

**Effect of Recovered
Binders from Recycled
Shingles and Increased
RAP Percentages on
Resultant Binder PG**

SPR # 0092-10-06

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December 2011

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Technical Report Documentation Page

1. Report No. WHRP 11-13	2. Government Accession No	3. Recipient's Catalog No	
4. Title and Subtitle Effect of Recovered Binders from Recycled Shingles and Increased RAP Percentages on Resultant Binder PG		5. Report Date December, 2011	6. Performing Organization Code Wisconsin Highway Research Program
7. Authors Ramon Bonaquist		8. Performing Organization Report No.	
9. Performing Organization Name and Address Advanced Asphalt Technologies, LLC 108 Powers Court, Suite 100 Sterling, VA 20166		10. Work Unit No. (TRAI5)	11. Contract or Grant No. WisDOT SPR# 0092-10-06
12. Sponsoring Agency Name and Address Wisconsin Department of Transportation Division of Business Services Research Coordination Section 4802 Sheboygan Ave. Rm 104 Madison, WI 53707		13. Type of Report and Period Covered Final Report, 2009-2011	14. Sponsoring Agency Code
15. Supplementary Notes			
16. Abstract This research evaluated the properties of recycled asphalt binders from Wisconsin sources. Continuous grading properties were measured for 18 recycled binder sources: 12 reclaimed asphalt pavement (RAP) sources and 6 recycled asphalt shingle sources (RAS). The data were used to evaluate the binder replacement criteria contained in the 2011 Wisconsin Department of Transportation (WisDOT) Standard Specifications for Highway and Structure Construction using a reliability analysis. This analysis considered the variability of both the design pavement temperature and the blended binder in the mixture. Recommendations were made to improve the reliability of the low temperature grade of the binder in the mixtures when recycled sources are used.			
17. Key Words Reclaimed asphalt pavement (RAP), recycled asphalt shingles (RAS), recycled binder, performance grade		18. Distribution Statement No restriction. This document is available to the public through the National Technical Information Service 5285 Port Royal Road Springfield VA 22161	
19. Security Classif.(of this report) Unclassified	19. Security Classif. (of this page) Unclassified	20. No. of Pages	21. Price

Executive Summary

Project Summary

This research evaluated the properties of recycled asphalt binders from Wisconsin sources. Continuous grading properties were measured for 18 recycled binder sources: 12 reclaimed asphalt pavement (RAP) sources and 6 recycled asphalt shingle sources (RAS). The data were used to evaluate the binder replacement criteria contained in the 2011 Wisconsin Department of Transportation (WisDOT) Standard Specifications for Highway and Structure Construction using a reliability analysis. This analysis considered the variability of both the design pavement temperature and the blended binder in the mixture. Recommendations were made to improve the reliability of the low temperature grade of the binder in the mixtures when recycled sources are used.

Background

The use of RAP and RAS in asphalt concrete is increasing because they provide economic and environmental benefits. These recycled materials reduce the amount of virgin aggregate and virgin asphalt binder required to produce asphalt concrete resulting in significant cost savings to the producer and the specifying agency. Adding recycled materials to asphalt concrete also conserves natural resources and landfill space, and reduces energy consumption. The Federal Highway Administration's (FHWA) policy on the use of recycled materials states: "*...recycled materials should get first consideration in materials selection ... and Restrictions that prohibit the use of recycled materials without technical basis should be removed from specifications.*"

One of the concerns with using recycled binders in asphalt concrete is the effect of the aged recycled binder on the performance grade of the binder in the mixture. Research completed in National Cooperative Highway Research Program (NCHRP) Project 9-12 concluded that the performance grading properties of binders in mixtures containing RAP can be reasonably estimated from the properties of the virgin binder and the properties of binder recovered from the RAP using a linear blending analysis. This procedure has been incorporated into the AASHTO specification for the design of Superpave mixtures, AASHTO M 323, *Standard Specification for Superpave Volumetric Mix Design*.

AASHTO PP53, *Standard Practice for Design Considerations When Using Reclaimed Asphalt Shingles (RAS) in New Hot-Mix Asphalt (HMA)*, recommends that the AASHTO M 323 blending analysis also be used with RAS binders. However, it is difficult to apply this procedure in practice because the continuous grade of recovered RAS binders cannot be easily determined using available binder testing equipment.

Given the recent increase in virgin binder prices and the FHWA's policy that recycling be given priority, there will be increased pressure to use mixtures with higher recycled binder contents in the future. There is, therefore, a need for a structured study to improve the AASHTO blending chart analyses to address RAS binders. The improved procedure should then be applied to typical recycled materials in Wisconsin to develop recommendations for appropriate use of RAP and RAS in asphalt mixtures. This research project addressed these needs.

Process

This project included three major studies: (1) review of current practice, (2) blending chart improvements, and (3) characterization of Wisconsin recycled materials. The first study, review of current practice, was conducted to evaluate WisDOT's 2010 binder replacement criteria relative to other agencies and to review the NCHRP Project 9-12 research that led to the development of the AASHTO M323 blending chart procedure. From this review detailed experimental plans for the two laboratory studies were prepared. The second study, blending chart improvements, was conducted to extend the AASHTO M323 blending chart analysis to include RAS binders and multiple recycled binders. It included performance grading analysis of blends of RAS, RAP, and RAS and RAP in PG 58-28 and PG 70-28 binders. In the third study, characterization of Wisconsin recycled materials, the improved blending chart analysis was applied to 18 recycled materials from Wisconsin. The data from this study was used to evaluate WisDOT's 2011 criteria for binder replacement, and to identify potential effects of using RAP and RAS on pavement service life.

Findings and Conclusions

The blending chart improvement study demonstrated that the linear blending charts included in AASHTO M323 can be extended to RAS and blends of RAS and RAP. The general blending

chart procedure for multiple binders was prepared in the form of a standard practice and is included as an appendix to this report.

Continuous grading properties were measured for 18 recycled sources used in Wisconsin. The recycled sources included 6 RAP stockpiles, 6 fractionate RAP (FRAP) stockpiles, and 6 RAS stockpiles. For each type of recycled material 3 sources from northern Wisconsin and 3 sources from southern Wisconsin were sampled and characterized. The recycled binder characterization study found that the continuous grading properties of binder recovered from Wisconsin RAP and FRAP sources to be very similar. The properties were not affected by the type of recycled binder, RAP or FRAP, nor the geographic location of the recycled binder. The average recovered continuous grade for RAP was PG 82.8 (26.9) – 21.8. The recycled binder characterization study also found that the continuous grading properties of binder recovered from Wisconsin RAS sources showed a geographical difference with southern sources being somewhat softer compared to northern sources. The average extrapolated continuous grade for southern sources was PG 113.1 (31.0) -8.4 and average extrapolated continuous grade for northern sources was PG 122.1 (34.4) -4.7.

The WisDOT 2011 binder replacement criteria were evaluated using a reliability analysis. This analysis considered both the variability of the design temperature at a given project location and the variability of the binder supplied. The reliability analysis used data from 170 weather stations included in LTPPBind for Wisconsin; 79 designated for low temperature grade of -28 °C and 61 for low temperature grade of -34 °C based on current WisDOT binder grade selection. The overall reliability of the low temperature performance grade, the reliability that the specified intermediate temperature grade was met, and the overall reliability that adding recycled binders increases the high temperature performance grade to PG 64 were evaluated. This evaluation found the following:

1. The WisDOT virgin binder selection provides high reliability for the low temperature performance grade throughout Wisconsin.

2. Adding recycled binders decreases the reliability of the low temperature performance grade and the effect is greater at locations having the lowest reliability based on the virgin binder selection.
3. The 2011 WisDOT binder replacement criteria for RAP and RAS do not result in equivalent changes to the low temperature performance grade reliability. When RAS binders are used, there is significantly lower reliability that the blended binder will meet the low pavement design temperature.
4. Adding recycled binders increases the high temperature performance grade of the combined binder. However, 25 percent RAP binder replacement does not reliably increase the high temperature performance grade to 64 °C when the variability of the binder is considered. The use of 20 percent RAS binder replacement does increase the performance grade of the binder to 64 °C.

Recommendations

The reliability analysis was used to develop recommended binder replacement criteria that treat RAP and RAS mixtures equally and provide high reliability that the blended binder will meet the low pavement design temperature. For surface courses these recommendations reduce the allowable RAP binder from 25 to 20 percent and the allowable RAS binder from 20 percent to 5 percent. For lower layers, defined as layers below 50 mm from the pavement surface, these recommendations increase the allowable RAP binder from 40 to 45 percent, but decrease the allowable RAS binder from 25 to 20 percent. RAS/RAP substitution rules for mixtures containing both RAP and RAS were also recommended. Recommendations were also made for using the reliability analysis to approve mixtures with binder replacement exceeding the standard binder replacement criteria, and for monitoring the continuous grading properties of recycled and virgin binder sources in Wisconsin.

Acknowledgements

The author acknowledges the contributions made by several organizations and individuals to the success of the project including:

- Ms. Judie Ryan and the members of the Technical Oversight Committee for their assistance in finalizing the recycled material sources included in the project, and their review and oversight of the work presented in this report.
- Mr. Andrew Hanz from the Department of Civil and Environmental Engineering at the University of Wisconsin – Madison for collecting samples of the recycled materials used in the project and arranging for their shipment to Sterling, VA.
- Wisconsin producers who provided the recycled materials used in the project.

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Chapter 1 Introduction and Research Approach

1.1 Background

The use of reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS) in asphalt concrete is increasing because they provide economic and environmental benefits. These recycled materials reduce the amount of virgin aggregate and virgin asphalt binder required to produce asphalt concrete resulting in significant cost savings to the producer and the specifying agency. Adding recycled materials to asphalt concrete also conserves natural resources and landfill space, and reduces energy consumption. The Federal Highway Administration's (FHWA) policy on the use of recycled materials includes the following statements (1):

"...Recycled materials should get first consideration in materials selection. ... Restrictions that prohibit the use of recycled materials without technical basis should be removed from specifications." The FHWA policy also states that *"FHWA has a longstanding position that any material used in highway or bridge construction, be it virgin or recycled, shall not adversely affect the performance, safety or the environment of the highway system."* This remains a cornerstone in our policy statement."

One of the concerns with using recycled binders in asphalt concrete is the effect of the aged recycled binder on the performance grade of the binder in the mixture (2). National Cooperative Highway Research Program (NCHRP) Project 9-12 addressed this concern for RAP binders (3). The product of this research was a blending chart procedure for estimating the performance grade of the binder in a mixture containing RAP. This procedure has been incorporated into the AASHTO specification for the design of Superpave mixtures, AASHTO M 323, *Standard Specification for Superpave Volumetric Mix Design*.

Figure 1 presents a flow chart of the testing that is required to prepare a blending chart for a specific RAP binder. The RAP binder testing involves determining critical temperatures, T_C , for the recovered RAP binder for high, intermediate, and low pavement temperatures. The critical temperature is the temperature where the properties of the RAP binder meet the specification requirements contained in the performance graded binder specification, AASHTO M 320,

Standard Specification for Performance-Graded Asphalt Binder. These requirements are summarized in Table 1. For high and low pavement temperature conditions, two criteria must be considered. The critical temperature for the high pavement temperature condition is the lower of the two, while that for the low pavement temperature condition is the higher of the two. This testing is also known as determining the “true” or “continuous” grade of the binder. The testing is performed in the same manner as grading a new binder except the intermediate and low temperature properties are measured on residue from the Rolling Thin Film Oven Test (RTFOT), AASHTO T 240, instead of residue from the Pressure Aging Vessel (PAV), AASHTO R 28. Research conducted in NCHRP 9-12 on a limited number of RAP sources concluded that the AASHTO M 320 properties of a blend of RAP and new binder could be accurately estimated from the as-recovered and RTFOT aged RAP binder without the need for performing PAV aging of the recovered RAP binder. This finding reduces the testing time and the amount of recovered binder needed for the testing.

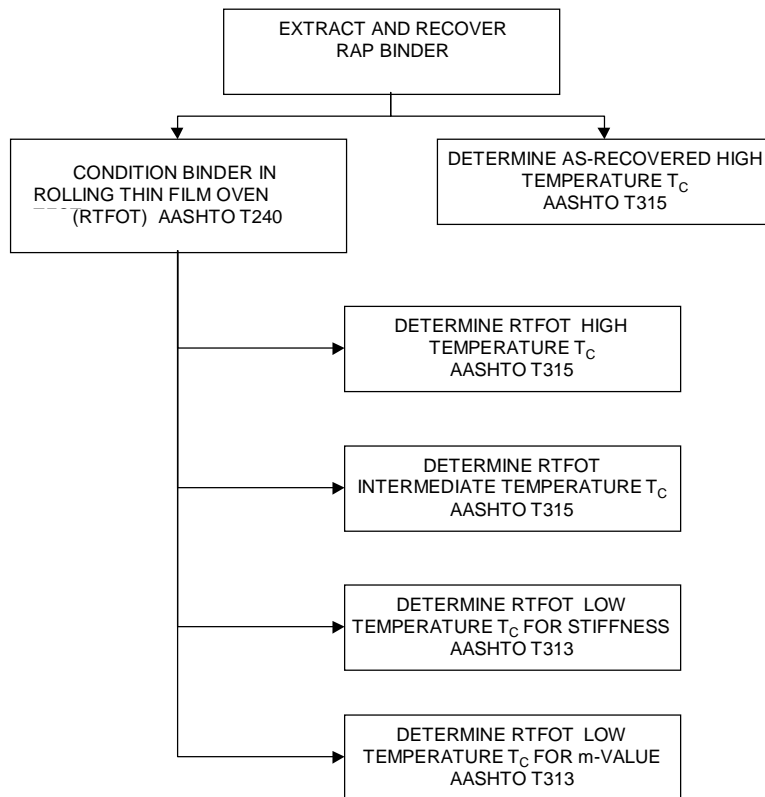


Figure 1. Flow Chart for RAP Binder Testing.

Table 1. Criteria for Determining Critical Temperatures.

Critical Temperature	Criteria	Sample
High Pavement Temperature	$G^*/\sin\delta = 1.00$ kPa	As Recovered
	$G^*/\sin\delta = 2.20$ kPa	RTFOT Aged
Intermediate Pavement Temperature	$G^*\sin\delta = 5000$ kPa	RTFOT Aged
Low Pavement Temperature	$S = 300$ MPa	RTFOT Aged
	$m = 0.300$	RTFOT Aged

AASHTO PP53, *Standard Practice for Design Considerations When Using Reclaimed Asphalt Shingles (RAS) in New Hot-Mix Asphalt (HMA)*, recommends that the AASHTO M 323 blending chart analysis also be used with RAS binders. However, it is difficult to apply this procedure in practice because the continuous grade of recovered RAS binders cannot be easily determined using available binder testing equipment. Shingle binders are usually air blown and have extremely high stiffness at high pavement temperatures. As a result, temperatures where $G^*/\sin\delta$ reaches the AASHTO M 320 specification requirement of 2.2 kPa are in the range of 124 to 154 °C, well above the normal high temperature range for paving grade binders. The low temperature properties of shingle binders are also much different. The temperature where the low temperature stiffness exceeds the AASHTO M 320 specification requirement of 300 MPa can be very low, often below -36 °C, the low temperature limit of the bending beam rheometer. Also, the temperature where the AASHTO M320 specification requirement for the m-value of 0.300 is reached for shingle binders is above 0 °C, the high temperature limit of the bending beam rheometer.

1.2 Problem Statement and Objectives

To effectively use RAP and RAS in asphalt mixtures and maintain acceptable performance at low temperatures, the Wisconsin Department of Transportation (WisDOT) needs to evaluate the effect of RAP and RAS binders on the properties of the blended binder in the mixture by constructing blending charts for recycled materials commonly used in Wisconsin. Although AASHTO M 323 includes a procedure for developing and using blending charts for performance graded binders, there are several shortcomings that must be addressed to effectively apply this approach to current practice in Wisconsin:

1. RAS binders were not included in the original NCHRP 9-12 research. These binders have substantially different rheology compared to aged paving grade binders. It is difficult to directly measure the continuous grade of these binders using available binder testing equipment. The continuous grade of the recycled binder is required for the current analysis.
2. In the current procedure, the recovered binder is not conditioned in the Pressure Aging Vessel (PAV) prior to measuring the intermediate and low temperature properties of the recycled binder. The limited number of binders tested in NCHRP 9-12 supported this practice, but for relatively soft recycled binders from northern climates, further aging may occur in-service indicating the need to PAV aged the recycled binder.
3. NCHRP Project 9-12 did not address the use of multiple recycled binders in a mixture. Many suppliers are interested in producing mixtures with both RAP and RAS, and the applicability of linear blending charts to these mixtures should be verified.
4. The current AASHTO procedure does not consider reliability. It uses average properties of the virgin and recycled binders and therefore represents a 50 percent reliability level. Higher reliability levels may be appropriate for certain distresses and pavement types.

Given the recent increase in virgin binder prices and the FHWA's policy that recycling be given priority, there will be increased pressure to use mixtures with higher recycled binder contents in the future. There is, therefore, a need for a structured study to improve the AASHTO blending chart analyses to address the shortcomings listed above. The improved procedure should then be applied to typical recycled materials in Wisconsin to develop recommendations for appropriate use of RAP and RAS in asphalt mixtures. This research project addressed these needs. The objectives of the research were to: (1) improve the AASHTO performance graded binder blending chart analysis, (2) use the improved blending chart analysis to evaluate current WisDOT criteria for binder replacement, and (3) identify potential effects of using RAP and RAS on pavement service life, both positive and negative.

1.3 Research Approach

The project included three major studies: (1) review of current practice, (2) blending chart improvements, (3) characterization of Wisconsin recycled materials. The first study, review of current practice, was conducted to evaluate WisDOT's 2010 binder replacement criteria relative to other agencies and to review the NCHRP Project 9-12 research that led to the development of the AASHTO M323 blending chart procedure. From this review detailed experimental plans for the two laboratory studies were prepared. The second study, blending chart improvements, was conducted to extend the AASHTO M323 blending chart analysis to include RAS binders and multiple recycled binders. It included performance grading analysis of blends of RAS, RAP, and RAS and RAP in PG 58-28 and PG 70-28 binders. In the third study, characterization of Wisconsin recycled materials, the improved blending chart analysis was applied to 18 recycled materials from Wisconsin. The data from this study were used to evaluate the 2011 WisDOT criteria for binder replacement, and to identify potential effects of using RAP and RAS on pavement service life.

Chapter 2 Review of Current Practice

2.1 Introduction

A review of current practice was conducted to evaluate WisDOT's 2010 binder replacement criteria relative to other agencies and to review the NCHRP Project 9-12 research that led to the development of the AASHTO M323 blending chart procedure. This review included the following:

1. Section 460, Hot Mix Asphalt Pavement, of the WisDOT 2010 Standard Specifications. Section 460.2.5, Recycled Asphaltic Materials, includes WisDOT's limits for binder replacement.
2. Standard Specifications, Supplemental Specifications, and Special Provisions from states allowing RAP and tear off RAS. Specifications from Alabama, Georgia, Minnesota, Missouri, South Carolina, Texas, and Virginia were reviewed.
3. AASHTO standards associated with the use of RAP and RAS in hot mix asphalt including: (1) AASHTO M323, *Superpave Volumetric Mix Design*, (2) AASHTO MP 15, *Use of Reclaimed Asphalt Shingles as an Additive in Hot Mix Asphalt (HMA)*, and (3) AASHTO PP 53, *Design Considerations When Using Reclaimed Asphalt Shingles in New Hot Mix Asphalt*.
4. NCHRP Web Document 30 (Project D9-12): Contractor's Final: Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method. This report documents the research that led to the binder grade change and blending chart analysis included in AASHTO M323.

2.2 Allowable Amounts of Recycled Asphalt Binders

2.2.1 WisDOT

The WisDOT 2010 Standard Specifications limit the percentage of the total binder in a mixture that can be replaced with recycled binder. The limits depend on the type of recycled binder being used and the location of the mixture in the pavement structure. Table 2 presents the maximum allowable percent binder replacement contained in Section 460.2.5 of the WisDOT

2010 Standard Specifications. The use of binder replacement as a specification criterion for recycled materials is very reasonable. Since recycled and virgin mixtures must meet the same mixture design and acceptance criteria, the primary reason for limiting the amount of recycled material in the mixture is to limit the effect that the stiffer recycled binders have on the properties of the binder in the mixture. The potential detrimental effect of recycled binders is an increase in the low temperature grade and the intermediate stiffness of the binder in the mixture. Increasing the low temperature grade increases the potential for thermal cracking while increasing the intermediate stiffness increases the potential for surface initiated cracking. Allowing higher percentages of recycled binders in lower layers is also reasonable, because these layers are not subjected to tire contact stresses and the extreme low temperature that occurs at the surface of the pavement. Since RAS binders are much stiffer than RAP binders, the lower limits for mixtures that include RAS binders are also reasonable. The higher allowable limits for mixtures with fractionated RAP (FRAP) can only be justified if the properties of the recycled binder in FRAP are less variable than in non fractionated RAP.

Table 2. WisDOT 2010 Maximum Allowable Percent Binder Replacement.

Recycled Material	Lower Layers	Upper Layers
RAS	20	15
RAP	35	20
FRAP	35	25
RAS and RAP	30	20
RAS and FRAP	30	25
RAS, RAP, and FRAP	30	25

2.2.2 Comparison With Other States

The specifications from Alabama, Georgia, Minnesota, Missouri, South Carolina, Texas, and Virginia were reviewed and compared to the WisDOT 2010 specifications. These states were selected because they permit the use of both RAP, and RAS from tear off sources. Of the specifications reviewed, WisDOT is the only specification based solely on percent binder replacement. The other specifications are based on recycled material as a percent of the total mixture or as a percent of the aggregate in the mixture. The specifications in Minnesota, Missouri, Texas, and Virginia also place requirements on the percent binder replacement. In order to compare the other specifications to WisDOT's, the following assumptions were made:

1. Mixture with a total binder content of 5 percent by weight of total mixture,
2. RAP having a binder content of 5 percent, and
3. RAS having a binder content of 20 percent.

Table 3 summarizes Alabama’s allowable RAP and RAS contents for dense graded mixtures. Alabama specifies the maximum recycled material content based on percentage of aggregate weight and allows a maximum of 3 percent tear off RAS and 5 percent manufacturer RAS. For RAP and RAS combinations, Alabama allows RAS to be substituted for RAP up to the limits of 3 percent for tear off RAS and 5 percent for manufacturer RAS. Table 3 also presents allowable RAP and RAS contents based on percent binder replacement for the assumed mixture. An interesting consequence of Alabama’s one for one substitution of RAS for RAP is that the highest binder replacement occurs for mixtures of RAP and RAS at its maximum allowable percentage and this replacement is significantly higher than that allowed if only RAS was used.

Table 3. Allowable RAS and RAP Contents for Alabama.

Mix	Alabama Specification				Allowable Binder Replacement for the Assumed Mixture, %				
	Allowable Recycled Material Content, percent of aggregate weight								
	RAP	RAP and RAS	Tear Off RAS	Mgr RAS	RAP	RAP and Tear Off RAS	RAP and Mgr RAS	Tear Off RAS	Mgr RAS
Bituminous Base	25	20	3	5	24	28	33	11	19
Intermediate	25	20	3	5	24	28	33	11	19
Surface	20	15	3	5	19	23	29	11	19

Georgia permits up to 40 percent of the total mixture to be RAP in mixtures produced in drum mix plants and up to 25 percent in mixtures produced in batch plants. RAS is limited to 5 percent of the total mixture and can be either tear off or manufacturer RAS. RAP and RAS cannot be combined in a mixture. Georgia also places a requirement that the combined virgin and recycled binder after Rolling Thin Film Oven conditioning have an absolute viscosity at 60 °C that is between 600 and 1600 Pa·s. From the performance grading system, a PG 64 binder would have an absolute viscosity around 500 Pa·s at 60 °C, so this requirement allows the recycled binder to approximately triple the viscosity of the combined binder. Based on the

assumed mixture, the binder replacement permitted in Georgia is up to 40 percent for RAP and 20 percent for RAS provided the binder viscosity requirement can be met.

Minnesota’s allowable recycled material contents depend on traffic level and type of recycled material being used. They are expressed as percent of the mixture and are summarized in Table 4. Table 4 also summarizes allowable RAP and RAS contents based on percent binder replacement for the assumed mixture. For cases where RAP and RAS are combined, the Minnesota specifications limit the maximum binder replacement to 30 percent, the maximum value allowed for RAP in surface mixtures.

Table 4. Allowable RAS and RAP Contents for Minnesota.

Traffic Level, MESAL	Minnesota Specification						Allowable Binder Replacement for the Assumed Mixture, %					
	Allowable Recycled Material Content, % of Mixture											
	RAP		Manufacturer RAS		Tear Off RAS		RAP		Manufacturer RAS		Tear Off RAS	
	Surface	Lower	Surface	Lower	Surface	Lower	Surface	Lower	Surface	Lower	Surface	Lower
< 1	30	40	5	5	5	5	30	40	20	20	20	20
1 to <3	30	30	5	5	5	5	30	30	20	20	20	20
3 to <10	30	30	5	5	0	5	30	30	20	20	0	20
10 to <30	30	30	5	5	0	0	30	30	20	20	0	0

Missouri permits RAP to make up 20 percent of the mixture without changing the grade of the binder. Greater than 20 percent RAP is permitted provided a blending chart analysis shows that the blended binder meets the specified performance grade. For the assumed mixture, 20 percent RAP by weight of total mixture replaces 20 percent of the binder in the mixture. Missouri also permits up to 7 percent RAS in mixtures without changing the grade of the binder provided the binder replacement is less than 30 percent. For the assumed mixture 7 percent RAS by weight of total mixture replaces 28 percent of the binder in the mixture. It is interesting that the Missouri specifications permit greater binder replacement when using stiffer RAS binder than when using RAP. The Missouri specifications do not address combining RAP and RAS in the same mixture.

Table 5 summarizes South Carolina’s allowable RAP and RAS contents for dense graded mixtures. South Carolina specifies maximum recycled material content based on percentage of aggregate weight and allows a maximum of 5 percent RAS in any mixture. The South Carolina

specifications do not address combining RAP and RAS in the same mixture. Table 5 also presents allowable RAP and RAS contents based on percent binder replacement for the assumptions listed above. For the assumed mixture, the allowable binder replacement is 5 to 10 percent less when using RAS compared to RAP.

Table 5. Allowable RAS and RAP Contents for South Carolina.

Mix	South Carolina Specification			Allowable Binder Replacement for the Assumed Mixture, %		
	Allowable Recycled Material Content, percent of aggregate weight			RAP	Fractionated RAP	RAS
	RAP	Fractionated RAP	RAS			
Surface A	0	10	0	0	10	0
Surface B	15	20	0	14	19	0
Surface C	20	25	5	19	24	19
Surface CM	20	25	0	19	24	0
Surface D	20	25	5	19	24	19
Surface E	0	25*	5	0	24	19
Intermediate A	0	10	0	0	10	0
Intermediate B	20	25	0	19	24	0
Intermediate C	25	30	5	24	29	19
Base A	30	30	5	29	29	19
Base B	30	30	5	29	29	19
Base C	0	30*	5	0	29	19
Base D	0	30*	5	0	29	19

* Fractionated Fine RAP only

The Texas specifications include criteria for both recycled content by weight of mixture and binder replacement. Table 6 presents these requirements. The Texas specifications permit FRAP and RAS to be combined in a mixture, with up to 5 percent RAS being substituted for an equal amount of FRAP. In most cases, the allowable recycled content by weight of the mixture will govern. The maximum binder replacement criteria will only govern when RAS is used in combination with FRAP.

Table 6. Allowable RAS and RAP Contents for Texas.

Mix	Texas Specifications				Allowable Binder Replacement for the Assumed Mixture, %			
	Maximum Allowable Binder Replacement, %	Allowable Recycled Material Content, % of Mixture			RAP	Fractionated RAP	RAS	Fractionated RAP +RAS
		RAP	Fractionated RAP	RAS				
Surface	35	10	20	5	10	20	20	35
Non-surface < 8 in below the surface	40	15	30	5	15	30	20	45
Non-surface > 8 in below the surface	45	20	40	5	20	40	20	55

The Virginia specifications permit RAP, RAS, and combinations of RAP and RAS to be used. Table 7 summarizes the Virginia specifications. When RAP and RAS are combined in a mixture, the binder replacement is limited to 25 percent. For mixtures not requiring polymer modified binder, Virginia has increased the low temperature grade from -22 to -16 °C to accommodate higher recycled materials contents. The combined binder in the mixture must meet the grade specified for the designated mixture.

Table 7. Allowable RAP and RAS Contents for Virginia.

Mix	Virginia Specifications			Allowable Binder Replacement for the Assumed Mixture, %	
	Allowable Recycled Material Content, % of Mixture		Maximum Allowable Binder Replacement for Mixture with Both RAP and RAS, %	RAP	RAS
	RAP	RAS			
Surface	30	5	25	30	20
Intermediate	30	5	25	30	20
Base	35	5	25	35	20

Figures 2 and 3 compare the WisDOT 2010 allowable binder replacement with the range of allowable binder replacement computed from the specifications for five of the six states using the assumed mixture. Georgia’s specification requirements were not included because Georgia places requirements on the combined binder in the mixture; therefore, a change in binder grade may be required to use the maximum amount of RAP or RAS. The ranges shown in Figures 2 and 3 for the other states are based on requirements that do not require a change in the grade of the binder. Like Wisconsin, some states permit higher recycled binder contents if blending chart analyses show that the blended binder meets the requirements of the grade specified for the project. Except for the combination of RAP and RAS in surface mixtures, the WisDOT 2010

requirements for binder replacement fall within the range of those computed for the assumed mixture for the other states. For the combination of RAP and RAS in surface mixtures, the WisDOT 2010 maximum allowable binder replacement is lower than the range for the other states. Figure 2 shows that for surface mixtures, the WisDOT 2010 maximum allowable binder replacement tends to be conservative based on the range of the other states. This is probably due to the fact that most of the states included in the analysis are south of Wisconsin, with less emphasis placed on thermal cracking. Figure 3 shows that for lower layers, the WisDOT 2010 maximum allowable binder replacement is near the middle of the range except for RAP and FRAP where they are at the upper end of the range from the other states.

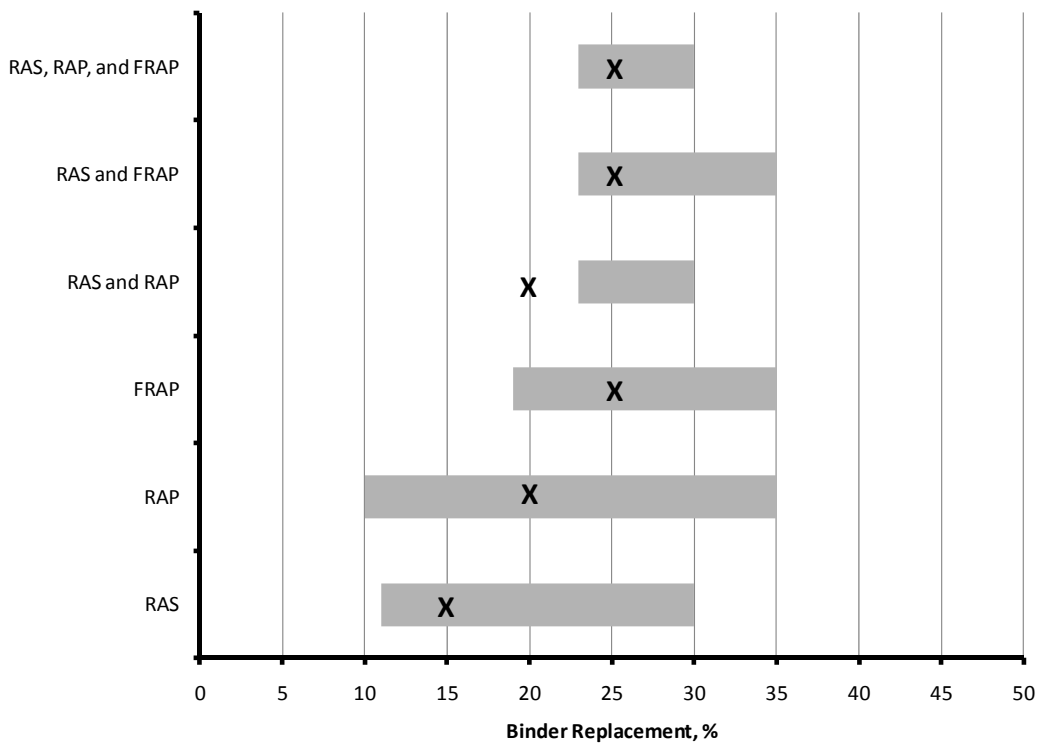


Figure 2. Comparison of Allowable Binder Replacement for Surface Mixtures.

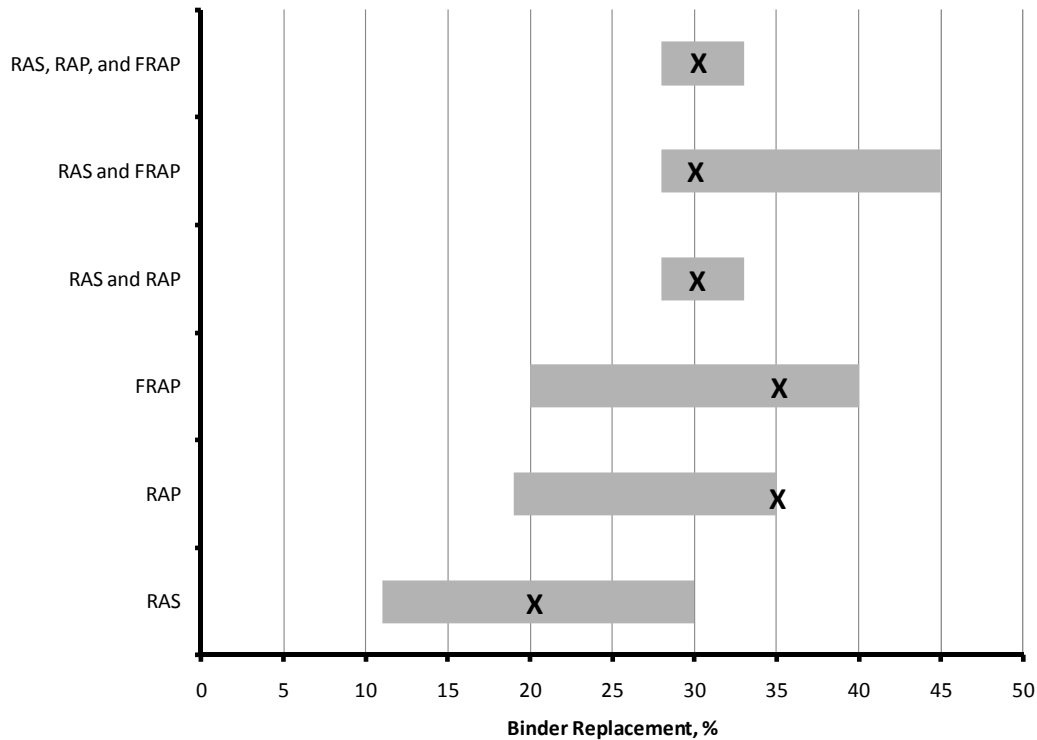


Figure 3. Comparison of Allowable Binder Replacement for Lower Layer Mixtures.

2.3 Blending Charts

2.3.1 RAP Blending Charts

Mixtures incorporating RAP are designed assuming complete blending of the new and recycled binders. Blending charts are used to estimate the grade of the combined binder in mixtures with RAP. The method for blending chart analysis is presented in the appendix to AASHTO M323. It consists of the following steps.

1. Extract and recover the RAP binder. It is recommended that AASHTO T319, *Quantitative Extraction and Recovery of Asphalt Binder From Hot Mix Asphalt*, or the combination of Method A of AASHTO T164, *Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)* and ASTM D5404, *Recovery of Asphalt from Solution Using the Rotary Evaporator*.
2. Determine the temperature where the as-recovered binder meets the AASHTO M320 tank binder high temperature grade requirement that $G^*/\sin\delta = 1.0$ kPa.

3. Condition the binder in the Rolling Thin Film Oven Test (RTFOT), AASHTO T240, *Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)*.
4. Determine the temperature where the RTFOT conditioned recovered binder meets the AASHTO M320 RTFOT binder high temperature grade requirement that $G^*/\sin\delta = 2.2$ kPa.
5. Determine the temperature where the RTFOT conditioned recovered binder meets the AASHTO M320 intermediate grade temperature requirement that $G^*\cdot\sin\delta = 5,000$ kPa.
6. Determine the temperature where the RTFOT conditioned recovered binder meets the AASHTO M320 low temperature grade requirement that the bending beam rheometer stiffness = 300 MPa.
7. Determine the temperature where the RTFOT conditioned recovered binder meets the AASHTO M320 low temperature grade requirement that the bending beam rheometer m-value = 0.300.
8. Use the continuous grade temperatures of the virgin binder and the continuous grade temperatures of the RAP binder from Steps 1 through 7 in linear blending charts for tank $G^*/\sin\delta$, RTFOT $G^*/\sin\delta$, $G^*\cdot\sin\delta$, S, and m-value.

One aspect of this procedure that is often questioned is the use of RTFOT conditioned recovered RAP binder in the intermediate and low temperature grading where Pressure Aging Vessel (PAV) residue is normally used. This issue was addressed during the development of the procedure in NCHRP Project 9-12. As part of NCHRP 9-12, three recovered RAP binders were blended (hard, intermediate, and soft) with two virgin binders (PG 58-34 and PG 64-22) at three percentages of 10, 20, and 40. The continuous grades for the 18 combinations were estimated using the proposed procedure. The blends were also graded in accordance with AASHTO R29, which included PAV conditioning for the intermediate and low temperature properties. Figures 4 through 7 present the comparisons for RTFOT high temperature $G^*/\sin\delta$, intermediate temperature $G^*\cdot\sin\delta$, low temperature S, and low temperature m-value. These figures show the data reported in the NCHRP Project 9-12 report and the best fit linear relationship having an intercept through zero.

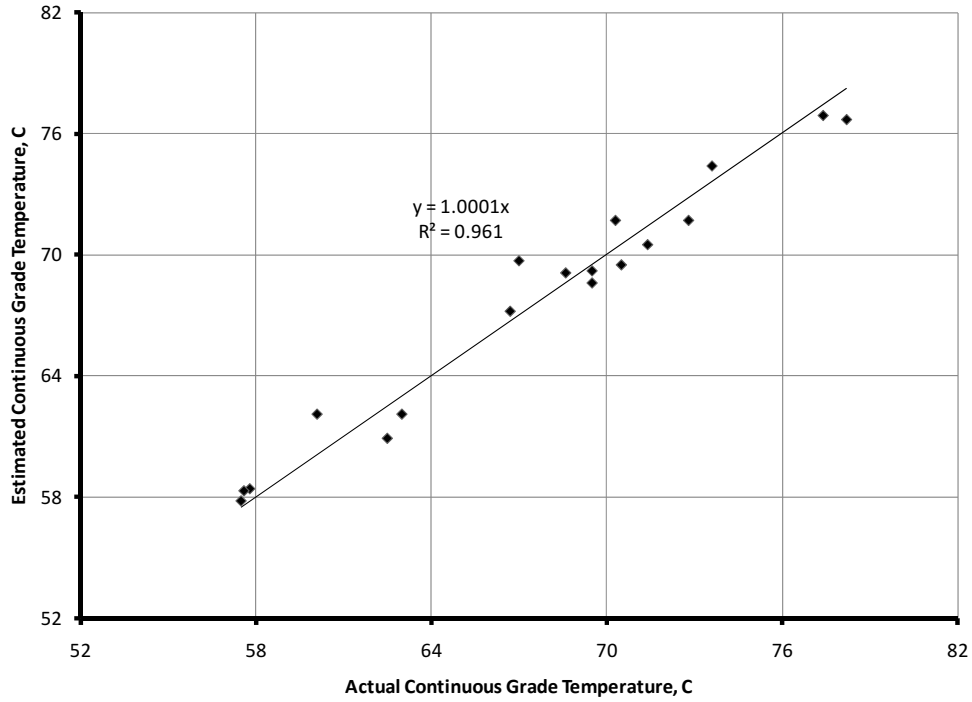


Figure 4. Comparison of Actual and Estimated Continuous RTFOT High Temperature Grade (Data From NCHRP 9-12 Report (3)).

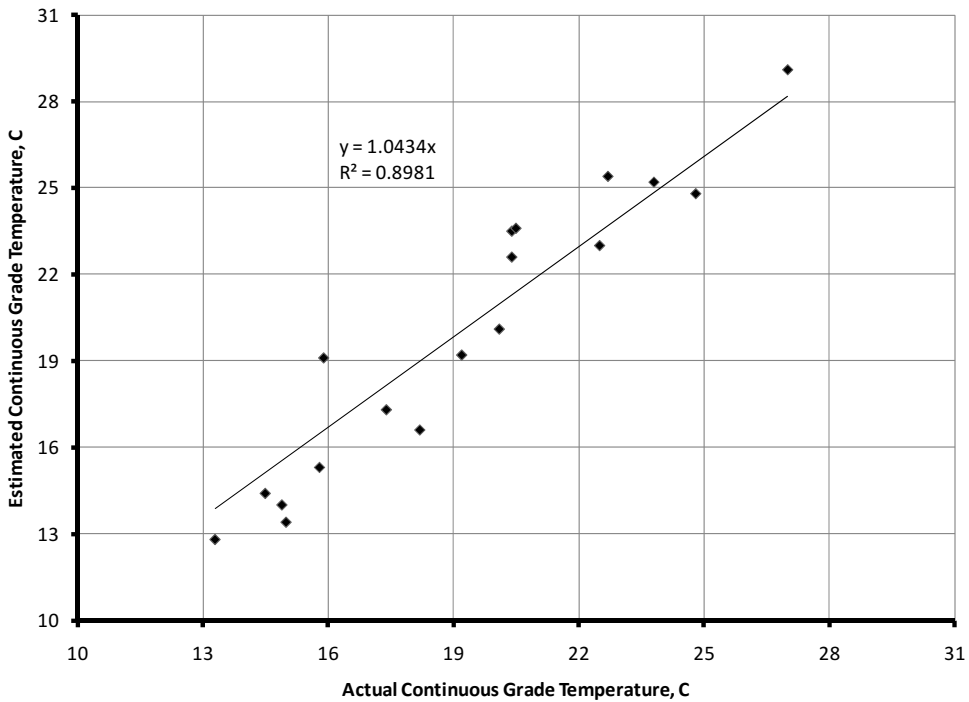


Figure 5. Comparison of Actual and Estimated Continuous Intermediate Temperature Grade (Data From NCHRP 9-12 Report (3)).

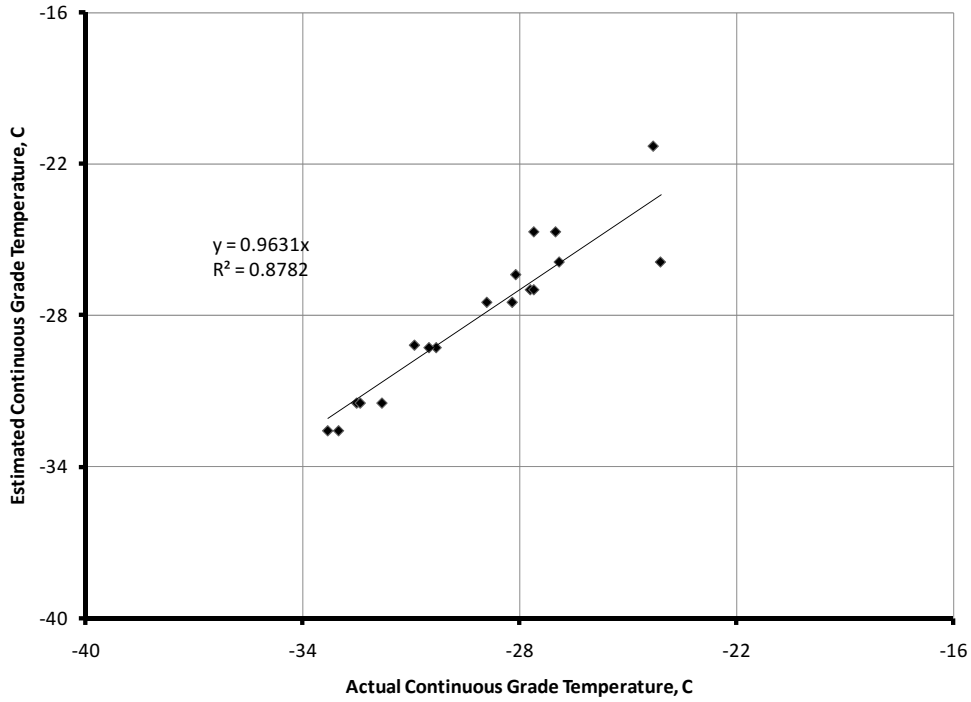


Figure 6. Comparison of Actual and Estimated Continuous Low Temperature Grade Based on Stiffness (Data From NCHRP 9-12 Report (3)).

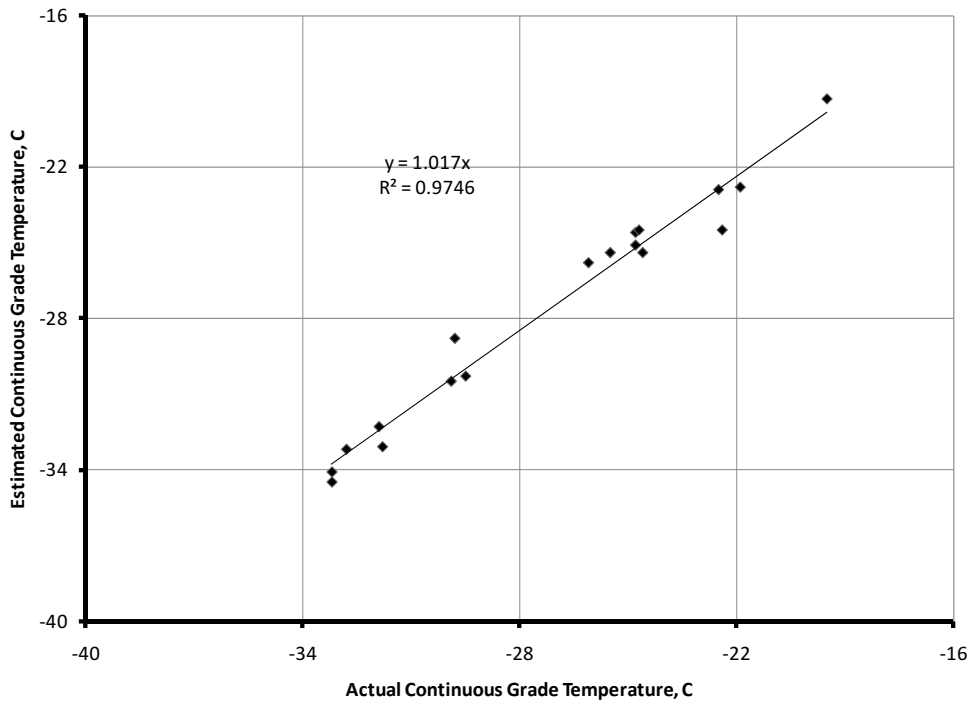


Figure 7. Comparison of Actual and Estimated Continuous Low Temperature Grade Based on m-value (Data From NCHRP 9-12 Report (3)).

These figures show that the blending chart analysis based on only RTFOT aging of the recovered binder provides an excellent estimate of the AASHTO M320 grade of the blended binders. The explained variance is quite high ranging from 0.88 to 0.97 and the slope of the best fit line is approximately one, even for the intermediate and low temperature grade data which included PAV aging when measuring the grade of the blended binders. Figure 4 shows that there is no bias for the RTFOT high temperature grade. The slope of the best fit line is 1.0001 and the explained variance is 0.96. Figure 5 shows that there is a small bias in the intermediate grade temperature. The slope of the best fit line is 1.0434 and the explained variance is 0.90. This indicates that there is a bias of approximately 4 percent, but the bias is in the opposite direction as would be expected when using RTFOT aged RAP properties to estimate PAV aged blended binder properties. The estimated intermediate temperature using PAV virgin properties and RTFOT aged RAP properties is higher than the actual intermediate grade of the blended binder. Figure 6 also shows that there is a small bias in the estimated low temperature grade based on stiffness. The slope of the best fit line is 0.9631 and the explained variance is 0.88. Like the intermediate temperature grade, the bias is small, approximately 4 percent and in the opposite direction as would be expected when using RTFOT aged RAP properties to estimate PAV aged blended binder properties. The estimated low temperature grade using PAV virgin properties and RTFOT aged RAP properties is higher than the actual stiffness based low temperature grade of the blended binder. Finally Figure 7 shows that there is also a small bias in the estimated low temperature grade based on m-value. The slope of the best fit line is 1.017 and the explained variance is 0.97. The bias for the m-value is in the direction that would be expected when using RTFOT aged RAP properties to estimate PAV aged blended binder properties. The estimated low temperature grade using PAV virgin properties and RTFOT aged RAP properties is lower than the actual m-value low temperature grade of the blended binder. For -28 binders, the bias is only approximately 0.5 °C.

Based on this analysis, it is not necessary to investigate whether PAV aging of the recovered RAP binder is necessary for the AASHTO M323 blending chart analysis. The bias in estimating the intermediate and low temperature properties of the blended binder from RTFOT conditioned RAP binder are approximately 1 °C for intermediate temperature grading and 0.5 °C for low temperature grading for binder grades that are typically used in Wisconsin.

2.3.2 RAS Blending Chart

A second issue with the AASHTO M323 blending chart analysis that is relevant to this project is the procedure cannot be applied to RAS binders. Although AASHTO PP53 recommends using the AASHTO M323 blending chart analysis with RAS binders, the continuous grade of recovered RAS binders cannot be determined using available binder testing equipment. Shingle binders are usually air blown and have extremely high stiffness at high pavement temperatures. As a result, temperatures where $G^*/\sin\delta$ reaches the AASHTO M320 specification requirement of 2.2 kPa are in the range of 124 to 154 °C, well above the normal high temperature ranges for paving grade binders. The low temperature properties of shingle binders are also much different. The temperature where the low temperature stiffness exceeds the AASHTO M320 specification requirement of 300 MPa can be very low, often below -36 °C, the low temperature limit of the bending beam rheometer. Also, the temperature where the AASHTO M320 specification requirement for the m-value of 0.300 is reached for shingle binders is above 0 °C, the high temperature limit of the bending beam rheometer.

Two approaches for developing blending charts for RAS binders using available binder testing equipment were identified. The first is to obtain the critical temperatures from a binder master curve developed using a combination of dynamic shear rheometer and bending beam rheometer tests at multiple temperatures. This approach requires extensive testing, fitting the data to a complicated rheological model, and then using the model to compute the critical temperatures for the loading rate of the various specification tests. The second approach is to measure the required properties on a blend of virgin binder and RAS binder. If the properties of the virgin binder are known, and linear blending applies, then the properties of the RAS binder can be extrapolated as shown schematically in Figure 8. Because this second approach is much easier to understand and implement, it was further developed in this research project. The procedure for developing a blending chart for RAS binder using this approach is described below.

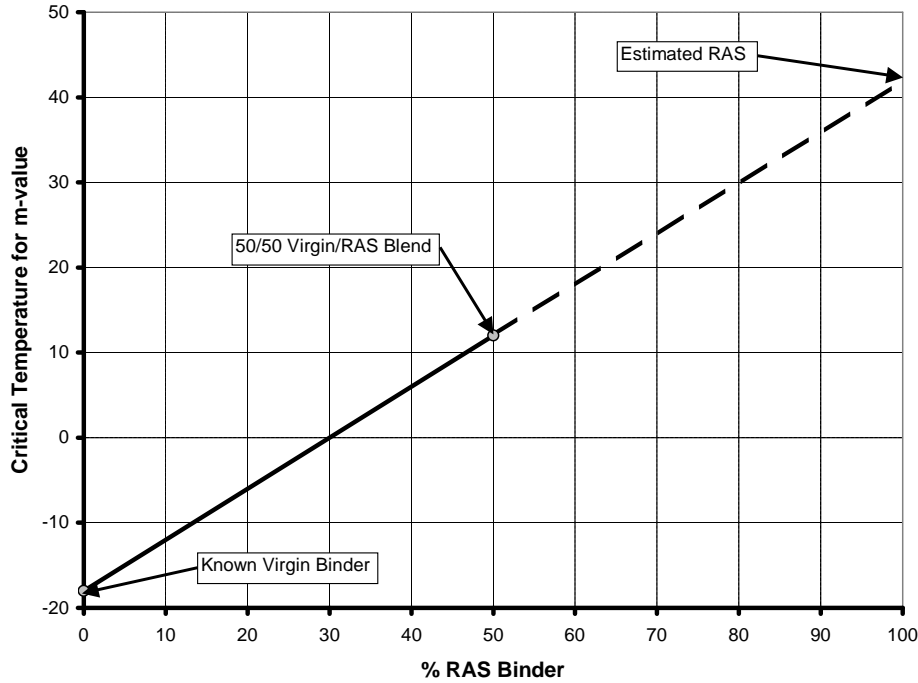


Figure 8. Estimating Critical m-value for RAS Binder Using 50/50 Blend.

1. Extract and recover the RAS binder using a combination of Method A of AASHTO T164, *Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)* and AASHTO T170, *Recovery of Asphalt from Solution by Absorbent Method*.
2. Prepare a blend of recovered RAS binder in a virgin binder with known continuous grade properties.
3. Condition the blended binder in the Rolling Thin Film Oven Test (RTFOT), AASHTO T240, *Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)*.
4. Determine the temperature where the RTFOT conditioned blend meets the AASHTO M320 RTFOT binder high temperature grade requirement that $G^*/\sin\delta = 2.2$ kPa. Estimate the high temperature grade of the RAS binder by extrapolation using Equation 1.

$$T_{HRAS} = T_{HV} + \frac{100 \times (T_{Hblend} - T_{HV})}{\% \text{ RAS}} \quad (1)$$

where:

$T_{H_{RAS}}$ = extrapolated high temperature grade of the RAS binder, °C

$T_{H_{blend}}$ = high temperature continuous grade of the blend of recovered RAS
and virgin binder, °C

T_{H_V} = high temperature continuous grade of the virgin binder, °C

%RAS = percent of RAS binder used in the blend, %

5. Condition the RTFOT conditioned binder in the Pressure Aging Vessel (PAV), AASHTO R 28, *Accelerated Aging of Asphalt Binder Using a Pressure Aging Vessel*.
6. Determine the temperature where the PAV conditioned blend meets the AASHTO M320 intermediate grade temperature requirement that $G^* \cdot \sin \delta = 5,000$ kPa. Estimate the intermediate temperature grade of the RAS binder by extrapolation using Equation 2.

$$T_{I_{RAS}} = T_{I_V} + \frac{100 \times (T_{I_{blend}} - T_{I_V})}{\% \text{ RAS}} \quad (2)$$

where:

$T_{I_{RAS}}$ = extrapolated intermediate temperature grade of the RAS binder, °C

$T_{I_{blend}}$ = intermediate temperature continuous grade of the blend of recovered
RAS and virgin binder, °C

T_{I_V} = intermediate temperature continuous grade of the virgin binder, °C

%RAS = percent of RAS binder used in the blend, %

7. Determine the temperature where the PAV conditioned blend meets the AASHTO M320 low temperature grade requirement that the bending beam rheometer stiffness = 300 MPa. Estimate the low temperature grade of the RAS binder based on stiffness by extrapolation using Equation 3.

$$T_{LSV} + \frac{100 \times (T_{LSblend} - T_{LSV})}{\% \text{ RAS}} \quad (3)$$

where:

T_{LSRAS} = extrapolated temperature grade of the RAS binder based on stiffness,
°C

$T_{LSblend}$ = low temperature continuous grade of the blend of recovered RAS and
virgin binder based on stiffness, °C

T_{LSV} = low temperature continuous grade of the virgin binder based on stiffness,
°C

%RAS = percent of RAS binder used in the blend, %

8. Determine the temperature where the PAV conditioned blend meets the AASHTO M320 low temperature grade requirement that the bending beam rheometer m-value = 0.300. Estimate the low temperature grade of the RAS binder based on m-value by extrapolation using Equation 4.

$$T_{LMRAS} = T_{LMV} + \frac{100 \times (T_{LMblend} - T_{LMV})}{\% \text{ RAS}} \quad (4)$$

where:

T_{LMRAS} = extrapolated temperature grade of the RAS binder based on m-value,
°C

$T_{LMblend}$ = low temperature continuous grade of the blend of recovered RAS and
virgin binder based on m-value, °C

T_{LMV} = low temperature continuous grade of the virgin binder based on m-value,
°C

%RAS = percent of RAS binder used in the blend, %

9. Determine the extrapolated low temperature continuous grade of the RAS binder as the higher of the low temperature continuous grade based on stiffness and the low temperature continuous grade based on m-value.

2.3.3 Reliability

The AASHTO blending chart analysis uses average data for the virgin and recycled binders; therefore, it has a reliability level of 50 percent. To add reliability to the blending chart analysis, the standard deviation of the blended binder is needed. This standard deviation can be estimated using Equation 5 (4).

$$\sigma_c = \sqrt{\alpha^2 \sigma_{\text{RAP}}^2 + (1-\alpha)^2 \sigma_{\text{Virgin}}^2 + (\bar{X}_{\text{RAP}} - \bar{X}_{\text{Virgin}})^2 \sigma_\alpha^2} \quad (5)$$

where:

- σ_c = standard deviation of the blended binder
- σ_{RAP} = standard deviation of the recycled binder
- σ_{Virgin} = standard deviation of the virgin binder
- α = proportion of the total binder made up by the recycled binder
- \bar{X}_{RAP} = continuous grade temperature for the recycled binder
- \bar{X}_{Virgin} = continuous grade temperature for the virgin binder
- σ_α = standard deviation of the proportion

Equation 5 was developed in NCHRP Project 9-33 to estimate allowable RAP contents based on the variability of gradation and asphalt content data. This equation relates the standard deviation of a property of a blend of two materials to the standard deviation of the property for the two materials and the standard deviation of the proportion of the two materials. The standard deviation of the proportion is related to the standard deviation of the binder content of the recycled material and the mixture. A reasonable estimate of the standard deviation of binder contents is 0.3 percent (0.003), which makes the last term in Equation 5 very small, so it can be neglected. With the last term being essentially zero, Equation 6 extends Equation 5 to estimating the variability of blends containing both RAP and RAS binders.

$$\sigma_c = \sqrt{\alpha^2 \sigma_{\text{RAP}}^2 + \beta^2 \sigma_{\text{RAS}}^2 + (1 - \alpha - \beta)^2 \sigma_{\text{Virgin}}^2} \quad (6)$$

where:

σ_c = standard deviation of the blended binder

σ_{RAP} = standard deviation of the RAP binder

σ_{RAS} = standard deviation of the RAS binder

σ_{Virgin} = standard deviation of the virgin binder

α = proportion of the total binder made up by the RAP binder

β = proportion of the total binder made up by the RAS binder

Using Equation 6 the standard deviation of the continuous grade temperature for any combination of recycled and virgin binder can be estimated from the standard deviation of the continuous grade temperature of the recycled and virgin binders and the proportion of the recycled binders used in the mixture.

An interesting consequence of blending materials with some level of variability is the variability of the blended material may be less than the variability of either component. This is shown in Figure 9 which shows the variability of the blend of two binders with the second binder having standard deviations equal to 1.0, 1.5, and 2.0 times that of the first binder. When the variability of the two binders are the same, the blended binder always has lower variability than either of the two component binders. As the variability of the second binder increases, the amount of the second binder that can be added without increasing the variability decreases to about 60 percent when the second binder has 1.5 times the variability of the first binder. It further decreases to about 40 percent when the second binder has 2.0 times the variability of the first binder.

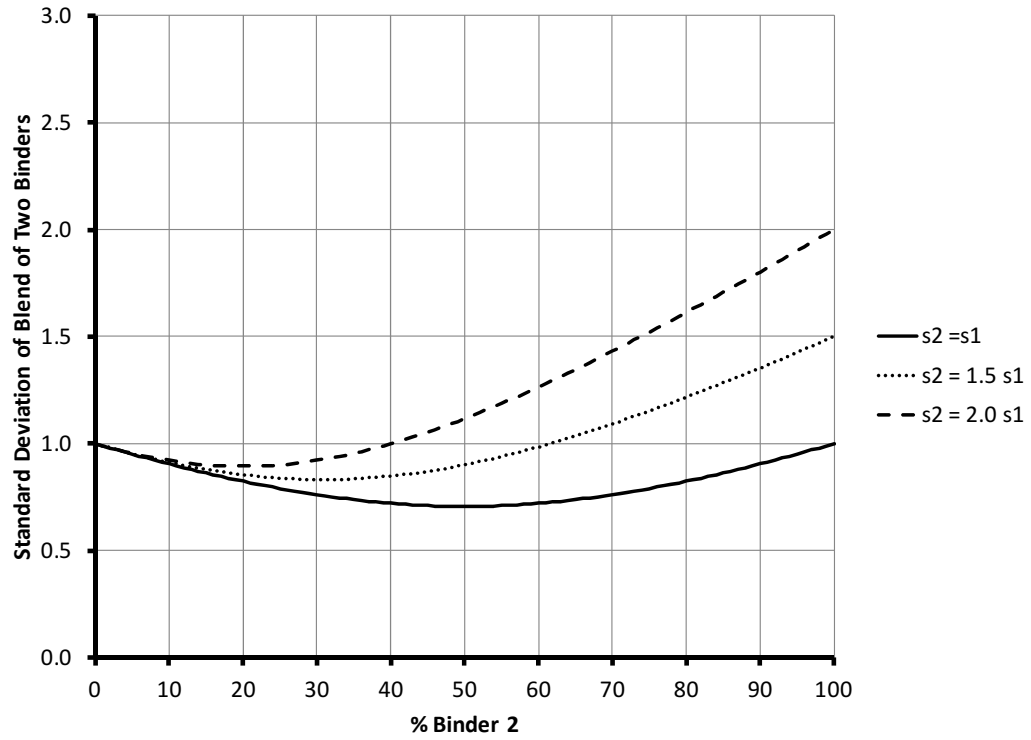


Figure 9. Variability of the Blend of Two Binders.

Chapter 3 Laboratory Testing and Analysis

3.1 Experimental Plan

Based on the review of current practice the experimental work in WHRP Project 0092-10-06 focused on four objectives:

1. Verification that linear blending chart analysis is applicable to RAS binders and combinations of RAP and RAS binders.
2. Verification that the approach developed for blending chart analysis of RAS binders produces results that are equivalent to those obtained with the AASHTO M323 approach for RAP binders.
3. Measuring the change in continuous grade properties for representative RAP and RAS sources in Wisconsin.
4. Determining the variability of the change in continuous grade properties for representative RAP and RAS sources in Wisconsin.

These objectives were accomplished by conducting and analyzing two experiments as described below.

3.1.1 Experiment 1, RAS Blending Chart Analysis

The objectives of this experiment were: (1) to verify that linear blending analysis applies to the continuous grade properties of blends of virgin and RAS binders, and blends of virgin, RAP and RAS binders, and (2) to verify that the RAS-virgin blend approach developed for RAS binders provides results that are equivalent to those obtained from the AASHTO M323 blending chart analysis. In this experiment, RAS and RAP binders from one source each were extracted and recovered. Then the recovered binders were blended with two virgin binders to produce a number of blends that were graded in accordance with AASHTO R29. The recovered RAP binder was also graded in accordance with the blending chart procedure in AASHTO M323. Table 8 summarizes the design of Experiment 1.

Table 8. Experiment 1, RAS Blending Chart Analysis.

Objective	Recycled Binder		Virgin Binder	
	RAS	RAP	PG 58-28	PG 70-28
Validity of Linear Blending to RAS	0	0	X	X
	10	0	X	X
	20	0	X	X
	30	0	X	X
	40	0	X	X
	50	0	X	X
Equivalence of RAS-Virgin Blend and M323 approaches	0	100	X	X
	0	50	X	X
Validity of Linear Blending to Combinations of RAP and RAS	10	20	X	X
	15	15	X	X
	20	10	X	X

To verify the validity of using linear blending charts with RAS binders, recovered RAS binder was blended in 10 percent increments up to 50 percent RAS with PG 58-28 and PG 70-28 binders. The continuous grade properties were then determined in accordance with AASHTO R29. Plots of the continuous grade properties and analysis of the residuals from linear regression were used to verify that linear blending analysis applies to RAS binders and the limits of linearity.

The equivalency of the blending approach for RAS binders and the AASHTO M323 blending analysis was verified by comparing the change in continuous grade properties for a RAP binder tested using the two approaches. A binder replacement ratio of 50 percent was used for this verification.

The last part of Experiment 1 was a verification that linear blending analyses can be applied to combinations of RAP and RAS up to the WisDOT 2010 maximum binder replacement ratio of 30 percent. In this part of the experiment, blends of both RAP and RAS were made with the two binders, and the continuous grade properties were determined in accordance with AASHTO R29. The continuous grade properties for the blends were also estimated from a linear combination of the change in continuous grade properties determined using the AASHTO M323 blending chart analysis for the RAP and the blend analysis for the RAS. The validity of linear blending analysis

to combinations of RAP and RAS was verified by comparing the measured and estimated continuous grade properties for the six combinations of virgin binder, RAP, and RAS shown in Table 8.

3.1.2 Experiment 2, Change in Continuous Grade Properties

The objective of Experiment 2 was to determine the change in continuous grade properties for typical Wisconsin recycled binder sources. Table 9 summarizes the design of Experiment 2. Experiment 2 involved extracting and recovering recycled binder from 18 different Wisconsin sources. The experiment included an equal number of RAP, FRAP, and RAS sources. An equal number of sources from northern and southern Wisconsin were included since environmental conditions may affect the stiffness of the recycled materials, particularly the RAP and fractioned RAP. The change in the continuous grade properties for each of these sources was determined using the method in AASHTO M323 for the RAP and fractioned RAP, and the RAS-virgin blend approach for the RAS sources. Linear blending analysis was then used to evaluate the 2011 WisDOT binder replacement criteria.

Table 9. Experiment 2, Change in Continuous Grade Properties.

Recycled Material	North Wisconsin Sources			South Wisconsin Sources		
	1	2	3	1	2	3
RAP	X	X	X	X	X	X
FRAP	X	X	X	X	X	X
RAS	X	X	X	X	X	X

3.2 Materials

3.2.1 Virgin Binders

Two virgin binders, PG 58-28 and PG 70-28, were used in the study. Both binders were supplied by Mathy Technology and Engineering Services, Inc., and are commonly used in Wisconsin. The PG 58-28 is a neat binder while the PG 70-28 is a binder modified with the Elvaloy® polymer. Table 10 summarizes performance grading properties for the two binders.

Table 10. Binder Performance Grading Properties.

Condition	Test	Temp, °C	PG 58-28	PG 70-28
Tank	G*/sinδ, kPa AASHTO T 315	58	1.39	
		64	0.66	
		70		1.28
		76		0.75
Rolling Thin Film Residue	G*/sinδ, kPa AASHTO T 315	58	4.11	
		64	1.86	
		70		3.64
		76		2.17
Pressure Aging Vessel Residue	G* sinδ, kPa AASHTO T 315	13		6470
		16	6170	4510
		19	4200	
	Creep Stiffness (MPa) / m AASHTO T 313	-24	463 / 0.255	463 / 0.267
		-18	229 / 0.322	215 / 0.337
Grade	AASHTO M320	NA	PG 58-28	PG 70-28
Continuous Grade	NA	NA	60.7 (17.6) –29.8	72.8 (15.1) –30.6

3.2.2 Recycled Sources

Recycled materials were obtained from 18 different Wisconsin sources. Samples of RAP, FRAP, and RAS were obtained from three sources in northern Wisconsin and three sources in southern Wisconsin. Table 11 summarizes the sources for the recycled materials. All of the materials in Table 11 were included in Experiment 2. The Tri-County RAS and the Badger Interchange RAP were used in Experiment 1.

Table 11. Recycled Material Sources.

Recycled Material	North Wisconsin Sources			South Wisconsin Sources		
	1	2	3	1	2	3
RAP	Cisler	Wimmie	Glenmore	Christian	Tri-County	I94 Badger Interchange
FRAP	Menasha	Eau Claire	Rhineland	Rock Road	Madison Vienna	Waukesha
RAS	Northeast Asphalt	Bruce Co. A	Amon	Allied Black Top Co.	Tri-County	LaCrosse City

3.3 Results

3.3.1 Experiment 1, RAS Blending Chart Analysis

The first part of Experiment 1 was conducted to establish that liner blending applies to blends of RAS and virgin binders. The Tri-County RAS source and both the PG 58-28 and PG 70-28 were used in this part of Experiment 1. Approximately 500g of RAS was recovered using the modified Abson method described in Appendix A. Seven extractions and recoveries were required to obtain this amount of recovered binder. The binder from the seven recoveries were blended for subsequent testing. The RAS blends were prepared by heating the virgin binder to 150 °C and the RAS binder to 170 °C, adding the appropriate proportions of virgin and RAS binders, then stirring with a mechanical impeller for 2 minutes. The blends were then graded in accordance with AASHTO R29. The results are summarized in Table 12 for the PG 58-28 blends and Table 13 for the PG 70-28 blends. Table 14 and Table 15 summarize continuous grade temperature for all of the RAS blends.

Plots of the continuous grade temperature as a function of RAS binder content are shown in Figure 10 through Figure 15. The effect of increasing RAS binder replacement is linear up to 50 percent RAS binder replacement for the stiffness based continuous grade properties. This includes the high temperature continuous grade, the intermediate temperature continuous grade, and the low temperature continuous grade based on creep stiffness. Figure 10 and Figure 11 show the effect for the high temperature continuous grade. The effect for the intermediate temperature continuous grade is shown in Figure 12 and Figure 13. The effect for the low temperature continuous grade is shown in Figure 14 and Figure 15. However, the effect is nonlinear for the low temperature continuous grade based on the m-value.

Figure 16 and Figure 17 show that a linear relationship for the m-value reasonably represents the data up to about 30 percent binder replacement. This is quantified in Table 16 which shows the difference in the continuous m-value low temperature grade for linear and non-linear analysis up to 30 percent RAS binder replacement. The maximum difference is approximately ± 0.7 degrees, which is well within the error associated with the blending analysis.

Table 12. AASHTO R29 Grading Results for RAS-PG 58-28 Blends.

Condition	Test	Temp, °C	Percent RAS Binder					
			0	10	20	30	40	50
Tank	G*/sinδ, kPa AASHTO T 315	58	1.39					
		64	0.66	1.10	2.04			
		70		0.54	0.99			
		76				1.06		
		82				0.55	1.22	
		88					0.65	1.43
		94						0.77
		100						
Rolling Thin Film Residue	G*/sinδ, kPa AASHTO T 315	58	4.11					
		64	1.86					
		70		2.81				
		76		1.36	2.88	3.07		
		82			1.44	1.50	3.93	
		88					2.06	
		94						2.40
		100						1.28
Pressure Aging Vessel Residue	G* sinδ, kPa AASHTO T 315	16	6170					
		19	4200	5550	6760			
		22		4110	4890	5070	5880	
		25				3670	4410	5150
		28						3940
	Creep Stiffness, MPa AASHTO T 313	-24	463					
		-18	229	251	268	262		
		-12		123	131	142	152	
		-6					79.4	88.2
		0						47.2
	m-value AASHTO T313	-24	0.255					
		-18	0.322	0.285	0.279	0.274		
		-12		0.339	0.320	0.313	0.289	
		-6					0.318	0.294
		0						0.321

Table 13. AASHTO R29 Grading Results for RAS-PG 70-28 Blends.

Condition	Test	Temp, °C	Percent RAS Binder					
			0	10	20	30	40	50
Tank	G*/sinδ, kPa AASHTO T 315	64						
		70	1.28					
		76	0.75	1.09	1.70			
		82		0.64	0.98	1.56		
		88				0.90		
		94					1.04	
		100					0.61	1.22
		106						0.72
Rolling Thin Film Residue	G*/sinδ, kPa AASHTO T 315	64						
		70	3.64					
		76	2.17	2.81				
		82		1.69	2.54	3.94		
		88			1.49	2.12		
		94					2.29	
		100					1.36	2.42
		106						1.48
Pressure Aging Vessel Residue	G*·sinδ, kPa AASHTO T 315	13	6470					
		16	4510	5610	6750			
		19		4210	4770	5670		
		22				4160	5040	6190
		25					3970	4810
		28						
	Creep Stiffness, MPa AASHTO T 313	-24	463	435				
		-18	215	227	247	241		
		-12			117	121	146	
		-6					77.9	92.7
		0						48.5
	m-value AASHTO T313	-24	0.267	0.264				
		-18	0.337	0.303	0.288	0.268		
		-12			0.335	0.308	0.287	
		-6					0.316	0.286
		0						0.314

Table 14. Continuous Grade Temperatures for the RAS-PG 58-28 Blends.

Property	Percent RAS Binder, %					
	0	10	20	30	40	50
Unaged $G^*/\sin\delta$	60.7	64.8	69.9	76.5	83.9	91.5
RTFOT $G^*/\sin\delta$	62.7	72.0	78.3	78.8	87.4	94.8
PAV $G^*\cdot\sin\delta$	17.6	20.0	21.8	22.1	23.7	25.3
PAV S	-30.3	-29.5	-28.9	-29.3	-28.3	-27.7
PAV m	-29.8	-26.2	-24.8	-23.9	-19.7	-14.6

Table 15. Continuous Grade Temperatures for the RAS- PG 70-28 Blends.

Property	Percent RAS Binder, %					
	0	10	20	30	40	50
Unaged $G^*/\sin\delta$	72.8	77.0	81.8	86.9	94.4	102.3
RTFOT $G^*/\sin\delta$	75.8	78.9	83.6	87.6	94.5	101.2
PAV $G^*\cdot\sin\delta$	15.1	17.2	18.6	20.2	22.1	24.5
PAV S	-30.6	-30.6	-29.6	-29.9	-28.9	-26.9
PAV m	-31.0	-28.4	-26.4	-23.1	-19.2	-12.9

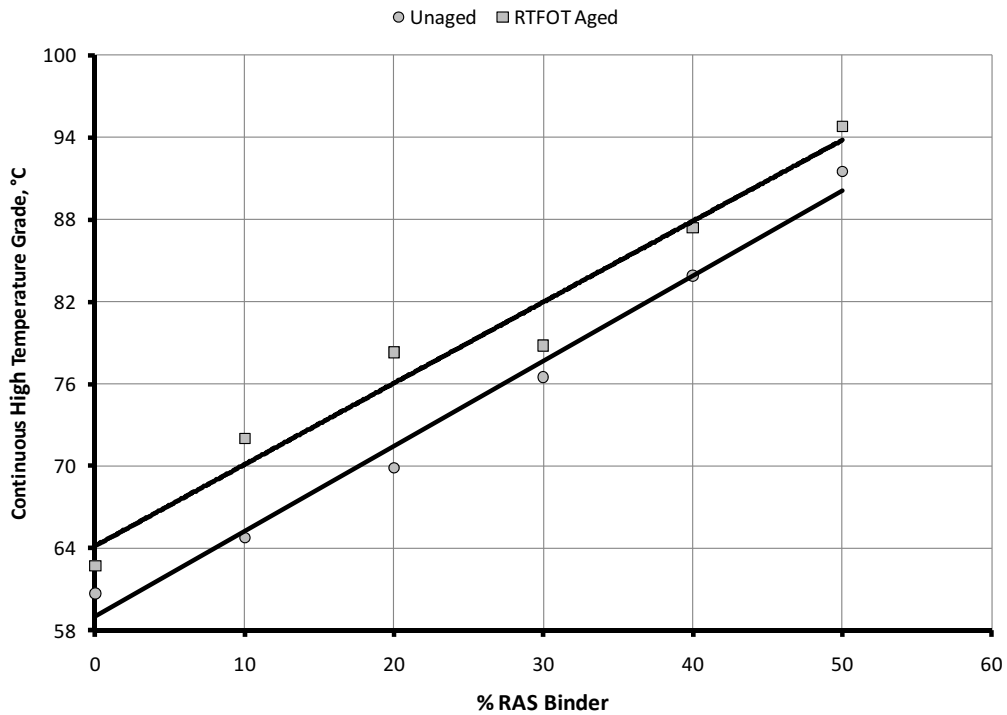


Figure 10. Effect of RAS Binder on Continuous High Temperature Grade for PG 58-28 Binder.

