APPENDIX M

SWEETGRASS COUNTY BRIDGE STANDARDS

Adopted April 1, 2002

BASIC POLICY

Sweet Grass County has adopted a policy of replacing old and unsafe bridges with culverts when feasible. The culverts shall be sized to handle the minimum storm event designated by this bridge standard. The use of multiple culverts is discouraged due to debris collection and siltation problems. Culvert materials and installation shall meet the guidelines of this bridge standard.

Should replacement with a culvert not be feasible, a new bridge shall be constructed to meet AASHTO and MDT standards as modified or amended by this bridge standard. All new bridge and culvert designs are subject to the approval of the Sweet Grass County Road & Bridge Department.

Bridges requiring rehabilitation or replacement shall be prioritized annually by the County Commission and County Road Superintendent. Replacement of existing structures shall follow the order of the priority list with the exception of emergencies and special exemptions.

HYDROLOGY

New bridge or bridge replacement planning shall include a site inspection by the County Road Superintendent to determine if evidence from historical flow patterns reveal a need for a hydrological study prior to a new bridge or culvert placement or replacement. Where hydrological studies are recommended the following procedure shall be used.

Hydrologic Method

The following factors are to be evaluated and included in the analysis:

-Size, shape, slope, land use, geology and soils of the drainage basin

-Geometry and configuration of stream channel

-Characteristics of the flood plain

Several methods are available to analyze the design storm runoff from a drainage basin. The following methods are recognized by Sweet Grass County:

USGS Rural Regression Equations per Analysis of the Magnitude & Frequency of Floods and the Peak Flow Gaging Network in Montana, USGS, 1992.

USGS Regional Regression Analysis per Analysis of the Magnitude & Frequency of Floods and the Peak Flow Gaging Network in Montana, USGS, 1992.

USGS Regional Frequency Analysis per Analysis of the Magnitude & Frequency of Floods and the Peak Flow Gaging Network in Montana, USGS, 1992.

Log Pearson Analysis of stream gauge data at a point near the proposed structure provided that a minimum of 10 years of gauging data is available.

SCS Curve Number Method for areas draining less than 3 square miles.

Rational Method for areas draining less than 80 acres.

FEMA 100 yr & 500 yr Floods in areas designated as being within the 100 & 500 year floodplains. Contact the Sweet Grass County floodplain administrator regarding whether structure is located within either floodplain. The County's permitting authority is described under the Sweet Grass County Floodplain Regulations.

Alternative methods may be considered should the design engineer determine that a more accurate estimate of the runoff is available.

For drainage basins with an area greater than one square mile at least three methods must be averaged to determine the peak runoff volume.

Design Frequency

The structure shall be sized to accommodate the 50 year event when possible without significantly increasing the project cost. Structures deemed to be of low significance by the County Road Superintendent may be permitted by the County to use a minimum design flow of a 25 year event.

Sweet Grass County Road & Bridge Department personnel shall be contacted during the hydraulic analysis to provide input on historic flood volumes.

Waterway Opening Size

The waterway opening for a bridge shall be sized to pass the design flood while providing a minimum freeboard of 12" between the bottom of the lowest stringer and the water surface. Additional freeboard may be required for mountain streams, which carry a large amount of debris. The opening shall be sufficiently large as to minimize backwater conditions that may cause damage to adjacent property. The waterway opening size for a culvert shall meet the requirements of the culvert section of these standards.

Bridges over large drainages or in densely populated areas should be analyzed with an appropriate modeling program such as HEC-2 or HEC-RAS to accurately determine the flow characteristics and backwater elevations.

BRIDGE & CULVERT DESIGN

Specifications

Bridge and culvert design and construction shall conform to the following specifications unless otherwise modified or amended in this document.

AASHTO Standard Specifications for Highway Bridges, current edition and any amendments thereto.

Montana Department of Transportation Standard Specification for Road and Bridge Construction, current edition and any amendments thereto.

Materials

All materials and workmanship shall be in accordance with AASHTO Specifications and MDT Road & Bridge Specifications or as amended in this document.

