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REPORT OF PAVEMENT TESTING, ENGINEERING ANALYSIS AND REVIEW

Pine Ridge Indian Reservation Roads

Pine Ridge, South Dakota

AET Project No. 01-04170

Date:

June 24, 2009

Prepared for:

Dakota Engineering, LLC
A Kadrmas, Lee & Jackson, Inc. Business Partner
330 Knollwood Drive
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Dakota Engineering, LLC
A Kadrmas, Lee & Jackson, Inc. Business Partner
330 Knollwood Drive
PO Box 3416
Rapid City, SD 57709-3416

Attn: Mr. Ross Eberle, PE

RE: Pavement Testing Engineering Analysis and Review
Pine Ridge Indian Reservation Roads
Pine Ridge, SD
AET Project No. 01-04170

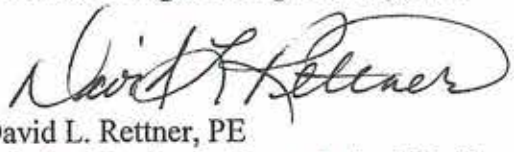
Dear Mr. Eberle:

This revised report presents the results of a pavement testing and analysis project performed on the roads of Pine Ridge Indian Reservation in South Dakota.

Please contact me if you have questions about the report.

Very truly yours,

American Engineering Testing, Inc.



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Report of Geotechnical Exploration and Review
Pine Ridge Indian Reservation Roads
AET Project No. 01-04170

June 24, 2009

Prepared for:

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Principal Engineer

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota

Date: 6/24/09 **License #:8560**

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PAVEMENT TESTING ENGINEERING ANALYSIS AND REVIEW FOR PINE RIDGE INDIAN RESERVATION ROADS PINE RIDGE, SOUTH DAKOTA AET PROJECT NO. 01-04170

1.0 INTRODUCTION

This report presents the results of the pavement testing, analysis and engineering review performed on the Pine Ridge Indian Reservation Roads located in South Dakota.

2.0 SCOPE OF SERVICES

The scope of work for the project is outlined below:

- Perform Falling Weight Deflectometer (FWD) testing at $1/10^{th}$ mile intervals. The total roadway mileage to be tested is approximately 206. Testing will be done using the standard 7 sensor Strategic Highway Research Program (SHRP) spacing and will be done with 2 seating drops and 2 drops at 9,000 lbs. force.
- Obtain pavement structure, soils, and traffic volume, and other information as shown in the RFP, from Dakota Engineering.
- Analyze FWD data for load capacity of the roadway (TONN), equivalent structural number, and subgrade modulus. If possible, determine the stiffness of each layer using back-calculation programs.
- Prepare engineering report discussing axle load capacity, equivalent structural number, general condition, and other issues related to roadway structure for each segment.
- After a review of the report above, AET will discuss possible rehabilitation options with Dakota Engineering and issue a second report with recommendations based on budgetary, functional, and other constraints, as identified during these discussions.

3.0 PROJECT INFORMATION

It is our understanding that this Falling Weight Deflectometer testing was performed both to determine the current structural condition of the roadways on the Pine Ridge Indian Reservation

and to assist in programming the most cost effective pavement repair/rehabilitation options for these roads in the future. The pavement structure information we have been provided (attached as Figure 1) indicates that several of the roadways currently are surfaced with only a chip seal over aggregate surfacing. The indicated surfacing construction dates vary between 1974 and 2004.

The presented project information represents our understanding of the project. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SITE CONDITIONS

4.1 Surface/Existing Pavement Conditions

The pavement condition of the roadways tested ranges from poor to excellent. Several of the roadways such as BIA 35 and BIA 41 sections 30 and 50 are only surfaced with a chip-seal over an aggregate surfacing and are in generally poor condition. Other roadways such as BIA 2 – Section 20 were reconstructed between 2004-2006, are in good to excellent condition, and are due for routine maintenance such as crack sealing and chip sealing. BIA 28 is in very good condition, with a high structural capacity, after receiving a structural overlay in 2002. BIA 27-Section 20 is scheduled for reconstruction in 2009. Subgrade soils information was supplied to AET by Dakota Engineering in the form of the Shannon County, South Dakota Soils Map from the USGS. The soils map provides general subgrade information for the roadways, but does not provide any information regarding any subgrade corrections performed during roadway construction. In general the roadways are supported by plastic soils consisting of silt, silty loam, loam, and clay of the Keith-Colby (KhD), Kadoka-Epping (KbC), Oglala-Canyon (OcE), Tuthill, Keith-Rosebud (KrA) and Badlands Association (Ba) formations. These soils typically have R-values ranging between 10 and 20, although lower and higher values can be obtained depending

upon in-situ moisture condition, compactive effort during construction, and depth to underlying bedrock

