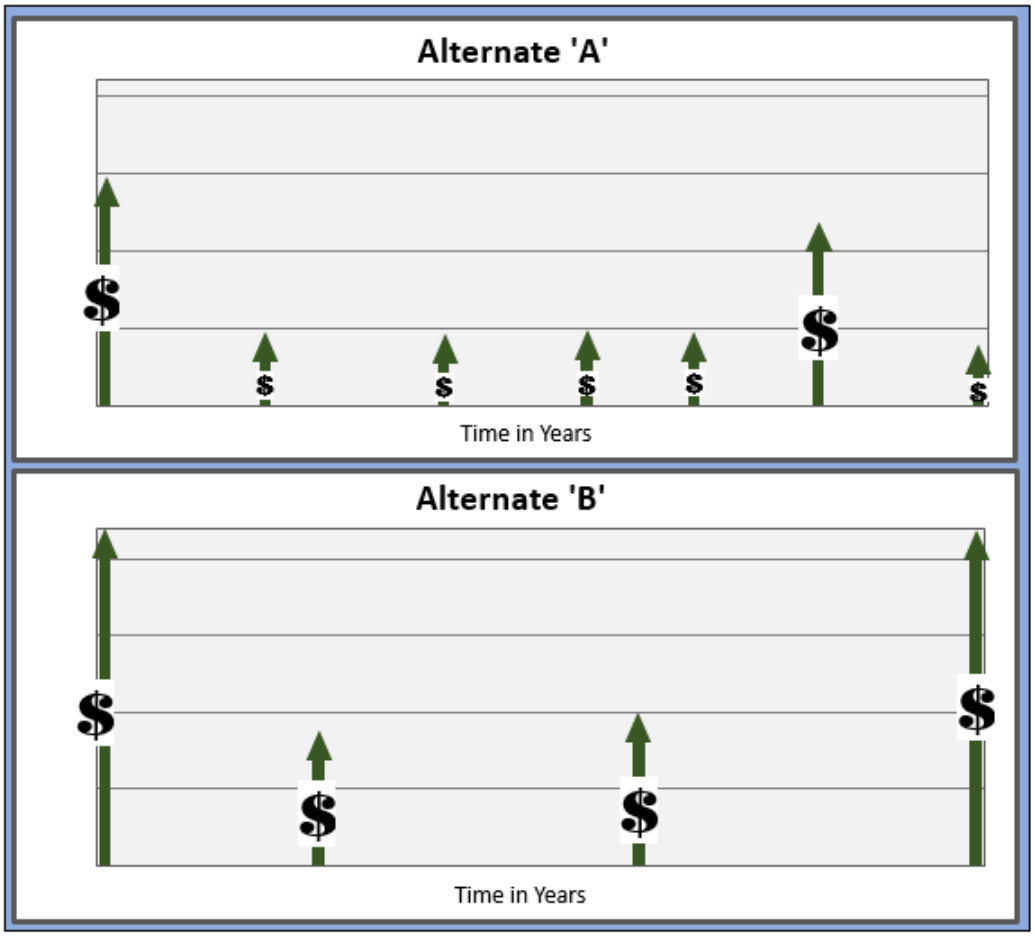
DEPARTMENT OF TRANSPORTATION

Chapter 7: Project-Type Selection

MnDOT Pavement Design Manual



December 16, 2019

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Introduction

Scope

This chapter contains the process to determine the pavement-type of MnDOT projects.

Background

MnDOT has had separate procedures to determine the pavement-type of new pavement projects (last documented in Technical Memorandum 10-04-MAT-01), rehabilitation projects (last documented in Technical Memorandum 09-12-MAT-03) and to determine the pavement-type through alternate bidding. This chapter replaces those procedures.

In addition, this chapter implements Minnesota State Statute 174.185. This legislation requires a life-cycle cost analysis (LCCA) to be performed for all pavement projects in the reconditioning (RD), resurfacing (RS), and road repair (RX) funding categories. The LCCA is required to compare competing paving materials using equal design lives and equal comparison periods. If the chosen alternate does not have the lowest life-cycle-cost, then the justification is required to be documented.

Overview

Pavement-type selection determines a project's pavement-type by using a LCCA or alternate bidding.

LCCA is used to calculate the low-cost alternate, among alternates with equal benefits, by comparing each alternate's combined initial and future costs. The value of future costs and benefits is converted into a present cost using a process called discounting. Discounting represents the time value of money given its ability to earn interest (i.e. a dollar today is worth more than a dollar tomorrow); this means the later a future cost occurs, the lower the value of its present cost. Initial cost is an estimate of an alternate's construction costs. The initial cost shouldn't include all construction costs, but it does need to include all costs that differ between the alternates.

Pavement-type selection requires following one of two LCCA processes, either Formal LCCA or District LCCA. The Formal LCCA process is performed to determine the low-cost alternate and to evaluate if the project is a good candidate for alternate bidding. Good candidates for alternate bidding are projects with competitive alternates that are both likely to attract bidders, which are typically projects that involve pavements with long design lives (20 years or greater). The District LCCA process is used only to determine the low-cost alternate.

Since the Formal LCCA is used to evaluate projects for alternate bidding costs must be calculated in the same manner as alternate bidding, by accounting for the length of the project, variations in pavement design and width, and variations in shoulder design and width that occur over the project's length. This involves calculating costs for multiple segments of pavement and summing the costs together to determine a total cost for each alternate.

The District LCCA process is used only to determine the low-cost alternate. The District LCCA process is simpler and not every variation in pavement design and pavement width is included in the LCCA.

Both LCCA processes use standard schedules of future activities to calculate future costs. The standard schedules specify when and what future activities will occur and the quantities needed to develop their cost. A

50-year schedule of future activities is provided for most pavement-types and design lives, which is a sufficient period to ensure that a major rehabilitation activity will occur in the schedule. Some pavement-types with short design lives (less than 20 years) only have 35-year schedules provided. These pavement-types will require multiple rehabilitations, and perhaps reconstruction, in a 50-year period and these activities are too uncertain to predict with accuracy. So that all schedules may be compared, a 35-year schedule is provided for all pavement-types and design lives.

The standard schedules of future costs were developed by the MnDOT Pavement Design Engineer and are based on preventive and rehabilitation activities as they are currently performed. Data for developing the standard schedules came from pavement management system (PMS) data and quantities from MnDOT projects. In addition, judgment and accepted MnDOT standards were used to supplement the available data when it was not sufficient. Draft schedules were distributed for review and comment to the District Materials/Soils Engineers as well as representatives of the HMA and PCC pavement industries.

