Clearwater River Stream Bank Stabilization and Revitalization Project

Report by:
Red Lake Watershed Staff
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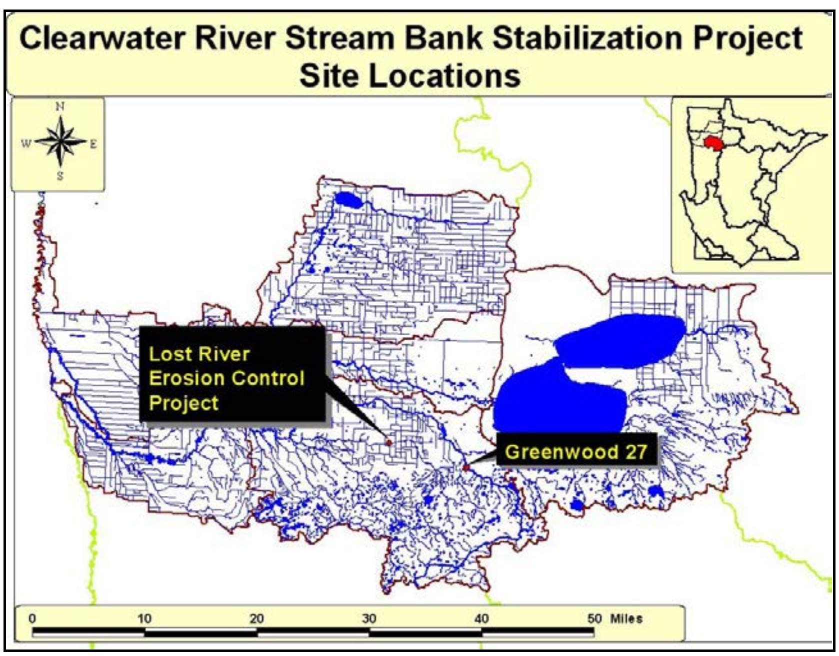
Introduction

The Clearwater River Stream Bank Stabilization and Revitalization Project is part of Phase II (implementation phase) of the Clearwater River Nonpoint Study. Phase I of the Clearwater River Nonpoint Study (1994) identified bank stabilization along the Clearwater River and its tributaries as a method to improve water quality in the Clearwater River watershed. Phase II of the project identified and assessed specific areas of severe erosion in the Clearwater River watershed. The erosion problem on Greenwood 27 was occurring on a much larger scale relative to previously implemented bank stabilization projects.

In April of 1999, the Red Lake Watershed District (RLWD) submitted a grant proposal to the Minnesota Pollution Control Agency (MPCA) to help fund a stream stabilization project on the Clearwater River that would include three sites: Section 27 of Greenwood Township in Clearwater County, Section 6 of Gully Township in Polk County, and Section 31 of Equality Township in Red Lake County, Minnesota. In June of 1999, the MPCA granted approval to provide a 319 grant. The grant funding was available in the year 2000. The Red Lake Watershed District was awarded $134,500.00 in matching grant funds by the Minnesota Pollution Control Agency for projects totaling $269,000.00 in cost. This funding is provided through the Section 319 Nonpoint Source Implementation Program. The goal of this project is to make improvements to water quality in the Clearwater River Watershed while demonstrating effective methods to use in future stream and stream bank stabilization in the Red Lake Watershed District.

The first project to be completed was the Greenwood 27 project. After the original work was completed, additional work was needed in order to ensure the success of the project. Since the erosion occurring at the Equality 31 site was determined to be part of the natural evolution of the stream, the funds allocated to that site were reallocated for additional work on Greenwood 27, which was completed in the fall of 2003. Construction at the Gully 6 site took place during the fall of 2003 as well.



General Work Plan for Each Site

Data collection

This task involved collecting data for use in designing and implementing erosion control measures. Work included a site survey that included alignment, channel profiles, and cross-sections. Additional field data on soils, vegetation, hydrology and geomorphology was collected to allow determination of stream stability characteristics following the methods of the Rosgen classification system. This item included field measurements of stream flow to supplement available stream flow records and statistical analyses. Photos were taken of each site for use in design and for further use in the information and education components of this project.

Analysis

This task provided a description of the problems occurring at each site. Specific goals and alternative solutions were identified and analyzed for each site. Alternative solutions were reviewed to ensure that selected designs meet site-specific needs as well as broad program goals.

Design

This task involved applying selected alternative solutions to each site. Design measures were implemented to achieve project goals-such as to improving stream stability, fish and wildlife habitat, water quality, and concurrently reducing erosion and non-point source pollution.

Construction Documents

This task involved developing the design and construction documents (plans, specifications, and bid documents) of the selected alternatives for each site. Engineer's estimates for the costs of implementation were also provided.

Right Of Way

This task included defining the land area necessary for implementing the selected erosion control measures. Easements were secured for short-term access for data collection and construction activities, as well as long-term access for the purpose of monitoring and demonstration tours.

Permits

This task included applying for required federal, state, and local governmental unit permits from the Corps of Engineers, MPCA, MDNR, and MWCA permits, as required.

Selection of contractor

This task involved advertising and receiving bids or contractor quotes as required to complete the planned construction work at each site. Contractors were selected from this process.

Construction management and inspection

This task involved providing all construction management and inspection services. This work included staking, performing construction observation and inspection, and certifying the quantities for pay requests.

Monitoring

This includes implementing a monitoring program to assess the success of the work at each site. A plan was provided utilizing the Standard Operating Procedures manual from the Red Lake Watershed District. Monitoring includes a combination of assessments. Physical assessments include establishing bank pins, cross-section monuments, and benchmarks for reference in the ongoing monitoring of the project. Photo reference points have been established so that successive photo records can be taken from the same reference points. Biologic assessments may be performed and may include monitoring of vegetation and other biotic indices. Monitoring activities are planned to continue once a year into the indefinite future to ensure success and stability of the project and area.

Information & Education

This task includes the preparation of newsletter articles describing the demonstration project. This task included the creation of this report. Tours of the demonstration sites will be given as part of the information and education efforts. This task also includes formation and meeting times of project committees. The committees consist of permit agency and other interested agency workers, landowners, local officials and RLWD-SWCD representatives.

Budgets

Greenwood 27 Project (original project design) – Original Budget

Activity	Responsibility	Match	Grant	Total
Design/Analysis/ Bid Documents	Clearwater Nonpoint Funding	$10,000.00	$14,000.00	$24,000.00
Right-of-Way	Landowners	$1,000.00		$1,000.00
Work Easement	Landowners	$5,000.00		$5,000.00
Permits/ Advertising	Clearwater Nonpoint Funding	$2,000.00		$2,000.00
Construction	Landowners	$5,000.00	$70,500.00	$132,000.00
	SWCD (special projects)	$25,000.00		
	Clearwater Nonpoint Funding	$31,500.00		
Monitoring/ Information/ Education	Clearwater Nonpoint Funding	$5,000.00		$5,000.00
Total		$84,500.00	$84,500.00	$169,000.00

Gully 6 and Equality 31 Projects – Original Budget

Activity	Responsibility	Match	Grant	Total
Design/Analysis/ Bid Documents	Clearwater Nonpoint Funding	$11,268.00	$10,268.00	$21,536.00
Right-of-Way	Landowners	$1,000.00		$1,000.00
Work Easement	Landowners	$2,000.00		$2,000.00
Permits/ Advertising	Clearwater Nonpoint Funding	$1,000.00		$1,000.00
Construction	Landowners/SWCD/ Clearwater Nonpoint Funding	$31,732.00	$39,732.00	$71,464.00
Monitoring/ Information/ Education	Clearwater Nonpoint Funding	$3,000.00		$3,000.00
Total		$50,000.00	$50,000.00	$100,000.00

Equality 31 Funds Allocated to Additional Work at Greenwood 27

Activity	Responsibility	Match	Grant	Total
Design/Analysis/ Bid Documents	Clearwater Nonpoint Funding	$3,500.00	$3,500.00	$7,000.00
Right-of-Way	Landowners	N/A	N/A	N/A
Work Easement	Landowners	N/A	N/A	N/A
Permits/ Advertising	Clearwater Nonpoint Funding	$300.00		$300.00
Construction	Landowners/SWCD/ Clearwater Nonpoint Funding	$10,000.00	$10,000.00	$20,000.00
Monitoring/ Information/ Education	Clearwater Nonpoint Funding	$1,000.00		$1,000.00
Total		$14,800.00	$13,500.00	$28,300.00

Funds Remaining for the Gully 6 Project

Activity	Responsibility	Match	Grant	Total
Design/Analysis/ Bid Documents	Clearwater Nonpoint Funding	$7,768.00	$6,768.00	$14,536.00
Right-of-Way	Landowners	$1,000.00		$1,000.00
Work Easement	Landowners	$2,000.00		$2,000.00
Permits/ Advertising	Clearwater Nonpoint Funding	$700.00		$700.00
Construction	Landowners/SWCD/ Clearwater Nonpoint Funding	$21,732.00	$29,732.00	$51,464.00
Monitoring/ Information/ Education	Clearwater Nonpoint Funding	$2,000.00		$2,000.00
Total		$35,200.00	$36,500.00	$71,700.00

Actual Expenditures for the Original Greenwood 27 Project

Activity	Responsibility	Match	Grant	Total
Design/Analysis/ Bid Documents	Clearwater Nonpoint Funding	$10,000.00	$14,000.00	$24,000.00
Right-of-Way/ Work Easements	Landowners	$17,822.36		$17,822.36
Permits/ Advertising	Clearwater Nonpoint Funding	$1,544.98		$1,544.98
Construction	Landowners	$18,500.00	$70,500.00	$154,942.75
	SWCD (special projects)	$25,000.00		
	Clearwater Nonpoint Funding	$40,942.75		
Monitoring/ Information/ Education	Clearwater Nonpoint Funding	$2,232.42		$2,232.42
Total		$116,042.51	$84,500.00	$200,542.51

Actual expenditures for Additional Greenwood 27 Work

Activity	Responsibility	Match	Grant	Total
Design/Analysis/ Bid Documents	Clearwater Nonpoint Funding	$3,076.84	$3,500.00	$6,576.84
Right-of-Way	Landowners	N/A	N/A	N/A
Work Easement	Landowners	N/A	N/A	N/A
Permits/ Advertising	Clearwater Nonpoint Funding	$771.75		$771.75
Construction	Landowners/SWCD/ Clearwater Nonpoint Funding	$22,714.93	$10,000.00	$32,714.93
Monitoring/ Information/ Education	Clearwater Nonpoint Funding	$42.24		$42.24
Total		$26,605.76	$13,500.00	$40,105.76

Actual Expenditures for the Gully 6 Project

Activity	Responsibility	Match	Grant	Total
Design/Analysis/ Bid Documents	Clearwater Nonpoint Funding	$15,364.93	$10,250.00	$25,614.93
Right-of-Way/ Work Easement	Landowners	N/A	N/A	N/A
Permits/ Advertising	Clearwater Nonpoint Funding	$2,004.21		$2,004.21
Construction	Landowners/SWCD/ Clearwater Nonpoint Funding	$6,725.32	$26,250.00	$32,975.32
Monitoring/ Information/ Education	Clearwater Nonpoint Funding	$400.00		$400.00
Total		$24,494.46	$36,500.00	$60,994.46

Milestone schedule

Timeline for Greenwood 27 (original design of project)

Activities	Feb/Mar, 2000	Apr./ May, 2000	June/ July, 2000	July/Oct. 2000	Oct. 2000/Dec. 2001	2001	2002	2003
Analysis	X							
Design	X	X						
Construction Documents		X	X					
Right of Way			X					
Permits				X				
Selection of Contractor				X				
Construction Management And Inspec.					X			
Monitoring			X	X	X	X	X	X
Information & Education	X	X	X	X	X	X	X	X

Timeline for Greenwood 27 (additional work on project)

Activities	Feb/Mar 2002	Apr/July 2002	July/Oct 2002	2003	2004	2005	2006
Analysis	X						
Design	X	X	X	X			
Construction Documents				X			
Right of Way				X			
Permits				X			
Selection of Contractor				X			
Construction Management And Inspect.				X			
Monitoring	X	X	X	X	X	X	X
Information & Education	X	X	X	X	X	X	X

Timeline for Gully 6 and Equality 31

	2000	Feb/Mar, 2001	Apr./ May, 2001	June/ July, 2001	July/Aug. 2001	Aug. 2001/Mar 2002	2002	2003
Analysis		X						
Design		X	X	X	X	X	X	X
Construction Documents			X	X				
Right of Way				X				
Permits								X
Selection of Contractor								X
Construction Management And Inspec.								X
Monitoring	X	X	X	X	X	X	X	X
Information & Education	X	X	X	X	X	X	X	X

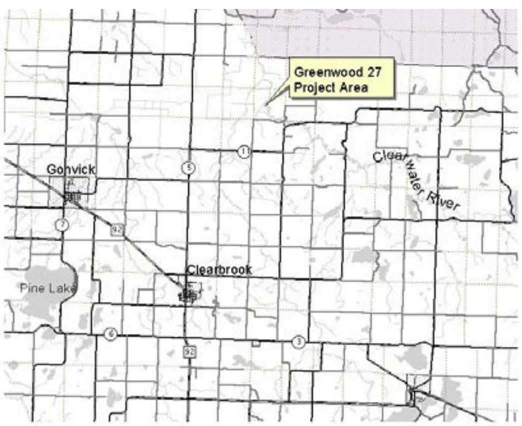
Greenwood 27 Project

Location

The project site is located on the Clearwater River within the Eastern ½ of Section 27 of Greenwood Township in Clearwater County. Most of the land surrounding this location is privately owned.

History

The US Army Corps of Engineers began a channel improvement project on the Red Lake and Clearwater Rivers in 1946, and completed the project in 1956. This work provides the Clearwater River with a channel capacity adequate to handle approximately a 5-year runoff event and included channelization of a reach approximately 38 miles. The work extends upstream from approximately river mile 41 to river mile 78.8. The aim of the stream bank stabilization and revitalization project is to stabilize the Clearwater River in the reach immediately upstream from the Corps channel project. This stream segment is actively eroding and the channel is degrading (downcutting). (Clearwater River Stabilization Project, pg. 1).



Problem Description

The Clearwater River in the project area was actively eroding prior to the project. Headcutting was occurring upstream of the USACE channelization project. Do to this straightening of the stream, the stream grade had increased in this area and channel banks were eroding around meanders. Channel erosion had increased the sediment supply to the river, and sandbars and sediment deposits were reported in the channelized portion downstream.
Mr. John Sandland is a landowner in the project area. He estimated that the river channel bottom had eroded (downcut) up to five feet over the last 30 years. Mr. Sandland was concerned that downcutting could cause failure of an in place (rock dam) grade control structure. Failure of this structure would affect an irrigation water supply channel and allow headcutting to continue up the Clearwater River and its tributaries. (Clearwater River Stabilization Project, pg. 2).

Greenwood 27 Streambank Stabilization Project Monitoring Plan

There are a few different sets of guidelines available for performing physical channel monitoring. For this plan two would be utilized, "Channel Monitoring Methodology" written by Dave Rosgen and presented at the Fifth Federal Interagency Sedimentation Conference (1991); and "Establishing Permanent Photo Points". Two types of monitoring will be performed, permanently photographed points and physical channel measurements.

Methods

The Greenwood 27 project area involves concerns with both vertical and lateral stability of the channel and the floodplain. Along with the monitoring of vertical and lateral stability, bed composition should be monitored to observe any shifts due to lack of stability or stabilization due to work performed. The work will involve five different aspects of geomorphological monitoring: bank pins, toe pins, monumented cross-sections and photographic points.

Monumented Cross-Sections

Monumented cross-sections will be employed at three locations on the Clearwater River in this area. The first cross section will be located above site D, the second will be located in the straight stretch of channel below site D and the third will be located on site A (Figure 1). Another site may be site B, depending on time and expense. During 1997 Houston Engineering, Inc. surveyed the Greenwood 27 site for the Red Lake Watershed District. This work involved several cross sections at certain points along the stream reach. A couple of these old sites will correspond to the monumented cross-sections proposed here. This information may be used for a background of pre-existing conditions before work was done in this area. The setup of these monumented cross-sections should proceed as follows:

1) Set up benchmarks using the original surveying work. A long rod (longer than 7 feet) will be pounded into the ground at the cross-section benchmarks on each side of the river. These will be surveyed and tied to the old benchmarks.
2) Measure the profile of the stream using the installed benchmarks. Do this by the following steps:
   a) Locate the permanent bench mark on both sides of the stream
   b) Stretch the measuring tape very tight with spring clamp and level tape
   c) Tape at same elevation as reference rod on bench mark
   d) Read distance and elevation reading of rod intercept with tape
   e) Measure major features including: left bench mark, left terrace/floodplain, left bankfull, left bank, left edge of water, differences in bed configurations across bed, thalweg, inner berm features, right edge of water, right bank, right bankfull, right terrace/floodplain, right bench mark.
3) Plot the cross-section and compare to previous measurements, note any high water marks and perform this annually or following storm flow/snowmelt runoff events.
4) Prepare a vicinity map and detailed site map for future location.

Bank Pins

To determine the lateral stability the Greenwood 27 work sites, bank pins will be installed at sites A and B (Figure 1). These two areas are where bank stabilization will be performed and should be located on the monumented cross sections. If time and money are not factors, bank pins should be installed at site C and a couple of straight reaches in this project area. These additional sites would give insight into lateral and vertical stability of the project area on a whole, rather than just monitoring the bank stabilization areas themselves.

The procedures for the bank pin installation are as follows:

1) Pound two or three smooth rods (5-7 feet in length) into the bank horizontally at even increments down the side of the bank.
2) Measure from the end of the rod to the bank at least once annually and more after storm periods or large runoff events.

Toe Pins

To determine the effectiveness of the proposed work at sites F, G, I, J, K, L and M, toe pins will be installed in the small channel ravines. The procedure is as follows:

1) Pound smooth rods (10-15 feet in length) into the thalweg of these small ravines. The rods will be located about 25 to 50 feet upstream of sites F, G, I and J. Two more rods will be pounded just above and below the points of headcutting in these small ravines (three separate ravines in total). About 3 to 4 feet should be left above the thalweg, depending upon the bank height of the ravines.
2) The distance from the end of the rod to the ground level should be measured once annually.
3) The horizontal distance between the rods above and below the points of headcutting should be measured along with the point of headcutting to determine if further headcutting is occurring. This should be done once annually.

Bed Composition

The bed composition should be measured along with the monumented cross sections. This may be accomplished by the River Watch program in Clearbrook-Gonvick, who will come up with a plan for this work.

Photographic Points

Photographs can be used to evaluate trends in riparian vegetation, stream bank stability and cover. In order to accomplish this, permanent photo points will be established at point A, point B, point K and near points G and H (Figure 1). Establishment of photo points at A and B will accomplish the goals listed above on stream bank and grade stabilization sites. The photo points at K and G/H will identify success of the floodplain work in delaying headcutting and establishing deposition along with identifying any vegetative succession. The photo points at points A and B will be established at the rod placed for the monumented cross section. Separate rods will be placed and marked at points K and G/H. The procedure for establishment and recording data are as follows:

1) Set the camera up at the rod marker for the monumented cross section or pound a 10 foot smooth rod into the ground at point which will not be inundated by water and which illustrates the work done at point K, L and M or at points G and H. The photo point should include a view of the ravine channel and upland floodplain. This may require three shots at one photo point. Ensure that the rod is permanently marked with surveying paint.
2) Acquire a profile board (1/3 meter by 2.5 meter plywood board marked in 0.5 meter intervals of alternating black and white). Using a measuring tape, measure 50 feet from the photo point, at a point about three feet from the waters' edge. Using another rod, mark where the board is placed. As mentioned above, there should be an upstream and downstream shot at the bank stabilization sites and two to three shots at each point on the floodplain.
3) Include landmarks such as large trees or ridgelines in the shots to assure that each scene can be relocated by different observers. Include a clipboard or chalkboard in the photograph with date, time and station location.
4) The same camera, lens, film type, tripod height and light conditions should be used in each photograph. Record this for future observers. Use Kodachrome™ slide film for the photograph.
5) Record the photo points on the same map as the rest of the monitoring efforts.

