REPORT

on

STARBUCKVILLE DAM

for

SCHROON LAKE PARK DISTRICT

October 1971
RFA 1359

RIST-FROST, ASSOCIATES
Consulting Engineers
Glens Falls, New York

INTRODUCTION

The Starbuckville Dam is situated on the Schroon River approximately two miles northeast of Chestertown, off New York State Route 8. The dam is located at a longitude of 73° 46' and a latitude of 43° 41' on the North Creek, New York 15 minute USCGS quadrangle.

The dam is the rockfill crib type that has been reconstructed, repaired, or altered in design several times. Since the advent of mechanization in the logging industry, the basic function of the dam is the control of the level of Schroon Lake, primarily for recreational uses.

According to the records of the New York State Department of Transportation filed in 1920, the dam was built in the 19th century. The dam was owned by Schroon River Pulp and Paper, Warrensburg, New York, and was used for logging. The writer of that report surmised that the spillway and the dam itself were on a foundation of rock and gravel. The report also stated the dam was 250 feet long overall with sluiceways located at each bank of the river. The sluiceways were 20 feet wide and 12 feet deep; the length of spillway was 150 feet. The report also stated the following: "Dam is in fair condition; no serious leaks. Probably no serious damage if structure went out."

A similar report on the dam was filed by Finch Pruyn Company, Inc., in 1925. This form reiterated much of the same information as the previous one; there were some noticeable differences and additions. No leakage was noted. The length of the spillway was 160 feet. The writer stated that in event of a failure, "the flow of the river in times of high water would be only slightly increased if the entire dam should fail."

In November 1960, an application to construct or reconstruct a dam was made to the Department of Public Works. A permit was required prior for the installation of a steel gate. The permit was issued; subsequently, the gate structure was built. The application stated that the dam was owned by the Schroon Lake Park District and the dam was utilized to retain the level of Schroon Lake. The application also stated that in event of a failure, "the flow of the river in times of high water would be slightly increased if dam should fail. Some meadow land would be flooded."

SCOPE

On October 6, 1970, the Schroon Lake Park District entered into an agreement with Rist-Frost, Associates to report on the condition of the Starbuckville Dam.

In fulfillment of this agreement, the investigation and study was conducted to include the following items:

1. Surveys and mapping of the immediate dam site.
2. Collection of existing hydraulic data, plans, records, reports and calculations.
3. Hydraulic analysis of watershed.
4. Detailed field measurement and investigation of existing conditions.
5. Recommendations of measures to be taken immediately to reinforce the dam for Spring (1971) runoff.
6. Consultations with review agencies to determine criteria.
7. Recommendations and cost estimates for long term solutions.
8. Consideration to participating in State and Federal Aid.

INVESTIGATION

WATERSHED:

A map showing the location of the watershed and Starbuckville Dam is shown on Plate I of the appendix.

The watershed is 435 square miles in area and consists basically of woodlands with some farmland and marshland. The ground slope varies from gentle to precipitous from the highest elevation of over 4,800 feet above sea level to an elevation of 807 for Schroon Lake. The average gradient of the watershed is about 140 feet per mile or 2.7 percent. The watershed is approximately 30 miles long.

SCHROON LAKE:

The Lake, naturally occurring but increased in size by the dam, covers an area of approximately 8 square miles. Schroon Lake is used primarily for recreational purposes. The economy of the Schroon Lake vicinity is highly dependent upon use of the Lake by tourists. Motels with beaches, campsites, boating, swimming and related activities attract thousands to the Lake each year. The Starbuckville Dam is instrumental in regulating the level of Schroon Lake.

DAM:

A plan view of the dam is shown on Plate 2.

The dam is rockfill crib type construction. The main spillway is almost 140 feet long. A rockfilled crib structure separates the spillway from a sluiceway on the southwest bank. The flow through the sluice is controlled by a steel gate, 16 feet wide. The bed of the sluiceway is timber. Another rockfill crib and concrete retaining wall separate the sluiceway from the southwest earth embankment. On the northeast side, the spillway terminates at an embankment composed of sand, gravel and boulders. Apparently, the sluiceway referred to in earlier reports was washed out or destroyed; subsequently, fill was placed over the remains of the sluiceway.

STRUCTURAL:

Field investigations during the late 1970 and early 1971 were conducted to determine the structural integrity of the structure. The investigations included visual inspection, physical probing, and review of existing plans or sketches.

