STABILIZATION OF THE CLYDE CREEK SITE. 21SL35
VOYAGEURS NATIONAL PARK

MARK J. LYNOTT

MIDWEST ARCHEOLOGICAL CENTER
NATIONAL PARK SERVICE
LINCOLN, NEBRASKA
JULY, 1984
Stabilization of the Clyde Creek site, 21SL35, Voyageurs National Park

Mark J. Lynott

Midwest Archeological Center
National Park Service
Lincoln, Nebraska
July, 1984
Abstract

In 1984, the Midwest Archeological Center and Voyageurs National Park initiated a program of site stabilization at the Clyde Creek site (21SL35). Previous archeological investigations indicated that the site represents a significant prehistoric site attributable to the Laurel Culture. Erosion from raised lake levels of Lake Kabetogama have been affecting the site since a dam was constructed at Kettle Falls in the early twentieth century. Only a limited portion of the original archeological deposit remains in primary context, and the stabilization activities described in this report are designed to mitigate the impact of lakeshore erosion by protecting the site from continuing shoreline erosion.

Stabilization of the Clyde Creek site included limited salvage excavation of slumped archeological remains along the eroding edge of the site. Vegetation along the eroding edge was carefully removed and sediment was piled against the eroding bank to lessen the slope of the bank. A layer of filter fabric was placed on top of the newly created bank, and covered with a six inch layer of soil. Native grass was seeded into this soil layer, and covered with a turf stabilization mat. A band of rip-rap was placed along the margin of the bank at the elevation of summer high water level to anchor the turf stabilization mat and protect the base of the bank from waves.
List of Figures

1. Location of the Clyde Creek site, Voyageurs National Park........19
2. Excavation units, 1984 investigations.................................20
3. Excavation of eroding bank edge........................................21
4. Excavation of eroding bank edge........................................21
5. Selected chipped stone and ceramic artifacts..........................22
6. Selected prehistoric ceramics.............................................23
7. Hauling sediments and rock across ice road............................24
8. Removing vegetation from eroding bank................................24
9. Adding sediments to bank to reduce slope...............................25
10. Excavation of toe trench at the base of the eroding bank..........25
11. Filter fabric was unrolled on the ice and cut to fit sections of the bank.........................................................26
12. Filter fabric laid in place..................................................26
13. Securing pins were used to anchor the filter fabric..................27
14. Covering filter fabric with a layer of sediment.......................27
15. Spreading grass seed.......................................................28
16. Installation of turf stabilization matting...............................28
17. Adding rip-rap along summer water line.................................29
18. Clyde Creek site after completion of stabilization project........29

List of Tables

1. Artifacts from 1984 excavations, 21SL35.................................7
2. Summary of stabilization costs, Clyde Creek site.....................13
Acknowledgements

The archeological research and stabilization at the Clyde Creek site was a cooperative effort between the Midwest Archeological Center and Voyageurs National Park. The archeological investigations at the site were conducted by Supervisory Archeologist Mark Lynott, Archeologists Jeffrey Richner and Melissa Connor, and Museum Aids Randall Farmer and Mary Riddle. These individuals also actively participated in the stabilization of the site. The author would like to express his deep gratitude to this group for their commitment to doing the best work possible under less than ideal working conditions.

The stabilization of the site could not have been completed without the enthusiastic support of the Park Staff. Superintendent Russell Berry and Facilities Manager Raoul Lufbery endorsed the project and committed the resources and personnel necessary to complete it. Voyageurs National Park personnel participating in the project included: Rod Booth, Foreman; Wes Horne, Equipment Operator; Bruce Barrett, Maintenance Worker; Dennis Lagergren, Maintenance Worker; Bill Knapp, Maintenance Worker; Jeff Friendt, Laborer; Bill Johnson, Laborer; Craig Moe, Equipment Repair Mechanic; Gar Gauthier, Small Engine Repair Mechanic. Each of these individuals played an important role in the completion of the project.

The author would like to make special note of the extensive efforts of Foreman, Rod Booth in the planning and completion of the Clyde Creek stabilization project. Rod paid careful attention to all the details of staffing, resource procurement and scheduling that were crucial to the completion of the project. His positive attitude and sense of planning made the project more pleasant and considerably less hectic.

I would like to express my sincere gratitude to Mr. Danny Campbell of Mirafi, Inc. for making the turf stabilization matting used in this project available at no cost the National Park Service. Mirafi, Inc. kindly offered their product to us as an experimental application, and the entire stabilization team was highly impressed with the strength and flexibility of the product. We feel comfortable that it will contribute to the overall success of the stabilization of the site.

