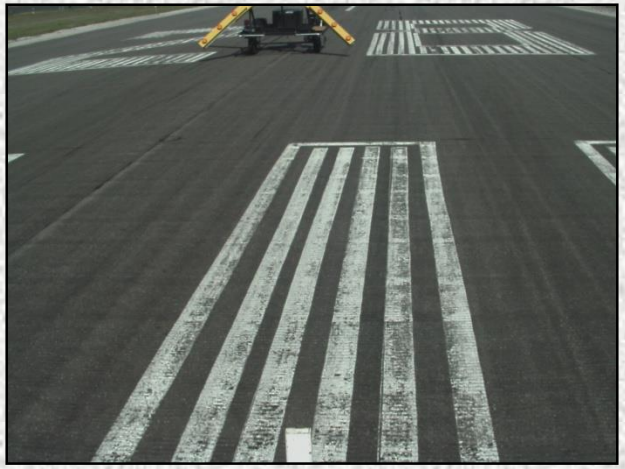
Truckee Tahoe Airport



Pavement Maintenance/Management Plan

Presentation to Truckee Tahoe Airport District

December 1, 2011

Reinard W. Brandley

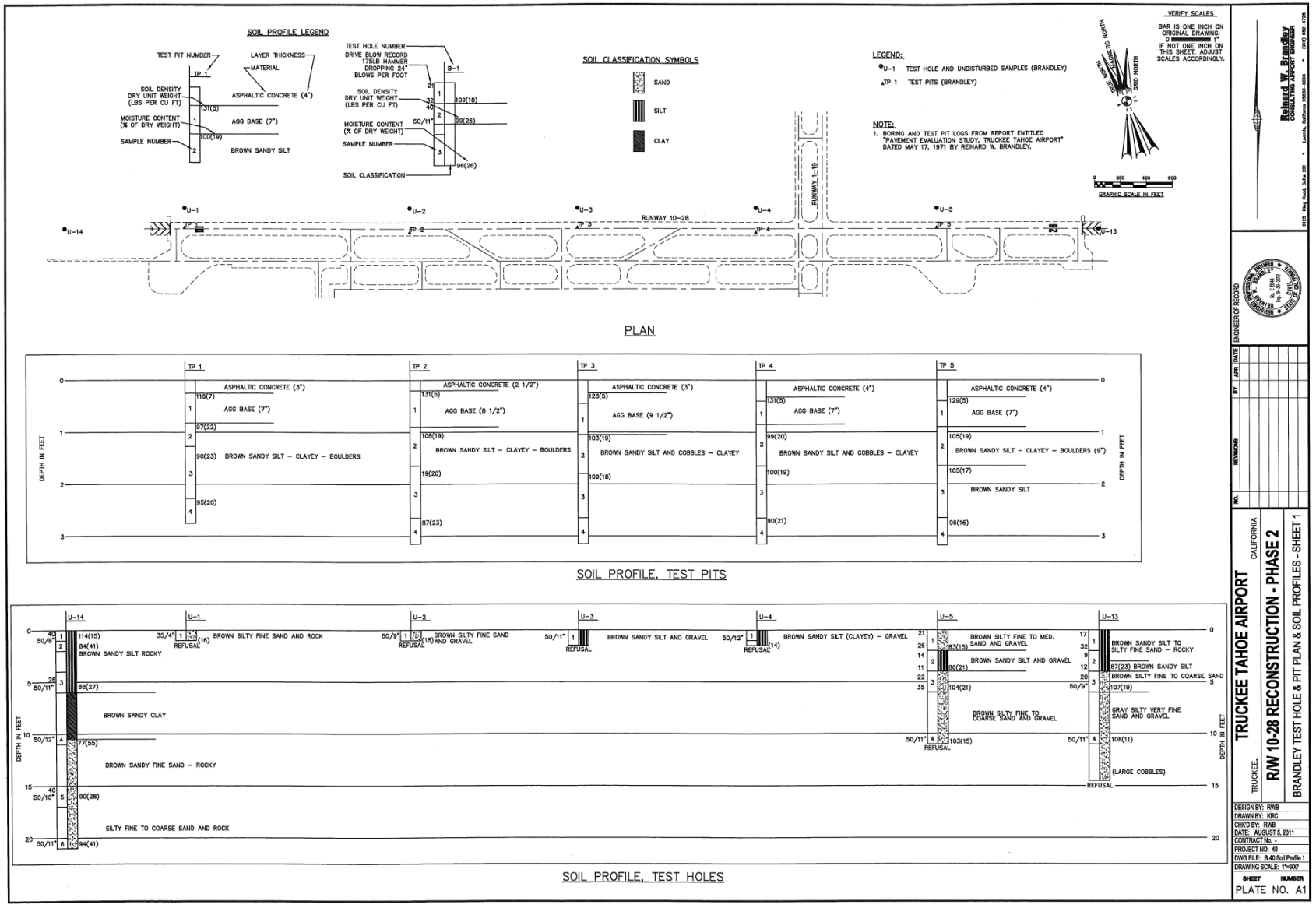
CONSULTING AIRPORT ENGINEER

6125 King Road, Suite 201

Loomis, California 95650

