

Use of Reclaimed Asphalt Shingles in Illinois

2nd Edition

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AUGUST 2013



Illinois Department of Transportation

Division of Highways / Bureau of Materials and Physical Research
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USE OF RECLAIMED ASPHALT SHINGLES IN ILLINOIS:

2ND EDITION

Illinois Department of Transportation
Bureau of Materials and Physical Research
Springfield, Illinois

August 2013

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ABSTRACT

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IDOT has been studying the use of RAS for several years; however, more work must be done to determine how increasing the use of this material impacts the performance of paving mixtures. Although IDOT has only been using RAS since 2010, the department has rapidly increased usage with the goal of reducing costs on paving projects. Performance of RAS projects has been adequate at early ages, but research continues to see if increased RAS content has any long-term effects.

This report summarizes potential uses of RAS, revisions to policies and special provisions, recorded quantities used in construction projects, estimated economic impacts, and ongoing research efforts. With these continued efforts, IDOT strives to maximize the use of RAS to stretch financial resources while maintaining quality construction and long-term pavement performance for the motoring public.

TABLE OF CONTENTS

CONTENTS	PAGE
Abstract.....	iii
List of Figures	v
List of Tables	v
Introduction	1
Uses and Sources of Shingles	1
Potential RAS Sources.....	1
RAS in Hot-Mix Asphalt.....	4
Policies and Special Provisions.....	4
Quantity of RAS Used in Calendar Year 2012.....	6
Economic Impact of RAS	8
RAS Studies	9
Summary	10
References	12
 APPENDIX A. 2012 POLICY MEMORANDUM FOR RECLAIMED ASPHALT SHINGLE (RAS) SOURCES	 13
 APPENDIX B. SPECIAL PROVISION FOR RECLAIMED ASPHALT SHINGLES (January 1, 2012)	 29
 APPENDIX C. SPECIAL PROVISION FOR RECLAIMED ASPHALT SHINGLES (November 1, 2012)	 35
 EXHIBIT D. SHINGLE MARKET AND ASPHALT SAVINGS CALCULATOR	 46

LIST OF FIGURES

Figure 1. Diagram of Production Stream for RAS into HMA.

Figure 2. Raw Post-Consumer Shingles and Processed RAS.

Figure 3. Stockpiling Finely Ground 0.25-inch RAS Particles.

Figure 4. Temperature Ranges for Performance Graded Asphalt Binders and Shingle Asphalt.

Figure 5. Percent of PG Asphalt Binder Grades Used on IDOT Projects During 2008-2012.

Figure 6. IDOT Districts and the Percentage of Total RAS Used in Calendar Year 2012.

LIST OF TABLES

Table 1. Subset of Shingle Market and Asphalt Savings Calculator.

INTRODUCTION

This report is the second annual issue released to meet the requirements outlined in Public Act 097-0314. The full text of the law can be found in Appendix A of Physical Research Report (PRR) 162 [1] at <http://www.dot.il.gov/materials/research/pdf/prr162.pdf>, or by directly accessing the law at <http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=097-0314>.

The intent of this law is to collect shingles from the waste stream and recycle the material into Illinois Department of Transportation (IDOT) hot-mix asphalt (HMA) paving projects. IDOT continues to carry out this law by allowing contractors to incorporate reclaimed asphalt shingles (RAS) into as many HMA projects as possible. This approach allows contractors to optimize each mix without causing mix production problems. The contracting community is opposed to usage mandates due to such mandates resulting in problems meeting mix requirements and creating spot shortages. Including the option for incorporating RAS has been shown to reduce costs of HMA mix.

This report will contain basic information on the use of RAS and how IDOT is continuing to incorporate the material into highway construction efforts. Detailed information about the value of RAS as a reclaimed material and the initial development of RAS policies and special provisions is available in PRR 162 at the link shown above.

USES AND SOURCES OF SHINGLES

The primary materials used in HMA mixtures are aggregate, asphalt binder, and additives. The various components of shingles can be used as a substitute for some of those HMA materials. The following is a list of the RAS components that can be used in HMA mixtures.

- Liquid asphalt binder, which makes up about 20 percent of the total volume of new shingles, can replace a portion of the asphalt binder in HMA mixtures.
- Fiberglass or cellulose fiber can serve as the fibers needed in a specialized HMA mixture called Stone Matrix Asphalt (SMA) which is used for high-volume roadways and high-stress intersections.
- Aggregate can be used as a substitute for some of the fine aggregate needed in SMA mixtures or traditional HMA mixtures.

IDOT allows shingles from two different sources: manufacturer's salvage (pre-consumer) or tear off (post-consumer). Figure 1 shows the process of reclaiming shingles from both of these sources into useable material for incorporation into HMA.

Before a producer can generate RAS, they must obtain a Beneficial Use Determination (BUD). This process is outlined in Section 22.54 of the Illinois Environmental Protection Act (415 ILCS 5/22.54) [2]. Figure 2 shows raw post-consumer shingles and processed RAS.

POTENTIAL RAS SOURCES

Manufacturer's Salvaged (Pre-Consumer) Shingles

Shingles rejected by the manufacturer, also known as manufacturer's salvaged shingles, are one of the RAS sources accepted by IDOT. These shingles are those in which the finished

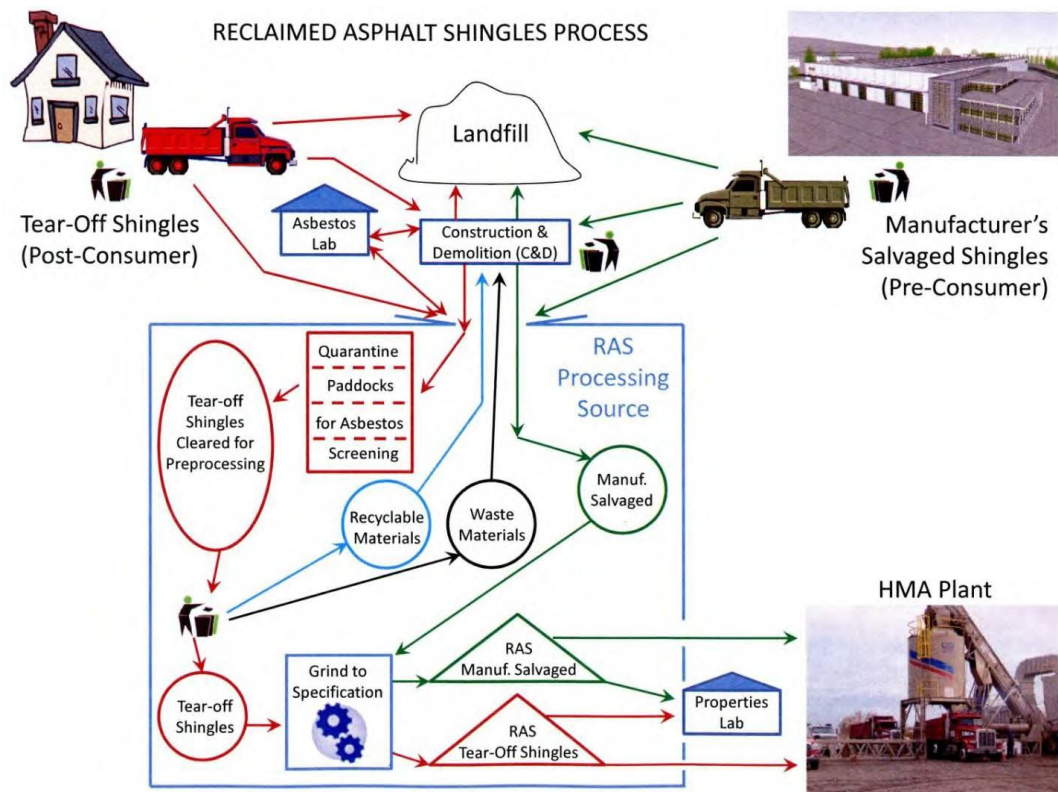


Figure 1. Diagram of Production Stream for RAS into HMA



Figure 2: Raw Post-Consumer Shingles (Left) and Processed RAS (Right).
 [Source: <http://www.roofingshinglerecycling.com/>]

product has imperfections that would be unacceptable to consumers. Variability in color, non-uniform aggregate coating, and other defects are the reasons for these shingles being rejected. Another type of manufacturer salvaged shingles are the tabs that are punched out of the three tab shingles. All of these pre-consumer shingles must be ground and processed to a nominal 0.25-inch or smaller material to incorporate the product into HMA. Figure 3 shows a producer stockpiling processed RAS. Using RAS to replace a portion of the asphalt and aggregate in HMA mixtures can result in a cost savings.



Figure 3: Stockpiling Finely Ground 0.25-inch RAS Particles.
[Source: IDOT Photo – Waste Commission of Scott County, Davenport, Iowa]

Tear-Off (Post-Consumer) Shingles

Another source of RAS is post-consumer shingles, also known as tear-off shingles. This source of RAS first became allowable for use in IDOT projects in 2010 when IDOT met with the Illinois Environmental Protection Association (IEPA) in an attempt to reduce the amount of waste shingles being deposited into approved landfill facilities.

One issue that must be addressed when using tear-off shingles is asbestos contamination. Asbestos fiber was potentially used by manufacturers prior to the early 1980s in the base mat of shingles. Asbestos has never been banned from shingle production. Because of the difficulty in determining if shingles contain asbestos, National Emission Standards for Hazardous Air Pollutants (NESHAP) requires asbestos screening when shingles are removed from commercial buildings or apartment complexes with four or more units.

RAS IN HOT-MIX ASPHALT

Even though all material components of RAS are also components of HMA mixtures, only a limited amount of RAS can effectively be added without adversely affecting mixture properties

and subsequent pavement performance. Shingle asphalt requires different properties than paving asphalt. High temperatures and long-term exposure to the sun are the primary environmental conditions that shingles must withstand. They are typically manufactured in 1 meter lengths and installed overlapping to compensate for shrinkage in cold weather.

Paving asphalt must also endure high temperatures in the summer; however it must also hold up to extreme cold conditions and resist cracking in the winter. To address the combination of extremes, paving asphalt uses a performance grading system which is explained in IDOT's Pavement Technology Advisory (PTA) D-4, *Performance Graded Binder Materials for Hot-Mix Asphalt* [3] located at <http://www.dot.il.gov/materials/research/pdf/ptad4.pdf>.

PG64-22 is the most common grade of asphalt used in Illinois paving mixtures. To compare shingle asphalt to paving asphalt, a sample of shingle asphalt from an Illinois manufacturer was tested and resulted in a grading of PG112 +2. After several years of ultraviolet exposure, the shingle asphalt hardens further and cannot be used in large quantities in HMA mixtures without adding softer paving asphalt grades to minimize cold weather cracking. Figure 4 presents the differences in temperature ranges for performance graded asphalt binders and shingle asphalt using the minimum and maximum temperatures. Figure 5 shows the percentage of each paving asphalt binder grade used in IDOT projects from 2008 to 2012.

POLICIES AND SPECIAL PROVISIONS

Acceptance methods and construction procedures for IDOT projects are outlined in policies and special provisions. The Bureau of Materials and Physical Research (BMPR) has developed policy memorandums and special provisions for RAS usage.

Policy Memorandum for Reclaimed Asphalt Shingle (RAS) Sources

The first IDOT BMPR Policy Memorandum for Reclaimed Asphalt Shingle (RAS) Sources was developed in 2010. Each section of the policy memorandum defines various requirements that RAS suppliers need to follow in order to supply their product to contractors for use in IDOT construction projects. The latest RAS policy memorandum was released July 1, 2012 and had several revisions to the April 1, 2011 version. The July 1, 2012 version is shown in Appendix A. The policy changes included adding, deleting, and revising definitions; rearranging sections; and renaming forms.

