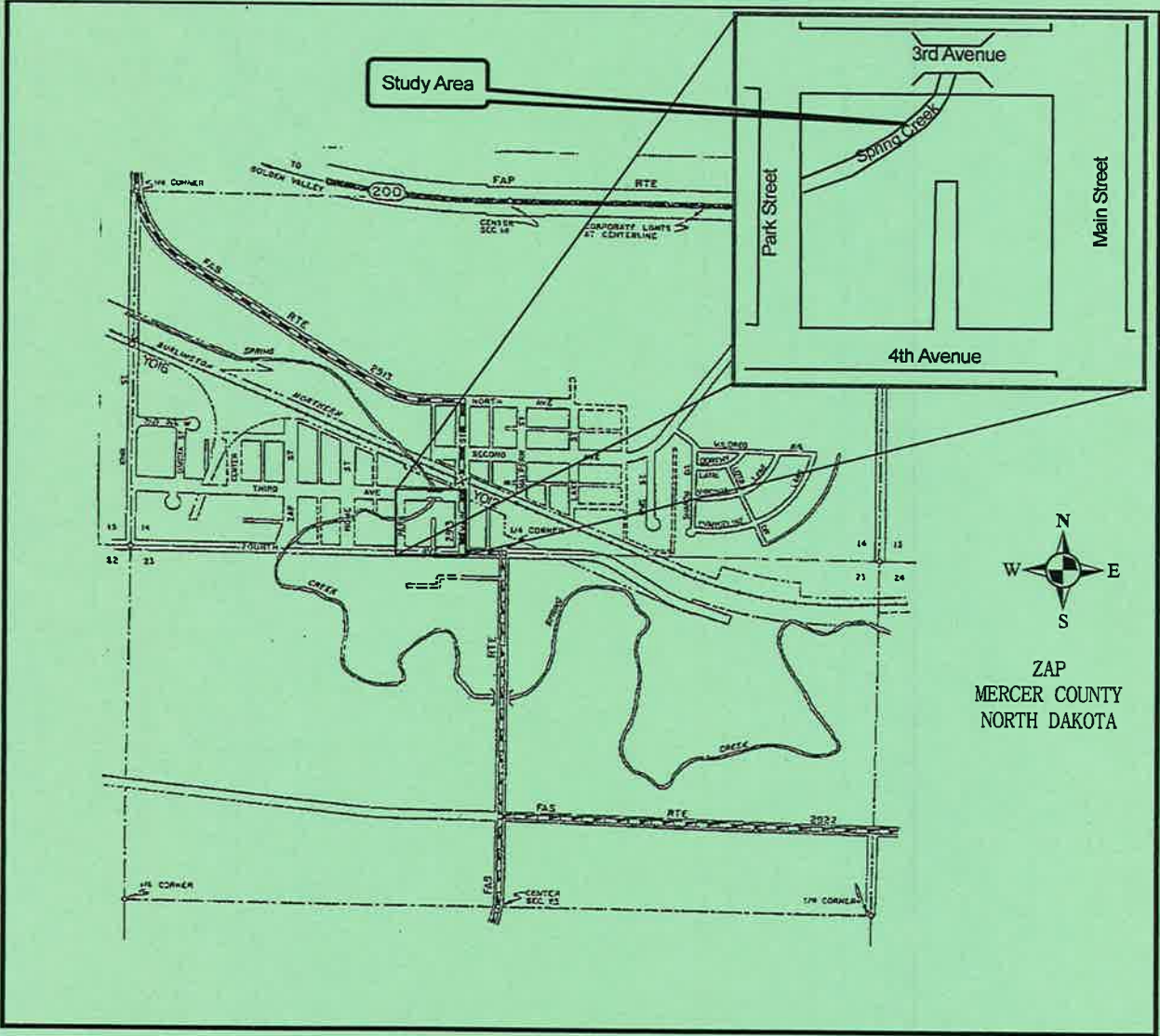


PRELIMINARY ENGINEERING REPORT SPRING CREEK BANK STABILIZATION

S. W. C. PROJECT NO. 1291

MERCER COUNTY

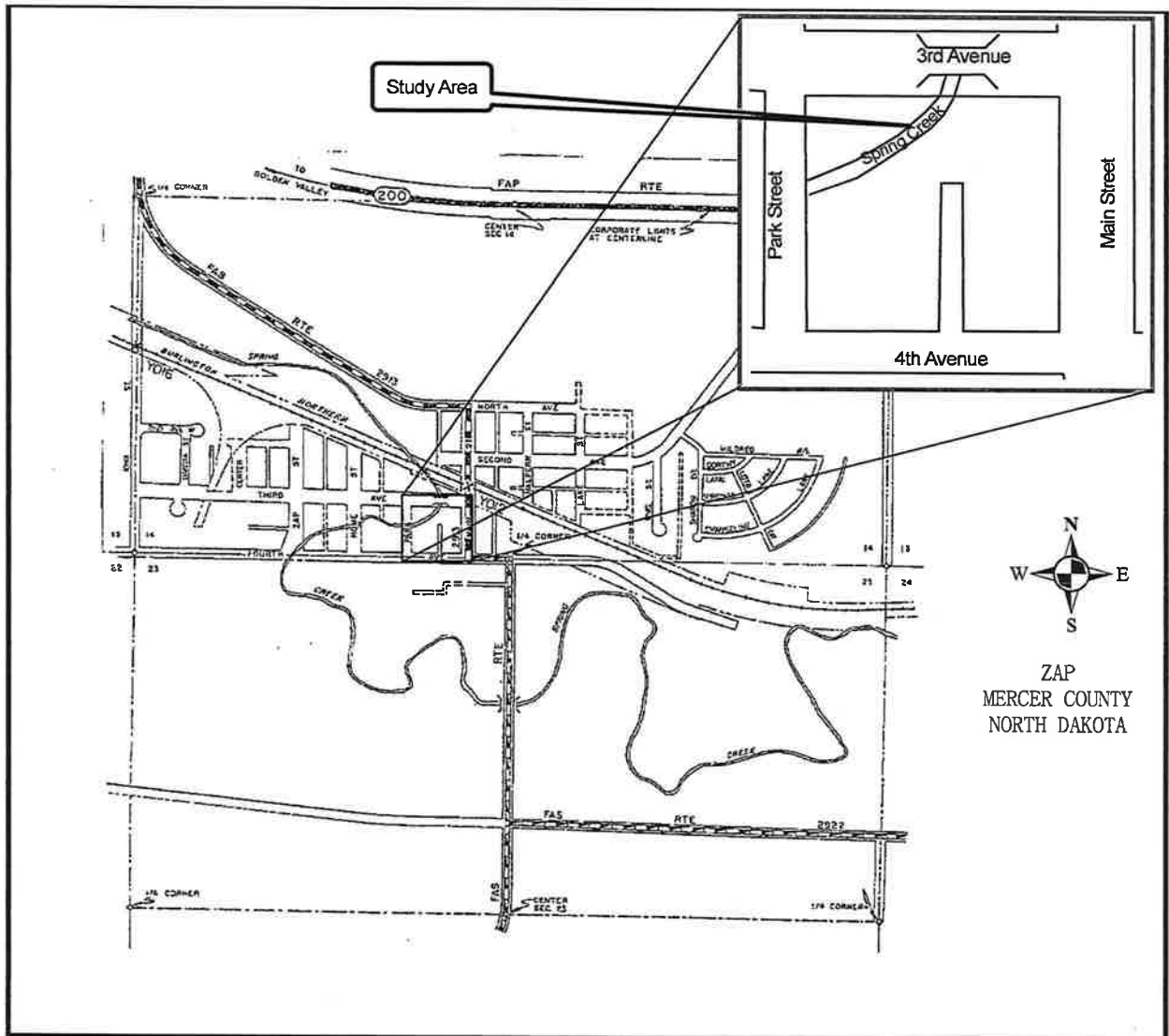


NORTH DAKOTA STATE WATER COMMISSION

PRELIMINARY ENGINEERING REPORT SPRING CREEK BANK STABILIZATION

S. W. C. PROJECT NO. 1291

MERCER COUNTY



NORTH DAKOTA STATE WATER COMMISSION

**PRELIMINARY ENGINEERING REPORT
SPRING CREEK BANK STABILIZATION**

CITY OF ZAP

Mercer County, North Dakota

SWC Project # 1291

North Dakota State Water Commission
900 East Boulevard
Bismarck, ND 58505-0187

February, 2007

Prepared by:



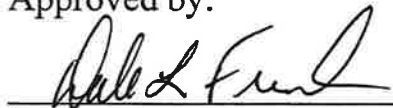
Sindhuja Subramania Pillai
Water Resource Engineer

Submitted by:



Bruce Engelhardt, P.E.
Head, Investigations Section

Approved by:



Dale L. Frink, P.E.
State Engineer

Prepared for the Mercer County
Water Resource Board

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INTRODUCTION

Background:

In 1989, the State Water Commission (SWC) assisted the Mercer County Water Resource District (MCWRB) with a bank stabilization project on Spring Creek in Zap, ND (SWC Project #1291). The project consisted of sloping back the eroded left bank and armoring it with riprap. The construction extended 291 feet downstream from the Third Avenue Bridge at a cost of approximately \$40,000.

In late October of 2005, the SWC received a letter from the MCWRB requesting assistance regarding bank erosion taking place across the stream (right bank) from the previous project. The bank failure was first noticed in the spring of 2005. In summer 2006, an investigation agreement (Appendix A) was signed between MCWRB and SWC. The erosion site was surveyed in July 2006 by the SWC survey crew.

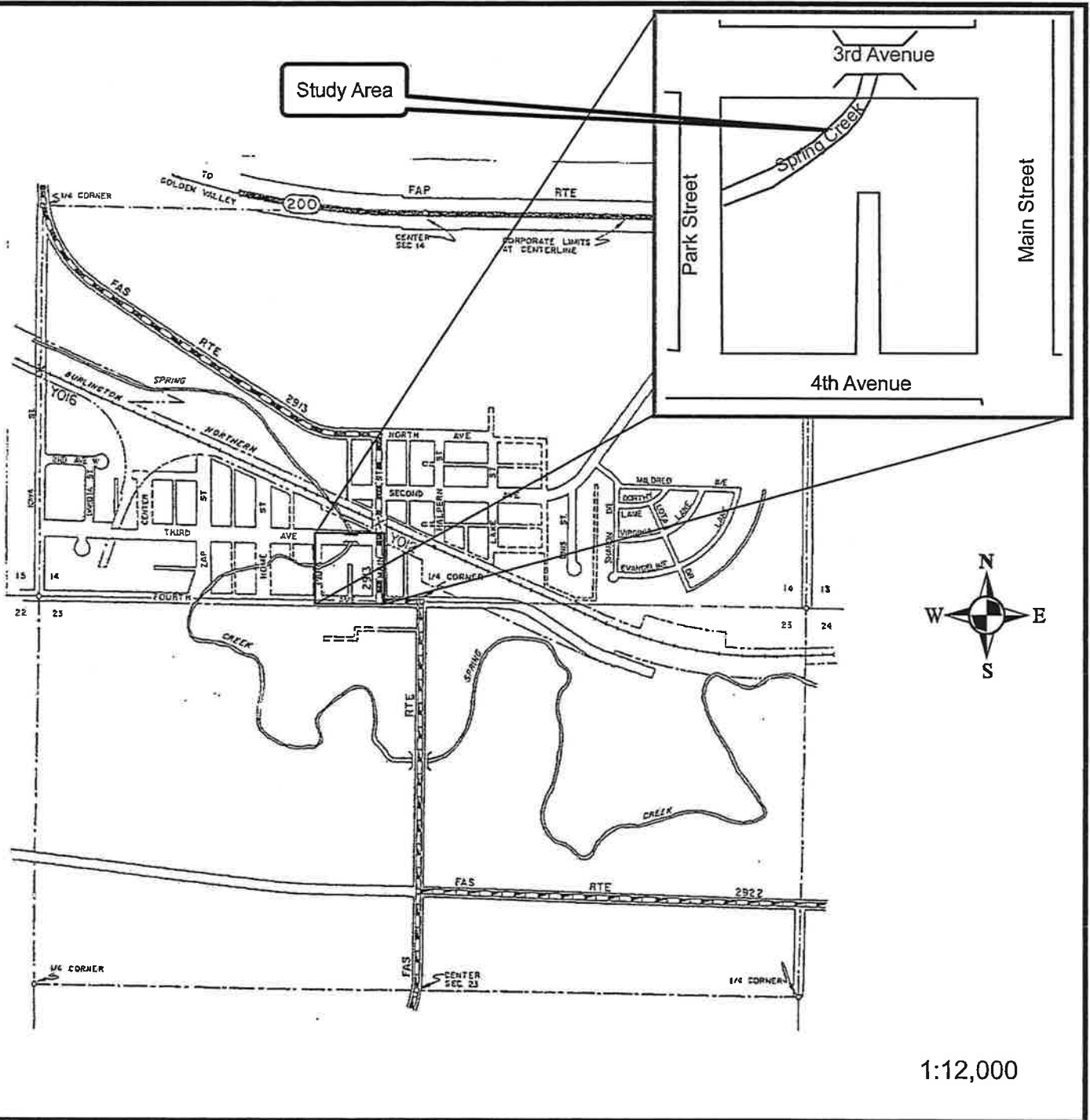
Study Objectives:

The objective of the study is to determine a feasible and effective erosion control method for the bank line in the City of Zap downstream of the Third Avenue Bridge and to evaluate erosion potential at the railway bridge site. This report presents a preliminary design for alleviating erosion problem along with its cost estimate.

Study Area:

The project is located in the City of Zap, Section 14, Township 144 North, Range 89 West, in Mercer County. The project is along the right bank of Spring Creek, extending approximately 200 feet south from the Third Avenue Bridge. Spring Creek makes a sharp bend to the west approximately 150 feet south of the Third Avenue Bridge. Figure 1 is the map of the project area.

COUNTY OF GOLDEN VALLEY
 PLANNING & ZONING DEPARTMENT
 1400 BROADWAY, SUITE 100
 GOLDEN, CO 80401
 PHONE: 303.440.3333
 FAX: 303.440.3334
 WWW.GOV.CO
 2025



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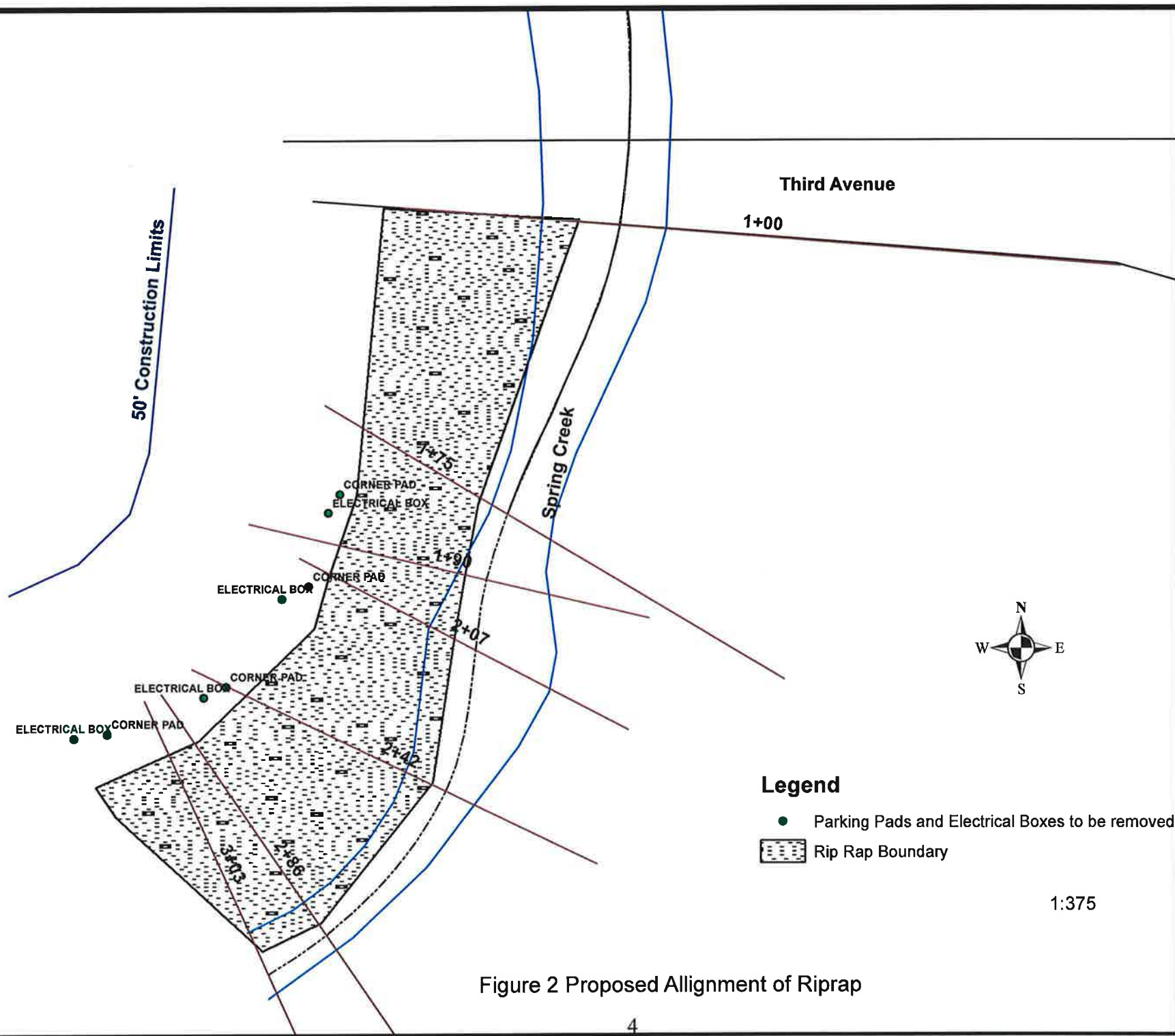
Figure 1
Map of the Project Area

Flows in Spring Creek are very low (less than tens of cfs) during most of the year. For a short time during the spring runoff, the creek experiences high flows which cause erosion. Recent spring runoff flows has caused severe erosion along the right bank. The bank is approximately 20 feet high and due to erosion nearly vertical. The left bank which was stabilized using riprap in fall 1989 seems to be very stable without any signs of erosion. The left bank was sloped back 1.5 to 1 (1.5 feet horizontally for each vertical foot) and protected with riprap up to an elevation of 1838 ft msl and above that elevation the ground was sloped at 3 to 1.

PRELIMINARY ENGINEERING DESIGN

Bank Protection Method near Third Avenue Bridge:

In this study, for protecting the right bank, the same bank protection method as constructed for the left bank was considered. The method consists of sloping the lower bank and protecting it with rock riprap. The riprap would consist of broken field stone and the top of the riprap would be at 1838 ft msl. The sloping of the bank would result in the loss of four electrical boxes and parking pads in the park located near to the creek. The bank protection consists of placing a continuous revetment or layer of rock riprap, along the bank line. The revetment would begin at the Third Avenue Bridge and extend approximately 200 ft downstream to cross-section 3 + 03. The alignment of the riprap along with the lost electrical boxes and parking pads is shown in Figure 2. The typical section of the protected bank is shown in Figure 3. The stone would be placed at an approximate rate of 4 tons per lineal foot with a top width of 3 feet. The riprap would be placed at the slope of 1.5 to 1. If the ground is less steep than 1.5 to 1, then the riprap



Third Avenue

1+00

50' Construction Limits

Spring Creek

CORNER PAD
ELECTRICAL BOX

CORNER PAD
ELECTRICAL BOX

ELECTRICAL BOX
CORNER PAD

ELECTRICAL BOX
CORNER PAD

1+75

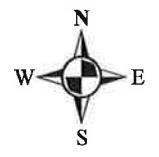
1+90

2+07

2+42

2+86

3+03



Legend

- Parking Pads and Electrical Boxes to be removed
- ▨ Rip Rap Boundary

1:375

Figure 2 Proposed Alignment of Riprap

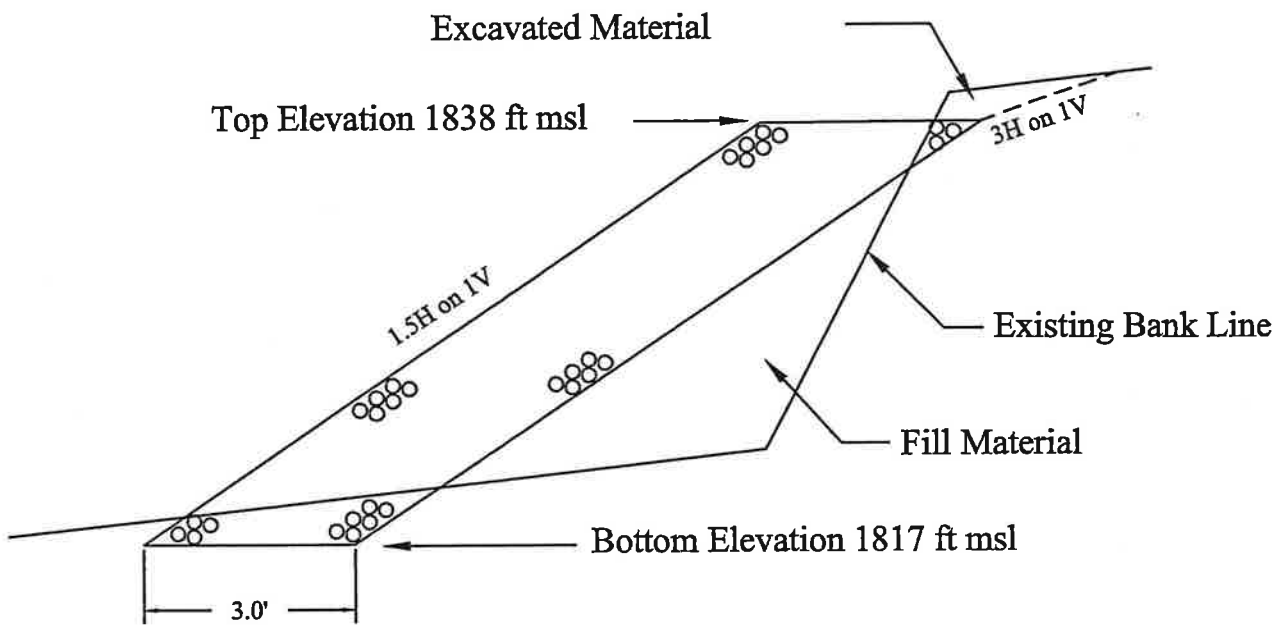


Figure 3
 Typical Section of the Protected Bank

would be placed directly on the ground with a top width of 3 feet. This is the case at cross-sections located at stations 1 + 00, 2 + 42, 2 + 86, 3 + 03. Appendix B has plots of the existing ground cross-sections along with the designed riprap. At station 1 + 00, the riprap will be placed at 1.5 to 1 slope up to 1835.6 ft msl, between 1835.6 to 1838 ft msl the riprap is placed over the existing ground surface. At cross-sections located at stations 1 + 75, 1 + 90 and 2 + 07, riprap is placed at 1.5 to 1 slope up to 1838 ft msl. At cross-section located at 2 + 42, the riprap is placed at 1.5 to 1 slope up to 1824.9 ft msl, between 1824.9 to 1838 ft msl the riprap is placed over the existing ground surface. Stations 2 + 86, 3 + 03 are flatter than 1.5 to 1 slope and so the top of the riprap is not taken up to 1838 ft msl since this would result in excessive riprap volume. At these two stations, the top of the riprap is at 1835 ft msl. The riprap would extend down to elevation 1817 ft msl. A cost estimate for this bank protection method is given below in Table 1.

Table 1: Cost Estimate

Item	Quantity	Unit	Unit Cost	Cost
Mobilization		L.S		10,000
Rock Riprap	573	C.Y	40	22,938
Fill	194	C.Y	4	777
Excavate	913	C.Y	3	2,739
Removing parking pads and electrical boxes		L.S		1,500
Clearing and Grubbing	1	Ac.	500	500
Seeding	0.5	Ac.	400	200
			Subtotal	38,654
			30% Contingencies & Engineering	11,346
			Total	50,000

The project site is located in a floodway and so the conveyance reduction because of the construction of the riprap was evaluated. The cross-section data obtained from the survey was used in creating the geometric model for the Hydrologic Engineering Center's

River Analysis System (HEC-RAS). In HEC-RAS, the roughness of the channel is described using Manning's n value. Visual inspection of the site indicated that the channel is winding and sluggish with grass and some weeds, so Manning's n value of 0.03 was used. Visual inspection also indicated that at certain locations on the bank downstream of the Third Avenue Bridge, there are trees present at the bank. Those trees with their branches obstruct the channel flow, so a Manning's n value of 0.10 was inputted at locations with trees. To represent the channel roughness with riprap in place, Manning's n value of 0.035 was used. Placing riprap according to the design up to 1838 ft msl would result in removing some trees from the bank. The 100 year flood flow of 11,800 cfs and elevation of 1842.2 ft msl were obtained from the Flood Insurance Study of the City of Zap dated January 1979. For the base flood elevation of 1842.2 ft msl, the conveyance of the existing channel and the channel with riprap was obtained by running the geometric preprocessor option in HEC-RAS. Table 2 shows the estimated conveyance with and without the riprap at the base flood elevation of 1842.2 ft msl. At station 2 + 42, the conveyance with the riprap is slightly lower than the conveyance of the natural channel since the riprap is placed on the existing ground surface. However the average conveyance of the channel with the riprap in place is greater than the average conveyance of the natural channel. Since the cross-sections are within tens of feet apart, it is reasonable to conclude based on the average conveyances that riprap does not result in reducing the conveyance.

Table 2: Conveyance Calculation

Cross-section Number	Stationing	Original Conveyance	Conveyance with Riprap in place	Difference
8	1+00	299,846	307,735	7,889
6	1+75	317,030	370,936	53,906
5	1+90	299,532	331,065	31,533
4	2+07	350,675	386,975	36,300
3	2+42	352,770	341,460	-11,310
2	2+86	200,418	342,751	142,333
1	3+03	138,656	254,172	115,516
	Average	279,847	333,585	53,738

Old Railroad Bridge Location:

Survey data near the old railroad bridge indicates that the slope of the existing bank is less than the 1.5 to 1 and no active erosion was noted, so sloping the bank and riprap does not appear to be needed. However visual inspection of the site indicated loss of vegetation along the slope and so seeding the bank slopes in those areas would help enhance the strength of the banks near the railroad bridge. There are nearly 50 piles of the old rail road bridge present at the bridge site which have not been completely removed. These piles increase the velocity and may result in the erosion of the toe. The piles also impact the aesthetics of the stream. So it is suggested that the remains of the piles be completely removed from the stream bed. The cost for removing the piles and seeding the area would be approximately \$10,000.

Regulatory Requirements:

Approval must be obtained from the Corps of Engineers before any fill can be placed in the waterway. Since the proposed project is located in the regulatory floodway,

a permit authorizing the bank stabilization construction should be obtained from the City of Zap.

SUMMARY

Conclusions:

The right bank of Spring Creek downstream of Third Avenue Bridge in the City of Zap has eroded because of high spring flows and needs bank protection. The bank protection method discussed in this report consists of placing rock riprap along the bank. This will help protect the right bank between elevations 1817 ft msl and 1838 ft msl and it would extend approximately 200 ft downstream of the Third Avenue Bridge. The approximate cost estimate for protecting the right bank is \$50,000. Placing riprap along the bank would not reduce the conveyance at the 100 year flood elevation of 1842.2 ft msl.

At the old rail road bridge location, no active erosion was identified. However, seeding is recommended to enhance the strength of the banks. It is also suggested that the remains of the piles from the old bridge be removed since they will increase the velocity of the flow and may result in the erosion of the toe. The piles also impact the aesthetics of the stream. The approximate cost estimate for seeding and removing the piles is \$10,000.

The preliminary design described in this report should reduce or eliminate bank erosion in the project area. However, no form of bank protection can provide guaranteed protection from erosive forces possible during high flows.

APPENDIX A

**Agreement for an Investigation of Erosion Control for
Spring Creek in the City of Zap, North Dakota**

1. **PARTIES.** This agreement is between the State of North Dakota, (State), acting through the State Water Commission (Commission), through its Secretary/State Engineer, Dale L. Frink (Secretary); and the Mercer County Water Resource District (District), acting through its Chairman, John Klein.

2. **PROJECT DESCRIPTION AND LOCATION.** The project involves a study of bank stabilization alternatives on Spring Creek in the city of Zap, North Dakota, to prevent further erosion. The project is located along the right bank of Spring Creek, adjacent to the Zap City Park, extending approximately 300 feet downstream from the Third Avenue bridge (City Park Site), and also in an area in the vicinity of the recently removed BNSF Railway Bridge, which is located approximately 300 feet upstream from the Third Avenue bridge (Railway Bridge Site) located in Section 14, Township 144 North, Range 89 West, Mercer County, North Dakota.

3. **PRELIMINARY INVESTIGATION.** The parties agree that further information is necessary concerning the proposed project. Therefore, the Commission shall:

- a. Conduct field surveys necessary to further define the problem at the City Park Site and the Railway Bridge Site.
- b. Develop and evaluate alternative methods to alleviate the riverbank erosion at the City Park Site, and to evaluate erosion potential at the Railway Bridge Site.
- c. Prepare preliminary designs for the proposed improvements at the City Park Site. Preliminary designs will also include work to be done at the Railway Bridge Site if it is determined that erosion potential exists at this site.
- d. Make preliminary cost estimates of the improvements at the City Park Site. Cost estimates will also include work to be done at the Railway Bridge Site if it is determined that erosion potential exists at this site.
- e. Prepare a preliminary engineering report for Spring Creek bank stabilization at the City Park Site that presents the results of the study. Findings for the Railway Bridge Site will also be included in this report.

4. **DEPOSIT AND REFUND.** The District shall deposit \$800 with the Commission to partially defray the cost of the investigation. Upon receipt of a request from the District to terminate proceeding further with the investigation or upon a breach of this agreement by either of the parties, the Commission shall provide the District with a statement of all expenses incurred in the investigation and shall refund to the District any unexpended funds.

5. **TERM.** This agreement becomes effective upon signing by all parties and will terminate on December 31, 2006, unless extended by agreement in writing signed by all parties.

6. **RIGHTS-OF-ENTRY.** The District agrees to obtain written permission from any affected landowners for field investigations and construction by the Commission required by this agreement.

7. **INDEMNIFICATION.** The Commission and the District each assume its own liability for all claims including all costs, expenses and attorneys' fees that may result from or arise out of this agreement.

8. **INSURANCE.** The District shall secure and keep in force during the term of this agreement, from an insurance company, government self-insurance pool, or government self-retention fund authorized to do business in North Dakota, commercial general liability with minimum limits of liability of \$250,000 per person and \$500,000 per occurrence.

9. **BREACH.** Violation of any provisions of this agreement is a breach. If a party breaches this agreement, a nonbreaching party may terminate this agreement by providing the other parties with a written notice of termination specifying the date of termination. At the discretion of the Secretary, a breach of this agreement by the District will relieve the Commission of all obligations under this agreement. A breach, however, will not remove the District's obligation to indemnify the State for claims, all costs, expenses, and attorney's fees against the State that may result from or arise out of this agreement.

10. **FORCE MAJEURE.** The District will not hold the Commission responsible for delay or default caused by fire, riot, acts of God, or war.

11. **TERMINATION.**

- a. The parties may terminate this agreement by mutual consent of all parties.
- b. The Commission may terminate this agreement effective upon delivery of written notice to the District, or a later date as may be stated in the notice, under any of the following conditions:
 - (1) If an emergency exists;
 - (2) If funding from federal, state or other sources is not obtained and continued at levels sufficient to provide the funds agreed upon or the services or supplies in the indicated quantities or term;
 - (3) If federal or state laws, rules or regulations are modified or interpreted in such a way that the services are no longer allowable or appropriate for purchase under this agreement or are no longer

eligible for the funding proposed for payments authorized by this agreement;

- (4) If any license, permit or certificate required by law, rule or regulation, or by the terms of this agreement, is for any reason not obtained, denied, revoked, suspended or not renewed;
- (5) The Commission, at any time, can determine that termination is necessary for the convenience of the Commission.

- c. Any termination of this agreement shall be without prejudice to any obligations or liabilities of any party already accrued prior to termination.
- d. The rights and remedies of any party provided in this agreement are not exclusive and are in addition to any other rights and remedies provided by law.
- e. Notice of termination will be made upon 30 days written notice.

12. **MERGER.** This agreement may not be waived, altered, modified, supplemented, or amended in any manner, except by written agreement signed by all parties. This agreement constitutes the entire agreement between the parties. Any waiver or modification made is effective only in the specific instance and for the specific purpose given.

NORTH DAKOTA STATE WATER COMMISSION

By:



DALE L. FRINK
Secretary

MERCER COUNTY WATER RESOURCE DISTRICT

By:



JOHN KLEIN
Chairman

DATE:

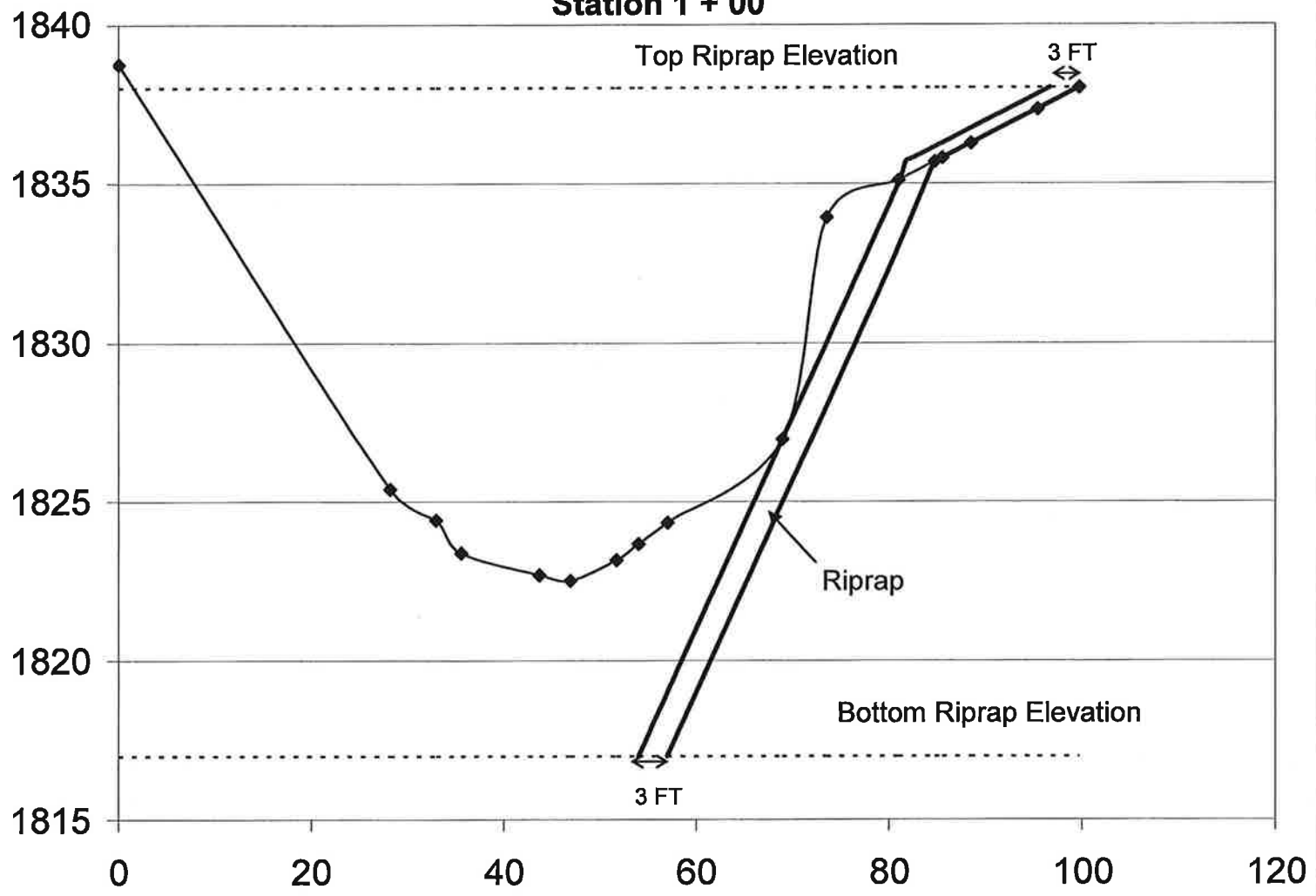
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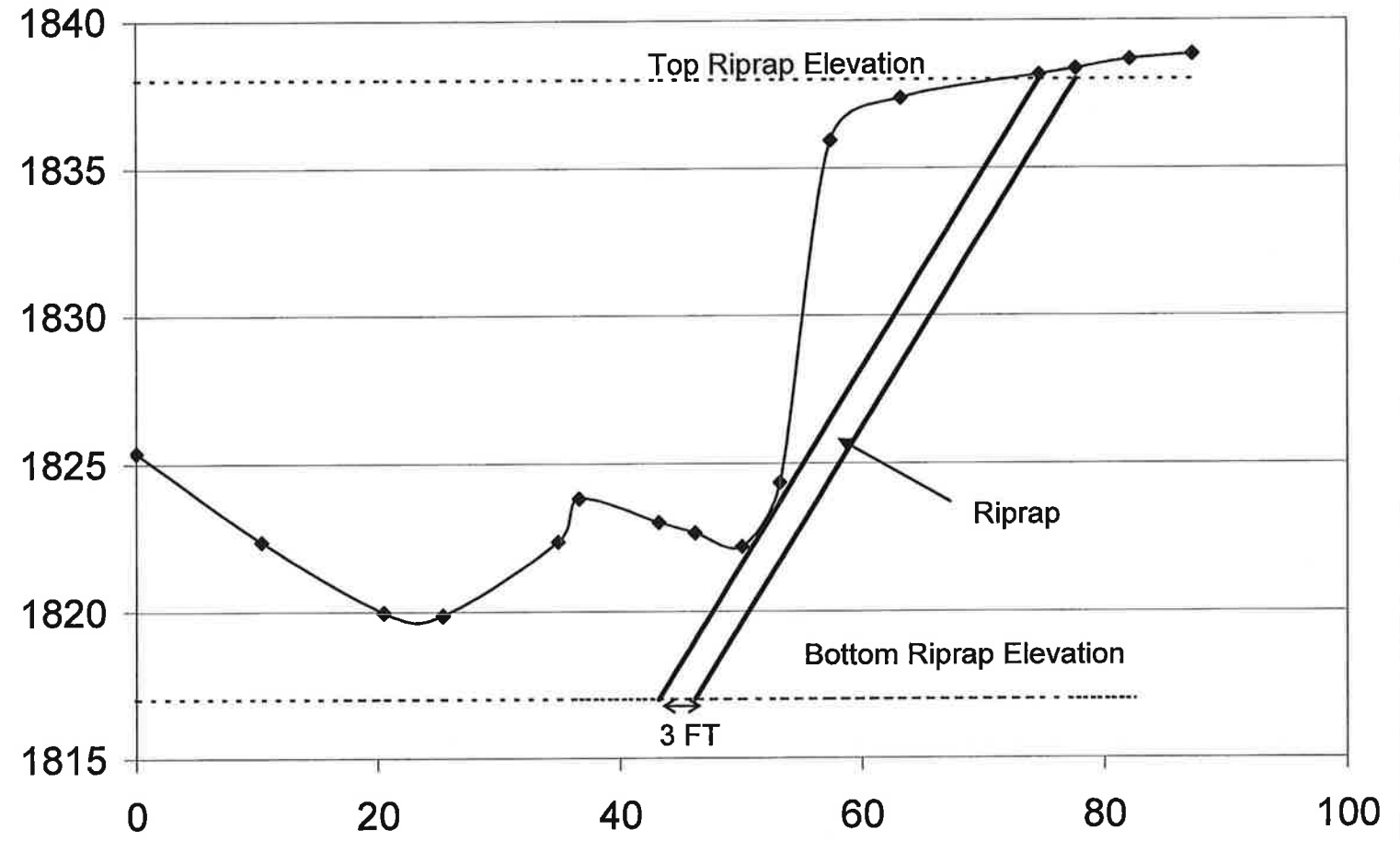
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APPENDIX B

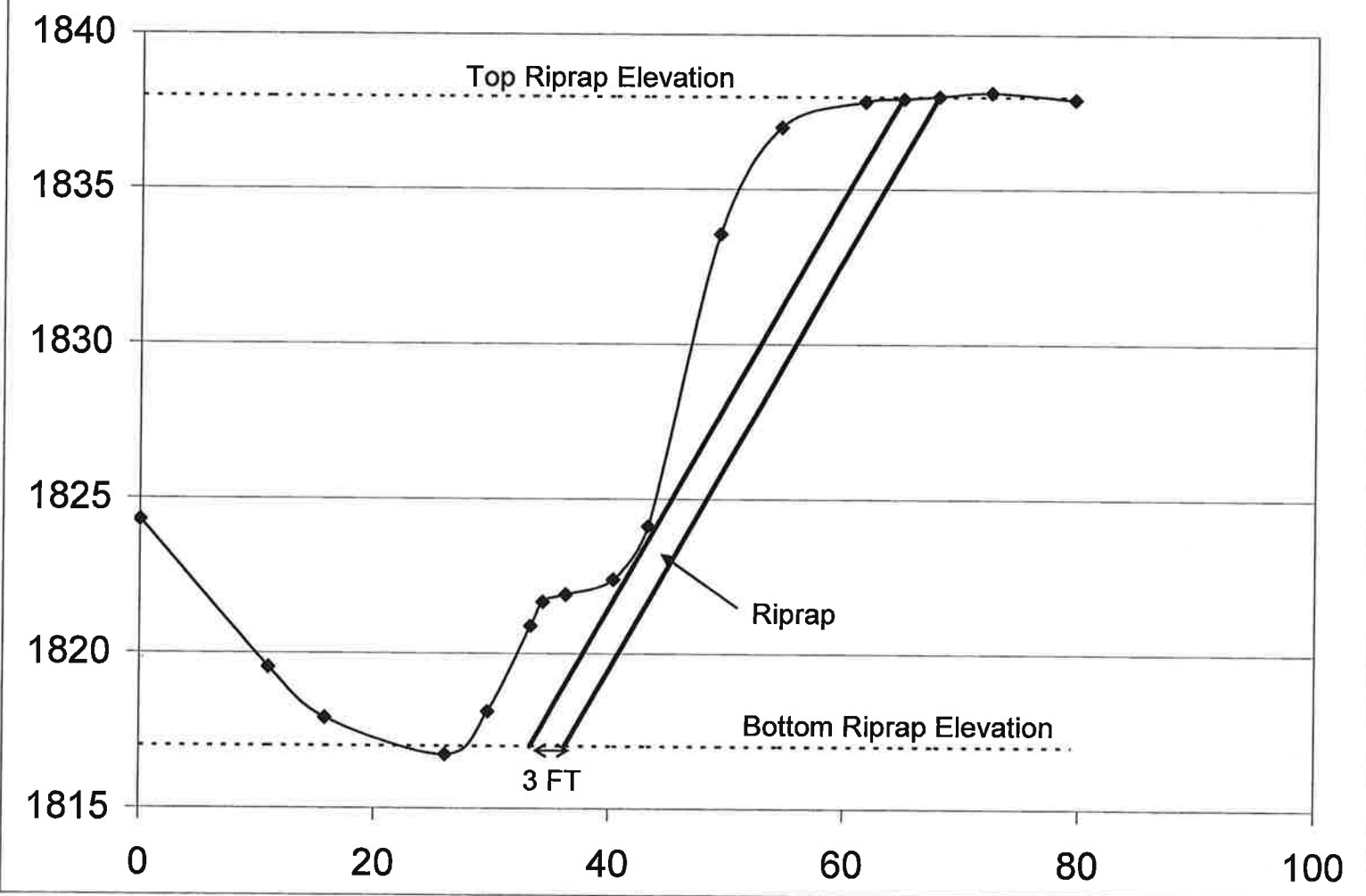
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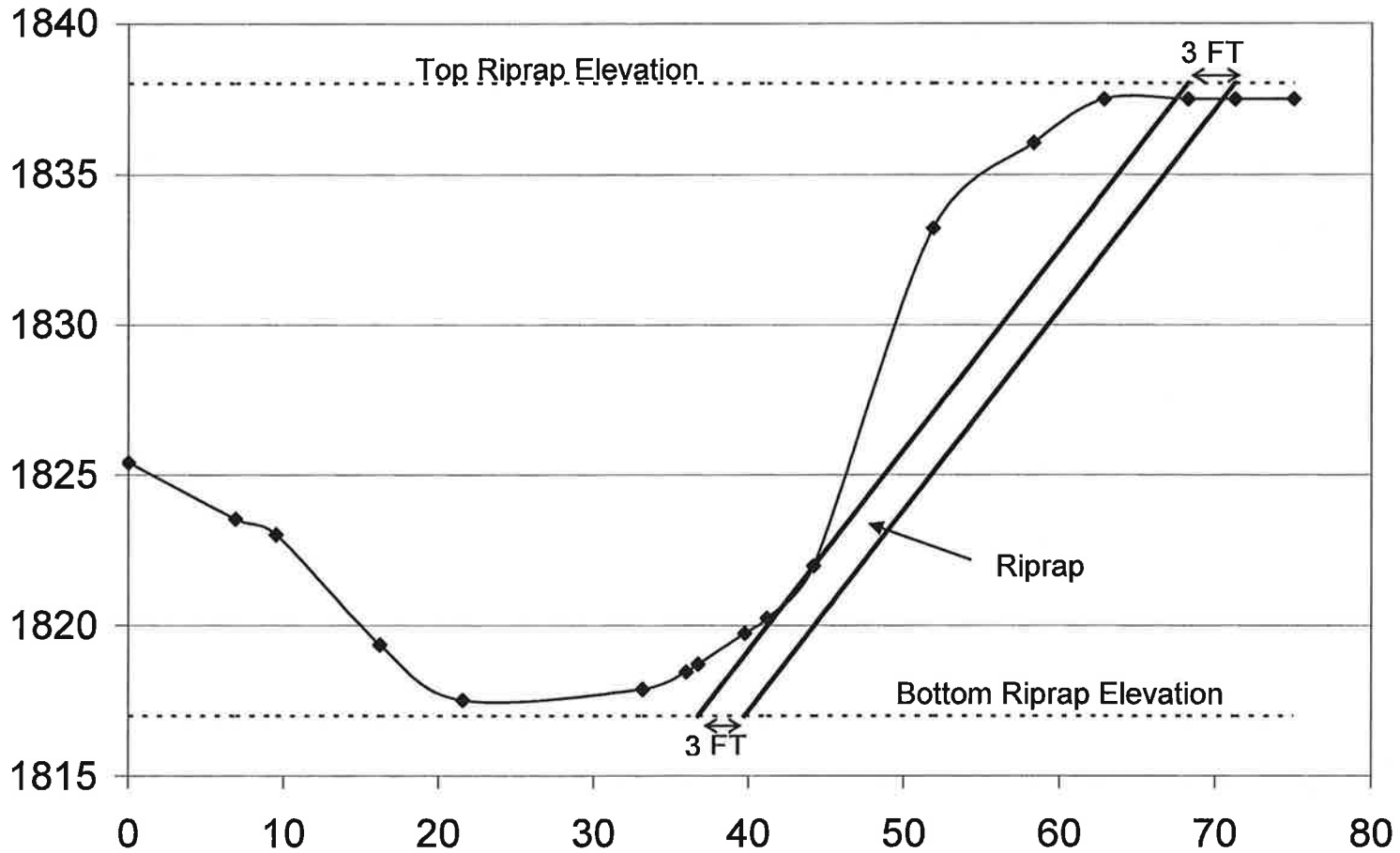
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Station 1 + 75**



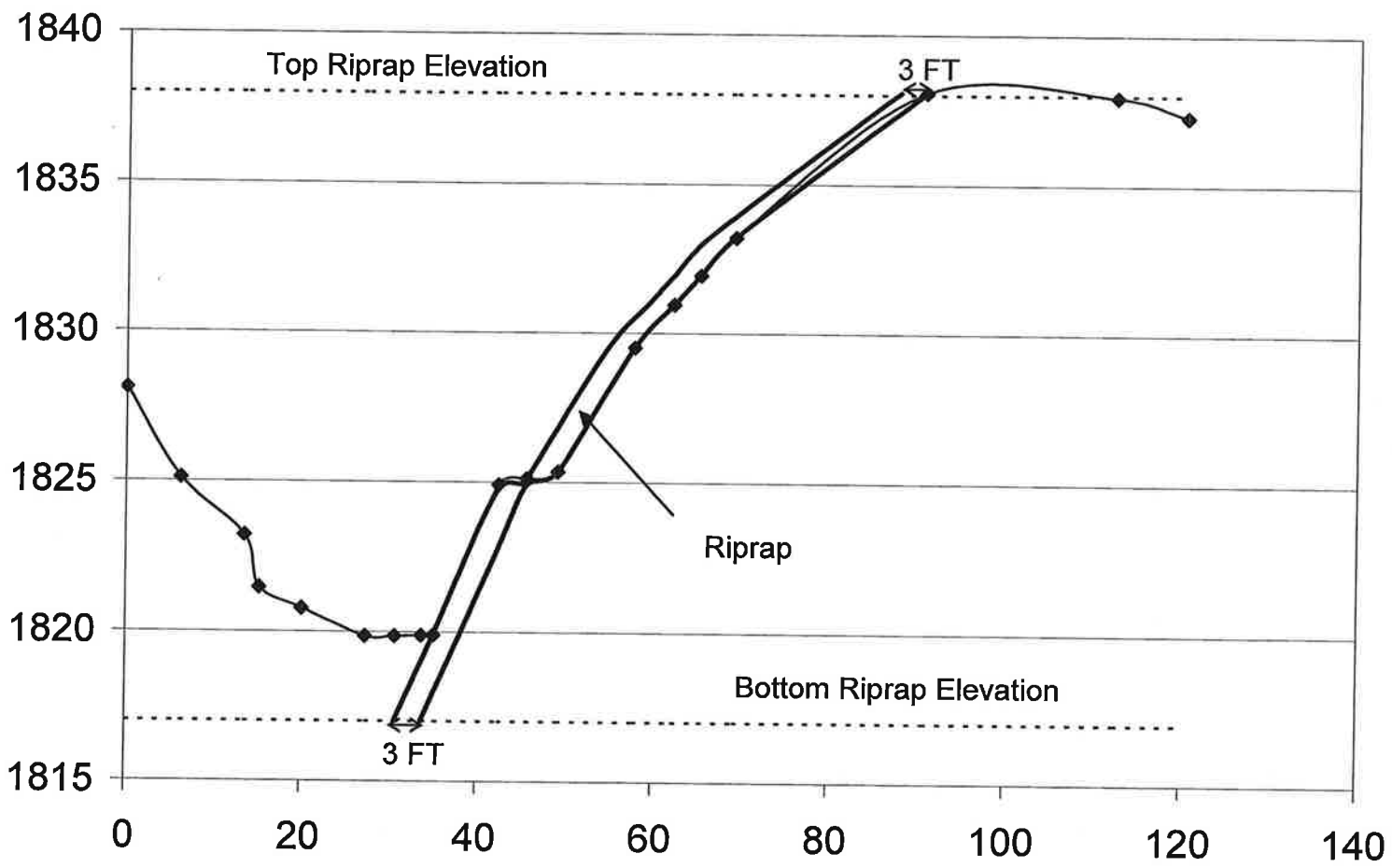
**Cross-section Number 5
Station 1 + 90**



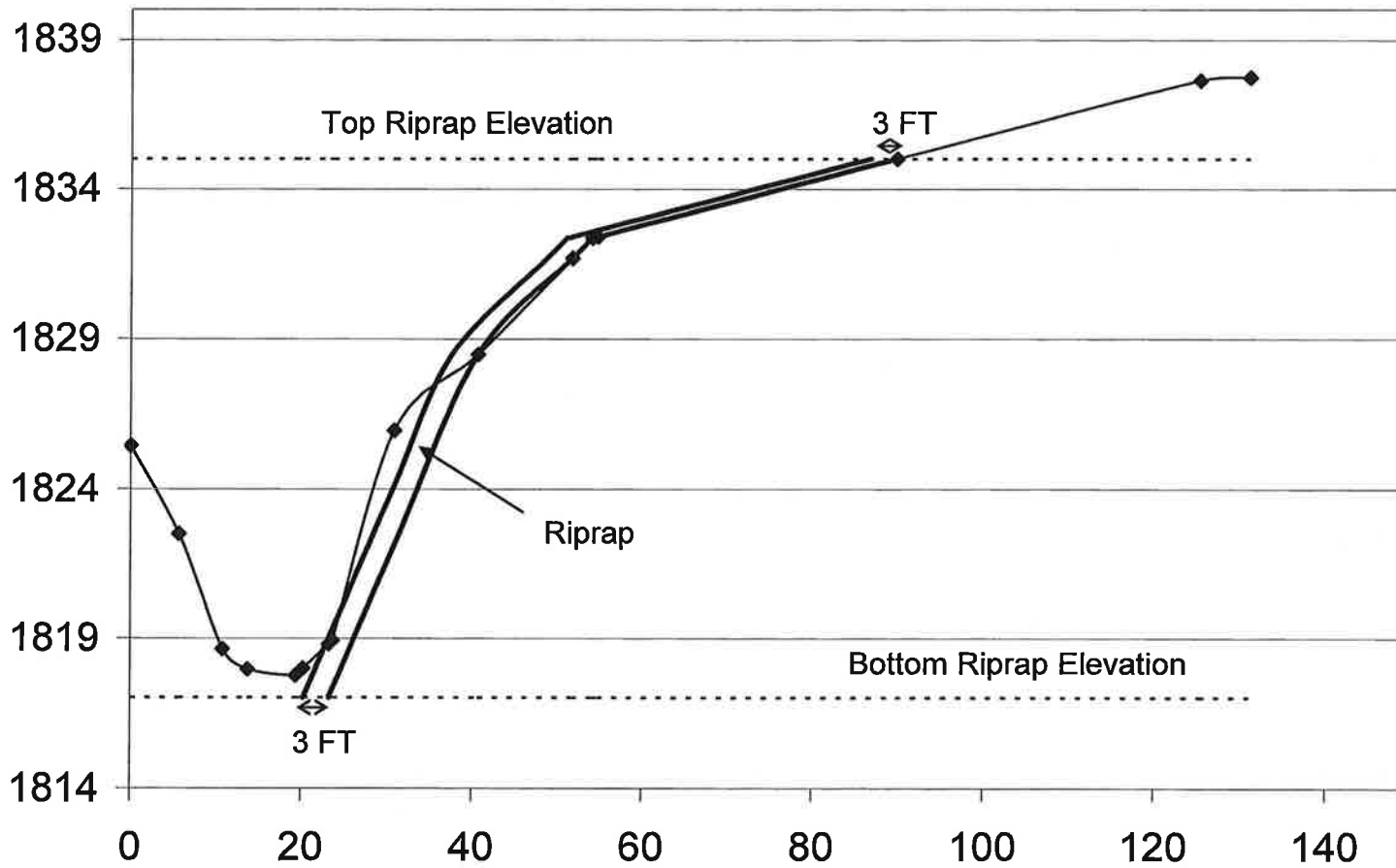
**Cross-section Number 4
Station 2 + 07**



**Cross-section Number 3
Station 2 + 42**



**Cross-section Number 2
Station 2 + 86**



**Cross-section Number 1
Station 3 + 03**