Roadway condition information for the roadways currently being programmed for work in the near future was provided to AET by Dakota Engineering and is shown below:

- BIA 33 is in poor condition and is being considered for a bituminous overlay at this time. Full-Depth Reclamation or Total Reconstruction is also being considered, however funding is a major issue.
- BIA 27 – Section 20 is scheduled for reconstruction in 2009. The design calls for widening the roadway embankment and surfacing with 8 inches of aggregate base and 4 inches of asphaltic concrete.
- BIA 27 – Sections 60 and 80 are rutting and it is hoped that a thin lift overlay or Microsurface Treatment could be completed to extend the pavement life.
- BIA 41 - Section 30&50 only has a double Chip Seal. It is currently programmed for 4 inches of Asphalt Cement Concrete Pavement surfacing.
- BIA 35 is also only surfaced with a double chip seal, recommendations for surfacing are needed.
- BIA 2 from Sharps Corner to Kyle will need at a min a preservation treatment (Thin Lift or Micro-surfacing) in the near future.

5.0 FALLING WEIGHT DEFLECTOMETER TESTING

Falling Weight Deflectometer testing was performed during mid June 2008 using a Dynatest 8000 falling weight deflectometer (FWD). Such testing provides a wealth of information about the load-carrying capabilities of the pavement and the uniformity of support conditions. For this project, a four-drop load sequence of approximately 6,600 and 9,000 lbs force was used. The 9,000 lbs. load sequence approximates the load provided by one set of rear tires of a 9-ton axle

load. Deflections were measured at nine locations: one sensor located directly under the load plate, seven sensors in front of the load plate (8, 12, 18, 24, 36, 48 and 60 inches). One additional sensor was located 12 inches behind the load plate but was not used in this analysis (this is only used for concrete pavement joint load transfer measurements).

5.1 Data Analysis

The deflection data were analyzed using the AASHTO method for calculating effective structural number (Eff SN) and the Mn/DOT method for determining the allowable axle loads for a roadway (Investigation 603) revised in 1983. The attached tables and data plots were obtained from an analysis tool provided by Mn/DOT and modified by AET. The roadways were tested in the outside wheel path in the increasing direction (from start to end points as shown on the map provided by Dakota Engineering – Figure 2) at 500 feet intervals. The analysis for each of the roadway sections, as well as graphs of the structural analysis for each testing point is attached to this report in Appendix A.

Table 1 below compares the measured pavement structure (from information provided by Dakota Engineering) and the calculated structural number for each pavement section to the Effective SN calculated by analyzing the FWD data. To calculate the structural number a layer coefficient of 0.10 was used for aggregate base and 0.27 was used for existing bituminous pavement (slightly lower than that for new bituminous to account for age). It can be seen that for the majority of the pavement sections the measured Structural Number and the calculated Structural Number are very similar with only BIA 32 Section 10, BIA 27 Section 80, BIA 23 Section 10, BIA 2 Section 20, and BIA 2 Section 110 differing by more than 0.39, or the equivalent of 1 inch of bituminous. Of these, only BIA 27 Section 80, BIA 2 Section 20 and BIA 2 Section 110 have higher Effective SN's calculated from the FWD data than were measured from pavement coring information (indicated by negative numbers in the far right column), indicating that for the majority of the pavements tested the bituminous surfacing and aggregate base are generally structurally sound and are performing as would be expected from a structural standpoint.

