Street Treatment Selection Manual

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Pavement Management
Street Treatment Selection Manual

The purpose of this document is to lay out the process of street selection for the City of Dallas annual maintenance plan. The Pavement Management System (PMS) is comprised of three arts:

- Immediate Repairs
- Maintenance Projects
- Bond Projects

Immediate repairs are types that are taken care of through 3-1-1 requests. They generally are made up of pot holes, crack sealing and 'make safe' repairs. These items, other than crack sealing, are reactionary and not planned out a year in advance.

Maintenance projects will be discussed at length in this document to lay out how the street candidates are identified and approved. The various repair types will be detailed with pictures for reference. The planning for this program starts the year before any construction begins and goes through several layers of identifications and approval before a candidate is accepted for the next years maintenance plan.

Bond Projects are selected from the City of Dallas Needs Inventory. The Needs Inventory for street reconstruction and resurfacing projects is made up of several factors that include the street condition, areas of Inequity, street classification and future DWU work. Pavement Management also tracks the citizen requests that come in for streets needing reconstruction. The two lists, Needs Inventory and Bond Requests , are then overlaid to provide a broader picture to Council so that they can make decisions on what goes on the next bond program.

More information can be found on the Pavement Management website and can be found at the following address: https://bit.ly/3vKaCat

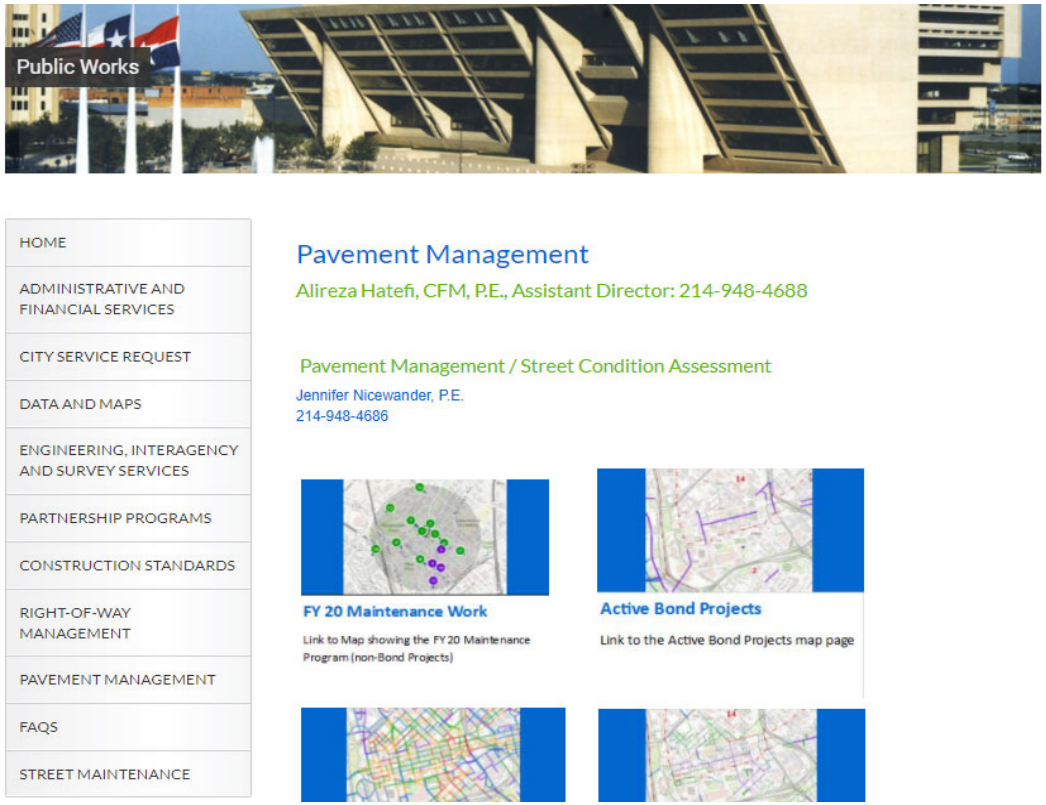


Figure 1. Pavement Management Web Page: https://bit.ly/3vKaCat

Maintenance Program Selection Summary

The Maintenance Program Selection is an annual program that looks at the current condition of the streets and utilizes budget dollars provided to maximize the number of lane miles that can be improved for that year. For more information on the Infrastructure Management Plan for the City of Dallas, please go to: https://bit.ly/3tRc1Ks

The Annual Program Development: The annual program starts with the condition rating of the streets. This rating, known as the Pavement Condition Index or PCI, is a number based on the visual inspection of the distresses found on the streets. The process has evolved from multiple inspectors taking hand notes identifying and rating the distresses to a single van with data and distress recording equipment. Data gathered is processed by an engineering firm specialized in the data assessment field. The streets go through this assessment every four-years because of the cost of the work. In the years where there is no field data collected, deterioration curves are applied to each of the street segments. These curves will lower the PCI of the street annually, and are based on Dallas street observations, pavement type, the age of street and the last repair done on the street.

Data Model: In 2020, the City of Dallas hired a Pavement Management Consultant to review current City practices and provide feed back on areas of improvements. One area of focus on was the City's Paving Model. Throughout the course of 2020 and 2021, Dallas transitioned to a new paving model that was sophisticated enough to handle the complexities of a City our size.

The model provides candidates for the future repair work and Fiscal Year '22 will be the first year incorporating the model recommendations.

Field Verification: The Paving Model has improved the way streets are selected as candidates, but the Department of Public Works will do an "eyes-on" inspection by our construction managers to ensure that the treatment selected by the model is appropriate.

A final step in the Maintenance Program selection of streets is to coordinate the street candidates with the current bond, Dallas Water Utilities and Atmos Gas. This will ensure we do as much as we possibly can to avoid conflicts with other programs, departments and entities.

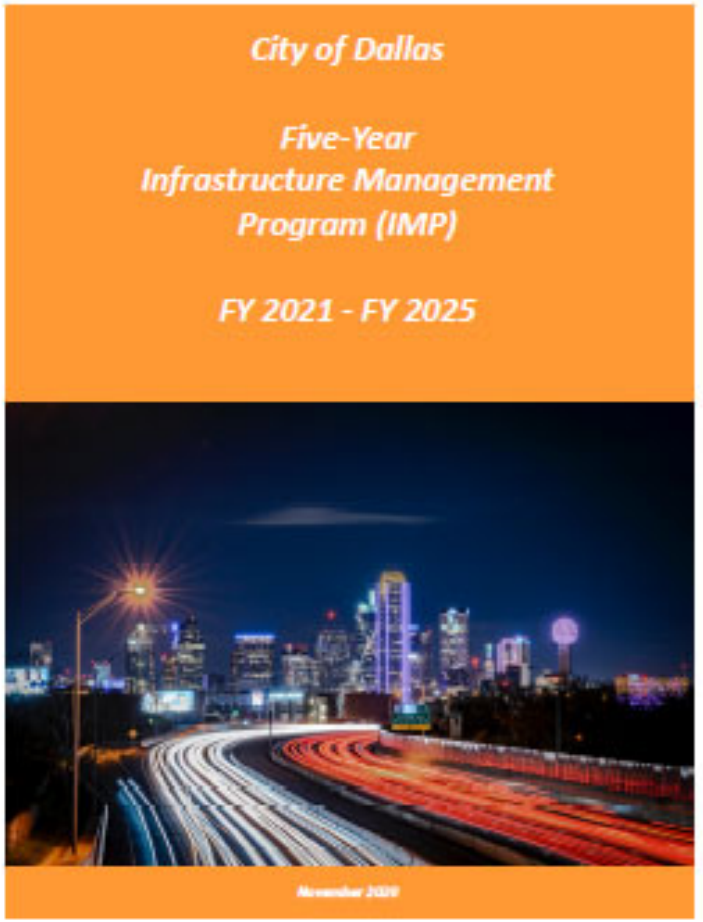


Figure 2. The Annual Infrastructure Management Plan: https://bit.ly/3tRc1Ks

Pavement Materials

The following are the paving materials used for Dallas streets

Concrete (PCCP) : All new streets in the City of Dallas are concrete streets unless approved otherwise by the Director of Public Works. Concrete streets have a lower maintenance cost over the life of the street but tend to have a higher upfront or construction cost.

Asphalt-over-Concrete (AOC): The City of Dallas utilizes the composite section of "Asphalt of Concrete" on approximately 15% of the City Streets.
Although this treatment is used less and less, it does have it's place on streets where concrete cracking is unsightly but the street is not in need of a total replacement. Concrete is an excellent base material because it is stable and allows for compaction of the asphalt above.

Asphalt (AC): Per the National Asphalt Pavement Association, the United States has more than 2.7 million miles of paved roads and highways, and 94 percent of those are surfaced with asphalt. Pavement Pro.com, "Asphalt pavement is known for its durability and resilience. It is this strength which makes asphalt pavement the best option for most all paved surfaces. Most state and federal governments highly prefer asphalt pavement because of its reliability and lasting life. If it is properly laid, it need not be replaced for twenty to twenty five years. Asphalt pavement is made up of stone (aggregate), sand, additives and liquid (petroleum) asphalt. Liquid asphalt – a sticky black substance – is used as the binding material in asphalt pavements." Asphalt Pavement permitted with the approval of the Public Works Director.

Pilot Program—Synthetic Reinforced Concrete
- The City of Dallas is working with the University of Texas in Arlington (UTA) on a pilot program for Synthetic-Fiber Reinforced Concrete, (SYNFRCP) in comparison to Steel reinforced concrete and Asphalt pavements. The Pilot program will create test sections through out the city to get actual deterioration rates over a 3-year period. UTA will develop Artificial Intelligence model to predict the service life of pavements. Results from this model will be utilized in the current paving model. SHOW 3 DIFFERENT

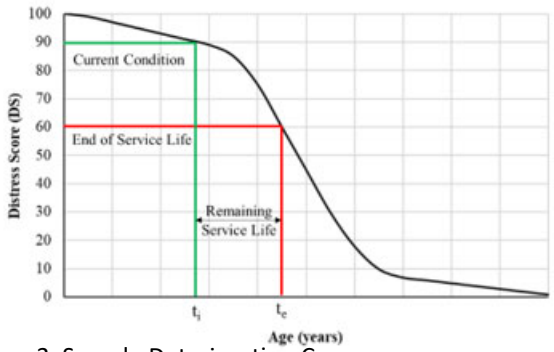


Figure 3. Sample Deterioration Curve

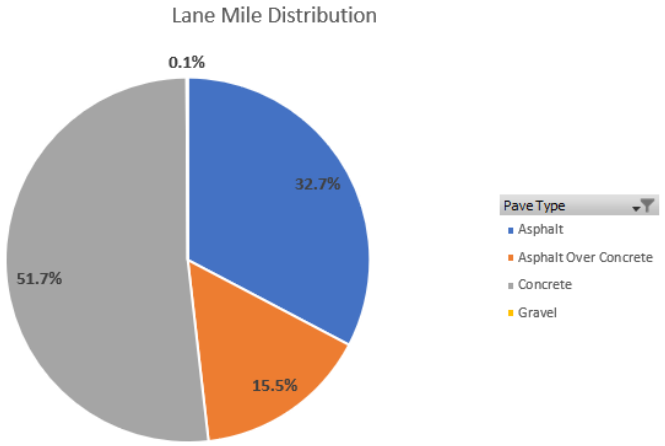


Figure 4. Lane Mile Distribution for the City of Dallas

Functional Class of Streets

Arterials: Arterial streets provide the links between areas of the city delivering traffic from collector streets to freeways and facilitate movement from one part of the city to another. They are designed for relatively heavy traffic volumes and higher speeds.