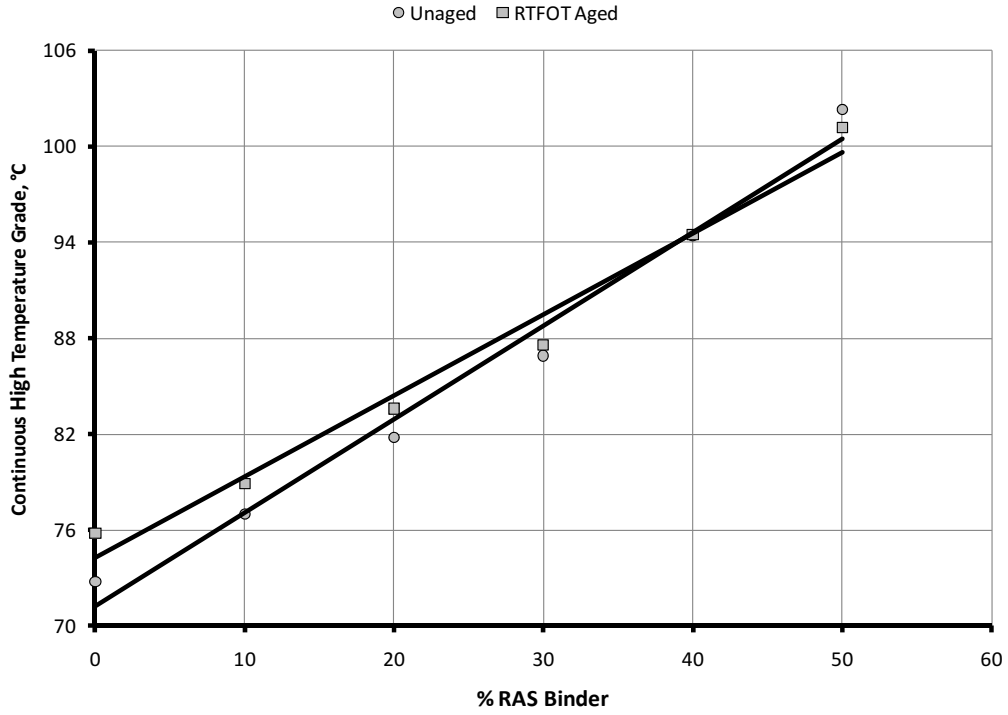


Figure 11. Effect of RAS Binder on Continuous High Temperature Grade for PG 70-28 Binder.

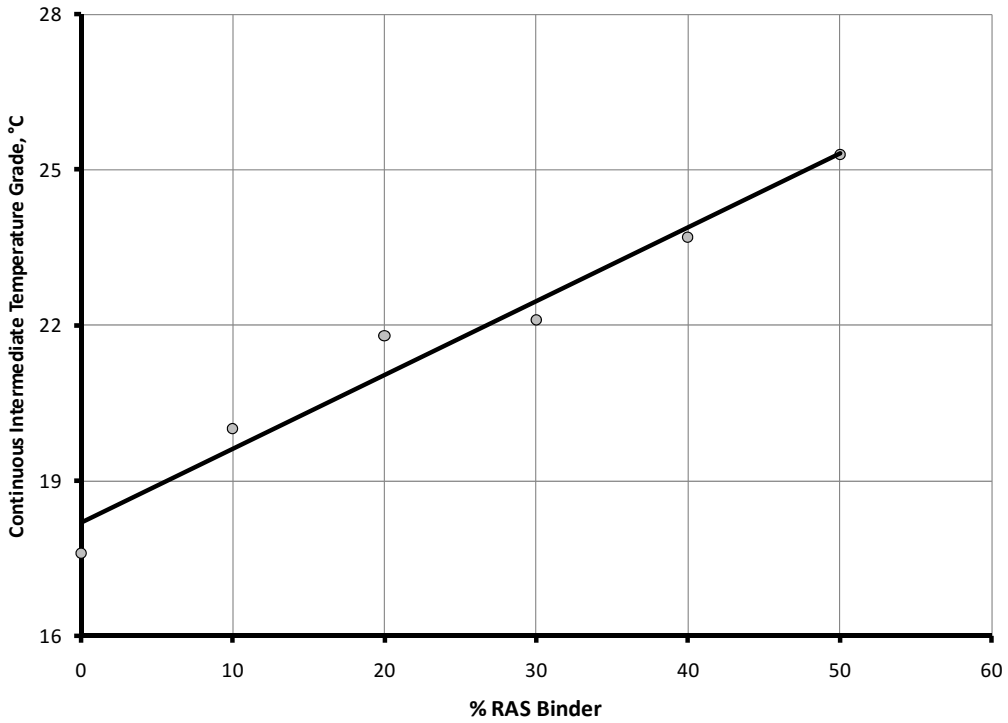


Figure 12. Effect of RAS Binder on Continuous Intermediate Temperature Grade for PG 58-28 Binder.

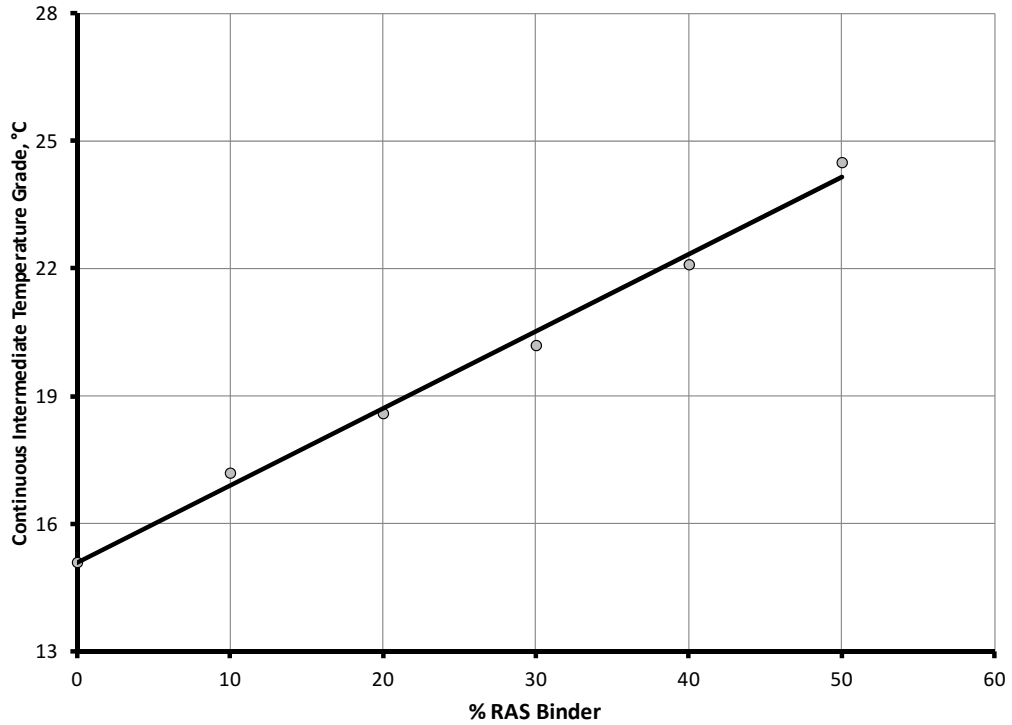


Figure 13. Effect of RAS Binder on Continuous Intermediate Temperature Grade for PG 70-28 Binder.

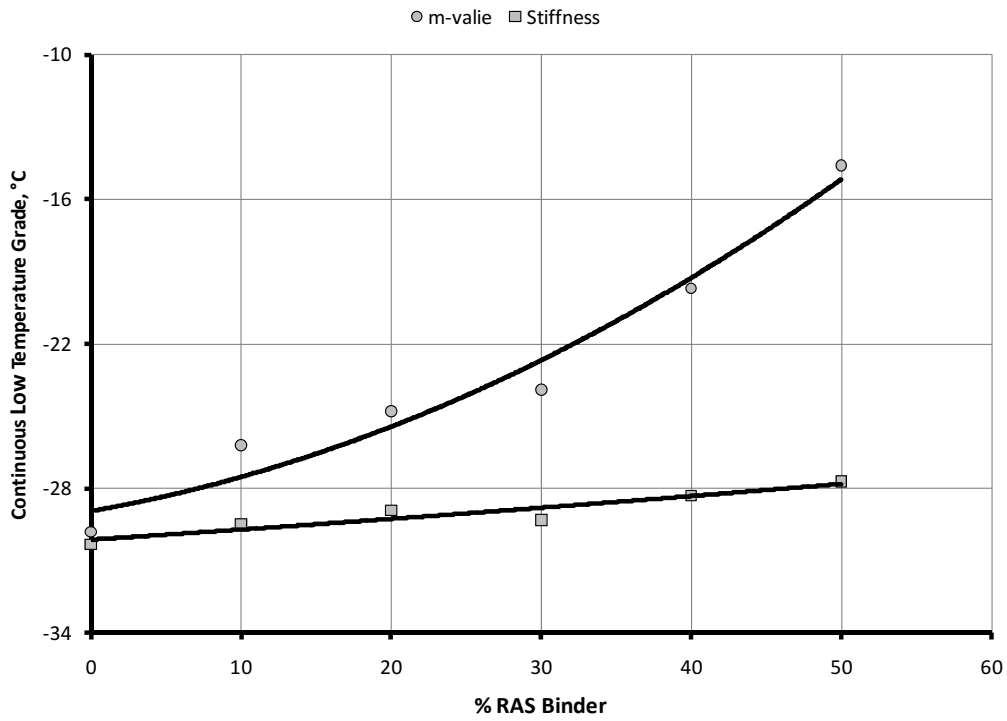


Figure 14. Effect of RAS Binder on Continuous Low Temperature Grade for PG 58-28 Binder.

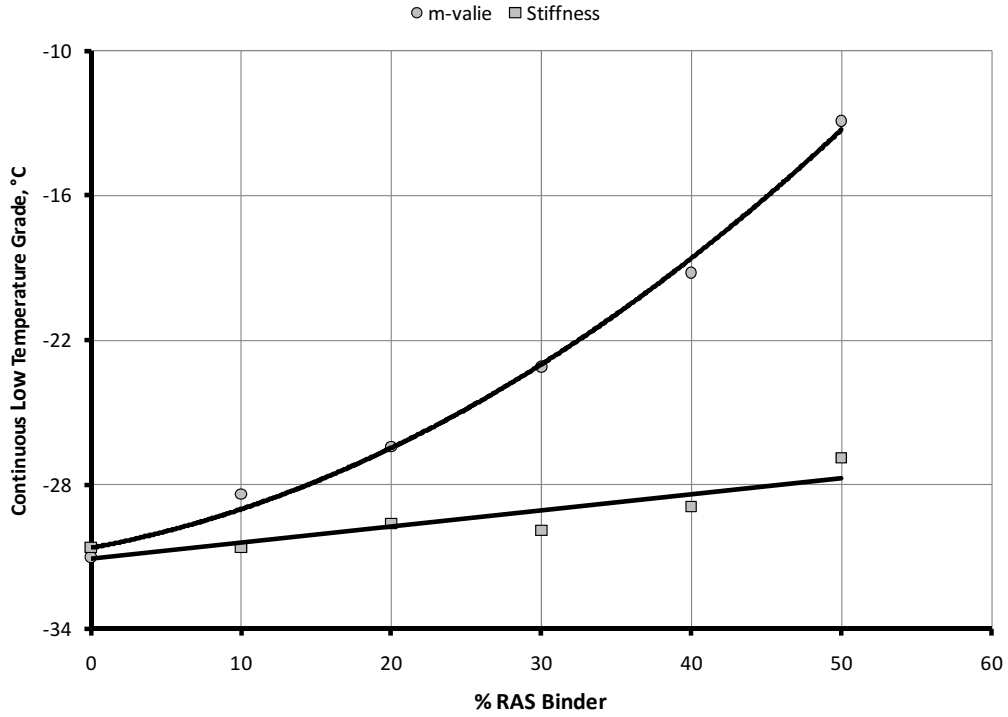


Figure 15. Effect of RAS Binder on Continuous Low Temperature Grade for PG 70-28 Binder.

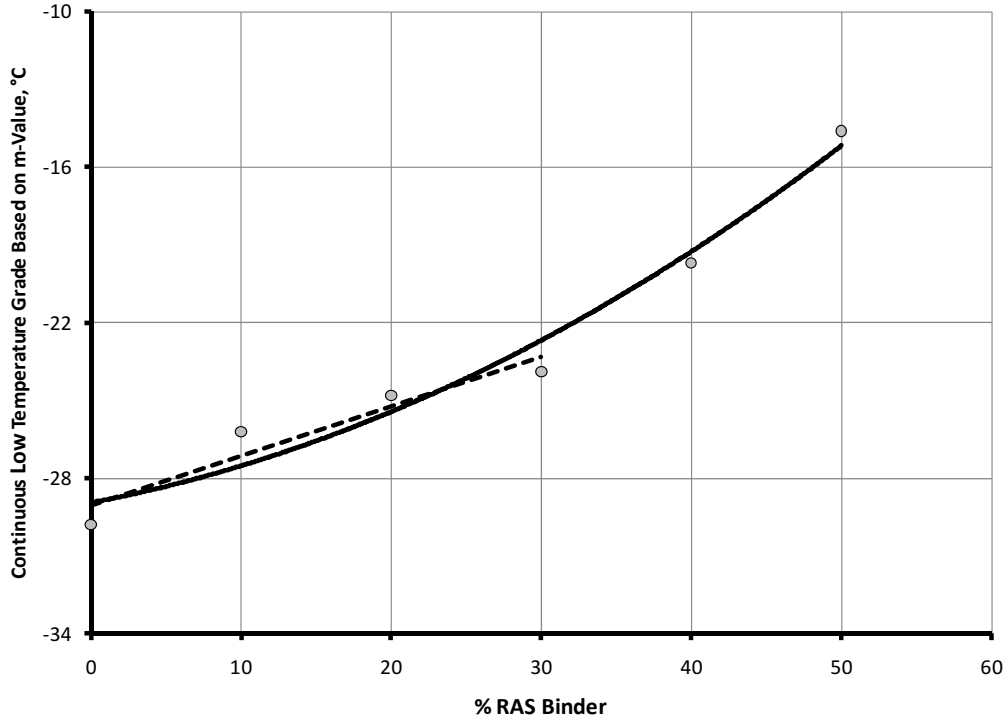


Figure 16. Linear Limit of Blending Analysis for Continuous Low Temperature Grade Based on m-value for PG 58-28 Binder.

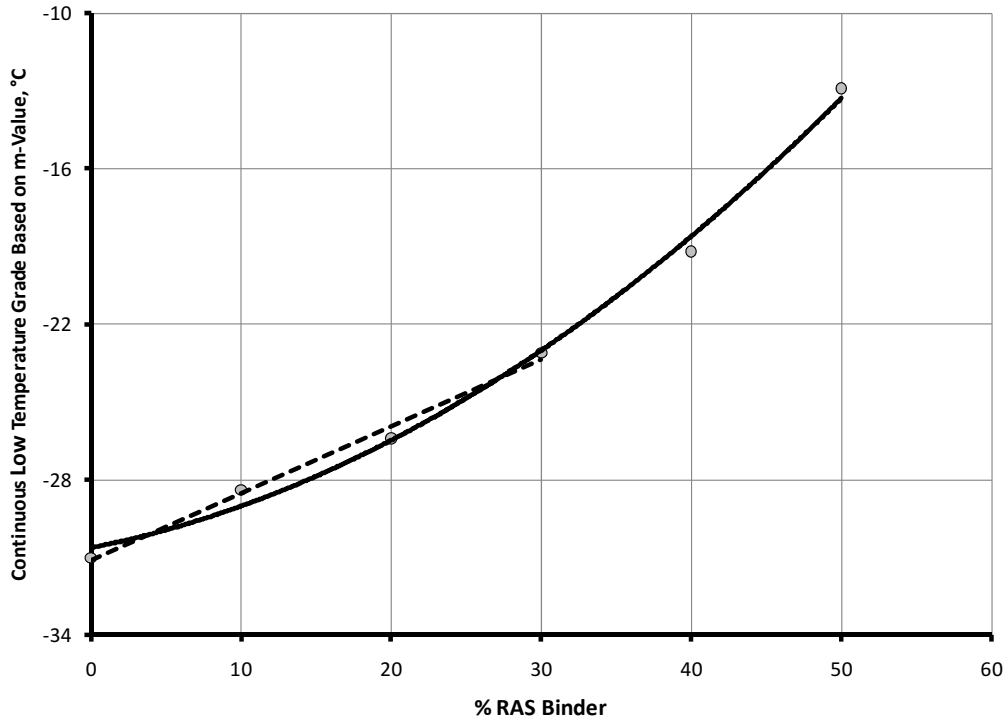


Figure 17. Linear Limit of Blending Analysis for Continuous Low Temperature Grade Based on m-value for PG 70 -28 Binder.

Table 16. Comparison of Linear and Non-Linear m-value Relationships.

% RAS Binder	PG 58-28			PG 70-28		
	Linear	Non-Linear	Diff	Linear	Non-Linear	Diff
5	-28.1	-28.3	-0.2	-29.8	-29.9	-0.1
10	-27.1	-27.5	-0.4	-28.5	-29.0	-0.5
15	-26.2	-26.6	-0.4	-27.2	-27.9	-0.7
20	-25.2	-25.4	-0.2	-25.9	-26.5	-0.6
25	-24.3	-24.2	0.1	-24.7	-24.8	-0.1
30	-23.3	-22.7	0.6	-23.4	-23.0	0.4

This analysis shows that linear blending applies to blends of virgin and RAS binder up to approximately 30 percent binder replacement. Above this level, the relationship between the change in m-value with increasing RAS binder replacement becomes non-linear.

The second part of Experiment 1 was a verification that the RAS-virgin binder blending approach provides recycled binder properties for RAP binders that are equivalent to those

obtained for the AASHTO M323 blending analysis. For this part of Experiment 1, approximately 300 g of the Vienna RAP was recovered in accordance with AASHTO T170. Four extractions and recoveries were required to obtain this amount recovered binder. The binder from the four recoveries were blended for subsequent testing. The RAP blends were prepared by heating the virgin binder and RAP binders to 150 °C, adding the appropriate proportions of virgin and RAP binders, then stirring with a mechanical impeller for 2 minutes. The blends were then graded in accordance with AASHTO R29. The results are summarized in Table 17. The extrapolated RAP binder properties are compared to the RAP binder properties measured in accordance with AASHTO M323 in Table 18. Most of the extrapolated properties are within approximately ± 2 °C of those measured using AASHTO M323 and all are within ± 3 °C. The differences in blending charts using the two approaches are shown in Figure 18 for the PG 58-28 binder and Figure 19 for the PG 70-28 binder. Up to 50 percent binder replacement, the difference between the two approaches is less than approximately 1 °C. Considering the accuracy of the extraction and recovery process, this difference is considered acceptable.

Table 17. AASHTO R29 Grading of 50 Percent Vienna RAP Blends.

Condition	Test	Temp, °C	Binder	
			PG 58-28 & Vienna RAP	PG 70-28 & Vienna RAP
Tank	G*/sin δ , kPa AASHTO T 315	70	1.48	
		76	0.73	1.20
		82		0.65
Rolling Thin Film Residue	G*/sin δ , kPa AASHTO T 315	70	3.36	
		76	1.61	2.70
		82		1.34
Pressure Aging Vessel Residue	G* sin δ , kPa AASHTO T 315	19	6910	6330
		22	4890	4480
	Creep Stiffness, MPa AASHTO T 313	-18	332	343
		-12	151	170
	m-value AASHTO T313	-18	0.280	0.285
		-12	0.330	0.322

Table 18. Extrapolated and AASHTO M323 Continuous Grade Temperatures for Vienna RAP.

Property	Extrapolated PG 58-28 Blend	AASHTO M323	Difference	Extrapolated PG 70-28 Blend	AASHTO M323	Difference
Unaged $G^*/\sin\delta$	86.1	84.4	1.7	82.8	83.9	-1.6
RTFOT $G^*/\sin\delta$	84.3	82.6	1.7	79.8	87.4	-2.8
PAV $G^*\cdot\sin\delta$	26.0	25.8	0.2	26.9	23.7	1.1
PAV S	-24.1	-24.6	0.5	-23.2	-28.3	1.4
PAV m	-21.2	-22.3	1.1	-20.0	-19.7	2.3

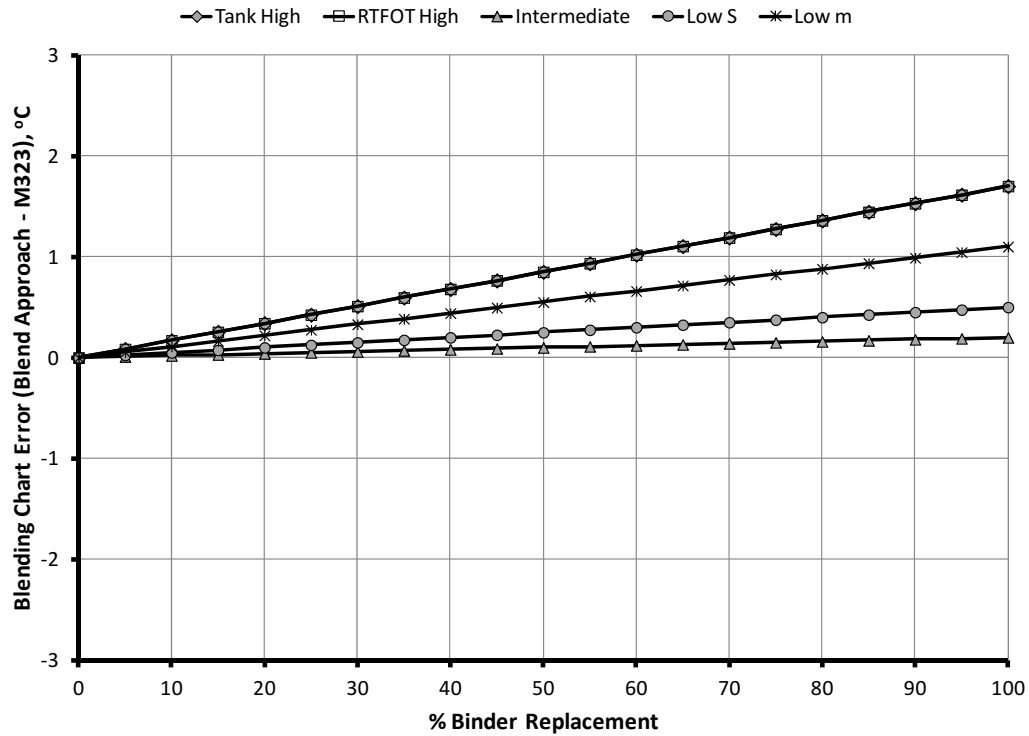


Figure 18. Comparison of Blending Chart Approaches for Vienna RAP in PG 58-28.

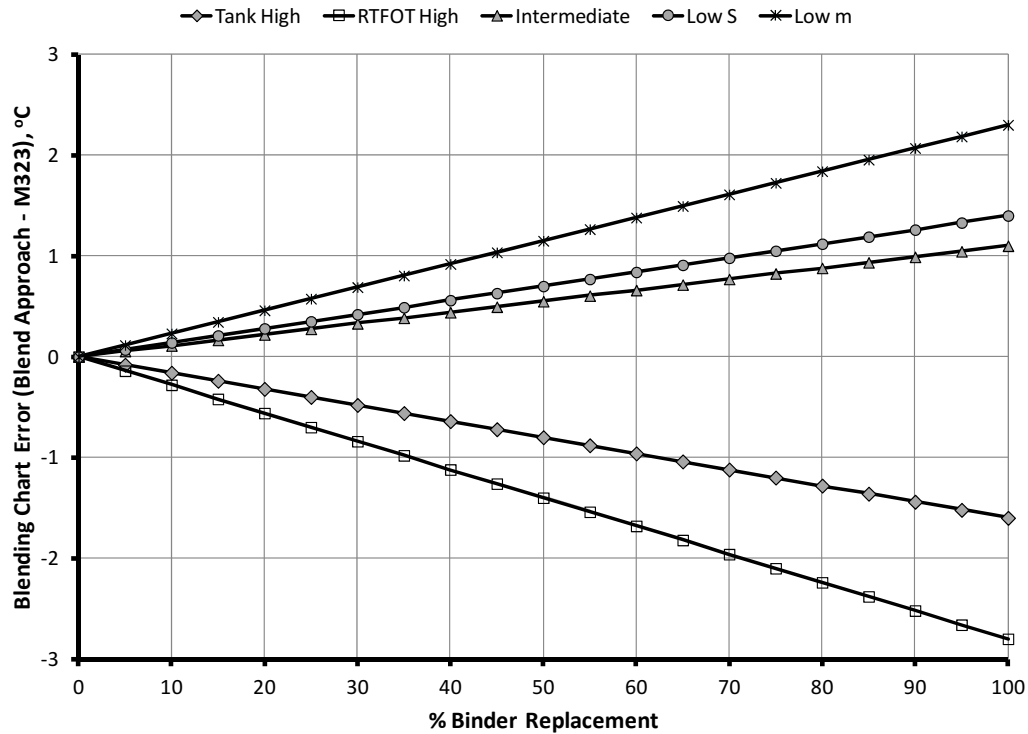


Figure 19. Comparison of Blending Chart Approaches for Vienna RAP in PG 70-28.

The last part of Experiment 1 was a verification that linear blending analyses can be applied to combinations of RAP and RAS up to the WisDOT maximum binder replacement ratio of 30 percent. In this part of the experiment, varying percentages of both RAP and RAS were added to the two binders, and the continuous grade properties were determined in accordance with AASHTO R29. The continuous grade properties for the blends were also estimated from a linear combination of the change in continuous grade properties determined using the AASHTO M323 blending chart analysis for the RAP and the blend analysis for the RAS.

For this part of Experiment 1, approximately 300 grams of the I-94 Badger Interchange RAP, and 300 grams of the Tri-County RAS were recovered. The RAP was recovered in accordance with AASHTO T170. The modified Abson method described in Appendix A was used for the RAS. Four extractions and recoveries were required to obtain the recovered RAP and RAS binders. The binder from the individual RAP recoveries was combined to for subsequent testing. The binder from the individual RAS recoveries was also combined. The blends for RAP, RAS, and virgin binder were prepared by heating the virgin and RAP binder to 150 °C, and the RAS

binder to 170 °C . The appropriate proportions of virgin, RAP, and RAS binders were combined, then stirred with a mechanical impeller for 2 minutes. The blends were then graded in accordance with AASHTO R29. The results are summarized in Table 19. Table 20 summarizes continuous grade properties from the AASHTO R29 grading for these blends and the RAS only blends used in the second part of Experiment 1.

The continuous grade properties for the blends were also estimated using linear blending. For the blending analysis, the properties of the Tri-County RAS were extrapolated from AASHTO R29 grading of a 30/70 blend of Tri-County RAS in the PG 58-28. The properties of the I-94 Badger Interchange RAS were measured in accordance with AASHTO M323 procedure. Equation 7 presents the linear blending analysis for multiple recycled binders.

$$T_{\text{blend}} = T_{\text{virgin}} + \left(\frac{\%RB_1}{100}\right) \times (T_{RB_1} - T_{\text{virgin}}) + \left(\frac{\%RB_2}{100}\right) \times (T_{RB_2} - T_{\text{virgin}}) + \dots + \left(\frac{\%RB_n}{100}\right) \times (T_{RB_n} - T_{\text{virgin}}) \quad (7)$$

Where:

T_{blend} = continuous grade for the blended binder °C,

T_{virgin} = continuous grade for the virgin binder, °C

T_{RB_1} = continuous grade for recycled binder 1, °C

$\%RB_1$ = percentage of total binder made up of recycled binder 1, %

T_{RB_2} = continuous grade for recycled binder 2, °C

RB_2 = percentage of total binder made up of recycled binder 1, %

T_{RB_n} = continuous grade for recycled binder n, °C

RB_n = percentage of total binder made up of recycled binder 1, %

n = number of recycled binders

Table 19. AASHTO R29 Grading of RAP, RAS, Virgin Binder Blends.

Condition	Test	Temp, °C	10 % RAP	10 % RAP	15 % RAP	15 % RAP	20 % RAP	20 % RAP
			20 % RAS 70 % PG58-28	20 % RAS 70 % PG70-28	15 % RAS 70 % PG58-28	15 % RAS 70 % PG70-28	10 % RAS 70 % PG58-28	10 % RAS 70 % PG70-28
Tank	G*/sinδ, kPa AASHTO T 315	82		0.966		0.825		0.666
		76	0.661	1.76	0.568	1.50	0.639	1.19
		70	1.32		1.14		1.30	
Rolling Thin Film Residue	G*/sinδ, kPa AASHTO T 315	88		1.39				
		82		2.45		1.91		1.63
		76	2.01		1.74	3.44	1.67	2.93
		70	4.20		3.63		3.52	
Pressure Aging Vessel Residue	G* sinδ, kPa AASHTO T 315	22	4540	4080	4560	3850	4840	4150
		19	6170	5630	6350	5400	6860	5890
	Creep Stiffness, MPa AASHTO T 313	-18	262	275	264	260	256	281
		-12	133	130	132	136	138	137
	m-value AASHTO T313	-18	0.277	0.279	0.286	0.281	0.274	0.293
		-12	0.326	0.322	0.328	0.335	0.330	0.332

Table 20. Summary of Continuous Grading Temperatures.

Method	Parameter	Continuous Grade, °C							
		50 % RAP 50% 58-28	50 % RAP 50% 58-28	10 % RAP 20 % RAS 70 % 58-28	10 % RAP 20 % RAS 70 % 70-28	15 % RAP 15 % RAS 70 % 58-28	15 % RAP 15 % RAS 70 % 70-28	20 % RAP 10 % RAS 70 % 58-28	20 % RAP 10 % RAS 70 % 70-28
AASHTO R29 Grading	Tank High	73.4	77.8	72.4	81.7	71.1	80.1	72.2	77.8
	RTFOT High	73.5	77.8	75.3	83.1	74.1	80.6	73.8	78.9
	Intermediate	21.8	21.0	21.1	20.1	21.2	19.7	21.7	20.4
	Stiffness Low	-27.2	-26.9	-29.2	-28.7	-29.1	-29.3	-29.5	-28.5
	m-value Low	-25.5	-25.5	-25.1	-25.0	-27.2	-25.8	-25.2	-26.9
Blending Chart Analysis	Tank High	72.6	78.6	73.4	81.9	71.9	80.4	70.3	78.8
	RTFOT High	72.7	79.2	75.3	84.5	73.6	82.8	71.8	81.0
	Intermediate	21.7	20.5	21.5	19.7	21.1	19.4	20.8	19.1
	Stiffness Low	-27.5	-27.6	-29.0	-29.2	-28.8	-29.1	-28.7	-28.9
	m-value Low	-26.1	-26.7	-25.3	-26.1	-25.9	-26.8	-26.6	-27.5

Continuous grade properties for the blends obtained from Equation 7 are also summarized in Table 20. The continuous grade data for the eight blends in Table 20 from the AASHTO R29 grading and the blending chart analysis are compared in Figure 20, Figure 21, and Figure 22 for high, intermediate and low temperature properties, respectively. These figures show that there is reasonable agreement between the blending chart analysis and the AASHTO R29 grading of the various blends.

A statistical analysis of the two approaches was done using a paired difference analysis. This analysis is commonly used to compare population means, in this case the continuous grade temperature from AASHTO R29 grading and the continuous grade temperature from the blending chart analysis. In this analysis, differences between the measured and estimated continuous grade temperatures are computed for each blend. If the two approaches produce the same continuous grade temperature, then the average of the differences will not be significantly different from zero. The difference for an individual blend may be positive or negative, but the average difference over several blends should be zero. A t-test is used to assess the statistical significance of the average difference as summarized below.

Null hypothesis: $\mu_{R29} - \mu_{BC} = 0$

Alternative hypothesis: $\mu_{R29} - \mu_{BC} > 0$ or $\mu_{R29} - \mu_{BC} < 0$ (as appropriate)

Test statistic:
$$t = \frac{\bar{d}}{\left(\frac{s_d}{\sqrt{n}}\right)}$$

Rejection region: Reject the null hypothesis and accept the alternative hypothesis if $t > t_{\alpha}$ for $n-1$ degrees of freedom.

Where:

μ_{R29} = population mean for AASHTO R29 continuous grade temperature

μ_{BC} = population mean for blending chart continuous grade temperature

\bar{d} = average of the differences between AASHTO R29 and
blending chart continuous grade temperatures

s_d = standard deviation of the differences

n = number of blends compared

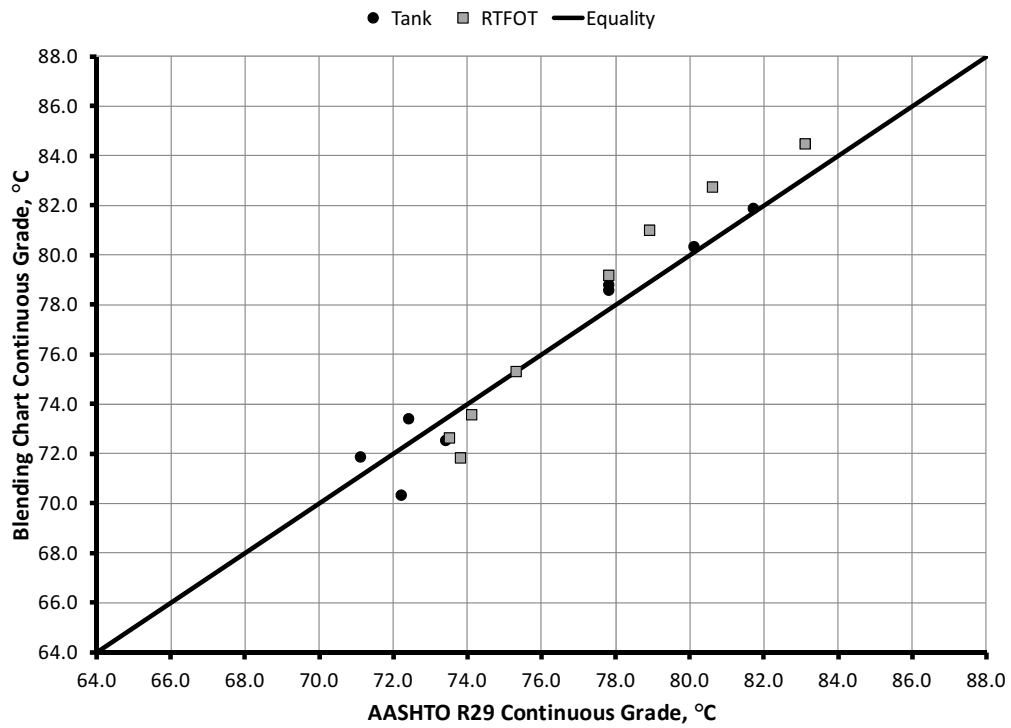


Figure 20. Comparison of Blending Chart and AASHTO R29 High Temperature Continuous Grade.

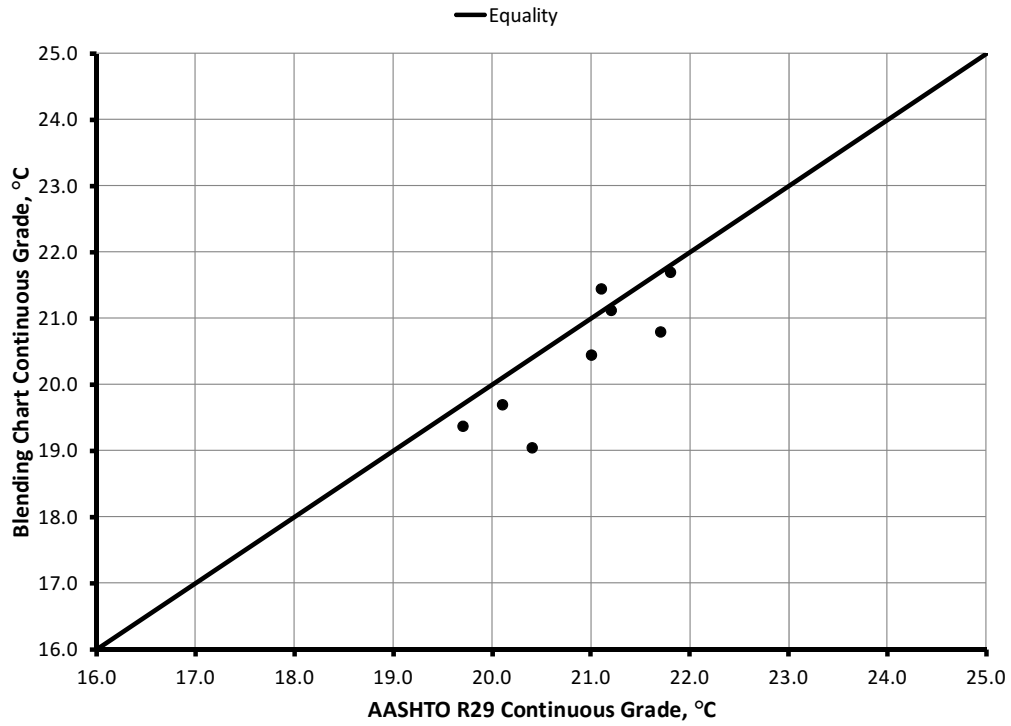


Figure 21. Comparison of Blending Chart and AASHTO R29 Intermediate Temperature Continuous Grade.

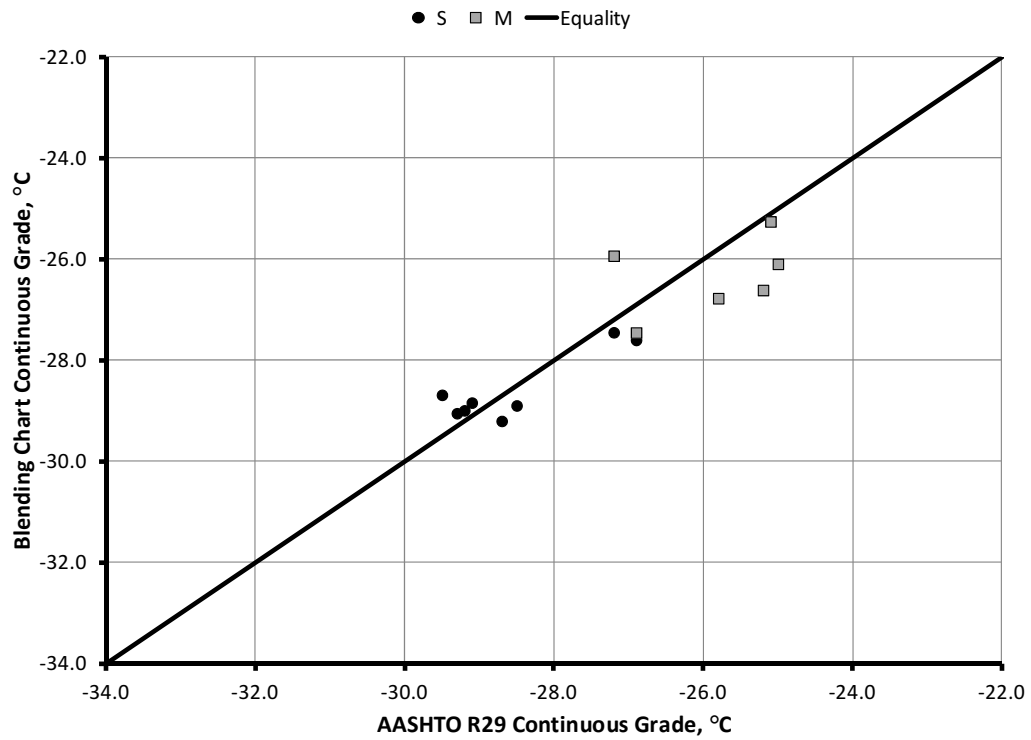


Figure 22. Comparison of Blending Chart and AASHTO R29 Low Temperature Continuous Grade.

The results of the paired difference analysis are summarized in Table 21. The mean differences in the continuous grade temperatures are typically less than 0.5 °C and the differences are not statistically significant at the 95 percent confidence level. This analysis confirms that linear blending charts can be used to provide a reasonable engineering estimate of the combined grade of binders in mixtures containing multiple recycled binders.

Table 21. Paired Difference Statistical Analysis of Multiple Recycled Binder Blends.

Parameter	Mean Difference	Standard Deviation of Difference	t statistic		Conclusion
			Calculated	Critical 95 % Level	
Tank High	0.2	1.03	0.472	2.365	Not significant
RTFOT High	0.5	1.51	0.880	2.365	Not significant
Intermediate	-0.4	0.53	-2.252	2.365	Not significant
Stiffness Low	0.0	0.50	-0.224	2.365	Not significant
m-value Low	-0.6	0.85	-1.932	2.365	Not significant

3.3.2 Experiment 2, Change in Continuous Grade Properties

In Experiment 2, the continuous grading properties for a number of recycled sources from Wisconsin were determined. This experiment included 6 RAS sources, 6 RAP sources, and 6 FRAP sources that were equally divided between northern and southern Wisconsin. The continuous grading properties for the RAP and FRAP sources were determined in accordance with the Appendix to AASHTO M323. The continuous grading properties for the RAS sources were estimated from 30 percent blends of the recovered RAS in the PG 58-28 binder as described for Experiment 1. All of the recycled materials were extracted in accordance with Method A of AASHTO T164 using reagent grade trichloroethylene, then recovered in accordance with AASHTO T170. The modified version of AASHTO T170 in Appendix A was used with the RAS sources. Tables 22, 23, and 24 present the test results for the RAP, FRAP, and RAS sources, respectively. The continuous grade properties are presented in Tables 25, 26, and 27.

Table 22. Recovered RAP Binder Grading per Appendix of AASHTO M323

RAP Source		Temperature, °C	Badger Interchange	Christian/Gade	Tri-County	Wimmie	Cisler	Glenmore
Location			South	South	South	North	North	North
Condition	Test		Result					
As- Recovered	G*/sinδ, kPa AASHTO T 315	88	0.549	0.898	0.663	0.645	0.616	
		82	1.07	1.82	1.34	1.31	1.24	0.742
		76						1.50
Rolling Thin Film Oven Residue	G*/sinδ, kPa AASHTO T 315	88		2.04	1.46	1.4	1.49	
		82	2.09	4.28	3.01	2.93	3.16	1.95
		76	4.46					4.22
	G* sinδ, kPa AASHTO T 315	31		4190		3900	4010	
		28	3960	5860	4890	5530	5770	
		25	5690		6690			4570
		22						6580
	Creep Stiffness, MPa AASHTO T 313	-6		143	139	144	155	
		-12	245	283	269	310	311	195
		-18	462					399
	m-value AASHTO T313	-6		0.320	0.340	0.348	0.343	
		-12	0.321	0.279	0.29	0.289	0.279	0.308
		-18	0.251					0.254

Table 23. Recovered FRAP Binder Grading per Appendix of AASHTO M323.

FRAP Source		Temperature, °C	Vienna	Waukesha	Rock Road	Menasha 1/2	Menasha 1/4	Eau Claire	Rheinlander
Location			South	South	South	North	North	North	North
Condition	Test		Result						
As- Recovered	G*/sinδ, kPa AASHTO T 315	88	0.662	0.716	0.574	0.817	0.686	0.661	
		82	1.32	1.44	1.15	1.67	1.37	1.32	0.571
		76							1.14
Rolling Thin Film Oven Residue	G*/sinδ, kPa AASHTO T 315	88	1.13	1.22	1.38	1.7	1.48	1.44	
		82	2.38	2.53	2.88	3.57	3.1	3.01	1.30
		76							2.68
	G* sinδ, kPa AASHTO T 315	28	3950	3960	5000	4900	4390	4910	
		25	5460	5400	6830	6690	6020	6840	
		22							4250
	Creep Stiffness, MPa AASHTO T 313	19							6610
		-6		116	135	134	115		
		-12	229	231	264	255	235	193	163
	m-value AASHTO T313	-18	423					403	304
		-6		0.347	0.347	0.338	0.347		
		-12	0.303	0.296	0.276	0.286	0.295	0.315	0.409
	-18	0.250					0.250	0.304	

Table 24. AASHTO R 29 Grading of 30/70 Recovered RAS Binder in PG 58-28.

RAS Source		Temperature, °C	Allied	Tricounty	LaCross	Northeast Asphalt	BR Amon	Bruce Co
Location			South	South	South	North	North	North
Condition	Test		Result					
As-Recovered	G*/sinδ, kPa AASHTO T 315	82	0.603	0.553		0.821	0.748	0.628
		76	1.15	1.06	0.944	1.6	1.46	1.21
		70			1.88			
Rolling Thin Film Oven Residue	G*/sinδ, kPa AASHTO T 315	88				1.27		
		82	1.85	1.5	1.43	2.49	2.11	1.97
		76	3.62	3.07	2.83		4.15	3.85
Pressure Aging Vessel Residue	G* sinδ, kPa AASHTO T 315	25		3670		4050	3900	3800
		22	4840	5070	4580	5530	5290	5160
		19	6510		6230			
	Creep Stiffness, MPa AASHTO T 313	-12	128	142	129	151	142	142
		-18	241	262	202	280	275	273
	m-value AASHTO T313	-12	0.308	0.313	0.334	0.301	0.302	0.302
-18		0.237	0.274	0.225	0.269	0.264	0.264	

Table 25. Continuous Grading Properties for Recovered RAP Binder

Parameter	Continuous Grade, °C					
	Badger Interchange	Christian/Gade	Tri-County	Wimmie	Cisler	Glenmore
	South	South	South	North	North	North
Recovered High	82.6	87.1	84.5	84.3	83.8	73.5
RTFOT High	81.6	87.4	84.6	84.3	84.9	75.1
High	81.6	87.1	84.5	84.3	83.8	73.5
Intermediate	26.1	29.4	27.8	28.9	29.2	25.3
Stiffness Low	-23.9	-22.5	-23.0	-21.7	-21.7	-25.6
m-value Low	-23.7	-18.8	-20.7	-20.8	-19.9	-22.8
Low	-23.7	-18.8	-20.7	-20.8	-19.9	-22.8

Table 26. Continuous Grading Properties for Recovered FRAP Binder.

Parameter	Continuous Grade, °C						
	Vienna	Waukesha	Rock Road	Menasha 1/2	Menasha 1/4	Eau Claire	Rheinlander
	South	South	South	North	North	North	North
Recovered High	84.4	85.1	83.2	86.3	84.7	84.4	77.1
RTFOT High	82.6	83.1	84.2	85.9	84.8	84.6	77.6
High	82.6	83.1	83.2	85.9	84.7	84.4	77.1
Intermediate	25.8	25.7	28.0	27.8	26.8	27.8	20.9
Stiffness Low	-24.6	-24.3	-23.1	-23.5	-24.1	-25.6	-27.9
m-value Low	-22.3	-21.5	-19.8	-20.3	-21.4	-23.3	-28.3
Low	-22.3	-21.5	-19.8	-20.3	-21.4	-23.3	-27.9

Table 27. Extrapolated Continuous Grading Properties for Recovered RAS Binder

Parameter	Continuous Grade, °C					
	Allied	Tricounty	LaCross	Northeast Asphalt	BR Amon	Bruce Co
	South	South	South	North	North	North
Recovered High	116.0	113.4	110.0	126.0	123.0	117.4
RTFOT High	122.0	116.4	114.4	130.7	125.7	123.7
High	116.0	113.4	110.0	126.0	123.0	117.4
Intermediate	31.3	32.6	29.3	35.6	34.3	33.3
Stiffness Low	-29.6	-27.0	-40.3	-25.0	-25.3	-25.6
m-value Low	-5.8	-10.1	-9.1	-4.5	-4.8	-4.8
Low	-5.8	-10.1	-9.1	-4.5	-4.8	-4.8

The continuous grading properties for the recovered RAP and FRAP binders are compared in Figures 23, 24, and 25 for the high, intermediate, and low temperature, respectively. These figures present average properties and 95 percent confidence intervals for the average property based on the pooled standard deviation of all of the measurements. These figures indicate that there is little difference in the average properties for RAP compared to FRAP, and northern sources compared to southern sources. These graphical findings were confirmed by two way analyses of variance using RAP type (RAP versus FRAP) and source location (north versus

south) as the independent variables. The analysis was performed for five dependent variables: (1) as- recovered high temperature grade, (2) RTFOT high temperature grade, (3) intermediate temperature grade, (4) stiffness based low temperature grade, and (5) m-value based low temperature grade. The results of the analysis of variance are summarized in Table 28, and show that the average continuous grade properties are not affected by RAP type or location. An F-test was also conducted to determine if the variability of the continuous grade properties for the recovered RAP binder is greater than that for the recovered FRAP binder. The results are summarized in Table 29. This analysis confirms that the variability of the recovered RAP is not greater than the variability of the recovered FRAP binder at the 95 percent significance level. This analysis of variance and the F-test confirm at the 95 percent significance level that none of the continuous grade properties are affected by either RAP type or location.

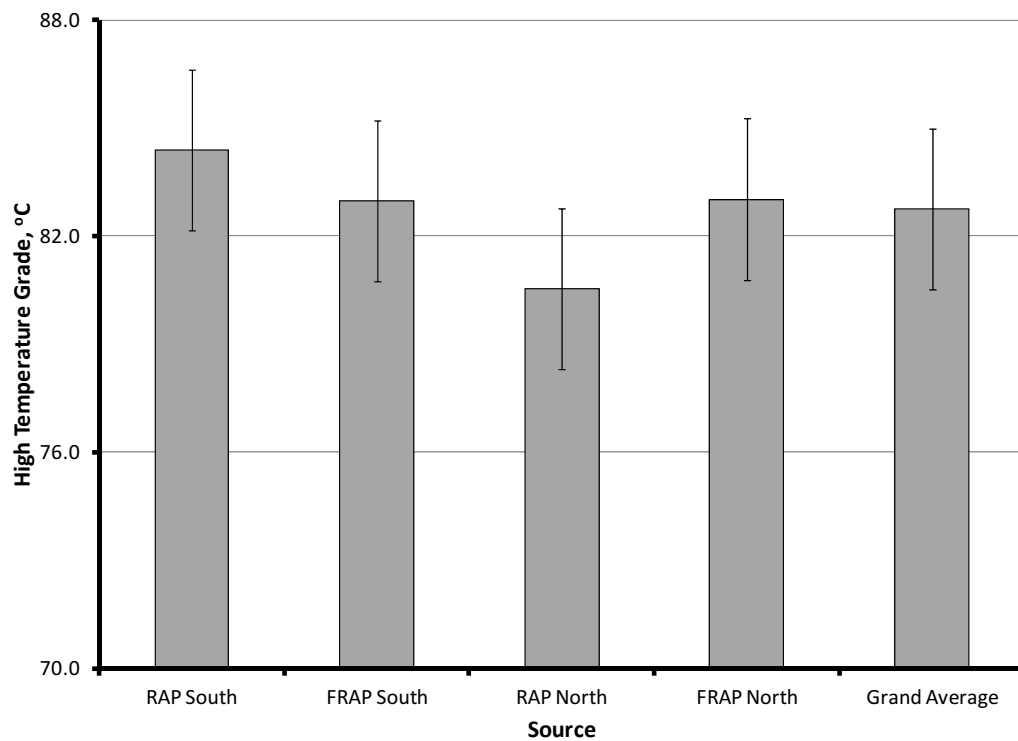


Figure 23. Comparison of Recovered RAP Binder High Temperature Continuous Grade.

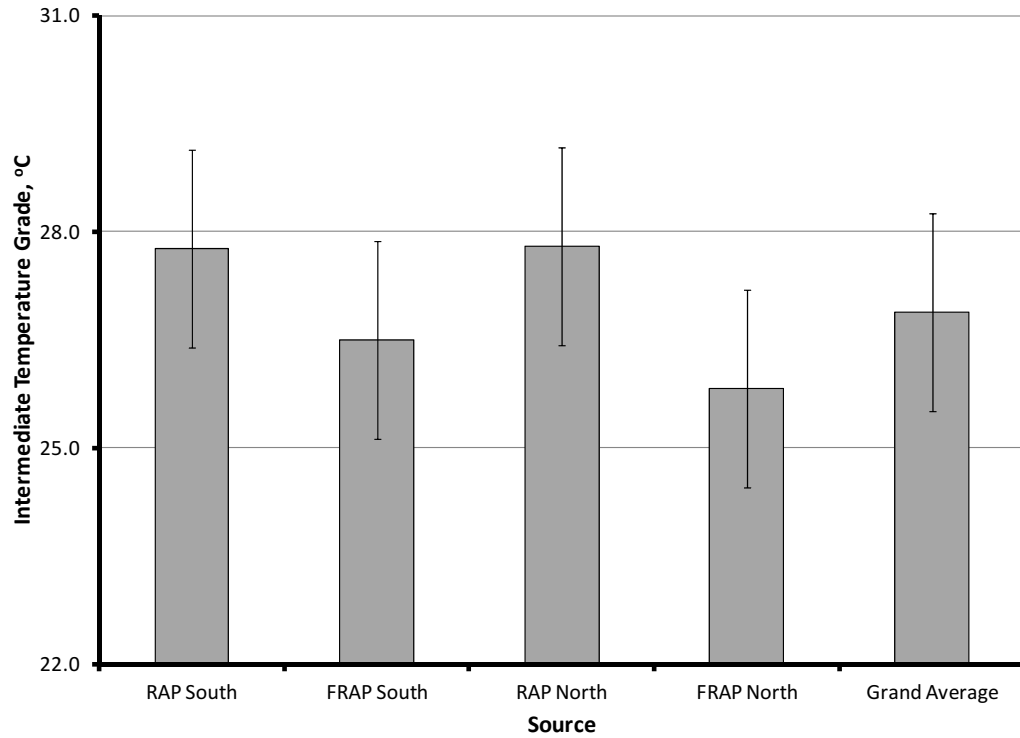


Figure 24. Comparison of Recovered RAP Binder Intermediate Temperature Continuous Grade.

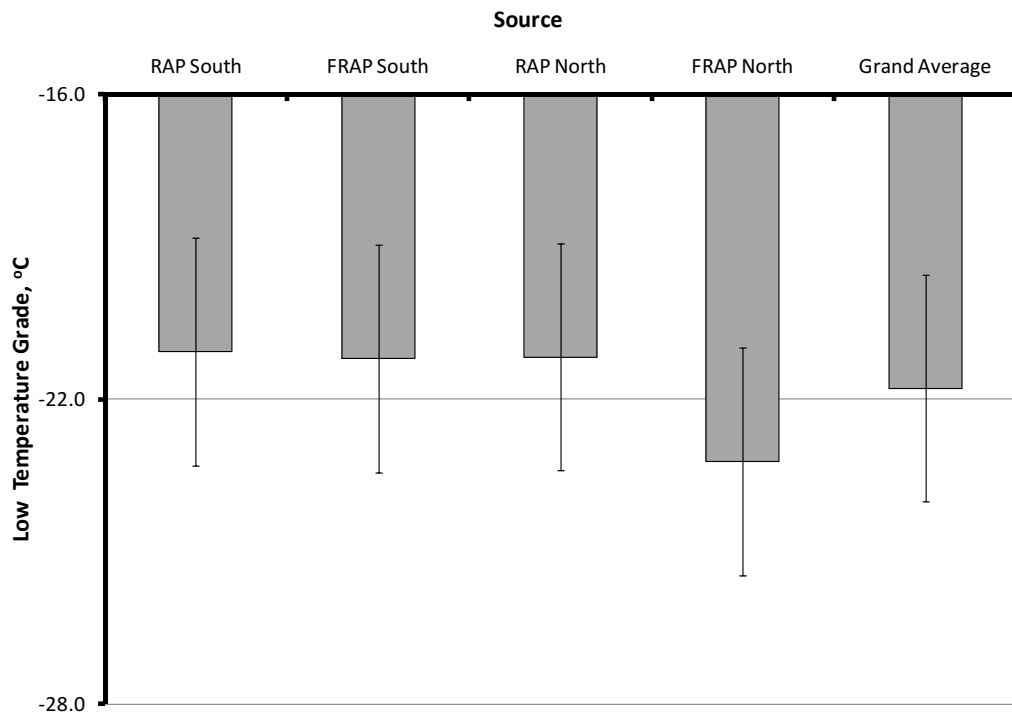


Figure 25. Comparison of Recovered RAP Binder Low Temperature Continuous Grade.

Table 28. Analysis of Variance for Continuous Grade of Recovered RAP Binders.

Property	Factor	Degrees of Freedom	Mean Square	Degrees of Freedom	Mean Square	F	p value	Conclusion
		Effect	Effect	Error	Error			
Recovered High Temperature Grade	Type (RAP/FRAP)	1	3.50	9.0	15.21	0.23	0.64	Not Significant
	Location (South/North)	1	22.54	9.0	15.21	1.48	0.25	Not Significant
	Interaction	1	7.65	9.0	15.21	0.50	0.50	Not Significant
RTFOT high Temperature Grade	Type (RAP/FRAP)	1	0.25	9.0	13.52	0.02	0.89	Not Significant
	Location (South/North)	1	8.06	9.0	13.52	0.60	0.46	Not Significant
	Interaction	1	7.32	9.0	13.52	0.54	0.48	Not Significant
Intermediate Temperature Grade	Type (RAP/FRAP)	1	8.41	9.0	5.69	1.48	0.26	Not Significant
	Location (South/North)	1	0.33	9.0	5.69	0.06	0.82	Not Significant
	Interaction	1	0.40	9.0	5.69	0.07	0.80	Not Significant
Stiffness Based Low Temperature Grade	Type (RAP/FRAP)	1	7.90	9.0	2.66	2.97	0.12	Not Significant
	Location (South/North)	1	1.04	9.0	2.66	0.39	0.55	Not Significant
	Interaction	1	1.59	9.0	2.66	0.60	0.46	Not Significant
m-value Based Low Temperature Grade	Type (RAP/FRAP)	1	11.10	9.0	5.69	1.95	0.20	Not Significant
	Location (South/North)	1	0.50	9.0	5.69	0.09	0.77	Not Significant
	Interaction	1	5.37	9.0	5.69	0.95	0.36	Not Significant

Table 29. F-test for Differences in Variability in the Recovered Continuous Grade Properties of RAP versus FRAP.

Property	RAP σ , °C	FRAP σ , °C	F	F _{critical}	Conclusion
Recovered High	4.71	3.01	1.56	3.97	Not significant
RTFOT High	4.28	2.72	1.57	3.97	Not significant
Intermediate	1.72	2.49	0.69	3.97	Not significant
Stiffness Based Low	1.49	1.61	0.93	3.97	Not significant
m-value Based Low	1.82	2.85	0.64	3.97	Not significant

The extrapolated continuous grading properties for the recovered RAS binders are compared in Figures 26, 27, and 28 for the high, intermediate, and low temperature, respectively. These figures present average properties and 95 percent confidence intervals for the average property based on the pooled standard deviation of all of the measurements. These figures indicate that the RAS from the northern sources is somewhat harder than that from the southern sources. These graphical findings were confirmed by a one way analysis of variance for the five continuous grade properties: (1) as- recovered high, (2) RTFOT high, (3) intermediate, (4) stiffness based low, and (5) m-value based low. The results are summarized in Table 30. Except for the low temperature continuous grade based on stiffness, the average continuous grade for the northern sources is greater than that for the southern sources.

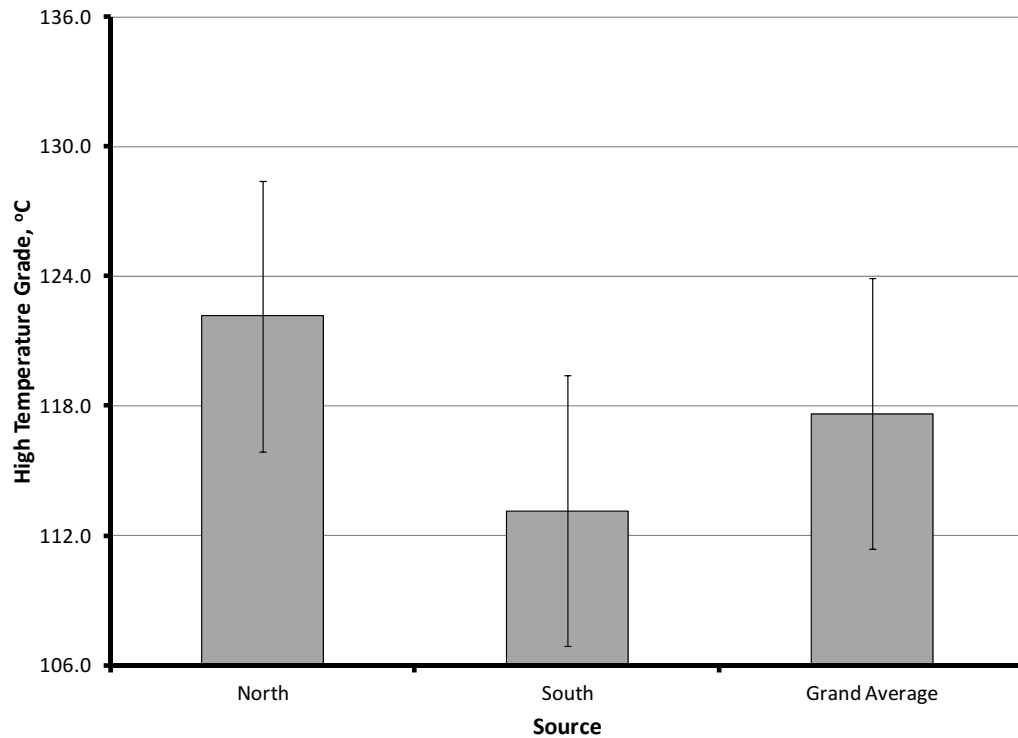


Figure 26. Comparison of Recovered RAS Binder High Temperature Continuous Grade.

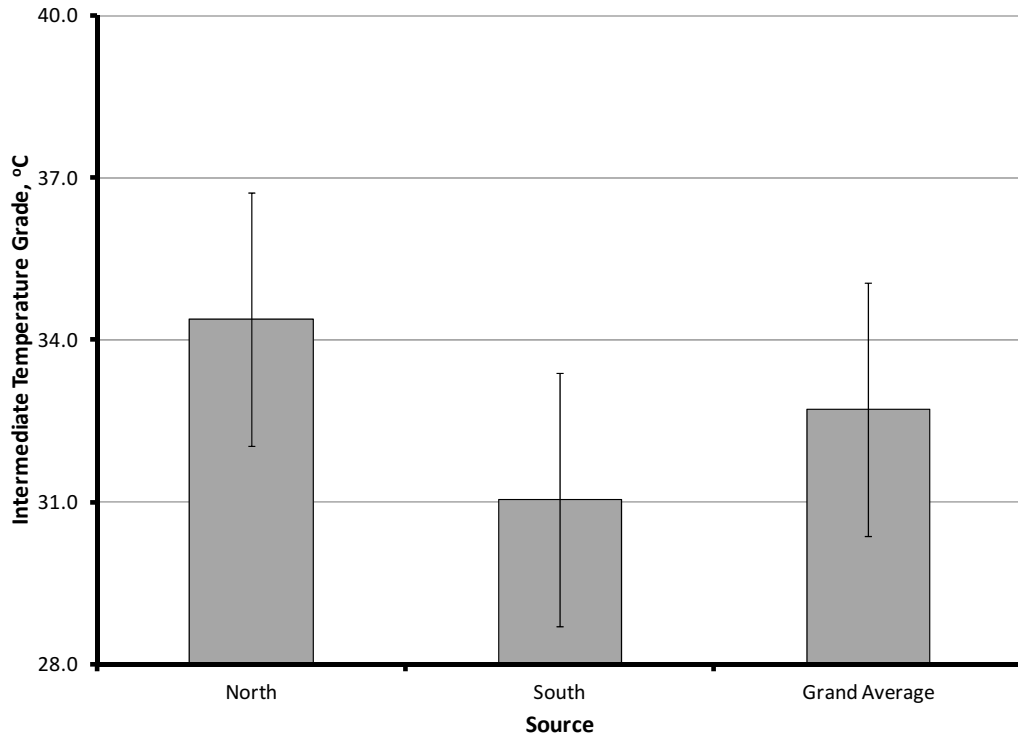


Figure 27. Comparison of Recovered RAS Binder Intermediate Temperature Continuous Grade.

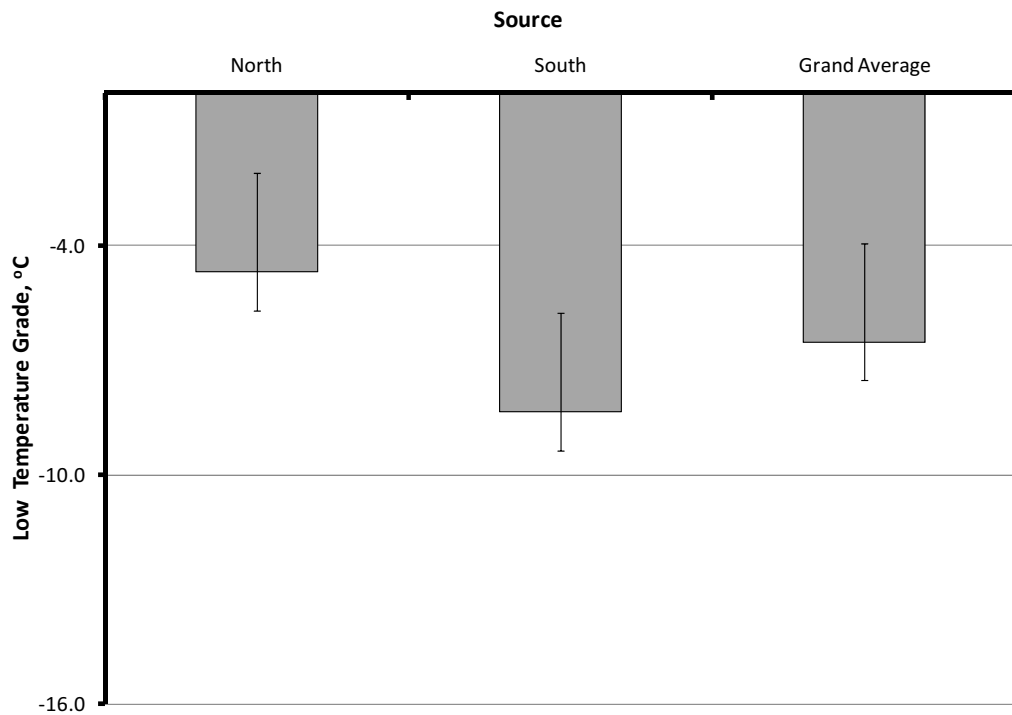


Figure 28. Comparison of Recovered RAS Binder Low Temperature Continuous Grade.

Table 30. Analysis of Variance for Extrapolated Continuous Grade of Recovered RAS Binders.

Property	Degrees of Freedom	Mean Square	Degrees of Freedom	Mean Square	F	P value	Conclusion
	Effect	Effect	Error	Error			
Recovered High Temperature Grade	1	121.50	4	14.05	8.65	0.04	Significant
RTFOT high Temperature Grade	1	124.21	4	14.26	8.71	0.04	Significant
Intermediate Temperature Grade	1	16.67	4	2.05	8.14	0.05	Significant
Stiffness Based Low Temperature Grade	1	73.50	4	24.89	2.95	0.16	Not Significant
m-value Based Low Temperature Grade	1	19.80	4	2.55	7.78	0.05	Significant

The continuous grading properties for the recovered RAP and RAS are compared in Figures 29, 30, and 31 for high, intermediate, and low temperature properties. These figures include the average continuous grade and 95 percent confidence intervals for the average. Clearly the recovered RAS binder has significantly higher continuous grade temperatures compared to the recovered RAP binder. Table 31 summarizes the change in continuous grade per percent recycled binder added for a typical PG 58-28 (continuous grade PG 60 (18) -30). For this assumed binder, the same level of binder replacement with RAS will change the high temperature grade approximately 2.5 times more, the intermediate temperature 1.7 times more, and the low temperature grade nearly 3.0 times more.

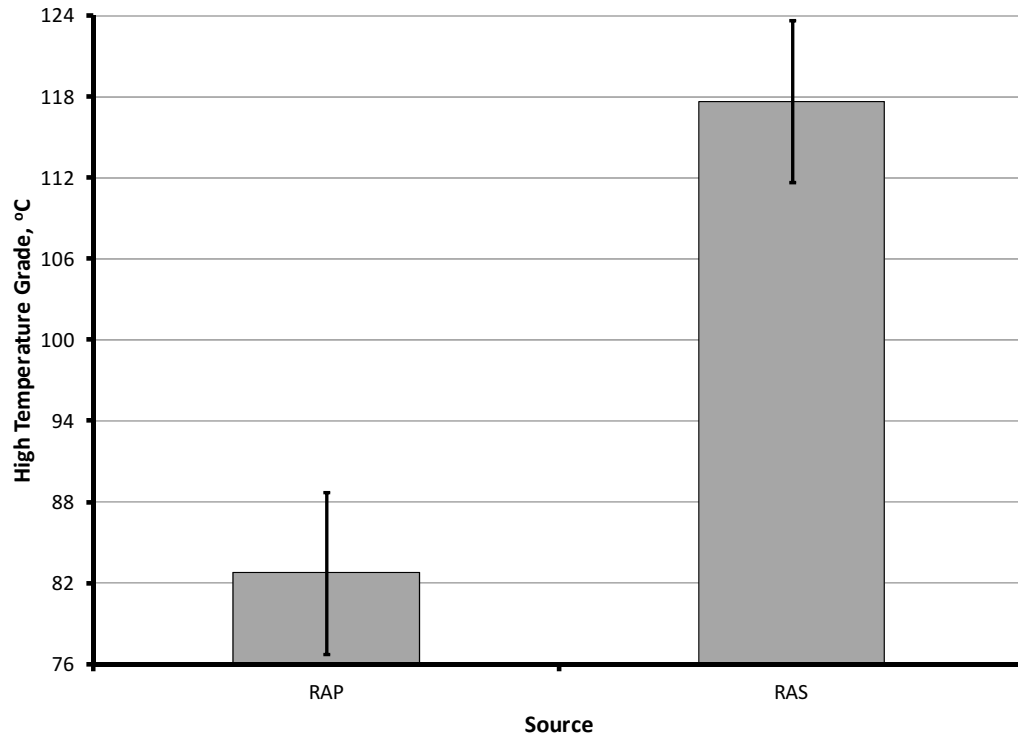


Figure 29. Comparison of Average High Temperature Continuous Grade for Recovered Recycled Binders.

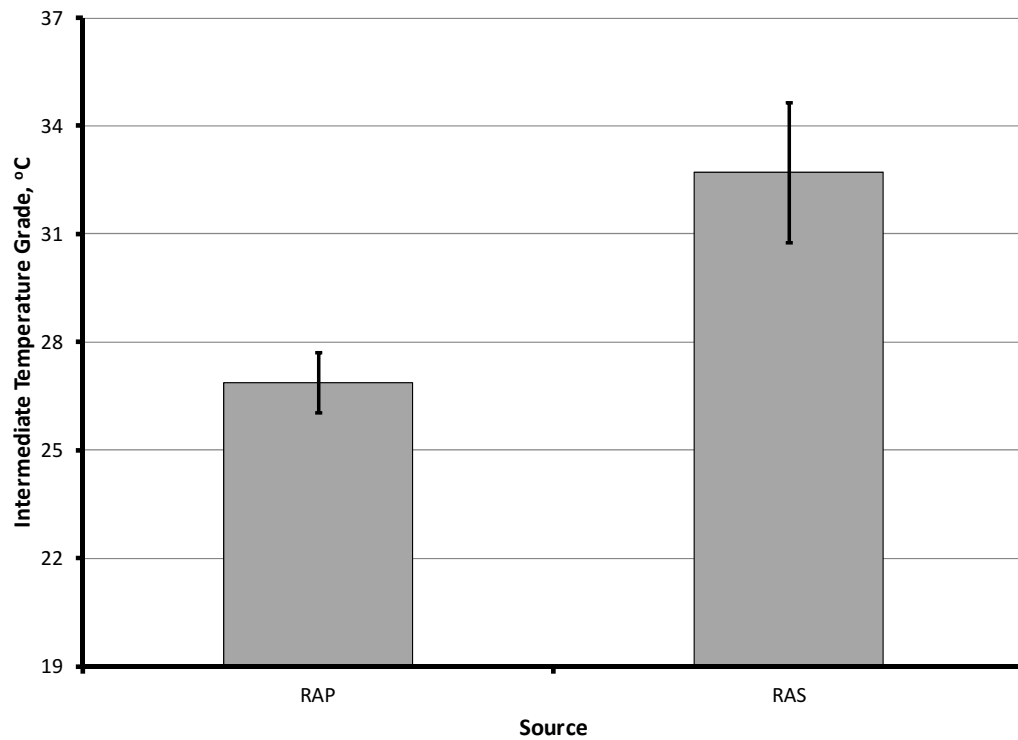


Figure 30. Comparison of Average Intermediate Temperature Continuous Grade for Recovered Recycled Binders.

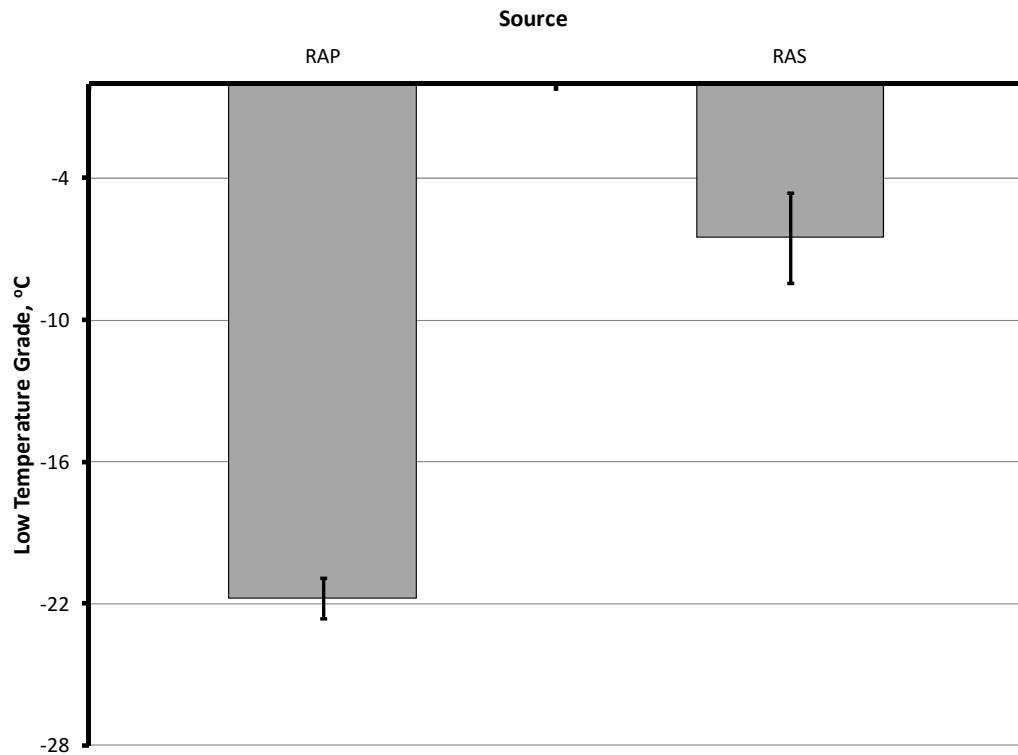


Figure 31. Comparison of Average Low Temperature Continuous Grade for Recovered Recycled Binders.

