APPENDIX D – PAVEMENT DESIGN

ANALYSIS

The analysis performed is based on topographic information available from the United States Geological Survey (USGS); no new field topographic surveys were completed. The USGS topographic information is not adequate for an engineering design product to be used for construction, but should be sufficient for a planning level analysis. Once an alternative is selected more precise topographic information will need to be collected in order to perform any engineering designs.

At the request of the FAA soil borings were collected on the existing runway and at locations for the possible parallel runway and taxiway extension. A copy of this report is included as **Appendix B**. These borings were limited in their breadth and additional borings will need to be collected once an alternative is selected in order to perform a complete engineering analysis and detailed design of the pavement sections. The goal of these borings to provide a preliminary indication of the existing pavement section and existing soils that might be found on the site for pavement construction.

The soil borings report indicated that the weakest pavement section on the existing runway consisted of 5.25 inches of bituminous pavement over 7.0 inches of aggregate base. The bituminous pavement varied from 5.25 inches to 6.5 inches in thickness, but was generally 5.25 to 6 inches. The aggregate base varied from 6 inches to 17.5 inches in thickness, but was generally 6 to 7 inches. The analysis of the existing runway pavements will use a conservative review consisting of the weakest pavement section, 5.25 inches of bituminous pavement over 6 inches of aggregate base, as is standard FAA design and engineering practice.

The soil report also include California Bearing Ratio (CBR) test results and using the FAA standard of using one standard deviation below the mean results in a design CBR of 2.2 based on the subgrade soils encountered at the site. The CBR test is a measure of the soil strength at a site. This is consistent with other soils found around the airport site.

PAVEMENT DESIGN

Based on the soil and pavement information obtained as well as the aircraft that are forecast to be using the airport in the 20-year forecast horizon ten pavement sections were developed:

1. New bituminous pavement section for Regional Aircraft
    a. 4 inch bituminous pavement
    b. 4 inch bituminous base
    c. 12 inch aggregate base
    d. 16 inch subbase
2. Bituminous overlay of existing runway pavement section for Regional Aircraft
    a. 11 inch bituminous overlay
3. New concrete pavement section for Regional Aircraft
    a. 11 inch concrete
    b. 8 inch cement treated base
    c. 12 inch aggregate base

4. Concrete overlay of existing runway pavement section for Regional Aircraft
    a. 12 inch concrete overlay
5. New bituminous pavement section for Narrow Body Aircraft
    a. 9.5 inch bituminous pavement
    b. 4 inch bituminous base
    c. 12 inch aggregate base
    d. 16 inch subbase
6. Bituminous overlay of existing runway pavement section for Narrow Body Aircraft
    a. 16 inch bituminous overlay
7. New concrete pavement section for Narrow Body Aircraft
    a. 15 inch concrete
    b. 8 inch cement treated base
    c. 12 inch aggregate base
8. Concrete overlay of existing runway pavement section for Narrow Body Aircraft
    a. 15 inch concrete overlay
9. New Bituminous ”Super” Taxiway Pavement – Outer edge design – for Regional Aircraft
    a. 4 inch bituminous pavement (P-401/403)
    b. 4 inch bituminous base (P-401/403)
    c. 12 inch aggregate base (P-209)
    d. 12 inch subbase (P-154)
10. New Concrete ”Super” Taxiway Pavement – Outer edge design – for Regional Aircraft
    a. 10 inch concrete (PCC Surface)
    b. 8 inch cement treated base (P-304)
    c. 12 inch aggregate base (P-209)

1. New Bituminous Pavement Section Design for Regional Aircraft

The following is the FAARField pavement design calculations for placing a new bituminous runway and taxiway pavement sections on the existing soil at Dickinson:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section asph-without in Job 1513301-New.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Flexible. Asphalt CDF was not computed.
Design Life = 20 years.
A design for this section was completed on 08/19/14 at 10:02:14.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	4.00	200,000	0.35	0
2	P-401/ P-403 St (flex)	4.00	400,000	0.35	0
3	P-209 Cr Ag	12.00	50,797	0.35	0
4	P-154 UnCr Ag	15.78	12,277	0.35	0
5	Subgrade	0.00	3,300	0.35	0

Total thickness to the top of the subgrade = 35.78 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	1.53
2	Dual Whl-45	0.00	0.00	1.53
3	Dual Whl-75	0.74	0.74	1.36
4	Dual Whl-75	0.26	0.26	1.36

2. Bituminous Overlay of Existing Runway Pavements for Regional Aircraft

The following is the FAARField pavement design calculations for overlaying the thinnest existing runway and taxiway pavement sections at Dickinson with bituminous pavement:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section asph-without in Job 1513301-Overlay.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is AC Overlay on Flexible. Asphalt CDF was not computed.
Design Life = 20 years.
A design for this section was completed on 08/12/14 at 11:44:52.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Overlay	10.51	200,000	0.35	0
2	P-401/ P-403 HMA Surface	6.00	200,000	0.35	0
3	P-208 Cr Ag	12.00	20,188	0.35	0
4	Subgrade	0.00	3,300	0.35	0

