

# A Review of the Western Lake Superior Basin Erosion-Sediment Control Project; the Red Clay Research and Demonstration Project

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## Introduction and Overview:

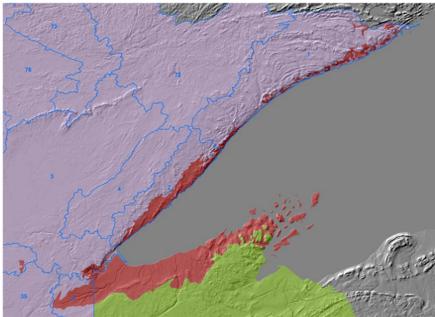
The Red Clay Project was a research and demonstration project completed in 1980 and sponsored by five soil and water conservation districts from two states. The local district supervisors were committed to the task of seeking practical solutions to the many forms of red clay erosion and the resulting water quality problems. The overall objectives of this project were to demonstrate economically feasible methods of improving water quality, to assess the capabilities of existing institutions to cooperatively implement a pollution control program and to provide data and recommendations that could be used in future programs.

## Scope:

Since the first settlers arrived in the western Lake Superior basin, the red clay soils dominating the region have presented problems. The primary concern was the pervasiveness of the erosion problem and associated damages and costs. In the early 1950's the first systematic study of erosion and land use problems was initiated by the Red Clay Interagency Committee. In the 1970's the soil and water conservation districts from Douglas County and Carlton County met to consider ways of reducing erosion in the Nemadji River Basin.

The red clay of the western Lake Superior basin extends in a narrow band from northeastern Minnesota to the western portion of Michigan's Upper Peninsula.

The predominant soils in this area are red clays interspersed with sands and silts. They were originally deposited as lake sediment during glacial periods but now, due to lake recession and geologic uplift, they form much of the land mass of present-day Lake Superior's south shore.



The soils are young and are undergoing a high rate of natural erosion as a geologic equilibrium evolves. The heterogeneous mixture of clay and sand produces soils with very little stability which, when exposed to varying moisture conditions on steep slopes, often erodes severely. Further, the red clays contain approximately 2 percent extractable iron oxide which produces a very visible and objectionable color where streams discharge into Lake Superior. This phenomenon occurs even when the turbidity and sediment rates are low.

## Recommendations:

- On construction sites, vegetation should be established at the earliest opportunity.
- Where possible, woody species should be phased into the herbaceous cover.
- Among woody species, the more advanced successional species are preferred, largely due to their greater root strength.
- Soil stability equations should be employed to demarcate the "100-year safe zone." Within this zone, all human activity that arrests or reverts the forest successional process should be prohibited unless it promotes advanced successional stands.
- In critical erosion sites, advanced successional woody vegetation should be actively promoted.
- Retaining peak discharges after rainfall slows erosion rates and preserves streambanks. Floodwater retention by adequate vegetative cover and leaf litter and land use practices which minimize runoff is desirable.
- Vegetation which stabilizes streambanks may allow undercutting, steeper banks, and deeper pools.
- Removal of stumps and other snags is detrimental to fish populations.
- The grazing of cattle and other livestock on streambanks breaks down slopes, eliminates cover, potentially decreases stream depth, and generally disrupts the stream biota. Livestock exclusion is recommended.

## Findings and Conclusions:

### Red Clay Slope Stability Studies

- The clay soils of this region generally contain approximately two percent extractable iron oxide.
- Historic removal of the forest cover, modification of natural drainage patterns and other activities have promoted soil drying.
- Surface zone drying has changed the mechanical behavior of the clay to a brittle solid susceptible to fissuring and slope failure.
- Moisture accumulation in fissures provides the necessary lubrication for flowing and sliding to occur within the surface zone.
- The topography of the red clay area will continue to evolve under the influence of natural processes.
- There are workable practices which can be incorporated into land use plans which will slow natural erosion processes.



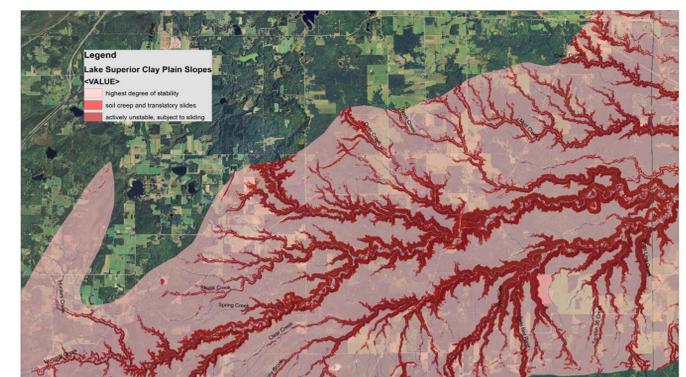
Topography in the St. Louis River Estuary of the Lake Superior Red Clay Plain.  
Slopes 0-8% Stable, 8-15% bank creep and translatory slides, >15% actively unstable.