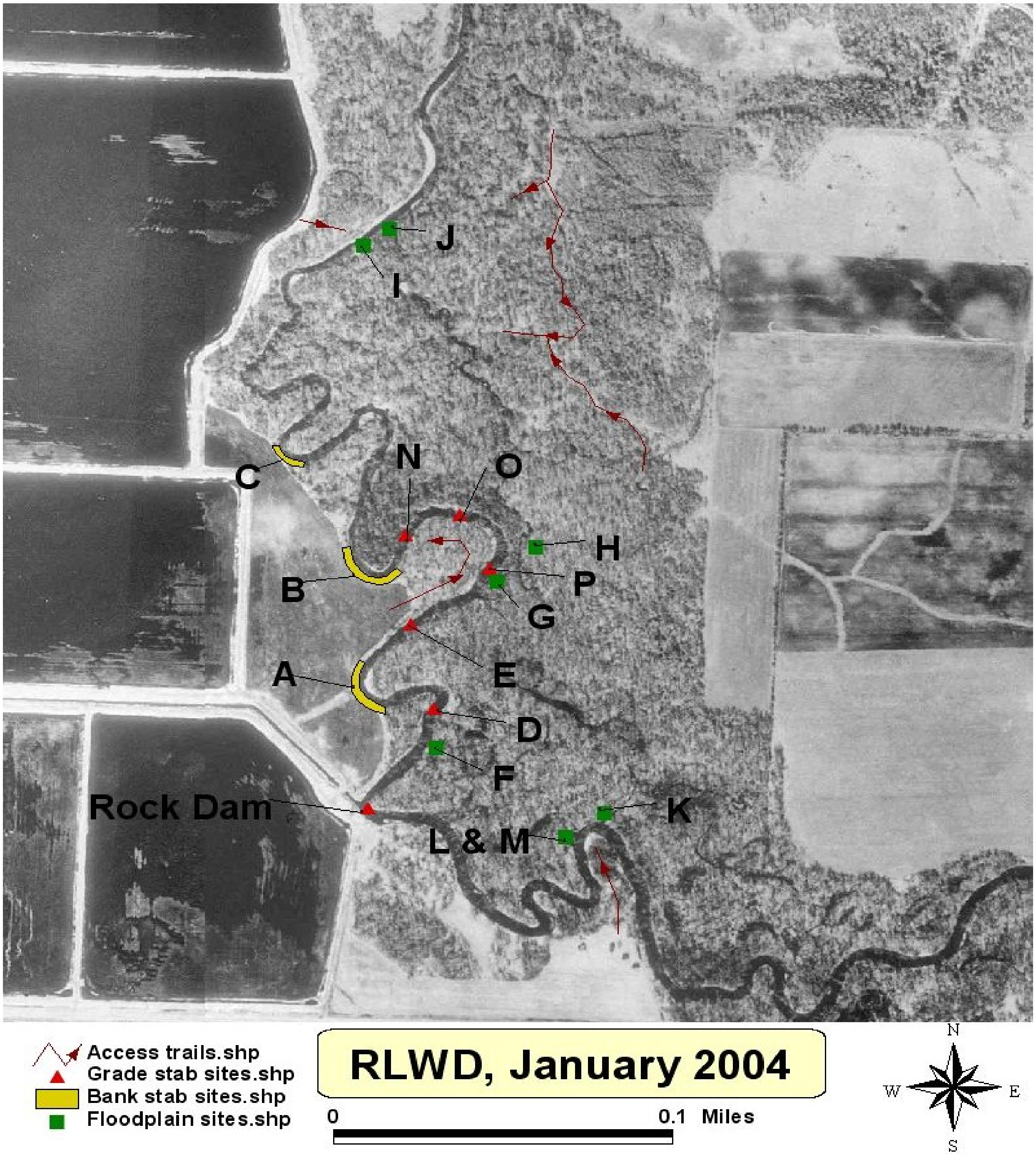
Vegetation Monitoring and Control

According to the requirements for vegetation management in Chapter 8420.0530, D of Minnesota Rules, control of noxious and invasive species is necessary for the success of wetland establishment. The RLWD will monitor the vegetation through the first five years of wetland establishment by inspection of the site and use of the photographs taken at the photographic reference points. Should noxious or invasive species be noted the RLWD will address these by use of recommended herbicides and reseeding of these areas at mixes and rates recommended by members of the local technical evaluation panel.

Equipment List for Monitoirng Based Upon Rosgen's Channel Monitoring Methodology

- Measuring tape
- Clip Board
- (10) Smooth Rods (10 feet or longer in length)
- (6) Smooth Rods (about 7 feet in length)
- Shovel or spade
- Post pounder
- Field Notebook, pens and pencils
- Surveying paint
- Surveying staff
- Camera, film and tripod
- Vegetation profile board
- Vicinity map
- Detailed site map
- Waders

Greenwood 27 Project Area



Completing the project

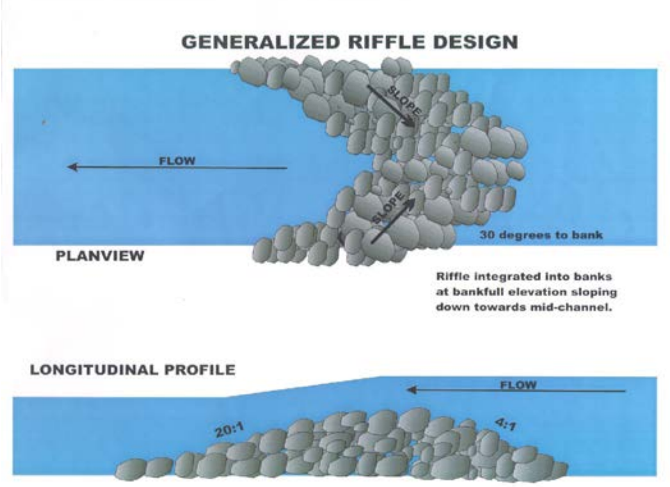
Before October 1999, the data collection phase of this project was completed. Houston Engineering completed a preliminary survey of the Clearwater River. The data collection included field data (cross-sections and stream profiles), stream flow records, and stream stability characteristics. Starting in the fall of 1999, engineering bids were submitted and Jeff Langan, an engineer from Widseth, Smith and Nolting (WSN), was selected for analysis and project design. Specific goals were set and alternative solutions were reviewed with the assistance of committee members. Some analysis occurred during the permitting process, which included alternative designs of grade control structures recommended by DNR personnel.

In the year 2000, a committee consisted of Red Lake Watershed District staff and a board member (Vernon Johnson), Clearwater County Soil and Water Conservation District staff, county board members, county staff (WCA and Environmental Services), BWSR staff, MPCA staff, area landowners, concerned citizens, Minnesota DNR staff, and Army Corps of Engineers staff. The committee was a success and this type of implementation strategy will be employed during RLWD projects in the future. The project design was completed in May 2000. Additional design recommendations mentioned above were added and a final project design was established in August 2000.

Four major components made-up the Clearwater River Bank Stabilization and Revitalization project. They are bank stabilization, grade stabilization, rock-riffle structures, and floodplain restoration. Below is a short paragraph detailing each area.

Bank stabilization was performed on three outside edges, or cutbanks of meanders in the Clearwater River. The reshaping of the stream bank at sites A, B, and C, was designed to protect the stream banks from toe failures due to the curves in the river, headcutting affects, and the appearance of the upper bank sloughing in the three areas. Riprap was anchored into the toe of the slopes, and the top of the riprap was placed at full bank flow. From the upper limit of the riprap to near the top of the bank and at the upstream and downstream points of rip rap, dense Red Willow fascines and live stakes were planted. Grass seed mix and geo-textile fiber blankets were also installed along the banks to stabilize the willows. The bank stabilization sites were designed to protect the bank from further erosion, and also protect the fields and the field access roads.

Grade stabilization (grade control structures or rock riffles) structures were placed in sites D and E. These sites were located in the channel, 400 ft and 1100 ft downstream of an already in-place rock dam. The purpose for these two sites was to stop any additional headcutting that most likely would continue to move upstream from the channelized segment. After straightening of the Clearwater River in the 1950's, the velocity of flow increased from 2 to 3 feet/second to 7 to 8 feet/second at these locations. Site D grade stabilization was placed 400 ft downstream to protect the present rock dam from the effects of headcutting. Each rock riffle structure was constructed by placing riprap along the sides of the river, beginning at the toe of the bank and continuing into the channel of the river at sites D and E. The center of the grade structure was in the center of the thalweg of the river. The rock riffle structures direct water toward the thalewag or center of the river, rather than cutting into the banks of the river.



Examples of Rock Weirs

The third part of the Clearwater River Bank Stabilization and Revitalization project was floodplain restoration using rock grade control structures. During floods, floodwater would cut across meanders in the river, creating eroded channels through the floodplain. This process was threatening the water supply of the nearby commercial wild rice operation. In order to prevent further erosion in the floodplains, rock structures were placed at the inlets and outlets of the floodplain channels in order to slow the velocity of water moving through them during flood events. This part consisted of sites F, G, H, I, and J. Parts of the river bank were rebuilt where the water was obviously leaving the channel. Rocks and geo-textile fiber blankets were placed down into the toe of the bank and worked into the top of the bank and sides to allow for stabilization and a partial block of the continued flow from the main channel of the river into the floodplain. The tops of the rebuilt areas were left lower then the adjacent bank to allow for a 5 or 10-year flood to continue over the top instead of forcing the excess water somewhere else. The cuts in the downstream banks were only minimally re-established to their original shape, which should allow slight high water events to enter into the floodplain. Grade control structures made of rock and clay were also installed along with willow plantings at sites K, L and M.

Red Lake Watershed District staff developed a monitoring plan, which included examination of aerial photographs, physical assessments and establishment of photo reference points. During the fall of 2000, photo reference points were established and pre-project photographs were taken. Videotapes and photographs were also taken of high flow events during the year 2000. These materials will be used for information and education about the project.

The project engineer identified the land area needed for construction and RLWD staff obtained (two) temporary five-year construction easements from the landowners. The landowners provided the easements as in-kind contributions to the project. This task was completed in October 2000.

Project plans, specifications, bid documents, and engineer's estimates were submitted by the project engineer in August 2000. Applications for permits from the Army Corps of Engineers, Minnesota DNR, and county environmental services were submitted in May and June of 2000. All of the required permits were obtained by August 2000.

Advertisements for construction bids were sent out in August and September 2000. A preliminary construction bid meeting was held on September 13, 2000, at which contractors were invited to view the unique project design. This meeting allowed for better estimations for construction bids and ideas for construction from the project engineer and landowners. Construction bids were accepted until 10:00 a.m. September 28, 2000, and at that time were opened at a meeting of the Red Lake Watershed District Board of Managers.

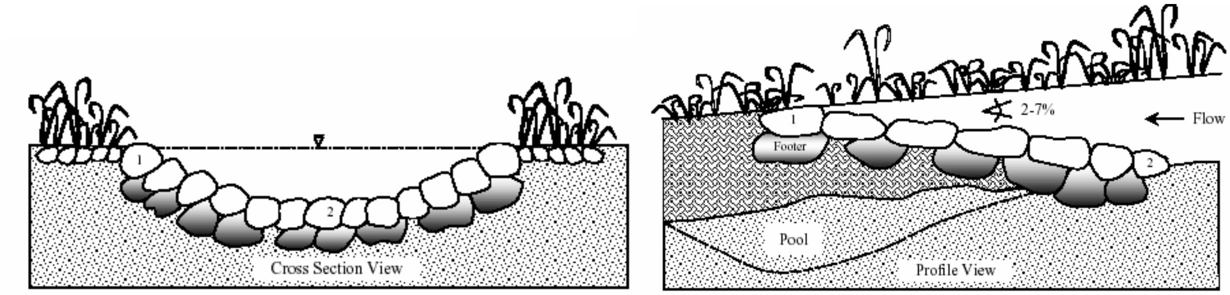
Wright Construction of Thief River Falls, MN, was selected as the construction contractor in October 2000. The contractor stockpiled needed materials (rip-rap) near the project site. John Sandland, area landowner, also provided in-kind construction work, which includes providing access trails and removal of excavated material. Wright Construction subcontracted the bioengineering portion of the project to Lee Nursery of Fertile, MN. The bioengineering portion includes planting of willow stakes and bundles and other seeding. Doug Thompson, Clearwater County SWCD assisted in this effort. Construction continued through 2001 with a scheduled completion deadline of November 15, 2001. Staff from WSN Engineering provided materials inspection and riprap sizing for the contractor.

Area River Watch schools have been informed of monitoring opportunities and may provide biological and other monitoring of the project area. In addition to the video tape, photographs and River Watch involvement, the Red Lake Watershed District continues to provide project updates in their annual reports and reports to other organizations and agencies. The RLWD will also provide newsletter articles or other information to local news publications.

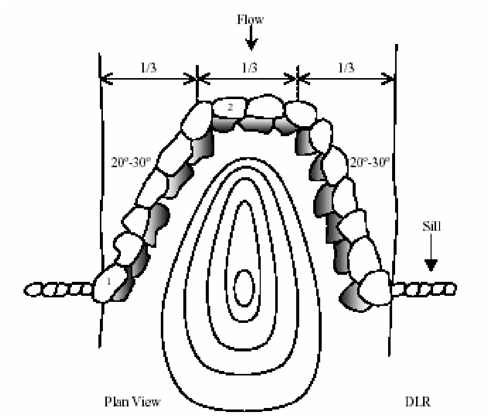
In Appendix A, willow fascines are further discussed.

Additional Work

In February of 2002, the RLWD submitted an updated work plan and explanation to MPCA. The work plan asked for approval of abandonment of the Equality 31 site and for a transfer of these funds to additional work that will be performed at the Greenwood 27 site. Additional work was based on MPCA and DNR staff recommendations for ensuring success of the project. Additional rock riffle structures were deemed necessary downstream of Site E. The reason for this was that there was too much of a drop in water elevation after Site E. Too much of a drop could create a scour hole and threaten the stability of the structure. Additional rock structures within the floodplain scour channels were also suggested, but there was only enough money available to construct the "in-stream" rock-riffle structures. Sites N, O, and P were constructed with geo-textile fiber blanket and rock structures in the channel. Riprap was placed along the sides beginning at the toe of the bank and continuing into the channel of the river at these sites. The center of the grade structure was in the center of the thalweg of the river. The cross-vane weir structures direct water toward the center of the channel and away from the banks of the river.



Diagrams of a Cross-Vane Weir



Examples of Flow Patterns over Cross-Vane Weirs

In the fall of 2002, recommendations for additional riffle structures in the river and grade control structures in the floodplain were received from Luther Aadland, MNDNR River Ecologist, and presented to Curt Meyer of WSN Engineering. A construction cost estimate was worked up in order to determine how much additional work could be done with the money available.

The RLWD has proceeded with plans for more cross vane weir installations and possible work addressing the floodplain erosion "nick points." Curt Meyer of Widseth, Smith and Nolting Engineering created plans and specs for three additional cross vane weirs. An extension of the previous permit for the Greenwood 27 project was received. Minnesota Department of Natural Resources permit fees were paid. All the necessary permits were received (DNR and United States Army Corps of Engineers). WSN Engineering submitted a construction cost estimate. The cost was estimated at less than $25,000, so the plans were initially sent out for quotes. If the quotes were higher than $25,000, then the project would need to be advertised for bids. Before advertising the project for bids, quotes were requested and they were all too high. Olson Construction TRF, Inc. was the successful bidder for the project. The final estimate for construction costs was $31,762.50. The contract date for the project was September 8, 2003. Construction was delayed by the permitting process, but was eventually completed on November 3, 2003. Three cross-vane weir structures were designed to increase the downstream elevation at Site E and reduce the amount of drop in water elevation at this structure. These new grade stabilization sites are labeled as sites N, O, and P. All three structures are similar in form. Areas disturbed during the construction were seeded and covered with wood fiber blankets.

Monitoring

In late June and early July of 2002, the area experienced heavy runoff events. In the fall of 2002 visit to the site, RLWD staff feared the worst for this site after the runoff and flooding. However, most of the site was in great condition. There were no major problems with project failure. The furthest downstream site "C," had some erosion near the top of the bank that resulted from a seven-inch rainfall event. The location of this area is the eastern edge of the bank stabilization work at site C. This problem worsened during the spring of 2004, but was fixed during the summer of 2004.

In late October of 2004, the Clearwater River watershed (and others) received a large amount of rain, resulting in unseasonably high flows. During these high flows, the cross-vane weirs appeared to be working as designed. The most recently installed cross-vane weirs (sites N,O, and P) seem to direct flow toward the center of the stream better than the original rock riffle structures (sites D and E).

In Appendix B are past and current photographs of the Greenwood 27 project.

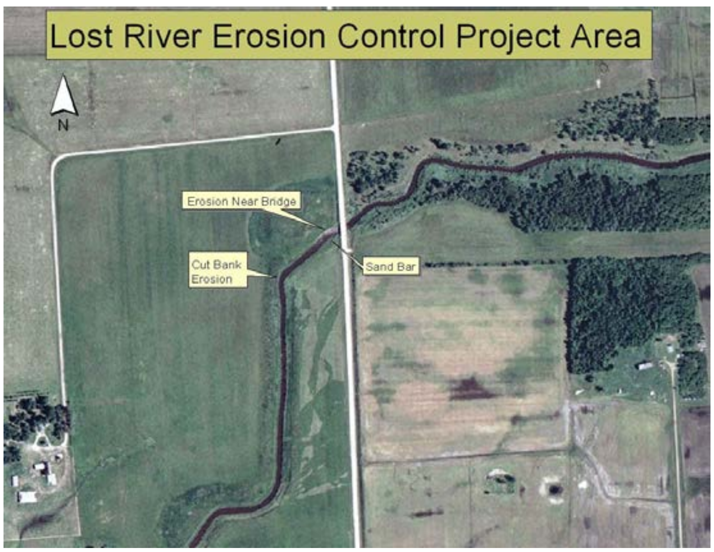
<u>**Gully 6 – Lost River Erosion Control Project**</u>

Background

This part of the Clearwater River Stream Bank Stabilization and Revitalization project was initiated to demonstrate the use of innovative techniques for erosion control, stream stabilization, and water quality improvements. The purpose of this project is to alleviate erosion near the bridge and around a river bend at the project site. This report will summarize the findings of the Lost River Design Report that was prepared for the Red Lake Watershed District by Engineering. This report will also cover the permitting and construction process. Copies of the Lost River Design Report are available at the RLWD office.

Location

The project site is located on the Lost River within Sections 5 and 6 of Gully Township in Polk County. The map below shows an aerial view of the project area.



History

The U.S. Army Corps of Engineers completed a channel improvement project on the Lost River in 1965. This project included clearing and snagging on the lower 20 miles of the Lost River as well as channel work in a reach of approximately 23 miles. The Corps project area extends from the confluence with the Clearwater River near Brooks to Section 28 of Winsor Township near Gonvick. The channel excavation began about two mile west of Oklee and extended 23 miles upstream, from river mile 20.25 upstream to river mile 43.3. The Lost River Erosion Control Project is located near the midpoint of this channelized section at river mile 32.5.

Survey

The Lost River channel in the erosion control project area was surveyed in November 2001 by Red Lake Watershed District staff. Channel alignment, bottom profile, and cross-sections were measured.

Hydrology

The drainage area of the project site is approximately 159 square miles. Flow frequency was examined using data from the USGS gauging on the Lost River in Oklee. The Army Corps of Engineers' River Analysis System (HEC-RAS) was used to complete the channel and bridge hydraulic analysis for the project. Channel capacity, channel profile changes over time, channel cross-section changes over time, and channel bank – full capacity were also examined by Houston Engineering as part of the Lost River Design report.

Stream Classification

The channel characteristics of the Lost River at the project site were examined and summarized in order to classify the channel according to Rosgen methodology. E6 and F6 Rosgen classifications were found within the project area.

Problem Description

There were several areas of active erosion within the project reach. A scour hole was forming downstream of the CSAH 28 bridge. Severe bank erosion is occurring downstream of the bridge as well, along with the formation of a sand bar on the opposite bank. Flow appeared to be directed into the eroding bank. The scour hole and bank erosion downstream of the bridge may have been aggravated by the erosive forces and velocities generated by a rock pile and beaver dam upstream. Channel bank erosion was also occurring along the outside of a meander within the project reach. Point bars were also forming on the outside of the eroding bend. Toe erosion was apparent along this eroding bend, which appeared to be a cause of the bank stability problems. Head-cutting did not seem to be a problem in this reach.

Erosion at Gully 6

Alternative solutions to the problem were evaluated including structural techniques, non-structural techniques, and doing nothing. The "do nothing" approach in this case would have resulted in continued erosion. Non-structural techniques to reduce the rate of runoff were out of the scope of the project and were not feasible alternatives for reaching the project goals. Structural alternatives were the most desirable method for stabilizing banks, reducing lateral erosion, and grade stabilization.

The recommended alternatives were discussed with and approved by the RLWD Board of Managers. These originally included removing point bars, installing a cross-vane weir just downstream of the bridge to direct flow away from the bank and toward the center of the channel, install bendway weirs (see example below) along the outside of the river bend to direct flow away from the bank, retain rocks and beaver dam under the bridge, and retaining vegetation on outside meander banks rather than reshaping the banks. During the permitting process, the Minnesota Department of Natural Resources requested that j-hook rock dams be used instead of bendway weirs. The reasoning for this is that they create a scour hole for fish habitat. Since purposefully creating channel erosion wasn't a desired outcome of this project, stream barbs were used as a compromise. A stream barbs may still create a scour hole in the channel, but it will be smaller than one from a j-hook rock dam. Stream barbs are pointed upstream at a sharper angle than bendway weirs, and also increase upstream sedimentation. Stream barbs, j-hook rock dams, and bendway weirs all work to direct the stream of highest velocity away from the stream bank and toward the center of the channel.

