St. Regis Indian Reservation

Potential Drainage Improvements for Three Watersheds

Prepared
for the Department of the Interior,
Bureau of Indian Affairs

US Army Corps
of Engineers
Buffalo District

December 1988

place until residential or agricultural development of Watershed no. 3 requires improved drainage.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ADA203335

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) St. Regis Indian Reservation, Potential Drainage Improvements for Three Watersheds.		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, Buffalo 1776 Niagara St. Buffalo, N.Y. 14207-3199		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE December 1988 13. NUMBER OF PAGES 42
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Drainage
Flooding
Watersheds

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents the Corps' evaluation of flood and drainage problems on three watersheds within the St. Regis Indian Reservation near Hogansburg, New York. Of the four plans, Plan 3, raising Drum Street, is the presently recommended plan. Plans 1 and 2 appear to be less effective than Plan 3 in reducing the magnitude and frequency of Drum Street flooding. The implentation of Plan 4 should not take

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ABSTRACT

This report was prepared in accordance with the August 27, 1987 Memorandum of Agreement between the Buffalo District Corps of Engineers and the Department of the Interior, Bureau of Indian Affairs, Eastern Area Office. It presents the Corps' evaluation of flood and drainage problems on three watersheds within the St. Regis Indian Reservation near Hogansburg, New York. The three watersheds studied are displayed on Plate 1.

Watershed No. 1

Watershed No. 1 has a drainage area of 5.0 mi^2 and is bisected by Tarbell Road, Cook Road, and River Road. Tarbell Road is flooded every year due to its low elevation and the inadequate capacity of road culverts and downstream ditches. Along the upstream side of Tarbell Road, the absence of a ditch, which would direct runoff to existing functional culverts, may also contribute to the road inundation. A secondary concern for the Tarbell Road area is poor agricultural drainage.

Unlike Tarbell Road, Cook Road and River Road rarely experience flooding. Their higher elevation with respect to the surrounding topography results in few flood problems. The primary need for the area upstream of Cook Road and River Road is improved agricultural drainage.

Four plans of improvement are presented to reduce the extent or frequency of Tarbell Road inundation. Three of these plans also provide enlarged channels for improved agricultural drainage.

Plan 1 proposes enlarged channels and culverts for the main ditches which cross Tarbell Road, Cook Road, and River Road. The capacity of the enlarged channels and culverts would be equal to the annual peak discharge which would be equalled or exceeded once in 10 years (10-year peak discharge), and would provide at least 10-year degree of protection for Tarbell Road. One disadvantage of this plan is the increased potential for the flooding of a low-lying residence near the mouth of the ditch at the St. Regis River. The total cost of this plan would be approximately $5 million.

Plan 2 also proposes channel and culvert improvements for the main ditches in Watershed No. 1 but not as extensively as Plan 1. Plan 2 improvements would provide improved agricultural drainage through the construction of 1-year to 2-year peak discharge capacity channels. The additional culverts placed under Tarbell Road, in conjunction with the improved channels, would provide between 5-year and 10-year degree of protection for Tarbell Road. The cost of this plan would be $1.8 million.

Plan 3 is similar to Plan 2 but provides improved agricultural drainage for the lower portion of the watershed only. Under this plan, the channels would be enlarged to 1-year to 2-year capacity from the mouth of the watershed to Tarbell Road. Additional culverts are also proposed for Tarbell, Cook, and River Roads. This plan would provide 5-year to 10-year degree of protection for Tarbell Road at a cost of $680,000.

Plan 4 provides between 5-year and 10-year degree of protection to Tarbell Road by raising 3,500 feet of the road, 0.5 feet to 2.5 feet above the existing road surface. Additional culverts would also be installed beneath Tarbell Road. The cost of this plan would be $490,000.

Of these 4 plans, Plan 3 is the best plan for providing both road protection and agricultural drainage for the present land use patterns. Plans 1 and 2 should not be implemented until existing undeveloped areas are specifically identified for residential or agricultural development. Plan 4 presents the best plan for Tarbell Road protection only.

Watershed No. 2

Watershed No. 2 parallels Cook Road and crosses Drum Street near the intersection of Cook Road, Phillips Road, and Drum Street (Spaghetti Corners). Its drainage area is 0.51 mi^2. The inundation of Drum Street is not a problem for this watershed. Rather, poor agricultural drainage is the primary concern.

Two plans are presented for providing improved agricultural drainage for Watershed No. 2. The first plan provides for improved ditch construction from the headwaters of Watershed No. 2 through Canada to the St. Lawrence River. Due to the low elevation of Watershed No. 2 with respect to the St. Lawrence River, this gravity drainage plan would likely be ineffective. It is not recommended for implementation unless additional studies show it to be effective. The cost of the gravity drainage plan would be $600,000.

Plan 2 for Watershed No. 2 proposes the construction of an enlarged agricultural drainage ditch from the headwaters of the watershed to Drum Street. At Drum Street, a pump station would be installed to discharge runoff northward into the existing unimproved ditch. The cost of this alternative is $500,000. This would be the most effective plan for Watershed No. 2.

Watershed No. 3

Watershed No. 3 is an 1.58 mi^2 undeveloped watershed, the runoff of which crosses a low-lying portion of Drum Street, 3,800 feet east of Spaghetti Corners. This site at Drum Street is overtopped yearly, making flood protection the major concern for this watershed. A secondary concern for the watershed is poor drainage of land considered for future agricultural use.

The cause of Drum Street flooding appears to be high tailwater conditions downstream of the road. A less likely cause is inadequate culvert capacity. If inadequate culvert capacity is the cause, it could be alleviated by installing an additional culvert for a cost of $21,000 (Plan 1).

If high tailwater is the reason for Drum Street flooding, two options are presented: construct an improved downstream channel from Drum Street to the St. Lawrence River (Plan 2) or raise the low portion of Drum Street (Plan 3). The estimated cost of constructing the downstream channel (Plan 2) is $600,000 and in all likelihood would not be effective in reducing the tailwater elevation, due to the relatively high elevation of the St. Lawrence River. Conversely, raising Drum Street (Plan 3) would be very effective at a cost of approximately $200,000. Whether Drum Street is flooded due to inadequate culvert capacity or high tailwater conditions can be determined by the St. Regis Mohawk Tribe and other interested parties during the next flood event using guidance provided in this report.

The final option presented for Watershed No. 3 combines the raising of Drum Street with the construction of an upstream agricultural drainage ditch and associated pump station at Drum Street (Plan 4). The estimated cost of this plan would be approximately $900,000.

Of these 4 plans, Plan 3, raising Drum Street, is the presently recommended plan. Plans 1 and 2 appear to be less effective than Plan 3 in reducing the magnitude and frequency of Drum Street flooding. The implementation of Plan 4 should not take place until residential or agricultural development of Watershed No. 3 requires improved drainage.

Recommendations for Future Studies

It is recommended that the St. Regis Mohawk Tribe pursue additional funding for a second stage of study which would provide detailed ditch and road surveys, refinement of the hydrologic analysis including determination of the St. Regis River and St. Lawrence River stage-frequency relationships, and the final design dimensions and cost of construction for any selected plans of improvement.

POTENTIAL DRAINAGE
IMPROVEMENTS FOR THREE WATERSHEDS

Table of Contents

Tables

Tables (continued)

Plates

1. INTRODUCTION

This report presents the Buffalo District Corps of Engineers' evaluation of flood and drainage problems along Tarbell Road, Cook Road, River Road, and Drum Street on the St. Regis Indian Reservation near Hogansburg, New York. The present frequency of flooding of these roads is discussed in this report along with alternatives for reducing the frequency of flooding and improving agricultural drainage. The costs of each alternative and its effectiveness are also presented.

2. TARBELL ROAD - COOK ROAD - RIVER ROAD WATERSHED (WATERSHED NO. 1)

A. Watershed Characteristics

The Tarbell Road - Cook Road - River Road (TCR) watershed (Watershed No. 1) is shown in Plate 1. The upstream end of the watershed is located near the intersection of McElwain Road and Drum Street. The downstream end of the watershed is in the vicinity of Cook Road and River Road. The entire watershed has a drainage area of 5.0 mi^2 and includes a 1.5 square mile tributary located west of Tarbell Road. The watershed empties into the St. Regis River, 2,000 feet downstream of River Road.

Watershed No. 1 exhibits diversity in topography, soil types, and land use. With respect to topography, the perimeter of the watershed is hilly while the areas adjoining the creek are very flat and poorly drained. The highest point in the watershed has an elevation of approximately 230 (1) and is located near Route 37 and Beaver Meadow Road. The elevation at the mouth of the watershed is 155.

The average slope of the existing main channel of Watershed No. 1 varies from 0.006 ft/ft in the upstream reach to 0.0002 ft/ft in the lower portion of the watershed, as shown on Plate 2. A similar channel profile for the Tarbell Road tributary is presented in Plate 3.

Soil types within the watershed are also varied. The hilly regions along the perimeter of the watershed exhibit moderately well drained soils classified as type B by the Soil Conservation Service (SCS). Soils located near the base of the hills and along the floodplain of the creek are more poorly drained, fine textured soils classified as types C and D by the SCS. Land use in the watershed consists primarily of woods and brush although some farming occurs in the lower portion of the watershed near Cook Road and River Road.

(1) All elevations in this report are in feet above mean sea level, National Geodetic Vertical Datum (NGVD).

B. Flood History and Study Focus

According to Mr. Wes Laughing, Planner for the St. Regis Mohawk Tribe, Tarbell Road is flooded annually while Cook Road and River Road rarely, if ever, experience flooding. His observations are supported by the hydrologic modelling performed for this report. The frequent flooding of Tarbell Road is due to inadequate road ditch, stream channel and culvert capacity along Tarbell Road. In particular, an existing culvert located 1,200 feet north of the main Tarbell Road stream crossing is damaged and non-functional. In addition, along the west side of Tarbell Road, the absence of a ditch, which would lead surface runoff to functioning culverts, could be a contributing factor to the frequent flooding of Tarbell Road. Therefore, the types of improvements proposed for the Tarbell Road area of Watershed No. 1 would provide flood protection and in many cases also provide improved land drainage.

Unlike Tarbell Road, the Cook Road and River Road crossings of the main channel are much higher than the surrounding watershed. Cook Road in particular provides significant storage of flood waters without overtopping and functions as a dam in storing water and releasing it slowly downstream. However, the temporary storage of this water hinders the efficient agricultural use of this land. Therefore, the plans of improvement for the main channel of Watershed No. 1 were chosen to provide improved land drainage.

C. Hydrologic Analysis

Several methods were used to design drainage improvements for Watershed No. 1. The SCS drainage guide [2] provided design discharges for agricultural drainage while TR-20 [3] was used to compute discharges of specific return interval such as the 10-year peak discharge. Manning's equation was then used to determine the improved channel characteristics for the design discharge. The 1987 mean water level (el. 155 ft. NGVD) for the St. Lawrence River between Cornwall, Ontario and Summerstown, Ontario was used to represent the St. Regis River at the mouth of Watershed No. 1 and was used in designing the plans of improvement.

D. Plans of Improvement

Four options are presented for reducing the frequency of Tarbell Road inundation. The first three plans presented also provide for improved agricultural drainage in addition to Tarbell Road flood reduction.

---

(2) USDA Soil Conservation Service. September 1987. Drainage Guide for New York State. Syracuse, New York. 80 pp.

(3) USDA Soil Conservation Service. May 1982. Technical Release Number 20 (TR-20), Project Formulation-Hydrology. Lanham, Maryland.

1. Plan 1

Plan 1 would provide 10-year peak discharge channel and culvert capacity for both the main channel and the Tarbell Road tributary. The 10-year design discharges for these streams, determined by TR-20, are displayed in Table 1. The watershed improvements proposed by Plan 1 are shown on Plate 4.

Table 1. 10-Year Peak Discharges for Watershed No. 1, Plan 1

Location	Drainage Area (mi^2)	Discharge (cfs)
Tarbell Road Tributary		
1. Tarbell Road	1.5	135
Main Channel		
1. Station 152+00 to 240+00	1.0	320
2. Station 69+00 to 152+00	2.7	475
3. Station 0+00 to 69+00	5.0	630

a. Tarbell Road Tributary

With respect to the Tarbell Road tributary, e 10-year capacity channel would extend from the mouth of the tributary upstream to the reservation boundary, a distance of 4,800 feet. TR-20 analysis of this tributary shows that the 10-year peak discharge under improved channel conditions is 135 cfs.

The improved channel for the lower 1,600 feet of the Tarbell Road tributary would have a bottom width of 15 feet, depth of 4 feet, and slope of 0.0016 ft/ft [4]. For the remaining 3,200 feet of the Tarbell Road tributary, the improved channel would be triangular in cross-section, 4-5 feet deep, and be sloped 0.002-0.003 ft/ft. The profile of the improved channel is displayed on Plate 3.

