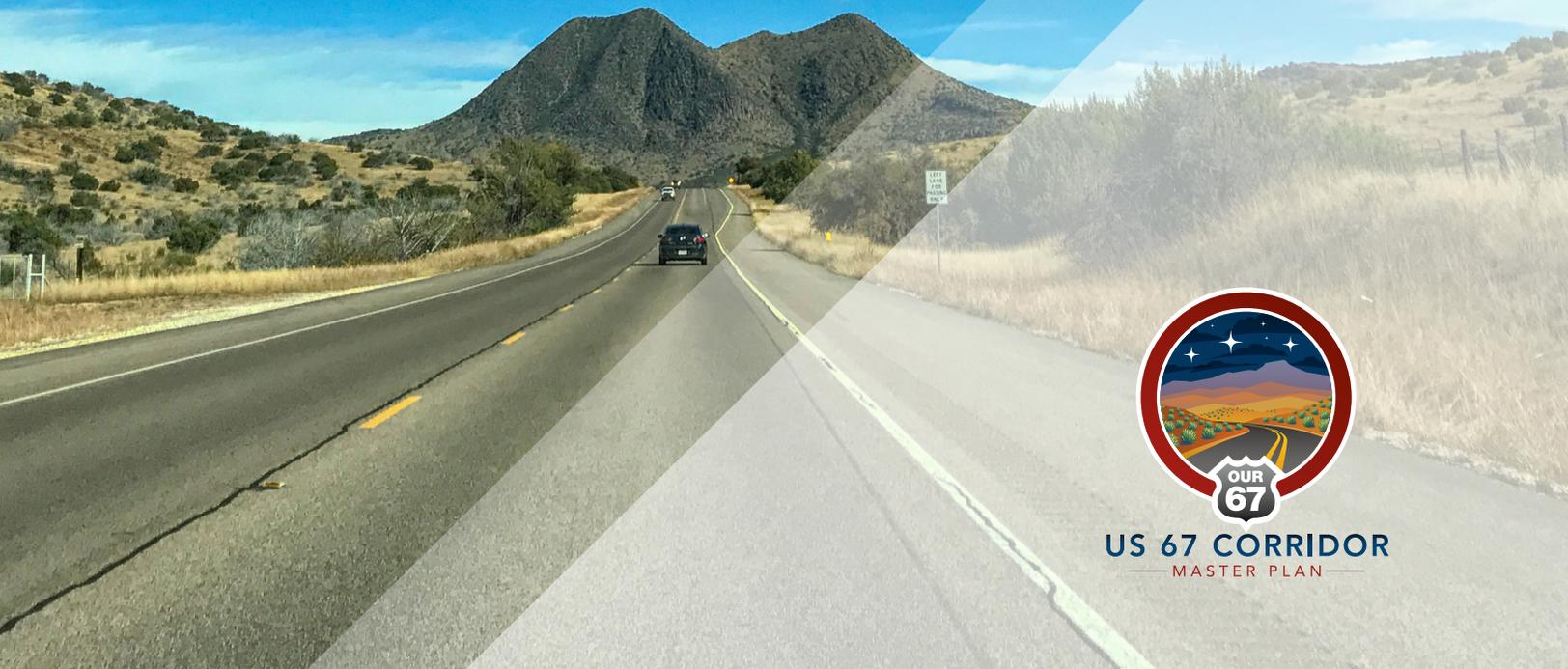
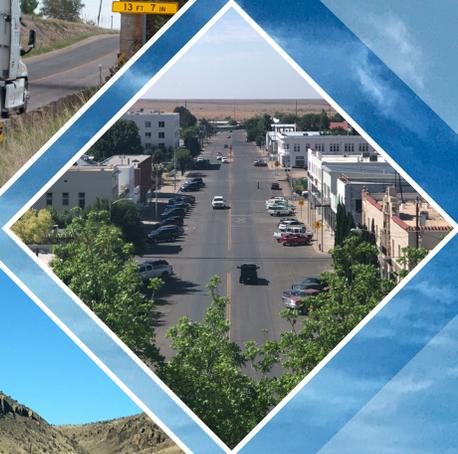




US 67 CORRIDOR MASTER PLAN

APPENDIX K

FEBRUARY 2020



US 67 CORRIDOR
MASTER PLAN

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Memorandum



US 67 CORRIDOR
— MASTER PLAN —

To: Rebecca Reyes, TxDOT Project Manager
Christopher Weber, TxDOT Alpine Area Engineer

From: CDM Smith

Date: February 2020

Subject: US 67 Corridor Master Plan Pavement Evaluation Technical Memorandum

1.0 Introduction

The purpose of this technical memorandum is to summarize the results of the network-level pavement evaluation performed as part of the US 67 Corridor Master Plan study. The US 67 study corridor stretches 142 miles from Interstate 10 (I-10) west of Fort Stockton to the Presidio/Ojinaga Port of Entry (POE) on the United States (U.S.)/Mexico border. US 67 provides access to the towns of Alpine, Marfa, Presidio, and surrounding communities, as well as Big Bend National Park, Sul Ross State University, the Marfa Lights, Big Bend Ranch State Park, Fort Leaton State Park, and Fort Davis attractions. **Figure 1** shows the study corridor.

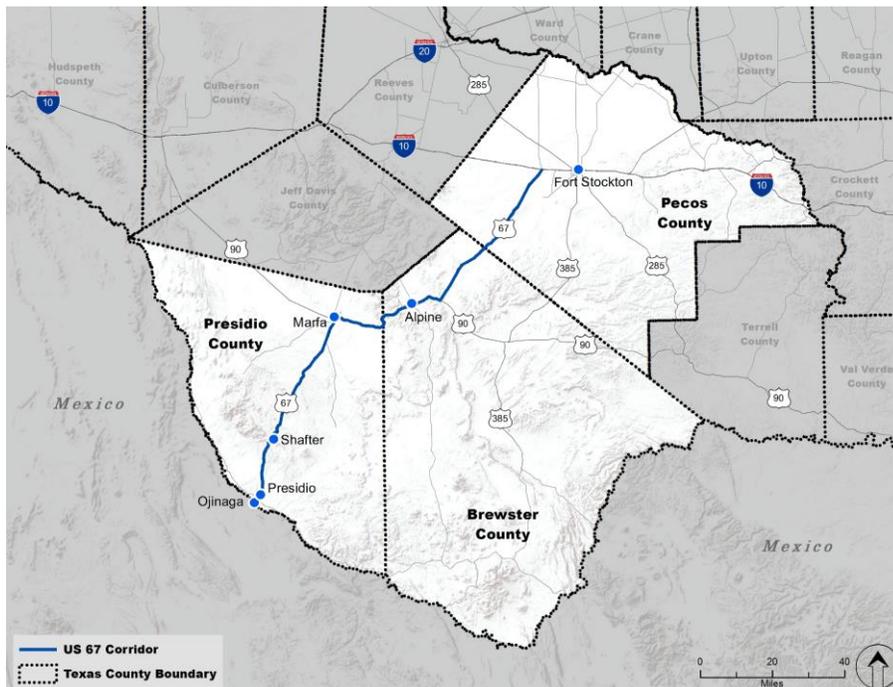


Figure 1: US 67 Corridor Master Plan Study Corridor

This rural area has experienced traffic growth in recent years driven by many factors including tourism growth, international commerce, and development in the Permian Basin oil field. In response to these growth patterns, the Texas Department of Transportation (TxDOT), in partnership with the communities along the corridor, is developing a Corridor Master Plan for US 67 to help determine current and future corridor transportation needs.

The study objectives are focused on enhancing efficiency, safety, and mobility along the corridor by recommending potential projects and strategies for short-, mid-, and long-term implementation.

The purpose of the pavement evaluation task is to summarize the pavement inventory, assess existing pavement conditions, and develop high-level pavement improvement needs in a list of candidate projects.

The remainder of this document is divided into the following sections:

- **Section 2.0** – Pavement Evaluation Methodology
- **Section 3.0** – Corridor Segmentation
- **Section 4.0** – Pavement Evaluation Findings and Recommendations
- **Section 5.0** – Planning Level Cost Estimates
- **Section 6.0** – Summary

2.0 Pavement Evaluation Methodology

The pavement evaluation task consisted of the following steps, which are described below:

- Review construction and maintenance records and summarize the existing pavement inventory,
- Review the most recent TxDOT Pavement Management Information System (PMIS) ratings to summarize pavement conditions,
- Perform field reconnaissance to verify existing pavement conditions,
- Segment the corridor based on pavement inventory and condition data, and
- Develop high-level potential pavement improvement projects based on findings.

2.1 Records Review

A review of construction and maintenance records provided by TxDOT was performed to determine pavement thicknesses in the corridor. This information was considered when dividing the pavements into logical segments. With few exceptions, construction documents and maintenance records were available for pavement sections along the corridor.

2.2 Pavement Condition Data Review

TxDOT’s PMIS has information on annually collected visual pavement distress ratings, ride quality, and rutting measurements. PMIS combines the collected ratings and measurements into several “Scores” to help pavement managers compare the quality of pavement segments. For this project, PMIS data provided by TxDOT for the El Paso and Odessa districts included overall “Condition Scores,” “Distress Scores,” and “Ride Scores.”