User, supplemental, and other noneconomic costs are not formally evaluated by the LCCA processes or alternate bidding; however, these costs may be used to help determine applicable alternates for the LCCA processes and may be used as justification (on a case-by-case basis) for an exception to the LCCA processes or for the use of alternate bidding.

At the completion of the LCCA processes either, the low-cost alternate is selected; a different alternate is selected if an exception is granted, or the project continues to alternate bidding.

Projects in the Formal LCCA process may have their pavement-types selected using the alternate bidding process. Plans for alternate bidding projects contain two pavement-type alternates and contractors choose the alternate on which they will bid. The low-cost bidder is determined after considering the initial construction cost (the contractor's bid) and the bid adjustment factor, which is the difference in the discounted future costs between the alternates and is added to the alternate with the greater discounted future costs.

Section 700: Steps to Perform Pavement-Type Selection

The pavement-type selection process begins with pavement designs that were proposed during the project planning or the project scoping processes. The proposed designs and the directions given in this chapter are used to select the pavement-type.

Begin the pavement-type selection with the following steps.

STEP 1. Identify the "unique pavement designs" that were proposed in the project selection or project scoping processes.

One or more pavement design may have been proposed over the length of the project. Each of these pavement designs (not necessarily contiguous) that are consistent in pavement structure, thickness, width, material, and design life is defined as a "unique pavement design."

For example, project scoping may only propose one pavement design, such as a 4.0-inch overlay for the length of the project, and therefore the project would have only one "unique pavement design." Project scoping of another project may propose a 4.0-inch overlay for the majority of the project but also proposes reconstruction at multiple locations. The overlay would be one "unique pavement design", and the reconstruction design would be a second "unique pavement design" (if the reconstruction design is the same for all locations).

STEP 2. Categorize each "unique pavement design" using **Section 710: Pavement Design Categories**.

STEP 3. Determine which LCCA process to follow using **Section 720: Determination of Which LCCA Process to Follow**.

STEP 4. Follow either the Formal LCCA process, **Section 730: Formal LCCA Process**, or the District LCCA process, **Section 740: District LCCA Process**, as determined by **Section 720: Determination of Which LCCA Process to Follow**.

STEP 5. Continue to the alternate bidding process, **Section 750: Alternate Bidding**, if it was determined to do so by the Formal LCCA process.

STEP 6. 12-18 months prior to the project letting, review any previously prepared LCCA for the project, and update the LCCA if changes to costs or to the project may change the outcome.

Section 710: Pavement Design Categories

Use the following descriptions, or **Flowchart 710.1**, to categorize each "unique pavement design" that was proposed by the project planning or project scoping processes. Reference **Chapter 4: HMA & Chapter 5: PCC** to determine design lives. After categorizing all of the project's "unique pavement designs", continue to **Section 720: Determination of Which LCCA Process to Follow**.

1. **DL ≥ 20** (Design Life of 20 years or greater)

   This category includes pavement with a design life of 20 or more years.

   Examples include:

   - New/reconstructed HMA
   - New/reconstructed PCC
   - Full-depth reclamation (FDR)
   - Stabilized full-depth reclamation (SFDR)
   - Rubblization of PCC
   - Cold-in-place recycling (CIR)
   - PCC overlays (whitetopping or unbonded overlay)
   - Other

   This category does not include HMA overlays 5.0 inches thick or less. For the purpose of choosing a LCCA process all HMA overlays 5.0 inches or less but greater than 2.0 inches in thickness are included in the **DL<20** category.

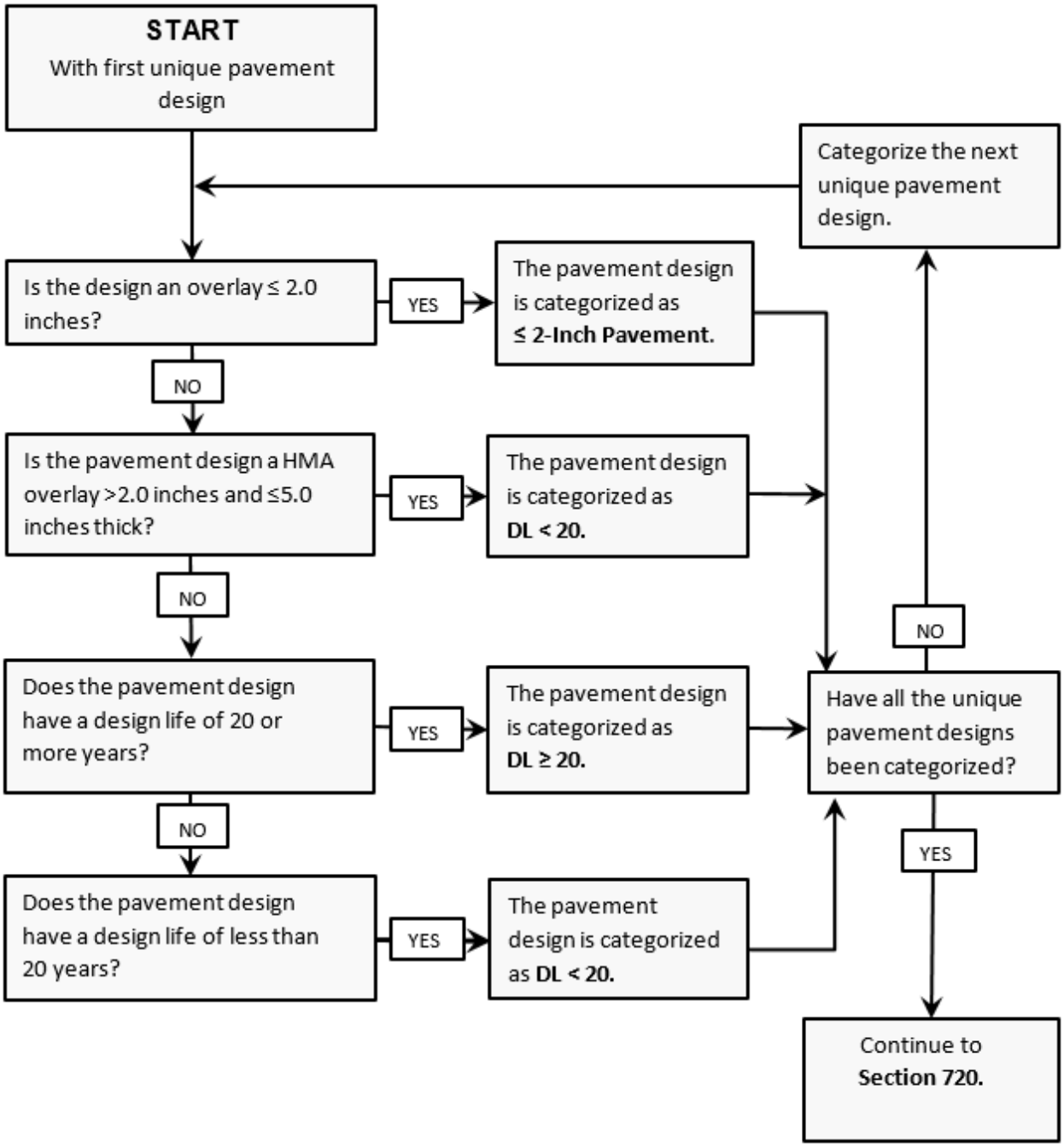
2. **DL < 20** (Design Life less than 20 years)