The two types of shingles that can be processed by an approved source include manufacturer's salvaged (pre-consumer) known as Type 1 and tear-offs (post-consumer) known as Type 2. Currently, facilities typically process only one type of shingle; however, the option to process both is allowed. If a facility decides to handle both types, each product must be kept separate throughout the entire process. This separation is required because of different gradation and asphalt contents for the two types of shingles. By keeping each product separate, the facility

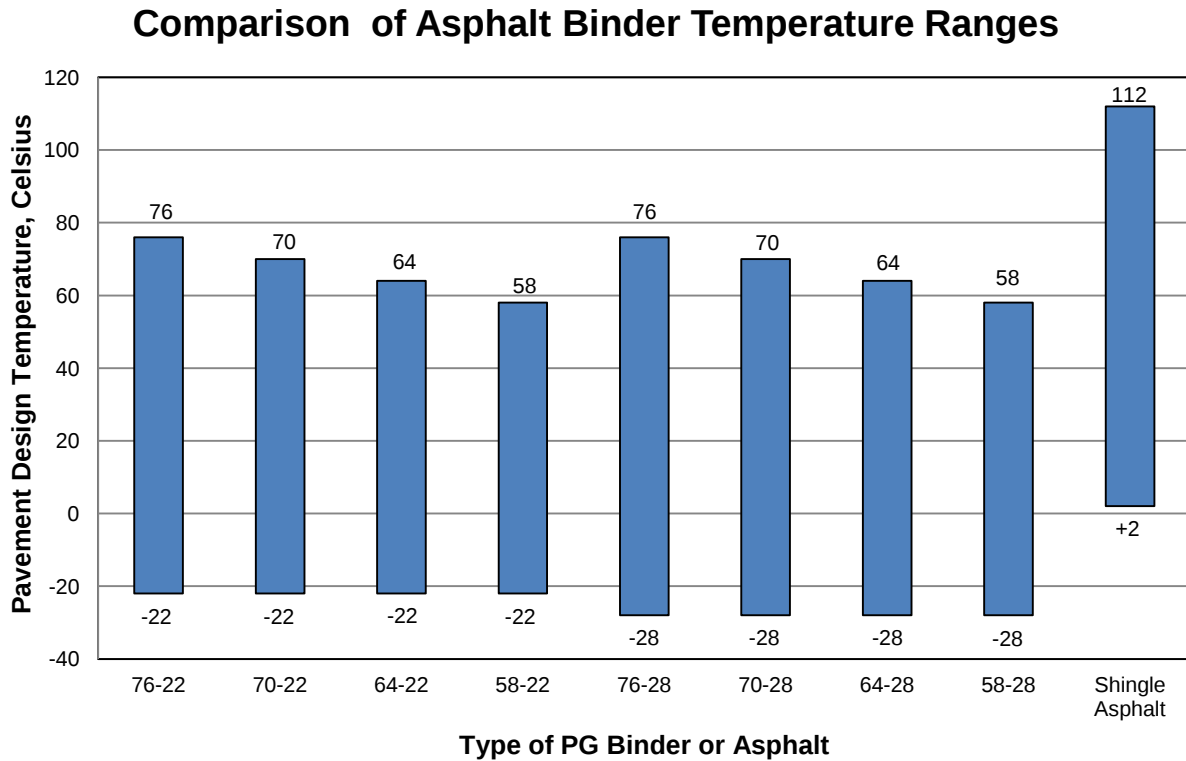


Figure 4: Temperature Ranges for Performance Graded Asphalt Binders and Shingle Asphalt

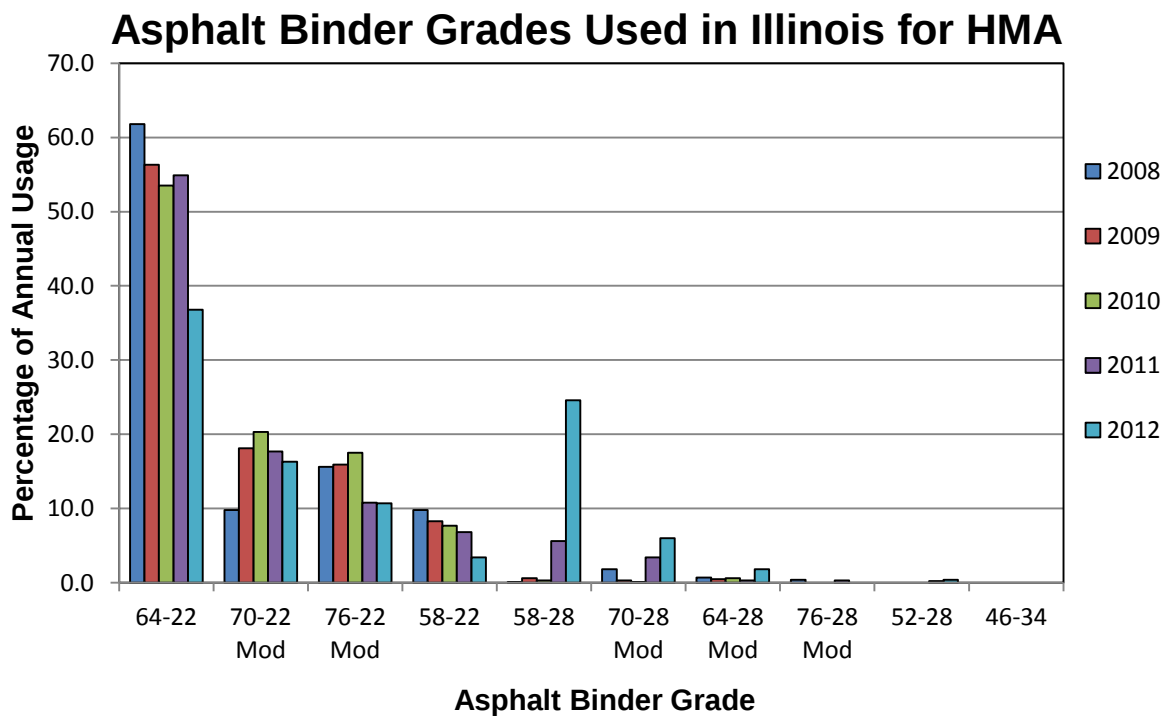


Figure 5: Percent of PG Asphalt Binder Grades Used on IDOT Projects During 2008-2012.

can maintain a more uniform final product. Also, unlike tear-off shingles, manufacturer's salvaged shingles do not require asbestos testing because asbestos is not being used as a material component in the manufacturing of shingles today.

Illinois monitors several aspects of tear-off shingles, including: presence of asbestos, cleanliness, asphalt binder content, and final gradation of the processed shingles. This strict monitoring effort prevents asbestos and unusable material contamination in the final product. Once the tear-offs are cleared, the material is ground and sized to special provisions. Finally, the ground shingles are tested for asphalt binder content and washed gradation to ensure the RAS meets IDOT special provisions for use in HMA.

Special Provisions for Reclaimed Asphalt Shingles (RAS)

IDOT also develops special provisions to provide Contractors with the requirements for constructing roadways in Illinois. The initial RAS special provision was developed in 2010 concurrently with the policy memorandum. Similar to the policy memorandum, the special provision has also been revised several times.

Requirements for all aspects of using RAS in HMA mixtures for IDOT construction projects are documented in the special provision. These aspects include: material handling and testing, percentage of RAS allowed in each HMA mixture, and equipment requirements for producing HMA. The January 1, 2012 version of the special provision allowed Type 1 or Type 2 RAS to be used alone or in conjunction with RAP in all HMA mixtures up to a maximum of 5.0 percent by weight of total mix, and up to a specified maximum binder replacement. Later in the year, BMPR combined the special provisions for RAP and RAS into one document and reformatted the information with the intent that once the special provision becomes stable it can eventually be moved into the Standard Specifications for Road and Bridge Construction. Copies of the special provisions used during calendar year 2012 are included in Appendices B and C.

QUANTITY OF RAS USED IN CALENDAR YEAR 2012

Quantities for RAS, similar to all materials used in highway construction, were reported to the Materials Integrated System for Test Information and Communication (MISTIC). The MISTIC database provides materials quantities according to contracted use, testing, and inspection data. This system was developed in the mid-1970s and included material components for HMA mixtures that were used at that time. Recycled and reclaimed materials were not used in that era, and IDOT has determined that the number of allowable fields for entering mixture components is too few for mixtures incorporating materials from several sources and multiple reclaimed products. Therefore, every IDOT project in which RAS was incorporated into the mix may not be included in the total quantities contained in this report – the end result being the RAS tonnage is under reported. IDOT is working toward a solution to address this issue so that all recycled products used in all projects may be captured in the future.

In 2012, MISTIC records indicated that IDOT constructed a total of 88 contracts incorporating RAS in HMA mixtures, with a total quantity of 12,412 tons. This number was calculated based upon the quantities of HMA and percent RAS used from the approved mix design. A majority of these projects were located in the Chicago area; however, the number of districts using RAS increased from the previous year. Figure 6 shows the nine IDOT districts and the percentage of the total RAS used by the four districts that constructed projects in calendar year 2012.

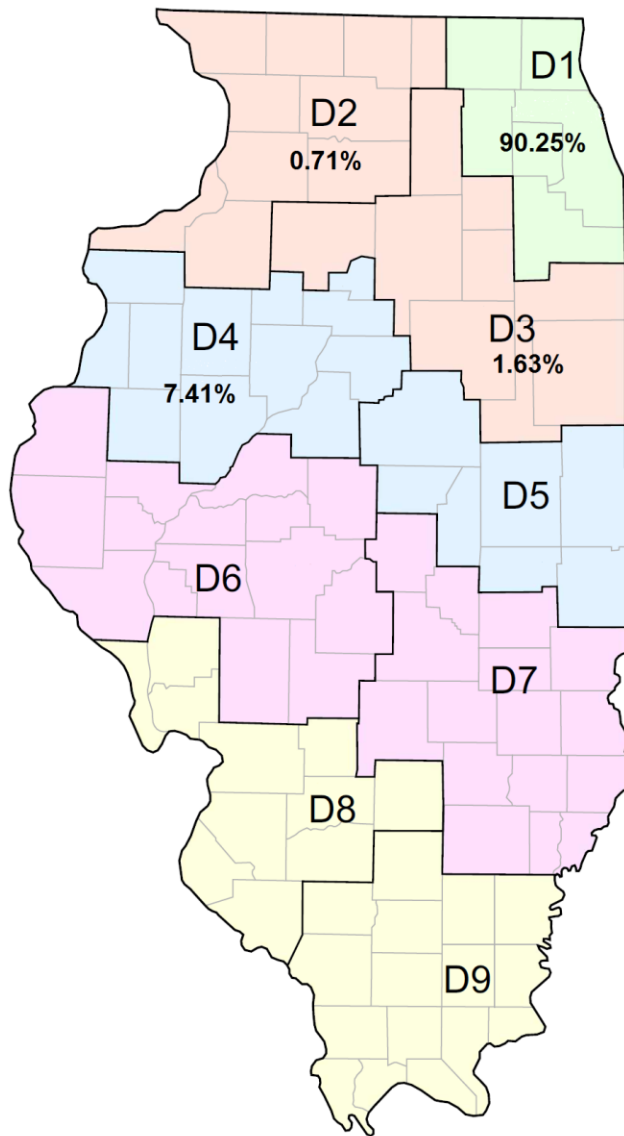


Figure 6: IDOT Districts and the Percentage of Total RAS Used in Calendar Year 2012.