PMIS condition scores combine the pavement distress score and the pavement ride score into a single value that corresponds to the average person’s perception of pavement quality. Condition scores range from 0 to 100 and are divided into the classes shown in **Table 1**.

Table 1: Condition Score Classes

Condition Score	Class	Description
90 – 100	A	Very Good
70 – 89	B	Good
50 – 69	C	Fair
35 – 49	D	Poor
1 – 34	F	Very Poor

PMIS distress scores range from 1 (most distress) to 100 (least distress), with a score below 80 indicating problems. A low distress score may result from multiple distresses (such as shallow rutting and alligator cracking) or from a single severe distress (such as deep rutting). Distress scores are divided into the classes shown in **Table 2**.

Table 2: Distress Score Classes

Distress Score	Class	Description
90 – 100	A	Very Good
80 – 89	B	Good
70 – 79	C	Fair
60 – 69	D	Poor
1 – 59	F	Very Poor

PMIS ride scores range from 0.1 (very rough) to 5 (very smooth). A ride score below 3.0 suggests a rough road to the average person. Ride scores are divided into the classes shown in **Table 3**.

Table 3: Ride Score Classes

Ride Score	Class	Description
4.0 – 5.0	A	Very Smooth
3.0 – 3.9	B	Smooth
2.0 – 2.9	C	Medium Rough
1.0 – 1.9	D	Rough
0.1 – 0.9	F	Very Rough

TxDOT provided Fiscal Year (FY) 2018 PMIS data for the El Paso District and FY 2017 data for the Odessa District. The pavement condition scores in the corridor ranged from “Good” to “Very Good,” and this was largely verified during the field reconnaissance described below. The PMIS data provided by TxDOT were reviewed and considered when dividing the pavements into logical segments.

2.3 Field Reconnaissance

The purpose of the pavement field reconnaissance was to determine the reasonableness of the existing pavement condition ratings and identify any additional issues that should be considered in planning future projects within the corridor.

The field reconnaissance was performed in March 2019, and the data acquisition system used for the field reconnaissance is shown in **Figure 2**. Traveling at posted speeds, the system collected high-resolution downward imagery of the pavement surface along with rutting and roughness data. These data were processed using a combination of automated and manual methods to assess pavement conditions along the corridor.



Figure 2: Pavement Condition Assessment System used for Reconnaissance

In general, the findings supported the pavement condition scores provided by TxDOT. Any discrepancies that were observed are discussed in **Section 4.0** of this technical memorandum.

2.4 Corridor Segmentation

Based on findings from the records review, the PMIS data review, and the field reconnaissance, the corridor was divided into logical pavement project segments (PPS) for the high-level identification of potential future projects. Due to the overall “Very Good” condition of the pavement sections in the corridor, segmentation was based primarily on pavement construction and maintenance records. Segmentation of the corridor is presented in **Section 3.0**.

2.5 Potential Corridor Pavement Improvements

High-level potential pavement improvement projects are recommended based on the review of construction and maintenance records, PMIS pavement condition scores, and observations made during the field reconnaissance. Recommendations are based primarily on conditions observed in the field, such as longitudinal cracking, transverse cracking, alligator cracking, and rutting. In general, the pavement structures in the corridor appear to be performing well and their condition should be monitored.

The potential pavement improvement recommendations provided herein are high-level, and additional pavement testing is needed along the corridor to assess the adequacy of the pavement for projected future traffic. For example, pavement layer thickness data from coring and ground-penetrating radar is needed along with pavement layer stiffness values determined from falling weight deflectometer testing to analyze the adequacy of the pavement sections for projected traffic.

Potential pavement improvement projects are presented in **Section 4.0** and summarized in **Section 5.0**.

3.0 Corridor Segmentation

To be consistent with the segmentation used in the traffic analysis part of the corridor study, the seven primary segments shown in **Figure 3** were used. These seven segments were defined based on major changes in traffic patterns in the corridor.

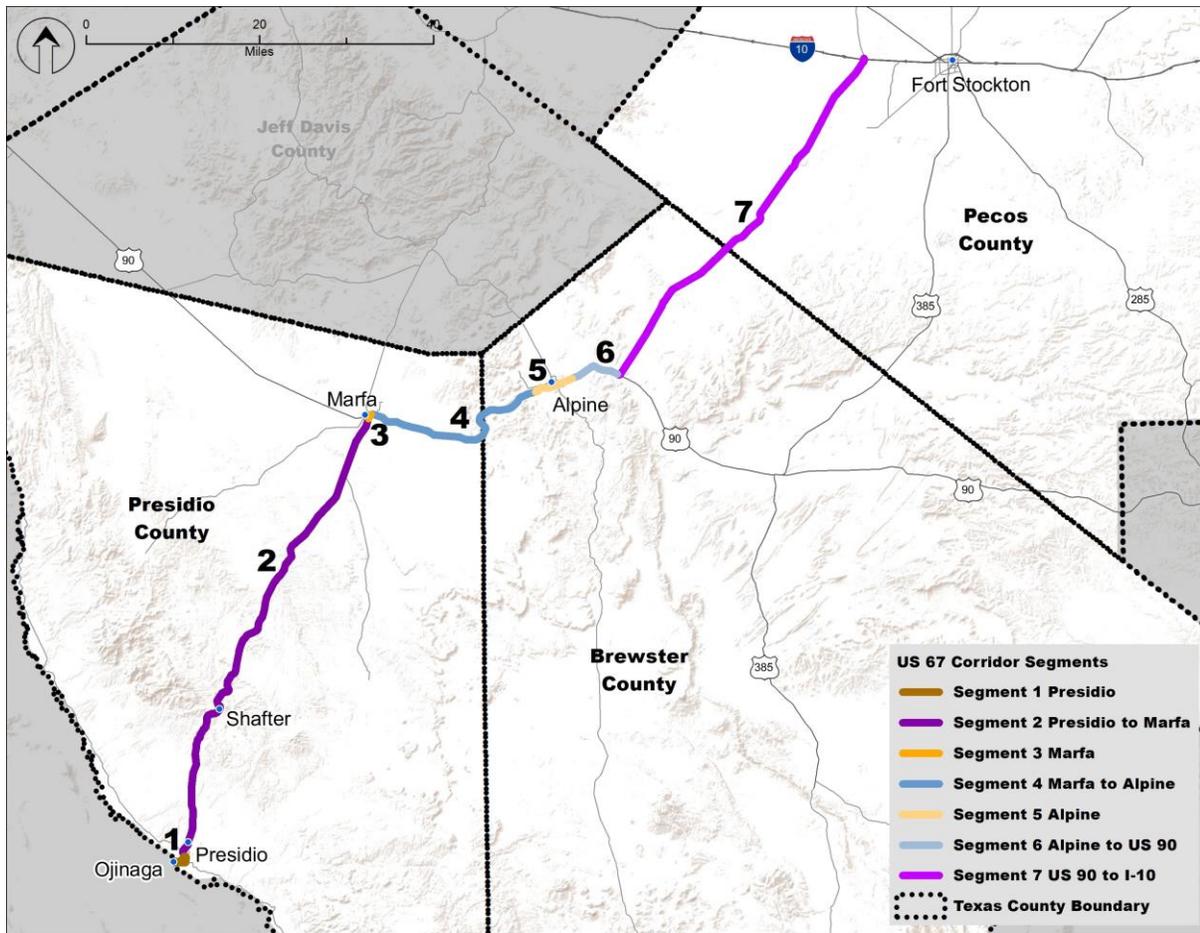


Figure 3: Primary Corridor Segments

The primary segments were further subdivided into smaller PPS based on our findings as shown in **Figure 4**.