Table 1 – Comparison of Measured Pavement SN vs. Calculated Pavement SN

Route #	Section #	Soil Type	Measured A/C	Measured Base	Measured SN	Calculated Average Effective SN	Measured SN - Calculated SN
41	20	Ba	6.7	3.0	3.60	3.80	-0.20
41	30&50	PsE	Chipseal	10.0	1.00	2.50	-1.50
41	60	Ba	4.0	10.0	2.08	2.40	-0.32
41	70	Tuthill	7.3		2.00	3.60	-1.60
39	10&20	KbC, OcE	4.0	6.5	1.73	2.40	-0.67
35	10	KhD	Chipseal	6.0	0.60	2.70	-2.10
33	10 (South 1.0 Mile)	Ba, KhB, OcE	3.5	7.7	1.72	2.60	-0.88
33	10 (mile 13.0 - 14.1)	Ba, KhB, OcE	3.5	7.7	1.72	1.70	0.02
33	10	Ba, KhB, OcE	3.5	7.7	1.72	2.10	-0.39
32	10	PcE, KbC	6.9	6.8	2.54	4.40	-1.86
28	10	OcE	7.8	8.5	2.96	4.70	-1.74
27	10	OcE	4.3	9.6	2.12	3.10	-0.98
27	20	OcE	4.1	6.0	1.71	2.60	-0.89
27	30	OcE	4.1	8.0	1.91	3.30	-1.39
27	40	KbC	5.1	8.1	2.19	3.40	-1.21
27	60	Aa, VaC	4.7	7.7	2.04	2.70	-0.66
27	80	Ba	4.8	7.5	2.05	2.20	-0.15
23	10	OcE	4.3	4.0	1.56	3.10	-1.54
4	10	KbC	7.4	6.4	2.64	4.10	-1.46
4	20	KbC	8.9	6.4	3.04	4.50	-1.46
2	20	Ba	4.0	10.0	2.08	2.50	-0.42
2	60	KbC	5.8	6.7	2.24	3.30	-1.06
2	80	KbC	6.2	6.0	2.27	3.30	-1.03
2	90		6.8	6.7	2.51	3.50	-0.99
2	110		5.6	8.0	2.31	3.00	-0.69
Allen Road			3.0	7.0	1.51	2.10	-0.59

Table 2 below shows summaries of the analysis of the FWD testing of each of the roadway sections. The daily traffic volume and ESAL's were provided by Dakota Engineering. The Average Effective Subgrade Modulus is the back-calculated subgrade modulus corrected to a

saturated spring condition for each section. The Design Subgrade Modulus was calculated at the 85th percentile of the Effective Modulus. While this method does not strictly follow the 1993 AASHTO Pavement Design Guide procedure which recommends divided the subgrade modulus by 3, we consider the values produced by this modified method to be more representative of the values that should be used for design.

Table 2 – Comparison of Calculated and Required Structural Number

Route #	Section #	AADT	ESALS	Soil Type	Effective SG Modulus	Design SG Modulus (85th Percentile)	Effective SN (85th Percentile)	Required SN	Required Additional SN	Required Overlay
41	20	1543	177331	Ba	6851	4677	2.8	2.9	0.1	0.26
41	30&50	562	128412	PsE	5775	4479	1.9	2.8	0.9	2.31
41	60	481	79493	Ba	5483	4102	1.9	2.7	0.8	2.05
41	70	498	48919	Tuthill	11256	6093	3	2.1	-0.9	0.00
39	10&20	367	12230	KbC, OcE	6572	4661	1.5	1.9	0.4	1.03
35	10	503	12230	KhD	8579	6071	2.2	1.8	-0.4	0.00
33	10 (South 1.0 Mile)		85608	Ba, KhB, OcE	6637	5584	2.4	2.9	0.5	1.30
33	10 (mile 13.0 - 14.1)	203	48919	Ba, KhB, OcE	3748	2987	1.35	2.7	1.35	3.46
33	10	203	48919	Ba, KhB, OcE	4541	3250	1.5	2.7	1.2	3.08
32	10	131	43239	PcE, KbC	8782	5965	3.8	2.1	-1.7	0.00
28	10	1266	85608	OcE	9057	6938	4.3	2.2	-2.1	0.00
27	10	1947	226250	OcE	8765	6430	2.7	2.7	0	0.00
27	20	1947	226250	OcE	7891	5578	2.2	2.9	0.7	1.79
27	30	1554	207905	OcE	11952	8030	2.7	2.5	-0.2	0.00
27	40	2133	195675	KbC	8649	5599	3	2.7	-0.3	0.00
27	60	425	183446	Aa, VaC	8058	5282	2.2	2.8	0.6	1.54
27	80	825	183446	Ba	7682	4707	1.6	2.9	1.3	3.33
23	10	582	31697	OcE	7537	6133	2.5	2	-0.5	0.00
4	10	1677	183446	KbC	8496	6509	3.5	2.6	-0.9	0.00
4	20	1071	183446	KbC	8886	6119	3.7	2.7	-1	0.00
2	20	112	18345	Ba	10265	8410	2.3	1.6	-0.7	0.00
2	60	2072	293513	KbC	6970	4480	2.6	3.2	0.6	1.54
2	80	1184	61459	KbC	6836	5113	2.5	2.4	-0.1	0.00