Table 31. Change in Continuous Grade Properties for Average Recycled Binders in PG 58-28 Binder.

Continuous Grade	Grade Change, °/percent binder replacement		Ratio of RAS change to RAP change
	RAP	RAS	
High Temperature	0.23	0.58	2.5
Intermediate Temperature	0.09	0.15	1.7
Low Temperature	0.08	0.23	2.9

Chapter 4 Analysis of 2011 WisDOT Binder Grade Replacement

This chapter uses linear blending charts and the recovered binder properties for the Wisconsin recycled sources to evaluate the 2011 WisDOT binder replacement criteria. Chapter 4 begins with a discussion of reliability as applied to binder grade selection. This is followed by an evaluation of the binder replacement criteria contained in the 2011 Wisconsin Standard Specification for Highway and Structures Construction based on reliability concepts.

4.1 Reliability of Performance Grade

Reliability is a measure of the ability of a system or component to perform its required function under stated conditions for a specified period of time. Reliability is the compliment of failure and is often expressed as a percentage. For example if a system has a 20 year reliability of 75 percent, there is a 25 percent chance that the system will fail at some point during its 20 year service life.

The performance grading system introduced the concept of reliability to binder grade selection for pavement construction. Performance graded binders are selected based on the high and low temperature grade reliability, which for a given project location, depends on the 20 year average and standard deviation of the high and low pavement temperatures. This reliability analysis only considers the variability of the climate at the project location and not the variability of the binder supplied. The continuous grade temperature of the binder supplied also varies and should be considered in the overall reliability analysis. For a system having two independent criteria, where failure can occur when either or both criteria are not met, the overall reliability is given by the product of the reliability for the two independent criteria. For binder grade selection, the two independent criteria are: (1) the reliability of the design pavement temperature at the project location, and (2) the reliability of the performance grade of the binder supplied.

4.1.1 Reliability of the Design Pavement Temperature

For a normal distribution of pavement temperatures, Equations 8 and 9 present the reliability associated the design high and low pavement temperatures at the project location. These equations provide the probability that the actual high pavement temperature will be less than the

design high pavement temperature and that the actual low pavement temperature will be greater than the low pavement design temperature.

$$\alpha_{\text{High}} = P\left(Z < \frac{\text{PG}_{\text{High Supplied}} - \text{PG}_{\text{High Climate}}}{\sigma_{\text{PG}_{\text{High}}}}\right) \quad (8)$$

Where

α_{High} = reliability of the high design pavement temperature

$\text{PG}_{\text{High Supplied}}$ = continuous high temperature performance grade of the binder supplied

$\text{PG}_{\text{High Climate}}$ = continuous high performance grade temperature required at the project location computed using the LTPPBind high temperature algorithm for 50 percent reliability

$\sigma_{\text{PG}_{\text{High}}}$ = standard deviation of the continuous high performance grade temperature at the project location computed using the LTPPBind high temperature algorithm

$$\alpha_{\text{Low}} = P\left(Z < \frac{\text{PG}_{\text{Low Climate}} - \text{PG}_{\text{Low Supplied}}}{\sigma_{\text{PG}_{\text{Low}}}}\right) \quad (9)$$

Where

α_{Low} = reliability of the low design pavement temperature

$\text{PG}_{\text{Low Supplied}}$ = continuous low temperature performance grade of the binder supplied

$\text{PG}_{\text{Low Climate}}$ = continuous low performance grade temperature required at the project location computed using the LTPPBind low temperature algorithm for 50 percent reliability

$\sigma_{\text{PG}_{\text{Low}}}$ = standard deviation of the continuous low performance grade temperature at the project location computed using the LTPPBind low temperature algorithm

4.1.2 Reliability of the Continuous Grade of the Binder Supplied

For a binder with a normal distribution of continuous grade properties, the continuous grade of the binder for a given reliability level is given by Equation 10 for the high temperature grade and Equation 11 for the low temperature grade.

$$PG_{\text{High supplied}\beta} = \overline{PG}_{\text{High supplied}} - Z_{\beta} \times \sigma_{\text{High supplied}} \quad (10)$$

Where

$PG_{\text{High supplied}\beta}$ = β percent reliability continuous high temperature performance grade of the binder supplied

$\overline{PG}_{\text{High supplied}}$ = average continuous high temperature performance grade of the binder supplied

Z_{β} = standard normal deviate for reliability level β

β = reliability level for binder supplied

$\sigma_{\text{High supplied}}$ = standard deviation of the continuous high grade temperature of the binder supplied

$$PG_{\text{Low supplied}\beta} = \overline{PG}_{\text{Low supplied}} + Z_{\alpha} \times \sigma_{\text{Low supplied}} \quad (11)$$

Where

$PG_{\text{Low supplied}\beta}$ = β percent reliability continuous low temperature performance grade of the binder supplied

$\overline{PG}_{\text{Low supplied}}$ = average continuous low temperature performance grade of the binder supplied

Z_{β} = standard normal deviate for reliability level β

β = reliability level for binder supplied

$\sigma_{\text{Low supplied}}$ = standard deviation of the continuous low temperature grade of the binder supplied

4.1.3 Overall Reliability

For a system having two independent criteria, where failure can occur when either or both criteria are not met, the overall reliability is given by the product of the reliability of the two criteria. Combining Equation 8 with Equation 10 and Equation 9 with Equation 11 yields equations for the overall reliability of the high and low temperature performance grades considering variation in both the binder supplied and the temperature at the project site.

$$\gamma_{\text{High}} = \beta_{\text{High}} \times \alpha_{\text{High}} = \beta_{\text{High}} \times P \left(Z < \frac{\overline{\text{PG}}_{\text{High supplied}} - Z_{\beta_{\text{High}}} \times \sigma_{\text{High supplied}} - \text{PG}_{\text{High climate}}}{\sigma_{\text{PG}_{\text{High}}}} \right) \quad (12)$$

Where

γ_{High} = overall high temperature reliability

$\overline{\text{PG}}_{\text{High supplied}}$ = average continuous high temperature performance grade of the binder supplied

$Z_{\beta_{\text{High}}}$ = standard normal deviate for the high temperature reliability level of the binder supplied

β_{High} = high temperature reliability level for binder supplied

$\sigma_{\text{High supplied}}$ = standard deviation of the continuous high grade temperature of the binder supplied

$\text{PG}_{\text{High climate}}$ = continuous high performance grade temperature at the project location computed using the LTPPBind high temperature algorithm for 50 percent reliability

$\sigma_{\text{PG}_{\text{High}}}$ = standard deviation of the high temperature continuous grade temperature at the project location computed using the LTPPBind high temperature algorithm

$$\gamma_{\text{Low}} = \beta_{\text{Low}} \times \alpha_{\text{Low}} = \beta_{\text{Low}} \times P \left(Z < \frac{\overline{\text{PG}}_{\text{Low supplied}} + Z_{\beta_{\text{Low}}} \times \sigma_{\text{Low supplied}} - \text{PG}_{\text{Low climate}}}{\sigma_{\text{PG}_{\text{Low}}}} \right) \quad (13)$$

Where

γ_{Low} = overall low temperature reliability

$\overline{PG}_{Low\ supplied}$ = average continuous low temperature performance grade of the binder supplied

$Z_{\beta_{Low}}$ = standard normal deviate for the low temperature reliability level of the binder supplied

β_{Low} = low temperature reliability level for binder supplied

$\sigma_{Low\ supplied}$ = standard deviation of the continuous low grade temperature of the binder supplied

$PG_{Low\ climate}$ = continuous performance grade temperature at the project location computed using the LTPPBind low temperature algorithm for 50 percent reliability

$\sigma_{PG_{low}}$ = standard deviation of the low temperature continuous grade temperature at the project location computed using the LTPPBind low temperature algorithm

4.1.4 Intermediate Continuous Grade Temperature Reliability

The reliability of the intermediate grade temperature is somewhat different because the intermediate temperature depends on the binder grade selected by the agency, not the intermediate temperatures at the project location. For PG 58-28 binders it is 19 °C; for PG 58-34 binders it is 16 °C. Therefore, it is only possible to estimate the reliability that the binder supplied will have a continuous grade temperature less than that specified for the binder selected by the agency. This is given by Equation 14.

$$\beta_{Int} = P\left(Z < \frac{PG_{Int\ Specified} - \overline{PG}_{Int\ Supplied}}{\sigma_{Int\ Supplied}} \right) \quad (14)$$

Where

β_{Int} = intermediate temperature reliability for the binder supplied

$PG_{Int\ Specified}$ = specified continuous intermediate temperature

$\overline{PG}_{Int\ Supplied}$ = average continuous intermediate temperature of the binder supplied

$\sigma_{Int\ Supplied}$ = standard deviation of the continuous intermediate temperature of the binder supplied

4.1.5 Standard Deviation of the Continuous Grade Temperature

In order to perform the reliability analysis estimates of the standard deviation of the pavement temperatures and the continuous grade properties of the binder supplied are needed. Estimates of the standard deviation of the pavement temperatures at the project location are obtained from LTPPBind. Estimates of the standard deviation of the binder supplied can be obtained from binder grading data collected over a period of time, preferably one construction season. Unfortunately data of this type has not been published, but Advanced Asphalt Technologies, LLC collected some data that can be used to obtain initial estimates of variability on a large paving project at the Port of Baltimore. Table 32 summarizes the continuous grade data that was collected for a neat PG 64-22 binder supplied by the same binder supplier over a four month period. The standard deviation of the high, intermediate, and low temperature continuous grade data are listed in the last row of Table 32. These standard deviations were assumed to be representative and were used for the virgin binder standard deviation in the reliability analysis.

For the RAP and RAS, the standard deviation of the continuous grade data measured in Chapter 3 was used. These standard deviations represent the variability of the recycled binders in Wisconsin. The statewide measure of variability was used because the WisDOT specifications allow a specified amount of recycled binder without having to characterize the binder in the recycled material. These standard deviations are summarized and compared to the virgin binder standard deviations in Table 33. The variability of the high temperature continuous grade of the recycled binders is much higher than that for a neat virgin binder from a single source; RAP is 5 times more variable and RAS is 12 times more variable. The variability of the low temperature continuous grade of the recycled binders ranges from about twice that of the virgin binder from a single source for RAP to about three times for RAS. Finally, the variability of the intermediate temperature continuous grade of the recycled binders is only 30 to 80 percent greater than that for the virgin binder from a single source. When blends of virgin and recycled binders are used, Equation 6 can be used to estimate the standard deviation of the combined

binder knowing the standard deviation of the components and the proportion of each component being used.

Table 32. Continuous Grade Data for PG 64-22 Binder From Baltimore, Maryland.

Date	Continuous Grade Temperature, °C		
	High	Intermediate	Low
06/12/02	67.0	19.9	-27.4
06/18/02	67.1	17.1	-25.8
06/24/02	66.7	16.2	-26.2
06/26/02	66.8	18.6	-26.0
06/27/02	67.2	18.8	-26.3
07/08/02	66.6	16.8	-27.6
07/16/02	66.9	18.8	-27.3
07/22/02	67.0	18.7	-27.4
08/01/02	66.9	18.3	-26.6
08/08/02	67.2	19.3	-26.8
08/14/02	67.1	18.0	-26.9
08/27/02	66.9	18.0	-26.4
09/05/02	66.2	16.9	-28.5
09/17/02	66.5	19.9	-28.1
09/25/02	68.4	19.2	-27.6
10/11/02	66.7	18.9	-27.8
10/10/02	67.1	18.4	-27.4
Average	67.0	18.3	-27.0
Standard Deviation	0.45	1.08	0.77

Table 33. Binder Grade Standard Deviations Used in the Reliability Analysis.

Source	Continuous Grade Temperature Standard Deviation, °C		
	High	Intermediate	Low
Virgin	0.45	1.08	0.77
RAP	2.24	1.38	1.43
RAS	5.42	1.86	1.84

4.2 Reliability Analysis of WisDOT Binder Replacement Criteria

This section presents the reliability analysis that was conducted to assess the effect of the 2011 WisDOT binder replacement criteria on pavement performance. The 2011 WisDOT binder

replacement criteria are listed in Table 34. The analysis is somewhat complicated by the note in Table 34 which limits RAS to 5 percent of the total weight of aggregate when used in combination with other binders. Therefore, the RAS binder replacement will depend on the binder content of the RAS and the binder content of the mixture. For RAS with a binder content of 20 percent the RAS binder replacement in a mixture with a binder content of 5.0 percent will be approximately 19 percent while a mixture with a binder content of 4.5 percent will have a RAS binder replacement of 21 percent. These two replacement levels were used for surface and lower layers in the analyses that follow.

Table 34. WisDOT 2011 Maximum Allowable Percent Binder Replacement.

Recycled Material	Maximum Percent Binder Replacement, %	
	Lower Layers	Upper Layers
RAS if used alone	25	20
RAP and FRAP in any combination	40	25
RAS, RAP, and FRAP in combination ^[1]	35	25

^[1] When used in combination the RAS component cannot exceed 5 percent of the total weight of the aggregate blend.

4.2.1 Wisconsin Weather Stations

The reliability analysis was performed for each of the weather stations from Wisconsin included in LTPPBind. Figure 32 presents a map highlighting the Wisconsin weather stations that were used in the analysis. This map includes the approximate location of State Highway 29 which dictates the low temperature binder grade selection. For locations south of State Highway 29, the low temperature grade is -28 °C. For locations north of State Highway 29, the low temperature grade is -34°C. A total of 140 weather stations were used in the analysis; 80 designated for low temperature grade of -28 °C and 60 for low temperature grade of -34 °C. Pertinent weather station data from LTPPBind for each of the weather stations used in the analysis is presented in Tables 35 and 36 for southern Wisconsin and northern Wisconsin weather stations, respectively. The temperatures for the lower layer mixtures are at a depth of 50 mm into the pavement.

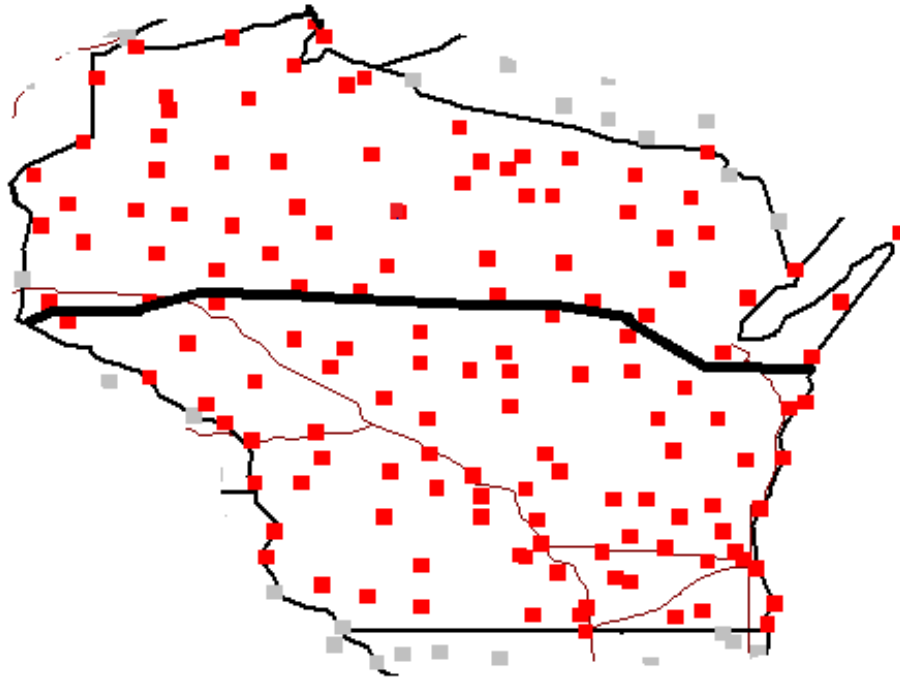


Figure 32. Map of Wisconsin Showing Weather Stations and Approximate Location of State Highway 29.

Table 35. Southern Wisconsin Weather Stations Included in the Reliability Analysis.

County/District	Station Name	WisDOT Low Grade, °C	Surface Mixture Design Pavement Temperatures, °C		Lower Layer Mixture Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C	
			Low	High	Low	High	Low	High
Rock	Beloit	-28	-18.9	53.5	-15.9	48.6	3.34	1.44
Kenosha	Kenosha	-28	-18.5	47.6	-15.5	42.7	3.86	1.29
Walworth	Lake Geneva	-28	-19.1	53.4	-16.1	48.5	3.39	1.45
Rock	Afton	-28	-19.4	52.5	-16.4	47.6	3.92	1.43
Green	Brodhead	-28	-21.0	52.8	-18.0	47.9	3.45	1.44
Racine	Burlington	-28	-19.2	51.2	-16.2	46.3	3.34	1.40
Rock	Janesville	-28	-19.7	54.8	-16.7	49.9	3.12	1.50
Lafayette	Darlington	-28	-21.3	52.6	-18.3	47.7	3.39	1.44
Racine	Racine	-28	-18.9	48.5	-15.9	43.6	3.57	1.33
Grant	Platteville	-28	-20.9	52.7	-17.9	47.8	3.28	1.45
Grant	Lancaster	-28	-21.2	51.7	-18.2	46.8	3.23	1.43
Walworth	Whitewater	-28	-19.8	52.9	-16.8	48	3.39	1.47
Jefferson	Fort Atkinson	-28	-20.8	52.6	-17.8	47.7	3.74	1.46

County/District	Station Name	WisDOT Low Grade, °C	Surface Mixture Design Pavement Temperatures, °C		Lower Layer Mixture Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C	
			Low	High	Low	High	Low	High
Dane	Stoughton	-28	-20.4	52.4	-17.4	47.5	3.34	1.46
Milwaukee	Milwaukee Mtchll Fld	-28	-18.2	49.2	-15.2	44.3	3.57	1.38
Iowa	Dodgeville	-28	-20.8	51.2	-17.8	46.3	3.23	1.44
Waukesha	Waukesha	-28	-19.3	51.6	-16.3	46.7	3.39	1.45
Milwaukee	West Allis	-28	-18.7	51.4	-15.7	46.5	3.34	1.45
Dane	Arboretum Univ Wis	-28	-21.7	52.7	-18.7	47.8	3.57	1.48
Crawford	Prairie Du Chien	-28	-21.7	54.8	-18.7	49.9	3.74	1.54
Dane	Charmany Farm	-28	-20.7	51.2	-17.7	46.3	3.57	1.45
Jefferson	Lake Mills	-28	-20.5	53.3	-17.5	48.4	3.23	1.51
Milwaukee	Milwaukee Mt Mary Co	-28	-18.7	52.9	-15.7	48.0	3.39	1.50
Waukesha	Oconomowoc	-28	-20.3	51.7	-17.3	46.8	3.34	1.47
Dane	Madison Dane Cnty Ap	-28	-20.6	52.0	-17.6	47.1	3.45	1.48
Jefferson	Watertown	-28	-20.4	52.4	-17.4	47.5	3.51	1.50
Crawford	Lynxville Dam 9	-28	-21.6	53.1	-18.6	48.2	3.57	1.52
Washington	Germantown	-28	-20.7	50.2	-17.7	45.3	3.57	1.44
Columbia	Arlington Univ Farm	-28	-21.3	51.9	-18.3	47.0	3.34	1.50
Washington	Hartford 2 W	-28	-21.6	51.3	-18.6	46.4	3.51	1.48
Richland	Richland Center	-28	-22.9	53.1	-19.9	48.2	3.74	1.53
Sauk	Prairie Du Sac 2 N	-28	-21.1	51.6	-18.1	46.7	3.34	1.49
Ozaukee	Port Washington	-28	-18.9	46.6	-15.9	41.7	3.34	1.35
Washington	West Bend	-28	-20.4	50.3	-17.4	45.4	3.45	1.46
Dodge	Horicon	-28	-21.2	51.3	-18.2	46.4	3.39	1.50
Dodge	Beaver Dam	-28	-20.7	52.3	-17.7	47.4	3.45	1.53
Sauk	Baraboo	-28	-23.2	51.5	-20.2	46.6	3.74	1.51
Columbia	Portage	-28	-21.6	52.6	-18.6	47.7	3.57	1.55
Sauk	Reedsburg	-28	-22.7	52.6	-19.7	47.7	3.39	1.55
Vernon	Genoa Dam 8	-28	-22.1	52.2	-19.1	47.3	3.68	1.54
Vernon	Viroqua 2 Nw	-28	-23.3	50.7	-20.3	45.8	3.63	1.50
Columbia	Wisconsin Dells	-28	-22.2	50.8	-19.2	45.9	3.63	1.51
Green Lake	Dalton	-28	-21.5	52.2	-18.5	47.3	3.23	1.55
Vernon	Hillsboro	-28	-23.6	52.1	-20.6	47.2	3.86	1.55
Sheboygan	Plymouth	-28	-20.3	50.6	-17.3	45.7	3.34	1.51
Monroe	Cashton	-28	-21.9	50.7	-18.9	45.8	3.68	1.52

County/District	Station Name	WisDOT Low Grade, °C	Surface Mixture Design Pavement Temperatures, °C		Lower Layer Mixture Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C	
			Low	High	Low	High	Low	High
Sheboygan	Sheboygan	-28	-19.0	48.8	-16.0	43.9	3.34	1.46
Juneau	Mauston 1 Se	-28	-23.0	52.2	-20.0	47.3	3.63	1.57
Marquette	Montello	-28	-22.5	51.7	-19.5	46.8	3.45	1.55
Fond Du Lac	Fond Du Lac	-28	-20.5	50.3	-17.5	45.4	3.39	1.51
La Crosse	La Crosse Muni Ap	-28	-22.2	52.9	-19.2	48.0	3.63	1.60
Monroe	Sparta	-28	-24.3	52.4	-21.3	47.5	3.74	1.59
Trempealeau	Trempealeau Dam 6	-28	-23.3	52.1	-20.3	47.2	3.63	1.59
Juneau	Necedah	-28	-24.6	53.0	-21.6	48.1	3.68	1.63
Calumet	Chilton	-28	-20.7	51.4	-17.7	46.5	3.23	1.58
Winnebago	Oshkosh	-28	-20.9	50.6	-17.9	45.7	3.34	1.55
Manitowoc	Manitowoc	-28	-19.8	48.2	-16.8	43.3	3.23	1.49
Waushara	Hancock Exp Farm	-28	-23.6	52.1	-20.6	47.2	3.51	1.61
Trempealeau	Dodge	-28	-25.7	54.0	-22.7	49.1	3.68	1.67
Manitowoc	Two Rivers 10 N	-28	-19.7	44.4	-16.7	39.5	3.17	1.38
Jackson	Mather 3 Nw	-28	-23.4	50.7	-20.4	45.8	3.57	1.57
Outagamie	Appleton	-28	-20.7	50.0	-17.7	45.1	3.07	1.56
Trempealeau	Blair	-28	-25.2	51.4	-22.2	46.5	3.80	1.61
Buffalo	Alma Dam 4	-28	-22.8	51.9	-19.8	47.0	3.63	1.63
Waupaca	Waupaca	-28	-21.6	51.4	-18.6	46.5	3.34	1.62
Portage	Coddington 1 E	-28	-25.7	49.9	-22.7	45.0	3.34	1.57
Waupaca	New London	-28	-22.4	51.9	-19.4	47.0	3.34	1.64
Wood	Wisconsin Rapids	-28	-23.1	51.0	-20.1	46.1	3.28	1.61
Jackson	Hatfield Hydro Plant	-28	-26.8	53.5	-23.8	48.6	3.57	1.69
Wood	Pittsville	-28	-25.3	51.5	-22.3	46.6	3.34	1.63
Portage	Stevens Point	-28	-22.8	50.0	-19.8	45.1	3.28	1.59
Clark	Neillsville 3 Sw	-28	-25.2	50.9	-22.2	46.0	3.57	1.63
Buffalo	Mondovi	-28	-24.7	52.1	-21.7	47.2	3.86	1.67
Eau Claire	Fairchild Ranger Sta	-28	-23.2	50.0	-20.2	45.1	3.17	1.61
Waupaca	Clintonville	-28	-22.2	50.5	-19.2	45.6	3.28	1.63
Wood	Marshfield Exp Farm	-28	-23.5	50.8	-20.5	45.9	3.23	1.64
Pierce	Ellsworth	-28	-24.1	51.4	-21.1	46.5	3.34	1.67
Portage	Rosholt	-28	-24.2	50.3	-21.2	45.4	3.28	1.64
Chippewa	Eau Claire County Ap	-28	-23.8	51.2	-20.8	46.3	3.39	1.68
Dunn	Menomonie	-34	-24.2	52.7	-21.2	47.8	3.57	1.73

Table 36. Northern Wisconsin Weather Stations Included in the Reliability Analysis.

County/District	Station Name	WisDOT Low Grade, °C	Surface Mixture Average Pavement Temperatures, °C		Lower Layer Mixture Average Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C	
			Low	High	Low	High	Low	High
Kewaunee	Kewaunee	-34	-19.7	46.3	-16.7	41.4	3.99	1.47
Brown	Green Bay	-34	-21.5	49.7	-18.5	44.8	3.23	1.58
Shawano	Shawano 2 Ssw	-34	-23.0	50.8	-20	45.9	3.34	1.66
Shawano	Bowler	-34	-23.9	48.9	-20.9	44	3.45	1.61
Pierce	River Falls	-34	-23.7	51.9	-20.7	47	3.39	1.71
Door	Sturgeon Bay Exp Far	-34	-20.4	47.9	-17.4	43	3.34	1.57
Oconto	Oconto	-34	-22.0	49.2	-19	44.3	3.39	1.62
Marathon	Wausau Municipal Ap	-34	-23.1	49.1	-20.1	44.2	3.28	1.62
Clark	Owen	-34	-25.2	48.2	-22.2	43.3	3.34	1.59
Chippewa	Stanley	-34	-24.7	50.2	-21.7	45.3	3.34	1.66
Oconto	Breed 6 Sse	-34	-24.7	50.8	-21.7	45.9	3.57	1.69
Chippewa	Bloomer	-34	-24.5	51.5	-21.5	46.6	3.51	1.72
Marinette	Marinette	-34	-20.9	50.8	-17.9	45.9	3.17	1.70
Taylor	Medford	-34	-25.1	47.9	-22.1	43	3.23	1.61
Langlade	Antigo	-34	-25.1	48.8	-22.1	43.9	3.17	1.64
Lincoln	Merrill	-34	-25.3	49.1	-22.3	44.2	3.57	1.65
Chippewa	Holcombe	-34	-26.3	51.2	-23.3	46.3	3.80	1.73
Barron	Ridgeland 1 Nne	-34	-26.5	50.7	-23.5	45.8	3.57	1.71
Polk	Amery	-34	-25.5	49.8	-22.5	44.9	3.74	1.69
Oconto	Lakewood 3 Ne	-34	-24.3	49.4	-21.3	44.5	3.23	1.68
Taylor	Jump River	-34	-27.8	49.2	-24.8	44.3	3.51	1.68
Marinette	Crivitz High Falls	-34	-24.2	49.4	-21.2	44.5	3.57	1.69
Door	Washington Island	-34	-19.5	44.5	-16.5	39.6	3.45	1.52
Polk	St Croix Falls	-34	-26.3	51.6	-23.3	46.7	3.28	1.77
Rusk	Weyerhauser	-34	-26.2	50.4	-23.2	45.5	3.23	1.73
Barron	Rice Lake	-34	-26.1	50.2	-23.1	45.3	3.63	1.73
Price	Prentice 5 W	-34	-28.2	47.3	-25.2	42.4	3.45	1.64
Forest	Laona	-34	-24.6	46.1	-21.6	41.2	3.17	1.60
Barron	Cumberland	-34	-25.4	50.9	-22.4	46	3.28	1.76
Rusk	Big Falls Hydro	-34	-27.5	49.8	-24.5	44.9	3.39	1.73
Polk	Luck	-34	-25.7	50.3	-22.7	45.4	3.39	1.75
Marinette	Goodman	-34	-23.8	47	-20.8	42.1	3.12	1.64
Oneida	North Pelican	-34	-26.7	46.4	-23.7	41.5	3.28	1.62

County/District	Station Name	WisDOT Low Grade, °C	Surface Mixture Average Pavement Temperatures, °C		Lower Layer Mixture Average Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C	
			Low	High	Low	High	Low	High
Oneida	Rhineland	-34	-25.5	48.1	-22.5	43.2	3.07	1.68
Oneida	Willow Reservoir	-34	-26.6	46.6	-23.6	41.7	3.23	1.64
Burnett	Grantsburg	-34	-26.7	49.7	-23.7	44.8	3.45	1.75
Forest	Newald 4 N	-34	-26.6	48.2	-23.6	43.3	3.23	1.70
Washburn	Spooner Exp Farm	-34	-27.0	50.6	-24	45.7	3.17	1.79
Oneida	Rainbow Rsvr Lake	-34	-26.1	46.8	-23.1	41.9	3.23	1.66
Sawyer	Couderay	-34	-29.0	49.5	-26	44.6	4.17	1.76
Oneida	Minocqua Dam	-34	-26.0	47	-23	42.1	3.39	1.67
Sawyer	Winter 5 Nw	-34	-27.1	46.9	-24.1	42	3.07	1.67
Oneida	Long Lake Dam	-34	-26.7	47.7	-23.7	42.8	3.01	1.70
Vilas	St Germain 2 E	-34	-26.1	45.1	-23.1	40.2	3.23	1.61
Price	Park Falls	-34	-24.8	46.8	-21.8	41.9	3.17	1.67
Florence	Brule Island	-34	-27.2	48.7	-24.2	43.8	3.28	1.74
Burnett	Danbury	-34	-27.6	49.5	-24.6	44.6	3.23	1.78
Washburn	Minong 2	-34	-29.2	49.7	-26.2	44.8	3.12	1.79
Vilas	Rest Lake	-34	-26.7	47.6	-23.7	42.7	3.28	1.73
Douglas	Gordon	-34	-29.4	49.3	-26.4	44.4	3.17	1.80
Bayfield	Drummond	-34	-26.8	49.1	-23.8	44.2	3.28	1.81
Douglas	Solon Springs	-34	-28.1	50.4	-25.1	45.5	3.23	1.86
Ashland	Mellen	-34	-27.1	47.7	-24.1	42.8	3.34	1.77
Douglas	Foxboro	-34	-27.8	48.3	-24.8	43.4	3.07	1.80
Iron	Gurney	-34	-25.2	47.3	-22.2	42.4	3.12	1.76
Bayfield	Ashland Exp Farm	-34	-25.2	48.7	-22.2	43.8	3.17	1.83
Douglas	Superior	-34	-25.1	44.2	-22.1	39.3	3.17	1.67
Bayfield	Port Wing	-34	-25.5	47.2	-22.5	42.3	3.12	1.80
Ashland	Madeline Island	-34	-22.8	45.4	-19.8	40.5	3.63	1.73
Bayfield	Bayfield	-34	-22.6	46.4	-19.6	41.4	3.28	1.78

4.2.2 Surface Mixture Analysis

4.2.2.1 Low Temperature Performance Grade Reliability

The surface mixture analysis was performed for two virgin binders: (1) mid grade, having intermediate and low temperature continuous grade temperatures midway between the WisDOT required grade and the next lower low temperature grade and (2) exceptional grade having

intermediate and low temperature continuous grade properties very close to the next lower low temperature grade. The effect of RAP and RAS on the continuous grade properties were estimated using Equation 7 and the average continuous grade properties determined for the Wisconsin recycled sources. For the surface mixtures with RAS and RAP, the RAS binder replacement was assumed to be 19.0 percent based on a maximum RAS content of 5 percent by weight of aggregate, a RAS binder content of 20 percent, and a mixture with 5.0 percent binder. The standard deviation of the continuous grade properties were estimated using Equation 6 and the standard deviations given in Table 33. The continuous grade temperatures and standard deviations used in the analysis are summarized in Table 37 for the mid grade virgin binder and Table 38 for the exceptional grade virgin binder. It is interesting to note that there is little change in the standard deviation of the intermediate and low temperature continuous grade temperatures for the mixtures with RAP and RAS binder replacement compared to the virgin binders. The high temperature continuous grade standard deviation is higher for the mixtures with recycled binders, particularly when RAS is used.

Table 37. Continuous Grade Temperatures for Mid Grade Virgin Binder for the Surface Mixture Reliability Analysis

Mixture	Statistic	Temperature, °C		
		High	Intermediate	Low
PG 58-28	Average	61.0	17.5	-31.0
	Standard Deviation	0.5	1.0	0.8
PG 58-28 + 25% RAP	Average	66.5	19.9	-28.7
	Standard Deviation	0.7	0.8	0.7
PG 58-28 + 20% Southern RAS	Average	71.4	20.2	-26.5
	Standard Deviation	1.2	0.9	0.7
PG 58-28 + 19% Southern RAS + 6% RAP	Average	72.2	20.6	-26.2
	Standard Deviation	1.1	0.8	0.7
PG 58-34	Average	61.0	14.5	-37.0
	Standard Deviation	0.5	1.0	0.8
PG 58-34 + 25% RAP	Average	66.5	17.6	-32.2
	Standard Deviation	0.7	0.8	0.7
PG 58-34 + 20% Northern RAS	Average	73.2	18.5	-30.5
	Standard Deviation	1.2	0.9	0.7
PG 58-28 + 19% Northern RAS + 6% RAP	Average	73.9	19.0	-30.0
	Standard Deviation	1.1	0.8	0.7

Table 38. Continuous Grade Temperatures for Exceptional Grade Virgin Binder for the Surface Mixture Reliability Analysis

Mixture	Statistic	Temperature, °C		
		High	Intermediate	Low
PG 58-28	Average	61.0	16.2	-33.5
	Standard Deviation	0.5	1.0	0.8
PG 58-28 + 25% RAP	Average	66.5	18.9	-30.6
	Standard Deviation	0.7	0.8	0.7
PG 58-28 + 20% Southern RAS	Average	71.4	19.2	-28.5
	Standard Deviation	1.2	0.9	0.7
PG 58-28 + 19% Southern RAS + 6% RAP	Average	72.2	19.7	-28.0
	Standard Deviation	1.1	0.8	0.7
PG 58-34	Average	61.0	13.2	-39.5
	Standard Deviation	0.5	1.0	0.8
PG 58-34 + 25% RAP	Average	66.5	16.7	-35.1
	Standard Deviation	0.7	0.8	0.7
PG 58-34 + 20% Northern RAS	Average	73.2	17.5	-32.5
	Standard Deviation	1.2	0.9	0.7
PG 58-28 + 19% Northern RAS + 6% RAP	Average	73.9	18.1	-31.8
	Standard Deviation	1.1	0.8	0.7

The reliability analysis was conducted for the low temperature grade for each of the Wisconsin weather stations. In the analysis, 98 percent reliability was used for the continuous grade of the binder supplied, then the overall reliability that the binder met the low pavement design temperature was calculated using Equation 13. The results are presented in Appendix C. Table 39 and Figure 33 summarize the distribution of the results for the mid grade binder while Table 40 and Figure 34 summarize the distribution of the results for the exceptional grade binder. These summaries include the extreme maximum and minimum values, the upper and lower quartile values, and the median and average values. Several interesting observations were made based on this analysis.

1. For mid grade virgin binders, the WisDOT virgin binder selection provides high reliability for the low temperature performance grade. For PG 58-28 locations, only 25 percent of the weather stations provide an overall reliability level less than 94.4 percent. For PG 58-34 locations, only 25 percent of the weather stations provide an overall reliability level less than 97.4 percent. The reliability is even higher when exceptional virgin binders are used. The minimum reliability level is over 90 percent for the exceptional virgin binders.

Table 39. Distribution of Low Temperature Grade Reliabilities for Surface Mixtures Produced Using Mid Grade Binder and 2011 WisDOT Binder Replacement Criteria.

Statistic	Reliability, %							
	S, Mid Grade, Virgin	N, Mid Grade, Virgin	S, Mid Grade, 25% RAP	N, Mid Grade, 25% RAP	S, Mid Grade, 20% RAS	N, Mid Grade, 20% RAS	S, Mid Grade, 19% RAS 6% RAP	N, Mid Grade, 19% RAS 6% RAP
Maximum	97.9	98.0	97.5	98.0	95.4	97.7	94.9	97.6
Upper Quartile	97.7	98.0	96.0	96.7	90.3	89.7	88.9	87.4
Median	97.0	97.8	93.9	94.5	84.3	82.5	82.3	78.8
Average	95.1	97.4	89.9	93.0	78.6	80.7	76.6	77.2
Lower Quartile	94.2	97.5	86.3	91.6	69.8	74.3	67.0	69.5
Minimum	75.2	90.9	54.5	73.4	31.0	45.3	28.2	39.2

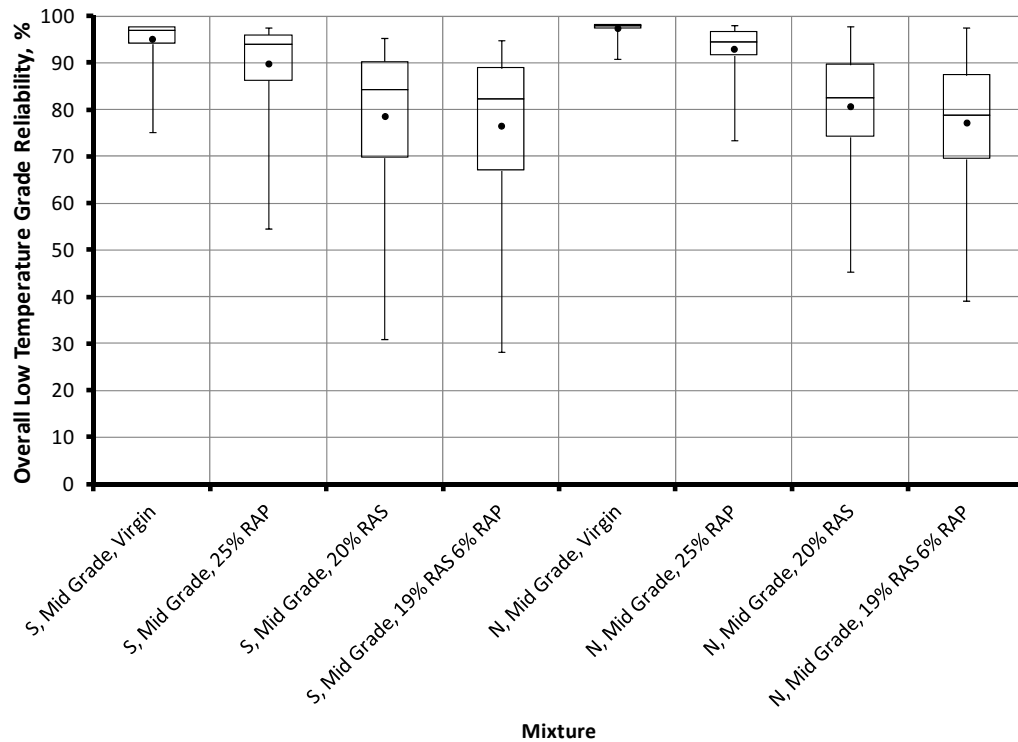


Figure 33. Distribution of Low Temperature Grade Reliabilities for Surface Mixtures Produced Using Mid Grade Binder and 2011 WisDOT Binder Replacement Criteria.

Table 40. Distribution of Low Temperature Grade Reliabilities for Surface Mixtures Produced Using Exceptional Grade Binder and 2011 WisDOT Binder Replacement Criteria.

Statistic	Reliability, %							
	S, Exceptional Grade, Virgin	N, Exceptional Grade, Virgin	S, Exceptional Grade, 25% RAP	N, Exceptional Grade, 25% RAP	S, Exceptional Grade, 20% RAS	N, Exceptional Grade, 20% RAS	S, Exceptional Grade, 19% RAS 6% RAP	N, Exceptional Grade, 19% RAS 6% RAP
Maximum	98.0	98.0	97.9	98.0	97.4	98.0	97.1	97.9
Upper Quartile	98.0	98.0	97.6	97.8	95.7	95.5	94.8	94.2
Median	97.9	98.0	96.9	97.1	93.3	92.2	91.8	89.9
Average	97.4	97.9	94.8	96.4	89.1	90.5	87.0	88.0
Lower Quartile	97.3	98.0	93.7	96.2	85.2	87.9	82.0	84.2
Minimum	90.5	96.4	73.5	85.3	52.3	67.1	46.8	61.1

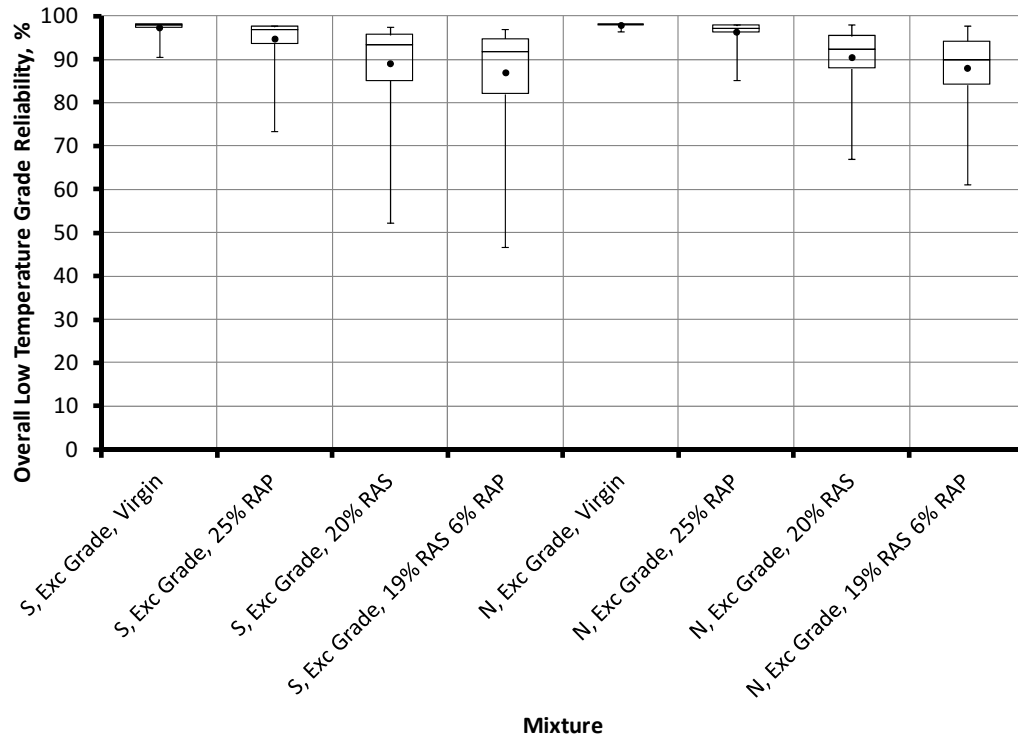


Figure 34. Distribution of Low Temperature Grade Reliabilities for Surface Mixtures Produced Using Exceptional Grade Binder and 2011 WisDOT Binder Replacement Criteria.

2. Adding recycled binders decreases the reliability of the low temperature performance grade and the effect is greater at locations having the lowest reliability based on the virgin binder selection. For mixtures with 25 percent RAP binder replacement, the median reliability when using mid grade binder decreases approximately 3 percent for both the PG 58-28 and PG 58-34 locations. For the mid grade binder the lower quartile reliability level decreases approximately twice as much compared to the median reliability.
3. The change in the low temperature reliability is less when exceptional virgin binders are used. For mixtures with 25 percent RAP binder replacement, the median reliability when using exceptional virgin binders is approximately 97 percent. The lower quartile reliabilities for the exceptional virgin binder with 25 percent RAP binder replacement are similar to those for the mid grade virgin binders.
4. The current WisDOT binder replacement criteria for RAP and RAS do not result in equivalent changes to the low temperature performance grade reliability. For mid grade virgin binders with 20 percent RAS binder replacement, the median low temperature reliability decreases about four times more and the lower quartile reliability decreases about three times more than that for the mixtures with 25 percent RAP binder replacement. For exceptional virgin binders differences between the 20 percent RAS binder replacement and 25 percent RAP binder replacement are similar to those for the mid grade virgin binder. However, the decrease in reliability is significantly less.
5. The current WisDOT binder replacement criteria for surface mixtures with RAS appear to be too lenient for mid grade binders. The median reliability when RAS is used drops to between 80 and 85 percent. Considering the overall reliability for virgin binders, median reliability of at least 90 percent appears appropriate.

4.2.2.2 High Temperature Performance Grade Reliability

A similar analysis was performed for the high temperature performance grade. The overall reliability of the high temperature performance grade was 98 percent for all cases. A more interesting analysis was whether the 2011 WisDOT binder replacement criteria reliably bumped PG 58-XX binders to PG 64-XX binders. The results of this analysis are also presented in Appendix C. Table 41 and Figure 35 summarize the distribution of the results. Because the mid grade and exceptional binders were assumed to have the same high temperature performance grade, only one analysis was required. This analysis shows that 25 percent RAP binder replacement does not reliably increase the high temperature performance grade to 64 °C when the variability of the binder is considered. The use of 20 percent RAS binder replacement does increase the performance grade of the binder to 64 °C.

4.2.2.3 Intermediate Temperature Performance Grade Reliability

As discussed earlier, the intermediate temperature is a function of the binder grade selected by the agency, not the pavement temperatures at the project location. Therefore, the reliability that the binder meets the intermediate grade requirements depend only on the average and standard deviation of the binder supplied. Equation 14 was used to estimate the intermediate temperature reliability for mid grade and exceptional grade binders using the averages and standard deviations presented in Table 37 and 38. The specified mid grade temperature are 19 °C for PG 58-28 locations and 16 °C for PG 58-34 locations. The results are summarized in Table 42 and presented graphically in Figure 36.

These results show that when the variability of the binder supplied is considered, the mid grade virgin binders provide approximately 77 percent reliability that the continuous intermediate grade temperature will be less than the intermediate grade temperature specified. For exceptional binders, the reliability is about 92 percent. When recycled binders are added, the intermediate temperature reliability decreases. It decreases more for the northern locations compared to the southern locations. For several combinations the reliability is less than 50 percent indicating that the average intermediate grade temperature of the binder supplied exceeds the intermediate grade specified.

Table 41. Distribution of PG 64 Reliabilities for Surface Mixtures Produced Using 2011 WisDOT Binder Replacement Criteria.

Statistic	Reliability, %							
	South, Virgin	North, Virgin	South, 25% RAP	North, 25% RAP	South, 20% RAS	North, 20% RAS	South, 19% RAS 6% RAP	North, 19% RAS 6% RAP
Maximum	1.0	1.5	78.8	75.7	98.0	98.0	98.0	98.0
Upper Quartile	0.6	1.1	75.8	73.4	98.0	98.0	98.0	98.0
Median	0.4	0.9	75.0	72.6	97.9	98.0	98.0	98.0
Average	0.5	0.9	75.0	72.7	97.9	98.0	98.0	98.0
Lower Quartile	0.3	0.7	74.0	72.0	97.9	98.0	98.0	98.0
Minimum	0.1	0.3	72.2	70.9	97.8	97.8	98.0	98.0

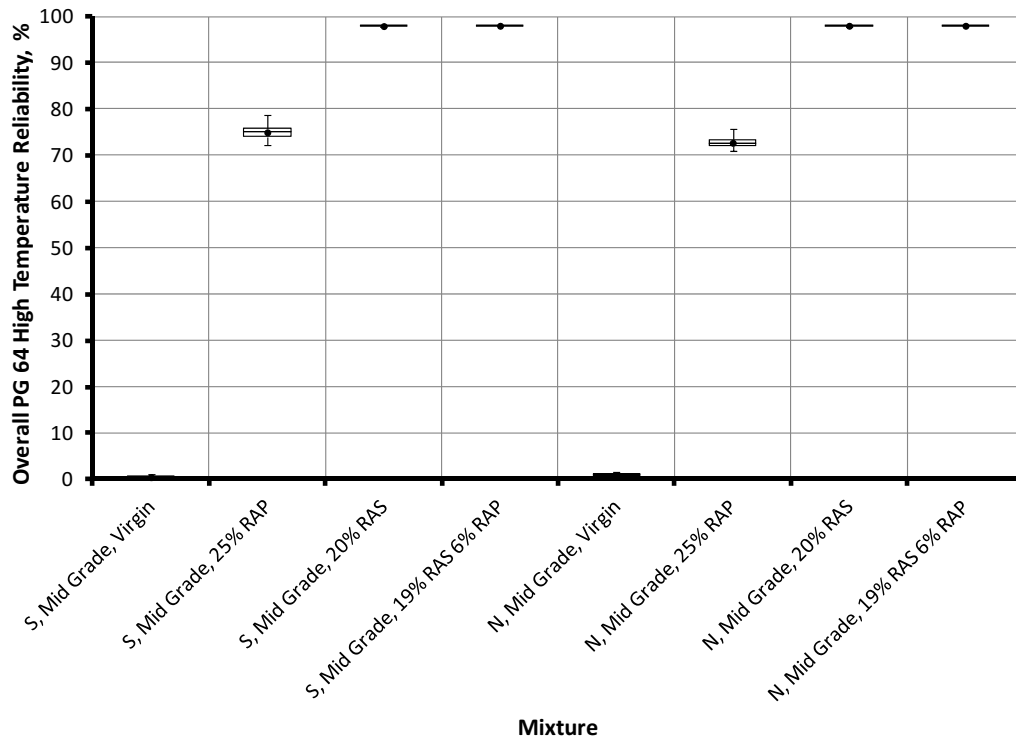


Figure 35. Distribution of PG 64 Reliabilities for Surface Mixtures Produced Using 2011 WisDOT Binder Replacement Criteria.

Table 42. Surface Mixture Intermediate Grade Temperature Reliability for 2011 WisDOT Binder Replacement Criteria.

Virgin Binder	Reliability, %							
	South, Virgin	North, Virgin	South, 25% RAP	North, 25% RAP	South, 20% RAS	North, 20% RAS	South, 19% RAS 6% RAP	North, 19% RAS 6% RAP
Mid Grade	77.3	77.3	26.0	12.7	25.2	8.2	17.3	3.9
Exceptional	91.9	91.9	59.9	44.0	50.0	17.7	38.8	9.9

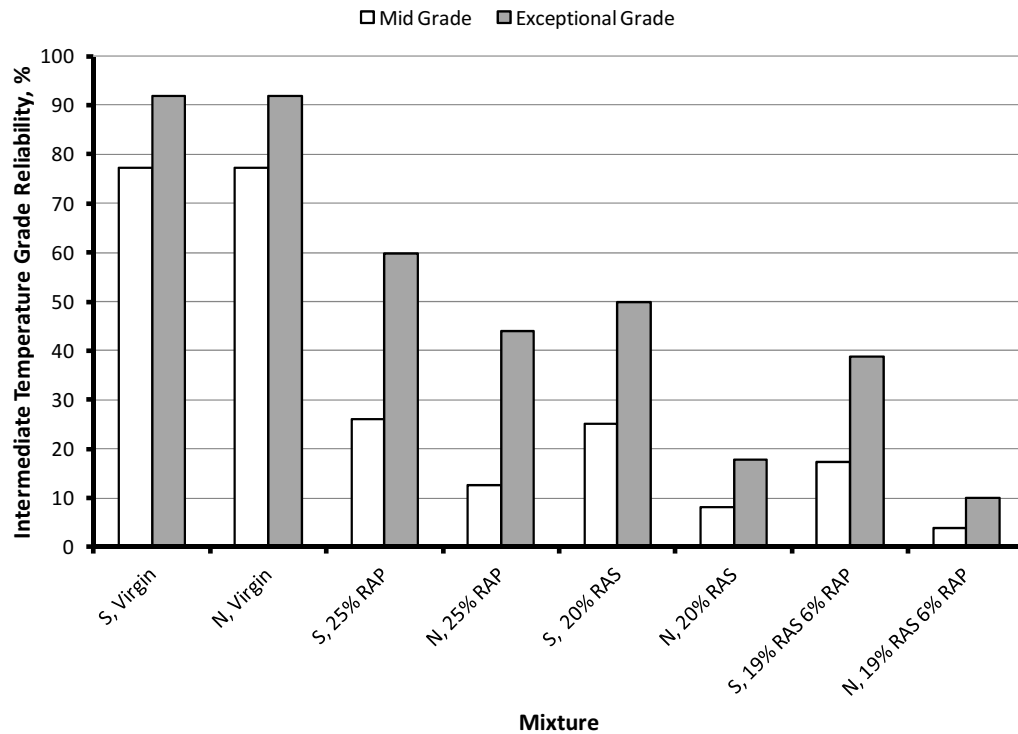


Figure 36. Surface Mixture Intermediate Temperature Grade Reliability for WisDOT 2011 Binder Replacement Criteria.

4.2.3 Lower Layer Mixture Analysis

Similar reliability analyses for the low and intermediate continuous grade temperatures were conducted for lower layers. In this analysis a lower layer was defined as a layer 50 mm or more below the pavement surface. At 50 mm the average low pavement temperature increases 3.0 °C and the average high pavement temperature decreases 4.9 °C. The lower layer analysis was conducted for the mid grade and exceptional grade binders. The continuous grade temperatures and standard deviations used in the lower layer reliability analysis are summarized in Table 43 for the mid grade virgin binder and Table 44 for the exceptional grade virgin binder.

4.2.3.1 Low Temperature Performance Grade Reliability

The reliability analysis was conducted for the low temperature grade for each of the Wisconsin weather stations. In the analysis, 98 percent reliability was used for the continuous grade of the binder supplied, then the overall reliability that the binder met the low pavement design temperature was calculated using Equation 13. The results are presented in Appendix C.

Table 43. Continuous Grade Temperatures for Mid Grade Virgin Binder for the Lower Layer Mixture Reliability Analysis

Mixture	Statistic	Temperature, °C		
		High	Intermediate	Low
PG 58-28	Average	61.0	17.5	-31.0
	Standard Deviation	0.5	1.0	0.8
PG 58-28 + 40% RAP	Average	69.7	21.3	-27.3
	Standard Deviation	0.9	0.8	0.7
PG 58-28 + 25% Southern RAS	Average	74.0	20.9	-25.4
	Standard Deviation	1.4	0.9	0.8
PG 58-28 + 21% Southern RAS + 14% RAP	Average	75.0	21.7	-25.0
	Standard Deviation	1.2	0.8	0.7
PG 58-34	Average	61.0	14.5	-37.0
	Standard Deviation	0.5	1.0	0.8
PG 58-34 + 40% RAP	Average	69.7	19.5	-30.9
	Standard Deviation	0.9	0.8	0.7
PG 58-34 + 25% Northern RAS	Average	76.3	19.5	-28.9
	Standard Deviation	1.4	0.9	0.8
PG 58-28 + 21% Northern RAS + 14% RAP	Average	76.9	20.4	-28.1
	Standard Deviation	1.2	0.8	0.7

Table 44. Continuous Grade Temperatures for Exceptional Grade Virgin Binder for the Lower Layer Mixture Reliability Analysis

Mixture	Statistic	Temperature, °C		
		High	Intermediate	Low
PG 58-28	Average	61.0	16.2	-33.5
	Standard Deviation	0.5	1.0	0.8
PG 58-28 + 40% RAP	Average	69.7	20.5	-28.8
	Standard Deviation	0.9	0.8	0.7
PG 58-28 + 25% Southern RAS	Average	74.0	19.9	-27.2
	Standard Deviation	1.4	0.9	0.8
PG 58-28 + 21% Southern RAS + 14% RAP	Average	75.0	20.8	-26.6
	Standard Deviation	1.2	0.8	0.7
PG 58-34	Average	61.0	13.2	-39.5
	Standard Deviation	0.5	1.0	0.8
PG 58-34 + 40% RAP	Average	69.7	18.7	-32.4
	Standard Deviation	0.9	0.8	0.7
PG 58-34 + 25% Northern RAS	Average	76.3	18.5	-30.8
	Standard Deviation	1.4	0.9	0.8
PG 58-28 + 21% Northern RAS + 14% RAP	Average	76.9	19.6	-29.7
	Standard Deviation	1.2	0.8	0.7

Table 45 and Figure 37 summarize the distribution of the results for the mid grade binder while Table 46 and Figure 38 summarize the distribution of the results for the exceptional grade binder. The virgin binders have very high low temperature performance grade reliability for lower layers because the design low pavement temperature increases with depth. The effect of adding recycled binders is similar to that for the surface mixtures. The low temperature performance grade reliability decreases when recycled binders are added, with RAS binders resulting in a greater decrease in the low temperature reliability. The effect is less than that for surface mixtures because the design low pavement temperature increases with depth.

Table 45. Distribution of Low Temperature Grade Reliabilities for Lower Layer Mixtures Produced Using Mid Grade Binder and 2011 WisDOT Binder Replacement Criteria.

Statistic	Reliability, %							
	S, Mid Grade, Virgin	N, Mid Grade, Virgin	S, Mid Grade, 40% RAP	N, Mid Grade, 40% RAP	S, Mid Grade, 25% RAS	N, Mid Grade, 25% RAS	S, Mid Grade, 19% RAS 6% RAP	N, Mid Grade, 19% RAS 6% RAP
Maximum	98.0	98.0	97.9	98.0	97.3	97.9	97.1	97.8
Upper Quartile	98.0	98.0	97.5	97.3	95.2	93.9	94.8	92.0
Median	97.9	98.0	96.6	95.8	92.5	89.4	91.8	86.3
Average	97.6	97.9	94.2	94.7	87.9	87.6	87.0	84.6
Lower Quartile	97.5	98.0	92.9	93.9	83.3	83.6	82.0	79.5
Minimum	92.3	96.8	70.8	78.3	49.0	59.9	46.8	52.7

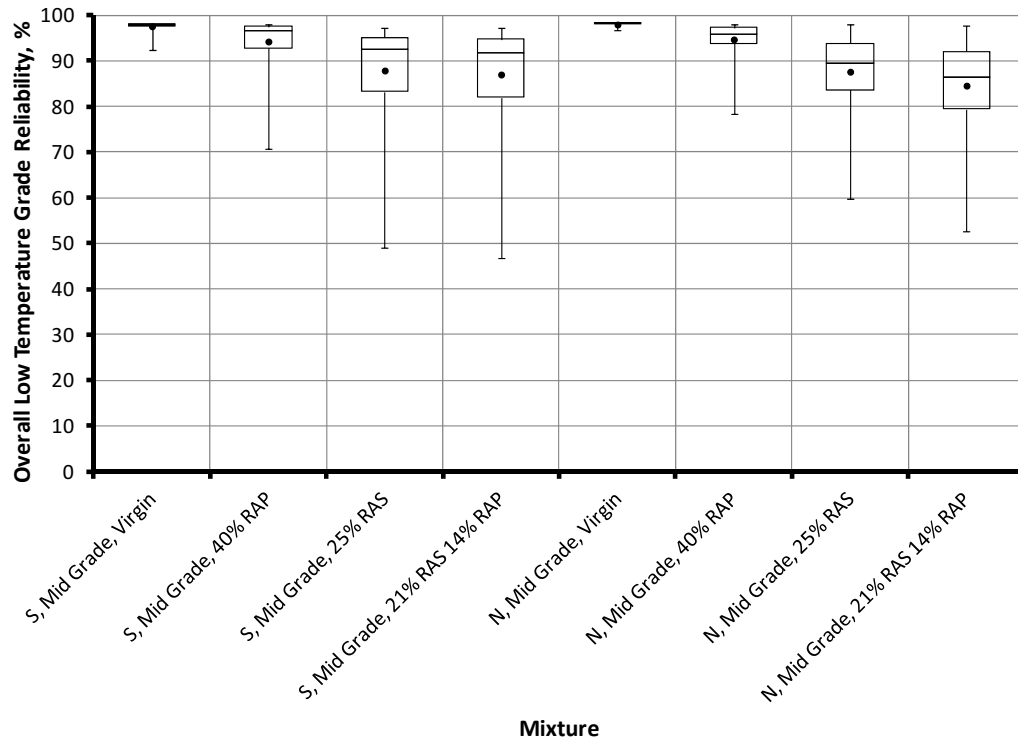


Figure 37. Distribution of Low Temperature Grade Reliabilities for Lower Layer Mixtures Produced Using Mid Grade Binder and 2011 WisDOT Binder Replacement Criteria.

Table 46. Distribution of Low Temperature Grade Reliabilities for Lower Layer Mixtures Produced Using Exceptional Grade Binder and 2011 WisDOT Binder Replacement Criteria.

Statistic	Reliability, %							
	S, Exceptional Grade, Virgin	N, Exceptional Grade, Virgin	S, Exceptional Grade, 40% RAP	N, Exceptional Grade, 40% RAP	S, Exceptional Grade, 25% RAS	N, Exceptional Grade, 25% RAS	S, Exceptional Grade, 19% RAS 6% RAP	N, Exceptional Grade, 19% RAS 6% RAP
Maximum	98.0	98.0	98.0	98.0	97.9	98.0	97.8	98.0
Upper Quartile	98.0	98.0	97.9	97.8	97.3	97.0	97.0	96.0
Median	98.0	98.0	97.6	97.3	96.2	95.3	95.6	93.2
Average	97.9	98.0	96.4	96.7	93.6	94.1	92.6	91.6
Lower Quartile	97.9	98.0	96.0	96.6	91.9	93.0	90.5	89.4
Minimum	96.9	97.8	82.7	86.7	67.9	76.3	64.0	69.5

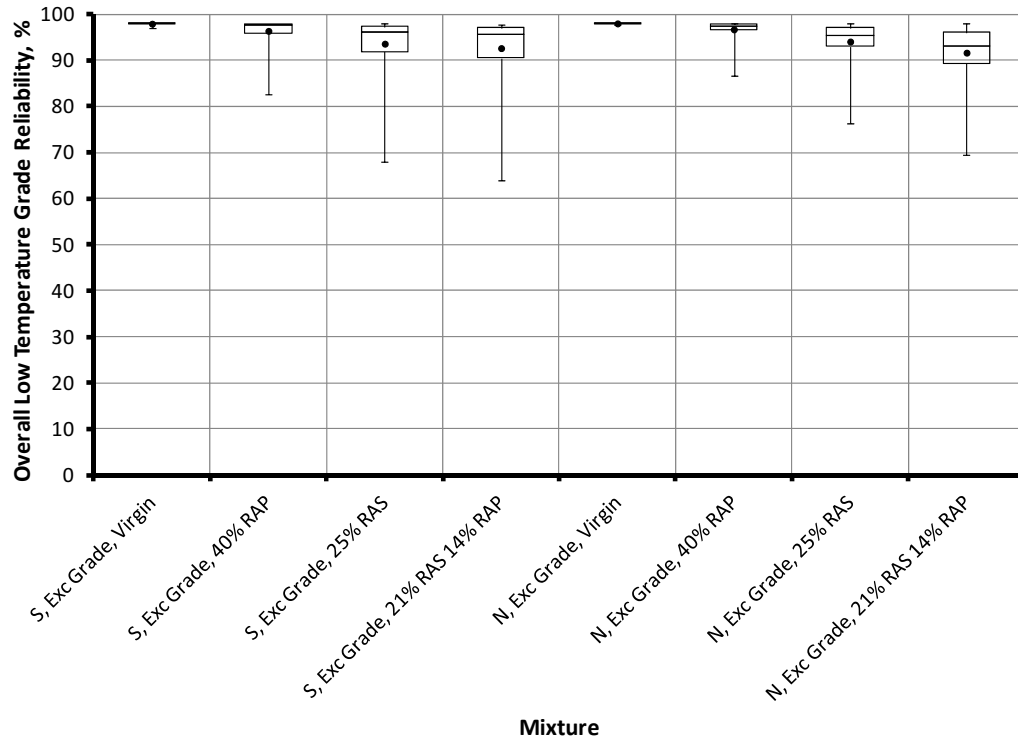


Figure 38. Distribution of Low Temperature Grade Reliabilities for Lower Layer Mixtures Produced Using Exceptional Grade Binder and 2011 WisDOT Binder Replacement Criteria.

4.2.3.2 Intermediate Temperature Performance Grade Reliability

The intermediate temperature performance grade reliability assessed the reliability that the binder supplied meets the intermediate temperature requirements for the binder specified. The specified mid grade temperatures are 19 °C for PG 58-28 locations and 16 °C for PG 58-34 locations. The results are summarized in Table 47 and presented graphically in Figure 39. The greater amount of recycled binder permitted in lower layers by the current WisDOT binder replacement criteria results in lower reliability that the specified intermediate grade temperature will be met. For all mixtures containing recycled binders, the overall reliability is less than 50 percent indicating that the average intermediate grade temperature of the binder supplied exceeds the intermediate grade specified.

Table 47. Lower Layer Mixture Intermediate Grade Temperature Reliability for 2011 WisDOT Binder Replacement Criteria.

Virgin Binder	Reliability, %							
	South, Virgin	North, Virgin	South, 40% RAP	North, 40% RAP	South, 25% RAS	North, 25% RAS	South, 21% RAS 14% RAP	North, 21% RAS 14% RAP
Mid Grade	77.3	77.3	5.0	0.6	14.6	2.6	6.3	0.6
Exceptional	91.9	91.9	14.2	2.7	30.9	8.2	15.9	2.0

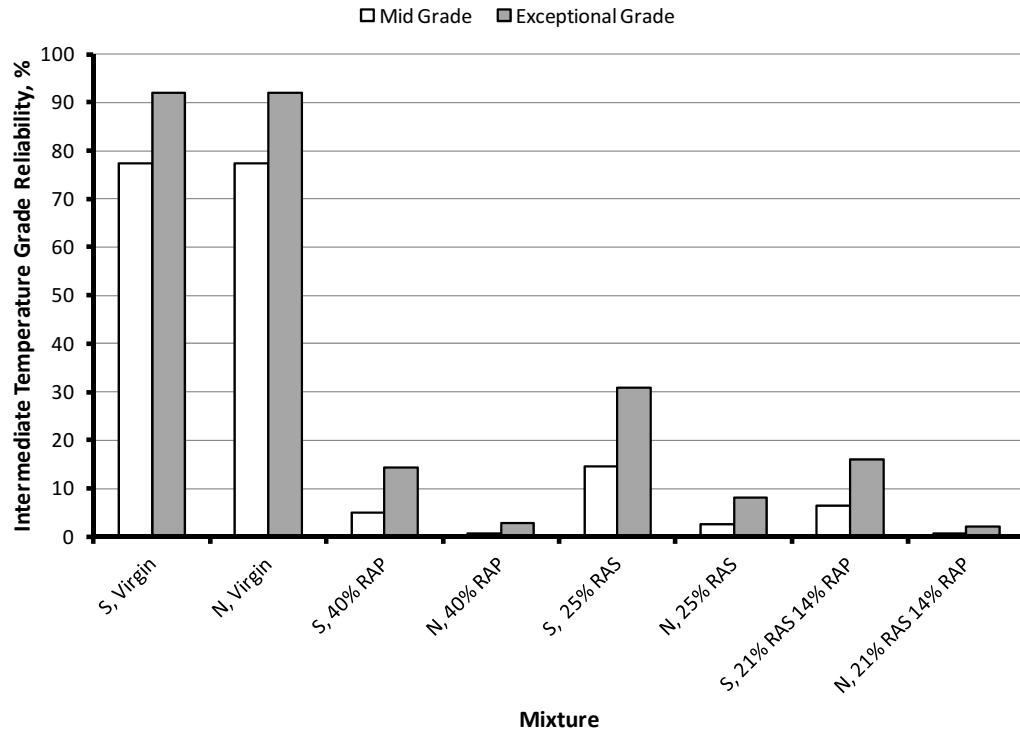


Figure 39. Lower Layer Mixture Intermediate Temperature Grade Reliability for 2011 WisDOT Binder Replacement Criteria.

Chapter 5 Conclusions and Recommendations

5.1 Conclusions

WHRP Project 0092-10-06 included three major studies: (1) review of current practice, (2) blending chart improvements, and (3) characterization of Wisconsin recycled materials. The first study, review of current practice, was conducted to evaluate WisDOT's 2010 binder replacement criteria relative to other agencies and to review the NCHRP Project 9-12 research that led to the development of the AASHTO M323 blending chart procedure. From this review detailed experimental plans for the two laboratory studies were prepared. The second study, blending chart improvements, was conducted to extend the AASHTO M323 blending chart analysis to include RAS binders and multiple recycled binders. It included performance grading analysis of blends of RAS, RAP, and RAS and RAP in PG 58-28 and PG 70-28 binders. In the third study, characterization of Wisconsin recycled materials, the improved blending chart analysis was applied to 18 recycled materials from Wisconsin. The data from this study were used to evaluate WisDOT's 2011 criteria for binder replacement, and to identify potential effects of using RAP and RAS on pavement service life. Major conclusions drawn from the two laboratory studies are presented below.

5.1.1 Blending Chart Improvements

The blending chart improvement study demonstrated that the linear blending charts included in AASHTO M323 can be extended to RAS and blends of RAS and RAP. This study showed the continuous grading properties of blends of RAS and virgin binders exhibited a linear relationship up to approximately 30 percent RAS binder replacement for the m-value and to more than 50 percent binder replacement for the various stiffness based performance grading properties. This conclusion led to the development of an approach where the continuous grading properties of recovered RAS binders are extrapolated from the continuous grading properties of a 30/70 blend of RAS in a virgin binder with known continuous grading properties. Recovering RAS binders can be difficult. Modifications to AASHTO T170 for recovering RAS binders are presented in Appendix A.

The blending chart improvement study also included an evaluation of using linear blending charts with multiple recycled binders. The major conclusion drawn from this part of the study was the continuous grading properties of a blend of RAP and RAS in a virgin binder can be reasonably estimated using a linear combination of the continuous grading properties of the virgin binder, the continuous grading properties of the RAP binder, and the extrapolated continuous grading properties of the RAS binder. The general blending chart procedure for multiple binders was prepared in the form of a standard practice and is included as Appendix B.

5.1.2 Wisconsin Recycled Materials

In WHRP Project 0092-10-06, continuous grading properties were measured for 18 recycled sources used in Wisconsin. The recycled sources included 6 RAP stockpiles, 6 FRAP stockpiles, and 6 RAS stockpiles. For each type of recycled material 3 sources from northern Wisconsin and 3 sources from southern Wisconsin were sampled and characterized. The RAP and FRAP sources were characterized in accordance with the Appendix to AASHTO M323. The continuous grading properties of the RAS sources were extrapolated from a 30/70 blend of recovered RAS in PG 58-28 binder using the procedures developed in the blending chart improvement study. Statistical analysis of the continuous grading properties of the recycled materials led to the following conclusions.

1. The continuous grading properties of binder recovered from Wisconsin RAP and FRAP sources are very similar. The properties are not affected by the type of recycled binder, RAP or FRAP, nor the geographic location of the recycled binder. The average recovered continuous grade was PG 82.8 (26.9) – 21.8. The standard deviation of the high, intermediate, and low temperature continuous grade temperatures were 2.2, 1.4, and 1.4 °C, respectively. The standard deviations of a neat virgin binder from the same source sampled over one construction season were 0.5, 1.5, and 0.9 °C for high, intermediate, and low continuous grade temperatures, respectively.
2. The continuous grading properties of binder recovered from Wisconsin RAS sources showed a geographical difference with southern sources being somewhat softer compared to northern sources. The average extrapolated continuous grade for southern

sources was PG 113.1 (31.0) -8.4 and average extrapolated continuous grade for northern sources was PG 122.1 (34.4) -4.7. The pooled standard deviation of the of the high, intermediate, and low temperature continuous grade temperature were 5.4, 1.8, and 1.8 °C, respectively.

3. Wisconsin RAS binders change the continuous grade properties of a typical PG 58-28 two to three times more rapidly than RAS binders. Additionally, the high temperature variability of RAS binders is greater than that for RAP binders.

5.1.3 Evaluation of WisDOT 2011 Binder Replacement Criteria

The WisDOT 2011 binder replacement criteria were evaluated using a reliability analysis. This analysis considered both the variability of the design temperature at a give project location and the variability of the binder supplied. An interesting finding from this study was that at typical binder replacement levels, the estimated variability of the low and intermediate temperature properties of the combined virgin and recycled binders was very similar to that for the virgin binder. The estimated variability of the high temperature properties of the combined virgin and recycled binders was somewhat greater than that for the virgin binder.

The reliability analysis used data from 170 weather stations included in LTPPBind for Wisconsin; 80 designated for low temperature grade of -28 °C and 60 for low temperature grade of -34 °C based on current WisDOT binder grade selection. The overall reliability of the low temperature performance grade, the reliability that the specified intermediate temperature grade was met, and the overall reliability that adding recycled binders increases the high temperature performance grade to PG 64 were evaluated. The analysis was conducted for a mid grade virgin binder, one having a continuous low temperature grade midway between the specified grade and the next lower grade, and for an exceptional virgin binder, one having a continuous low temperature grade 0.5 °C higher than the next lower grade. The analysis was conducted for surface layers and lower layers, which were defined as layers more than 50 mm below the pavement surface. The major conclusions from the reliability analysis are listed below.

Low Temperature

1. For mid grade virgin binders, the WisDOT virgin binder selection provides high reliability for the low temperature performance grade. For surface mixtures in PG 58-28 locations, only 25 percent of the weather stations provide an overall reliability level less than 94.4 percent. For surface mixtures in PG 58-34 locations, only 25 percent of the weather stations provide an overall reliability level less than 97.4 percent. For lower layer mixtures, the reliability of the low temperature performance grade is 98 percent for almost all weather stations. The reliability is even higher when exceptional virgin binders are used. The minimum reliability level is over 90 percent for surface mixtures with exceptional virgin binders.
2. Adding recycled binders decreases the reliability of the low temperature performance grade and the effect is greater at locations having the lowest reliability based on the virgin binder selection. For surface mixtures with 25 percent RAP binder replacement, the median reliability when using mid grade binder decreases approximately 3 percent for both the PG 58-28 and PG 58-34 locations. For these same mixtures, the lower quartile reliability level decreases approximately twice as much compared to the median reliability.
3. The change in the low temperature reliability is less when exceptional virgin binders are used. For surface mixtures with 25 percent RAP binder replacement, the median reliability when using exceptional virgin binders is approximately 97 percent. The lower quartile reliabilities for surface mixtures made with exceptional virgin binder and 25 percent RAP binder replacement are similar to those for the mid grade virgin binders.
4. The 2011 WisDOT binder replacement criteria for RAP and RAS do not result in equivalent changes to the low temperature performance grade reliability. For surface mixtures made with mid grade virgin binders and 20 percent RAS binder replacement, the median low temperature reliability decreases about four times more and the lower quartile reliability decreases about three times more than that for the same mixtures with 25 percent RAP binder replacement. Similar differences were observed for lower layer

mixtures. For exceptional virgin binders differences between the 20 percent RAS binder replacement and 25 percent RAP binder replacement are similar to those for the mid grade virgin binder. However, the overall decrease in reliability is significantly less.

