

RIPRAP CRITERIA FOR STABILIZATION PONDS

Effective Date: May 1991
Technical Criteria

PART I - GENERAL

Scope

These guidelines describe the materials, installation and testing of riprap. The guidelines have been developed by the Minnesota Pollution Control Agency (MPCA) and are intended to serve as recommended minimum requirements for the design, installation and testing of riprap. These guidelines are not, however, intended to replace competent engineering documents and practices produced and undertaken by qualified and experienced engineering designers and inspectors. Specifications issued by the engineer that deviate from these guidelines may be allowed; however, justification for these changes will be required by the MPCA. The intended use of these guidelines is for applications involving municipal sewage and approved industrial wastes.

These guidelines do not guarantee that the riprap, when installed, will not fail during the initial operation or at any time in the future. However, the information contained within should provide the engineer a firm basis for designing, specifying and inspecting.

PART II - MATERIALS

1. Minimum Requirements

Riprap or some other acceptable method of erosion control is required on all pond dikes and around all piping entrances and exits.

Discussion: Riprap is recommended because grass cannot usually be established in one season to adequately protect the dikes from erosion. The fluctuating water levels in a pond's operation are not conclusive to good grass growth.

2. Kind, Quality, Size

The stone shall be durable field stone (round) or quarry stone (angular crushed bedrock) of approved quality, sound, hard and free of seams, cracks and other structural defects. The stone should be resistant to abrasion and other defects that would tend to increase unduly its destruction by water and frost actions. Stones shall be generally round or cubiform in shape. Slabby or elongated stone pieces having width or thickness less than one-third the length shall not exceed 10 percent of the total. No sandstone, shale, broken concrete or slate is allowed. Durable limestone may be used, but is not recommended if other material can be obtained.

Discussion: At a minimum, durable limestone should meet the following requirements.

Specific Gravity (Saturated Surface-dry basis)	ASTM C127	Greater than 2.40
Water Adsorption (24 hour immersion)	ASTM C127	Less than 2.0%
Soundness loss	ASTM C88	Less than 13.0%

PART III - SAMPLING AND TESTING

1. The materials will be inspected by the engineer for compliance with the specified requirements for quality, weight, soundness, and gradation. During the design phase, the consultant should locate sources capable of meeting the riprap specifications. Once contracts are awarded, the contractor should identify the riprap source(s) that will be used. One gradation should be run at each source prior to riprap being accepted on-site. One gradation per pond should be done on in-place material. If the specified riprap material or gradations cannot be met by the contractor, or the consultant wishes to modify the riprap specification, it must be justified through a change order which must be approved by the MPCA prior to the delivery of riprap to the construction site.

Discussion: The following is MnDOT's 3601 gradation requirements of Class I through V riprap.

Weight (lbs.)	Size (in)*	Approx. % of Total Weight Smaller than Given Weight				
		Class of Riprap				
		I	II	III	IV	V
2000	30					100
1000	24				100	
650	21					75
400	18			100		
250	15				75	50
120	12		100	75	50	
50	9		75	50		
15	6	100	50			10
5	4				10	
2	3	50		10		
	2		10			
	1	10				

*Weight to approximate size conversion based on a specific gravity of 2.60 and a volume average between a sphere and a cube.

For a typical 9" to 12" of riprap depth placement, MnDOT Class I material can generally contain too much small material and the Class II can contain a little too much large material. Therefore, we recommend the following MPCA's modified gradation requirements for pond dikes with a 9" deep riprap mat.

PASSING	RIPRAP SIZE (Inches)	PERCENT
	9	100%
	8	70-100%
	6	50-80%
	3	15-30%
	2	0-10%
	Passing No. 4 Sieve	0-2%

The percent passing the number 4 sieve should be zero. However, this is not always practicable. Any amount of fines may cause long-term weed problems.

2. A riprap control unit of at least ten cubic yards of riprap shall be constructed. The control unit should be constructed on the dike at the construction site. The control unit shall be in full compliance with the approved plans and specifications. All other riprap placed on the dikes shall be equivalent in all respects to the approved control unit. The control unit should be identified for ease of reference and only one control unit should be constructed and approved per project.