Bendway Weirs in Emardville Township of Red Lake County in 2004 (Installed in 1998)

Permits

Permit applications, plans, and specifications were sent to all agencies with review and permit authority including the U.S. Army Corps of Engineers, MN Department of Natural Resources, MN Wetland Conservation Act, Minnesota Pollution Control Agency, and the Polk County Highway Department. In order to receive a MN DNR permit, the bendway weirs were re-engineered to be stream barbs, similar to j-hook dams, in order to provide better fish habitat through the creation of a small scour hole in the thalweg of the channel.

Construction

Most of the construction for this project was completed in December of 2003. Additional work involving seeding and some stream bank re-sloping will be completed in the spring of 2004. A cross-vane weir was constructed immediately downstream of the bridge and the sand bar was removed to prevent the bank from eroding on the north side and depositing sediment on the south side. The cross-vane weir directs flow down the center of the channel and away from the eroding bank. Three stream barbs were installed to direct the flow around the bend in the river toward the thalweg (center of the channel) and away from the eroding stream banks.

Cross-Vane Weir and Sand Bar Removal at Gully 6 – Summer 2004

Stream Barbs at Gully 6 – Summer 2004

Stream Barb Directing Flow Toward Mid-Channel During November 2004 High Flow

Near the Peak of High Flow in Late October/Early November of 2004

Cross-Vane Weir and Bridge, Looking Upstream

References

Federal Interagency Stream Restoration Working Group. *Stream Corridor Restoration Principles, Processes, and Practices.* October 1998.

HDR Engineering, Inc, Red Lake Watershed District. *Clearwater River Nonpoint Study.* June 6, 1994.

Houston Engineering, Inc. *Lost River Design Report*. June 2003.

Houston Engineering, Inc. Lost River Erosion Control Project Construction Plans and Specifications. 2002.

Natural Resources Conservation Service. "Streambank and Shoreline Protection." *Engineering Field Handbook*, chapter 16. US Department of Agriculture, Washington, DC. December 1996.

Widseth, Smith, and Nolting. Streambank and Grade Stabilization Located Within a Reach of the Clearwater River Within Section 27 of Greenwood Township Construction Plans and Specifications. 2000.

Widseth, Smith, and Nolting. Streambank and Grade Stabilization Located Within a Reach of the Clearwater River Within Section 27 of Greenwood Township Construction Plans and Specifications. 2003.

Appendix A - Willow Fascines

(from the NRCS Streambank and Shoreline Restoration Handbook)

Live Fascines

Live fascines (fa-sheens) are long bundles of live woody vegetation buried in a streambank in shallow trenches placed parallel to the flow of the stream (Figure 1). The plant bundles sprout and develop a root mass that will hold the soil in place and protect the streambank from erosion. For optimum success in Ohio, fascines are constructed of thin live cuttings of willow or red-osier dogwood. These cuttings are bound together in bundles 6-8 inches in diameter and 4-20 feet in length. The name fascine comes from the Latin for 'bundle of sticks.'

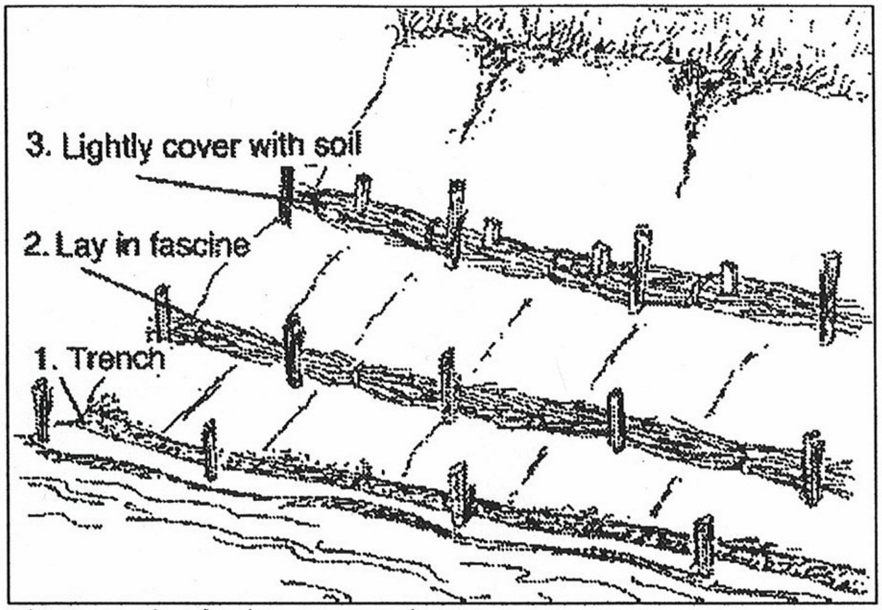


Figure 1. Live fascine construction

To build a fascine:

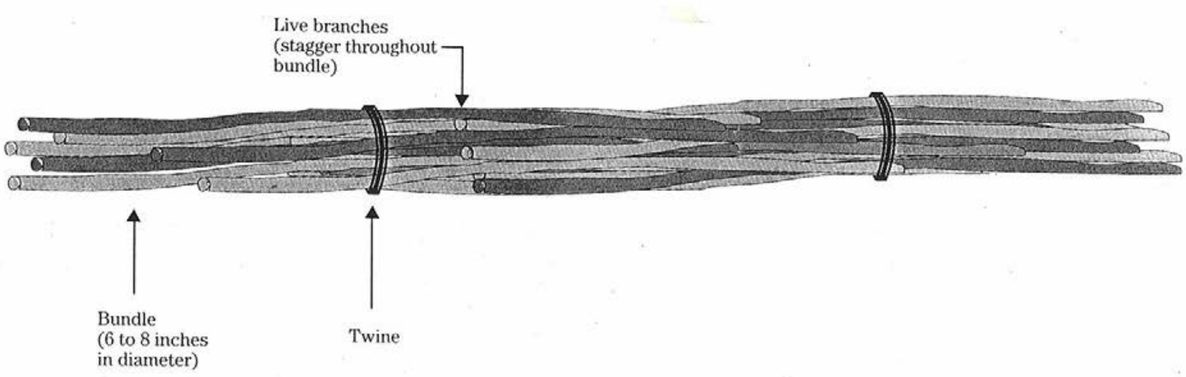
1. Harvest and stockpile an assortment (being different species, ages and lengths) of live, dormant cuttings. Fascines can be built from a wide range of cuttings, but are best built from slim relatively unbranched cuttings (coppice) because they are the easiest to work with and produce the densest fascines. If the cuttings have multiple, hard to bend side branches, prune them, being sure to use the trimmings

2. Fascines are easier to build in a set of saw horses (figure). Lay the cuttings on the sawhorses, with the growing tips facing in the same direction, and with the cut ends staggered throughout.

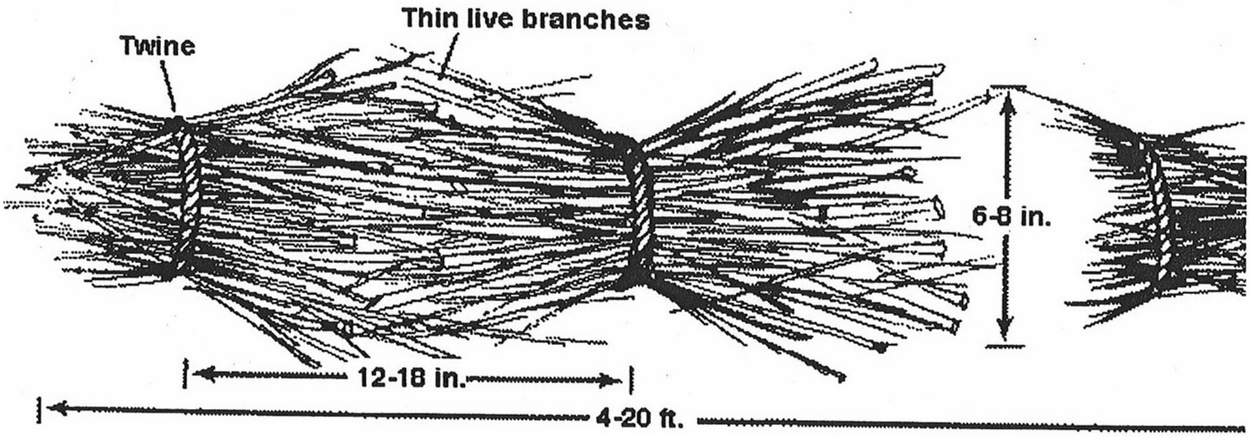
3. Tightly tie the fascines together tight with rope or twine. The distance between ties can vary. You should be able to carry, bend, and not be able to pull apart, a properly tied fascine. If your first attempt fails, make sure the cut ends are staggered, and that the ties are tight, and frequent. Fascines can be constructed in varying lengths and diameters, but work best if they are tied so they are dense.

All the butt ends of the cuttings should point towards the same end of the bundle with the bundle ends tapered to form a cigar shape. The ends of the cuttings may be staggered along the length of tl bundle to facilitate the construction of a long bundle with a maximum length of 15 feet to 20 feet. Ultimately, the bundle should be 6-8 inches in diameter. The cuttings are then bound together every 12-18 inches with untreated/un-dyed bailing twine (see Figure 3). It is helpful to make a saw-horse type frame to support the bundles at waist height as they are being tied together. The frame can be constructed of lumber or cuttings from the site. Each set of legs should extend beyond the crossbar into a "V" shape so that the cuttings can lay inside the V's while being tied together.

Sawhorses and fascine willow bundles



The bundles themselves, as previously noted, are composed of cuttings of willow or red-osier dogwood. The bundles need to contain at least five cuttings, each being a minimum of 1/2 inch in diameter. These bundles can contain some dead cuttings as long as they are in the center of the bundle leaving the live cuttings on the outside in direct contact with the soil. The cuttings must be in a dormant condition cut between mid-November and mid-March. They must be installed into the streambank within 48 hours of being cut. The cuttings must not be allowed to dry out. They must be kept moist or soaked in water before being formed into bundles and installed in the streambank.



Willow Fascine Bundle

To install a fascine:

1. Dig a shallow trench, slightly less wide and deep than the diameter of the fascine. The fascine should be approximately 20% exposed once installed.

2. Place the fascine in the trench, and stake into place. The growing tips should point upstream, or if placed on angles on slopes, pointed uphill. There are several methods of staking. Refer to Figure . Livestakes are recommended as they will grow, providing extra strength in the long run for the structure. In compact soils such as clays and clay/shales, UNTREATED 2"x2" stakes, or 2"x4"s cut on a diagonal work well. Place the stakes every 1-1.5 metres. You should not be able to lift the fascine out of the trench.

3. Care should be taken to make sure the upstream end of the fascine is "returned" to the streambank. This means tucking the upstream end into the bank, and staking it securely so that the current cannot dislodge it. If the upstream end of the fascine is pulled away the entire structure could fail.

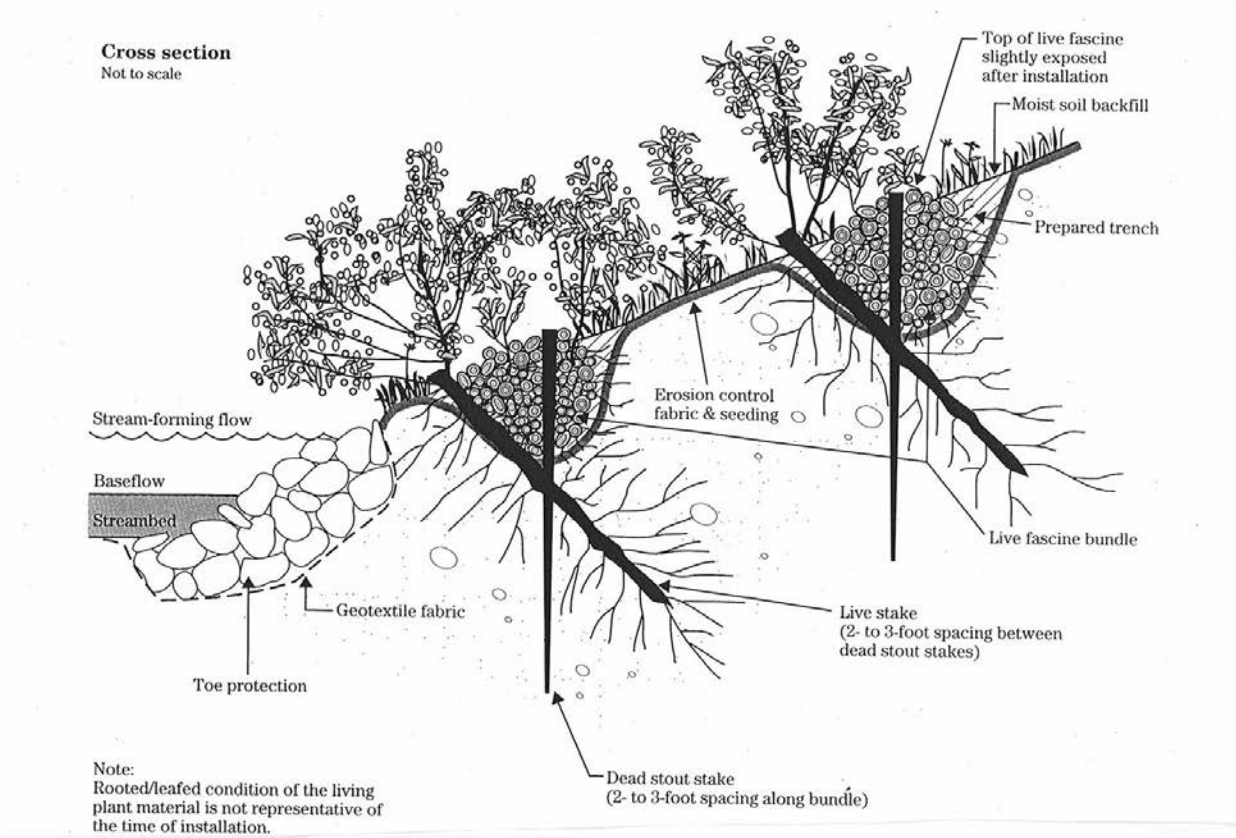
4. Bury the facine by placing soil around and on top of it, tamping gently into place. Make sure you fill in all of the air spaces. Large air spaces around the fascine should be avoided as they will promote dessication of the live material.

Materials

- rope or twine, strong enough to tie the fascines together, and resilient enough to last 1 year. Hemp rope, heavy bailer twine, or plastic utility cord are good examples.
- ample quantities of live cuttings, for example a 4 m long fascine 25 cm in diameter will use approximately 5 bundles of cuttings (bundles being 20-30 cm in diameter, and 2 m long). Fascines should be constructed with a minimum of 2 different species. This will optimize the chances of successful growth. Recommended species:

Small streams - Heartleaf willow, Sandbar willow, Shining willow, Pussy willow, all of the dogwoods.
Large streams - Black willow, Peachleaf willow, Pussy willow, Sandbar willow, Heartleaf willow, Carolina poplar, Balsam poplar, all of the dogwoods.

- shovels, rakes, deadblow and sledge hammers, pruning shears, utility knife, sawhorses.
- stakes, depending upon the application, from live stakes, to untreated 2"x2"s, to 2"x4"s cut into wedges.
- straw (for mulching on slopes), or an erosion control blanket (jute, coir, or a straw mix).



Materials & Equipment

The type of equipment required to install a live fascine streambank stabilization project will vary depending on the size and scope of the project, the labor available and the condition of the streambank itself (see Table 2). The tall, steep banks requiring excavation will probably need a backhoe. A backhoe may also be handy to dig the trenches for the live fascines on projects that effe longer stretches of streambank. If plenty of hand labor is available and the site permits, hand tools may be all that is required.

Bank excavation, if needed		Backhoe. Alternately: hand tools (shovels, mattock) & wheel barrow.
Excavate trenches		Hand tools (shovels, mattock), wheel barrow, & measuring tape. Alternately: backhoe.
Construct live fascine bundle	willow (Salix spp.) or red-osier dogwood (Cornus stolonifera) cuttings, bailing twine	Saws, loppers, knives, & saw-horse type frame.
Install fascine	Live willow stakes, dead stakes	Sledge hammers & hand tools (shovels, mattock).

Pointers from Other Sources:

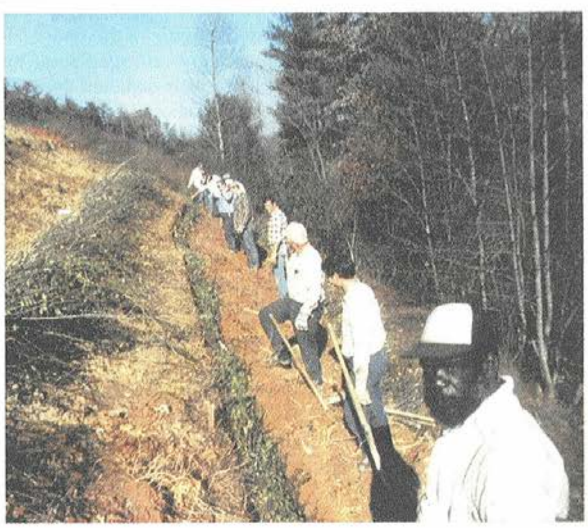
Installation

- Prepare the live fascine bundle and live stakes immediately before installation.
- Beginning at the base of the slope, dig a trench on the contour approximately 10 inches wide and deep.
- Excavate trenches up the slope at intervals specified in table 16–1. Where possible, place one or two rows over the top of the slope.
- Place long straw and annual grasses between rows.
- Install jute mesh, coconut netting, or other acceptable erosion control fabric. Secure the fabric.
- Place the live fascine into the trench (fig. 16–9a).
- Drive the dead stout stakes directly through the live fascine. Extra stakes should be used at connections or bundle overlaps. Leave the top of the dead stout stakes flush with the installed bundle.
- Live stakes are generally installed on the downslope side of the bundle. Tamp the live stakes below and against the bundle between the previously installed dead stout stakes, leaving 3 inches to protrude above the top of the ground (fig. 16–9b). Place moist soil along the sides of the bundles. The top of the live fascine should be slightly visible when the installation is completed. Figure 16–9c shows an established live fascine system 2 years after installation is completed.

Installation

The installation methods are similar to those discussed for live fascines, with the following variations:

- Excavate a trench approximately 10 inches wide and deep, beginning at one end of and parallel to the shoreline section to be repaired and extending to the other end.
- Spread jute mesh or geotextile fabric across the excavated trench and temporarily leave the remainder on the slope immediately above the trench.
- Place a live fascine bundle in the trench on top of the fabric and anchor with live and dead stout stakes.
- Spread long straw on the slope above the trench to the approximate location of the next trench to be constructed upslope.
- Pull the fabric upslope over the long straw and spread in the next excavated trench. Trenches should be spaced 3 to 5 feet apart and parallel to each other.
- Repeat the process until the system is in place over the treatment area.



Construction Guidelines

Make sure the toe is stable when using fascines on slopes. If the toe is not stable, erosion can move up the slope, undermining the fascines and causing failure. Should the toe be experiencing erosion, you will need to remedy the situation by using one of the other appropriate methods in this manual. Once this has been addressed, you can then place the fascines on the slope. The following steps should be followed when placing fascines on slopes:

- install the first fascine at the bottom of the slope.
- move upslope, placing fascines using the recommended spacing of 1 metre for 1:1 slopes (height:vertical), 1.5 metre for 2:1, 2 metres for 3:1, and 3 metres for 4:1 slopes.
- on dry slopes fascines can be placed level or on contour.
- on wet slopes fascines can be placed on slight angles to facilitate drainage of runoff.
- place long straw on the slope between fascines (on slopes 1.5:1 or flatter), steeper slopes would require the use of an erosion control fabric. This fabric would be anchored in place by tucking the leading edge into the trench, and staking the fascine on top.

Excavate the bank to the appropriate slope, if needed, according to design specifications (see Tab 1). Starting at the toe of the slope, dig or excavate trenches into the exposed slope at the designatec spacing, parallel to the stream course. The trenches should be 10-15 inches wide and deep to accommodate the live fascines. Lay the fascines into the trench and backfill soil loosely, leaving the top of the fascine partially exposed (Figure 4). When more than one fascine bundle is used to fill the length of a trench, a slight overlap (6-12 inches) of the ends of the bundles should be used.

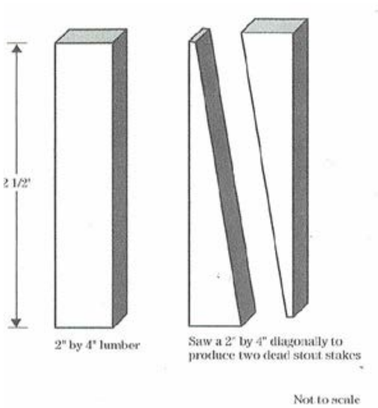
Table 1. Timing of Construction and Resource

Activity	Time Frame
Stabilize bank if necessary	Period of low flow prior to live fascine installation
Bank excavation to 1:2 or 1:3 slope	Late Sept. to Early April (but just prior to fascine installation)
Cut willows for fascines, keep moist at project site	October 1 to April 1
Construct fascine at project site, keep moist at project site	October 1 to April 1
Entrench and install fascines	October 1 to April 15

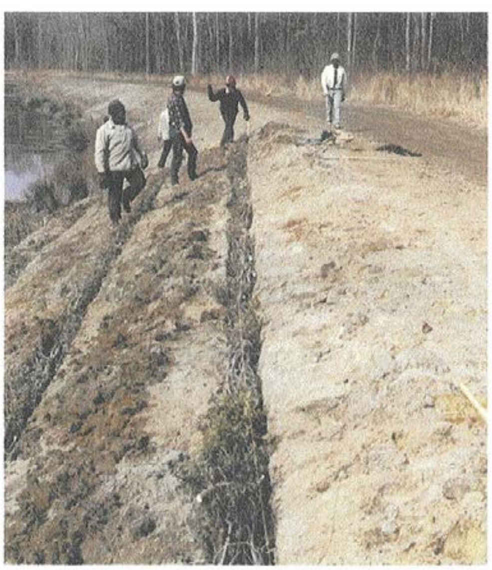
Cost and Maintenance Needs

Fascines cost very little, especially if the live materials are cut for free. Costs can be reduced even further if livestakes are used to anchor the fascine. The main expense is the time required to harvest live cuttings, transport them, and construct the fascines. Time required to install varies from 0.5 - 1 hour per linear metre. Fascines should be inspected periodically in the first year. Once the fascine is growing, they require little maintenance.

Preparation of a dead stunt stake



Installing live stakes in live fascine system



Placing live fascines in trench

Established fascines after 2 years growth

<u>Local Plants that could be used for making fascines</u>:

<u>Excellent to Very Good</u>
Sandbar Willow (*Salix exigua*) Large shrub, very long, narrow leaves
Peach-leaved Willow (*Salix amygdaloides*) large shrub to small tree, fat leaves
Shining Willow (*Salix lucida*) Medium to tall shrub
Pussy Willow (*Salix discolor*) Large shrub
Balsam Poplar (*Populus balsamifera*) Tall tree, long sticky, sweet-smelling buds
Black Willow (*Salix nigra*) Small to large tree
Eastern Cottonwood (*Populus deltoides*)

**note: Bebb's Willow (Salix bebbianna) is a very common medium to large shrub with a beaked and coarse textured leaf. Try to avoid this willow since it sprouts poorly.

<u>Good</u>
Red-osier Dogwood (*Cornus stolonifera*) Medium shrub, red stems

<u>Fair</u>
Roundleaf Dogwood (*Cornus rugosa*) Medium to small shrub
Nannyberry (*Viburnum lentago*) Large Shrub
Gray Dogwood (*Cornus racemosa*) Medium to small shrub

If you have questions please contact Doug Thompson at the Clearwater SWCD (694-6845) for identification of these local plants. Local nurseries may also be able to find this plant material for you.

Live Stakes

(i) Live stakes—Live staking involves the insertion and tamping of live, rootable vegetative cuttings into the ground (figs. 16–4 and 16–5). If correctly prepared, handled, and placed, the live stake will root and grow (fig. 16–6).

A system of stakes creates a living root mat that stabilizes the soil by reinforcing and binding soil particles together and by extracting excess soil moisture. Most willow species root rapidly and begin to dry out a bank soon after installation.

Applications and effectiveness

- Effective streambank protection technique where site conditions are uncomplicated, construction time is limited, and an inexpensive method is needed.
- Appropriate technique for repair of small earth slips and slumps that frequently are wet.
- Can be used to peg down and enhance the performance of surface erosion control materials.
- Enhance conditions for natural colonization of vegetation from the surrounding plant community.
- Stabilize intervening areas between other soil bioengineering techniques, such as live fascines.
- Produce streamside habitat.

Construction guidelines

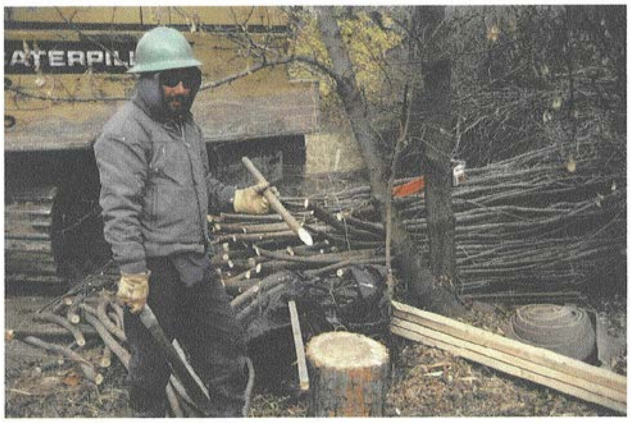
Live material sizes—The stakes generally are 0.5 to 1.5 inches in diameter and 2 to 3 feet long. The specific site requirements and available cutting source determine sizes.

Live material preparation

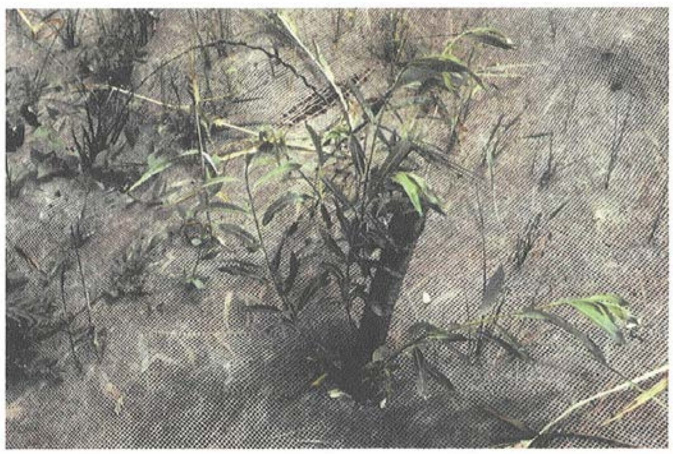
- The materials must have side branches cleanly removed with the bark intact.
- The basal ends should be cut at an angle or point for easy insertion into the soil. The top should be cut square.
- Materials should be installed the same day that they are prepared.

Installation

- Erosion control fabric should be placed on slopes subject to erosive inundation.
- Tamp the live stake into the ground at right angles to the slope and diverted downstream. The installation may be started at any point on the slope face.
- The live stakes should be installed 2 to 3 feet apart using triangular spacing. The density of the installation will range from 2 to 4 stakes per square yard. Site variations may require slightly different spacing.
- Placement may vary by species. For example, along many western streams, tree-type willow species are placed on the inside curves of point bars where more inundation occurs, while shrub willow species are planted on outside curves where the inundation period is minimal.
- The buds should be oriented up.
- Four-fifths of the length of the live stake should be installed into the ground, and soil should be firmly packed around it after installation.
- Do not split the stakes during installation. Stakes that split should be removed and replaced.
- An iron bar can be used to make a pilot hole in firm soil.
- Tamp the stake into the ground with a dead blow hammer (hammer head filled with shot or sand).



Prepared Live Stake


Growing Live Stake


Prepared Live Stake (note angled basal end and flat-topped end)

Appendix B
Greenwood 27
Monitoring Photos

Pictures of Greenwood 27
Bank Stabilization Sites Before, During, and After Construction

Site A Before Construction,
Bank Slumping

Bank Stabilization
Site A
During Construction
In 2001

Bank Stabilization
Site B
During Construction

Bank Stabilization
Site A Willows and Riprap
Along Bend

Bank Stabilization
Site A Willows Shortly
After Construction

Site C Bank Stabilization with Willows and Riprap

Site C Bank Stabilization - Willows Shortly After Construction

Bank Stabilization Site B Willows, Fiber Blanket, and Riprap Around Bend

Bank Stabilization Site B Willows Shortly After Construction

Fall of 2002 Photographic Monitoring
One Year after Construction

Site A
Bank Stabilization

Bank Stabilization
Site B

Site C
Bank Slumping Near Upstream
End of the Site

Bank slumping at Bank
Stabilization
Site C
1 year after construction
Malfunctioning Drain Tile?

Bank Slumping at Bank
Stabilization
Site C
Pooling of water that is the Apparent
Cause of the Slumping

Photographic Monitoring Fall 2003

Bank Stabilization
Site A Looking Downstream

Bank Stabilization
Site A Looking Upstream
2 years after construction

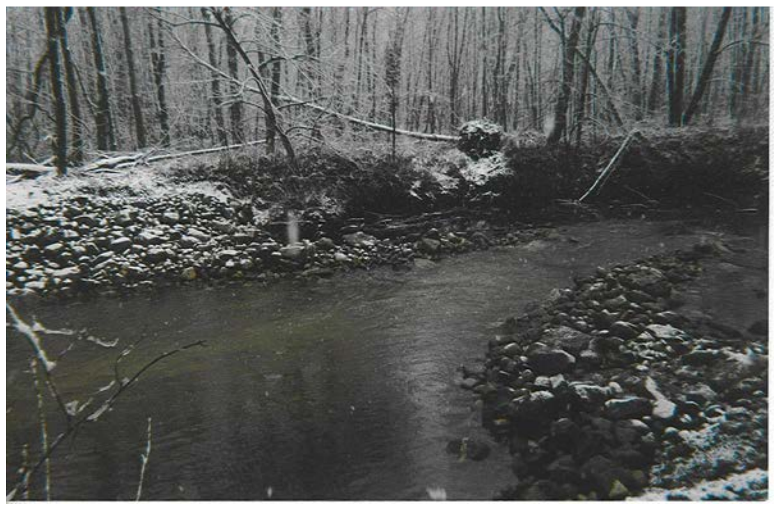
Cross-Vane Weirs (Grade Stabilization) at Sites N, O, and P after Construction 2002-2003

Grade Stabilization
Site D

Grade Stabilization
Site E

Additional Cross-Vane Weirs
Site P
Newly Constructed, Fall 2003

Additional Cross-Vane Weirs
Site O
Newly Constructed Fall 2003



Additional Cross-Vane Weirs
Site N
Newly Constructed Fall 2003

Floodplain Improvements after Construction

Floodplain Restoration
Site G
1 year after Construction
(Fall 2002)

Floodplain Restoration
Site H
1 year after Construction
Floodplain Side of Rock Dam, Facing Toward Old Scour Channel in Floodplain
(Fall 2002)

Floodplain Restoration
Site K
(Fall 2002)

2004 Monitoring at Greenwood 27

Erosion at Site C.

This was apparently caused by a drainage tile, the end of which was buried during the construction. Drainage from the tile caused the sloughing and erosion of the bank. This site was repaired in the summer of 2004.

Site A Looking Upstream

Site B Looking Downstream

Site C Looking Downstream

Grade Stabilization Site E

Pool Behind Site H Structure

Floodplain Restoration Site G

Floodplain Restoration Site K

Floodplain Restoration Site H
Lots of Vegetation on Rock Structure

Grade Stabilization Site N


Grade Stabilization Site O


Grade Stabilization Site P


High Flow in November ‘04 at Site E


High Flow in November ‘04 at Site P


Site A, August 4, 2005


Site C, 2005 – Erosion Repaired


Site B, August 4, 2005


Site D, August 4, 2005


Site C, August 4, 2005


Site E, August 4, 2005


Site G, August 4, 2005


Site P, August 4, 2005


Site K, August 4, 2005


Gully 6 Erosion Control Site – August, 2005


Site O, August 4, 2005

Appendix C
Greenwood 27 Construction Plans and Specifications

(Scanned and Reduced from 11” X 17” to 8.5” X 11”)

GOVERNING SPECIFICATIONS

INDEX OF PLAN SHEETS

SHEET NO. DESCRIPTION

RED LAKE WATERSHED DISTRICT
CONSTRUCTION PLANS
FOR
STREAMBANK AND GRADE STABILIZATION
2000

LOCATED WITHIN A REACH OF THE CLEARWATER RIVER
WITHIN SECTION 27 OF GREENWOOD TOWNSHIP

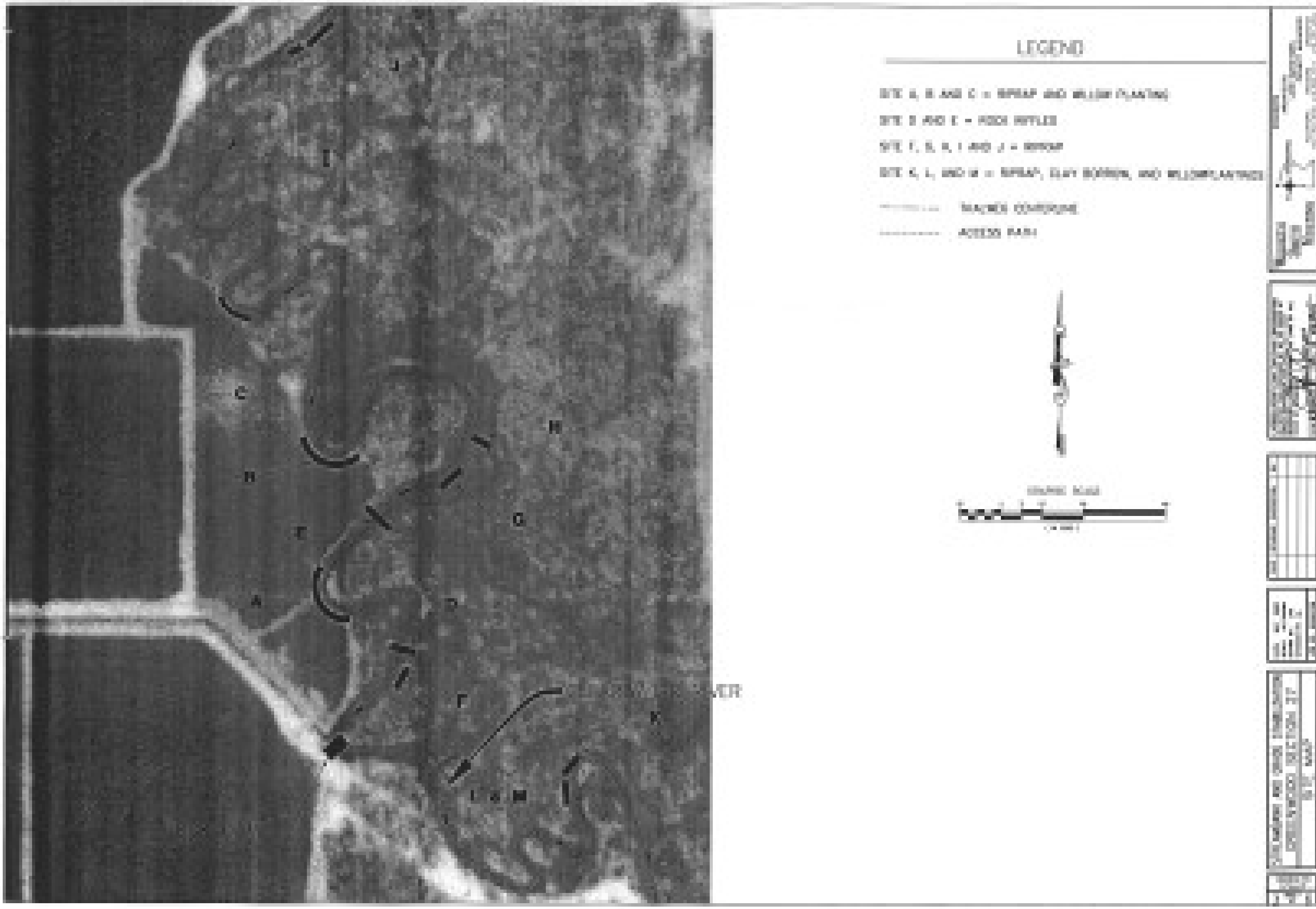
PROJECT AREA

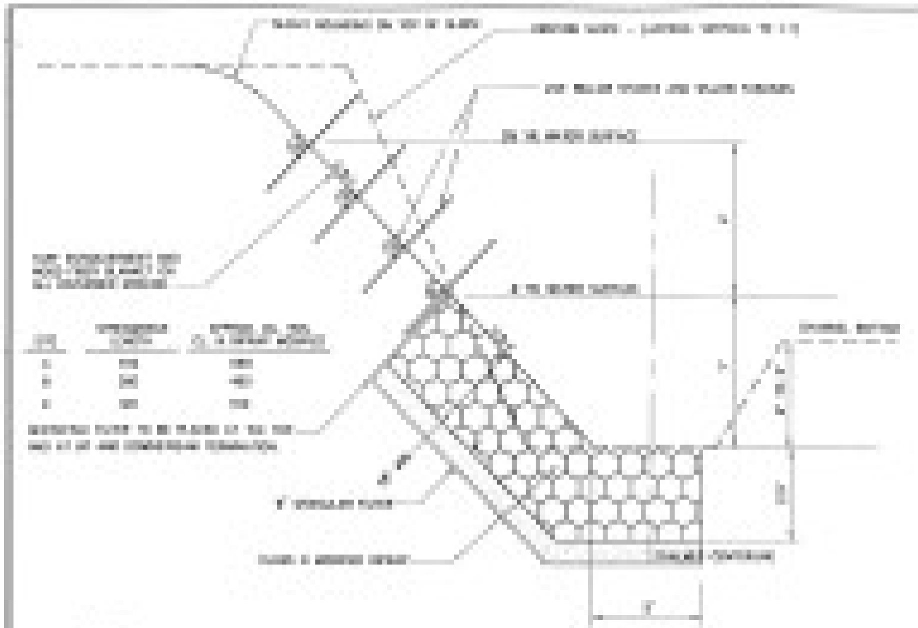
STATEMENT OF QUANTITIES

ITEM NO.	SPEC. NO.	ITEM DESCRIPTION	UNIT	TOTAL QUANTITY	
				EST.	FINAL
1	2021.501	MOBILIZATION	LUMP SUM	1	
2	2105.601	SITE PREP WORK – SITE A (1) (7)	LUMP SUM	1	
3	2105.601	SITE PREP WORK – SITE B (1) (7)	LUMP SUM	1	
4	2105.601	SITE PREP WORK – SITE C (1) (7)	LUMP SUM	1	
5	2105.601	SITE PREP WORK – SITE D (1)	LUMP SUM	1	
6	2105.601	SITE PREP WORK – SITE E (1)	LUMP SUM	1	
7	2105.601	SITE PREP WORK – SITE F (1)	LUMP SUM	1	
8	2105.601	SITE PREP WORK – SITE G (1)	LUMP SUM	1	
9	2105.601	SITE PREP WORK – SITE H (1)	LUMP SUM	1	
10	2105.601	SITE PREP WORK – SITE I (1)	LUMP SUM	1	
11	2105.601	SITE PREP WORK – SITE J (1)	LUMP SUM	1	
12	2105.601	SITE PREP WORK – SITE K (1), (3), (4)	LUMP SUM	1	
13	2511.501	RANDOM RIPRAP, CLASS III MODIFIED	CU. YD.	1080	
14	2511.501	RANDOM RIPRAP, CLASS IV MODIFIED	CU. YD.	450	
15	2511.507	GRANULAR FILTER	CU. YD.	720	
16	2511.515	GEOTEXTILE FILTER, TYPE IV	SQ. YD.	850	
17	2575.601	TURF ESTABLISHMENT (2)	ACRE	0.87	
18	2575.505	WOOD FIBER BLANKET, TYPE REGULAR	SQ. YD.	3800	
19	2575.608	LIVE WILLOW FASCINES	LIN. FT.	5850	
20	2575.604	LIVE WILLOW STAKES	EACH	1930	

GENERAL NOTES

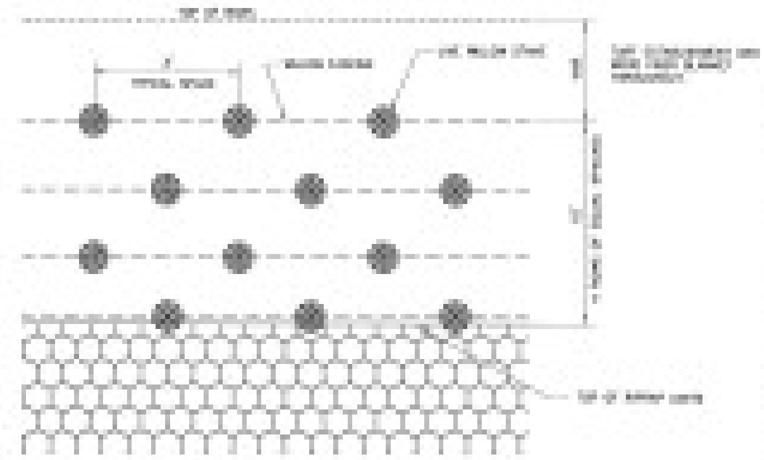
1. THIS ITEM SHALL BE USED TO RE-SHAPE THE RIVER BANK AND TO PERFORM MINOR CLEARING PRIOR TO PLACEMENT OF RIPRAP AND FILTER BLANKET.
2. TURF ESTABLISHMENT SHALL INCLUDE: MNDOT NO. 400, 500, OR 700 SEED MIXTURE APPLIED AT [illegible] LBS/ACRE.
COMMERCIAL FERTILIZER ANALYSIS 40-20-10 APPLIED AT 150 LBS/ACRE.
WOOD FIBER BLANKET TO BE PLACED OVER ALL AREAS SEEDED.
FERTILIZER SHALL BE APPLIED TO ALL SEEDED AREAS.
3. COMPACTED CLAY BORROW MATERIAL SHALL BE CONSIDERED INCIDENTAL TO THE SITE PREP WORK – SITE K PAY ITEM, AND NO DIRECT COMPENSATION WILL BE MADE THEREOF.
4. SITE PREP WORK AND COMPACTED CLAY BORROW MATERIAL FOR SITES L AND M SHALL BE CONSIDERED INCIDENTAL TO SITE PREP WORK – SITE K, AND NO DIRECT COMPENSATION WILL BE MADE THEREOF. THIS IS DUE TO THEIR CLOSE PROXIMITY ([illegible] FT.)
5. SITES A, B, C AND E ARE ACCESSIBLE TO CONSTRUCTION FROM THE FIELD ROAD ADJACENT TO THE RIVER. SITES D, F, G, H, I, J, K, L, AND M ARE ACCESSIBLE FOR CONSTRUCTION THROUGH A WOODED AREA WITH NO ACCESS ROAD. ACCESS TO THESE AREAS, UP TO THE RIVER, WILL BE PROVIDED BY THE OWNER AT NO EXPENSE TO THE CONTRACTOR (SEE PROPOSED ACCESS ROUTES ON SHEET 2). THE CONTRACTOR WILL BE REQUIRED TO PROVIDE HIS OWN ACCESS ACROSS THE RIVER TO THE RESPECTIVE SITES.
6. GEOTEXTILE FILTER CLOTH SHALL BE A TYPE IV NONWOVEN.
7. EXCAVATED MATERIAL SHALL BE NEATLY PILED ALONG THE RIVER BANK IN A MANNER APPROVED BY THE ENGINEER. THE OWNER WILL REMOVE THE MATERIAL AT THE CONCLUSION OF THE PROJECT. THE PILE SHALL NOT BE PLACED WITHIN 20 FT. FROM THE TOP OF THE NEW SLOPE.