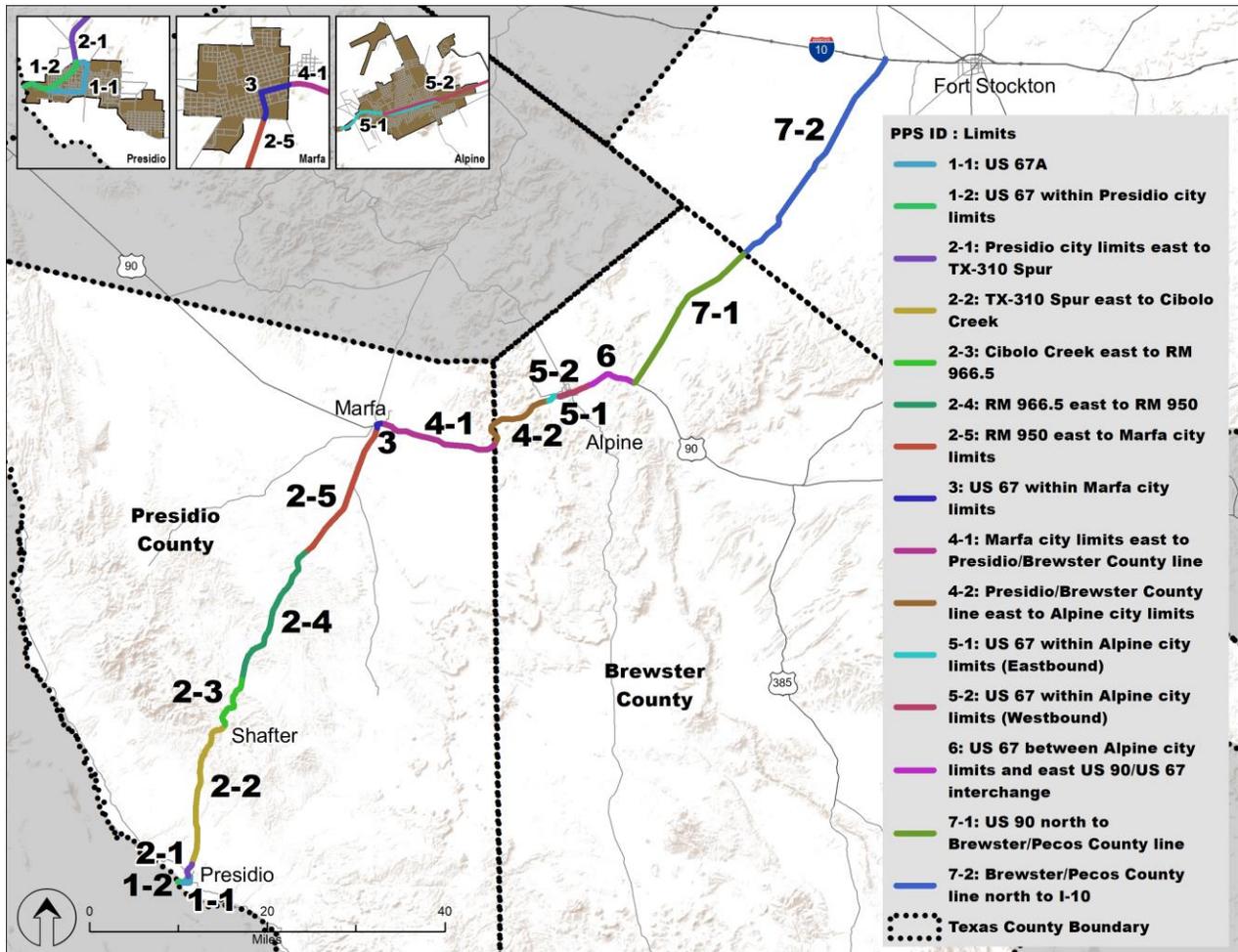


Figure 4: Pavement Project Segments (PPS)

The extent of the pavement project segments are summarized below.

Segment 1 Presidio: US 67 within Presidio city limits

PPS 1-1. US 67A

PPS 1-2. US 67 within Presidio city limits

Segment 2 Presidio to Marfa: US 67 between Presidio city limits and Marfa city limits

PPS 2-1. Presidio city limit north to TX-310 Spur

PPS 2-2. TX-310 Spur north to Cibolo Creek

PPS 2-3. Cibolo Creek north to ~RM 966.5

PPS 2-4. ~RM 966.5 north to ~RM 950

PPS 2-5. ~RM 950 north to Marfa city limits

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Segment 3 Marfa: US 67 within Marfa city limits

PPS 3. US 67 within Marfa city limits

Segment 4 Marfa to Alpine: US 67 between Marfa city limits and Alpine city limits

PPS 4-1. Marfa city limits north to Presidio/Brewster County line

PPS 4-2. Presidio/Brewster County line north to Alpine city limits

Segment 5 Alpine: US 67 within Alpine city limits

PPS 5-1. US 67 within Alpine city limits (Northbound – Holland Avenue)

PPS 5-2. US 67 within Alpine city limits (Southbound – Avenue E)

Segment 6 Alpine to US 90: US 67 between Alpine city limits and the north US 90/US 67 interchange

PPS 6. US 67 between Alpine city limits and the north US 90/US 67 interchange

Segment 7 US 90 to I-10: US 67 from US 90/US 67 interchange north of Alpine to I-10

PPS 7-1. US 90 north to Brewster/Pecos County line

PPS 7-2. Brewster/Pecos County line north to I-10

4.0 Pavement Evaluation Findings and Recommendations

This section presents inventory and condition information for each pavement project segment, which includes:

- Summary of the pavement structure
- Examples of collected reconnaissance data
- Summary of PMIS scores for the segment
- Observations made during analysis of the field reconnaissance data
- TxDOT planned maintenance and rehabilitation projects
- Recommended projects

Figure 5 summarizes the locations of roughness and early stage fatigue cracking observed during the field reconnaissance. These observations are discussed for each pavement project segment.

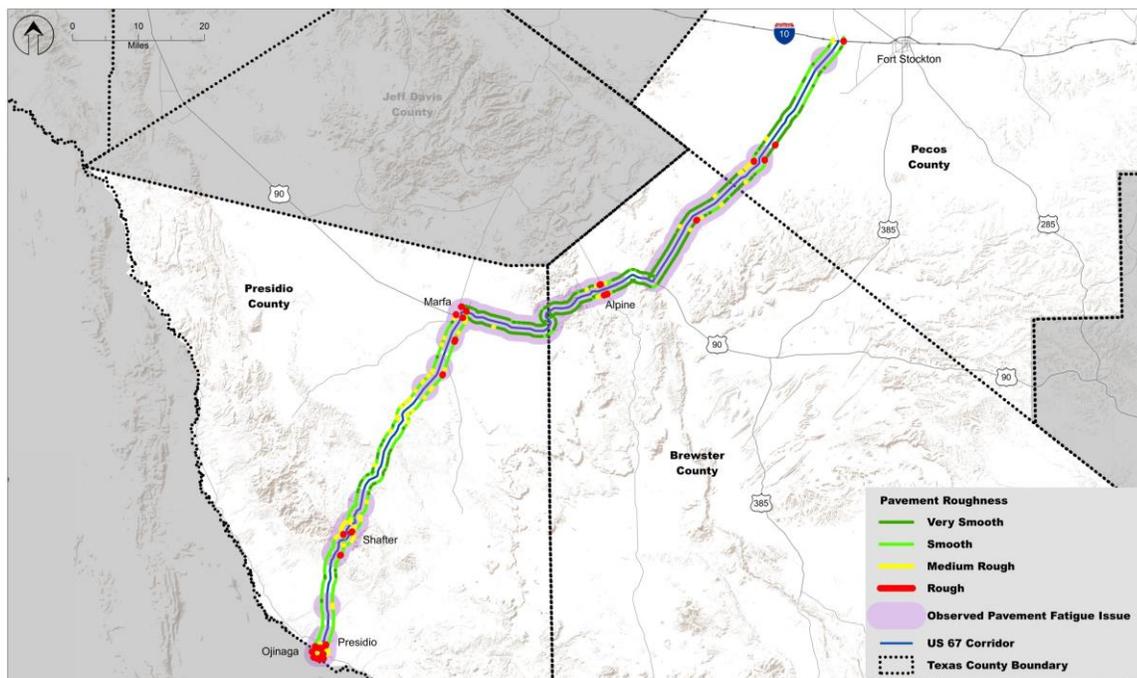


Figure 5: Observed Roughness and Early Stage Alligator Cracking

Figure 6 summarizes the 2019 PMIS scores received from TxDOT. These scores appear consistent with the field reconnaissance observations presented in **Section 4.1** of this technical memorandum.