2	90	1184	61459		6677	5056	2.6	2.4	-0.2	0.00
2	110	388	61459		7358	5201	2.5	2.4	-0.1	0.00
Allen Rd			214020		6915	4866	1.5	3	1.5	3.85

The Average Effective SN was calculated using the AASHTO method. The required Structural Number (SN) was calculated using the AASHTO 1993 Pavement Design Guide procedure for flexible pavements using the 85th percentile subgrade modulus value. The reliability used for the designs was 85%. This is typical of low to medium volume roads. A higher reliability would increase the required pavement thickness (SN) and also increase the probability of the roadway reaching its 20-year design life with only normal maintenance. Based on the comparison of the calculated SN for each roadway vs. the required SN for each roadway, it appears that the Reliability of 85% is a good choice since for the roadways sections in good condition the two numbers are very similar. For calculating required overlay thickness a layer coefficient of 0.39 was used for bituminous. This number was supplied to us by Dakota Engineering and is based on their experience for new asphalt using the local materials and mix design procedures.

It can be seen from the Required Overlay column (far right) that several of the roadway sections require significant overlays (2-3 inches) to meet the structural requirements for the projected 20 year design traffic. This is not necessarily an indication of poor pavement condition, but rather an indication that the in place pavement structure is insufficient for the projected future traffic on the roadways.

It is noteworthy that the calculated subgrade resilient modulus for the majority of the roadways is comparatively low, ranging from 5,000 psi to 12,000 psi, with corresponding R-values between 5 and 20. Our experience with silty subgrade soils has shown that this is common if compaction subcuts of 3-4 feet were not performed on the existing soils. Generally, these types of soils have natural densities in the range of 85-92% of standard proctor density and can be expected to measure strengths of these magnitudes.

Since the SN estimates are sensitive to the pavement deterioration variables, the SN values can be used as a good indicator of the existing (or effective) structural condition of a pavement for the purpose of managing pavements. With the effective and required SN values of a pavement, the Structural Condition Index (SCI) can be established as the ratio of the effective SN and the required SN.

The Structural Condition Index generally has a variable range that is incompatible with the range of Pavement Condition Index (PCI) (0 to 100). The remaining structural life vs. SCI curve in the AASHTO 1993 Pavement Design Guide procedure was used to convert SCI to the remaining structural index (RSI), as shown in Appendix A.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions made in this report are based on our understanding of the project as described above. We have the following recommendations for the roadways that were being evaluated for rehabilitation projects in the near future.

- BIA 33 – Section 10 (BIA 14 to BIA 28 at Manderson). This roadway is currently in poor condition and is being considered for a bituminous overlay at this time. The roadway currently has a calculated average SN of 2.1, which is slightly below the SN of 2.5 obtained from the measured bituminous and aggregate base thickness. The 85th percentile SN is 1.5. Based on our analysis this roadway requires an SN of 2.7 to meet the 20 year design ESAL's of 48,919, which equates to a minimum 3.0 inch bituminous overlay. The attached data plot (Appendix A) shows that the strength of the roadway is generally consistent throughout its length, although the section between miles 13.0 and 14.1 is slightly weaker, with an 85th percentile SN of 1.35, equating to a 3.5 inch bituminous overlay. Additionally, the southern 1 mile of the roadway has a 20-year design traffic of 85,608 ESAL's. This portion of the roadway is more uniform, is slightly stronger and has a stronger subgrade, with an 85th percentile SN of 2.4 and a subgrade resilient modulus of 5,584 psi. This higher design traffic requires a design SN of 2.9, resulting in

a required overlay of 1.3 inches.