In addition to the enlarged channel, three 48-inch corrugated metal pipes (cmp) would be placed beneath Tarbell Road to pass 135 cfs with a headwater elevation of 161.5, 2.3 feet below the top of the road. A tailwater elevation of 161.0 was used in sizing the culverts since 161.0 is the 10-year peak elevation of the TCR main channel under Plan 1.

The final Plan 1 improvement to the Tarbell Road tributary would be a 1,500-foot long ditch which would be constructed along the west (upstream) side of Tarbell Road. The ditch would be triangular in cross-section, 2 feet deep, and exhibit a slope of 0.001 ft/ft. The mouth of the ditch should be connected to the tributary channel on the upstream side of Tarbell

[4] All improved channels proposed in this report are designed with 2H:1V sideslopes.

Road. This ditch, along with the other Plan 1 improvements, will provide more than 10-year degree of protection for Tarbell Road.

b. Main Channel of Watershed No. 1

Plan 1 for the main channel of the Watershed No.1 also provides a 10-year discharge channel capacity from the mouth of the channel at the St. Regis River to the headwaters of the watershed, a length of 24,000 feet (4.5 miles) (Plate 4). For this analysis, the main channel was divided into three reaches. The first reach extends from station 0+00, the mouth of the stream, to station 69+00, the confluence with the Tarbell Road tributary. The 10-year peak discharge for this reach is 630 cfs under improved channel conditions and requires an improved channel with bottom width of 80 feet, channel slope of 0.0002 and depth of 4-5 feet. Both River Road and Cook Road cross the main channel within this reach, and each road requires seven 60-inch diameter cmps, 45 feet long, to pass 630 cfs without significantly raising the headwater elevation above the top of the 10-year channel.

There are three lateral inflow sites between stations 0+00 and 69+00 which may require riprap protection. They are located at stations 10+00, 62+00, and 69+00.

The second mainstem reach is from station 69+00 to station 152+00 and is 8,300 feet long. The 10-year peak discharge for this reach is 475 cfs. To accommodate this discharge at a depth of 5 feet, the improved channel with a slope of 0.0002 must have a bottom width of 60 feet.

The third reach is 8,800 feet long and extends from station 152+00 to station 240+00. The 10-year discharge for this reach is 320 cfs. A trapezoidal channel 5 feet deep and slope of 0.002 requires a bottom width of 20 feet to pass 320 cfs. In addition, three 60-inch cmps, 30 feet long, would be required at station 159+00 (Swamp Road). Plate 2 presents the improved channel profile for all 3 reaches of the main channel of Watershed No. 1.

As evident from the descriptions above, the proposed improved channels for Plan 1 are extremely large and, therefore, costly. Table 2 presents the expected costs of constructing Plan 1, which would have a total cost of approximately $5 million.

In addition to its high cost, Plan 1 would result in potential flooding problems near the mouth of the Watershed No. 1. A residence located along the main channel between River Road and the St. Regis River would likely be inundated by the 10-year design discharge of 630 cfs.

Modelling of the existing watershed shows that the present 2.5 foot by 5.0 foot box culvert under Cook Road normally restricts streamflow, thus causing Cook Road to act as a dam by storing water upstream and thereby reducing downstream flows. Under Plan 1, this flow restriction would be removed. Due to the high cost and potential downstream flood problems associated with Plan 1, an alternate drainage plan is presented next.

Table 2. Costs for Watershed No. 1, Plan 1

Main Channel

Station 0+00 to 69+00

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
60-inch cmp	630	lin. ft.	155	97.6
Bituminous roadway w/subgrade	220	lin. ft.	85	18.7
Channel excavation	153,300	yd^3	10	1,533.0
18-inch riprap w/6 in. bedding	208	yd^2	35	7.3
Total contractor's earnings				1,656.6

Station 69+00 to 152+00

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
Clear and grub (medium)	22.9	ac	6,000	137.4
Channel excavation	91,600	yd^3	10	916.0
Total contractor's earnings				1,053.4

Station 152+00 to 240+00

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
60-inch cmp	90	lin. ft.	155	14.0
Clear and grub (medium)	16.2	ac	6,000	97.2
Channel excavation	37,800	yd^3	10	378.0
Total contractor's earnings				489.2

Table 2. Continued

Tarbell Road Tributary

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	135	lin. ft.	115	15.5
Bituminous roadway w/subgrade	78	lin. ft.	85	6.6
Clear and grub	7.2	ac	6,000	43.2
Channel excavation	10,720	yd^3	10	107.2
Total contractor's earnings				172.5

Summary

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	135	lin. ft.	115	15.5
60-inch cmp	720	lin. ft.	155	111.6
Bituminous roadway w/subgrade	298	lin. ft.	85	25.3
Clear and grub	46.3	ac	6,000	277.8
Channel excavation	293,420	yd^3	10	2,934.2
18-inch riprap w/6 in. bedding	208	yd^2	35	7.3
Total contractor's earnings				3,371.7
Contingencies (25%)				842.9
Total contractor's earnings w/contingencies				4,214.6
Engineering and design (6%)				252.9
Supervision and administration (12%)				505.8
Total construction cost				4,973.3

2. Plan 2

Plan 2 for Watershed No. 1 is based on the SCS Drainage Guide. This guide does not base channel and culvert improvements on a particular discharge frequency or return period but rather on land use. For a given land use and drainage area, the guide provides the appropriate channel capacity to improve land drainage while still allowing overbank flooding during moderate and large runoff events.

Table 3 presents the drainage areas and design discharges for various locations in the watershed. Cropland is the land use chosen for this design.

Table 3. Design Discharges for Watershed No. 1, Plan 2

Location	Drainage Area (mi^2)	Discharge (cfs)
Tarbell Road Tributary		
1. Tarbell Road	1.5	55
Main Channel		
1. Station 152+00 to 240+00	1.0	40
2. Station 69+00 to 152+00	2.7	85
3. Station 0+00 to 69+00	5.0	140

a. Tarbell Road Tributary

To provide the 55 cfs design discharge at Tarbell Road, a 4-foot deep trapezoidal channel with 5-foot bottom width is proposed. This improved channel would extend from the mouth of the Tarbell Road tributary to a location 1,000 feet upstream of Tarbell Road (total length: 1,600 feet) (Plate 5). From 1,000 feet upstream of Tarbell Road to the reservation boundary, a total distance of 3,200 feet, the improved channel would be triangular with a depth of 4 feet. The profile of this improved channel is the same as the one presented for Plan 1 (Plate 3).

An additional culvert is proposed for the Tarbell Road tributary. A single 48-inch cmp with invert at elevation 157.0 would be placed next to the two existing 30-inch cmps.

In addition to the above channel and culvert, a 1,500-foot long ditch would be constructed along the west side of Tarbell Road. The dimensions of this ditch are the same as those presented previously in Plan 1. These improvements to the Tarbell Road tributary, along with the Plan 2 improvements to the main channel, would provide between 5-year and 10-year degree of protection to Tarbell Road.

b. Main Channel of Watershed No. 1

The following text describes the main channel of Watershed No. 1, under Plan 2 conditions. From station 0+00 to 69+00 the improved channel has a 30-foot bottom width, a depth of 4-5 feet, and will accommodate the design discharge of 140 cfs. Four 48-inch cmp's are required at both Cook Road and River Road to adequately pass the design discharge. In addition, riprap protection may be required at stations 10+00, 62+00, and 69+00.

From station 69+00 to 152+00 an improved channel with a 15-foot bottom width would be constructed. Its 4-5 foot depth would provide the needed capacity of 85 cfs.

From station 152+00 to 240+00 the improved channel would be triangular with a depth of 5 feet. One 36-inch cmp would be required at Swamp Road to pass the design discharge of 40 cfs.

Plate 2 presents the profile of the improved channel and Plate 5 displays the locations of Plan 2 improvements. The costs associated with Plan 2 are presented in Table 4. The total cost for this channel improvement would be $1.8 million.

Like Plan 1, this plan would also increase the potential for flooding at the mouth of the stream but to a much lesser extent. If chosen to be implemented, the final design of this plan should evaluate the potential for increased flooding and provide possible preventative measures to protect the residence at the stream mouth.

Table 4. Costs for Watershed No. 1, Plan 2

Main Channel

Station 0+00 to 69+00

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	360	lin. ft.	115	41.4
Bituminous roadway w/subgrade	180	lin. ft.	85	15.3
Channel excavation	37,100	yd^3	10	371.0
18-inch riprap w/6 in. bedding	208	yd^2	35	7.3
Total contractor's earnings				435.0

Station 69+00 to 152+00

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
Clear and grub (medium)	14.3	ac	6,000	85.8
Channel excavation	28,000	yd^3	10	280.0
Total contractor's earnings				365.8

Station 152+00 to 240+00

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
36-inch cmp	30	lin. ft.	75	2.3
Clear and grub (medium)	12.1	ac	6,000	72.6
Channel excavation	18,900	yd^3	10	189.0
Total contractor's earnings				263.9

Table 4. Continued

Tarbell Road Tributary

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	45	lin. ft.	115	5.2
Bituminous roadway w/subgrade	74	lin. ft.	85	6.3
Clear and grub (medium)	5.9	ac	6,000	35.4
Channel excavation	8,940	yd^3	10	89.4
Total contractor's earnings				136.3

Summary

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
36-inch cmp	30	lin. ft.	75	2.3
48-inch cmp	405	lin. ft.	115	46.6
Bituminous roadway w/subgrade	254	lin. ft.	85	21.6
Clear and grub (medium)	32.3	ac	6,000	193.8
Channel excavation	92,940	yd^3	10	929.4
18-inch riprap w/6 in. bedding	208	yd^2	35	7.3
Total contractor's earnings				1,201.0
Contingencies (25%)				300.2
Total contractor's earnings w/contingencies				1,501.2
Engineering and design (6%)				90.1
Supervision and administration (12%)				180.2
Total construction cost				1,771.5

3. Plan 3

Plan 3 would provide 5-year to 10-year degree of protection for Tarbell Road and improved drainage for the downstream agricultural portion of Watershed No. 1 by proposing a scaled-down version of Plan 2. Plan 3 proposes a 4-foot deep, 5-foot bottom width trapezoidal channel for the Tarbell Road tributary, which would extend from Tarbell Road downstream to the main channel of Watershed No. 1, a distance of 600 feet (Plate 6). A 48-inch cmp would be installed alongside the existing 30-inch cmps at Tarbell Road. A 1,500-foot long, 2-foot deep ditch would be constructed along the upstream side of Tarbell Road to direct surface runoff to the main culverts beneath the road.

The main channel of the watershed would be enlarged to a 4-foot deep, 30-foot bottom width trapezoidal channel which would extend from the St. Regis River (Station 0+00) to the confluence with the Tarbell Road tributary (Station 69+00), a distance of 6,900 feet. In addition, four 48-inch cmps would be installed at Cook Road and River Road and riprap would be placed at Stations 10+00, 62+00, and 69+00. The total cost of this plan would be $680,000 as presented in Table 5.

Table 5. Costs for Watershed No. 1, Plan 3

Main Channel

Station 0+00 to 69+00

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	360	lin. ft.	115	41.4
Bituminous roadway w/subgrade	180	lin. ft.	85	15.3
Channel excavation	37,100	yd^3	10	371.0
18-inch riprap w/6 in. bedding	208	yd^2	35	7.3
Total contractor's earnings				435.0

Tarbell Road Tributary

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	45	lin. ft.	115	5.2
Bituminous roadway w/subgrade	74	lin. ft.	85	6.3
Channel excavation	1,600	yd^3	10	16.0
Total contractor's earnings				27.5

Table 5. Continued

Summary

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	405	lin. ft.	115	46.6
Bituminous roadway w/subgrade	254	lin. ft.	85	21.6
Channel excavation	38,700	yd^3	10	387.0
18-inch riprap w/6 in. bedding	208	yd^2	35	7.3
Total contractor's earnings				462.5
Contingencies (25%)				115.6
Total contractor's earnings w/contingencies				578.1
Engineering and design (6%)				34.7
Supervision and administration (12%)				69.4
Total construction cost				682.2

4. Plan 4

Plan 4 would provide between 5-year and 10-year degree of protection to Tarbell Road by raising 3,300 feet of Tarbell Road and 200 feet of adjacent Cook Road to elevation 165, which is 0.5-2.5 feet above the existing road surface. In addition to raising the road, two 48-inch cmps would be installed next to the two existing 30-inch cmps, and a 1,500-foot long ditch would be constructed along the upstream side of Tarbell Road. No channel improvements are proposed by this plan. Plates 7 and 8 present the details of Plan 4 while Table 6 provides the expected costs of the plan.