5. The 2010 WisDOT binder replacement criteria for RAS appear to be too lenient for surface mixtures made with mid grade binders. For these mixtures, the median reliability when RAS is used drops to between 80 and 85 percent. Considering the overall reliability for virgin binders, median reliability of at least 90 percent appears appropriate.

Intermediate Temperature

1. There is low reliability that mixtures with recycled binders will have a continuous intermediate grade temperature less than that for the specified virgin binder, 19 °C for PG 58-28 locations or 16 °C for PG 58-34 locations. The continuous intermediate grade temperature increases for increasing recycled binder content. It is higher for mixtures with RAS and it is also higher for RAP and RAS mixtures made with the mid grade virgin binder compared to the exceptional virgin binder.

High Temperature

1. Adding recycled binders increases the high temperature performance grade of the combined binder. However, 25 percent RAP binder replacement does not reliably increase the high temperature performance grade to 64 °C when the variability of the binder is considered. The use of 20 percent RAS binder replacement does increase the performance grade of the binder to 64 °C.

5.2 Recommendations

Several recommendations are appropriate based on the testing and analysis completed in WHRP Project 0092-10-06. These recommendations are listed below.

1. WisDOT should consider using the procedures developed in this project to monitor the consistency of recycled binder sources used in Wisconsin. This evaluation should

include annual random sampling of several RAP and RAS sources and the determination of the continuous grading properties for each source as well as the average and standard deviation of the continuous grading properties for the RAP and RAS sources. These data will provide WisDOT the data on recycled binders that are needed to perform the reliability analysis of blended binders.

2. WisDOT should consider monitoring the continuous grading properties of various sources of virgin binder supplied in Wisconsin. The reliability of the low temperature grade at a given project location and the reliability that the intermediate temperature grade complies with the specified grade depend on the mean and standard deviation of both the recycled binder and the virgin binder. The recommended modifications to the 2011 WisDOT binder replacement criteria presented below are based on a mid grade virgin binder and the variability of one binder source from Baltimore, Maryland.
3. WisDOT should consider updating the reliability analysis presented in this report annually based on data collected from the recommended monitoring programs for recycled sources and virgin binder sources.
4. WisDOT should consider using the reliability analysis to approve proposed mixtures with RAP that exceed the binder replacement criteria. This will require producers to provide average and standard deviation data for the continuous grade temperatures for both the proposed virgin binder and the recycled binder, and to demonstrate that the blended binder provides a high reliability that the low temperature continuous grade provided will be less than the low pavement design temperature at the project location. Current blending charts, which are based on the mean of the continuous grade temperature, provide 50 percent reliability that the blended binder meets the calculated grade. Combining this with 98 percent reliability that the low pavement design temperature is met provides an overall reliability of the low temperature grade of only 49 percent. The recommended modifications to the 2011 WisDOT binder replacement criteria presented below provide a median reliability of over 90 percent that the low temperature grade provided is less than the design low temperature grade.

5. WisDOT should consider replacing the 2011 binder replacement criteria with the criteria listed in Table 48. These criteria are based on the reliability analysis presented in Chapter 4 and the following considerations:
 - a. The recommended criteria are based on mid grade virgin binders and the RAP and RAS properties determined in WHRP Project 0092-10-09.
 - b. Blended binders based on the criteria must provide high overall reliability that they will have a low temperature continuous grade that is less than the design low pavement temperature. High reliability was defined as a lower quartile overall reliability greater than 89 percent.
 - c. The criteria must provide equivalent low temperature reliability for mixtures made with RAP, RAS, and combinations of RAP and RAS.
 - d. The criteria must provide equal or better low temperature reliability for mixtures in lower layers and mixtures in surface layers. It is expected that the surface layer will be replaced periodically, but lower layers should not. Therefore, the resistance of mixtures in lower layers to thermal cracking distress should be at least as good as mixtures in surface layers.

The results of the reliability analysis using the criteria recommended in Table 48 are summarized in Table 49 for surface layers and Table 50 for lower layers. The distributions are shown graphically in Figure 40 for surface layers and Figure 41 for lower layers. The detailed analysis is presented in Appendix D. These recommended criteria remove the difference between the reliability of mixtures with RAP and mixtures with RAS that was evident in the analysis of the 2011 WisDOT binder replacement criteria.

Table 48. Recommended Binder Replacement Criteria.

Recycled Binder Type	Maximum Binder Replacement ¹ , %	
	Surface Layers	Lower Layers ³
RAP ²	20	45
RAS	5	20
Combination of RAP and RAS	Reduce RAP binder replacement 4 % for each 1 % RAS binder replacement.	Reduce RAP binder replacement 2.25 % for each 1 % RAS binder replacement.

Notes:

- ¹ Defined as ratio of recycled binder content to total binder content
- ² Includes RAP, FRAP, and combinations of RAP and FRAP
- ³ Layers 50 mm (2 in) or more below surface of the pavement

Table 49. Distribution of Low Temperature Grade Reliabilities for Surface Layer Mixtures Produced Using Mid Grade Binder and Recommended Binder Replacement Criteria.

Statistic	Reliability, %							
	S, Mid Grade, Virgin	N, Mid Grade, Virgin	S, Mid Grade, 20% RAP	N, Mid Grade, 20% RAP	S, Mid Grade, 5% RAS	N, Mid Grade, 5% RAS	S, Mid Grade, 2.5% RAS 10% RAP	N, Mid Grade, 2.5% RAS 10% RAP
Maximum	98.0	97.7	98.0	97.8	98.0	97.8	98.0	98.0
Upper Quartile	98.0	96.6	97.3	97.1	97.8	96.9	97.6	98.0
Median	97.8	95.0	95.9	95.8	97.2	95.5	96.8	97.8
Average	95.1	97.4	91.5	94.8	92.9	96.4	92.4	95.8
Lower Quartile	94.2	97.5	88.9	94.2	90.9	96.4	90.1	95.7
Minimum	75.2	90.9	59.8	79.0	65.0	85.7	62.9	83.2

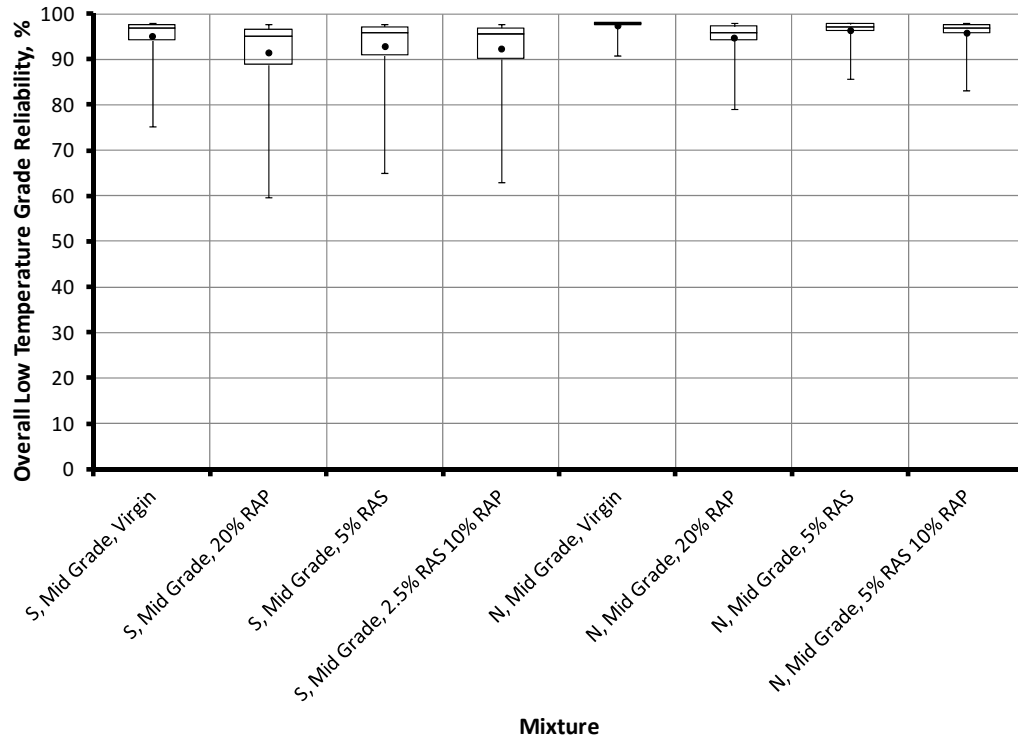


Figure 40. Distribution of Low Temperature Grade Reliabilities for Surface Layer Mixtures Produced Using Mid Grade Binder and Recommended Binder Replacement Criteria.

Table 50. Distribution of Low Temperature Grade Reliabilities for Lower Layer Mixtures Produced Using Mid Grade Binder and Recommended Binder Replacement Criteria.

Statistic	Reliability, %							
	S, Mid Grade, Virgin	N, Mid Grade, Virgin	S, Mid Grade, 45% RAP	N, Mid Grade, 45% RAP	S, Mid Grade, 20% RAS	N, Mid Grade, 20% RAS	S, Mid Grade, 10% RAS 22.5% RAP	N, Mid Grade, 10% RAS 22.5% RAP
Maximum	98.0	98.0	97.8	98.0	97.8	98.0	97.8	98.0
Upper Quartile	98.0	98.0	97.1	96.4	96.9	97.0	97.1	96.9
Median	97.9	98.0	95.8	94.0	95.5	95.1	95.8	94.9
Average	97.6	97.9	92.9	92.6	92.4	93.8	92.9	93.6
Lower Quartile	97.5	98.0	90.9	90.8	90.1	92.7	90.9	92.4
Minimum	92.3	96.8	65.0	71.9	62.9	75.6	65.0	74.9

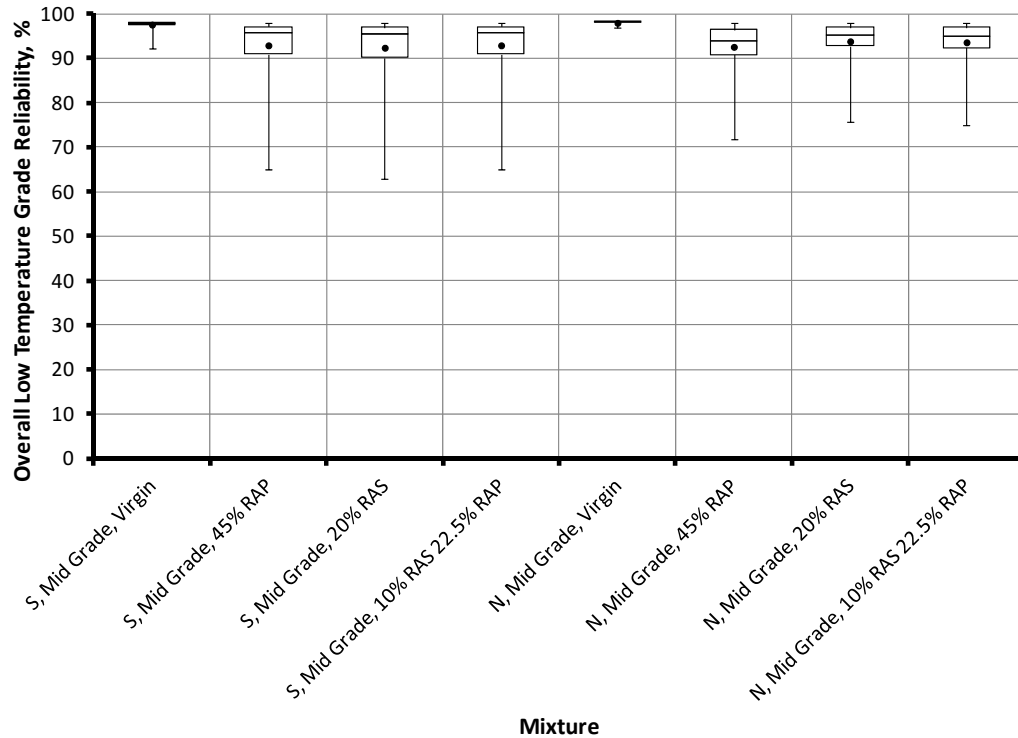


Figure 41. Distribution of Low Temperature Grade Reliabilities for Lower Layer Mixtures Produced Using Mid Grade Binder and Recommended Binder Replacement Criteria.

The recommended binder replacement criteria do not provide a high reliability that the intermediate temperature continuous grade will be lower than the intermediate temperature for the specified grade. Figure 42 compares the intermediate temperature grade reliabilities for mixtures produced using mid grade binder and the recommended binder replacement criteria. The intermediate temperature grade reliability is less for the lower layer mixtures because higher recycled binder contents are used in these mixtures. The higher intermediate temperature stiffness of mixtures with recycled binders may affect the cracking performance of pavements. WisDOT should monitor the performance of pavements constructed with recycled binders to determine if pavements with recycled binders are more susceptible to top down cracking.

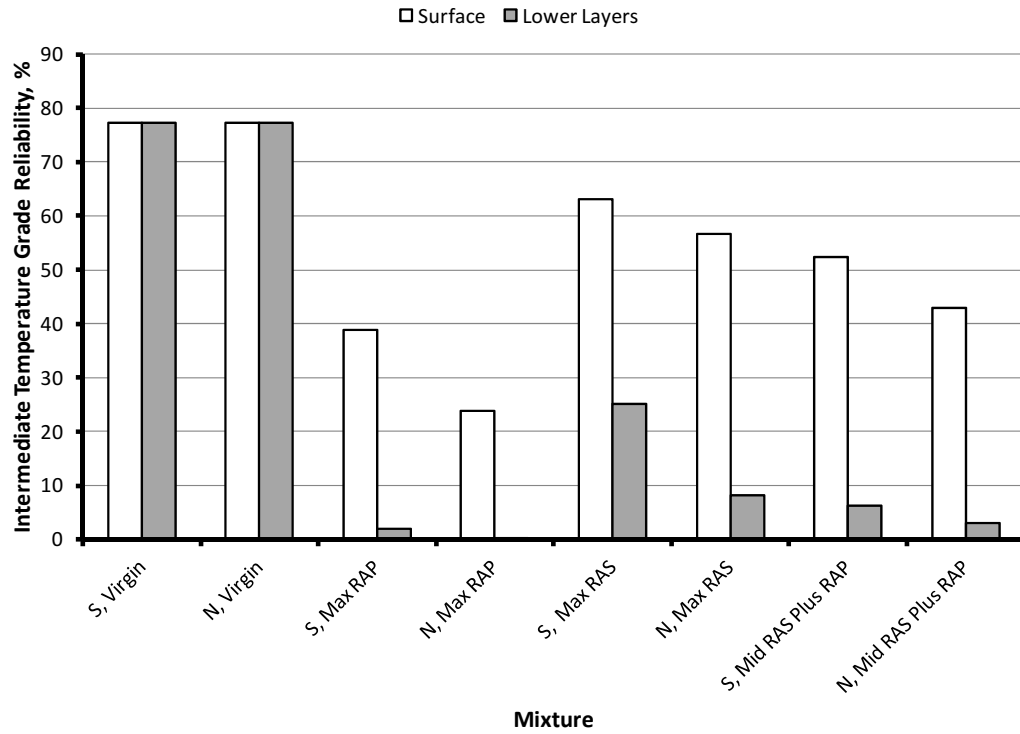


Figure 42. Intermediate Temperature Grade Reliability for Mixtures Produced Using Mid Grade Binder and Recommended Recycled Binder Replacement Criteria.

References

1. Wright, Jr., F. (2001). *FHWA Recycled Materials Policy*, Federal Highway Administration, Washington, DC. Obtained from:
<http://www.fhwa.dot.gov/legsregs/directives/policy/recmatpolicy.htm>
last accessed August 4, 2011.
2. Copeland, A., “Reclaimed Asphalt Pavement in Asphalt Mixtures: State of the Practice,” Report No. FHWA-HRT-11-021, Federal Highway Administration, McLean, VA, April, 2011.
3. McDaniel, R., Soleymani, H., Anderson, R.M., Turner, P., and Peterson, R., *Recommended Use of Reclaimed Asphalt Pavement in the Superpave Mix Design Method*, NCHRP Web Document 30 (Project D9-12): Contractor’s Final Report. Obtained from:
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w30-a.pdf
last accessed August 15, 2011.
4. Advanced Asphalt Technologies, LLC, “A Manual for Design of Hot Mix Asphalt with Commentary,” NCHRP Report 673. National Cooperative highway Research Program, National Academy Press, Washington, D.C., 2011, pp 255.

Appendix A. Modified AASHTO T170 for RAS Binders

Recommended Procedure for Extraction and Recovery of Recycled Asphalt Shingle Binders for Blending Chart Analysis

General

Extract and recover recycled asphalt shingle (RAS) binders using a combination of Method A (centrifuge extraction) of AASHTO T164 for extraction, and AASHTO 170 as modified below for recovery. The solvent should be reagent grade trichloroethylene.

Extraction

1. Determine the binder content of the RAS in accordance with Method A of AASHTO 160.
2. Using the binder content from Step 1, determine the mass of RAS to be extracted to yield between 75 and 90 g of binder after recovery.
3. Extract the RAS binder in accordance with Method A of AASHTO T164. One recovery yielding between 75 and 90 g of binder will provide between 250 and 300 g of blended RAS/virgin binder for subsequent performance grading.

Recovery

1. Before beginning the recovery, preheat approximately 175 g of virgin binder of known performance grade in a covered container to 150 °C. Record the mass of binder to the nearest 0.1 g. Determine the mass of recovered RAS binder to be blended with this virgin binder to provide a 30/70 RAS to virgin binder blend. Using Equation A1.

$$m_{RAS} = \frac{.30}{.70} \times m_{virgin} = 0.4286 \times m_{virgin} \quad (A1)$$

Where:

m_{RAS} = mass of recovered RAS binder

m_{virgin} = mass of recovered RAS binder

2. Recover RAS binder in accordance with AASHTO T170 as modified below.
3. Sample size in Section 8 of AASHTO T170
 - a. When recovering RAS binders the recovered sample mass should be between 75 and 90 g. The lower mass is needed to provide additional space in the Abson recovery flask to avoid boil over.
4. Primary distillation in Section 9.3 of AASHTO T170. For RAS binders modify Section 9.3 of AASHTO T170 to read.
 - a. Concentrate the solution to approximately 200 ml using a rotovapor apparatus. Transfer the residue from the primary distillation flask to the Abson flask when rapid boiling begins to occur in the primary distillation flask. Place the uncovered Abson flask in a ventilated 135 °C oven until the solution begins to boil. Remove the Abson flask from the oven, assemble the apparatus shown in Figure 1, and

begin heating. Introduce carbon dioxide at a low rate (approximately 100 ml/min) to provide agitation. Increase the temperature of the residue and maintain the carbon dioxide flow rate of 100 ml/min until the temperature of the residue reaches 157 to 160 °C. At that point increase the carbon dioxide gas flow to approximately 900 ml/min. Continue to increase the temperature of the residue while maintaining the carbon dioxide gas flow at 900 ml/min until the temperature of the residue reaches 190 to 196 °C. Maintain the temperature of the residue and carbon dioxide flow for 5 minutes after solvent dripping ceases, but not less than 20 minutes after reaching 190 °C.

5. Immediately blend the recovered RAS binder with a virgin binder of known performance grade as follows.
 - a. Discontinue the carbon dioxide gas flow and heat.
 - b. Remove the previously weighed virgin binder from the 150 °C oven and place on a hot plate under a mechanical stirrer.
 - c. Disassemble the Abson apparatus and immediately add the mass of recovered RAS binder determined from Equation A1 to the virgin binder and stir for 2 minutes.
 - d. Pour a 1 oz tin of blended binder for high temperature unaged performance grade characterization in accordance with AASHTO T315.
 - e. Pour remaining blended binder into an 8 oz tin for subsequent conditioning in accordance with AASHTO T240.

Appendix B. Blending Charts for Multiple Recycled Binders

Recommended Procedure for Blending Chart Analysis for Mixtures With Multiple Recycled Binders

Summary

This appendix presents the recommended procedure for estimating the grade of the binder in mixtures containing multiple recycled binders.

General Blending Chart Equation

Equation B1 presents the general blending chart equation for multiple binders. The estimated continuous high, intermediate, and low temperature grades for the blend is the linear combination of the continuous grade properties of the components.

$$T_{\text{blend}} = T_{\text{virgin}} + \left(\frac{\%RB_1}{100}\right) \times (T_{RB_1} - T_{\text{virgin}}) + \left(\frac{\%RB_2}{100}\right) \times (T_{RB_2} - T_{\text{virgin}}) + \dots + \left(\frac{\%RB_n}{100}\right) \times (T_{RB_n} - T_{\text{virgin}}) \quad (\text{B1})$$

Where:

- T_{blend} = continuous grade for the blended binder °C,
- T_{virgin} = continuous grade for the virgin binder, °C
- T_{RB_1} = continuous grade for recycled binder 1, °C
- $\%RB_1$ = percentage of total binder made up of recycled binder 1, %
- T_{RB_2} = continuous grade for recycled binder 2, °C
- $\%RB_2$ = percentage of total binder made up of recycled binder 1, %
- T_{RB_n} = continuous grade for recycled binder n, °C
- $\%RB_n$ = percentage of total binder made up of recycled binder 1, %
- n = number of recycled binders

When using average properties of the component binders, Equation B1 produces a 50 percent reliability estimate of the properties of the combined binder. If higher reliability estimates are desired they can be obtained from the 50 percent reliability estimate using Equations B2, B3, and B4 for the high, intermediate, and low temperature continuous grade properties. Standard normal deviates for various reliability levels are summarized in Table B1.

Table B1. Standard Normal Deviates for Various Reliability Levels.

Reliability Level, %	Z
50	0.0
75	0.67
90	1.28
95	1.64
98	2.05

For each continuous grading temperature, the standard deviation of the binder supplied can be estimated from the standard deviation of the continuous grading temperature for the various components using Equation B5.

$$PG_{\text{High supplied}\beta} = \overline{PG}_{\text{High supplied}} - Z_{\beta} \times \sigma_{\text{High supplied}} \quad (\text{B2})$$

Where

$PG_{\text{High supplied}\beta}$ = β percent reliability continuous high temperature performance

grade of the binder supplied

$\overline{PG}_{\text{High supplied}}$ = average continuous high temperature performance grade of the binder supplied

Z_{β} = standard normal deviate for reliability level β

β = reliability level for binder supplied

$\sigma_{\text{High supplied}}$ = standard deviation of the continuous high grade temperature of the binder supplied

$$PG_{\text{Int supplied}\beta} = \overline{PG}_{\text{Int supplied}} + Z_{\alpha} \times \sigma_{\text{Int supplied}} \quad (\text{B3})$$

Where

$PG_{\text{Int supplied}\beta}$ = β percent reliability continuous intermediate temperature

performance grade of the binder supplied

$\overline{PG}_{\text{Int supplied}}$ = average continuous intermediate temperature performance grade of the binder supplied

Z_{β} = standard normal deviate for reliability level β

β = reliability level for binder supplied

$\sigma_{\text{Int supplied}}$ = standard deviation of the continuous intermediate temperature grade of the binder supplied

$$PG_{\text{Low supplied}\beta} = \overline{PG}_{\text{Low supplied}} + Z_{\alpha} \times \sigma_{\text{Low supplied}} \quad (\text{B4})$$

Where

$PG_{\text{Low supplied}\beta}$ = β percent reliability continuous low temperature performance

grade of the binder supplied

$\overline{PG}_{\text{Low supplied}}$ = average continuous low temperature performance grade of the binder supplied

Z_{β} = standard normal deviate for reliability level β

β = reliability level for binder supplied

$\sigma_{\text{Low supplied}}$ = standard deviation of the continuous low temperature grade of the binder supplied

$$\sigma_c = \sqrt{\alpha^2 \sigma_{RB1}^2 + \beta^2 \sigma_{RB2}^2 + \dots \gamma^2 \sigma_{RBn}^2 + \dots (1 - \alpha - \beta - \dots \gamma)^2 \sigma_{Virgin}^2} \quad (B5)$$

where:

σ_c = standard deviation of the blended binder

σ_{RB1} = standard deviation of recycled binder 1

σ_{RB2} = standard deviation of recycled binder 2

σ_{RBn} = standard deviation of recycled binder n

σ_{Virgin} = standard deviation of the virgin binder

α = proportion of the total binder made up by recycled binder 1

β = proportion of the total binder made up by recycled binder 2

γ = proportion of the total binder made up by recycled binder n

Continuous Grade Temperatures for Reclaimed Asphalt Pavement Binders.

1. Determine the continuous high, intermediate, and low temperature properties of recovered RAP binders in accordance with the appendix to AASHTO M323, *Superpave Volumetric Mix Design*.

Continuous Grade Temperatures for Recycled Asphalt Shingle Binders.

1. Extract and recover the RAS binder using a combination of Method A of AASHTO T164, *Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)* and AASHTO T170, *Recovery of Asphalt from Solution by Absorbent Method*. See appendix A for recommended modifications to AASHTO T170 for RAS binders.
2. Prepare a blend of 30 percent recovered RAS binder in 70 percent virgin binder with known continuous grade properties.
3. Condition the blended binder in the Rolling Thin Film Oven Test (RTFOT), AASHTO T240, *Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)*.
4. Determine the temperature where the RTFOT conditioned blend meets the AASHTO M320 RTFOT binder high temperature grade requirement that $G^*/\sin \delta = 2.2$ kPa. Estimate the high temperature grade of the RAS binder by extrapolation using Equation B6.

$$T_{HRAS} = T_{HV} + \frac{100 \times (T_{Hblend} - T_{HV})}{\% \text{ RAS}} \quad (B6)$$

where:

- $T_{H_{RAS}}$ = extrapolated high temperature grade of the RAS binder, °C
- $T_{H_{blend}}$ = high temperature continuous grade of the blend of recovered RAS and virgin binder, °C
- T_{H_V} = high temperature continuous grade of the virgin binder, °C
- %RAS = percent of RAS binder used in the blend, %

5. Condition the RTFOT conditioned binder in the Pressure Aging Vessel (PAV), AASHTO R 28, *Accelerated Aging of Asphalt Binder Using a Pressure Aging Vessel*.
6. Determine the temperature where the PAV conditioned blend meets the AASHTO M320 intermediate grade temperature requirement that $G^* \cdot \sin \delta = 5,000$ kPa. Estimate the intermediate temperature grade of the RAS binder by extrapolation using Equation B7.

$$T_{I_{RAS}} = T_{I_V} + \frac{100 \times (T_{I_{blend}} - T_{I_V})}{\% \text{ RAS}} \quad (B7)$$

where:

- $T_{I_{RAS}}$ = extrapolated intermediate temperature grade of the RAS binder, °C
- $T_{I_{blend}}$ = intermediate temperature continuous grade of the blend of recovered RAS and virgin binder, °C
- T_{I_V} = intermediate temperature continuous grade of the virgin binder, °C
- %RAS = percent of RAS binder used in the blend, %

7. Determine the temperature where the PAV conditioned blend meets the AASHTO M320 low temperature grade requirement that the bending beam rheometer stiffness = 300 MPa. Estimate the low temperature grade of the RAS binder based on stiffness by extrapolation using Equation B8.

$$T_{LS_V} + \frac{100 \times (T_{LS_{blend}} - T_{LS_V})}{\% \text{ RAS}} \quad (B8)$$

where:

- $T_{LS_{RAS}}$ = extrapolated temperature grade of the RAS binder based on stiffness, °C
- $T_{LS_{blend}}$ = low temperature continuous grade of the blend of recovered RAS and virgin binder based on stiffness, °C
- T_{LS_V} = low temperature continuous grade of the virgin binder based on stiffness, °C
- %RAS = percent of RAS binder used in the blend, %

8. Determine the temperature where the PAV conditioned blend meets the AASHTO M320 low temperature grade requirement that the bending beam rheometer m-value = 0.300.

Estimate the low temperature grade of the RAS binder based on m-value by extrapolation using Equation B9.

$$T_{LM_{RAS}} = T_{LM_V} + \frac{100 \times (T_{LM_{blend}} - T_{LM_V})}{\% \text{ RAS}} \quad (\text{B9})$$

where:

$T_{LM_{RAS}}$ = extrapolated temperature grade of the RAS binder based on m-value, °C

$T_{LM_{blend}}$ = low temperature continuous grade of the blend of recovered RAS and virgin binder based on m-value, °C

T_{LM_V} = low temperature continuous grade of the virgin binder based on m-value, °C

%RAS = percent of RAS binder used in the blend, %

9. Determine the extrapolated low temperature continuous grade of the RAS binder as the higher of the low temperature continuous grade based on stiffness and the low temperature continuous grade based on m-value.

Appendix C. Reliability Analyses of WisDOT 2011 Binder Replacement Criteria

Table C1. Surface Layer Reliability Analysis for Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	60.0	-29.4	-2.78	0.3	-3.15	97.9
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	60.0	-29.4	-3.11	0.1	-2.82	97.8
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	60.0	-29.4	-2.76	0.3	-3.03	97.9
Rock	Afton	52.5	-24.8	1.43	3.92	60.0	-29.4	-2.80	0.2	-2.55	97.5
Green	Brodhead	52.8	-24.8	1.44	3.45	60.0	-29.4	-2.79	0.3	-2.43	97.3
Racine	Burlington	51.2	-24.8	1.40	3.34	60.0	-29.4	-2.87	0.2	-3.06	97.9
Rock	Janesville	54.8	-24.8	1.50	3.12	60.0	-29.4	-2.67	0.4	-3.11	97.9
Lafayette	Darlington	52.6	-24.8	1.44	3.39	60.0	-29.4	-2.78	0.3	-2.39	97.2
Racine	Racine	48.5	-24.8	1.33	3.57	60.0	-29.4	-3.01	0.1	-2.94	97.8
Grant	Platteville	52.7	-24.8	1.45	3.28	60.0	-29.4	-2.76	0.3	-2.59	97.5
Grant	Lancaster	51.7	-24.8	1.43	3.23	60.0	-29.4	-2.79	0.3	-2.54	97.5
Walworth	Whitewater	52.9	-24.8	1.47	3.39	60.0	-29.4	-2.73	0.3	-2.83	97.8
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	60.0	-29.4	-2.73	0.3	-2.30	96.9
Dane	Stoughton	52.4	-24.8	1.46	3.34	60.0	-29.4	-2.74	0.3	-2.70	97.7
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	60.0	-29.4	-2.91	0.2	-3.14	97.9
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	60.0	-29.4	-2.79	0.3	-2.67	97.6
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	60.0	-29.4	-2.76	0.3	-2.98	97.9
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	60.0	-29.4	-2.76	0.3	-3.21	97.9
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	60.0	-29.4	-2.69	0.3	-2.16	96.5
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	60.0	-29.4	-2.59	0.5	-2.06	96.1
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	60.0	-29.4	-2.77	0.3	-2.44	97.3
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	60.0	-29.4	-2.65	0.4	-2.76	97.7
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	60.0	-29.4	-2.67	0.4	-3.15	97.9
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	60.0	-29.4	-2.73	0.3	-2.73	97.7
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	60.0	-29.4	-2.71	0.3	-2.55	97.5
Jefferson	Watertown	52.4	-24.8	1.50	3.51	60.0	-29.4	-2.67	0.4	-2.57	97.5
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	60.0	-29.4	-2.63	0.4	-2.19	96.6
Washington	Germantown	50.2	-24.8	1.44	3.57	60.0	-29.4	-2.78	0.3	-2.44	97.3
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	60.0	-29.4	-2.67	0.4	-2.43	97.3
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	60.0	-29.4	-2.70	0.3	-2.22	96.7
Richland	Richland Center	53.1	-24.8	1.53	3.74	60.0	-29.4	-2.61	0.4	-1.74	94.0
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	60.0	-29.4	-2.68	0.4	-2.49	97.4
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	60.0	-29.4	-2.96	0.2	-3.15	97.9
Washington	West Bend	50.3	-24.8	1.46	3.45	60.0	-29.4	-2.73	0.3	-2.61	97.6
Dodge	Horicon	51.3	-24.8	1.50	3.39	60.0	-29.4	-2.67	0.4	-2.42	97.2
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	60.0	-29.4	-2.62	0.4	-2.52	97.4
Sauk	Baraboo	51.5	-24.8	1.51	3.74	60.0	-29.4	-2.65	0.4	-1.66	93.2
Columbia	Portage	52.6	-24.8	1.55	3.57	60.0	-29.4	-2.59	0.5	-2.19	96.6
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	60.0	-29.4	-2.59	0.5	-1.97	95.6
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	60.0	-29.4	-2.60	0.5	-1.98	95.7
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	60.0	-29.4	-2.67	0.4	-1.68	93.5
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	60.0	-29.4	-2.66	0.4	-1.99	95.7
Green Lake	Dalton	52.2	-24.8	1.55	3.23	60.0	-29.4	-2.58	0.5	-2.45	97.3

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	60.0	-29.4	-2.58	0.5	-1.50	91.5
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	60.0	-29.4	-2.64	0.4	-2.73	97.7
Monroe	Cashton	50.7	-24.8	1.52	3.68	60.0	-29.4	-2.63	0.4	-2.04	96.0
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	60.0	-29.4	-2.74	0.3	-3.12	97.9
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	60.0	-29.4	-2.55	0.5	-1.77	94.2
Marquette	Montello	51.7	-24.8	1.55	3.45	60.0	-29.4	-2.58	0.5	-2.00	95.8
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	60.0	-29.4	-2.64	0.4	-2.62	97.6
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	60.0	-29.4	-2.50	0.6	-1.99	95.7
Monroe	Sparta	52.4	-24.8	1.59	3.74	60.0	-29.4	-2.51	0.6	-1.36	89.5
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	60.0	-29.4	-2.51	0.6	-1.68	93.5
Juneau	Necedah	53	-24.8	1.63	3.68	60.0	-29.4	-2.46	0.7	-1.30	88.6
Calumet	Chilton	51.4	-24.8	1.58	3.23	60.0	-29.4	-2.54	0.5	-2.70	97.7
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	60.0	-29.4	-2.58	0.5	-2.55	97.5
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	60.0	-29.4	-2.69	0.4	-2.98	97.9
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	60.0	-29.4	-2.48	0.6	-1.65	93.2
Trempealeau	Dodge	54	-24.8	1.67	3.68	60.0	-29.4	-2.39	0.8	-1.00	82.6
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	60.0	-29.4	-2.91	0.2	-3.06	97.9
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	60.0	-29.4	-2.54	0.5	-1.68	93.5
Outagamie	Appleton	50	-24.8	1.56	3.07	60.0	-29.4	-2.56	0.5	-2.84	97.8
Trempealeau	Blair	51.4	-24.8	1.61	3.80	60.0	-29.4	-2.48	0.6	-1.10	84.8
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	60.0	-29.4	-2.45	0.7	-1.82	94.6
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	60.0	-29.4	-2.47	0.7	-2.34	97.0
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	60.0	-29.4	-2.54	0.5	-1.11	84.9
Waupaca	New London	51.9	-24.8	1.64	3.34	60.0	-29.4	-2.44	0.7	-2.10	96.2
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	60.0	-29.4	-2.48	0.6	-1.92	95.3
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	60.0	-29.4	-2.36	0.9	-0.73	75.2
Wood	Pittsville	51.5	-24.8	1.63	3.34	60.0	-29.4	-2.45	0.7	-1.23	87.3
Portage	Stevens Point	50	-24.8	1.59	3.28	60.0	-29.4	-2.51	0.6	-2.01	95.8
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	60.0	-29.4	-2.46	0.7	-1.18	86.3
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	60.0	-29.4	-2.39	0.8	-1.22	87.0
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	60.0	-29.4	-2.49	0.6	-1.95	95.5
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	60.0	-29.4	-2.46	0.7	-2.19	96.6
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	60.0	-29.4	-2.44	0.7	-1.83	94.7
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	60.0	-29.4	-2.40	0.8	-1.59	92.5
Marathon	Rosholt	50.3	-24.8	1.64	3.28	60.0	-29.4	-2.44	0.7	-1.58	92.5
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	60.0	-29.4	-2.38	0.9	-1.65	93.2
Dunn	Menomonie	52.7	-24.2	1.73	3.57	60.0	-29.4	-2.31	1.0	-1.46	90.9

Table C2. Surface Layer Reliability Analysis for Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	60.0	-35.4	-2.72	0.3	-3.94	98.0
Brown	Green Bay	49.7	-21.5	1.58	3.23	60.0	-35.4	-2.52	0.6	-4.31	98.0
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	60.0	-35.4	-2.42	0.8	-3.72	98.0
Shawano	Bowler	48.9	-23.9	1.61	3.45	60.0	-35.4	-2.49	0.6	-3.33	98.0
Pierce	River Falls	51.9	-23.7	1.71	3.39	60.0	-35.4	-2.35	0.9	-3.45	98.0
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	60.0	-35.4	-2.54	0.5	-4.49	98.0
Oconto	Oconto	49.2	-22	1.62	3.39	60.0	-35.4	-2.47	0.7	-3.95	98.0
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	60.0	-35.4	-2.47	0.7	-3.75	98.0
Clark	Owen	48.2	-25.2	1.59	3.34	60.0	-35.4	-2.51	0.6	-3.06	97.9
Chippewa	Stanley	50.2	-24.7	1.66	3.34	60.0	-35.4	-2.41	0.8	-3.21	97.9
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	60.0	-35.4	-2.37	0.9	-3.00	97.9
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	60.0	-35.4	-2.32	1.0	-3.11	97.9
Marinette	Marinette	50.8	-20.9	1.70	3.17	60.0	-35.4	-2.35	0.9	-4.57	98.0
Taylor	Medford	47.9	-25.1	1.61	3.23	60.0	-35.4	-2.49	0.6	-3.19	97.9
Langlade	Antigo	48.8	-25.1	1.64	3.17	60.0	-35.4	-2.44	0.7	-3.25	97.9
Lincoln	Merrill	49.1	-25.3	1.65	3.57	60.0	-35.4	-2.42	0.8	-2.83	97.8
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	60.0	-35.4	-2.31	1.0	-2.39	97.2
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	60.0	-35.4	-2.33	1.0	-2.50	97.4
Polk	Amery	49.8	-25.5	1.69	3.74	60.0	-35.4	-2.36	0.9	-2.64	97.6
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	60.0	-35.4	-2.38	0.9	-3.44	98.0
Taylor	Jump River	49.2	-27.8	1.68	3.51	60.0	-35.4	-2.38	0.9	-2.17	96.5
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	60.0	-35.4	-2.37	0.9	-3.14	97.9
Door	Washington Island	44.5	-19.5	1.52	3.45	60.0	-35.4	-2.63	0.4	-4.61	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	60.0	-35.4	-2.26	1.2	-2.77	97.7
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	60.0	-35.4	-2.31	1.0	-2.85	97.8
Barron	Rice Lake	50.2	-26.1	1.73	3.63	60.0	-35.4	-2.31	1.0	-2.57	97.5
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	60.0	-35.4	-2.44	0.7	-2.09	96.2
Forest	Laona	46.1	-24.6	1.60	3.17	60.0	-35.4	-2.51	0.6	-3.40	98.0
Barron	Cumberland	50.9	-25.4	1.76	3.28	60.0	-35.4	-2.27	1.1	-3.05	97.9
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	60.0	-35.4	-2.32	1.0	-2.33	97.0
Polk	Luck	50.3	-25.7	1.75	3.39	60.0	-35.4	-2.29	1.1	-2.86	97.8
Marinette	Goodman	47	-23.8	1.64	3.12	60.0	-35.4	-2.44	0.7	-3.72	98.0
Oneida	North Pelican	46.4	-26.7	1.62	3.28	60.0	-35.4	-2.47	0.7	-2.65	97.6
Oneida	Rhineland	48.1	-25.5	1.68	3.07	60.0	-35.4	-2.38	0.8	-3.23	97.9
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	60.0	-35.4	-2.44	0.7	-2.73	97.7
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	60.0	-35.4	-2.28	1.1	-2.52	97.4
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	60.0	-35.4	-2.35	0.9	-2.73	97.7
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	60.0	-35.4	-2.23	1.3	-2.65	97.6
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	60.0	-35.4	-2.41	0.8	-2.88	97.8
Sawyer	Couderay	49.5	-29	1.76	4.17	60.0	-35.4	-2.27	1.1	-1.53	91.9
Oneida	Minocqua Dam	47	-26	1.67	3.39	60.0	-35.4	-2.39	0.8	-2.77	97.7
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	60.0	-35.4	-2.40	0.8	-2.71	97.7
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	60.0	-35.4	-2.35	0.9	-2.89	97.8
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	60.0	-35.4	-2.48	0.6	-2.88	97.8
Price	Park Falls	46.8	-24.8	1.67	3.17	60.0	-35.4	-2.39	0.8	-3.34	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	60.0	-35.4	-2.30	1.1	-2.50	97.4
Burnett	Danbury	49.5	-27.6	1.78	3.23	60.0	-35.4	-2.25	1.2	-2.42	97.2
Washburn	Minong 2	49.7	-29.2	1.79	3.12	60.0	-35.4	-2.23	1.3	-1.99	95.7
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	60.0	-35.4	-2.32	1.0	-2.65	97.6
Douglas	Gordon	49.3	-29.4	1.80	3.17	60.0	-35.4	-2.22	1.3	-1.89	95.1
Bayfield	Drummond	49.1	-26.8	1.81	3.28	60.0	-35.4	-2.21	1.3	-2.62	97.6
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	60.0	-35.4	-2.15	1.5	-2.26	96.8
Ashland	Mellen	47.7	-27.1	1.77	3.34	60.0	-35.4	-2.26	1.2	-2.49	97.4
Douglas	Foxboro	48.3	-27.8	1.80	3.07	60.0	-35.4	-2.22	1.3	-2.48	97.4
Iron	Gurney	47.3	-25.2	1.76	3.12	60.0	-35.4	-2.27	1.1	-3.27	97.9
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	60.0	-35.4	-2.19	1.4	-3.22	97.9
Douglas	Superior	44.2	-25.1	1.67	3.17	60.0	-35.4	-2.39	0.8	-3.25	97.9
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	60.0	-35.4	-2.23	1.3	-3.17	97.9
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	60.0	-35.4	-2.31	1.0	-3.48	98.0
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	60.0	-35.4	-2.25	1.2	-3.90	98.0

Table C3. Surface Layer Reliability Analysis for 25 % RAP, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	65.1	-27.3	0.76	76.2	-2.52	97.4
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	65.1	-27.3	0.86	78.8	-2.28	96.9
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	65.1	-27.3	0.76	76.1	-2.42	97.2
Rock	Afton	52.5	-24.8	1.43	3.92	65.1	-27.3	0.77	76.4	-2.01	95.8
Green	Brodhead	52.8	-24.8	1.44	3.45	65.1	-27.3	0.77	76.3	-1.83	94.7
Racine	Burlington	51.2	-24.8	1.40	3.34	65.1	-27.3	0.79	76.9	-2.43	97.3
Rock	Janesville	54.8	-24.8	1.50	3.12	65.1	-27.3	0.74	75.4	-2.44	97.3
Lafayette	Darlington	52.6	-24.8	1.44	3.39	65.1	-27.3	0.77	76.2	-1.77	94.2
Racine	Racine	48.5	-24.8	1.33	3.57	65.1	-27.3	0.83	78.0	-2.36	97.1
Grant	Platteville	52.7	-24.8	1.45	3.28	65.1	-27.3	0.76	76.1	-1.95	95.5
Grant	Lancaster	51.7	-24.8	1.43	3.23	65.1	-27.3	0.77	76.3	-1.89	95.1
Walworth	Whitewater	52.9	-24.8	1.47	3.39	65.1	-27.3	0.75	75.8	-2.21	96.7
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	65.1	-27.3	0.75	75.8	-1.74	94.0
Dane	Stoughton	52.4	-24.8	1.46	3.34	65.1	-27.3	0.75	75.9	-2.07	96.1
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	65.1	-27.3	0.80	77.2	-2.55	97.5
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	65.1	-27.3	0.77	76.3	-2.01	95.8
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	65.1	-27.3	0.76	76.0	-2.36	97.1
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	65.1	-27.3	0.76	76.1	-2.58	97.5
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	65.1	-27.3	0.74	75.5	-1.57	92.3
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	65.1	-27.3	0.71	74.7	-1.50	91.4
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	65.1	-27.3	0.76	76.1	-1.85	94.9
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	65.1	-27.3	0.73	75.2	-2.11	96.3
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	65.1	-27.3	0.74	75.4	-2.53	97.4
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	65.1	-27.3	0.75	75.8	-2.10	96.2
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	65.1	-27.3	0.74	75.6	-1.94	95.4
Jefferson	Watertown	52.4	-24.8	1.50	3.51	65.1	-27.3	0.74	75.4	-1.97	95.6
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	65.1	-27.3	0.72	75.0	-1.60	92.6
Washington	Germantown	50.2	-24.8	1.44	3.57	65.1	-27.3	0.77	76.2	-1.85	94.9
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	65.1	-27.3	0.73	75.3	-1.80	94.5
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	65.1	-27.3	0.74	75.6	-1.62	92.9
Richland	Richland Center	53.1	-24.8	1.53	3.74	65.1	-27.3	0.72	74.8	-1.18	86.2
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	65.1	-27.3	0.74	75.4	-1.86	94.9
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	65.1	-27.3	0.81	77.6	-2.52	97.4
Washington	West Bend	50.3	-24.8	1.46	3.45	65.1	-27.3	0.75	75.8	-2.00	95.8
Dodge	Horicon	51.3	-24.8	1.50	3.39	65.1	-27.3	0.73	75.3	-1.80	94.5
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	65.1	-27.3	0.72	74.9	-1.91	95.3
Sauk	Baraboo	51.5	-24.8	1.51	3.74	65.1	-27.3	0.73	75.2	-1.10	84.6
Columbia	Portage	52.6	-24.8	1.55	3.57	65.1	-27.3	0.71	74.6	-1.60	92.6
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	65.1	-27.3	0.71	74.6	-1.36	89.4
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	65.1	-27.3	0.71	74.7	-1.41	90.3
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	65.1	-27.3	0.74	75.3	-1.10	84.8
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	65.1	-27.3	0.73	75.2	-1.41	90.2
Green Lake	Dalton	52.2	-24.8	1.55	3.23	65.1	-27.3	0.71	74.6	-1.80	94.5

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	65.1	-27.3	0.71	74.6	-0.96	81.4
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	65.1	-27.3	0.73	75.1	-2.10	96.2
Monroe	Cashton	50.7	-24.8	1.52	3.68	65.1	-27.3	0.72	75.0	-1.47	91.0
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	65.1	-27.3	0.75	75.9	-2.49	97.4
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	65.1	-27.3	0.70	74.3	-1.19	86.5
Marquette	Montello	51.7	-24.8	1.55	3.45	65.1	-27.3	0.71	74.5	-1.39	90.0
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	65.1	-27.3	0.73	75.1	-2.00	95.8
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	65.1	-27.3	0.69	73.9	-1.41	90.2
Monroe	Sparta	52.4	-24.8	1.59	3.74	65.1	-27.3	0.69	74.0	-0.80	77.3
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	65.1	-27.3	0.69	74.0	-1.10	84.8
Juneau	Necedah	53	-24.8	1.63	3.68	65.1	-27.3	0.68	73.6	-0.73	75.3
Calumet	Chilton	51.4	-24.8	1.58	3.23	65.1	-27.3	0.70	74.2	-2.05	96.0
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	65.1	-27.3	0.71	74.6	-1.92	95.3
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	65.1	-27.3	0.74	75.5	-2.32	97.0
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	65.1	-27.3	0.68	73.8	-1.05	83.7
Trempealeau	Dodge	54	-24.8	1.67	3.68	65.1	-27.3	0.66	73.0	-0.43	65.5
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	65.1	-27.3	0.80	77.2	-2.40	97.2
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	65.1	-27.3	0.70	74.2	-1.09	84.6
Outagamie	Appleton	50	-24.8	1.56	3.07	65.1	-27.3	0.70	74.4	-2.15	96.5
Trempealeau	Blair	51.4	-24.8	1.61	3.80	65.1	-27.3	0.68	73.7	-0.55	69.5
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	65.1	-27.3	0.67	73.5	-1.24	87.5
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	65.1	-27.3	0.68	73.7	-1.71	93.7
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	65.1	-27.3	0.70	74.2	-0.48	67.0
Waupaca	New London	51.9	-24.8	1.64	3.34	65.1	-27.3	0.67	73.4	-1.47	91.0
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	65.1	-27.3	0.68	73.8	-1.28	88.2
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	65.1	-27.3	0.65	72.7	-0.14	54.5
Wood	Pittsville	51.5	-24.8	1.63	3.34	65.1	-27.3	0.67	73.5	-0.60	71.1
Portage	Stevens Point	50	-24.8	1.59	3.28	65.1	-27.3	0.69	74.0	-1.37	89.7
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	65.1	-27.3	0.68	73.5	-0.59	70.8
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	65.1	-27.3	0.66	73.0	-0.67	73.5
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	65.1	-27.3	0.68	73.8	-1.29	88.4
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	65.1	-27.3	0.68	73.6	-1.55	92.1
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	65.1	-27.3	0.67	73.4	-1.18	86.3
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	65.1	-27.3	0.66	73.0	-0.96	81.5
Marathon	Rosholt	50.3	-24.8	1.64	3.28	65.1	-27.3	0.67	73.4	-0.94	81.1
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	65.1	-27.3	0.65	72.9	-1.03	83.2
Dunn	Menomonie	52.7	-24.2	1.73	3.57	65.1	-27.3	0.63	72.2	-0.87	79.1

Table C4. Surface Layer Reliability Analysis for 25 % RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	65.1	-31.8	0.75	75.7	-3.04	97.9
Brown	Green Bay	49.7	-21.5	1.58	3.23	65.1	-31.8	0.69	74.1	-3.19	97.9
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	65.1	-31.8	0.66	73.2	-2.64	97.6
Shawano	Bowler	48.9	-23.9	1.61	3.45	65.1	-31.8	0.68	73.8	-2.29	96.9
Pierce	River Falls	51.9	-23.7	1.71	3.39	65.1	-31.8	0.65	72.6	-2.39	97.2
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	65.1	-31.8	0.70	74.3	-3.42	98.0
Oconto	Oconto	49.2	-22	1.62	3.39	65.1	-31.8	0.68	73.6	-2.89	97.8
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	65.1	-31.8	0.68	73.6	-2.65	97.6
Clark	Owen	48.2	-25.2	1.59	3.34	65.1	-31.8	0.69	74.0	-1.98	95.6
Chippewa	Stanley	50.2	-24.7	1.66	3.34	65.1	-31.8	0.66	73.1	-2.13	96.4
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	65.1	-31.8	0.65	72.7	-1.99	95.7
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	65.1	-31.8	0.64	72.4	-2.08	96.2
Marinette	Marinette	50.8	-20.9	1.70	3.17	65.1	-31.8	0.65	72.6	-3.44	98.0
Taylor	Medford	47.9	-25.1	1.61	3.23	65.1	-31.8	0.68	73.8	-2.08	96.1
Langlade	Antigo	48.8	-25.1	1.64	3.17	65.1	-31.8	0.67	73.4	-2.11	96.3
Lincoln	Merrill	49.1	-25.3	1.65	3.57	65.1	-31.8	0.67	73.2	-1.82	94.6
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	65.1	-31.8	0.64	72.3	-1.45	90.7
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	65.1	-31.8	0.64	72.5	-1.49	91.3
Polk	Amery	49.8	-25.5	1.69	3.74	65.1	-31.8	0.65	72.7	-1.68	93.5
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	65.1	-31.8	0.65	72.8	-2.32	97.0
Taylor	Jump River	49.2	-27.8	1.68	3.51	65.1	-31.8	0.65	72.9	-1.14	85.5
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	65.1	-31.8	0.65	72.8	-2.13	96.4
Door	Washington Island	44.5	-19.5	1.52	3.45	65.1	-31.8	0.72	75.0	-3.56	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	65.1	-31.8	0.62	71.8	-1.68	93.4
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	65.1	-31.8	0.64	72.3	-1.74	94.0
Barron	Rice Lake	50.2	-26.1	1.73	3.63	65.1	-31.8	0.63	72.2	-1.57	92.3
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	65.1	-31.8	0.67	73.4	-1.04	83.5
Forest	Laona	46.1	-24.6	1.60	3.17	65.1	-31.8	0.69	74.0	-2.27	96.9
Barron	Cumberland	50.9	-25.4	1.76	3.28	65.1	-31.8	0.62	71.9	-1.95	95.5
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	65.1	-31.8	0.64	72.3	-1.27	87.9
Polk	Luck	50.3	-25.7	1.75	3.39	65.1	-31.8	0.63	72.1	-1.80	94.5
Marinette	Goodman	47	-23.8	1.64	3.12	65.1	-31.8	0.67	73.4	-2.57	97.5
Oneida	North Pelican	46.4	-26.7	1.62	3.28	65.1	-31.8	0.68	73.7	-1.55	92.1
Oneida	Rhineland	48.1	-25.5	1.68	3.07	65.1	-31.8	0.66	72.9	-2.06	96.0
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	65.1	-31.8	0.67	73.4	-1.61	92.8
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	65.1	-31.8	0.63	72.0	-1.48	91.2
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	65.1	-31.8	0.65	72.6	-1.61	92.8
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	65.1	-31.8	0.61	71.6	-1.51	91.6
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	65.1	-31.8	0.66	73.1	-1.77	94.2
Sawyer	Couderay	49.5	-29	1.76	4.17	65.1	-31.8	0.63	71.9	-0.67	73.4
Oneida	Minocqua Dam	47	-26	1.67	3.39	65.1	-31.8	0.66	73.0	-1.71	93.7
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	65.1	-31.8	0.66	73.0	-1.53	91.9
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	65.1	-31.8	0.65	72.6	-1.69	93.6
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	65.1	-31.8	0.68	73.8	-1.77	94.2
Price	Park Falls	46.8	-24.8	1.67	3.17	65.1	-31.8	0.66	73.0	-2.21	96.7

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	65.1	-31.8	0.63	72.1	-1.40	90.1
Burnett	Danbury	49.5	-27.6	1.78	3.23	65.1	-31.8	0.62	71.7	-1.30	88.5
Washburn	Minong 2	49.7	-29.2	1.79	3.12	65.1	-31.8	0.61	71.5	-0.83	78.2
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	65.1	-31.8	0.64	72.3	-1.55	92.1
Douglas	Gordon	49.3	-29.4	1.80	3.17	65.1	-31.8	0.61	71.4	-0.76	76.0
Bayfield	Drummond	49.1	-26.8	1.81	3.28	65.1	-31.8	0.61	71.4	-1.52	91.7
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	65.1	-31.8	0.59	70.9	-1.15	85.7
Ashland	Mellen	47.7	-27.1	1.77	3.34	65.1	-31.8	0.62	71.8	-1.41	90.2
Douglas	Foxboro	48.3	-27.8	1.80	3.07	65.1	-31.8	0.61	71.5	-1.30	88.6
Iron	Gurney	47.3	-25.2	1.76	3.12	65.1	-31.8	0.62	71.9	-2.12	96.3
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	65.1	-31.8	0.60	71.2	-2.08	96.2
Douglas	Superior	44.2	-25.1	1.67	3.17	65.1	-31.8	0.66	73.0	-2.11	96.3
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	65.1	-31.8	0.61	71.5	-2.02	95.9
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	65.1	-31.8	0.64	72.3	-2.48	97.4
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	65.1	-31.8	0.62	71.7	-2.80	97.8

Table C5. Surface Layer Reliability Analysis for 20 % RAS, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	68.9	-25.1	3.41	98.0	-1.86	94.9
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	68.9	-25.1	3.81	98.0	-1.71	93.7
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	68.9	-25.1	3.38	98.0	-1.77	94.2
Rock	Afton	52.5	-24.8	1.43	3.92	68.9	-25.1	3.43	98.0	-1.45	90.8
Green	Brodhead	52.8	-24.8	1.44	3.45	68.9	-25.1	3.41	98.0	-1.19	86.5
Racine	Burlington	51.2	-24.8	1.40	3.34	68.9	-25.1	3.51	98.0	-1.77	94.2
Rock	Janesville	54.8	-24.8	1.50	3.12	68.9	-25.1	3.28	97.9	-1.73	93.9
Lafayette	Darlington	52.6	-24.8	1.44	3.39	68.9	-25.1	3.41	98.0	-1.12	85.1
Racine	Racine	48.5	-24.8	1.33	3.57	68.9	-25.1	3.69	98.0	-1.74	94.0
Grant	Platteville	52.7	-24.8	1.45	3.28	68.9	-25.1	3.38	98.0	-1.28	88.2
Grant	Lancaster	51.7	-24.8	1.43	3.23	68.9	-25.1	3.42	98.0	-1.21	86.9
Walworth	Whitewater	52.9	-24.8	1.47	3.39	68.9	-25.1	3.34	98.0	-1.56	92.2
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	68.9	-25.1	3.35	98.0	-1.15	85.7
Dane	Stoughton	52.4	-24.8	1.46	3.34	68.9	-25.1	3.35	98.0	-1.41	90.2
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	68.9	-25.1	3.56	98.0	-1.93	95.4
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	68.9	-25.1	3.41	98.0	-1.33	89.1
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	68.9	-25.1	3.38	98.0	-1.71	93.7
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	68.9	-25.1	3.39	98.0	-1.92	95.3
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	68.9	-25.1	3.30	98.0	-0.95	81.3
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	68.9	-25.1	3.17	97.9	-0.91	80.2
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	68.9	-25.1	3.39	98.0	-1.23	87.4
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	68.9	-25.1	3.25	97.9	-1.43	90.5
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	68.9	-25.1	3.28	97.9	-1.89	95.1
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	68.9	-25.1	3.34	98.0	-1.44	90.6
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	68.9	-25.1	3.32	98.0	-1.30	88.6
Jefferson	Watertown	52.4	-24.8	1.50	3.51	68.9	-25.1	3.28	97.9	-1.34	89.2
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	68.9	-25.1	3.22	97.9	-0.98	82.0
Washington	Germantown	50.2	-24.8	1.44	3.57	68.9	-25.1	3.41	98.0	-1.23	87.4
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	68.9	-25.1	3.27	97.9	-1.14	85.5
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	68.9	-25.1	3.31	98.0	-1.00	82.4
Richland	Richland Center	53.1	-24.8	1.53	3.74	68.9	-25.1	3.19	97.9	-0.59	70.7
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	68.9	-25.1	3.29	98.0	-1.20	86.7
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	68.9	-25.1	3.62	98.0	-1.86	94.9
Washington	West Bend	50.3	-24.8	1.46	3.45	68.9	-25.1	3.35	98.0	-1.36	89.5
Dodge	Horicon	51.3	-24.8	1.50	3.39	68.9	-25.1	3.27	97.9	-1.15	85.7
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	68.9	-25.1	3.21	97.9	-1.28	88.1
Sauk	Baraboo	51.5	-24.8	1.51	3.74	68.9	-25.1	3.25	97.9	-0.51	68.0
Columbia	Portage	52.6	-24.8	1.55	3.57	68.9	-25.1	3.17	97.9	-0.98	82.0
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	68.9	-25.1	3.17	97.9	-0.71	74.5
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	68.9	-25.1	3.18	97.9	-0.81	77.6
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	68.9	-25.1	3.27	97.9	-0.50	67.6
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	68.9	-25.1	3.25	97.9	-0.80	77.2
Green Lake	Dalton	52.2	-24.8	1.55	3.23	68.9	-25.1	3.16	97.9	-1.12	85.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	68.9	-25.1	3.17	97.9	-0.39	63.8
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	68.9	-25.1	3.24	97.9	-1.44	90.6
Monroe	Cashton	50.7	-24.8	1.52	3.68	68.9	-25.1	3.23	97.9	-0.87	79.1
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	68.9	-25.1	3.35	98.0	-1.83	94.7
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	68.9	-25.1	3.12	97.9	-0.58	70.4
Marquette	Montello	51.7	-24.8	1.55	3.45	68.9	-25.1	3.15	97.9	-0.75	75.9
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	68.9	-25.1	3.24	97.9	-1.36	89.4
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	68.9	-25.1	3.06	97.9	-0.80	77.2
Monroe	Sparta	52.4	-24.8	1.59	3.74	68.9	-25.1	3.07	97.9	-0.21	57.3
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	68.9	-25.1	3.07	97.9	-0.50	67.6
Juneau	Necedah	53	-24.8	1.63	3.68	68.9	-25.1	3.01	97.9	-0.14	54.3
Calumet	Chilton	51.4	-24.8	1.58	3.23	68.9	-25.1	3.11	97.9	-1.36	89.5
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	68.9	-25.1	3.16	97.9	-1.26	87.8
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	68.9	-25.1	3.29	98.0	-1.64	93.1
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	68.9	-25.1	3.04	97.9	-0.43	65.2
Trempealeau	Dodge	54	-24.8	1.67	3.68	68.9	-25.1	2.93	97.8	0.16	42.7
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	68.9	-25.1	3.56	98.0	-1.70	93.7
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	68.9	-25.1	3.11	97.9	-0.48	67.0
Outagamie	Appleton	50	-24.8	1.56	3.07	68.9	-25.1	3.14	97.9	-1.44	90.6
Trempealeau	Blair	51.4	-24.8	1.61	3.80	68.9	-25.1	3.04	97.9	0.03	48.0
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	68.9	-25.1	3.00	97.9	-0.63	72.2
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	68.9	-25.1	3.03	97.9	-1.05	83.6
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	68.9	-25.1	3.11	97.9	0.18	42.0
Waupaca	New London	51.9	-24.8	1.64	3.34	68.9	-25.1	2.99	97.9	-0.81	77.5
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	68.9	-25.1	3.04	97.9	-0.61	71.4
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	68.9	-25.1	2.90	97.8	0.48	31.0
Wood	Pittsville	51.5	-24.8	1.63	3.34	68.9	-25.1	3.00	97.9	0.06	46.7
Portage	Stevens Point	50	-24.8	1.59	3.28	68.9	-25.1	3.07	97.9	-0.70	74.3
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	68.9	-25.1	3.01	97.9	0.03	47.9
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	68.9	-25.1	2.93	97.8	-0.10	53.0
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	68.9	-25.1	3.05	97.9	-0.60	71.1
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	68.9	-25.1	3.01	97.9	-0.88	79.5
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	68.9	-25.1	2.99	97.9	-0.50	67.6
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	68.9	-25.1	2.93	97.8	-0.30	60.5
Marathon	Rosholt	50.3	-24.8	1.64	3.28	68.9	-25.1	2.99	97.9	-0.27	59.6
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	68.9	-25.1	2.91	97.8	-0.38	63.6
Dunn	Menomonie	52.7	-24.2	1.73	3.57	68.9	-25.1	2.83	97.8	-0.25	58.8

Table C6. Surface Layer Reliability Analysis for 20 % RAS, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	70.7	-29.1	4.55	98.0	-2.36	97.1
Brown	Green Bay	49.7	-21.5	1.58	3.23	70.7	-29.1	4.23	98.0	-2.36	97.1
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	70.7	-29.1	4.05	98.0	-1.83	94.7
Shawano	Bowler	48.9	-23.9	1.61	3.45	70.7	-29.1	4.17	98.0	-1.51	91.5
Pierce	River Falls	51.9	-23.7	1.71	3.39	70.7	-29.1	3.93	98.0	-1.59	92.5
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	70.7	-29.1	4.26	98.0	-2.61	97.6
Oconto	Oconto	49.2	-22	1.62	3.39	70.7	-29.1	4.13	98.0	-2.09	96.2
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	70.7	-29.1	4.14	98.0	-1.83	94.7
Clark	Owen	48.2	-25.2	1.59	3.34	70.7	-29.1	4.20	98.0	-1.17	86.1
Chippewa	Stanley	50.2	-24.7	1.66	3.34	70.7	-29.1	4.03	98.0	-1.32	88.8
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	70.7	-29.1	3.96	98.0	-1.23	87.4
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	70.7	-29.1	3.89	98.0	-1.31	88.7
Marinette	Marinette	50.8	-20.9	1.70	3.17	70.7	-29.1	3.94	98.0	-2.58	97.5
Taylor	Medford	47.9	-25.1	1.61	3.23	70.7	-29.1	4.17	98.0	-1.24	87.5
Langlade	Antigo	48.8	-25.1	1.64	3.17	70.7	-29.1	4.09	98.0	-1.26	87.8
Lincoln	Merrill	49.1	-25.3	1.65	3.57	70.7	-29.1	4.05	98.0	-1.07	84.0
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	70.7	-29.1	3.87	98.0	-0.74	75.4
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	70.7	-29.1	3.91	98.0	-0.73	75.2
Polk	Amery	49.8	-25.5	1.69	3.74	70.7	-29.1	3.96	98.0	-0.96	81.5
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	70.7	-29.1	3.98	98.0	-1.49	91.3
Taylor	Jump River	49.2	-27.8	1.68	3.51	70.7	-29.1	3.98	98.0	-0.37	63.2
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	70.7	-29.1	3.97	98.0	-1.37	89.7
Door	Washington Island	44.5	-19.5	1.52	3.45	70.7	-29.1	4.40	98.0	-2.78	97.7
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	70.7	-29.1	3.78	98.0	-0.85	78.7
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	70.7	-29.1	3.87	98.0	-0.90	79.9
Barron	Rice Lake	50.2	-26.1	1.73	3.63	70.7	-29.1	3.86	98.0	-0.83	78.0
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	70.7	-29.1	4.09	98.0	-0.26	59.1
Forest	Laona	46.1	-24.6	1.60	3.17	70.7	-29.1	4.20	98.0	-1.42	90.4
Barron	Cumberland	50.9	-25.4	1.76	3.28	70.7	-29.1	3.80	98.0	-1.13	85.3
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	70.7	-29.1	3.88	98.0	-0.47	66.8
Polk	Luck	50.3	-25.7	1.75	3.39	70.7	-29.1	3.83	98.0	-1.00	82.5
Marinette	Goodman	47	-23.8	1.64	3.12	70.7	-29.1	4.09	98.0	-1.70	93.6
Oneida	North Pelican	46.4	-26.7	1.62	3.28	70.7	-29.1	4.14	98.0	-0.73	75.2
Oneida	Rhineland	48.1	-25.5	1.68	3.07	70.7	-29.1	3.99	98.0	-1.17	86.2
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	70.7	-29.1	4.09	98.0	-0.77	76.5
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	70.7	-29.1	3.82	98.0	-0.70	74.1
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	70.7	-29.1	3.94	98.0	-0.77	76.5
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	70.7	-29.1	3.74	98.0	-0.66	73.1
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	70.7	-29.1	4.04	98.0	-0.93	80.7
Sawyer	Couderay	49.5	-29	1.76	4.17	70.7	-29.1	3.81	98.0	-0.02	49.9
Oneida	Minocqua Dam	47	-26	1.67	3.39	70.7	-29.1	4.01	98.0	-0.91	80.3
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	70.7	-29.1	4.01	98.0	-0.65	72.8
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	70.7	-29.1	3.94	98.0	-0.80	77.1
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	70.7	-29.1	4.16	98.0	-0.93	80.7
Price	Park Falls	46.8	-24.8	1.67	3.17	70.7	-29.1	4.01	98.0	-1.36	89.4

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	70.7	-29.1	3.85	98.0	-0.58	70.4
Burnett	Danbury	49.5	-27.6	1.78	3.23	70.7	-29.1	3.76	98.0	-0.46	66.5
Washburn	Minong 2	49.7	-29.2	1.79	3.12	70.7	-29.1	3.73	98.0	0.03	47.7
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	70.7	-29.1	3.88	98.0	-0.73	75.2
Douglas	Gordon	49.3	-29.4	1.80	3.17	70.7	-29.1	3.71	98.0	0.09	45.3
Bayfield	Drummond	49.1	-26.8	1.81	3.28	70.7	-29.1	3.71	98.0	-0.70	74.3
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	70.7	-29.1	3.60	98.0	-0.31	60.9
Ashland	Mellen	47.7	-27.1	1.77	3.34	70.7	-29.1	3.78	98.0	-0.60	71.1
Douglas	Foxboro	48.3	-27.8	1.80	3.07	70.7	-29.1	3.72	98.0	-0.42	65.1
Iron	Gurney	47.3	-25.2	1.76	3.12	70.7	-29.1	3.80	98.0	-1.25	87.7
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	70.7	-29.1	3.67	98.0	-1.23	87.3
Douglas	Superior	44.2	-25.1	1.67	3.17	70.7	-29.1	4.00	98.0	-1.26	87.8
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	70.7	-29.1	3.73	98.0	-1.15	85.8
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	70.7	-29.1	3.87	98.0	-1.74	94.0
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	70.7	-29.1	3.76	98.0	-1.98	95.7

Table C7. Surface Layer Reliability Analysis for 19 % RAS and 6% RAP, Mid Grade Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	70.0	-24.8	4.17	98.0	-1.77	94.2
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	70.0	-24.8	4.67	98.0	-1.63	93.0
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	70.0	-24.8	4.14	98.0	-1.68	93.4
Rock	Afton	52.5	-24.8	1.43	3.92	70.0	-24.8	4.20	98.0	-1.38	89.7
Green	Brodhead	52.8	-24.8	1.44	3.45	70.0	-24.8	4.18	98.0	-1.10	84.7
Racine	Burlington	51.2	-24.8	1.40	3.34	70.0	-24.8	4.30	98.0	-1.68	93.4
Rock	Janesville	54.8	-24.8	1.50	3.12	70.0	-24.8	4.01	98.0	-1.64	93.0
Lafayette	Darlington	52.6	-24.8	1.44	3.39	70.0	-24.8	4.17	98.0	-1.03	83.2
Racine	Racine	48.5	-24.8	1.33	3.57	70.0	-24.8	4.52	98.0	-1.65	93.2
Grant	Platteville	52.7	-24.8	1.45	3.28	70.0	-24.8	4.14	98.0	-1.19	86.5
Grant	Lancaster	51.7	-24.8	1.43	3.23	70.0	-24.8	4.19	98.0	-1.12	85.0
Walworth	Whitewater	52.9	-24.8	1.47	3.39	70.0	-24.8	4.09	98.0	-1.47	91.1
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	70.0	-24.8	4.10	98.0	-1.07	84.0
Dane	Stoughton	52.4	-24.8	1.46	3.34	70.0	-24.8	4.10	98.0	-1.32	88.8
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	70.0	-24.8	4.36	98.0	-1.85	94.9
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	70.0	-24.8	4.18	98.0	-1.24	87.5
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	70.0	-24.8	4.14	98.0	-1.62	92.8
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	70.0	-24.8	4.15	98.0	-1.83	94.7
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	70.0	-24.8	4.04	98.0	-0.87	79.1
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	70.0	-24.8	3.89	98.0	-0.83	78.0
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	70.0	-24.8	4.15	98.0	-1.15	85.7
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	70.0	-24.8	3.98	98.0	-1.33	89.1
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	70.0	-24.8	4.01	98.0	-1.80	94.5
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	70.0	-24.8	4.09	98.0	-1.35	89.3
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	70.0	-24.8	4.06	98.0	-1.22	87.0
Jefferson	Watertown	52.4	-24.8	1.50	3.51	70.0	-24.8	4.01	98.0	-1.25	87.7
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	70.0	-24.8	3.94	98.0	-0.90	79.9
Washington	Germantown	50.2	-24.8	1.44	3.57	70.0	-24.8	4.17	98.0	-1.15	85.7
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	70.0	-24.8	4.01	98.0	-1.05	83.6
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	70.0	-24.8	4.05	98.0	-0.91	80.3
Richland	Richland Center	53.1	-24.8	1.53	3.74	70.0	-24.8	3.91	98.0	-0.51	68.0
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	70.0	-24.8	4.02	98.0	-1.11	84.9
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	70.0	-24.8	4.43	98.0	-1.77	94.2
Washington	West Bend	50.3	-24.8	1.46	3.45	70.0	-24.8	4.10	98.0	-1.28	88.1
Dodge	Horicon	51.3	-24.8	1.50	3.39	70.0	-24.8	4.00	98.0	-1.06	83.8
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	70.0	-24.8	3.93	98.0	-1.19	86.5
Sauk	Baraboo	51.5	-24.8	1.51	3.74	70.0	-24.8	3.98	98.0	-0.43	65.2
Columbia	Portage	52.6	-24.8	1.55	3.57	70.0	-24.8	3.88	98.0	-0.90	79.9
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	70.0	-24.8	3.88	98.0	-0.62	71.7
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	70.0	-24.8	3.89	98.0	-0.73	75.3
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	70.0	-24.8	4.01	98.0	-0.41	64.7
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	70.0	-24.8	3.99	98.0	-0.72	74.8
Green Lake	Dalton	52.2	-24.8	1.55	3.23	70.0	-24.8	3.87	98.0	-1.02	83.0
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	70.0	-24.8	3.88	98.0	-0.31	60.9

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	70.0	-24.8	3.96	98.0	-1.35	89.3
Monroe	Cashton	50.7	-24.8	1.52	3.68	70.0	-24.8	3.95	98.0	-0.79	76.9
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	70.0	-24.8	4.10	98.0	-1.74	94.0
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	70.0	-24.8	3.83	98.0	-0.50	67.6
Marquette	Montello	51.7	-24.8	1.55	3.45	70.0	-24.8	3.86	98.0	-0.67	73.3
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	70.0	-24.8	3.96	98.0	-1.27	87.9
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	70.0	-24.8	3.75	98.0	-0.72	74.8
Monroe	Sparta	52.4	-24.8	1.59	3.74	70.0	-24.8	3.76	98.0	-0.13	54.2
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	70.0	-24.8	3.76	98.0	-0.41	64.7
Juneau	Necedah	53	-24.8	1.63	3.68	70.0	-24.8	3.69	98.0	-0.05	51.1
Calumet	Chilton	51.4	-24.8	1.58	3.23	70.0	-24.8	3.81	98.0	-1.27	88.0
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	70.0	-24.8	3.87	98.0	-1.17	86.1
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	70.0	-24.8	4.03	98.0	-1.55	92.1
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	70.0	-24.8	3.73	98.0	-0.34	62.1
Trempealeau	Dodge	54	-24.8	1.67	3.68	70.0	-24.8	3.59	98.0	0.24	39.5
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	70.0	-24.8	4.36	98.0	-1.61	92.7
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	70.0	-24.8	3.81	98.0	-0.39	64.0
Outagamie	Appleton	50	-24.8	1.56	3.07	70.0	-24.8	3.84	98.0	-1.34	89.1
Trempealeau	Blair	51.4	-24.8	1.61	3.80	70.0	-24.8	3.72	98.0	0.11	44.9
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	70.0	-24.8	3.68	98.0	-0.55	69.5
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	70.0	-24.8	3.71	98.0	-0.96	81.5
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	70.0	-24.8	3.81	98.0	0.27	38.6
Waupaca	New London	51.9	-24.8	1.64	3.34	70.0	-24.8	3.66	98.0	-0.72	74.9
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	70.0	-24.8	3.73	98.0	-0.52	68.4
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	70.0	-24.8	3.55	98.0	0.56	28.2
Wood	Pittsville	51.5	-24.8	1.63	3.34	70.0	-24.8	3.67	98.0	0.15	43.2
Portage	Stevens Point	50	-24.8	1.59	3.28	70.0	-24.8	3.76	98.0	-0.61	71.4
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	70.0	-24.8	3.69	98.0	0.11	44.6
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	70.0	-24.8	3.59	98.0	-0.03	50.0
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	70.0	-24.8	3.73	98.0	-0.50	67.9
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	70.0	-24.8	3.69	98.0	-0.79	77.0
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	70.0	-24.8	3.66	98.0	-0.40	64.3
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	70.0	-24.8	3.59	98.0	-0.21	57.1
Marathon	Rosholt	50.3	-24.8	1.64	3.28	70.0	-24.8	3.66	98.0	-0.18	56.1
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	70.0	-24.8	3.57	98.0	-0.29	60.4
Dunn	Menomonie	52.7	-24.2	1.73	3.57	70.0	-24.8	3.46	98.0	-0.17	55.5