PART IV. - CONSTRUCTION REQUIREMENTS

1. The foundation for the riprap shall be excavated and shaped to the cross sections indicated in the plans, unless otherwise stated by the engineer.
2. All loose foundation material shall be thoroughly compacted prior to placement of filter material and riprap.

Discussion: All soil tests, including core permeabilities of the seal, should be completed and reviewed by MPCA before riprap is placed. If this is not done, the city, consultant and contractor all bear full responsibility for removal of riprap and reworking dikes if soil tests show inadequate compaction or other noncompliance with the specifications.

3. Stones shall not be dropped on the fabric from a height greater than one foot. Riprap shall be placed by starting at the lowest elevations and working upwards. At a minimum, riprap shall extend down to the low water level and at least to one foot above the high water level. The contractor will be required to use a drop/drag box to unload and pick up riprap at the pond site to avoid soil contamination. The bottom layer of riprap at the pit source will not be allowed to be delivered to the pond site if it is contaminated by the soil it is resting on. Any scooping, loading or digging of riprap that includes scooping of the soil below will be rejected unless washed or screened to remove the soil contamination.

Discussion: Extreme care should be taken to not incorporate fines into the riprap. If fines do become mixed with riprap during placement, the fines must either be removed, more riprap added to cover bad or riprap removed and placed properly. A weed control program should be included in the O&M manual if any fines are allowed to remain.

4. Before placement of riprap stone on geotextile, the contractor shall demonstrate to the satisfaction of the engineer that his placement methods will not damage the fabric. For his assurance, the engineer may order the removal of at least four square yards of riprap to inspect for fabric damage.
5. In no case shall the rock be allowed to be pushed down the slope with a dozer or other equipment traveling on top of the riprap. The riprap shall be placed using a backhoe with a wide bucket or other similar equipment so that the rock can be dropped into place. If some segregation of particles does occur, hand placing or rearranging

individual stones by mechanical equipment may be required to the extent necessary to secure the results specified.

6. Random riprap shall be positioned in a manner that will provide a well-graded, uniform distribution of the various sizes of stone and a well-keyed, multilayered mass of rock with the least practical amount of void space. The surface shall be leveled as necessary to produce a reasonably uniform appearance and the required thickness. Riprap shall be placed to the thickness shown on the plans or greater thickness, if approved by the engineer, as found to be most convenient to the contractor. Well graded is defined as a continuous distribution of particle sizes from the largest to the smallest components in the proportions such that the successively smaller particles fill the spaces between the larger particles so that the maximum overall density of riprap can be obtained.

Discussion: In some cases, smaller stones may segregate in the stockpile. Care should be taken to assure uniform placement throughout.

7. The riprap shall be placed to within a minimum depth of six-inches.

Discussion: Each pond system should be analyzed to determine what riprap depth is proper. Small ponds with short reach distances may only require six inches. Large ponds where wave action may be a problem may require 12 inches. Engineer shall submit design calculations for riprap thickness with the plans and specifications. The design calculation shall be based on accepted standards and guidelines (i.e., soil conservation service or Corps of Engineers).

8. Riprap shall not be contaminated with fines prior to or during placement. After placement, measures shall be taken to prevent soil and other debris from contaminating the riprap. Sections of riprap should be rejected if tests show more than two percent passing the #4 sieve, either as a result of improper construction techniques or subsequent contamination.

Discussion: Areas above the riprap should be seeded as soon as possible after riprap placement to control erosion.

9. Riprap measured by volume will be computed on the basis of actual surface dimensions as staked and the specified thickness.
10. Payment at the unit price bid per cubic yard for riprap material shall be considered full compensation for this material complete in place. The plan quantity for riprap material shall be the final quantity for which payment will be made for the respective materials, unless the planned quantities are revised by a change order, in which case payment will be based on the recomputed volume. Bid price shall include all work and material associated with the riprap.