Even with the potentially missing data, IDOT saw the number of paving projects incorporating RAS increase by 65 (283 percent) in calendar year 2012. Looking at usage in terms of tonnage, IDOT saw an increase of 9,178 tons (284 percent) from the previous year. As a comparison, the City of Chicago and the Illinois Tollway used about 21,000 and 24,000 tons of RAS, respectively, during calendar year 2012. IDOT is still lagging behind the City of Chicago and the Illinois Tollway for quantity of RAS used; however, the gap is narrowing. The main reason for the lag is potentially because the RAS projects are not easily identified in MISTIC due to the previously mentioned reporting structure problem.

ECONOMIC IMPACT OF RAS

Facilities for processing RAS tend to be located near larger metropolitan areas where shingle replacements provide a steady supply of material to process. A shingle market and asphalt savings calculator was developed by David Lippert, IDOT Bureau of Materials and Physical Research, to help determine which areas would be considered collection operations and which areas would be true recycling operations. Table 1 shows a subset of the urban areas in Illinois grouped by region. This table provides an estimate of the annual amount of shingles generated in tons, the value for collection and sale of RAS, and the cost savings of liquid asphalt binder replaced with RAS. A complete version of the calculator is included in Appendix D. The calculator provides estimates for each item. Actual values would vary by project size, location, and available resources. To determine these estimated values, assumptions were made and applied uniformly to all counties.

Table 1. Subset of Shingle Market and Asphalt Savings Calculator.

IDOT Region	County	Total Population	Annual Tons Generated ⁽¹⁾	Tipping and Sale Value ⁽²⁾	Liquid Asphalt Savings ⁽³⁾
1	Cook	5,288,655	158,660	\$11,106,176	\$10,471,537
	DuPage	932,670	27,980	\$1,958,607	\$1,846,687
	Lake	713,076	21,392	\$1,497,460	\$1,411,890
	Will	668,217	20,047	\$1,403,256	\$1,323,070
	Kane	493,735	14,812	\$1,036,844	\$977,595
	McHenry	312,373	9,371	\$655,983	\$618,499
	Partial Regional Totals	8,408,726	252,262	\$17,658,325	\$16,649,277
2	Rock Island	147,545	4,426	\$309,845	\$292,139
	Henry	50,339	1,510	\$105,712	\$99,671
	Partial Regional Totals	197,884	5,937	\$415,556	\$391,810
3	Peoria	182,495	5,475	\$383,240	\$361,340
	Tazewell	130,559	3,917	\$274,174	\$258,507
	Partial Regional Totals	313,054	9,392	\$657,413	\$619,847
5	Madison	265,303	7,959	\$557,136	\$525,300
	St. Clair	260,919	7,828	\$547,930	\$516,620
	Partial Regional Totals	526,222	15,787	\$1,105,066	\$1,041,920
Statewide Totals		12,831,970	282,303	\$26,947,137	\$25,407,301

(1) The tonnage generated is based upon 60 pounds per person.

(2) This value is based upon \$70 per ton – tipping value \$30 plus sale value \$40.

(3) Savings is based upon a difference of \$300 per ton.

The 2013 United States population was about 315 million people and approximately 11 million tons of shingle waste (Type 1 and Type 2 combined) was generated. This equates to an average generated shingle waste of 70 pounds per person. Illinois has a portion of generated waste from commercial buildings which is not allowed for recycling. Therefore, the value in the calculator was reduced to 60 pounds per person.

Assumptions for tipping and sale values were also used in the calculator. These assumed values were \$30 per ton for tipping (roofing contractor dumping waste shingles at a processing facility) and \$40 per ton for sale of the material (value of processed RAS sold to contractor for

use in HMA). These values are combined to come up with a total potential gross earnings by the processing facility.

Finally, an assumption was made for the value of liquid asphalt savings. This value represents the cost of liquid asphalt less the cost of shingle asphalt and was assumed to be \$300 per ton. An overall saving was determined by using that assumed value and another assumption of shingles containing 22 percent liquid asphalt. This value of savings for liquid asphalt provides an estimate of savings if all of the shingle waste material was used in HMA mixtures for roadway construction projects.

It should be noted that facilities in the processing business need to collect and sell around 5,000 tons of shingles annually to be viable as an ongoing business. Many counties generate far fewer tons of shingle waste annually. Collection facilities opening in such areas may result in abandoned piles similar to tire dumps with similar environmental concerns.

RAS STUDIES

Recycling is good for the environment; however, there is a possibility that recycled (reclaimed) materials may have detrimental effects on performance. IDOT has taken a closer look into the use of RAS in HMA mixtures and the impacts on performance through research projects that have been conducted by the Illinois Center for Transportation (ICT).

R27-SP19: Evaluation of the Effect of RAS on IDOT Asphalt Mixtures

This special project conducted by the ICT began in December 2011 and ended in June 2012. It was undertaken to evaluate the effect of RAS use on certain properties of asphalt mixtures, such as rutting potential, cold-weather cracking potential, and long-term pavement strength.

Two softer binder grades not commonly used by IDOT were selected to balance the harder shingle asphalts. RAS and RAP percentages were varied based on the binder used. Both loose mix and field samples were evaluated.

The final report was published in October 2012. The research found that the addition of RAS favorably improved the resistance of HMA mixtures to rutting under loading. There was no conclusive finding regarding cold-weather cracking potential, although it was evident that use of softer binders and lower RAS amounts provided greater resistance to cold-weather cracking. However, as the percentage of RAS in an HMA mixture increased, the fatigue, or long-term, performance of the HMA mixture declined. Higher amounts of RAS accelerated the rate of damage. While larger amounts of RAS result in contractor savings, a decrease in long-term performance can result in increased agency costs with more frequent rehabilitations.

R27-128 - Testing Protocols to Insure Performance of High Asphalt Binder Replacement Mixes using RAP and RAS

This project conducted by the ICT began January 1, 2013 and is scheduled to end December 31, 2015. This study is designed to assess the impact of the joint use of RAP and RAS on the cost and performance of HMA mixtures. Can higher quantities of RAP and RAS be used together while ensuring that the basic engineering properties of the original selected PG asphalt grade are retained?

The National Asphalt Pavement Association (NAPA) conducted a second survey of the asphalt pavement industry in 2011 to determine usage of RAP, RAS, and warm-mix asphalt (WMA), and published a report of their findings in 2013 [4]. The survey results show that from 2009 to 2011 the use of RAP and RAS increased significantly. In two years, the amount of RAP used in HMA mixtures increased from 56 million tons to 66.7 million tons (19 percent). During the same time period, the amount of RAS used in HMA mixtures increased from 0.7 million to 1.2 million tons (70 percent). The total asphalt binder savings due to RAP and RAS use was about 3.7 million tons.

The use of RAS and RAP are expected to remain on the rise as the understanding of these materials continues to grow. However, for this environmentally responsible approach to highway construction to be considered cost-effective, it must be accompanied by equivalent or superior performance.

With the increased desire to use RAS and RAP in wearing surface materials, low temperature cracking and environmental block cracking due to the presence of stiff binder (mainly from the recycled materials), is of concern and currently limits the use of recycled materials in wearing surface to restrictions based on traffic volume (e.g. 10% with polymer-modified mixes, 20% with SMA mixes, etc). To address these environmental concerns, a less stiff mix is needed.

The State of Illinois desires to move forward with the implementation of more sustainable pavements. This includes increasing the use of RAS and RAP and determining the effect their joint use has on asphalt binder replacement. The desired result is to allow more liberal usage of RAS and RAP while ensuring that the basic engineering properties of the originally selected asphalt binder are retained. The outcome of this study will have an impact on reducing the use of natural resources, reduced emissions and carbon imprint, and ultimately a more cost-effective product.

SUMMARY

According to the requirements of Public Act 097-0314, this report was issued as annual documentation of IDOT's use of RAS in roadway construction projects. This report reflects revisions to policies and special provisions, summarizes the use of RAS during the 2012 calendar year, and provides an estimate of economic impact.

The policy memorandum and special provision were revised from previous years. Each revision was made to improve the quality of construction practices and increase the potential for allowing RAS use in HMA mixtures. IDOT will continue to monitor performance of pavement constructed with RAS and revise the policies and special provisions as necessary to maximize use of the reclaimed material and protect the environment.

The amount of RAS used by IDOT in 2012 increased by 284 percent compared to the previous calendar year. Illinois will continue to increase the amount of RAS used in construction projects. Use of this reclaimed material not only reduces the amount of waste material deposited in approved landfill facilities, but it also generates opportunities to establish processing facilities, which in turn can generate employment opportunities. One issue that must be addressed to realize the total use of RAS is to improve the capabilities of IDOT's materials certification and reporting system to allow additional input fields to allow a larger number of material components used in HMA mixtures. IDOT will also look to promote the use of RAS in an attempt to expand use into additional regions throughout the state.

A calculator was developed to estimate the tons of waste shingles generated, value of tipping and sale, and liquid asphalt savings. This calculator can help provide information to industry to determine where facilities can be located to maximize earnings and promote new business opportunities.

Finally, as Illinois continues to move forward with use of RAS, research studies will guide the best balance of maximizing RAS and RAP usage without negatively impacting pavement performance. Ongoing research efforts may be monitored at the following website:
<http://www.ict.illinois.edu/idotprojects.asp>.

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APPENDIX A

State of Illinois
Department of Transportation
Bureau of Materials and Physical Research
Springfield

POLICY MEMORANDUM

Revised: July 1, 2012

28-10.3

This Policy Memorandum supersedes number 28-10.2 dated April 1, 2011

TO: REGIONAL ENGINEERS AND HIGHWAY BUREAU CHIEFS

SUBJECT: RECLAIMED ASPHALT SHINGLE (RAS) SOURCES

DEFINITIONS:

Asbestos Containing Material (ACM) – Any material containing more than one percent (1%) asbestos as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763, Section 1, Polarized Light Microscopy.

Asbestos Free – Asbestos is not detectable using Polarized Light Microscopy.

Asphalt Shingles – A roof shingle mat of fibers impregnated with asphalt and covered with aggregate.

BUD (Beneficial Use Determination) – Written conditional exemption from Illinois EPA under the authority of Section 22.54 of the Illinois Environmental Protection Act (415 ILCS 5/22.54) that specifically exempts a Source that is providing Post Consumer shingles from Illinois EPA solid waste permit requirements.

Bureau – The Illinois Department of Transportation Bureau of Materials and Physical Research at 126 East Ash Street, Springfield, Illinois 62704-4766

C&D (Construction and Demolition) Debris – Waste including, without limitation, shingle materials from the construction, remodeling, repair, and demolition of structures.

Department – Illinois Department of Transportation

District – The Illinois Department of Transportation District where the Source facility is located.

Extraction/Gradation Testing – Testing that must be performed by a Department prequalified Phase III Construction consultant laboratory, or in-house by a technician that has successfully completed the Department's HMA Level I course utilizing a Department approved lab.

Homeowner – Person supplying Post-Consumer Shingles from their home.

Local Agency – Municipality, county or road district

Illinois EPA – Illinois Environmental Protection Agency

NESHAP – National Emission Standards for Hazardous Air Pollutants

Manufacturer's Salvaged Shingles – Asphalt shingles, tabs, and end runs salvaged directly from a shingle manufacturer.

Paddock – A fenced-in or walled enclosure that can be locked and/or sealed to prevent undocumented removal or addition of new material. This area shall have a surface suitable to prevent soil from contaminating the RAS.

Pre-processed Shingles – Manufacturer's Salvaged or Post Consumer shingles that remain to be ground to Department specifications.