Table C8. Surface Layer Reliability Analysis for 19 % RAS and 6 % RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	71.7	-28.6	5.23	98.0	-2.23	96.7
Brown	Green Bay	49.7	-21.5	1.58	3.23	71.7	-28.6	4.86	98.0	-2.20	96.6
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	71.7	-28.6	4.65	98.0	-1.68	93.4
Shawano	Bowler	48.9	-23.9	1.61	3.45	71.7	-28.6	4.79	98.0	-1.36	89.5
Pierce	River Falls	51.9	-23.7	1.71	3.39	71.7	-28.6	4.52	98.0	-1.44	90.7
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	71.7	-28.6	4.89	98.0	-2.46	97.3
Oconto	Oconto	49.2	-22	1.62	3.39	71.7	-28.6	4.75	98.0	-1.94	95.5
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	71.7	-28.6	4.75	98.0	-1.68	93.4
Clark	Owen	48.2	-25.2	1.59	3.34	71.7	-28.6	4.83	98.0	-1.02	82.9
Chippewa	Stanley	50.2	-24.7	1.66	3.34	71.7	-28.6	4.63	98.0	-1.17	86.1
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	71.7	-28.6	4.55	98.0	-1.09	84.6
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	71.7	-28.6	4.47	98.0	-1.17	86.1
Marinette	Marinette	50.8	-20.9	1.70	3.17	71.7	-28.6	4.53	98.0	-2.43	97.3
Taylor	Medford	47.9	-25.1	1.61	3.23	71.7	-28.6	4.79	98.0	-1.08	84.4
Langlade	Antigo	48.8	-25.1	1.64	3.17	71.7	-28.6	4.70	98.0	-1.10	84.8
Lincoln	Merrill	49.1	-25.3	1.65	3.57	71.7	-28.6	4.66	98.0	-0.93	80.6
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	71.7	-28.6	4.45	98.0	-0.60	71.3
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	71.7	-28.6	4.49	98.0	-0.59	70.8
Polk	Amery	49.8	-25.5	1.69	3.74	71.7	-28.6	4.55	98.0	-0.83	78.0
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	71.7	-28.6	4.57	98.0	-1.33	89.1
Taylor	Jump River	49.2	-27.8	1.68	3.51	71.7	-28.6	4.58	98.0	-0.23	57.8
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	71.7	-28.6	4.56	98.0	-1.23	87.4
Door	Washington Island	44.5	-19.5	1.52	3.45	71.7	-28.6	5.06	98.0	-2.64	97.6
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	71.7	-28.6	4.35	98.0	-0.70	74.3
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	71.7	-28.6	4.45	98.0	-0.74	75.6
Barron	Rice Lake	50.2	-26.1	1.73	3.63	71.7	-28.6	4.44	98.0	-0.69	74.0
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	71.7	-28.6	4.71	98.0	-0.12	53.5
Forest	Laona	46.1	-24.6	1.60	3.17	71.7	-28.6	4.83	98.0	-1.26	87.8
Barron	Cumberland	50.9	-25.4	1.76	3.28	71.7	-28.6	4.37	98.0	-0.98	81.9
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	71.7	-28.6	4.46	98.0	-0.32	61.5
Polk	Luck	50.3	-25.7	1.75	3.39	71.7	-28.6	4.41	98.0	-0.85	78.8
Marinette	Goodman	47	-23.8	1.64	3.12	71.7	-28.6	4.70	98.0	-1.54	91.9
Oneida	North Pelican	46.4	-26.7	1.62	3.28	71.7	-28.6	4.76	98.0	-0.58	70.4
Oneida	Rhineland	48.1	-25.5	1.68	3.07	71.7	-28.6	4.59	98.0	-1.01	82.7
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	71.7	-28.6	4.70	98.0	-0.62	71.8
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	71.7	-28.6	4.39	98.0	-0.55	69.5
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	71.7	-28.6	4.52	98.0	-0.62	71.8
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	71.7	-28.6	4.30	98.0	-0.50	67.9
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	71.7	-28.6	4.64	98.0	-0.77	76.5
Sawyer	Couderay	49.5	-29	1.76	4.17	71.7	-28.6	4.38	98.0	0.10	45.3
Oneida	Minocqua Dam	47	-26	1.67	3.39	71.7	-28.6	4.60	98.0	-0.77	76.3
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	71.7	-28.6	4.61	98.0	-0.49	67.4
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	71.7	-28.6	4.53	98.0	-0.63	72.1
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	71.7	-28.6	4.78	98.0	-0.77	76.5
Price	Park Falls	46.8	-24.8	1.67	3.17	71.7	-28.6	4.61	98.0	-1.20	86.7

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	71.7	-28.6	4.42	98.0	-0.43	65.2
Burnett	Danbury	49.5	-27.6	1.78	3.23	71.7	-28.6	4.32	98.0	-0.31	60.9
Washburn	Minong 2	49.7	-29.2	1.79	3.12	71.7	-28.6	4.29	98.0	0.19	41.5
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	71.7	-28.6	4.46	98.0	-0.58	70.4
Douglas	Gordon	49.3	-29.4	1.80	3.17	71.7	-28.6	4.27	98.0	0.25	39.2
Bayfield	Drummond	49.1	-26.8	1.81	3.28	71.7	-28.6	4.26	98.0	-0.55	69.4
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	71.7	-28.6	4.14	98.0	-0.15	55.0
Ashland	Mellen	47.7	-27.1	1.77	3.34	71.7	-28.6	4.35	98.0	-0.45	66.0
Douglas	Foxboro	48.3	-27.8	1.80	3.07	71.7	-28.6	4.28	98.0	-0.26	59.1
Iron	Gurney	47.3	-25.2	1.76	3.12	71.7	-28.6	4.37	98.0	-1.09	84.5
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	71.7	-28.6	4.22	98.0	-1.07	84.1
Douglas	Superior	44.2	-25.1	1.67	3.17	71.7	-28.6	4.60	98.0	-1.10	84.8
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	71.7	-28.6	4.29	98.0	-0.99	82.3
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	71.7	-28.6	4.45	98.0	-1.60	92.6
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	71.7	-28.6	4.32	98.0	-1.83	94.7

Table C9. Surface Layer Reliability Analysis for Exceptional Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	60.0	-31.9	-2.78	0.3	-3.90	98.0
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	60.0	-31.9	-3.11	0.1	-3.47	98.0
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	60.0	-31.9	-2.76	0.3	-3.77	98.0
Rock	Afton	52.5	-24.8	1.43	3.92	60.0	-31.9	-2.80	0.2	-3.18	97.9
Green	Brodhead	52.8	-24.8	1.44	3.45	60.0	-31.9	-2.79	0.3	-3.16	97.9
Racine	Burlington	51.2	-24.8	1.40	3.34	60.0	-31.9	-2.87	0.2	-3.81	98.0
Rock	Janesville	54.8	-24.8	1.50	3.12	60.0	-31.9	-2.67	0.4	-3.91	98.0
Lafayette	Darlington	52.6	-24.8	1.44	3.39	60.0	-31.9	-2.78	0.3	-3.12	97.9
Racine	Racine	48.5	-24.8	1.33	3.57	60.0	-31.9	-3.01	0.1	-3.65	98.0
Grant	Platteville	52.7	-24.8	1.45	3.28	60.0	-31.9	-2.76	0.3	-3.35	98.0
Grant	Lancaster	51.7	-24.8	1.43	3.23	60.0	-31.9	-2.79	0.3	-3.32	98.0
Walworth	Whitewater	52.9	-24.8	1.47	3.39	60.0	-31.9	-2.73	0.3	-3.57	98.0
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	60.0	-31.9	-2.73	0.3	-2.97	97.9
Dane	Stoughton	52.4	-24.8	1.46	3.34	60.0	-31.9	-2.74	0.3	-3.45	98.0
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	60.0	-31.9	-2.91	0.2	-3.84	98.0
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	60.0	-31.9	-2.79	0.3	-3.44	98.0
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	60.0	-31.9	-2.76	0.3	-3.71	98.0
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	60.0	-31.9	-2.76	0.3	-3.96	98.0
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	60.0	-31.9	-2.69	0.3	-2.86	97.8
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	60.0	-31.9	-2.59	0.5	-2.72	97.7
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	60.0	-31.9	-2.77	0.3	-3.14	97.9
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	60.0	-31.9	-2.65	0.4	-3.53	98.0
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	60.0	-31.9	-2.67	0.4	-3.89	98.0
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	60.0	-31.9	-2.73	0.3	-3.48	98.0
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	60.0	-31.9	-2.71	0.3	-3.27	97.9
Jefferson	Watertown	52.4	-24.8	1.50	3.51	60.0	-31.9	-2.67	0.4	-3.28	97.9
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	60.0	-31.9	-2.63	0.4	-2.89	97.8
Washington	Germantown	50.2	-24.8	1.44	3.57	60.0	-31.9	-2.78	0.3	-3.14	97.9
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	60.0	-31.9	-2.67	0.4	-3.18	97.9
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	60.0	-31.9	-2.70	0.3	-2.94	97.8
Richland	Richland Center	53.1	-24.8	1.53	3.74	60.0	-31.9	-2.61	0.4	-2.40	97.2
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	60.0	-31.9	-2.68	0.4	-3.24	97.9
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	60.0	-31.9	-2.96	0.2	-3.90	98.0
Washington	West Bend	50.3	-24.8	1.46	3.45	60.0	-31.9	-2.73	0.3	-3.33	98.0
Dodge	Horicon	51.3	-24.8	1.50	3.39	60.0	-31.9	-2.67	0.4	-3.15	97.9
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	60.0	-31.9	-2.62	0.4	-3.25	97.9
Sauk	Baraboo	51.5	-24.8	1.51	3.74	60.0	-31.9	-2.65	0.4	-2.32	97.0
Columbia	Portage	52.6	-24.8	1.55	3.57	60.0	-31.9	-2.59	0.5	-2.89	97.8
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	60.0	-31.9	-2.59	0.5	-2.71	97.7
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	60.0	-31.9	-2.60	0.5	-2.66	97.6
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	60.0	-31.9	-2.67	0.4	-2.37	97.1
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	60.0	-31.9	-2.66	0.4	-2.68	97.6
Green Lake	Dalton	52.2	-24.8	1.55	3.23	60.0	-31.9	-2.58	0.5	-3.22	97.9

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	60.0	-31.9	-2.58	0.5	-2.15	96.4
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	60.0	-31.9	-2.64	0.4	-3.48	98.0
Monroe	Cashton	50.7	-24.8	1.52	3.68	60.0	-31.9	-2.63	0.4	-2.71	97.7
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	60.0	-31.9	-2.74	0.3	-3.87	98.0
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	60.0	-31.9	-2.55	0.5	-2.46	97.3
Marquette	Montello	51.7	-24.8	1.55	3.45	60.0	-31.9	-2.58	0.5	-2.72	97.7
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	60.0	-31.9	-2.64	0.4	-3.36	98.0
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	60.0	-31.9	-2.50	0.6	-2.68	97.6
Monroe	Sparta	52.4	-24.8	1.59	3.74	60.0	-31.9	-2.51	0.6	-2.03	95.9
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	60.0	-31.9	-2.51	0.6	-2.37	97.1
Juneau	Necedah	53	-24.8	1.63	3.68	60.0	-31.9	-2.46	0.7	-1.98	95.7
Calumet	Chilton	51.4	-24.8	1.58	3.23	60.0	-31.9	-2.54	0.5	-3.47	98.0
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	60.0	-31.9	-2.58	0.5	-3.30	98.0
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	60.0	-31.9	-2.69	0.4	-3.75	98.0
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	60.0	-31.9	-2.48	0.6	-2.37	97.1
Trempealeau	Dodge	54	-24.8	1.67	3.68	60.0	-31.9	-2.39	0.8	-1.68	93.5
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	60.0	-31.9	-2.91	0.2	-3.85	98.0
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	60.0	-31.9	-2.54	0.5	-2.38	97.2
Outagamie	Appleton	50	-24.8	1.56	3.07	60.0	-31.9	-2.56	0.5	-3.65	98.0
Trempealeau	Blair	51.4	-24.8	1.61	3.80	60.0	-31.9	-2.48	0.6	-1.76	94.2
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	60.0	-31.9	-2.45	0.7	-2.51	97.4
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	60.0	-31.9	-2.47	0.7	-3.09	97.9
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	60.0	-31.9	-2.54	0.5	-1.86	94.9
Waupaca	New London	51.9	-24.8	1.64	3.34	60.0	-31.9	-2.44	0.7	-2.85	97.8
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	60.0	-31.9	-2.48	0.6	-2.68	97.6
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	60.0	-31.9	-2.36	0.9	-1.43	90.5
Wood	Pittsville	51.5	-24.8	1.63	3.34	60.0	-31.9	-2.45	0.7	-1.98	95.6
Portage	Stevens Point	50	-24.8	1.59	3.28	60.0	-31.9	-2.51	0.6	-2.77	97.7
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	60.0	-31.9	-2.46	0.7	-1.88	95.0
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	60.0	-31.9	-2.39	0.8	-1.86	94.9
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	60.0	-31.9	-2.49	0.6	-2.74	97.7
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	60.0	-31.9	-2.46	0.7	-2.96	97.8
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	60.0	-31.9	-2.44	0.7	-2.60	97.5
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	60.0	-31.9	-2.40	0.8	-2.34	97.0
Marathon	Rosholt	50.3	-24.8	1.64	3.28	60.0	-31.9	-2.44	0.7	-2.35	97.1
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	60.0	-31.9	-2.38	0.9	-2.39	97.2
Dunn	Menomonie	52.7	-24.2	1.73	3.57	60.0	-31.9	-2.31	1.0	-2.16	96.5

Table C10. Surface Layer Reliability Analysis for Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	60.0	-37.9	-2.72	0.3	-4.57	98.0
Brown	Green Bay	49.7	-21.5	1.58	3.23	60.0	-37.9	-2.52	0.6	-5.08	98.0
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	60.0	-37.9	-2.42	0.8	-4.46	98.0
Shawano	Bowler	48.9	-23.9	1.61	3.45	60.0	-37.9	-2.49	0.6	-4.06	98.0
Pierce	River Falls	51.9	-23.7	1.71	3.39	60.0	-37.9	-2.35	0.9	-4.18	98.0
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	60.0	-37.9	-2.54	0.5	-5.24	98.0
Oconto	Oconto	49.2	-22	1.62	3.39	60.0	-37.9	-2.47	0.7	-4.68	98.0
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	60.0	-37.9	-2.47	0.7	-4.51	98.0
Clark	Owen	48.2	-25.2	1.59	3.34	60.0	-37.9	-2.51	0.6	-3.81	98.0
Chippewa	Stanley	50.2	-24.7	1.66	3.34	60.0	-37.9	-2.41	0.8	-3.96	98.0
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	60.0	-37.9	-2.37	0.9	-3.70	98.0
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	60.0	-37.9	-2.32	1.0	-3.82	98.0
Marinette	Marinette	50.8	-20.9	1.70	3.17	60.0	-37.9	-2.35	0.9	-5.36	98.0
Taylor	Medford	47.9	-25.1	1.61	3.23	60.0	-37.9	-2.49	0.6	-3.97	98.0
Langlade	Antigo	48.8	-25.1	1.64	3.17	60.0	-37.9	-2.44	0.7	-4.04	98.0
Lincoln	Merrill	49.1	-25.3	1.65	3.57	60.0	-37.9	-2.42	0.8	-3.53	98.0
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	60.0	-37.9	-2.31	1.0	-3.05	97.9
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	60.0	-37.9	-2.33	1.0	-3.20	97.9
Polk	Amery	49.8	-25.5	1.69	3.74	60.0	-37.9	-2.36	0.9	-3.31	98.0
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	60.0	-37.9	-2.38	0.9	-4.21	98.0
Taylor	Jump River	49.2	-27.8	1.68	3.51	60.0	-37.9	-2.38	0.9	-2.88	97.8
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	60.0	-37.9	-2.37	0.9	-3.84	98.0
Door	Washington Island	44.5	-19.5	1.52	3.45	60.0	-37.9	-2.63	0.4	-5.33	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	60.0	-37.9	-2.26	1.2	-3.53	98.0
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	60.0	-37.9	-2.31	1.0	-3.63	98.0
Barron	Rice Lake	50.2	-26.1	1.73	3.63	60.0	-37.9	-2.31	1.0	-3.26	97.9
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	60.0	-37.9	-2.44	0.7	-2.81	97.8
Forest	Laona	46.1	-24.6	1.60	3.17	60.0	-37.9	-2.51	0.6	-4.19	98.0
Barron	Cumberland	50.9	-25.4	1.76	3.28	60.0	-37.9	-2.27	1.1	-3.81	98.0
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	60.0	-37.9	-2.32	1.0	-3.06	97.9
Polk	Luck	50.3	-25.7	1.75	3.39	60.0	-37.9	-2.29	1.1	-3.59	98.0
Marinette	Goodman	47	-23.8	1.64	3.12	60.0	-37.9	-2.44	0.7	-4.52	98.0
Oneida	North Pelican	46.4	-26.7	1.62	3.28	60.0	-37.9	-2.47	0.7	-3.41	98.0
Oneida	Rhineland	48.1	-25.5	1.68	3.07	60.0	-37.9	-2.38	0.8	-4.05	98.0
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	60.0	-37.9	-2.44	0.7	-3.50	98.0
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	60.0	-37.9	-2.28	1.1	-3.25	97.9
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	60.0	-37.9	-2.35	0.9	-3.50	98.0
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	60.0	-37.9	-2.23	1.3	-3.44	98.0
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	60.0	-37.9	-2.41	0.8	-3.66	98.0
Sawyer	Couderay	49.5	-29	1.76	4.17	60.0	-37.9	-2.27	1.1	-2.13	96.4
Oneida	Minocqua Dam	47	-26	1.67	3.39	60.0	-37.9	-2.39	0.8	-3.51	98.0
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	60.0	-37.9	-2.40	0.8	-3.52	98.0
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	60.0	-37.9	-2.35	0.9	-3.72	98.0
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	60.0	-37.9	-2.48	0.6	-3.66	98.0
Price	Park Falls	46.8	-24.8	1.67	3.17	60.0	-37.9	-2.39	0.8	-4.13	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	60.0	-37.9	-2.30	1.1	-3.26	97.9
Burnett	Danbury	49.5	-27.6	1.78	3.23	60.0	-37.9	-2.25	1.2	-3.19	97.9
Washburn	Minong 2	49.7	-29.2	1.79	3.12	60.0	-37.9	-2.23	1.3	-2.79	97.7
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	60.0	-37.9	-2.32	1.0	-3.41	98.0
Douglas	Gordon	49.3	-29.4	1.80	3.17	60.0	-37.9	-2.22	1.3	-2.68	97.6
Bayfield	Drummond	49.1	-26.8	1.81	3.28	60.0	-37.9	-2.21	1.3	-3.38	98.0
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	60.0	-37.9	-2.15	1.5	-3.04	97.9
Ashland	Mellen	47.7	-27.1	1.77	3.34	60.0	-37.9	-2.26	1.2	-3.24	97.9
Douglas	Foxboro	48.3	-27.8	1.80	3.07	60.0	-37.9	-2.22	1.3	-3.29	98.0
Iron	Gurney	47.3	-25.2	1.76	3.12	60.0	-37.9	-2.27	1.1	-4.07	98.0
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	60.0	-37.9	-2.19	1.4	-4.00	98.0
Douglas	Superior	44.2	-25.1	1.67	3.17	60.0	-37.9	-2.39	0.8	-4.04	98.0
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	60.0	-37.9	-2.23	1.3	-3.98	98.0
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	60.0	-37.9	-2.31	1.0	-4.17	98.0
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	60.0	-37.9	-2.25	1.2	-4.66	98.0

Table C11. Surface Layer Reliability Analysis for 25 % RAP, Exceptional Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	65.1	-29.2	0.76	76.2	-3.09	97.9
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	65.1	-29.2	0.86	78.8	-2.77	97.7
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	65.1	-29.2	0.76	76.1	-2.98	97.9
Rock	Afton	52.5	-24.8	1.43	3.92	65.1	-29.2	0.77	76.4	-2.50	97.4
Green	Brodhead	52.8	-24.8	1.44	3.45	65.1	-29.2	0.77	76.3	-2.38	97.1
Racine	Burlington	51.2	-24.8	1.40	3.34	65.1	-29.2	0.79	76.9	-3.00	97.9
Rock	Janesville	54.8	-24.8	1.50	3.12	65.1	-29.2	0.74	75.4	-3.05	97.9
Lafayette	Darlington	52.6	-24.8	1.44	3.39	65.1	-29.2	0.77	76.2	-2.33	97.0
Racine	Racine	48.5	-24.8	1.33	3.57	65.1	-29.2	0.83	78.0	-2.89	97.8
Grant	Platteville	52.7	-24.8	1.45	3.28	65.1	-29.2	0.76	76.1	-2.53	97.4
Grant	Lancaster	51.7	-24.8	1.43	3.23	65.1	-29.2	0.77	76.3	-2.48	97.4
Walworth	Whitewater	52.9	-24.8	1.47	3.39	65.1	-29.2	0.75	75.8	-2.77	97.7
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	65.1	-29.2	0.75	75.8	-2.24	96.8
Dane	Stoughton	52.4	-24.8	1.46	3.34	65.1	-29.2	0.75	75.9	-2.64	97.6
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	65.1	-29.2	0.80	77.2	-3.08	97.9
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	65.1	-29.2	0.77	76.3	-2.60	97.5
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	65.1	-29.2	0.76	76.0	-2.92	97.8
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	65.1	-29.2	0.76	76.1	-3.15	97.9
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	65.1	-29.2	0.74	75.5	-2.10	96.3
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	65.1	-29.2	0.71	74.7	-2.00	95.8
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	65.1	-29.2	0.76	76.1	-2.38	97.2
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	65.1	-29.2	0.73	75.2	-2.70	97.7
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	65.1	-29.2	0.74	75.4	-3.09	97.9
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	65.1	-29.2	0.75	75.8	-2.67	97.6
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	65.1	-29.2	0.74	75.6	-2.49	97.4
Jefferson	Watertown	52.4	-24.8	1.50	3.51	65.1	-29.2	0.74	75.4	-2.51	97.4
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	65.1	-29.2	0.72	75.0	-2.13	96.4
Washington	Germantown	50.2	-24.8	1.44	3.57	65.1	-29.2	0.77	76.2	-2.38	97.2
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	65.1	-29.2	0.73	75.3	-2.37	97.1
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	65.1	-29.2	0.74	75.6	-2.17	96.5
Richland	Richland Center	53.1	-24.8	1.53	3.74	65.1	-29.2	0.72	74.8	-1.68	93.5
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	65.1	-29.2	0.74	75.4	-2.43	97.3
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	65.1	-29.2	0.81	77.6	-3.09	97.9
Washington	West Bend	50.3	-24.8	1.46	3.45	65.1	-29.2	0.75	75.8	-2.55	97.5
Dodge	Horicon	51.3	-24.8	1.50	3.39	65.1	-29.2	0.73	75.3	-2.36	97.1
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	65.1	-29.2	0.72	74.9	-2.46	97.3
Sauk	Baraboo	51.5	-24.8	1.51	3.74	65.1	-29.2	0.73	75.2	-1.60	92.7
Columbia	Portage	52.6	-24.8	1.55	3.57	65.1	-29.2	0.71	74.6	-2.13	96.4
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	65.1	-29.2	0.71	74.6	-1.92	95.3
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	65.1	-29.2	0.71	74.7	-1.93	95.4
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	65.1	-29.2	0.74	75.3	-1.63	92.9
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	65.1	-29.2	0.73	75.2	-1.93	95.4
Green Lake	Dalton	52.2	-24.8	1.55	3.23	65.1	-29.2	0.71	74.6	-2.39	97.2

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	65.1	-29.2	0.71	74.6	-1.45	90.8
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	65.1	-29.2	0.73	75.1	-2.67	97.6
Monroe	Cashton	50.7	-24.8	1.52	3.68	65.1	-29.2	0.72	75.0	-1.98	95.7
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	65.1	-29.2	0.75	75.9	-3.06	97.9
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	65.1	-29.2	0.70	74.3	-1.71	93.7
Marquette	Montello	51.7	-24.8	1.55	3.45	65.1	-29.2	0.71	74.5	-1.94	95.4
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	65.1	-29.2	0.73	75.1	-2.56	97.5
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	65.1	-29.2	0.69	73.9	-1.93	95.4
Monroe	Sparta	52.4	-24.8	1.59	3.74	65.1	-29.2	0.69	74.0	-1.31	88.7
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	65.1	-29.2	0.69	74.0	-1.63	92.9
Juneau	Necedah	53	-24.8	1.63	3.68	65.1	-29.2	0.68	73.6	-1.25	87.6
Calumet	Chilton	51.4	-24.8	1.58	3.23	65.1	-29.2	0.70	74.2	-2.63	97.6
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	65.1	-29.2	0.71	74.6	-2.49	97.4
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	65.1	-29.2	0.74	75.5	-2.91	97.8
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	65.1	-29.2	0.68	73.8	-1.60	92.6
Trempealeau	Dodge	54	-24.8	1.67	3.68	65.1	-29.2	0.66	73.0	-0.95	81.2
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	65.1	-29.2	0.80	77.2	-2.99	97.9
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	65.1	-29.2	0.70	74.2	-1.63	92.9
Outagamie	Appleton	50	-24.8	1.56	3.07	65.1	-29.2	0.70	74.4	-2.77	97.7
Trempealeau	Blair	51.4	-24.8	1.61	3.80	65.1	-29.2	0.68	73.7	-1.05	83.6
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	65.1	-29.2	0.67	73.5	-1.77	94.2
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	65.1	-29.2	0.68	73.7	-2.28	96.9
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	65.1	-29.2	0.70	74.2	-1.05	83.6
Waupaca	New London	51.9	-24.8	1.64	3.34	65.1	-29.2	0.67	73.4	-2.04	96.0
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	65.1	-29.2	0.68	73.8	-1.86	94.9
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	65.1	-29.2	0.65	72.7	-0.67	73.5
Wood	Pittsville	51.5	-24.8	1.63	3.34	65.1	-29.2	0.67	73.5	-1.17	86.1
Portage	Stevens Point	50	-24.8	1.59	3.28	65.1	-29.2	0.69	74.0	-1.95	95.5
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	65.1	-29.2	0.68	73.5	-1.12	85.2
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	65.1	-29.2	0.66	73.0	-1.16	86.0
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	65.1	-29.2	0.68	73.8	-1.89	95.1
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	65.1	-29.2	0.68	73.6	-2.13	96.4
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	65.1	-29.2	0.67	73.4	-1.77	94.2
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	65.1	-29.2	0.66	73.0	-1.53	91.8
Marathon	Rosholt	50.3	-24.8	1.64	3.28	65.1	-29.2	0.67	73.4	-1.52	91.7
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	65.1	-29.2	0.65	72.9	-1.59	92.5
Dunn	Menomonie	52.7	-24.2	1.73	3.57	65.1	-29.2	0.63	72.2	-1.40	90.1

Table C12. Surface Layer Reliability Analysis for 25 % RAP, Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	65.1	-33.7	0.75	75.7	-3.51	98.0
Brown	Green Bay	49.7	-21.5	1.58	3.23	65.1	-33.7	0.69	74.1	-3.78	98.0
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	65.1	-33.7	0.66	73.2	-3.21	97.9
Shawano	Bowler	48.9	-23.9	1.61	3.45	65.1	-33.7	0.68	73.8	-2.84	97.8
Pierce	River Falls	51.9	-23.7	1.71	3.39	65.1	-33.7	0.65	72.6	-2.95	97.8
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	65.1	-33.7	0.70	74.3	-3.98	98.0
Oconto	Oconto	49.2	-22	1.62	3.39	65.1	-33.7	0.68	73.6	-3.45	98.0
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	65.1	-33.7	0.68	73.6	-3.23	97.9
Clark	Owen	48.2	-25.2	1.59	3.34	65.1	-33.7	0.69	74.0	-2.55	97.5
Chippewa	Stanley	50.2	-24.7	1.66	3.34	65.1	-33.7	0.66	73.1	-2.70	97.7
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	65.1	-33.7	0.65	72.7	-2.52	97.4
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	65.1	-33.7	0.64	72.4	-2.62	97.6
Marinette	Marinette	50.8	-20.9	1.70	3.17	65.1	-33.7	0.65	72.6	-4.04	98.0
Taylor	Medford	47.9	-25.1	1.61	3.23	65.1	-33.7	0.68	73.8	-2.67	97.6
Langlade	Antigo	48.8	-25.1	1.64	3.17	65.1	-33.7	0.67	73.4	-2.71	97.7
Lincoln	Merrill	49.1	-25.3	1.65	3.57	65.1	-33.7	0.67	73.2	-2.36	97.1
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	65.1	-33.7	0.64	72.3	-1.95	95.5
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	65.1	-33.7	0.64	72.5	-2.02	95.9
Polk	Amery	49.8	-25.5	1.69	3.74	65.1	-33.7	0.65	72.7	-2.19	96.6
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	65.1	-33.7	0.65	72.8	-2.91	97.8
Taylor	Jump River	49.2	-27.8	1.68	3.51	65.1	-33.7	0.65	72.9	-1.68	93.5
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	65.1	-33.7	0.65	72.8	-2.66	97.6
Door	Washington Island	44.5	-19.5	1.52	3.45	65.1	-33.7	0.72	75.0	-4.11	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	65.1	-33.7	0.62	71.8	-2.25	96.8
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	65.1	-33.7	0.64	72.3	-2.32	97.0
Barron	Rice Lake	50.2	-26.1	1.73	3.63	65.1	-33.7	0.63	72.2	-2.10	96.2
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	65.1	-33.7	0.67	73.4	-1.59	92.6
Forest	Laona	46.1	-24.6	1.60	3.17	65.1	-33.7	0.69	74.0	-2.87	97.8
Barron	Cumberland	50.9	-25.4	1.76	3.28	65.1	-33.7	0.62	71.9	-2.53	97.4
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	65.1	-33.7	0.64	72.3	-1.83	94.7
Polk	Luck	50.3	-25.7	1.75	3.39	65.1	-33.7	0.63	72.1	-2.36	97.1
Marinette	Goodman	47	-23.8	1.64	3.12	65.1	-33.7	0.67	73.4	-3.17	97.9
Oneida	North Pelican	46.4	-26.7	1.62	3.28	65.1	-33.7	0.68	73.7	-2.13	96.4
Oneida	Rhineland	48.1	-25.5	1.68	3.07	65.1	-33.7	0.66	72.9	-2.67	97.6
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	65.1	-33.7	0.67	73.4	-2.20	96.6
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	65.1	-33.7	0.63	72.0	-2.03	95.9
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	65.1	-33.7	0.65	72.6	-2.20	96.6
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	65.1	-33.7	0.61	71.6	-2.11	96.3
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	65.1	-33.7	0.66	73.1	-2.36	97.1
Sawyer	Couderay	49.5	-29	1.76	4.17	65.1	-33.7	0.63	71.9	-1.13	85.3
Oneida	Minocqua Dam	47	-26	1.67	3.39	65.1	-33.7	0.66	73.0	-2.27	96.9
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	65.1	-33.7	0.66	73.0	-2.15	96.5
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	65.1	-33.7	0.65	72.6	-2.32	97.0
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	65.1	-33.7	0.68	73.8	-2.36	97.1
Price	Park Falls	46.8	-24.8	1.67	3.17	65.1	-33.7	0.66	73.0	-2.81	97.8

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	65.1	-33.7	0.63	72.1	-1.98	95.7
Burnett	Danbury	49.5	-27.6	1.78	3.23	65.1	-33.7	0.62	71.7	-1.89	95.1
Washburn	Minong 2	49.7	-29.2	1.79	3.12	65.1	-33.7	0.61	71.5	-1.44	90.7
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	65.1	-33.7	0.64	72.3	-2.13	96.4
Douglas	Gordon	49.3	-29.4	1.80	3.17	65.1	-33.7	0.61	71.4	-1.36	89.4
Bayfield	Drummond	49.1	-26.8	1.81	3.28	65.1	-33.7	0.61	71.4	-2.10	96.3
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	65.1	-33.7	0.59	70.9	-1.74	94.0
Ashland	Mellen	47.7	-27.1	1.77	3.34	65.1	-33.7	0.62	71.8	-1.98	95.6
Douglas	Foxboro	48.3	-27.8	1.80	3.07	65.1	-33.7	0.61	71.5	-1.92	95.3
Iron	Gurney	47.3	-25.2	1.76	3.12	65.1	-33.7	0.62	71.9	-2.73	97.7
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	65.1	-33.7	0.60	71.2	-2.68	97.6
Douglas	Superior	44.2	-25.1	1.67	3.17	65.1	-33.7	0.66	73.0	-2.71	97.7
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	65.1	-33.7	0.61	71.5	-2.63	97.6
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	65.1	-33.7	0.64	72.3	-3.01	97.9
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	65.1	-33.7	0.62	71.7	-3.38	98.0

Table C13. Surface Layer Reliability Analysis for 20 % RAS, Exceptional Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	68.9	-27.1	3.41	98.0	-2.46	97.3
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	68.9	-27.1	3.81	98.0	-2.23	96.7
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	68.9	-27.1	3.38	98.0	-2.36	97.1
Rock	Afton	52.5	-24.8	1.43	3.92	68.9	-27.1	3.43	98.0	-1.96	95.6
Green	Brodhead	52.8	-24.8	1.44	3.45	68.9	-27.1	3.41	98.0	-1.77	94.2
Racine	Burlington	51.2	-24.8	1.40	3.34	68.9	-27.1	3.51	98.0	-2.37	97.1
Rock	Janesville	54.8	-24.8	1.50	3.12	68.9	-27.1	3.28	97.9	-2.37	97.1
Lafayette	Darlington	52.6	-24.8	1.44	3.39	68.9	-27.1	3.41	98.0	-1.71	93.7
Racine	Racine	48.5	-24.8	1.33	3.57	68.9	-27.1	3.69	98.0	-2.30	96.9
Grant	Platteville	52.7	-24.8	1.45	3.28	68.9	-27.1	3.38	98.0	-1.89	95.1
Grant	Lancaster	51.7	-24.8	1.43	3.23	68.9	-27.1	3.42	98.0	-1.83	94.7
Walworth	Whitewater	52.9	-24.8	1.47	3.39	68.9	-27.1	3.34	98.0	-2.15	96.5
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	68.9	-27.1	3.35	98.0	-1.68	93.5
Dane	Stoughton	52.4	-24.8	1.46	3.34	68.9	-27.1	3.35	98.0	-2.01	95.8
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	68.9	-27.1	3.56	98.0	-2.50	97.4
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	68.9	-27.1	3.41	98.0	-1.95	95.5
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	68.9	-27.1	3.38	98.0	-2.30	96.9
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	68.9	-27.1	3.39	98.0	-2.52	97.4
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	68.9	-27.1	3.30	98.0	-1.51	91.6
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	68.9	-27.1	3.17	97.9	-1.44	90.7
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	68.9	-27.1	3.39	98.0	-1.79	94.4
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	68.9	-27.1	3.25	97.9	-2.05	96.0
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	68.9	-27.1	3.28	97.9	-2.48	97.3
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	68.9	-27.1	3.34	98.0	-2.04	96.0
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	68.9	-27.1	3.32	98.0	-1.88	95.1
Jefferson	Watertown	52.4	-24.8	1.50	3.51	68.9	-27.1	3.28	97.9	-1.91	95.2
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	68.9	-27.1	3.22	97.9	-1.54	92.0
Washington	Germantown	50.2	-24.8	1.44	3.57	68.9	-27.1	3.41	98.0	-1.79	94.4
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	68.9	-27.1	3.27	97.9	-1.74	94.0
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	68.9	-27.1	3.31	98.0	-1.57	92.3
Richland	Richland Center	53.1	-24.8	1.53	3.74	68.9	-27.1	3.19	97.9	-1.12	85.2
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	68.9	-27.1	3.29	98.0	-1.80	94.5
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	68.9	-27.1	3.62	98.0	-2.46	97.3
Washington	West Bend	50.3	-24.8	1.46	3.45	68.9	-27.1	3.35	98.0	-1.94	95.4
Dodge	Horicon	51.3	-24.8	1.50	3.39	68.9	-27.1	3.27	97.9	-1.74	94.0
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	68.9	-27.1	3.21	97.9	-1.85	94.9
Sauk	Baraboo	51.5	-24.8	1.51	3.74	68.9	-27.1	3.25	97.9	-1.04	83.4
Columbia	Portage	52.6	-24.8	1.55	3.57	68.9	-27.1	3.17	97.9	-1.54	92.0
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	68.9	-27.1	3.17	97.9	-1.30	88.5
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	68.9	-27.1	3.18	97.9	-1.36	89.4
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	68.9	-27.1	3.27	97.9	-1.05	83.6
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	68.9	-27.1	3.25	97.9	-1.35	89.4
Green Lake	Dalton	52.2	-24.8	1.55	3.23	68.9	-27.1	3.16	97.9	-1.74	94.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	68.9	-27.1	3.17	97.9	-0.91	80.1
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	68.9	-27.1	3.24	97.9	-2.04	96.0
Monroe	Cashton	50.7	-24.8	1.52	3.68	68.9	-27.1	3.23	97.9	-1.41	90.3
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	68.9	-27.1	3.35	98.0	-2.43	97.3
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	68.9	-27.1	3.12	97.9	-1.13	85.4
Marquette	Montello	51.7	-24.8	1.55	3.45	68.9	-27.1	3.15	97.9	-1.33	89.1
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	68.9	-27.1	3.24	97.9	-1.94	95.5
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	68.9	-27.1	3.06	97.9	-1.35	89.4
Monroe	Sparta	52.4	-24.8	1.59	3.74	68.9	-27.1	3.07	97.9	-0.75	75.7
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	68.9	-27.1	3.07	97.9	-1.05	83.6
Juneau	Necedah	53	-24.8	1.63	3.68	68.9	-27.1	3.01	97.9	-0.68	73.6
Calumet	Chilton	51.4	-24.8	1.58	3.23	68.9	-27.1	3.11	97.9	-1.98	95.7
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	68.9	-27.1	3.16	97.9	-1.86	94.9
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	68.9	-27.1	3.29	98.0	-2.26	96.8
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	68.9	-27.1	3.04	97.9	-1.00	82.4
Trempealeau	Dodge	54	-24.8	1.67	3.68	68.9	-27.1	2.93	97.8	-0.38	63.5
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	68.9	-27.1	3.56	98.0	-2.33	97.0
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	68.9	-27.1	3.11	97.9	-1.04	83.3
Outagamie	Appleton	50	-24.8	1.56	3.07	68.9	-27.1	3.14	97.9	-2.09	96.2
Trempealeau	Blair	51.4	-24.8	1.61	3.80	68.9	-27.1	3.04	97.9	-0.50	67.7
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	68.9	-27.1	3.00	97.9	-1.19	86.5
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	68.9	-27.1	3.03	97.9	-1.65	93.1
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	68.9	-27.1	3.11	97.9	-0.42	64.9
Waupaca	New London	51.9	-24.8	1.64	3.34	68.9	-27.1	2.99	97.9	-1.41	90.2
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	68.9	-27.1	3.04	97.9	-1.22	87.1
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	68.9	-27.1	2.90	97.8	-0.08	52.3
Wood	Pittsville	51.5	-24.8	1.63	3.34	68.9	-27.1	3.00	97.9	-0.54	69.1
Portage	Stevens Point	50	-24.8	1.59	3.28	68.9	-27.1	3.07	97.9	-1.31	88.7
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	68.9	-27.1	3.01	97.9	-0.53	68.9
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	68.9	-27.1	2.93	97.8	-0.62	71.8
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	68.9	-27.1	3.05	97.9	-1.23	87.3
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	68.9	-27.1	3.01	97.9	-1.49	91.4
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	68.9	-27.1	2.99	97.9	-1.12	85.0
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	68.9	-27.1	2.93	97.8	-0.90	79.9
Marathon	Rosholt	50.3	-24.8	1.64	3.28	68.9	-27.1	2.99	97.9	-0.88	79.5
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	68.9	-27.1	2.91	97.8	-0.97	81.8
Dunn	Menomonie	52.7	-24.2	1.73	3.57	68.9	-27.1	2.83	97.8	-0.81	77.6

Table C14. Surface Layer Reliability Analysis for 20 % RAS, Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	70.7	-31.1	4.55	98.0	-2.86	97.8
Brown	Green Bay	49.7	-21.5	1.58	3.23	70.8	-31.0	4.29	98.0	-2.94	97.8
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	70.8	-31.0	4.11	98.0	-2.40	97.2
Shawano	Bowler	48.9	-23.9	1.61	3.45	70.8	-31.0	4.23	98.0	-2.06	96.1
Pierce	River Falls	51.9	-23.7	1.71	3.39	70.8	-31.0	3.99	98.0	-2.15	96.5
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	70.8	-31.0	4.32	98.0	-3.18	97.9
Oconto	Oconto	49.2	-22	1.62	3.39	70.8	-31.0	4.20	98.0	-2.65	97.6
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	70.8	-31.0	4.20	98.0	-2.41	97.2
Clark	Owen	48.2	-25.2	1.59	3.34	70.8	-31.0	4.27	98.0	-1.74	94.0
Chippewa	Stanley	50.2	-24.7	1.66	3.34	70.8	-31.0	4.09	98.0	-1.89	95.1
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	70.8	-31.0	4.02	98.0	-1.77	94.2
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	70.8	-31.0	3.95	98.0	-1.85	94.9
Marinette	Marinette	50.8	-20.9	1.70	3.17	70.8	-31.0	4.00	98.0	-3.18	97.9
Taylor	Medford	47.9	-25.1	1.61	3.23	70.8	-31.0	4.23	98.0	-1.83	94.7
Langlade	Antigo	48.8	-25.1	1.64	3.17	70.8	-31.0	4.15	98.0	-1.86	94.9
Lincoln	Merrill	49.1	-25.3	1.65	3.57	70.8	-31.0	4.11	98.0	-1.60	92.6
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	70.8	-31.0	3.93	98.0	-1.24	87.4
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	70.8	-31.0	3.97	98.0	-1.26	87.9
Polk	Amery	49.8	-25.5	1.69	3.74	70.8	-31.0	4.02	98.0	-1.47	91.1
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	70.8	-31.0	4.04	98.0	-2.08	96.1
Taylor	Jump River	49.2	-27.8	1.68	3.51	70.8	-31.0	4.04	98.0	-0.91	80.3
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	70.8	-31.0	4.03	98.0	-1.91	95.2
Door	Washington Island	44.5	-19.5	1.52	3.45	70.8	-31.0	4.47	98.0	-3.33	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	70.8	-31.0	3.84	98.0	-1.43	90.5
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	70.8	-31.0	3.93	98.0	-1.49	91.3
Barron	Rice Lake	50.2	-26.1	1.73	3.63	70.8	-31.0	3.92	98.0	-1.35	89.4
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	70.8	-31.0	4.16	98.0	-0.81	77.6
Forest	Laona	46.1	-24.6	1.60	3.17	70.8	-31.0	4.26	98.0	-2.02	95.9
Barron	Cumberland	50.9	-25.4	1.76	3.28	70.8	-31.0	3.86	98.0	-1.71	93.7
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	70.8	-31.0	3.94	98.0	-1.03	83.2
Polk	Luck	50.3	-25.7	1.75	3.39	70.8	-31.0	3.89	98.0	-1.56	92.2
Marinette	Goodman	47	-23.8	1.64	3.12	70.8	-31.0	4.15	98.0	-2.31	97.0
Oneida	North Pelican	46.4	-26.7	1.62	3.28	70.8	-31.0	4.20	98.0	-1.31	88.7
Oneida	Rhineland	48.1	-25.5	1.68	3.07	70.8	-31.0	4.05	98.0	-1.79	94.4
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	70.8	-31.0	4.15	98.0	-1.36	89.5
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	70.8	-31.0	3.88	98.0	-1.25	87.6
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	70.8	-31.0	4.00	98.0	-1.36	89.5
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	70.8	-31.0	3.79	98.0	-1.26	87.8
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	70.8	-31.0	4.10	98.0	-1.52	91.7
Sawyer	Couderay	49.5	-29	1.76	4.17	70.8	-31.0	3.86	98.0	-0.48	67.1
Oneida	Minocqua Dam	47	-26	1.67	3.39	70.8	-31.0	4.07	98.0	-1.47	91.1
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	70.8	-31.0	4.07	98.0	-1.27	88.0
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	70.8	-31.0	4.00	98.0	-1.43	90.5
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	70.8	-31.0	4.22	98.0	-1.52	91.7
Price	Park Falls	46.8	-24.8	1.67	3.17	70.8	-31.0	4.07	98.0	-1.95	95.5

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	70.8	-31.0	3.90	98.0	-1.16	85.9
Burnett	Danbury	49.5	-27.6	1.78	3.23	70.8	-31.0	3.82	98.0	-1.05	83.7
Washburn	Minong 2	49.7	-29.2	1.79	3.12	70.8	-31.0	3.79	98.0	-0.58	70.4
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	70.8	-31.0	3.94	98.0	-1.31	88.7
Douglas	Gordon	49.3	-29.4	1.80	3.17	70.8	-31.0	3.77	98.0	-0.50	67.9
Bayfield	Drummond	49.1	-26.8	1.81	3.28	70.8	-31.0	3.76	98.0	-1.28	88.2
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	70.8	-31.0	3.66	98.0	-0.90	79.9
Ashland	Mellen	47.7	-27.1	1.77	3.34	70.8	-31.0	3.84	98.0	-1.17	86.1
Douglas	Foxboro	48.3	-27.8	1.80	3.07	70.8	-31.0	3.78	98.0	-1.04	83.5
Iron	Gurney	47.3	-25.2	1.76	3.12	70.8	-31.0	3.86	98.0	-1.86	94.9
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	70.8	-31.0	3.72	98.0	-1.83	94.7
Douglas	Superior	44.2	-25.1	1.67	3.17	70.8	-31.0	4.06	98.0	-1.86	94.9
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	70.8	-31.0	3.78	98.0	-1.76	94.2
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	70.8	-31.0	3.93	98.0	-2.26	96.8
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	70.8	-31.0	3.82	98.0	-2.56	97.5

Table C15. Surface Layer Reliability Analysis for 19 % RAS and 6% RAP, Exceptional Grade Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-24.8	1.44	3.34	70.0	-26.6	4.17	98.0	-2.31	97.0
Kenosha	Kenosha	47.6	-24.8	1.29	3.86	70.0	-26.6	4.67	98.0	-2.10	96.2
Walworth	Lake Geneva	53.4	-24.8	1.45	3.39	70.0	-26.6	4.14	98.0	-2.21	96.7
Rock	Afton	52.5	-24.8	1.43	3.92	70.0	-26.6	4.20	98.0	-1.83	94.7
Green	Brodhead	52.8	-24.8	1.44	3.45	70.0	-26.6	4.18	98.0	-1.62	92.9
Racine	Burlington	51.2	-24.8	1.40	3.34	70.0	-26.6	4.30	98.0	-2.22	96.7
Rock	Janesville	54.8	-24.8	1.50	3.12	70.0	-26.6	4.01	98.0	-2.21	96.7
Lafayette	Darlington	52.6	-24.8	1.44	3.39	70.0	-26.6	4.17	98.0	-1.56	92.2
Racine	Racine	48.5	-24.8	1.33	3.57	70.0	-26.6	4.52	98.0	-2.16	96.5
Grant	Platteville	52.7	-24.8	1.45	3.28	70.0	-26.6	4.14	98.0	-1.74	94.0
Grant	Lancaster	51.7	-24.8	1.43	3.23	70.0	-26.6	4.19	98.0	-1.67	93.4
Walworth	Whitewater	52.9	-24.8	1.47	3.39	70.0	-26.6	4.09	98.0	-2.00	95.8
Jefferson	Fort Atkinson	52.6	-24.8	1.46	3.74	70.0	-26.6	4.10	98.0	-1.55	92.1
Dane	Stoughton	52.4	-24.8	1.46	3.34	70.0	-26.6	4.10	98.0	-1.86	94.9
Milwaukee	Milwaukee Mtchl Fld	49.2	-24.8	1.38	3.57	70.0	-26.6	4.36	98.0	-2.36	97.1
Iowa	Dodgeville	51.2	-24.8	1.44	3.23	70.0	-26.6	4.18	98.0	-1.80	94.5
Waukesha	Waukesha	51.6	-24.8	1.45	3.39	70.0	-26.6	4.14	98.0	-2.15	96.5
Milwaukee	West Allis	51.4	-24.8	1.45	3.34	70.0	-26.6	4.15	98.0	-2.37	97.1
Dane	Arboretum Univ Wis	52.7	-24.8	1.48	3.57	70.0	-26.6	4.04	98.0	-1.37	89.7
Crawford	Prairie Du Chien	54.8	-24.8	1.54	3.74	70.0	-26.6	3.89	98.0	-1.31	88.7
Dane	Charmany Farm	51.2	-24.8	1.45	3.57	70.0	-26.6	4.15	98.0	-1.65	93.2
Jefferson	Lake Mills	53.3	-24.8	1.51	3.23	70.0	-26.6	3.98	98.0	-1.89	95.1
Milwaukee	Milwaukee Mt Mary Co	52.9	-24.8	1.50	3.39	70.0	-26.6	4.01	98.0	-2.33	97.0
Waukesha	Oconomowoc	51.7	-24.8	1.47	3.34	70.0	-26.6	4.09	98.0	-1.89	95.1
Dane	Madison Dane Cnty Ap	52	-24.8	1.48	3.45	70.0	-26.6	4.06	98.0	-1.74	94.0
Jefferson	Watertown	52.4	-24.8	1.50	3.51	70.0	-26.6	4.01	98.0	-1.77	94.2
Crawford	Lynxville Dam 9	53.1	-24.8	1.52	3.57	70.0	-26.6	3.94	98.0	-1.40	90.1
Washington	Germantown	50.2	-24.8	1.44	3.57	70.0	-26.6	4.17	98.0	-1.65	93.2
Columbia	Arlington Univ Farm	51.9	-24.8	1.50	3.34	70.0	-26.6	4.01	98.0	-1.59	92.5
Washington	Hartford 2 W	51.3	-24.8	1.48	3.51	70.0	-26.6	4.05	98.0	-1.43	90.4
Richland	Richland Center	53.1	-24.8	1.53	3.74	70.0	-26.6	3.91	98.0	-0.99	82.2
Sauk	Prairie Du Sac 2 N	51.6	-24.8	1.49	3.34	70.0	-26.6	4.02	98.0	-1.65	93.1
Ozaukee	Port Washington	46.6	-24.8	1.35	3.34	70.0	-26.6	4.43	98.0	-2.31	97.0
Washington	West Bend	50.3	-24.8	1.46	3.45	70.0	-26.6	4.10	98.0	-1.80	94.5
Dodge	Horicon	51.3	-24.8	1.50	3.39	70.0	-26.6	4.00	98.0	-1.59	92.5
Dodge	Beaver Dam	52.3	-24.8	1.53	3.45	70.0	-26.6	3.93	98.0	-1.71	93.7
Sauk	Baraboo	51.5	-24.8	1.51	3.74	70.0	-26.6	3.98	98.0	-0.91	80.2
Columbia	Portage	52.6	-24.8	1.55	3.57	70.0	-26.6	3.88	98.0	-1.40	90.1
Sauk	Reedsburg	52.6	-24.8	1.55	3.39	70.0	-26.6	3.88	98.0	-1.15	85.7
Vernon	Genoa Dam 8	52.2	-24.8	1.54	3.68	70.0	-26.6	3.89	98.0	-1.22	87.1
Vernon	Viroqua 2 Nw	50.7	-24.8	1.50	3.63	70.0	-26.6	4.01	98.0	-0.91	80.2
Columbia	Wisconsin Dells	50.8	-24.8	1.51	3.63	70.0	-26.6	3.99	98.0	-1.21	87.0
Green Lake	Dalton	52.2	-24.8	1.55	3.23	70.0	-26.6	3.87	98.0	-1.58	92.4
Vernon	Hillsboro	52.1	-24.8	1.55	3.86	70.0	-26.6	3.88	98.0	-0.78	76.6

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Sheboygan	Plymouth	50.6	-24.8	1.51	3.34	70.0	-26.6	3.96	98.0	-1.89	95.1
Monroe	Cashton	50.7	-24.8	1.52	3.68	70.0	-26.6	3.95	98.0	-1.28	88.1
Sheboygan	Sheboygan	48.8	-24.8	1.46	3.34	70.0	-26.6	4.10	98.0	-2.28	96.9
Juneau	Mauston 1 Se	52.2	-24.8	1.57	3.63	70.0	-26.6	3.83	98.0	-0.99	82.3
Marquette	Montello	51.7	-24.8	1.55	3.45	70.0	-26.6	3.86	98.0	-1.19	86.5
Fond Du Lac	Fond Du Lac	50.3	-24.8	1.51	3.39	70.0	-26.6	3.96	98.0	-1.80	94.5
La Crosse	La Crosse Muni Ap	52.9	-24.8	1.60	3.63	70.0	-26.6	3.75	98.0	-1.21	87.0
Monroe	Sparta	52.4	-24.8	1.59	3.74	70.0	-26.6	3.76	98.0	-0.61	71.6
Trempealeau	Trempealeau Dam 6	52.1	-24.8	1.59	3.63	70.0	-26.6	3.76	98.0	-0.91	80.2
Juneau	Necedah	53	-24.8	1.63	3.68	70.0	-26.6	3.69	98.0	-0.54	69.2
Calumet	Chilton	51.4	-24.8	1.58	3.23	70.0	-26.6	3.81	98.0	-1.83	94.7
Winnebago	Oshkosh	50.6	-24.8	1.55	3.34	70.0	-26.6	3.87	98.0	-1.71	93.7
Manitowoc	Manitowoc	48.2	-24.8	1.49	3.23	70.0	-26.6	4.03	98.0	-2.11	96.3
Waushara	Hancock Exp Farm	52.1	-24.8	1.61	3.51	70.0	-26.6	3.73	98.0	-0.86	78.8
Trempealeau	Dodge	54	-24.8	1.67	3.68	70.0	-26.6	3.59	98.0	-0.24	58.5
Manitowoc	Two Rivers 10 N	44.4	-24.8	1.38	3.17	70.0	-26.6	4.36	98.0	-2.18	96.5
Jackson	Mather 3 Nw	50.7	-24.8	1.57	3.57	70.0	-26.6	3.81	98.0	-0.90	79.9
Outagamie	Appleton	50	-24.8	1.56	3.07	70.0	-26.6	3.84	98.0	-1.92	95.3
Trempealeau	Blair	51.4	-24.8	1.61	3.80	70.0	-26.6	3.72	98.0	-0.37	63.1
Buffalo	Alma Dam 4	51.9	-24.8	1.63	3.63	70.0	-26.6	3.68	98.0	-1.05	83.6
Waupaca	Waupaca	51.4	-24.8	1.62	3.34	70.0	-26.6	3.71	98.0	-1.50	91.4
Portage	Coddington 1 E	49.9	-24.8	1.57	3.34	70.0	-26.6	3.81	98.0	-0.27	59.4
Waupaca	New London	51.9	-24.8	1.64	3.34	70.0	-26.6	3.66	98.0	-1.26	87.8
Wood	Wisconsin Rapids	51	-24.8	1.61	3.28	70.0	-26.6	3.73	98.0	-1.07	84.0
Jackson	Hatfield Hydro Plant	53.5	-24.8	1.69	3.57	70.0	-26.6	3.55	98.0	0.06	46.8
Wood	Pittsville	51.5	-24.8	1.63	3.34	70.0	-26.6	3.67	98.0	-0.39	63.9
Portage	Stevens Point	50	-24.8	1.59	3.28	70.0	-26.6	3.76	98.0	-1.16	85.9
Clark	Neillsville 3 Sw	50.9	-24.8	1.63	3.57	70.0	-26.6	3.69	98.0	-0.39	64.0
Buffalo	Mondovi	52.1	-24.8	1.67	3.86	70.0	-26.6	3.59	98.0	-0.49	67.5
Eau Claire	Fairchild Ranger Sta	50	-24.8	1.61	3.17	70.0	-26.6	3.73	98.0	-1.07	84.1
Waupaca	Clintonville	50.5	-24.8	1.63	3.28	70.0	-26.6	3.69	98.0	-1.34	89.2
Wood	Marshfield Exp Farm	50.8	-24.8	1.64	3.23	70.0	-26.6	3.66	98.0	-0.96	81.5
Pierce	Ellsworth	51.4	-24.8	1.67	3.34	70.0	-26.6	3.59	98.0	-0.75	75.8
Marathon	Rosholt	50.3	-24.8	1.64	3.28	70.0	-26.6	3.66	98.0	-0.73	75.2
Chippewa	Eau Claire County Ap	51.2	-24.8	1.68	3.39	70.0	-26.6	3.57	98.0	-0.83	77.9
Dunn	Menomonie	52.7	-24.2	1.73	3.57	70.0	-26.6	3.46	98.0	-0.67	73.5

Table C16. Surface Layer Reliability Analysis for 19 % RAS and 6 % RAP, Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	71.7	-30.4	5.23	98.0	-2.68	97.6
Brown	Green Bay	49.7	-21.5	1.58	3.23	71.7	-30.4	4.86	98.0	-2.76	97.7
Shawano	Shawano 2 Ssw	50.8	-23	1.66	3.34	71.7	-30.4	4.65	98.0	-2.22	96.7
Shawano	Bowler	48.9	-23.9	1.61	3.45	71.7	-30.4	4.79	98.0	-1.88	95.1
Pierce	River Falls	51.9	-23.7	1.71	3.39	71.7	-30.4	4.52	98.0	-1.97	95.6
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	71.7	-30.4	4.89	98.0	-3.00	97.9
Oconto	Oconto	49.2	-22	1.62	3.39	71.7	-30.4	4.75	98.0	-2.48	97.3
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	71.7	-30.4	4.75	98.0	-2.22	96.7
Clark	Owen	48.2	-25.2	1.59	3.34	71.7	-30.4	4.83	98.0	-1.56	92.2
Chippewa	Stanley	50.2	-24.7	1.66	3.34	71.7	-30.4	4.63	98.0	-1.71	93.7
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	71.7	-30.4	4.55	98.0	-1.60	92.6
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	71.7	-30.4	4.47	98.0	-1.68	93.5
Marinette	Marinette	50.8	-20.9	1.70	3.17	71.7	-30.4	4.53	98.0	-2.99	97.9
Taylor	Medford	47.9	-25.1	1.61	3.23	71.7	-30.4	4.79	98.0	-1.64	93.1
Langlade	Antigo	48.8	-25.1	1.64	3.17	71.7	-30.4	4.70	98.0	-1.67	93.4
Lincoln	Merrill	49.1	-25.3	1.65	3.57	71.7	-30.4	4.66	98.0	-1.43	90.5
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	71.7	-30.4	4.45	98.0	-1.08	84.2
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	71.7	-30.4	4.49	98.0	-1.09	84.6
Polk	Amery	49.8	-25.5	1.69	3.74	71.7	-30.4	4.55	98.0	-1.31	88.7
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	71.7	-30.4	4.57	98.0	-1.89	95.1
Taylor	Jump River	49.2	-27.8	1.68	3.51	71.7	-30.4	4.58	98.0	-0.74	75.5
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	71.7	-30.4	4.56	98.0	-1.74	94.0
Door	Washington Island	44.5	-19.5	1.52	3.45	71.7	-30.4	5.06	98.0	-3.16	97.9
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	71.7	-30.4	4.35	98.0	-1.25	87.6
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	71.7	-30.4	4.45	98.0	-1.30	88.5
Barron	Rice Lake	50.2	-26.1	1.73	3.63	71.7	-30.4	4.44	98.0	-1.19	86.5
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	71.7	-30.4	4.71	98.0	-0.64	72.3
Forest	Laona	46.1	-24.6	1.60	3.17	71.7	-30.4	4.83	98.0	-1.83	94.7
Barron	Cumberland	50.9	-25.4	1.76	3.28	71.7	-30.4	4.37	98.0	-1.52	91.7
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	71.7	-30.4	4.46	98.0	-0.85	78.8
Polk	Luck	50.3	-25.7	1.75	3.39	71.7	-30.4	4.41	98.0	-1.38	89.9
Marinette	Goodman	47	-23.8	1.64	3.12	71.7	-30.4	4.70	98.0	-2.12	96.3
Oneida	North Pelican	46.4	-26.7	1.62	3.28	71.7	-30.4	4.76	98.0	-1.13	85.3
Oneida	Rhineland	48.1	-25.5	1.68	3.07	71.7	-30.4	4.59	98.0	-1.60	92.6
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	71.7	-30.4	4.70	98.0	-1.18	86.3
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	71.7	-30.4	4.39	98.0	-1.07	84.1
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	71.7	-30.4	4.52	98.0	-1.18	86.3
Washburn	Spooner Exp Farm	50.6	-27	1.79	3.17	71.7	-30.4	4.30	98.0	-1.07	84.1
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	71.7	-30.4	4.64	98.0	-1.33	89.1
Sawyer	Couderay	49.5	-29	1.76	4.17	71.7	-30.4	4.38	98.0	-0.34	61.9
Oneida	Minocqua Dam	47	-26	1.67	3.39	71.7	-30.4	4.60	98.0	-1.30	88.5
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	71.7	-30.4	4.61	98.0	-1.08	84.2
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	71.7	-30.4	4.53	98.0	-1.23	87.2
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	71.7	-30.4	4.78	98.0	-1.33	89.1
Price	Park Falls	46.8	-24.8	1.67	3.17	71.7	-30.4	4.61	98.0	-1.77	94.2

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	71.7	-30.4	4.42	98.0	-0.98	81.9
Burnett	Danbury	49.5	-27.6	1.78	3.23	71.7	-30.4	4.32	98.0	-0.87	79.1
Washburn	Minong 2	49.7	-29.2	1.79	3.12	71.7	-30.4	4.29	98.0	-0.38	63.7
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	71.7	-30.4	4.46	98.0	-1.13	85.3
Douglas	Gordon	49.3	-29.4	1.80	3.17	71.7	-30.4	4.27	98.0	-0.32	61.1
Bayfield	Drummond	49.1	-26.8	1.81	3.28	71.7	-30.4	4.26	98.0	-1.10	84.6
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	71.7	-30.4	4.14	98.0	-0.71	74.7
Ashland	Mellen	47.7	-27.1	1.77	3.34	71.7	-30.4	4.35	98.0	-0.99	82.2
Douglas	Foxboro	48.3	-27.8	1.80	3.07	71.7	-30.4	4.28	98.0	-0.85	78.6
Iron	Gurney	47.3	-25.2	1.76	3.12	71.7	-30.4	4.37	98.0	-1.67	93.3
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	71.7	-30.4	4.22	98.0	-1.64	93.0
Douglas	Superior	44.2	-25.1	1.67	3.17	71.7	-30.4	4.60	98.0	-1.67	93.4
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	71.7	-30.4	4.29	98.0	-1.57	92.3
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	71.7	-30.4	4.45	98.0	-2.10	96.2
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	71.7	-30.4	4.32	98.0	-2.38	97.1

Table C17. Lower Layer Reliability Analysis for Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	60.0	-29.4	-3.06	0.1	-4.04	98.0
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	60.0	-29.4	-3.47	0.0	-3.60	98.0
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	60.0	-29.4	-3.04	0.1	-3.92	98.0
Rock	Afton	47.6	-16.4	1.29	3.92	60.0	-29.4	-3.09	0.1	-3.31	98.0
Green	Brodhead	47.9	-18.0	1.30	3.45	60.0	-29.4	-3.07	0.1	-3.30	98.0
Racine	Burlington	46.3	-16.2	1.26	3.34	60.0	-29.4	-3.17	0.1	-3.96	98.0
Rock	Janesville	49.9	-16.7	1.36	3.12	60.0	-29.4	-2.94	0.2	-4.07	98.0
Lafayette	Darlington	47.7	-18.3	1.30	3.39	60.0	-29.4	-3.07	0.1	-3.27	97.9
Racine	Racine	43.6	-15.9	1.19	3.57	60.0	-29.4	-3.35	0.0	-3.79	98.0
Grant	Platteville	47.8	-17.9	1.31	3.28	60.0	-29.4	-3.04	0.1	-3.50	98.0
Grant	Lancaster	46.8	-18.2	1.30	3.23	60.0	-29.4	-3.09	0.1	-3.47	98.0
Walworth	Whitewater	48.0	-16.8	1.33	3.39	60.0	-29.4	-3.00	0.1	-3.71	98.0
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	60.0	-29.4	-3.02	0.1	-3.10	97.9
Dane	Stoughton	47.5	-17.4	1.33	3.34	60.0	-29.4	-3.02	0.1	-3.60	98.0
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	60.0	-29.4	-3.23	0.1	-3.98	98.0
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	60.0	-29.4	-3.08	0.1	-3.60	98.0
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	60.0	-29.4	-3.05	0.1	-3.86	98.0
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	60.0	-29.4	-3.06	0.1	-4.10	98.0
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	60.0	-29.4	-2.97	0.1	-3.00	97.9
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	60.0	-29.4	-2.84	0.2	-2.86	97.8
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	60.0	-29.4	-3.06	0.1	-3.28	97.9
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	60.0	-29.4	-2.92	0.2	-3.69	98.0
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	60.0	-29.4	-2.95	0.2	-4.04	98.0
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	60.0	-29.4	-3.02	0.1	-3.63	98.0
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	60.0	-29.4	-2.99	0.1	-3.42	98.0
Jefferson	Watertown	47.5	-17.4	1.36	3.51	60.0	-29.4	-2.95	0.2	-3.42	98.0
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	60.0	-29.4	-2.90	0.2	-3.03	97.9
Washington	Germantown	45.3	-17.7	1.30	3.57	60.0	-29.4	-3.08	0.1	-3.28	97.9
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	60.0	-29.4	-2.95	0.2	-3.33	98.0
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	60.0	-29.4	-2.98	0.1	-3.08	97.9
Richland	Richland Center	48.2	-19.9	1.39	3.74	60.0	-29.4	-2.87	0.2	-2.54	97.5
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	60.0	-29.4	-2.96	0.1	-3.39	98.0
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	60.0	-29.4	-3.30	0.0	-4.04	98.0
Washington	West Bend	45.4	-17.4	1.32	3.45	60.0	-29.4	-3.03	0.1	-3.48	98.0
Dodge	Horicon	46.4	-18.2	1.36	3.39	60.0	-29.4	-2.95	0.2	-3.30	98.0
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	60.0	-29.4	-2.89	0.2	-3.39	98.0
Sauk	Baraboo	46.6	-20.2	1.36	3.74	60.0	-29.4	-2.93	0.2	-2.46	97.3
Columbia	Portage	47.7	-18.6	1.40	3.57	60.0	-29.4	-2.85	0.2	-3.03	97.9
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	60.0	-29.4	-2.85	0.2	-2.86	97.8
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	60.0	-29.4	-2.87	0.2	-2.80	97.7
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	60.0	-29.4	-2.96	0.2	-2.51	97.4
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	60.0	-29.4	-2.94	0.2	-2.81	97.8
Green Lake	Dalton	47.3	-18.5	1.41	3.23	60.0	-29.4	-2.85	0.2	-3.38	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	60.0	-29.4	-2.85	0.2	-2.28	96.9
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	60.0	-29.4	-2.93	0.2	-3.63	98.0
Monroe	Cashton	45.8	-18.9	1.37	3.68	60.0	-29.4	-2.91	0.2	-2.85	97.8
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	60.0	-29.4	-3.04	0.1	-4.01	98.0
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	60.0	-29.4	-2.81	0.2	-2.59	97.5
Marquette	Montello	46.8	-19.5	1.41	3.45	60.0	-29.4	-2.85	0.2	-2.87	97.8
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	60.0	-29.4	-2.93	0.2	-3.51	98.0
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	60.0	-29.4	-2.75	0.3	-2.81	97.8
Monroe	Sparta	47.5	-21.3	1.45	3.74	60.0	-29.4	-2.77	0.3	-2.16	96.5
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	60.0	-29.4	-2.77	0.3	-2.51	97.4
Juneau	Necedah	48.1	-21.6	1.48	3.68	60.0	-29.4	-2.71	0.3	-2.12	96.3
Calumet	Chilton	46.5	-17.7	1.43	3.23	60.0	-29.4	-2.80	0.2	-3.63	98.0
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	60.0	-29.4	-2.85	0.2	-3.45	98.0
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	60.0	-29.4	-2.99	0.1	-3.90	98.0
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	60.0	-29.4	-2.74	0.3	-2.51	97.4
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	60.0	-29.4	-2.63	0.4	-1.82	94.6
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	60.0	-29.4	-3.27	0.1	-4.00	98.0
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	60.0	-29.4	-2.81	0.2	-2.52	97.4
Outagamie	Appleton	45.1	-17.7	1.41	3.07	60.0	-29.4	-2.84	0.2	-3.82	98.0
Trempealeau	Blair	46.5	-22.2	1.46	3.80	60.0	-29.4	-2.74	0.3	-1.89	95.1
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	60.0	-29.4	-2.71	0.3	-2.65	97.6
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	60.0	-29.4	-2.73	0.3	-3.24	97.9
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	60.0	-29.4	-2.82	0.2	-2.01	95.8
Waupaca	New London	47.0	-19.4	1.48	3.34	60.0	-29.4	-2.70	0.3	-3.00	97.9
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	60.0	-29.4	-2.75	0.3	-2.83	97.8
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	60.0	-29.4	-2.60	0.5	-1.57	92.3
Wood	Pittsville	46.6	-22.3	1.48	3.34	60.0	-29.4	-2.71	0.3	-2.13	96.4
Portage	Stevens Point	45.1	-19.8	1.44	3.28	60.0	-29.4	-2.78	0.3	-2.93	97.8
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	60.0	-29.4	-2.72	0.3	-2.02	95.9
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	60.0	-29.4	-2.64	0.4	-1.99	95.7
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	60.0	-29.4	-2.76	0.3	-2.90	97.8
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	60.0	-29.4	-2.72	0.3	-3.11	97.9
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	60.0	-29.4	-2.70	0.3	-2.76	97.7
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	60.0	-29.4	-2.65	0.4	-2.49	97.4
Marathon	Rosholt	45.4	-21.2	1.48	3.28	60.0	-29.4	-2.70	0.3	-2.50	97.4
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	60.0	-29.4	-2.63	0.4	-2.53	97.4
Dunn	Menomonie	47.8	-21.2	1.57	3.57	60.0	-29.4	-2.54	0.5	-2.30	96.9

Table C18. Lower Layer Reliability Analysis for Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	60.0	-35.4	-3.04	0.1	-4.69	98.0
Brown	Green Bay	44.8	-18.5	1.43	3.23	60.0	-35.4	-2.80	0.3	-5.24	98.0
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	60.0	-35.4	-2.67	0.4	-4.61	98.0
Shawano	Bowler	44.0	-20.9	1.45	3.45	60.0	-35.4	-2.77	0.3	-4.20	98.0
Pierce	River Falls	47.0	-20.7	1.54	3.39	60.0	-35.4	-2.59	0.5	-4.33	98.0
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	60.0	-35.4	-2.83	0.2	-5.39	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	60.0	-35.4	-2.74	0.3	-4.83	98.0
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	60.0	-35.4	-2.74	0.3	-4.66	98.0
Clark	Owen	43.3	-22.2	1.43	3.34	60.0	-35.4	-2.79	0.3	-3.96	98.0
Chippewa	Stanley	45.3	-21.7	1.50	3.34	60.0	-35.4	-2.67	0.4	-4.10	98.0
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	60.0	-35.4	-2.62	0.4	-3.84	98.0
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	60.0	-35.4	-2.56	0.5	-3.96	98.0
Marinette	Marinette	45.9	-17.9	1.54	3.17	60.0	-35.4	-2.60	0.5	-5.52	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	60.0	-35.4	-2.77	0.3	-4.12	98.0
Langlade	Antigo	43.9	-22.1	1.48	3.17	60.0	-35.4	-2.71	0.3	-4.19	98.0
Lincoln	Merrill	44.2	-22.3	1.49	3.57	60.0	-35.4	-2.69	0.4	-3.67	98.0
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	60.0	-35.4	-2.56	0.5	-3.18	97.9
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	60.0	-35.4	-2.58	0.5	-3.34	98.0
Polk	Amery	44.9	-22.5	1.53	3.74	60.0	-35.4	-2.62	0.4	-3.45	98.0
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	60.0	-35.4	-2.64	0.4	-4.37	98.0
Taylor	Jump River	44.3	-24.8	1.51	3.51	60.0	-35.4	-2.64	0.4	-3.02	97.9
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	60.0	-35.4	-2.63	0.4	-3.98	98.0
Door	Washington Island	39.6	-16.5	1.35	3.45	60.0	-35.4	-2.95	0.2	-5.48	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	60.0	-35.4	-2.50	0.6	-3.69	98.0
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	60.0	-35.4	-2.56	0.5	-3.78	98.0
Barron	Rice Lake	45.3	-23.1	1.56	3.63	60.0	-35.4	-2.56	0.5	-3.39	98.0
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	60.0	-35.4	-2.73	0.3	-2.96	97.8
Forest	Laona	41.2	-21.6	1.43	3.17	60.0	-35.4	-2.81	0.2	-4.35	98.0
Barron	Cumberland	46.0	-22.4	1.59	3.28	60.0	-35.4	-2.51	0.6	-3.96	98.0
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	60.0	-35.4	-2.57	0.5	-3.21	97.9
Polk	Luck	45.4	-22.7	1.58	3.39	60.0	-35.4	-2.54	0.5	-3.74	98.0
Marinette	Goodman	42.1	-20.8	1.47	3.12	60.0	-35.4	-2.72	0.3	-4.68	98.0
Oneida	North Pelican	41.5	-23.7	1.45	3.28	60.0	-35.4	-2.76	0.3	-3.57	98.0
Oneida	Rhineland	43.2	-22.5	1.51	3.07	60.0	-35.4	-2.65	0.4	-4.21	98.0
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	60.0	-35.4	-2.73	0.3	-3.66	98.0
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	60.0	-35.4	-2.53	0.6	-3.39	98.0
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	60.0	-35.4	-2.62	0.4	-3.66	98.0
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	60.0	-35.4	-2.47	0.7	-3.59	98.0
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	60.0	-35.4	-2.69	0.3	-3.81	98.0
Sawyer	Couderay	44.6	-26.0	1.59	4.17	60.0	-35.4	-2.52	0.6	-2.25	96.8
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	60.0	-35.4	-2.67	0.4	-3.65	98.0
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	60.0	-35.4	-2.68	0.4	-3.69	98.0
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	60.0	-35.4	-2.62	0.4	-3.88	98.0
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	60.0	-35.4	-2.79	0.3	-3.81	98.0
Price	Park Falls	41.9	-21.8	1.50	3.17	60.0	-35.4	-2.67	0.4	-4.29	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	60.0	-35.4	-2.55	0.5	-3.41	98.0
Burnett	Danbury	44.6	-24.6	1.60	3.23	60.0	-35.4	-2.49	0.6	-3.35	98.0
Washburn	Minong 2	44.8	-26.2	1.62	3.12	60.0	-35.4	-2.47	0.7	-2.95	97.8
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	60.0	-35.4	-2.58	0.5	-3.57	98.0
Douglas	Gordon	44.4	-26.4	1.63	3.17	60.0	-35.4	-2.46	0.7	-2.84	97.8
Bayfield	Drummond	44.2	-23.8	1.63	3.28	60.0	-35.4	-2.46	0.7	-3.53	98.0
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	60.0	-35.4	-2.38	0.8	-3.19	97.9
Ashland	Mellen	42.8	-24.1	1.59	3.34	60.0	-35.4	-2.52	0.6	-3.39	98.0
Douglas	Foxboro	43.4	-24.8	1.62	3.07	60.0	-35.4	-2.47	0.7	-3.46	98.0
Iron	Gurney	42.4	-22.2	1.58	3.12	60.0	-35.4	-2.53	0.6	-4.23	98.0
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	60.0	-35.4	-2.44	0.7	-4.16	98.0
Douglas	Superior	39.3	-22.1	1.49	3.17	60.0	-35.4	-2.69	0.4	-4.19	98.0
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	60.0	-35.4	-2.48	0.6	-4.14	98.0
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	60.0	-35.4	-2.59	0.5	-4.30	98.0
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	60.0	-35.4	-2.25	1.2	-4.81	98.0