(916) 652-4725

Brandley Test Hole & Pit Plan and Soil Profiles



FWD Deflection Data
Runway 10-28 – North of Centerline

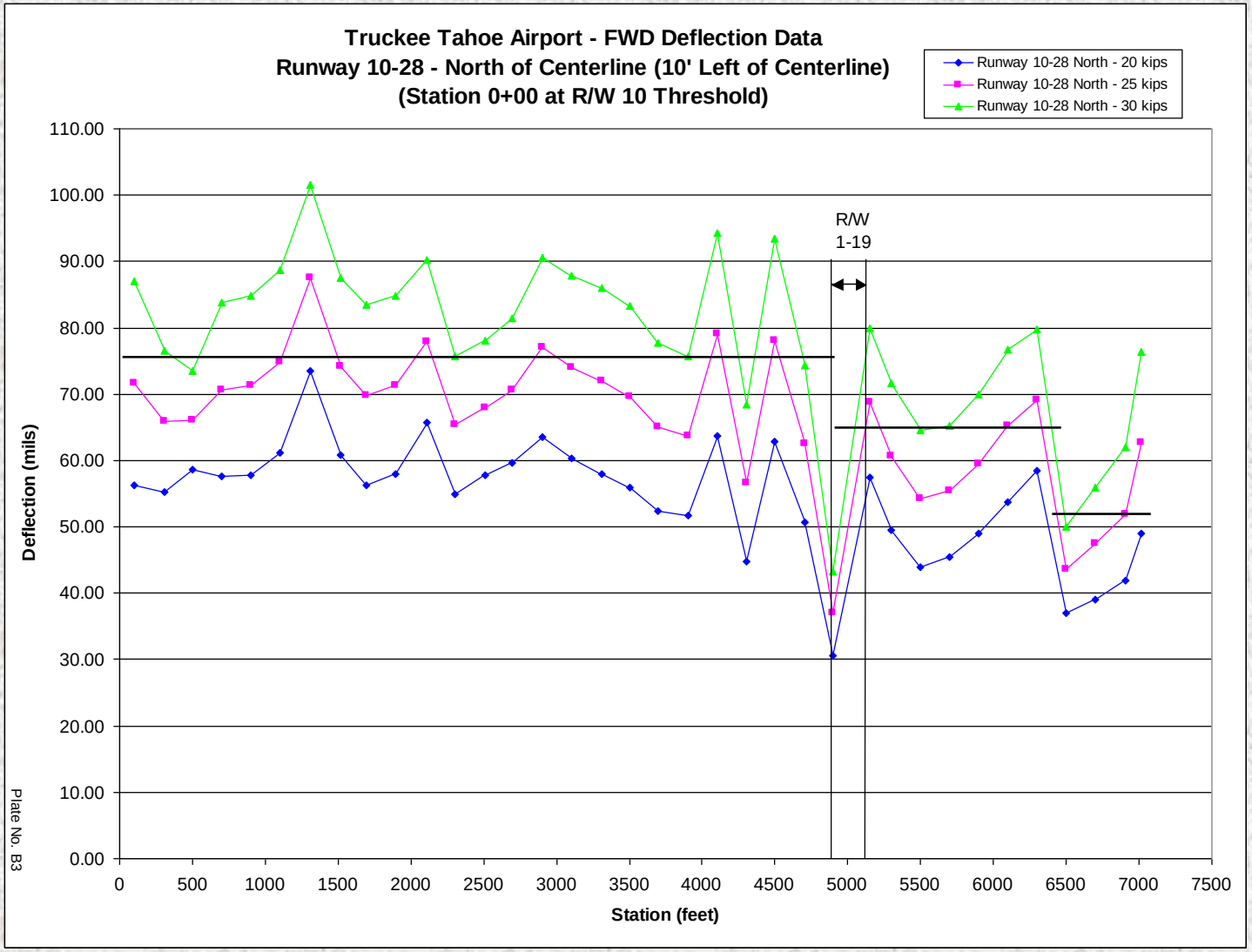


Plate No. B3

Reinard W. Brandley
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FWD Deflection Data – Runway 10-28 – South of Centerline

