Appendix A: RISK ASSESSMENT

Risk analysis and/or assessment is based on the theory that roads should not all be designed for an arbitrary design frequency. Instead the design selected for an encroachment should be supported by analysis of design alternatives with consideration given to capital cost and risks; and other economic, engineering, social and environmental concerns.

Mn/DOT has developed a risk assessment procedure which is an attempt to screen projects and determine the level of analysis required. The purpose of the questionnaire is to determine if a risk analysis is required.   It is not a comprehensive design check list nor should it replace good engineering judgement. Culverts that are 48 inches or larger will require an assessment to determine whether or not an economic analysis is necessary to determine the frequency of design flood.   The form should be filled out and signed by the engineer making the hydraulic recommendation and placed the documentation file.

The procedure, included in Appendix A, consists of a DATA REQUIREMENTS section and a LTEC DESIGN section.   Start with the first question and follow directions included in the form. All questions do not have to be answered. Figures A and B are provided for use in answering question 2d. The form has a column on the right hand side that is titled LTEC DESIGN. LTEC refers to the Least Total Economic Cost. If any checks are made in the LTEC column then the designer must proceed with a Risk Analysis or document justification of why the Risk Analysis is not needed.

Figure A - Capital Cost when i = 7 1/8%

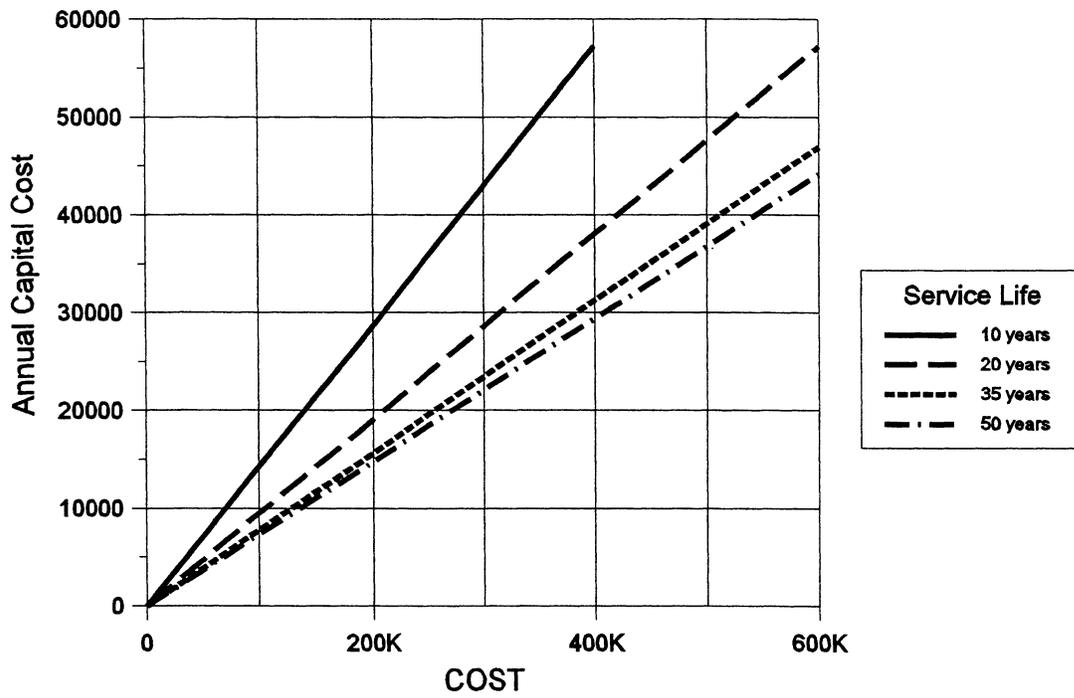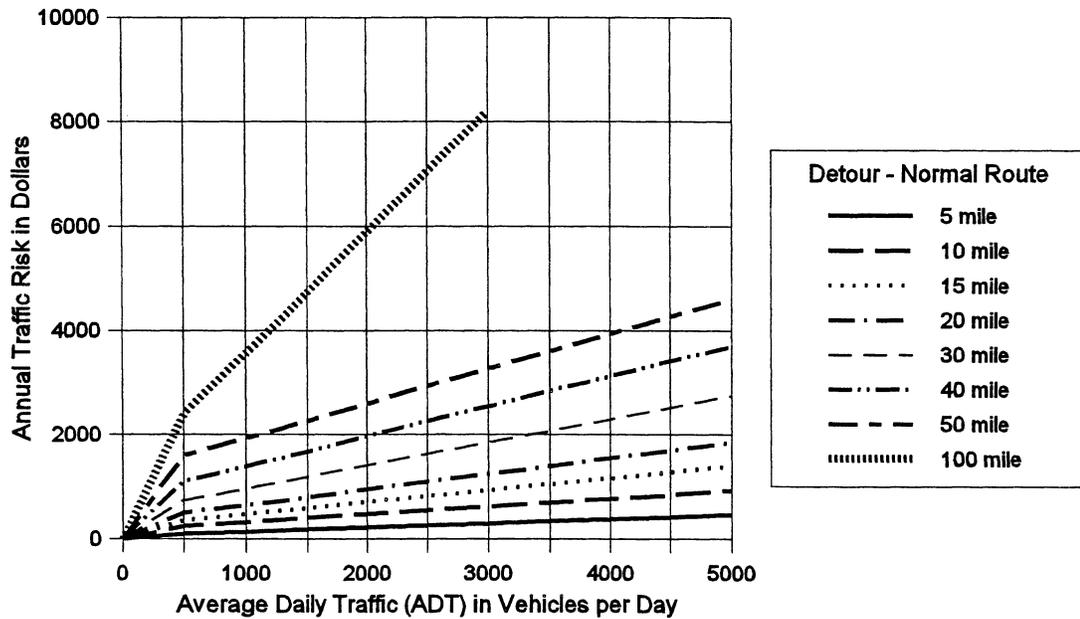## Figure B - Annual Traffic Risk vs. ADT