The total cost of constructing this plan would be $495,000. This cost estimate was based on approximate road profile and topographic data. Accurate field surveys of the existing road and adjacent areas could significantly reduce the length of roadway being raised or fill necessary for raising the roadway, thus reducing the cost of this alternative.

Table 6. Costs for Watershed No. 1, Plan 4

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
48-inch cmp	90	lin. ft.	115	10.4
Bituminous roadway w/subgrade	3,500	lin. ft.	85	297.5
Fill	2,330	yd^3	10	23.3
Ditch excavation	440	yd^3	10	4.4
Total contractor's earnings				335.6
Contingencies (25%)				83.9
Total contractor's earnings w/contingencies				419.5
Engineering and design (6%)				25.2
Supervision and administration (12%)				50.4
Total construction cost				495.1

E. Recommendations

Of these 4 plans, Plan 3 is the best plan for providing both road protection and agricultural drainage for the present land use patterns. Plans 1 and 2 should not be implemented until existing undeveloped areas are specifically identified for residential or agricultural development. Plan 4 presents the best plan for Tarbell Road flood protection only.

3. COOK ROAD - PHILLIPS ROAD - DRUM STREET WATERSHED (WATERSHED NO. 2)

A. Watershed Description

Watershed No. 2 is shown on Plate 1. A small, unmaintained ditch, which extends from the headwaters of the watershed to Drum Street, is 7,200 feet long. Downstream from Drum Street, the ditch extends 1,000 feet to the U.S.-Canada border. In Canada, the ditch is intermittent from the border to the ditch's confluence with Bittern Creek, a distance of 9,400 feet. The ditch's confluence with Bittern Creek is 4,100 feet upstream of the mouth of Bittern Creek and the St. Lawrence River.

The drainage area of Watershed No. 2 is 0.51 mi^2 to Drum Street. The primary land use of this watershed is crop production associated with dairy farming. The watershed is very flat and requires improved drainage to provide maximum crop production.

B. Flood History and Study Focus

The main channel (ditch) for Watershed No. 2 rarely floods Drum Street, according to Mr. Wes Laughing. The primary need for this watershed is improved drainage for crop production.

C. Hydrologic Analysis

The SCS Drainage Guide was used to determine the design discharge for the main ditch of the watershed under improved conditions. For a drainage area of 0.51 mi^2, the design discharge for cropland is 25 cfs. Following the calculation of the design discharge, Manning's equation was used to size the ditch. In addition to providing the design discharge, the drainage guide also provided information concerning pump station design, an option considered for this watershed.

D. Plans of Improvement

Two plans for improving land drainage were considered. Plan 1 investigated the potential for improved gravity ditch flow from the headwaters of the watershed to the St. Lawrence River. Plan 2 combines improved gravity flow and a pump station to facilitate cropland drainage. The following sections describe the plans in detail.

1. Plan 1

Drainage improvements based on gravity flow through enlarged ditches and culverts are generally less costly and therefore preferable over the installation of pump stations. This plan considered gravity flow improvements for Watershed No. 2 and the downstream Canadian reach from the U.S.-Canada border to Bittern Creek and the St. Lawrence River. The Canadian portion of this stream was included in the plan to insure that flow from the U.S. portion would not be hindered by downstream obstructions. However, based on the existing ditch elevation and the downstream water level of the St. Lawrence River, this plan may still be ineffective.

For gravity drainage to be effective, the water level of the St. Lawrence River at the mouth of Bittern Creek must be low enough to provide slope for the ditch. An evaluation of the St. Lawrence River gages at Cornwall and Summerstown, Ontario showed that the typical elevation of the river near the mouth of Bittern Creek is 154 to 155. SCS surveys show that the present ditch and land elevation in the vicinity of Drum Street is 155. Therefore, deepening and enlarging the ditch within Watershed No. 2 and downstream through Canada would likely be ineffective in providing improved drainage of adjacent land.

Nevertheless, an improved gravity drainage plan is described below and presented in Plate 9. It is presented primarily for cost comparison to the pump station design of Plan 2, and is not intended for implementation.

The improved ditch for Watershed No. 2 would be a 4-foot deep triangular channel which would follow the existing ditch from the headwaters of the watershed to the McDonald Road Extension at the U.S.-Canada border. The length of this reach is 8,200 feet.

From the U.S.-Canada border to the St. Lawrence River, a distance of 12,500 feet, a 4-foot deep trapezoidal channel with 5-foot bottom width would be constructed. This reach would follow the existing intermittent ditch to Bittern Creek and the St. Lawrence River.

Additional culverts may be required at Drum Street, McDonald Road Extension, LaFrance Road, and Chenail Road. Therefore, the cost estimate for this plan assumes an additional 60-inch cmp would be required at each of the above sites.

The costs associated with this plan are presented in Table 7. The total cost for the plan would be about $600,000.

Table 7. Costs for Watershed No. 2, Plan 1

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
60-inch cmp	180	lin. ft.	155	27.9
Bituminous roadway w/subgrade	340	lin. ft.	85	28.9
Clear and grub (medium)	4.3	ac.	6,000	25.8
Channel excavation	33,790	yd^3	10	337.9
Total contractor's earnings				420.5
Contingencies (25%)				105.1
Total contractor's earnings with contingencies				525.6
Engineering and design (6%)				31.5
Supervision and administration (12%)				63.1
Total construction cost				620.2

2. Plan 2

This plan would enlarge the existing shallow ditch to a 4-foot deep triangular ditch from the headwaters of the watershed to Drum Street, a distance of 7,200 feet (Plate 10). The 4-foot depth is the minimum depth required for tile drainage of adjacent land. The 4-foot depth also provides the 25 cfs design discharge capacity as determined from the SCS drainage guide.

In addition to the improved ditch, a pump station would be constructed on the upstream side of Drum Street. The pump station would have 2 or 3 pumps with a total capacity of 25 cfs (11,000 gpm). Based on information supplied by Mr. Walt Grajko, SCS, Syracuse, New York, the pump station cost is estimated at $250,000 and would include an improved gravity flow outlet with flap gates at Drum Street. The total cost of this alternative is approximately $500,000 as displayed in Table 8.

This alternative would increase the frequency with which McDonald Road Extension, 1,000 feet downstream of Drum Street, is flooded. However, since there are alternative routes to McDonald Road Extension and since the McDonald Road Extension is presently low-lying and likely flooded each year, no raising of the McDonald Road Extension is recommended. Raising the McDonald Road Extension by 6 feet, to the height of adjacent roadways, would add $300,000 to $400,000 to the cost of Plan 2.

Table 8. Costs for Watershed No. 2, Plan 2

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
Channel excavation	8,530	yd^3	10	85.3
Pump station, 11,000 gpm capacity				250.0
Total contractor's earnings				335.3
Contingencies (25%)				83.8
Total contractor's earnings w/contingencies				419.1
Engineering and design (6%)				25.1
Supervision and administration (12%)				50.3
Total construction cost				494.5

E. Recommendation

Plan 2 is recommended as the most effective plan for providing improved agricultural drainage for Watershed No. 2.

4. DRUM STREET WATERSHED (WATERSHED NO. 3)

A. Watershed Description

Watershed No. 3 is located adjacent to and eastward of Watershed No. 2 (Plate 1). The outflow from Watershed No. 3 crosses Drum Street approximately 3,800 feet east of the intersection of Cook Road, Phillips Road, and Drum Street. The intersection of these 3 roads is known locally as Spaghetti Corners. The drainage area of Watershed No. 3 upstream of Drum Street is 1.58 mi^2.

The central portion of the watershed is flat, low-lying, swampy and brush-covered. There is no crop production at present in this watershed. Drainage of runoff from the watershed is hindered by the lack of slope from Drum Street to the St. Lawrence River. Maps of this area show no defined channel downstream of the watershed outlet at Drum Street. Rather, the watershed drains to a swamp on the north side of Drum Street which extends approxiamtely 9,400 feet northward to Bittern Creek.

B. Flood History and Study Focus

Mr. Wes Laughing reports that Drum Street is inundated each year in the vicinity of Watershed No. 3. Therefore, the primary concern for this watershed is the reduction of Drum Street inundation.

In addition to road inundation, poor drainage causes Watershed No. 3 to be unsuitable for crop production. For this reason, improved drainage is also desirable for this watershed, although it is not as important as road protection from flooding. Both road protection and improved agricultural drainage are addressed by the plans of improvement which follow.

C. Hydrologic Analysis

The SCS drainage guide, described previously, was used to determine improved channel capacities for crop production. Manning's equation was then used to size the channel for the design discharge.

D. Plans of Improvement

Assuming there is no blockage of the box culvert by ice or debris during runoff events, there are only two possible reasons for the frequent flooding of Drum Street: either the existing 4 foot by 5.5 foot box culvert is inadequate to pass frequently experienced discharges, or the downstream tailwater elevation is too high to allow the culvert to function properly. The following guidance is provided for the St. Regis Mohawk Tribe and the NYSDOT to observe and identify the source of the flood problem during the next flood event. Then, having identified the reason for the frequent flooding, the proper plan of improvement can be selected from the four provided below.

The adequacy of the existing culvert can be determined by observing the headwater and tailwater elevations when the headwater reaches the top of the road. If the difference between the headwater and tailwater is more than 0.5 feet, then the existing box culvert is inadequate and should be supplemented with additional culverts. Plan 1, below, presents the costs of adding additional culverts under Drum Street.

If, however, the difference between headwater and tailwater is very small when the headwater is at the top of the road, then there are two possible solutions to the flood problem: improve the downstream channel which will lower the tailwater and improve the existing culvert's performance, or raise the road which will provide a greater head on the culvert and more potential runoff storage upstream of the road. Given the absence of a defined channel downstream of Drum Street, high tailwater conditions are likely responsible for the inundation of Drum Street. Plans 2 and 3 present options for improving the downstream channel and raising the road, respectively, while Plan 4 provides for both raising the road and improving the upstream drainage for agriculture.

1. Plan 1

Plan 1 addresses possible culvert inadequacy at Drum Street (Plate 11). The cross-sectional area of the existing box culvert is slightly greater than that of a 60-inch diameter pipe. If the observation described above indicates additional culverts are warranted, the cost of installing one more 60-in. cmp would be $21,000, as presented in Table 9.

Table 9. Costs for Watershed No. 3, Plan 1

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
60-inch cmp	45	lin. ft.	155	7.0
Bituminous roadway	85	lin. ft.	85	7.2
Total contractor's earnings				14.2
Contingencies (25%)				3.6
Total contractor's earnings w/contingencies				17.8
Engineering and design (6%)				1.1
Supervision and administration (12%)				2.2
Total construction cost				21.2

2. Plan 2

Plan 2 proposes the construction of an improved channel from Drum Street to the St. Lawrence River, to lower the tailwater elevation at Drum Street (Plate 12). This would allow the existing box culvert to pass more water and, thereby, reduce the frequency of Drum Street inundation. In studying this alternative, however, it appears that an improved channel would be ineffective due to the low ground elevation (153-155) in the vicinity of Drum Street with respect to the elevation of the St. Lawrence River (154-155). This is the same concern expressed previously for Watershed No. 2, Plan 1.

Therefore, the following description of an improved channel is presented only for providing construction costs for comparison with other plans. This plan should not be implemented without further study.

The hypothetical improved channel is 3 feet deep with a 10-foot bottom width and 2:1 sideslopes. The channel would extend 13,500 feet from Drum Street to the St. Lawrence River and would follow a portion of the Bittern Creek channel. Two additional 60-inch cmps are proposed at each of the two road crossings between Drum Street and the St. Lawrence River. The total cost for this plan would be approximately $600,000 as presented in Table 10.

Table 10. Costs for Watershed No. 3, Plan 2

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
60-inch cmp	180	lin. ft.	155	27.9
Bituminous roadway w/subgrade	180	lin. ft.	85	15.3
Clear and grub	19.2	ac	6,000	115.2
Channel excavation	24,000	yd^3	10	240.0
Total contractor's earnings				398.4
Contingencies (25%)				99.6
Total contractor's earnings w/contingencies				498.0
Engineering and design (6%)				29.9
Supervison and administration (12%)				59.8
Total construction cost				587.7

3. Plan 3

Increasing the elevation of Drum Street is likely to be more effective than enlarging the downstream channel for reducing road inundation. Plate 13 shows the profile of Drum Street in the vicinity of Watershed No. 3, as determined from NYSDOT, April 1987, road profiles. The lowest portion of the road is at el. 157.4, the second lowest at 158.5. This plan proposes raising the lowest portion of the road from el. 157.4 to 158.5, an increase in height of 1.1 feet over a distance of 1,600 feet (Plates 13 and 14).

It may be desirable to add a 60-inch cmp alongside the existing box culvert while the road is being raised. Therefore, the placement of an additional culvert is included in this plan. The total cost associated with Plan 3 would be approximately $210,000 and is shown in Table 11.