In the last few days of our work at Clyde Creek, there was a strong feeling of accomplishment among the project participants. A lot of energy was expended in the effort to preserve the Clyde Creek site, but all personnel demonstrated a determination to do the job properly. This was certainly the first time a project of this type has been attempted in the Midwest Region, but the filter fabrics and techniques used in this project are likely to have wide applications. It is gratifying to participate in a program that is aimed at preserving the archeological record at a time when many agencies are looking for means to reduce their obligation to historic preservation programs. If we cannot preserve significant archeological sites within the National Park System, then it is unlikely that any of this nation's prehistoric and historic archeological sites can be preserved.
Voyageurs National Park was established in 1975 to preserve and protect a tract of southern boreal forest along the international boundary with Canada. While the area is rugged, isolated and beautiful, careful examination reveals the heavy hand of Euro-American development and exploitation. The timber resources of this region are well known, and still form a critical element of the local economy. Intensive settlement of this portion of the border lakes region was clearly linked to early twentieth century lumbering. In addition to widespread timber cutting, the logging industry built dams to generate hydroelectric power at Kettle Falls and International Falls in about 1914. The resulting changes in the hydrological cycle have had a major impact on the archaeological record of past Indian occupation within Voyageurs National Park. As a relatively new National Park, archaeological research activities have focused on inventory and evaluation of resources.

Initial site survey of the park was conducted under contractual agreement by the University of Minnesota (Gibbon 1977, 1978) and the Minnesota Historical Society (Watson, Oothoudt and Birk 1976; George 1973; Birk 1972). These studies documented the presence of numerous prehistoric and historic sites and proposed that aboriginal settlement in the region was largely focused on the margins of lakes and rivers. The investigators also noted the heavy erosion of lakeshore sites in the park, and offered a gloomy forecast for the potential of finding intact archeological deposits behind the eroding beaches (Gibbon 1976:42).

In 1979 and 1980, the Midwest Archeological Center began a program of survey and site testing that was designed to test the model of aboriginal settlement proposed by Gibbon (1977, 1978) through additional survey activities, and to evaluate the condition, content and research potential of known sites through limited site testing. During the two seasons of fieldwork, a total of 89 previously recorded sites were revisited, 49 previously unknown sites were recorded, and 24 sites were evaluated through a program of limited test excavations. The data from these investigations is presented in a report which discusses efforts at chronology building, reconstruction of settlement and subsistence patterns, and other facets of the research program (Lynott, Thompson and Richner 1984).

The 1979 and 1980 field investigations substantiated the interpretations made by the University of Minnesota about the impact of dam construction and lake enlargement on the archeological resources in the park. Shoreline erosion is obvious at most sites in the park, and annual monitoring of these sites has demonstrated that erosion is continuing. In an effort to preserve the archeological resources which still retain some contextual integrity, plans to stabilize the shoreline at one of the archeological sites were developed and subsequently implemented. This report is intended to document the research and stabilization activities conducted along the western third of the Clyde Creek site (Figure 1), and discuss the applicability of site stabilization practices for other eroding archeological sites at Voyageurs National Park.
The inventory of archeological sites at Voyageurs National Park has been compiled through a combination of shoreline survey along major lakes in the park, and survey of selected transects designed to cross-cut a variety of biotic and geomorphologic zones. Shoreline survey in 1976 and 1977 focused on sandy beaches (Gibbon 1977, 1978), while shoreline survey in 1980 focused on survey of all shoreline areas except those with obvious bedrock outcrops. These shoreline surveys have resulted in the identification of 294 prehistoric and historic archeological sites. Transect survey on the other hand has been far less productive, and considerably more difficult. The dense vegetation necessitates that transect survey coverage include systematic interval shovel testing to expose archeological resources normally covered by the thick duff layer which is characteristic of this area. Shovel test intervals varied from 15 m to 25 meters between the 1976 and 1979 transect surveys, but the results were essentially the same. After survey of 5094 acres, no prehistoric sites have been located more than 50 m from existing lakeshores. The only sites we have found in non-lakeshore contexts are twentieth century lumber camps and lumber industry features.

Site testing in 1979 incorporated two different techniques to determine the extent, condition, context and content of the archeological sites in the park. Testing was initiated with interval shovel testing to determine the extent of archeological materials and to determine if they occur in subsurface contexts. If artifacts were located in subsurface contexts, then one or more 1 m x 1 m test pits were excavated. This testing strategy was conducted at most sites which could be relocated in the Namakan and Kabetogama Lakes area, with less intensive testing in the Rainy and Crane Lakes segments of the park.

The net result of the fieldwork conducted to date is the realization that the raised lake levels associated with lumber era dams at International Falls and Kettle Falls have greatly changed the configuration of the lakes in the park. The pre-lumbering shorelines, which were the focus of Woodland and Historic Indian settlement in the park, are now incorporated in the beach zone which is subject to the annual fluctuation of the lakes between summer high water and winter low water conditions. These annual fluctuations are controlled by the dams, which are controlled by the International Joint Commission as part of an International agreement between the United States and Canada. Our research has produced evidence that only 25% of the sites located thus far retain any primary context deposit, and these sites are subject to the ongoing process of shoreline erosion.

