 feet downstream and covered to ground level. The landowners, instead, attempted to pressure Mr. Wassman and the former owners into assuming responsibility, with no success, and as the dry cycle continued, they became more concerned about the receding lake level and appeared to lose interest in flood control.

The lots subdivided within District Lot 280 were entitled to a share of Conditional Licence No. 20605 so it was apportioned on June 25th, 1965, resulting in new Conditional Licence No. 29271 being issued to Mr. Wassman while C.L.20605 was amended to authorize the diversion of 11.58 acre feet per annum for the irrigation of 5.79 acres of Lots 5 - 16, inclusive, of Block 1 and Lots 1 to 7, inclusive, of Block 2, Plan 9937; Lot 1 of Plan 10699; Lots 2, 4, 5, 6, and 13 to 16, inclusive of Plan 11719, all of D.L.280 S.D.Y.D. Mr. Wassman's new licence, C.L.29271, authorized the diversion by pump directly from Lower Twin Lake, of 188.42 acre feet per annum to irrigate 94.21 acres of District Lot 280 except Plans 9937, 10699, 11043, and 11719, and he proceeded to plug the outlet pipe and fill the deeper section of the ditch.

Meanwhile, the Dude Ranch had been acquired by Mr. and Mrs. Douglas Hadley, who were granted Conditional Licence No. 29489 on December 1st, 1964, authorizing the diversion from Lower Twin Lake of 2,000 gallons per day, for domestic purposes in three buildings on the Fractional West  $\frac{1}{2}$  of Northeast  $\frac{1}{4}$  of Section 36, Tp.89, S.D.Y.D.

The Lower Nipit Improvement District was incorporated on September 21st, 1965. (See Drawing No. 2) Clause 3 of Letters Patent states, "The objects of the Improvement District shall be the acquisition, maintenance, and operation of works for land improvement purpose and all matters incidental thereto." At January 1st, 1973 no application for a water licence to authorize any works had been filed by the District trustees.

The surface level of Lower Twin Lakes continued to drop during the 1960's (See Drawing No.3). The level was approximately four feet below the lip of the outlet pipe in 1964 and 1965, dropped to 6 feet below the lip in 1966 and to 7.4 feet below in 1967. The District trustees protested the continued irrigation diversion by Mr. Wassman during years of minimum inflow but were informed by the Comptroller of Water Rights that the licensee was entitled to divert the quantity under licence. Trustees then became concerned that the licensee was exceeding his licenced withdrawal so in June, 1968, with the consent of the licensee, they purchased and had installed a 4-inch flow meter. By the end of the 1968 irrigation season the surface level had dropped to 10 feet below the lip of the outlet pipe.

Some difficulties were encountered in the operation of the meter and it was replaced by a 6-inch meter in 1969, and remained in operation through the 1970 season. The lake recovered very slightly in 1969 but in 1970, a minimum inflow year, the surface level had receded to 13 feet below the outlet sill lip when irrigation ceased.

During 1970 all the property surrounding the lake with the exception of the residential lots and the Dude Ranch were acquired by a land-development company, Gabriola Wildwood Estates Limited, who thereby became the holders of Water Licences F.L.4192, F.L.10377, C.L.20606, and C.L.29271. The upper ranch was leased to Mr. Hadley who did not operate the irrigation system but used the ranch for cattle grazing. The middle ranch was leased to Mr. Wassman until his untimely death in January, 1971.

Although 1971 was a year of above average precipitation, the surface level of Lower Twin Lake rose only 2 feet to about 11 feet below the outlet sill. The bulk of the snowpack was apparently expended in recharging groundwater aquifers, which had been depleted during the preceding dry cycle. The middle ranch was not irrigated during 1971 and Upper Twin Lake had been drained to its outlet sill, in a continuing effort to increase the lower lake surface level.

The 1972 April to July inflow was of record proportions, raising the Upper Lake surface to above spillway level and raising the surface level of the lower lake over 10 feet, to just 1.2 feet below the outlet sill. The storage table in Appendix D (accuracy  $\pm 5\%$ ) indicates the upper reservoir stores 379 acre feet and the change in levels in the lower lake represents 659 acre feet for a total inflow of 1038 acre feet.

The peak inflow appears to have been during the week May 13 - 20, when the lower lake rose 2.93 feet, representing an average inflow of almost 30 acre feet per day. The peak flow recorded on Horn Creek during the 1972 freshet was 30 cubic feet per second or about 60 acre feet over a 24-hour period. Although no buildings were flooded at this level, the District trustees felt a renewed concern that periodic flooding could occur in the future so they requested that a report be prepared concerning control of the lower lake levels and possible re-establishment of the overflow outlet. They were advised by the Comptroller that that had been the purpose for the formation of the District and that they should apply for a water licence to authorize the necessary works. They were also informed that this report was under preparation and might provide further advice.

#### INVESTIGATION

The Kelowna District Office staff conducted surveys and investigations throughout 1972, to determine the location and relative elevations of the various lake gauges, control works, and private structures near the perimeter of the lower lake, for the purpose of establishing the desirable maximum and minimum surface levels on Lower Twin Lakes.

The sill of the former outlet works was selected as the reference Datum and was found to be equivalent to gauge reading 17.6 at gauge station No. 08M148, established on Lower Twin Lake in 1968 by Water Survey of Canada. This sill elevation was considered to be the normal high water level (H.W.L.) to be exceeded only during periods of heavy inflow. The desirable minimum surface level was considered to be the H.W.L. diminished by a quantity of water equivalent to the licenced annual diversion of water together with allowances for evaporation and seepage losses:

Licensed Diversion	202.7 acre feet
Estimated Evaporation (18" depth)	160.2 acre feet
Estimated Seepage	<u>27.1 acre feet</u>
Total	390 acre feet

This quantity is equivalent to the volume of water contained in the zone 5 feet in depth below the outlet sill in Lower Twin Lake, hence the desirable low water level (L.W.L.) was calculated to be at gauge reading 12.6 (See Appendix "D").