Table 11. Costs for Watershed No. 3, Plan 3

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
60-inch cmp	45	lin. ft.	155	7.0
Bituminous roadway w/subgrade	1,600	lin. ft.	85	136.0
Total contractor's earnings				143.0
Contingencies (25%)				35.8
Total contractor's earnings w/contingencies				178.8
Engineering and design (6%)				10.7
Supervision and administration (12%)				21.5
Total construction cost				211.0

4. Plan 4

Plan 4 for Watershed No. 3 proposes to both reduce the frequency of Drum Street inundation and provide improved drainage upstream of Drum Street for crop production. Under Plan 4, Drum Street would be raised to el. 158.5, to reduce the frequency of inundation, just as in Plan 3. In addition to raising Drum Street, an improved channel and pump station would be installed upstream of Drum Street to facilitate agricultural drainage (Plate 15).

For the drainage area of 1.58 mi^2 upstream of Drum Street, the SCS drainage guide recommends a channel capacity of 55 cfs. The improved agriculture drainage ditch to accommodate this design discharge would be 4 feet deep with a 5-foot bottom width and 2:1 sideslopes and would extend from Drum Street to a point 2,300 feet upstream of Drum Street (Station 23+00). From Station 23+00 to the headwaters of the watershed, a distance of 6,500 feet, a 4-foot deep triangular ditch would be constructed.

The pump station at Drum Street would contain several pumps with a total capacity of 55 cfs (25,000 gpm). The pump station would also possess gravity outlets with flap gates for the passage of flows greater than the 55 cfs pump capacity. The cost of this pump station is estimated at $300,000. The total cost of the project including the pump station, upstream drainage, and elevating Drum Street would be approximately $900,000, as shown in Table 12.

Table 12. Costs for Watershed No. 3, Plan 4

Item Description	Estimated Quantity	Unit	Unit Price ($)	Cost ($1,000)
Bituminous roadway w/subgrade	1,600	lin. ft.	85	136.0
Clear and grub (medium)	10.5	ac	6,000	63.0
Channel excavation	12,130	yd^3	10	121.3
Pump station, 25,000 gpm capacity				300.0
Total contractor's earnings				620.3
Contingencies (25%)				155.1
Total contractor's earnings w/contingencies				775.4
Engineering and design (6%)				46.5
Supervison and administration (12%)				93.0
Total construction cost				914.9

E. Recommendations

Of the 4 plans, Plan 3 is the presently recommended plan. Plans 1 and 2 appear to be less effective than Plan 3 in reducing the magnitude and frequency of Drum Street flooding. The implementation of Plan 4 should not take place until residential or agricultural development of Watershed No. 3 requires improved drainage.

5. RECOMMENDATIONS FOR FUTURE STUDIES

All plans of improvement presented in this report were based on available approximate topographic and survey data. Therefore, before any plan is implemented, it should undergo a final design analysis based on accurate survey and topographic data.

In addition, the 1987 average (mean) water level of the St. Lawrence River (approx. el. 155 ft NGVD) was used as the downstream design condition for all plans of improvement. Increases in the water levels of the St. Lawrence and St. Regis Rivers above el. 155, which presently occur during spring runoff and peak power generation periods, reduce the effectiveness of gravity drainage improvements such as Plans 1, 2, and 3 for Watershed No. 1. Therefore, before any gravity drainage improvement is implemented, a study should be performed to determine the stage-frequency relationship for the St. Lawrence and St. Regis Rivers, and the effectiveness of the plans evaluated in conjunction with the downstream stage-frequency conditions.

Given the above uncertainties with respect to the preliminary designs of plans of improvement presented in this report, it is recommended that the St. Regis Mohawk Tribe pursue additional funding for a second stage of study which would provide detailed ditch and road surveys, refinement of the hydrologic analysis including the determination of the St. Regis River and St. Lawrence River stage-frequency relationship, and the final design and cost of construction for any selected plans of improvement.

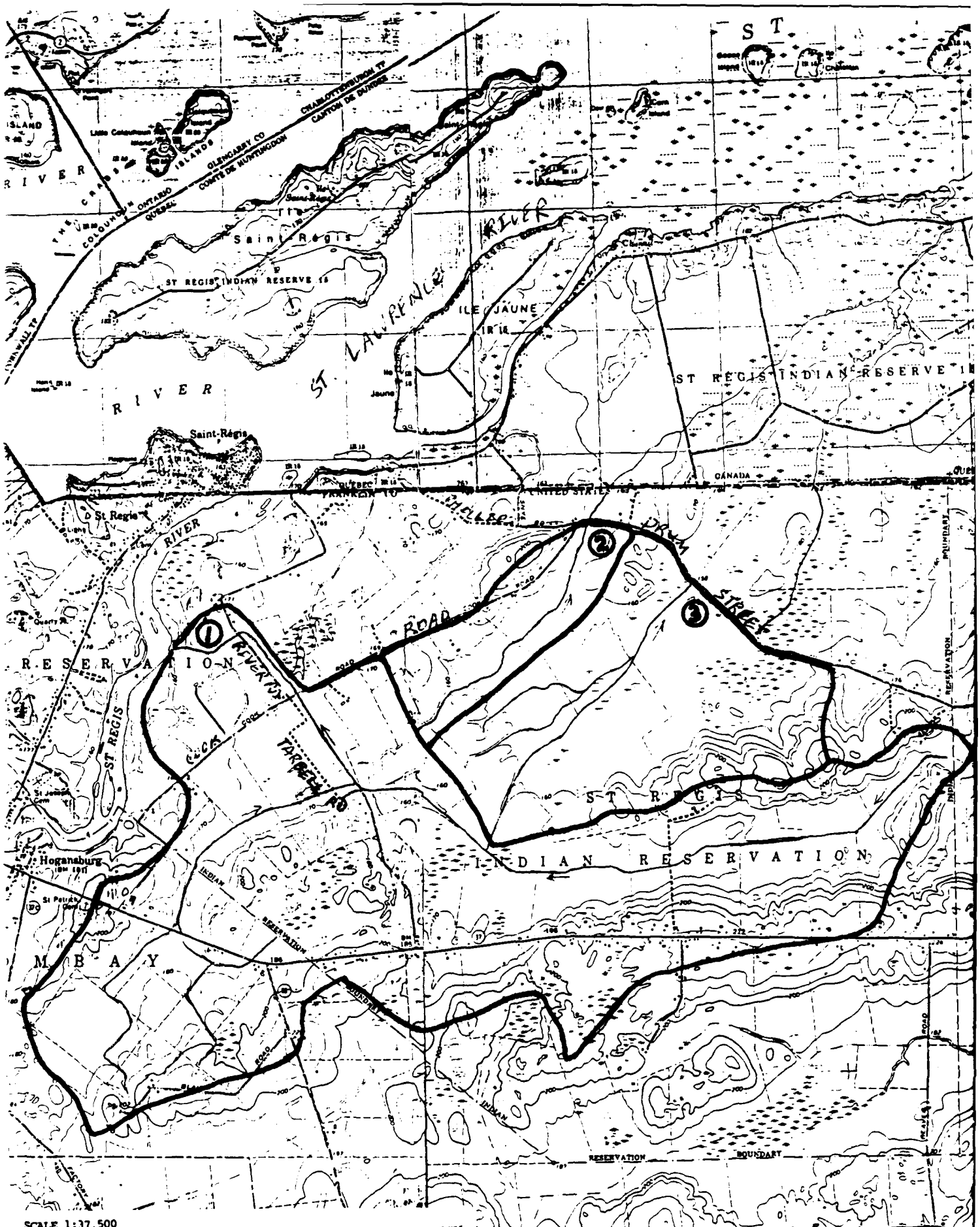
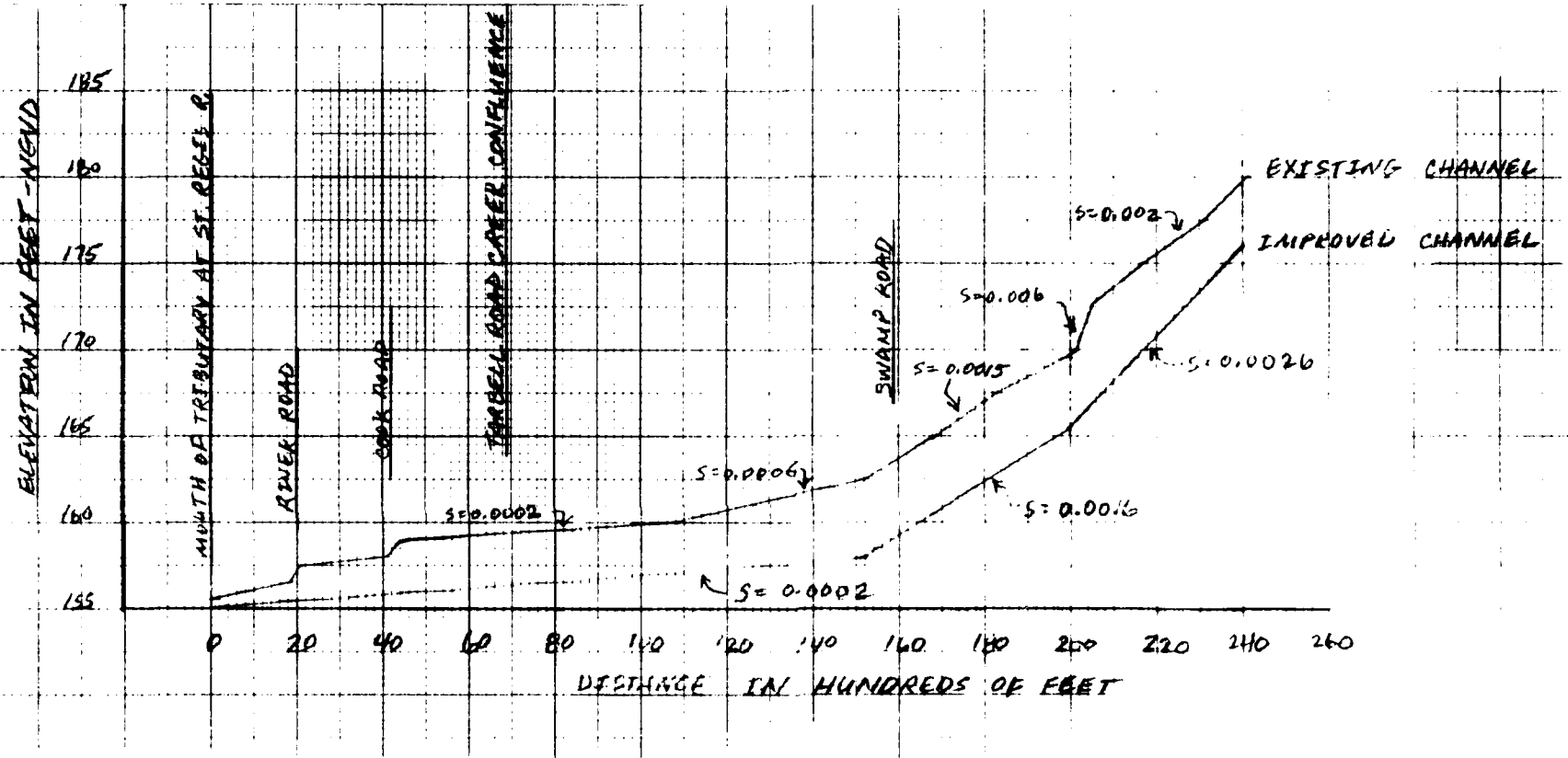

ST
RIVER
ISLAND
Long Sault Islands
CHARLOTTENBURGH TP
CANTON DE DUNDEE
GLENGARRY CO
COMTE DE HUNTINGDON
THE UNITED COUNTIES OF STORMONT DUNDAS AND GLENGARRY
ONTARIO
QUEBEC
Saint Regis
ST REGIS INDIAN RESERVE 18
ST LAWRENCE RIVER
ILE JAUNE
IR 16
ST REGIS INDIAN RESERVE 1
RIVER
ST
Saint-Régis
CANADA
QUEBEC
FRANKLIN CO
UNITED STATES
St Regis
ST REGIS RIVER
DRUM STREET
ROAD
RESERVATION
ST REGIS
TARBELL RD
CREEK
ROAD
St Joseph's Conv
Hogansburg
INDIAN
RESERVATION
ST REGIS
INDIAN RESERVATION
St Patrick's Church
MOHAWK BAY
INDIAN
RESERVATION
BOUNDARY
ROAD
INDIAN
RESERVATION
BOUNDARY
1
2
3
SCALE 1:37,500
1 MILE
0
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER
0
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL
N
Watershed Location

