When Reclaimed Asphalt Pavement (RAP) is reused in a new mixture, it is necessary to properly account for the old material in the mix design. Aggregates from RAP have to blend with new aggregate, and the resulting blend of aggregate has to meet certain physical properties (preferably Superpave (SP) aggregate criteria). Old binder usually reduces the need for new binder to be added but old binder from RAP must blend with virgin binder and the resulting target binder has to meet SP criteria. During the construction and service life of the roadway, the RAP asphalt binder becomes aged or hardened by reacting with oxygen in the air. If the RAP binder is highly aged or if there is a lot of it, blending the RAP asphalt with the virgin binder becomes difficult. A maximum 35% of RAP can be used (although the study considered 40%) for pavement construction in Hot Mix Asphalt (HMA) to determine whether it’s good for rutting, fatigue and low-temperature cracking in New Mexico. The primary reason for limited use was uncertainty of the long term pavement performance. The interaction of old and new asphalt and their physicochemical response is not well understood. Effect of RAP in HMA was determined using the AASHTOWare Pavement ME (or, ME-Design) software on effect of RAP in Hot Mix Asphalt (HMA) on pavement performance.

### Objectives
- Evaluate whether current allowed percentage of RAP in NM DOT asphalt mixes result in poor performing pavements in the long run.
- Assess current state-of-the-practices regarding RAP in HMA mixes with special emphasis on RAP source, binder, aggregate, SP mix design, lab and field performances of RAP pavement.
- Gather data, procedures, standards on stockpile handling, processing, and quality control of selected NM sources of RAP.
- Test matrix consisted of three RAP sources to evaluate the effect of RAP sources in HMA mixes.
- All HMA mixes designed to NMDOT specifications/superpave guidelines.
- Main target was to evaluate current RAP thresholds to be used for NMDOT mixes and evaluate the Department’s maximum % of RAP to be used in top and bottom mats without affecting pavement performance.

### Benefits
- RAP is old asphalt pavement materials that are milled from old pavements and reused.
- RAP material can be reused in new asphalt mixtures because it contains old asphalt binder and durable aggregate. Use of RAP in HMA mixture can reduce the amount of new material that has to be added, saving money and natural resources.
- Reduces total mix cost as RAP replaces a portion of virgin binder/aggregates.
- Conserves energy, allows milling as standard practice and reduces generating waste material.

### Analysis
- Study compared and evaluated field performance of a number of field sections with five different percentages of RAP (0%, 15%, 25%, 35% and 40%).
- Extracted binders showed an increase in thermal cracking with an increase in RAP percentage.
- Fatigue performance decreases about 70% when comparing 0% RAP with more than 25% RAP.
- Extracted binders showed an increase in thermal cracking with an increase in RAP percentage for all RAP sources.
- Overall, fatigue and low temperature cracking are concerns for using more than 25% RAP based on the tests performed in this study.

### Results
- Project determined laboratory performances of RAP in HMA for constructing durable and long lasting pavements.
- Past synthesized literature, examined 50 State DOT best practices on RAP use protocols, current RAP practice in NM, effects of RAP sources, binders, and aggregates as well as Superpave mix design and the laboratory and field performance of RAP pavements.
- RAP extracted binders and HMA mix with 0%, 15%, 25%, 35% and 40% RAP covered three different RAP sources including two different virgin asphalt binders. Binder and HMA samples showed a decrease in rutting with an increase in the RAP %. Fatigue testing on binder and mix showed fatigue life decreases with an increase in RAP percentage.
- Fatigue performance decreases about 70% when comparing 0% RAP with more than 25% RAP.
- Extracted binders showed an increase in thermal cracking with an increase in RAP percentage for all RAP sources.
- Overall, fatigue and low temperature cracking are concerns for using more than 25% RAP based on the tests performed in this study.

### Implementation Status
Study findings are expected to be useful to pavement engineers and contractors in analyzing and designing HMA mixes with high RAP content. Research findings and benefits are now included in an Implementation Plan Guidebook that will impact not only pavement design and materials, but also asphalt mix performances relative to RAP. Research results will provide better RAP mix design estimations, usage of lab material properties determined during a project to help predict distresses more accurately, and lab/field evaluations of RAP mixed HMA & pavements to better understand different RAP % effects on characteristics of mixtures & pavements.