The lowest permanent summer home on the lakeshore, situated at the northeast of the subdivisions, was found to be 5 feet above the outlet sill while the others were 7 feet or more above the sill. The lowest survey markers designating private property were about 4 feet above the sill. The lowest structures on the lakeshore were at the "Dude Ranch", where access to three cabins is at 1.7 feet, another at 2.4 feet, and the balance more than 6 feet above the sill. The deck of the swimming pool was  $4\frac{1}{2}$  feet and the well head for the main pump supplying most of the Dude Ranch facilities was 6 feet above the outlet sill. These elevations indicated that serious flooding would commence when the surface level of Lower Twin Lake exceeded 4 feet above the outlet sill or gauge reading 21.6 feet.

#### ALTERNATIVE SCHEMES FOR LAKE LEVEL CONTROL

Three alternative schemes for maintaining a controlled maximum water level on Lower Twin Lake were considered. In each case the scheme was analyzed to determine its ability to contend with a freshet inflow similar to that which occurred in 1972. For the purposes of this analysis the following assumptions were made:

1. That agreement was reached with downstream property owners to permit the discharge of surplus water into Park Rill.
2. That both lakes were at the level of their respective outlet pipes when the inflow commenced.
3. That the maximum quantity of water was being impounded on the upper lake during the freshet period.
4. That no diversion of water for consumptive purposes (irrigation and domestic) occurred during the freshet period.

The estimated levels of lower Twin Lake that would result from the use of each scheme are depicted on Drawing No. 4.

#### A. Expansion of Former Works

The former outlet works were buried, but have been described in correspondence as consisting of 500 feet of 15-inch diameter concrete pipe, laid with a drop in elevation of one foot (0.2% grade). The lake outflow was controlled by a vertical steel slide-gate with the frame embedded in a concrete headwall at the entrance to the pipe. The former owner had requested an extension of 300 feet of pipe due to the depth of the open ditch in this section. It was assumed that this additional pipe would also be requested by the present owners of Lot 280. The outlet end of the pipe was plugged by filling the ditch to a depth of almost 20 feet. It was assumed that the safest and most economical method of re-opening the ditch and extending the pipe would be to use a bulldozer to excavate a wide, well-sloped trench, to a depth that would permit a back-hoe to excavate a narrow trench to the pipe grade. A thorough sub-surface investigation may establish the presence of very stable material, permitting excavation with steeper side slopes, in which case a contractor might achieve greater economy by the use of a drag-line to excavate a single trench to the pipe grade. Once the trench was prepared 300 feet of 15-inch diameter reinforced concrete pipe would be laid from the downstream end of the existing pipe at a slope of 0.5%.

From an hydraulic analysis of this scheme it was concluded that during a freshet similar to that which occurred in 1972, the maximum level of the lower lake would be 3 feet 8 inches over the outlet sill. The lake level would exceed a 3-foot depth for 25 days and a 2-foot depth for 60 days. The maximum rate of discharge was estimated to be 5 cubic feet per second.

B. Alternative Gravity Works

For comparative purposes 1,300 feet of 24-inch diameter concrete pipe was considered, laid at the same slope and sill elevation as the former pipe. The above flood routing procedure was then repeated for these works. It was estimated that the surface level of Lower Twin Lake would reach a maximum of 2.2 feet above the outlet sill, that the water level would exceed two feet over the sill for three days and would exceed one foot over the sill for twenty-five days (See Drawing No.4). The maximum discharge was estimated to be 11.5 cfs.

C. Alternative Pumping System

Because of the cyclic pattern of high and low inflows to the lakes, lake level control works would provide a useful service no more than half the years, over a period of time. Rental and operation of a low head pump during wet cycles was, therefore, considered as another alternative method of flood control.

It was assumed that some pumping would be required in the second and each subsequent year of a wet cycle, and that considerable pumping would be required in years of exceptionally large runoff. It was estimated from Appendix "B" that over a 25-year period, pumping would be required to the following extent:

- 1 year - Extremely long pumping period (e.g. 1948, 1972)
- 4 years - Considerable pumping (e.g. 1950-52, 56, 59, etc.)
- 6 years - Some pumping.

The pump selected was an 8-inch, Diesel powered, centrifugal pump, with a rated capacity of about 3.5 cfs under the operating conditions (25 - 30 foot head; 100 feet of outlet pipe, open ended).

Assuming the same inflow conditions as in the previous analysis, it was estimated that the surface elevation of Lower Twin Lake would reach a maximum level of 3.4 feet over the sill. The lake level would exceed a three-foot depth for thirty-two days and a two-foot depth for sixty-one days. The pump would have been operated for three months to bring the surface level down to sill level in preparation for the following year, but the upper lake would still contain full storage of 379 acre feet. If this water was not diverted for irrigation, an additional two months pumping would be required to drain the two lakes to their respective outlet levels.

ESTIMATED CAPITAL COSTS

A. To Re-establish and Extend Former Works

1. Excavate trench with bulldozer, 800 feet long to a maximum, 8 feet above pipe grade - minimum width 8 feet, with 1:1 side slopes 3,500 cubic yards @ \$1.20 per cubic yard	\$ 4,200.00
2. Excavate Trench, lay pipe and backfill 800 feet @ \$2.00 per lineal foot	1,600.00
3. Supply 15-inch diameter reinforced concrete pipe 800 feet @ \$3.00 per lineal foot	2,400.00
4. Backfill by bulldozer 3,500 cubic yards @ 60¢ per cubic yard	2,100.00
5. Acquire old works, easement, legal and survey L.S.	500.00
	\$10,800.00
6. Engineering and contingencies @ 15%	1,620.00
	\$12,420.00
Total	Say \$12,500.00

B. Replace Former Works With 1,300 feet of 24-inch Diameter Pipe

1. Excavate Trench by Bulldozer as above, but 1,300 feet long 7,600 cubic yards @ \$1.20 per cubic yard	\$ 9,120.00
2. Excavate Trench, Lay Pipe, Backfill 1,300 feet @ \$3.00 per lineal foot	3,900.00
3. Supply 24-inch diameter, reinforced concrete pipe 1,300 feet @ \$6.00 per lineal foot	7,800.00
4. Backfill by Bulldozer, Soil on Top 7,600 cubic yards @ 60¢ per cubic yard	4,560.00
5. Acquire Easement, Legal, and Survey Lump Sum	500.00
6. Intake Structure and Control Gate Lump Sum	1,200.00
	<hr/>
	27,030.00
7. Engineering & Contingencies @ 15%	4,062.00
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Total	\$31,142.00
	Say \$31,000.00
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C. Temporary Rental Pumping Unit

The pumping unit will be rented only when required, therefore, no permanent works were considered necessary. All costs associated with this proposal are operating expenses.