It is our understanding that a second option to consider for this roadway is 6.0 inches of bituminous stabilized Full-Depth Reclamation (FDR) overlaid with 2.0 inches of bituminous. This material can achieve a layer coefficient of 0.25- 0.28, which would result in a SN of approximately 3.0 and as well as the elimination of all of the underlying transverse cracks and any block cracking, which should improve the long-term performance of the roadway. Due to the relatively low subgrade modulus (average of 4,451 psi) we recommend that this type of work be scheduled for only July through early September to minimize impacts from rain events softening the subgrade during construction. We also recommend that the FDR contractor be required to use equipment with low contact pressure (less than 20 psi) so that the soft subgrade is not damaged during construction.

- BIA 33 – Section 10 (BIA 14 north to BIA 27 at Rockyford). It is our understanding that the Oglala Sioux Tribe Department of Transportation is considering reclaiming this section of roadway and temporarily making it an aggregate surfaced roadway until funding can be provided for reconstruction. We have been informed that the Tribe possesses an "Asphalt Zipper" and can self perform reclamation work using this equipment and their own labor forces. We have researched the use of this equipment and have determined that this approach would be feasible for a short term (up to 3-5 years with maintenance) rehabilitation option. We would recommend reclaiming the surface to a depth of 7 inches so that the blend of recycled asphalt pavement (RAP) and aggregate base is approximately 50/50. We also recommend that the Oglala Sioux Tribe Department of Transportation consider blending the reclaimed material onsite with 3-4% CSS-1H or HFMS-2 emulsion to stabilize the surface. The procedure would be to make one pass with the "Asphalt Zipper" to reclaim the material and break it into 1-inch minus material and then make a pass with an emulsion application truck such as a tack truck, and make a second pass with the "Asphalt Zipper" to blend the emulsion and the

reclaimed material together. The blended material should then be compacted with a pad foot roller (approximately 4 passes) followed by a road grader to trim the roadway to final grade and a steel drum roller (approximately 4 passes). A nuclear density gauge should be used to determine the optimum rolling configuration.

- BIA 27 -Section 40, 60, and 80 is rutting and it was hoped that a thin lift overlay or Microsurface Treatment could be completed to extend the pavement life. Section 40 is significantly stronger than Sections 60 and 80, with no need for a structural overlay. Based on our analysis and the presence of rutting in the roadway we do not recommend a bituminous overlay for Sections 60 and 80. We recommend that a 2.0 inch mill (nominal depth) and 4.5 inch bituminous overlay be considered. Our experience has found that if significant rutting has occurred, it is difficult to obtain adequate compaction in the ruts, oftentimes resulting in the reoccurrence of the rutting due to the presence of the higher air void material in the wheel-paths. Again, we also recommend the consideration of 6.0 inches of bituminous stabilized Full-Depth Reclamation (FDR) overlaid with 2.5 inches of bituminous. This material can achieve a layer coefficient of 0.25- 0.28, which would result in a SN of approximately 3.2 – 3.4. This type of rehabilitation treatment will also eliminate all of the underlying transverse cracks, which should improve the long-term performance of the roadway.

  We understand that this roadway will be used as a haul road during the reconstruction of BIA 14 and BIA 27 - Section 20, and that any rehabilitation or reconstruction will be delayed until those projects are completed. We recommend that these recommendations be revisited after these construction projects are completed and the condition of the roadway should be re-evaluated at that time due to potential damage caused by the heavy hauling.

- BIA 41 - Section 30&50 currently only has a double chip seal surfacing. It is currently programmed for 4 inches of Asphalt Cement Concrete Pavement surfacing. Based on our analysis we believe that a 4.0 inch bituminous overlay would perform very well, but may

be thicker than is required. Our analysis shows that a 2.0 inch overlay is necessary to provide the required SN for the roadway for the forecast traffic; however the currently programmed 4.0 inch bituminous overlay will provide additional structure and increase the probability that the roadway will meet its design life. Our experience has also shown that when a roadway is improved this oftentimes attracts additional traffic due to the improved ride quality. Our discussions with Dakota Engineering indicate that the bituminous surfacing will consist of SDDOT Hot Asphalt Concrete Pavement Class E. We recommend that either a PG 64-28 (preferred) or PG 64-22 binder be used in the asphalt. The former binder will be more crack resistant (down to -28 ^{O}C) but may be cost prohibitive or unavailable. The latter will be crack resistant down to -22 ^{O}C and will be less expensive.