   This category includes pavement designs that have a design life less than 20 years and are thicker than 2.0 inches. For the purpose of choosing a LCCA process, all HMA overlays 5.0 inches or less but greater than 2.0 inches in thickness are included in this category regardless of design life.

3. **≤ 2-Inch Pavement**

   This category includes new pavements ≤ 2.0 inches thick. These projects are considered to have no opportunity to develop an alternate pavement type.

Flowchart 710. 1 – Categorizing "unique pavement designs"



Section 720: Determination of Which LCCA Process to Follow

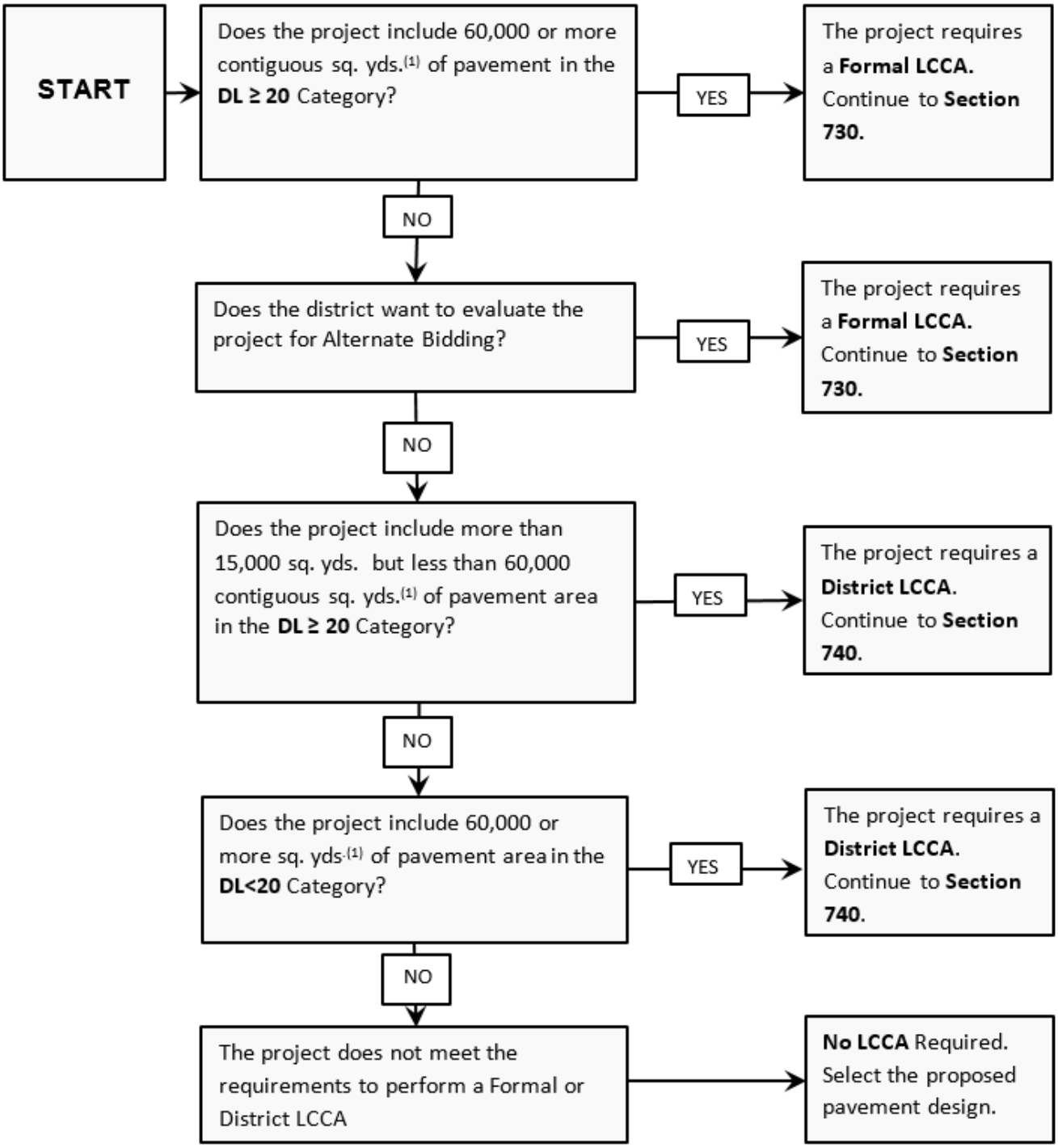
Use the following table, or **Flowchart 720.1**, and the pavement design categories determined in **Section 710: Pavement Design Categories** to determine which LCCA process to follow.

Table 720.1 – LCCA Process Criteria

LCCA Process	Criteria
Formal	Projects that have 60,000 or more contiguous sq. yds.(1) of pavement in the **DL≥ 20** Category.
Formal	Any project that the district wants to evaluate as a potential alternate bidding candidate.
District	Projects that have more than 15,000 sq. yds. but less than 60,000 contiguous sq. yds.(1) of pavement in the **DL≥ 20** Category and does not meet the requirements to follow the Formal LCCA process.
District	Projects that have 60,000 or more sq. yds.(1) of pavement in the **DL<20** Category and does not meet the requirements to follow the Formal LCCA process.
No LCCA Required	LCCAs are not required for indefinite delivery/indefinite quantity (IDIQ) projects. These projects involve an indefinite quantity of pavement which makes it impractical to develop competitive alternates and their costs.
No LCCA Required	Any projects that does not meet the requirements to follow the Formal LCCA process or District LCCA process. The designer should select the proposed pavement design.