The extent of this erosion is particularly distressing because the sites which remain partially intact have been found to contain a wealth of archeological material. The few partially intact sites have produced ceramics, lithics, macrobotanical and faunal remains in contexts that may contribute to an understanding of past adaptive patterns. Interpretation of the settlement patterns in the park is complicated by the erosional destruction of the sites, leaving 75% of the sites as simply scatters of artifacts exposed on beaches during periods of low
water. Subsistence data is likewise lost through mechanical fragmentation resulting from lakeshore erosion. Since the lakeshore erosional process is ongoing, and an International agreement is needed to return the lakes to a more natural hydrological cycle, the few intact archeological sites must be considered highly significant. As stewards of these resources, and recognizing that these archeological sites are the only record of prehistoric and early historic Indian history in the park, the National Park Service has elected to attempt a program of shoreline stabilization designed to preserve these few partially intact sites in-place. This option was selected because it was felt that in-place preservation was more beneficial to the public than would be large-scale contemporary salvage and wholesale museum storage.
Excavations at the Clyde Creek site

The Clyde Creek site was originally recorded by the University of Minnesota (Gibbon 1977). In 1979, a field crew from the Midwest Archeological Center initiated limited test excavations at the site for the purpose of determining the size, content, condition and potential significance of the resource. The 1979 test excavations began with systematic interval shovel testing to determine the extent of the archeological deposit. The data from the shovel testing indicated that the site covers an area about 140 m parallel to the Lake Kabetogama shoreline, and extending 10 to 15 m inland from the shoreline (Figure 2).

In an effort to determine the depth, condition and potential significance of the site, seven test pits were also excavated. Test pits were one meter by one meter in size, and were excavated in arbitrary 10 cm levels. Data from these test excavations indicate that the cultural deposit is generally limited to the upper 20 cm of the soil profile, but that subsurface pits and other features may extend below this level. The testing also indicated that the evidence of occupation is not uniformly distributed across the site, but occurs in distinct clusters.

A large number and variety of artifacts were recovered during the 1979 test excavations, and have been described elsewhere (Lynott, Richner and Thompson 1984). The nature and number of these artifacts indicate that the site may be attributed to the Laurel Culture, which represents the Initial Woodland occupation in the boundary waters region. The decorative techniques present on the prehistoric ceramics and three thermoluminescence dates processed from ceramics collected at the site provide further evidence that the site dates to the period between A.D. 500 and A.D. 750. This is the terminal portion of the Laurel cultural sequence and is known as the Smith phase. The 1979 investigations at the Clyde Creek site indicate that the site represents a base camp, that was probably occupied by six to ten families during the warm season of the year when resource availability was sufficient to permit populations to aggregate.

After completion of evaluative testing in 1979, it was obvious that the Clyde Creek met the criteria for eligibility to the National Register of Historic Places. With the parkwide problem of shoreline erosion, and the obvious erosional bank at the Clyde Creek site, a program of annual monitoring was initiated. During each summer between 1980 and 1983, the author visited the site and examined the bank at several reference points which were established during 1979. During the period between 1979 and 1981, very little erosion of the shoreline was observed. However, during the period between July 1981 and June 1982, fairly substantial erosion occurred. In June 1982, the author collected a large portion of a prehistoric Laurel ceramic vessel from the eroding bank. In this area, it appears that about 30 cm of the bank was eroded during the preceding year. Further erosion was observed when the site was revisited during September 1983.
As plans to stabilize the Clyde Creek site developed, it was noted that the irregular configuration of the bank would make application of filter fabric and other materials difficult. It was also noted that the bank was severely undercut in several areas. In an effort to produce an even bank edge that could be successfully stabilized, plans to conduct limited archeological excavations along the edge of the bank were developed. These excavations were intended to trim the edge of the bank and recover any archeological data which might otherwise be lost during stabilization of the bank.

The archeological investigations associated with the bank stabilization were initiated at the same time that site stabilization began. Archeological excavation in northern Minnesota in March is severely inhibited by ground frost conditions, and the fieldcrew found the work was greatly delayed by this problem. The reason for this scheduling lies in the cycle of NPS funding. Since Fiscal Year funds for the project were not available until December 1983, it was not possible to conduct the necessary archeology before the onset of winter conditions. Consequently, work was scheduled to begin as soon as weather conditions would permit in the spring, 1984. As will be discussed later, the stabilization portion of the project could only be conducted when it was still sufficiently cold to permit access to the site via an ice road.