Reinforcement Steel:	Reinforcement steel shall be ASTM A615 Grade 60 steel minimum. Heating of reinforcement steel for bending will not be allowed.
Structural Steel:	ASTM A36 or A588
Portland Cement Concrete:	Class "AD" or "DD" concrete shall be used for all cast-in-place structures. Minimum 6.5 Sack Mix, 3000 PSI @ 28 days. Class "Pre" concrete shall be used for all pre-stressed members.
Timber:	The use of timber stringers is discouraged in new structures. However, treated timbers are acceptable in low volume, isolated areas. Treated timber may be used for piles and decking material. Timber piles may not be spliced. All timber shall be treated with a preservative approved by the American Wood Products Association (AWPA).

Loads

Design loads shall be applied as specified in the AASHTO Standard Specifications. The minimum design live load shall be HS 20-44. Please refer to Appendix A of the AASHTO Standard Specifications for HS 20-44 loading requirements. Reductions from the minimum design live load may be considered on a case by case basis with a variance granted by the County Commission.

The weight of future surface overlays must be addressed in the dead loads should they be a possibility.

Summary Design Requirements by Road Classification

Class I:

Class I roads are maintained by the Montana Department of Transportation. Design requirements shall meet Montana Department of Transportation requirements.

Class II:

Road Width:	Min. 24' Shoulder - Shoulder
Road Crown:	Min. 2%
Bridge Width:	Min. 24' Rail - Rail
Freeboard:	Min. 12" between lowest stringer and design flood
Bridge Rail:	Must meet AASHTO T-101 standards. Neoprene pads should be placed between the base plate and bridge deck on concrete structures.

Substructure: Concrete spread footing or driven pile with reinforced concrete cap or steel beam cap depending on bridge type and location. HP section, Steel Pipe and Timber are acceptable pile materials. Timber piles may not be spliced.

Superstructure: Generally precast/pre-stressed concrete. Bulb Tees, Tridecks, Twin Tees and Channels are acceptable types of precast, pre-stressed beams. Steel girders are acceptable for long span structures and aesthetics. Treated gluelam stringers and gluelam deck panels are acceptable for aesthetic reasons.

Bridge Deck Surface: Skid Resistant Texture

Painting: Shop Coat on all exposed steel

Drainage: Bridge shall be sufficiently cambered, crowned or super elevated to provide adequate storm drainage.

Impact Protection: Guard angles shall be provided on all concrete structures.

Deflection: Live load + Impact deflection < L/1000 for simple or continuous spans.

Class III through Class VI

Bridges on Class III through Class VI roads shall meet the Class II specifications with the following exceptions:

Road Width:	Width requirements shall be reviewed on a case-by-case basis. Single lane bridge widths may be approved on low volume roads.
Bridge Rail:	Rail requirements shall be reviewed on a case-by-case basis. Alternative rail requirements may be authorized by the County Road Superintendent.

Quality Control

The County Road Superintendent shall have the authority to decide whether a new bridge installation shall include that the bridge be designed and stamped by a professional engineer registered with the State of Montana.

Geotechnical

Where a comprehensive geotechnical investigation is deemed a requirement by the County Road Superintendent a reputable geotechnical engineering firm shall be retained to determine the engineering properties of the soils through the use of borings, test pits, sampling and other methods. The geotechnical report shall be stamped by a professional engineer registered with the State of Montana.

As-Constructed Plans

Upon completion of the structure the design engineer shall provide the County Bridge Department with one set of full size and one set of half size As-Constructed plans of the project for their records.

Scour

Scour shall be evaluated on a case-by-case basis. Historically scour has not been a problem on end abutments properly armored with riprap and underlain with a geotextile. However, should the abutment be located on the outside of a channel bend a scour analysis may be warranted.

A scour analysis is suggested whenever a pier(s) is placed within the stream channel.

The substructure (spread footing or piles) must extend a minimum of 6' below the scour depth unless a geotechnical investigation indicates otherwise.

Temperature Effects

The effect of temperature shall be investigated when designing the stringer-substructure connection. The use of elastomeric bearing pads is recommended when precast/prestressed beams are incorporated into the design.