(1) The pavement area is calculated using only the 12-foot wide travel lane of the mainline pavement and doesn't include shoulders, ramps, parking lanes, turn lanes, or auxiliary lanes.

Flowchart 720.1 – Determining which LCCA process to follow.



(1) The pavement area is calculated using only the 12-foot wide travel lane of the mainline pavement and doesn't include shoulders, ramps, parking lanes, turn lanes, or auxiliary lanes.

Section 730: Formal LCCA Process

Follow this section if **Section 720: Determination of Which LCCA Process to Follow** determined that a Formal LCCA is required.

STEP 1. Develop pavement designs for the required alternates for each "unique pavement design" that meets either of the following criteria (A or B below). **Chapter 9**: **Construction and Rehabilitation Alternates** may be consulted to determine appropriate alternates.

Criteria A: For each "unique pavement design" in the **DL≥ 20** Category, develop pavement designs for the required alternates in **Table 730.1**.

Table 730.1 - Required Alternates for DL≥20 Category

Alternate Number	Pavement Material	Design Life
1	HMA	20 Years
2	PCC	20 Years
3	PCC	35 Years

Criteria B: For each "unique pavement design" in the **DL< 20** Category that is greater than 15,000 sq.yds(1), develop pavement designs for the required alternates in **Table 730.2.**

Table 730.2 - Required Alternates for DL<20 Category

Alternate Number	Pavement Material	Design Life
1	As Proposed in Scoping or Project Development(2)	For the Pavement Design Proposed in Scoping or Project Development(2)
2	HMA	20 Years
3	PCC	20 Years

(1) The pavement area is calculated using only the 12-foot wide travel lane of the mainline pavement and doesn't include shoulders, ramps, parking lanes, turn lanes, or auxiliary lanes.

(2) The design life and pavement material of the pavement design proposed in scoping or project development process. **Chapter 4: HMA** and **Chapter 5: PCC** may be consulted to determine design life.

STEP 2. Perform a LCCA to calculate the net present cost of each alternate.

A. Get the most current version of the "LCCA standard spreadsheet" from the Pavement Design website.

The website contains a version of the "LCCA standard spreadsheet" for each district. This spreadsheet contain item prices specific to each district and are updated annually. In addition to annually updating the prices, the spreadsheet may be updated to improve usability or correct errors.

B. Perform LCCA(s) using the "LCCA standard spreadsheet"

This spreadsheet follows the LCCA standards in **Section 760: LCCA Formulas and Standards** and **Section 770: LCCA Future Activities**.

(1) Perform a LCCA for alternates developed from **Table 730.1** and a separate LCCA for alternates developed from **Table 730.2**.

(2) For each LCCA:

- Use a 50-year analysis period for alternates developed from **Table 730.1**.
- Use a 35-year analysis period for alternates developed from **Table 730.2**.

(3) The "LCCA standard spreadsheet" automates the calculation of future costs using the user's inputs, **Section 760: LCCA Formulas and Standards** and **Section 770: LCCA Future Activities**, and the "District Standard Prices."

(4) For each segment, Use the "Initial cost" tab to calculate the initial cost of constructing a representative mile of each pavement design. The initial cost must include the cost of constructing the pavement section between the shoulder points of intersection (PI). This includes the cost of the mainline and shoulder pavements, base, subbase, and engineered soil. Additional costs may also be included that reflect the difference in construction of the alternates, such as; different grade raises between alternates, traffic detour or no detour, constructing under traffic, or A+B contracting.

The "Initial cost" tab contains the most common item costs to estimate the construction cost but if a necessary item cost is not provided contact the MnDOT Pavement Design Engineer.

(5) The "LCCA standard spreadsheet" spreadsheet will calculate the net present cost of each alternate by summing the individual net present costs of each segment of the alternate.

STEP 3. Send the completed LCCA to the MnDOT Pavement Design Engineer for review and changes. When the LCCA is to the satisfaction of the MnDOT Pavement Design Engineer continue to Step 4.

STEP 4. If the Net Present Cost of a HMA and a PCC option are within 10% of each other, then continue to **Section 750: Alternate Bidding**, otherwise continue to Step 5.

STEP 5. Select the low cost alternate

The alternate with the least Net Present Cost is the low-cost option and must be selected unless the district is granted an exception. The reason for the exception must be documented in an exception form and is considered granted when it is signed by the MnDOT Pavement Engineer. The exception form is available on the Pavement Design website.

Reasons for an exception may include;

- The low-cost alternate isn't physically constructible
- Construction would cause unreasonable user delay or user hardship (e.g. construction would require unacceptable closures, long detours, or an extended construction period)
- Performance would be unacceptable
- Other supplemental costs or noneconomic factors (see **Table 960.1**)

STEP 6. Based on the selected pavement alternate, prepare and distribute a Materials Design Recommendation (MDR) in accordance with **Section 810: Materials Design Recommendation (MDR)**. Attach the LCCA and any exceptions to the MDR.

Section 740 - District LCCA Process

Follow this section if **Section 720: Determination of Which LCCA Process to Follow** indicated that a District LCCA is required.

STEP 1. For each "unique pavement design" that meets either of the following criteria (A or B below), develop the required alternate pavement designs. **Chapter 9**: **Construction and Rehabilitation Alternates** may be consulted to determine appropriate alternates that meet the requirements of the tables.

Criteria A: For each "unique pavement design" in the **DL<20** Category, that has a pavement area of 60,000 or more sq. yds [(1)], develop pavement designs for the alternates required in **Table 740.1**.

If the project contains a total pavement area greater than 60,000 sq. yds [(1)] in the **DL<20** Category, but no individual "unique pavement design" has an area greater than 60,000 sq. yds [(1)], develop pavement designs for alternates of the longest design in the **DL<20** Category.