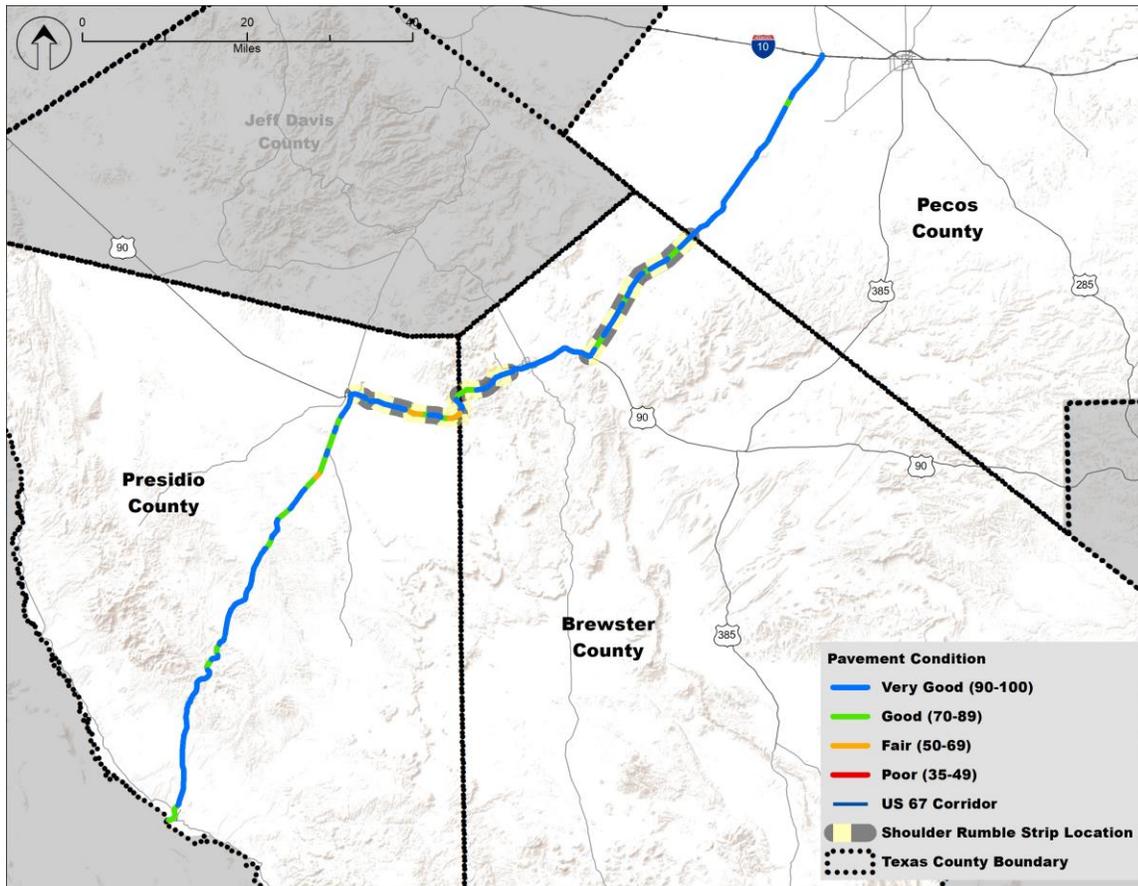


Figure 6: 2019 TxDOT PMIS Condition Scores

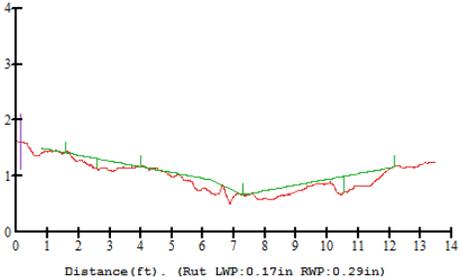
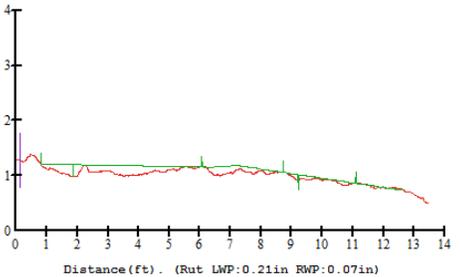
Data presented in the following tables should be verified prior to any detailed pavement analysis. While pavement condition scores provide an indication of the structural integrity of a pavement, they do not measure load carrying capacity and should not be used alone in assessing the structural adequacy of a pavement for projected traffic.

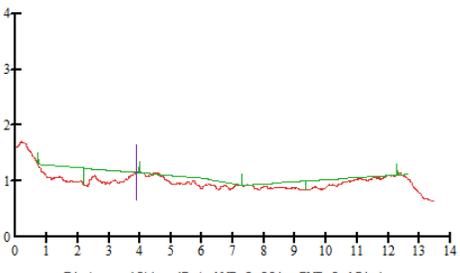
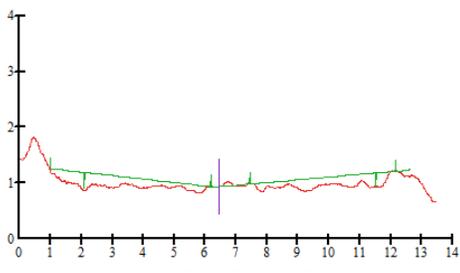
Furthermore, seal coats have been used throughout the corridor, and while seal coats may help extend pavement life, they can also mask underlying pavement distress. Additional pavement non-destructive testing, including coring, is recommended to assess the adequacy of the pavement structures along the corridor for projected traffic.

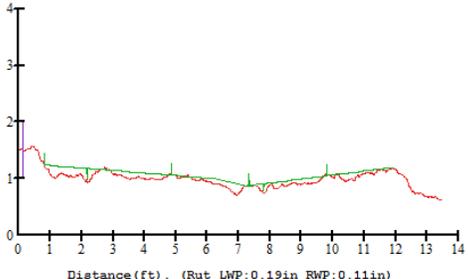
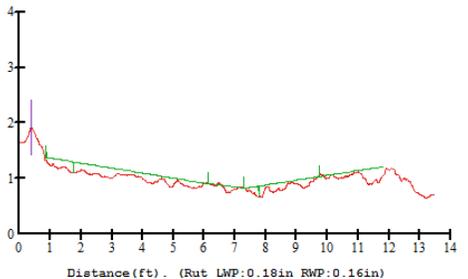
Pavement structure information presented in **Section 4.1** was gathered from construction and maintenance records provided by TxDOT, and planned pavement maintenance and rehabilitation activities were captured from the TxDOT online Statewide Planning Map in August 2019¹.

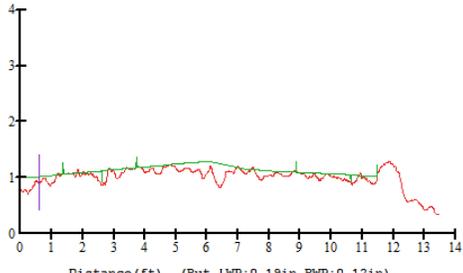
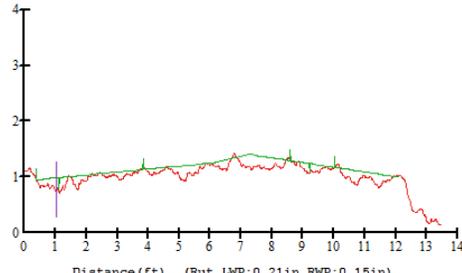
¹ Statewide Planning Map. Retrieved August 2019.
https://www.txdot.gov/apps/statewide_mapping/StatewidePlanningMap.html

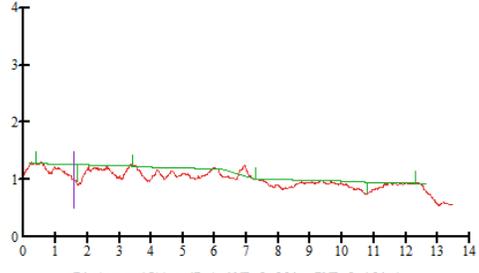
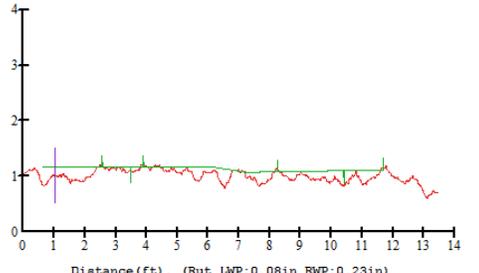
4.1. Pavement Inventory and Condition Information

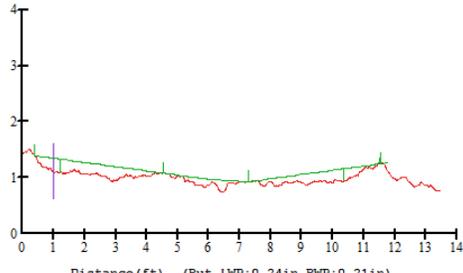
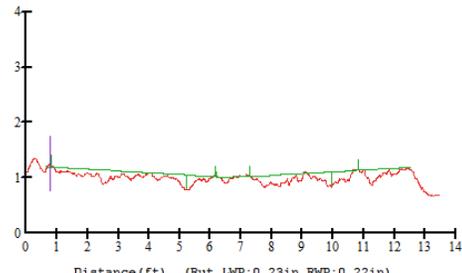
PPS 1-1	Limits: US 67A
El Paso District – Presidio County	South and north junctions with US 67
Pavement structure (<i>Verify with coring</i>) Surface: Microsurface Base: 12 inches flexible base	
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>	
Location – Southbound Lat. +29.5607063 Lon. -104.3795194	Location – Northbound Lat. +29.5606679 Lon. -104.3784292
  <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>	  <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores: Not Available	
Field reconnaissance observations: Areas of alligator cracking, rutting, flushing, raveling, and longitudinal and transverse cracking were observed along the segment. Roughness was present throughout the segment as well.	
TxDOT planned maintenance and rehabilitation projects: 1) Seal coating of the north/south stretch of the segment is planned within the next 5 to 10 years. 2) No maintenance is currently planned for the southernmost east/west stretch of the segment.	
Recommended projects: Prior to the planned seal coat, it is recommended that localized patching of areas exhibiting alligator cracking be performed. Due to the presence of alligator cracking and rutting, resurfacing of the southernmost east/west segment of US 67A may be considered in the future. In the long-term, the entire length of US 67A may be considered for base rehabilitation and resurfacing.	