ESTIMATED ANNUAL COSTS

For the purposes of this report it was assumed that the required capital for schemes "A" and "B" could be raised through the issuance of 25 year debentures, guaranteed by the Government of British Columbia, bearing interest at the rate of 7½% per annum, and that a sinking fund earning interest at 5% would be established to repay the capital sum at the end of the 25-year period. It was considered that the intermittent operating costs under Scheme "C" should be met by the establishment of a contingency fund and short-term financing when required.

System A

1. Debenture Costs	
Interest - \$12,500 X 0.075 =	937.50
Sinking Fund \$12,500.00 X 0.021 =	262.50
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	\$1,200.00
2. Maintenance and operation at 1%	120.00
3. Administration (estimated)	180.00
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Total Estimated Annual Cost	\$1,500.00
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System B

1. Debenture Costs		
Interest - 31,000 X 0.075 =	2,032.50	
Sinking Fund 31,000 X 0.021 =	651.00	
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	2,683.50	2,683.50
2. Maintenance & Operation @ 1%		310.00
3. Administration (Estimated)		206.50
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Total Estimated Annual Cost		\$3,200.00
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C. Temporary Rental Pumping Unit

The annual cost of operation of the rental pump will vary from year to year depending upon the relative magnitude of the freshet. Shown below is an estimated operating costs for a 5-month, 3-month, and 1-month pumping period.

(a) Extremely Heavy Runoff (5 months of Pumping)

1. Transport Pump, Pipe, Fuel; Set Up and Return	Lump Sum	\$ 200.00
2. Pump Rental - 5 months @ \$600.00		3,000.00
3. Discharge Hose Rental - 5 months @ \$100.00		500.00
4. Fuel Consumption		
154 days = 3,696 hours @ 96¢		3,550.00
		<hr/>
		7,250.00
5. Maintenance and Contingencies @ 10%		725.00
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Total		\$7,975.00
	Say	\$8,000.00
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(b) Heavy Runoff (3 months of pumping)

1. Transport Pump, Pipe, Fuel; Set Up	Lump Sum	\$ 200.00
And Return		
2. Pump Rental - 3 Months @ \$600.00 per month		1,800.00
3. Discharge Hose Rental - 3 months @ \$100.00 per month		300.00
4. Fuel Consumption @ 3 gallons per hour		
92 days X 24 hours X 3 gal. X 32¢ per gallon =		
2,208 hours @ 96¢	Say	2,200.00
		<hr/>
		\$4,500.00
5. Maintenance & Contingencies @ 10%		450.00
		<hr/>
Total		\$4,950.00
	Say	\$5,000.00
		<hr/> <hr/>

(c) Above Average Runoff (One Month of Pumping)

1. Transport Pump, Pipe, Fuel; Set up and Return	Lump Sum	\$ 200.00
2. Pump Rental - 1 Month @ \$600.00		600.00
3. Discharge Hose Rental, 1 Month @ \$100.00		100.00
4. Fuel Consumption 31 Days = 744 hours @ \$1.00		744.00
		<hr/> 1,644.00
5. Maintenance, Contingencies, Tank Rental, Estimated Higher for Short Term @ 20%		329.00
		<hr/>
Total		\$1,973.00
	Say	\$2,000.00
		<hr/> <hr/>

To estimate the average annual cost of this alternative, the total pumping cost over a twenty-five year period was estimated and then averaged.

<u>Magnitude of Freshet</u>	<u>Estimated Pumping Period</u>	<u>Estimated Operating Cost</u>	<u>Estimated Occurrences</u>	<u>Estimated Cost</u>
Extreme	5 months	\$8,000.00	1	\$ 8,000.00
Heavy	3 months	5,000.00	4	20,000.00
Above Average	1 month	2,000.00	6	12,000.00
Average & Below	Nil	Nil	14	0.00
			<hr/>	
		Total	(25)	\$40,000.00
			<hr/> <hr/>	

AVERAGE ANNUAL COST OVER 25 YEARS

1. Contingency Fund Contributions - \$40,000 ÷ 25 years (This could vary according to surplus or deficit situation)	1,600.00
2. Administration (Estimate)	200.00
	<hr/>
Total Estimated Annual Cost	\$ 1,800.00
	<hr/> <hr/>

Note: Rental and operational costs will undoubtedly increase, perhaps double, over a twenty-five year period. Interest earned on the contingency fund was omitted as unpredictable, but would be unlikely to offset this cost escalation entirely.

FINANCING

It was assumed that the estimated annual costs would be raised through a tax on the benefiting lands within the District and that the District boundaries would be expanded to include all benefiting land; particularly all lakeshore properties and possibly the upland residential lots, which would benefit by the improvement in esthetic and recreational values.



The actual tax structure would be decided by the elected trustees of the District, but assuming alternative A is adopted the annual revenue required could be raised in the following manner:

30 lakeshore residential parcels @ \$36.00 per annum	\$1,080.00
26 upland residential parcels @ \$9.00 per annum	234.00
2 large lakeshore parcels @ \$108.00 per annum	216.00
Total	<u>\$1,530.00</u>

CONCLUSIONS

1. A prolonged period of heavy inflow to Twin Lakes would result in extensive flooding of private land and structures around the lower lake.
2. It is recommended that the Trustees of Lower Nipit Improvement District consider the installation of Scheme "A" presented in this report to divert surplus water into Park Rill. If the Trustees accept this recommendation, then it is further recommended that they make application for a water licence to authorize these works and that they enter into negotiations with the downstream landowners regarding the discharge of surplus water into Park Rill.
3. The present boundaries of the Lower Nipit Improvement District do not include all the lands which would benefit from a lake level control system and consideration should be given to boundary amendments.
4. It is recommended that regulated levels of Lower Twin Lake be as follows:
  - a. Normal High Water Level - Sill Elevation of Existing Outlet Works.
  - b. Minimum Water Level - 5 feet Below Sill Elevation of Existing Outlet Works.

W. V. Raudsepp,  
Chief Engineer

Mr. E. Livingston, Chief,  
Groundwater Division

June 2

66

Twin Lakes Area

0249723

At the suggestion of Mr. Talbot, District Engineer at Kelowna, I visited the Twin Lakes Area in May. Irrigators who hold licenses on Trout Lake about a mile north of Twin Lakes think that new irrigation wells south of Trout Lake are causing a lowering of Trout Lake Level.