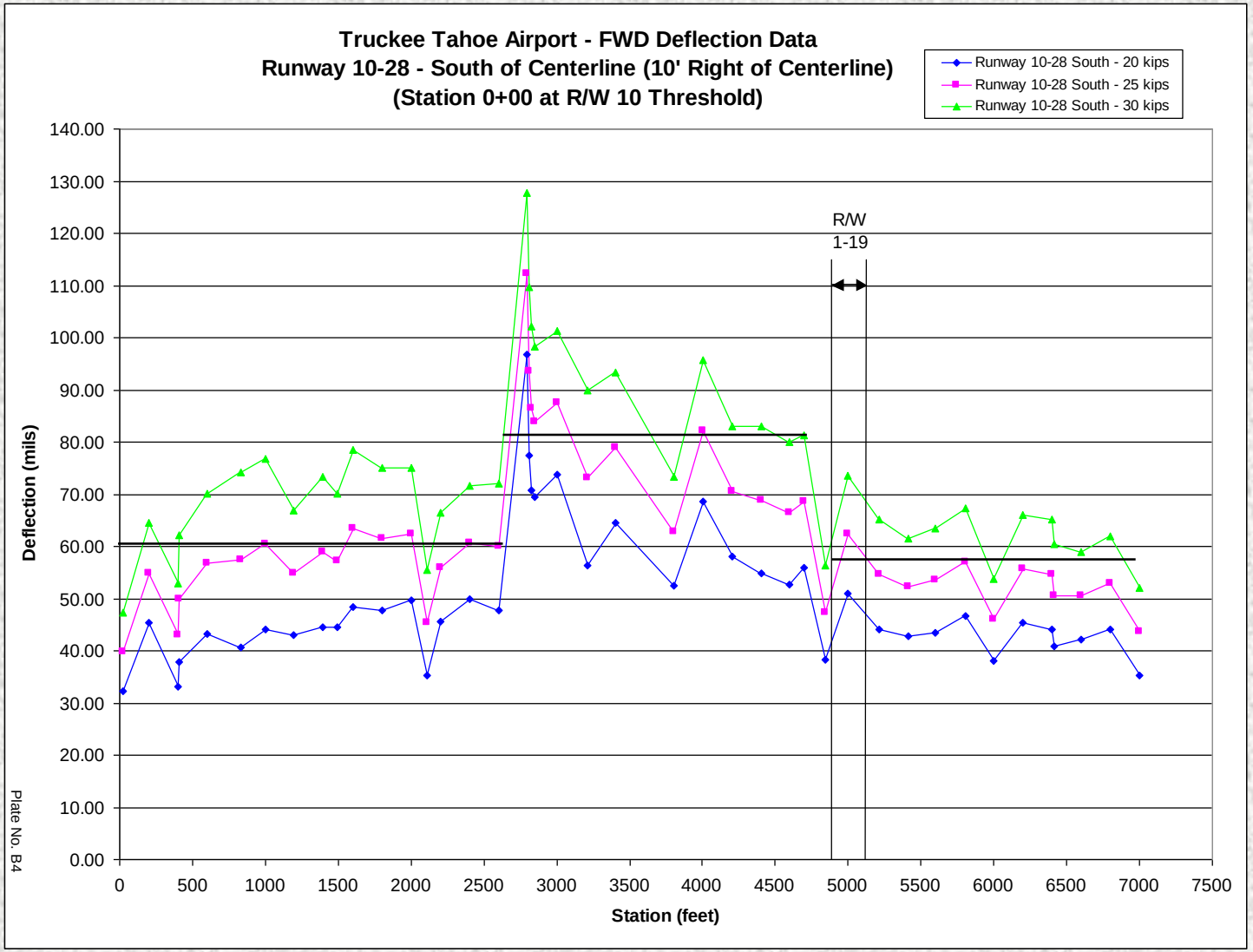


Plate No. B4

Reinard W. Brandley
CONSULTING AIRPORT ENGINEER

Pavement Condition Survey & Rehabilitation Schedule
Runway 10-28 * Station 0+00 to Station 22+00

TABLE NO. C2 - PAVEMENT CONDITION SURVEY AND REHABILITATION SCHEDULE

Airport:	Truckee-Tahoe Airport	**Date of Survey:**	May 5 & 6, 2011
Element:	Runway 10-28		
Station:	0+00 to 22+00		
Dimensions:	100' x 2200'		
FAA Pavement Strength Survey - Element Identification (Form 5335-1):	R1 Single Gear - 60 kips Dual Gear - 100 kips		

		T-inch	CBR	E ksi	μ	K pci	Remarks
Existing Pavement Section:	**PFC**						
	PCC						
	AC	4		150	0.35		
	AB	8		40	0.35		
	ASB						
	Subgrade	48		10	0.35		
	Sub-soil	S.I.		25	0.35		

Date Constructed: 1963

Rehabilitation Record:	**Date**	**Type**
	1986	

Pavement Condition: Grooved, Sealed.

Cracks - Longitudinal - Light South Side, Moderate North Side - Sealed

-Transverse - Light to Moderate - Some Secondary - Sealed

Weathering - Moderate

No Rutting, Shoving, or Ravelling

Pavement Rating = Good PCI = 60

Pavement Remaining Life Analysis	Brandley - Fatigue Analysis		FAA - FAARFIELD	
Traffic Index	A	A1	A	A1
FWD Center Plate Deflection - 25 K Load	43-88 (75)	43-88 (75)	43-88 (75)	43-88 (75)
Pavement Structure Remaining Life - Years	36	25	0.2	0.2

Recommended Rehabilitation:

Date	**Rehab. Code**	**Description**
2012	C	Add Rock, Pulverize, Recompact + 3" AC (lower hump)
2026	F, H	Saw & Seal New Joints, Fog Seal

Remarks: Station based on Sta. 0 located at Runway 10 threshold and proceeding east.

FWD used was mean value for section - See FWD Graphs, Appendix B

For Traffic Index see Appendix D. For Rehabilitation Code see Tables 3-1 & 3-3.

Reinard W. Brandley
CONSULTING AIRPORT ENGINEER

Traffic Summary

TABLE No. 2-1 - TRAFFIC SUMMARY

TABLE No. 2-1a - Traffic Group Summary

Aircraft Group	Aircraft Type	Aircraft Empty (lbs)	Aircraft 60% Fuel (lbs)	Aircraft MTOW (lbs)	Gear Configuration
1	Beech Baron	4,190	4,930	5,424	Single
2	Conquest	6,210	8,439	9,925	Single
	Citation CJ1	6,160	8,704	10,400	Single
3	Raytheon Premier I	8,600	10,940	12,500	Single
	King Air 350	10,000	13,000	15,000	Single
	Citation CJ II Bravo	9,300	12,780	15,100	Single
	Lear 31	10,250	13,400	15,500	Dual
	Raytheon Hawker 400	10,550	14,000	16,300	Single
	Citation Ultra/Encore	9,900	13,938	16,630	Single
4	Citation Excel	12,550	17,020	20,000	Single
5	Lear 45	12,050	16,940	20,200	Dual
	Citation III	13,500	18,600	22,000	Dual
	Lear 60	14,750	20,000	23,500	Dual
6	Gulfstream 150	15,100	21,700	26,100	Dual
	Raytheon Hawker 800	16,100	23,240	28,000	Dual
	Citation Sovereign	20,800	26,500	30,300	Dual
	Raytheon Hawker 1000	17,220	25,488	31,000	Dual
7	Gulfstream 200	21,200	29,390	34,850	Dual
	Citation X	21,600	30,060	35,700	Dual
	Dessault Falcon 2000	19,700	29,360	35,800	Dual
8	Challenger 300	23,800	32,020	37,500	Dual
	Raytheon Hawker 4000	23,500	33,100	39,500	Dual
	Dassault Falcon 50 EX	20,200	31,900	39,700	Dual
	Dassault Falcon 2000EX	23,190	34,596	42,200	Dual
9	Dassault Falcon 900B	22,610	36,344	45,500	Dual
	Challenger 605	26,990	39,716	48,200	Dual
	Dassault Falcon 900EX	24,700	38,860	48,300	Dual
	Legacy	30,000	41,760	49,600	Dual
10	Gulfstream III	38,000	57,020	69,700	Dual
	Gulfstream IV	43,000	61,120	73,200	Dual
11	Gulfstream V	48,300	73,920	91,000	Dual
	Bombardier Global Express	52,000	79,600	98,000	Dual

Note: 60% Fuel Weight is the weight of the aircraft with 60% of the total fuel, passengers, and payload allowable.

