



Pavement Marking Life Cycle Cost Analysis

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Overview

- NC pavement markings include paint, thermoplastic, cold applied plastic, and polyurea. Cold applied plastic is only used in select locations.
- This cost analysis was coordinated by the NCDOT Signing & Delineation Unit using NCSU research.
- NCDOT maintains approximately 79,000 miles of roadway with almost 70% of that being two-lane two-way routes. These routes are usually painted.
- These results can be used to assist in the selection of pavement marking materials for roadways based on AADT and needed service life.
- The basis for this pavement marking life cycle analysis is the retroreflectivity of the material which is measured in mcd/lux/m².



Data Acquisition

- Retroreflectivity readings were taken on 350 route segments. Of these segments 21 were striped with paint, 197 with polyurea, and 132 with extruded thermoplastic.
- These readings were taken annually from the initial installation of the markings until the markings were replaced or otherwise removed.
- NCSU used this data in its *Pavement Marking Performance Analysis* research to provide degradation models for paint and thermoplastic.
- Data for spray thermoplastic was gathered by taking handheld retroreflectometer readings on 17 routes in Wake, Forsyth, and Davidson Counties.
- Polyurea life was derived based on the above readings and historical performance.

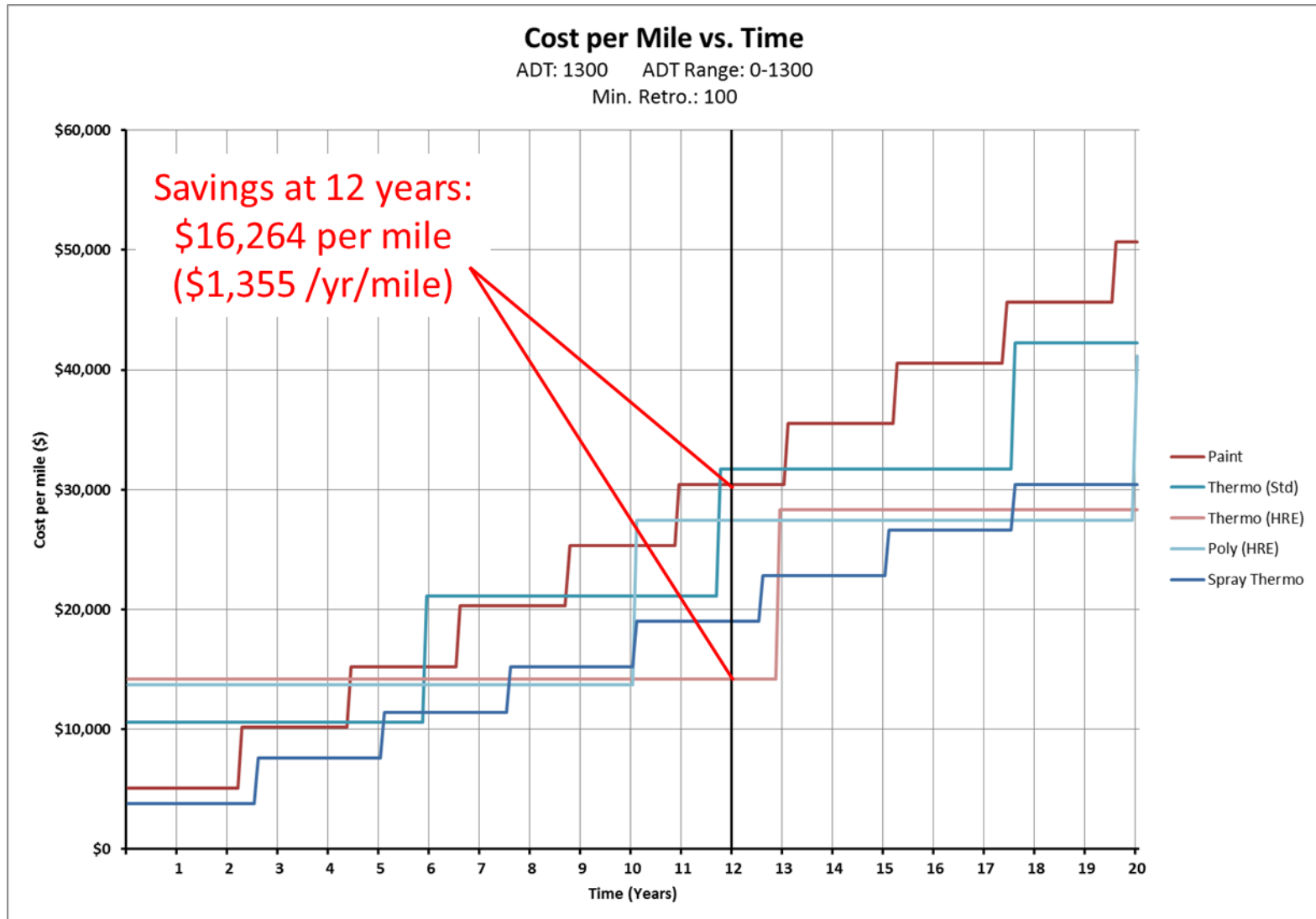
Assumptions

- The replacement retroreflectivity value used was 100 mcd/lux/m².
- This value is based on information from AASHTO, MUTCD subcommittee, and a Paul Carlson (TTI) study.
- In moderate to heavily snowplowed areas it was assumed that paint would last 1 year and polyurea life would be reduced by 3 years.
- Yellow center and white skip lines wear quickest due to color and location in roadway.