Total thickness to the top of the subgrade = 28.51 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	1.54
2	Dual Whl-45	0.00	0.00	1.54
3	Dual Whl-75	0.74	0.74	1.37
4	Dual Whl-75	0.26	0.26	1.37

3. New Concrete Pavement Section Design for Regional Aircraft

The following is the FAARField pavement design calculations for placing a new concrete runway and taxiway pavement sections on the existing soil at Dickinson:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section PCC-without in Job 1513301-New.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Rigid.
Design Life = 20 years.
A design for this section was completed on 08/19/14 at 10:03:11.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	PCC Surface	10.46	4,000,000	0.15	700
2	P-304 CTB	8.00	500,000	0.20	0
3	P-209 Cr Ag	12.00	20,007	0.35	0
4	Subgrade	0.00	3,253	0.40	0

Total thickness to the top of the subgrade = 30.46 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	5.30
2	Dual Whl-45	0.00	0.00	5.30
3	Dual Whl-75	0.74	0.74	3.60
4	Dual Whl-75	0.26	0.26	3.60

4. Concrete Overlay of Existing Runway Pavements for Regional Aircraft

The following is the FAARField pavement design calculations for overlaying the thinnest existing runway and taxiway pavement sections at Dickinson with concrete:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section PCC-without in Job 1513301-Overlay.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is PCC Overlay on Flexible.
Design Life = 20 years.
A design for this section was completed on 08/12/14 at 11:44:16.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	PCC Overlay on Flex.	11.48	4,000,000	0.15	700
2	P-401/ P-403 HMA Surface	6.00	200,000	0.35	0
3	P-208 Cr Ag	12.00	20,007	0.35	0
4	Subgrade	0.00	3,253	0.40	0

Total thickness to the top of the subgrade = 29.48 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	5.30
2	Dual Whl-45	0.00	0.00	5.30
3	Dual Whl-75	0.73	0.73	3.60
4	Dual Whl-75	0.27	0.27	3.60

5. New Bituminous Pavement Section Design for Narrow Body Aircraft

The following is the FAARField pavement design calculations for placing a new bituminous runway and taxiway pavement sections on the existing soil at Dickinson:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section asph-with01 in Job 1513301-New.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Flexible.
Design Life = 20 years.
A design for this section was completed on 08/19/14 at 13:40:11.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	9.50	200,000	0.35	0
2	P-401/ P-403 St (flex)	4.00	400,000	0.35	0
3	P-209 Cr Ag	12.00	56,691	0.35	0
4	P-154 UnCr Ag	15.34	13,568	0.35	0
5	Subgrade	0.00	3,300	0.35	0

Total thickness to the top of the subgrade = 40.84 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00
5	MD83	161,000	208	2.00
6	A319-100 std	141,978	104	0.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	1.44
2	Dual Whl-45	0.00	0.00	1.44
3	Dual Whl-75	0.00	0.00	1.30
4	Dual Whl-75	0.00	0.00	1.30
5	MD83	0.98	0.98	1.22
6	A319-100 std	0.02	0.05	1.16

6. Bituminous Overlay of Existing Runway Pavements for Narrow Body Aircraft

The following is the FAARField pavement design calculations for overlaying the thinnest existing runway and taxiway pavement sections at Dickinson with bituminous pavement:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section asph-with in Job 1513301-Overlay.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is AC Overlay on Flexible. Asphalt CDF was not computed.
Design Life = 20 years.
A design for this section was completed on 08/12/14 at 11:44:55.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Overlay	15.63	200,000	0.35	0
2	P-401/ P-403 HMA Surface	6.00	200,000	0.35	0
3	P-208 Cr Ag	12.00	20,188	0.35	0
4	Subgrade	0.00	3,300	0.35	0

Total thickness to the top of the subgrade = 33.63 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00
5	MD83	161,000	208	2.00
6	A319-100 std	141,978	104	0.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	1.38
2	Dual Whl-45	0.00	0.00	1.38
3	Dual Whl-75	0.00	0.00	1.26
4	Dual Whl-75	0.00	0.00	1.26
5	MD83	0.98	0.98	1.19
6	A319-100 std	0.02	0.05	1.14

7. New Concrete Pavement Section Design for Narrow Body Aircraft

The following is the FAARField pavement design calculations for placing a new concrete runway and taxiway pavement sections on the existing soil at Dickinson:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section PCC-with in Job 1513301-New.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is New Rigid.
Design Life = 20 years.
A design for this section was completed on 08/19/14 at 10:09:27.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	PCC Surface	14.15	4,000,000	0.15	700
2	P-304 CTB	8.00	500,000	0.20	0
3	P-209 Cr Ag	12.00	20,007	0.35	0
4	Subgrade	0.00	3,253	0.40	0