The cribwork of the spillway is in good condition. The main members have not deteriorated appreciably. The rockfill has retained its strength. The planking on the upstream side is

generally in poor condition. Several small whirlpools are evident behind the spillway crust. When the spillway was uncovered, leakage underneath the crib was noticed. The planking should be replaced and backfilled with impervious material to prevent the leakage. The planking on the downstream side of the spillway crest is worn but still sound. The two timber cribs adjacent to the sluiceway are in poor condition. The members in the high sections are totally rotted caused by the continual wet-dry cycle. The lower portion of the crib is in somewhat better condition but should be replaced promptly. Probes were driven completely through some members, indicating little or no strength. The planking on the sluiceway is structurally sound. The gate structure is also sound. Some concrete has spalled from the piers; these areas should be patched. When steel bracing was installed to protect the cribwork, bolts holes were drilled through the concrete piers, at the time the concrete still had retained its strength.

EMERGENCY REPAIRS:

During the winter of 1971, the dam was reinforced to withstand the runoff during the spring of 1971. The concrete wall joining the gate structure and the southerly bank was raised to prevent the need for sandbagging as the level of water rises. The cribwork separating the spillway and the sluiceway was reinforced with a ring of channel steel to prevent total collapse and possible serious damage to the entire structure.

It should be noted that these measures were temporary in nature and were not intended to insure long-term stability.

SURVEY:

The immediate dam site was surveyed. Detailed field measurement supplemented the survey. The mapping produced is twenty scale (1"=20') and extends several hundred feet upstream and downstream of the site. The bridge across the Schroon River is also detailed.

FINANCIAL AID:

Consideration was given to applying for financial assistance. However, it appears there is no aid available for a program of maintenance work on the dam. In order to qualify for assistance, the scope of the project would have to be expanded.

HYDRAULIC ANALYSIS

GENERAL:

In the summer months when runoff is relatively small, the steel gate is closed to prevent the lake level from dropping below the crest of the spillway. In winter and early spring months, the gate is left open to allow additional capacity in preparation for the high runoff.

STREAM FLOW DATA:

A stream flow gauging station was located on the Schroon River at Riverbank, New York, about 6 miles downstream from the dam. Stream flow records are available covering a period of 63 years (1907-1970). The gauge has been abandoned since. The following data is pertinent to the analysis under consideration:

Drainage area above dam	435 square miles
Drainage area above gauge	527 square miles
Average discharge at gauge	819 cfs
Maximum discharge at gauge	12,000 cfs

These records and data have been analyzed by the Water Resources Division of the United States Department of the Interior to produce the maximum anticipated runoff for Riverbank gauging station for various recurrance intervals.

By prorating measured flows at Riverbank in proportion to the drainage areas, an estimated flow at Starbuckville can be computed for all flows at Riverbank. Since the drainage area of the Schroon River at the Riverbank gauging station is 527 square miles, the flow at Starbuckville is 435/527 or 83% of the measured flow at Riverbank.

The following table lists the anticipated runoff for various recurrence intervals for Riverbank, as produced by the Water Resources Division, and for Starbuckville.

Recurrence Interval	Discharge at Riverbank	Discharge at Starbuckville
2 years	2,393 cfs	1,400 cfs
10	7,822	6,500
25	9,063	7,500
50	9,909	8,200
100	10,698	8,900
200	11,439	9,500

SPILLWAY CAPACITY:

The capacity of the main spillway to discharge runoff is dependent upon the water level upstream from the dam. As the level raises, the discharge capacity increases.

The basic formula for a non-sharp crested weir, $Q = CL(H)\ 3/2$, was utilized to calculate the discharge. The length (L) used was 140 feet. The coefficient (C) was taken from the works of Horton. The following table lists the calculated discharges.

Head Above Spillway Crest	C	Discharge	Lake Level
1 ft.	3.12	425 cfs	806.7
2 ft.	3.22	1,270	807.7
3 ft.	3.22	2,350	808.7
4 ft.	3.22	3,610	809.7
5 ft.	3.22	5,050	810.7
6 ft.	3.22	6,650	811.7

SLUICEWAY CAPACITY:

The discharge capacity of the sluiceway is a function of the water level or head. The discharge has been calculated using the following formula:

$$Q = C(A)(2gH)^{1/2}$$

C = discharge coefficient = .70

A = opening area (sq. ft.)