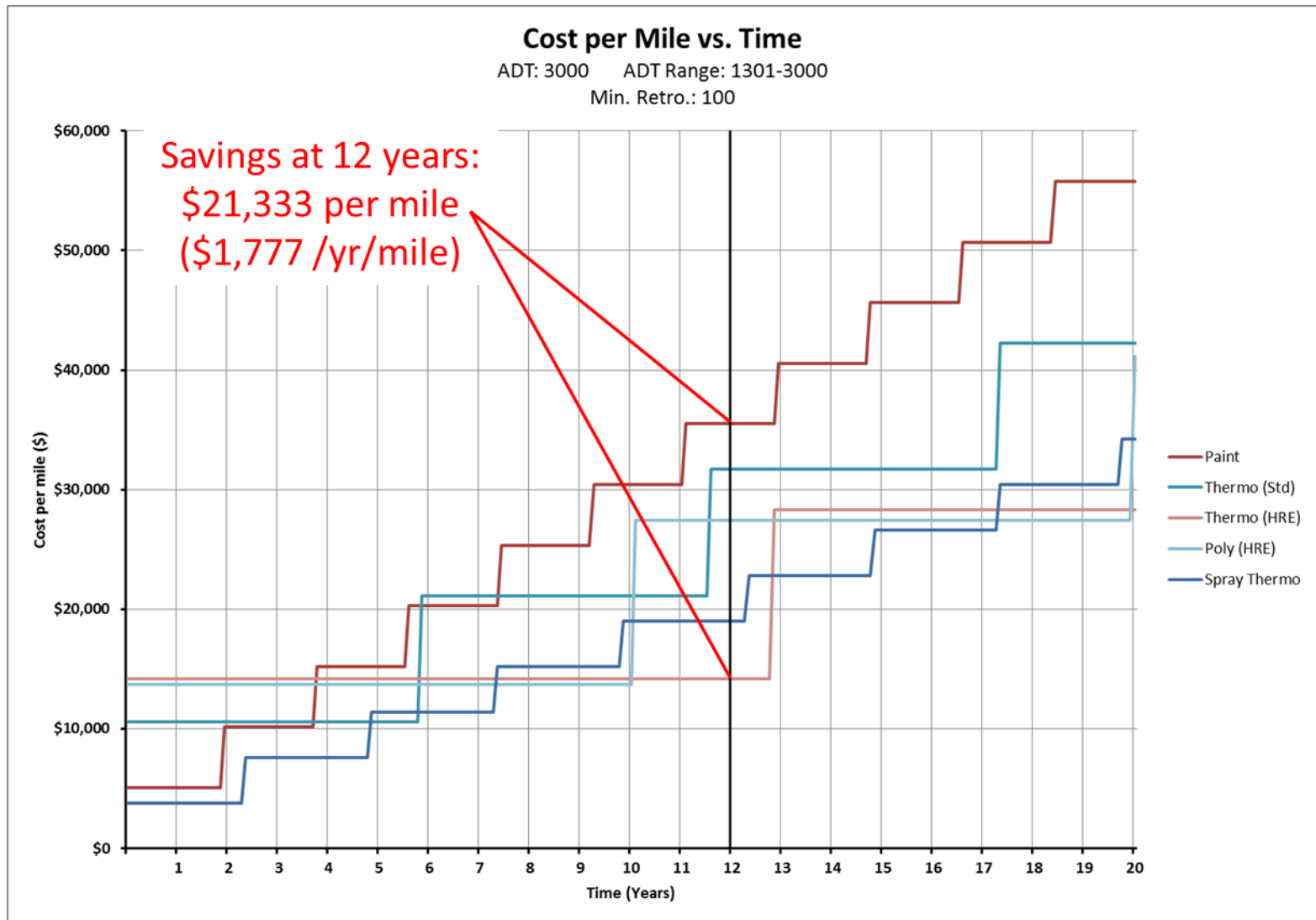
Chart Explanation

- Charts 1-4 show cost per mile on a 2 lane road for five different materials at four different AADT ranges based on time.
- Charts 5 shows cost per mile on a 2 lane road with moderate to heavy snowplowing for two different materials at an AADT range from 0-10000 based on time. Paint and Polyurea lives are 1 and 7 years respectively in these conditions.
- Materials shown:
 - Paint with Standard Beads
 - Extruded Thermoplastic with Standard Beads
 - Extruded Thermoplastic with Highly Reflective Elements
 - Polyurea with Highly Reflective Elements
 - Hot Spray Thermoplastic with Standard Beads