TABLE No. 2-1b - Summary of Traffic Data for Truckee Tahoe Airport

	Aircraft Group	Aircraft MTOW (lbs)	Gear Type	2011 Operations	Annual Growth Rate
Small to Medium Aircraft	1	5,500	Single	16,746	0.70%
	2	10,000	Single	2,618	2.27%
	3	16,000	Single	2,654	2.90%
	4	20,000	Single	464	4.40%
	5	23,000	Dual	312	4.40%
	6	30,000	Dual	192	4.40%
	7	35,700	Dual	416	4.40%
Large Aircraft	8	42,000	Dual	58	4.32%
	9	49,000	Dual	98	4.27%
	10	73,000	Dual	50	3.65%
	11	94,000	Dual	72	3.30%
Total 2011 Operations				*23,680*	

TABLE No. 2-1c - Summary of Traffic Indexes

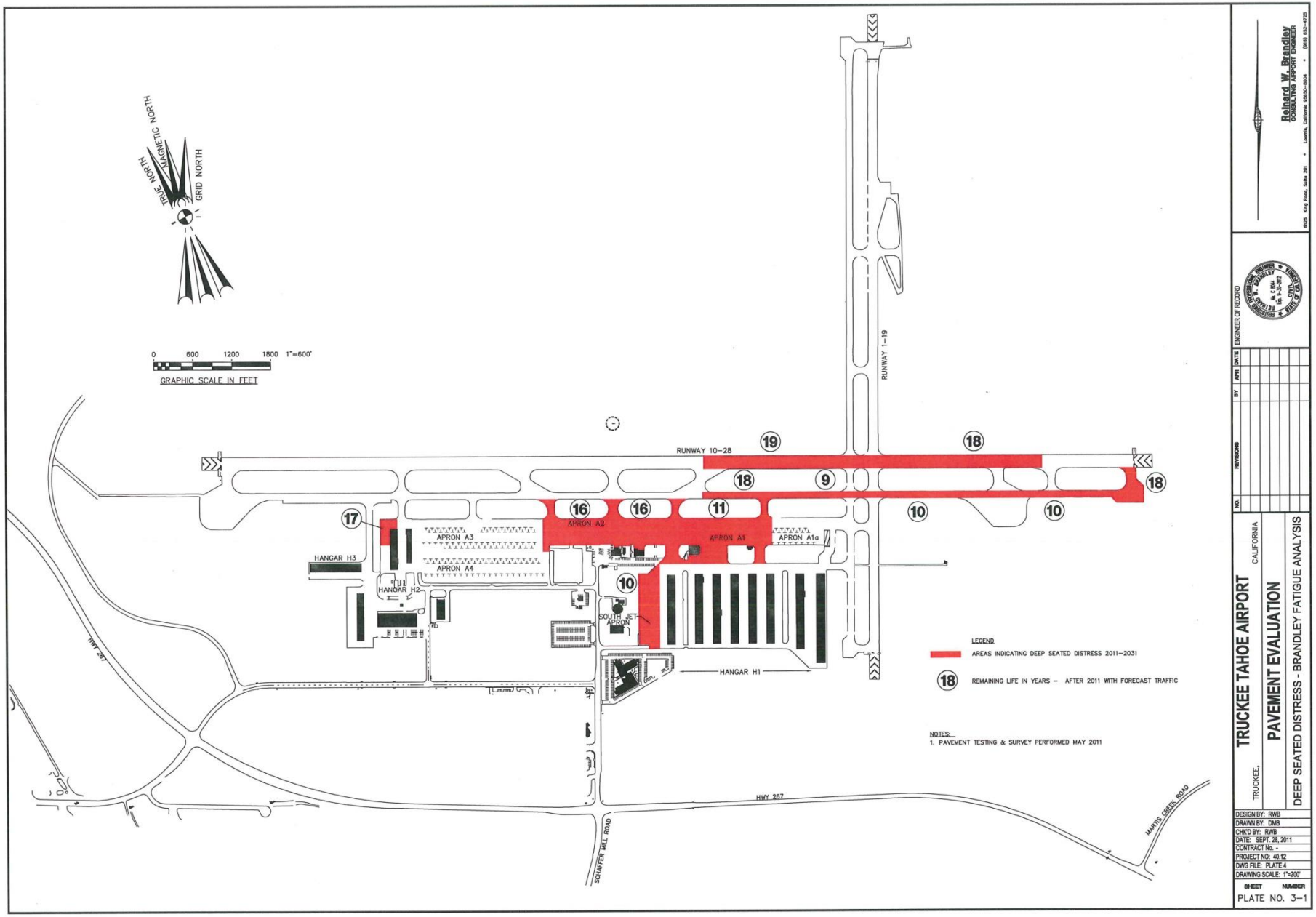
	Aircraft Group	Traffic Index (Aircraft Operations in 2011)																
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Small to Medium Aircraft	1	4,521	8,206	13,732	2,512	6,029	8,708	6,866	3,014	1,507	1,172	5,024	6,698	6,698	5,024	1,675	1,675	3,349
	2	707	1,283	2,147	393	942	1,361	1,073	471	236	183	785	1,047	1,047	785	262	262	524
	3	717	1,300	2,176	398	955	1,380	1,088	478	239	186	796	1,062	1,062	796	265	265	531
	4	125	227	380	70	167	241	190	84	42	32	139	186	186	139	46	46	93
	5	84	153	256	47	112	162	128	56	28	22	94	125	125	94	31	31	62
	6	52	94	157	29	69	100	79	35	17	13	58	77	77	58	19	19	38
	7	112	204	341	62	150	216	171	75	37	29	125	166	166	125	42	42	83
Large Aircraft	8	31	49	50	21	27	30	24	5	5	3	-	26	53	-	6	-	17
	9	53	82	85	35	45	51	40	9	9	6	-	44	89	-	10	-	29
	10	27	42	44	18	23	26	21	5	5	3	-	23	46	-	-	-	15
	11	39	60	63	26	33	37	30	6	6	4	-	32	66	-	-	-	22
Total 2011 Operations		6,468	11,700	19,431	3,611	8,552	12,312	9,710	4,238	2,131	1,653	7,021	9,486	9,615	7,021	2,356	2,340	4,763
% Use of Small/Medium Aircraft		27%	49%	82%	15%	36%	52%	41%	18%	9%	7%	30%	40%	40%	30%	10%	10%	20%
% Use of Large Aircraft		54%	84%	87%	36%	46%	52%	41%	9%	9%	6%	0%	45%	91%	0%	10%	0%	30%