Collector: Collector streets provide links between local and arterial streets. They provide access to the neighborhood by collecting or distributing traffic between the arterial and local streets. They accommodate medium traffic volumes and speeds.

Local Streets: Local streets provide access to adjacent property and are usually contained within a neighborhood. They carry low traffic volumes and lower speeds.

More Details can be found in the City of Dallas Street Design Manual, located on the Construction Standards tab of the City of Dallas Public Works website and can be found here: https://bit.ly/3rm37TF

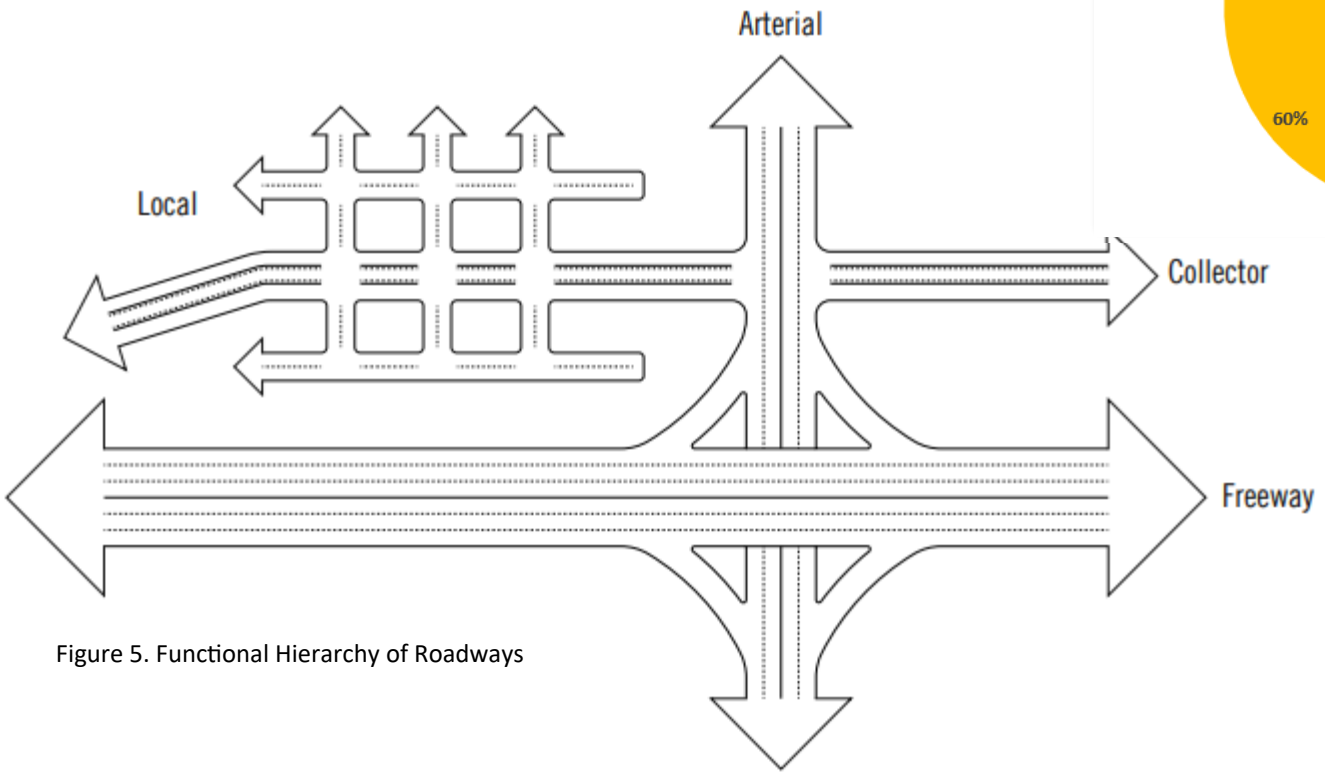
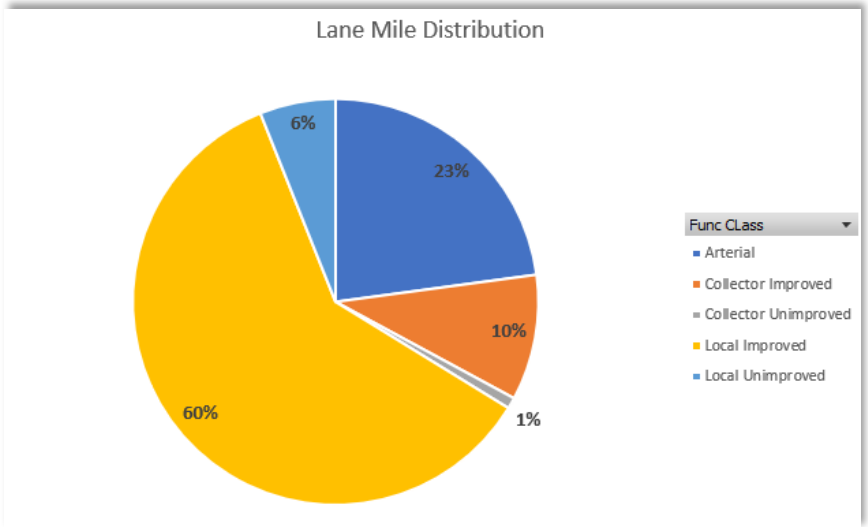


Figure 5. Functional Hierarchy of Roadways



Graph 6. Distribution of Lane miles by Functional Class

Decision Modeling

As mentioned earlier, the Pavement Management division has worked over the past 3 years to identify areas of improvement. One of the biggest changes recently made was changing the paving model and working with an engineering firm specializing in pavement management. This has brought a systematic approach to determining the appropriate application of a treatment to a specific situation or need. The overall goal utilizing the new model s to implement the 3R Repair Strategy Concept:

Right Treatment
Right Place
Right Time

The new model is much more complex and able to handle multiple restraints such as budget, number of lane miles per council district while maximizing the lane miles treated on an annual basis. The models typical decision variables:

- Pavement Type
- Classification
- Traffic Condition Indices

Decision Thresholds

Thresholds are used to define the limits of treatment selection.

As the Pavement Condition Index of a street deteriorates over time, and if not funded, it will fall below a repair treatment threshold, thereby triggering a different type of repair

Thresholds can also include budgets, treatment types and utilization of treatment locations to ensure all council districts get a minimum number of dollars spent or lane miles improved.

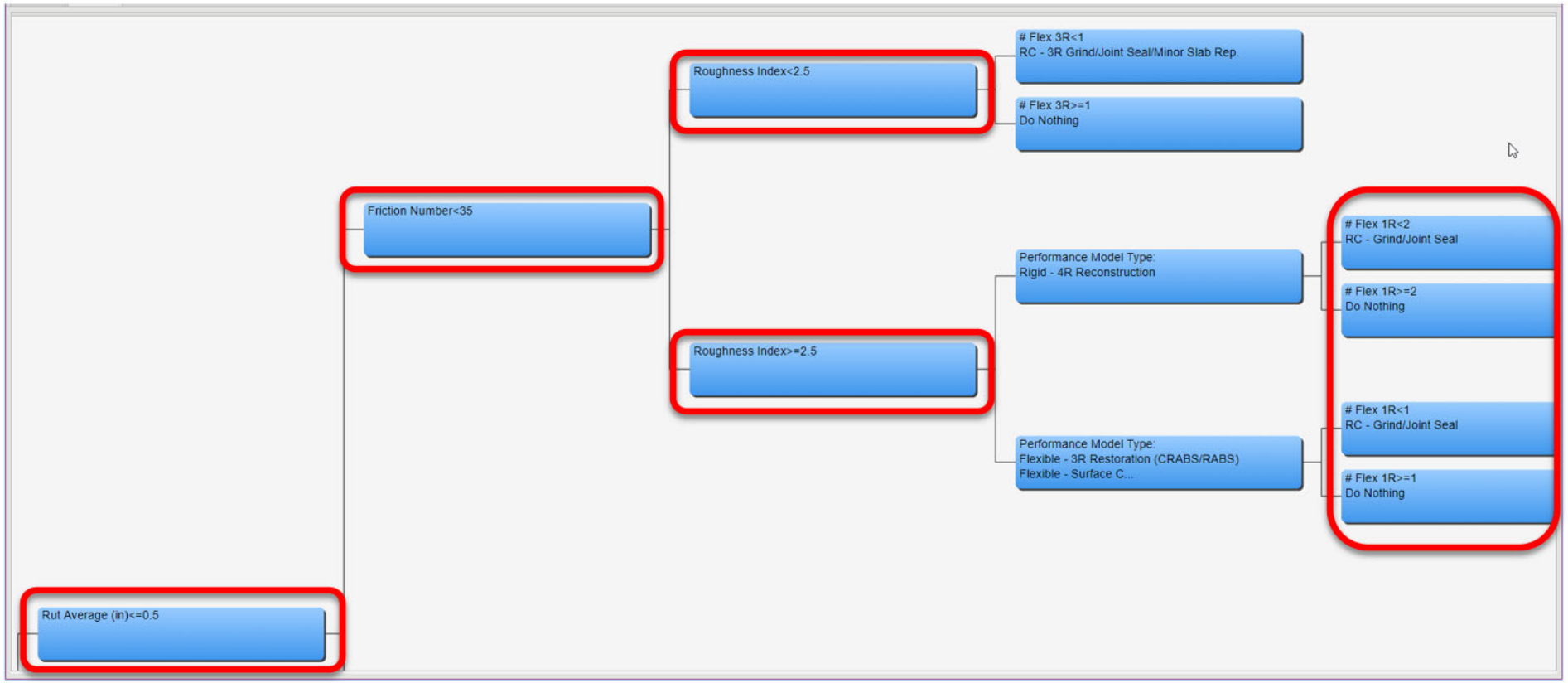


Figure 7. Example of decision matrix used in paving model for treatment selection

Decision Variables

The paving model takes in the following variables and uses them in decision trees to determine the nest recommended treatment.