The locations of the two wells owned by Twin Lakes Ranch are shown on the map. No. 1 was put in two years ago and No. 2 was drilled early this spring. I do not have the log of No. 1 which I believe showed sand and gravel to about 80 feet. The log of No. 2 is as follows:

0 - 18	Loose bouldery gravel
18 - 40	Loose silty gravel
40 - 80	Sandy gravel, fine to medium
80 - 88	Sand medium to coarse
88 - 100	Fine sand, some silt
100 - 100	Rock, sandstone

The static level is about 35'. The well has 20' of Johnson iron screen set from 68' to 88'. The upper half is .020' slot, the bottom half .030" slot.

An approximate pumping test showed the capacity of the well to be about 250 US g.p.m. I believe the capacity of well No. 1 is about 200 US g.p.m.

Both wells are in use irrigating the hay land east of the road from Trout Lake to Twin Lakes.

Twin Lakes are large kettles in outwash filling old pre-ice drainage. Old partially filled valleys of this type are common all through the area from Summerland to Richter Pass. Nasmith in his report on ice retreat from the Okanagan Valley discusses some of these features but I am inclined to disagree with his analysis of this situation. Anyhow, it is not obvious from an examination of the present topography to tell just what the configuration of the rock valleys is in this area.

I checked with a Thommen pocket altimeter the surface elevations of Twin Lakes and Trout Lake and also a sump near well No. 1. The sump is about 30' above Trout Lake and the north east Twin Lake is about 85' above Trout Lake. From the logs of the wells and from what we know of the geology of this area I think it is reasonable to assume that the gravel fill is continuous through this valley. The elevations show a water table gradient of about 85' per mile northward from Twin Lakes indicating a flow of groundwater in this direction. Trout Lake which has no outlet probably discharges eastward through sand and gravel toward Marron Creek rather than westward to Yellow Lake as the valley in this direction seems to be cut in rock. Twin Lakes almost certainly also drain eastward underground down Park Rill.

If the speculation above is correct, Twin Lakes, Trout Lake and the aquifer between is all part of the same hydrologic system. Input to this system is from precipitation directly into the lake and the aquifers and by groundwater recharge from creeks leading into the basin. Discharge is by groundwater flow toward Park Rill and Marron Creek and by the usual evapo-transpiration and consumptive use. Therefore, consumptive use, whether from surface water or groundwater, cuts down on the total amount of water available.

Visual inspection indicates that Twin Lakes are very low even at this time of year (May) and that the level has been going down over a period of several years. Water is being removed at a faster rate than it is being replenished. This situation will probably continue unless more water can be added to the system or the rate of withdrawal is decreased.

This is an ideal situation for artificial recharge provided a source of water can be found. Perhaps freshet flow or winter flow of the upper part of Park Rill could be diverted into Twin Lakes. Before doing anything of this sort a brief geologic investigation of the whole drainage system might be worthwhile. Regular measurements of groundwater levels either in observation wells or in the lakes would give quantitative data on what is happening.

(Sgd.) E. Livingston, Chief  
Groundwater Division

EL:jes

cc: R. Talbot, District Engineer, Kelowna  
H.D. DeBeck, Comptroller, Water Rights Branch.



## APPENDIX "B"

ANNUAL NET INFLOW TO OKANAGAN LAKE (CALENDAR YEAR)  
(EXPRESSED AS PERCENTAGE OF 1921 - 1971 MEAN)

<u>Year</u>	<u>Inflow</u>	<u>Year</u>	<u>Inflow</u>
1921	97%	1951	165%
1922	83	1952	122
1923	116	1953	95
1924	35	1954	161
1925	68	1955	124
1926	32	1956	152
1927	112	1957	112
1928	185	1958	103
1929	30	1959	179
1930	25	1960	91
1931	20	1961	83
1932	102	1962	77
1933	142	1963	58
1934	127	1964	135
1935	145	1965	112
1936	101	1966	56
1937	102	1967	70
1938	83	1968	113
1939	54	1969	115
1940	43	1970	30
1941	90	1971	121
1942	128	1972	200 plus
1943	62		
1944	65		
1945	115		
1946	159		
1947	59		
1948	202		
1949	123		
1950	135		

c.c. Mr. R.G. Harris  
 District Engineer  
 Water Rights Branch  
 KELOWNA, B.C.

June 19th, 1961

0176625  
 091083  
 0162179

Mr. T.E. Ripley,  
 Slinger Realty Ltd.,  
 800 Park Royal,  
 West Vancouver, B.C.

Dear Sir:

Re: Twin Lake

We refer to a petition, signed by yourself and others, owners of property on the shore of Twin Lakes, which petition was forwarded to the Water Rights Branch District Office at Kelowna, B.C. in February this year, concerning water levels and the use of water from the lower Twin Lake, near Penticton, B.C.

We would advise you regarding this matter as follows:

(1) The Twin (Nipit) Lakes appear to have no natural outlet. However, there appears to be an overflow channel leading to Park Rill (Myers Creek) at an elevation about 25 feet above the normal elevation of the lower Twin Lake.

Information available at this time indicates that for many years, the inflow to Twin Lakes from Horn (Bear) Creek has been small with the greatest problem appearing to be to hold the lower lake elevation at a normal level. However, during periods of above normal runoff, the lower Twin Lake has risen to an elevation considerably higher than normal. For example, in May, 1951, the lower Twin Lake rose some eight feet.

(2) Conditional Water Licence Nos. 20605 and 20606 were issued to Messrs. Gordon Robertson Sutherland and Donald Archibald Sutherland on Twin Lakes in March, 1952. Conditional Water Licence No. 20606 authorizes storage of 200 acre feet of water per annum on Upper Twin (Nipit) Lake, and Conditional Water Licence No. 20605 authorizes a diversion of 200 acre feet of water per annum from Lower Twin Lake for irrigation purposes on Lot 280, and in addition, the use of a concrete pipe and ditch from the lower Twin Lake for drainage purposes under a condition that prior approval of the Water Rights Engineer at Kelowna be obtained before these works could be used for the drainage of the lower Twin Lake.