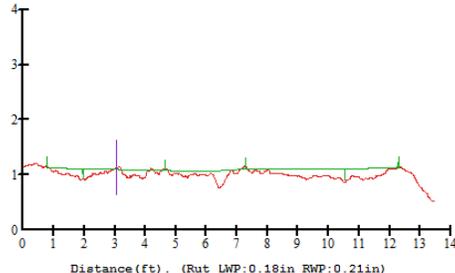
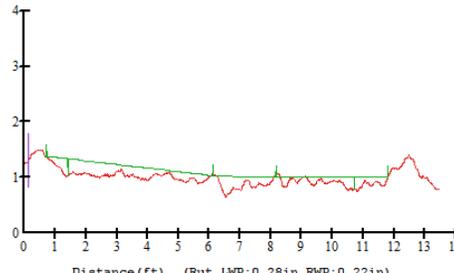
PPS 1-2		Limits: US 67 within Presidio city limits
El Paso District – Presidio County		~RM 994 (at US 67A junction) north to ~RM 993 along US 67
Pavement structure (<i>Verify with coring</i>) Surface: Sealcoat/Microsurface Base: 12 inches flexible base		
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>		
Image location – Southbound <i>Lat. +29.5661932 Lon. -104.3783886</i>		Image location – Northbound <i>Lat. +29.5655861 Lon. -104.3790621</i>
		
 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 85 (Good) Distress: 85 (Good) Ride: 3.8 (Smooth)		
Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall good condition. Localized areas of early stage rutting and alligator cracking were observed along the segment. Flushing and longitudinal and transverse cracking were observed as well.		
TxDOT planned maintenance and rehabilitation projects: Seal coating is planned within the next 4 years.		
Recommended projects: In the short-term, monitor the progression of rutting and early stage alligator cracking prior to the next seal coat. If these distresses progress, investigate localized patching prior to application of the next seal coat. In the long-term, continue monitoring the progression of distress. Rehabilitation of the existing base may eventually be needed. Perform a structural evaluation to assess the condition of the existing pavement structure and determine the appropriate rehabilitation activity.		

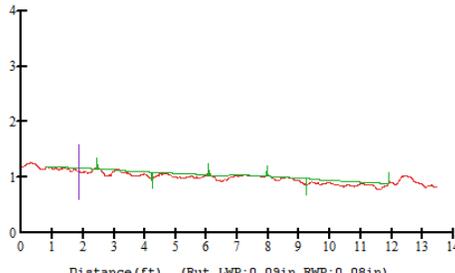
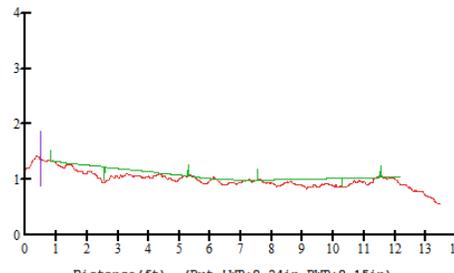
PPS 2-1	Limits: Presidio city limits north to TX-310 Spur
El Paso District – Presidio County	~RM 993 north to ~RM 991 along US 67
Pavement structure (<i>Verify with coring</i>) Surface: Seal coats and surface treatment Base: 10 inches flexible base	
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>	
Location – Southbound Lat. +29.5791388 Lon. -104.3772277	Location – Northbound Lat. +29.5873057 Lon. -104.3704047
  <p style="text-align: center;">Distance (ft). (Rut LWP:0.19in RWP:0.11in)</p> <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>	  <p style="text-align: center;">Distance (ft). (Rut LWP:0.18in RWP:0.16in)</p> <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 92 (Very Good) Distress: 92 (Very Good) Ride: 3.6 (Smooth)	
Field reconnaissance observations: Localized areas of early stage alligator cracking and rutting were observed along the segment. Flushing, raveling, and longitudinal and transverse cracking were also observed.	
TxDOT planned maintenance and rehabilitation projects: Seal coating is planned within the next 4 years.	
Recommended projects: In the short-term, localized patching of areas exhibiting alligator cracking is recommended prior to the next seal coat. Monitor the progression of alligator cracking and rutting. In the long-term, as freight traffic gradually increases, rehabilitation of the existing base and an overlay of this segment may eventually be needed to increase the load-carrying capacity of the pavement. Additional testing will be required to assess the condition of the pavement structure and determine the appropriate rehabilitation activity.	

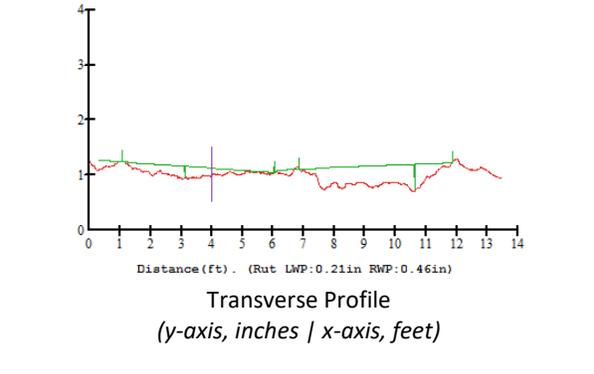
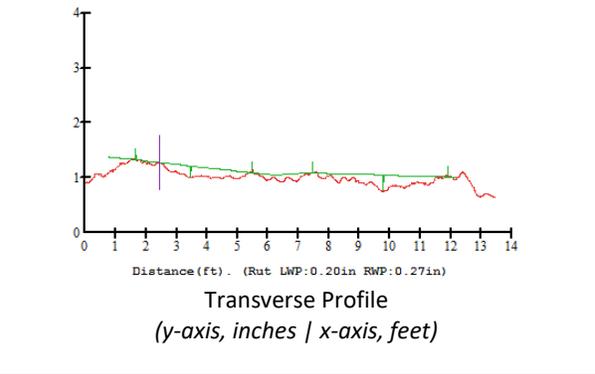
PPS 2-2		Limits: TX-310 Spur north to Cibolo Creek
El Paso District – Presidio County		~RM 991 north to ~RM 974 along US 67
Pavement structure (<i>Verify with coring</i>) Surface: Seal coats and surface treatment Base: 10 inches flexible base		
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>		
Location – Southbound Lat. +29.7484964 Lon. -104.3526665		Location – Northbound Lat. +29.6929534 Lon. -104.3601341
		
 <p style="text-align: center;">Distance(ft). (Rut LWP:0.19in RWP:0.12in)</p> <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p style="text-align: center;">Distance(ft). (Rut LWP:0.21in RWP:0.15in)</p> <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 100 (Very Good) Distress: 100 (Very Good) Ride: 3.9 (Smooth)		
Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Minimal cracking was observed. Some shallow rutting and flushing were observed along the segment.		
TxDOT planned maintenance and rehabilitation projects: Seal coating is planned within the next 4 years.		
Recommended projects: In the short-term, no additional projects are recommended. In the long-term, as freight traffic gradually increases, rehabilitation of the existing base and an overlay of this segment may eventually be needed to increase the load-carrying capacity of the pavement. Additional testing will be required to assess the condition of the pavement structure and determine the appropriate rehabilitation activity.		

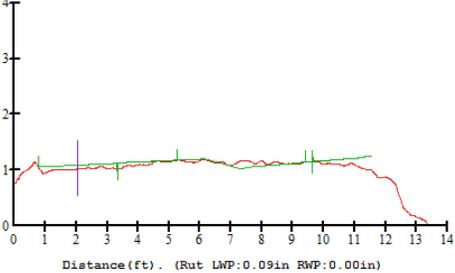
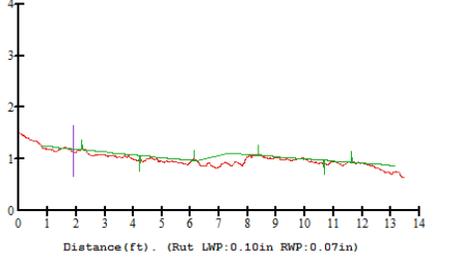
PPS 2-3		Limits: Cibolo Creek north to ~RM 966.5
El Paso District – Presidio County		~RM 974 north to ~RM 966.5 along US 67
Pavement structure (<i>Verify with coring</i>) Surface: Seal coats and surface treatment Base: 8 inches flexible base		
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>		
Location – Southbound Lat. +29.8456686 Lon. -104.3004686		Location – Northbound Lat. +29.8702686 Lon. -104.2871249
		
 <p>Distance (ft). (Rut LWP: 0.29in RWP: 0.18in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p>Distance (ft). (Rut LWP: 0.08in RWP: 0.23in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 93 (Very Good) Distress: 93 (Very Good) Ride: 3.4 (Smooth)		
Field reconnaissance observations: Localized areas of alligator cracking, shallow rutting, flushing, raveling, and longitudinal and transverse cracking were observed along the segment.		
TxDOT planned maintenance and rehabilitation projects: Seal coating is planned along most of the segment within the next 4 years.		
Recommended projects: In the short-term, localized patching of areas exhibiting alligator cracking is recommended prior to the next seal coat. Monitor the progression of alligator cracking and rutting. In the long-term, as freight traffic gradually increases, rehabilitation of the existing base and an overlay of this segment may eventually be needed to increase the load-carrying capacity of the pavement. Additional testing will be required to assess the condition of the pavement structure and determine the appropriate rehabilitation activity.		