H = head to center of opening (ft.)

g = acceleration of gravity = 32.2 (ft./sec.)

Q = discharge (cfs)

The following table gives the calculated sluiceway discharges for the corresponding heads above the spillway crests:

Head Above Spillway Crest	Discharge	Lake Level
1 ft.	560 cfs	806.7
2 ft.	830	807.7
3 ft.	1,060	808.7
4 ft.	1,300	809.7
5 ft.	1,420	810.7
6 ft.	1,540	811.7

COMBINED CAPACITY:

The following chart tabulates the discharge capacity for the spillway and sluiceway:

Head Above Spillway Crest	Combined Discharge	Lake Level
1 ft.	985 cfs	806.7
2 ft.	2,100	807.7
3 ft.	3,410	808.7
4 ft.	4,910	809.7
5 ft.	6,470	810.7
6 ft.	8,190	811.7

The sluiceway and spillway with a rise of five (5) feet, is capable of passing the 10-year storm.

FREEBOARD:

The elevation of Schroon Lake is controlled by the Starbuckville Dam. The elevation of the lake raises considerably during peak runoff.

Presently, the water will bypass the dam on the northerly side with a rise of approximately 4 1/2 feet. The bridge and county road are at a failure condition at a rise of seven feet. A sustained rise of six (6) feet coupled with wave action and seepage would threaten the road and bridge.

The structure should be altered to retain a momentary rise of seven (7) feet. This would provide a freeboard of two (2) feet at a rise of five (5) feet.

CONCLUSIONS

1. The sluiceway and the associated cribbing is in very poor condition; these structures have been temporarily reinforced and should be permanently replaced.

   If the present cribbing collapsed, the end of the spillway would be exposed. Severe erosion then would threaten the entire dam.

2. The poor condition of planking on the upstream side of the spillway contributes to the leakage under the spillway. This leakage should be stopped to protect the long-term stability of the entire structure.

3. The existing spillway and sluiceway are capable of handling a 10-year runoff with a rise of five (5) feet.

4. The existing sluiceway and spillway are capable of passing a 50-year runoff with a rise of six (6) feet. This condition leaves less than one foot of freeboard before a failure condition.

5. The existing dam and the topography adjacent to it can withstand a rise in water level of four (4) $\pm$ feet without going around the structure. This controlling point is on the northeast side of the structure. The bridge and road are at a failure condition with a rise of seven (7) feet.

RECOMMENDATIONS

PRIORITY NO. 1:

Place fill on the northeast side of the structure to allow a rise in water level of seven (7) feet without going around the dam.

PRIORITY NO. 2:

The existing sluiceway and cribs should be replaced with a concrete structure. The concrete will not be deteriorated by the wet-dry cycle as the wooden structure has. The concrete sluiceway should utilize the existing gate structure and be incorporated into the existing spillway.

PRIORITY NO. 3:

Replace the planking on the upstream and downstream faces of the existing spillway. At the same time, impervious backfill should be placed on the upstream planking to reduce seepage beneath the structure.

PRIORITY NO. 4:

Additional spillway capacity should be added to accommodate the 100-year recurrence interval runoff with a rise of five (5) feet. This would allow a 200-year runoff to be passed with a rise of less than six (6) feet. The additional capacity should be added on the northeast side of the existing structure. The additional capacity should be provided using a concrete sluiceway.