### The Significance of Vegetation in Moderating Red Clay Erosion

- Vegetation plays a major role in retarding erosion in the geologically young red clay soils though it cannot completely offset the natural erosion forces.
- Grasses and herbaceous plants yield beneficial anti-erosion effects but cannot prevent slope failure where brittle clay exist.
- Woody plant species have stronger root systems which do help prevent slides.
- Climax woody species such as firs, pines and maples provide the best erosion control.
- Woody climax vegetation species are not efficient at lowering soil moisture content.
- Herbaceous species and some woody species (aspens) are relatively more efficient at removing water from soil.
- The use of vegetative methods specifically for reducing soil moisture content in the surface zones of red clay soils has not been shown to be beneficial for controlling massive slides. Species which are best suited for water removal (grasses and aspens) are most effective in drier years when they tend to lower moisture content too far which, in turn, induces fracturing, fissure formation and a greater potential for massive slide erosion.

### The Effects of Red Clay Turbidity and Sedimentation on Aquatic Life in Western Lake Superior Basin Rivers

- Red clay does not contribute significant quantities of nutrients to Lake Superior.
- Oxygen levels are not significantly affected by red clay or associated organics.
- Primary production does not appear to be significantly affected by turbidity.
- Bacteria exhibit no definite trends with turbidity within sites, but do seem to have higher counts in turbid than in non-turbid sites. Fungal counts exhibit opposite trends.
- Number of macro invertebrates per unit area, total number of taxa, diversity, and biomass are not significantly affected by clay turbidity and siltation.
- Only where sand was the primary product were significant detrimental effects of erosion identified.
- Certain insects associate with silts, especially certain mayflies and beetle larvae, were found only in the turbid streams.
- Laboratory activity and respiration of stonefly demonstrated no significant effects at turbidity levels normally encountered.
- Fish populations were not demonstrated to change as a result of turbid conditions but rather, because of water temperature and discharge differences.
- Walleye in the lower Nemadji River, the Duluth-Superior harbor, and Lake Superior benefit from red clay turbidity.
- Rainbow smelt and four species of suckers successfully reproduce in the turbid areas of the Nemadji River.
- Channel form and available cover are the primary factors affecting fish population size for all species in the Nemadji River system.



Extent of the Nemadji River in the Lake Superior Red Clay Plain.  
Slopes 0-8% Stable, 8-15% bank creep and translatory slides, >15% actively unstable.

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## Acknowledgements:

The contents of this poster present no new findings but were taken directly from the three "Western Lake Superior Basin Erosion-Sediment Control Project" reports published by the EPA. Much of the content was taken verbatim.

## Original Partners:

Arrowhead Regional Development Commission - Richard Isle, Minnesota Department of Natural Resources - Dan Retka, Minnesota Pollution Control Agency - John Pegors, Minnesota Soil and Water Conservation Board - Steve Pedersen, Vern Reinert, National Association of Conservation Districts - William Horvath, Northland College - Robert Brander, Tom Klein, Virginia Prentice, Northwest Regional Planning Commission - Mark Mueller, John Post, United States Army Corps of Engineers - Louis Kowalski, United States Bureau of Indian Affairs - USDI - Charles McCurdy, United States Environmental Protection Agency - Ralph Christensen, Carl Wilson, United States Geological Survey - Eno Giacomini - Steve Hindall, Vito Latkovich, William Rose, Ron Wolf, United States Soil Conservation Service - USDA - Clarence Austin, Don Benrud, John Ourada, Steve Payne, John Streich, Peg Whiteside, University of Minnesota Duluth - Don Olson, Michael Sydor, University of Minnesota Extension - Arnie Heikkila, University of Wisconsin Extension - William Lontz, Raymond Polzin, University of Wisconsin Madison - Tuncer Edil, Peter Monkmeyer, University of Wisconsin Milwaukee - Bruce Brown, University of Wisconsin - Stevens Point, Bob Burull, University of Wisconsin Superior - David Bray, Donald Davidson, Philip DeVore, Albert Dickas, Larry Kapustka, Rudy Koch, Joseph Mengel, William Swenson, Paul Webster, Wisconsin Board of Soil and Water Conservation Districts - Don Houtman, Eugene Savage, Wisconsin Department of Natural Resources - John Konrad, Wisconsin Department of Transportation - Emil Meitzner, Wisconsin Red Clay Interagency Committee - William Briggs, Garit Tenpas