PLATE 1



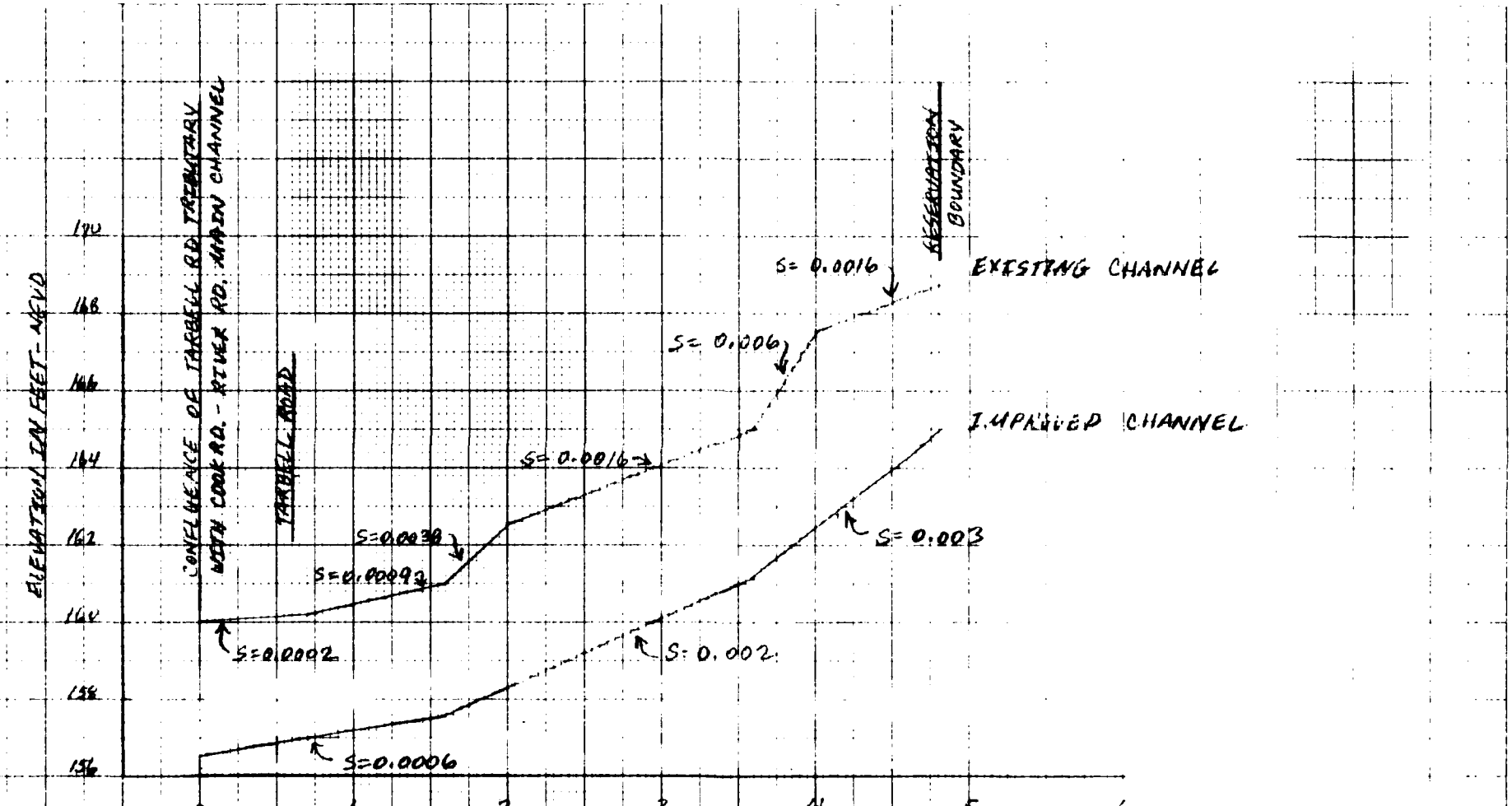
EXISTING PROFILE WAS DETERMINED FROM AVAILABLE TOPOGRAPHIC MAPS (SCALE 1" = 200', 5' CONTOUR INTERVAL) AND SCS SURVEYS.

PROFILES

OF WATERSHED NO. 1,

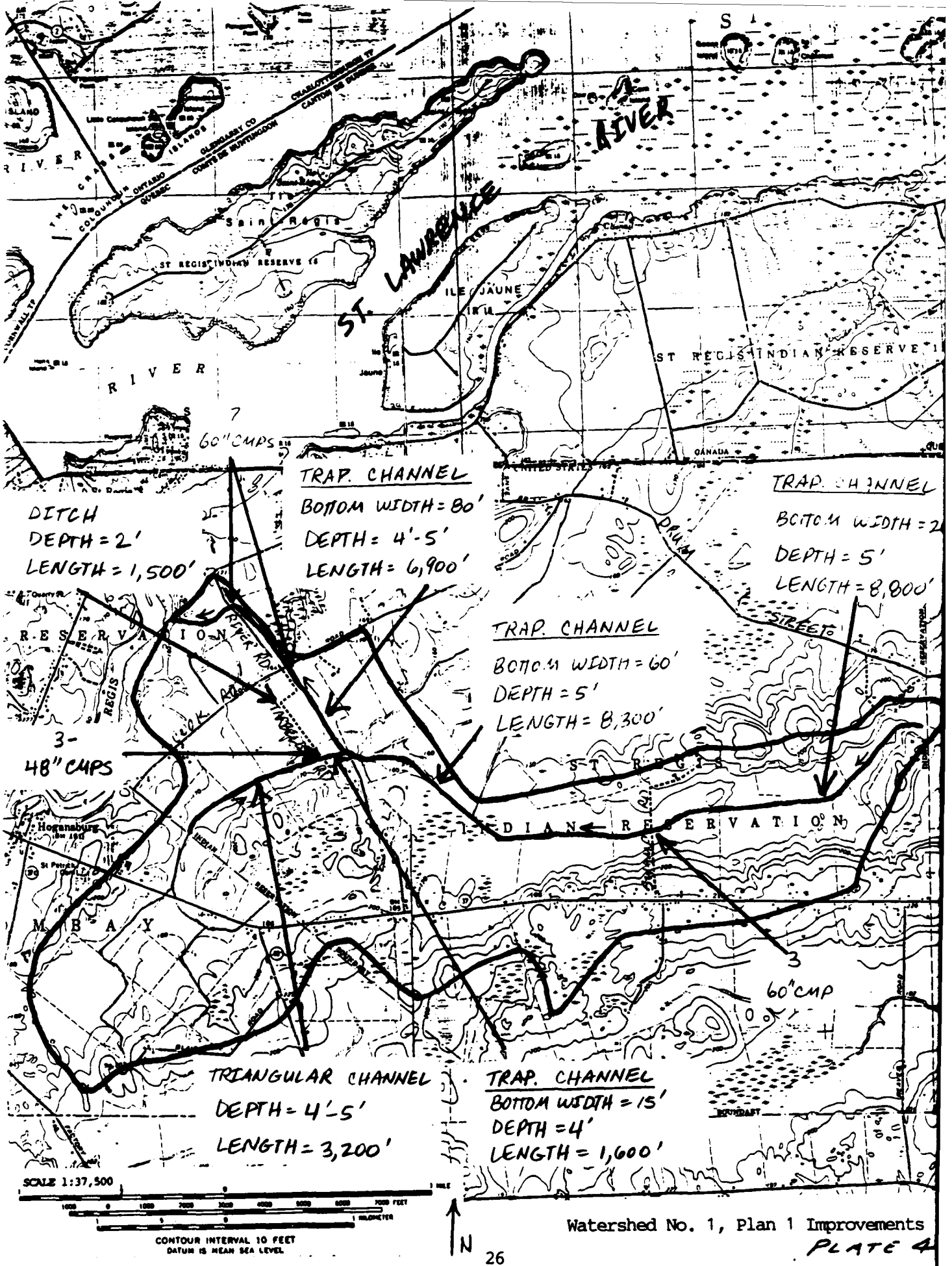
MAINSTEM CHANNEL

PLATE 2



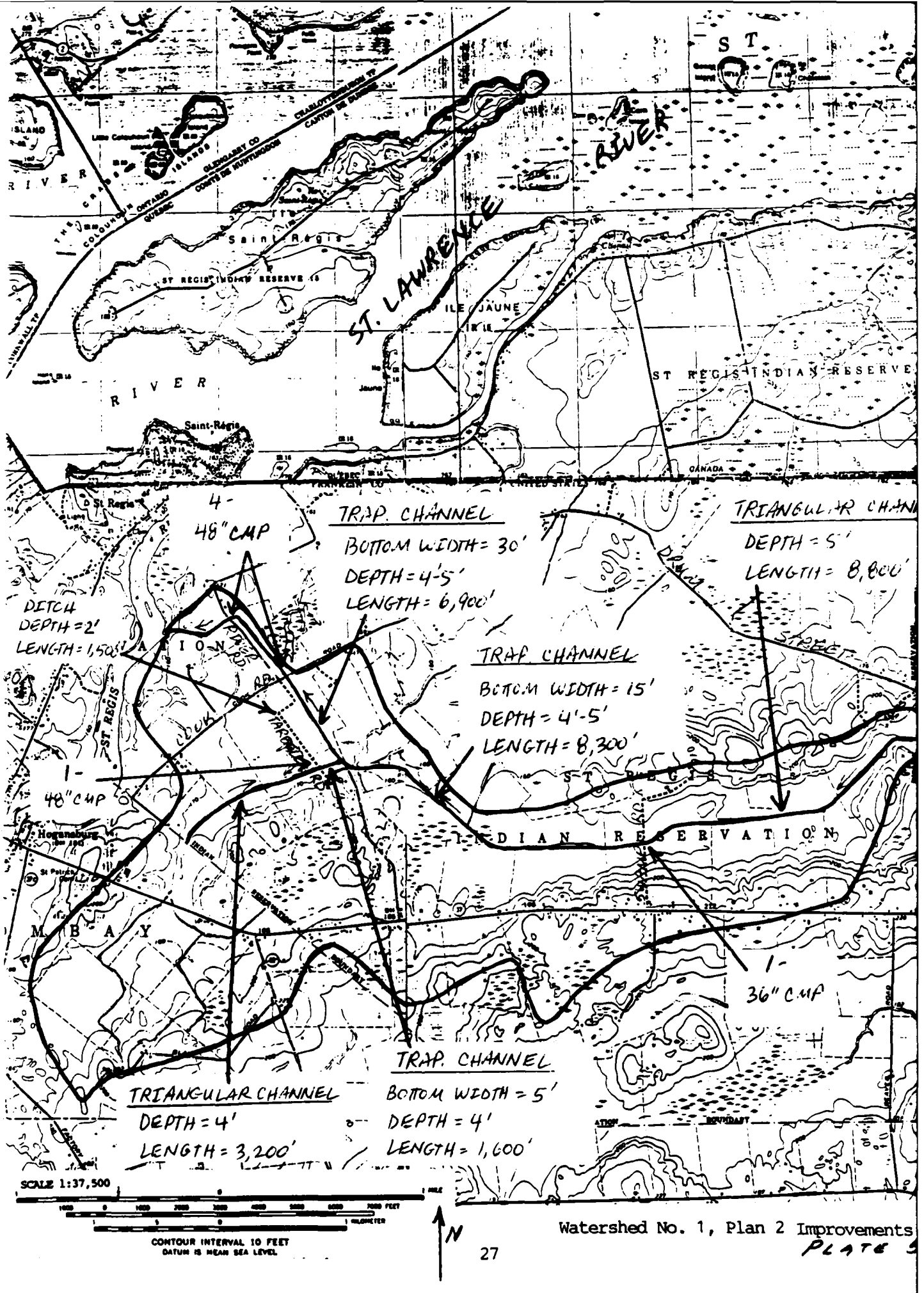
THE CONFLUENCE WAS DETERMINED FROM MYSLET TOPOGRAPHIC MAPS (SCALE 1"= 200', 5' CONTOUR INTERVAL) AND SCS SURVEYS