This condition was added to the water licence in view of the fact that excess water from the lower Twin Lake could cause flooding damage downstream along the channel of the Park Rill (Myers Creek) and that several landowners in the Park Rill area objected to such a drainage arrangement. Regarding the latter, the following property owners objected in 1951: N.F. Doerfler (District Lot 234), John Ure (District Lot 246) and W.H. Anderson (District Lot 28).

(3) The Water Rights District Engineer at Kelowna, B.C., in his letter to Messrs. D. A. & G. R. Sutherland, dated May 1st, 1953, gave permission to divert water from Twin Lakes to Myers Creek, under the condition that the quantity of water so diverted be not greater than the quantity taken out of Myers Creek by Mr. John M. Stewart on his D.L. 282 and 283. As no complaints have been received by the Water Rights Branch regarding flooding in Myers Creek area, it is assumed that Mr. Stewart used for irrigation purpose all the water that was diverted from Twin Lakes to Myers Creek and that no excess water reached the aforesaid downstream properties in Myers Creek area.

(4) Both the aforesaid Conditional Water Licences Nos. 20605 and 20606 are appurtenant to Lot 280, Similkameen Division of Yale District, as it was applied for Messrs. G.R. and D.A. Sutherland, and there is nothing in the "Water Act" prohibiting the owner or owners of Lot 280 to cease the operation of the pump, pipeline, and ditch constructed under Conditional Water Licence No. 20605, or to abandon these water licences. Should the owner or owners of Lot 280 wish to abandon these water licences, the Water Rights Branch would be concerned about the existing pipeline and ditch from the lower Twin Lake, which pipeline, if left open and unattended, could cause damage by flooding lands along the Park Rill channel. Therefore, in such a case, the Water Rights Branch will have to instruct the holder of Conditional Water Licence No. 20605 to permanently plug the pipeline before the water licence is abandoned.

(5) The original properties abutting on the lower Twin Lake apparently have now been subdivided. If these property owners wish to install and operate any works for the purpose of controlling the level of the lower Twin Lake, they should apply to the Comptroller of Water Rights for a water licence for land improvement purpose. In view of the fact that a number of landowners appear to be interested in such a drainage scheme, it would be advisable if all the lands abutting on the Lower Twin Lake, and benefiting from this drainage scheme, were incorporated into an Improvement District for drainage purposes under the "Water Act". For this end, the landowners should form an Organizing Committee who then could circulate a petition for incorporation. A form of petition and two sheets of general information concerning incorporation procedure and administration of an Improvement District are enclosed herewith for your information.

The Improvement District, if incorporated, could then apply to the Comptroller of Water Rights for a water licence on the lower Twin Lake for land improvement purposes, and if a water licence issues, the Trustees of the Improvement District would have the power to install and operate the drainage works as approved under their water licence.

It is likely that certain landowners along Park Rill (Myers Creek) will again object to the issuance of such a water licence on the grounds that any excess water from the lower Twin Lake would cause flooding damage to their lands. Therefore, the landowners around Twin Lakes would be well advised to discuss this matter with the owners in Park Rill valley in order to reach an amicable solution before an application for a water licence is made. In this connection, we would point out that under the "Water Act", every holder of a water licence is required to make full compensation for any damage or loss resulting from the construction, maintenance, use or operation of the works authorized under the "Water Act".

(6) It is pointed out that Conditional Water Licences Nos. 20605 and 20606 do not authorize any diversion or use of water from Twin Lakes for domestic or waterworks purposes. While it is not an offence against the "Water Act" for a person to divert unrecorded water for his domestic use, if a person intends to install a waterworks system for his subdivision, he is required to apply for a water licence for waterworks purpose in which case the Comptroller of Water Rights will require, among other things, submission of plans and specifications showing the proposed water supply system.

- 3 -

Generally speaking, every person who intends to divert and use water from a surface source of water supply should apply for a water licence as set out in the "Water Act".

A copy of this letter has been forwarded to the following persons:

Mr. & Mrs. G.C. Pottinger  
Mr. and Mrs. R. Kamals  
Mr. D.A. Sutherland  
Mr. G.R. Sutherland  
Mr. Stewart Glendinning  
Mrs. Yvonne Friry  
Mrs. A.S. Bryson  
Beverly J. Kline  
Mr. A. Holst  
Mr. and Mrs. E. Alexander  
Mr. and Mrs. John Habkick  
Mr. and Mrs. D.R. Johnson  
Mr. Rinaldo A. Wassman