LEGEND
SITE A, B AND C = RIPRAP AND WILLOW PLANTING
SITE D AND E = ROCK RIFFLES
SITE F, G, H, I AND J = RIPRAP
SITE K, L, AND M = RIPRAP, CLAY BOTTOM, AND WILLOW PLANTINGS
THALWEG CENTERLINE
ACCESS PATH
J
I
C
H
B
G
F
A
D
F
K
L & M



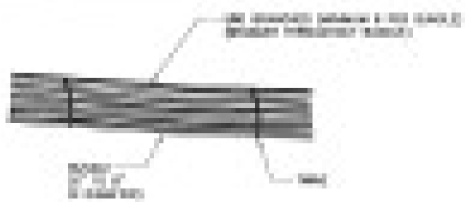
STREAM BANK STABILIZATION DETAIL

SITES A, B, AND C



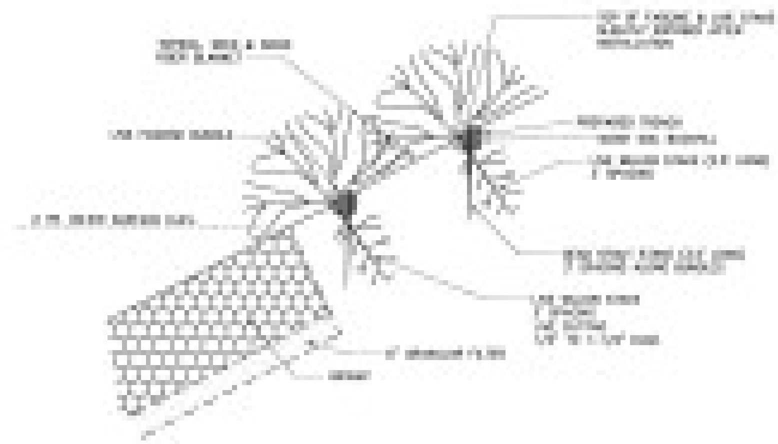
STREAM BANK STABILIZATION PLAN VIEW

SITES A, B, AND C



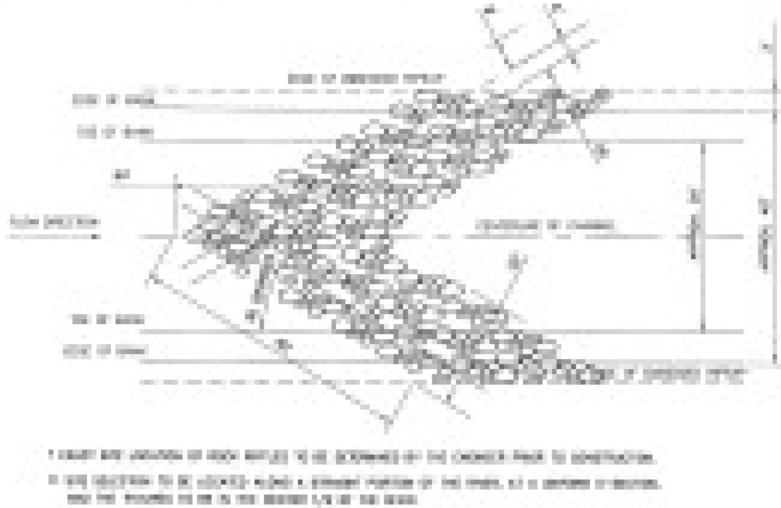
STREAM BANK STABILIZATION

LIVE WILLOW FASCINE DETAIL

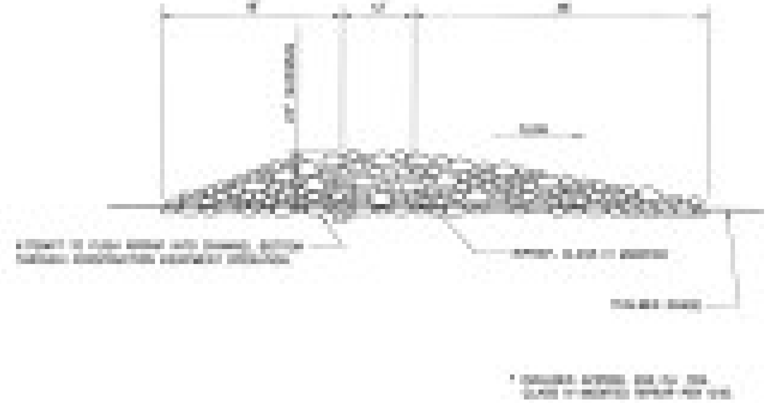


STREAM BANK STABILIZATION

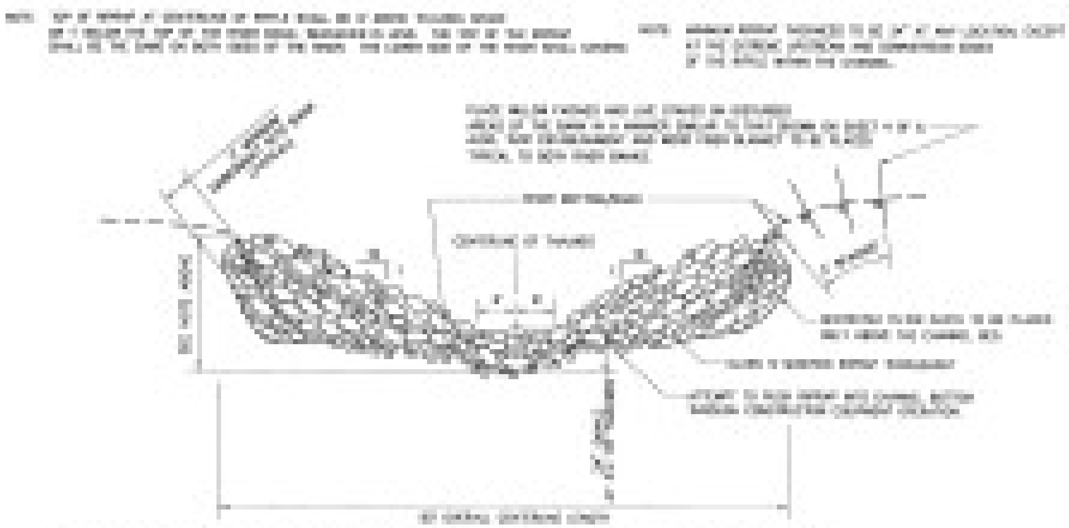
LIVE WILLOW STAKE AND LIVE WILLOW FASCINE DETAILS



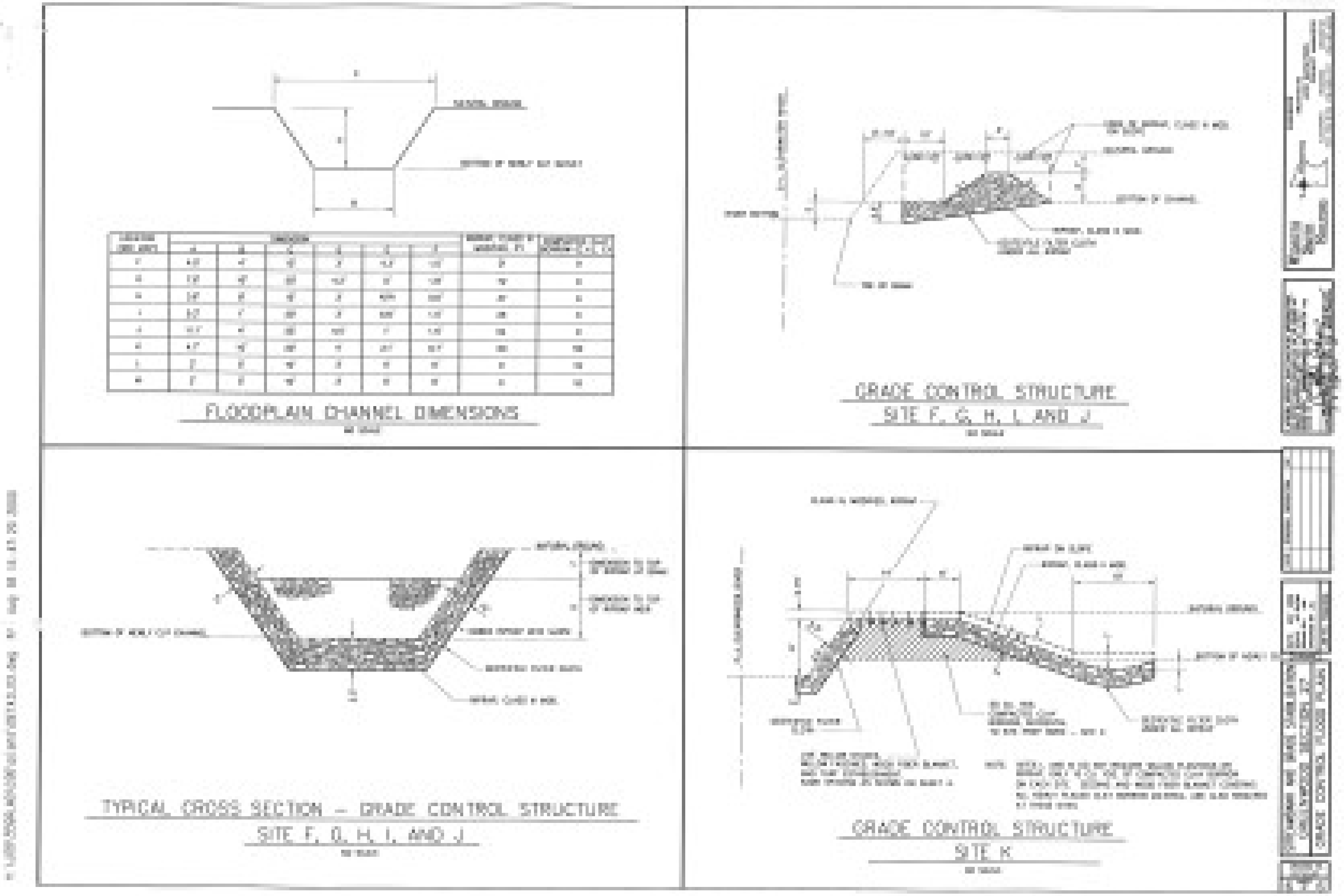
PLAN OF ROCK RIFFLES
SITE D AND E



CROSS SECTION OF ROCK RIFFLE AT C.L. OF CHANNEL
SITE D AND E



TYPICAL SECTION THROUGH CENTER LINE OF ROCK RIFFLE
SITE D AND E


FLOODPLAIN CHANNEL DIMENSIONS
GRADE CONTROL STRUCTURE
SITE F, G, H, I, AND J
TYPICAL CROSS SECTION – GRADE CONTROL STRUCTURE
SITE F, G, H, I, AND J
GRADE CONTROL STRUCTURE
SITE K

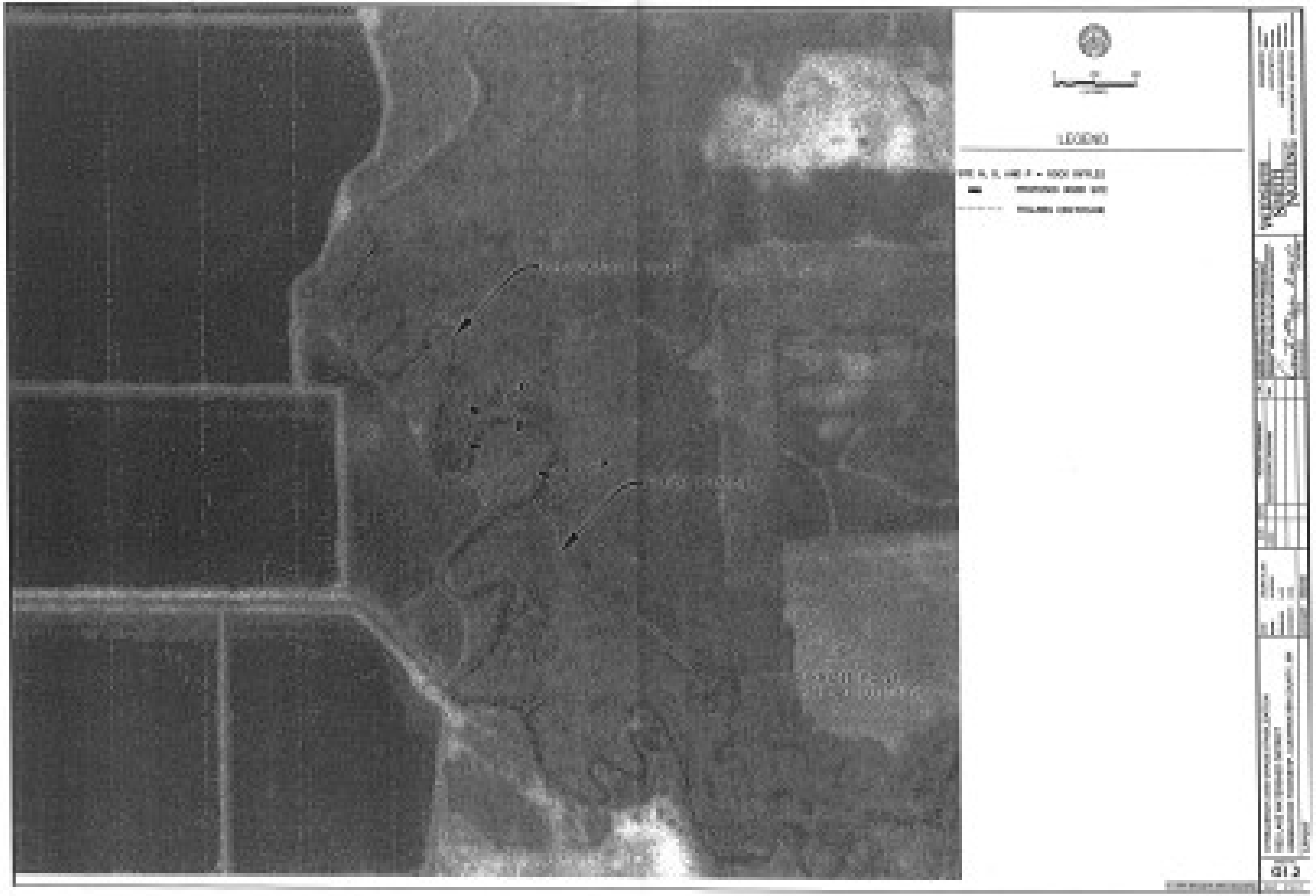
RED LAKE WATERSHED DISTRICT
CONSTRUCTION PLANS
FOR
STREAMBANK AND GRADE STABILIZATION
2003
LOCATED WITHIN A REACH OF THE CLEARWATER RIVER WITHIN SECTION 27 OF GREENWOOD TOWNSHIP

GOVERNING SPECIFICATIONS

INDEX OF PLAN SHEETS

SHEET NO. DESCRIPTION

PROJECT AREA

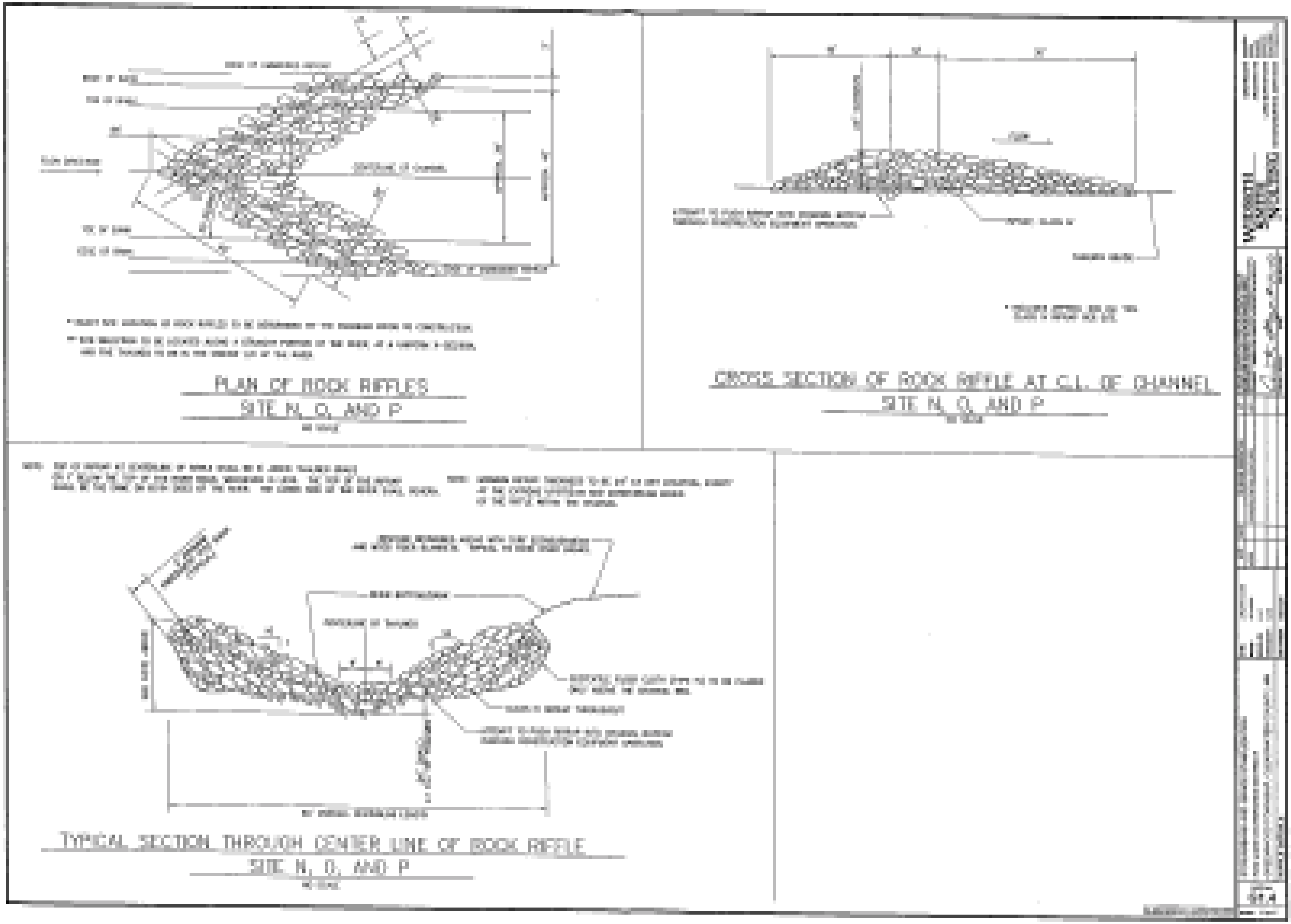

LEGEND

STATEMENT OF QUANTITIES

ITEM NO.	SPEC NO.	ITEM DESCRIPTION	UNIT	[illegible]		[illegible]		[illegible]		TOTAL	
				EST.	FINAL	EST.	FINAL	EST.	FINAL	EST.	FINAL
1	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	
2	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	
3	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	
4	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	
5	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	
6	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]	