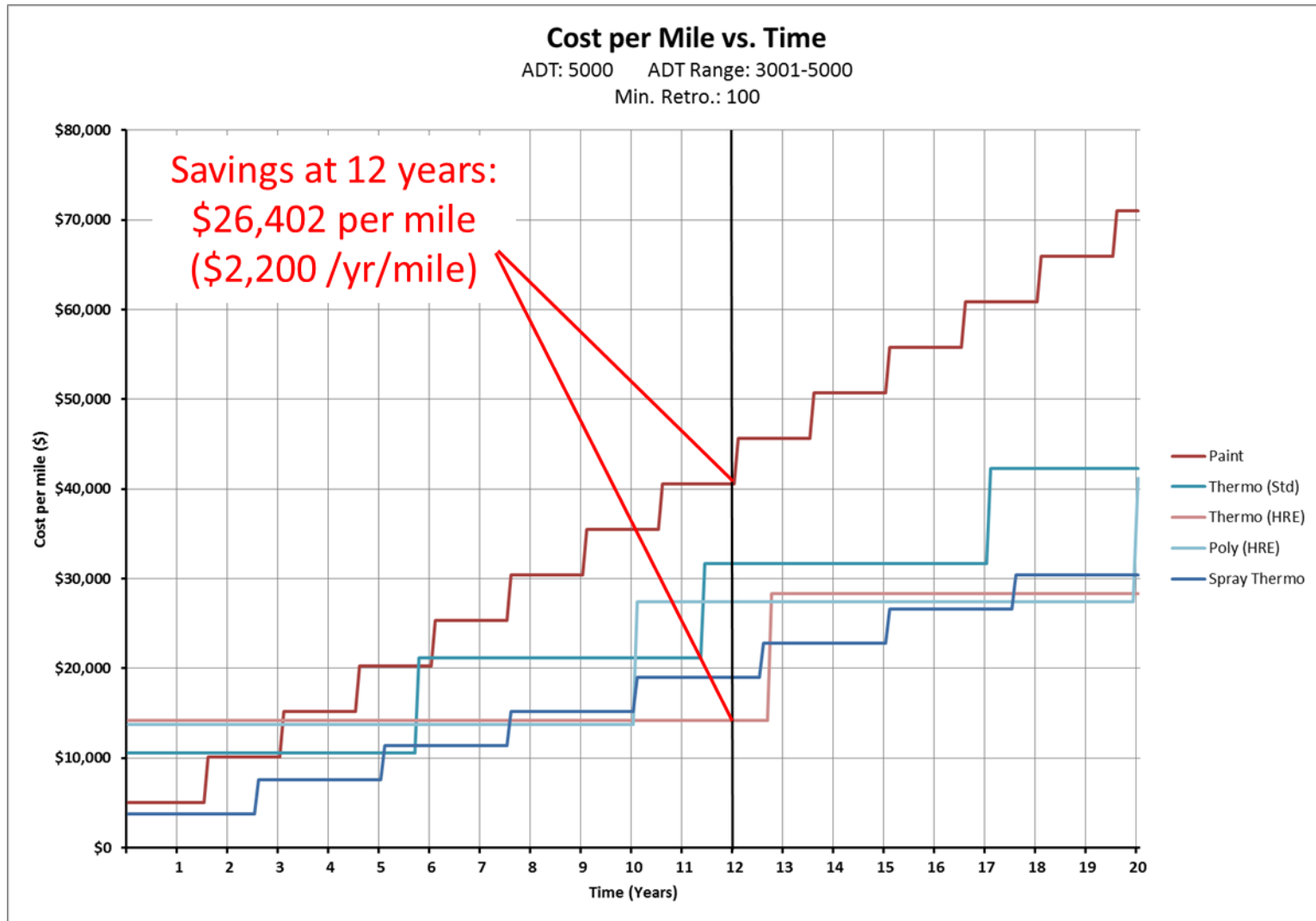
Results



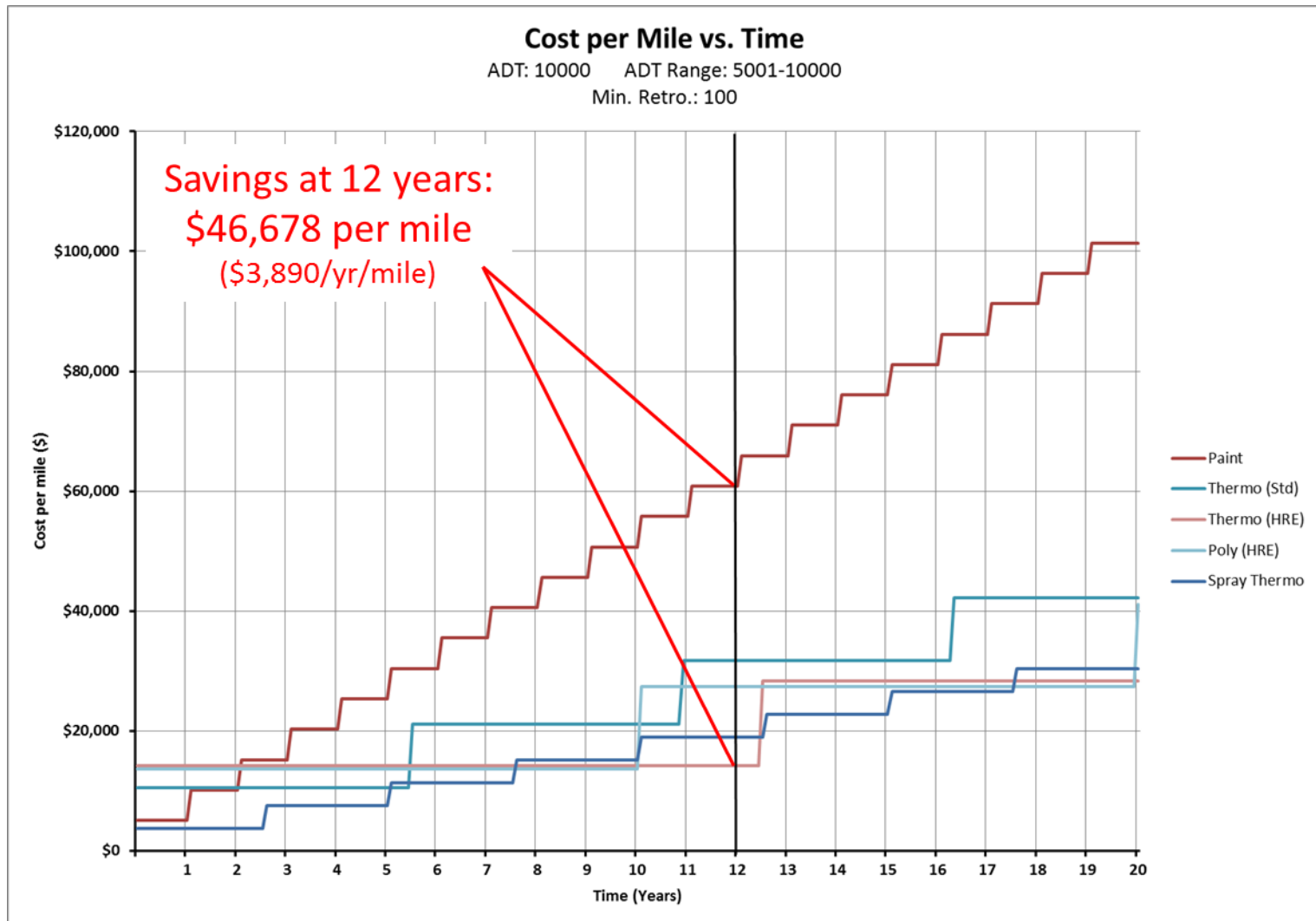