Table 740.1 - Required Alternates for DL<20 Category

Alternate Number	Pavement Material	Design Life
1	As Proposed in Scoping or Project Development[(2)]	For the Pavement Design Proposed in Scoping or Project Development[(2)]
2	HMA	20 Years
3	PCC	20 Years

(1) The pavement area is calculated using only the 12-foot wide travel lane of the mainline pavement and doesn't include shoulders, ramps, parking lanes, turn lanes, or auxiliary lanes.

(2) The design life and pavement material of the pavement design proposed in scoping or project development process. **Chapter 4: HMA** and **Chapter 5: PCC** may be consulted to determine design life.

Criteria B: For each "unique pavement design", **DL≥ 20** Category, that is greater than 15,000 sq. yds. but has a pavement area less than 60,000 sq. yds. (1), develop pavement designs for the alternates in **Table 740.2**.

Table 740.2 - Required Alternates for DL≥20 Category

Alternate Number	Pavement Material	Design Life
1	HMA	20 Years
2	PCC	20 Years
3	PCC	35 Years

(1) The pavement area is calculated using only the 12-foot wide travel lane of the mainline pavement and doesn't include shoulders, ramps, parking lanes, turn lanes, or auxiliary lanes.

STEP 2. Perform a LCCA to calculate the net present cost of each alternate.

A. Get the most current version of the "LCCA standard spreadsheet" from the Pavement Design website.

The website contains a version of the "LCCA standard spreadsheet" for each district. This spreadsheet contain item prices specific to each district and are updated annually. In addition to annually updating the prices, the spreadsheet may be updated to improve usability or correct errors.

B. Perform LCCA(s) using the "LCCA standard spreadsheet"

This spreadsheet follows the LCCA standards in **Section 760: LCCA Formulas and Standards** and **Section 770: LCCA Future Activities**.

(1) Perform a LCCA for alternates developed from **Table 740.1** and a separate LCCA for alternates developed from **Table 740.2**.

(2) For each LCCA:

- Use a 35-year analysis period for alternates developed from **Table 740.1**.
- Use a 50-year analysis period for alternates developed from **Table 740.2**.

(3) The "LCCA standard spreadsheet" automates the calculation of future costs using the user's inputs, **Section 760: LCCA Formulas and Standards** and **Section 770: LCCA Future Activities**, and the "District Standard Prices."

(4) For each segment, use the "Initial cost" tab to calculate the initial cost of constructing a representative mile of each pavement design. The initial cost must include the cost of constructing the pavement section between the shoulder points of intersection (PI). This includes the cost of the mainline and shoulder pavements, base, subbase, and engineered soil. Additional costs may also be included that reflect the difference in construction of the alternates, such as; different grade raises between alternates, traffic detour or no detour, constructing under traffic, or A+B contracting.

The "Initial cost" tab contains the most common item costs to estimate the construction cost but if a necessary item cost is not provided contact the MnDOT Pavement Design Engineer.

(5) The "LCCA standard spreadsheet" spreadsheet will calculate the net present cost of each alternate by summing the individual net present costs of each segment of the alternate.

STEP 3. Select the low cost alternate

The alternate with the least Net Present Cost is the low-cost option and must be selected unless the district is granted an exception. The reason for the exception must be documented in an exception form and is considered granted when it is signed by the District Engineer. The exception form is available on the Pavement Design website.

Reasons for an exception may include;

- The low-cost alternate isn't physically constructible
- Construction would cause unreasonable user delay or user hardship (e.g. construction would require unacceptable closures, long detours, or an extended construction period)
- Performance would be unacceptable
- Other supplemental costs or noneconomic factors (see **Table 960.1**)

STEP 4. Based on the selected pavement alternate, prepare and distribute a Materials Design Recommendation (MDR) in accordance with **Section 810: Materials Design Recommendation (MDR)**. Attach the LCCA and any exceptions to the MDR.

Section 750: Alternate Bidding

Follow this section if **Section 730: Formal LCCA Process** indicated that the Net Present Cost of one HMA and one PCC option are within 10% of each other.

1. Determine if the project is a good candidate for alternate bidding

   Having alternates with Net Present Costs within 10% of each other is indicative of a good project for alternate bid but there are also other concerns to evaluate to determine if a project is a good candidate. A good project is a project where both pavement types are constructible, will provide acceptable performance and will have competitive bidders. Below are examples of reasons that a project will not be a good candidate.

   - An alternate isn't physically constructible
   - An alternate's construction would cause unreasonable user delay or user hardship (e.g. construction would require unacceptable closures, long detours, or an extended construction period)
   - The performance of an alternate would not be unacceptable
   - It's unlikely that there will be competitive bidders for both alternates
   - Other supplemental costs or noneconomic factors (see **Table 960.1**)

   If a project is believed to not be a good candidate for alternate bidding then the district (with the guidance MnDOT Pavement Design Engineer) may request an exception to using the alternate bidding process. The exception is granted when it is signed by the MnDOT Pavement Engineer. This exception may also serve as an exception to choosing the low-cost option. The exception form is located on the MnDOT Pavement Design website.

2. Documentation

   A. If an exception to following the Alternate Bidding process has been granted

      Based on the selected pavement alternate, prepare and distribute a Materials Design Recommendation (MDR) in accordance with **Section 810: Materials Design Recommendation (MDR)**. Attach the LCCA and any exceptions to the MDR.

   B. Good candidate for Alternate Bidding

      Prepare a Pavement Design Memorandum (PDM) in accordance with **Section 800: Pavement Design Memorandum (PDM)**. The PDM details the pavement alternates, how they were developed and which pavement alternates will be used for alternate bidding. Attach the LCCA to the PDM and submit it to the MnDOT Pavement Design Engineer. The MnDOT Pavement Design Engineer will review the PDM and attachments and may request that the district make changes. After any changes are made, the MnDOT Pavement Design Engineer will distribute the PDM to representatives of the Concrete Paving Association of Minnesota (CPAM) and Minnesota Asphalt Pavement Association (MAPA) for a comment period of two weeks. After the comment period, the MnDOT Pavement Design Engineer will address any comments and sign the PDM.

When the PDM is signed, the MDR may be developed using the paving alternates for alternate bidding. Prepare and distribute the MDR in accordance with **Section 810: Materials Design Recommendation (MDR)**. Attach the LCCA to the MDR and continue to the next section, **Section 750. C: Alternate bidding process**.

C. Alternate bidding process

STEP 1. Design the project plans with the HMA and PCC alternates that were developed in the Formal LCCA process. Attempt to have the same pavement widths and profile grade between the alternates.