TABLE No. 2-1d - Summary of Enhanced Traffic Indexes

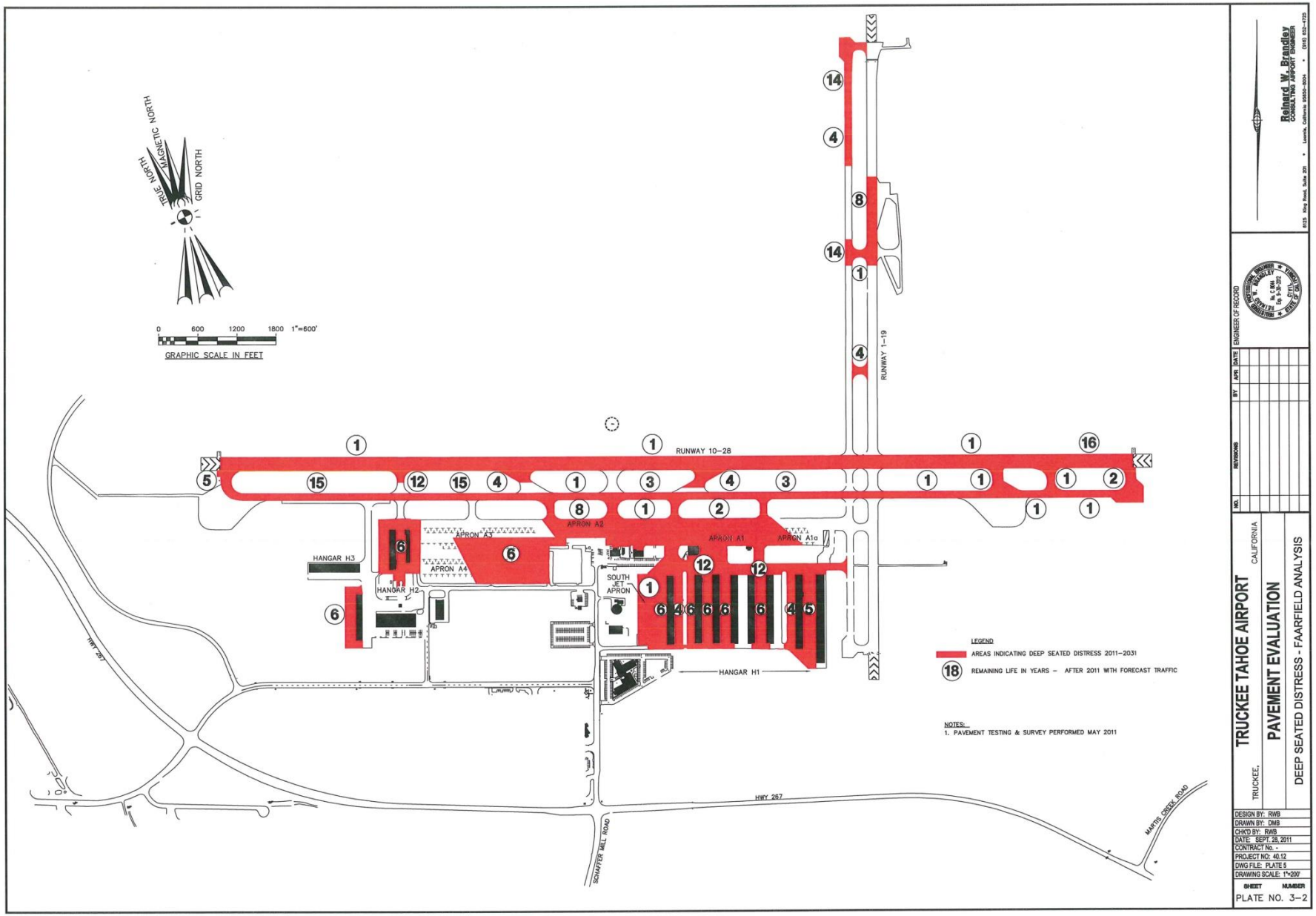
	Aircraft Group	Enhanced Traffic Index (Aircraft Operations in 2011 with Large Aircraft Operations Doubled)																
		A1	B1	C1	D1	E1	F1	G1	H1	I1	J1	K1	L1	M1	N1	O1	P1	Q1
Small to Medium Aircraft	1	4,521	8,206	13,732	2,512	6,029	8,708	6,866	3,014	1,507	1,172	5,024	6,698	6,698	5,024	1,675	1,675	3,349
	2	707	1,283	2,147	393	942	1,361	1,073	471	236	183	785	1,047	1,047	785	262	262	524
	3	717	1,300	2,176	398	955	1,380	1,088	478	239	186	796	1,062	1,062	796	265	265	531
	4	125	227	380	70	167	241	190	84	42	32	139	186	186	139	46	46	93
	5	84	153	256	47	112	162	128	56	28	22	94	125	125	94	31	31	62
	6	52	94	157	29	69	100	79	35	17	13	58	77	77	58	19	19	38
	7	112	204	341	62	150	216	171	75	37	29	125	166	166	125	42	42	83
Large Aircraft	8	62	98	100	42	54	60	48	10	10	6	-	52	106	-	12	-	34
	9	106	164	170	70	90	102	80	18	18	12	-	88	178	-	20	-	58
	10	54	84	88	36	46	52	42	10	10	6	-	46	92	-	-	-	30
	11	78	120	126	52	66	74	60	12	12	8	-	64	132	-	-	-	44
Total 2011 Operations		6,618	11,933	19,673	3,711	8,680	12,456	9,825	4,263	2,156	1,669	7,021	9,611	9,869	7,021	2,372	2,340	4,846
% Use of Small/Medium Aircraft*		27%	49%	82%	15%	36%	52%	41%	18%	9%	7%	30%	40%	40%	30%	10%	10%	20%
% Use of Large Aircraft*		54%	84%	87%	36%	46%	52%	41%	9%	9%	6%	0%	45%	91%	0%	10%	0%	30%

* - Percent use inidcates the percentage of different aircraft groups using an analyzed pavement element.