Processed Shingles – Manufacturer's Salvaged or Post-Consumer shingles meeting requirements herein that have been ground to Department specifications.

Polarized Light Microscopy (PLM) – Test method to identify asbestos following EPA 600/R-93/116.

Post-Consumer Shingles (*Tear-Off*) – Shingles salvaged from residential buildings of four or fewer dwelling units and/or single family dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP). Shingles must be collected separately from other general construction or demolition debris at the generation source. Shingles from whole house demolition will not be allowed.

Quality Control Plan – A document provided by the Source outlining proposed operational details to control the equipment, materials, and production methods to ensure the specified product is obtained.

Source – Recycler / Processer who processes shingles for use in Hot Mix Asphalt (HMA) and is authorized by the Illinois EPA and approved by the Department.

State – Illinois

Stockpile – Pile of pre-processed shingles limited in size by the Illinois EPA BUD or Permit.

Supplier – An individual or business that brings shingles into the facility for the production of RAS.

Direct suppliers can be:

- Roofing Company
- Homeowner

Indirect suppliers (must be listed in QC Plan):

- Construction/Demolition Recyclers
- Salvager from new shingle manufacturer

Tipping Pad – Designated paddock for unloading incoming loads of shingles prior to asbestos sampling.

Training – An educational program specific to the job duties described in the quality control plan. The education program shall include specific position responsibilities and the type of training required. For positions that require asbestos training, the education program shall be developed for the specific methods being used by the Source and presented by licensed specialist knowledgeable in the safe handling, usage and disposal of this material.

1.0 **PURPOSE**

- 1.1 To establish a procedure whereby the Reclaimed Asphalt Shingle (RAS) production of a Source will be conducted in accordance with applicable environmental laws and regulations in a manner that results in a product that may be accepted for use on State or Local Agency projects based on a uniform certified QC program. This policy shall be referenced with all applications for Illinois Environmental Protection Agency (Illinois EPA) permits (Bureaus of Air, Land and Water) or for applications of BUD permits required to operate a RAS processing facility.

2.0 **SCOPE**

- 2.1 This procedure shall apply to all Sources which desire to supply RAS for incorporation into Hot Mix Asphalt and Warm Mix Asphalt (HMA) mixes for State and Local Agency projects.

3.0 **REQUIREMENTS FOR APPROVAL**

- 3.1 Potential Sources, whether in or outside of the State, shall have received a BUD or permit authorizing them to process shingles to Department Specifications from the Illinois EPA.
- 3.2 Potential Sources requesting Department approved status for their facilities shall make application in writing to the Bureau. This application shall include:
 - 3.2.1 An initial certified statement of compliance with the applicable provisions contained in Section 4.
 - 3.2.2 A complete, detailed QC Plan following the Model QC Plan (Attachment 1 & Section 6) and history if applicable. The QC Plan will be reviewed and approved by the Bureau.
 - 3.2.3 A copy of the BUD or permit from the Illinois EPA for that facility.
- 3.3 After the Source receives a permit or BUD from the Illinois EPA and the facility has been constructed, the Source shall contact BMPP to schedule an onsite inspection.

- 3.4 A Source with a BUD or permit, an approved QC Plan, certified statement, and passing onsite inspection by the Bureau, will be placed on the Department's approved Source list for RAS.

4.0 **SOURCE RESPONSIBILITY**

- 4.1 The Source shall submit annually for District approval by January 31:

- 4.1.1 A QC Plan containing:

- General Company information
- Organizational chart
- Contact information
- Location of Processing site
- Flow Diagram including stockpile signage and location of signs
- Capacity of processing units/equipment at the site
- Average/anticipated tons ground per hour (TPH)
- Final Products
- Manpower at the site (i.e. foreman, manager, tester, etc.)
- Ticket information (copy to be provided)
- Corrective action procedures in writing if applicable
- Any changes unique to the contract (changes in plant, personnel, flow diagrams)
- Any updates to previous documents

- 4.1.2 The Reclaimed Asphalt Shingle (RAS) Source Certification form (BMPR RASCRT, <http://www.dot.il.gov/materials/materialforms.html>) as seen in Attachment 2.

- 4.1.3 A copy of current BUD approval or Illinois EPA permit.

- 4.2 Process and test RAS furnished to State and Local Agency projects according to the Source QC Plan and be in compliance with the material requirements specified in the Department's RAS specification before shipment.

- 4.3 Transport, stockpile, and process Manufacturer's Salvaged shingles separately from Post-Consumer shingles.

- 4.4 For Post-Consumer shingles:

- 4.4.1 Shingles shall be delivered only by trained haulers or a Homeowner.

- 4.4.2 All incoming loads of Post-Consumer shingles shall be quarantined until all asbestos testing is completed and found to be asbestos free.

- 4.4.3 The entire quarantined stockpile shall be immediately removed from the premises if any test result indicates asbestos is present within the quarantined stockpile.

- 4.5 The Source shall reimburse the Department for on-site inspection costs associated with the initial Bureau and subsequent District inspections if the Source is located more than 50 miles outside the state line and inspections cannot be completed within one day's normal work hours of 8:00 A.M. to 4:30 P.M. The Source shall

pay for transportation, per diem (meals), lodging and incidental travel costs incurred by the Department's inspector. The costs shall not exceed the limits established by the Department's travel regulations. At the Department's option, sampling arrangements may be made through a mutually approved private inspection agency.

- 4.6 The Source shall provide to the HMA Producer written certification that the RAS has been produced in compliance with all State and Federal laws, statutes and this policy. The certification shall include whether it was classified as Post-Consumer or Manufacturer's Salvaged RAS. When processed Post-Consumer RAS is supplied, the HMA Producer shall also be provided with written certification from the Source that the Source has been issued all the necessary permits and authorizations from Illinois EPA and is operating in compliance with these authorizations.
- 4.7 The Source shall clearly identify each paddock of Manufacturer's Salvaged and Post-Consumer shingles, processed RAS from Manufacturer's Salvaged and Post-Consumer shingles, and storage areas for other recyclable materials (such as nails and aluminum trim) and waste as referenced in the QC Plan. The Source shall maintain each paddock to control the flow of material.
- 4.8 The Source shall post and maintain staff and Suppliers' training records that are immediately accessible to any state inspector during hours of operation.

5.0 **DOCUMENTATION**

- 5.1 The Bureau will maintain a current list of approved RAS Sources and issue a unique Producer/Supplier number. The list will include the name of the Source, the Source code number, the location of the Source, and the Source's qualified products. The Bureau will update the list when the status of any Source changes. The approved RAS Source list is available on the Internet. To access, log onto the following IDOT website: <http://www.dot.il.gov>. The list is located under: Doing Business/Materials/Approved Lists for Materials.
- 5.2 HMA contractors receiving material from a Source whose certification has been revoked will be notified immediately by the District.
- 5.3 The HMA producer incorporating RAS in mixes shall maintain for a period of three years bills of lading and material certification from the RAS Source.
- 5.4 During production, the Source shall test the processed RAS, and provide results to the District, according to one of the following frequencies:
- A minimum of 1 dry shake gradation every 500 tons.
 - Asphalt binder content, washed extracted gradation, and dry shake gradations at the frequency outlined in the IDOT reclaimed asphalt shingles specifications.
- 5.5 RAS material at the HMA plant shall be identified by the bill of lading accompanying the shipment from the Source.

6.0 **ELEMENTS OF THE QUALITY CONTROL PLAN**

- 6.1 The purpose of the QC Plan is to document the Source's process of control for recycling Manufacturer's Salvaged and Post-Consumer asphalt shingles into raw ingredient material that meets Department requirements for use in HMA applications.
- 6.2 The Source QC Plan shall contain the following (see Attachment 1):
- 6.2.1 The QC Plan shall declare all types of material that will be accepted at the facility. The allowable types are:
- Post-Consumer shingles.
 - Manufacturer's Salvaged shingles.
- 6.2.2 Detail the process for inspection of incoming loads of Manufacturer's Salvaged shingles. For Post-Consumer shingles, detail the process for inspection, sampling, testing and method of quarantine of incoming loads. Include the following:
- Source inspection personnel duties, responsibilities and training.
 - Describe criteria for accepting and rejecting loads from Suppliers.
 - A plan for random asbestos sampling and submittal to a laboratory accredited through the National Institute of Standards and Technology (NIST) if the Source is conducting required PLM testing on site through its own certified technician.
 - Provide a plan view diagram showing flow of the processing operation with labels identifying the various components.
- 6.2.3 List training and qualification of staff and Suppliers. Records shall be kept of the dates of training and of the names of employees trained. Original certificates of training shall be available upon request.
- 6.2.4 The QC Plan shall identify the Source location, laboratory names and locations, and a complete description of the types and frequencies of the tests to be performed.
- 6.2.5 The frequency of testing the Source will use to monitor production as outlined in Section 5.4.
- 6.2.6 Attach an outline of required training for:
- Source asbestos inspectors for incoming loads.
 - Source sorting personnel.
 - Suppliers/Trained Haulers. This shall include the process for accepting shingles delivered by the Homeowner.
- 6.2.7 Provide an Occupational Safety and Health Administration (OSHA) approved personnel protection plan for Source personnel as well as Department inspectors. Air monitoring of the equipment operators during the grinding of any Post-Consumer shingles shall be completed by a certified industrial hygienist (CIH). The QC Plan shall identify the air sampling procedures and frequencies for initial and periodic exposure assessment (personal breathing zone air sampling).

- 6.2.8 All approved addendums to the QC Plan in the preceding year shall be incorporated in the annual submittal. **[Note: Any changes to the QC Plan may require prior amendment of the BUD or a permit modification]**

7.0 **OPERATION OF SOURCE FACILITY**

- 7.1 A sign shall be posted at the entrance to the Source facility indicating the name of the facility and hours of operation.
- 7.2 Access to the facility shall be controlled by a gated entrance and exit. The gate shall be locked when facility personnel are not present.
- 7.3 Source sorting personnel shall attend a training session conducted by a certified asbestos inspector to learn to identify and remove unacceptable material prior to processing as outlined in the QC Plan.
- 7.4 Incoming loads shall only be accepted from a Supplier/Homeowner on the Source's list (BMPR RASSPL, <http://www.dot.il.gov/materials/materialforms.html>) as seen in Attachment 3. Upon entrance to the facility, incoming loads shall be inspected for unacceptable materials (Attachment 4) by a certified asbestos inspector familiar with the requirements and operation procedures of the facility and trained as required by the accepted QC Plan.
- 7.5 Unloading and storage of the Manufacturer's Salvaged and Post-Consumer shingles will each be separately confined to approved designated areas.
- 7.6 Post-Consumer shingles shall be tested according to the following upon entry to the facility:
- 7.6.1 During start-up of the Source, incoming loads shall be tested by PLM at a frequency of 1 sample per 10 tons for the first 1000 tons or 1 sample per load for the first 100 loads. Start-up testing frequencies are not required if there is another approved Source in the County that has completed start-up.
- 7.6.2 If asbestos is detected during start-up frequencies, the Source shall discard the Stockpile containing the contaminated shingles and restart the sampling frequency of 1 sample per 10 tons for a further 1000 tons.
- 7.6.3 If no asbestos is detected for any of the 100 tests completed during start-up, the Source shall test all future incoming loads by PLM at a minimum frequency of 2 samples per 250 tons or 1 sample per 100 tons.
- 7.6.4 If asbestos is detected at any time during the testing process, the Stockpile containing the asbestos contaminated shingles shall be rejected and properly disposed of in a landfill.
- 7.7 Post-Consumer shingles shall be quarantined in a paddock until acceptable results from the asbestos testing are received.
- 7.8 All materials potentially containing asbestos including caulks, cements, tars and other sealants shall be removed during the sorting process.