- BIA 35 is also only surfaced with a double chip seal, recommendations for surfacing are needed. Based on our analysis this roadway has adequate strength to perform adequately for its forecast 20 year traffic of 12,230 ESAL's. We recommend either a thin bituminous overlay of 1.5 inches or a regular series of chip seals (3-5 year schedule) to maintain the roadway surface. We believe either alternative will perform adequately and that economics (both first cost and maintenance) should govern the decision
- BIA 2 Section 60-70, from Sharps Corner to Kyle will need at a minimum a preservation treatment (Thin Lift or Micro-surfacing) in the near future. Our analysis indicates that a 1.50 inch bituminous overlay is required to obtain the SN of 3.2 necessary to meet the 20 year forecasted traffic of 293,513 ESAL's. Based on the observed condition of the pavement on this roadway, we believe that this overlay will perform adequately for the desired 20 year performance period with regular maintenance. We recommend that the section of pavement between 0.5 miles and 0.8 miles east of Sharps Corner receive an additional 1.50 inches of bituminous, or a total of 4 inches. This portion of the roadway has an average SN of only 2.2. The 3.0 inch overlay will result in an SN of 3.5.
- BIA 2 Section 80, 90 & 110 (Kyle East to SD 44). We understand that the OST has

requested funding for reconstruction of this roadway. The FWD testing indicates the existing subgrade has a design resilient modulus of approximately 5100 psi for the entire section (ranging from 5056 to 5201 psi). Based on the design traffic of 61,459 ESAL's a SN of 2.4 is required. We would recommend a structure of 4 inches of Hot Asphalt Concrete Pavement over 9 inches of aggregate base which results in a SN of 2.46. The mix properties and binder should be determined during the final design stage of the project, when asphalt binder supply information is available, however we preliminarily recommend a PG 64-28 binder if the cost is reasonable. We also recommend that the traffic forecast be revisited prior to the final design. It is likely that if this roadway is improved the traffic volume will increase significantly.

In general the roads that were tested indicate pavement strength consistent with the materials in place and the measured pavement structures. The subgrade strengths measured appear to be somewhat lower than what would be expected, however the calculated strength is consistent throughout the majority of the roadways, indicating uniformity in the subgrade.

We do recommend a regular systematic approach to crack sealing, chip sealing, rut filling, and pot-hole patching be conducted to maintain and preserve the performance of the roadways. Much of this type of work can be self performed by OST roadway maintenance staff, which is very cost effective. This type of regular maintenance can increase the usable life of a low-volume roadway by as much as 50-75%.

7.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, our services have been conducted according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, either expressed or implied, is intended.

Important information regarding risk management and proper use of this report is given in

Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use".