GENERAL NOTES

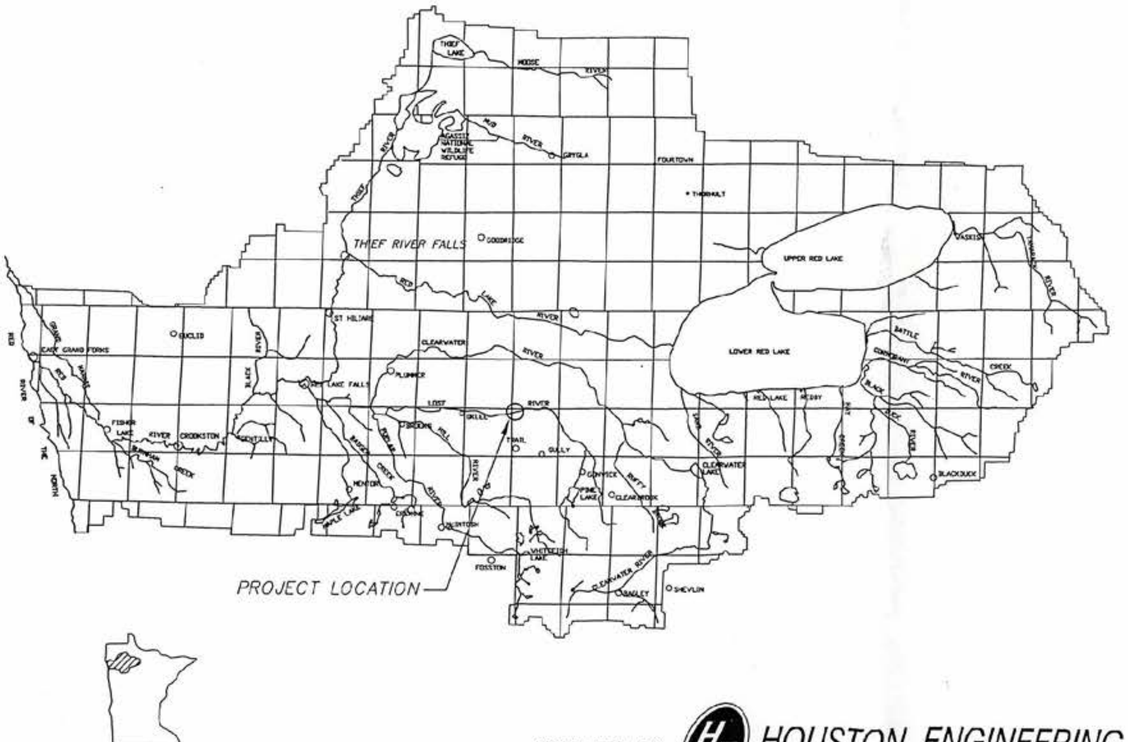
1. THE OWNER RESERVES THE RIGHT TO MAKE MINOR REVISIONS TO THE PLANS TO FIT CONDITIONS ENCOUNTERED DURING CONSTRUCTION.
2. THE LOCATIONS OF UNDERGROUND UTILITIES SHOWN ON THE PLAN SHEETS ARE APPROXIMATE. THE CONTRACTOR SHALL VERIFY THE UTILITY LOCATIONS AND DEPTHS AS REQUIRED BY CONSTRUCTION.
EXCAVATION TO LOCATE UNDERGROUND UTILITIES SHALL BE INCIDENTAL.
3. THE STATEMENT OF QUANTITIES IS NOT INTENDED TO BE ALL INCLUSIVE, BUT MERELY TO PROVIDE GUIDANCE TO THE CONTRACTOR FOR PLANNING PURPOSES. QUANTITIES MAY VARY.
4. THE CONTRACTOR SHALL NOTIFY UTILITY COMPANIES AND OWNERS OF OBSTRUCTIONS AT LEAST 48 HOURS PRIOR TO COMMENCING WORK.
[illegible] STATE ONE-CALL 1-800-[illegible]


PLAN OF ROCK RIFFLES
SITE N, O, AND P
CROSS SECTION OF ROCK RIFFLE AT C.L. OF CHANNEL
SITE N, O, AND P
TYPICAL SECTION THROUGH CENTER LINE OF ROCK RIFFLE
SITE N, O, AND P

CONSTRUCTION PLANS FOR

LOST RIVER EROSION CONTROL PROJECT

RED LAKE WATERSHED DISTRICT
THIEF RIVER FALLS, MINNESOTA
JUNE 23, 2003



SHEET INDEX

1	COVER SHEET
2	ESTIMATED QUANTITIES AND SITE MAP
3–4	PLAN AND PROFILE SHEETS
5–6	CONSTRUCTION DETAILS
7–9	CROSS SECTIONS
10	EROSION CONTROL DETAILS

I hereby certify that this plan, specification, or report was prepared be me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: Brent H. Johnson Typed or Printed Name: Brent H. Johnson

Date: 6-23-2003 Lic. No. 20378

PREPARED BY: HOUSTON ENGINEERING, INC.

FARGO, NORTH DAKOTA MAPLE GROVE, MINNESOTA BISMARCK, NORTH DAKOTA

CAD. REF. S:/3655-040/CADD/FINAL PLANS/COVER.DWG

ESTIMATED QUANTITIES

NOTES	ITEM NO.	ITEM	UNIT	BASE BID QUANTITIES	BID OPTION QUANTITIES	TOTAL ESTIMATED QUANTITIES	FINAL QUANTITIES
	2563.601	TRAFFIC CONTROL	LUMP SUM	1		1	
	2021.501	MOBILIZATION	LUMP SUM	1		1	
(1)	2123.509	DOZER	HOUR	4	2	6	
(2)	2123.610	2.5 C.Y. BACKHOE	HOUR	10	5	15	
(3)	2511.501	RANDOM RIPRAP, CLASS IV	CU. YD.	335	162	497	
(4)	2573.502	SILT FENCE, TYPE PREASSEMBLED	LIN. FT.	100	50	150	
	2573.505	FLOATING SILT CURTAIN, TYPE MOVING WATER, 3'	LIN. FT.	80		80	
	2575.501	SEEDING	ACRE	0.50		0.50	
(5)	2575.502	SEED, MIXTURE 1	POUND	24		24	
(6)	2575.523	EROSION CONTROL BLANKET, CATEGORY 4	SQ. YD.	163	107	270	

NOTES:

(1) BID ITEM FOR BACKHOE IS FOR REMOVAL OF EXISTING SEDIMENT DEPOSITS IN THE RIVER BED AS SHOWN IN THE PLANS OR AS DIRECTED BY THE ENGINEER. EXCAVATED MATERIAL SHALL BE PLACED ON EXISTING SPOIL BANKS OR USED AS BANK FILL AT THE CROSS-VANE WEIR AS DIRECTED.

(2) BID ITEM FOR DOZER IS FOR SPOIL LEVELING, FINAL SHAPING AND REPAIRING DISTURBED AREAS PRIOR TO SEEDING.

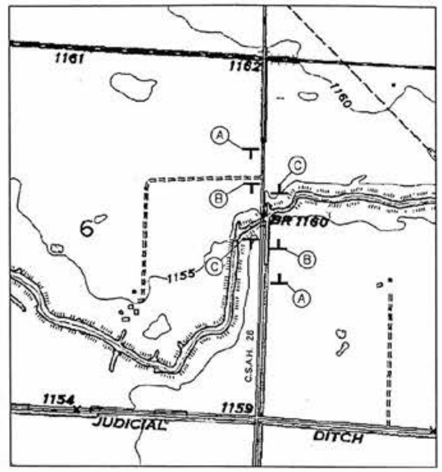
(3) SEE SHEET 6 FOR A SCHEDULE OF RIPRAP QUANTITIES AND LOCATIONS.

(4) SILT FENCE, TYPE PREASSEMBLED, SHALL BE INSTALLED AS DIRECTED WHERE EVER EXCAVATED RIVER SEDIMENT CANNOT BE SPOILED SUCH THAT THEY DRAIN AWAY FROM THE RIVER (SEE DETAIL – SHEET 10).

(5) BID ITEM FOR SEED, MIXTURE 1, INCLUDES A NURSE CROP OF OATS OR WINTER RYE AT 1 BU./ACRE.

(6) EROSION CONTROL BLANKET, CATEGORY 4, SHALL BE PLACED ON ALL RIVER BANKS DISTURBED BY THE CONTRACTOR AS DIRECTED BY THE ENGINEER. BID QUANTITY IS ESTIMATE ONLY BASED ON AN AREA 20' ON EACH SIDE OF THE PROPOSED WEIRS AND THE LENGTH OF THE BANK SLOPE. FINAL QUANTITIES MAY VARY DEPENDING ON THE CONTRACTORS OPERATIONS.

TRAFFIC CONTROL PLAN

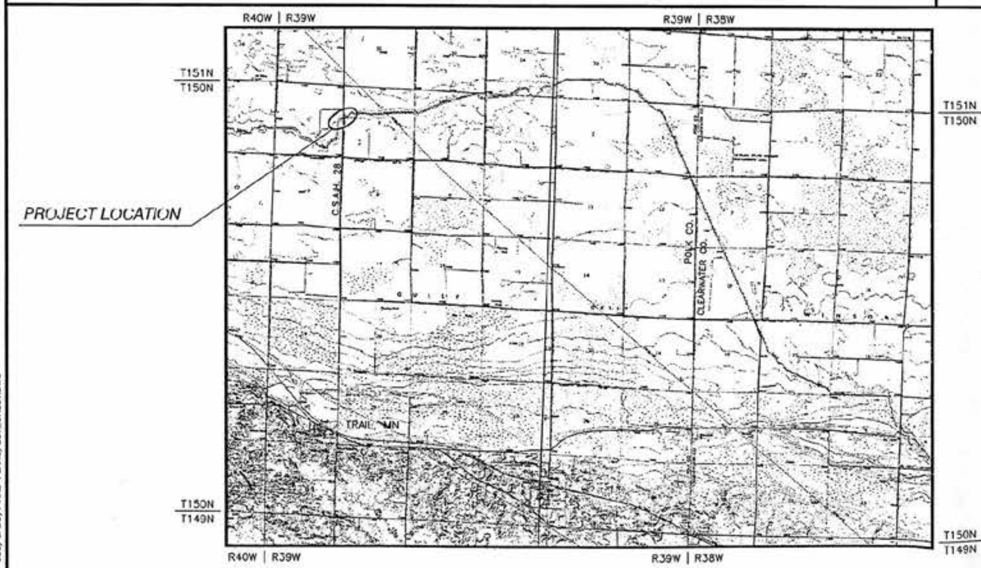


(A)	(B)	(C)
2	2	2
W20-1		G20-2A
48" x 48"	36" x 36"	48" x 24"
ROAD WORK AHEAD	TRUCKS HAULING	END ROAD WORK
PLACE 750 FT. FROM BRIDGE	PLACE 500 FT. FROM BRIDGE	PLACE 200 FT. FROM BRIDGE

NOTES:

1. ALL TRAFFIC CONTROL DEVICES SHALL CONFORM TO CURRENT MMUTCD. (INCLUDING FIELD MANUAL, DATED JANUARY 2001)

2. THE ABOVE REFERENCED SIGNS SHALL BE IN PLACE WHENEVER THE CONTRACTOR IS HAULING PROJECT MATERIALS TO THE SITE OR WHEN THE CONTRACTORS OPERATIONS HAVE EQUIPMENT ON OR NEAR THE ROADWAY. SIGNS MAY BE PLACED ON APPROVED TEMPORARY MOUNTS.



PROJECT LOCATION
SECTIONS 5 & 6
CULLY TOWNSHIP
POLK COUNTY, MINNESOTA

BASIS OF ESTIMATED QUANTITIES

SEED, MIXTURE 1	48 LB/ACRE
MULCH MATERIAL, TYPE 1	2 TON/ACRE
COMM. FERT. ANAL. 40-20-10	150 LB/ACRE

STANDARD PLATES

THE FOLLOWING STANDARD PLATES, APPROVED BY THE FEDERAL HIGHWAY ADMINISTRATION SHALL APPLY ON THIS PROJECT.

PLATE NO.	DESCRIPTION

CAD. REF. S:/1851-053/CADD/FINAL PLANS/EST_SHEET.DWG

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: Brent H. Johnson Typed or Printed Name: Brent H. Johnson

Date: 6-23-2003 Lic. No. 20378

No.	Revision	Date	By

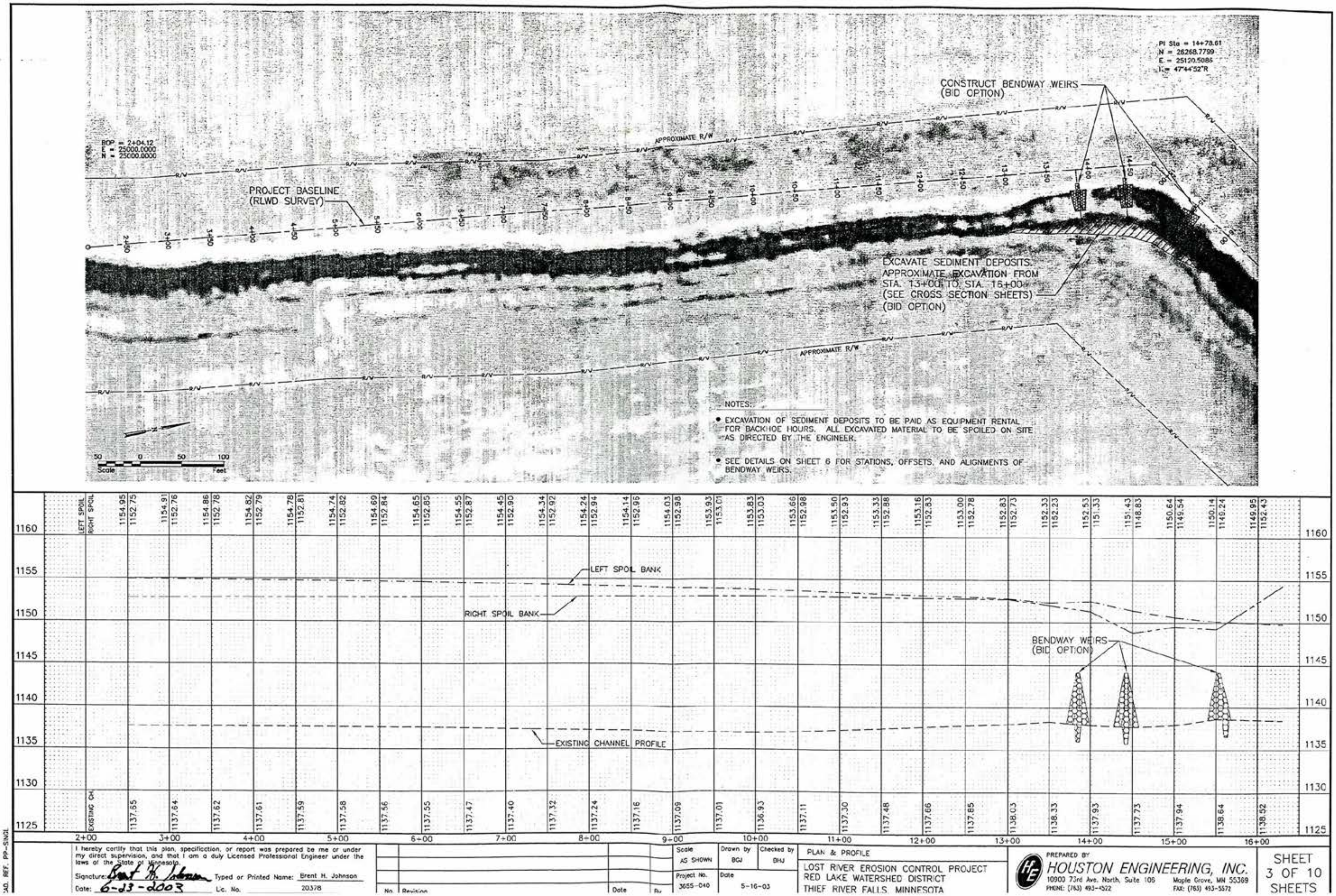
Scale	Drawn by	Checked by
AS SHOWN	BGJ	BHJ
Project No. 3855-040	Date 5-16-03	

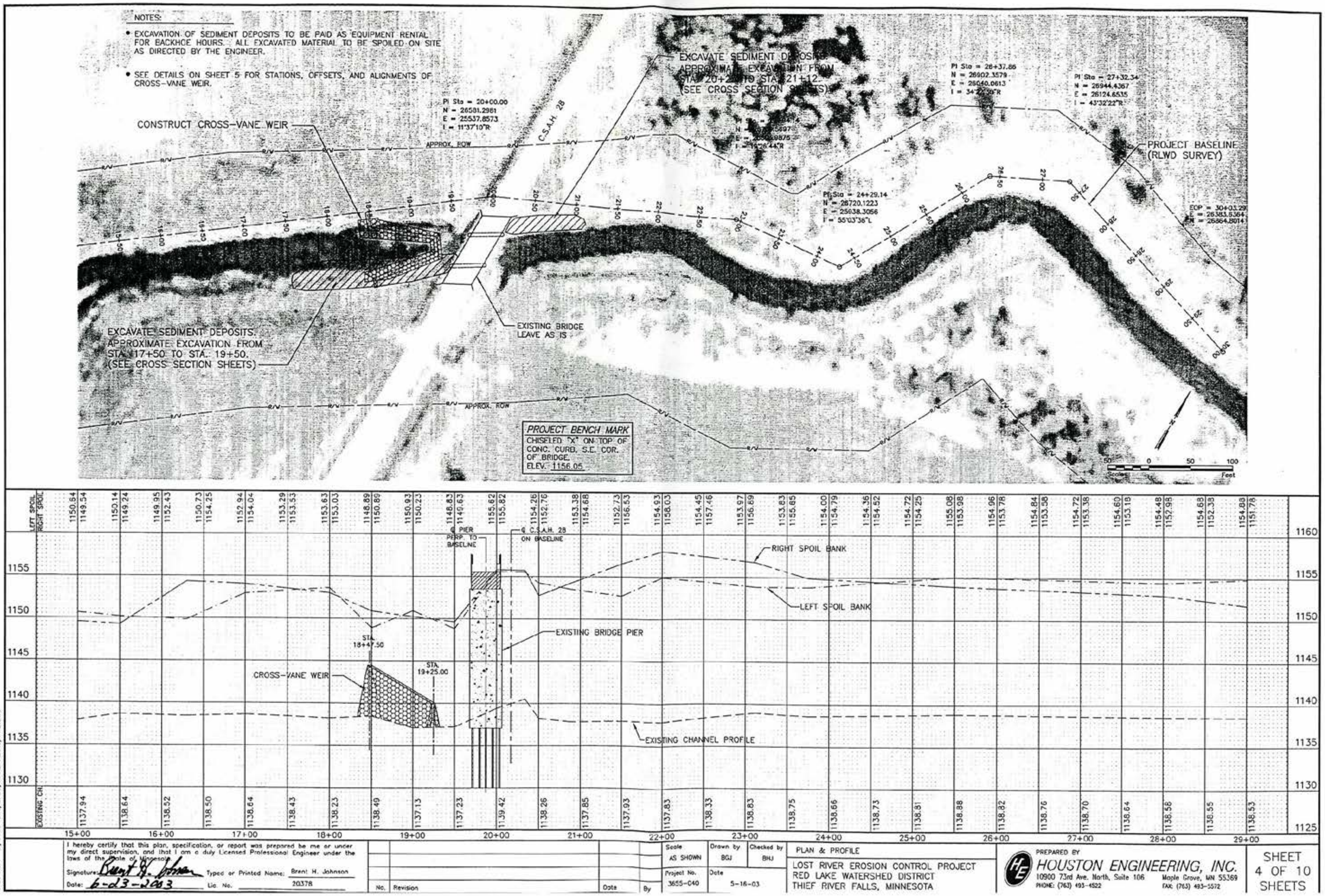
ESTIMATED QUANTITIES AND SITE MAP

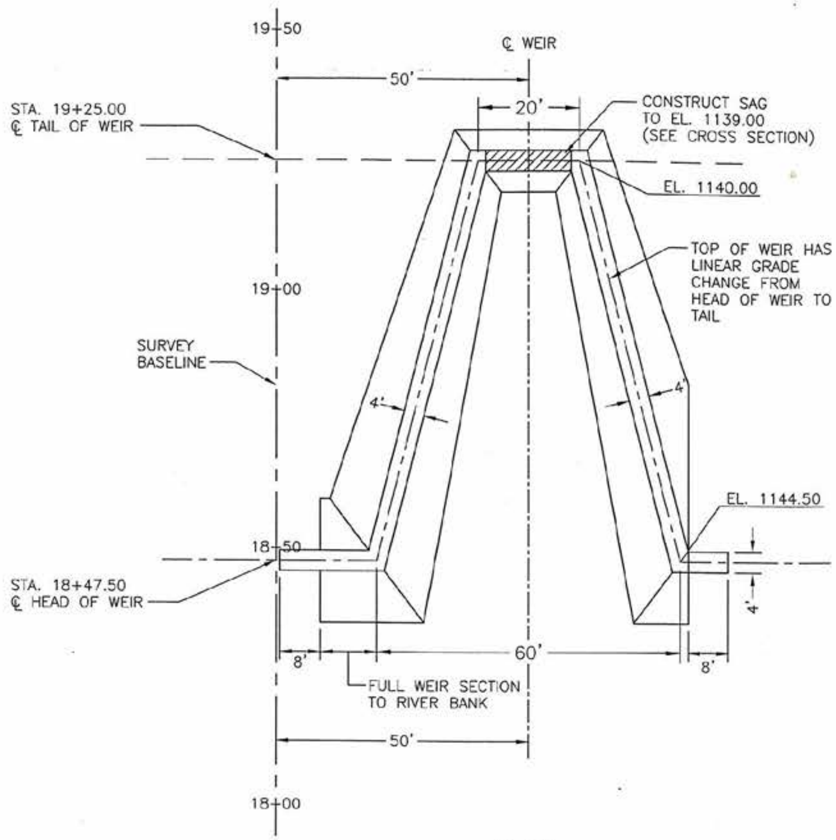
LOST RIVER EROSION CONTROL PROJECT
RED LAKE WATERSHED DISTRICT
THIEF RIVER FALLS, MINNESOTA

PREPARED BY
HOUSTON ENGINEERING, INC.
10900 73rd Ave. North, Suite 106 Maple Grove, MN 55369
PHONE: (763) 493-4522 FAX: (763) 493-5572

SHEET 2 OF 10 SHEETS

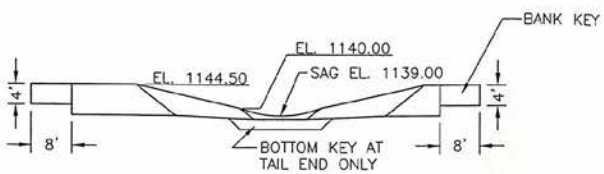

PI Sta = 14+78.61
CONSTRUCT BENDWAY WEIRS
(BID OPTION)
APPROXIMATE R/W
BOP = 2+04.12
E = 25000.0000
N = 25000.0000
PROJECT BASELINE
(RLWD SURVEY)
EXCAVATE SEDIMENT DEPOSITS.
APPROXIMATE EXCAVATION FROM
STA. 13+00 TO STA. 16+00
(SEE CROSS SECTION SHEETS)
(BID OPTION)
NOTES:
• EXCAVATION OF SEDIMENT DEPOSITS TO BE PAID AS EQUIPMENT RENTAL FOR BACKHOE HOURS. ALL EXCAVATED MATERIAL TO BE SPOILED ON SITE AS DIRECTED BY THE ENGINEER.
• SEE DETAILS ON SHEET 6 FOR STATIONS, OFFSETS, AND ALIGNMENTS OF BENDWAY WEIRS.
Scale
Feet
LEFT SPOIL
RIGHT SPOIL
LEFT SPOIL BANK
RIGHT SPOIL BANK
BENDWAY WEIRS
(BID OPTION)
EXISTING CHANNEL PROFILE
EXISTING CH
I hereby certify that this plan, specification, or report was prepared be me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.
Signature:
Typed or Printed Name: Brent H. Johnson
Date: 6-23-2003
Lic. No. 20378
No. Revision Date By
Scale AS SHOWN
Drawn by BGJ
Checked by BHJ
Project No. 3655-040
Date 5-16-03
PLAN & PROFILE
LOST RIVER EROSION CONTROL PROJECT
RED LAKE WATERSHED DISTRICT
THIEF RIVER FALLS, MINNESOTA
PREPARED BY
HOUSTON ENGINEERING, INC.
10900 73rd Ave. North, Suite 106 Maple Grove, MN 55369
PHONE: (763) 493-4522 FAX: (763) 493-5572
SHEET 3 OF 10 SHEETS


NOTES:
• EXCAVATION OF SEDIMENT DEPOSITS TO BE PAID AS EQUIPMENT RENTAL FOR BACKHOE HOURS. ALL EXCAVATED MATERIAL TO BE SPOILED ON SITE AS DIRECTED BY THE ENGINEER.
• SEE DETAILS ON SHEET 5 FOR STATIONS, OFFSETS, AND ALIGNMENTS OF CROSS-VANE WEIR.
CONSTRUCT CROSS-VANE WEIR
PI Sta = 20+00.00
N = 26581.2981
E = 25537.8573
I = 11°37'10"R
C.S.A.H. 28
APPROX. ROW
EXCAVATE SEDIMENT DEPOSITS. APPROXIMATE EXCAVATION FROM STA. 17+50 TO STA. 19+50. (SEE CROSS SECTION SHEETS)
EXISTING BRIDGE LEAVE AS IS
PI Sta = 24+29.14
N = 26720.1223
E = 25038.3056
I = 55°03'38"L
PI Sta = 26+37.86
N = 26902.3579
E = 26040.0613
PI Sta = 27+32.34
N = 26944.4367
E = 26124.6535
I = 43°32'22"R
PROJECT BASELINE (RLWD SURVEY)
PROJECT BENCH MARK
CHISELED "X" ON TOP OF CONC. CURB, S.E. COR. OF BRIDGE.
ELEV. 1156.05
Scale Feet
RIGHT SPOIL BANK
LEFT SPOIL BANK
EXISTING BRIDGE PIER
CROSS-VANE WEIR
STA. 18+47.50
STA. 19+25.00
EXISTING CHANNEL PROFILE
LEFT SPOIL
RIGHT SPOIL
EXISTING CH.
15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00
1125 1130 1135 1140 1145 1150 1155 1160
I hereby certify that this plan, specification, or report was prepared be me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.
Signature: Brent H. Johnson
Typed or Printed Name: Brent H. Johnson
Date: 6-23-2003
Lic. No. 20378
No. Revision Date By
Scale AS SHOWN
Drawn by BGJ
Checked by BHJ
Project No. 3655-040
Date 5-16-03
PLAN & PROFILE
LOST RIVER EROSION CONTROL PROJECT
RED LAKE WATERSHED DISTRICT
THIEF RIVER FALLS, MINNESOTA
PREPARED BY
HOUSTON ENGINEERING, INC.
10900 73rd Ave. North, Suite 106 Maple Grove, MN 55369
PHONE: (763) 493-4522 FAX: (763) 493-5572
SHEET 4 OF 10 SHEETS
CAD. REF. S:/3655-040/CADD/FINAL PLANS/PP2.DWG



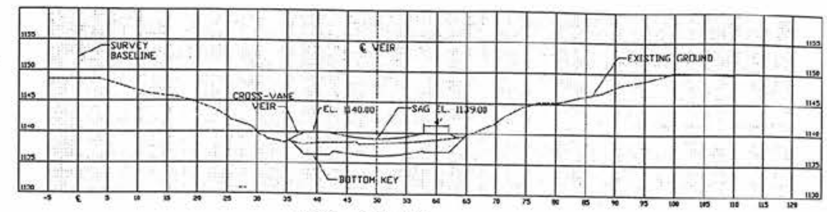
PLAN

NOT TO SCALE

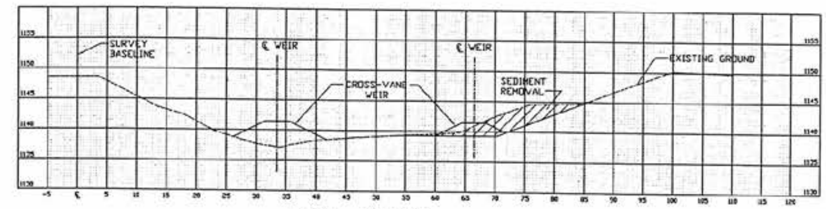


ELEVATION

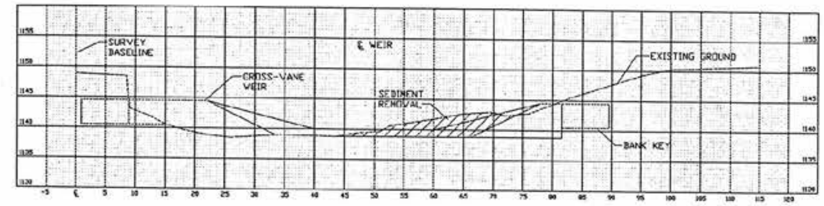
NOT TO SCALE



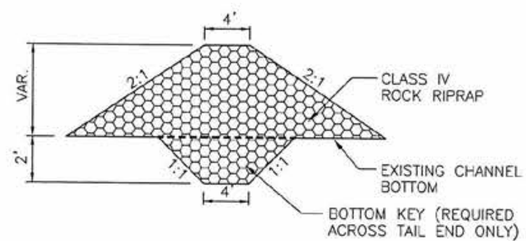
STA. 19+25



STA. 19+00



STA. 18+47.50



TYPICAL WEIR SECTION

NOTES:

- LOCATIONS, LENGTHS, AND ESTIMATED QUANTITIES FOR THE CROSS-VANE WEIR IS ESTIMATED BASED ON AVAILABLE CROSS SECTION DATA. FINAL LOCATIONS AND QUANTITIES MAY VARY BASED ON EXISTING CONDITIONS AT TIME OF CONSTRUCTION.
- ESTIMATED RIPRAP QUANTITIES FOR CROSS-VANE WEIR:
  TOTAL CLASS IV RIPRAP = 335 CU. YD.
- ALL EXCAVATION REQUIRED TO CONSTRUCT THE CROSS-VANE WEIR AS DETAILED IN THE PLANS AND SPECIFICATIONS SHALL BE CONSIDERED INCIDENTAL AND NO DIRECT COMPENSATION SHALL BE MADE.

CAD. REF. S:/3655-040/CADD/FINAL PLANS/DETAILS_1.DWG

No.	Revision	Date	By

CONSTRUCTION DETAIL – CROSS-VANE WEIR

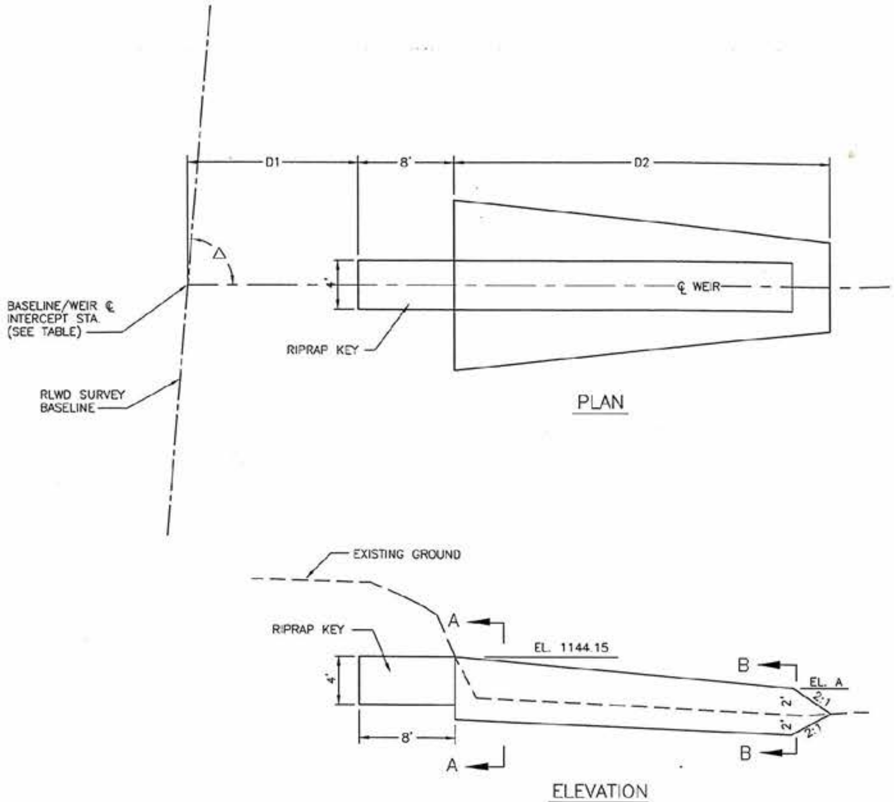
LOST RIVER EROSION CONTROL PROJECT
RED LAKE WATERSHED DISTRICT
THIEF RIVER FALLS, MINNESOTA

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	BGJ	BHJ	3655-040	5-20-03	5 of 10

PREPARED BY

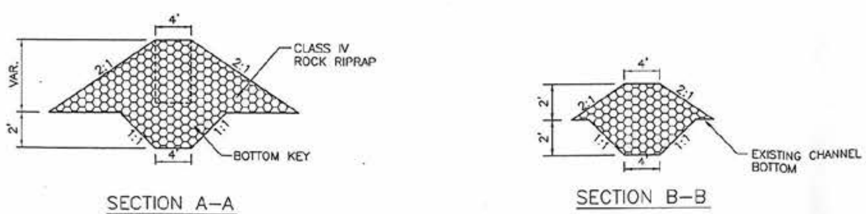
HOUSTON ENGINEERING, INC.

10900 73rd Ave. North, Suite 106 Maple Grove, MN 55369



TYPICAL BENDWAY WEIR

NOT TO SCALE



BENDWAY WEIR LAYOUT DATA				
INTERCEPT STATION	△	D1	D2	EL. A
13+85.26"	87°44'07"	16'	24'	1140.60
14+42.82	89°57'53"	14'	26'	1140.60
15+46.80	75°16'19"	2'	32'	1140.80

NOTES:

- LOCATIONS, LENGTHS, AND ESTIMATED QUANTITIES FOR BENDWAY WEIRS IS ESTIMATED BASED ON AVAILABLE CROSS SECTION DATA. FINAL LOCATIONS AND QUANTITIES MAY VARY BASED ON EXISTING CONDITIONS AT TIME OF CONSTRUCTION.
- ESTIMATED RIPRAP QUANTITIES FOR BENDWAY WEIRS:
  STA. 13+85.26 = 45 CU. YD.
  STA. 14+42.82 = 53 CU. YD.
  STA. 15+46.80 = 64 CU. YD.
- ALL EXCAVATION REQUIRED TO CONSTRUCT THE BENDWAY WEIRS AS DETAILED IN THE PLANS AND SPECIFICATIONS SHALL BE CONSIDERED INCIDENTAL AND NO DIRECT COMPENSATION SHALL BE MADE.

CAD. REF. S:/3655-040/CADD/FINAL PLANS/DETAILS_2.DWG

No.	Revision	Date	By

CONSTRUCTION DETAIL – BENDWAY WEIRS

LOST RIVER EROSION CONTROL PROJECT
RED LAKE WATERSHED DISTRICT
THIEF RIVER FALLS, MINNESOTA

Scale	Drawn by	Checked by	Project No.	Date	Sheet
AS SHOWN	BCJ	BHJ	3655-040	5-20-03	6 of 10

PREPARED BY
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10900 73rd Ave. North, Suite 106 Maple Grove, MN 55369
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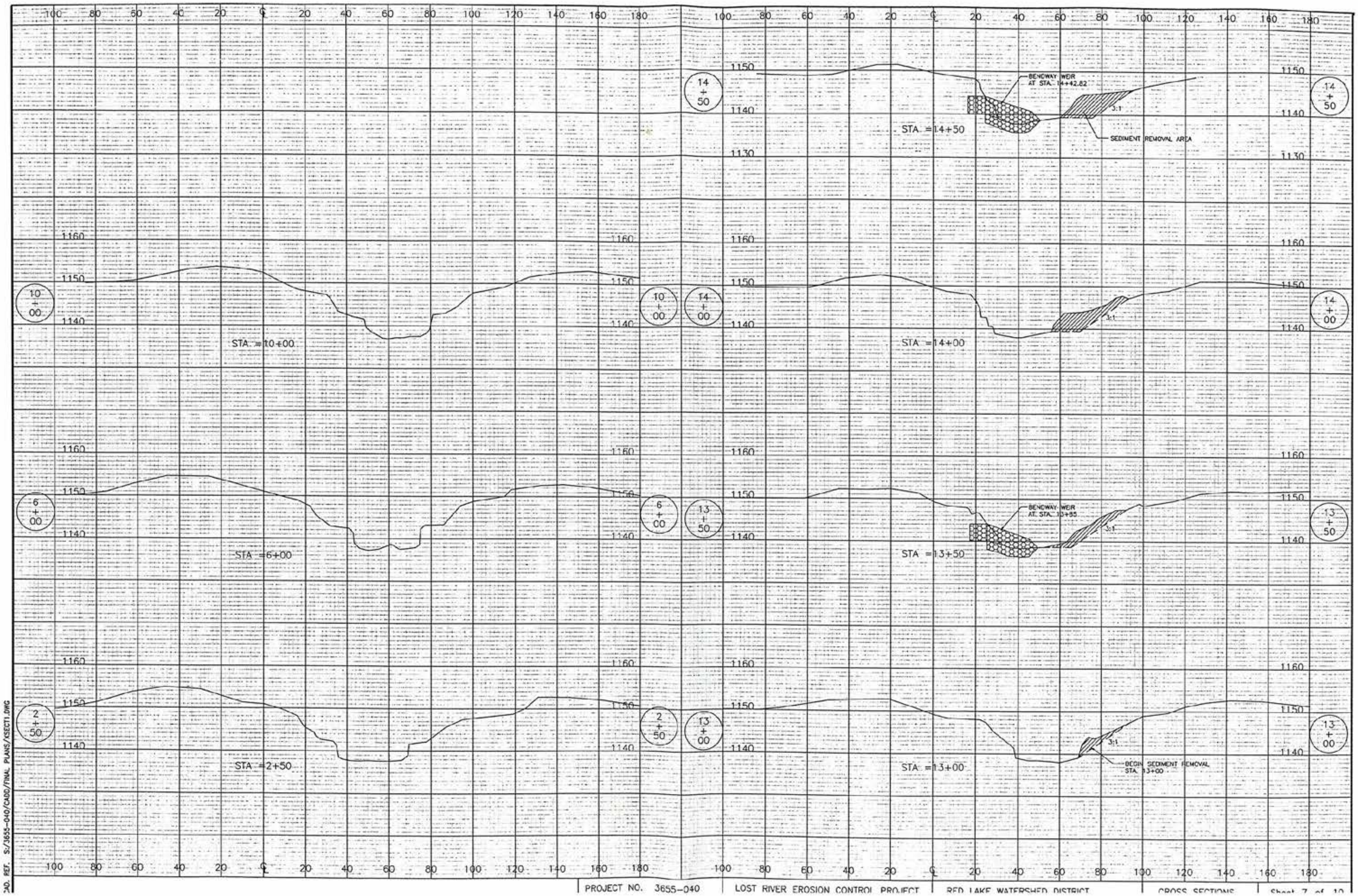
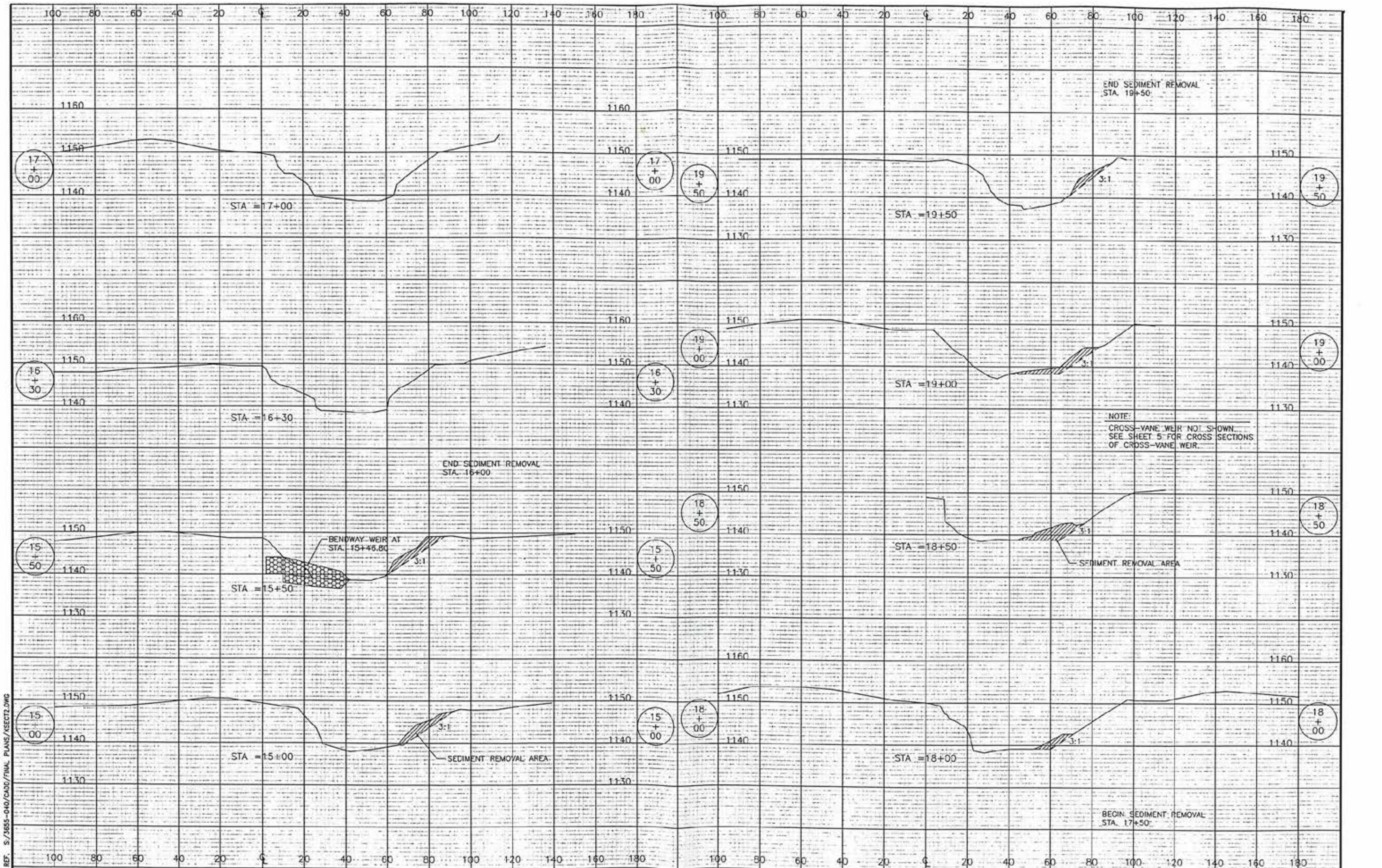
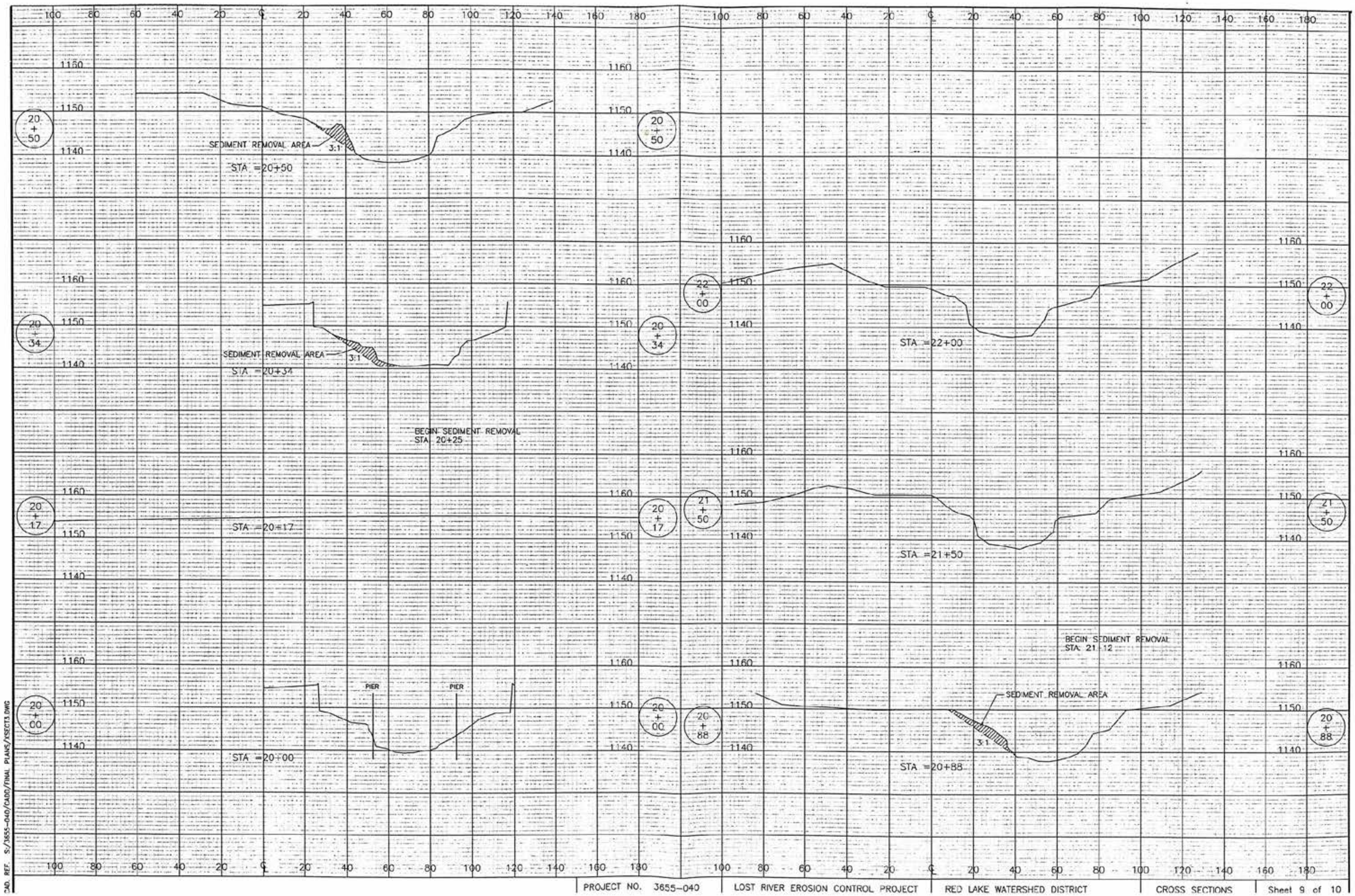


STA. =14+50
BENDWAY WEIR AT STA. 14+42.82
3:1
SEDIMENT REMOVAL AREA
STA. =10+00
STA. =14+00
3:1
STA. =6+00
STA. =13+50
BENDWAY WEIR AT STA. 13+85
3:1
STA. =2+50
STA. =13+00
3:1
BEGIN SEDIMENT REMOVAL STA. 13+00
CAD. REF. S:/3655-040/CADD/FINAL PLANS/XSECT1.DWG
PROJECT NO. 3655-040
LOST RIVER EROSION CONTROL PROJECT
RED LAKE WATERSHED DISTRICT
CROSS SECTIONS
Sheet 7 of 10



PROJECT NO. 3655-040	LOST RIVER EROSION CONTROL PROJECT	RED LAKE WATERSHED DISTRICT	CROSS SECTIONS	Sheet 8 of 10


STA =20+50
SEDIMENT REMOVAL AREA
3:1
STA =20+34
SEDIMENT REMOVAL AREA
3:1
BEGIN SEDIMENT REMOVAL
STA 20+25
STA =20+17
STA =20+00
PIER
PIER
STA =22+00
STA =21+50
BEGIN SEDIMENT REMOVAL
STA 21+12
SEDIMENT REMOVAL AREA
3:1
STA =20+88
CAD. REF. S:/3655-040/CADD/FINAL PLANS/XSECT3.DWG
PROJECT NO. 3655-040
LOST RIVER EROSION CONTROL PROJECT
RED LAKE WATERSHED DISTRICT
CROSS SECTIONS
Sheet 9 of 10

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS

1. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING A COPY OF AND BEING FAMILIAR WITH THE MINNESOTA POLLUTION CONTROL AGENCY GENERAL PERMIT FOR STORM WATER DISCHARGES ASSOCIATED WITH A CONSTRUCTION SITE.

2. THE CONTRACTOR SHALL PRESERVE THE EXISTING VEGETATION WHERE ATTAINABLE. DISTURBED AREAS WILL BE STABILIZED AS SOON AS PRACTICABLE. STABILIZATION PRACTICES MAY INCLUDE: TEMPORARY SEEDING, PERMANENT SEEDING, MULCHING, GEOTEXTILES, SODDING, VEGETATIVE BUFFER STRIPS AND OTHER MEASURES.

3. ~~THE CONTRACTOR SHALL MAINTAIN A RECORD OF THE DATES WHEN MAJOR GRADING ACTIVITIES OCCUR, WHEN CONSTRUCTION ACTIVITIES TEMPORARILY OR PERMANENTLY CEASE ON A PORTION OF THE SITE AND WHEN STABILIZATION MEASURES ARE INITIATED.~~

4. ~~DISTURBED AREAS WHERE CONSTRUCTION ACTIVITIES HAVE TEMPORARILY OR PERMANENTLY CEASED WILL BE STABILIZED AS SOON AS PRACTICAL BUT IN NO CASE LATER THAN 14 DAYS AFTER CONSTRUCTION ACTIVITY HAS CEASED, UNLESS STABILIZATION IS PRECLUDED BY SNOW COVER.~~

5. ~~AREAS WHERE CONSTRUCTION ACTIVITY WILL RESUME WITHIN 21 DAYS OF THE TIME CONSTRUCTION ACTIVITY TEMPORARILY CEASES NEED NOT BE STABILIZED.~~

6. ~~IN ARID AREAS (AVERAGE ANNUAL RAINFALL OF 0 TO 10 INCHES) AND SEMI-ARID AREAS (AVERAGE ANNUAL RAINFALL 10 TO 20 INCHES), STABILIZATION MEASURES SHALL BE INITIATED AS SOON AS PRACTICAL.~~

7. THE CONTRACTOR SHALL MINIMIZE OFF-SITE TRACKING OF SEDIMENTS AND THE GENERATION OF DUST. ~~GRAVEL CONSTRUCTION ENTRANCE SHALL BE FIELD LOCATED AS NEEDED.~~

8. THE CONTRACTOR SHALL MAINTAIN, REPAIR OR RESTORE ALL GRADE SURFACES, WALLS, DAMS AND STRUCTURES, VEGETATION, EROSION AND SEDIMENT CONTROL MEASURES AND OTHER PROTECTIVE DEVICES IDENTIFIED IN THE SITE PLAN.

9. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL PRACTICES ON THE SITE AT LEAST EVERY SEVEN DAYS AND WITHIN 24 HOURS AFTER A STORM EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR SHALL TAKE ACTION TO ELIMINATE ANY DEFICIENCIES FOUND DURING THESE INSPECTIONS. DOCUMENTATION OF THE INSPECTIONS, THE FINDINGS AND ANY CORRECTIVE ACTIONS SHALL BE MAINTAINED AT THE SITE. ~~THE DOCUMENTATION SHALL INCLUDE A REPORT SUMMARIZING THE SCOPE OF THE INSPECTION(S), NAME(S) AND QUALIFICATIONS OF PERSON MAKING THE INSPECTIONS, THE DATE(S), THE INSPECTIONS, MAJOR OBSERVATIONS RELATED TO THE SWPPP AND ACTIONS TAKEN.~~

10. WASTE DISPOSAL

    THE CONTRACTOR SHALL REMOVE ALL WASTE COMPOSED OF BUILDING MATERIALS FROM THE SITE FOR DISPOSAL IN LICENSED DISPOSAL FACILITIES.

    A. NO BUILDING MATERIAL WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURIED, DUMPED OR DISCHARGED TO WATERS OF THE STATE AT THE SITE.

    B. ~~EACH SITE SHALL HAVE GRAVELED ACCESS ENTRANCE AND EXIT DRIVES AND PARKING AREAS TO REDUCE THE TRACKING OF SEDIMENT ONTO PUBLIC OR PRIVATE ROADS.~~

    C. ~~ALL UNPAVED ROADS ON THE SITE CARRYING MORE THAN 25 VEHICLES PER DAY SHALL BE GRAVELED.~~

    D. THE CONTRACTOR SHALL ENSURE AND DEMONSTRATE COMPLIANCE WITH THE APPLICABLE STATE DEPARTMENT OF ENVIRONMENTAL QUALITY OR LOCAL SANITARY SEWER OR SEPTIC SYSTEM REGULATIONS.

11. FUEL AND CHEMICAL STORAGE AREAS

    THE CONTRACTOR SHALL PROVIDE CONTAINMENT AROUND FUELING AND CHEMICAL STORAGE AREAS TO ENSURE THAT SPILLS IN THESE AREAS DO NOT REACH WATERS OF THE STATE. CONTINGENCIES SHALL BE PROVIDED FOR THE TREATMENT AND/OR DISPOSAL OF CONTAMINATED SOILS.

12. EXISTING STATE OR LOCAL REQUIREMENTS FOR SEDIMENT AND EROSION CONTROL ARE HEREBY INCORPORATED BY REFERENCE AND ARE ENFORCEABLE.

13. ~~THE CONTRACTOR MUST CLEARLY IDENTIFY FOR EACH MEASURE IDENTIFIED IN THE PLAN. THE CONTRACTOR(S) AND/OR SUBCONTRACTOR(S) THAT WILL IMPLEMENT THE MEASURE. ALL CONTRACTORS AND SUBCONTRACTORS IDENTIFIED BY THE CONTRACTOR MUST SIGN A COPY OF THE CERTIFICATION STATEMENT. ALL CERTIFICATIONS MUST BE INCLUDED IN THE STORM WATER POLLUTION PREVENTION PLAN.~~

14. CERTIFICATION STATEMENT

    ~~ALL CONTRACTORS AND SUBCONTRACTORS SHALL SIGN A COPY OF THE STATE SIGNATORY CERTIFICATION STATEMENT BEFORE CONDUCTING ANY PROFESSIONAL SERVICE AT THE SITE IDENTIFIED IN THE STORM WATER POLLUTION PREVENTION PLAN.~~

15. ~~THE CERTIFICATION MUST INCLUDE THE NAME AND TITLE OF THE PERSON PROVIDING THE SIGNATURE IN ACCORDANCE WITH THE STATE NPDES PERMIT. THE NAME, ADDRESS AND TELEPHONE NUMBER OF THE CONTRACTING FIRM; THE ADDRESS (OR OTHER IDENTIFYING DESCRIPTION) OF THE SITE; AND THE DATE THE CERTIFICATION IS MADE.~~

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) GENERAL SPECIFICATIONS

THE PURPOSE OF THE SWPPP, OF WHICH THE EROSION CONTROL PLAN IS A PART, IS TO MINIMIZE POLLUTION TO STORM WATERS, IN COMPLIANCE WITH THE NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM (NPDES) ENACTED BY THE EPA IN SEPTEMBER, 1992.

~~THE CONTRACTOR AND THE OWNER ARE JOINTLY REQUIRED TO SUBMIT TO THE MPCA AND THE STATE A NOTICE OF INTENT (NOI) AT LEAST 48 HOURS PRIOR TO COMMENCEMENT OF CONSTRUCTION AT THE SITE. THE CONTRACT DOCUMENTS AND CONSTRUCTION SPECIFICATIONS FOR THIS PROJECT WILL SPECIFICALLY ADDRESS THE RESPONSIBILITIES OF THE OWNER AND THE CONTRACTOR REGARDING THE NOI.~~

~~THE CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING THE SWPPP AS REQUIRED BY THE CONTRACT. THE PLAN PROVIDES STRUCTURAL CONTROLS AND/OR STABILIZATION PRACTICES DESIGNED TO MINIMIZE POLLUTANTS IN THE STORM WATER DISCHARGE (INCLUDING SOIL SEDIMENT), TO MINIMIZE EROSION ON THE SITE, AND TO ELIMINATE TRACKING OF SOIL OFF SITE BY VEHICLES.~~

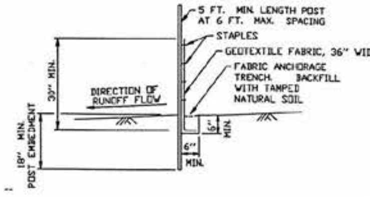
~~A REGULAR PROGRAM OF INSPECTION AND MAINTENANCE OF THE EROSION AND POLLUTION CONTROLS IS REQUIRED BY MCPA. THE CONTRACT DOCUMENTS AND CONSTRUCTION SPECIFICATIONS FOR THIS PROJECT IDENTIFY THE PARTY RESPONSIBLE FOR SUCH INSPECTIONS. BASED ON THESE INSPECTIONS, THE EROSION AND POLLUTION CONTROLS WILL BE MAINTAINED, MAY BE MODIFIED AND MAY BE SUPPLEMENTED BY ADDITIONAL MEASURES IN ORDER TO ADEQUATELY MINIMIZE POLLUTANTS.~~

~~THE CONTRACTOR AND THE OWNER ARE JOINTLY REQUIRED TO SUBMIT TO THE MCPA AND THE STATE A NOTICE OF TERMINATION (NOT) AFTER THE SITE HAS BEEN STABILIZED, CONSTRUCTION HAS ENDED AND TEMPORARY EROSION CONTROL MEASURES HAVE BEEN REMOVED.~~

~~STORM WATER MANAGEMENT FEATURES IN ADDITION TO THOSE SHOWN ON THE PLANS SHALL BE PLACED, MONITORED, MAINTAINED, AND REMOVED AT THE DISCRETION AND DIRECTION OF THE ENGINEER AS NECESSARY.~~

~~STRAW BALE CHECKS SHOULD BE INSTALLED AS NEEDED AT SLOPES AND DITCHES. SILT FENCES WILL BE REQUIRED AT THE BOTTOM OF SLOPES AS OUTLINED ON THE PLANS.~~

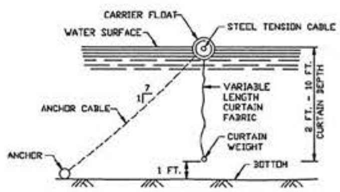
SEQUENCE OF CONSTRUCTION



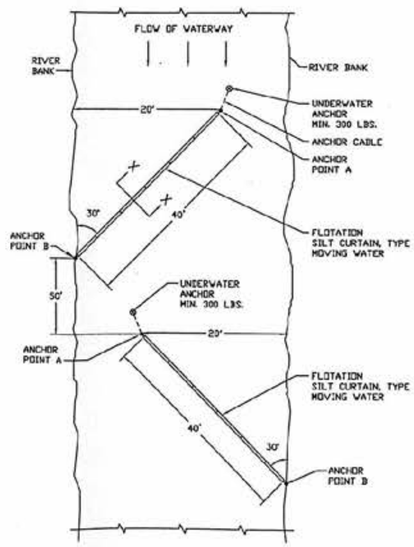
SILT FENCE - TYPE PREASSEMBLED

NOT TO SCALE

NOTES:
1. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN NECESSARY.
2. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND CAN BE PERMANENTLY STABILIZED.



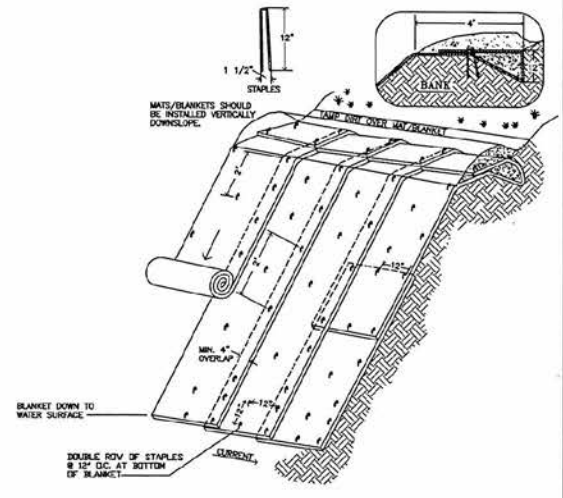
SECTION X-X
FLOTATION SILT CURTAINS



PLAN VIEW

FLOTATION SILT CURTAIN DETAIL

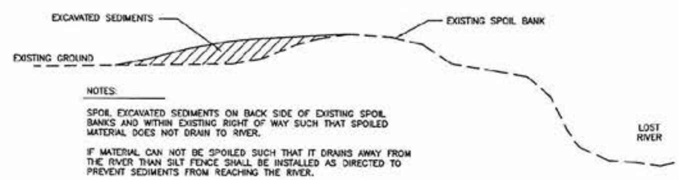
NOT TO SCALE



NOTES:
1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS. MATS/BLANKETS SHALL HAVE GOOD SOIL CONTACT.
2. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH.
3. MATS/BLANKETS TO BE ANCHORED IN A TRENCH AT THE TOP AND THE UPSTREAM EDGE.

EROSION CONTROL BLANKET DETAIL

NOT TO SCALE



NOTES:

SPOIL EXCAVATED SEDIMENTS ON BACK SIDE OF EXISTING SPOIL BANKS AND WITHIN EXISTING RIGHT OF WAY SUCH THAT SPOILED MATERIAL DOES NOT DRAIN TO RIVER.

IF MATERIAL CAN NOT BE SPOILED SUCH THAT IT DRAINS AWAY FROM THE RIVER THAN SILT FENCE SHALL BE INSTALLED AS DIRECTED TO PREVENT SEDIMENTS FROM REACHING THE RIVER.

SPOIL PLACEMENT DETAIL

NOT TO SCALE

I hereby certify that this plan, specification, or report was prepared be me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota. Signature: Brent H. Johnson Typed or Printed Name: Brent H. Johnson Date: 6-23-2003 Lic. No. 20378	No.	Revision	Date	By	Scale AS SHOWN	Drawn by BGJ	Checked by BHJ	EROSION & SEDIMENT CONTROL DETAILS AND NOTES	SHEET
					Project No. 3655-040	Date 5-28-03		LOST RIVER EROSION CONTROL PROJECT RED LAKE WATERSHED DISTRICT THIEF RIVER FALLS, MINNESOTA	10 OF 10 SHEETS

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