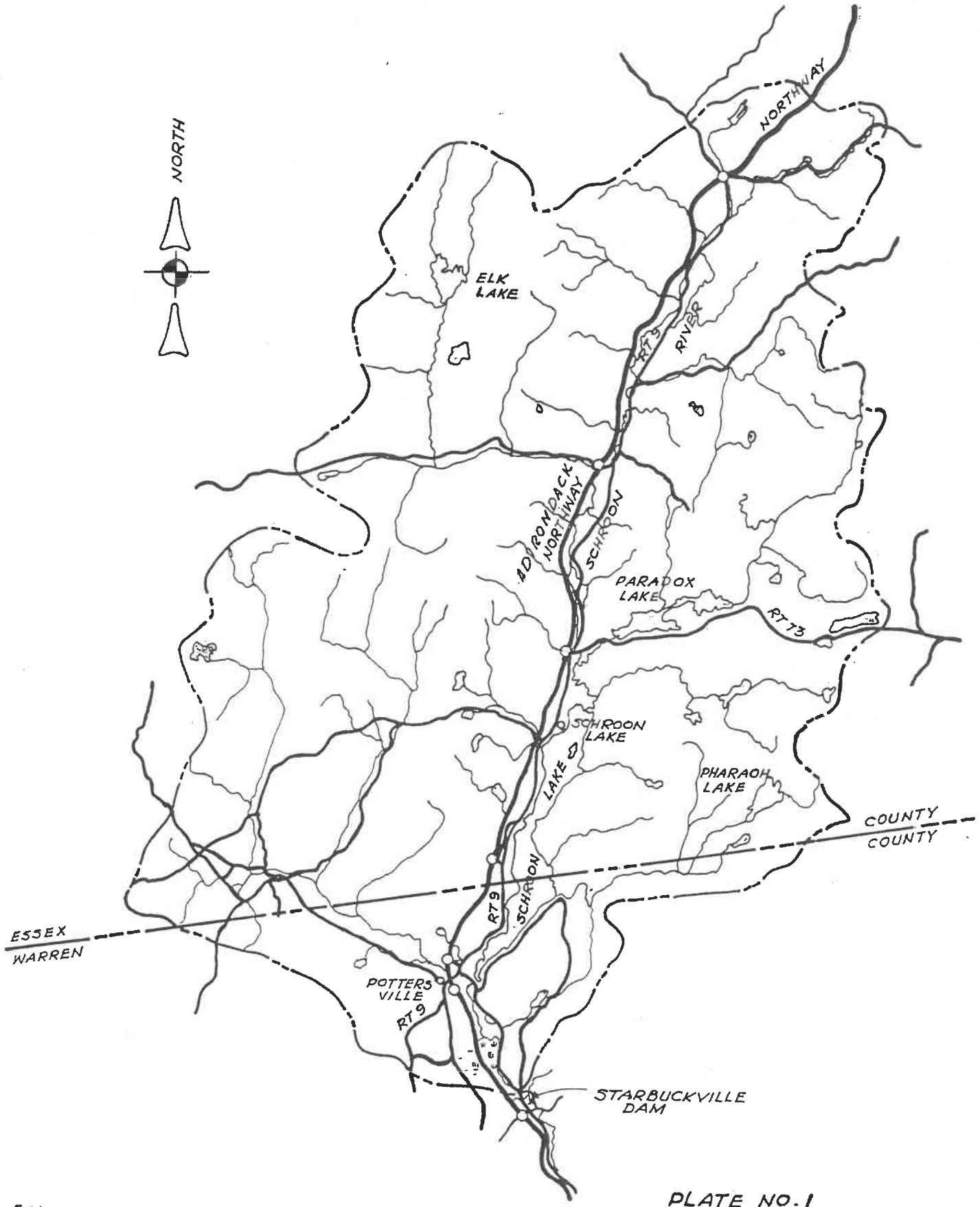

PLATE NO. 1

WATERSHED ABOVE SCHROON RIVER AT STARBUCKVILLE DAM

RIST-FROST ASSOCIATES
CONSULTING ENGINEERS
GLENS FALLS, NEW YORK

RFA # 1359

AUG. 5, 1971

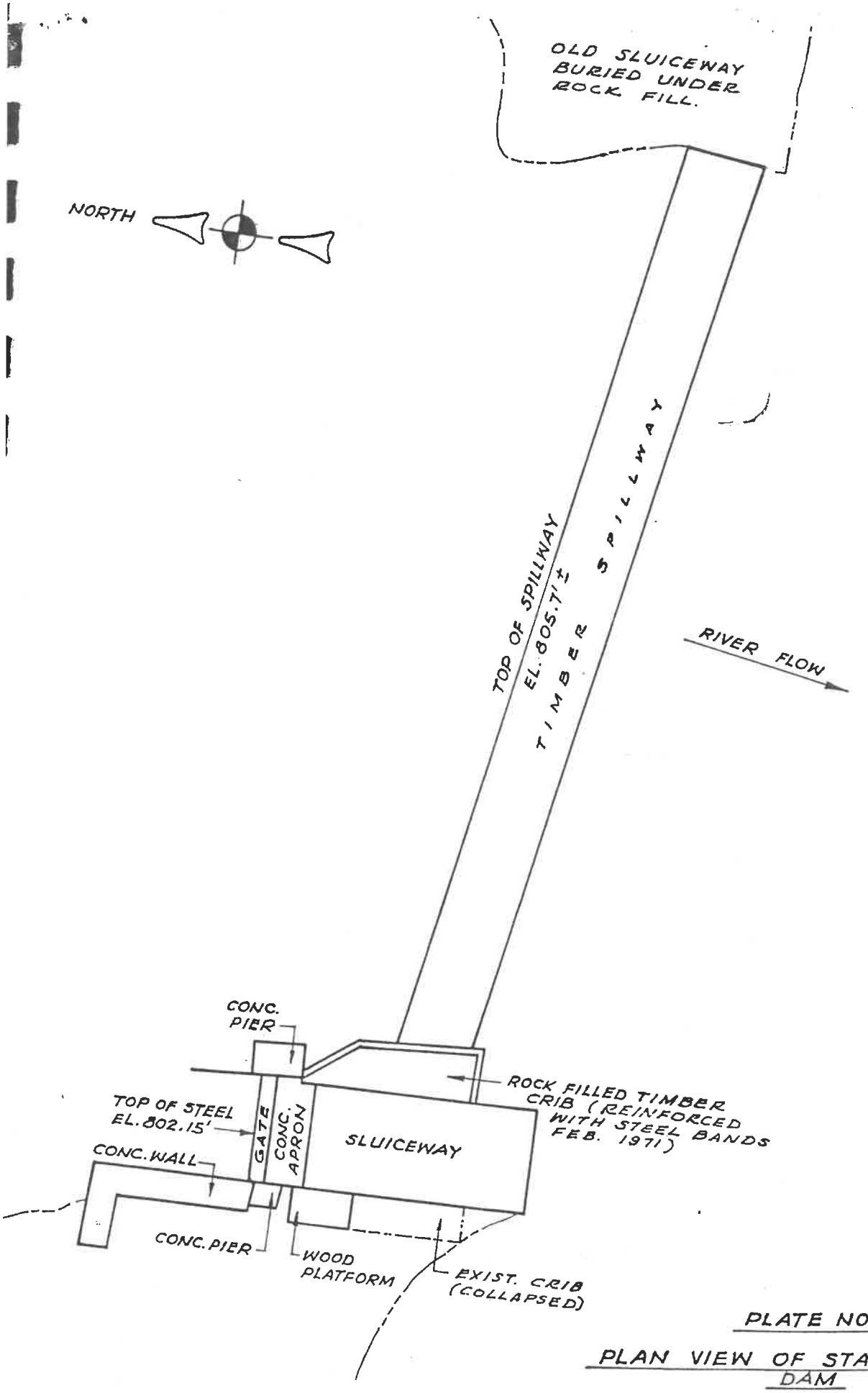

PLATE NO. 2

PLAN VIEW OF STARBUCKVILLE DAM

SCALE 1" = 20'

RIST-FROST ASSOCIATES RFA# 1359
CONSULTING ENGINEERS
GLENS FALLS, NEW YORK AUG. 5, 1971

KIST-FROST, ASSOCIATES
CONSULTING ENGINEERS

BY JEH DATE _____ SUBJECT Starbuckville Dam SHEET 1 OF 1
CHKD. BY _____ DATE _____ JOB NO. 1359

ENGINEER'S ESTIMATE

NO.	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT
1	Replace decking; backfill				
	with clay				
	a. Remove fill	C.Y.	100	20.00	$ 2,000
	b. Remove decking	S.F.	3,360	0.75	2,500
	c. Cofferdam	L.S.		20,000.00	$20,000
	d. Replace decking	S.F.	3,360	1.80	6,000
	e. Clay backfill	C.Y.	100	25.00	2,500
	f. Equipment Mobilization	L.S.		2,000.00	2,000
				SUB-TOTAL	$35,000
2	Remove and replace exist-				
	ing sluiceway				
	a. Demolition	L.S.		2,000.00	$ 2,000
	b. Concrete	C.Y.	110	100.00	11,000
	c. Cofferdam	L.S.		4,000.00	4,000
				SUB-TOTAL	$17,000
3	Spillway addition				
	a. Gate structure	L.S.		10,000.00	$10,000
	b. Concrete	C.Y.	80	100.00	8,000
	c. Excavation	C.Y.	800	8.00	6,400
	d. Cofferdam	L.S.		6,000.00	6,000
	e. Rip-Rap	S.Y.	10	150.00	1,500
				SUB-TOTAL	$32,900
				TOTAL	$84,900
				Contingencies	9,100
				GRAND TOTAL	$93,000