The 1984 archeological investigations at the Clyde Creek site began by clearing the remaining snow from the sides and top of the bank in the area of the site to be stabilized. A datum and grid system was then established along the edge of the site, and this grid was integrated into the grid system established during the 1979 testing program. Grid pins were placed at one meter intervals along the margin of the eroding bank, and a series of units were then established for excavation. While the units were all one meter from northwest to southeast, the northeast to southwest dimensions varied due to the irregularity of the bank edge. To obtain a relatively even bank edge, it was necessary to excavate between 0.25 to 1.25 meters back from the bank edge.

Excavations were initiated in 10 cm levels, but the frost conditions within the site made it difficult to maintain even and regular surfaces within excavation units. The frost also greatly slowed the work, forcing excavators to remove a few cm and then wait for the surface to thaw in the sun. Progress was accelerated when the park made a gas powered torch available to heat and thaw the ground during excavations (Figures 3, 4). While this had the deleterious affect of damaging the thermoluminescence content of ceramic samples, it was necessary to complete the project within the limited temporal constraints provided by the weather. Overall, a total of 18 units were excavated, with these representing about 10 sq. m. of the site area. All matrix from these excavation units were screened through 1/4 inch mesh hardware cloth. The materials remaining in the screen were bagged and returned to the Midwest Archeological Center for washing, cataloging, identification and analysis.

Five different classes of artifactual material were recovered during
the 1984 excavations. Ceramics and lithics were the most numerous, and will be discussed in greater detail below. Organic artifacts were less abundant due to the acidic nature of the soils, but charred macrobotanical remains, animal bone and shell were collected.

Lithic artifacts collected in 1984 include chipped stone debris, cores and a limited number of tools. The chipped stone cores consist of a single platform quartz core and a bipolar chert core. Chipped stone debris consists of six flakes and 66 pieces of non-diagnostic shatter. These materials consist of 11% chert or agate and 89% white quartz. The only two chipped stone tools were collected in 1984. Both of these are small, thumb nail size scrapers. One is a tiny end scraper and the other has been fragmented as a result of exposure to extreme heat. Both are made of chert or agate. The provenience of the chipped stone artifacts is presented in Table 1.

A total of 511 prehistoric ceramics were collected during the limited excavations. These consist of nineteen rim sherds, one base sherd, 24 decorated body sherds, 160 plain body sherds and 307 sloughed or sherdlets. Typical Laurel vessels are smooth or plain with conical bottoms. Decorative techniques associated with Laurel ceramics include dentate stamps, linear stamps, pseudo-scallop shell impressions, punctations and bosses in varying combinations (Figures 5 and 6). Decorations are almost always limited to the rim and neck of the vessel. The ceramics collected at Clyde Creek in 1979 and 1984 clearly meet these criteria, and further document the Initial Woodland placement of the site. The provenience of the ceramics collected in 1984 is presented in Table 1, and Appendix A provides descriptive information about the rim sherds, decorated body sherds and base from these investigations.

The distribution of artifacts collected in 1984 provides evidence of prehistoric activity areas at the Clyde Creek site. A comparison of the lithic and ceramic artifacts indicates that 93.4% of the lithics were collected from units west of 17W on the site grid, while 88% of the ceramics are from east of 4W. This evidence indicates that activities utilizing chipped stone tools were conducted on the western end of the site, while activities utilizing ceramics were conducted near the datum point of the 1984 investigations. It is unclear how these patterns relate to other features and activity areas at the site, but the evidence documents the potential of these types of data for explaining past activities at the site. It also documents the value of preserving the site intact, rather than excavating portions of the site as erosion progresses.

The data collected in 1984 provides further documentation on the temporal placement of the Clyde Creek site and the nature of the activities conducted at the site during the Initial Woodland period. As noted earlier, the types of ceramic decorative techniques and motifs exhibited by the ceramics from the Clyde Creek site are characteristic of the Smith phase. This is the final phase of the Laurel culture in the Boundary Waters area, and three thermoluminescence dates on ceramics from the site substantiate this placement. The site is
estimated to date between A.D. 500 and A.D. 750. The Clyde Creek site is somewhat atypical of Laurel sites in Voyageurs National Park, because it is quite a bit larger than most of the other sites. The size of the site and the density of artifacts collected at the site suggest that it represents a small village or base camp. During the severe winter season, food resources were limited and dispersed. Prehistoric populations scattered and dispersed into single family or small groups of families during the winter as an adaptive strategy. During the warmer seasons when food was more plentiful, it was possible for people to gather at villages or base camps. The nature of the archeological remains at the Clyde Creek site are indicative of a small population aggregate, probably a warm weather base camp.