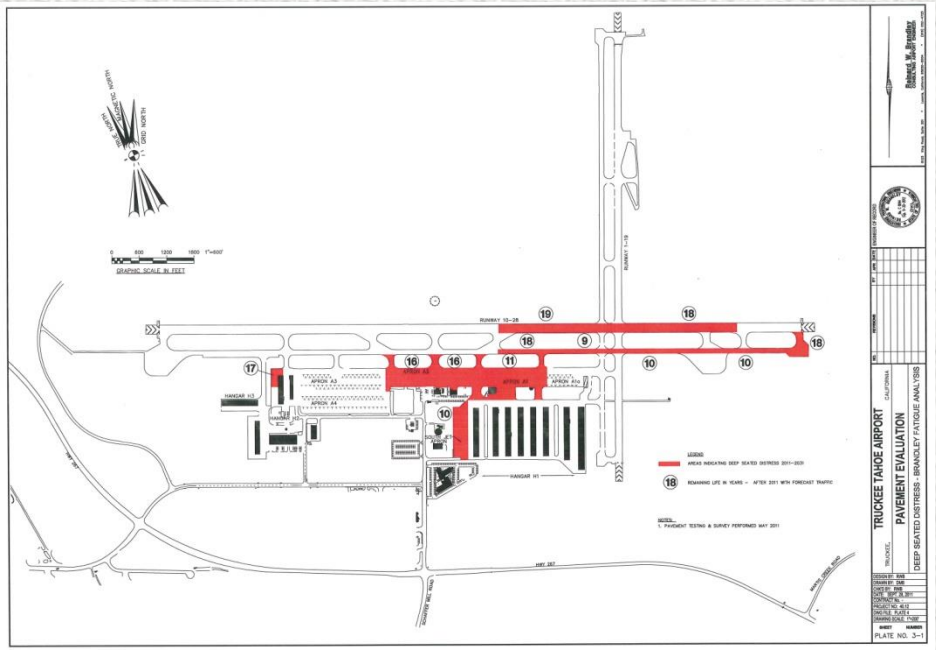
Deep-Seated Distress – Brandley Fatigue Analysis

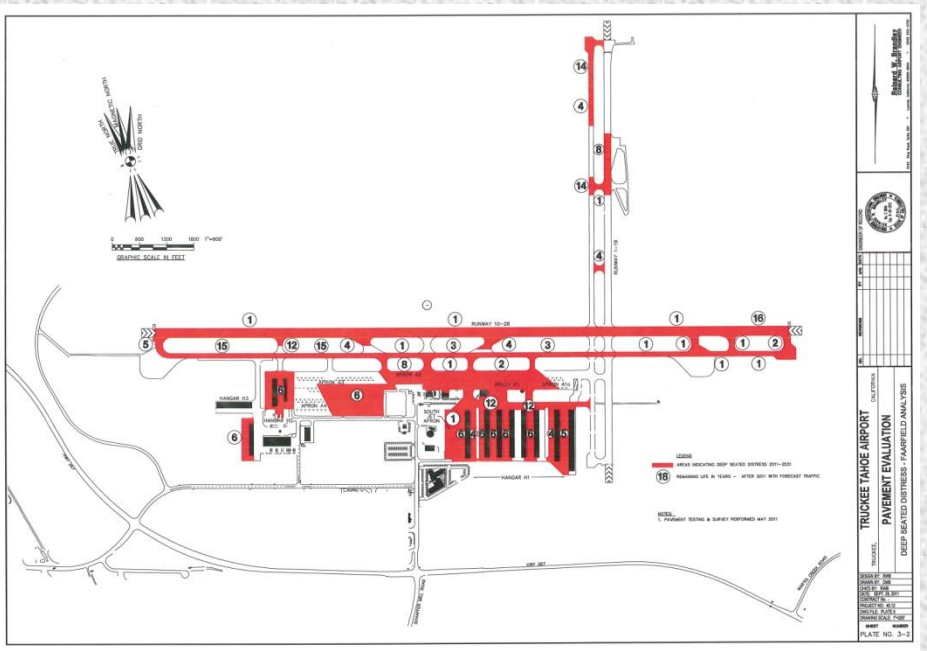


Deep-Seated Distress – FAARFIELD Analysis



Deep-Seated Distress – Brandley vs. FAARFIELD





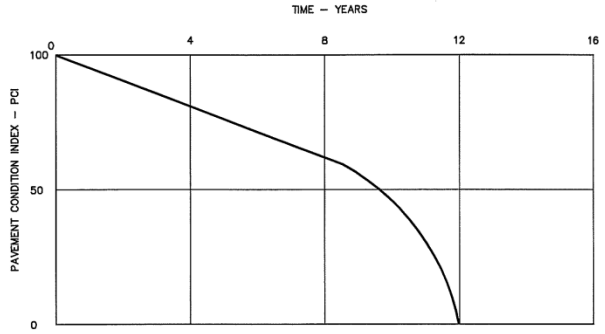
Comparative Study of Remaining Life – Brandley and FAARFIELD

Airport	Facility	Forecast Remaining Life (Years)		Actual Life*
		Brandley	FAARFIELD	
Sacramento International Airport	Runway 16L-34R	5	0.25	5.1
Stockton Metropolitan Airport	Runway 11-29	6 to 8	22	7
Nashville International Airport	New Apron Taxiway	3	0.2	3
Truckee-Tahoe Airport	Runway 10-28 Station 40+00	16	1	**

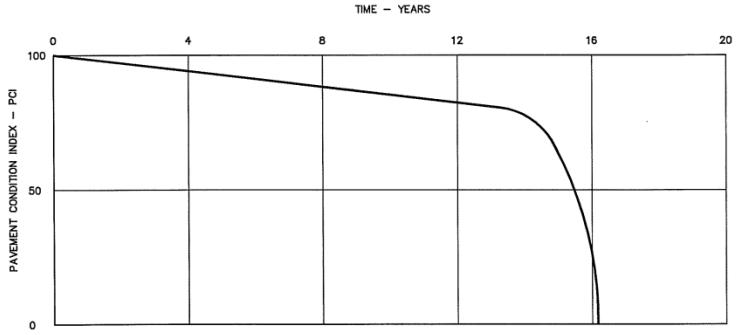
*Number of years to failure.