RISK ASSESSMENT
FOR
ENCROACHMENT DESIGN

Date _____

District _____

County _____

Vicinity of _____

_____

<u>DATA REQUIREMENTS</u>   Sec. _____ T _____ R _____

1. Location of Crossing: Roadway _____ C.S. _____ M.P. _____

2. Name of Stream: _____ Bridge No. Old: _____ New: _____

3. Current ADT _____ ; Projected ADT_____

4. Practicable detour available   Yes _____ No_____

    If no is checked, please explain: _____

    _____

    If there is no practicable detour available, then the use of the road must be analyzed. Considerations such as emergency vehicle access, emergency supply and evacuation route, and the need for school bus, milk and mail routes should be studied. Factors to consider for this analysis include design frequency, depth, duration, and frequency of inundation if appropriate, and available funding.

5. Hydraulic Data: (Fill in as appropriate)

    Approximate Flowline Elevation _____

    Q_2 = _____ TW_2 Elevation_____

    Q_5 = _____ TW_5 Elevation_____

    Q_{10} = _____ TW_{10} Elevation_____

    Q_{25} = _____ TW_{25} Elevation_____

    Q_{50} = _____ TW_{50} Elevation_____

    Q_{100} = _____ TW_{100} Elevation_____

    Circle Design Frequency

Reasons for selecting Design Frequency:_____

_____

_____

6. Magnitude and Frequency of the smaller of "Overtopping" or "500 yr." (Greatest)flood:

_____ cfs   _____ year frequency

7. Low member elevation _____

8. Minimum roadway overflow elevation if appropriate_____

9. Elevation of high risk property, i.e. residences_____

    Other buildings _____

10. Horizontal location of overflow:

    At structure _____(See 12); Not at structure_____

11. Type of proposed structure:

    Bridge _____(See 12); Culvert(s)_____

12. If the proposed structure is a bridge with the sag point located on the bridge and there is ice and debris potential, strong consideration should be given to using Q_{50} as design discharge with 3' of clearance between the 50 year tailwater stage and low member.

LTEC DESIGN

1. BACKWATER DAMAGE - Major flood damage in this context refers to shopping centers, hospitals, chemical plants, power plants, housing developments, etc.	LTEC DESIGN
1a. Is the overtopping flood greater than the 100 yr. flood? Yes __(Go to 1 b.); No__ (Go to 1 e.) 1b. Is the overtopping flood greater than the "greatest" flood (500 yr. frequency)? Yes __(Go to 1 d.); No__ (Go to 1 c.) 1c. Is there major flood damage potential for the overtopping flood? No __(Go to 1 e.)	 YES __ (Go to 1 e.)

1d. Is there major flood damage potential for the greatest flood (500 year frequency)?

    No ___ (Go to 1 e.)

1e. Will there be flood damage potential to residence(s) or other buildings during a 100 yr. flood?