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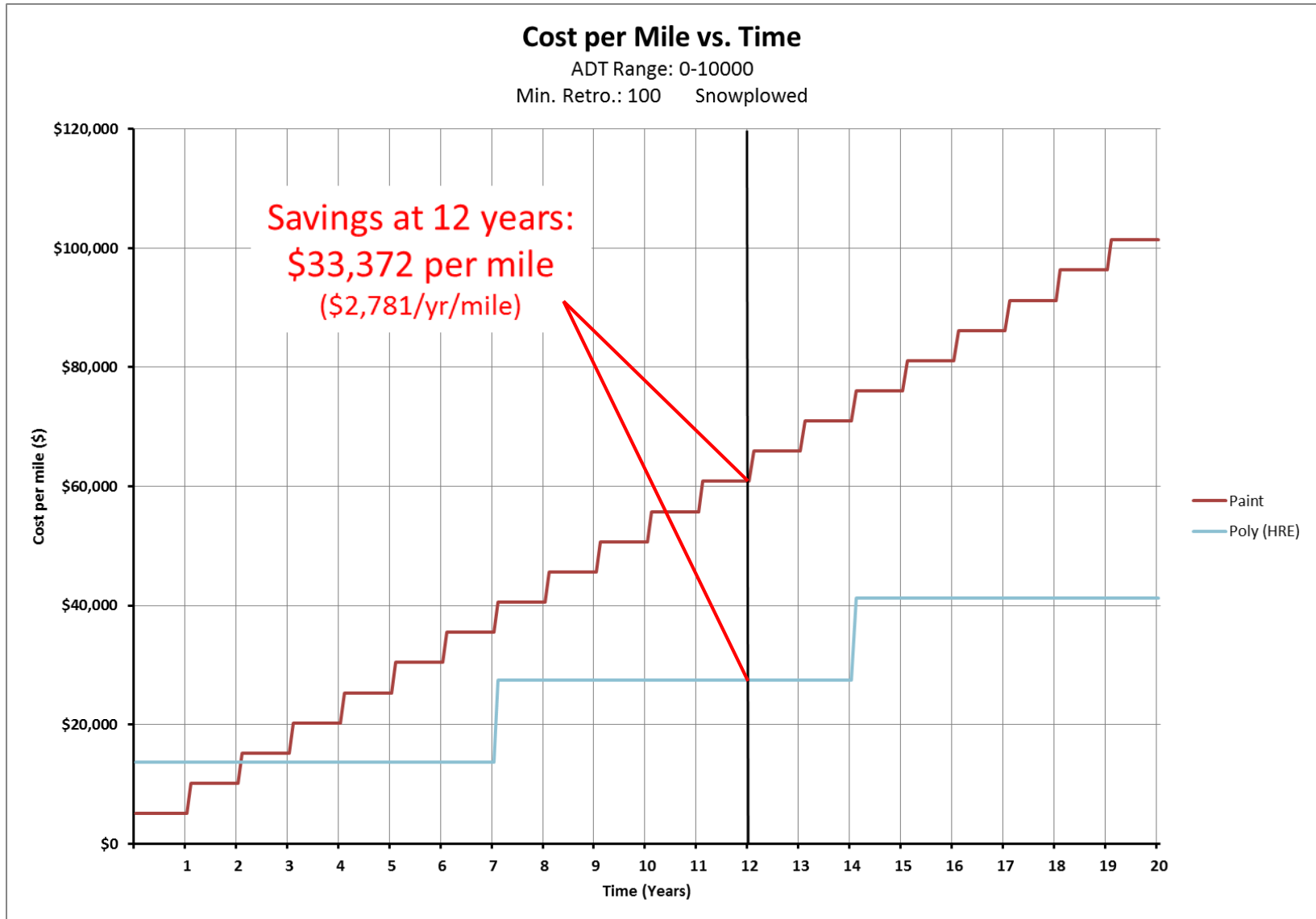
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