**This section of the runway has performed under forecast loading for the past 8 to 10 years with no sign of deep-seated distress. There is surface cracking of the asphalt pavement due to thermal stresses. According to FAARFIELD it should have failed 7 to 9 years ago.

PCI vs. Time



ASPHALT CONCRETE PAVEMENT SECTION
PCI VS. TIME - RELATIONSHIP



PORTLAND CEMENT CONCRETE PAVEMENT SECTION
PCI VS. TIME - RELATIONSHIP

PLATE NO. 3-3

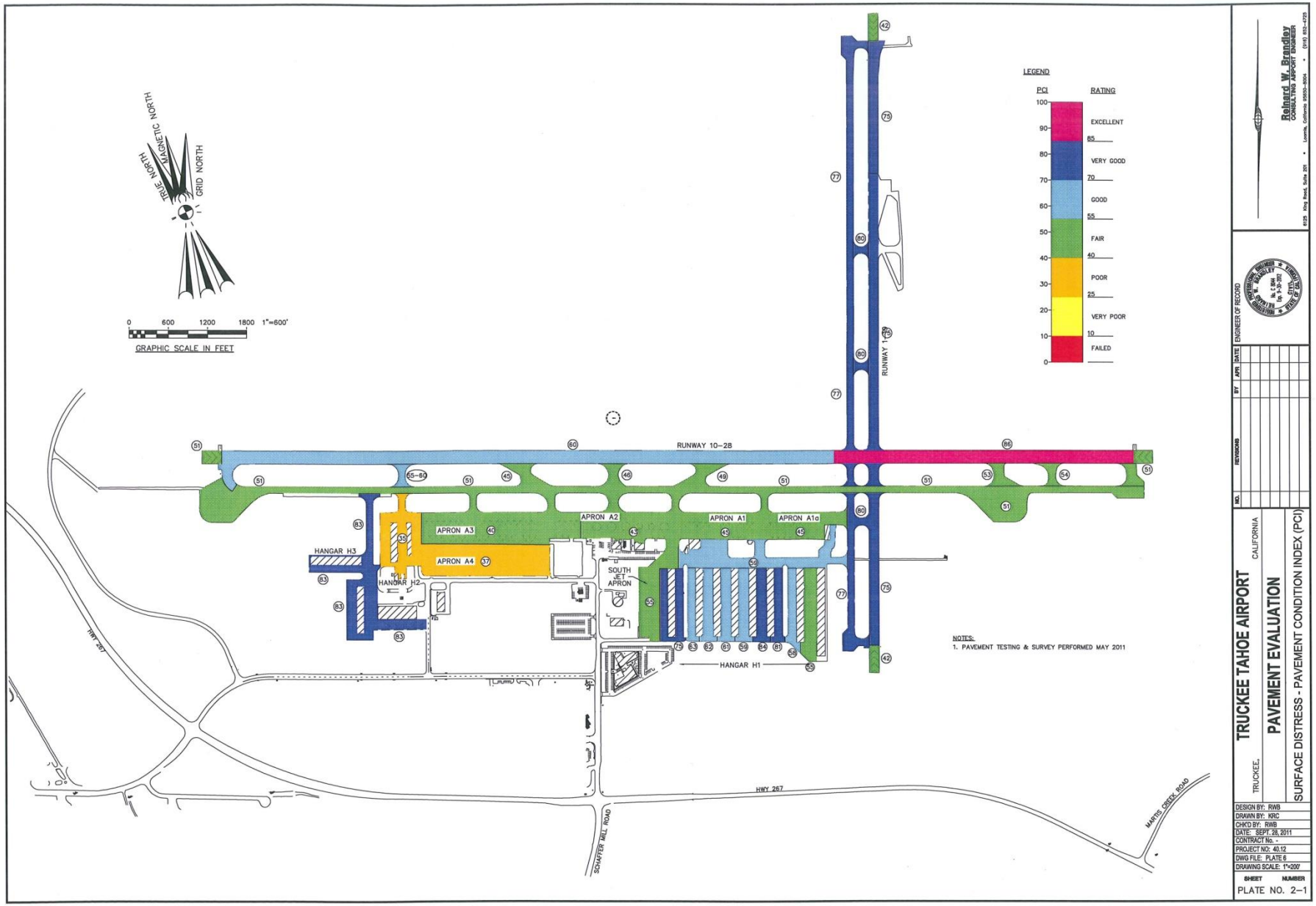
TRUCKEE TAHOE AIRPORT
TRUCKEE, CALIFORNIA
PAVEMENT EVALUATION
PCI vs. TIME

NO.	REVISIONS	BY	APP.	DATE

ENGINEER OF RECORD

Reinard W. Brandley
CONSULTING AIRPORT ENGINEER

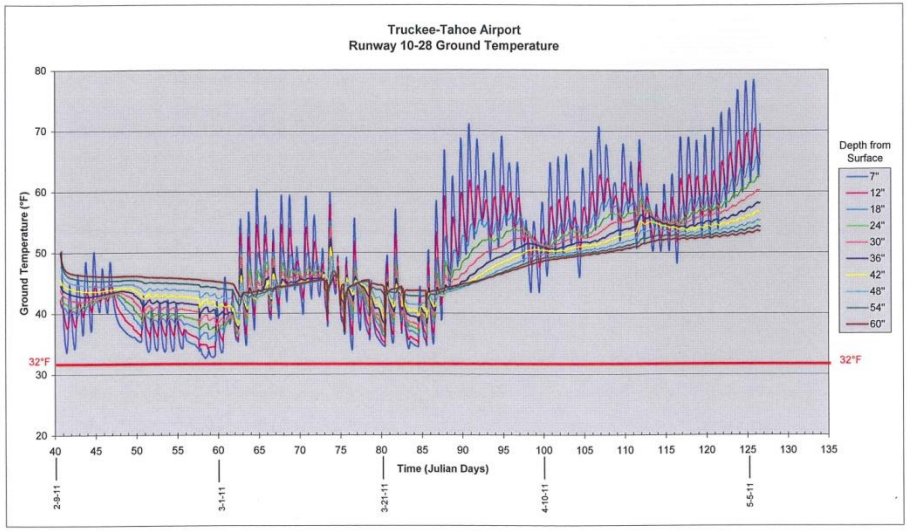
Surface Distress – Pavement Condition Index (PCI)