Table 1: Artifacts from 1984 investigations, 21SL35

<table>
<thead>
<tr>
<th>Surface</th>
<th>FLKS</th>
<th>NDS</th>
<th>CORS</th>
<th>SCRP</th>
<th>RIMS</th>
<th>BASE</th>
<th>DECO</th>
<th>PLN</th>
<th>SHLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump Area</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>0-1W/0-1S</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>9</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>0-1W/0-.25N</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1-2W/0.25N</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>22</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1-2W/0-1S</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>2-3W/0-.25N</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>27</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>3-4W/0-.25N</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3-4W/0-1S</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>5</td>
<td>44</td>
<td>177</td>
<td></td>
</tr>
<tr>
<td>17-18W/0-1S</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>18-19W/0-1S</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>20-21W/0-1S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>21-22W/0-1S</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>22-23W/0-1S</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>23-24W/0-1S</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>24-25W/0-1S</td>
<td>1</td>
<td>17</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>25-26W/0-1S</td>
<td>1</td>
<td>29</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>11</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>26-27W/0-1S</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>27-28W/0-1S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>13-14E/1-2S</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Totals          | 6    | 66  | 2    | 2    | 19   | 1    | 24   | 160 | 307  |

Flk = Flakes, NDS = Non-Diagnostic Shatter, CORS = Cores, SCRP = Scrapers, RIMS = Rimsherds, BASE = Base Sherds, DECO = Decorated Body Sherds, PLN = Plain Body Sherds, SHLS = Sherdlets and Sloughed Sherds
Stabilization Activities

The stabilization of archeological sites managed by the National Park Service has a relatively long history, unfortunately it is almost totally the story of ruins stabilization in the southwest (Richert and Vivian 1974). Stabilization of an eroding shoreline site in the northwoods presented a whole series of new challenges. Stabilization of eroding beaches along the margins of reservoirs is a widespread problem, and the U.S. Army Corps of Engineers has done considerable research into materials and techniques that may be suitable for the wide range of conditions under which shoreline erosion occurs.

Many different types of stabilization materials are available, but only three were given extensive consideration for this project. Early efforts at shoreline stabilization have emphasized the use of rip-rap or other forms of revetment to prevent erosion. This approach was improved with the addition of a granular filter layer beneath the revetment to prevent sediments from being washed from between the larger stones, blocks, etc. More recent efforts have utilized synthetic products or vegetation. Synthetic revetments were first constructed in the Netherlands in 1956 (Keown and Dardeau 1980), where sand bags made of synthetic filter fabric were used to construct a seawall. Recent developments have seen an increase in the range of applications and the types of filter fabrics available (Keown and Dardeau 1980). Filter fabrics or membranes are designed to permit the movement of water through the membrane, but to prohibit the movement of sediments. These materials have been effective in settings where hydrostatic pressure is exerted on stream banks and lakeshores. Vegetative stabilization of reservoir shorelines has been successfully attempted at several reservoirs (Allen 1983, Klimas and Allen 1981, Klimas 1982). This approach has the added advantage of producing a largely natural appearance along the shoreline.

All three of these procedures have specific advantages and disadvantages. The approach that was used at the Clyde Creek site was selected because of the location of the site and the difficulty in transporting materials and personnel, and the need to maintain a largely natural looking shoreline. While liquid concrete products like gunnite have been used to inhibit lakeshore erosion at archeological sites in Oklahoma and Texas (Dervin, personal communication), and filter fabric sand bags have been used to curtail wind erosion in California (Snethkamp 1984), stabilization of the Clyde Creek site was planned to address the local conditions associated with Lake Kabetogama.

The initial step in the stabilization program involved developing a stabilization plan. This was accomplished through a review of the available literature. As noted earlier, there have been few applications of stabilization techniques that could serve as effective precedents for the necessary work at the Clyde Creek site. Conversations with Daphne Dervin and Dr. Roger Saucier of the U.S. Army Corps of Engineers produced convincing arguments for the use of
synthetic filter fabrics. Fortunately, the U.S. Army Corps of Engineers has developed excellent guidelines on the application and use of filter fabrics (Keown and Dardeau 1980). These guidelines were carefully reviewed in selecting materials and planning the activities for this project.

The plan which was finally adopted, called for the combined use of filter fabric, rip-rap and vegetation in stabilizing the site. Filter fabric was to be used to hold bank and beach sediments in place, and a turf stabilization mat would be used to anchor vegetation on the newly created bank and shoreline. Rip-rap would be placed along the normal high-water level to absorb the major force of the wave action and anchor the two filter fabrics. Sediment samples collected from the archeological site were used to determine the granulometric composition of the sediments. Then using the guidelines provided by Keown and Dardeau (1980), appropriate filter fabrics specifications were developed. Once specifications for both the filter fabric and the turf stabilization matting were available, numerous manufacturers and suppliers of filter fabric products were contacted.