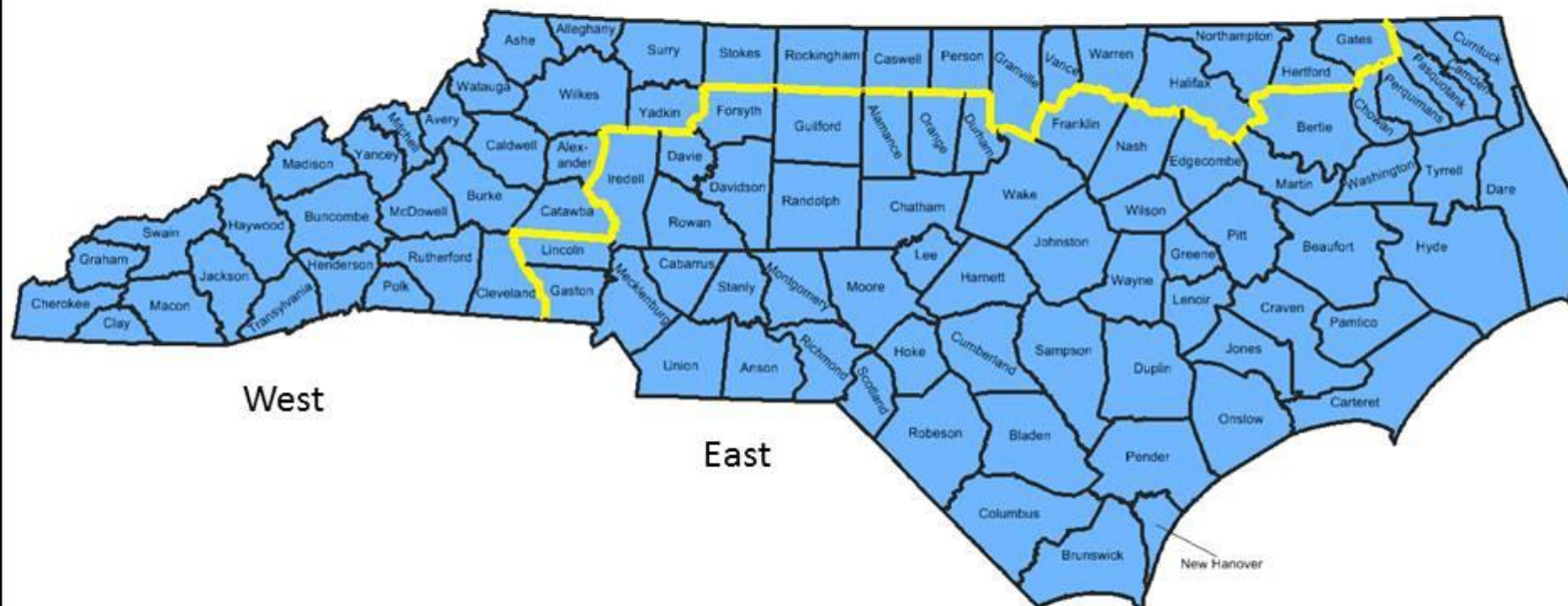
Results