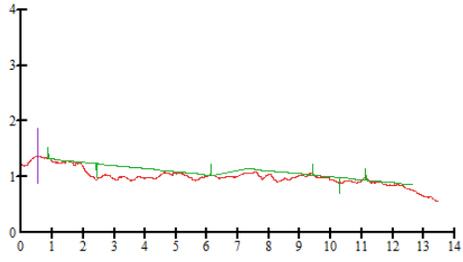
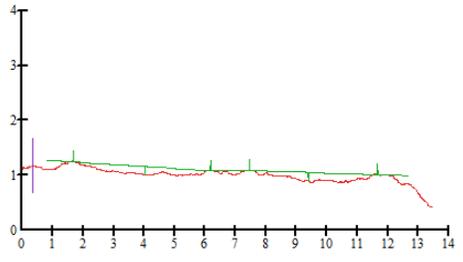
PPS 2-4		Limits: ~RM 966.5 north to ~RM 950
El Paso District – Presidio County		~RM 966.5 north to ~RM 950 along US 67
Pavement structure (<i>Verify with coring</i>) Surface: Seal coats and surface treatment Base: 8 inches flexible base		
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>		
Location – Southbound Lat. +30.0261455 Lon. -104.2039389		Location – Northbound Lat. +29.9758596 Lon. -104.2232786
		
 <p>Distance(ft). (Rut LWP:0.24in RMP:0.21in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p>Distance(ft). (Rut LWP:0.23in RMP:0.22in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 97 (Very Good) Distress: 97 (Very Good) Ride: 4.0 (Very Smooth)		
Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Minimal cracking was observed. Some shallow rutting and flushing were observed along the segment.		
TxDOT planned maintenance and rehabilitation projects: Seal coating of this segment is currently underway or will begin soon. Additional seal coating is planned within the next 5 to 10 years.		
Recommended projects: In the short-term, no additional projects are recommended. In the long-term, as freight traffic gradually increases, rehabilitation of the existing base and an overlay of this segment may eventually be needed to increase the load-carrying capacity of the pavement. Additional testing will be required to assess the condition of the pavement structure and determine the appropriate rehabilitation activity.		

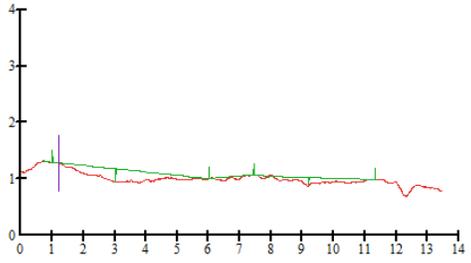
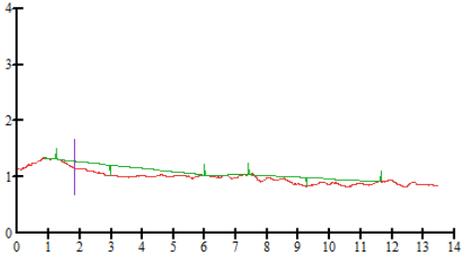
PPS 2-5		Limits: ~RM 950 north to Marfa city limits.
El Paso District – Presidio County		~RM 950 north to ~RM 934.5 along US 67
Pavement structure (<i>Verify with coring</i>) Surface: Seal coats and surface treatment Base: 6 inches flexible base		
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>		
Location – Southbound Lat. +30.1120830 Lon. -104.1404735		Location – Northbound Lat. +30.2055937 Lon. -104.0690123
		
 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 92 (Very Good) Distress: 92 (Very Good) Ride: 3.7 (Smooth)		
Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Minimal cracking was observed. Some shallow rutting and flushing were observed along the segment.		
TxDOT planned maintenance and rehabilitation projects: Seal coating of this segment is currently underway or will begin soon.		
Recommended projects: In the short-term, no additional projects are recommended. In the long-term, as freight traffic gradually increases, rehabilitation of the existing base and an overlay of this segment may eventually be needed to increase the load-carrying capacity of the pavement. Additional testing will be required to assess the condition of the pavement structure and determine the appropriate rehabilitation activity.		

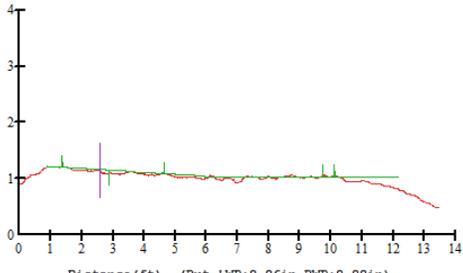
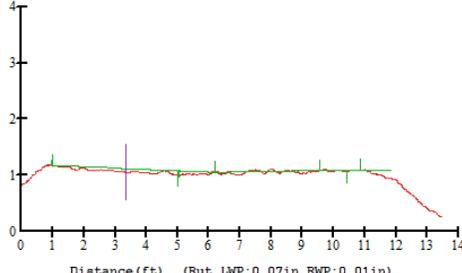
PPS 3		Limits: US 67 corridor within Marfa city limits.
El Paso District – Presidio County		~RM 934.5 north to ~RM 933.5 along US 67
Pavement structure (<i>Verify with coring</i>) Surface: Seal coats and surface treatment Base: 8 inches flexible base		
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>		
Location – Southbound Lat. +30.3102788 Lon. -104.0176808		Location – Northbound Lat. +30.3102110 Lon. -104.0177943
		
 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 96 (Very Good) Distress: 96 (Very Good) Ride: 3.6 (Smooth)		
Field reconnaissance observations: Longitudinal and transverse cracking were the predominant distress types observed. Where applied, crack seal appeared to be in overall good condition. The segment exhibited early stage alligator cracking in the wheel paths. Some shallow rutting was observed along the segment as well. These distresses should be monitored. Increasing freight traffic will likely accelerate their progression.		
TxDOT planned maintenance and rehabilitation projects: Seal coating of a 0.4-mile stretch beginning at the junction of US 67/ US 90 in Marfa to 0.4 miles north is currently underway or will begin soon. Seal coating of US 67 south of the US 67/ US 90 junction to the city limits is also currently underway or will begin soon.		
Recommended projects: In the short-term, no additional projects are recommended. Monitor progression of alligator cracking and rutting. As freight gradually traffic increases, rehabilitation of the existing base and a mill and inlay of this segment may eventually be needed to increase the load-carrying capacity of the pavement.		

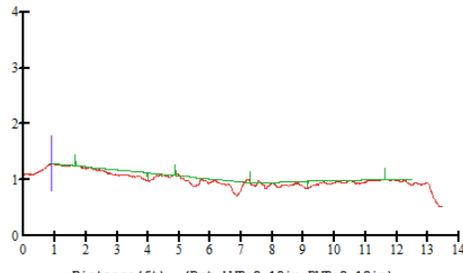
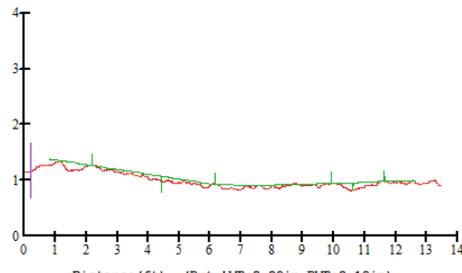
<p>PPS 4-1</p>	<p>Limits: Marfa city limits north to Presidio/ Brewster County line.</p>
<p>El Paso District – Presidio County</p>	<p>~RM 933.5 north to ~RM 920 along US 67</p>
<p>Pavement structure (<i>Verify with coring</i>) 2 inches hot mix asphalt overlay on 8 inches flexible base</p>	
<p>Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i></p>	
<p>Location – Southbound <i>Lat. +30.2685728 Lon. -103.8157756</i></p>	<p>Location – Northbound <i>Lat. +30.2753337 Lon. -103.8765773</i></p>
	
 <p>Transverse Profile <i>(y-axis, inches x-axis, feet)</i></p>	 <p>Transverse Profile <i>(y-axis, inches x-axis, feet)</i></p>
<p>FY18 PMIS Scores – Condition: 99 (Very Good) Distress: 99 (Very Good) Ride: 4.5 (Very Smooth)</p>	
<p>Field reconnaissance observations: PMIS condition scores do not appear to reflect the overall condition of the pavement during field reconnaissance. The segment exhibited early stage alligator cracking in the wheel paths along the segment. Some shallow rutting was observed along the segment as well. Longitudinal and transverse cracking were the predominant distress types observed. Where applied, crack seal appeared to be in overall good condition.</p>	
<p>TxDOT planned maintenance and rehabilitation projects: None.</p>	
<p>Recommended projects: Due to the presence of early stage alligator cracking and rutting along the length of this segment, it is recommended that this segment be further investigated for a potential overlay in the short-term. Additional testing is required to determine the adequacy of the pavement for projected traffic.</p>	