Yours very truly,

A.F. Paget,  
Comptroller of Water Rights

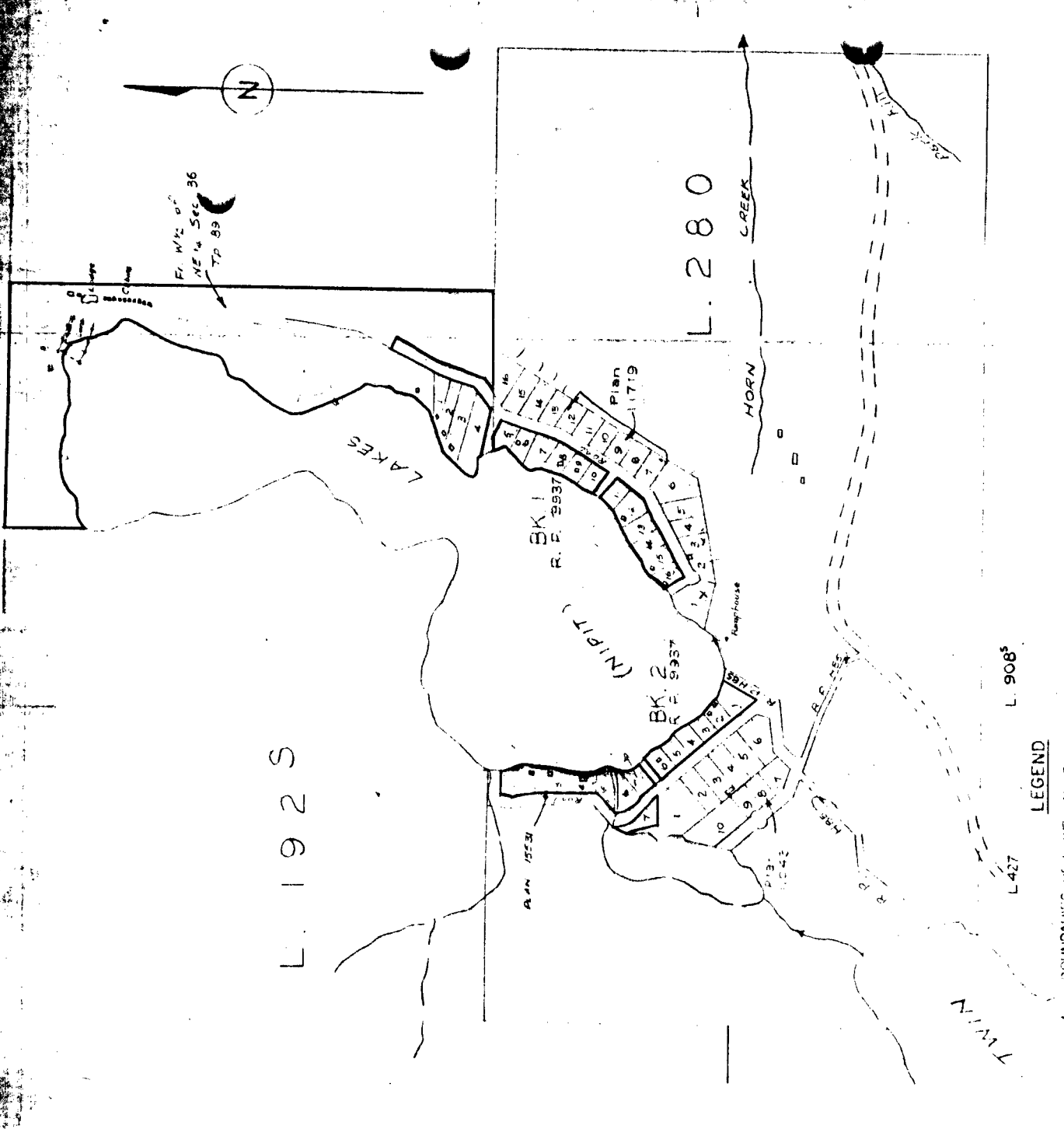
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per:



STORAGE CAPACITY TABLES  
NIPIT (TWIN) LAKES

Geodetic	Contours		Area Acres	Volume of Storage		Remarks
	Local	Gauge		Net	Gross	
<u>Lower Twin Lake</u>						
		4.6	66.5		564	Unlicenced Capacity
		5.6	67.5	67.0		" "
		6.6	68.5	68.0	497	
		7.6	69.5	69.0	429	
	- 10	8.6	70.5	70.0	360	
		9.6	71.5	71.0	290	
		10.6	72.5	72.0	219	
		11.6	73.5	73.0	147	
		12.6	74.5	74.0	74	
	- 5	13.6	75.9	75.2	0	Proposed Minimum
	- 4	14.6	77.3	76.6	75	
	- 3	15.6	78.7	78.0	152	Licenced Diversion
	- 2	16.6	80.1	79.4	230	Plus Evaporation
	- 1	17.6	81.5	80.8	309	
2600 <sup>e</sup>	0	18.6	82.5	82.0	390	Invert old outlet pipe
	1	19.6	89.0	85.8	472	Culvert to middle pond at elev. 105
	2	20.6	90.4	89.6	558	
	3	21.6	91.8	90.8	647	
	4	22.0	92.3	90.8	738	
2604.4 <sup>e</sup>	4.4	22.0	92.3	37.0	775	Upper Lake Sluice Inle
2605	5		93.2	54.5	831	
	6		94.6	93.9	925	
	7		96.0	95.3	1020	
	8		97.5	96.7	1117	
	9		99.0	98.3	1215	
2609.3 <sup>e</sup>	9.3		99.5	29.8	1245	Upper Lake Spillway Crest.
<u>Upper Twin Lake - Upper Gauge</u>						
2604.4 <sup>e</sup>	- 4.4	0.1	72.6		0	Sluice Inlet Invert
	5.4	1.1	73.9	73.3	73	
	6.4	2.1	75.2	74.5	148	
	7.4	3.1	76.5	75.8	224	
	8.4	4.1	77.8	77.2	301	
2609.3 <sup>e</sup>	9.3	5.0	78.9	78.4	379	Spillway Crest
	10.8	6.5				Design Surcharge
2613.8 <sup>e</sup>	13.8	9.5				Crest of Dam