STEP 2. The MnDOT Pavement Design Engineer develops the project bid adjustment factor(s) as follows:

A. For the alternate designs presented in the final plans, perform an LCCA of all costs other than initial costs using the approach described in **Section 730 - Formal LCCA Process**.

B. The bid adjustment factor for an alternate is calculated as the difference between its net present cost and the net present cost of the alternate with the lowest net present cost. The alternate with the lowest net present cost always has a bid adjustment factor of $0.00 which doesn't need to be reported.

C. Calculate the bid adjustment factor on the alternates as presented in the final plans.

D. Develop the bid adjustment factor within 6 months of the project bid.

STEP 3. Letting and awarding for alternate bidding

The project will be advertised for bids with the bid adjustment factor(s) and plans that include the pavement alternates. Bidders may bid on either pavement alternate. The low-cost bidder will be determined after adding the appropriate bid adjustment factor to each bid.

Section 760: LCCA Formulas and Standards

LCCA compares pavement alternates by calculating the net present cost for each alternate. The net present cost is the initial cost plus the discounted cost of future activities minus the cost of any discounted remaining service life (RSL) value.

1. Discount rate (r)

   The discount rate is equal to the average of the 5 most recent years' real interest rate of a 30-year treasury bonds as published each year by the federal Office of Management & Budget (OMB). Each year's discount rate will be determined by the MnDOT Office of Investment & Management and distributed by July 1st.

2. Remaining service life (RSL) value

   The Remaining service life value is the residual value of an improvement when its service life extends beyond the end of the analysis period. The RSL value is calculated as the cost of the last rehabilitation or reconstruction activity multiplied by the ratio of the number of years of the activity's service life that are remaining at the end of the analysis period over the service life of the activity. The RSL value is included in the LCCA as negative cost. A remaining service life value will not be calculated for minor maintenance/preservation activities (e.g. surface or crack treatments, shoulder joint sealing, and shoulder fog sealing).

3. District standard prices

   This is a list of each district's item costs which are used to estimate initial and future costs. It will be updated annually by the MnDOT Pavement Design Engineer by July 1st of each year. The values will be based on each district's bid prices from the March 1st of the previous year to April 30th of the current year. The proposed price list will be made available for review by the district, CPAM, and MAPA prior to being accepted.

4. Formulas

   A. Remaining service life (RSL)

$$RSL = C_{Last\ Activity} \times \frac{N_{RL}}{N_{SL}}$$

RSL = Remaining service life value

$C_{Last\ Activity}$ = Cost of the last rehabilitation or reconstruction activity. This activity may include reconstruction or a rehabilitation activity such as a CPR or an overlay. This would not include minor maintenance/preservation activities such as surface treatments or crack treatments, shoulder joint sealing, or shoulder fog sealing.

N_{SL} = Service life of the last activity in years.

N_{RL} = Unused service life, in years, of the last activity at the end of the Analysis Period.

B. Present cost of each activity

$$PC_{Activity} = C_{Activity} \times \left[\frac{1}{(1+r)}\right]^{N_{Acivity}}$$

$PC_{Activity}$ = Present cost of an activity (or RSL)

$C_{Activity}$ = Cost of an activity (or RSL)

$N_{Activity}$ = Number of years after construction that an activity is scheduled to take place

r = Discount rate, decimal form (**Section 760.1**)

C. Net present cost of an alternate (for one segment)

$$\sum[NPC_{ALT}]_{SEGMENT} = C_{Initial} + \sum PC_{Activity}$$

NPC_{ALT} = Net present cost of an alternate (for one segment)

$PC_{activity}$ = Present cost of activities (or RSL)

$C_{Initial}$ = Initial cost of construction

Note: Do not include an initial cost ($C_{Initial}$) when calculating the bid adjustment factor for alternate bidding.

D. Net present cost of an alternate (for an entire project with multiple segments)

$$[NPC_{ALT}]_{PROJECT} = \sum [NPC_{ALT}]_{SEGMENT}$$

$[NPC_{ALT}]_{PROJECT}$ = Net present cost of an alternate for the entire project when the project has multiple segments.

$[NPC_{ALT}]_{SEGMENT}$= Net present cost of an alternate for an individual segment.

E. Bid adjustment factor for an alternate

$$BAF_{ALTERNATE} = [NPC_{ALT}]_{PROJECT} - lowest\ [NPC_{ALT}]_{PROJECT}$$

$BAF_{ALTERNATE}$ = Bid adjustment factor for an alternate.

$[NPC_{ALT}]_{PROJECT}$ = Net present cost of the alternate (for all segments)

Lowest $[NPC_{ALT}]_{PROJECT}$ = Net present cost of the alternate with the lowest net present cost

Section 770: LCCA Future Activities

This section contains the schedules and quantities that are used by the "MnLCCA" spreadsheet for performing LCCA's and determining bid adjustment factors for use in alternate bidding.

1. The following Schedules are presented in this section

   - **Table 770.1** - PCC with 12' or 15' joint spacing - design life = 20 years
   - **Table 770.2** - PCC with 12' or 15' joint spacing - design life = 35 years
   - **Table 770.3** - PCC with 6' X 6' joint spacing - design life = 20 years PCC thickness = 5.5 inches or greater
   - **Table 770.4** - PCC with 6' X 6' joint spacing - design life = 20 years PCC thickness = 5.0 inches or less
   - **Table 770.5** - PCC with 6' X 6' joint spacing - design life = 35 years
   - **Table 770.6** - New HMA pavement over aggregate base, FDR, SFDR, CIR, or rubblized PCC - design life = 20 years
   - **Table 770.7** - HMA Overlay - design life (DL) = 13 to 17 years
   - **Table 770.8** - HMA Overlay - design life (DL) >17 years

2. Use the following definitions:

   - Thin HMA Shoulders – are less than 4.0 inches in thickness.
   - Thick HMA Shoulders – are 4.0 inches or greater in thickness.

Table 770.1 - PCC with 12’ or 15’ Joint Spacing and a Design Life of 20 years

Age	35-year Analysis Period Activities	50-year Analysis Period Activities
0	Initial Construction	Initial Construction
20	1st CPR	1st CPR
35	End of Analysis Period (No Remaining Service Life)	Remove & Replace with PCC pavement with a 20-year Design Life
50		End of Analysis Period (5/20 Remaining Service Life)

1st CPR Quantities

Description	Quantity
Type BA Repair	1% Mainline Surface Area
Type B3 Repair	2% Mainline Transverse & Longitudinal Joints
Type CD-HV Repair	7% Mainline Transverse Joints
Type CX Repair	6% Mainline Surface Area
Surface Grind	68% Mainline Surface Area
Thin HMA Shoulders: Remove & Replace	100% of Shoulders
Thick HMA Shoulders: 1.5” Mill & Overlay	100% of Shoulders

Remove & Replace Quantities

Description	Quantity
Remove mainline PCC pavement	100% of mainline PCC pavement
Replace mainline PCC pavement with 20-year Design Life PCC pavement.	100% of mainline PCC pavement
Remove & Replace shoulder pavement	100% of existing shoulder pavement

Table 770.2 - PCC with 12’ or 15’ Joint Spacing and a Design Life of 35 years

Age	35-year Analysis Period Activities	50-year Analysis Period Activities
0	Initial Construction	Initial Construction
20	1st CPR	1st CPR
35	End of Analysis Period (No Remaining Service Life)	2nd CPR
50		End of Analysis Period (No Remaining Service Life)

1st CPR Quantities

Description	Quantity
Type BA Repair	1% Mainline Surface Area
Type B3 Repair	1% Mainline Transverse & Longitudinal Joints
Type CD-HV Repair	7% Mainline Transverse Joints
Type CX Repair	3% Mainline Surface Area
Surface Grind	23% Mainline Surface Area
Thin HMA Shoulders: Remove & Replace	100% of Shoulders
Thick HMA Shoulders: 1.5” Mill & Overlay	100% of Shoulders

2nd CPR Quantities

Description	Quantity
Type B3 Repair	2% Mainline Transverse & Longitudinal Joints
Type CD-HV Repair	7% Mainline Transverse Joints
Type CX Repair	6% Mainline Surface Area
Surface Grind	68% Mainline Surface Area
Thin HMA Shoulders: Fog Seal	100% of Shoulders
Thick HMA Shoulders: Fog Seal	100% of Shoulders

Table 770.3 - PCC with 6' X 6'Joint Spacing with a Design Life of 20 years and a PCC thickness of 5.5 inches or Greater

Age	35-year Analysis Period Activities	50-year Analysis Period Activities
0	Initial Construction	Initial Construction
20	1st CPR	1st CPR
35	End of Analysis Period (No Remaining Service Life)	Remove & Replace with PCC pavement with a 20-year Design Life
50		End of Analysis Period (5/20 Remaining Service Life)

1st CPR Quantities

Description	Quantity
Type A2 Repair	10% Mainline Transverse & Longitudinal Joints
Type CX Repair	15% Mainline Surface Area
Surface Grind	50% Mainline Surface Area
Thin HMA Shoulders: Remove & Replace	100% of Shoulders
Thick HMA Shoulders: 1.5" Mill & Overlay	100% of Shoulders

Remove & Replace Quantities

Description	Quantity
Remove mainline PCC pavement	100% of mainline PCC pavement
Replace mainline PCC pavement with 20-year Design Life PCC pavement.	100% of mainline PCC pavement
Remove & Replace shoulder pavement	100% of existing shoulder pavement

Table 770.4 - PCC with 6' X 6'Joint Spacing with a Design Life of 20 years and a PCC thickness of 5.0 inches or less

Age	35-year Analysis Period Activities	50-year Analysis Period Activities
0	Initial Construction	Initial Construction
20	1st CPR	1st CPR
30	Remove & Replace with PCC pavement with a 35-year Design Life	Remove & Replace with PCC pavement with a 35-year Design Life
35	End of Analysis Period (30/35 Remaining Service Life)	
50		End of Analysis Period (15/35 Remaining Service Life)

1st CPR Quantities

Description	Quantity
Type A2 Repair	10% Mainline Transverse & Longitudinal Joints
Type CX Repair	25% Mainline Surface Area
Surface Grind	100% Mainline Surface Area
Thin HMA Shoulders: Fog Seal	100% of Shoulders
Thick HMA Shoulders: Fog Seal	100% of Shoulders

Remove & Replace Quantities

Description	Quantity
Remove mainline PCC pavement	100% of mainline PCC pavement
Replace mainline PCC pavement with 35-year Design Life PCC pavement.	100% of mainline PCC pavement
Remove & Replace shoulder pavement	100% of existing shoulder pavement

Table 770.5 - PCC with 6' X 6'Joint Spacing with a Design Life of 35 years

Age	35-year Analysis Period Activities	50-year Analysis Period Activities
0	Initial Construction	Initial Construction
20	1st CPR	1st CPR
35	End of Analysis Period (No Remaining Service Life)	2nd CPR
50		End of Analysis Period (No Remaining Service Life)

1st CPR Quantities

Description	Quantity
Type A2 Repair	5% Mainline Transverse & Longitudinal Joints
Type B3 Repair	1% Mainline Transverse & Longitudinal Joints
Type CX Repair	5% Mainline Surface Area
Surface Grind	23% Mainline Surface Area
Thin HMA Shoulders: Remove & Replace	100% of Shoulders
Thick HMA Shoulders: 1.5" Mill & Overlay	100% of Shoulders

2ndt CPR Quantities

Description	Quantity
Type A2 Repair	10% Mainline Transverse & Longitudinal Joints
Type B3 Repair	2% Mainline Transverse & Longitudinal Joints
Type CX Repair	8% Mainline Surface Area
Surface Grind	68% Mainline Surface Area
Thin HMA Shoulders: Fog Seal	100% of Shoulders
Thick HMA Shoulders: Fog Seal	100% of Shoulders

Table 770.6.A - New HMA Pavement over Aggregate Base, FDR, SFDR, CIR, or Rubblized PCC – Rural Section

Age	Mainline Treatment	Mainline Quantity	Shoulder Treatment	Shoulder Quantity
0	Initial Construction	Initial Construction		
8	Crack Treatment	16% Mainline Length		
12	Chip Seal (1) (2)	31% Mainline Length	Fog Seal (1) (2)	31% Shoulder Length
12	Microsurfacing (1) (2)	9% Mainline Length	Fog Seal (1) (2)	9% Shoulder Length
20	Mill Top lift + ½" & Overlay Mill Thickness +1.5"	100% Mainline Area	1.5" Overlay	100% Shoulder Area
23	Crack Treatment	32% Mainline Length		
27	Chip Seal (1) (2)	31% Mainline Length	Fog Seal (1) (2)	31% Shoulder Length
35	End of 35-Year Analysis Period	2/17 Remaining Service Life		
37	Mill 2" & Overlay 3.5"	100% Mainline Area	1.5" Overlay	100% Shoulder Area
40	Crack Treatment	32% Mainline Length		
44	Chip Seal (1) (2)	31% Mainline Length	Fog Seal (1) (2)	31% Shoulder Length
50	End of 50-Year Analysis Period	4/17 Remaining Service Life		

(1) Delete when ultra-thin bonded wearing course is used.

(2) Eliminate chip seal and fog seal when 20 year BESALs are >7 million.

Table 770.6.B - New HMA Pavement over Aggregate Base, FDR, SFDR, CIR, or Rubblized PCC – Urban Section

Age	Mainline Treatment	Mainline Quantity	Shoulder Treatment	Shoulder Quantity
0	Initial Construction	Initial Construction		
8	Crack Treatment	16% Mainline Length		
12	Chip Seal (1) (2)	31% Mainline Length	Fog Seal (1) (2)	31% Shoulder Length
12	Microsurfacing (1) (2)	9% Mainline Length	Fog Seal(1) (2)	9% Shoulder Length
20	Mill & Overlay 3”	100% Mainline Area	Thick Shoulder - 1.5” Mill & Overlay Thin Shoulder - Remove & Replace	100% Shoulder Area
23	Crack Treatment	32% Mainline Length		
27	Chip Seal (1) (2)	31% Mainline Length	Fog Seal (1) (2)	31% Shoulder Length
35	End of 35-Year Analysis Period	2/17 Remaining Service Life		
37	Mill & Overlay 3.5”	100% Mainline Area	Thick Shoulder - 2.0” Mill & Overlay Thin Shoulder - Remove & Replace	100% Shoulder Area
40	Crack Treatment	32% Mainline Length		
44	Chip Seal (1) (2)	31% Mainline Length	Fog Seal (1) (2)	31% Shoulder Length
50	End of 50-Year Analysis Period	4/17 Remaining Service Life		

(1) Delete when ultra-thin bonded wearing course is used.

(2) Eliminate chip seal and fog seal when 20 year BESALs are >7 million.

Table 770.7.A - HMA Overlay with a Design Life (DL) of 13 to 17 years – Rural Section

Age	Mainline Treatment	Mainline Quantity	Shoulder Treatment	Shoulder Quantity
0	Initial Construct (1st Overlay)			
3	Crack Treatment	32% Mainline Length		
7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
DL	Mill 2” & Overlay 3.5” (2nd Overlay)	100% Mainline Area	1.5” Overlay	100% Shoulder Area
DL + 3	Crack Treatment	32% Mainline Length		
DL + 7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
2×DL-1	Mill 2” & Overlay 3.5” (3rd Overlay)	100% Mainline Area	1.5” Overlay	100% Shoulder Area
2×DL+2	Crack Treatment (1)	32% Mainline Length		
2×DL+6	Chip Seal* (2)	31% Mainline Length	Fog Seal*	31% Shoulder Length
35	End of Analysis Period	Remaining Service Life = [(3*DL-38)/(DL-2)])		

* Eliminate chip seal and fog seal when 20 year BESALs are >7 million

(1) Do not use when DL = 17

(2) Do not use when DL = 15, 16, 17

Table 770.7.B - HMA Overlay with a Design Life (DL) of 13 to 17 years – Urban Section

Age	Mainline Treatment	Mainline Quantity	Shoulder Treatment	Shoulder Quantity
0	Initial Construct (1st Overlay)			
3	Crack Treatment	32% Mainline Length		
7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
DL	Mill 3” & Overlay 3.5” (2nd Overlay)	100% Mainline Area	Thick Shoulder - 1.5” Mill & Overlay Thin Shoulder - Remove & Replace	100% Shoulder Area
DL + 3	Crack Treatment	32% Mainline Length		
DL + 7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
2×DL-1	Mill & Overlay 4” (3rd Overlay)	100% Mainline Area	Thick Shoulder - 2.0” Mill & Overlay Thin Shoulder - Remove & Replace	100% Shoulder Area
2×DL+2	Crack Treatment (1)	32% Mainline Length		
2×DL+6	Chip Seal* (2)	31% Mainline Length	Fog Seal*	31% Shoulder Length
35	End of Analysis Period	Remaining Service Life = [(3*DL-38)/(DL-2)])		

* Eliminate chip seal and fog seal when 20 year BESALs are >7 million

(1) Do not use when DL = 17

(2) Do not use when DL = 15, 16, 17

Table 770.8.A - HMA Overlay with a Design Life (DL) of > 17 years – Rural Section

Age	Mainline Treatment	Mainline Quantity	Shoulder Treatment	Shoulder Quantity
0	Initial Construct (1st Overlay)			
3	Crack Treatment	32% Mainline Length		
7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
DL	Mill 2.5” & Overlay 3.5” (2nd Overlay)	100% Mainline Area	1.5” Overlay	100% Shoulder Area
DL + 3	Crack Treatment	32% Mainline Length		
DL + 7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
35	End of Analysis Period	Remaining service life = [(2*DL-36)/(DL-1)]		

* Eliminate chip seal and fog seal when 20 year BESALs are >7 million

(1) Do not use when DL = 17

(2) Do not use when DL = 15, 16, 17

Table 770.8.B - HMA Overlay with a Design Life (DL) of > 17 years – Urban Section

Age	Mainline Treatment	Mainline Quantity	Shoulder Treatment	Shoulder Quantity
0	Initial Construct (1st Overlay)			
3	Crack Treatment	32% Mainline Length		
7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
DL	Mill & Overlay 3.5" (2nd Overlay)	100% Mainline Area	Thick Shoulder - 2.0" Mill & Overlay Thin Shoulder - Remove & Replace	100% Shoulder Area
DL + 3	Crack Treatment	32% Mainline Length		
DL + 7	Chip Seal*	31% Mainline Length	Fog Seal*	31% Shoulder Length
35	End of Analysis Period	Remaining service life = [(2*DL-36)/(DL-1)]		

* Eliminate chip seal and fog seal when 20 year BESALs are >7 million

(1) Do not use when DL = 17

(2) Do not use when DL = 15, 16, 17