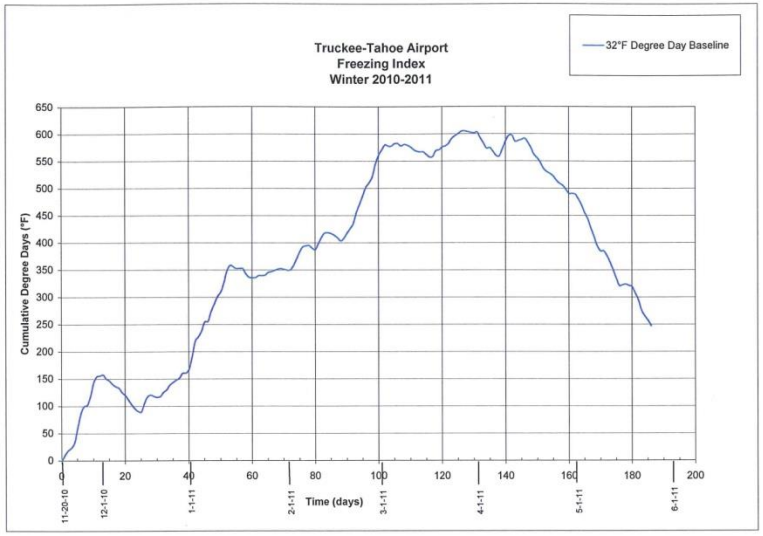


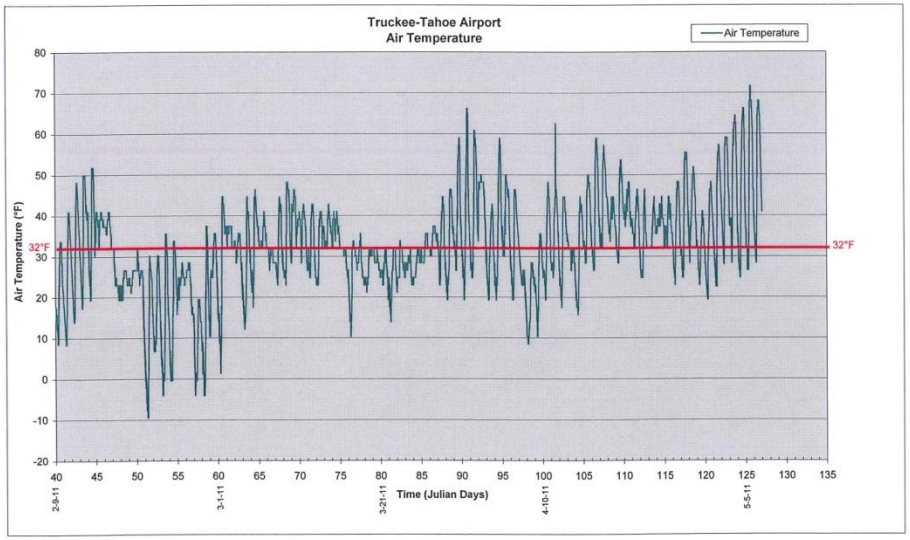
Frost Penetration Study

PLATE NO. 2-3 - FROST PENETRATION STUDY

Data Collection: February 9 -May 5, 2011







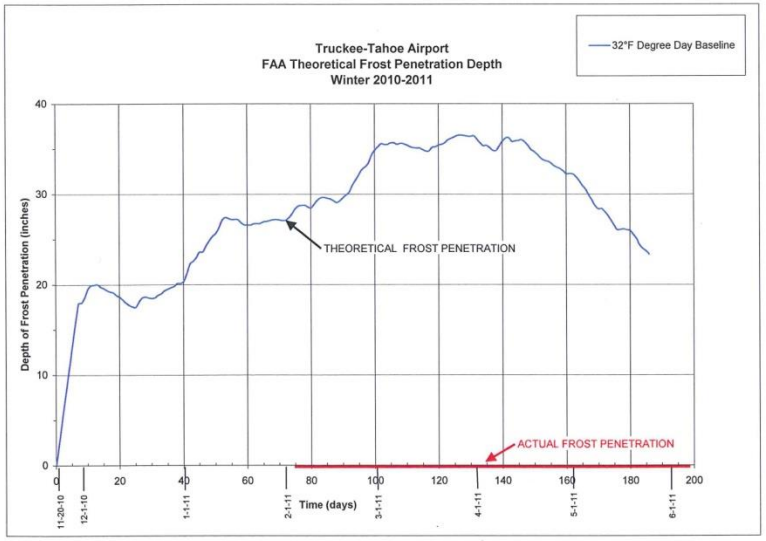


PLATE NO. 2-3
FROST PENETRATION STUDY

Rehabilitation Plan – Deep-Seated Distress

TABLE NO. 3-2

TRUCKEE TAHOE AIRPORT

REHABILITATION PLAN - DEEP-SEATED DISTRESS

Year	Element	Station	Remaining Life (Years)	Estimated Year of Failure	Recommended Rehabilitation	
					Code	Description
2012	Hangar H2, Hangars J & K		17	2028	A	Remove Existing & Reconstruct
2012	Runway 10-28	0+00 to 47+00	19-30	2029	A	Hump Removal Area - Remove and Reconstruct
		0+00 to 47+00	19-30	2029	C	Remaining Areas - Add Rock, Pulverize & Reconstruct
2026		47+00 to 70+00	18-30	2029	E	Remove 4" AC, Scar/Recomp Base, Add 4" AB, 3" AC
2020	Apron A1		11-38	2022	A	Remove Existing & Reconstruct - Includes T/W M
2025	Apron A2		16-44	2027	A	Remove Existing & Reconstruct
2020	South Jet Apron		10	2021	A	Remove Existing and Reconstruct
2024	Taxiway A, B, C, D	0+00 to 28+00	31-36	2042	B	Rehabilitate and Reconstruct - Includes T/Ws A, B, C, D
2018	Taxiway A, E, F, H, U, J	28+00 to 72+00	8-22	2019	B	Rehabilitate and Reconstruct - