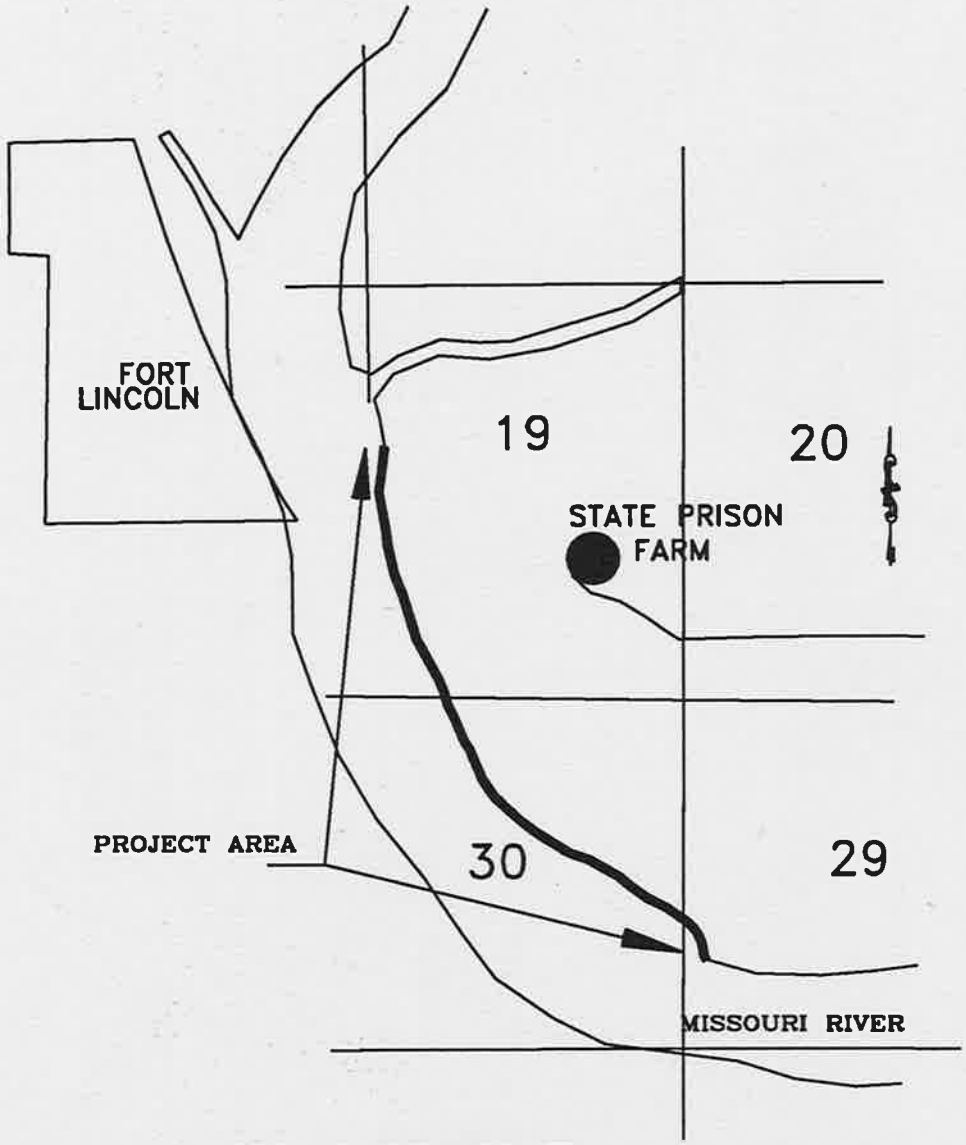
PRELIMINARY ENGINEERING REPORT

MISSOURI RIVER BANK STABILIZATION

MISSOURI RIVER CORRECTIONAL CENTER

SWC NO. 576-29
BURLEIGH COUNTY



NORTH DAKOTA
STATE WATER COMMISSION

September 1992

PRELIMINARY ENGINEERING REPORT

Missouri River Bank Stabilization
Missouri River Correctional Center

SWC Project #576-29

Burleigh County

North Dakota State Water Commission
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I. INTRODUCTION

Study Objectives:

In June, 1992, Governor George Sinner asked the State Engineer to conduct a preliminary review of possible measures to protect a bank erosion site on the Missouri River adjacent to the Missouri River Correctional Center (State Farm). The site has experienced severe erosion over the past few years. This report presents several alternatives, including cost estimates, to control the erosion; a description of construction practices that may be implemented; a summary of regulatory permits the project will require; and a statement of conclusions and recommendations regarding the project.

Project Location and Purpose:

The project is located approximately four miles south of Bismarck in Sections 19 and 30, Township 138 North, Range 80 West, in Burleigh County. The project is along the left bank of the Missouri River at approximately river mile 1310. The eroding bank extends approximately 10,000 feet. The project area is shown in Figure 1.

During a May 1991 site inspection, it was estimated that approximately 50 feet of stream bank had eroded at the site since the previous fall. It appears that the low-level of Lake Oahe has contributed to the erosion in this area. When Lake Oahe is at its normal level, the river's current is slowed through this area by the reservoir. However, during the last few years, Lake Oahe has

LOCATION MAP

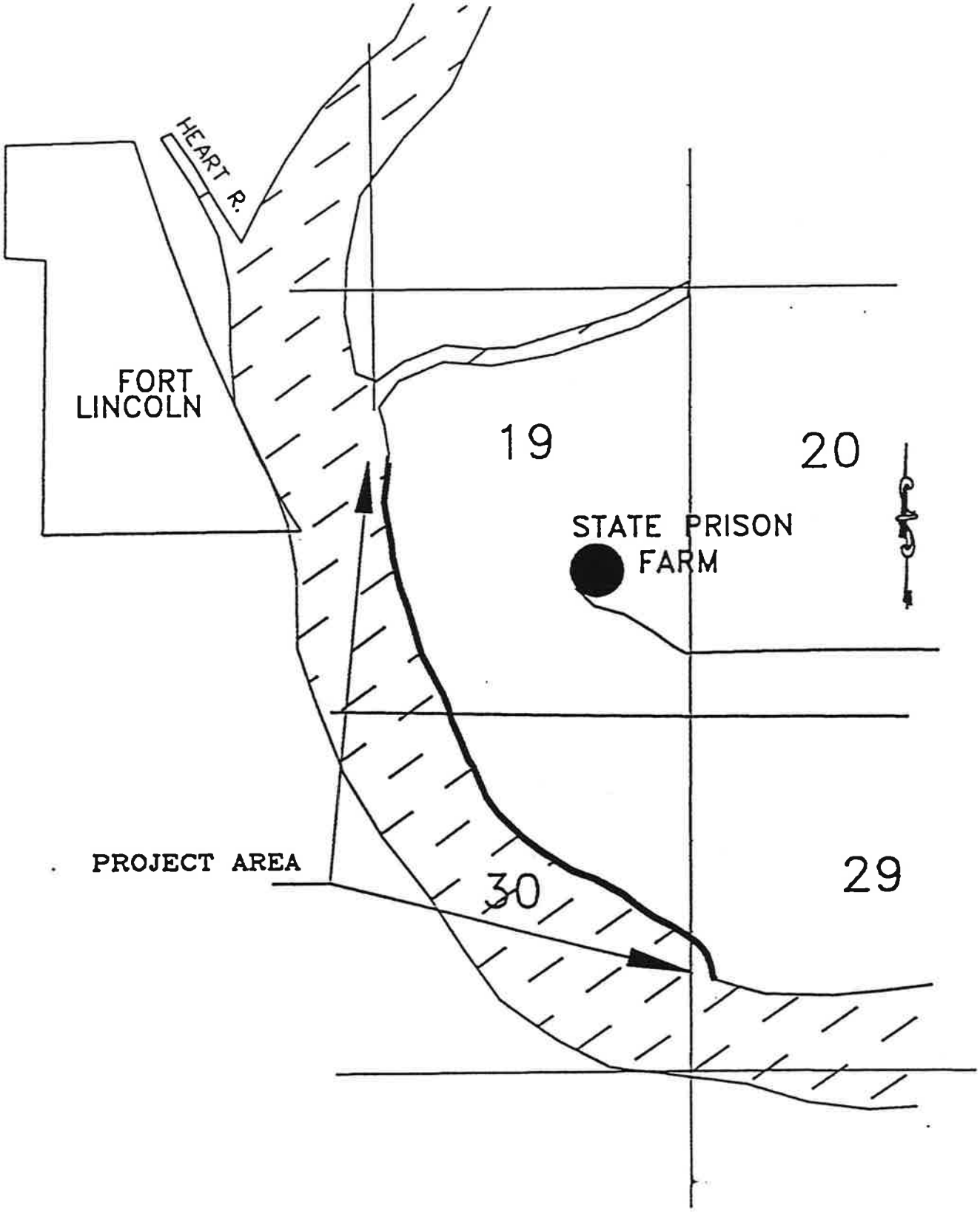

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FIGURE 1

been much below its normal level; therefore, the current remains strong and erodes the bank. Future losses are impossible to predict. When Lake Oahe returns to its normal level, erosion may decrease, but it appears erosion will continue unless preventative measures are implemented.

II. ALTERNATIVE BANK PROTECTION METHODS