- Pavement Type – AC, PCC, AOC
- Functional Class – Freeway, Arterial, Major/Minor Collector, Local, Alley
- Improved/Unimproved – Curb/No Curb – Good for determining Milling Needs
- Districts – Maintenance and Council
- Speed Limit – Sometimes used to limit certain treatment uses
- Pavement Width – For improvement of narrow sections
- Age – Preservation timing – Extract from Construction History
- Condition – Cracking, Rutting, Ride, or specific distresses
- Cross-slope – Found in assessment data
- Curb Length – For incorporating into project costs

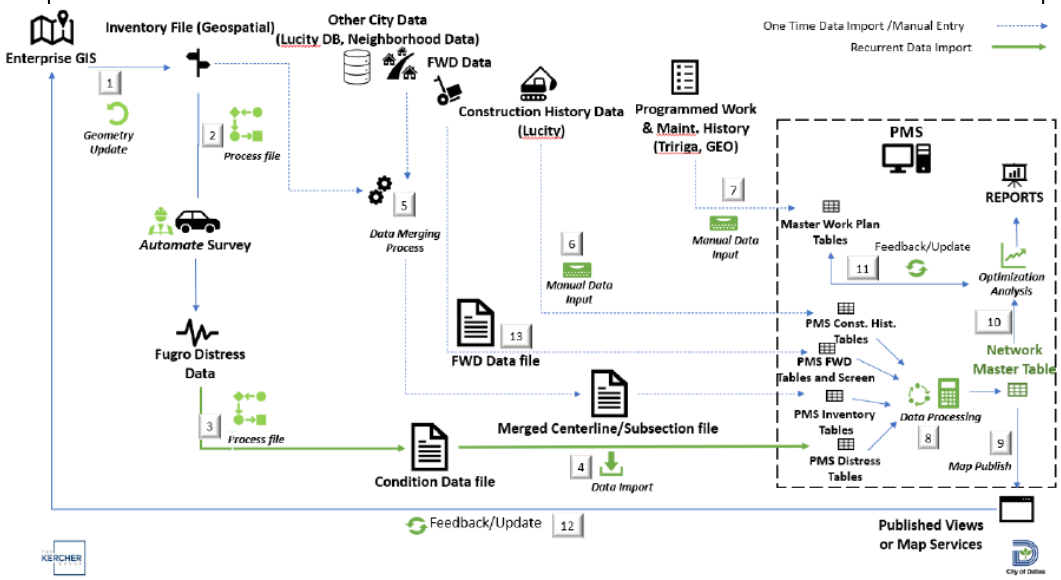


Figure 8.—configuration of new paving model

We are currently working with NCTCOG to incorporate Traffic/Average Annual Daily Traffic (AADT) – High, Medium, and Low Volume – to work into future models.

Deterioration Curves

The city has the roads assessed every 4 years and it is the road assessment that captures the distress data for the streets and establishes the PCI. In the years there are no assessments, the PCI for the roads are adjusted upwards if there was any kind of maintenance work done and adjusted downwards if not. In a typical year, the City improves around 5% of the roadway network, leaving the remaining 95% of the streets to deteriorate. The deterioration that is applied to the remaining street segments are based on deterioration curves. The rate of deterioration is dependedent on the type of street, Concrete or asphalt, the function of the street, local vs arterial, the age of the street and the current condition of the street. Streets typically deteriorate as shown in the figure below. Streets in good condition tend to stay there for a few years then start to fail at a steady slope, before leveling off in a failed condition.

Current deterioration curves are based on historic data and pavement end-of-life assumptions. Over the next few years, we plan on refining these curves based on infield observations. ILLUSTRATION PURPOSES

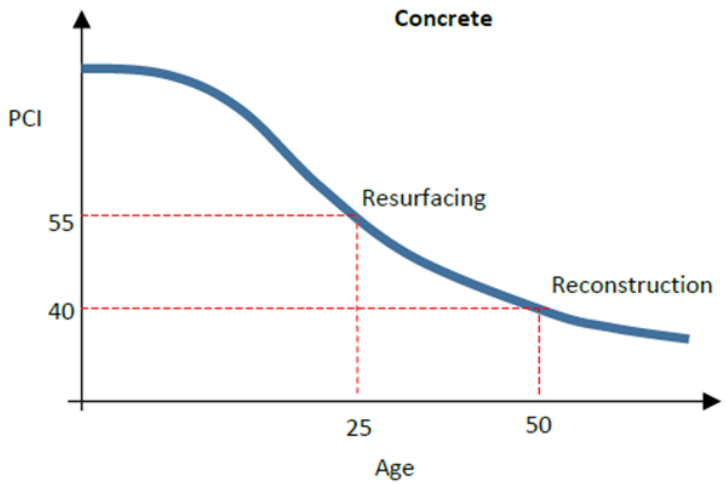


Figure 9. Deterioration Curve for Concrete pavement

PCI Ranges

The Pavement Condition Index ranges from an “A” or Excellent condition to an “E” or failed condition. The “A” - “D” streets all have a 15-point range and the “E” category has a 40-percent range. One of the major changes recently made to the paving model was to evaluate the “E” streets to determine if a repair other than reconstruction could be applied. This also aligned with the results of the inspections from the construction managers. Streets with a high “E” can be resurfaced, saving Dallas money and time.

City of Dallas PCI Ranges		
Rating	**Description**	**PCI Range**
A	Excellent	100-85
B	Good	70-84.9
C	Fair	55-69.9
D	Poor	40-54.9
E	Failed	0-39.9

Figure 10. PCI Range Table

- PCI range examples
  - Asphalt streets

PCI Ranges

- PCI range examples
  - Concrete streets

Treatment Types

The following pages lay out the various treatment utilized by the annual maintenance plan. The annual plan works on approximately 700 lane miles out of the 11,700 lane miles that make up the City of Dallas. The Maintenance plan is broken up into preservation and maintenance work.

Preservation treatments are used on streets that are in excellent or good , “A” an “B” condition. It is a cost effective way for the City to keep the streets in excellent/good streets in that condition for as long as possible. Preventative treatments are Light Slurry, Slurry Seal and Microslurry.

Maintenance Projects are more involved treatments that involve improving the distresses' found, from weather cracking to base repairs. These treatments are also more expensive then preventative repairs and are performed on streets in the “B” - “C” range.

Rehabilitation Projects are the most intensive paving treatments used by the City of Dallas and are reserved for streets in “C”, “C” and high “E” streets.

Types of Street Treatments

Light Slurry

for “A” & “B” Streets

Application Examples

Light Slurry / Onyx— Spray applied high polymer modified (two applications) include crack sealing prior to application. This is a preservation treatment to keep streets in “Good” condition in that condition for as long as possible. City of Dallas will be using a gravity applicator.

Cost: $20.3K per lane-mile. **Life:** 5-7 years.
Typical next Treatment: Slurry Seal.

The city added this treatment type to its maintenance plan in 2021 as a way to increase the ways to preserve streets in “A” condition.

Types of Street Treatments

Microsurfacing or Slurry Seal

for “A” & “B” Streets

5000 Linnet—Slurry Treatment

2900 8th Street—Microsurfacing Treatment

Slurry Seal—This treatment for asphalt streets or concrete streets with asphalt surface consists of a ¼-inch layer of sand and fine stone mixed with asphalt emulsion. This seals and smooths the surface and conceals scars from previous repairs. It is used predominately for residential roads with curb and gutter. The work is outsourced to a specialized contractor – after the City performs preparation work (such as minor base repair and crack sealing)

Cost: $18K per lane-mile. **Life:** 5-7 years.
Typical next Treatment : Additional Slurry Seal, maximum 3 until a heavier treatment is needed.

Microsurfacing—A treatment for asphalt streets or concrete streets with asphalt surface which places a ¼-inch layer of crushed stone mixed with asphalt emulsion. This seals and smooths the surface and conceals scars from previous repairs. It is used predominately for higher-traffic-volume streets with curb and gutter. It is more expensive than slurry seal but cures more quickly. This work is outsourced to a specialized contractor – after the City prepares the site (doing minor base repair and crack sealing, curb & gutter repair).

Cost: $27K per lane-mile. **Life:** 5-7 years.
Typical next Treatment : Additional Microsurfacing, maximum 3 until a heavier treatment is needed.

Types of Street Treatments

Full-Depth Asphalt Repair

for “C” Streets

Full-depth Asphalt Repair - A treatment for asphalt streets to repair the surface and base failures. Repairs are typically larger than a pothole, but smaller than either Street Resurfacing or Street Rehabilitation projects. After the failed area is cut square and removed, a new base is placed and compacted, and an asphalt surface is put in place. The year following this treatment the street is automatically given a slurry or micro-slurry in the next maintenance years program.

Cost: $82.5k per lane miles. **Life:** 5-7 years.
Typical Next Treatment: Additional Full Depth repairs until a Resurfacing is requited.

Types of Street Treatments

Asphalt over Concrete (AOC) —Localized Repair

for “C” and “D” rated Streets

1100 E Brighton—AOC Treatment

AOC—Localized Repair—a Partial Reconstruction with an asphalt cap; not mill and resurface. This is a method used on AOC or concrete streets. It is removal and replacement of large, failed sections, including breakout and removal of old pavement, repair of any base failures, and placing new concrete. The work includes milling off 1/4” of asphalt making the panel and base repairs where needed and capping with a 2” of asphalt. To be a candidate for this repair, residential and thoroughfare streets must have less than 20% of failed area. No Curb and Gutter replacement.

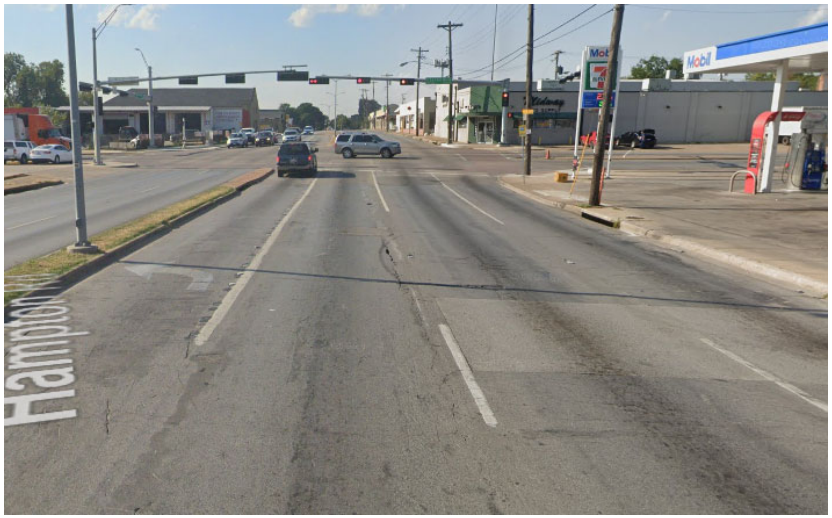
Cost: $110K per lane-mile. **Life:** 10-15 years (with maintenance).

Typical Next Treatment: Additional AOC repairs until a Resurfacing is required.

Types of Street Treatments

Asphalt over Concrete—Global Repair

for “C” and “D” rated Streets



1003 S Hampton—AOC Treatment

AOC - Global Repair Partial Reconstruction with an asphalt cap; not mill and resurface. This is a method used on AOC or concrete streets. It is removal and replacement of large, failed sections, including breakout and removal of old pavement, repair of any base failures, and placing new concrete. To be a candidate for this repair, residential and thoroughfare streets must have greater than 20% of failed area. No Curb and Gutter replacement.

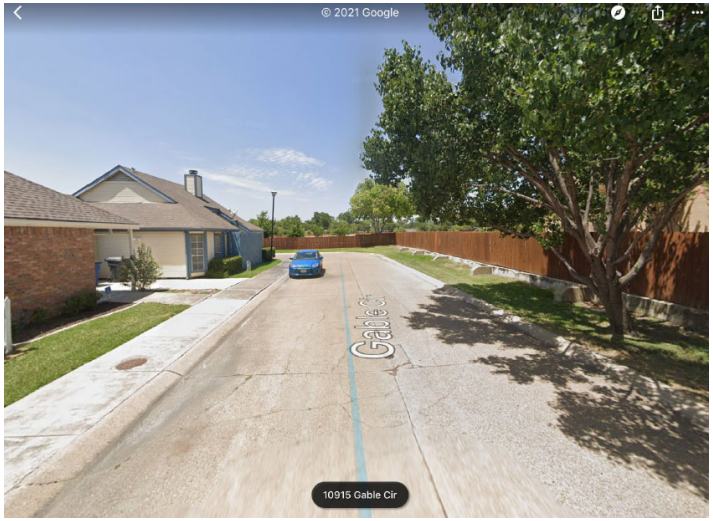
Cost: $231K per lane-mile. **Life:** 10-15 years (with maintenance).

Typical Next Treatment: Additional AOC repairs until a Resurfacing is required.

Types of Street Treatments

Partial Reconstruction (1-25% Panel Replacement)
Enhanced Partial Reconstruction (26-50% Panel Replacement)

for “C” (and some “D” rated) Streets



Partial Reconstruction (1-25% panel Replacement) - This is a method used on CONCRETE STREETS. It is removal and replacement of large, failed sections, including breakout and removal of old pavement, repair of any base failures, and placing new concrete. To be a candidate for this repair, residential and thoroughfare streets must have less than 25% of failed area.

Cost: $173k per lane mile. **Life:** 10-12 years.

Typical Next Treatment: Partial Reconstruction repairs until a Resurfacing is required.

Enhanced Partial Reconstruction (26-50% panel Replacement)- This is a method used on CONCRETE STREETS. It is removal and replacement of large, failed sections, including breakout and removal of old pavement, repair of any base failures, and placing new concrete. To be a candidate for this repair, residential and thoroughfare streets must have between 26-50% of failed area.

Cost: $200k per lane mile, 1-26%. **Life:** 10-12 years.

Typical Next Treatment: Additional Partial Reconstruction repairs until a Resurfacing is required.

Types of Street Treatments

Rehabilitation (Mill /Overlay + 1-15% Patching)
Enhanced Rehabilitation (Mill /Overlay + 16-30% Patching)

for “D” rated Streets

2700 Wright Street

Rehabilitation Mill & Overlay 1-15% Patching- A treatment for asphalt streets when a large portion of the surface and the base have deteriorated to an **unsatisfactory level over less than 15% of the total road area.** It includes the full depth repairs of base failures, followed by a chip seal, and a new two-inch layer of hot mix asphalt over the entire treated segment. Candidate streets are predominately residential asphalt surfaced streets without curb & gutter.

Cost: $205K per lane-mile. **Life:** 10-12 years.
Typical Next Treatment: Restoration

Enhanced Rehabilitation Mill & Overlay 16-30% Patching- A treatment for asphalt streets when a large portion of the surface and the base have deteriorated **to an unsatisfactory level over 16-30% of the total road area**. It includes the full depth repairs of base failures, followed by a chip seal, and a new two-inch layer of hot mix asphalt over the entire treated segment. Candidate streets are predominately residential asphalt surfaced streets without curb & gutter.

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Cost: $250K per lane-mile, 16-30%. **Life:** 10-12 years
Typical Next Treatment: Restoration

Types of Street Treatments

Restoration

for “E” rated Streets

4000 Davilia—Restoration Treatment

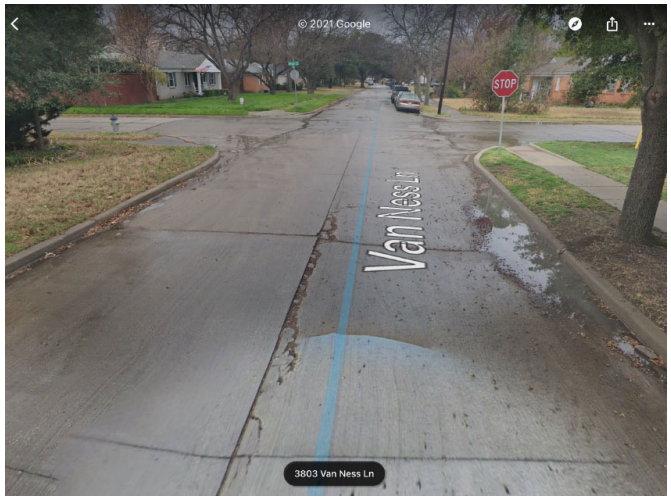
Restoration - A treatment for ASPHALT STREETS when the entire surface and the base have deteriorated to an unsatisfactory level. It includes rebuilding the entire base by recycling the old base and surface materials into a new base, followed by a chip seal, and new two-inch layer of hot mix asphalt placed over the entire treated segment. Candidate streets are predominately residential asphalt surfaced streets without curb and gutter.

Cost: $210K per lane-mile. **Life:** 18-20 years.
Typical Next Treatment: Reconstruction to concrete street per current City of Dallas Guidelines.

Types of Street Treatments

Resurfacing

for “D” rated Streets



Candidate streets are usually in "poor" condition. Resurfacing is done in house or by contract and includes curb and gutter replacement <50% of total curb length.

Asphalt - This treatment removes the entire asphalt surface and pulverizes and recycles the old material with a new asphalt binder. Any place there was alligator cracking or other base failures are observed, the base is fixed and compacted. The new asphalt surface, typically 2-inches, is then placed over the entire surface, compacted and smoothed to a proper finish. Barrier Free Ramp and curb and gutter repair, if needed, is accomplished with the re-surfacing efforts.

AOC - Partial with an asphalt cap; not mill and resurface. This is a method used on AOC or concrete streets. This treatment removes the entire asphalt surface and removes and replaces large, failed base and sub-base sections, including breakout and removal of old pavement, repair of any base failures, and placing new concrete. To be a candidate for this repair, residential and thoroughfare streets must have less than 25% - 50% of failed area. Barrier free ramps, curb and gutter replacement is also included in this repair method as needed.

Concrete - Removal and replacement of failed concrete panels of concrete panels, as described in "Partial Reconstruction" up to 50% of the street panels. Barrier free ramps, curb and gutter replacement is also included in this repair method as needed.

Cost: $325K per lane-mile. **Life:** 20-25 years (with maintenance).

Typical Next Treatment: Reconstruction to concrete street per current City of Dallas Guidelines.

Types of Street Treatments

Resurfacing +

for “D” and high “E” rated Streets

8th Street between Madison & Zang

Resurfacing + - Candidate streets are usually in "poor" to “failed” condition. Resurfacing is done in house or by contract and includes curb and gutter replacement greater than 50% total curb length. Sidewalks, Barrier free ramps, curb and gutter replacement is also included in this repair method as needed,

Asphalt - This treatment removes the entire asphalt surface and pulverizes and recycles the old material with a new asphalt binder. Any place there was alligator cracking or other base failures are observed, the base is fixed and compacted. The new asphalt surface, typically 2-inches, is then placed over the entire surface, compacted and smoothed to a proper finish.

AOC - Partial with an asphalt cap, not a mill and resurface. This is a method used on AOC or concrete streets. This treatment removes the entire asphalt surface and removes and replaces large, failed base and sub-base sections, including breakout and removal of old pavement, repair of any base failures, and placing new concrete. To be a candidate for this repair, residential and thoroughfare streets must have less than 25% - 50% of failed area.

Concrete - Removal and replacement of failed concrete panels of concrete panels, as described in "Partial Reconstruction" 50%-70% of the street panels.

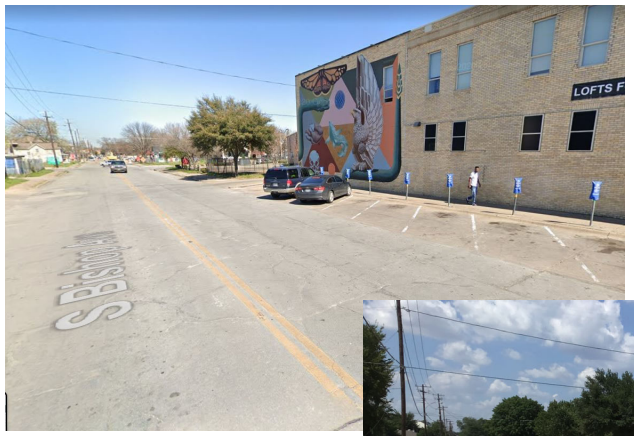
Cost: $410K per lane-mile. **Life:** 20-25 years (with maintenance).
Typical Next Treatment: Reconstruction to concrete street per current City of Dallas Guidelines.

Types of Street Treatments

Reconstruction

for “E” rated Streets

2012 Bond Program—Hendricks Street from Denley to Moore



Restoration - This process is the removal of an existing street with extensive failures and/or badly deteriorated condition. In the process, the pavement is broken and removed (and often recycled), as is the base. Drainage concerns are addressed with this process and drainage systems including pipes, upgraded based on current design standard. The sub-base may be reconditioned as needed, then a new base is placed and compacted. The new concrete surface pavement is then placed, as shown above. Treatment includes widening the roadway to minimum standard width.

Reconstruction streets are funded through bond initiatives.

Cost: $1.5-$2.0M per lane-mile. **Life:** 30 years.

Lane Mile Costs of Asphalt and concrete roadway sections

Estimates shown based on Fy 21 treatment costs and take into account the treatment types that would occur on the roadway assuming a fully funded program. Repair types may be delayed or deferred due to budget constraints.

Asphalt

Evaluate for:	Year	Cost
Initial Conctruction	0	
Warranty	<1	$0
crack seal	2	$12,000
Light Slurry	4-5	$16,300
Slurry Seal	5-7	$18,730
Slurry Seal	10	$18,730
Slurry/full depth repairs	15	$82,500
Mill and overlay	20	$400,000
		$548,260
	Average Cost per year	
		$27,413

Concrete

Evaluate for:	Year	Cost
Initial Conctruction	0	
Warranty	<1	$0
Partial Reconstruction	15	$156,200
Enhanced Partial	20	$186,000
Recon	30	$ 1,500,000.00
		$1,842,200
	Average Cost per year	
		$61,407

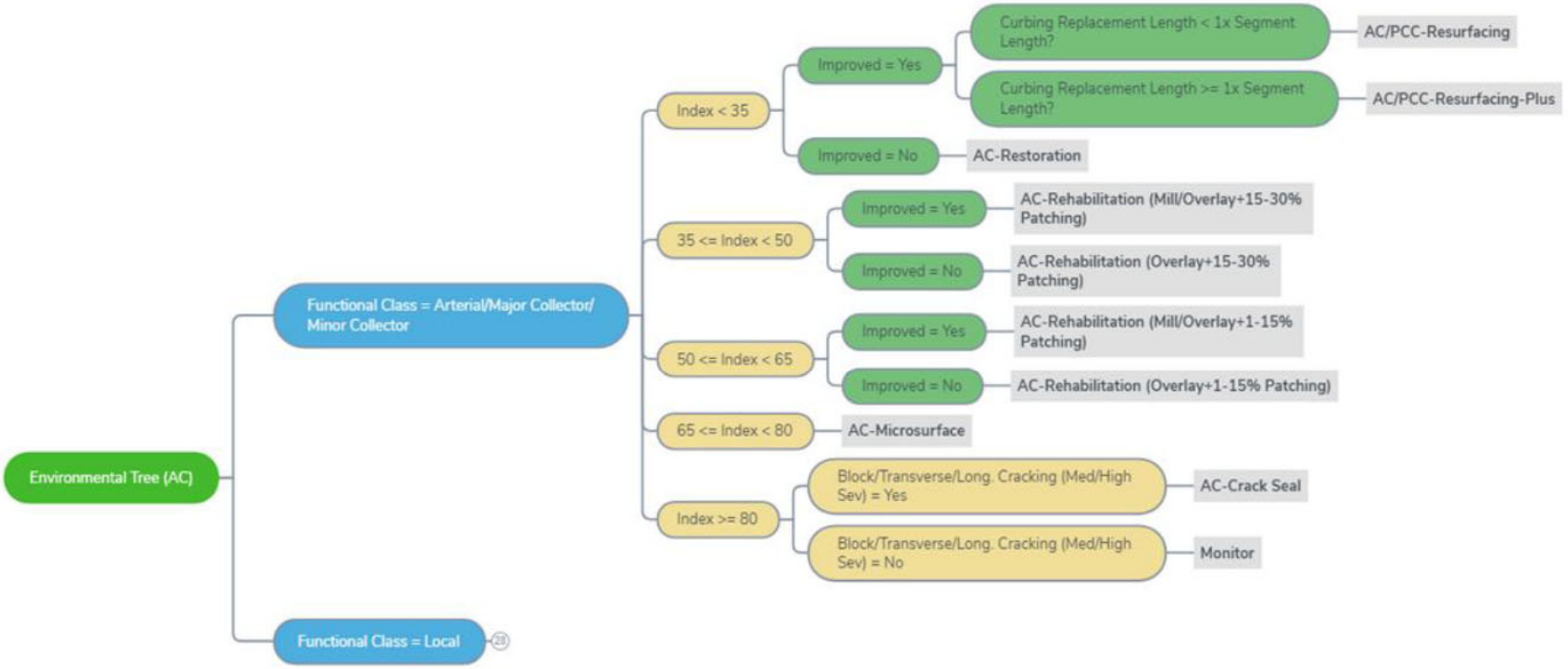
Appendix—A

Decision Trees

The following charts are utilized by the paving model to determine the next recommended treatment. A street can have several decision trees applied to it with multiple treatments recommended. A tree for in-house Vs contract work, or environmental vs structural distressed. The treatment selected will be the tree with the most intensive recommendation.

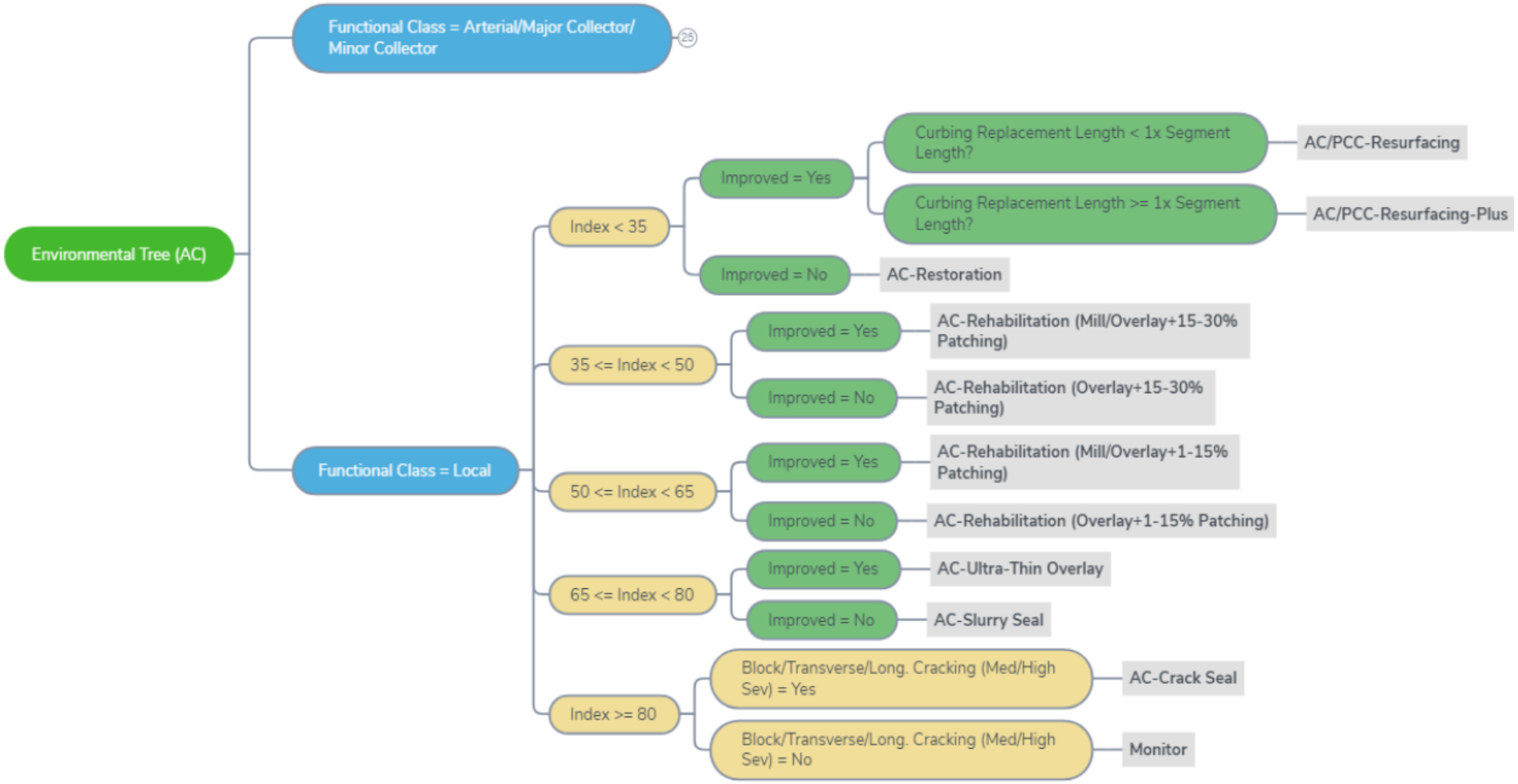
Decision Trees Utilized

Figure 10: Decision Tree- AC Environmental-Contract- Major Roads



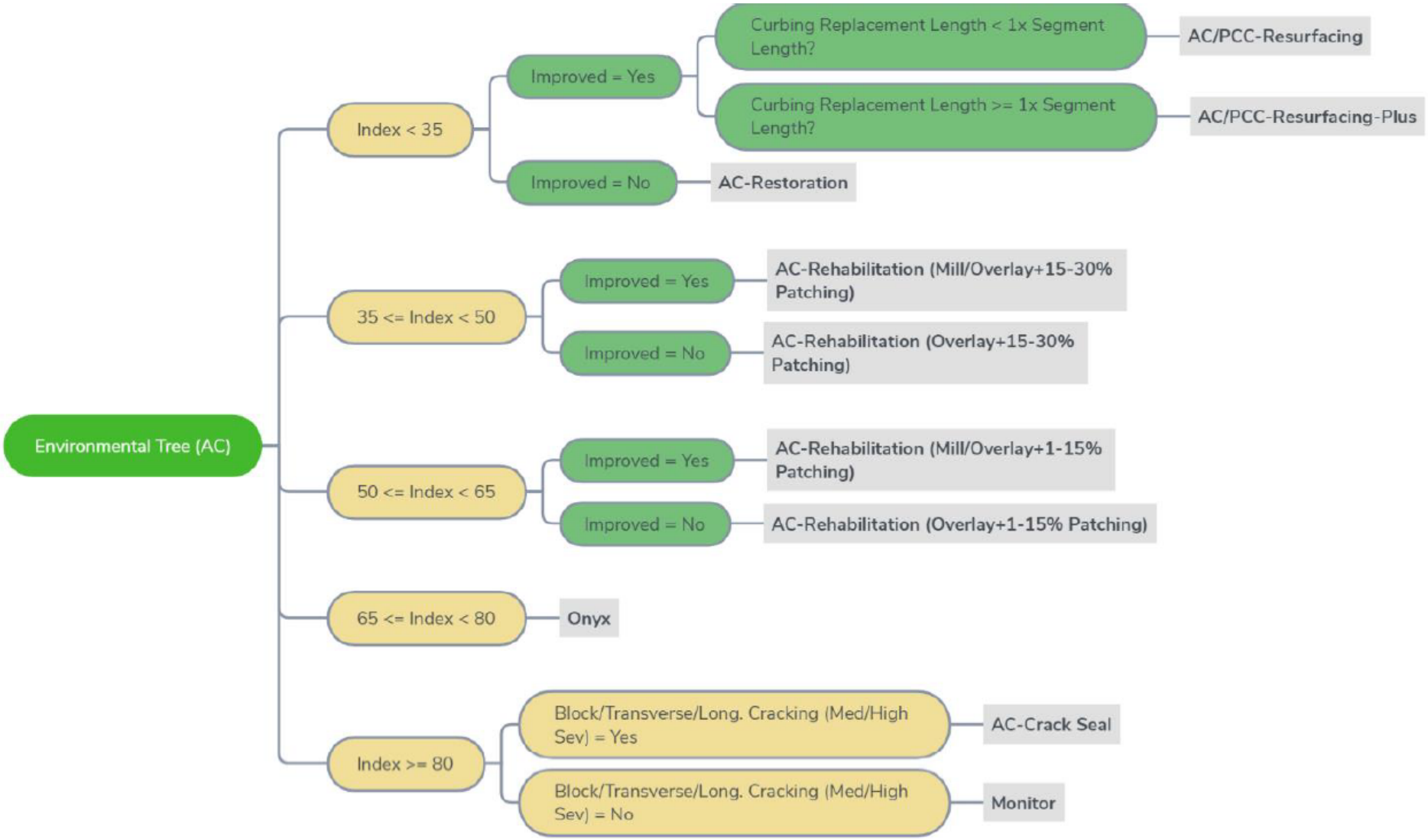
Decision Trees Utilized

Figure 11: Decision Tree- AC Environmental-Contract- Local Roads



Decision Trees Utilized

Figure 12: Decision Tree- AC Environmental- In-House



Decision Trees Utilized

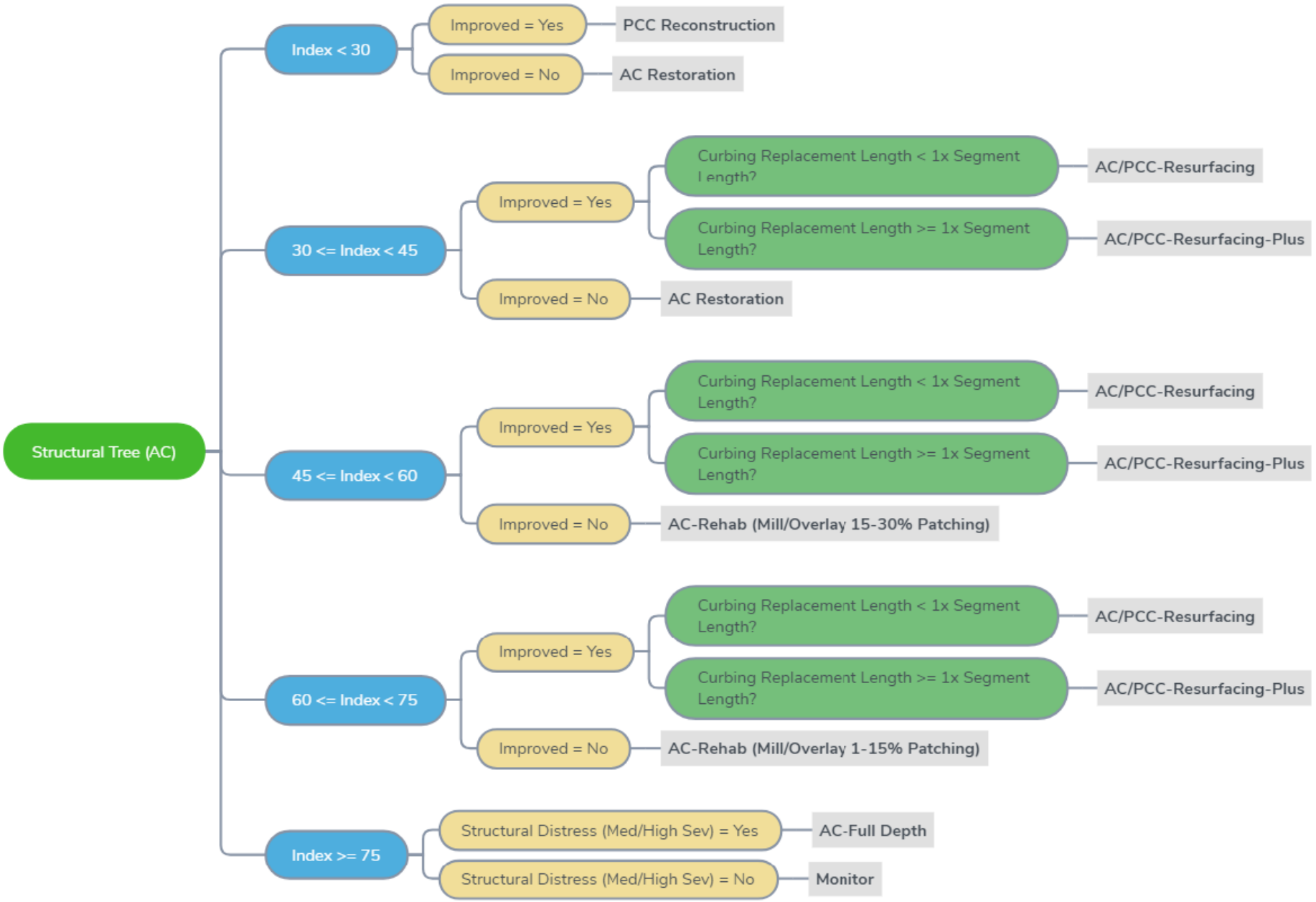
Figure 13: Decision Tree- AC Functional-Contract RI<75

Decision Trees Utilized

Figure 14: Decision Tree- AC Functional-Contract RI>75

Decision Trees Utilized

Figure 15:Decision Tree- AC Structural- Contract

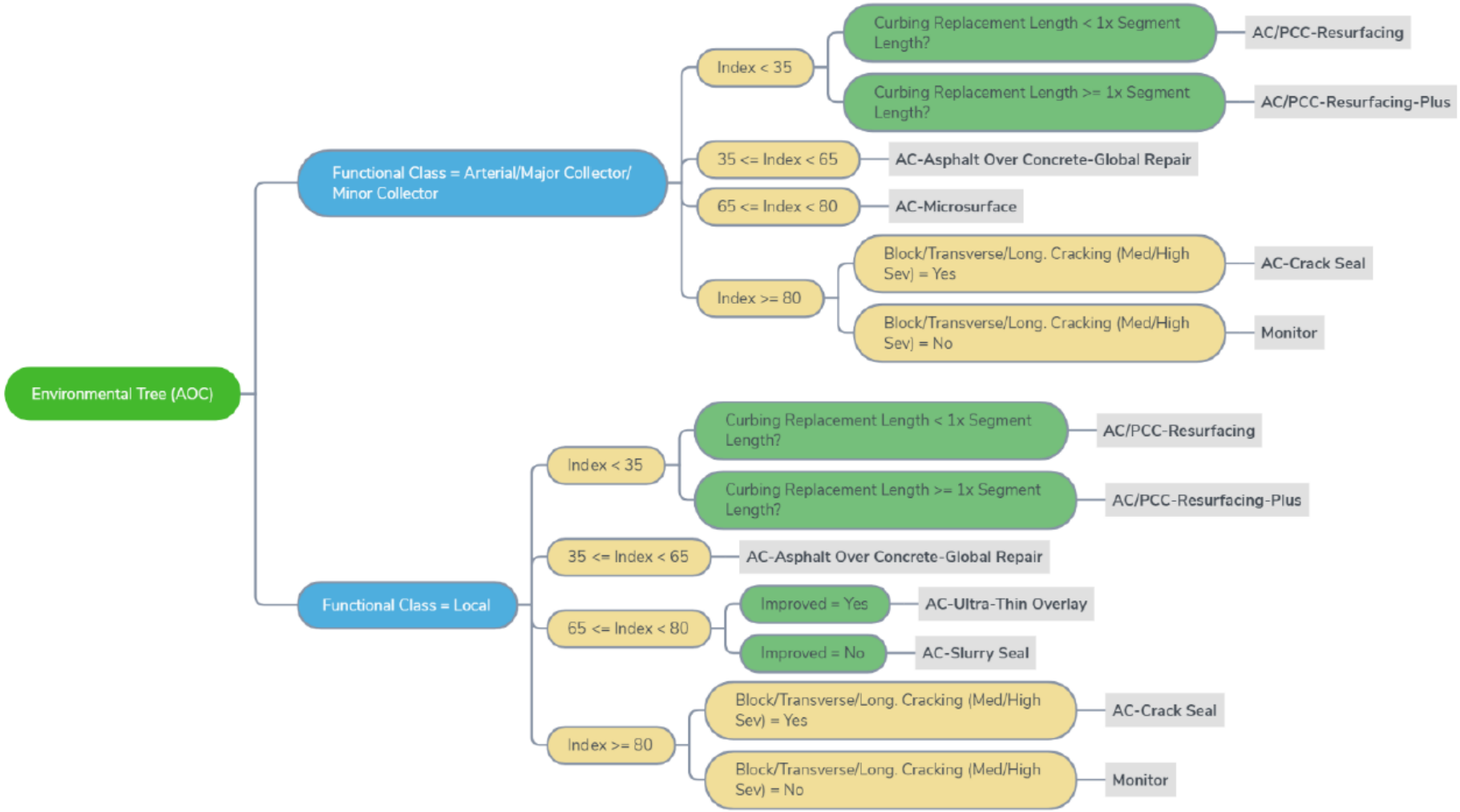


Decision Trees Utilized

Figure 16: Decision Tree- AC Structural- In-House

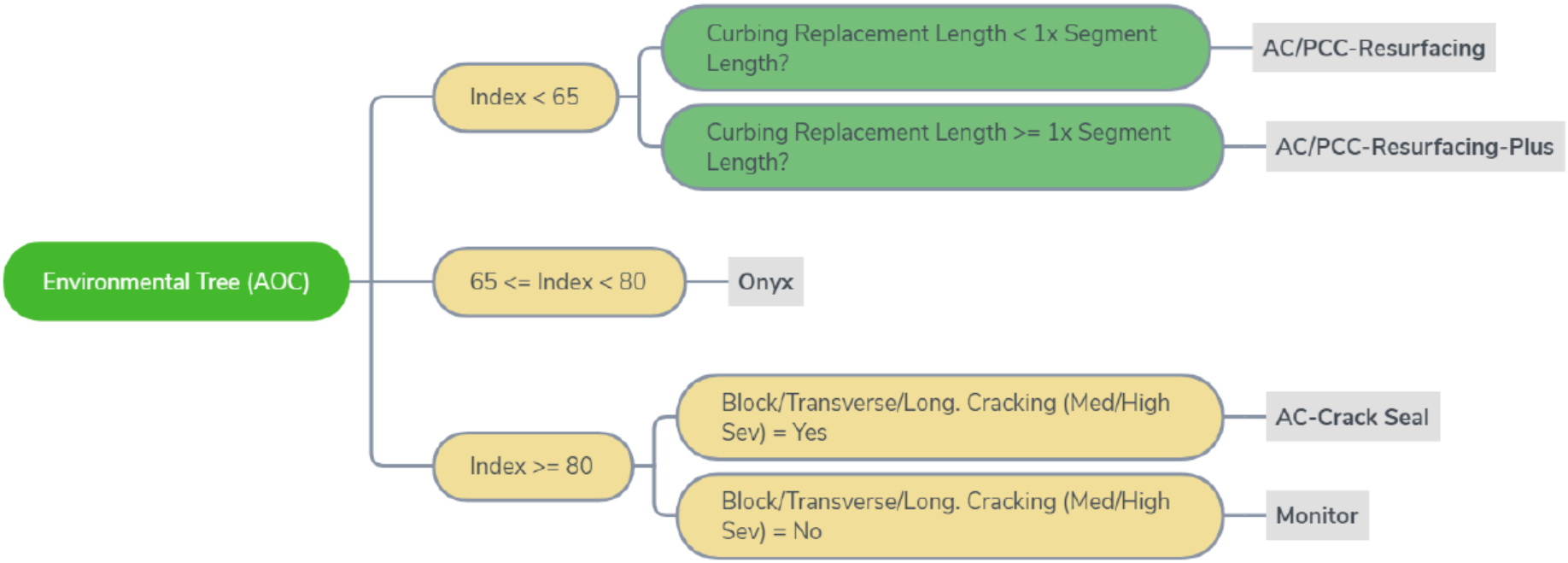
Decision Trees Utilized

Figure 17: Decision Tree- AOC Environmental-Contract



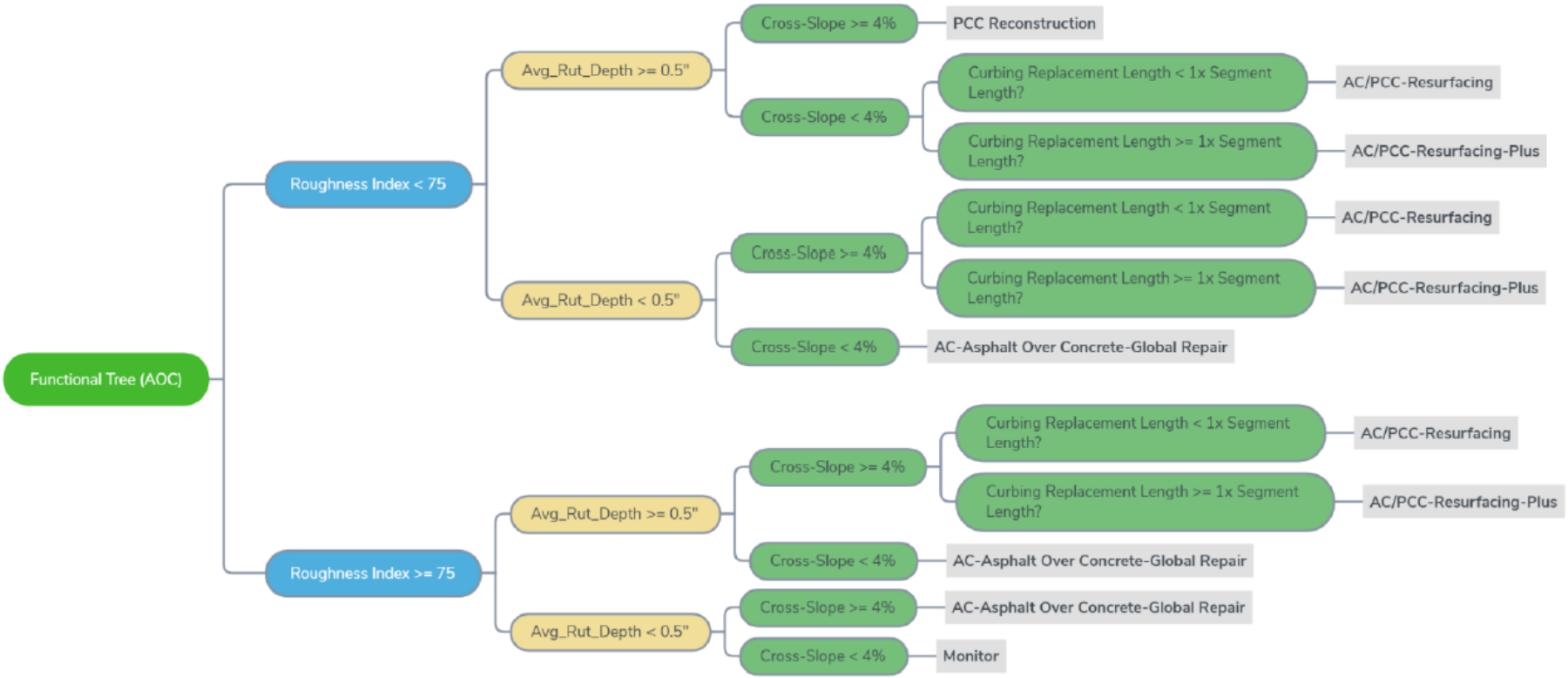
Decision Trees Utilized

Figure 18: Decision Tree- AOC Environmental-In-House



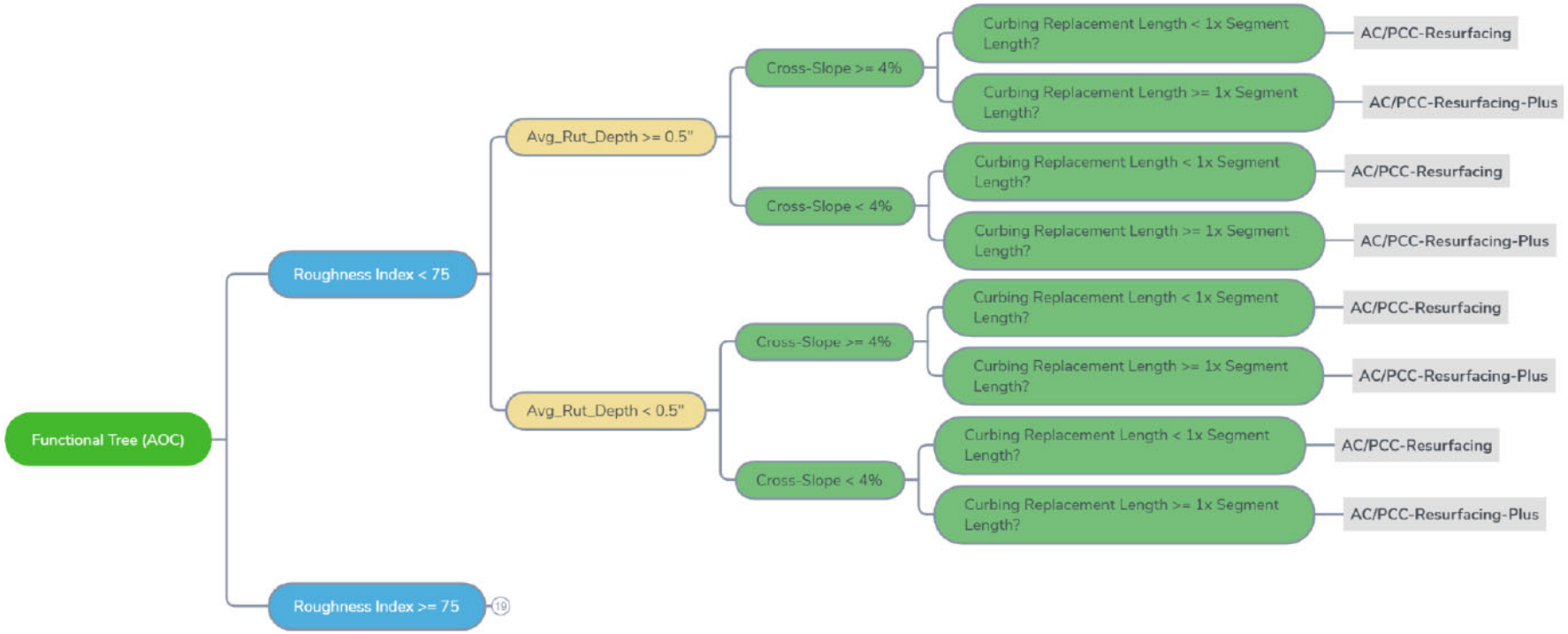
Decision Trees Utilized

Figure 19: Decision Tree- AOC Functional-Contract



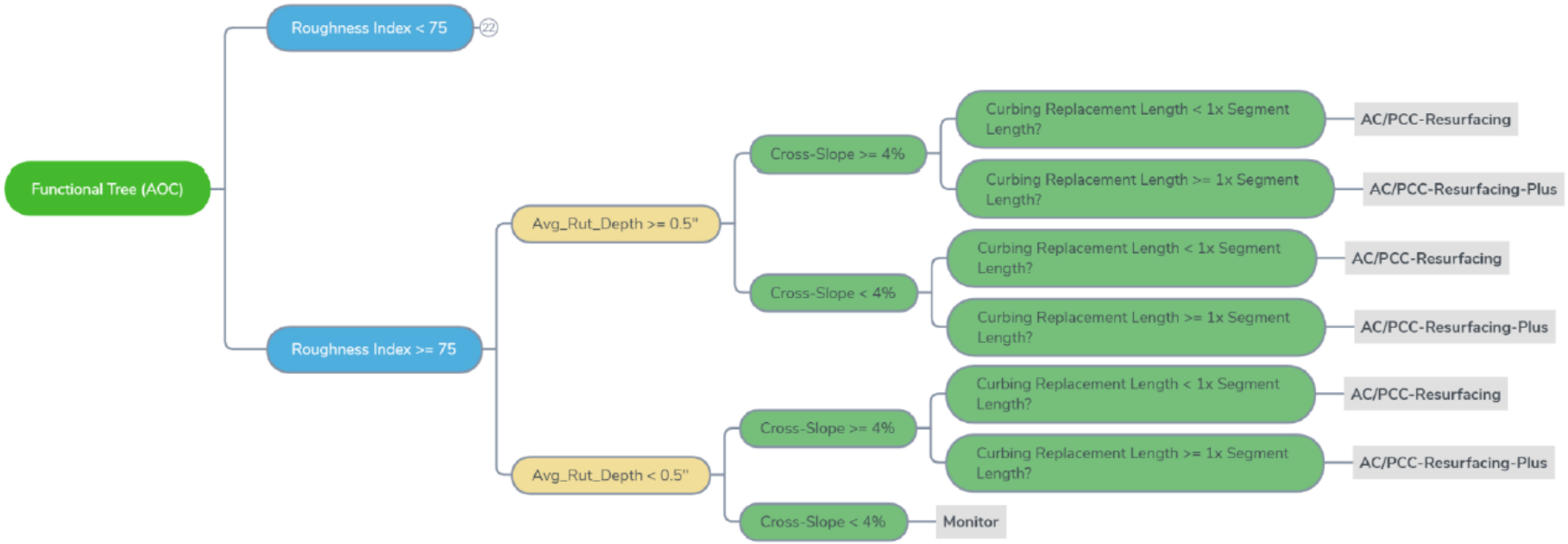
Decision Trees Utilized

Figure 20: Decision Tree- AOC Functional-In-House-RI<75



Decision Trees Utilized

Figure 21: Decision Tree- AOC Functional-In-House-RI>75



Decision Trees Utilized

Figure 23:Decision Tree- AOC Structural- In-House tree

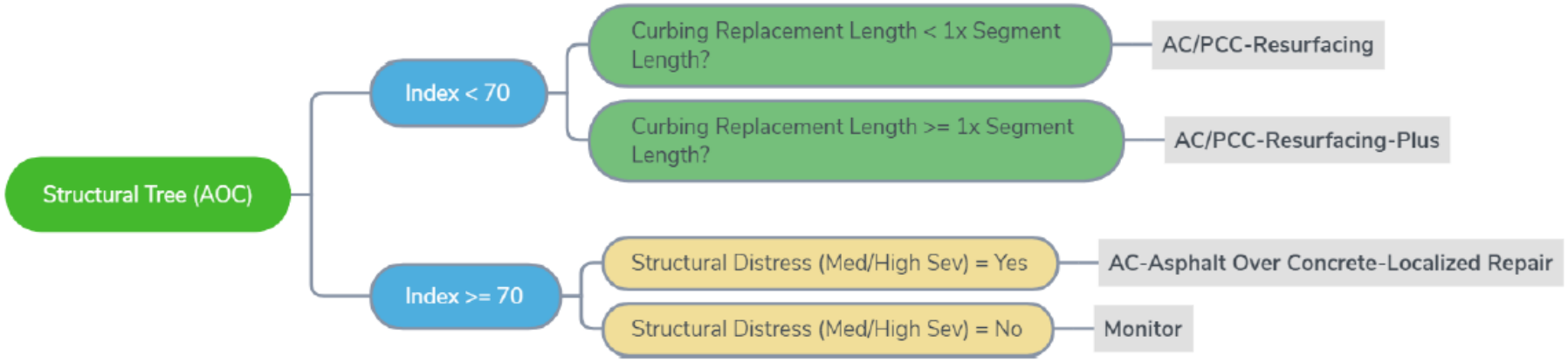
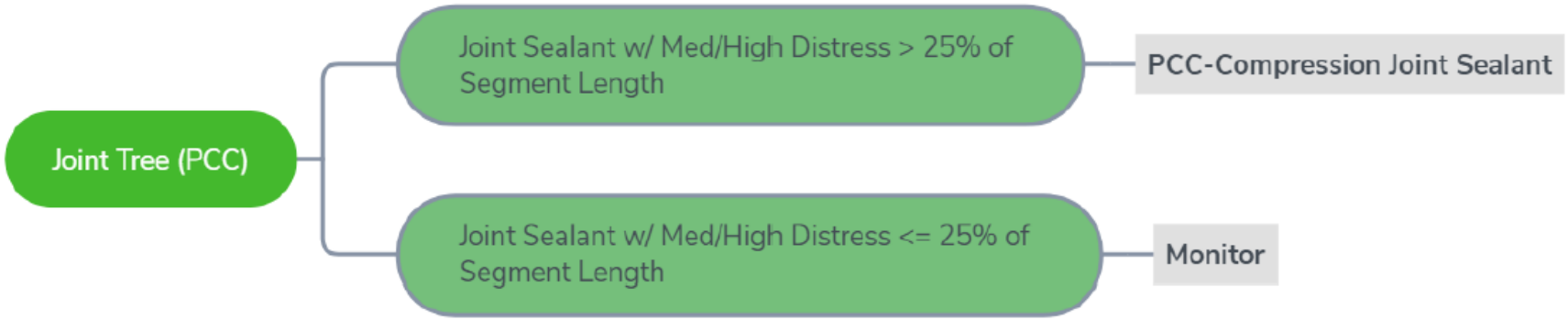
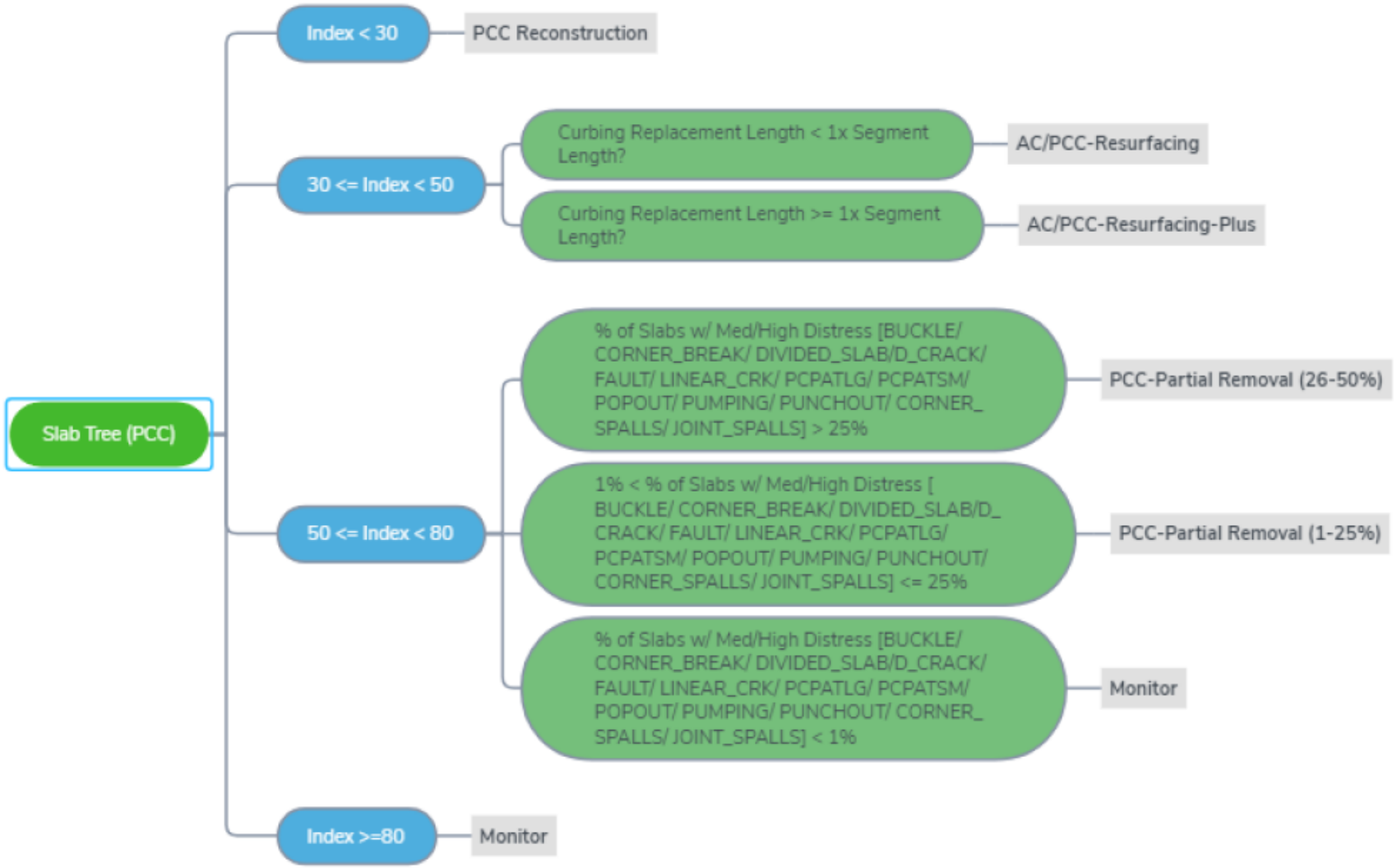


Figure 24:Decision Tree-PCC Joint-Contract



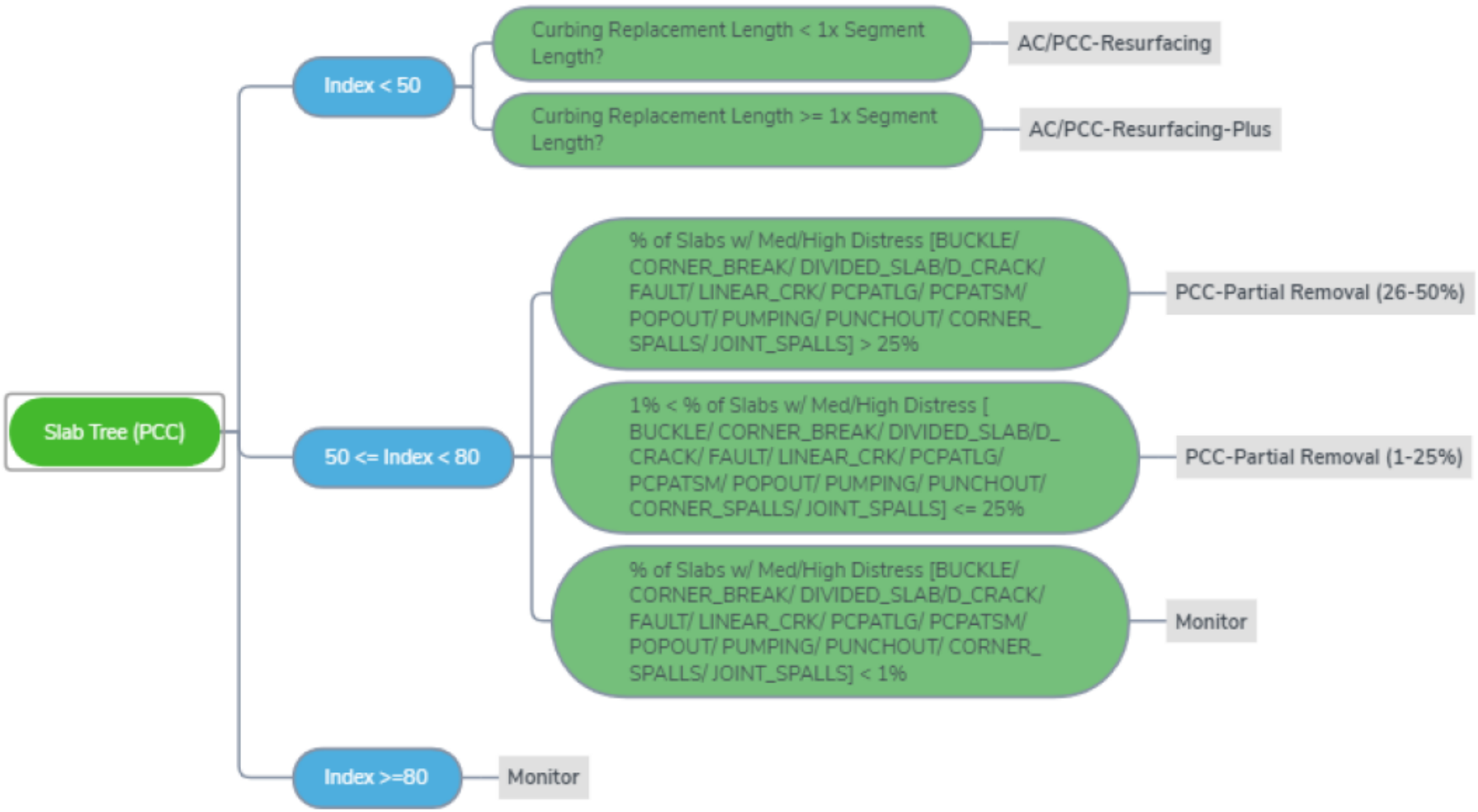
Decision Trees Utilized

Figure 25: Decision Tree-PCC Slab-Contract



Decision Trees Utilized

Figure 26: Decision Tree-PCC Slab- In-House



Decision Trees Utilized

Figure 27: Decision Tree- Age-Contract-AC

Decision Trees Utilized

Figure 28: Decision Tree- Age- In-House