Table C19. Lower Layer Reliability Analysis for 40 % RAP, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	67.9	-25.9	2.98	97.9	-3.00	97.9
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	67.9	-25.9	3.38	98.0	-2.69	97.7
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	67.9	-25.9	2.96	97.9	-2.89	97.8
Rock	Afton	47.6	-16.4	1.29	3.92	67.9	-25.9	3.01	97.9	-2.42	97.2
Green	Brodhead	47.9	-18.0	1.30	3.45	67.9	-25.9	3.00	97.9	-2.29	96.9
Racine	Burlington	46.3	-16.2	1.26	3.34	67.9	-25.9	3.09	97.9	-2.91	97.8
Rock	Janesville	49.9	-16.7	1.36	3.12	67.9	-25.9	2.86	97.8	-2.95	97.8
Lafayette	Darlington	47.7	-18.3	1.30	3.39	67.9	-25.9	2.99	97.9	-2.24	96.8
Racine	Racine	43.6	-15.9	1.19	3.57	67.9	-25.9	3.27	97.9	-2.80	97.8
Grant	Platteville	47.8	-17.9	1.31	3.28	67.9	-25.9	2.97	97.9	-2.44	97.3
Grant	Lancaster	46.8	-18.2	1.30	3.23	67.9	-25.9	3.01	97.9	-2.39	97.2
Walworth	Whitewater	48.0	-16.8	1.33	3.39	67.9	-25.9	2.93	97.8	-2.68	97.6
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	67.9	-25.9	2.94	97.8	-2.16	96.5
Dane	Stoughton	47.5	-17.4	1.33	3.34	67.9	-25.9	2.94	97.8	-2.55	97.5
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	67.9	-25.9	3.15	97.9	-3.00	97.9
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	67.9	-25.9	3.01	97.9	-2.51	97.4
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	67.9	-25.9	2.97	97.9	-2.83	97.8
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	67.9	-25.9	2.98	97.9	-3.06	97.9
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	67.9	-25.9	2.90	97.8	-2.02	95.9
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	67.9	-25.9	2.77	97.7	-1.92	95.3
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	67.9	-25.9	2.98	97.9	-2.30	96.9
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	67.9	-25.9	2.85	97.8	-2.60	97.5
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	67.9	-25.9	2.87	97.8	-3.01	97.9
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	67.9	-25.9	2.94	97.8	-2.58	97.5
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	67.9	-25.9	2.91	97.8	-2.41	97.2
Jefferson	Watertown	47.5	-17.4	1.36	3.51	67.9	-25.9	2.88	97.8	-2.42	97.2
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	67.9	-25.9	2.82	97.8	-2.05	96.0
Washington	Germantown	45.3	-17.7	1.30	3.57	67.9	-25.9	3.01	97.9	-2.30	96.9
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	67.9	-25.9	2.88	97.8	-2.28	96.9
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	67.9	-25.9	2.91	97.8	-2.08	96.2
Richland	Richland Center	48.2	-19.9	1.39	3.74	67.9	-25.9	2.80	97.8	-1.60	92.7
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	67.9	-25.9	2.89	97.8	-2.34	97.0
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	67.9	-25.9	3.22	97.9	-3.00	97.9
Washington	West Bend	45.4	-17.4	1.32	3.45	67.9	-25.9	2.95	97.8	-2.46	97.3
Dodge	Horicon	46.4	-18.2	1.36	3.39	67.9	-25.9	2.88	97.8	-2.27	96.9
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	67.9	-25.9	2.82	97.8	-2.38	97.1
Sauk	Baraboo	46.6	-20.2	1.36	3.74	67.9	-25.9	2.86	97.8	-1.52	91.7
Columbia	Portage	47.7	-18.6	1.40	3.57	67.9	-25.9	2.78	97.7	-2.05	96.0
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	67.9	-25.9	2.78	97.7	-1.83	94.7
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	67.9	-25.9	2.79	97.7	-1.85	94.8
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	67.9	-25.9	2.89	97.8	-1.54	92.0
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	67.9	-25.9	2.87	97.8	-1.85	94.8
Green Lake	Dalton	47.3	-18.5	1.41	3.23	67.9	-25.9	2.77	97.7	-2.29	96.9

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	67.9	-25.9	2.78	97.7	-1.37	89.7
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	67.9	-25.9	2.85	97.8	-2.58	97.5
Monroe	Cashton	45.8	-18.9	1.37	3.68	67.9	-25.9	2.84	97.8	-1.90	95.2
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	67.9	-25.9	2.96	97.9	-2.97	97.9
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	67.9	-25.9	2.74	97.7	-1.63	92.9
Marquette	Montello	46.8	-19.5	1.41	3.45	67.9	-25.9	2.77	97.7	-1.85	94.9
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	67.9	-25.9	2.85	97.8	-2.48	97.3
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	67.9	-25.9	2.68	97.6	-1.85	94.8
Monroe	Sparta	47.5	-21.3	1.45	3.74	67.9	-25.9	2.70	97.7	-1.23	87.3
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	67.9	-25.9	2.70	97.7	-1.54	92.0
Juneau	Necedah	48.1	-21.6	1.48	3.68	67.9	-25.9	2.64	97.6	-1.17	86.1
Calumet	Chilton	46.5	-17.7	1.43	3.23	67.9	-25.9	2.73	97.7	-2.54	97.5
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	67.9	-25.9	2.78	97.7	-2.40	97.2
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	67.9	-25.9	2.92	97.8	-2.82	97.8
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	67.9	-25.9	2.67	97.6	-1.51	91.6
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	67.9	-25.9	2.57	97.5	-0.87	79.1
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	67.9	-25.9	3.19	97.9	-2.90	97.8
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	67.9	-25.9	2.74	97.7	-1.54	92.0
Outagamie	Appleton	45.1	-17.7	1.41	3.07	67.9	-25.9	2.77	97.7	-2.67	97.6
Trempealeau	Blair	46.5	-22.2	1.46	3.80	67.9	-25.9	2.67	97.6	-0.97	81.8
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	67.9	-25.9	2.64	97.6	-1.68	93.5
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	67.9	-25.9	2.66	97.6	-2.19	96.6
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	67.9	-25.9	2.75	97.7	-0.96	81.5
Waupaca	New London	47.0	-19.4	1.48	3.34	67.9	-25.9	2.63	97.6	-1.95	95.5
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	67.9	-25.9	2.68	97.6	-1.77	94.2
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	67.9	-25.9	2.54	97.5	-0.59	70.8
Wood	Pittsville	46.6	-22.3	1.48	3.34	67.9	-25.9	2.64	97.6	-1.08	84.2
Portage	Stevens Point	45.1	-19.8	1.44	3.28	67.9	-25.9	2.71	97.7	-1.86	94.9
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	67.9	-25.9	2.65	97.6	-1.04	83.3
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	67.9	-25.9	2.58	97.5	-1.09	84.4
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	67.9	-25.9	2.69	97.6	-1.80	94.5
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	67.9	-25.9	2.66	97.6	-2.04	96.0
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	67.9	-25.9	2.63	97.6	-1.67	93.4
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	67.9	-25.9	2.58	97.5	-1.44	90.6
Marathon	Rosholt	45.4	-21.2	1.48	3.28	67.9	-25.9	2.64	97.6	-1.43	90.5
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	67.9	-25.9	2.56	97.5	-1.50	91.5
Dunn	Menomonie	47.8	-21.2	1.57	3.57	67.9	-25.9	2.48	97.4	-1.32	88.8

Table C20. Lower Layer Reliability Analysis for 40 % RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	67.9	-29.5	2.96	97.8	-3.21	97.9
Brown	Green Bay	44.8	-18.5	1.43	3.23	67.9	-29.5	2.73	97.7	-3.41	98.0
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	67.9	-29.5	2.61	97.6	-2.85	97.8
Shawano	Bowler	44.0	-20.9	1.45	3.45	67.9	-29.5	2.70	97.7	-2.49	97.4
Pierce	River Falls	47.0	-20.7	1.54	3.39	67.9	-29.5	2.53	97.4	-2.59	97.5
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	67.9	-29.5	2.76	97.7	-3.63	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	67.9	-29.5	2.67	97.6	-3.09	97.9
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	67.9	-29.5	2.67	97.6	-2.86	97.8
Clark	Owen	43.3	-22.2	1.43	3.34	67.9	-29.5	2.72	97.7	-2.19	96.6
Chippewa	Stanley	45.3	-21.7	1.50	3.34	67.9	-29.5	2.60	97.5	-2.34	97.0
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	67.9	-29.5	2.55	97.5	-2.19	96.6
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	67.9	-29.5	2.50	97.4	-2.28	96.9
Marinette	Marinette	45.9	-17.9	1.54	3.17	67.9	-29.5	2.54	97.5	-3.66	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	67.9	-29.5	2.70	97.7	-2.29	96.9
Langlade	Antigo	43.9	-22.1	1.48	3.17	67.9	-29.5	2.64	97.6	-2.33	97.0
Lincoln	Merrill	44.2	-22.3	1.49	3.57	67.9	-29.5	2.62	97.6	-2.02	95.9
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	67.9	-29.5	2.49	97.4	-1.63	92.9
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	67.9	-29.5	2.52	97.4	-1.68	93.5
Polk	Amery	44.9	-22.5	1.53	3.74	67.9	-29.5	2.55	97.5	-1.87	95.0
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	67.9	-29.5	2.57	97.5	-2.54	97.5
Taylor	Jump River	44.3	-24.8	1.51	3.51	67.9	-29.5	2.57	97.5	-1.34	89.2
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	67.9	-29.5	2.56	97.5	-2.33	97.0
Door	Washington Island	39.6	-16.5	1.35	3.45	67.9	-29.5	2.88	97.8	-3.77	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	67.9	-29.5	2.43	97.3	-1.89	95.1
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	67.9	-29.5	2.50	97.4	-1.95	95.5
Barron	Rice Lake	45.3	-23.1	1.56	3.63	67.9	-29.5	2.49	97.4	-1.77	94.2
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	67.9	-29.5	2.66	97.6	-1.25	87.6
Forest	Laona	41.2	-21.6	1.43	3.17	67.9	-29.5	2.74	97.7	-2.49	97.4
Barron	Cumberland	46.0	-22.4	1.59	3.28	67.9	-29.5	2.45	97.3	-2.16	96.5
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	67.9	-29.5	2.50	97.4	-1.47	91.1
Polk	Luck	45.4	-22.7	1.58	3.39	67.9	-29.5	2.47	97.3	-2.00	95.8
Marinette	Goodman	42.1	-20.8	1.47	3.12	67.9	-29.5	2.66	97.6	-2.79	97.7
Oneida	North Pelican	41.5	-23.7	1.45	3.28	67.9	-29.5	2.69	97.7	-1.77	94.2
Oneida	Rhineland	43.2	-22.5	1.51	3.07	67.9	-29.5	2.59	97.5	-2.28	96.9
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	67.9	-29.5	2.66	97.6	-1.83	94.7
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	67.9	-29.5	2.47	97.3	-1.68	93.5
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	67.9	-29.5	2.55	97.5	-1.83	94.7
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	67.9	-29.5	2.41	97.2	-1.73	93.9
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	67.9	-29.5	2.63	97.6	-1.98	95.7
Sawyer	Couderay	44.6	-26.0	1.59	4.17	67.9	-29.5	2.46	97.3	-0.84	78.3
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	67.9	-29.5	2.60	97.5	-1.92	95.3
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	67.9	-29.5	2.61	97.6	-1.76	94.2
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	67.9	-29.5	2.56	97.5	-1.92	95.3
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	67.9	-29.5	2.72	97.7	-1.98	95.7
Price	Park Falls	41.9	-21.8	1.50	3.17	67.9	-29.5	2.61	97.6	-2.43	97.3

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	67.9	-29.5	2.49	97.4	-1.61	92.8
Burnett	Danbury	44.6	-24.6	1.60	3.23	67.9	-29.5	2.43	97.3	-1.52	91.7
Washburn	Minong 2	44.8	-26.2	1.62	3.12	67.9	-29.5	2.41	97.2	-1.06	83.8
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	67.9	-29.5	2.52	97.4	-1.77	94.2
Douglas	Gordon	44.4	-26.4	1.63	3.17	67.9	-29.5	2.40	97.2	-0.98	81.9
Bayfield	Drummond	44.2	-23.8	1.63	3.28	67.9	-29.5	2.40	97.2	-1.74	94.0
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	67.9	-29.5	2.32	97.0	-1.36	89.5
Ashland	Mellen	42.8	-24.1	1.59	3.34	67.9	-29.5	2.46	97.3	-1.62	92.8
Douglas	Foxboro	43.4	-24.8	1.62	3.07	67.9	-29.5	2.41	97.2	-1.53	91.9
Iron	Gurney	42.4	-22.2	1.58	3.12	67.9	-29.5	2.47	97.3	-2.34	97.1
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	67.9	-29.5	2.37	97.1	-2.30	97.0
Douglas	Superior	39.3	-22.1	1.49	3.17	67.9	-29.5	2.62	97.6	-2.33	97.0
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	67.9	-29.5	2.42	97.2	-2.24	96.8
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	67.9	-29.5	2.53	97.4	-2.68	97.6
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	67.9	-29.5	2.19	96.6	-3.02	97.9

Table C21. Lower Layer Reliability Analysis for 25 % RAS, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	71.1	-23.8	5.43	98.0	-2.37	97.1
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	71.1	-23.8	6.16	98.0	-2.15	96.4
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	71.1	-23.8	5.40	98.0	-2.27	96.9
Rock	Afton	47.6	-16.4	1.29	3.92	71.1	-23.8	5.49	98.0	-1.89	95.1
Green	Brodhead	47.9	-18.0	1.30	3.45	71.1	-23.8	5.45	98.0	-1.68	93.5
Racine	Burlington	46.3	-16.2	1.26	3.34	71.1	-23.8	5.63	98.0	-2.28	96.9
Rock	Janesville	49.9	-16.7	1.36	3.12	71.1	-23.8	5.21	98.0	-2.28	96.9
Lafayette	Darlington	47.7	-18.3	1.30	3.39	71.1	-23.8	5.45	98.0	-1.62	92.8
Racine	Racine	43.6	-15.9	1.19	3.57	71.1	-23.8	5.95	98.0	-2.22	96.7
Grant	Platteville	47.8	-17.9	1.31	3.28	71.1	-23.8	5.40	98.0	-1.80	94.5
Grant	Lancaster	46.8	-18.2	1.30	3.23	71.1	-23.8	5.48	98.0	-1.74	94.0
Walworth	Whitewater	48.0	-16.8	1.33	3.39	71.1	-23.8	5.33	98.0	-2.06	96.1
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	71.1	-23.8	5.35	98.0	-1.60	92.7
Dane	Stoughton	47.5	-17.4	1.33	3.34	71.1	-23.8	5.36	98.0	-1.92	95.3
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	71.1	-23.8	5.73	98.0	-2.41	97.2
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	71.1	-23.8	5.47	98.0	-1.86	94.9
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	71.1	-23.8	5.41	98.0	-2.21	96.7
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	71.1	-23.8	5.42	98.0	-2.43	97.3
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	71.1	-23.8	5.27	98.0	-1.43	90.5
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	71.1	-23.8	5.05	98.0	-1.36	89.5
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	71.1	-23.8	5.43	98.0	-1.71	93.7
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	71.1	-23.8	5.19	98.0	-1.95	95.5
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	71.1	-23.8	5.23	98.0	-2.39	97.2
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	71.1	-23.8	5.35	98.0	-1.95	95.5
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	71.1	-23.8	5.30	98.0	-1.80	94.5
Jefferson	Watertown	47.5	-17.4	1.36	3.51	71.1	-23.8	5.24	98.0	-1.82	94.7
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	71.1	-23.8	5.14	98.0	-1.46	90.9
Washington	Germantown	45.3	-17.7	1.30	3.57	71.1	-23.8	5.47	98.0	-1.71	93.7
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	71.1	-23.8	5.24	98.0	-1.65	93.1
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	71.1	-23.8	5.30	98.0	-1.48	91.2
Richland	Richland Center	48.2	-19.9	1.39	3.74	71.1	-23.8	5.10	98.0	-1.04	83.4
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	71.1	-23.8	5.26	98.0	-1.71	93.7
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	71.1	-23.8	5.86	98.0	-2.37	97.1
Washington	West Bend	45.4	-17.4	1.32	3.45	71.1	-23.8	5.38	98.0	-1.85	94.9
Dodge	Horicon	46.4	-18.2	1.36	3.39	71.1	-23.8	5.24	98.0	-1.65	93.2
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	71.1	-23.8	5.13	98.0	-1.77	94.2
Sauk	Baraboo	46.6	-20.2	1.36	3.74	71.1	-23.8	5.21	98.0	-0.96	81.5
Columbia	Portage	47.7	-18.6	1.40	3.57	71.1	-23.8	5.06	98.0	-1.46	90.9
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	71.1	-23.8	5.06	98.0	-1.21	86.9
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	71.1	-23.8	5.09	98.0	-1.28	88.1
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	71.1	-23.8	5.25	98.0	-0.97	81.6
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	71.1	-23.8	5.22	98.0	-1.27	88.0
Green Lake	Dalton	47.3	-18.5	1.41	3.23	71.1	-23.8	5.05	98.0	-1.64	93.1

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	71.1	-23.8	5.06	98.0	-0.83	78.0
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	71.1	-23.8	5.19	98.0	-1.95	95.5
Monroe	Cashton	45.8	-18.9	1.37	3.68	71.1	-23.8	5.17	98.0	-1.33	89.0
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	71.1	-23.8	5.40	98.0	-2.34	97.0
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	71.1	-23.8	5.00	98.0	-1.05	83.6
Marquette	Montello	46.8	-19.5	1.41	3.45	71.1	-23.8	5.05	98.0	-1.25	87.6
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	71.1	-23.8	5.20	98.0	-1.86	94.9
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	71.1	-23.8	4.89	98.0	-1.27	88.0
Monroe	Sparta	47.5	-21.3	1.45	3.74	71.1	-23.8	4.91	98.0	-0.67	73.3
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	71.1	-23.8	4.92	98.0	-0.97	81.6
Juneau	Necedah	48.1	-21.6	1.48	3.68	71.1	-23.8	4.81	98.0	-0.60	71.0
Calumet	Chilton	46.5	-17.7	1.43	3.23	71.1	-23.8	4.98	98.0	-1.89	95.1
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	71.1	-23.8	5.06	98.0	-1.77	94.2
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	71.1	-23.8	5.31	98.0	-2.17	96.5
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	71.1	-23.8	4.87	98.0	-0.91	80.3
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	71.1	-23.8	4.67	98.0	-0.30	60.5
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	71.1	-23.8	5.80	98.0	-2.24	96.8
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	71.1	-23.8	4.99	98.0	-0.95	81.3
Outagamie	Appleton	45.1	-17.7	1.41	3.07	71.1	-23.8	5.04	98.0	-1.99	95.7
Trempealeau	Blair	46.5	-22.2	1.46	3.80	71.1	-23.8	4.87	98.0	-0.42	65.0
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	71.1	-23.8	4.80	98.0	-1.10	84.8
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	71.1	-23.8	4.85	98.0	-1.56	92.2
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	71.1	-23.8	5.00	98.0	-0.33	61.7
Waupaca	New London	47.0	-19.4	1.48	3.34	71.1	-23.8	4.79	98.0	-1.32	88.8
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	71.1	-23.8	4.88	98.0	-1.13	85.3
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	71.1	-23.8	4.62	98.0	0.00	49.0
Wood	Pittsville	46.6	-22.3	1.48	3.34	71.1	-23.8	4.81	98.0	-0.45	66.0
Portage	Stevens Point	45.1	-19.8	1.44	3.28	71.1	-23.8	4.94	98.0	-1.22	87.1
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	71.1	-23.8	4.83	98.0	-0.45	66.0
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	71.1	-23.8	4.69	98.0	-0.54	69.2
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	71.1	-23.8	4.90	98.0	-1.13	85.4
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	71.1	-23.8	4.84	98.0	-1.40	90.1
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	71.1	-23.8	4.79	98.0	-1.02	83.0
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	71.1	-23.8	4.70	98.0	-0.81	77.5
Marathon	Rosholt	45.4	-21.2	1.48	3.28	71.1	-23.8	4.80	98.0	-0.79	77.0
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	71.1	-23.8	4.67	98.0	-0.88	79.5
Dunn	Menomonie	47.8	-21.2	1.57	3.57	71.1	-23.8	4.52	98.0	-0.73	75.2

Table C22. Lower Layer Reliability Analysis for 25 % RAS, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	73.4	-27.3	7.14	98.0	-2.66	97.6
Brown	Green Bay	44.8	-18.5	1.43	3.23	73.4	-27.3	6.58	98.0	-2.73	97.7
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	73.4	-27.3	6.28	98.0	-2.19	96.6
Shawano	Bowler	44.0	-20.9	1.45	3.45	73.4	-27.3	6.50	98.0	-1.85	94.9
Pierce	River Falls	47.0	-20.7	1.54	3.39	73.4	-27.3	6.09	98.0	-1.94	95.5
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	73.4	-27.3	6.65	98.0	-2.97	97.9
Oconto	Oconto	44.3	-19.0	1.46	3.39	73.4	-27.3	6.44	98.0	-2.45	97.3
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	73.4	-27.3	6.45	98.0	-2.19	96.6
Clark	Owen	43.3	-22.2	1.43	3.34	73.4	-27.3	6.56	98.0	-1.53	91.8
Chippewa	Stanley	45.3	-21.7	1.50	3.34	73.4	-27.3	6.26	98.0	-1.68	93.4
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	73.4	-27.3	6.15	98.0	-1.57	92.3
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	73.4	-27.3	6.03	98.0	-1.65	93.2
Marinette	Marinette	45.9	-17.9	1.54	3.17	73.4	-27.3	6.12	98.0	-2.96	97.9
Taylor	Medford	43.0	-22.1	1.44	3.23	73.4	-27.3	6.52	98.0	-1.61	92.8
Langlade	Antigo	43.9	-22.1	1.48	3.17	73.4	-27.3	6.37	98.0	-1.64	93.0
Lincoln	Merrill	44.2	-22.3	1.49	3.57	73.4	-27.3	6.31	98.0	-1.40	90.1
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	73.4	-27.3	6.01	98.0	-1.05	83.6
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	73.4	-27.3	6.07	98.0	-1.07	84.0
Polk	Amery	44.9	-22.5	1.53	3.74	73.4	-27.3	6.16	98.0	-1.28	88.2
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	73.4	-27.3	6.20	98.0	-1.86	94.9
Taylor	Jump River	44.3	-24.8	1.51	3.51	73.4	-27.3	6.21	98.0	-0.71	74.7
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	73.4	-27.3	6.18	98.0	-1.71	93.7
Door	Washington Island	39.6	-16.5	1.35	3.45	73.4	-27.3	6.94	98.0	-3.13	97.9
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	73.4	-27.3	5.86	98.0	-1.22	87.1
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	73.4	-27.3	6.02	98.0	-1.27	88.0
Barron	Rice Lake	45.3	-23.1	1.56	3.63	73.4	-27.3	6.01	98.0	-1.16	85.9
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	73.4	-27.3	6.41	98.0	-0.61	71.4
Forest	Laona	41.2	-21.6	1.43	3.17	73.4	-27.3	6.59	98.0	-1.80	94.5
Barron	Cumberland	46.0	-22.4	1.59	3.28	73.4	-27.3	5.90	98.0	-1.49	91.4
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	73.4	-27.3	6.04	98.0	-0.83	77.9
Polk	Luck	45.4	-22.7	1.58	3.39	73.4	-27.3	5.96	98.0	-1.36	89.4
Marinette	Goodman	42.1	-20.8	1.47	3.12	73.4	-27.3	6.40	98.0	-2.08	96.2
Oneida	North Pelican	41.5	-23.7	1.45	3.28	73.4	-27.3	6.49	98.0	-1.10	84.6
Oneida	Rhineland	43.2	-22.5	1.51	3.07	73.4	-27.3	6.24	98.0	-1.57	92.2
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	73.4	-27.3	6.41	98.0	-1.15	85.7
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	73.4	-27.3	5.94	98.0	-1.04	83.5
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	73.4	-27.3	6.15	98.0	-1.15	85.7
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	73.4	-27.3	5.81	98.0	-1.04	83.4
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	73.4	-27.3	6.33	98.0	-1.30	88.5
Sawyer	Couderay	44.6	-26.0	1.59	4.17	73.4	-27.3	5.93	98.0	-0.31	61.0
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	73.4	-27.3	6.28	98.0	-1.27	87.9
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	73.4	-27.3	6.29	98.0	-1.04	83.5
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	73.4	-27.3	6.16	98.0	-1.19	86.6
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	73.4	-27.3	6.55	98.0	-1.30	88.5
Price	Park Falls	41.9	-21.8	1.50	3.17	73.4	-27.3	6.28	98.0	-1.73	93.9

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	73.4	-27.3	6.00	98.0	-0.94	81.1
Burnett	Danbury	44.6	-24.6	1.60	3.23	73.4	-27.3	5.86	98.0	-0.84	78.3
Washburn	Minong 2	44.8	-26.2	1.62	3.12	73.4	-27.3	5.81	98.0	-0.35	62.5
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	73.4	-27.3	6.07	98.0	-1.10	84.6
Douglas	Gordon	44.4	-26.4	1.63	3.17	73.4	-27.3	5.78	98.0	-0.28	59.9
Bayfield	Drummond	44.2	-23.8	1.63	3.28	73.4	-27.3	5.77	98.0	-1.07	84.0
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	73.4	-27.3	5.60	98.0	-0.68	73.7
Ashland	Mellen	42.8	-24.1	1.59	3.34	73.4	-27.3	5.92	98.0	-0.96	81.5
Douglas	Foxboro	43.4	-24.8	1.62	3.07	73.4	-27.3	5.81	98.0	-0.82	77.7
Iron	Gurney	42.4	-22.2	1.58	3.12	73.4	-27.3	5.95	98.0	-1.64	93.0
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	73.4	-27.3	5.72	98.0	-1.61	92.7
Douglas	Superior	39.3	-22.1	1.49	3.17	73.4	-27.3	6.32	98.0	-1.64	93.0
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	73.4	-27.3	5.84	98.0	-1.54	91.9
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	73.4	-27.3	6.09	98.0	-2.07	96.1
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	73.4	-27.3	5.28	98.0	-2.35	97.1

Table C23. Lower Layer Reliability Analysis for 21 % RAS and 14% RAP, Mid Grade Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	72.5	-23.6	6.50	98.0	-2.31	97.0
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	72.5	-23.6	7.37	98.0	-2.10	96.2
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	72.5	-23.6	6.46	98.0	-2.21	96.7
Rock	Afton	47.6	-16.4	1.29	3.92	72.5	-23.6	6.57	98.0	-1.83	94.7
Green	Brodhead	47.9	-18.0	1.30	3.45	72.5	-23.6	6.53	98.0	-1.62	92.9
Racine	Burlington	46.3	-16.2	1.26	3.34	72.5	-23.6	6.74	98.0	-2.22	96.7
Rock	Janesville	49.9	-16.7	1.36	3.12	72.5	-23.6	6.24	98.0	-2.21	96.7
Lafayette	Darlington	47.7	-18.3	1.30	3.39	72.5	-23.6	6.52	98.0	-1.56	92.2
Racine	Racine	43.6	-15.9	1.19	3.57	72.5	-23.6	7.12	98.0	-2.16	96.5
Grant	Platteville	47.8	-17.9	1.31	3.28	72.5	-23.6	6.47	98.0	-1.74	94.0
Grant	Lancaster	46.8	-18.2	1.30	3.23	72.5	-23.6	6.56	98.0	-1.67	93.4
Walworth	Whitewater	48.0	-16.8	1.33	3.39	72.5	-23.6	6.38	98.0	-2.00	95.8
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	72.5	-23.6	6.41	98.0	-1.55	92.1
Dane	Stoughton	47.5	-17.4	1.33	3.34	72.5	-23.6	6.41	98.0	-1.86	94.9
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	72.5	-23.6	6.86	98.0	-2.36	97.1
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	72.5	-23.6	6.55	98.0	-1.80	94.5
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	72.5	-23.6	6.48	98.0	-2.15	96.5
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	72.5	-23.6	6.49	98.0	-2.37	97.1
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	72.5	-23.6	6.31	98.0	-1.37	89.7
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	72.5	-23.6	6.05	98.0	-1.31	88.7
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	72.5	-23.6	6.50	98.0	-1.65	93.2
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	72.5	-23.6	6.21	98.0	-1.89	95.1
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	72.5	-23.6	6.26	98.0	-2.33	97.0
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	72.5	-23.6	6.41	98.0	-1.89	95.1
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	72.5	-23.6	6.35	98.0	-1.74	94.0
Jefferson	Watertown	47.5	-17.4	1.36	3.51	72.5	-23.6	6.27	98.0	-1.77	94.2
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	72.5	-23.6	6.16	98.0	-1.40	90.1
Washington	Germantown	45.3	-17.7	1.30	3.57	72.5	-23.6	6.55	98.0	-1.65	93.2
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	72.5	-23.6	6.27	98.0	-1.59	92.5
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	72.5	-23.6	6.34	98.0	-1.43	90.4
Richland	Richland Center	48.2	-19.9	1.39	3.74	72.5	-23.6	6.10	98.0	-0.99	82.2
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	72.5	-23.6	6.30	98.0	-1.65	93.1
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	72.5	-23.6	7.02	98.0	-2.31	97.0
Washington	West Bend	45.4	-17.4	1.32	3.45	72.5	-23.6	6.44	98.0	-1.80	94.5
Dodge	Horicon	46.4	-18.2	1.36	3.39	72.5	-23.6	6.27	98.0	-1.59	92.5
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	72.5	-23.6	6.14	98.0	-1.71	93.7
Sauk	Baraboo	46.6	-20.2	1.36	3.74	72.5	-23.6	6.23	98.0	-0.91	80.2
Columbia	Portage	47.7	-18.6	1.40	3.57	72.5	-23.6	6.06	98.0	-1.40	90.1
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	72.5	-23.6	6.06	98.0	-1.15	85.7
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	72.5	-23.6	6.09	98.0	-1.22	87.1
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	72.5	-23.6	6.29	98.0	-0.91	80.2
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	72.5	-23.6	6.25	98.0	-1.21	87.0
Green Lake	Dalton	47.3	-18.5	1.41	3.23	72.5	-23.6	6.05	98.0	-1.58	92.4
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	72.5	-23.6	6.06	98.0	-0.78	76.6

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	72.5	-23.6	6.22	98.0	-1.89	95.1
Monroe	Cashton	45.8	-18.9	1.37	3.68	72.5	-23.6	6.19	98.0	-1.28	88.1
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	72.5	-23.6	6.46	98.0	-2.28	96.9
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	72.5	-23.6	5.98	98.0	-0.99	82.3
Marquette	Montello	46.8	-19.5	1.41	3.45	72.5	-23.6	6.05	98.0	-1.19	86.5
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	72.5	-23.6	6.22	98.0	-1.80	94.5
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	72.5	-23.6	5.85	98.0	-1.21	87.0
Monroe	Sparta	47.5	-21.3	1.45	3.74	72.5	-23.6	5.88	98.0	-0.61	71.6
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	72.5	-23.6	5.89	98.0	-0.91	80.2
Juneau	Necedah	48.1	-21.6	1.48	3.68	72.5	-23.6	5.76	98.0	-0.54	69.2
Calumet	Chilton	46.5	-17.7	1.43	3.23	72.5	-23.6	5.96	98.0	-1.83	94.7
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	72.5	-23.6	6.06	98.0	-1.71	93.7
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	72.5	-23.6	6.36	98.0	-2.11	96.3
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	72.5	-23.6	5.83	98.0	-0.86	78.8
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	72.5	-23.6	5.60	98.0	-0.24	58.5
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	72.5	-23.6	6.95	98.0	-2.18	96.5
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	72.5	-23.6	5.98	98.0	-0.90	79.9
Outagamie	Appleton	45.1	-17.7	1.41	3.07	72.5	-23.6	6.03	98.0	-1.92	95.3
Trempealeau	Blair	46.5	-22.2	1.46	3.80	72.5	-23.6	5.83	98.0	-0.37	63.1
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	72.5	-23.6	5.75	98.0	-1.05	83.6
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	72.5	-23.6	5.80	98.0	-1.50	91.4
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	72.5	-23.6	5.99	98.0	-0.27	59.4
Waupaca	New London	47.0	-19.4	1.48	3.34	72.5	-23.6	5.73	98.0	-1.26	87.8
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	72.5	-23.6	5.84	98.0	-1.07	84.0
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	72.5	-23.6	5.53	98.0	0.06	46.8
Wood	Pittsville	46.6	-22.3	1.48	3.34	72.5	-23.6	5.75	98.0	-0.39	63.9
Portage	Stevens Point	45.1	-19.8	1.44	3.28	72.5	-23.6	5.91	98.0	-1.16	85.9
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	72.5	-23.6	5.78	98.0	-0.39	64.0
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	72.5	-23.6	5.62	98.0	-0.49	67.5
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	72.5	-23.6	5.86	98.0	-1.07	84.1
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	72.5	-23.6	5.79	98.0	-1.34	89.2
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	72.5	-23.6	5.74	98.0	-0.96	81.5
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	72.5	-23.6	5.63	98.0	-0.75	75.8
Marathon	Rosholt	45.4	-21.2	1.48	3.28	72.5	-23.6	5.74	98.0	-0.73	75.2
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	72.5	-23.6	5.59	98.0	-0.83	77.9
Dunn	Menomonie	47.8	-21.2	1.57	3.57	72.5	-23.6	5.41	98.0	-0.67	73.5

Table C24. Lower Layer Reliability Analysis for 21 % RAS and 14 % RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	74.4	-26.7	7.90	98.0	-2.51	97.4
Brown	Green Bay	44.8	-18.5	1.43	3.23	74.4	-26.7	7.28	98.0	-2.54	97.5
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	74.4	-26.7	6.95	98.0	-2.01	95.8
Shawano	Bowler	44.0	-20.9	1.45	3.45	74.4	-26.7	7.19	98.0	-1.68	93.5
Pierce	River Falls	47.0	-20.7	1.54	3.39	74.4	-26.7	6.73	98.0	-1.77	94.2
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	74.4	-26.7	7.36	98.0	-2.79	97.7
Oconto	Oconto	44.3	-19.0	1.46	3.39	74.4	-26.7	7.13	98.0	-2.27	96.9
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	74.4	-26.7	7.13	98.0	-2.01	95.8
Clark	Owen	43.3	-22.2	1.43	3.34	74.4	-26.7	7.26	98.0	-1.35	89.3
Chippewa	Stanley	45.3	-21.7	1.50	3.34	74.4	-26.7	6.93	98.0	-1.50	91.4
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	74.4	-26.7	6.81	98.0	-1.40	90.1
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	74.4	-26.7	6.67	98.0	-1.48	91.2
Marinette	Marinette	45.9	-17.9	1.54	3.17	74.4	-26.7	6.77	98.0	-2.77	97.7
Taylor	Medford	43.0	-22.1	1.44	3.23	74.4	-26.7	7.21	98.0	-1.43	90.5
Langlade	Antigo	43.9	-22.1	1.48	3.17	74.4	-26.7	7.05	98.0	-1.45	90.8
Lincoln	Merrill	44.2	-22.3	1.49	3.57	74.4	-26.7	6.99	98.0	-1.23	87.4
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	74.4	-26.7	6.65	98.0	-0.89	79.8
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	74.4	-26.7	6.72	98.0	-0.90	79.9
Polk	Amery	44.9	-22.5	1.53	3.74	74.4	-26.7	6.81	98.0	-1.12	85.2
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	74.4	-26.7	6.86	98.0	-1.67	93.4
Taylor	Jump River	44.3	-24.8	1.51	3.51	74.4	-26.7	6.87	98.0	-0.54	69.2
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	74.4	-26.7	6.83	98.0	-1.54	92.0
Door	Washington Island	39.6	-16.5	1.35	3.45	74.4	-26.7	7.68	98.0	-2.96	97.8
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	74.4	-26.7	6.49	98.0	-1.04	83.3
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	74.4	-26.7	6.66	98.0	-1.08	84.4
Barron	Rice Lake	45.3	-23.1	1.56	3.63	74.4	-26.7	6.65	98.0	-0.99	82.3
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	74.4	-26.7	7.09	98.0	-0.43	65.5
Forest	Laona	41.2	-21.6	1.43	3.17	74.4	-26.7	7.30	98.0	-1.61	92.7
Barron	Cumberland	46.0	-22.4	1.59	3.28	74.4	-26.7	6.53	98.0	-1.31	88.7
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	74.4	-26.7	6.68	98.0	-0.65	72.7
Polk	Luck	45.4	-22.7	1.58	3.39	74.4	-26.7	6.60	98.0	-1.18	86.3
Marinette	Goodman	42.1	-20.8	1.47	3.12	74.4	-26.7	7.08	98.0	-1.89	95.1
Oneida	North Pelican	41.5	-23.7	1.45	3.28	74.4	-26.7	7.18	98.0	-0.91	80.3
Oneida	Rhineland	43.2	-22.5	1.51	3.07	74.4	-26.7	6.90	98.0	-1.37	89.6
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	74.4	-26.7	7.10	98.0	-0.96	81.5
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	74.4	-26.7	6.57	98.0	-0.87	79.2
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	74.4	-26.7	6.80	98.0	-0.96	81.5
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	74.4	-26.7	6.43	98.0	-0.85	78.7
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	74.4	-26.7	7.00	98.0	-1.12	85.0
Sawyer	Couderay	44.6	-26.0	1.59	4.17	74.4	-26.7	6.56	98.0	-0.17	55.5
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	74.4	-26.7	6.94	98.0	-1.09	84.5
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	74.4	-26.7	6.96	98.0	-0.85	78.6
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	74.4	-26.7	6.82	98.0	-1.00	82.3
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	74.4	-26.7	7.25	98.0	-1.12	85.0
Price	Park Falls	41.9	-21.8	1.50	3.17	74.4	-26.7	6.95	98.0	-1.54	92.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	74.4	-26.7	6.64	98.0	-0.76	76.1
Burnett	Danbury	44.6	-24.6	1.60	3.23	74.4	-26.7	6.48	98.0	-0.65	72.8
Washburn	Minong 2	44.8	-26.2	1.62	3.12	74.4	-26.7	6.43	98.0	-0.16	55.2
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	74.4	-26.7	6.72	98.0	-0.91	80.3
Douglas	Gordon	44.4	-26.4	1.63	3.17	74.4	-26.7	6.40	98.0	-0.09	52.7
Bayfield	Drummond	44.2	-23.8	1.63	3.28	74.4	-26.7	6.39	98.0	-0.88	79.5
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	74.4	-26.7	6.20	98.0	-0.50	67.6
Ashland	Mellen	42.8	-24.1	1.59	3.34	74.4	-26.7	6.55	98.0	-0.78	76.6
Douglas	Foxboro	43.4	-24.8	1.62	3.07	74.4	-26.7	6.43	98.0	-0.62	71.8
Iron	Gurney	42.4	-22.2	1.58	3.12	74.4	-26.7	6.58	98.0	-1.44	90.7
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	74.4	-26.7	6.33	98.0	-1.42	90.4
Douglas	Superior	39.3	-22.1	1.49	3.17	74.4	-26.7	6.99	98.0	-1.45	90.8
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	74.4	-26.7	6.46	98.0	-1.35	89.3
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	74.4	-26.7	6.74	98.0	-1.90	95.2
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	74.4	-26.7	5.84	98.0	-2.16	96.5

Table C25. Lower Layer Reliability Analysis for Exceptional Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	60.0	-31.9	-3.06	0.1	-4.79	98.0
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	60.0	-31.9	-3.47	0.0	-4.24	98.0
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	60.0	-31.9	-3.04	0.1	-4.66	98.0
Rock	Afton	47.6	-16.4	1.29	3.92	60.0	-31.9	-3.09	0.1	-3.95	98.0
Green	Brodhead	47.9	-18.0	1.30	3.45	60.0	-31.9	-3.07	0.1	-4.03	98.0
Racine	Burlington	46.3	-16.2	1.26	3.34	60.0	-31.9	-3.17	0.1	-4.70	98.0
Rock	Janesville	49.9	-16.7	1.36	3.12	60.0	-31.9	-2.94	0.2	-4.87	98.0
Lafayette	Darlington	47.7	-18.3	1.30	3.39	60.0	-31.9	-3.07	0.1	-4.01	98.0
Racine	Racine	43.6	-15.9	1.19	3.57	60.0	-31.9	-3.35	0.0	-4.49	98.0
Grant	Platteville	47.8	-17.9	1.31	3.28	60.0	-31.9	-3.04	0.1	-4.27	98.0
Grant	Lancaster	46.8	-18.2	1.30	3.23	60.0	-31.9	-3.09	0.1	-4.25	98.0
Walworth	Whitewater	48.0	-16.8	1.33	3.39	60.0	-31.9	-3.00	0.1	-4.45	98.0
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	60.0	-31.9	-3.02	0.1	-3.77	98.0
Dane	Stoughton	47.5	-17.4	1.33	3.34	60.0	-31.9	-3.02	0.1	-4.34	98.0
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	60.0	-31.9	-3.23	0.1	-4.68	98.0
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	60.0	-31.9	-3.08	0.1	-4.37	98.0
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	60.0	-31.9	-3.05	0.1	-4.60	98.0
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	60.0	-31.9	-3.06	0.1	-4.85	98.0
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	60.0	-31.9	-2.97	0.1	-3.70	98.0
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	60.0	-31.9	-2.84	0.2	-3.53	98.0
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	60.0	-31.9	-3.06	0.1	-3.98	98.0
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	60.0	-31.9	-2.92	0.2	-4.46	98.0
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	60.0	-31.9	-2.95	0.2	-4.77	98.0
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	60.0	-31.9	-3.02	0.1	-4.37	98.0
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	60.0	-31.9	-2.99	0.1	-4.14	98.0
Jefferson	Watertown	47.5	-17.4	1.36	3.51	60.0	-31.9	-2.95	0.2	-4.13	98.0
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	60.0	-31.9	-2.90	0.2	-3.73	98.0
Washington	Germantown	45.3	-17.7	1.30	3.57	60.0	-31.9	-3.08	0.1	-3.98	98.0
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	60.0	-31.9	-2.95	0.2	-4.07	98.0
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	60.0	-31.9	-2.98	0.1	-3.79	98.0
Richland	Richland Center	48.2	-19.9	1.39	3.74	60.0	-31.9	-2.87	0.2	-3.21	97.9
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	60.0	-31.9	-2.96	0.1	-4.13	98.0
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	60.0	-31.9	-3.30	0.0	-4.79	98.0
Washington	West Bend	45.4	-17.4	1.32	3.45	60.0	-31.9	-3.03	0.1	-4.20	98.0
Dodge	Horicon	46.4	-18.2	1.36	3.39	60.0	-31.9	-2.95	0.2	-4.04	98.0
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	60.0	-31.9	-2.89	0.2	-4.11	98.0
Sauk	Baraboo	46.6	-20.2	1.36	3.74	60.0	-31.9	-2.93	0.2	-3.13	97.9
Columbia	Portage	47.7	-18.6	1.40	3.57	60.0	-31.9	-2.85	0.2	-3.73	98.0
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	60.0	-31.9	-2.85	0.2	-3.59	98.0
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	60.0	-31.9	-2.87	0.2	-3.47	98.0
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	60.0	-31.9	-2.96	0.2	-3.20	97.9
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	60.0	-31.9	-2.94	0.2	-3.50	98.0
Green Lake	Dalton	47.3	-18.5	1.41	3.23	60.0	-31.9	-2.85	0.2	-4.15	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	60.0	-31.9	-2.85	0.2	-2.92	97.8
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	60.0	-31.9	-2.93	0.2	-4.37	98.0
Monroe	Cashton	45.8	-18.9	1.37	3.68	60.0	-31.9	-2.91	0.2	-3.53	98.0
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	60.0	-31.9	-3.04	0.1	-4.76	98.0
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	60.0	-31.9	-2.81	0.2	-3.28	97.9
Marquette	Montello	46.8	-19.5	1.41	3.45	60.0	-31.9	-2.85	0.2	-3.59	98.0
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	60.0	-31.9	-2.93	0.2	-4.24	98.0
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	60.0	-31.9	-2.75	0.3	-3.50	98.0
Monroe	Sparta	47.5	-21.3	1.45	3.74	60.0	-31.9	-2.77	0.3	-2.83	97.8
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	60.0	-31.9	-2.77	0.3	-3.20	97.9
Juneau	Necedah	48.1	-21.6	1.48	3.68	60.0	-31.9	-2.71	0.3	-2.80	97.7
Calumet	Chilton	46.5	-17.7	1.43	3.23	60.0	-31.9	-2.80	0.2	-4.40	98.0
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	60.0	-31.9	-2.85	0.2	-4.19	98.0
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	60.0	-31.9	-2.99	0.1	-4.68	98.0
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	60.0	-31.9	-2.74	0.3	-3.22	97.9
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	60.0	-31.9	-2.63	0.4	-2.50	97.4
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	60.0	-31.9	-3.27	0.1	-4.79	98.0
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	60.0	-31.9	-2.81	0.2	-3.22	97.9
Outagamie	Appleton	45.1	-17.7	1.41	3.07	60.0	-31.9	-2.84	0.2	-4.63	98.0
Trempealeau	Blair	46.5	-22.2	1.46	3.80	60.0	-31.9	-2.74	0.3	-2.55	97.5
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	60.0	-31.9	-2.71	0.3	-3.34	98.0
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	60.0	-31.9	-2.73	0.3	-3.98	98.0
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	60.0	-31.9	-2.82	0.2	-2.76	97.7
Waupaca	New London	47.0	-19.4	1.48	3.34	60.0	-31.9	-2.70	0.3	-3.75	98.0
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	60.0	-31.9	-2.75	0.3	-3.60	98.0
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	60.0	-31.9	-2.60	0.5	-2.27	96.9
Wood	Pittsville	46.6	-22.3	1.48	3.34	60.0	-31.9	-2.71	0.3	-2.88	97.8
Portage	Stevens Point	45.1	-19.8	1.44	3.28	60.0	-31.9	-2.78	0.3	-3.69	98.0
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	60.0	-31.9	-2.72	0.3	-2.72	97.7
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	60.0	-31.9	-2.64	0.4	-2.64	97.6
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	60.0	-31.9	-2.76	0.3	-3.69	98.0
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	60.0	-31.9	-2.72	0.3	-3.87	98.0
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	60.0	-31.9	-2.70	0.3	-3.53	98.0
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	60.0	-31.9	-2.65	0.4	-3.24	97.9
Marathon	Rosholt	45.4	-21.2	1.48	3.28	60.0	-31.9	-2.70	0.3	-3.26	97.9
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	60.0	-31.9	-2.63	0.4	-3.27	97.9
Dunn	Menomonie	47.8	-21.2	1.57	3.57	60.0	-31.9	-2.54	0.5	-3.00	97.9

Table C26. Lower Layer Reliability Analysis for Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	60.0	-37.9	-3.04	0.1	-5.32	98.0
Brown	Green Bay	44.8	-18.5	1.43	3.23	60.0	-37.9	-2.80	0.3	-6.01	98.0
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	60.0	-37.9	-2.67	0.4	-5.36	98.0
Shawano	Bowler	44.0	-20.9	1.45	3.45	60.0	-37.9	-2.77	0.3	-4.93	98.0
Pierce	River Falls	47.0	-20.7	1.54	3.39	60.0	-37.9	-2.59	0.5	-5.07	98.0
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	60.0	-37.9	-2.83	0.2	-6.14	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	60.0	-37.9	-2.74	0.3	-5.57	98.0
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	60.0	-37.9	-2.74	0.3	-5.42	98.0
Clark	Owen	43.3	-22.2	1.43	3.34	60.0	-37.9	-2.79	0.3	-4.70	98.0
Chippewa	Stanley	45.3	-21.7	1.50	3.34	60.0	-37.9	-2.67	0.4	-4.85	98.0
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	60.0	-37.9	-2.62	0.4	-4.54	98.0
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	60.0	-37.9	-2.56	0.5	-4.67	98.0
Marinette	Marinette	45.9	-17.9	1.54	3.17	60.0	-37.9	-2.60	0.5	-6.30	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	60.0	-37.9	-2.77	0.3	-4.90	98.0
Langlade	Antigo	43.9	-22.1	1.48	3.17	60.0	-37.9	-2.71	0.3	-4.98	98.0
Lincoln	Merrill	44.2	-22.3	1.49	3.57	60.0	-37.9	-2.69	0.4	-4.37	98.0
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	60.0	-37.9	-2.56	0.5	-3.84	98.0
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	60.0	-37.9	-2.58	0.5	-4.04	98.0
Polk	Amery	44.9	-22.5	1.53	3.74	60.0	-37.9	-2.62	0.4	-4.11	98.0
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	60.0	-37.9	-2.64	0.4	-5.14	98.0
Taylor	Jump River	44.3	-24.8	1.51	3.51	60.0	-37.9	-2.64	0.4	-3.73	98.0
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	60.0	-37.9	-2.63	0.4	-4.68	98.0
Door	Washington Island	39.6	-16.5	1.35	3.45	60.0	-37.9	-2.95	0.2	-6.20	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	60.0	-37.9	-2.50	0.6	-4.45	98.0
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	60.0	-37.9	-2.56	0.5	-4.56	98.0
Barron	Rice Lake	45.3	-23.1	1.56	3.63	60.0	-37.9	-2.56	0.5	-4.08	98.0
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	60.0	-37.9	-2.73	0.3	-3.68	98.0
Forest	Laona	41.2	-21.6	1.43	3.17	60.0	-37.9	-2.81	0.2	-5.14	98.0
Barron	Cumberland	46.0	-22.4	1.59	3.28	60.0	-37.9	-2.51	0.6	-4.72	98.0
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	60.0	-37.9	-2.57	0.5	-3.95	98.0
Polk	Luck	45.4	-22.7	1.58	3.39	60.0	-37.9	-2.54	0.5	-4.48	98.0
Marinette	Goodman	42.1	-20.8	1.47	3.12	60.0	-37.9	-2.72	0.3	-5.48	98.0
Oneida	North Pelican	41.5	-23.7	1.45	3.28	60.0	-37.9	-2.76	0.3	-4.33	98.0
Oneida	Rhineland	43.2	-22.5	1.51	3.07	60.0	-37.9	-2.65	0.4	-5.02	98.0
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	60.0	-37.9	-2.73	0.3	-4.43	98.0
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	60.0	-37.9	-2.53	0.6	-4.11	98.0
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	60.0	-37.9	-2.62	0.4	-4.43	98.0
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	60.0	-37.9	-2.47	0.7	-4.38	98.0
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	60.0	-37.9	-2.69	0.3	-4.59	98.0
Sawyer	Couderay	44.6	-26.0	1.59	4.17	60.0	-37.9	-2.52	0.6	-2.85	97.8
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	60.0	-37.9	-2.67	0.4	-4.39	98.0
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	60.0	-37.9	-2.68	0.4	-4.50	98.0
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	60.0	-37.9	-2.62	0.4	-4.71	98.0
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	60.0	-37.9	-2.79	0.3	-4.59	98.0
Price	Park Falls	41.9	-21.8	1.50	3.17	60.0	-37.9	-2.67	0.4	-5.08	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	60.0	-37.9	-2.55	0.5	-4.17	98.0
Burnett	Danbury	44.6	-24.6	1.60	3.23	60.0	-37.9	-2.49	0.6	-4.12	98.0
Washburn	Minong 2	44.8	-26.2	1.62	3.12	60.0	-37.9	-2.47	0.7	-3.75	98.0
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	60.0	-37.9	-2.58	0.5	-4.33	98.0
Douglas	Gordon	44.4	-26.4	1.63	3.17	60.0	-37.9	-2.46	0.7	-3.63	98.0
Bayfield	Drummond	44.2	-23.8	1.63	3.28	60.0	-37.9	-2.46	0.7	-4.30	98.0
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	60.0	-37.9	-2.38	0.8	-3.97	98.0
Ashland	Mellen	42.8	-24.1	1.59	3.34	60.0	-37.9	-2.52	0.6	-4.13	98.0
Douglas	Foxboro	43.4	-24.8	1.62	3.07	60.0	-37.9	-2.47	0.7	-4.27	98.0
Iron	Gurney	42.4	-22.2	1.58	3.12	60.0	-37.9	-2.53	0.6	-5.03	98.0
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	60.0	-37.9	-2.44	0.7	-4.95	98.0
Douglas	Superior	39.3	-22.1	1.49	3.17	60.0	-37.9	-2.69	0.4	-4.98	98.0
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	60.0	-37.9	-2.48	0.6	-4.94	98.0
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	60.0	-37.9	-2.59	0.5	-4.99	98.0
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	60.0	-37.9	-2.25	1.2	-5.58	98.0

Table C27. Lower Layer Reliability Analysis for 40 % RAP, Exceptional Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	67.9	-27.4	2.98	97.9	-3.45	98.0
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	67.9	-27.4	3.38	98.0	-3.08	97.9
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	67.9	-27.4	2.96	97.9	-3.33	98.0
Rock	Afton	47.6	-16.4	1.29	3.92	67.9	-27.4	3.01	97.9	-2.80	97.8
Green	Brodhead	47.9	-18.0	1.30	3.45	67.9	-27.4	3.00	97.9	-2.72	97.7
Racine	Burlington	46.3	-16.2	1.26	3.34	67.9	-27.4	3.09	97.9	-3.36	98.0
Rock	Janesville	49.9	-16.7	1.36	3.12	67.9	-27.4	2.86	97.8	-3.43	98.0
Lafayette	Darlington	47.7	-18.3	1.30	3.39	67.9	-27.4	2.99	97.9	-2.68	97.6
Racine	Racine	43.6	-15.9	1.19	3.57	67.9	-27.4	3.27	97.9	-3.22	97.9
Grant	Platteville	47.8	-17.9	1.31	3.28	67.9	-27.4	2.97	97.9	-2.89	97.8
Grant	Lancaster	46.8	-18.2	1.30	3.23	67.9	-27.4	3.01	97.9	-2.85	97.8
Walworth	Whitewater	48.0	-16.8	1.33	3.39	67.9	-27.4	2.93	97.8	-3.12	97.9
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	67.9	-27.4	2.94	97.8	-2.56	97.5
Dane	Stoughton	47.5	-17.4	1.33	3.34	67.9	-27.4	2.94	97.8	-3.00	97.9
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	67.9	-27.4	3.15	97.9	-3.42	98.0
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	67.9	-27.4	3.01	97.9	-2.98	97.9
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	67.9	-27.4	2.97	97.9	-3.27	97.9
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	67.9	-27.4	2.98	97.9	-3.51	98.0
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	67.9	-27.4	2.90	97.8	-2.44	97.3
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	67.9	-27.4	2.77	97.7	-2.32	97.0
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	67.9	-27.4	2.98	97.9	-2.72	97.7
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	67.9	-27.4	2.85	97.8	-3.07	97.9
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	67.9	-27.4	2.87	97.8	-3.45	98.0
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	67.9	-27.4	2.94	97.8	-3.03	97.9
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	67.9	-27.4	2.91	97.8	-2.84	97.8
Jefferson	Watertown	47.5	-17.4	1.36	3.51	67.9	-27.4	2.88	97.8	-2.85	97.8
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	67.9	-27.4	2.82	97.8	-2.47	97.3
Washington	Germantown	45.3	-17.7	1.30	3.57	67.9	-27.4	3.01	97.9	-2.72	97.7
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	67.9	-27.4	2.88	97.8	-2.73	97.7
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	67.9	-27.4	2.91	97.8	-2.51	97.4
Richland	Richland Center	48.2	-19.9	1.39	3.74	67.9	-27.4	2.80	97.8	-2.00	95.8
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	67.9	-27.4	2.89	97.8	-2.79	97.7
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	67.9	-27.4	3.22	97.9	-3.45	98.0
Washington	West Bend	45.4	-17.4	1.32	3.45	67.9	-27.4	2.95	97.8	-2.90	97.8
Dodge	Horicon	46.4	-18.2	1.36	3.39	67.9	-27.4	2.88	97.8	-2.71	97.7
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	67.9	-27.4	2.82	97.8	-2.81	97.8
Sauk	Baraboo	46.6	-20.2	1.36	3.74	67.9	-27.4	2.86	97.8	-1.92	95.3
Columbia	Portage	47.7	-18.6	1.40	3.57	67.9	-27.4	2.78	97.7	-2.47	97.3
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	67.9	-27.4	2.78	97.7	-2.27	96.9
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	67.9	-27.4	2.79	97.7	-2.25	96.8
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	67.9	-27.4	2.89	97.8	-1.96	95.5
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	67.9	-27.4	2.87	97.8	-2.26	96.8
Green Lake	Dalton	47.3	-18.5	1.41	3.23	67.9	-27.4	2.77	97.7	-2.76	97.7

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	67.9	-27.4	2.78	97.7	-1.76	94.2
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	67.9	-27.4	2.85	97.8	-3.03	97.9
Monroe	Cashton	45.8	-18.9	1.37	3.68	67.9	-27.4	2.84	97.8	-2.31	97.0
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	67.9	-27.4	2.96	97.9	-3.42	98.0
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	67.9	-27.4	2.74	97.7	-2.04	96.0
Marquette	Montello	46.8	-19.5	1.41	3.45	67.9	-27.4	2.77	97.7	-2.29	96.9
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	67.9	-27.4	2.85	97.8	-2.92	97.8
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	67.9	-27.4	2.68	97.6	-2.26	96.8
Monroe	Sparta	47.5	-21.3	1.45	3.74	67.9	-27.4	2.70	97.7	-1.63	92.9
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	67.9	-27.4	2.70	97.7	-1.96	95.5
Juneau	Necedah	48.1	-21.6	1.48	3.68	67.9	-27.4	2.64	97.6	-1.57	92.3
Calumet	Chilton	46.5	-17.7	1.43	3.23	67.9	-27.4	2.73	97.7	-3.01	97.9
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	67.9	-27.4	2.78	97.7	-2.85	97.8
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	67.9	-27.4	2.92	97.8	-3.29	98.0
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	67.9	-27.4	2.67	97.6	-1.94	95.4
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	67.9	-27.4	2.57	97.5	-1.28	88.1
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	67.9	-27.4	3.19	97.9	-3.37	98.0
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	67.9	-27.4	2.74	97.7	-1.96	95.6
Outagamie	Appleton	45.1	-17.7	1.41	3.07	67.9	-27.4	2.77	97.7	-3.16	97.9
Trempealeau	Blair	46.5	-22.2	1.46	3.80	67.9	-27.4	2.67	97.6	-1.37	89.6
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	67.9	-27.4	2.64	97.6	-2.10	96.2
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	67.9	-27.4	2.66	97.6	-2.64	97.6
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	67.9	-27.4	2.75	97.7	-1.41	90.2
Waupaca	New London	47.0	-19.4	1.48	3.34	67.9	-27.4	2.63	97.6	-2.40	97.2
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	67.9	-27.4	2.68	97.6	-2.22	96.7
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	67.9	-27.4	2.54	97.5	-1.01	82.7
Wood	Pittsville	46.6	-22.3	1.48	3.34	67.9	-27.4	2.64	97.6	-1.53	91.8
Portage	Stevens Point	45.1	-19.8	1.44	3.28	67.9	-27.4	2.71	97.7	-2.32	97.0
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	67.9	-27.4	2.65	97.6	-1.46	90.9
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	67.9	-27.4	2.58	97.5	-1.48	91.1
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	67.9	-27.4	2.69	97.6	-2.27	96.9
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	67.9	-27.4	2.66	97.6	-2.50	97.4
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	67.9	-27.4	2.63	97.6	-2.14	96.4
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	67.9	-27.4	2.58	97.5	-1.89	95.1
Marathon	Rosholt	45.4	-21.2	1.48	3.28	67.9	-27.4	2.64	97.6	-1.89	95.1
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	67.9	-27.4	2.56	97.5	-1.94	95.5
Dunn	Menomonie	47.8	-21.2	1.57	3.57	67.9	-27.4	2.48	97.4	-1.74	94.0

Table C28. Lower Layer Reliability Analysis for 40 % RAP, Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	67.9	-31.0	2.96	97.8	-3.59	98.0
Brown	Green Bay	44.8	-18.5	1.43	3.23	67.9	-31.0	2.73	97.7	-3.87	98.0
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	67.9	-31.0	2.61	97.6	-3.30	98.0
Shawano	Bowler	44.0	-20.9	1.45	3.45	67.9	-31.0	2.70	97.7	-2.93	97.8
Pierce	River Falls	47.0	-20.7	1.54	3.39	67.9	-31.0	2.53	97.4	-3.03	97.9
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	67.9	-31.0	2.76	97.7	-4.07	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	67.9	-31.0	2.67	97.6	-3.54	98.0
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	67.9	-31.0	2.67	97.6	-3.32	98.0
Clark	Owen	43.3	-22.2	1.43	3.34	67.9	-31.0	2.72	97.7	-2.64	97.6
Chippewa	Stanley	45.3	-21.7	1.50	3.34	67.9	-31.0	2.60	97.5	-2.79	97.7
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	67.9	-31.0	2.55	97.5	-2.61	97.6
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	67.9	-31.0	2.50	97.4	-2.71	97.7
Marinette	Marinette	45.9	-17.9	1.54	3.17	67.9	-31.0	2.54	97.5	-4.13	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	67.9	-31.0	2.70	97.7	-2.76	97.7
Langlade	Antigo	43.9	-22.1	1.48	3.17	67.9	-31.0	2.64	97.6	-2.81	97.8
Lincoln	Merrill	44.2	-22.3	1.49	3.57	67.9	-31.0	2.62	97.6	-2.44	97.3
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	67.9	-31.0	2.49	97.4	-2.02	95.9
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	67.9	-31.0	2.52	97.4	-2.10	96.3
Polk	Amery	44.9	-22.5	1.53	3.74	67.9	-31.0	2.55	97.5	-2.27	96.9
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	67.9	-31.0	2.57	97.5	-3.01	97.9
Taylor	Jump River	44.3	-24.8	1.51	3.51	67.9	-31.0	2.57	97.5	-1.77	94.2
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	67.9	-31.0	2.56	97.5	-2.75	97.7
Door	Washington Island	39.6	-16.5	1.35	3.45	67.9	-31.0	2.88	97.8	-4.20	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	67.9	-31.0	2.43	97.3	-2.35	97.1
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	67.9	-31.0	2.50	97.4	-2.42	97.2
Barron	Rice Lake	45.3	-23.1	1.56	3.63	67.9	-31.0	2.49	97.4	-2.18	96.6
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	67.9	-31.0	2.66	97.6	-1.68	93.5
Forest	Laona	41.2	-21.6	1.43	3.17	67.9	-31.0	2.74	97.7	-2.96	97.9
Barron	Cumberland	46.0	-22.4	1.59	3.28	67.9	-31.0	2.45	97.3	-2.62	97.6
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	67.9	-31.0	2.50	97.4	-1.92	95.3
Polk	Luck	45.4	-22.7	1.58	3.39	67.9	-31.0	2.47	97.3	-2.45	97.3
Marinette	Goodman	42.1	-20.8	1.47	3.12	67.9	-31.0	2.66	97.6	-3.27	97.9
Oneida	North Pelican	41.5	-23.7	1.45	3.28	67.9	-31.0	2.69	97.7	-2.22	96.7
Oneida	Rhineland	43.2	-22.5	1.51	3.07	67.9	-31.0	2.59	97.5	-2.77	97.7
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	67.9	-31.0	2.66	97.6	-2.29	96.9
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	67.9	-31.0	2.47	97.3	-2.12	96.3
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	67.9	-31.0	2.55	97.5	-2.29	96.9
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	67.9	-31.0	2.41	97.2	-2.21	96.7
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	67.9	-31.0	2.63	97.6	-2.45	97.3
Sawyer	Couderay	44.6	-26.0	1.59	4.17	67.9	-31.0	2.46	97.3	-1.20	86.7
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	67.9	-31.0	2.60	97.5	-2.36	97.1
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	67.9	-31.0	2.61	97.6	-2.25	96.8
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	67.9	-31.0	2.56	97.5	-2.42	97.2
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	67.9	-31.0	2.72	97.7	-2.45	97.3
Price	Park Falls	41.9	-21.8	1.50	3.17	67.9	-31.0	2.61	97.6	-2.90	97.8

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	67.9	-31.0	2.49	97.4	-2.07	96.1
Burnett	Danbury	44.6	-24.6	1.60	3.23	67.9	-31.0	2.43	97.3	-1.98	95.7
Washburn	Minong 2	44.8	-26.2	1.62	3.12	67.9	-31.0	2.41	97.2	-1.54	91.9
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	67.9	-31.0	2.52	97.4	-2.22	96.7
Douglas	Gordon	44.4	-26.4	1.63	3.17	67.9	-31.0	2.40	97.2	-1.45	90.8
Bayfield	Drummond	44.2	-23.8	1.63	3.28	67.9	-31.0	2.40	97.2	-2.19	96.6
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	67.9	-31.0	2.32	97.0	-1.83	94.7
Ashland	Mellen	42.8	-24.1	1.59	3.34	67.9	-31.0	2.46	97.3	-2.07	96.1
Douglas	Foxboro	43.4	-24.8	1.62	3.07	67.9	-31.0	2.41	97.2	-2.02	95.9
Iron	Gurney	42.4	-22.2	1.58	3.12	67.9	-31.0	2.47	97.3	-2.82	97.8
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	67.9	-31.0	2.37	97.1	-2.77	97.7
Douglas	Superior	39.3	-22.1	1.49	3.17	67.9	-31.0	2.62	97.6	-2.81	97.8
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	67.9	-31.0	2.42	97.2	-2.73	97.7
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	67.9	-31.0	2.53	97.4	-3.09	97.9
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	67.9	-31.0	2.19	96.6	-3.47	98.0

Table C29. Lower Layer Reliability Analysis for 25 % RAS, Exceptional Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	71.1	-25.6	5.43	98.0	-2.91	97.8
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	71.1	-25.6	6.16	98.0	-2.61	97.6
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	71.1	-25.6	5.40	98.0	-2.80	97.7
Rock	Afton	47.6	-16.4	1.29	3.92	71.1	-25.6	5.49	98.0	-2.34	97.1
Green	Brodhead	47.9	-18.0	1.30	3.45	71.1	-25.6	5.45	98.0	-2.20	96.6
Racine	Burlington	46.3	-16.2	1.26	3.34	71.1	-25.6	5.63	98.0	-2.82	97.8
Rock	Janesville	49.9	-16.7	1.36	3.12	71.1	-25.6	5.21	98.0	-2.85	97.8
Lafayette	Darlington	47.7	-18.3	1.30	3.39	71.1	-25.6	5.45	98.0	-2.15	96.5
Racine	Racine	43.6	-15.9	1.19	3.57	71.1	-25.6	5.95	98.0	-2.72	97.7
Grant	Platteville	47.8	-17.9	1.31	3.28	71.1	-25.6	5.40	98.0	-2.35	97.1
Grant	Lancaster	46.8	-18.2	1.30	3.23	71.1	-25.6	5.48	98.0	-2.29	96.9
Walworth	Whitewater	48.0	-16.8	1.33	3.39	71.1	-25.6	5.33	98.0	-2.59	97.5
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	71.1	-25.6	5.35	98.0	-2.08	96.2
Dane	Stoughton	47.5	-17.4	1.33	3.34	71.1	-25.6	5.36	98.0	-2.46	97.3
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	71.1	-25.6	5.73	98.0	-2.92	97.8
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	71.1	-25.6	5.47	98.0	-2.42	97.2
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	71.1	-25.6	5.41	98.0	-2.74	97.7
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	71.1	-25.6	5.42	98.0	-2.97	97.9
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	71.1	-25.6	5.27	98.0	-1.93	95.4
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	71.1	-25.6	5.05	98.0	-1.84	94.8
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	71.1	-25.6	5.43	98.0	-2.22	96.7
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	71.1	-25.6	5.19	98.0	-2.51	97.4
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	71.1	-25.6	5.23	98.0	-2.92	97.8
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	71.1	-25.6	5.35	98.0	-2.49	97.4
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	71.1	-25.6	5.30	98.0	-2.32	97.0
Jefferson	Watertown	47.5	-17.4	1.36	3.51	71.1	-25.6	5.24	98.0	-2.34	97.0
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	71.1	-25.6	5.14	98.0	-1.96	95.6
Washington	Germantown	45.3	-17.7	1.30	3.57	71.1	-25.6	5.47	98.0	-2.22	96.7
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	71.1	-25.6	5.24	98.0	-2.19	96.6
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	71.1	-25.6	5.30	98.0	-2.00	95.7
Richland	Richland Center	48.2	-19.9	1.39	3.74	71.1	-25.6	5.10	98.0	-1.52	91.7
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	71.1	-25.6	5.26	98.0	-2.25	96.8
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	71.1	-25.6	5.86	98.0	-2.91	97.8
Washington	West Bend	45.4	-17.4	1.32	3.45	71.1	-25.6	5.38	98.0	-2.38	97.1
Dodge	Horicon	46.4	-18.2	1.36	3.39	71.1	-25.6	5.24	98.0	-2.18	96.6
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	71.1	-25.6	5.13	98.0	-2.29	96.9
Sauk	Baraboo	46.6	-20.2	1.36	3.74	71.1	-25.6	5.21	98.0	-1.44	90.7
Columbia	Portage	47.7	-18.6	1.40	3.57	71.1	-25.6	5.06	98.0	-1.96	95.6
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	71.1	-25.6	5.06	98.0	-1.74	94.0
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	71.1	-25.6	5.09	98.0	-1.76	94.2
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	71.1	-25.6	5.25	98.0	-1.46	91.0
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	71.1	-25.6	5.22	98.0	-1.77	94.2
Green Lake	Dalton	47.3	-18.5	1.41	3.23	71.1	-25.6	5.05	98.0	-2.20	96.6

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	71.1	-25.6	5.06	98.0	-1.29	88.4
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	71.1	-25.6	5.19	98.0	-2.49	97.4
Monroe	Cashton	45.8	-18.9	1.37	3.68	71.1	-25.6	5.17	98.0	-1.82	94.6
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	71.1	-25.6	5.40	98.0	-2.88	97.8
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	71.1	-25.6	5.00	98.0	-1.54	92.0
Marquette	Montello	46.8	-19.5	1.41	3.45	71.1	-25.6	5.05	98.0	-1.77	94.2
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	71.1	-25.6	5.20	98.0	-2.39	97.2
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	71.1	-25.6	4.89	98.0	-1.77	94.2
Monroe	Sparta	47.5	-21.3	1.45	3.74	71.1	-25.6	4.91	98.0	-1.15	85.7
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	71.1	-25.6	4.92	98.0	-1.46	91.0
Juneau	Necedah	48.1	-21.6	1.48	3.68	71.1	-25.6	4.81	98.0	-1.09	84.4
Calumet	Chilton	46.5	-17.7	1.43	3.23	71.1	-25.6	4.98	98.0	-2.45	97.3
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	71.1	-25.6	5.06	98.0	-2.31	97.0
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	71.1	-25.6	5.31	98.0	-2.73	97.7
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	71.1	-25.6	4.87	98.0	-1.43	90.4
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	71.1	-25.6	4.67	98.0	-0.79	76.9
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	71.1	-25.6	5.80	98.0	-2.81	97.8
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	71.1	-25.6	4.99	98.0	-1.46	90.9
Outagamie	Appleton	45.1	-17.7	1.41	3.07	71.1	-25.6	5.04	98.0	-2.58	97.5
Trempealeau	Blair	46.5	-22.2	1.46	3.80	71.1	-25.6	4.87	98.0	-0.89	79.8
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	71.1	-25.6	4.80	98.0	-1.60	92.6
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	71.1	-25.6	4.85	98.0	-2.10	96.2
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	71.1	-25.6	5.00	98.0	-0.87	79.1
Waupaca	New London	47.0	-19.4	1.48	3.34	71.1	-25.6	4.79	98.0	-1.86	94.9
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	71.1	-25.6	4.88	98.0	-1.68	93.4
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	71.1	-25.6	4.62	98.0	-0.50	67.9
Wood	Pittsville	46.6	-22.3	1.48	3.34	71.1	-25.6	4.81	98.0	-0.99	82.2
Portage	Stevens Point	45.1	-19.8	1.44	3.28	71.1	-25.6	4.94	98.0	-1.77	94.2
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	71.1	-25.6	4.83	98.0	-0.95	81.3
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	71.1	-25.6	4.69	98.0	-1.01	82.7
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	71.1	-25.6	4.90	98.0	-1.70	93.7
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	71.1	-25.6	4.84	98.0	-1.95	95.5
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	71.1	-25.6	4.79	98.0	-1.58	92.4
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	71.1	-25.6	4.70	98.0	-1.35	89.3
Marathon	Rosholt	45.4	-21.2	1.48	3.28	71.1	-25.6	4.80	98.0	-1.34	89.2
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	71.1	-25.6	4.67	98.0	-1.41	90.3
Dunn	Menomonie	47.8	-21.2	1.57	3.57	71.1	-25.6	4.52	98.0	-1.23	87.4