Alternative One - Continuous Revetment:

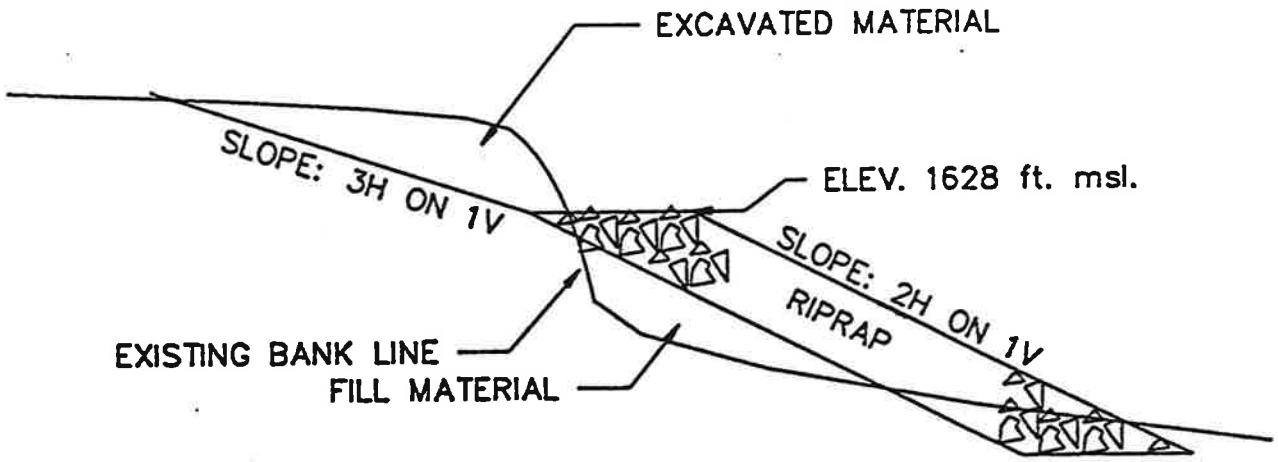
This alternative consists of placing a continuous revetment, which consists of a layer of rock riprap along the bank. The riprap would consist of broken field stone. The riprap would be placed on a 2:1 (2 Horizontal to 1 Vertical) slope with a crown width of 4 feet. The bank area above the rock would be back-sloped at 3:1. A typical section of the protected bank is shown in Figure 2. The riprap would extend down a minimum of 16 feet to elevation 1612 feet msl.

Irregularly shaped banks increase the susceptibility to erosion. Straightening the bank reduces the erosion potential and also reduces the quantity and cost of the riprap. Figure 3 shows the alignment of the straightened and riprapped bank. Straightening and sloping of the bank will result in the loss of land and trees. Clearing of trees within the project area will be minimized. A revegetation plan including tree plantings will be needed for mitigation of the disturbed areas. Project costs could be reduced if the Department of Corrections would clear the necessary trees before construction begins.