PROFILES OF WATER-HED NO. 1, TARBELL ROAD TRIBUTARY



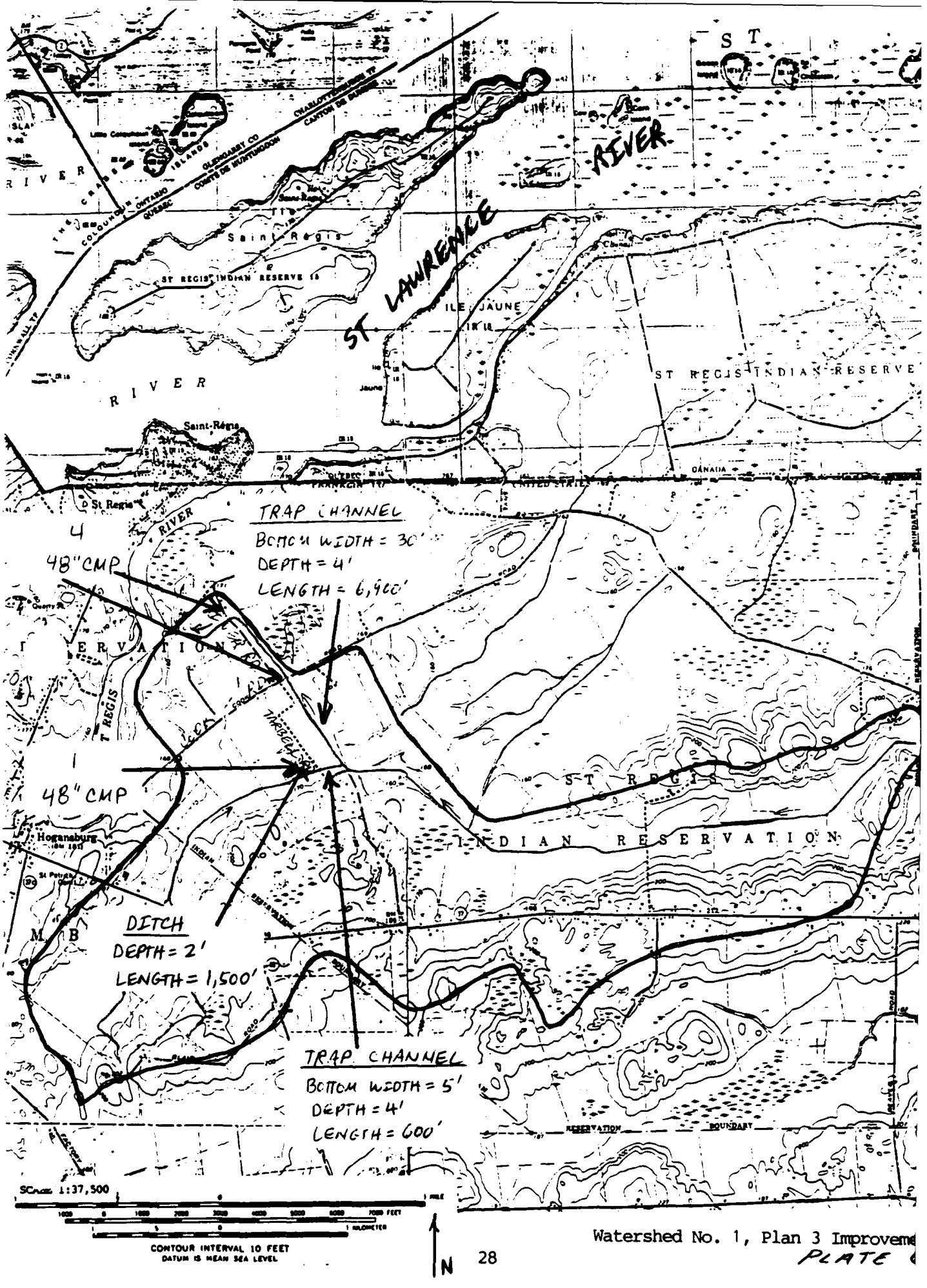
Watershed No. 1, Plan 1 Improvements

PLATE 4



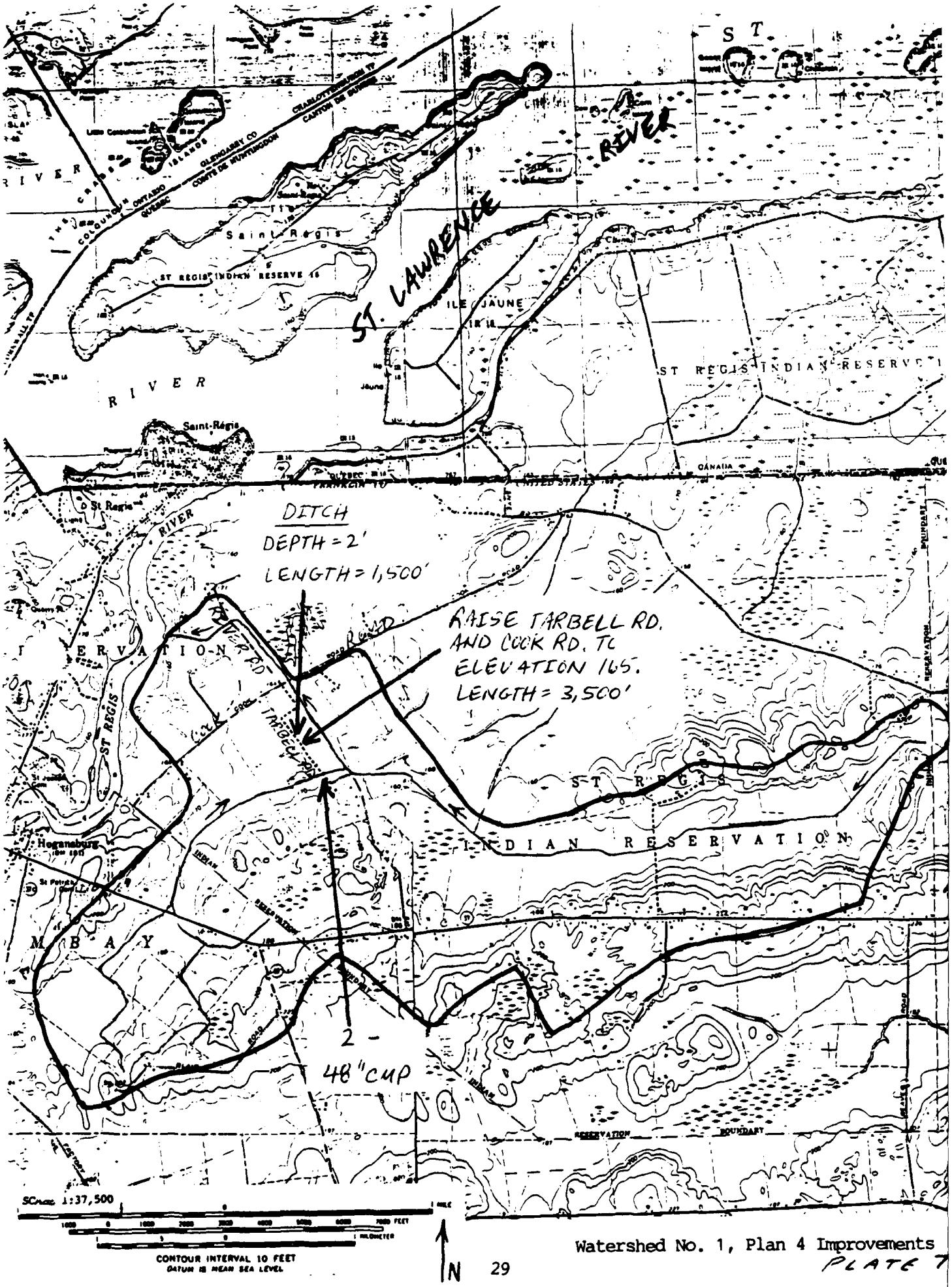
Watershed No. 1, Plan 2 Improvements

PLATE 5



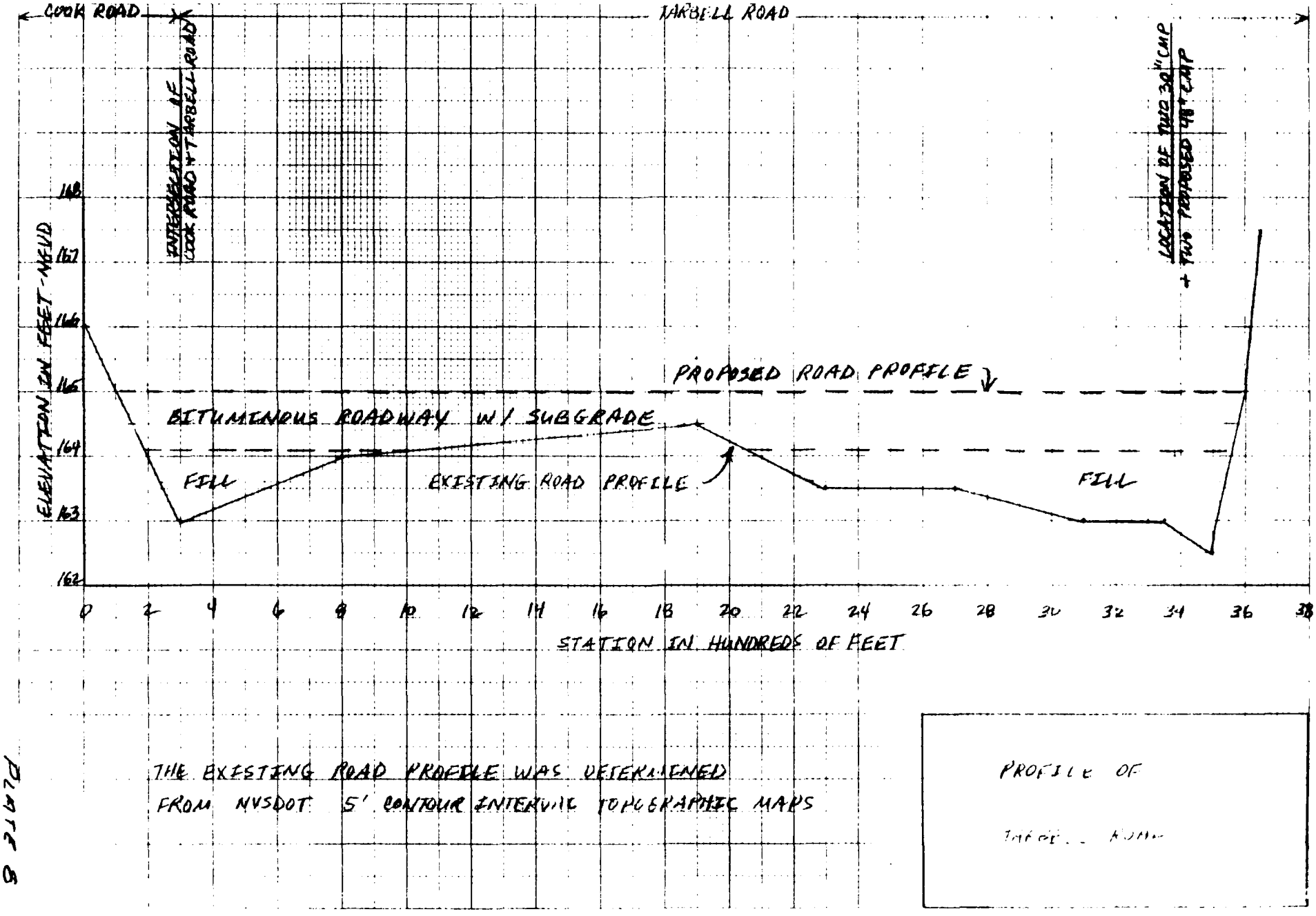
Watershed No. 1, Plan 3 Improvem

PLATE



Watershed No. 1, Plan 4 Improvements

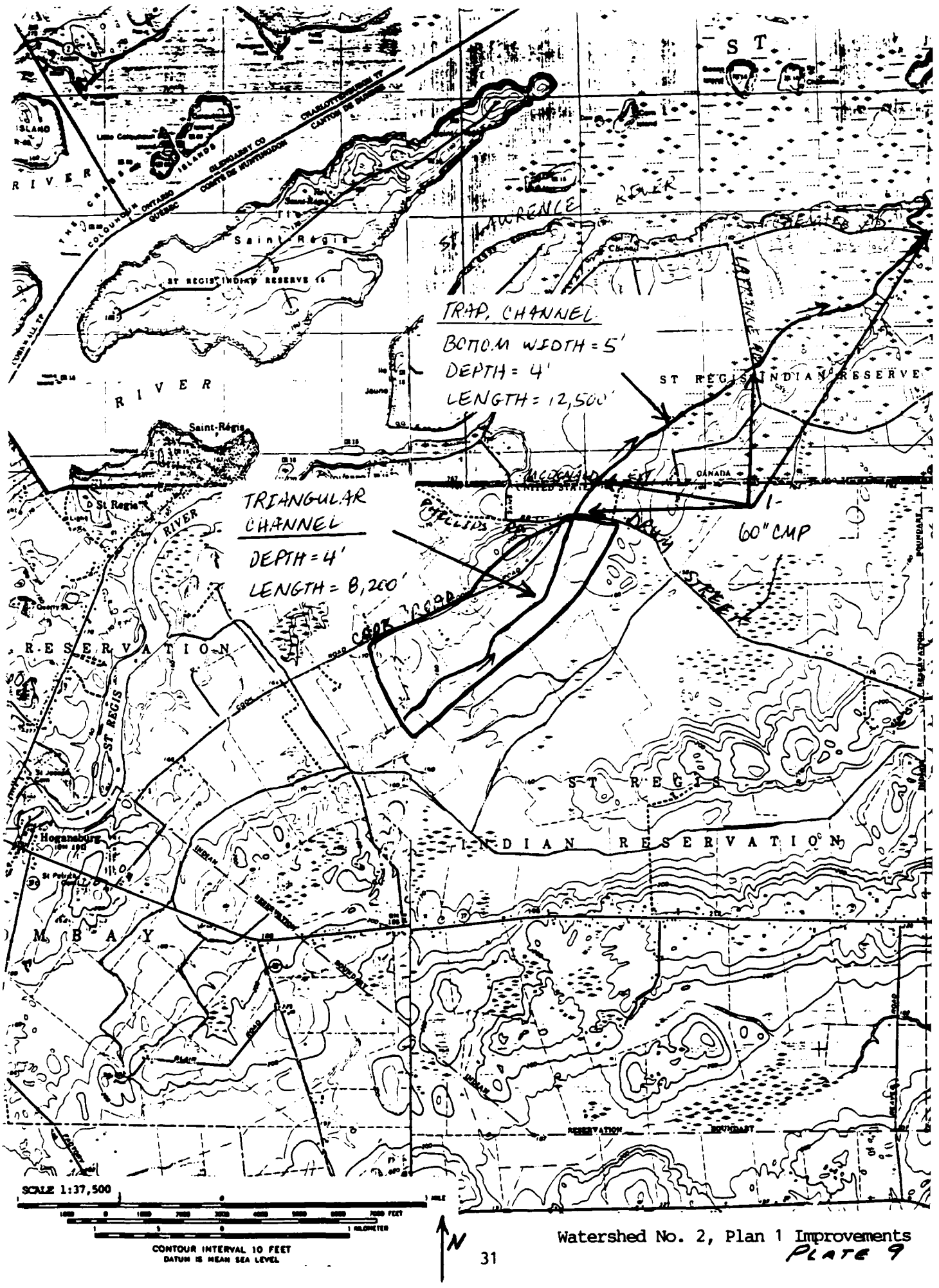