Table C30. Lower Layer Reliability Analysis for 25 % RAS, Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	73.4	-29.2	7.14	98.0	-3.14	97.9
Brown	Green Bay	44.8	-18.5	1.43	3.23	73.4	-29.2	6.58	98.0	-3.32	98.0
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	73.4	-29.2	6.28	98.0	-2.76	97.7
Shawano	Bowler	44.0	-20.9	1.45	3.45	73.4	-29.2	6.50	98.0	-2.41	97.2
Pierce	River Falls	47.0	-20.7	1.54	3.39	73.4	-29.2	6.09	98.0	-2.50	97.4
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	73.4	-29.2	6.65	98.0	-3.54	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	73.4	-29.2	6.44	98.0	-3.01	97.9
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	73.4	-29.2	6.45	98.0	-2.77	97.7
Clark	Owen	43.3	-22.2	1.43	3.34	73.4	-29.2	6.56	98.0	-2.10	96.2
Chippewa	Stanley	45.3	-21.7	1.50	3.34	73.4	-29.2	6.26	98.0	-2.25	96.8
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	73.4	-29.2	6.15	98.0	-2.10	96.3
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	73.4	-29.2	6.03	98.0	-2.19	96.6
Marinette	Marinette	45.9	-17.9	1.54	3.17	73.4	-29.2	6.12	98.0	-3.56	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	73.4	-29.2	6.52	98.0	-2.20	96.6
Langlade	Antigo	43.9	-22.1	1.48	3.17	73.4	-29.2	6.37	98.0	-2.24	96.8
Lincoln	Merrill	44.2	-22.3	1.49	3.57	73.4	-29.2	6.31	98.0	-1.93	95.4
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	73.4	-29.2	6.01	98.0	-1.55	92.1
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	73.4	-29.2	6.07	98.0	-1.60	92.6
Polk	Amery	44.9	-22.5	1.53	3.74	73.4	-29.2	6.16	98.0	-1.79	94.4
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	73.4	-29.2	6.20	98.0	-2.45	97.3
Taylor	Jump River	44.3	-24.8	1.51	3.51	73.4	-29.2	6.21	98.0	-1.25	87.7
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	73.4	-29.2	6.18	98.0	-2.24	96.8
Door	Washington Island	39.6	-16.5	1.35	3.45	73.4	-29.2	6.94	98.0	-3.68	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	73.4	-29.2	5.86	98.0	-1.80	94.5
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	73.4	-29.2	6.02	98.0	-1.86	94.9
Barron	Rice Lake	45.3	-23.1	1.56	3.63	73.4	-29.2	6.01	98.0	-1.68	93.5
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	73.4	-29.2	6.41	98.0	-1.16	85.9
Forest	Laona	41.2	-21.6	1.43	3.17	73.4	-29.2	6.59	98.0	-2.40	97.2
Barron	Cumberland	46.0	-22.4	1.59	3.28	73.4	-29.2	5.90	98.0	-2.07	96.1
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	73.4	-29.2	6.04	98.0	-1.38	89.9
Polk	Luck	45.4	-22.7	1.58	3.39	73.4	-29.2	5.96	98.0	-1.92	95.3
Marinette	Goodman	42.1	-20.8	1.47	3.12	73.4	-29.2	6.40	98.0	-2.69	97.7
Oneida	North Pelican	41.5	-23.7	1.45	3.28	73.4	-29.2	6.49	98.0	-1.68	93.4
Oneida	Rhineland	43.2	-22.5	1.51	3.07	73.4	-29.2	6.24	98.0	-2.19	96.6
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	73.4	-29.2	6.41	98.0	-1.74	94.0
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	73.4	-29.2	5.94	98.0	-1.59	92.6
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	73.4	-29.2	6.15	98.0	-1.74	94.0
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	73.4	-29.2	5.81	98.0	-1.64	93.0
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	73.4	-29.2	6.33	98.0	-1.89	95.1
Sawyer	Couderay	44.6	-26.0	1.59	4.17	73.4	-29.2	5.93	98.0	-0.77	76.3
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	73.4	-29.2	6.28	98.0	-1.83	94.7
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	73.4	-29.2	6.29	98.0	-1.66	93.3
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	73.4	-29.2	6.16	98.0	-1.83	94.7
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	73.4	-29.2	6.55	98.0	-1.89	95.1
Price	Park Falls	41.9	-21.8	1.50	3.17	73.4	-29.2	6.28	98.0	-2.33	97.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	73.4	-29.2	6.00	98.0	-1.52	91.7
Burnett	Danbury	44.6	-24.6	1.60	3.23	73.4	-29.2	5.86	98.0	-1.43	90.5
Washburn	Minong 2	44.8	-26.2	1.62	3.12	73.4	-29.2	5.81	98.0	-0.96	81.5
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	73.4	-29.2	6.07	98.0	-1.68	93.4
Douglas	Gordon	44.4	-26.4	1.63	3.17	73.4	-29.2	5.78	98.0	-0.88	79.5
Bayfield	Drummond	44.2	-23.8	1.63	3.28	73.4	-29.2	5.77	98.0	-1.65	93.1
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	73.4	-29.2	5.60	98.0	-1.27	88.0
Ashland	Mellen	42.8	-24.1	1.59	3.34	73.4	-29.2	5.92	98.0	-1.53	91.8
Douglas	Foxboro	43.4	-24.8	1.62	3.07	73.4	-29.2	5.81	98.0	-1.44	90.6
Iron	Gurney	42.4	-22.2	1.58	3.12	73.4	-29.2	5.95	98.0	-2.24	96.8
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	73.4	-29.2	5.72	98.0	-2.21	96.7
Douglas	Superior	39.3	-22.1	1.49	3.17	73.4	-29.2	6.32	98.0	-2.24	96.8
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	73.4	-29.2	5.84	98.0	-2.15	96.4
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	73.4	-29.2	6.09	98.0	-2.59	97.5
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	73.4	-29.2	5.28	98.0	-2.93	97.8

Table C31. Lower Layer Reliability Analysis for 21 % RAS and 14% RAP, Exceptional Grade Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	72.5	-25.2	6.50	98.0	-2.79	97.7
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	72.5	-25.2	7.37	98.0	-2.51	97.4
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	72.5	-25.2	6.46	98.0	-2.68	97.6
Rock	Afton	47.6	-16.4	1.29	3.92	72.5	-25.2	6.57	98.0	-2.24	96.8
Green	Brodhead	47.9	-18.0	1.30	3.45	72.5	-25.2	6.53	98.0	-2.09	96.2
Racine	Burlington	46.3	-16.2	1.26	3.34	72.5	-25.2	6.74	98.0	-2.70	97.7
Rock	Janesville	49.9	-16.7	1.36	3.12	72.5	-25.2	6.24	98.0	-2.73	97.7
Lafayette	Darlington	47.7	-18.3	1.30	3.39	72.5	-25.2	6.52	98.0	-2.03	95.9
Racine	Racine	43.6	-15.9	1.19	3.57	72.5	-25.2	7.12	98.0	-2.61	97.6
Grant	Platteville	47.8	-17.9	1.31	3.28	72.5	-25.2	6.47	98.0	-2.22	96.7
Grant	Lancaster	46.8	-18.2	1.30	3.23	72.5	-25.2	6.56	98.0	-2.17	96.5
Walworth	Whitewater	48.0	-16.8	1.33	3.39	72.5	-25.2	6.38	98.0	-2.48	97.3
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	72.5	-25.2	6.41	98.0	-1.98	95.6
Dane	Stoughton	47.5	-17.4	1.33	3.34	72.5	-25.2	6.41	98.0	-2.34	97.0
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	72.5	-25.2	6.86	98.0	-2.80	97.8
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	72.5	-25.2	6.55	98.0	-2.29	96.9
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	72.5	-25.2	6.48	98.0	-2.62	97.6
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	72.5	-25.2	6.49	98.0	-2.85	97.8
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	72.5	-25.2	6.31	98.0	-1.82	94.6
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	72.5	-25.2	6.05	98.0	-1.74	94.0
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	72.5	-25.2	6.50	98.0	-2.10	96.3
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	72.5	-25.2	6.21	98.0	-2.39	97.2
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	72.5	-25.2	6.26	98.0	-2.80	97.7
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	72.5	-25.2	6.41	98.0	-2.37	97.1
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	72.5	-25.2	6.35	98.0	-2.20	96.6
Jefferson	Watertown	47.5	-17.4	1.36	3.51	72.5	-25.2	6.27	98.0	-2.22	96.7
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	72.5	-25.2	6.16	98.0	-1.85	94.9
Washington	Germantown	45.3	-17.7	1.30	3.57	72.5	-25.2	6.55	98.0	-2.10	96.3
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	72.5	-25.2	6.27	98.0	-2.07	96.1
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	72.5	-25.2	6.34	98.0	-1.88	95.1
Richland	Richland Center	48.2	-19.9	1.39	3.74	72.5	-25.2	6.10	98.0	-1.42	90.3
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	72.5	-25.2	6.30	98.0	-2.13	96.4
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	72.5	-25.2	7.02	98.0	-2.79	97.7
Washington	West Bend	45.4	-17.4	1.32	3.45	72.5	-25.2	6.44	98.0	-2.26	96.8
Dodge	Horicon	46.4	-18.2	1.36	3.39	72.5	-25.2	6.27	98.0	-2.06	96.1
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	72.5	-25.2	6.14	98.0	-2.17	96.5
Sauk	Baraboo	46.6	-20.2	1.36	3.74	72.5	-25.2	6.23	98.0	-1.34	89.1
Columbia	Portage	47.7	-18.6	1.40	3.57	72.5	-25.2	6.06	98.0	-1.85	94.9
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	72.5	-25.2	6.06	98.0	-1.62	92.8
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	72.5	-25.2	6.09	98.0	-1.66	93.2
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	72.5	-25.2	6.29	98.0	-1.35	89.4
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	72.5	-25.2	6.25	98.0	-1.66	93.2
Green Lake	Dalton	47.3	-18.5	1.41	3.23	72.5	-25.2	6.05	98.0	-2.08	96.1
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	72.5	-25.2	6.06	98.0	-1.19	86.5

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	72.5	-25.2	6.22	98.0	-2.37	97.1
Monroe	Cashton	45.8	-18.9	1.37	3.68	72.5	-25.2	6.19	98.0	-1.71	93.7
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	72.5	-25.2	6.46	98.0	-2.76	97.7
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	72.5	-25.2	5.98	98.0	-1.43	90.6
Marquette	Montello	46.8	-19.5	1.41	3.45	72.5	-25.2	6.05	98.0	-1.65	93.2
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	72.5	-25.2	6.22	98.0	-2.27	96.9
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	72.5	-25.2	5.85	98.0	-1.66	93.2
Monroe	Sparta	47.5	-21.3	1.45	3.74	72.5	-25.2	5.88	98.0	-1.04	83.4
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	72.5	-25.2	5.89	98.0	-1.35	89.4
Juneau	Necedah	48.1	-21.6	1.48	3.68	72.5	-25.2	5.76	98.0	-0.98	81.9
Calumet	Chilton	46.5	-17.7	1.43	3.23	72.5	-25.2	5.96	98.0	-2.32	97.0
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	72.5	-25.2	6.06	98.0	-2.19	96.6
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	72.5	-25.2	6.36	98.0	-2.60	97.5
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	72.5	-25.2	5.83	98.0	-1.31	88.7
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	72.5	-25.2	5.60	98.0	-0.68	73.6
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	72.5	-25.2	6.95	98.0	-2.68	97.6
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	72.5	-25.2	5.98	98.0	-1.35	89.3
Outagamie	Appleton	45.1	-17.7	1.41	3.07	72.5	-25.2	6.03	98.0	-2.45	97.3
Trempealeau	Blair	46.5	-22.2	1.46	3.80	72.5	-25.2	5.83	98.0	-0.79	76.9
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	72.5	-25.2	5.75	98.0	-1.49	91.3
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	72.5	-25.2	5.80	98.0	-1.98	95.6
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	72.5	-25.2	5.99	98.0	-0.75	75.8
Waupaca	New London	47.0	-19.4	1.48	3.34	72.5	-25.2	5.73	98.0	-1.74	94.0
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	72.5	-25.2	5.84	98.0	-1.55	92.1
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	72.5	-25.2	5.53	98.0	-0.39	64.0
Wood	Pittsville	46.6	-22.3	1.48	3.34	72.5	-25.2	5.75	98.0	-0.87	79.1
Portage	Stevens Point	45.1	-19.8	1.44	3.28	72.5	-25.2	5.91	98.0	-1.65	93.1
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	72.5	-25.2	5.78	98.0	-0.84	78.4
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	72.5	-25.2	5.62	98.0	-0.91	80.1
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	72.5	-25.2	5.86	98.0	-1.58	92.4
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	72.5	-25.2	5.79	98.0	-1.83	94.7
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	72.5	-25.2	5.74	98.0	-1.46	90.9
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	72.5	-25.2	5.63	98.0	-1.23	87.3
Marathon	Rosholt	45.4	-21.2	1.48	3.28	72.5	-25.2	5.74	98.0	-1.22	87.1
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	72.5	-25.2	5.59	98.0	-1.30	88.5
Dunn	Menomonie	47.8	-21.2	1.57	3.57	72.5	-25.2	5.41	98.0	-1.12	85.2

Table C32. Lower Layer Reliability Analysis for 21 % RAS and 14 % RAP, Exceptional Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	74.4	-28.3	7.90	98.0	-2.91	97.8
Brown	Green Bay	44.8	-18.5	1.43	3.23	74.4	-28.3	7.28	98.0	-3.04	97.9
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	74.4	-28.3	6.95	98.0	-2.49	97.4
Shawano	Bowler	44.0	-20.9	1.45	3.45	74.4	-28.3	7.19	98.0	-2.14	96.4
Pierce	River Falls	47.0	-20.7	1.54	3.39	74.4	-28.3	6.73	98.0	-2.24	96.8
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	74.4	-28.3	7.36	98.0	-3.27	97.9
Oconto	Oconto	44.3	-19.0	1.46	3.39	74.4	-28.3	7.13	98.0	-2.74	97.7
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	74.4	-28.3	7.13	98.0	-2.50	97.4
Clark	Owen	43.3	-22.2	1.43	3.34	74.4	-28.3	7.26	98.0	-1.83	94.7
Chippewa	Stanley	45.3	-21.7	1.50	3.34	74.4	-28.3	6.93	98.0	-1.98	95.6
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	74.4	-28.3	6.81	98.0	-1.85	94.9
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	74.4	-28.3	6.67	98.0	-1.94	95.4
Marinette	Marinette	45.9	-17.9	1.54	3.17	74.4	-28.3	6.77	98.0	-3.28	97.9
Taylor	Medford	43.0	-22.1	1.44	3.23	74.4	-28.3	7.21	98.0	-1.92	95.3
Langlade	Antigo	43.9	-22.1	1.48	3.17	74.4	-28.3	7.05	98.0	-1.95	95.5
Lincoln	Merrill	44.2	-22.3	1.49	3.57	74.4	-28.3	6.99	98.0	-1.68	93.5
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	74.4	-28.3	6.65	98.0	-1.31	88.8
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	74.4	-28.3	6.72	98.0	-1.35	89.3
Polk	Amery	44.9	-22.5	1.53	3.74	74.4	-28.3	6.81	98.0	-1.55	92.1
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	74.4	-28.3	6.86	98.0	-2.17	96.5
Taylor	Jump River	44.3	-24.8	1.51	3.51	74.4	-28.3	6.87	98.0	-1.00	82.4
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	74.4	-28.3	6.83	98.0	-1.99	95.7
Door	Washington Island	39.6	-16.5	1.35	3.45	74.4	-28.3	7.68	98.0	-3.42	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	74.4	-28.3	6.49	98.0	-1.52	91.7
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	74.4	-28.3	6.66	98.0	-1.58	92.4
Barron	Rice Lake	45.3	-23.1	1.56	3.63	74.4	-28.3	6.65	98.0	-1.43	90.6
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	74.4	-28.3	7.09	98.0	-0.90	79.9
Forest	Laona	41.2	-21.6	1.43	3.17	74.4	-28.3	7.30	98.0	-2.11	96.3
Barron	Cumberland	46.0	-22.4	1.59	3.28	74.4	-28.3	6.53	98.0	-1.80	94.5
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	74.4	-28.3	6.68	98.0	-1.12	85.1
Polk	Luck	45.4	-22.7	1.58	3.39	74.4	-28.3	6.60	98.0	-1.65	93.2
Marinette	Goodman	42.1	-20.8	1.47	3.12	74.4	-28.3	7.08	98.0	-2.41	97.2
Oneida	North Pelican	41.5	-23.7	1.45	3.28	74.4	-28.3	7.18	98.0	-1.40	90.1
Oneida	Rhineland	43.2	-22.5	1.51	3.07	74.4	-28.3	6.90	98.0	-1.89	95.1
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	74.4	-28.3	7.10	98.0	-1.46	90.9
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	74.4	-28.3	6.57	98.0	-1.33	89.1
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	74.4	-28.3	6.80	98.0	-1.46	90.9
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	74.4	-28.3	6.43	98.0	-1.36	89.4
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	74.4	-28.3	7.00	98.0	-1.61	92.8
Sawyer	Couderay	44.6	-26.0	1.59	4.17	74.4	-28.3	6.56	98.0	-0.55	69.5
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	74.4	-28.3	6.94	98.0	-1.56	92.2
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	74.4	-28.3	6.96	98.0	-1.37	89.6
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	74.4	-28.3	6.82	98.0	-1.53	91.8
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	74.4	-28.3	7.25	98.0	-1.61	92.8
Price	Park Falls	41.9	-21.8	1.50	3.17	74.4	-28.3	6.95	98.0	-2.05	96.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	74.4	-28.3	6.64	98.0	-1.25	87.6
Burnett	Danbury	44.6	-24.6	1.60	3.23	74.4	-28.3	6.48	98.0	-1.15	85.7
Washburn	Minong 2	44.8	-26.2	1.62	3.12	74.4	-28.3	6.43	98.0	-0.67	73.5
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	74.4	-28.3	6.72	98.0	-1.40	90.1
Douglas	Gordon	44.4	-26.4	1.63	3.17	74.4	-28.3	6.40	98.0	-0.60	71.1
Bayfield	Drummond	44.2	-23.8	1.63	3.28	74.4	-28.3	6.39	98.0	-1.37	89.7
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	74.4	-28.3	6.20	98.0	-0.99	82.3
Ashland	Mellen	42.8	-24.1	1.59	3.34	74.4	-28.3	6.55	98.0	-1.26	87.8
Douglas	Foxboro	43.4	-24.8	1.62	3.07	74.4	-28.3	6.43	98.0	-1.14	85.6
Iron	Gurney	42.4	-22.2	1.58	3.12	74.4	-28.3	6.58	98.0	-1.96	95.5
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	74.4	-28.3	6.33	98.0	-1.92	95.3
Douglas	Superior	39.3	-22.1	1.49	3.17	74.4	-28.3	6.99	98.0	-1.95	95.5
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	74.4	-28.3	6.46	98.0	-1.86	94.9
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	74.4	-28.3	6.74	98.0	-2.34	97.1
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	74.4	-28.3	5.84	98.0	-2.65	97.6

Appendix D. Reliability Analyses of Recommended Binder Replacement Criteria

Table D1. Surface Layer Reliability Analysis for Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	60.0	-29.4	-2.78	0.3	-3.15	97.9	60.0	-29.4	-2.78	0.3
Kenosha	Kenosha	60.0	-29.4	-3.11	0.1	-2.82	97.8	60.0	-29.4	-3.11	0.1
Walworth	Lake Geneva	60.0	-29.4	-2.76	0.3	-3.03	97.9	60.0	-29.4	-2.76	0.3
Rock	Afton	60.0	-29.4	-2.80	0.2	-2.55	97.5	60.0	-29.4	-2.80	0.2
Green	Brodhead	60.0	-29.4	-2.79	0.3	-2.43	97.3	60.0	-29.4	-2.79	0.3
Racine	Burlington	60.0	-29.4	-2.87	0.2	-3.06	97.9	60.0	-29.4	-2.87	0.2
Rock	Janesville	60.0	-29.4	-2.67	0.4	-3.11	97.9	60.0	-29.4	-2.67	0.4
Lafayette	Darlington	60.0	-29.4	-2.78	0.3	-2.39	97.2	60.0	-29.4	-2.78	0.3
Racine	Racine	60.0	-29.4	-3.01	0.1	-2.94	97.8	60.0	-29.4	-3.01	0.1
Grant	Platteville	60.0	-29.4	-2.76	0.3	-2.59	97.5	60.0	-29.4	-2.76	0.3
Grant	Lancaster	60.0	-29.4	-2.79	0.3	-2.54	97.5	60.0	-29.4	-2.79	0.3
Walworth	Whitewater	60.0	-29.4	-2.73	0.3	-2.83	97.8	60.0	-29.4	-2.73	0.3
Jefferson	Fort Atkinson	60.0	-29.4	-2.73	0.3	-2.30	96.9	60.0	-29.4	-2.73	0.3
Dane	Stoughton	60.0	-29.4	-2.74	0.3	-2.70	97.7	60.0	-29.4	-2.74	0.3
Milwaukee	Milwaukee Mtchl Fld	60.0	-29.4	-2.91	0.2	-3.14	97.9	60.0	-29.4	-2.91	0.2
Iowa	Dodgeville	60.0	-29.4	-2.79	0.3	-2.67	97.6	60.0	-29.4	-2.79	0.3
Waukesha	Waukesha	60.0	-29.4	-2.76	0.3	-2.98	97.9	60.0	-29.4	-2.76	0.3
Milwaukee	West Allis	60.0	-29.4	-2.76	0.3	-3.21	97.9	60.0	-29.4	-2.76	0.3
Dane	Arboretum Univ Wis	60.0	-29.4	-2.69	0.3	-2.16	96.5	60.0	-29.4	-2.69	0.3
Crawford	Prairie Du Chien	60.0	-29.4	-2.59	0.5	-2.06	96.1	60.0	-29.4	-2.59	0.5
Dane	Charmany Farm	60.0	-29.4	-2.77	0.3	-2.44	97.3	60.0	-29.4	-2.77	0.3
Jefferson	Lake Mills	60.0	-29.4	-2.65	0.4	-2.76	97.7	60.0	-29.4	-2.65	0.4
Milwaukee	Milwaukee Mt Mary Co	60.0	-29.4	-2.67	0.4	-3.15	97.9	60.0	-29.4	-2.67	0.4
Waukesha	Oconomowoc	60.0	-29.4	-2.73	0.3	-2.73	97.7	60.0	-29.4	-2.73	0.3
Dane	Madison Dane Cnty Ap	60.0	-29.4	-2.71	0.3	-2.55	97.5	60.0	-29.4	-2.71	0.3
Jefferson	Watertown	60.0	-29.4	-2.67	0.4	-2.57	97.5	60.0	-29.4	-2.67	0.4
Crawford	Lynxville Dam 9	60.0	-29.4	-2.63	0.4	-2.19	96.6	60.0	-29.4	-2.63	0.4
Washington	Germantown	60.0	-29.4	-2.78	0.3	-2.44	97.3	60.0	-29.4	-2.78	0.3
Columbia	Arlington Univ Farm	60.0	-29.4	-2.67	0.4	-2.43	97.3	60.0	-29.4	-2.67	0.4
Washington	Hartford 2 W	60.0	-29.4	-2.70	0.3	-2.22	96.7	60.0	-29.4	-2.70	0.3
Richland	Richland Center	60.0	-29.4	-2.61	0.4	-1.74	94.0	60.0	-29.4	-2.61	0.4
Sauk	Prairie Du Sac 2 N	60.0	-29.4	-2.68	0.4	-2.49	97.4	60.0	-29.4	-2.68	0.4
Ozaukee	Port Washington	60.0	-29.4	-2.96	0.2	-3.15	97.9	60.0	-29.4	-2.96	0.2
Washington	West Bend	60.0	-29.4	-2.73	0.3	-2.61	97.6	60.0	-29.4	-2.73	0.3
Dodge	Horicon	60.0	-29.4	-2.67	0.4	-2.42	97.2	60.0	-29.4	-2.67	0.4
Dodge	Beaver Dam	60.0	-29.4	-2.62	0.4	-2.52	97.4	60.0	-29.4	-2.62	0.4
Sauk	Baraboo	60.0	-29.4	-2.65	0.4	-1.66	93.2	60.0	-29.4	-2.65	0.4
Columbia	Portage	60.0	-29.4	-2.59	0.5	-2.19	96.6	60.0	-29.4	-2.59	0.5
Sauk	Reedsburg	60.0	-29.4	-2.59	0.5	-1.97	95.6	60.0	-29.4	-2.59	0.5
Vernon	Genoa Dam 8	60.0	-29.4	-2.60	0.5	-1.98	95.7	60.0	-29.4	-2.60	0.5
Vernon	Viroqua 2 Nw	60.0	-29.4	-2.67	0.4	-1.68	93.5	60.0	-29.4	-2.67	0.4
Columbia	Wisconsin Dells	60.0	-29.4	-2.66	0.4	-1.99	95.7	60.0	-29.4	-2.66	0.4
Green Lake	Dalton	60.0	-29.4	-2.58	0.5	-2.45	97.3	60.0	-29.4	-2.58	0.5

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	60.0	-29.4	-2.58	0.5	-1.50	91.5	60.0	-29.4	-2.58	0.5
Sheboygan	Plymouth	60.0	-29.4	-2.64	0.4	-2.73	97.7	60.0	-29.4	-2.64	0.4
Monroe	Cashton	60.0	-29.4	-2.63	0.4	-2.04	96.0	60.0	-29.4	-2.63	0.4
Sheboygan	Sheboygan	60.0	-29.4	-2.74	0.3	-3.12	97.9	60.0	-29.4	-2.74	0.3
Juneau	Mauston 1 Se	60.0	-29.4	-2.55	0.5	-1.77	94.2	60.0	-29.4	-2.55	0.5
Marquette	Montello	60.0	-29.4	-2.58	0.5	-2.00	95.8	60.0	-29.4	-2.58	0.5
Fond Du Lac	Fond Du Lac	60.0	-29.4	-2.64	0.4	-2.62	97.6	60.0	-29.4	-2.64	0.4
La Crosse	La Crosse Muni Ap	60.0	-29.4	-2.50	0.6	-1.99	95.7	60.0	-29.4	-2.50	0.6
Monroe	Sparta	60.0	-29.4	-2.51	0.6	-1.36	89.5	60.0	-29.4	-2.51	0.6
Trempealeau	Trempealeau Dam 6	60.0	-29.4	-2.51	0.6	-1.68	93.5	60.0	-29.4	-2.51	0.6
Juneau	Necedah	60.0	-29.4	-2.46	0.7	-1.30	88.6	60.0	-29.4	-2.46	0.7
Calumet	Chilton	60.0	-29.4	-2.54	0.5	-2.70	97.7	60.0	-29.4	-2.54	0.5
Winnebago	Oshkosh	60.0	-29.4	-2.58	0.5	-2.55	97.5	60.0	-29.4	-2.58	0.5
Manitowoc	Manitowoc	60.0	-29.4	-2.69	0.4	-2.98	97.9	60.0	-29.4	-2.69	0.4
Waushara	Hancock Exp Farm	60.0	-29.4	-2.48	0.6	-1.65	93.2	60.0	-29.4	-2.48	0.6
Trempealeau	Dodge	60.0	-29.4	-2.39	0.8	-1.00	82.6	60.0	-29.4	-2.39	0.8
Manitowoc	Two Rivers 10 N	60.0	-29.4	-2.91	0.2	-3.06	97.9	60.0	-29.4	-2.91	0.2
Jackson	Mather 3 Nw	60.0	-29.4	-2.54	0.5	-1.68	93.5	60.0	-29.4	-2.54	0.5
Outagamie	Appleton	60.0	-29.4	-2.56	0.5	-2.84	97.8	60.0	-29.4	-2.56	0.5
Trempealeau	Blair	60.0	-29.4	-2.48	0.6	-1.10	84.8	60.0	-29.4	-2.48	0.6
Buffalo	Alma Dam 4	60.0	-29.4	-2.45	0.7	-1.82	94.6	60.0	-29.4	-2.45	0.7
Waupaca	Waupaca	60.0	-29.4	-2.47	0.7	-2.34	97.0	60.0	-29.4	-2.47	0.7
Portage	Coddington 1 E	60.0	-29.4	-2.54	0.5	-1.11	84.9	60.0	-29.4	-2.54	0.5
Waupaca	New London	60.0	-29.4	-2.44	0.7	-2.10	96.2	60.0	-29.4	-2.44	0.7
Wood	Wisconsin Rapids	60.0	-29.4	-2.48	0.6	-1.92	95.3	60.0	-29.4	-2.48	0.6
Jackson	Hatfield Hydro Plant	60.0	-29.4	-2.36	0.9	-0.73	75.2	60.0	-29.4	-2.36	0.9
Wood	Pittsville	60.0	-29.4	-2.45	0.7	-1.23	87.3	60.0	-29.4	-2.45	0.7
Portage	Stevens Point	60.0	-29.4	-2.51	0.6	-2.01	95.8	60.0	-29.4	-2.51	0.6
Clark	Neillsville 3 Sw	60.0	-29.4	-2.46	0.7	-1.18	86.3	60.0	-29.4	-2.46	0.7
Buffalo	Mondovi	60.0	-29.4	-2.39	0.8	-1.22	87.0	60.0	-29.4	-2.39	0.8
Eau Claire	Fairchild Ranger Sta	60.0	-29.4	-2.49	0.6	-1.95	95.5	60.0	-29.4	-2.49	0.6
Waupaca	Clintonville	60.0	-29.4	-2.46	0.7	-2.19	96.6	60.0	-29.4	-2.46	0.7
Wood	Marshfield Exp Farm	60.0	-29.4	-2.44	0.7	-1.83	94.7	60.0	-29.4	-2.44	0.7
Pierce	Ellsworth	60.0	-29.4	-2.40	0.8	-1.59	92.5	60.0	-29.4	-2.40	0.8
Marathon	Rosholt	60.0	-29.4	-2.44	0.7	-1.58	92.5	60.0	-29.4	-2.44	0.7
Chippewa	Eau Claire County Ap	60.0	-29.4	-2.38	0.9	-1.65	93.2	60.0	-29.4	-2.38	0.9
Dunn	Menomonie	60.0	-29.4	-2.31	1.0	-1.46	90.9	60.0	-29.4	-2.31	1.0

Table D2. Surface Layer Reliability Analysis for Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	60.0	-35.4	-2.72	0.3	-3.94	98.0	60.0	-35.4	-2.72	0.3
Brown	Green Bay	60.0	-35.4	-2.52	0.6	-4.31	98.0	60.0	-35.4	-2.52	0.6
Shawano	Shawano 2 Ssw	60.0	-35.4	-2.42	0.8	-3.72	98.0	60.0	-35.4	-2.42	0.8
Shawano	Bowler	60.0	-35.4	-2.49	0.6	-3.33	98.0	60.0	-35.4	-2.49	0.6
Pierce	River Falls	60.0	-35.4	-2.35	0.9	-3.45	98.0	60.0	-35.4	-2.35	0.9
Door	Sturgeon Bay Exp Far	60.0	-35.4	-2.54	0.5	-4.49	98.0	60.0	-35.4	-2.54	0.5
Oconto	Oconto	60.0	-35.4	-2.47	0.7	-3.95	98.0	60.0	-35.4	-2.47	0.7
Marathon	Wausau Municipal Ap	60.0	-35.4	-2.47	0.7	-3.75	98.0	60.0	-35.4	-2.47	0.7
Clark	Owen	60.0	-35.4	-2.51	0.6	-3.06	97.9	60.0	-35.4	-2.51	0.6
Chippewa	Stanley	60.0	-35.4	-2.41	0.8	-3.21	97.9	60.0	-35.4	-2.41	0.8
Oconto	Breed 6 Sse	60.0	-35.4	-2.37	0.9	-3.00	97.9	60.0	-35.4	-2.37	0.9
Chippewa	Bloomer	60.0	-35.4	-2.32	1.0	-3.11	97.9	60.0	-35.4	-2.32	1.0
Marinette	Marinette	60.0	-35.4	-2.35	0.9	-4.57	98.0	60.0	-35.4	-2.35	0.9
Taylor	Medford	60.0	-35.4	-2.49	0.6	-3.19	97.9	60.0	-35.4	-2.49	0.6
Langlade	Antigo	60.0	-35.4	-2.44	0.7	-3.25	97.9	60.0	-35.4	-2.44	0.7
Lincnln	Merrill	60.0	-35.4	-2.42	0.8	-2.83	97.8	60.0	-35.4	-2.42	0.8
Chippewa	Holcombe	60.0	-35.4	-2.31	1.0	-2.39	97.2	60.0	-35.4	-2.31	1.0
Barron	Ridgeland 1 Nne	60.0	-35.4	-2.33	1.0	-2.50	97.4	60.0	-35.4	-2.33	1.0
Polk	Amery	60.0	-35.4	-2.36	0.9	-2.64	97.6	60.0	-35.4	-2.36	0.9
Oconto	Lakewood 3 Ne	60.0	-35.4	-2.38	0.9	-3.44	98.0	60.0	-35.4	-2.38	0.9
Taylor	Jump River	60.0	-35.4	-2.38	0.9	-2.17	96.5	60.0	-35.4	-2.38	0.9
Marinette	Crivitz High Falls	60.0	-35.4	-2.37	0.9	-3.14	97.9	60.0	-35.4	-2.37	0.9
Door	Washington Island	60.0	-35.4	-2.63	0.4	-4.61	98.0	60.0	-35.4	-2.63	0.4
Polk	St Croix Falls	60.0	-35.4	-2.26	1.2	-2.77	97.7	60.0	-35.4	-2.26	1.2
Rusk	Weyerhauser	60.0	-35.4	-2.31	1.0	-2.85	97.8	60.0	-35.4	-2.31	1.0
Barron	Rice Lake	60.0	-35.4	-2.31	1.0	-2.57	97.5	60.0	-35.4	-2.31	1.0
Price	Prentice 5 W	60.0	-35.4	-2.44	0.7	-2.09	96.2	60.0	-35.4	-2.44	0.7
Forest	Laona	60.0	-35.4	-2.51	0.6	-3.40	98.0	60.0	-35.4	-2.51	0.6
Barron	Cumberland	60.0	-35.4	-2.27	1.1	-3.05	97.9	60.0	-35.4	-2.27	1.1
Rusk	Big Falls Hydro	60.0	-35.4	-2.32	1.0	-2.33	97.0	60.0	-35.4	-2.32	1.0
Polk	Luck	60.0	-35.4	-2.29	1.1	-2.86	97.8	60.0	-35.4	-2.29	1.1
Marinette	Goodman	60.0	-35.4	-2.44	0.7	-3.72	98.0	60.0	-35.4	-2.44	0.7
Oneida	North Pelican	60.0	-35.4	-2.47	0.7	-2.65	97.6	60.0	-35.4	-2.47	0.7
Oneida	Rhineland	60.0	-35.4	-2.38	0.8	-3.23	97.9	60.0	-35.4	-2.38	0.8
Oneida	Willow Reservoir	60.0	-35.4	-2.44	0.7	-2.73	97.7	60.0	-35.4	-2.44	0.7
Burnett	Grantsburg	60.0	-35.4	-2.28	1.1	-2.52	97.4	60.0	-35.4	-2.28	1.1
Forest	Newald 4 N	60.0	-35.4	-2.35	0.9	-2.73	97.7	60.0	-35.4	-2.35	0.9
Washburn	Spooner Exp Farm	60.0	-35.4	-2.23	1.3	-2.65	97.6	60.0	-35.4	-2.23	1.3
Oneida	Rainbow Rsvr Lake	60.0	-35.4	-2.41	0.8	-2.88	97.8	60.0	-35.4	-2.41	0.8
Sawyer	Couderay	60.0	-35.4	-2.27	1.1	-1.53	91.9	60.0	-35.4	-2.27	1.1
Oneida	Minocqua Dam	60.0	-35.4	-2.39	0.8	-2.77	97.7	60.0	-35.4	-2.39	0.8
Sawyer	Winter 5 Nw	60.0	-35.4	-2.40	0.8	-2.71	97.7	60.0	-35.4	-2.40	0.8
Oneida	Long Lake Dam	60.0	-35.4	-2.35	0.9	-2.89	97.8	60.0	-35.4	-2.35	0.9
Vilas	St Germain 2 E	60.0	-35.4	-2.48	0.6	-2.88	97.8	60.0	-35.4	-2.48	0.6
Price	Park Falls	60.0	-35.4	-2.39	0.8	-3.34	98.0	60.0	-35.4	-2.39	0.8

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	60.0	-35.4	-2.30	1.1	-2.50	97.4	60.0	-35.4	-2.30	1.1
Burnett	Danbury	60.0	-35.4	-2.25	1.2	-2.42	97.2	60.0	-35.4	-2.25	1.2
Washburn	Minong 2	60.0	-35.4	-2.23	1.3	-1.99	95.7	60.0	-35.4	-2.23	1.3
Vilas	Rest Lake	60.0	-35.4	-2.32	1.0	-2.65	97.6	60.0	-35.4	-2.32	1.0
Douglas	Gordon	60.0	-35.4	-2.22	1.3	-1.89	95.1	60.0	-35.4	-2.22	1.3
Bayfield	Drummond	60.0	-35.4	-2.21	1.3	-2.62	97.6	60.0	-35.4	-2.21	1.3
Douglas	Solon Springs	60.0	-35.4	-2.15	1.5	-2.26	96.8	60.0	-35.4	-2.15	1.5
Ashland	Mellen	60.0	-35.4	-2.26	1.2	-2.49	97.4	60.0	-35.4	-2.26	1.2
Douglas	Foxboro	60.0	-35.4	-2.22	1.3	-2.48	97.4	60.0	-35.4	-2.22	1.3
Iron	Gurney	60.0	-35.4	-2.27	1.1	-3.27	97.9	60.0	-35.4	-2.27	1.1
Bayfield	Ashland Exp Farm	60.0	-35.4	-2.19	1.4	-3.22	97.9	60.0	-35.4	-2.19	1.4
Douglas	Superior	60.0	-35.4	-2.39	0.8	-3.25	97.9	60.0	-35.4	-2.39	0.8
Bayfield	Port Wing	60.0	-35.4	-2.23	1.3	-3.17	97.9	60.0	-35.4	-2.23	1.3
Ashland	Madeline Island	60.0	-35.4	-2.31	1.0	-3.48	98.0	60.0	-35.4	-2.31	1.0
Bayfield	Bayfield	60.0	-35.4	-2.25	1.2	-3.90	98.0	60.0	-35.4	-2.25	1.2

Table D3. Surface Layer Reliability Analysis for 20 % RAP, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-18.9	1.44	3.34	64.2	-27.8	0.14	54.4	-2.67	97.6
Kenosha	Kenosha	47.6	-18.5	1.29	3.86	64.2	-27.8	0.16	55.1	-2.41	97.2
Walworth	Lake Geneva	53.4	-19.1	1.45	3.39	64.2	-27.8	0.14	54.4	-2.56	97.5
Rock	Afton	52.5	-19.4	1.43	3.92	64.2	-27.8	0.14	54.5	-2.14	96.4
Green	Brodhead	52.8	-21.0	1.44	3.45	64.2	-27.8	0.14	54.4	-1.97	95.6
Racine	Burlington	51.2	-19.2	1.40	3.34	64.2	-27.8	0.14	54.6	-2.58	97.5
Rock	Janesville	54.8	-19.7	1.50	3.12	64.2	-27.8	0.13	54.2	-2.60	97.5
Lafayette	Darlington	52.6	-21.3	1.44	3.39	64.2	-27.8	0.14	54.4	-1.92	95.3
Racine	Racine	48.5	-18.9	1.33	3.57	64.2	-27.8	0.15	54.9	-2.50	97.4
Grant	Platteville	52.7	-20.9	1.45	3.28	64.2	-27.8	0.14	54.4	-2.10	96.3
Grant	Lancaster	51.7	-21.2	1.43	3.23	64.2	-27.8	0.14	54.4	-2.05	96.0
Walworth	Whitewater	52.9	-19.8	1.47	3.39	64.2	-27.8	0.14	54.3	-2.36	97.1
Jefferson	Fort Atkinson	52.6	-20.8	1.46	3.74	64.2	-27.8	0.14	54.3	-1.87	95.0
Dane	Stoughton	52.4	-20.4	1.46	3.34	64.2	-27.8	0.14	54.3	-2.22	96.7
Milwaukee	Milwaukee Mtchl Fld	49.2	-18.2	1.38	3.57	64.2	-27.8	0.15	54.7	-2.69	97.7
Iowa	Dodgeville	51.2	-20.8	1.44	3.23	64.2	-27.8	0.14	54.4	-2.17	96.5
Waukesha	Waukesha	51.6	-19.3	1.45	3.39	64.2	-27.8	0.14	54.4	-2.50	97.4
Milwaukee	West Allis	51.4	-18.7	1.45	3.34	64.2	-27.8	0.14	54.4	-2.73	97.7
Dane	Arboretum Univ Wis	52.7	-21.7	1.48	3.57	64.2	-27.8	0.13	54.2	-1.71	93.7
Crawford	Prairie Du Chien	54.8	-21.7	1.54	3.74	64.2	-27.8	0.13	54.0	-1.63	92.9
Dane	Charmany Farm	51.2	-20.7	1.45	3.57	64.2	-27.8	0.14	54.4	-1.99	95.7
Jefferson	Lake Mills	53.3	-20.5	1.51	3.23	64.2	-27.8	0.13	54.2	-2.26	96.8
Milwaukee	Milwaukee Mt Mary Co	52.9	-18.7	1.50	3.39	64.2	-27.8	0.13	54.2	-2.68	97.6
Waukesha	Oconomowoc	51.7	-20.3	1.47	3.34	64.2	-27.8	0.14	54.3	-2.25	96.8
Dane	Madison Dane Cnty Ap	52.0	-20.6	1.48	3.45	64.2	-27.8	0.14	54.3	-2.09	96.2
Jefferson	Watertown	52.4	-20.4	1.50	3.51	64.2	-27.8	0.13	54.2	-2.11	96.3
Crawford	Lynxville Dam 9	53.1	-21.6	1.52	3.57	64.2	-27.8	0.13	54.1	-1.74	94.0
Washington	Germantown	50.2	-20.7	1.44	3.57	64.2	-27.8	0.14	54.4	-1.99	95.7
Columbia	Arlington Univ Farm	51.9	-21.3	1.50	3.34	64.2	-27.8	0.13	54.2	-1.95	95.5
Washington	Hartford 2 W	51.3	-21.6	1.48	3.51	64.2	-27.8	0.13	54.3	-1.77	94.2
Richland	Richland Center	53.1	-22.9	1.53	3.74	64.2	-27.8	0.13	54.1	-1.31	88.7
Sauk	Prairie Du Sac 2 N	51.6	-21.1	1.49	3.34	64.2	-27.8	0.13	54.2	-2.01	95.8
Ozaukee	Port Washington	46.6	-18.9	1.35	3.34	64.2	-27.8	0.15	54.8	-2.67	97.6
Washington	West Bend	50.3	-20.4	1.46	3.45	64.2	-27.8	0.14	54.3	-2.14	96.4
Dodge	Horicon	51.3	-21.2	1.50	3.39	64.2	-27.8	0.13	54.2	-1.94	95.5
Dodge	Beaver Dam	52.3	-20.7	1.53	3.45	64.2	-27.8	0.13	54.1	-2.06	96.1
Sauk	Baraboo	51.5	-23.2	1.51	3.74	64.2	-27.8	0.13	54.2	-1.23	87.3
Columbia	Portage	52.6	-21.6	1.55	3.57	64.2	-27.8	0.13	54.0	-1.74	94.0
Sauk	Reedsburg	52.6	-22.7	1.55	3.39	64.2	-27.8	0.13	54.0	-1.50	91.5
Vernon	Genoa Dam 8	52.2	-22.1	1.54	3.68	64.2	-27.8	0.13	54.1	-1.55	92.0
Vernon	Viroqua 2 Nw	50.7	-23.3	1.50	3.63	64.2	-27.8	0.13	54.2	-1.24	87.5
Columbia	Wisconsin Dells	50.8	-22.2	1.51	3.63	64.2	-27.8	0.13	54.2	-1.54	92.0
Green Lake	Dalton	52.2	-21.5	1.55	3.23	64.2	-27.8	0.13	54.0	-1.95	95.5

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-23.6	1.55	3.86	64.2	-27.8	0.13	54.0	-1.09	84.4
Sheboygan	Plymouth	50.6	-20.3	1.51	3.34	64.2	-27.8	0.13	54.2	-2.25	96.8
Monroe	Cashton	50.7	-21.9	1.52	3.68	64.2	-27.8	0.13	54.1	-1.60	92.6
Sheboygan	Sheboygan	48.8	-19.0	1.46	3.34	64.2	-27.8	0.14	54.3	-2.64	97.6
Juneau	Mauston 1 Se	52.2	-23.0	1.57	3.63	64.2	-27.8	0.13	54.0	-1.32	88.9
Marquette	Montello	51.7	-22.5	1.55	3.45	64.2	-27.8	0.13	54.0	-1.54	91.9
Fond Du Lac	Fond Du Lac	50.3	-20.5	1.51	3.39	64.2	-27.8	0.13	54.2	-2.15	96.5
La Crosse	La Crosse Muni Ap	52.9	-22.2	1.60	3.63	64.2	-27.8	0.12	53.9	-1.54	92.0
Monroe	Sparta	52.4	-24.3	1.59	3.74	64.2	-27.8	0.13	53.9	-0.93	80.9
Trempealeau	Trempealeau Dam 6	52.1	-23.3	1.59	3.63	64.2	-27.8	0.13	53.9	-1.24	87.5
Juneau	Necedah	53.0	-24.6	1.63	3.68	64.2	-27.8	0.12	53.8	-0.87	79.1
Calumet	Chilton	51.4	-20.7	1.58	3.23	64.2	-27.8	0.13	53.9	-2.20	96.6
Winnebago	Oshkosh	50.6	-20.9	1.55	3.34	64.2	-27.8	0.13	54.0	-2.07	96.1
Manitowoc	Manitowoc	48.2	-19.8	1.49	3.23	64.2	-27.8	0.13	54.2	-2.48	97.4
Waushara	Hancock Exp Farm	52.1	-23.6	1.61	3.51	64.2	-27.8	0.12	53.8	-1.20	86.7
Trempealeau	Dodge	54.0	-25.7	1.67	3.68	64.2	-27.8	0.12	53.7	-0.57	70.1
Manitowoc	Two Rivers 10 N	44.4	-19.7	1.38	3.17	64.2	-27.8	0.15	54.7	-2.55	97.5
Jackson	Mather 3 Nw	50.7	-23.4	1.57	3.57	64.2	-27.8	0.13	54.0	-1.23	87.4
Outagamie	Appleton	50.0	-20.7	1.56	3.07	64.2	-27.8	0.13	54.0	-2.32	97.0
Trempealeau	Blair	51.4	-25.2	1.61	3.80	64.2	-27.8	0.12	53.8	-0.68	73.8
Buffalo	Alma Dam 4	51.9	-22.8	1.63	3.63	64.2	-27.8	0.12	53.8	-1.38	89.8
Waupaca	Waupaca	51.4	-21.6	1.62	3.34	64.2	-27.8	0.12	53.8	-1.86	94.9
Portage	Coddington 1 E	49.9	-25.7	1.57	3.34	64.2	-27.8	0.13	54.0	-0.63	72.1
Waupaca	New London	51.9	-22.4	1.64	3.34	64.2	-27.8	0.12	53.8	-1.62	92.8
Wood	Wisconsin Rapids	51.0	-23.1	1.61	3.28	64.2	-27.8	0.12	53.8	-1.43	90.5
Jackson	Hatfield Hydro Plant	53.5	-26.8	1.69	3.57	64.2	-27.8	0.12	53.6	-0.28	59.8
Wood	Pittsville	51.5	-25.3	1.63	3.34	64.2	-27.8	0.12	53.8	-0.75	75.8
Portage	Stevens Point	50.0	-22.8	1.59	3.28	64.2	-27.8	0.13	53.9	-1.52	91.7
Clark	Neillsville 3 Sw	50.9	-25.2	1.63	3.57	64.2	-27.8	0.12	53.8	-0.73	75.2
Buffalo	Mondovi	52.1	-24.7	1.67	3.86	64.2	-27.8	0.12	53.7	-0.80	77.3
Eau Claire	Fairchild Ranger Sta	50.0	-23.2	1.61	3.17	64.2	-27.8	0.12	53.9	-1.45	90.8
Waupaca	Clintonville	50.5	-22.2	1.63	3.28	64.2	-27.8	0.12	53.8	-1.71	93.7
Wood	Marshfield Exp Farm	50.8	-23.5	1.64	3.23	64.2	-27.8	0.12	53.8	-1.33	89.1
Pierce	Ellsworth	51.4	-24.1	1.67	3.34	64.2	-27.8	0.12	53.7	-1.11	84.9
Marathon	Rosholt	50.3	-24.2	1.64	3.28	64.2	-27.8	0.12	53.8	-1.10	84.6
Chippewa	Eau Claire County Ap	51.2	-23.8	1.68	3.39	64.2	-27.8	0.12	53.6	-1.18	86.3
Dunn	Menomonie	52.7	-24.2	1.73	3.57	64.2	-27.8	0.12	53.5	-1.01	82.7

Table D4. Surface Layer Reliability Analysis for 20 % RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	64.2	-32.6	0.14	54.3	-3.24	97.9
Brown	Green Bay	49.7	-21.5	1.58	3.23	64.2	-32.6	0.13	53.9	-3.44	98.0
Shawano	Shawano 2 Ssw	50.8	-23.0	1.66	3.34	64.2	-32.6	0.12	53.7	-2.88	97.8
Shawano	Bowler	48.9	-23.9	1.61	3.45	64.2	-32.6	0.12	53.9	-2.52	97.4
Pierce	River Falls	51.9	-23.7	1.71	3.39	64.2	-32.6	0.12	53.6	-2.62	97.6
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	64.2	-32.6	0.13	54.0	-3.66	98.0
Oconto	Oconto	49.2	-22.0	1.62	3.39	64.2	-32.6	0.12	53.8	-3.12	97.9
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	64.2	-32.6	0.12	53.8	-2.89	97.8
Clark	Owen	48.2	-25.2	1.59	3.34	64.2	-32.6	0.13	53.9	-2.22	96.7
Chippewa	Stanley	50.2	-24.7	1.66	3.34	64.2	-32.6	0.12	53.7	-2.37	97.1
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	64.2	-32.6	0.12	53.6	-2.22	96.7
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	64.2	-32.6	0.12	53.5	-2.31	97.0
Marinette	Marinette	50.8	-20.9	1.70	3.17	64.2	-32.6	0.12	53.6	-3.69	98.0
Taylor	Medford	47.9	-25.1	1.61	3.23	64.2	-32.6	0.12	53.9	-2.32	97.0
Langlade	Antigo	48.8	-25.1	1.64	3.17	64.2	-32.6	0.12	53.8	-2.36	97.1
Lincoln	Merrill	49.1	-25.3	1.65	3.57	64.2	-32.6	0.12	53.7	-2.05	96.0
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	64.2	-32.6	0.12	53.5	-1.66	93.2
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	64.2	-32.6	0.12	53.6	-1.71	93.7
Polk	Amery	49.8	-25.5	1.69	3.74	64.2	-32.6	0.12	53.6	-1.90	95.2
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	64.2	-32.6	0.12	53.6	-2.57	97.5
Taylor	Jump River	49.2	-27.8	1.68	3.51	64.2	-32.6	0.12	53.6	-1.37	89.6
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	64.2	-32.6	0.12	53.6	-2.36	97.1
Door	Washington Island	44.5	-19.5	1.52	3.45	64.2	-32.6	0.13	54.1	-3.80	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	64.2	-32.6	0.11	53.4	-1.92	95.3
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	64.2	-32.6	0.12	53.5	-1.98	95.7
Barron	Rice Lake	50.2	-26.1	1.73	3.63	64.2	-32.6	0.12	53.5	-1.79	94.4
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	64.2	-32.6	0.12	53.8	-1.28	88.1
Forest	Laona	46.1	-24.6	1.60	3.17	64.2	-32.6	0.13	53.9	-2.52	97.4
Barron	Cumberland	50.9	-25.4	1.76	3.28	64.2	-32.6	0.11	53.4	-2.19	96.6
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	64.2	-32.6	0.12	53.5	-1.50	91.5
Polk	Luck	50.3	-25.7	1.75	3.39	64.2	-32.6	0.11	53.5	-2.03	95.9
Marinette	Goodman	47.0	-23.8	1.64	3.12	64.2	-32.6	0.12	53.8	-2.82	97.8
Oneida	North Pelican	46.4	-26.7	1.62	3.28	64.2	-32.6	0.12	53.8	-1.80	94.5
Oneida	Rhineland	48.1	-25.5	1.68	3.07	64.2	-32.6	0.12	53.6	-2.32	97.0
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	64.2	-32.6	0.12	53.8	-1.86	94.9
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	64.2	-32.6	0.11	53.4	-1.71	93.7
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	64.2	-32.6	0.12	53.6	-1.86	94.9
Washburn	Spooner Exp Farm	50.6	-27.0	1.79	3.17	64.2	-32.6	0.11	53.4	-1.77	94.2
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	64.2	-32.6	0.12	53.7	-2.01	95.8
Sawyer	Couderay	49.5	-29.0	1.76	4.17	64.2	-32.6	0.11	53.4	-0.86	79.0
Oneida	Minocqua Dam	47.0	-26.0	1.67	3.39	64.2	-32.6	0.12	53.7	-1.94	95.5
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	64.2	-32.6	0.12	53.7	-1.79	94.4
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	64.2	-32.6	0.12	53.6	-1.96	95.5
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	64.2	-32.6	0.12	53.8	-2.01	95.8
Price	Park Falls	46.8	-24.8	1.67	3.17	64.2	-32.6	0.12	53.7	-2.46	97.3

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	64.2	-32.6	0.11	53.5	-1.65	93.1
Burnett	Danbury	49.5	-27.6	1.78	3.23	64.2	-32.6	0.11	53.4	-1.55	92.1
Washburn	Minong 2	49.7	-29.2	1.79	3.12	64.2	-32.6	0.11	53.3	-1.09	84.5
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	64.2	-32.6	0.12	53.5	-1.80	94.5
Douglas	Gordon	49.3	-29.4	1.80	3.17	64.2	-32.6	0.11	53.3	-1.01	82.7
Bayfield	Drummond	49.1	-26.8	1.81	3.28	64.2	-32.6	0.11	53.3	-1.77	94.2
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	64.2	-32.6	0.11	53.2	-1.39	90.0
Ashland	Mellen	47.7	-27.1	1.77	3.34	64.2	-32.6	0.11	53.4	-1.65	93.1
Douglas	Foxboro	48.3	-27.8	1.80	3.07	64.2	-32.6	0.11	53.3	-1.57	92.2
Iron	Gurney	47.3	-25.2	1.76	3.12	64.2	-32.6	0.11	53.4	-2.37	97.1
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	64.2	-32.6	0.11	53.3	-2.33	97.0
Douglas	Superior	44.2	-25.1	1.67	3.17	64.2	-32.6	0.12	53.7	-2.36	97.1
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	64.2	-32.6	0.11	53.3	-2.28	96.9
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	64.2	-32.6	0.12	53.5	-2.70	97.7
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	64.2	-32.6	0.11	53.4	-3.05	97.9

Table D5. Surface Layer Reliability Analysis for 5 % RAS, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-18.9	1.44	3.34	62.6	-28.3	-0.97	16.2	-2.82	97.8
Kenosha	Kenosha	47.6	-18.5	1.29	3.86	62.6	-28.3	-1.09	13.5	-2.54	97.5
Walworth	Lake Geneva	53.4	-19.1	1.45	3.39	62.6	-28.3	-0.97	16.4	-2.71	97.7
Rock	Afton	52.5	-19.4	1.43	3.92	62.6	-28.3	-0.98	16.0	-2.27	96.9
Green	Brodhead	52.8	-21.0	1.44	3.45	62.6	-28.3	-0.98	16.1	-2.12	96.3
Racine	Burlington	51.2	-19.2	1.40	3.34	62.6	-28.3	-1.00	15.5	-2.73	97.7
Rock	Janesville	54.8	-19.7	1.50	3.12	62.6	-28.3	-0.94	17.1	-2.76	97.7
Lafayette	Darlington	52.6	-21.3	1.44	3.39	62.6	-28.3	-0.97	16.2	-2.06	96.1
Racine	Racine	48.5	-18.9	1.33	3.57	62.6	-28.3	-1.05	14.3	-2.64	97.6
Grant	Platteville	52.7	-20.9	1.45	3.28	62.6	-28.3	-0.97	16.4	-2.25	96.8
Grant	Lancaster	51.7	-21.2	1.43	3.23	62.6	-28.3	-0.98	16.1	-2.20	96.6
Walworth	Whitewater	52.9	-19.8	1.47	3.39	62.6	-28.3	-0.95	16.7	-2.50	97.4
Jefferson	Fort Atkinson	52.6	-20.8	1.46	3.74	62.6	-28.3	-0.96	16.6	-2.00	95.8
Dane	Stoughton	52.4	-20.4	1.46	3.34	62.6	-28.3	-0.96	16.6	-2.37	97.1
Milwaukee	Milwaukee Mtchl Fld	49.2	-18.2	1.38	3.57	62.6	-28.3	-1.02	15.1	-2.83	97.8
Iowa	Dodgeville	51.2	-20.8	1.44	3.23	62.6	-28.3	-0.98	16.1	-2.32	97.0
Waukesha	Waukesha	51.6	-19.3	1.45	3.39	62.6	-28.3	-0.97	16.4	-2.65	97.6
Milwaukee	West Allis	51.4	-18.7	1.45	3.34	62.6	-28.3	-0.97	16.3	-2.88	97.8
Dane	Arboretum Univ Wis	52.7	-21.7	1.48	3.57	62.6	-28.3	-0.94	16.9	-1.85	94.9
Crawford	Prairie Du Chien	54.8	-21.7	1.54	3.74	62.6	-28.3	-0.91	17.9	-1.76	94.2
Dane	Charmany Farm	51.2	-20.7	1.45	3.57	62.6	-28.3	-0.97	16.3	-2.13	96.4
Jefferson	Lake Mills	53.3	-20.5	1.51	3.23	62.6	-28.3	-0.93	17.3	-2.42	97.2
Milwaukee	Milwaukee Mt Mary Co	52.9	-18.7	1.50	3.39	62.6	-28.3	-0.94	17.1	-2.83	97.8
Waukesha	Oconomowoc	51.7	-20.3	1.47	3.34	62.6	-28.3	-0.96	16.6	-2.40	97.2
Dane	Madison Dane Cnty Ap	52.0	-20.6	1.48	3.45	62.6	-28.3	-0.95	16.8	-2.23	96.7
Jefferson	Watertown	52.4	-20.4	1.50	3.51	62.6	-28.3	-0.94	17.1	-2.25	96.8
Crawford	Lynxville Dam 9	53.1	-21.6	1.52	3.57	62.6	-28.3	-0.92	17.5	-1.88	95.0
Washington	Germantown	50.2	-20.7	1.44	3.57	62.6	-28.3	-0.97	16.2	-2.13	96.4
Columbia	Arlington Univ Farm	51.9	-21.3	1.50	3.34	62.6	-28.3	-0.94	17.1	-2.10	96.2
Washington	Hartford 2 W	51.3	-21.6	1.48	3.51	62.6	-28.3	-0.94	16.9	-1.91	95.2
Richland	Richland Center	53.1	-22.9	1.53	3.74	62.6	-28.3	-0.91	17.7	-1.44	90.7
Sauk	Prairie Du Sac 2 N	51.6	-21.1	1.49	3.34	62.6	-28.3	-0.94	17.0	-2.16	96.5
Ozaukee	Port Washington	46.6	-18.9	1.35	3.34	62.6	-28.3	-1.03	14.7	-2.82	97.8
Washington	West Bend	50.3	-20.4	1.46	3.45	62.6	-28.3	-0.96	16.6	-2.29	96.9
Dodge	Horicon	51.3	-21.2	1.50	3.39	62.6	-28.3	-0.93	17.2	-2.09	96.2
Dodge	Beaver Dam	52.3	-20.7	1.53	3.45	62.6	-28.3	-0.92	17.6	-2.20	96.6
Sauk	Baraboo	51.5	-23.2	1.51	3.74	62.6	-28.3	-0.93	17.3	-1.36	89.5
Columbia	Portage	52.6	-21.6	1.55	3.57	62.6	-28.3	-0.91	17.9	-1.88	95.0
Sauk	Reedsburg	52.6	-22.7	1.55	3.39	62.6	-28.3	-0.90	17.9	-1.65	93.2
Vernon	Genoa Dam 8	52.2	-22.1	1.54	3.68	62.6	-28.3	-0.91	17.8	-1.68	93.5
Vernon	Viroqua 2 Nw	50.7	-23.3	1.50	3.63	62.6	-28.3	-0.94	17.1	-1.38	89.8
Columbia	Wisconsin Dells	50.8	-22.2	1.51	3.63	62.6	-28.3	-0.93	17.3	-1.68	93.5
Green Lake	Dalton	52.2	-21.5	1.55	3.23	62.6	-28.3	-0.90	18.0	-2.11	96.3

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	52.1	-23.6	1.55	3.86	62.6	-28.3	-0.90	17.9	-1.22	87.0
Sheboygan	Plymouth	50.6	-20.3	1.51	3.34	62.6	-28.3	-0.92	17.4	-2.40	97.2
Monroe	Cashton	50.7	-21.9	1.52	3.68	62.6	-28.3	-0.92	17.5	-1.74	94.0
Sheboygan	Sheboygan	48.8	-19.0	1.46	3.34	62.6	-28.3	-0.96	16.6	-2.79	97.7
Juneau	Mauston 1 Se	52.2	-23.0	1.57	3.63	62.6	-28.3	-0.89	18.2	-1.46	91.0
Marquette	Montello	51.7	-22.5	1.55	3.45	62.6	-28.3	-0.90	18.0	-1.68	93.5
Fond Du Lac	Fond Du Lac	50.3	-20.5	1.51	3.39	62.6	-28.3	-0.92	17.4	-2.30	96.9
La Crosse	La Crosse Muni Ap	52.9	-22.2	1.60	3.63	62.6	-28.3	-0.87	18.7	-1.68	93.5
Monroe	Sparta	52.4	-24.3	1.59	3.74	62.6	-28.3	-0.88	18.6	-1.07	84.0
Trempealeau	Trempealeau Dam 6	52.1	-23.3	1.59	3.63	62.6	-28.3	-0.88	18.6	-1.38	89.8
Juneau	Necedah	53.0	-24.6	1.63	3.68	62.6	-28.3	-0.86	19.1	-1.00	82.6
Calumet	Chilton	51.4	-20.7	1.58	3.23	62.6	-28.3	-0.89	18.4	-2.36	97.1
Winnebago	Oshkosh	50.6	-20.9	1.55	3.34	62.6	-28.3	-0.90	18.0	-2.22	96.7
Manitowoc	Manitowoc	48.2	-19.8	1.49	3.23	62.6	-28.3	-0.94	17.0	-2.63	97.6
Waushara	Hancock Exp Farm	52.1	-23.6	1.61	3.51	62.6	-28.3	-0.87	18.8	-1.34	89.2
Trempealeau	Dodge	54.0	-25.7	1.67	3.68	62.6	-28.3	-0.84	19.7	-0.71	74.5
Manitowoc	Two Rivers 10 N	44.4	-19.7	1.38	3.17	62.6	-28.3	-1.02	15.1	-2.71	97.7
Jackson	Mather 3 Nw	50.7	-23.4	1.57	3.57	62.6	-28.3	-0.89	18.3	-1.37	89.7
Outagamie	Appleton	50.0	-20.7	1.56	3.07	62.6	-28.3	-0.90	18.1	-2.48	97.4
Trempealeau	Blair	51.4	-25.2	1.61	3.80	62.6	-28.3	-0.87	18.9	-0.82	77.7
Buffalo	Alma Dam 4	51.9	-22.8	1.63	3.63	62.6	-28.3	-0.86	19.2	-1.52	91.7
Waupaca	Waupaca	51.4	-21.6	1.62	3.34	62.6	-28.3	-0.86	19.0	-2.01	95.8
Portage	Coddington 1 E	49.9	-25.7	1.57	3.34	62.6	-28.3	-0.89	18.3	-0.78	76.6
Waupaca	New London	51.9	-22.4	1.64	3.34	62.6	-28.3	-0.85	19.2	-1.77	94.2
Wood	Wisconsin Rapids	51.0	-23.1	1.61	3.28	62.6	-28.3	-0.87	18.8	-1.58	92.5
Jackson	Hatfield Hydro Plant	53.5	-26.8	1.69	3.57	62.6	-28.3	-0.83	20.0	-0.42	65.0
Wood	Pittsville	51.5	-25.3	1.63	3.34	62.6	-28.3	-0.86	19.2	-0.90	79.9
Portage	Stevens Point	50.0	-22.8	1.59	3.28	62.6	-28.3	-0.88	18.6	-1.68	93.4
Clark	Neillsville 3 Sw	50.9	-25.2	1.63	3.57	62.6	-28.3	-0.86	19.1	-0.87	79.1
Buffalo	Mondovi	52.1	-24.7	1.67	3.86	62.6	-28.3	-0.84	19.7	-0.93	80.8
Eau Claire	Fairchild Ranger Sta	50.0	-23.2	1.61	3.17	62.6	-28.3	-0.87	18.8	-1.61	92.7
Waupaca	Clintonville	50.5	-22.2	1.63	3.28	62.6	-28.3	-0.86	19.1	-1.86	94.9
Wood	Marshfield Exp Farm	50.8	-23.5	1.64	3.23	62.6	-28.3	-0.85	19.3	-1.49	91.3
Pierce	Ellsworth	51.4	-24.1	1.67	3.34	62.6	-28.3	-0.84	19.7	-1.26	87.8
Marathon	Rosholt	50.3	-24.2	1.64	3.28	62.6	-28.3	-0.85	19.3	-1.25	87.6
Chippewa	Eau Claire County Ap	51.2	-23.8	1.68	3.39	62.6	-28.3	-0.83	19.9	-1.33	88.9
Dunn	Menomonie	52.7	-24.2	1.73	3.57	62.6	-28.3	-0.81	20.5	-1.15	85.7

Table D6. Surface Layer Reliability Analysis for 5 % RAS, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	63.1	-33.8	-0.61	26.5	-3.54	98.0
Brown	Green Bay	49.7	-21.5	1.58	3.23	63.1	-33.8	-0.57	27.9	-3.81	98.0
Shawano	Shawano 2 Ssw	50.8	-23.0	1.66	3.34	63.1	-33.8	-0.54	28.8	-3.24	97.9
Shawano	Bowler	48.9	-23.9	1.61	3.45	63.1	-33.8	-0.56	28.2	-2.87	97.8
Pierce	River Falls	51.9	-23.7	1.71	3.39	63.1	-33.8	-0.53	29.3	-2.98	97.9
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	63.1	-33.8	-0.57	27.8	-4.01	98.0
Oconto	Oconto	49.2	-22.0	1.62	3.39	63.1	-33.8	-0.56	28.4	-3.48	98.0
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	63.1	-33.8	-0.56	28.3	-3.26	97.9
Clark	Owen	48.2	-25.2	1.59	3.34	63.1	-33.8	-0.56	28.0	-2.58	97.5
Chippewa	Stanley	50.2	-24.7	1.66	3.34	63.1	-33.8	-0.54	28.8	-2.73	97.7
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	63.1	-33.8	-0.53	29.1	-2.55	97.5
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	63.1	-33.8	-0.52	29.5	-2.65	97.6
Marinette	Marinette	50.8	-20.9	1.70	3.17	63.1	-33.8	-0.53	29.2	-4.07	98.0
Taylor	Medford	47.9	-25.1	1.61	3.23	63.1	-33.8	-0.56	28.2	-2.70	97.7
Langlade	Antigo	48.8	-25.1	1.64	3.17	63.1	-33.8	-0.55	28.6	-2.74	97.7
Lincoln	Merrill	49.1	-25.3	1.65	3.57	63.1	-33.8	-0.54	28.7	-2.38	97.2
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	63.1	-33.8	-0.52	29.5	-1.97	95.6
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	63.1	-33.8	-0.53	29.4	-2.05	96.0
Polk	Amery	49.8	-25.5	1.69	3.74	63.1	-33.8	-0.53	29.2	-2.22	96.7
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	63.1	-33.8	-0.53	29.1	-2.94	97.8
Taylor	Jump River	49.2	-27.8	1.68	3.51	63.1	-33.8	-0.53	29.0	-1.71	93.7
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	63.1	-33.8	-0.53	29.1	-2.69	97.7
Door	Washington Island	44.5	-19.5	1.52	3.45	63.1	-33.8	-0.59	27.2	-4.14	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	63.1	-33.8	-0.51	30.0	-2.29	96.9
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	63.1	-33.8	-0.52	29.5	-2.36	97.1
Barron	Rice Lake	50.2	-26.1	1.73	3.63	63.1	-33.8	-0.52	29.6	-2.12	96.4
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	63.1	-33.8	-0.55	28.5	-1.62	92.9
Forest	Laona	46.1	-24.6	1.60	3.17	63.1	-33.8	-0.56	28.1	-2.90	97.8
Barron	Cumberland	50.9	-25.4	1.76	3.28	63.1	-33.8	-0.51	29.9	-2.56	97.5
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	63.1	-33.8	-0.52	29.5	-1.86	94.9
Polk	Luck	50.3	-25.7	1.75	3.39	63.1	-33.8	-0.52	29.7	-2.39	97.2
Marinette	Goodman	47.0	-23.8	1.64	3.12	63.1	-33.8	-0.55	28.6	-3.21	97.9
Oneida	North Pelican	46.4	-26.7	1.62	3.28	63.1	-33.8	-0.56	28.3	-2.16	96.5
Oneida	Rhineland	48.1	-25.5	1.68	3.07	63.1	-33.8	-0.54	29.0	-2.71	97.7
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	63.1	-33.8	-0.55	28.5	-2.23	96.7
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	63.1	-33.8	-0.51	29.8	-2.06	96.1
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	63.1	-33.8	-0.53	29.2	-2.23	96.7
Washburn	Spooner Exp Farm	50.6	-27.0	1.79	3.17	63.1	-33.8	-0.50	30.2	-2.14	96.4
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	63.1	-33.8	-0.54	28.8	-2.39	97.2
Sawyer	Couderay	49.5	-29.0	1.76	4.17	63.1	-33.8	-0.51	29.8	-1.15	85.8
Oneida	Minocqua Dam	47.0	-26.0	1.67	3.39	63.1	-33.8	-0.54	28.9	-2.30	96.9
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	63.1	-33.8	-0.54	28.9	-2.19	96.6
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	63.1	-33.8	-0.53	29.2	-2.36	97.1
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	63.1	-33.8	-0.56	28.2	-2.39	97.2
Price	Park Falls	46.8	-24.8	1.67	3.17	63.1	-33.8	-0.54	28.9	-2.84	97.8

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	63.1	-33.8	-0.52	29.7	-2.01	95.8
Burnett	Danbury	49.5	-27.6	1.78	3.23	63.1	-33.8	-0.51	30.0	-1.92	95.3
Washburn	Minong 2	49.7	-29.2	1.79	3.12	63.1	-33.8	-0.50	30.2	-1.48	91.1
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	63.1	-33.8	-0.52	29.5	-2.16	96.5
Douglas	Gordon	49.3	-29.4	1.80	3.17	63.1	-33.8	-0.50	30.3	-1.39	89.9
Bayfield	Drummond	49.1	-26.8	1.81	3.28	63.1	-33.8	-0.50	30.3	-2.13	96.4
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	63.1	-33.8	-0.48	30.8	-1.77	94.2
Ashland	Mellen	47.7	-27.1	1.77	3.34	63.1	-33.8	-0.51	29.9	-2.01	95.8
Douglas	Foxboro	48.3	-27.8	1.80	3.07	63.1	-33.8	-0.50	30.2	-1.96	95.5
Iron	Gurney	47.3	-25.2	1.76	3.12	63.1	-33.8	-0.51	29.9	-2.76	97.7
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	63.1	-33.8	-0.49	30.5	-2.71	97.7
Douglas	Superior	44.2	-25.1	1.67	3.17	63.1	-33.8	-0.54	29.0	-2.74	97.7
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	63.1	-33.8	-0.50	30.2	-2.66	97.6
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	63.1	-33.8	-0.52	29.5	-3.03	97.9
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	63.1	-33.8	-0.51	30.1	-3.41	98.0