A windrow refusal, which consists of a row of buried rock running perpendicular to the bank, will be placed at the upstream end of the revetment to prevent the water from flowing behind the bank protection. This refusal will extend approximately 30 feet

ALTERNATIVE #1

TYPICAL CROSS SECTION



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TYPICAL CROSS SECTION

FIGURE 2

ALTERNATIVE #1
RIPRAPPED BANK ALIGNMENT

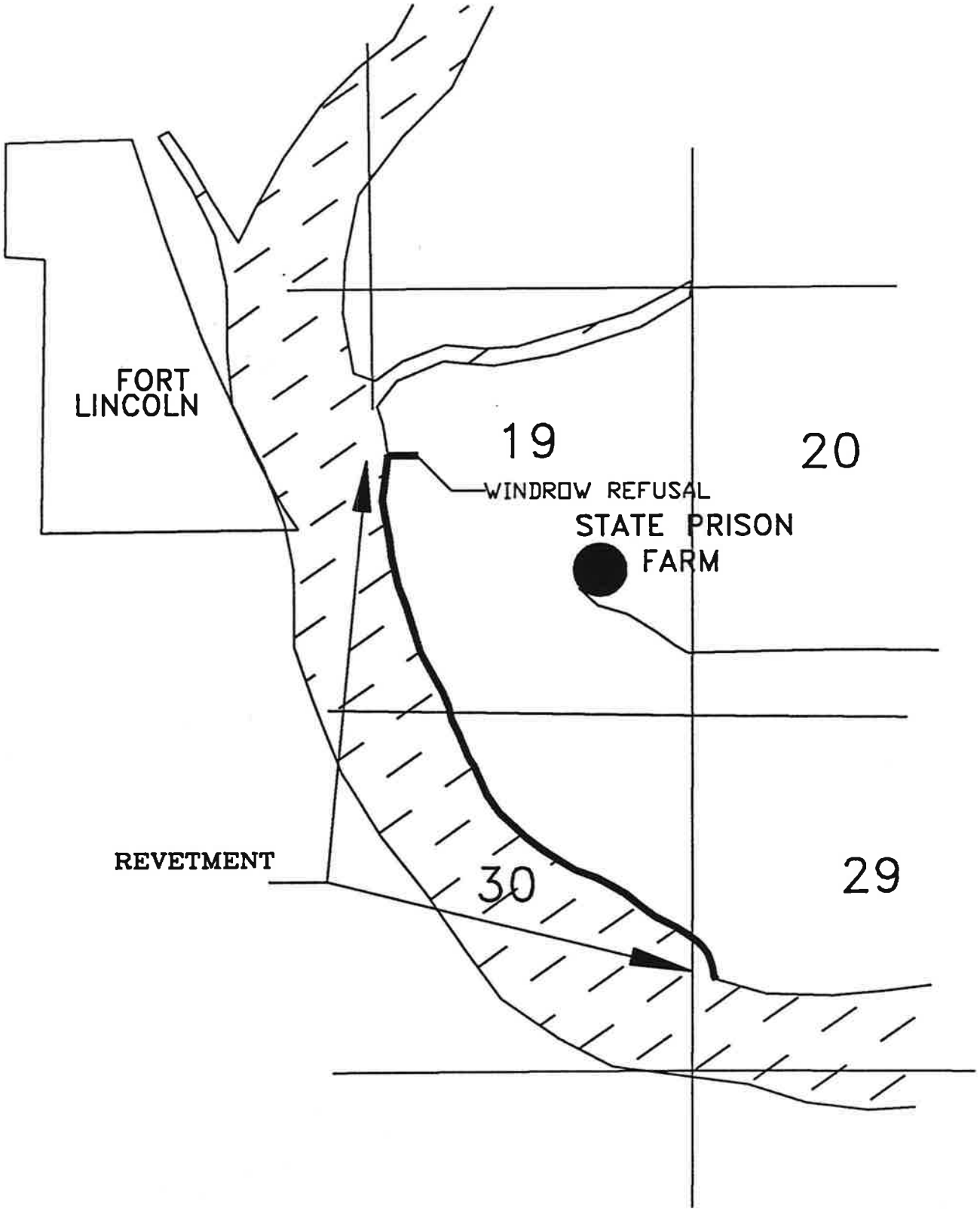

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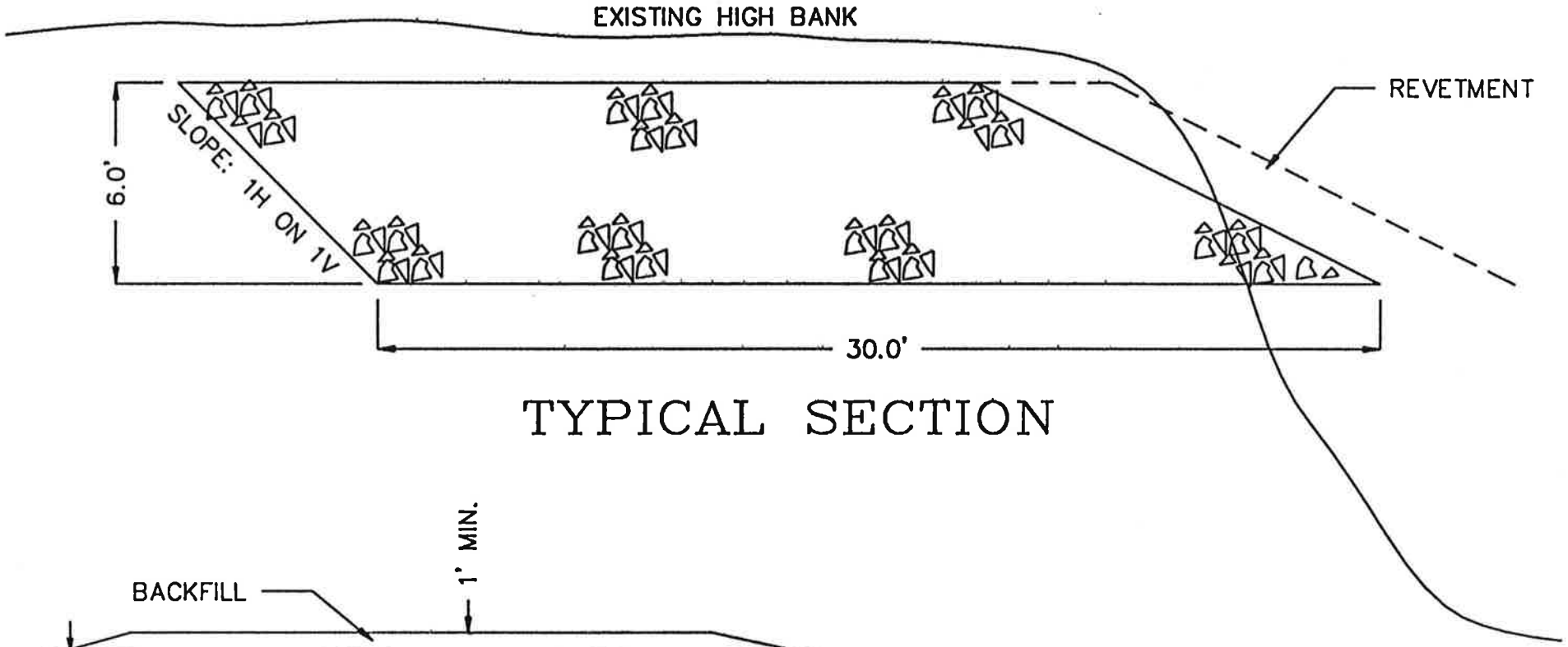
FIGURE 3

back from the bank, Figure 4. A cost estimate for Alternative One is shown below.

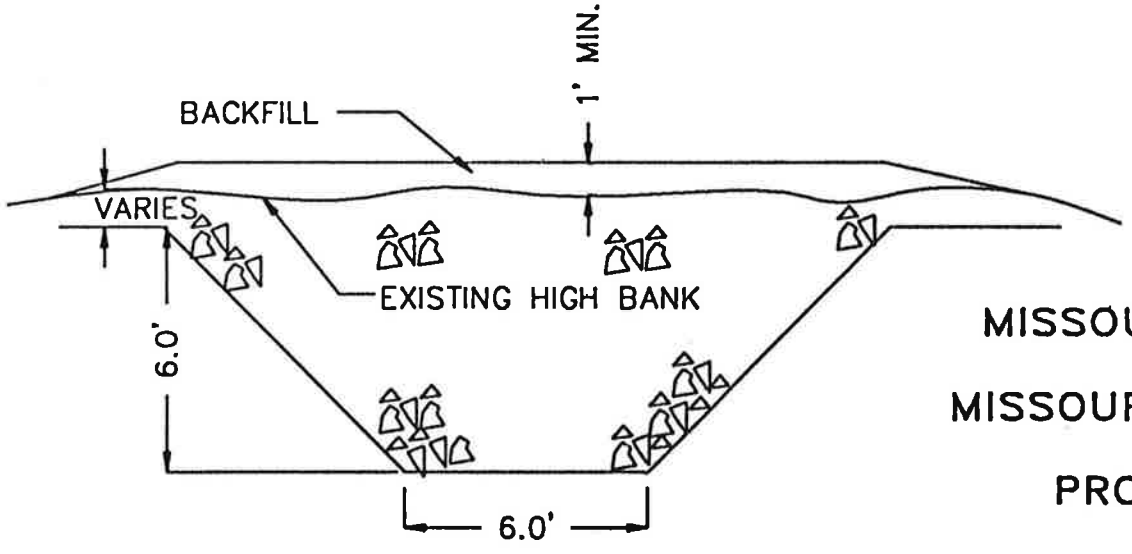
Cost Estimate - Alternative One

Item	Quantity	Unit	Unit Cost	Cost
Mobilization		L.S.	$3,000.00	$ 3,000
Rock Riprap	25,185	C.Y.	30.00	755,600
Excavate	68,520	C.Y.	3.00	205,600
Revegetation	9	Ac.	400.00	3,600
Grubbing and Clearing	10	Ac.	300.00	3,000
Subtotal				970,800
Engineering (+/-10%)				96,400
Contract Administration (+10%)				96,400
Contingencies (+/-10%)				96,400
Total				$1,260,000

ALTERNATIVE #1
WINDROW REFUSAL



TYPICAL SECTION



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WINDROW REFUSAL
PROFILE AND TYPICAL SECTION
SCALE: 1" = 5'
FIGURE 4

Alternative Two - Segmented Revetment:

This alternative is essentially the same as Alternative One except that the revetment is divided into several sections with unprotected bank between the sections, Figure 5. The segmented revetment would protect the areas where the revetment is located. The unprotected areas between the segments would continue to erode for a time, but would stabilize a few feet behind the revetments. Each section of riprap would have a windrow refusal on the upstream end. A cost estimate for Alternative Two is shown below.

Cost Estimate - Alternative Two

Item	Quantity	Unit	Unit Cost	Cost
Mobilization		L.S.	$3,000.00	$ 3,000
Rock Riprap	15,500	C.Y.	30.00	465,000
Excavate	34,400	C.Y.	3.00	103,200
Revegetation	5	Ac.	400.00	2,000
Grubbing and Clearing	6	Ac.	300.00	1,800
Subtotal				575,000
Engineering (+/-10%)				57,700
Contract Administration (+/-10%)				57,700
Contingencies (+/-10%)				57,600
Total				$748,000

ALTERNATIVE #2
RIPRAPPED BANK ALIGNMENT

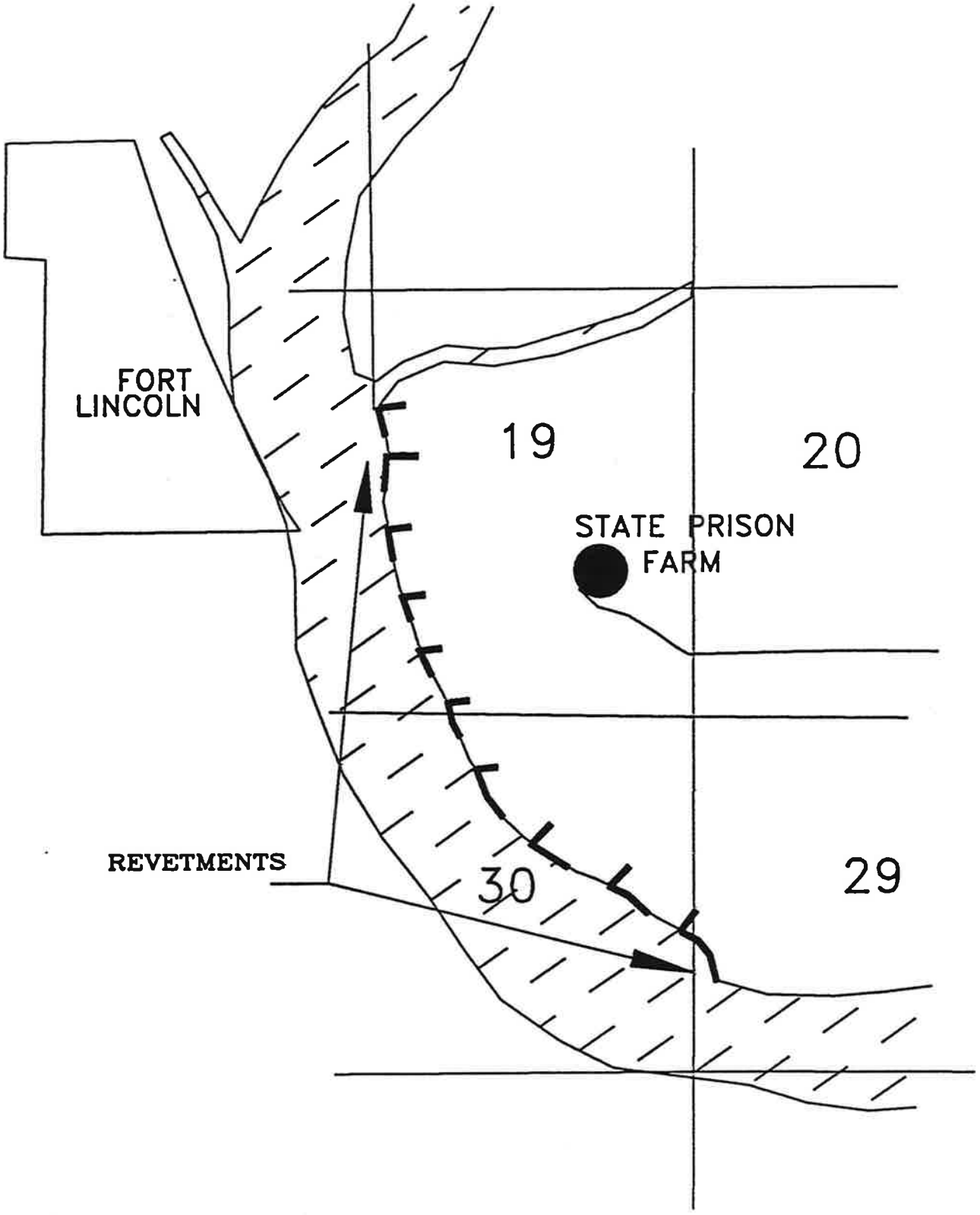

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FIGURE 5

Alternative Three - Windrow Revetment:

This alternative would consist of stockpiling rock in a windrow revetment on top of the bank; the alignment of the revetment would follow the existing bank line. The windrow revetment would contain approximately 8 tons of rock per lineal foot. As the windrow is undercut, riprap will slide down the bank and armor the eroding area to prevent further undercutting. The revetment could be buried along the bank to improve the aesthetics of the area. The trench to bury the revetment would be 5 feet deep with a bottom width of 12 feet and 1:1 side slopes. The material excavated from the trench would be used to bury the riprap. Cost estimates for Alternative Three are shown below.

Cost Estimate
Alternative Three - Above Ground

Item	Quantity	Unit	Unit Cost	Cost
Mobilization		L.S.	$2,000.00	$ 2,000
Rock Riprap	25,100	C.Y.	30.00	753,000
Grubbing and Clearing	11	Ac.	300.00	3,300
Subtotal				758,300
Engineering (+/-10%)				75,900
Contract Administration (+/-10%)				75,900
Contingencies (+/-10%)				75,900
Total				$ 986,000

Cost Estimate
Alternative Three - Buried

Item	Quantity	Unit	Unit Cost	Cost
Mobilization		L.S.	$3,000.00	$ 3,000
Rock Riprap	25,100	C.Y.	30.00	753,000
Excavate	30,360	C.Y.	3.00	91,100
Seeding	11	Ac.	200.00	2,200
Grubbing and Clearing	11	Ac.	300.00	3,300
Subtotal				852,600
Engineering (+/-10%)				85,800
Contract Administration (+/-10%)				85,800
Contingencies (+/-10%)				85,800
Total				$1,110,000

III. CONSTRUCTION

General:

The only materials which will need to be brought to the site are the rock for riprap. There is no rock available in the Missouri River bottoms; therefore, the rock will have to be hauled in from the adjoining high ground. This will result in a relatively long-haul distance which will increase the cost of the project.

Due to the high cost of the project it may be desireable to construct the project in phases. Alternative Two would be the easiest to construct in phases if necessary. Several segments could be built in the most active erosion areas each year over a period of several years. Due to the dynamic nature of the river, the areas to be protected each year under a phased approach would have to be determined during the year construction would take place. Alternatives One and Three would be much more difficult to construct in phases.

Potential Participating Agencies:

Because the Missouri River functions as a conveyance channel between the Corps of Engineer's reservoirs and because the bank erosion is a result of the operation of the dams, the Corps of Engineers is responsible for bank protection along the Missouri River. The Corps is willing to purchase an interest in eroding land, but is currently not willing to construct protection works unless the structures can be completed for less than the cost of

purchasing the interest in the eroding land. Although this project should be submitted to the Corps of Engineers for consideration, it must be assumed that, based on their statements to date, they will refuse to protect the bank.

The State Water Commission can provide engineering assistance, but construction funding is not available. Although the erosion at this site is very active, it is only one of the 54 sites identified between Garrison Dam and Lake Oahe. Obviously the state does not have the resources to protect all these sites at an estimated cost of $17 million. The Water Commission is continuing an effort to persuade the Corps to protect these erosion areas.

Governor Sinner suggested that the National Guard may be able to provide assistance. Their involvement could lower the costs. However, it should be noted that construction must be completed in a timely manner to ensure that the bank does not continue to erode and affect the alignment of the revetment.

A major cost of the project is the transportion of rock to the site. If the National Guard is unable to construct the entire project, perhaps they can transport and stockpile the rock at the site. It may also be possible for the National Guard to fracture the rock before stockpiling.

Alternative Three may be the best alternative for construction by the National Guard, as the need to complete the project without

halting construction is not as great. Also, the level of expertise required to construct Alternatives One and Two is much greater than for Alternative Three.

Regulatory Requirements:

A Section 404 permit must be obtained from the Corps of Engineers before any fill can be placed in a waterway. Also, a Sovereign Lands permit must be obtained from the North Dakota State Engineer's Office to allow construction below the ordinary high water mark.

IV. SUMMARY

The Missouri River Correctional Center is losing land due to bank erosion caused by the Missouri River. Although the low level of Lake Oahe may be contributing to the severity of the erosion, the erosion will continue unless the bank is protected. Several alternatives were considered as potential solutions to the bank erosion problem.

Alternative One, consisting of a continuous revetment, would provide the most protection, stabilizing the entire reach near the existing bank. Alternative One was also the most expensive alternative, with an estimated cost of $1,260,000.

Alternative Two, consisting of a segmented revetment, would provide adequate protection near the existing bank. The main advantage of Alternative Two was the reduction in cost, at an estimated cost of $748,000; it was the least expensive alternative.

Alternative Three, consisting of a windrow revetment, would provide excellent protection along the entire reach. However, the protection is set back from the existing bank, and unlike Alternatives One and Two, which provide protection close to the existing bank, a significant amount of land will be lost before Alternative Three begins to protect the bank. The estimated cost of this alternative, $986,000, is less than the cost of Alternative One. Unfortunately, this alternative would be very unsightly. If the rock is buried to improve the appearance of the project, the cost estimate increases to $1,110,000.

V. RECOMMENDATIONS

Alternative Two provides protection to the majority of the bank and reduces erosion in the remainder of the reach. It is also the least costly alternative. Therefore, Alternative Two is recommended.

If the National Guard is able to participate in the construction, discussions should be held between representatives of the Governor's Office, the Department of Corrections, the National Guard, and the State Water Commission to determine the preferred alternative and the responsibilities of each agency.