BRITISH COLUMBIA  
 DEPARTMENT OF LANDS AND FORESTS  
 WATER RIGHTS BRANCH  
 KELOWNA OFFICE

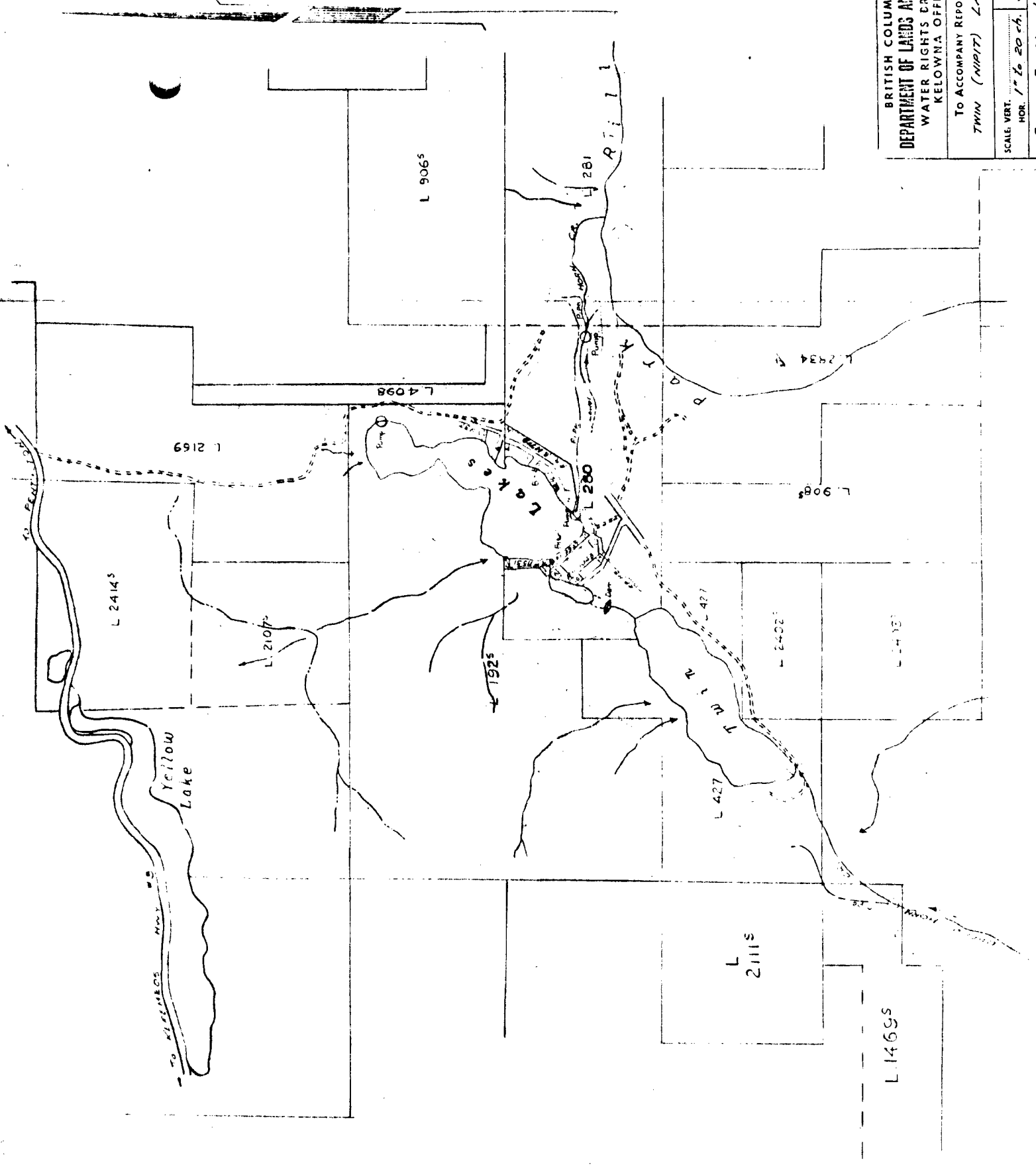
To ACCOMPANY REPORT ON  
 TWIN (NIPIT) LAKES

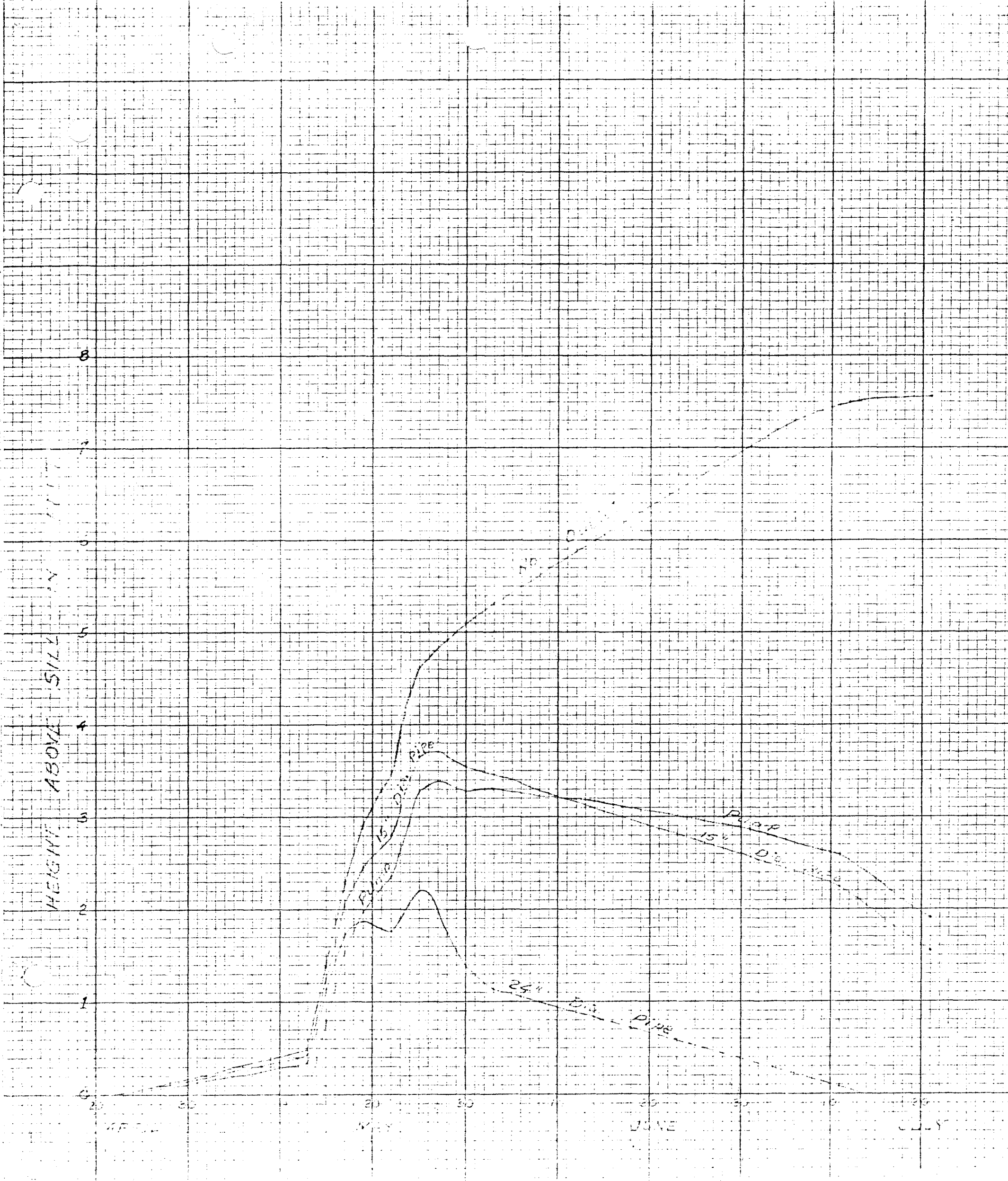
SCALE VERT. ....  
 HOR. 1" = 500'