Table D7. Surface Layer Reliability Analysis for 2.5 % RAS and 10 % RAP, Mid Grade Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	53.5	-18.9	1.44	3.34	63.5	-28.1	-0.35	35.7	-2.76	97.7
Kenosha	Kenosha	47.6	-18.5	1.29	3.86	63.5	-28.1	-0.39	34.2	-2.48	97.4
Walworth	Lake Geneva	53.4	-19.1	1.45	3.39	63.5	-28.1	-0.35	35.8	-2.65	97.6
Rock	Afton	52.5	-19.4	1.43	3.92	63.5	-28.1	-0.35	35.6	-2.22	96.7
Green	Brodhead	52.8	-21.0	1.44	3.45	63.5	-28.1	-0.35	35.7	-2.06	96.1
Racine	Burlington	51.2	-19.2	1.40	3.34	63.5	-28.1	-0.36	35.3	-2.67	97.6
Rock	Janesville	54.8	-19.7	1.50	3.12	63.5	-28.1	-0.33	36.2	-2.69	97.7
Lafayette	Darlington	52.6	-21.3	1.44	3.39	63.5	-28.1	-0.35	35.7	-2.00	95.8
Racine	Racine	48.5	-18.9	1.33	3.57	63.5	-28.1	-0.38	34.6	-2.58	97.5
Grant	Platteville	52.7	-20.9	1.45	3.28	63.5	-28.1	-0.35	35.8	-2.19	96.6
Grant	Lancaster	51.7	-21.2	1.43	3.23	63.5	-28.1	-0.35	35.6	-2.14	96.4
Walworth	Whitewater	52.9	-19.8	1.47	3.39	63.5	-28.1	-0.34	35.9	-2.45	97.3
Jefferson	Fort Atkinson	52.6	-20.8	1.46	3.74	63.5	-28.1	-0.34	35.9	-1.95	95.5
Dane	Stoughton	52.4	-20.4	1.46	3.34	63.5	-28.1	-0.34	35.9	-2.31	97.0
Milwaukee	Milwaukee Mtchl Fld	49.2	-18.2	1.38	3.57	63.5	-28.1	-0.36	35.1	-2.78	97.7
Iowa	Dodgeville	51.2	-20.8	1.44	3.23	63.5	-28.1	-0.35	35.6	-2.26	96.8
Waukesha	Waukesha	51.6	-19.3	1.45	3.39	63.5	-28.1	-0.34	35.8	-2.59	97.5
Milwaukee	West Allis	51.4	-18.7	1.45	3.34	63.5	-28.1	-0.35	35.8	-2.82	97.8
Dane	Arboretum Univ Wis	52.7	-21.7	1.48	3.57	63.5	-28.1	-0.34	36.1	-1.79	94.4
Crawford	Prairie Du Chien	54.8	-21.7	1.54	3.74	63.5	-28.1	-0.32	36.6	-1.71	93.7
Dane	Charmany Farm	51.2	-20.7	1.45	3.57	63.5	-28.1	-0.35	35.7	-2.07	96.1
Jefferson	Lake Mills	53.3	-20.5	1.51	3.23	63.5	-28.1	-0.33	36.3	-2.36	97.1
Milwaukee	Milwaukee Mt Mary Co	52.9	-18.7	1.50	3.39	63.5	-28.1	-0.33	36.2	-2.77	97.7
Waukesha	Oconomowoc	51.7	-20.3	1.47	3.34	63.5	-28.1	-0.34	35.9	-2.34	97.0
Dane	Madison Dane Cnty Ap	52.0	-20.6	1.48	3.45	63.5	-28.1	-0.34	36.0	-2.17	96.5
Jefferson	Watertown	52.4	-20.4	1.50	3.51	63.5	-28.1	-0.33	36.2	-2.19	96.6
Crawford	Lynxville Dam 9	53.1	-21.6	1.52	3.57	63.5	-28.1	-0.33	36.4	-1.82	94.6
Washington	Germantown	50.2	-20.7	1.44	3.57	63.5	-28.1	-0.35	35.7	-2.07	96.1
Columbia	Arlington Univ Farm	51.9	-21.3	1.50	3.34	63.5	-28.1	-0.33	36.2	-2.04	96.0
Washington	Hartford 2 W	51.3	-21.6	1.48	3.51	63.5	-28.1	-0.34	36.1	-1.85	94.9
Richland	Richland Center	53.1	-22.9	1.53	3.74	63.5	-28.1	-0.33	36.5	-1.39	89.9
Sauk	Prairie Du Sac 2 N	51.6	-21.1	1.49	3.34	63.5	-28.1	-0.34	36.1	-2.10	96.2
Ozaukee	Port Washington	46.6	-18.9	1.35	3.34	63.5	-28.1	-0.37	34.9	-2.76	97.7
Washington	West Bend	50.3	-20.4	1.46	3.45	63.5	-28.1	-0.34	35.9	-2.23	96.7
Dodge	Horicon	51.3	-21.2	1.50	3.39	63.5	-28.1	-0.33	36.2	-2.03	95.9
Dodge	Beaver Dam	52.3	-20.7	1.53	3.45	63.5	-28.1	-0.33	36.4	-2.14	96.4
Sauk	Baraboo	51.5	-23.2	1.51	3.74	63.5	-28.1	-0.33	36.3	-1.31	88.7
Columbia	Portage	52.6	-21.6	1.55	3.57	63.5	-28.1	-0.32	36.6	-1.82	94.6
Sauk	Reedsburg	52.6	-22.7	1.55	3.39	63.5	-28.1	-0.32	36.6	-1.59	92.5
Vernon	Genoa Dam 8	52.2	-22.1	1.54	3.68	63.5	-28.1	-0.32	36.5	-1.63	92.9
Vernon	Viroqua 2 Nw	50.7	-23.3	1.50	3.63	63.5	-28.1	-0.33	36.2	-1.32	88.9
Columbia	Wisconsin Dells	50.8	-22.2	1.51	3.63	63.5	-28.1	-0.33	36.3	-1.63	92.9
Green Lake	Dalton	52.2	-21.5	1.55	3.23	63.5	-28.1	-0.32	36.6	-2.05	96.0
Vernon	Hillsboro	52.1	-23.6	1.55	3.86	63.5	-28.1	-0.32	36.6	-1.16	86.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Sheboygan	Plymouth	50.6	-20.3	1.51	3.34	63.5	-28.1	-0.33	36.3	-2.34	97.0
Monroe	Cashton	50.7	-21.9	1.52	3.68	63.5	-28.1	-0.33	36.4	-1.68	93.5
Sheboygan	Sheboygan	48.8	-19.0	1.46	3.34	63.5	-28.1	-0.34	35.9	-2.73	97.7
Juneau	Mauston 1 Se	52.2	-23.0	1.57	3.63	63.5	-28.1	-0.32	36.7	-1.41	90.2
Marquette	Montello	51.7	-22.5	1.55	3.45	63.5	-28.1	-0.32	36.6	-1.62	92.9
Fond Du Lac	Fond Du Lac	50.3	-20.5	1.51	3.39	63.5	-28.1	-0.33	36.3	-2.24	96.8
La Crosse	La Crosse Muni Ap	52.9	-22.2	1.60	3.63	63.5	-28.1	-0.31	37.0	-1.63	92.9
Monroe	Sparta	52.4	-24.3	1.59	3.74	63.5	-28.1	-0.31	36.9	-1.02	82.8
Trempealeau	Trempealeau Dam 6	52.1	-23.3	1.59	3.63	63.5	-28.1	-0.31	36.9	-1.32	88.9
Juneau	Necedah	53.0	-24.6	1.63	3.68	63.5	-28.1	-0.31	37.2	-0.95	81.2
Calumet	Chilton	51.4	-20.7	1.58	3.23	63.5	-28.1	-0.32	36.8	-2.29	96.9
Winnebago	Oshkosh	50.6	-20.9	1.55	3.34	63.5	-28.1	-0.32	36.6	-2.16	96.5
Manitowoc	Manitowoc	48.2	-19.8	1.49	3.23	63.5	-28.1	-0.34	36.1	-2.57	97.5
Waushara	Hancock Exp Farm	52.1	-23.6	1.61	3.51	63.5	-28.1	-0.31	37.1	-1.28	88.2
Trempealeau	Dodge	54.0	-25.7	1.67	3.68	63.5	-28.1	-0.30	37.5	-0.65	72.8
Manitowoc	Two Rivers 10 N	44.4	-19.7	1.38	3.17	63.5	-28.1	-0.36	35.1	-2.65	97.6
Jackson	Mather 3 Nw	50.7	-23.4	1.57	3.57	63.5	-28.1	-0.32	36.8	-1.32	88.8
Outagamie	Appleton	50.0	-20.7	1.56	3.07	63.5	-28.1	-0.32	36.7	-2.41	97.2
Trempealeau	Blair	51.4	-25.2	1.61	3.80	63.5	-28.1	-0.31	37.1	-0.76	76.2
Buffalo	Alma Dam 4	51.9	-22.8	1.63	3.63	63.5	-28.1	-0.31	37.2	-1.46	91.0
Waupaca	Waupaca	51.4	-21.6	1.62	3.34	63.5	-28.1	-0.31	37.1	-1.95	95.5
Portage	Coddington 1 E	49.9	-25.7	1.57	3.34	63.5	-28.1	-0.32	36.8	-0.72	74.9
Waupaca	New London	51.9	-22.4	1.64	3.34	63.5	-28.1	-0.31	37.2	-1.71	93.7
Wood	Wisconsin Rapids	51.0	-23.1	1.61	3.28	63.5	-28.1	-0.31	37.1	-1.52	91.7
Jackson	Hatfield Hydro Plant	53.5	-26.8	1.69	3.57	63.5	-28.1	-0.30	37.6	-0.36	62.9
Wood	Pittsville	51.5	-25.3	1.63	3.34	63.5	-28.1	-0.31	37.2	-0.84	78.3
Portage	Stevens Point	50.0	-22.8	1.59	3.28	63.5	-28.1	-0.31	36.9	-1.61	92.8
Clark	Neillsville 3 Sw	50.9	-25.2	1.63	3.57	63.5	-28.1	-0.31	37.2	-0.81	77.6
Buffalo	Mondovi	52.1	-24.7	1.67	3.86	63.5	-28.1	-0.30	37.5	-0.88	79.4
Eau Claire	Fairchild Ranger Sta	50.0	-23.2	1.61	3.17	63.5	-28.1	-0.31	37.0	-1.54	92.0
Waupaca	Clintonville	50.5	-22.2	1.63	3.28	63.5	-28.1	-0.31	37.2	-1.80	94.5
Wood	Marshfield Exp Farm	50.8	-23.5	1.64	3.23	63.5	-28.1	-0.30	37.3	-1.43	90.5
Pierce	Ellsworth	51.4	-24.1	1.67	3.34	63.5	-28.1	-0.30	37.5	-1.20	86.7
Marathon	Rosholt	50.3	-24.2	1.64	3.28	63.5	-28.1	-0.30	37.3	-1.19	86.5
Chippewa	Eau Claire County Ap	51.2	-23.8	1.68	3.39	63.5	-28.1	-0.30	37.5	-1.27	87.9
Dunn	Menomonie	52.7	-24.2	1.73	3.57	63.5	-28.1	-0.29	37.9	-1.09	84.6

Table D8. Surface Layer Reliability Analysis for 2.5 % RAS and 10 % RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	46.3	-19.7	1.47	3.99	63.7	-33.3	-0.20	41.1	-3.41	98.0
Brown	Green Bay	49.7	-21.5	1.58	3.23	63.7	-33.3	-0.19	41.6	-3.66	98.0
Shawano	Shawano 2 Ssw	50.8	-23.0	1.66	3.34	63.7	-33.3	-0.18	42.0	-3.09	97.9
Shawano	Bowler	48.9	-23.9	1.61	3.45	63.7	-33.3	-0.19	41.7	-2.72	97.7
Pierce	River Falls	51.9	-23.7	1.71	3.39	63.7	-33.3	-0.18	42.2	-2.83	97.8
Door	Sturgeon Bay Exp Far	47.9	-20.4	1.57	3.34	63.7	-33.3	-0.19	41.6	-3.87	98.0
Oconto	Oconto	49.2	-22.0	1.62	3.39	63.7	-33.3	-0.19	41.8	-3.33	98.0
Marathon	Wausau Municipal Ap	49.1	-23.1	1.62	3.28	63.7	-33.3	-0.19	41.8	-3.11	97.9
Clark	Owen	48.2	-25.2	1.59	3.34	63.7	-33.3	-0.19	41.7	-2.43	97.3
Chippewa	Stanley	50.2	-24.7	1.66	3.34	63.7	-33.3	-0.18	42.0	-2.58	97.5
Oconto	Breed 6 Sse	50.8	-24.7	1.69	3.57	63.7	-33.3	-0.18	42.1	-2.41	97.2
Chippewa	Bloomer	51.5	-24.5	1.72	3.51	63.7	-33.3	-0.17	42.2	-2.51	97.4
Marinette	Marinette	50.8	-20.9	1.70	3.17	63.7	-33.3	-0.18	42.1	-3.91	98.0
Taylor	Medford	47.9	-25.1	1.61	3.23	63.7	-33.3	-0.19	41.7	-2.54	97.5
Langlade	Antigo	48.8	-25.1	1.64	3.17	63.7	-33.3	-0.18	41.9	-2.58	97.5
Lincoln	Merrill	49.1	-25.3	1.65	3.57	63.7	-33.3	-0.18	41.9	-2.24	96.8
Chippewa	Holcombe	51.2	-26.3	1.73	3.80	63.7	-33.3	-0.17	42.3	-1.84	94.8
Barron	Ridgeland 1 Nne	50.7	-26.5	1.71	3.57	63.7	-33.3	-0.18	42.2	-1.91	95.2
Polk	Amery	49.8	-25.5	1.69	3.74	63.7	-33.3	-0.18	42.1	-2.08	96.2
Oconto	Lakewood 3 Ne	49.4	-24.3	1.68	3.23	63.7	-33.3	-0.18	42.1	-2.79	97.7
Taylor	Jump River	49.2	-27.8	1.68	3.51	63.7	-33.3	-0.18	42.1	-1.57	92.3
Marinette	Crivitz High Falls	49.4	-24.2	1.69	3.57	63.7	-33.3	-0.18	42.1	-2.55	97.5
Door	Washington Island	44.5	-19.5	1.52	3.45	63.7	-33.3	-0.20	41.3	-4.00	98.0
Polk	St Croix Falls	51.6	-26.3	1.77	3.28	63.7	-33.3	-0.17	42.4	-2.13	96.4
Rusk	Weyerhauser	50.4	-26.2	1.73	3.23	63.7	-33.3	-0.17	42.3	-2.20	96.6
Barron	Rice Lake	50.2	-26.1	1.73	3.63	63.7	-33.3	-0.17	42.3	-1.99	95.7
Price	Prentice 5 W	47.3	-28.2	1.64	3.45	63.7	-33.3	-0.18	41.9	-1.48	91.2
Forest	Laona	46.1	-24.6	1.60	3.17	63.7	-33.3	-0.19	41.7	-2.74	97.7
Barron	Cumberland	50.9	-25.4	1.76	3.28	63.7	-33.3	-0.17	42.4	-2.41	97.2
Rusk	Big Falls Hydro	49.8	-27.5	1.73	3.39	63.7	-33.3	-0.17	42.2	-1.71	93.7
Polk	Luck	50.3	-25.7	1.75	3.39	63.7	-33.3	-0.17	42.3	-2.24	96.8
Marinette	Goodman	47.0	-23.8	1.64	3.12	63.7	-33.3	-0.18	41.9	-3.05	97.9
Oneida	North Pelican	46.4	-26.7	1.62	3.28	63.7	-33.3	-0.19	41.8	-2.01	95.8
Oneida	Rhineland	48.1	-25.5	1.68	3.07	63.7	-33.3	-0.18	42.0	-2.54	97.5
Oneida	Willow Reservoir	46.6	-26.6	1.64	3.23	63.7	-33.3	-0.18	41.9	-2.08	96.1
Burnett	Grantsburg	49.7	-26.7	1.75	3.45	63.7	-33.3	-0.17	42.3	-1.91	95.3
Forest	Newald 4 N	48.2	-26.6	1.70	3.23	63.7	-33.3	-0.18	42.1	-2.08	96.1
Washburn	Spooner Exp Farm	50.6	-27.0	1.79	3.17	63.7	-33.3	-0.17	42.5	-1.99	95.7
Oneida	Rainbow Rsvr Lake	46.8	-26.1	1.66	3.23	63.7	-33.3	-0.18	42.0	-2.23	96.7
Sawyer	Couderay	49.5	-29.0	1.76	4.17	63.7	-33.3	-0.17	42.4	-1.03	83.2
Oneida	Minocqua Dam	47.0	-26.0	1.67	3.39	63.7	-33.3	-0.18	42.0	-2.15	96.5
Sawyer	Winter 5 Nw	46.9	-27.1	1.67	3.07	63.7	-33.3	-0.18	42.0	-2.02	95.9
Oneida	Long Lake Dam	47.7	-26.7	1.70	3.01	63.7	-33.3	-0.18	42.1	-2.19	96.6
Vilas	St Germain 2 E	45.1	-26.1	1.61	3.23	63.7	-33.3	-0.19	41.8	-2.23	96.7
Price	Park Falls	46.8	-24.8	1.67	3.17	63.7	-33.3	-0.18	42.0	-2.68	97.6

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	48.7	-27.2	1.74	3.28	63.7	-33.3	-0.17	42.3	-1.86	94.9
Burnett	Danbury	49.5	-27.6	1.78	3.23	63.7	-33.3	-0.17	42.4	-1.77	94.2
Washburn	Minong 2	49.7	-29.2	1.79	3.12	63.7	-33.3	-0.17	42.5	-1.31	88.8
Vilas	Rest Lake	47.6	-26.7	1.73	3.28	63.7	-33.3	-0.17	42.2	-2.01	95.8
Douglas	Gordon	49.3	-29.4	1.80	3.17	63.7	-33.3	-0.17	42.5	-1.23	87.3
Bayfield	Drummond	49.1	-26.8	1.81	3.28	63.7	-33.3	-0.17	42.5	-1.98	95.7
Douglas	Solon Springs	50.4	-28.1	1.86	3.23	63.7	-33.3	-0.16	42.7	-1.61	92.8
Ashland	Mellen	47.7	-27.1	1.77	3.34	63.7	-33.3	-0.17	42.4	-1.86	94.9
Douglas	Foxboro	48.3	-27.8	1.80	3.07	63.7	-33.3	-0.17	42.5	-1.79	94.4
Iron	Gurney	47.3	-25.2	1.76	3.12	63.7	-33.3	-0.17	42.4	-2.60	97.5
Bayfield	Ashland Exp Farm	48.7	-25.2	1.83	3.17	63.7	-33.3	-0.16	42.6	-2.55	97.5
Douglas	Superior	44.2	-25.1	1.67	3.17	63.7	-33.3	-0.18	42.0	-2.58	97.5
Bayfield	Port Wing	47.2	-25.5	1.80	3.12	63.7	-33.3	-0.17	42.5	-2.50	97.4
Ashland	Madeline Island	45.4	-22.8	1.73	3.63	63.7	-33.3	-0.17	42.3	-2.90	97.8
Bayfield	Bayfield	46.4	-22.6	1.78	3.28	63.7	-33.3	-0.17	42.4	-3.26	97.9

Table D9. Lower Layer Reliability Analysis for Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	60.0	-29.4	-3.06	0.1	-4.04	98.0
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	60.0	-29.4	-3.47	0.0	-3.60	98.0
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	60.0	-29.4	-3.04	0.1	-3.92	98.0
Rock	Afton	47.6	-16.4	1.29	3.92	60.0	-29.4	-3.09	0.1	-3.31	98.0
Green	Brodhead	47.9	-18.0	1.30	3.45	60.0	-29.4	-3.07	0.1	-3.30	98.0
Racine	Burlington	46.3	-16.2	1.26	3.34	60.0	-29.4	-3.17	0.1	-3.96	98.0
Rock	Janesville	49.9	-16.7	1.36	3.12	60.0	-29.4	-2.94	0.2	-4.07	98.0
Lafayette	Darlington	47.7	-18.3	1.30	3.39	60.0	-29.4	-3.07	0.1	-3.27	97.9
Racine	Racine	43.6	-15.9	1.19	3.57	60.0	-29.4	-3.35	0.0	-3.79	98.0
Grant	Platteville	47.8	-17.9	1.31	3.28	60.0	-29.4	-3.04	0.1	-3.50	98.0
Grant	Lancaster	46.8	-18.2	1.30	3.23	60.0	-29.4	-3.09	0.1	-3.47	98.0
Walworth	Whitewater	48.0	-16.8	1.33	3.39	60.0	-29.4	-3.00	0.1	-3.71	98.0
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	60.0	-29.4	-3.02	0.1	-3.10	97.9
Dane	Stoughton	47.5	-17.4	1.33	3.34	60.0	-29.4	-3.02	0.1	-3.60	98.0
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	60.0	-29.4	-3.23	0.1	-3.98	98.0
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	60.0	-29.4	-3.08	0.1	-3.60	98.0
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	60.0	-29.4	-3.05	0.1	-3.86	98.0
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	60.0	-29.4	-3.06	0.1	-4.10	98.0
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	60.0	-29.4	-2.97	0.1	-3.00	97.9
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	60.0	-29.4	-2.84	0.2	-2.86	97.8
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	60.0	-29.4	-3.06	0.1	-3.28	97.9
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	60.0	-29.4	-2.92	0.2	-3.69	98.0
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	60.0	-29.4	-2.95	0.2	-4.04	98.0
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	60.0	-29.4	-3.02	0.1	-3.63	98.0
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	60.0	-29.4	-2.99	0.1	-3.42	98.0
Jefferson	Watertown	47.5	-17.4	1.36	3.51	60.0	-29.4	-2.95	0.2	-3.42	98.0
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	60.0	-29.4	-2.90	0.2	-3.03	97.9
Washington	Germantown	45.3	-17.7	1.30	3.57	60.0	-29.4	-3.08	0.1	-3.28	97.9
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	60.0	-29.4	-2.95	0.2	-3.33	98.0
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	60.0	-29.4	-2.98	0.1	-3.08	97.9
Richland	Richland Center	48.2	-19.9	1.39	3.74	60.0	-29.4	-2.87	0.2	-2.54	97.5
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	60.0	-29.4	-2.96	0.1	-3.39	98.0
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	60.0	-29.4	-3.30	0.0	-4.04	98.0
Washington	West Bend	45.4	-17.4	1.32	3.45	60.0	-29.4	-3.03	0.1	-3.48	98.0
Dodge	Horicon	46.4	-18.2	1.36	3.39	60.0	-29.4	-2.95	0.2	-3.30	98.0
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	60.0	-29.4	-2.89	0.2	-3.39	98.0
Sauk	Baraboo	46.6	-20.2	1.36	3.74	60.0	-29.4	-2.93	0.2	-2.46	97.3
Columbia	Portage	47.7	-18.6	1.40	3.57	60.0	-29.4	-2.85	0.2	-3.03	97.9
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	60.0	-29.4	-2.85	0.2	-2.86	97.8
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	60.0	-29.4	-2.87	0.2	-2.80	97.7
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	60.0	-29.4	-2.96	0.2	-2.51	97.4
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	60.0	-29.4	-2.94	0.2	-2.81	97.8
Green Lake	Dalton	47.3	-18.5	1.41	3.23	60.0	-29.4	-2.85	0.2	-3.38	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	60.0	-29.4	-2.85	0.2	-2.28	96.9
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	60.0	-29.4	-2.93	0.2	-3.63	98.0
Monroe	Cashton	45.8	-18.9	1.37	3.68	60.0	-29.4	-2.91	0.2	-2.85	97.8
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	60.0	-29.4	-3.04	0.1	-4.01	98.0
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	60.0	-29.4	-2.81	0.2	-2.59	97.5
Marquette	Montello	46.8	-19.5	1.41	3.45	60.0	-29.4	-2.85	0.2	-2.87	97.8
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	60.0	-29.4	-2.93	0.2	-3.51	98.0
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	60.0	-29.4	-2.75	0.3	-2.81	97.8
Monroe	Sparta	47.5	-21.3	1.45	3.74	60.0	-29.4	-2.77	0.3	-2.16	96.5
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	60.0	-29.4	-2.77	0.3	-2.51	97.4
Juneau	Necedah	48.1	-21.6	1.48	3.68	60.0	-29.4	-2.71	0.3	-2.12	96.3
Calumet	Chilton	46.5	-17.7	1.43	3.23	60.0	-29.4	-2.80	0.2	-3.63	98.0
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	60.0	-29.4	-2.85	0.2	-3.45	98.0
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	60.0	-29.4	-2.99	0.1	-3.90	98.0
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	60.0	-29.4	-2.74	0.3	-2.51	97.4
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	60.0	-29.4	-2.63	0.4	-1.82	94.6
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	60.0	-29.4	-3.27	0.1	-4.00	98.0
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	60.0	-29.4	-2.81	0.2	-2.52	97.4
Outagamie	Appleton	45.1	-17.7	1.41	3.07	60.0	-29.4	-2.84	0.2	-3.82	98.0
Trempealeau	Blair	46.5	-22.2	1.46	3.80	60.0	-29.4	-2.74	0.3	-1.89	95.1
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	60.0	-29.4	-2.71	0.3	-2.65	97.6
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	60.0	-29.4	-2.73	0.3	-3.24	97.9
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	60.0	-29.4	-2.82	0.2	-2.01	95.8
Waupaca	New London	47.0	-19.4	1.48	3.34	60.0	-29.4	-2.70	0.3	-3.00	97.9
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	60.0	-29.4	-2.75	0.3	-2.83	97.8
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	60.0	-29.4	-2.60	0.5	-1.57	92.3
Wood	Pittsville	46.6	-22.3	1.48	3.34	60.0	-29.4	-2.71	0.3	-2.13	96.4
Portage	Stevens Point	45.1	-19.8	1.44	3.28	60.0	-29.4	-2.78	0.3	-2.93	97.8
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	60.0	-29.4	-2.72	0.3	-2.02	95.9
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	60.0	-29.4	-2.64	0.4	-1.99	95.7
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	60.0	-29.4	-2.76	0.3	-2.90	97.8
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	60.0	-29.4	-2.72	0.3	-3.11	97.9
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	60.0	-29.4	-2.70	0.3	-2.76	97.7
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	60.0	-29.4	-2.65	0.4	-2.49	97.4
Marathon	Rosholt	45.4	-21.2	1.48	3.28	60.0	-29.4	-2.70	0.3	-2.50	97.4
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	60.0	-29.4	-2.63	0.4	-2.53	97.4
Dunn	Menomonie	47.8	-21.2	1.57	3.57	60.0	-29.4	-2.54	0.5	-2.30	96.9

Table D10. Lower Layer Reliability Analysis for Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	60.0	-35.4	-3.04	0.1	-4.69	98.0
Brown	Green Bay	44.8	-18.5	1.43	3.23	60.0	-35.4	-2.80	0.3	-5.24	98.0
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	60.0	-35.4	-2.67	0.4	-4.61	98.0
Shawano	Bowler	44.0	-20.9	1.45	3.45	60.0	-35.4	-2.77	0.3	-4.20	98.0
Pierce	River Falls	47.0	-20.7	1.54	3.39	60.0	-35.4	-2.59	0.5	-4.33	98.0
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	60.0	-35.4	-2.83	0.2	-5.39	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	60.0	-35.4	-2.74	0.3	-4.83	98.0
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	60.0	-35.4	-2.74	0.3	-4.66	98.0
Clark	Owen	43.3	-22.2	1.43	3.34	60.0	-35.4	-2.79	0.3	-3.96	98.0
Chippewa	Stanley	45.3	-21.7	1.50	3.34	60.0	-35.4	-2.67	0.4	-4.10	98.0
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	60.0	-35.4	-2.62	0.4	-3.84	98.0
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	60.0	-35.4	-2.56	0.5	-3.96	98.0
Marinette	Marinette	45.9	-17.9	1.54	3.17	60.0	-35.4	-2.60	0.5	-5.52	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	60.0	-35.4	-2.77	0.3	-4.12	98.0
Langlade	Antigo	43.9	-22.1	1.48	3.17	60.0	-35.4	-2.71	0.3	-4.19	98.0
Lincoln	Merrill	44.2	-22.3	1.49	3.57	60.0	-35.4	-2.69	0.4	-3.67	98.0
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	60.0	-35.4	-2.56	0.5	-3.18	97.9
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	60.0	-35.4	-2.58	0.5	-3.34	98.0
Polk	Amery	44.9	-22.5	1.53	3.74	60.0	-35.4	-2.62	0.4	-3.45	98.0
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	60.0	-35.4	-2.64	0.4	-4.37	98.0
Taylor	Jump River	44.3	-24.8	1.51	3.51	60.0	-35.4	-2.64	0.4	-3.02	97.9
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	60.0	-35.4	-2.63	0.4	-3.98	98.0
Door	Washington Island	39.6	-16.5	1.35	3.45	60.0	-35.4	-2.95	0.2	-5.48	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	60.0	-35.4	-2.50	0.6	-3.69	98.0
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	60.0	-35.4	-2.56	0.5	-3.78	98.0
Barron	Rice Lake	45.3	-23.1	1.56	3.63	60.0	-35.4	-2.56	0.5	-3.39	98.0
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	60.0	-35.4	-2.73	0.3	-2.96	97.8
Forest	Laona	41.2	-21.6	1.43	3.17	60.0	-35.4	-2.81	0.2	-4.35	98.0
Barron	Cumberland	46.0	-22.4	1.59	3.28	60.0	-35.4	-2.51	0.6	-3.96	98.0
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	60.0	-35.4	-2.57	0.5	-3.21	97.9
Polk	Luck	45.4	-22.7	1.58	3.39	60.0	-35.4	-2.54	0.5	-3.74	98.0
Marinette	Goodman	42.1	-20.8	1.47	3.12	60.0	-35.4	-2.72	0.3	-4.68	98.0
Oneida	North Pelican	41.5	-23.7	1.45	3.28	60.0	-35.4	-2.76	0.3	-3.57	98.0
Oneida	Rhineland	43.2	-22.5	1.51	3.07	60.0	-35.4	-2.65	0.4	-4.21	98.0
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	60.0	-35.4	-2.73	0.3	-3.66	98.0
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	60.0	-35.4	-2.53	0.6	-3.39	98.0
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	60.0	-35.4	-2.62	0.4	-3.66	98.0
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	60.0	-35.4	-2.47	0.7	-3.59	98.0
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	60.0	-35.4	-2.69	0.3	-3.81	98.0
Sawyer	Couderay	44.6	-26.0	1.59	4.17	60.0	-35.4	-2.52	0.6	-2.25	96.8
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	60.0	-35.4	-2.67	0.4	-3.65	98.0
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	60.0	-35.4	-2.68	0.4	-3.69	98.0
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	60.0	-35.4	-2.62	0.4	-3.88	98.0
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	60.0	-35.4	-2.79	0.3	-3.81	98.0
Price	Park Falls	41.9	-21.8	1.50	3.17	60.0	-35.4	-2.67	0.4	-4.29	98.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	60.0	-35.4	-2.55	0.5	-3.41	98.0
Burnett	Danbury	44.6	-24.6	1.60	3.23	60.0	-35.4	-2.49	0.6	-3.35	98.0
Washburn	Minong 2	44.8	-26.2	1.62	3.12	60.0	-35.4	-2.47	0.7	-2.95	97.8
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	60.0	-35.4	-2.58	0.5	-3.57	98.0
Douglas	Gordon	44.4	-26.4	1.63	3.17	60.0	-35.4	-2.46	0.7	-2.84	97.8
Bayfield	Drummond	44.2	-23.8	1.63	3.28	60.0	-35.4	-2.46	0.7	-3.53	98.0
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	60.0	-35.4	-2.38	0.8	-3.19	97.9
Ashland	Mellen	42.8	-24.1	1.59	3.34	60.0	-35.4	-2.52	0.6	-3.39	98.0
Douglas	Foxboro	43.4	-24.8	1.62	3.07	60.0	-35.4	-2.47	0.7	-3.46	98.0
Iron	Gurney	42.4	-22.2	1.58	3.12	60.0	-35.4	-2.53	0.6	-4.23	98.0
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	60.0	-35.4	-2.44	0.7	-4.16	98.0
Douglas	Superior	39.3	-22.1	1.49	3.17	60.0	-35.4	-2.69	0.4	-4.19	98.0
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	60.0	-35.4	-2.48	0.6	-4.14	98.0
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	60.0	-35.4	-2.59	0.5	-4.30	98.0
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	60.0	-35.4	-2.25	1.2	-4.81	98.0

Table D11. Lower Layer Reliability Analysis for 45 % RAP, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	68.6	-25.3	3.52	98.0	-2.82	97.8
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	68.6	-25.3	3.99	98.0	-2.54	97.5
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	68.6	-25.3	3.50	98.0	-2.71	97.7
Rock	Afton	47.6	-16.4	1.29	3.92	68.6	-25.3	3.56	98.0	-2.27	96.9
Green	Brodhead	47.9	-18.0	1.30	3.45	68.6	-25.3	3.53	98.0	-2.12	96.3
Racine	Burlington	46.3	-16.2	1.26	3.34	68.6	-25.3	3.65	98.0	-2.73	97.7
Rock	Janesville	49.9	-16.7	1.36	3.12	68.6	-25.3	3.38	98.0	-2.76	97.7
Lafayette	Darlington	47.7	-18.3	1.30	3.39	68.6	-25.3	3.53	98.0	-2.06	96.1
Racine	Racine	43.6	-15.9	1.19	3.57	68.6	-25.3	3.85	98.0	-2.64	97.6
Grant	Platteville	47.8	-17.9	1.31	3.28	68.6	-25.3	3.50	98.0	-2.25	96.8
Grant	Lancaster	46.8	-18.2	1.30	3.23	68.6	-25.3	3.55	98.0	-2.20	96.6
Walworth	Whitewater	48.0	-16.8	1.33	3.39	68.6	-25.3	3.45	98.0	-2.50	97.4
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	68.6	-25.3	3.47	98.0	-2.00	95.8
Dane	Stoughton	47.5	-17.4	1.33	3.34	68.6	-25.3	3.47	98.0	-2.37	97.1
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	68.6	-25.3	3.71	98.0	-2.83	97.8
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	68.6	-25.3	3.54	98.0	-2.32	97.0
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	68.6	-25.3	3.50	98.0	-2.65	97.6
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	68.6	-25.3	3.51	98.0	-2.88	97.8
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	68.6	-25.3	3.42	98.0	-1.85	94.9
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	68.6	-25.3	3.27	97.9	-1.76	94.2
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	68.6	-25.3	3.52	98.0	-2.13	96.4
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	68.6	-25.3	3.36	98.0	-2.42	97.2
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	68.6	-25.3	3.39	98.0	-2.83	97.8
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	68.6	-25.3	3.47	98.0	-2.40	97.2
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	68.6	-25.3	3.44	98.0	-2.23	96.7
Jefferson	Watertown	47.5	-17.4	1.36	3.51	68.6	-25.3	3.39	98.0	-2.25	96.8
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	68.6	-25.3	3.33	98.0	-1.88	95.0
Washington	Germantown	45.3	-17.7	1.30	3.57	68.6	-25.3	3.55	98.0	-2.13	96.4
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	68.6	-25.3	3.39	98.0	-2.10	96.2
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	68.6	-25.3	3.43	98.0	-1.91	95.2
Richland	Richland Center	48.2	-19.9	1.39	3.74	68.6	-25.3	3.30	98.0	-1.44	90.7
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	68.6	-25.3	3.41	98.0	-2.16	96.5
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	68.6	-25.3	3.80	98.0	-2.82	97.8
Washington	West Bend	45.4	-17.4	1.32	3.45	68.6	-25.3	3.48	98.0	-2.29	96.9
Dodge	Horicon	46.4	-18.2	1.36	3.39	68.6	-25.3	3.39	98.0	-2.09	96.2
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	68.6	-25.3	3.32	98.0	-2.20	96.6
Sauk	Baraboo	46.6	-20.2	1.36	3.74	68.6	-25.3	3.37	98.0	-1.36	89.5
Columbia	Portage	47.7	-18.6	1.40	3.57	68.6	-25.3	3.28	97.9	-1.88	95.0
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	68.6	-25.3	3.28	97.9	-1.65	93.2
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	68.6	-25.3	3.30	98.0	-1.68	93.5
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	68.6	-25.3	3.40	98.0	-1.38	89.8
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	68.6	-25.3	3.38	98.0	-1.68	93.5
Green Lake	Dalton	47.3	-18.5	1.41	3.23	68.6	-25.3	3.27	97.9	-2.11	96.3

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	68.6	-25.3	3.28	97.9	-1.22	87.0
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	68.6	-25.3	3.36	98.0	-2.40	97.2
Monroe	Cashton	45.8	-18.9	1.37	3.68	68.6	-25.3	3.35	98.0	-1.74	94.0
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	68.6	-25.3	3.50	98.0	-2.79	97.7
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	68.6	-25.3	3.24	97.9	-1.46	91.0
Marquette	Montello	46.8	-19.5	1.41	3.45	68.6	-25.3	3.27	97.9	-1.68	93.5
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	68.6	-25.3	3.37	98.0	-2.30	96.9
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	68.6	-25.3	3.17	97.9	-1.68	93.5
Monroe	Sparta	47.5	-21.3	1.45	3.74	68.6	-25.3	3.18	97.9	-1.07	84.0
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	68.6	-25.3	3.18	97.9	-1.38	89.8
Juneau	Necedah	48.1	-21.6	1.48	3.68	68.6	-25.3	3.12	97.9	-1.00	82.6
Calumet	Chilton	46.5	-17.7	1.43	3.23	68.6	-25.3	3.22	97.9	-2.36	97.1
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	68.6	-25.3	3.28	97.9	-2.22	96.7
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	68.6	-25.3	3.44	98.0	-2.63	97.6
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	68.6	-25.3	3.15	97.9	-1.34	89.2
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	68.6	-25.3	3.03	97.9	-0.71	74.5
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	68.6	-25.3	3.76	98.0	-2.71	97.7
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	68.6	-25.3	3.23	97.9	-1.37	89.7
Outagamie	Appleton	45.1	-17.7	1.41	3.07	68.6	-25.3	3.26	97.9	-2.48	97.4
Trempealeau	Blair	46.5	-22.2	1.46	3.80	68.6	-25.3	3.15	97.9	-0.82	77.7
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	68.6	-25.3	3.11	97.9	-1.52	91.7
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	68.6	-25.3	3.14	97.9	-2.01	95.8
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	68.6	-25.3	3.24	97.9	-0.78	76.6
Waupaca	New London	47.0	-19.4	1.48	3.34	68.6	-25.3	3.10	97.9	-1.77	94.2
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	68.6	-25.3	3.16	97.9	-1.58	92.5
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	68.6	-25.3	2.99	97.9	-0.42	65.0
Wood	Pittsville	46.6	-22.3	1.48	3.34	68.6	-25.3	3.11	97.9	-0.90	79.9
Portage	Stevens Point	45.1	-19.8	1.44	3.28	68.6	-25.3	3.20	97.9	-1.68	93.4
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	68.6	-25.3	3.13	97.9	-0.87	79.1
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	68.6	-25.3	3.04	97.9	-0.93	80.8
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	68.6	-25.3	3.17	97.9	-1.61	92.7
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	68.6	-25.3	3.13	97.9	-1.86	94.9
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	68.6	-25.3	3.10	97.9	-1.49	91.3
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	68.6	-25.3	3.04	97.9	-1.26	87.8
Marathon	Rosholt	45.4	-21.2	1.48	3.28	68.6	-25.3	3.11	97.9	-1.25	87.6
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	68.6	-25.3	3.02	97.9	-1.33	88.9
Dunn	Menomonie	47.8	-21.2	1.57	3.57	68.6	-25.3	2.93	97.8	-1.15	85.7

Table D12. Lower Layer Reliability Analysis for 45 % RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	68.6	-28.6	3.49	98.0	-2.99	97.9
Brown	Green Bay	44.8	-18.5	1.43	3.23	68.6	-28.6	3.22	97.9	-3.13	97.9
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	68.6	-28.6	3.07	97.9	-2.58	97.5
Shawano	Bowler	44.0	-20.9	1.45	3.45	68.6	-28.6	3.18	97.9	-2.23	96.7
Pierce	River Falls	47.0	-20.7	1.54	3.39	68.6	-28.6	2.98	97.9	-2.33	97.0
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	68.6	-28.6	3.26	97.9	-3.36	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	68.6	-28.6	3.15	97.9	-2.83	97.8
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	68.6	-28.6	3.15	97.9	-2.59	97.5
Clark	Owen	43.3	-22.2	1.43	3.34	68.6	-28.6	3.21	97.9	-1.92	95.3
Chippewa	Stanley	45.3	-21.7	1.50	3.34	68.6	-28.6	3.07	97.9	-2.07	96.1
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	68.6	-28.6	3.01	97.9	-1.93	95.4
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	68.6	-28.6	2.95	97.8	-2.02	95.9
Marinette	Marinette	45.9	-17.9	1.54	3.17	68.6	-28.6	2.99	97.9	-3.37	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	68.6	-28.6	3.19	97.9	-2.01	95.8
Langlade	Antigo	43.9	-22.1	1.48	3.17	68.6	-28.6	3.12	97.9	-2.05	96.0
Lincoln	Merrill	44.2	-22.3	1.49	3.57	68.6	-28.6	3.09	97.9	-1.77	94.2
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	68.6	-28.6	2.94	97.8	-1.39	90.0
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	68.6	-28.6	2.97	97.9	-1.43	90.5
Polk	Amery	44.9	-22.5	1.53	3.74	68.6	-28.6	3.01	97.9	-1.63	92.9
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	68.6	-28.6	3.03	97.9	-2.26	96.8
Taylor	Jump River	44.3	-24.8	1.51	3.51	68.6	-28.6	3.04	97.9	-1.08	84.3
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	68.6	-28.6	3.02	97.9	-2.07	96.1
Door	Washington Island	39.6	-16.5	1.35	3.45	68.6	-28.6	3.40	98.0	-3.51	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	68.6	-28.6	2.87	97.8	-1.61	92.8
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	68.6	-28.6	2.95	97.8	-1.67	93.4
Barron	Rice Lake	45.3	-23.1	1.56	3.63	68.6	-28.6	2.94	97.8	-1.52	91.7
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	68.6	-28.6	3.14	97.9	-0.99	82.1
Forest	Laona	41.2	-21.6	1.43	3.17	68.6	-28.6	3.23	97.9	-2.21	96.7
Barron	Cumberland	46.0	-22.4	1.59	3.28	68.6	-28.6	2.89	97.8	-1.89	95.1
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	68.6	-28.6	2.95	97.8	-1.21	86.9
Polk	Luck	45.4	-22.7	1.58	3.39	68.6	-28.6	2.92	97.8	-1.74	94.0
Marinette	Goodman	42.1	-20.8	1.47	3.12	68.6	-28.6	3.13	97.9	-2.50	97.4
Oneida	North Pelican	41.5	-23.7	1.45	3.28	68.6	-28.6	3.18	97.9	-1.49	91.4
Oneida	Rhineland	43.2	-22.5	1.51	3.07	68.6	-28.6	3.05	97.9	-1.99	95.7
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	68.6	-28.6	3.14	97.9	-1.55	92.1
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	68.6	-28.6	2.91	97.8	-1.42	90.4
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	68.6	-28.6	3.01	97.9	-1.55	92.1
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	68.6	-28.6	2.84	97.8	-1.45	90.8
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	68.6	-28.6	3.10	97.9	-1.70	93.7
Sawyer	Couderay	44.6	-26.0	1.59	4.17	68.6	-28.6	2.90	97.8	-0.62	71.9
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	68.6	-28.6	3.07	97.9	-1.65	93.2
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	68.6	-28.6	3.08	97.9	-1.47	91.0
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	68.6	-28.6	3.02	97.9	-1.63	92.9
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	68.6	-28.6	3.21	97.9	-1.70	93.7
Price	Park Falls	41.9	-21.8	1.50	3.17	68.6	-28.6	3.07	97.9	-2.14	96.4

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	68.6	-28.6	2.94	97.8	-1.34	89.2
Burnett	Danbury	44.6	-24.6	1.60	3.23	68.6	-28.6	2.87	97.8	-1.24	87.5
Washburn	Minong 2	44.8	-26.2	1.62	3.12	68.6	-28.6	2.84	97.8	-0.77	76.4
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	68.6	-28.6	2.97	97.9	-1.49	91.4
Douglas	Gordon	44.4	-26.4	1.63	3.17	68.6	-28.6	2.83	97.8	-0.69	74.1
Bayfield	Drummond	44.2	-23.8	1.63	3.28	68.6	-28.6	2.83	97.8	-1.46	91.0
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	68.6	-28.6	2.74	97.7	-1.08	84.4
Ashland	Mellen	42.8	-24.1	1.59	3.34	68.6	-28.6	2.90	97.8	-1.35	89.3
Douglas	Foxboro	43.4	-24.8	1.62	3.07	68.6	-28.6	2.85	97.8	-1.24	87.5
Iron	Gurney	42.4	-22.2	1.58	3.12	68.6	-28.6	2.91	97.8	-2.05	96.0
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	68.6	-28.6	2.80	97.7	-2.02	95.9
Douglas	Superior	39.3	-22.1	1.49	3.17	68.6	-28.6	3.09	97.9	-2.05	96.0
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	68.6	-28.6	2.86	97.8	-1.96	95.5
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	68.6	-28.6	2.98	97.9	-2.43	97.3
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	68.6	-28.6	2.58	97.5	-2.74	97.7

Table D13. Lower Layer Reliability Analysis for 20 % RAS, Mid Grade PG 58-28 Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	68.9	-25.1	3.75	98.0	-2.76	97.7
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	68.9	-25.1	4.25	98.0	-2.48	97.4
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	68.9	-25.1	3.72	98.0	-2.65	97.6
Rock	Afton	47.6	-16.4	1.29	3.92	68.9	-25.1	3.79	98.0	-2.22	96.7
Green	Brodhead	47.9	-18.0	1.30	3.45	68.9	-25.1	3.76	98.0	-2.06	96.1
Racine	Burlington	46.3	-16.2	1.26	3.34	68.9	-25.1	3.88	98.0	-2.67	97.6
Rock	Janesville	49.9	-16.7	1.36	3.12	68.9	-25.1	3.60	98.0	-2.69	97.7
Lafayette	Darlington	47.7	-18.3	1.30	3.39	68.9	-25.1	3.76	98.0	-2.00	95.8
Racine	Racine	43.6	-15.9	1.19	3.57	68.9	-25.1	4.11	98.0	-2.58	97.5
Grant	Platteville	47.8	-17.9	1.31	3.28	68.9	-25.1	3.73	98.0	-2.19	96.6
Grant	Lancaster	46.8	-18.2	1.30	3.23	68.9	-25.1	3.78	98.0	-2.14	96.4
Walworth	Whitewater	48.0	-16.8	1.33	3.39	68.9	-25.1	3.68	98.0	-2.45	97.3
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	68.9	-25.1	3.69	98.0	-1.95	95.5
Dane	Stoughton	47.5	-17.4	1.33	3.34	68.9	-25.1	3.70	98.0	-2.31	97.0
Milwaukee	Milwaukee Mtchl Fld	44.3	-15.2	1.24	3.57	68.9	-25.1	3.95	98.0	-2.78	97.7
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	68.9	-25.1	3.78	98.0	-2.26	96.8
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	68.9	-25.1	3.73	98.0	-2.59	97.5
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	68.9	-25.1	3.74	98.0	-2.82	97.8
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	68.9	-25.1	3.64	98.0	-1.79	94.4
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	68.9	-25.1	3.49	98.0	-1.71	93.7
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	68.9	-25.1	3.75	98.0	-2.07	96.1
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	68.9	-25.1	3.58	98.0	-2.36	97.1
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	68.9	-25.1	3.61	98.0	-2.77	97.7
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	68.9	-25.1	3.69	98.0	-2.34	97.0
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	68.9	-25.1	3.66	98.0	-2.17	96.5
Jefferson	Watertown	47.5	-17.4	1.36	3.51	68.9	-25.1	3.61	98.0	-2.19	96.6
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	68.9	-25.1	3.55	98.0	-1.82	94.6
Washington	Germantown	45.3	-17.7	1.30	3.57	68.9	-25.1	3.78	98.0	-2.07	96.1
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	68.9	-25.1	3.61	98.0	-2.04	96.0
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	68.9	-25.1	3.66	98.0	-1.85	94.9
Richland	Richland Center	48.2	-19.9	1.39	3.74	68.9	-25.1	3.52	98.0	-1.39	89.9
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	68.9	-25.1	3.63	98.0	-2.10	96.2
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	68.9	-25.1	4.05	98.0	-2.76	97.7
Washington	West Bend	45.4	-17.4	1.32	3.45	68.9	-25.1	3.71	98.0	-2.23	96.7
Dodge	Horicon	46.4	-18.2	1.36	3.39	68.9	-25.1	3.61	98.0	-2.03	95.9
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	68.9	-25.1	3.54	98.0	-2.14	96.4
Sauk	Baraboo	46.6	-20.2	1.36	3.74	68.9	-25.1	3.59	98.0	-1.31	88.7
Columbia	Portage	47.7	-18.6	1.40	3.57	68.9	-25.1	3.50	98.0	-1.82	94.6
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	68.9	-25.1	3.49	98.0	-1.59	92.5
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	68.9	-25.1	3.51	98.0	-1.63	92.9
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	68.9	-25.1	3.63	98.0	-1.32	88.9
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	68.9	-25.1	3.60	98.0	-1.63	92.9
Green Lake	Dalton	47.3	-18.5	1.41	3.23	68.9	-25.1	3.49	98.0	-2.05	96.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	68.9	-25.1	3.49	98.0	-1.16	86.0
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	68.9	-25.1	3.58	98.0	-2.34	97.0
Monroe	Cashton	45.8	-18.9	1.37	3.68	68.9	-25.1	3.57	98.0	-1.68	93.5
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	68.9	-25.1	3.72	98.0	-2.73	97.7
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	68.9	-25.1	3.45	98.0	-1.41	90.2
Marquette	Montello	46.8	-19.5	1.41	3.45	68.9	-25.1	3.49	98.0	-1.62	92.9
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	68.9	-25.1	3.59	98.0	-2.24	96.8
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	68.9	-25.1	3.37	98.0	-1.63	92.9
Monroe	Sparta	47.5	-21.3	1.45	3.74	68.9	-25.1	3.39	98.0	-1.02	82.8
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	68.9	-25.1	3.39	98.0	-1.32	88.9
Juneau	Necedah	48.1	-21.6	1.48	3.68	68.9	-25.1	3.32	98.0	-0.95	81.2
Calumet	Chilton	46.5	-17.7	1.43	3.23	68.9	-25.1	3.44	98.0	-2.29	96.9
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	68.9	-25.1	3.50	98.0	-2.16	96.5
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	68.9	-25.1	3.67	98.0	-2.57	97.5
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	68.9	-25.1	3.36	98.0	-1.28	88.2
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	68.9	-25.1	3.23	97.9	-0.65	72.8
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	68.9	-25.1	4.00	98.0	-2.65	97.6
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	68.9	-25.1	3.44	98.0	-1.32	88.8
Outagamie	Appleton	45.1	-17.7	1.41	3.07	68.9	-25.1	3.48	98.0	-2.41	97.2
Trempealeau	Blair	46.5	-22.2	1.46	3.80	68.9	-25.1	3.36	98.0	-0.76	76.2
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	68.9	-25.1	3.32	98.0	-1.46	91.0
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	68.9	-25.1	3.35	98.0	-1.95	95.5
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	68.9	-25.1	3.45	98.0	-0.72	74.9
Waupaca	New London	47.0	-19.4	1.48	3.34	68.9	-25.1	3.30	98.0	-1.71	93.7
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	68.9	-25.1	3.37	98.0	-1.52	91.7
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	68.9	-25.1	3.19	97.9	-0.36	62.9
Wood	Pittsville	46.6	-22.3	1.48	3.34	68.9	-25.1	3.32	98.0	-0.84	78.3
Portage	Stevens Point	45.1	-19.8	1.44	3.28	68.9	-25.1	3.41	98.0	-1.61	92.8
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	68.9	-25.1	3.33	98.0	-0.81	77.6
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	68.9	-25.1	3.24	97.9	-0.88	79.4
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	68.9	-25.1	3.38	98.0	-1.54	92.0
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	68.9	-25.1	3.34	98.0	-1.80	94.5
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	68.9	-25.1	3.31	98.0	-1.43	90.5
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	68.9	-25.1	3.24	97.9	-1.20	86.7
Marathon	Rosholt	45.4	-21.2	1.48	3.28	68.9	-25.1	3.31	98.0	-1.19	86.5
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	68.9	-25.1	3.22	97.9	-1.27	87.9
Dunn	Menomonie	47.8	-21.2	1.57	3.57	68.9	-25.1	3.12	97.9	-1.09	84.6

Table D14. Lower Layer Reliability Analysis for 20 % RAS, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	41.4	-16.7	1.32	3.99	70.7	-29.1	5.09	98.0	-3.11	97.9
Brown	Green Bay	44.8	-18.5	1.43	3.23	70.7	-29.1	4.69	98.0	-3.29	98.0
Shawano	Shawano 2 Ssw	45.9	-20.0	1.50	3.34	70.7	-29.1	4.48	98.0	-2.73	97.7
Shawano	Bowler	44.0	-20.9	1.45	3.45	70.7	-29.1	4.63	98.0	-2.38	97.1
Pierce	River Falls	47.0	-20.7	1.54	3.39	70.7	-29.1	4.34	98.0	-2.48	97.3
Door	Sturgeon Bay Exp Far	43.0	-17.4	1.41	3.34	70.7	-29.1	4.74	98.0	-3.51	98.0
Oconto	Oconto	44.3	-19.0	1.46	3.39	70.7	-29.1	4.59	98.0	-2.98	97.9
Marathon	Wausau Municipal Ap	44.2	-20.1	1.46	3.28	70.7	-29.1	4.59	98.0	-2.74	97.7
Clark	Owen	43.3	-22.2	1.43	3.34	70.7	-29.1	4.68	98.0	-2.07	96.1
Chippewa	Stanley	45.3	-21.7	1.50	3.34	70.7	-29.1	4.47	98.0	-2.22	96.7
Oconto	Breed 6 Sse	45.9	-21.7	1.53	3.57	70.7	-29.1	4.39	98.0	-2.07	96.1
Chippewa	Bloomer	46.6	-21.5	1.56	3.51	70.7	-29.1	4.30	98.0	-2.17	96.5
Marinette	Marinette	45.9	-17.9	1.54	3.17	70.7	-29.1	4.36	98.0	-3.53	98.0
Taylor	Medford	43.0	-22.1	1.44	3.23	70.7	-29.1	4.64	98.0	-2.17	96.5
Langlade	Antigo	43.9	-22.1	1.48	3.17	70.7	-29.1	4.54	98.0	-2.21	96.7
Lincoln	Merrill	44.2	-22.3	1.49	3.57	70.7	-29.1	4.50	98.0	-1.91	95.2
Chippewa	Holcombe	46.3	-23.3	1.56	3.80	70.7	-29.1	4.28	98.0	-1.52	91.8
Barron	Ridgeland 1 Nne	45.8	-23.5	1.55	3.57	70.7	-29.1	4.33	98.0	-1.57	92.3
Polk	Amery	44.9	-22.5	1.53	3.74	70.7	-29.1	4.39	98.0	-1.76	94.2
Oconto	Lakewood 3 Ne	44.5	-21.3	1.52	3.23	70.7	-29.1	4.42	98.0	-2.42	97.2
Taylor	Jump River	44.3	-24.8	1.51	3.51	70.7	-29.1	4.42	98.0	-1.23	87.2
Marinette	Crivitz High Falls	44.5	-21.2	1.52	3.57	70.7	-29.1	4.40	98.0	-2.22	96.7
Door	Washington Island	39.6	-16.5	1.35	3.45	70.7	-29.1	4.95	98.0	-3.65	98.0
Polk	St Croix Falls	46.7	-23.3	1.60	3.28	70.7	-29.1	4.18	98.0	-1.77	94.2
Rusk	Weyerhauser	45.5	-23.2	1.56	3.23	70.7	-29.1	4.29	98.0	-1.83	94.7
Barron	Rice Lake	45.3	-23.1	1.56	3.63	70.7	-29.1	4.28	98.0	-1.66	93.2
Price	Prentice 5 W	42.4	-25.2	1.47	3.45	70.7	-29.1	4.57	98.0	-1.13	85.3
Forest	Laona	41.2	-21.6	1.43	3.17	70.7	-29.1	4.70	98.0	-2.36	97.1
Barron	Cumberland	46.0	-22.4	1.59	3.28	70.7	-29.1	4.21	98.0	-2.04	96.0
Rusk	Big Falls Hydro	44.9	-24.5	1.56	3.39	70.7	-29.1	4.30	98.0	-1.36	89.4
Polk	Luck	45.4	-22.7	1.58	3.39	70.7	-29.1	4.25	98.0	-1.89	95.1
Marinette	Goodman	42.1	-20.8	1.47	3.12	70.7	-29.1	4.56	98.0	-2.66	97.6
Oneida	North Pelican	41.5	-23.7	1.45	3.28	70.7	-29.1	4.63	98.0	-1.65	93.1
Oneida	Rhineland	43.2	-22.5	1.51	3.07	70.7	-29.1	4.44	98.0	-2.15	96.5
Oneida	Willow Reservoir	41.7	-23.6	1.47	3.23	70.7	-29.1	4.57	98.0	-1.70	93.7
Burnett	Grantsburg	44.8	-23.7	1.58	3.45	70.7	-29.1	4.24	98.0	-1.56	92.2
Forest	Newald 4 N	43.3	-23.6	1.53	3.23	70.7	-29.1	4.38	98.0	-1.70	93.7
Washburn	Spooner Exp Farm	45.7	-24.0	1.62	3.17	70.7	-29.1	4.14	98.0	-1.61	92.7
Oneida	Rainbow Rsvr Lake	41.9	-23.1	1.49	3.23	70.7	-29.1	4.51	98.0	-1.86	94.9
Sawyer	Couderay	44.6	-26.0	1.59	4.17	70.7	-29.1	4.23	98.0	-0.74	75.6
Oneida	Minocqua Dam	42.1	-23.0	1.50	3.39	70.7	-29.1	4.47	98.0	-1.80	94.5
Sawyer	Winter 5 Nw	42.0	-24.1	1.49	3.07	70.7	-29.1	4.48	98.0	-1.63	93.0
Oneida	Long Lake Dam	42.8	-23.7	1.53	3.01	70.7	-29.1	4.39	98.0	-1.79	94.4
Vilas	St Germain 2 E	40.2	-23.1	1.43	3.23	70.7	-29.1	4.67	98.0	-1.86	94.9
Price	Park Falls	41.9	-21.8	1.50	3.17	70.7	-29.1	4.48	98.0	-2.30	97.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	43.8	-24.2	1.57	3.28	70.7	-29.1	4.28	98.0	-1.49	91.4
Burnett	Danbury	44.6	-24.6	1.60	3.23	70.7	-29.1	4.18	98.0	-1.39	90.0
Washburn	Minong 2	44.8	-26.2	1.62	3.12	70.7	-29.1	4.14	98.0	-0.93	80.7
Vilas	Rest Lake	42.7	-23.7	1.55	3.28	70.7	-29.1	4.33	98.0	-1.65	93.1
Douglas	Gordon	44.4	-26.4	1.63	3.17	70.7	-29.1	4.12	98.0	-0.85	78.7
Bayfield	Drummond	44.2	-23.8	1.63	3.28	70.7	-29.1	4.12	98.0	-1.61	92.8
Douglas	Solon Springs	45.5	-25.1	1.68	3.23	70.7	-29.1	3.99	98.0	-1.24	87.5
Ashland	Mellen	42.8	-24.1	1.59	3.34	70.7	-29.1	4.22	98.0	-1.50	91.4
Douglas	Foxboro	43.4	-24.8	1.62	3.07	70.7	-29.1	4.14	98.0	-1.40	90.1
Iron	Gurney	42.4	-22.2	1.58	3.12	70.7	-29.1	4.24	98.0	-2.21	96.7
Bayfield	Ashland Exp Farm	43.8	-22.2	1.64	3.17	70.7	-29.1	4.08	98.0	-2.18	96.5
Douglas	Superior	39.3	-22.1	1.49	3.17	70.7	-29.1	4.50	98.0	-2.21	96.7
Bayfield	Port Wing	42.3	-22.5	1.61	3.12	70.7	-29.1	4.16	98.0	-2.12	96.3
Ashland	Madeline Island	40.5	-19.8	1.54	3.63	70.7	-29.1	4.34	98.0	-2.57	97.5
Bayfield	Bayfield	46.4	-19.6	1.78	3.28	70.7	-29.1	3.76	98.0	-2.89	97.8

Table D15. Lower Layer Reliability Analysis for 10 % RAS and 22.5% RAP, Mid Grade Binder, South (PG 58-28) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Rock	Beloit	48.6	-15.9	1.31	3.34	69.5	-25.3	4.21	98.0	-2.82	97.8
Kenosha	Kenosha	42.7	-15.5	1.15	3.86	69.5	-25.3	4.77	98.0	-2.54	97.5
Walworth	Lake Geneva	48.5	-16.1	1.32	3.39	69.5	-25.3	4.18	98.0	-2.71	97.7
Rock	Afton	47.6	-16.4	1.29	3.92	69.5	-25.3	4.25	98.0	-2.27	96.9
Green	Brodhead	47.9	-18.0	1.30	3.45	69.5	-25.3	4.22	98.0	-2.12	96.3
Racine	Burlington	46.3	-16.2	1.26	3.34	69.5	-25.3	4.36	98.0	-2.73	97.7
Rock	Janesville	49.9	-16.7	1.36	3.12	69.5	-25.3	4.04	98.0	-2.76	97.7
Lafayette	Darlington	47.7	-18.3	1.30	3.39	69.5	-25.3	4.22	98.0	-2.06	96.1
Racine	Racine	43.6	-15.9	1.19	3.57	69.5	-25.3	4.61	98.0	-2.64	97.6
Grant	Platteville	47.8	-17.9	1.31	3.28	69.5	-25.3	4.18	98.0	-2.25	96.8
Grant	Lancaster	46.8	-18.2	1.30	3.23	69.5	-25.3	4.24	98.0	-2.20	96.6
Walworth	Whitewater	48.0	-16.8	1.33	3.39	69.5	-25.3	4.13	98.0	-2.50	97.4
Jefferson	Fort Atkinson	47.7	-17.8	1.33	3.74	69.5	-25.3	4.15	98.0	-2.00	95.8
Dane	Stoughton	47.5	-17.4	1.33	3.34	69.5	-25.3	4.15	98.0	-2.37	97.1
Milwaukee	Milwaukee Mchll Fld	44.3	-15.2	1.24	3.57	69.5	-25.3	4.44	98.0	-2.83	97.8
Iowa	Dodgeville	46.3	-17.8	1.30	3.23	69.5	-25.3	4.24	98.0	-2.32	97.0
Waukesha	Waukesha	46.7	-16.3	1.31	3.39	69.5	-25.3	4.19	98.0	-2.65	97.6
Milwaukee	West Allis	46.5	-15.7	1.31	3.34	69.5	-25.3	4.20	98.0	-2.88	97.8
Dane	Arboretum Univ Wis	47.8	-18.7	1.35	3.57	69.5	-25.3	4.08	98.0	-1.85	94.9
Crawford	Prairie Du Chien	49.9	-18.7	1.41	3.74	69.5	-25.3	3.91	98.0	-1.76	94.2
Dane	Charmany Farm	46.3	-17.7	1.31	3.57	69.5	-25.3	4.21	98.0	-2.13	96.4
Jefferson	Lake Mills	48.4	-17.5	1.37	3.23	69.5	-25.3	4.02	98.0	-2.42	97.2
Milwaukee	Milwaukee Mt Mary Co	48.0	-15.7	1.36	3.39	69.5	-25.3	4.05	98.0	-2.83	97.8
Waukesha	Oconomowoc	46.8	-17.3	1.33	3.34	69.5	-25.3	4.15	98.0	-2.40	97.2
Dane	Madison Dane Cnty Ap	47.1	-17.6	1.34	3.45	69.5	-25.3	4.11	98.0	-2.23	96.7
Jefferson	Watertown	47.5	-17.4	1.36	3.51	69.5	-25.3	4.06	98.0	-2.25	96.8
Crawford	Lynxville Dam 9	48.2	-18.6	1.38	3.57	69.5	-25.3	3.98	98.0	-1.88	95.0
Washington	Germantown	45.3	-17.7	1.30	3.57	69.5	-25.3	4.24	98.0	-2.13	96.4
Columbia	Arlington Univ Farm	47.0	-18.3	1.36	3.34	69.5	-25.3	4.06	98.0	-2.10	96.2
Washington	Hartford 2 W	46.4	-18.6	1.34	3.51	69.5	-25.3	4.10	98.0	-1.91	95.2
Richland	Richland Center	48.2	-19.9	1.39	3.74	69.5	-25.3	3.95	98.0	-1.44	90.7
Sauk	Prairie Du Sac 2 N	46.7	-18.1	1.35	3.34	69.5	-25.3	4.08	98.0	-2.16	96.5
Ozaukee	Port Washington	41.7	-15.9	1.21	3.34	69.5	-25.3	4.54	98.0	-2.82	97.8
Washington	West Bend	45.4	-17.4	1.32	3.45	69.5	-25.3	4.16	98.0	-2.29	96.9
Dodge	Horicon	46.4	-18.2	1.36	3.39	69.5	-25.3	4.06	98.0	-2.09	96.2
Dodge	Beaver Dam	47.4	-17.7	1.38	3.45	69.5	-25.3	3.97	98.0	-2.20	96.6
Sauk	Baraboo	46.6	-20.2	1.36	3.74	69.5	-25.3	4.03	98.0	-1.36	89.5
Columbia	Portage	47.7	-18.6	1.40	3.57	69.5	-25.3	3.92	98.0	-1.88	95.0
Sauk	Reedsburg	47.7	-19.7	1.40	3.39	69.5	-25.3	3.92	98.0	-1.65	93.2
Vernon	Genoa Dam 8	47.3	-19.1	1.40	3.68	69.5	-25.3	3.94	98.0	-1.68	93.5
Vernon	Viroqua 2 Nw	45.8	-20.3	1.35	3.63	69.5	-25.3	4.07	98.0	-1.38	89.8
Columbia	Wisconsin Dells	45.9	-19.2	1.36	3.63	69.5	-25.3	4.04	98.0	-1.68	93.5
Green Lake	Dalton	47.3	-18.5	1.41	3.23	69.5	-25.3	3.91	98.0	-2.11	96.3
Vernon	Hillsboro	47.2	-20.6	1.40	3.86	69.5	-25.3	3.92	98.0	-1.22	87.0

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Sheboygan	Plymouth	45.7	-17.3	1.37	3.34	69.5	-25.3	4.02	98.0	-2.40	97.2
Monroe	Cashton	45.8	-18.9	1.37	3.68	69.5	-25.3	4.01	98.0	-1.74	94.0
Sheboygan	Sheboygan	43.9	-16.0	1.32	3.34	69.5	-25.3	4.18	98.0	-2.79	97.7
Juneau	Mauston 1 Se	47.3	-20.0	1.42	3.63	69.5	-25.3	3.87	98.0	-1.46	91.0
Marquette	Montello	46.8	-19.5	1.41	3.45	69.5	-25.3	3.91	98.0	-1.68	93.5
Fond Du Lac	Fond Du Lac	45.4	-17.5	1.37	3.39	69.5	-25.3	4.03	98.0	-2.30	96.9
La Crosse	La Crosse Muni Ap	48.0	-19.2	1.45	3.63	69.5	-25.3	3.79	98.0	-1.68	93.5
Monroe	Sparta	47.5	-21.3	1.45	3.74	69.5	-25.3	3.81	98.0	-1.07	84.0
Trempealeau	Trempealeau Dam 6	47.2	-20.3	1.44	3.63	69.5	-25.3	3.81	98.0	-1.38	89.8
Juneau	Necedah	48.1	-21.6	1.48	3.68	69.5	-25.3	3.73	98.0	-1.00	82.6
Calumet	Chilton	46.5	-17.7	1.43	3.23	69.5	-25.3	3.86	98.0	-2.36	97.1
Winnebago	Oshkosh	45.7	-17.9	1.40	3.34	69.5	-25.3	3.92	98.0	-2.22	96.7
Manitowoc	Manitowoc	43.3	-16.8	1.34	3.23	69.5	-25.3	4.12	98.0	-2.63	97.6
Waushara	Hancock Exp Farm	47.2	-20.6	1.46	3.51	69.5	-25.3	3.77	98.0	-1.34	89.2
Trempealeau	Dodge	49.1	-22.7	1.52	3.68	69.5	-25.3	3.62	98.0	-0.71	74.5
Manitowoc	Two Rivers 10 N	39.5	-16.7	1.22	3.17	69.5	-25.3	4.49	98.0	-2.71	97.7
Jackson	Mather 3 Nw	45.8	-20.4	1.42	3.57	69.5	-25.3	3.87	98.0	-1.37	89.7
Outagamie	Appleton	45.1	-17.7	1.41	3.07	69.5	-25.3	3.90	98.0	-2.48	97.4
Trempealeau	Blair	46.5	-22.2	1.46	3.80	69.5	-25.3	3.77	98.0	-0.82	77.7
Buffalo	Alma Dam 4	47.0	-19.8	1.48	3.63	69.5	-25.3	3.72	98.0	-1.52	91.7
Waupaca	Waupaca	46.5	-18.6	1.46	3.34	69.5	-25.3	3.76	98.0	-2.01	95.8
Portage	Coddington 1 E	45.0	-22.7	1.42	3.34	69.5	-25.3	3.87	98.0	-0.78	76.6
Waupaca	New London	47.0	-19.4	1.48	3.34	69.5	-25.3	3.71	98.0	-1.77	94.2
Wood	Wisconsin Rapids	46.1	-20.1	1.46	3.28	69.5	-25.3	3.78	98.0	-1.58	92.5
Jackson	Hatfield Hydro Plant	48.6	-23.8	1.54	3.57	69.5	-25.3	3.58	98.0	-0.42	65.0
Wood	Pittsville	46.6	-22.3	1.48	3.34	69.5	-25.3	3.72	98.0	-0.90	79.9
Portage	Stevens Point	45.1	-19.8	1.44	3.28	69.5	-25.3	3.82	98.0	-1.68	93.4
Clark	Neillsville 3 Sw	46.0	-22.2	1.47	3.57	69.5	-25.3	3.74	98.0	-0.87	79.1
Buffalo	Mondovi	47.2	-21.7	1.51	3.86	69.5	-25.3	3.63	98.0	-0.93	80.8
Eau Claire	Fairchild Ranger Sta	45.1	-20.2	1.45	3.17	69.5	-25.3	3.79	98.0	-1.61	92.7
Waupaca	Clintonville	45.6	-19.2	1.47	3.28	69.5	-25.3	3.75	98.0	-1.86	94.9
Wood	Marshfield Exp Farm	45.9	-20.5	1.48	3.23	69.5	-25.3	3.71	98.0	-1.49	91.3
Pierce	Ellsworth	46.5	-21.1	1.51	3.34	69.5	-25.3	3.64	98.0	-1.26	87.8
Marathon	Rosholt	45.4	-21.2	1.48	3.28	69.5	-25.3	3.72	98.0	-1.25	87.6
Chippewa	Eau Claire County Ap	46.3	-20.8	1.52	3.39	69.5	-25.3	3.62	98.0	-1.33	88.9
Dunn	Menomonie	47.8	-21.2	1.57	3.57	69.5	-25.3	3.50	98.0	-1.15	85.7

Table D16. Lower Layer Reliability Analysis for 10 % RAS and 22.5 %RAP, Mid Grade PG 58-34 Binder, North (PG 58-34) Weather Stations.

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Kewaunee	Kewaunee	48.6	-15.9	1.31	3.34	69.5	-25.3	4.21	98.0	-2.82	97.8
Brown	Green Bay	42.7	-15.5	1.15	3.86	69.5	-25.3	4.77	98.0	-2.54	97.5
Shawano	Shawano 2 Ssw	48.5	-16.1	1.32	3.39	69.5	-25.3	4.18	98.0	-2.71	97.7
Shawano	Bowler	47.6	-16.4	1.29	3.92	69.5	-25.3	4.25	98.0	-2.27	96.9
Pierce	River Falls	47.9	-18.0	1.30	3.45	69.5	-25.3	4.22	98.0	-2.12	96.3
Door	Sturgeon Bay Exp Far	46.3	-16.2	1.26	3.34	69.5	-25.3	4.36	98.0	-2.73	97.7
Oconto	Oconto	49.9	-16.7	1.36	3.12	69.5	-25.3	4.04	98.0	-2.76	97.7
Marathon	Wausau Municipal Ap	47.7	-18.3	1.30	3.39	69.5	-25.3	4.22	98.0	-2.06	96.1
Clark	Owen	43.6	-15.9	1.19	3.57	69.5	-25.3	4.61	98.0	-2.64	97.6
Chippewa	Stanley	47.8	-17.9	1.31	3.28	69.5	-25.3	4.18	98.0	-2.25	96.8
Oconto	Breed 6 Sse	46.8	-18.2	1.30	3.23	69.5	-25.3	4.24	98.0	-2.20	96.6
Chippewa	Bloomer	48.0	-16.8	1.33	3.39	69.5	-25.3	4.13	98.0	-2.50	97.4
Marinette	Marinette	47.7	-17.8	1.33	3.74	69.5	-25.3	4.15	98.0	-2.00	95.8
Taylor	Medford	47.5	-17.4	1.33	3.34	69.5	-25.3	4.15	98.0	-2.37	97.1
Langlade	Antigo	44.3	-15.2	1.24	3.57	69.5	-25.3	4.44	98.0	-2.83	97.8
Lincoln	Merrill	46.3	-17.8	1.30	3.23	69.5	-25.3	4.24	98.0	-2.32	97.0
Chippewa	Holcombe	46.7	-16.3	1.31	3.39	69.5	-25.3	4.19	98.0	-2.65	97.6
Barron	Ridgeland 1 Nne	46.5	-15.7	1.31	3.34	69.5	-25.3	4.20	98.0	-2.88	97.8
Polk	Amery	47.8	-18.7	1.35	3.57	69.5	-25.3	4.08	98.0	-1.85	94.9
Oconto	Lakewood 3 Ne	49.9	-18.7	1.41	3.74	69.5	-25.3	3.91	98.0	-1.76	94.2
Taylor	Jump River	46.3	-17.7	1.31	3.57	69.5	-25.3	4.21	98.0	-2.13	96.4
Marinette	Crivitz High Falls	48.4	-17.5	1.37	3.23	69.5	-25.3	4.02	98.0	-2.42	97.2
Door	Washington Island	48.0	-15.7	1.36	3.39	69.5	-25.3	4.05	98.0	-2.83	97.8
Polk	St Croix Falls	46.8	-17.3	1.33	3.34	69.5	-25.3	4.15	98.0	-2.40	97.2
Rusk	Weyerhauser	47.1	-17.6	1.34	3.45	69.5	-25.3	4.11	98.0	-2.23	96.7
Barron	Rice Lake	47.5	-17.4	1.36	3.51	69.5	-25.3	4.06	98.0	-2.25	96.8
Price	Prentice 5 W	48.2	-18.6	1.38	3.57	69.5	-25.3	3.98	98.0	-1.88	95.0
Forest	Laona	45.3	-17.7	1.30	3.57	69.5	-25.3	4.24	98.0	-2.13	96.4
Barron	Cumberland	47.0	-18.3	1.36	3.34	69.5	-25.3	4.06	98.0	-2.10	96.2
Rusk	Big Falls Hydro	46.4	-18.6	1.34	3.51	69.5	-25.3	4.10	98.0	-1.91	95.2
Polk	Luck	48.2	-19.9	1.39	3.74	69.5	-25.3	3.95	98.0	-1.44	90.7
Marinette	Goodman	46.7	-18.1	1.35	3.34	69.5	-25.3	4.08	98.0	-2.16	96.5
Oneida	North Pelican	41.7	-15.9	1.21	3.34	69.5	-25.3	4.54	98.0	-2.82	97.8
Oneida	Rhineland	45.4	-17.4	1.32	3.45	69.5	-25.3	4.16	98.0	-2.29	96.9
Oneida	Willow Reservoir	46.4	-18.2	1.36	3.39	69.5	-25.3	4.06	98.0	-2.09	96.2
Burnett	Grantsburg	47.4	-17.7	1.38	3.45	69.5	-25.3	3.97	98.0	-2.20	96.6
Forest	Newald 4 N	46.6	-20.2	1.36	3.74	69.5	-25.3	4.03	98.0	-1.36	89.5
Washburn	Spooner Exp Farm	47.7	-18.6	1.40	3.57	69.5	-25.3	3.92	98.0	-1.88	95.0
Oneida	Rainbow Rsvr Lake	47.7	-19.7	1.40	3.39	69.5	-25.3	3.92	98.0	-1.65	93.2
Sawyer	Couderay	47.3	-19.1	1.40	3.68	69.5	-25.3	3.94	98.0	-1.68	93.5
Oneida	Minocqua Dam	45.8	-20.3	1.35	3.63	69.5	-25.3	4.07	98.0	-1.38	89.8
Sawyer	Winter 5 Nw	45.9	-19.2	1.36	3.63	69.5	-25.3	4.04	98.0	-1.68	93.5
Oneida	Long Lake Dam	47.3	-18.5	1.41	3.23	69.5	-25.3	3.91	98.0	-2.11	96.3
Vilas	St Germain 2 E	47.2	-20.6	1.40	3.86	69.5	-25.3	3.92	98.0	-1.22	87.0
Price	Park Falls	45.7	-17.3	1.37	3.34	69.5	-25.3	4.02	98.0	-2.40	97.2

County/District	Station name	Design Pavement Temperatures, °C		Standard Deviation of Pavement Temperatures, °C		98 % Reliability Binder Continuous Grade Temperature, °C		PG 64-22 Reliability		Low Temperature Reliability	
		High	Low	High	Low	High	Low	z	%	z	%
Florence	Brule Island	45.8	-18.9	1.37	3.68	69.5	-25.3	4.01	98.0	-1.74	94.0
Burnett	Danbury	43.9	-16.0	1.32	3.34	69.5	-25.3	4.18	98.0	-2.79	97.7
Washburn	Minong 2	47.3	-20.0	1.42	3.63	69.5	-25.3	3.87	98.0	-1.46	91.0
Vilas	Rest Lake	46.8	-19.5	1.41	3.45	69.5	-25.3	3.91	98.0	-1.68	93.5
Douglas	Gordon	45.4	-17.5	1.37	3.39	69.5	-25.3	4.03	98.0	-2.30	96.9
Bayfield	Drummond	48.0	-19.2	1.45	3.63	69.5	-25.3	3.79	98.0	-1.68	93.5
Douglas	Solon Springs	47.5	-21.3	1.45	3.74	69.5	-25.3	3.81	98.0	-1.07	84.0
Ashland	Mellen	47.2	-20.3	1.44	3.63	69.5	-25.3	3.81	98.0	-1.38	89.8
Douglas	Foxboro	48.1	-21.6	1.48	3.68	69.5	-25.3	3.73	98.0	-1.00	82.6
Iron	Gurney	46.5	-17.7	1.43	3.23	69.5	-25.3	3.86	98.0	-2.36	97.1
Bayfield	Ashland Exp Farm	45.7	-17.9	1.40	3.34	69.5	-25.3	3.92	98.0	-2.22	96.7
Douglas	Superior	43.3	-16.8	1.34	3.23	69.5	-25.3	4.12	98.0	-2.63	97.6
Bayfield	Port Wing	47.2	-20.6	1.46	3.51	69.5	-25.3	3.77	98.0	-1.34	89.2
Ashland	Madeline Island	49.1	-22.7	1.52	3.68	69.5	-25.3	3.62	98.0	-0.71	74.5
Bayfield	Bayfield	39.5	-16.7	1.22	3.17	69.5	-25.3	4.49	98.0	-2.71	97.7

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