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## ENGINEERING DIRECTIVE

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### Standard Practice for Design of Culvert Rehabilitation

Designers are directed to use the following two resources when making recommendations for culvert rehabilitation and developing Alternates for Rehabilitation Study Reports (RSR) for bridge culverts:

- Design Guidance for Culvert Rehabilitation
- Liner Selection Worksheet

These resources are available on the Department's Bridge Design web page for [Guide Sheets](#). Designers must review the entire guidance document and worksheet prior to making any selections on materials or decisions on alternates.

#### Design Guidance for Culvert Rehabilitation

Use the guidance to determine service life due to abrasion and corrosion, which is an important aspect of designing a culvert rehabilitation, along with many other factors. In addition, the guidance document discusses hydraulic analysis, environmental needs, constructability, and structural adequacy. Appendix A contains a list of advantages and disadvantages for each liner material. Designers are required to incorporate the applicable information into the RSR and develop a construction cost estimate for each alternate. Current material costs are best obtained from suppliers. The estimate will also be influenced by site access, water handling and constructability. Comparing the construction cost of alternates with different anticipated service lives or maintenance requirements will be challenging. For these comparisons, a life cycle cost analysis (LCCA) must be developed. (See EB-2022-2 LCCA Guidance)

Appendix B includes tables, graphs, and tools to assist Designers in manually computing service life of a rehabilitated culvert.

Appendix C presents examples for manually calculating losses due to abrasion and corrosion of culvert liners and estimating service life.

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### Liner Selection Worksheet

The Liner Selection Worksheet simplifies the calculation of service life and ensures uniformity in the process of selecting culvert liner material. The Worksheet has multiple tabs that consider other factors and must be reviewed and populated as part of the design process. Designers are required to review all tabs before using the Worksheet.

Input cells and pull-down menus are highlighted in yellow. Designers must review all highlighted cells to ensure that inputs are appropriate and compatible for the liner option being evaluated. When the Worksheet is used to evaluate multiple options, inputs from previous options must be reviewed to avoid erroneous conclusions.

The first tab describes the Design Process and how to use the other tabs to calculate service life. A preliminary hydraulic analysis and field observations are required regarding aggregates that are in the channel that may cause abrasion of the culvert liner during a 2-year storm event. Environmental testing data (pH, resistivity, chlorides, and sulfates) are also required. Once this information is entered, the Abrasion Level to which the culvert will be exposed, and the estimated rate of corrosion and abrasion can be determined which will result in a recommended liner material.

Typically, environmental testing will be requested from the Environmental Compliance Unit at project initiation by the Bridge Management Unit. Test results are expected to be available during Preliminary Design. The Design Guidance document offers recommendations for environmental test data if it is not available.

The “Liner Selection for Abrasion” tab requires a single liner material be chosen from a drop-down menu and selection of a material thickness for metal liners. The Designer must also specify a target service life for the liner. The total abrasion and corrosion over the target service life allows the Designer to compare potential losses to the initial thickness of different options. The Designer has the option to accept the selections, revise and re-evaluate, or add a concrete invert to extend the life of the liner. Designers can evaluate many options quickly using this tool and should save the results from each evaluation as a separate file to document the selection process.

Designers are reminded that the Worksheet is a tool that can provide rapid assessment of environmental influences on corrosion and abrasion of culvert liners provided valid inputs are made. Designers are ultimately responsible for any conclusions based on the worksheet output and their own good judgment.