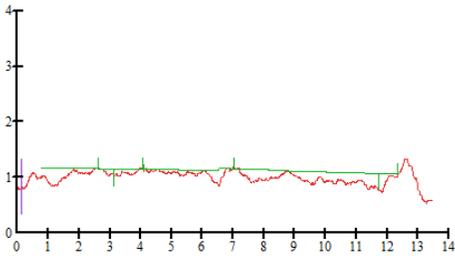
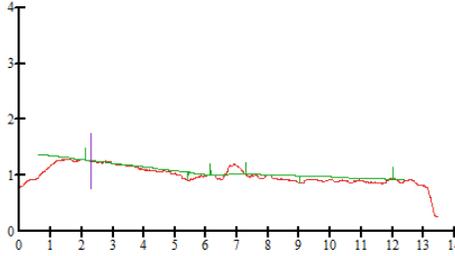
<p>PPS 4-2</p>	<p>Limits: Presidio/Brewster County line north to Alpine city limits.</p>
<p>El Paso District – Brewster County</p>	<p>~RM 920 north to ~RM 910.5 along US 67</p>
<p>Pavement structure (<i>Verify with coring</i>) 2 inches hot mix asphalt overlay on 12.5 inches flexible base</p>	
<p>Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i></p>	
<p>Location – Southbound <i>Lat. +30.3389724 Lon. -103.7253734</i></p>	<p>Location – Northbound <i>Lat. +30.3179130 Lon. -103.7846720</i></p>
  <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>	  <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
<p>FY18 PMIS Scores – Condition: 100 (Very Good) Distress: 100 (Very Good) Ride: 4.7 (Very Smooth)</p>	
<p>Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Longitudinal and transverse cracking were the predominant distress types observed. Where applied, crack seal appeared to be in overall good condition.</p>	
<p>TxDOT planned maintenance and rehabilitation projects: None.</p>	
<p>Recommended projects: In the short-term, continue the preventive maintenance crack sealing program and seal the paving joint where needed. In the long-term, as freight traffic gradually increases, rehabilitation of the existing base and an overlay of this segment may eventually be needed to increase the load-carrying capacity of the pavement. Additional testing will be required to assess the condition of the pavement structure and determine the appropriate rehabilitation activity.</p>	

<p>PPS 5-1</p>	<p>Limits: US 67 corridor within Alpine city limits. (Northbound – Holland Ave.)</p>
<p>El Paso District – Brewster County</p>	<p>~RM 910.5 north to ~RM 905.5 along US 67</p>
<p>Pavement structure (Verify with coring) Holland Ave. – Several cross-sections: (1) Surface treatment over 8 inches asphalt stabilized base over var. thick. flexible base (3 to 6 inches); and (2) 2 inches asphalt layer over 6 to 9 inches of concrete. (Ref. Brewster 0020-11-045.)</p>	
<p>Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i></p>	
<p>Location – Northbound Lat. +30.3544511 Lon. -103.6746294</p>   <p>Distance(ft). (Rut LWP:0.25in RWP:0.08in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>	<p>Location – Northbound Lat. +30.3581379 Lon. -103.6596794</p>   <p>Distance(ft). (Rut LWP:0.14in RWP:0.16in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>
<p>FY18 PMIS Scores – Condition: 96 (Very Good) Distress: 98 (Very Good) Ride: 4.1 (Very Smooth)</p>	
<p>Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Longitudinal and transverse cracking were the predominant distress types observed. Where applied, crack seal appeared to be in overall good condition. Localized areas of alligator cracking were observed along the segment, especially near the railroad bridge. Some shallow rutting was observed along the segment as well.</p>	
<p>TxDOT planned maintenance and rehabilitation projects: None.</p>	
<p>Recommended projects: In the short-term, localized patching of highly alligatorated (fatigued) areas near the railroad bridge and through the downtown corridor is recommended. As freight traffic gradually increases, the load-carrying capacity of the pavement may need to be increased. Due to the many cross-sections making-up this segment, additional testing and analysis should be performed to determine appropriate rehabilitation strategies.</p>	

<p>PPS 5-2</p>	<p>Limits: US 67 corridor within Alpine city limits. <i>(Southbound – Avenue E)</i></p>
<p>El Paso District – Brewster County</p>	<p>~RM 905.5 south to ~RM 910.5 along US 67</p>
<p>Pavement structure <i>(Verify with coring)</i> US 67/90 – Several sections: (1) Surface treatment over asphalt stabilized base (4 to 8 inches) over flexible base (3 to 12 inches); and (2) 2 inches asphalt over 6 to 9 inches of concrete. (Ref. Brewster 0020-11-045.) Avenue E – 4 inches asphalt stabilized flexible base on 12 inches flexible base</p>	
<p>Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i></p>	
<p>Location – Southbound <i>Lat. +30.3596388 Lon. -103.6580325</i></p>	<p>Location – Southbound <i>Lat. +30.3581379 Lon. -103.6596794</i></p>
  <p>Distance (ft). (Rut LMP:0.22in RMP:0.12in)</p> <p>Transverse Profile <i>(y-axis, inches x-axis, feet)</i></p>	  <p>Distance (ft). (Rut LMP:0.18in RMP:0.14in)</p> <p>Transverse Profile <i>(y-axis, inches x-axis, feet)</i></p>
<p>FY18 PMIS Scores – Condition: 99 (Very Good) Distress: 100 (Very Good) Ride: 4.2 (Very Smooth)</p>	
<p>Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Longitudinal and transverse cracking were the predominant distress types observed. Where applied, crack seal appeared to be in overall good condition. Localized areas of alligator cracking were observed along the segment, especially near intersections in the downtown area. Some shallow rutting was also observed in the segment.</p>	
<p>TxDOT planned maintenance and rehabilitation projects: None.</p>	
<p>Recommended projects: In the short-term, localized patching of fatigued areas near intersections in the downtown area is recommended. Eventually, the load-carrying capacity of the pavement may need to be increased. Due to the many cross-sections making-up this segment, additional testing and analysis should be performed to determine appropriate rehabilitation strategies.</p>	

PPS 6	Limits: US 67 between Alpine city limits and north US 90/US 67 interchange
El Paso District – Brewster County	~RM 905.5 to ~RM 900 along US 67
Pavement structure (<i>Verify with coring</i>) Recently overlaid. As built drawings not available.	
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>	
Location – Southbound <i>Lat. +30.3864597 Lon. -103.5740953</i>	Location – Northbound <i>Lat. +30.3880939 Lon. -103.5774812</i>
	
 <p>Distance(ft). (Rut LWP:0.06in RWP:0.00in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>	 <p>Distance(ft). (Rut LWP:0.07in RWP:0.01in)</p> <p>Transverse Profile (y-axis, inches x-axis, feet)</p>
FY18 PMIS Scores – Condition: 100 (Very Good) Distress: 100 (Very Good) Ride: 3.4 (Smooth)	
Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. The pavement was recently overlaid and no distress was observed.	
TxDOT planned maintenance and rehabilitation projects: None.	
Recommended projects: In the short-term, begin a crack sealing program. This segment was recently overlaid and appears to be performing well. Eventually, the load-carrying capacity of the pavement may need to be increased.	

PPS 7-1		Limits: US 90 north to Brewster/Pecos County line.	
El Paso District – Brewster County		~RM 900 north to ~RM 878 along US 67	
Pavement structure (<i>Verify with coring</i>) Surface: 2 inches hot mix asphalt Base: 8 inches flexible base			
Examples of data collected during field reconnaissance <i>Images and corresponding transverse profiles</i>			
Location – Northbound <i>Lat. +30.5313673 Lon. -103.4038919</i>		Location – Southbound <i>Lat. +30.5409051 Lon. -103.3842149</i>	
			
 <p style="text-align: center;">Distance (ft). (Rut LWP:0.13in RWP:0.10in)</p> <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p style="text-align: center;">Distance (ft). (Rut LWP:0.08in RWP:0.13in)</p> <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>	
FY18 PMIS Scores – Condition: 95 (Very Good) Distress: 95 (Very Good) Ride: 4.6 (Very Smooth)			
Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Longitudinal and transverse cracking were the predominant distress types observed. Where applied, crack seal appeared to be in overall good condition. Some small areas of flushing were observed as well. Localized areas of early stage alligator cracking were observed along the segment. Shallow rutting was observed along the segment as well. These distresses should be monitored. Increasing freight traffic will likely accelerate their progression.			
TxDOT planned maintenance and rehabilitation projects: Seal coating is planned within the next 4 years.			
Recommended projects: In the short-term, continue crack sealing program and seal the paving joint. Monitor progression of alligator cracking and rutting.			

PPS 7-2		Limits: Brewster/Pecos County line north to I-10
Odessa District – Pecos County		~RM 878 north to ~RM 850 (I-10 junction) along US 67
<p>Pavement structure (<i>Verify with coring</i>)</p> <p>Surface: 1.5 inches seal coats</p> <p>Base: 10 inches flexible base (~RM 878 to ~RM 860.5) based on 2017 TTI report². (<i>Note: 12 inches flexible base (~RM 869 to ~RM 872) from construction drawings.</i>)</p> <p>Base: 8 inches flexible base (~RM 860.5 to ~RM 850) based on 2017 TTI report.</p>		
<p>Examples of data collected during field reconnaissance</p> <p><i>Images and corresponding transverse profiles</i></p>		
<p>Location 1 – Northbound Lat. +30.7857079 Lon. -103.1467825</p>		<p>Location 2 – Southbound Lat. +30.4995501 Lon. -103.4462547</p>
		