Total thickness to the top of the subgrade = 34.15 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00
5	MD83	161,000	208	2.00
6	A319-100 std	141,978	104	0.00

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	5.30
2	Dual Whl-45	0.00	0.00	5.30
3	Dual Whl-75	0.00	0.00	3.60
4	Dual Whl-75	0.00	0.00	3.60
5	MD83	0.99	0.99	3.42
6	A319-100 std	0.01	0.03	3.68

8. Concrete Overlay of Existing Runway Pavements for Narrow Body Aircraft

The following is the FAARField pavement design calculations for overlaying the thinnest existing runway and taxiway pavement sections at Dickinson with concrete:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section PCC-with in Job 1513301-Overlay.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The structure is PCC Overlay on Flexible.
Design Life = 20 years.
A design for this section was completed on 08/12/14 at 11:44:46.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	PCC Overlay on Flex.	14.96	4,000,000	0.15	700
2	P-401/ P-403 HMA Surface	6.00	200,000	0.35	0
3	P-208 Cr Ag	12.00	20,007	0.35	0
4	Subgrade	0.00	3,253	0.40	0

Total thickness to the top of the subgrade = 32.96 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00
5	MD83	161,000	208	2.00
6	A319-100 std	141,978	104	0.00

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	5.30
2	Dual Whl-45	0.00	0.00	5.30
3	Dual Whl-75	0.00	0.00	3.60
4	Dual Whl-75	0.00	0.00	3.60
5	MD83	0.99	0.99	3.42
6	A319-100 std	0.01	0.03	3.68

9. New Bituminous "Super" Taxiway Pavement – Outer Edge Design – for Regional Aircraft

The pavement section would be used on the outer 25' of each side of the parallel taxiway while it is being used for a temporary runway. It has been designed to support 50 and 70 seat regional jets for a period of only five years, which would require FAA approval. This is not anticipated to be utilized for narrowbody (+100,000lb aircraft) and would consist of the following section:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section asph-cw5yr in Job 1513301-New.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The section does not have a design life of 20 years. This constitutes a deviation from standards and requires FAA approval.
The structure is New Flexible.
Design Life = 5 years.
A design has not been completed for this section.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	P-401/ P-403 HMA Surface	4.00	200,000	0.35	0
2	P-401/ P-403 St (flex)	4.00	400,000	0.35	0
3	P-209 Cr Ag	12.00	47,078	0.35	0
4	P-154 UnCr Ag	11.52	10,787	0.35	0
5	Subgrade	0.00	3,300	0.35	0

Total thickness to the top of the subgrade = 31.52 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00

Additional Airplane Information

Subgrade CDF

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	0.00
2	Dual Whl-45	0.00	0.00	0.00
3	Dual Whl-75	0.00	0.00	0.00
4	Dual Whl-75	0.00	0.00	0.00

10. New Concrete "Super" Taxiway Pavement – Outer Edge Design – for Regional Aircraft

The pavement section would be used on the outer 25' of each side of the parallel taxiway while it is being used for a temporary runway. It has been designed to support 50 and 70 seat regional jets for a period of only five years, which would require FAA approval. This is not anticipated to be utilized for narrowbody (+100,000lb aircraft) and would consist of the following section:

FAARFIELD - Airport Pavement Design (V 1.305, 9/28/10 64-bit)

Section PCC-wo5yr in Job 1513301-New.
Working directory is C:\Program Files (x86)\FAA\FAARFIELD\

The section does not have a design life of 20 years. This constitutes a deviation from standards and requires FAA approval.
The structure is New Rigid.
Design Life = 5 years.
A design for this section was completed on 08/25/14 at 14:19:43.

Pavement Structure Information by Layer, Top First

No.	Type	Thickness in	Modulus psi	Poisson's Ratio	Strength R,psi
1	PCC Surface	9.29	4,000,000	0.15	700
2	P-304 CTB	8.00	500,000	0.20	0
3	P-209 Cr Ag	12.00	20,007	0.35	0
4	Subgrade	0.00	3,253	0.40	0

Total thickness to the top of the subgrade = 29.29 in

Airplane Information

No.	Name	Gross Wt. lbs	Annual Departures	% Annual Growth
1	Dual Whl-45	45,415	676	-10.00
2	Dual Whl-45	51,000	364	-10.00
3	Dual Whl-75	85,517	624	8.00
4	Dual Whl-75	80,500	624	5.00

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	Dual Whl-45	0.00	0.00	0.00
2	Dual Whl-45	0.00	0.00	0.00
3	Dual Whl-75	0.00	0.00	0.00
4	Dual Whl-75	0.00	0.00	0.00