After reviewing the stabilization plans with the staff at Voyageurs National Park, it was decided that the large quantities of sediment and rock which were needed for the project could best be transported to the site across the ice. However, it was also obvious that the archeological excavations which would be done in association with the actual site stabilization could not be readily accomplished when the ground was frozen. Since the Clyde Creek site is on a south facing shore, it was decided to conduct the project in early spring when the lake ice would still be at maximum thickness, but when the snow cover would have already melted from the site. This relatively narrow interval of time necessitated careful advance planning and coordination between the Park staff and the Midwest Archeological Center.

The sediments and rock needed for the stabilization work were procured by the Park during the fall prior to advent of heavy frost. These materials were stored under straw and black plastic so that they would not freeze, and would be easily workable when the stabilization activities commenced. During the winter, the Park constructed an ice road to the Clyde Creek site. This was then used to transport all the equipment, materials and personnel needed to stabilize the site (Figure 7). These preparatory activities were critical to the success of the project and the enthusiastic support of the Park staff were essential to overcoming the logistic and scheduling problems involved in this stabilization project.

Stabilization activities were initiated at the Clyde Creek site during the week of March 18, 1984. Initial efforts were aimed largely at preparing the bank for proper application of the filter fabrics. This involved creating a smooth and snag-free surface and a slope of one to one or less. The stabilization plan called for the bank preparation to include archeological excavation of deposits along the more steep and eroded portions of the bank and addition of sediments to the bank to produce the desired slope. The park began moving about 150 cubic yards
of sediment and rock to the site across the ice road. The limited archeological investigations conducted in association with this project were initiated at that time as well. Under supervision from the archeological team, the park staff began removing vegetation from the eroding bank slope. This involved some limited removal of live trees, and removal of dead or recently fallen trees (Figure 8).

After the eroding slope had been cleared of vegetation, earth was piled against the eroding bank and a backhoe in association with hand labor were used to create the desired slope (Figure 9). The backhoe was used to provide the general contour for the bank slope, and shovels and rakes were then used to smooth the surface. The sediments used in this filling operation are similar in texture to the soils which occur naturally at the site. After the slope was built up and graded, the backhoe was used to dig a toe trench at the base of the slope (Figure 10). The toe trench was approximately 18 inches deep and ran the entire length of the bank being stabilized.

After the bank had been properly graded and smoothed, the filter fabric was applied in sheets. The fabric was available in a 12 ft. wide roll, and it was laid out on the lake ice and pieces were cut to fit individual sections of the bank (Figure 11). The fabric was laid in place and anchored at the top of the slope in a shallow hand excavated toe trench with six inch overlapping seams between individual pieces of filter fabric (Figure 12). These trenches were only a few inches deep and were excavated to fit individual sections of filter fabric on the bank. The pieces of filter fabric were anchored at the base by being placed in the deeper toe trench. The sides and seams of the filter fabric were anchored to the ground with 16 inch long pins (Figure 13). This latter task was occasionally complicated by ground frost, but it was effective in anchoring the filter fabric in place on the bank. Approximately 400 sq. yards of Mirafi 600x filter fabric was installed.

When the filter fabric was installed, the backhoe was used to fill the toe trench at the base of the slope and to pile dirt on top of the filter fabric (Figure 14). Hand labor was then utilized to distribute the earth on top of the filter fabric to a minimum thickness of six inches. Soil depth at the base of the slope was considerably more than six inches. This soil layer was intended to provide a base for rooting vegetation on the slope. Consequently, the surface was again raked smooth. and then grass seed was scattered across the slope (Figure 15).

Once the grass seed was scattered, the turf stabilization matting provided by Mirafi, Inc. was installed (Figure 16). This material consists of a series of interwoven, flexible strands, producing a rubber-like mat that was easily applied to the surface of the slope. The lengths of mat were cut on the ice and laid from the top of the slope to an elevation equivalent with the summer high water level. The mats were pinned in place on the top of the bank and laid adjacent to one another with minimally overlapping seams. Approximately 350 square yards of turf stabilization matting were installed.

The final step in the stabilization process involved installation of
rip-rap at the base of the slope (Figure 17). A transit was used to mark the normal summer high water level for Lake Kabetogama, and the backhoe and a front-end loader were used to place the rip-rap on the base of the slope. The rip-rap was laid to cover the slope about two feet above and one foot below the normal summer lake level. The rip-rap was intended to break the force of heavy wave action from southwest winds, and to better anchor the bottom of the turf reinforcement matting (Figure 18).
Conclusions

The efforts described here to protect the archeological resources at the Clyde Creek site are certainly consistent with the mission of the National Park Service to protect significant cultural resources under its stewardship. The park-wide lakeshore erosion problem is continuing to destroy the limited number of archeological sites still intact within the park and continued efforts at site stabilization are highly recommended. The archeological sites at Voyageurs National Park contain the only record of American Indian prehistory, and a major record of American Indian history in this region. The archeological resources in Voyageurs National Park have the potential to contribute to a variety of research problems ranging from prehistoric settlement and subsistence patterns to ethnic identification of prehistoric groups occupying the Boundary Waters region. These research concerns are of considerable interest to professional archeologists, American Indians, and the general public. Future research at the archeological sites in Voyageurs National Park will certainly contribute to a greater understanding of the past, but only if the continuing erosional damage can be curtailed.