DATE  
 Jan 23, 1923

**LEGEND**

BOUNDARIES OF L. WEA. NIPIT WATERSHED DISTRICT  
 WATER BODIES





BRITISH COLUMBIA  
 DEPARTMENT OF LANDS AND FORESTS  
 WATER RIGHTS BRANCH  
 KELOWNA OFFICE

TO ACCOMPANY REPORT ON  
 TWIN (NIPIT) LAKES

SCALE: VERT. \_\_\_\_\_ DATE \_\_\_\_\_  
 HOR. \_\_\_\_\_ Feb. 22, 1973

Barry F. Alcock foreENGINEER

FILE No. 02263748 DWG. No. 4

DISTANCE FROM STILL IN FEET

100  
90  
80  
70  
60  
50  
40  
30  
20  
10  
0

BRITISH COLUMBIA	
DEPARTMENT OF LANDS AND FORESTS	
WATER RESOURCES BRANCH	
KELOWNA OFFICE	
TO ACCOMPANY REPORT ON	
TWIN INLET LAKES	
SCALE VERT	DATE
HOR	Feb 1, 1973
Barry F. Alcock	PER ENGINEER
FILE NO. TWIN	DWG NO. 3
4263745	

DISTANCE

100  
90  
80  
70  
60  
50  
40  
30  
20  
10  
0

1970      1971      1972

April May June July August Sept. Oct.      April May June July August Sept. Oct.

1970      1971      1972

L. 1925

Fr. W/2 32  
NE 1/4 Sec. 36  
Tp. 39



LAKES

PLAN 15531

BK. 1  
R. P. 9937

Plan 11719

BK. 2  
R. P. 9937

L. 280

GAUGES

D. KRIEGER Ho.  
Fam. house

HORN

CREEK

Plan 11043

H85

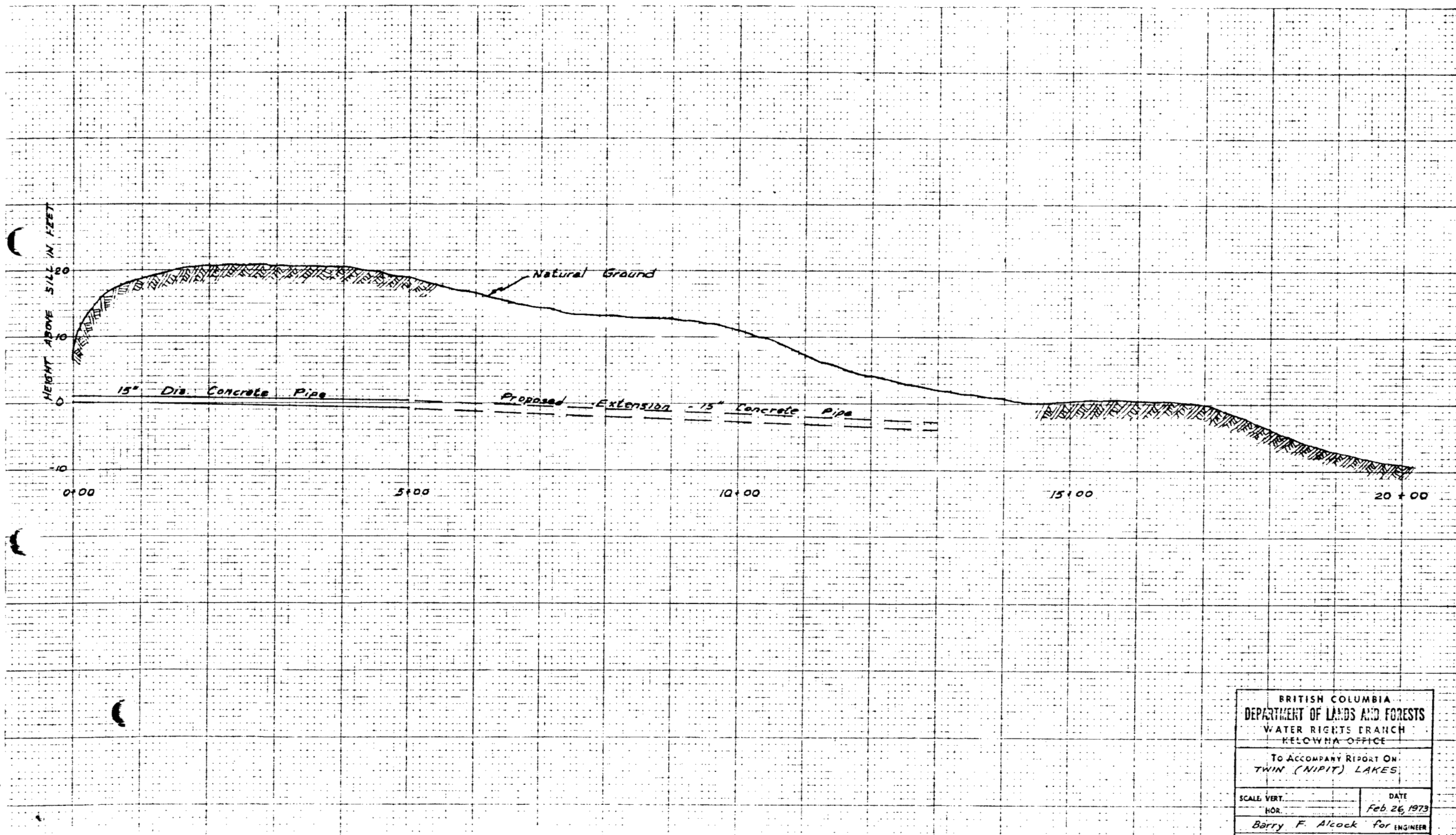
R. P. H85

TWIN

L. 427 L. 3085

PARK  
RILL

BRITISH COLUMBIA DEPARTMENT OF LANDS AND FORESTS WATER RIGHTS BRANCH KELOWNA OFFICE	
TO ACCOMPANY REPORT ON <i>TWIN (NIPIT) LAKES</i>	
SCALE: VERT. _____ HOR. 1" = 500	DATE 23-11-72
<i>Barry F. Alcorn</i> ENGINEER	
FILE No. <i>TWIN</i>	DWG. No. <i>1</i>



BRITISH COLUMBIA DEPARTMENT OF LANDS AND FORESTS WATER RIGHTS BRANCH KELOWNA OFFICE	
TO ACCOMPANY REPORT ON TWIN (NIPIT) LAKES	
SCALE VERT. HOR.	DATE Feb 26, 1973
Barry F. Alcock for ENGINEER	
FILE No. C263748 DWG No. 5	