Skew

While crossings at 90º to the flowline are preferred, skewed bridges may be required to best fit a specific site. When a skew is required the angle should be kept to 30º or less as measured between a line normal to the bridge centerline and a line parallel to the flowline.

Culverts

Culverts shall generally be constructed of reinforced concrete, (RCP), aluminum, aluminized steel, polyethylene or CMP coated with bituminastic to prolong service life. Uncoated CMP culverts may be acceptable for small diameter pipes.

Culvert headwater (HW) should be kept to a reasonable level at the design flow to prevent flooding of adjacent property. Headwater depths at design flow shall generally follow the MDT design criteria listed below where D is the diameter of a circular pipe and R is the rise of an arch pipe.

Pipe Size	**HW @ Design Flow**
<= 42"	< 3D or 3R
48"-108"	<1.5D or 1.5R
>= 120"	< D+2' or R+2'

The headwater at the entrance during a 100 year flood may not exceed historic levels by more than 6" in FEMA floodplains per State and County codes.

The minimum culvert diameter shall be 12" for cross drains to allow for routine maintenance and cleaning.

Culvert alignment shall match the horizontal and vertical configuration of the existing channel as closely as possible to minimize sedimentation. Culverts shall be adequately sized to accommodate debris or ice that may occur in the channel.

Open bottom culverts, such as aluminum boxes, should be considered where feasible to minimize the impact on the streambed. Open culverts shall be set on either a metal or concrete footing per the manufacturer's recommendation.

Culverts carrying large volumes of water shall have concrete cutoff walls on both the upstream and downstream ends to prevent erosion below the pipe. Cutoff walls are not required when an open bottom culvert is utilized.

The upstream fill slope must be adequately protected against erosion. Slopes of 3:1 or less may only require reseeding whereas a more severe slope (>3:1) should either have riprap or a headwall. Culverts with upstream fill slopes exceeding 2:1 must have concrete headwalls.

Permits

The design engineer shall obtain the permits necessary to construct the new structure unless otherwise directed by the County. The design engineer should follow the Guide to Stream Permitting in Montana to determine which permits are required for various type of work. A 124 Permit (FWP), 3A Permit (DEQ) and 404 Permit (Corps) will generally be required for all projects. Private projects will require a 310 Permit (Sweet Grass Co. Conservation District) in place of the 124 Permit. An erosion and sediment control plan may be required by the Sweet Grass County Conservation District as well.

Signing

Object markers per the FHWA Manual of Uniform Traffic Control Devices for Streets and Highways shall be installed at each corner of the new bridge or at the ends of the guardrail leading to the fill section over a culvert.

Riprap

Class II random riprap shall be used for erosion protection on bridge abutments and culvert outfalls.

Placement of a geotextile fabric below the riprap is recommended in order to prevent the migration of fines. The Engineer and County Road Foreman shall jointly determine whether a geotextile is required on a case-by-case basis.

Riprap may not be placed on slopes greater than 1.5:1. A 2:1 maximum slope is desirable.

The depth of the riprap section shall be 1.5' minimum at culvert outfalls and 2.5' minimum for bridge abutments. The nominal diameter of the riprap shall be taken as one-half the depth of the riprap section. The riprap should be keyed at the bottom of the slope.

The placement of riprap around piers set in the stream channel shall not serve to reduce the minimum footing/pile depth required for scour.

Guardrail

Existing guardrail in the vicinity of the new structure shall be removed and replaced with new guardrail. Should the existing guardrail be in good condition it may be removed and reused. New guardrail should not be connected to existing guardrail unless specifically approved by the County Road Superintendent.

In general, the length of new guardrail location should match the length of preexisting guardrail. The length of the new guardrail may only be reduced when the roadside slopes have been flattened to a 3:1 or less. The limits of the new guardrail should not be reduced from the preexisting length without approval of the County Road Superintendent.

The ends of the guardrail leading into a bridge or culvert shall be signed with object markers per the Signing section of these Standards.

Bridge Approaches

The roadway leading to the new bridge should be reconstructed as required to provide a smooth transition that will minimize the impact forces transmitted to the structure. This may require the road to be reconstructed for several hundred feet on either side of the bridge