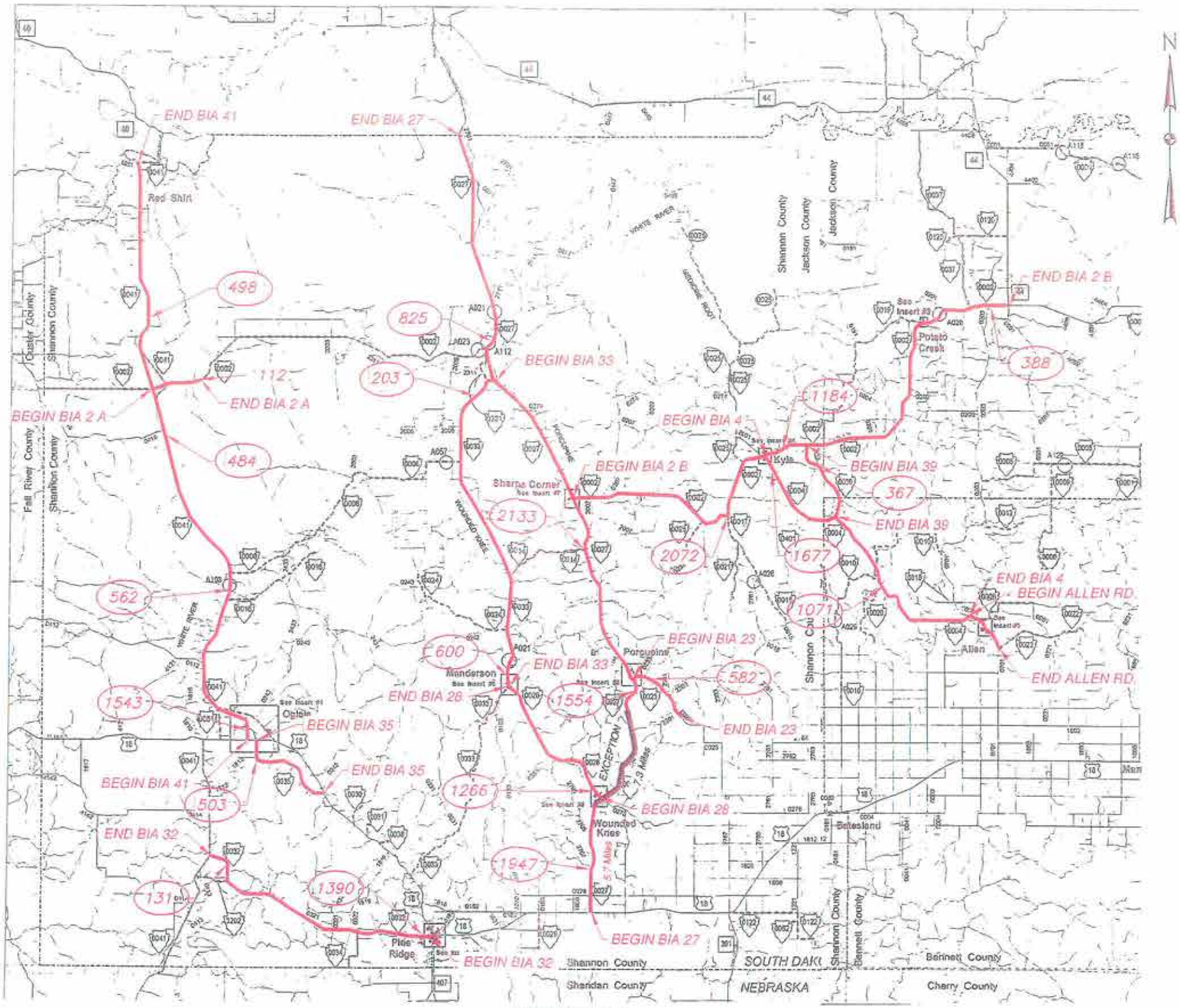
Appendix A

AET Project No. 01-04170

Oglala Sioux Tribe Bituminous Surfaced Road Summary
FWD Roadway Testing Map
FWD Testing Summaries
Remaining Structure Index Calculations