- 7.9 Manufacturer's Salvaged shingles shall be delivered with no unacceptable material (Attachment 4).
- 7.10 Loads consisting of sorted, preprocessed, Post-Consumer shingle material ready for processing shall not exceed a cumulative total weight of 1.5 percent of felt attached to shingles, metal flashing, glass, rubber, paper, plastic, rolls or sheets of felt, or other unacceptable material (Attachment 4). This total does not include nails that are attached to the shingles and removed for recycling in conjunction with the grinding process.
- 7.11 Manufacturer's Salvaged and Post-Consumer shingles shall not be processed into the same Stockpile.
- 7.12 Processing of sorted loads of Manufacturer's Salvaged and Post-Consumer shingles shall be conducted on-site with an industrial grinder. The industrial shingle grinder shall utilize water nozzles for dust control and to reduce the heat build-up during the grinding process as needed. The final ground product shall meet the Department specifications.
- 7.13 The final Processed Shingles shall be free of visible nails and have at most 0.5 percent unacceptable material (Attachment 4). After 1/1/13 Processed Shingles shall be stored on a well drained, all weather surface that prevents contamination of the final product. Unacceptable materials shall not exceed a cumulative total of 0.5 percent by weight based on material retained on the 4.75 mm (No. 4) sieve.
- 7.14 During stockpiling, care shall be taken to avoid segregation due to wind or other causes.
- 7.15 Mechanically blending manufactured sand (FM 20 or FM 22) up to an equal weight of processed Post-Consumer or Manufacturer Salvaged RAS using Department approved calibrated feeders will be permitted to improve workability.
- 7.16 The following documentation shall be collected, maintained in bound or electronically imaged chronological files on site for a minimum of three years, and made available to the regulatory agency upon request:
- Original Supplier Certification Forms (Attachment 3, BMPR RASSPL, <http://www.dot.il.gov/materials/materialforms.html>) shall be compiled daily
 - Tonnage of Manufacturer's Salvaged and Post-Consumer shingles accepted shall be compiled monthly.
 - Tonnage of Post-Consumer shingles initially accepted but subsequently rejected and disposed of shall be compiled monthly.
 - Tonnages of processed RAS shall be compiled monthly.
 - Tonnages of preprocessed and processed Manufacturer's Salvaged and Post-Consumer shingles stored and retention times shall be compiled monthly.
 - Training records shall be compiled for each training session.
 - Copies of all environmental permits, BUDs and other authorizations issued by the Illinois EPA.

- 7.17 Copies of bills of lading shall accompany each load and be presented to the HMA plant for filing. The bills of lading shall contain the following information:
- Name and location of Source.
 - Sequence number identifying the shipment.
 - Consignee & destination.
 - Date of shipment.
 - Type of material. (Post consumer or Manufacturer's Salvaged RAS).
 - Gross, tare and net weights.
- 7.17.1 If the Source chooses to adopt the testing frequency outlined in the IDOT RAS Specifications, the initial gradation and asphalt content averages, as well as the properties of the transported stockpile, shall be included on the bill of lading.
- 7.18 Regulatory agencies shall be allowed to conduct random inspections of the facilities during normal working hours as deemed necessary and as otherwise authorized by law including C&D facilities supplying shingles to the Source.
- 7.19 Any changes to the general operation of the Source facility as documented in the QC Plan will require prior Bureau notification and approval and may require modification to the BUD or permit issued by the Illinois EPA prior to implementation.
- 8.0 **REVOCATION OF A SOURCE'S APPROVAL**
- 8.1 The Department may revoke a Source's approval for any of the following reasons:
- 8.1.1 An approved Source that fails to timely renew or to comply with the conditions of a permit, BUD or other authorization issued by the Illinois EPA or Department's criteria for approved status.
- 8.1.2 Unscheduled visits will be made to all Sources periodically by the Department. If an approved Source is not in compliance with provisions listed in Section 4, or fails to follow the Bureau's RAS policy, specification or its approved QC Plan, the Source will be removed from the approved list.
- 8.2 The Source may re-apply for approval status after 1 year. Re-application shall be in writing to the Bureau and include the specific steps taken to correct the cause for loss of certification.



David L. Lippert, P.E.
Engineer of Materials
and Physical Research

Model QC Plan

Company Name: _____

Address: _____

Contact: _____

Source/Facility Address: _____

Phone Number: _____

Hours of Business: _____

Description: Include plan view drawing of facility as attachment & identify on drawing: 1) what areas are paved, 2) paddock contents, 3) means of containment (i.e. fence, wall, locked gate, other security devices etc....).

In space provided list facility area, paddock areas & wall height).

A. Personnel (list full name, and training received for each title listed):

Title	Name	Training Received
Certified Inspector		
Sorter		
Certified Asbestos Inspector*		

* - If not an employee, list company employed under name.

B. Suppliers (list full name, company and date approved for each approved delivery person):

Name	Company	Date Approved

C. Material to be processed: Post-Consumer, Manufacturer's Salvaged, or both. (Circle one):

(Attachment 1)

D. Outline Process for inspection, sampling & asbestos testing of incoming loads:

E. Laboratory Testing (name, location, contact person, phone number):

Testing (e.g. dry shake gradation, extraction gradation & AC content, contaminants, asbestos etc.).

Test	Test Method	Frequency

F. Outline process for record keeping & storage documentation (i.e. paddock contents), include receiving & shipping dates and file storage location:

(Attachment 1)

G. Detailed processing plan (include: equipment used, products made, use of storage, scales etc...). Provide a plan view diagram showing the flow of the processing operation with labels identifying the various components:

H. Example Bill of Lading (include as attachment)

I. Describe all personnel protection equipment needed for Department inspectors.

J. Corrective actions (when required).

(Attachment 1)



The following individual certifications shall be initialed with a full signature at the bottom by a responsible officer of the Source with authority to bind the Source. This certification statement shall also be notarized.

**All
Sources
must fill
out this
section.**

Reclaimed Asphalt Shingles (RAS): *Please enter your initials into the following statements*

I, _____, certify that the RAS will be produced from shingles not classified as Asbestos Containing Material (ACM).

I, _____, certify that all RAS to be furnished to State and Local Agency projects will be sampled and tested according to the Source Quality Control Plan and be in compliance with the material requirements specified in the Department's RAS

**NOTE:
Only fill
out this
section if
you will be
processin
g Post-
Consumer
Shingles.**

Post-Consumer Shingles: *Please enter your initials into the following statements.*

I, _____, certify that only Post-Consumer Shingles that: (1) are not subject to the National Emissions Standards for Hazardous Air Pollutants (NESHAP) and (2) will be maintained separately from other C&D Debris or waste will be accepted for processing; any other type of shingle will be rejected removed from the premises.

I, _____, certify that all Post-Consumer Shingles will be managed and processed by trained personnel.

I, _____, certify that all shingle types will be sampled and tested for asbestos according to the Source Quality Control Plan.

I, _____, certify that all incoming loads of Post-Consumer Shingles will be quarantined until all asbestos testing is completed and found to be asbestos free.

I, _____, certify that all shingles within a quarantine Paddock will be immediately removed from the premises if any sample taken from within the quarantine Paddock tests positive for

**Responsible officer for the Source with
authority to bind the Source:**

Printed name

Signature

Date

Notary:

Signature

Date



Illinois Department of Transportation

Supplier Certification Form for Manufacturer's Salvaged and Post-Consumer (Tear-Off) Asphalt Shingles

PART I: Supplier Company

Please indicate which best describes the Supplier:

- ☐ <- Manufacturer Salvager ☐ <- C&D
☐ <- Roofing company ☐ <- Homeowner

Supplier

Supplier

Supplier e-

Supplier address:

PART II: Supplier Rep (unless same as PART I)

Rep's

Rep's title:

Rep's

Rep's e-

Rep's address (if not same as Supplier main address):

PART III: Shingle Verification (Please check the following boxes as directed.)

Mark all that apply.

I the undersigned certify that:

- ☐ I have completed all appropriate hauler training.
☐ All shingle material delivered is from an approved Supplier cited in the Source's Quality Control Plan.

Fill out if you
selected "C&D" or
"Roofing Company"
in PART I.

Please check ONLY ONE of the following options:

- ☐ (1): Asbestos test results are included, indicating all material is Asbestos Free.
☐ (2): Asbestos testing has been initiated but is not complete.

PART IV: To be completed by Trained Hauler/Homeowner

Trained Hauler/Homeowner (Print name)

Trained Hauler/Homeowner (Signature)

Date

e

For Source Use Only: One or two certified asbestos inspectors may fill out this section over time.

Load status: ☐ <-Accepted ☐ <-Rejected Reason for rejection: _____

Delivery Vehicle License: _____

Certified asbestos inspector (Print name)

Certified asbestos inspector (Signature)

Date

Results of asbestos testing (attached): ☐ <-Asbestos Free ☐ <-Asbestos found

Certified asbestos inspector (Print name)

Certified asbestos inspector (Signature)

Date

Suppliers List of Acceptable and Unacceptable Materials For Recycling of Post-Consumer Tear-off Asphalt Shingles

“Acceptable” materials

Include these items:

- Shingles
- Felt attached to shingles
- Nails

All other materials are “Unacceptable”

Unacceptable materials include, without limitation:

- Asbestos and asbestos-containing materials
- Wood, ply wood and sheeting
- Wire
- Cans
- Metal flashing, gutter, etc
- Rolls of sheets of felt paper
- Plastic wrap, buckets
- Paper waste
- Garbage trash or other waste materials
- Flat roofing shingles
- Rubber membrane roofing systems
- Built-up asphalt roofing
- Caulk
- Sealant
- Rubber gaskets

(Attachment 4)

APPENDIX B

RECLAIMED ASPHALT SHINGLES (RAS) (BDE)

Effective: January 1, 2012

Description. Reclaimed asphalt shingles (RAS) meeting the requirements herein will be permitted in all HMA mixtures used for overlay applications only. RAS shall not be used in full-depth HMA pavement. When RAS is used in conjunction with Reclaimed Asphalt Pavement (RAP), the RAP shall be according to the special provision, "Reclaimed Asphalt Pavement (RAP)"

Definitions. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable materials, as defined in Bureau of Materials and Physical Research Policy Memorandum "Reclaimed Asphalt Shingle (RAS) Sources", by weight of RAS. All RAS used shall come from a Bureau of Materials and Physical Research approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 93 percent passing the #4 (4.75 mm) sieve based on a dry shake gradation. RAS shall be uniform in gradation and asphalt binder content and shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.

- (a) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.
- (b) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall not be intermingled. Each stockpile shall be signed indicating what type of RAS is present.

Unless otherwise approved by the Engineer, mechanically blending manufactured sand (FM 20 or FM 22) up to an equal weight of RAS with the processed RAS will be permitted to improve workability. The sand shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The sand shall be accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type and lot number shall be maintained by project contract number and kept for a minimum of 3 years.

Testing. RAS shall be sampled and tested during stockpiling.

For testing during stockpiling, washed extraction, and testing for unacceptable materials shall be run at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 250 tons (225 metric tons) thereafter. A minimum of five tests are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-test stockpile has been established it shall be sealed. Additional incoming RAS shall be stockpiled in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

Before testing, each field sample shall be split to obtain two samples. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

Evaluation of Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. Individual test results, when compared to the averages, will be accepted if within the tolerances listed below.