 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>		 <p style="text-align: center;">Transverse Profile (y-axis, inches x-axis, feet)</p>
<p>FY17 PMIS Scores – Condition: 98 (Very Good) Distress: 98 (Very Good) Ride: 4.1 (Very Smooth)</p>		
<p>Field reconnaissance observations: Consistent with the PMIS condition scores, the segment was found to be in overall very good condition. Longitudinal and transverse cracking were the predominant distress types observed. Where applied, crack seal appeared to be in overall good condition. Areas of flushing were observed as well. Localized areas of early stage alligator cracking were observed along the segment. Shallow rutting was observed along the segment as well. These distresses should be monitored. Increasing freight traffic will likely accelerate their progression.</p>		
<p>TxDOT planned maintenance and rehabilitation projects: Widening of the roadbed and the addition of shoulders is planned within the next 4 years.</p>		
<p>Recommended projects: Continue crack sealing program and seal the paving joint. Monitor progression of alligator cracking and rutting. Based on the 2017 pavement study performed by TTI, the pavement was found to be structurally adequate, and no rehabilitation is recommended within the next ten years. If future hot mix overlays are planned, a minimum of 3.5 inches thickness is recommended based on the loading.</p>		

²Goehl, Darlene. *Corridor Analysis of US 67 in the Odessa District*. Texas A&M Transportation Institute. (2017). College Station, TX. Print

5.0 Planning Level Cost Estimates

Planning level cost estimates were developed for the recommended pavement projects described in **Section 4.1** of this technical memorandum. The assumptions used for the development of the planning level cost estimates for the recommended pavement projects are as follows:

- For localized patching, base deformation only extends 4 inches into the existing base and base will be reworked.
- For base rehabilitation and resurfacing, base will be completely replaced.
- Base rehabilitation will be 9 inches in depth throughout the entire corridor.
- Short-term traffic control plan will be used for localized patching and long-term traffic plan will be used for base rehabilitation and resurfacing.
- Along the East Avenue and Holland Avenue within Alpine, existing base is assumed to be cement stabilized base.
- Typical corridor sections consist of two-lane undivided roadway with 12 feet lanes and 6 feet shoulders.
- Between RM 905.5 and RM 900 existing base is assumed to be 8 inches of flexible base.
- Localized patching required per PPS is based on the pavement condition and engineering judgment.

Table 4 shows the planning level cost estimates for the recommended pavement projects. **Attachment A** provides a detailed methodology used for the development of the total length for the project types cost estimates.

Table 4: Planning level cost estimates for recommended pavement projects

Project Type	Total Length (miles)	Unit Cost (\$/mile) ³	Total Cost (\$)
Localized Patching (Surface Treatment)	3.66	\$ 128,170.05	\$ 468,718
Localized Patching (ACP)	9.59	\$ 304,100.15	\$ 2,916,016
Resurfacing	0.90	\$ 817,376.37	\$ 735,639
Base Rehabilitation and Resurfacing	143.22	\$ 1,128,485.08	\$ 161,621,634
Sub Total			\$ 165,742,007
40% Contingency			\$ 66,296,803
Grand Total (rounded)			\$ 232,100,000

³ Unit Costs were obtained from TxDOT's unit bid prices from El Paso District. Multiple relevant bid codes and assumption were used to develop the unit cost for each project type.

6.0 Summary

The pavement within the US 67 corridor master plan study was found to have PMIS condition scores ranging from “Good” to “Very Good,” with most of the pavement in “Very Good” condition. Localized areas of early stage alligator cracking and roughness were observed along the corridor. TxDOT has been applying seal coats and localized overlays to segments in the corridor, and both appear to be performing well.

Table 5 summarizes the planned and potential short-, mid-, and long-term projects identified and discussed in the previous section. Additional pavement testing is needed to analyze the segments based on projected traffic. In lieu of additional testing in the short-term, PMIS condition scores should be monitored from year-to-year to determine if the rate of pavement condition deterioration along the corridor is increasing.

Table 5: Summary of Planned and Potential Future Projects

PPS	Limits	TxDOT Planned Projects ⁴	Short- to Mid-term Potential Projects	Long-term Potential Projects
1-1	US 67A	SC ⁵ within 5-10 years	LSP ⁶	RB+OL ⁷ (Monitor)
1-2	US 67 within Presidio city limits	SC within 4 years	LSP	RB+OL (Monitor)
2-1	Presidio city limit north to TX-310 Spur	SC within 4 years	LSP	RB+OL (Monitor)
2-2	TX-310 Spur north to Cibolo Creek	SC within 4 years	None	RB+OL (Monitor)
2-3	Cibolo Creek north to ~RM 966.5	SC within 4 years	LSP	RB+OL (Monitor)
2-4	~RM 966.5 north to ~RM 950	SC begins soon +SC in 5-10 years	None	RB+OL (Monitor)
2-5	~RM 950 north to Marfa city limits	SC begins soon	None	RB+OL (Monitor)
3	US 67 within Marfa city limits	SC begins soon	None	RB+OL (Monitor)
4-1	Marfa city limits north to Presidio/Brewster County line	None	<i>Investigate soon:</i> RB+OL	None
4-2	Presidio/Brewster County line north to Alpine city limits	None	PM ⁸	RB+OL (Monitor)
5-1	US 67 within Alpine city limits (Northbound – Holland Ave.)	None	LSP	Monitor
5-2	US 67 within Alpine city limits (Southbound – Avenue E)	None	LSP	Monitor
6	US 67 between Alpine city limits and north US 90/US 67 interchange	None	PM	RB+OL (Monitor)
7-1	US 90 north to Brewster/Pecos County line	SC within 4 years	None	RB+OL (Monitor)
7-2	Brewster/Pecos County line north to I-10	Widening road + adding shoulders	None	RB+OL (Monitor)

⁴ TxDOT online Statewide Planning Map. Retrieved August 2019.

https://www.txdot.gov/apps/statewide_mapping/StatewidePlanningMap.html

⁵ Seal Coat (SC)

⁶ Localized Structural Patching (LSP)

⁷ Rehabilitate base and overlay (RB+OL)

⁸ Preventive Maintenance (PM)

Attachment A: Planning level cost estimates for the recommended pavement projects

PPS	Begin Project Limit	End Project Limit	Length (miles)	Pavement Condition	Localized Patching Percentage	Recommended Pavement Project	Total Project Length
1-1	US 67A	US 67A	1.8	N/A	40%	Localized Patching (Surface Treatment)	0.72
					N/A	Resurfacing	0.90
					N/A	Base Rehabilitation and Resurfacing	1.80
1-2	US 67 within Presidio City Limits	US 67 within Presidio City Limits	1.02	85 (Good)	30%	Localized Patching (Surface Treatment)	0.31
					N/A	Base Rehabilitation and Resurfacing	1.02
2-1	Presidio City Limit East	TX 310 Spur	1.5	92 (Very Good)	20%	Localized Patching (Surface Treatment)	0.30
					N/A	Base Rehabilitation and Resurfacing	1.50
2-2	TX 310 Spur	Cibolo Creek	17.3	100 (Very Good)	20%	Base Rehabilitation and Resurfacing	17.3
2-3	Cibolo Creek	RM 966.5	7.6	93 (Very Good)	20%	Localized Patching (Surface Treatment)	1.52
					N/A	Base Rehabilitation and Resurfacing	7.60
2-4	RM 966.5	RM 950	16.5	97 (Very Good)	N/A	Base Rehabilitation and Resurfacing	16.5
2-5	RM 950	Marfa City Limits	15.5	92 (Very Good)	N/A	Base Rehabilitation and Resurfacing	15.5
3-0	RM 934.5	RM 933.5	1	96 (Very Good)	N/A	Base Rehabilitation and Resurfacing	1.00
4-1	RM 933.5	RM 920	13.5	99 (Very Good)	40%	Localized Patching (ACP)	5.40
					N/A	Base Rehabilitation and Resurfacing	13.5
4-2	RM 920	RM 910.5	10.5	100 (Very Good)	30%	Localized Patching (ACP)	3.15
					N/A	Base Rehabilitation and Resurfacing	10.5
5-1 (Northbound)	US 67 within Alpine City Limits	US 67 within Alpine City Limits	2.5	96 (Very Good)	20%	Localized Patching (Surface Treatment)	0.25
					N/A	Base Rehabilitation and Resurfacing	1.25
5-1 (Southbound)	US 67 within Alpine City Limits	US 67 within Alpine City Limits	2.5	96 (Very Good)	20%	Localized Patching (ACP)	0.25
					N/A	Base Rehabilitation and Resurfacing	1.25

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PPS	Begin Project Limit	End Project Limit	Length (miles)	Pavement Condition	Localized Patching Percentage	Recommended Pavement Project	Total Project Length
5-2 (Surface Treatment)	US 67 within Alpine City Limits	US 67 within Alpine City Limits	1.7	99 (Very Good)	20%	Localized Patching (Surface Treatment)	0.56
5-2 (Surface Treatment)	US 67 within Alpine City Limits	US 67 within Alpine City Limits	1.7	99 (Very Good)	20%	Localized Patching (ACP)	0.56
5-2 (ACP)	East Ave	East Ave	1.6	99 (Very Good)	20%	Localized Patching (ACP)	0.53
6-0	RM 905.5	RM 900	5.5	100 (Very Good)	N/A	Base Rehabilitation and Resurfacing	5.50
7-1	RM 900	RM 878	22	95 (Very Good)	N/A	Base Rehabilitation and Resurfacing	22.0
7-2	RM 878	RM 850	28	98 (Very Good)	N/A	Base Rehabilitation and Resurfacing	28.0



US 67 CORRIDOR
MASTER PLAN