Oglala Sioux Tribe Bituminous Surfaced Rural Road Summary

Route #	Section #	Location Description	Length (Miles)	Pavement Type	2006 ADT	% Trucks	20 YR DESIGN LANE ESAL'S	Average Traffic Growth %	Soil Type	Core Data (avg's)		Pavement Section History										Surface Width (Ft)	Remarks
										Asphalt	Aggr Base	Year	Surface	Year	Base 1	Year	Base 2	Year	Subbase	Year	Subgrade		
2	20	BIA 41, East 1.8 Miles	1.8	Asphalt Concrete	112	1.3	18345	2%	S	4"	10"	2002	4"	2002	10"Aggr							37'	30	
2	10,30-50	Gravel					18345	2%	E															
2	60 - 70	BIA 27, Sharps Corner, East	17.9	Asphalt Concrete	2072	3.6	293513	2%	E	5.8"	6.7"	1988	2"	1974	2.5" Bit	1974	0.5" Seal	1974	6" Aggr	1974	29'	23	
2	70	Bridge # A129						2%																
2	80	Bridge # A129 East to BIA 19	3	Asphalt Concrete	1184	1.9	61459	2%	S	6.2"	6"	1979	2.5"	1975	0.5" Seal	1975	6" Aggr			1975	26'	22	
2	90	Shannon/Jackson County Line, East	11.8	Asphalt Concrete	1184	1.9	61459	2%	H	6.8"	6.7"	1980	2.5"	1976	0.5" Seal	1976	6" Aggr			1976	26'	22	
2	100	Bridge # A028						2%	A														
2	110	4.7 West of SD44(Bridge A028), East	4.7	Asphalt Concrete	388	6.1	61459	2%	N	5.6"	8"										27'	21	
								2%	N														
4	10	BIA 2 @ Kyle, South to County Line	5.5	Asphalt Concrete	1677	2.9	183446	2%	O	7.4	6.4	1995	2"								29'	23	
4	20	Shannon/Jackson County Line, South	11.9	Asphalt Concrete	1071	3	183446	2%	N	8.9	6.4	1995	2"								28'	24	
								2%															
23	10	BIA 27 @ Porcupine, East	3.9	Asphalt Concrete	582	3.5	31697	2%	C	4.3"	4"										27'	23	
								2%	O														
27	10	US 18, North	5.7	Asphalt Concrete	1947	3	226250	2%	U	4.3"	9.6"	1987	4"	1987	6" Aggr	1987	2" Salv			1987	36'	24	US 18 to Wounded Knee
27	20	5.7 Miles North of US 18, North	7.4	Asphalt Concrete	1947	3	226250	2%	N			1987	4"	1987	6" Aggr	1987	2" Salv			1987	46'	23	Recon Project Designed
27	30	13.1 Miles North of US 18, North	8.9	Asphalt Concrete	1554	4.2	207905	2%	T	4.1"	8"	1991	6"	1991	5" Aggr	1990	3"Aggr			1990	37'	31	BIA 2, S. 6 Mi
27	40	22 miles North of US 18, North	15.5	Asphalt Concrete	2133	3.1	195675	2%	Y	5.1"	8.1"	1974	2.5"	1974	0.5" Seal	1974	6" Aggr			1974	36'	26	BIA 2, N. 10.2 Mi
27	50	Bridge # A112						2%															
27	60	Cheyenne River Bridge, North	2.5	Asphalt Concrete	425	3	183446	2%	S	4.7"	7.7"										32'	22	
27	70	Bridge # A021						2%	O														
27	80	Pennington County Line, South	10.5	Asphalt Concrete	825	3	183446	2%	I	4.8"	7.5"	1987	4"	1987	2" Aggr						32'	22	Preservation
								2%	L														
28	10	BIA 27 @ Wounded Knee, North	8.8	Asphalt Concrete	1266	2.8	85608	2%		7.8"	8.5"	2002	4.5"								34'	26	
								2%	S														
32	10	BIA 41, East to Pine Ridge	14.3	Asphalt Concrete	131	6.9	43239	2%	U	6.9"	6.8"										28'	24	
								2%	R														
33	10	BIA 27 @ Rockyford, South	18.4	Asphalt Concrete	203	4.2	48919	2%	V	3.5"	7.7"										28'	23	
33	20	Bridge # A134						2%	E														May Need Reconstruction
33	30	Bridge # A134 to Manderson BIA 28	1	Asphalt Concrete	600	4.1	85608	2%	Y	3"	8"										28'	23	
33	40	BIA 28 @ Manderson, South	3	Gravel	430	3.5	37062	2%														20	
								2%															
35	10	1 mile west of Oglala, South	6	Chip Seal	503	2.1	12230	2%				2005	.5" Seal	2005	6" Aggr						30'	26	
								2%															
39	10	BIA 2, South	2.3	Asphalt Concrete	367	1.4	12230	2%		4.0"	7.2"										26'	22	
39	20	BIA 4, North	2.7	Asphalt Concrete	367	1.4	12230	2%		4.0"	5.8										26'	22	
								2%															
41	10	Nebraska State Line, North to US 18	13.9	Gravel	189	2.7	18531	2%										1964	4" Aggr	1964	32'	29	
41	20	US 18, North	9.2	Asphalt Concrete	1543	3.9	177331	2%		6.7"	1-3"	1994	3"					1962	4" Aggr	1962	29'	24	May Need Reconstuction
41	30	BIA 16, North	0.5	Chip Seal	562	3.1	128412	2%				2006	.5" Seal	2004	10"						44'	32	
41	40	Bridge # A103						2%															
41	50	Bridge # A103, North	10.1	Chip Seal	562	3.1	128412	2%				2006	.5" Seal	2004	10"						44'	32	
41	60	2.5 Miles South of BIA 2, North	5.3	Asphalt Concrete	481	2.9	79493	2%				2005	4"	2005	10" Aggr						36'	30	
41	70	Custer County Line, South	11	Asphalt Concrete	498	1.6	48919	2%		7.3"	0										30'	24	



NOT TO SCALE

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