PLATE 7



THE EXISTING ROAD PROFILE WAS DETERMINED FROM NVSDOT 5' CONTOUR INTERVAL TOPOGRAPHIC MAPS

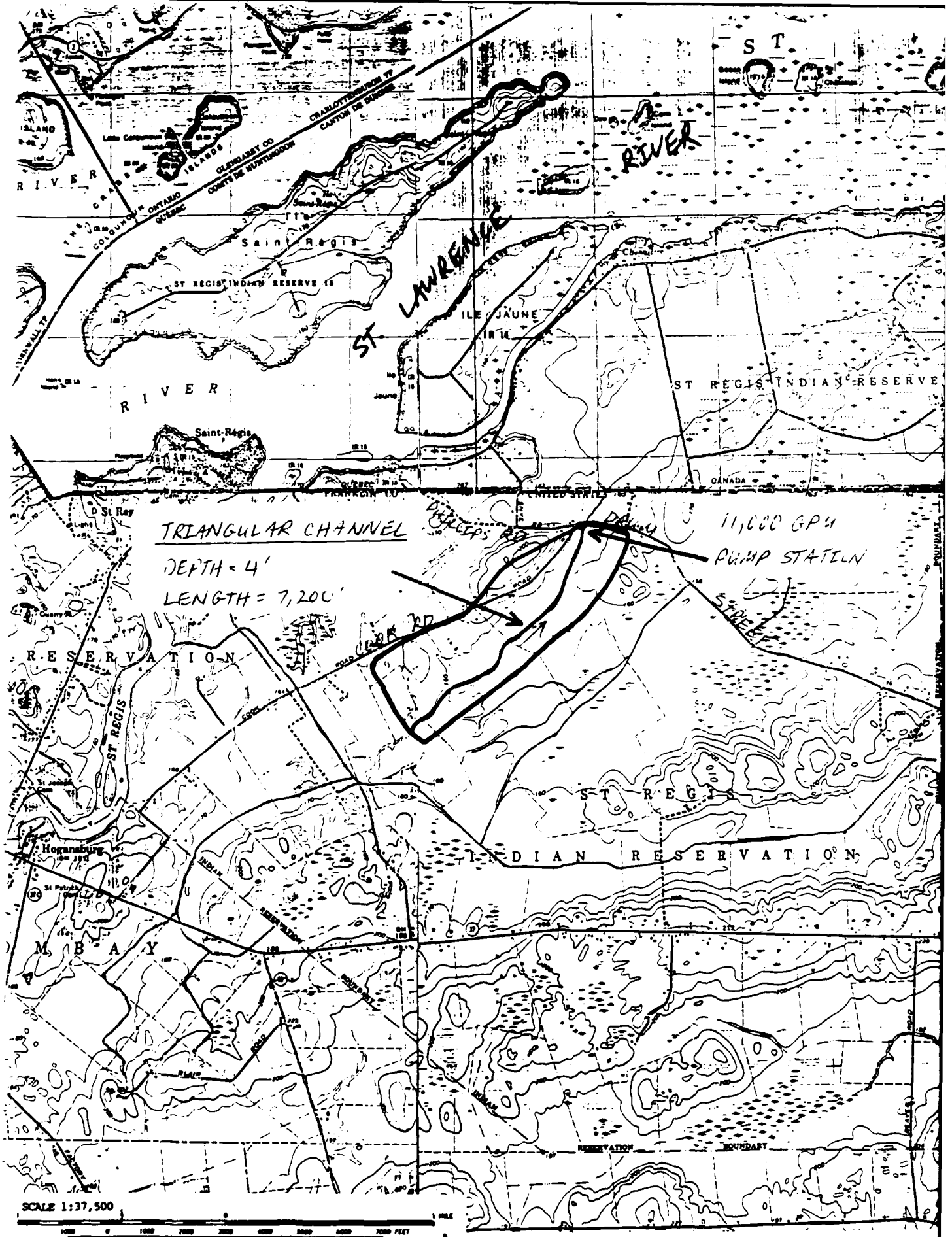
PROFILE OF

PLATE 8

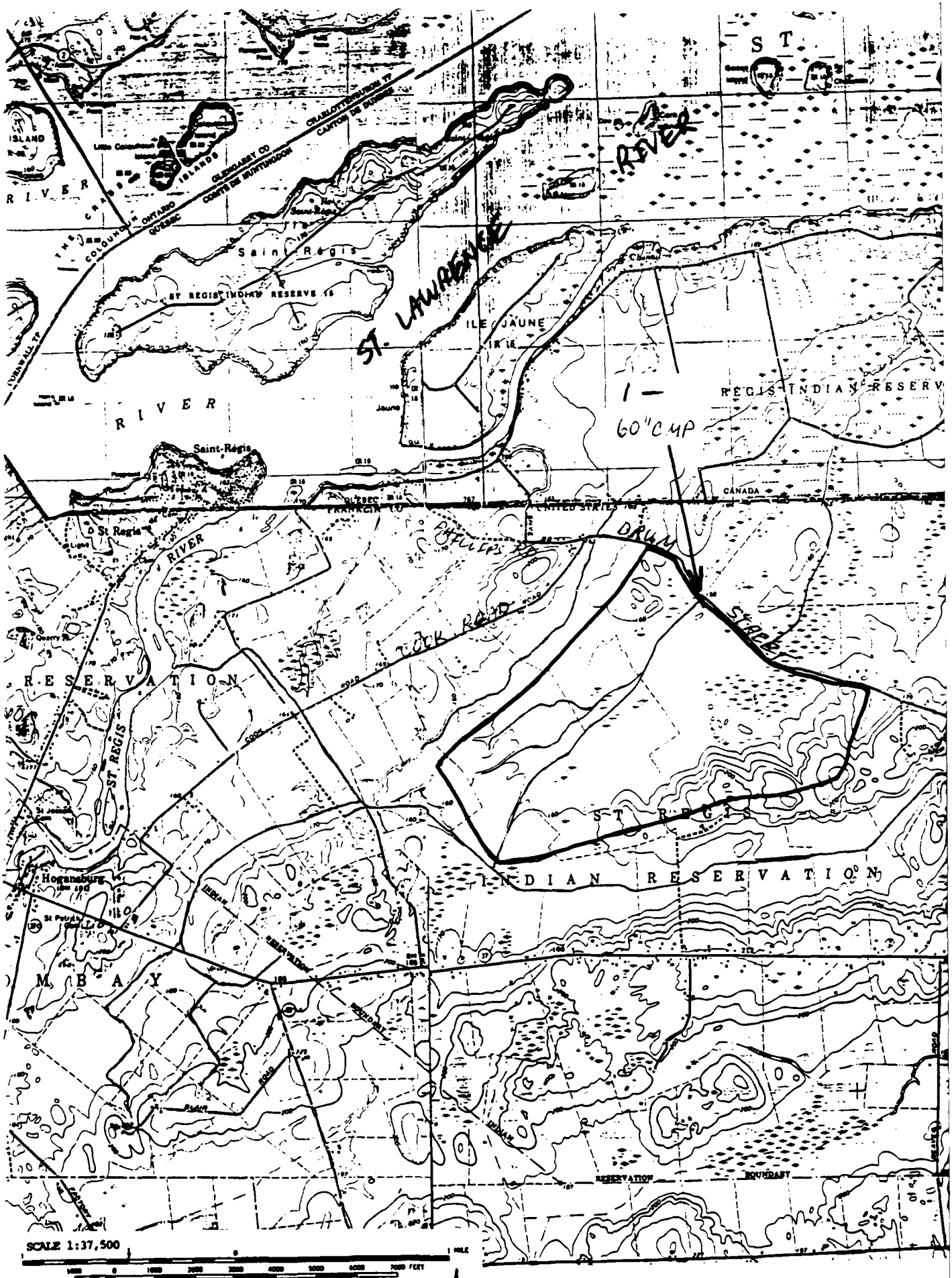


Watershed No. 2, Plan 1 Improvements

PLATE 9

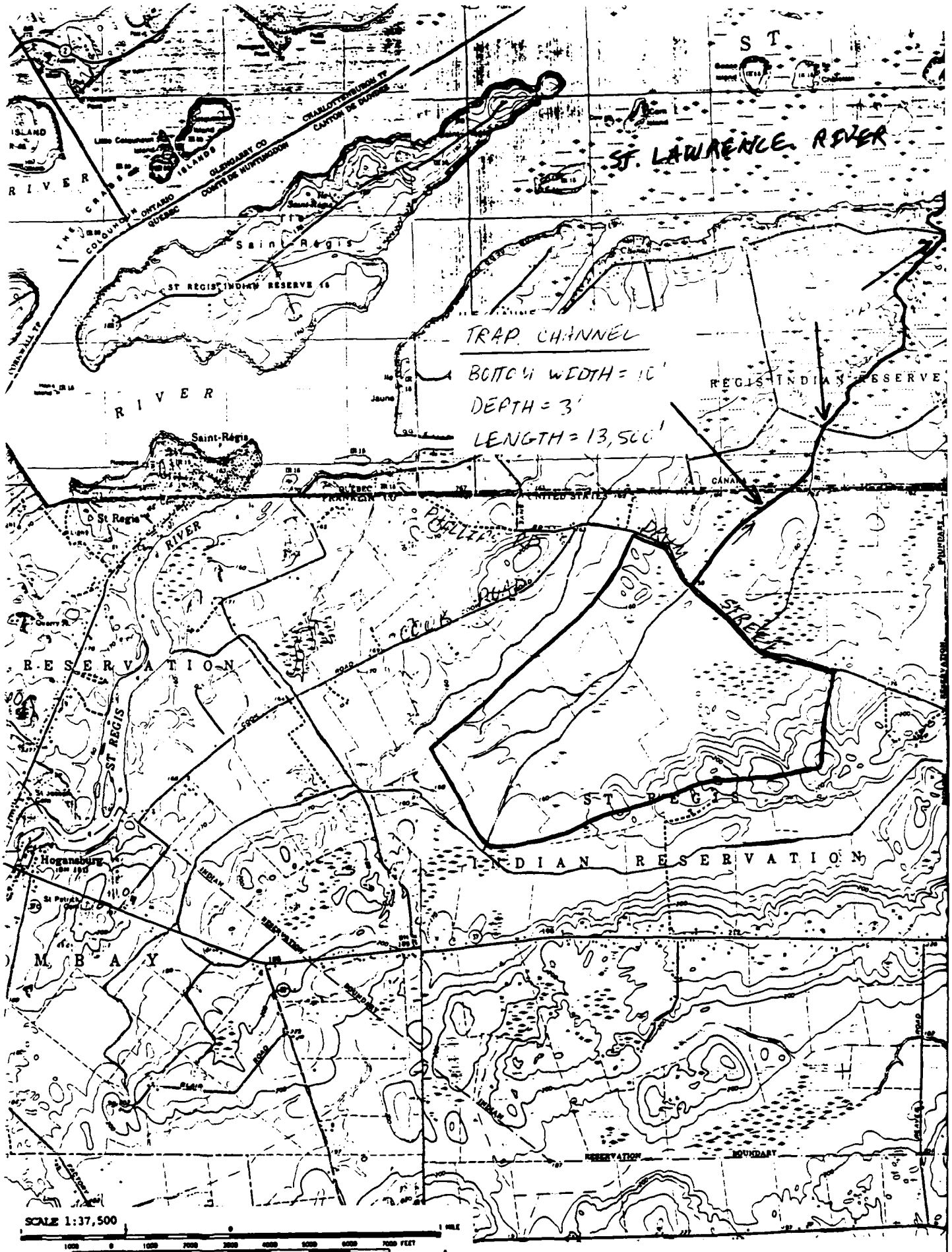


Watershed No. 2, Plan 2 Improvements
PLATE 1

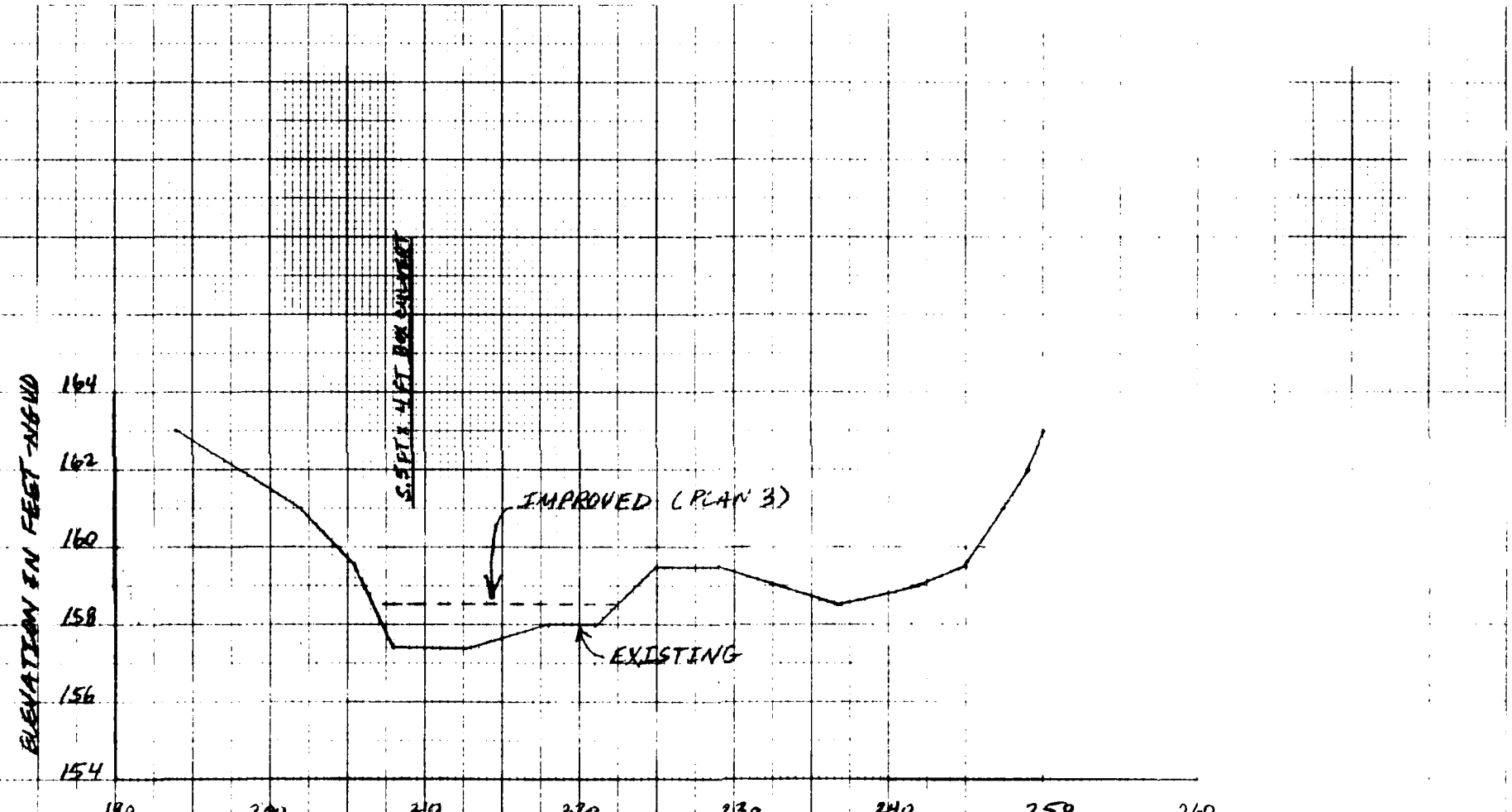