Prior to the start of the stabilization project, the National Park Service considered data recovery as an alternate method of mitigating the damage being caused by lakeshore erosion. This alternative was judged less desirable because it would not preserve the archeological resource in-place, but would result in the collection of massive quantities of artifacts for permanent curation. While the value of preserving the site in-place cannot be effectively quantified in terms of cost benefit ratios or other measures of fiscal management, it should be noted that this approach to site stabilization is considerably less expensive than large scale data recovery.

The cost of the shoreline stabilization project reported here was about $22,000. The costs associated with the project are identified in Table 2. In contrast to the stabilization of the site, data recovery would have been considerably more expensive. Excavation of a 50% sample of the threatened portion of the site would have necessitated excavation of 120 sq. m. The 1979 test excavations involved only 7 sq. m. and produced 1290 artifacts. It is likely that the alternate data recovery excavations would have produced 22114 artifacts. We estimate that it requires one person day of labor to excavate and screen one sq. m. of matrix, so it would require 120 person days to complete the entire data recovery excavation. This would likely cost $10,750 in travel, salaries, equipment and support. Laboratory analysis of the recovered artifacts and preparation of a report would require six to nine months for an archeologist, and six months for one or more laboratory assistants. This would probably cost about $24,000. After all excavation and analysis is completed, the National Park Service would have been faced with the responsibility and costs of cataloging and curating the artifacts according to NPS standards. The actual cost of these activities would probably exceed $10,000. Thus, the total cost of major data recovery would be $44,750 or greater.
Field installation of the filter fabrics used in this project demonstrated to the project personnel that they are highly suitable for this type of application. The remote setting of the Clyde Creek site and the need to preserve a natural looking shoreline posed a major challenge to the stabilization effort. The filter fabrics used in this project were highly suitable for the situation, because they are lightweight yet durable, and were easily installed. The turf stabilization mat should provide protective cover for new vegetative growth, and within a few years the site should be visually unobtrusive.

The success of this project in stabilizing the shoreline of Lake Kabetogama to protect the Clyde Creek site cannot be fully assessed for several years. As noted earlier, shoreline erosion is not constant and predictable. Consequently, it will require several years of varying weather and lake conditions to determine whether the approach described here is fully successful. In the interim, the Voyageurs National Park staff should monitor the site on a regular basis and keep photographic records to document conditions at the site. Based upon the success of this approach in stabilizing non-archeological shorelines, there is ample reason to believe the stabilization work will be successful. Filter fabrics such as these should have a lifespan of twenty years or greater. During this period, it is likely that new archeological techniques will be developed and it would be desirable to again conduct limited excavations at the Clyde Creek site.

Table 2: Summary of Stabilization Costs, Clyde Creek site

<table>
<thead>
<tr>
<th>Materials</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirafi filter fabric (500 sq. yds.)</td>
<td>625</td>
</tr>
<tr>
<td>Mirafi turf stabilization mat (350 sq. yds.)</td>
<td>nc</td>
</tr>
<tr>
<td>securing pins (400 count)</td>
<td>92</td>
</tr>
<tr>
<td>peat moss (500 cu. yds.)</td>
<td>2500</td>
</tr>
<tr>
<td>grass seed (100 lbs.)</td>
<td>400</td>
</tr>
<tr>
<td>straw (100 bales)</td>
<td>200</td>
</tr>
<tr>
<td>fuel</td>
<td>100</td>
</tr>
<tr>
<td>misc.</td>
<td>500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field Salaries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voyageurs NP</td>
<td>5070</td>
</tr>
<tr>
<td>Midwest Archeological Center</td>
<td>3698</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laboratory/Office Salaries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest Archeological Center</td>
<td>5500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Travel and Vehicle Expenses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest Archeological Center</td>
<td>2900</td>
</tr>
</tbody>
</table>

| Project Costs                                 | 21,585|
References Cited

Allen, Hollis

Birk, Douglas A.

George, Douglas C.

Gibbon, Guy E.


Keown, Malcomb P. and Elba A. Dardeau, Jr.

Klimas, Charles V.