Parameter	RAS
No. 8 (2.36 mm)	± 5%
No. 16 (1.18 mm)	± 5%
No. 30 (600 µm)	± 4%
No. 200 (75 µm)	± 2.0%
Asphalt Binder Content	± 1.5%

If more than 20 percent of the individual sieves are out of the gradation tolerances, or if more than 20 percent of the asphalt binder content, or if the percent unacceptable materials exceeds 0.5 percent by weight of material retained on the # 4 (4.75 mm) sieve, the RAS shall not be used in Department projects. All test data and acceptance ranges shall be sent to the District for evaluation.

Use of RAS in HMA. Type 1 or Type 2 RAS may be used alone or in conjunction with Reclaimed Asphalt Pavement (RAP) in all HMA mixtures up to a maximum of 5.0 percent by weight of total mix.

- (a) Level 1 asphalt binder replacement. The maximum Level 1 RAS or RAS/RAP blend usage will be dictated by the Level 1 – Maximum Asphalt Binder Replacement (MABR) table listed below.

HMA Mixtures ^{1/} _{2/}	Level 1 – Maximum Asphalt Binder Replacement, %		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified ^{3/, 4/}
30	35	35	10
50	30	25	10
70	25	20	10
90	20	15	10
105	10	10	10

- 1/ For HMA shoulder and stabilized subbase (HMA "All Other") N-30, the maximum binder replacement shall be 50 percent.
- 2/ When the asphalt binder replacement exceeds 20 percent for all mixtures, except for SMA and IL-4.75, the high and low virgin asphalt binder grade shall each be reduced by one grade (i.e. 25 percent asphalt binder replacement would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

3/ For SMA the maximum asphalt binder replacement shall be 20 percent. When the binder replacement exceeds 10 percent, the high and low virgin asphalt binder grade shall each be reduced by one grade (i.e. 15 percent asphalt binder replacement would require a virgin asphalt binder grade of PG76-22 to be reduced to PG70-28).

4/ For IL-4.75 mix the maximum asphalt binder replacement shall not exceed 20 percent. When the asphalt binder replacement exceeds 10 percent, the high and low virgin asphalt binder grade shall each be reduced by one grade (i.e. 15 percent asphalt binder replacement would require a virgin asphalt binder grade of PG76-22 to be reduced to a PG70-28).

(b) Level 2 asphalt binder replacement. The maximum Level 2 RAS or RAS/RAP blend usage will be dictated by the Level 2 – MABR table listed below.

HMA Mixtures ^{1/} _{2/}	Level 2 – Maximum Asphalt Binder Replacement, %		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified ^{3/, 4/}
30	40	40	10
50	40	30	10
70	30	20	10
90	30	20	10
105	30	15	10

1/ For HMA shoulder and stabilized subbase (HMA “All Other”) N-30, the maximum binder replacement shall be 50 percent.

2/ When the asphalt binder replacement exceeds 20 percent for all mixtures, except for SMA and IL-4.75, the high and low virgin asphalt binder grade shall each be reduced by one grade (i.e. 25 percent asphalt binder replacement would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

3/ For SMA the maximum asphalt binder replacement shall be 20 percent. When the binder replacement exceeds 10 percent, the high and low virgin asphalt binder grade shall each be reduced by one grade (i.e. 15 percent asphalt binder replacement would require a virgin asphalt binder grade of PG76-22 to be reduced to PG70-28).

4/ For IL-4.75 mix the maximum asphalt binder replacement shall not exceed 30 percent. When the asphalt binder replacement exceeds 10 percent, the high and low virgin asphalt binder grade shall each be reduced by one grade (i.e. 15 percent asphalt binder replacement would require a virgin asphalt binder grade of PG76-22 to be reduced to a PG70-28).

HMA Mix Designs. RAS and RAS/RAP designs shall be submitted for volumetric verification. Type 1 and Type 2 RAS are not interchangeable in a mix design. A RAS stone bulk specific gravity (Gsb) of 2.500 shall be used for mix design purposes.

RAS and RAS/RAP mix designs with asphalt binder replacements exceeding the Level 1 – MABR limits specified herein, shall be tested prior to submittal for verification, according to Illinois Modified AASHTO T324 (Hamburg Wheel). RAS and RAS/RAP mixtures exceeding the Level 1 MABR limits shall meet the following requirements.

Asphalt Binder Grade	# Repetitions	Maximum Rut Depth in. (mm)
PG76-XX	20,000	1/2 (12.5)
PG70-XX	15,000	1/2 (12.5)
PG64-XX	10,000	1/2 (12.5)
PG58-XX	10,000	1/2 (12.5)

HMA Production. Mixture production, where the RAS and RAS/RAP asphalt binder replacement exceeds the Level 1 MABR, shall be sampled within the first 500 tons (450 metric tons) on the first day of production with a split reserved for the Department. The mix sample shall be tested according to Illinois Modified AASHTO T324 and shall meet the requirements specified herein. RAS and RAS/RAP mix production shall not exceed 1500 tons (1350 metric tons) or one day's production, whichever comes first, until the testing is completed and the mixture is found to be in conformance. The requirement to cease mix production may be waived if the RAS and RAS/RAP plant produced mixture conformance is demonstrated prior to start of mix production for a State contract.

RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

When producing HMA containing RAS, a positive duct control system shall be utilized.

HMA plants utilizing RAS shall be capable of automatically recording and printing the following information.

(a) Dryer Drum Plants.

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA mix number assigned by the Department.
- (3) Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- (4) Accumulated dry weight of RAS in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- (5) Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.

- (6) Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.
- (7) Residual asphalt binder in the RAS material as a percent of the total mix to the nearest 0.1 percent.
- (8) Aggregate and RAS moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS are printed in wet condition.)

(b) Batch Plants.

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA mix number assigned by the Department.
- (3) Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).
- (4) Mineral Filler weight to the nearest pound (kilogram).
- (5) RAS weight to the nearest pound (kilogram).
- (6) Virgin asphalt binder weight to the nearest pound (kilogram).
- (7) Residual asphalt binder in the RAS material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

80282

APPENDIX C

RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES (BDE)

Effective: November 1, 2012

Revise Section 1031 of the Standard Specifications to read:

“SECTION 1031. RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES

1031.01Description. Reclaimed asphalt pavement and reclaimed asphalt shingles shall be according to the following.

- (a) Reclaimed Asphalt Pavement (RAP). RAP is the material produced by cold milling or crushing an existing hot-mix asphalt (HMA) pavement. The Contractor shall supply written documentation that the RAP originated from routes or airfields under federal, state, or local agency jurisdiction.
- (b) Reclaimed Asphalt Shingles (RAS). Reclaimed asphalt shingles (RAS). RAS is from the processing and grinding of preconsumer or post-consumer shingles. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable material, as defined in Bureau of Materials and Physical Research Policy Memorandum “Reclaimed Asphalt Shingle (RAS) Sources”, by weight of RAS. All RAS used shall come from a Bureau of Materials and Physical Research approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. (9.5 mm) sieve and 93 percent passing the #4 (4.75 mm) sieve based on a dry shake gradation. RAS shall be uniform in gradation and asphalt binder content and shall meet the testing requirements specified herein. In addition, RAS shall meet the following Type 1 or Type 2 requirements.
 - (1) Type 1. Type 1 RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.
 - (2) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

1031.02Stockpiles. RAP and RAS stockpiles shall be according to the following.

- (a) RAP Stockpiles. The Contractor shall construct individual, sealed RAP stockpiles meeting one of the following definitions. No additional RAP shall be added to the pile after the pile has been sealed. Stockpiles shall be sufficiently separated to prevent intermingling at the base. Stockpiles shall be identified by signs indicating the type as listed below (i.e. “Homogeneous Surface”).

Prior to milling, the Contractor shall request the District provide documentation on the quality of the RAP to clarify the appropriate stockpile.

- (1) Fractionated RAP (FRAP). FRAP shall consist of RAP from Class I, HMA (High and Low ESAL) mixtures. The coarse aggregate in FRAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. All FRAP shall be fractionated prior to testing by screening into a

minimum of two size fractions with the separation occurring on or between the #4 (4.75 mm) and 1/2 in. (12.5 mm) sieves. Agglomerations shall be minimized such that 100 percent of the RAP shall pass the sieve size specified below for the mix the FRAP will be incorporated.

Mixture FRAP will be used in:	Sieve Size that 100% of FRAP Shall Pass
IL-25.0	2 in. (50 mm)
IL-19.0	1 1/2 in. (40 mm)
IL-12.5	1 in. (25 mm)
IL-9.5	3/4 in. (20 mm)
IL-4.75	1/2 in. (13 mm)

- (2) Homogeneous. Homogeneous RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) mixtures and represent: 1) the same aggregate quality, but shall be at least C quality; 2) the same type of crushed aggregate (either crushed natural aggregate, ACBF slag, or steel slag); 3) similar gradation; and 4) similar asphalt binder content. If approved by the Engineer, combined single pass surface/binder millings may be considered "homogenous" with a quality rating dictated by the lowest coarse aggregate quality present in the mixture.
- (3) Conglomerate. Conglomerate RAP stockpiles shall consist of RAP from Class I, HMA (High and Low ESAL) mixtures. The coarse aggregate in this RAP shall be crushed aggregate and may represent more than one aggregate type and/or quality but shall be at least C quality. This RAP may have an inconsistent gradation and/or asphalt binder content prior to processing. All conglomerate RAP shall be processed prior to testing by crushing to where all RAP shall pass the 5/8 in. (16 mm) or smaller screen. Conglomerate RAP stockpiles shall not contain steel slag.
- (4) Conglomerate "D" Quality (DQ). Conglomerate DQ RAP stockpiles shall consist of RAP from Class I, HMA (High or Low ESAL), or "All Other" (as defined by Article 1030.04(a)(3)) mixtures. The coarse aggregate in this RAP may be crushed or round but shall be at least D quality. This RAP may have an inconsistent gradation and/or asphalt binder content. Conglomerate DQ RAP stockpiles shall not contain steel slag.
- (5) Non-Quality. RAP stockpiles that do not meet the requirements of the stockpile categories listed above shall be classified as "Non-Quality".

RAP/FRAP containing contaminants, such as earth, brick, sand, concrete, sheet asphalt, bituminous surface treatment (i.e. chip seal), pavement fabric, joint sealants, etc., will be unacceptable unless the contaminants are removed to the satisfaction of the Engineer. Sheet asphalt shall be stockpiled separately.

- (b) RAS Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall not be intermingled. Each stockpile shall be signed indicating what type of RAS is present.

Unless otherwise approved by the Engineer, mechanically blending manufactured sand (FM 20 or FM 22) up to an equal weight of RAS with the processed RAS will be permitted to improve workability. The sand shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The sand shall be accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type and lot number shall be maintained by project contract number and kept for a minimum of three years.

1031.03 Testing. RAP/FRAP and RAS testing shall be according to the following.

(a) RAP/FRAP Testing. When used in HMA, the RAP/FRAP shall be sampled and tested either during or after stockpiling.

(1) During Stockpiling. For testing during stockpiling, washed extraction samples shall be run at the minimum frequency of one sample per 500 tons (450 metric tons) for the first 2000 tons (1800 metric tons) and one sample per 2000 tons (1800 metric tons) thereafter. A minimum of five tests shall be required for stockpiles less than 4000 tons (3600 metric tons).

(2) After Stockpiling. For testing after stockpiling, the Contractor shall submit a plan for approval to the District proposing a satisfactory method of sampling and testing the RAP/FRAP pile either in-situ or by restockpiling. The sampling plan shall meet the minimum frequency required above and detail the procedure used to obtain representative samples throughout the pile for testing.