Watershed No. 3, Plan 1 Improvement

PLATE 11

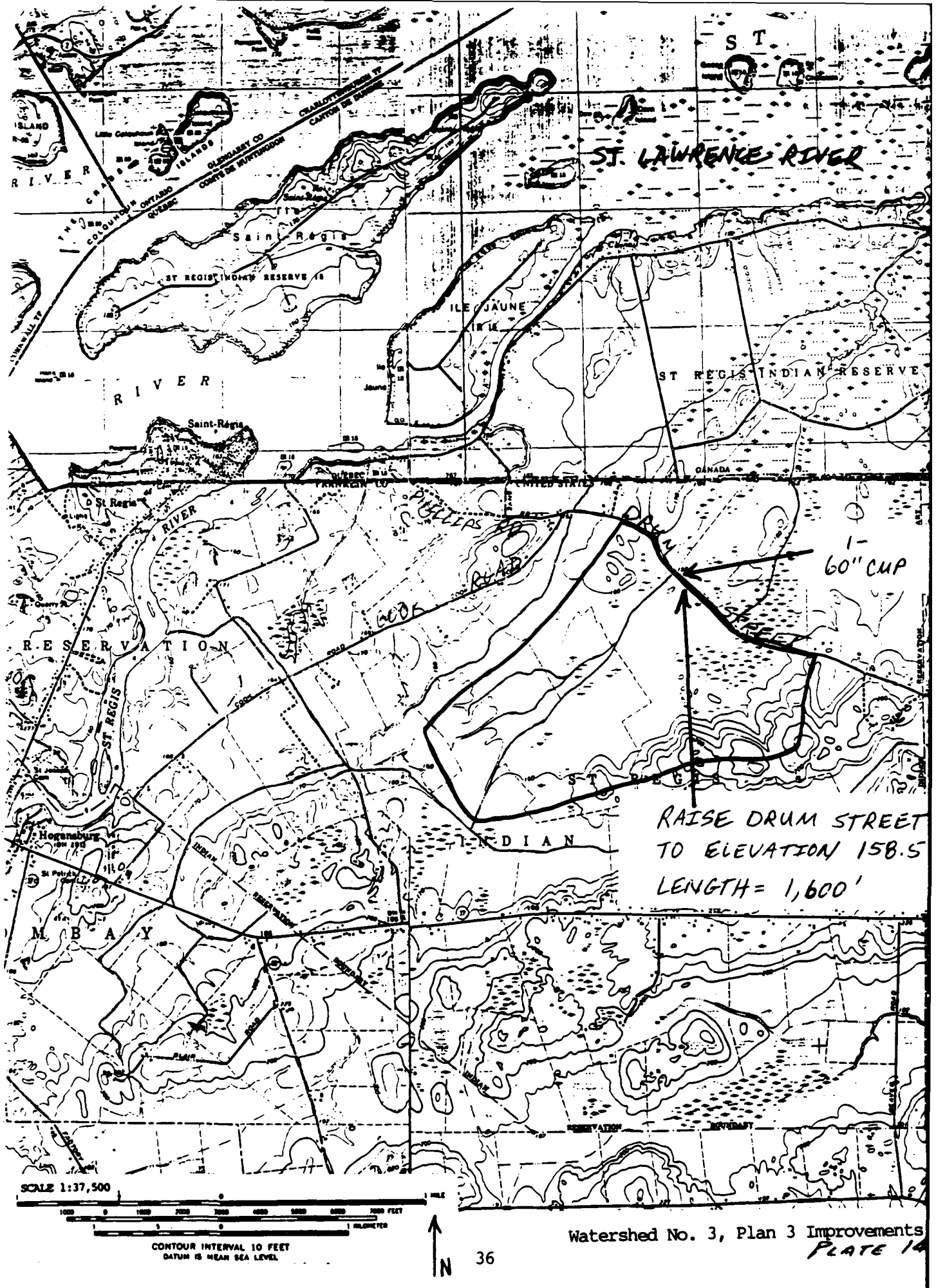


Watershed No. 3, Plan 2 Improvements
PLATE 12

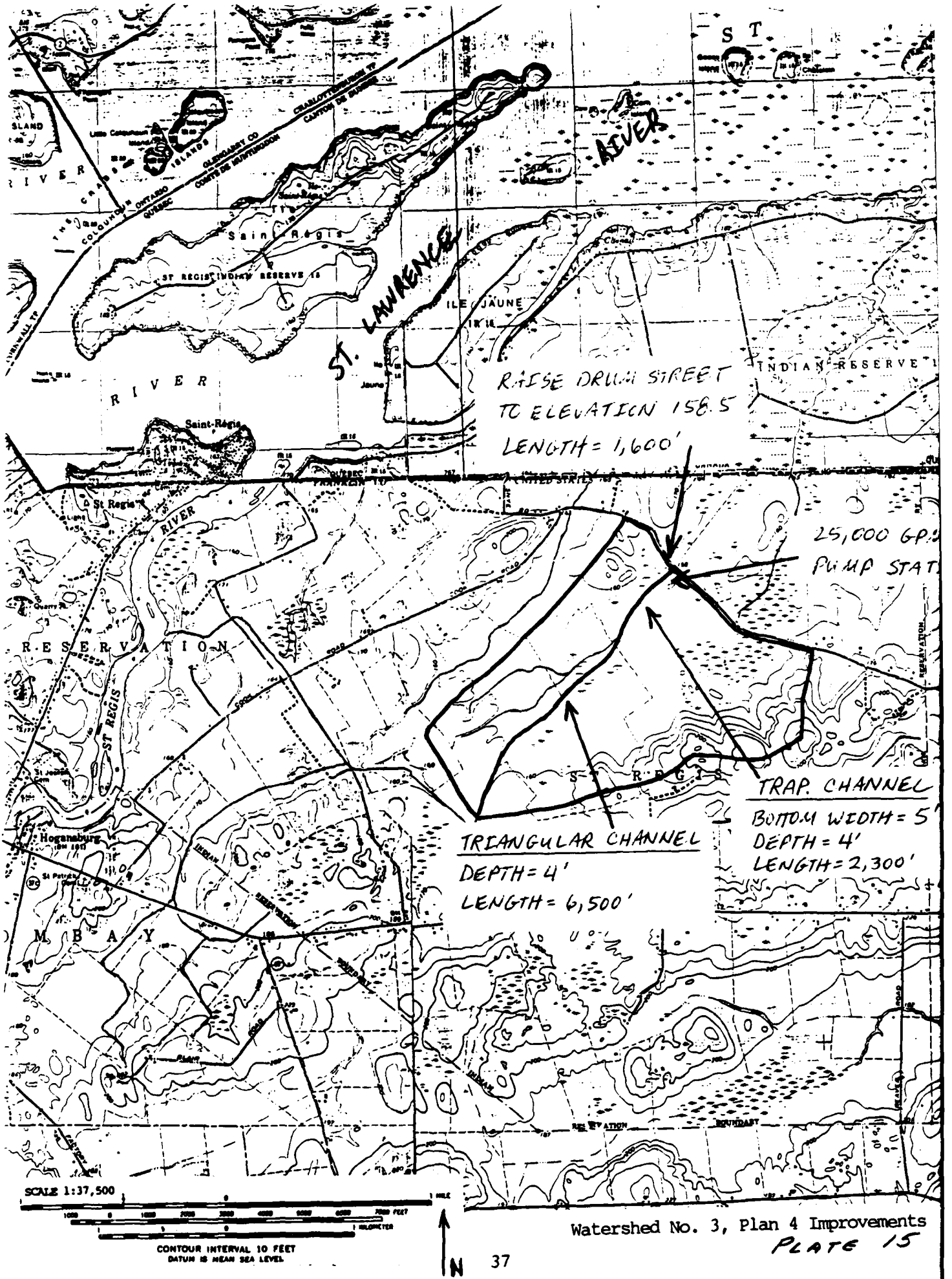


NOTE: THIS PROFILE WAS DETERMINED FROM NYSDOT, APRIL 1987, AS-BUILT DRAWINGS

PROFILE OF DRAKE STREET IN THE VICINITY OF WATERSHED NO. 3



Watershed No. 3, Plan 3 Improvements
PLATE 14



Watershed No. 3, Plan 4 Improvements

PLATE 15