Results

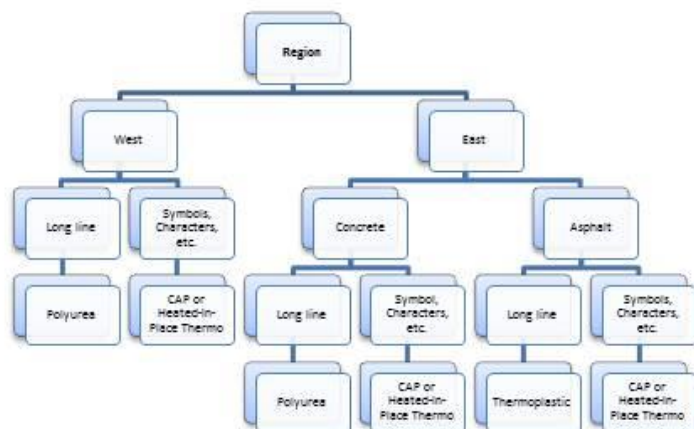


Pavement Marking Material Selection



West

East



Notes:

-All bike lane markings should be heated-in-place thermoplastic

Summary of Analysis

Savings per Year Using Long-Life Markings					
Division	ADT Range				Total
	0-1300	1301-3000	3001-5000	5001-10000	
Division 1	\$476,000	\$176,000	\$139,000	\$183,000	\$974,000
Division 2	\$122,000	\$50,000	\$42,000	\$78,000	\$292,000
Division 3	\$508,000	\$243,000	\$174,000	\$331,000	\$1,256,000
Division 4	\$89,000	\$44,000	\$31,000	\$43,000	\$207,000
Division 5	\$256,000	\$140,000	\$123,000	\$276,000	\$795,000
Division 6	\$474,000	\$233,000	\$174,000	\$292,000	\$1,173,000
Division 7	\$423,000	\$309,000	\$251,000	\$486,000	\$1,469,000
Division 8	\$778,000	\$313,000	\$196,000	\$408,000	\$1,695,000
Division 9	\$65,000	\$44,000	\$35,000	\$70,000	\$214,000
Division 10	\$211,000	\$87,000	\$64,000	\$202,000	\$564,000
Division 11	\$1,071,000	\$467,000	\$259,000	\$295,000	\$2,092,000
Division 12	\$684,000	\$339,000	\$253,000	\$303,000	\$1,579,000
Division 13	\$1,021,000	\$417,000	\$192,000	\$261,000	\$1,891,000
Division 14	\$954,000	\$264,000	\$189,000	\$222,000	\$1,629,000
Total	\$7,132,000	\$3,126,000	\$2,122,000	\$3,450,000	\$15,830,000

Notes:

- Total mileage marked from statewide 2014 data.
- Estimated mileage marked in each Division is based on average percent of 4" paint marking from the past 5 years.
- Estimated mileage marked in each ADT range is a weighted percentage of each Division's total mileage in that range.
- Division 11 – 14 have moderate to heavy snowplowing

Requirements & Options

Anticipated Federal Requirements

- The next version of the MUTCD will likely have minimum retroreflectivity values for pavement markings.
- Our current practices will not meet these requirements as a whole on our roadway system.

Options

- Spend more money marking roadways or,
- Become more efficient with the money we have by using long-life pavement markings.

Recommendations

The second option proves to be the most cost effective.

Immediate Actions

- Use long-life final markings on all TIP and Resurfacing projects, and in all cases where it is cost effective.

Future Solutions

- Use long-life markings on all final applications.
- This would also lessen worker exposure.

Requirements & Options

Expected Results

- Systematically meet minimum retroreflectivity requirements.
- Save an estimated \$15,800,000 a year statewide.

State Forces

- Eventually minimize or phase out utilization of state forces for pavement marking operations.

Questions / Comments