Each sample shall be split to obtain two equal samples of test sample size. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedure. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

(b) RAS Testing. RAS or RAS blended with manufactured sand shall be sampled and tested during stockpiling according to Illinois Department of Transportation Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Source".

Samples shall be collected during stockpiling at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 250 tons (225 metric tons) thereafter. A minimum of five samples are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton (900 metric ton), five-sample/test stockpile has been established it shall be sealed. Additional incoming RAS or RAS blended with manufactured sand shall be stockpiled in a separate working pile as designated in the Quality Control plan and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

Before testing, each sample shall be split to obtain two test samples. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall perform a washed extraction and test for unacceptable materials on the

other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

If the sampling and testing was performed at the shingle processing facility in accordance with the QC Plan, the Contractor shall obtain and make available all of the test results from start of the initial stockpile.

1031.04 Evaluation of Tests. Evaluation of tests results shall be according to the following.

- (a) Evaluation of RAP/FRAP Test Results. All of the extraction results shall be compiled and averaged for asphalt binder content and gradation and, when applicable G_{mm} . Individual extraction test results, when compared to the averages, will be accepted if within the tolerances listed below.

Parameter	FRAP/Homogeneous/Conglomerate	Conglomerate "D" Quality
1 in. (25 mm)		$\pm 5 \%$
1/2 in. (12.5 mm)	$\pm 8 \%$	$\pm 15 \%$
No. 4 (4.75 mm)	$\pm 6 \%$	$\pm 13 \%$
No. 8 (2.36 mm)	$\pm 5 \%$	
No. 16 (1.18 mm)		$\pm 15 \%$
No. 30 (600 μm)	$\pm 5 \%$	
No. 200 (75 μm)	$\pm 2.0 \%$	$\pm 4.0 \%$
Asphalt Binder	$\pm 0.4 \%$ ^{1/}	$\pm 0.5 \%$
G_{mm}	± 0.03	

1/ The tolerance for FRAP shall be $\pm 0.3 \%$.

If more than 20 percent of the individual sieves and/or asphalt binder content tests are out of the above tolerances, the RAP/FRAP shall not be used in HMA unless the RAP/FRAP representing the failing tests is removed from the stockpile. All test data and acceptance ranges shall be sent to the District for evaluation.

With the approval of the Engineer, the ignition oven may be substituted for extractions according to the Illinois Test Procedure, "Calibration of the Ignition Oven for the Purpose of Characterizing Reclaimed Asphalt Pavement (RAP)".

- (b) Evaluation of RAS and RAS Blended with Manufactured Sand Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content and gradation. Individual test results, when compared to the averages, will be accepted if within the tolerances listed below.

Parameter	RAS
No. 8 (2.36 mm)	$\pm 5 \%$
No. 16 (1.18 mm)	$\pm 5 \%$
No. 30 (600 μm)	$\pm 4 \%$
No. 200 (75 μm)	$\pm 2.0 \%$
Asphalt Binder Content	$\pm 1.5 \%$

If more than 20 percent of the individual sieves and/or asphalt binder content tests are out of the above tolerances, or if the percent unacceptable material exceeds 0.5 percent by weight of material retained on the # 4 (4.75 mm) sieve, the RAS or RAS blend shall not be used in Department projects. All test data and acceptance ranges shall be sent to the District for evaluation.

1031.05 Quality Designation of Aggregate in RAP/FRAP.

(a) RAP. The aggregate quality of the RAP for homogenous, conglomerate, and conglomerate "D" quality stockpiles shall be set by the lowest quality of coarse aggregate in the RAP stockpile and are designated as follows.

- (1) RAP from Class I, Superpave/HMA (High ESAL), or (Low ESAL) IL-9.5L surface mixtures are designated as containing Class B quality coarse aggregate.
- (2) RAP from Superpave/HMA (Low ESAL) IL-19.0L binder mixture is designated as Class D quality coarse aggregate.
- (3) RAP from Class I, Superpave/HMA (High ESAL) binder mixtures, bituminous base course mixtures, and bituminous base course widening mixtures are designated as containing Class C quality coarse aggregate.
- (4) RAP from bituminous stabilized subbase and BAM shoulders are designated as containing Class D quality coarse aggregate.

(b) FRAP. If the Engineer has documentation of the quality of the FRAP aggregate, the Contractor shall use the assigned quality provided by the Engineer.

If the quality is not known, the quality shall be determined as follows. Coarse and fine FRAP stockpiles containing plus #4 (4.75 mm) sieve coarse aggregate shall have a maximum tonnage of 5,000 tons (4,500 metric tons). The Contractor shall obtain a representative sample witnessed by the Engineer. The sample shall be a minimum of 50 lb (25 kg). The sample shall be extracted according to Illinois Modified AASHTO T 164 by a consultant prequalified by the Department for the specified testing. The consultant shall submit the test results along with the recovered aggregate to the District Office. The cost for this testing shall be paid by the Contractor. The District will forward the sample to the BMPR Aggregate Lab for MicroDeval Testing, according to Illinois Modified AASHTO T 327. A maximum loss of 15.0 percent will be applied for all HMA applications.

1031.06 Use of RAP/FRAP and/or RAS in HMA. The use of RAP/FRAP and/or RAS shall be a Contractor's option when constructing HMA in all contracts.

(a) RAP/FRAP. The use of RAP/FRAP in HMA shall be as follows.

- (1) Coarse Aggregate Size. The coarse aggregate in all RAP shall be equal to or less than the nominal maximum size requirement for the HMA mixture to be produced.

- (2) Steel Slag Stockpiles. Homogeneous RAP stockpiles containing steel slag will be approved for use in all HMA (High ESAL and Low ESAL) Surface and Binder Mixture applications.
- (3) Use in HMA Surface Mixtures (High and Low ESAL). RAP/FRAP stockpiles for use in HMA surface mixtures (High and Low ESAL) shall be FRAP or homogeneous in which the coarse aggregate is Class B quality or better. RAP/FRAP from Conglomerate stockpiles shall be considered equivalent to limestone for frictional considerations. Known frictional contributions from plus #4 (4.75 mm) homogeneous RAP and FRAP stockpiles will be accounted for in meeting frictional requirements in the specified mixture.
- (4) Use in HMA Binder Mixtures (High and Low ESAL), HMA Base Course, and HMA Base Course Widening. RAP/FRAP stockpiles for use in HMA binder mixtures (High and Low ESAL), HMA base course, and HMA base course widening shall be FRAP, homogeneous, or conglomerate, in which the coarse aggregate is Class C quality or better.
- (5) Use in Shoulders and Subbase. RAP/FRAP stockpiles for use in HMA shoulders and stabilized subbase (HMA) shall be FRAP, homogeneous, conglomerate, or conglomerate DQ.
- (6) When the Contractor chooses the RAP option, the percentage of RAP shall not exceed the amounts indicated in Article 1031.06(c)(1) below for a given N Design.
- (b) RAS. RAS meeting Type 1 or Type 2 requirements will be permitted in all HMA applications as specified herein.
- (c) RAP/FRAP and/or RAS Usage Limits. Type 1 or Type 2 RAS may be used alone or in conjunction with RAP or FRAP in HMA mixtures up to a maximum of 5.0% by weight of the total mix.
- (1) RAP/RAS. When RAP is used alone or RAP is used in conjunction with RAS, the percentage of virgin asphalt binder replacement shall not exceed the amounts listed in the Max RAP/RAS ABR table listed below for the given Ndesign.

RAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage

HMA Mixtures ^{1/} _{2/}	RAP/RAS Maximum ABR %		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified
30	30	30	10
50	25	15	10
70	15	10	10
90	10	10	10
105	10	10	10

1/ For HMA "All Other" (shoulder and stabilized subbase) N-30, the RAP/RAS ABR shall not exceed 50 percent of the mixture.

- 2/ When RAP/RAS ABR exceeds 20 percent, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when RAP/RAS ABR exceeds 25 percent (i.e. 26 percent RAP/RAS ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).
- (2) FRAP/RAS. When FRAP is used alone or FRAP is used in conjunction with RAS, the percentage of virgin asphalt binder replacement shall not exceed the amounts listed in the FRAP/RAS tables listed below for the given N design.

Level 1 - FRAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage

HMA Mixtures ^{1/, 2/}	Level 1 - FRAP/RAS Maximum ABR %		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified ^{3/, 4/}
30	35	35	10
50	30	25	10
70	25	20	10
90	20	15	10
105	10	10	10

- 1/ For HMA "All Other" (shoulder and stabilized subbase) N30, the FRAP/RAS ABR shall not exceed 50 percent of the mixture.
- 2/ When FRAP/RAS ABR exceeds 20 percent for all mixes the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when FRAP/RAS ABR exceeds 25 percent (i.e. 26 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).
- 3/ For SMA the FRAP/RAS ABR shall not exceed 20 percent.
- 4/ For IL-4.75 mix the FRAP/RAS ABR shall not exceed 20 percent.

Level 2 – FRAP/RAS Maximum Asphalt Binder Replacement (ABR) Percentage

HMA Mixtures ^{1/, 2/}	Level 2 – FRAP/RAS Maximum ABR %		
Ndesign	Binder/Leveling Binder	Surface	Polymer Modified ^{3/, 4/}
30	40	40	10

50	40	30	10
70	30	20	10
90	30	20	10
105	30	15	10

- 1/ For HMA "All Other" (shoulder and stabilized subbase) N30, the FRAP/RAS ABR shall not exceed 50 percent of the mixture.
- 2/ When FRAP/RAS ABR exceeds 20 percent for all mixes the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28). If warm mix asphalt (WMA) technology is utilized, and production temperatures do not exceed 275 °F (135 °C) the high and low virgin asphalt binder grades shall each be reduced by one grade when FRAP/RAS ABR exceeds 25 percent (i.e. 26 percent ABR would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).
- 3/ For SMA the FRAP/RAS ABR shall not exceed 20 percent.
- 4/ For IL-4.75 mix the FRAP/RAS ABR shall not exceed 30 percent.

1031.07HMA Mix Designs. At the Contractor's option, HMA mixtures may be constructed utilizing RAP/FRAP and/or RAS material meeting the above detailed requirements.

FRAP/RAS mix designs exceeding the Level 1 FRAP/RAS Maximum ABR percentages shall be tested prior to submittal for verification, according to Illinois Modified AASHTO T 324 (Hamburg Wheel) and shall meet the following requirements.

Asphalt Binder Grade	# Repetitions	Max. Rut Depth in. (mm)
PG76-XX	20,000	1/2 (12.5)
PG70-XX	15,000	1/2 (12.5)
PG64-XX	7,500	1/2 (12.5)
PG58-XX	5,000	1/2 (12.5)

- (a) RAP/FRAP and/or RAS. RAP/FRAP and/or RAS designs shall be submitted for volumetric verification. If additional RAP/FRAP stockpiles are tested and found that no more than 20 percent of the results, as defined under "Testing" herein, are outside of the control tolerances set for the original RAP/FRAP stockpile and HMA mix design, and meets all of the requirements herein, the additional RAP/FRAP stockpiles may be used in the original mix design at the percent previously verified.
- (b) RAS. Type 1 and Type 2 RAS are not interchangeable in a mix design. A RAS stone bulk specific gravity (Gsb) of 2.500 shall be used for mix design purposes.

1031.08HMA Production. Mixture production where the FRAP/RAS ABR percentage exceeds the Level 1 limits, shall be sampled within the first 500 tons (450 metric tons) on the first day of production with a split reserved for the Department. The mix sample shall be tested according to the Illinois Modified AASHTO T 324 and shall meet the requirements specified herein. Mix production shall not exceed 1500 tons (1350 metric tons) or one day's

production, whichever comes first, until the testing is completed and the mixture is found to be in conformance. The requirement to cease mix production may be waived if the plant produced mixture conformance is demonstrated prior to start of mix production for a State contract.

- (a) RAP/FRAP. The coarse aggregate in all RAP/FRAP used shall be equal to or less than the nominal maximum size requirement for the HMA mixture being produced.

To remove or reduce agglomerated material, a scalping screen, gator, crushing unit, or comparable sizing device approved by the Engineer shall be used in the RAP feed system to remove or reduce oversized material. If material passing the sizing device adversely affects the mix production or quality of the mix, the sizing device shall be set at a size specified by the Engineer.

If the RAP/FRAP control tolerances or QC/QA test results require corrective action, the Contractor shall cease production of the mixture containing RAP/FRAP and either switch to the virgin aggregate design or submit a new RAP/FRAP design.

- (b) RAS. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that the mixture production is halted when RAS flow is interrupted.

When producing HMA containing RAS, a positive dust control system shall be utilized.

- (c) RAP/FRAP and/or RAS. HMA plants utilizing RAP/FRAP and/or RAS shall be capable of automatically recording and printing the following information.

(1) Dryer Drum Plants.

- a. Date, month, year, and time to the nearest minute for each print.
- b. HMA mix number assigned by the Department.
- c. Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- d. Accumulated dry weight of RAP/FRAP/RAS in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- e. Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.
- f. Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.

- g. Residual asphalt binder in the RAP/FRAP material as a percent of the total mix to the nearest 0.1 percent.
- h. Aggregate and RAP/FRAP moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAP/FRAP are printed in wet condition.)

(2) Batch Plants.

- a. Date, month, year, and time to the nearest minute for each print.
- b. HMA mix number assigned by the Department.
- c. Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).
- d. Mineral filler weight to the nearest pound (kilogram).
- f. RAP/FRAP/RAS weight to the nearest pound (kilogram).
- g. Virgin asphalt binder weight to the nearest pound (kilogram).
- h. Residual asphalt binder in the RAP/FRAP/RAS material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.

1031.09RAP in Aggregate Surface Course and Aggregate Shoulders. The use of RAP in aggregate surface course and aggregate shoulders shall be as follows.

- (a) Stockpiles and Testing. RAP stockpiles may be any of those listed in Article 1031.02, except "Non-Quality" and "FRAP". The testing requirements of Article 1031.03 shall not apply.
- (b) Gradation. One hundred percent of the RAP material shall pass the 1 1/2 in. (37.5 mm) sieve. The RAP material shall be reasonably well graded from coarse to fine. RAP material that is gap-graded or single sized will not be accepted."

80306

APPENDIX D

Shingle Market and Asphalt Savings Calculator

County	Total Population	Annual Tons		Annual Regional Tons	Tipping + Sale Value @ \$70/ton	Liquid Asphalt Savings @ Dif of \$300/ton	Regional Tipping + Sale Value	Regional Liquid Asphalt Savings
		Shingles						
		Generated Based upon	60lbs/person					
Cook	5,288,655	158,660			\$ 11,106,176	\$ 10,471,537		
DuPage	932,670	27,980			\$ 1,958,607	\$ 1,846,687		
Lake	713,076	21,392			\$ 1,497,460	\$ 1,411,890		
Will	668,217	20,047			\$ 1,403,256	\$ 1,323,070		
Kane	493,735	14,812			\$ 1,036,844	\$ 977,595		
McHenry	312,373	9,371	252,262		\$ 655,983	\$ 618,499	\$ 17,658,325	\$ 16,649,277
Winnebago	295,635	8,869			\$ 620,834	\$ 585,357		
Madison	265,303	7,959			\$ 557,136	\$ 525,300		
St. Clair	260,919	7,828	15,787		\$ 547,930	\$ 516,620	\$ 1,105,066	\$ 1,041,920
Sangamon	193,524	5,806			\$ 406,400	\$ 383,178		
Champaign	185,682	5,570			\$ 389,932	\$ 367,650		
Peoria	182,495	5,475			\$ 383,240	\$ 361,340		
McLean	161,202	4,836			\$ 338,524	\$ 319,180		
Rock Island	147,545	4,426			\$ 309,845	\$ 292,139		
Tazewell	130,559	3,917	9,392		\$ 274,174	\$ 258,507	\$ 657,413	\$ 619,847
La Salle	113,065	3,392			\$ 237,437	\$ 223,869		
Macon	109,309	3,279			\$ 229,549	\$ 216,432		
Kankakee	109,090	3,273			\$ 229,089	\$ 215,998		
DeKalb	100,139	3,004			\$ 210,292	\$ 198,275		
Kendall	88,158	2,645			\$ 185,132	\$ 174,553		
Vermilion	81,941	2,458			\$ 172,076	\$ 162,243		
Adams	67,221	2,017			\$ 141,164	\$ 133,098		
Williamson	63,740	1,912			\$ 133,854	\$ 126,205		
Whiteside	59,880	1,796			\$ 125,748	\$ 118,562		
Jackson	57,778	1,733			\$ 121,334	\$ 114,400		
Ogle	54,826	1,645			\$ 115,135	\$ 108,555		
Knox	52,906	1,587			\$ 111,103	\$ 104,754		
Boone	52,617	1,579			\$ 110,496	\$ 104,182		
Coles	50,949	1,528			\$ 106,993	\$ 100,879		
Henry	50,339	1,510	5,937		\$ 105,712	\$ 99,671	\$ 415,556	\$ 391,810
Macoupin	48,841	1,465			\$ 102,566	\$ 96,705		
Stephenson	47,388	1,422			\$ 99,515	\$ 93,828		
Grundy	45,828	1,375			\$ 96,239	\$ 90,739		
Jefferson	40,523	1,216			\$ 85,098	\$ 80,236		
Marion	40,088	1,203			\$ 84,185	\$ 79,374		
Franklin	39,862	1,196			\$ 83,710	\$ 78,927		
Livingston	38,658	1,160			\$ 81,182	\$ 76,543		
Woodford	37,904	1,137			\$ 79,598	\$ 75,050		
Fulton	37,378	1,121			\$ 78,494	\$ 74,008		
Clinton	36,633	1,099			\$ 76,929	\$ 72,533		
Lee	35,701	1,071			\$ 74,972	\$ 70,688		

County	Total Population	Annual Tons Shingles Generated Based upon		Annual Regional Tons	Tipping + Sale Value @ \$70/ton	Liquid Asphalt Savings @ Dif of \$300/ton	Regional Tipping + Sale Value	Regional Liquid Asphalt Savings
		60lbs/person						
Morgan	35,666	1,070		\$	74,899	\$	70,619	
Bureau	35,257	1,058		\$	74,040	\$	69,809	
Christian	35,063	1,052		\$	73,632	\$	69,425	
Effingham	34,429	1,033		\$	72,301	\$	68,169	
Randolph	33,028	991		\$	69,359	\$	65,395	
Monroe	31,876	956		\$	66,940	\$	63,114	
McDonough	31,823	955		\$	66,828	\$	63,010	
Iroquois	30,598	918		\$	64,256	\$	60,584	
Montgomery	30,367	911		\$	63,771	\$	60,127	
Logan	30,302	909		\$	63,634	\$	59,998	
Saline	26,062	782		\$	54,730	\$	51,603	
Perry	22,865	686		\$	48,017	\$	45,273	
Jersey	22,628	679		\$	47,519	\$	44,803	
Jo Daviess	22,594	678		\$	47,447	\$	44,736	
Shelby	22,172	665		\$	46,561	\$	43,901	
Fayette	21,774	653		\$	45,725	\$	43,113	
Crawford	19,825	595		\$	41,633	\$	39,254	
Douglas	19,791	594		\$	41,561	\$	39,186	
Edgar	19,183	575		\$	40,284	\$	37,982	
Hancock	19,091	573		\$	40,091	\$	37,800	
Union	18,261	548		\$	38,348	\$	36,157	
Bond	18,055	542		\$	37,916	\$	35,749	
Warren	17,480	524		\$	36,708	\$	34,610	
Clark	16,987	510		\$	35,673	\$	33,634	
Pike	16,840	505		\$	35,364	\$	33,343	
Mercer	16,786	504		\$	35,251	\$	33,236	
De Witt	16,768	503		\$	35,213	\$	33,201	
Piatt	16,688	501		\$	35,045	\$	33,042	
Wayne	16,602	498		\$	34,864	\$	32,872	
Carroll	16,035	481		\$	33,674	\$	31,749	
Lawrence	15,887	477		\$	33,363	\$	31,456	
Richland	15,724	472		\$	33,020	\$	31,134	
Mason	15,503	465		\$	32,556	\$	30,696	
Massac	15,135	454		\$	31,784	\$	29,967	
White	15,078	452		\$	31,664	\$	29,854	
Washington	14,927	448		\$	31,347	\$	29,555	
Moultrie	14,383	431		\$	30,204	\$	28,478	
Greene	14,255	428		\$	29,936	\$	28,225	
Ford	14,211	426		\$	29,843	\$	28,138	
Clay	14,028	421		\$	29,459	\$	27,775	
Cass	13,766	413		\$	28,909	\$	27,257	
Johnson	13,360	401		\$	28,056	\$	26,453	
Marshall	13,003	390		\$	27,306	\$	25,746	
Menard	12,588	378		\$	26,435	\$	24,924	

County	Total Population	Annual Tons Shingles Generated Based upon		Annual Regional Tons	Tipping + Sale Value @ \$70/ton	Liquid Asphalt Savings @ Dif of \$300/ton	Regional Tipping + Sale Value	Regional Liquid Asphalt Savings
		60lbs/person						
Wabash	12,457	374			\$ 26,160	\$ 24,665		
Cumberland	11,000	330			\$ 23,100	\$ 21,780		
Jasper	9,880	296			\$ 20,748	\$ 19,562		
Alexander	8,635	259			\$ 18,134	\$ 17,097		
Hamilton	8,335	250			\$ 17,504	\$ 16,503		
Henderson	7,819	235			\$ 16,420	\$ 15,482		
Schuyler	6,984	210			\$ 14,666	\$ 13,828		
Pulaski	6,726	202			\$ 14,125	\$ 13,317		
Brown	6,701	201			\$ 14,072	\$ 13,268		
Edwards	6,617	199			\$ 13,896	\$ 13,102		
Stark	6,233	187			\$ 13,089	\$ 12,341		
Gallatin	6,159	185			\$ 12,934	\$ 12,195		
Putnam	6,005	180			\$ 12,611	\$ 11,890		
Scott	5,377	161			\$ 11,292	\$ 10,646		
Calhoun	5,177	155			\$ 10,872	\$ 10,250		
Hardin	4,585	138			\$ 9,629	\$ 9,078		
Pope	4,184	126			\$ 8,786	\$ 8,284		
Total	12,831,970	282,303			\$ 26,947,137	\$ 25,407,301		

Assumptions:

Tipping Fee (dumping income to collector) = \$30/ton

RAS Sale Value = \$40/ton

Liquid Asphalt savings = Cost of Liquid Asphalt - Cost of Shingle Asphalt = \$300/ton of Liquid Asphalt

Post consumer shingles - 11 M tons/year + 1 M tons manufactures waste

2013 USA Population - 315 M

Ave Pounds of singles per person in US -

70 lbs/person/Yr ave in US

Asphalt shingle used more in Illinois more than other areas so pounds/person higher in IL than USA use

However a number of tons of waste are from commercial buildings not allowed for recycling -

use 60 lbs/person/yr for Illinois estimate of shingles available for recycling.

Matching highlighted areas are regional urban areas