    Yes ___ (Go to 1 f.);   No ___ (Go to 2)

1f. Could this flood damage occur even if the roadway crossing wasn't there?

    Yes ___ (Go to 1 g.);   No ___ (Go to 1 h.)

1g. Could this flood damage be significantly increased by the backwater caused by the proposed crossing?

    Yes ___ (Go to 1 h.);   No ___ (Go to 2)

1h. Could the stream crossing be designed in such a manner so as to minimize this potential flood damage?

    Yes ___ (Go to 1 i.);   No ___ (Go to 2)

1i. Does the value of the building(s) and/or its contents have sufficient value to justify further evaluation of risk and potential flood damage?

    No ___ (Go to 2)

2. TRAFFIC RELATED LOSSES

2a. Is the overtopping flood greater than the "greatest" flood (500 yr. frequency)?

    Yes ___ (Go to 3);   No ___ (Go to 2 b.)

2b. Does the ADT exceed 50 vehicles per day?

    Yes ___ (Go to 2 c.);   No ___ (Go to 3)

2c. Would the (duration of road closure in days) multiplied by the (length of detour minus the length of normal route in miles) exceed 20?

    Yes ___ (Go to 2 d.);   No ___ (Go to 3)

2d. Does the annual risk cost for traffic related costs exceed 10% of the annual capital costs?

    No ___ (Go to 3)
    (See figures A and B for assistance)

Sidebar (right margin):

LTEC
DESIGN

YES ___
(Go to 1 e.)

YES ___
(Go to 2)

YES ___
(Go to 3)

3. ROADWAY AND/OR STRUCTURE REPAIR COSTS

3a. Is the overtopping flood less than a 100 year frequency flood?

Yes___ (Go to 3 b.);   No___ (Go to 3 i.)

3b. Compare the tailwater (TW) elevation with the roadway sag point elevation for the overtopping flood. Check the appropriate category.

___ When TW is above the sag point (Go to 4)

___ When TW is between 0 and .5′ below sag point (Go to 3 c.)

___ When TW is between .5′ and 1.0′ below sag point (Go to 3 d.)

___ When TW is 1.0′ and 2.0′ below sag point (Go to 3 e.)

___ When TW is more than 2.0′ below sag point (Go to 3 g.)

3c. Does the embankment have a good erosion resistant vegetative cover?

Yes___ (Go to 3 i.);   No___ (Go to 3 d.)

3d. Is the shoulder constructed from erosion resistant material such as paved, coarse gravel, or clay type soil?

Yes___ (Go to 3 i.);   No___ (Go to 3 e.)

3e. Will the duration of overtopping for the 25 year flood exceed 1 hour?

Yes___ (Go to 3 f.);   No___ (Go to 3 i.)

3f. Is the embankment constructed from erosion resistant material such as a clay type soil?

Yes___ (Go to 3 i.);   No___ (Go to 3 g.)

3g. Is the overtopping flood less than a 25 year frequency flood?

Yes___ (Go to 3 h.);   No___ (Go to 3 i.)

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3h. Will the cost of protecting the roadway and/or embankment from severe damage caused by overtopping exceed the cost of providing additional culvert or bridge capacity?

    No ___ (Go to 3 i.);

3i. Is there damage potential to the structure caused by scour, ice, debris or other means during the lesser of the overtopping flood or the 100 year flood?
Yes ___ (Go to 3 j.);   No ___ (Go to 4)

3j. Will the cost of protecting the structure from damage exceed the cost of providing additional culvert or bridge water capacity?

    No ___ (Go to 4);

4. Will the capital cost of the structure exceed $500,000?

    No ___ (Go to 5);

5. In your opinion, are there any other factors which you feel should require further study through a risk analysis?

    No ___ (Go to 6);

6. If there are no ✓'s in the LTEC Design column on the right, proceed with the design, selecting the lowest acceptable grade line and the smallest waterway opening consistent with the constraints imposed on the project. The risk assessment has demonstrated that potential flood damage costs, traffic related costs, roadway and/or structure repair costs are minor and therefore disregarded for this project.

One or more ✓'s in the LTEC Design column indicates further analysis in the category checked may be required utilizing the LTEC design process or justification why it is not required.

LTEC DESIGN

YES
(Go to 3 i.)

YES___
(Go to 4)

YES___
(Go to 5)

YES___
(Indicate)

JUSTIFICATION _____

_____

_____

_____

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

_____

Registration Number: _____   Date: _____

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