Klimas, Charles V. and Hollis H. Allen

Lynott, Mark J., Jeffrey J. Richner and Mona Thompson

Richert, Roland Von S. and R. Gordon Vivian
1974 Ruins Stabilization in the Southwestern United States.
Snethkamp, Pandora E.

Watson, Clifford W., Jerry W. Oothoudt, and Douglas A. Birk
Appendix A: Prehistoric ceramics from 1984 investigations, Clyde Creek site (21SL35)

The 1984 research at the Clyde Creek site resulted in the collection of 511 prehistoric ceramic sherds. Nineteen of these sherds were rim fragments, one was a base fragment, 24 were decorated body sherds, 160 were plain body sherds, and 307 were either split or smaller than a cm in diameter. The latter class of sherds is referred to here as sherdlets.

The 1984 investigations were directed largely at areas of the Clyde Creek site which were not tested in 1979, so the majority of rimsherds and decorated body sherds in this sample seem to represent parts of vessels not described from the earlier research (Lynott, Richner and Thompson 1984). The most notable exception to this are the plain and linear stamped sherds collected from units 1-4W during 1984. These sherds are clearly part of the linear stamped vessel collected in 1982 while eroding from this point on the bank (Lynott, Richner and Thompson 1984). The remaining sherds described below provide new data about the number and diversity of ceramics from the Smith phase occupation at the Clyde Creek site.

All of the vessels represented at the Clyde Creek site appear to be deep bowls or wide mouth jars with conical bottoms. A single base sherd from the 1984 documents this generalization. It is thick, conical in shape and undecorated (Figure 5) The vessels are characteristically smoothed or plain, except on the neck and rim, where stamped, incised and punctated decorative motifs are common.

The decorated body sherds from the 1984 investigations at Clyde Creek include eleven linear stamped sherds, twelve dentate stamped sherds and one pseudo-scallop shell impressed sherd. The linear stamped sherds appear to be part of a single vessel that was partially recovered in 1982 and has been dated by thermoluminescence at A.D. 625 ± 265 (Alpha-863). The dentate stamped sherds are vertical or oblique stamp impressions in bands covering what appears to be the neck of the vessel. The pseudo-scallop shell impressed sherd was collected from the surface on the northeast end of the site, and does not represent a classic example of this decorative technique. The decorative elements are not clear, so the sherd may instead represent a poorly executed dentate stamp. Pseudo-scallop shell impressed sherds are rare in the Smith phase and at the Clyde Creek site, and if this identification is correct it may be indicative of an earlier Laurel occupation at Clyde Creek.

The rimsherds from the most recent research at Clyde Creek consist of 15 decorated sherds, three plain rims and one split or sloughed rim. With two exceptions, these all exhibit undecorated lips. Of the decorated rims, eight exhibit vertical or oblique dentate stamping without any other decorative elements. Two other rims exhibit dentate stamping in combination with punctates and bosses. Two of the sherds exhibit linear stamping and punctations, while two other linear stamped
sherds exhibit cross-hatched incised lines on the lip. The final rim is pseudo-scallop shell impressed with superimposed bosses. This latter sherd, like the pseudo-scallop shell impressed body sherd was collected from the surface of the northeast end of the site.

These ceramics are characteristic of the Laurel culture, and the decorative elements and motifs are most characteristic of the final phase of the Laurel sequence. Thermoluminescence dates from ceramics collected in 1979 and 1982 indicate the site was occupied between A.D. 500 and A.D. 750. The ceramics collected in 1984 are similar to those collected in earlier investigations. The relatively large number of ceramic vessels represented within the ceramic assemblage provide an excellent sample of Smith phase ceramics in Voyageurs National Park.

Reference Cited

Lynott, Mark J., Jeffrey J. Richner and Mona Thompson
Figure 1. Location of the Clyde Creek site, Voyageurs National Park.
Figure 2. Excavation units, 1984 investigations.
Figure 3. Excavation of eroding bank edge.

Figure 4. Excavation of eroding bank edge.
Figure 5. Selected chipped stone and ceramic artifacts.
Figure 6. Selected prehistoric ceramics.
Figure 7. Hauling sediments and rock across ice road.

Figure 8. Removing vegetation from eroding bank.
Figure 9. Adding sediments to bank to reduce slope.

Figure 10. Excavation of toe trench at the base of the eroding bank.
Figure 11. Filter fabric was unrolled on the ice and cut to fit sections of the bank.

Figure 12. Filter fabric laid in place.
Figure 13. Securing pins were used to anchor the filter fabric.

Figure 14. Covering filter fabric with a layer of sediment.
Figure 15. Spreading grass seed.

Figure 16. Installation of turf stabilization matting.
Figure 17. Adding rip-rap along summer water line.

Figure 18. Clyde Creek site after completion of stabilization project.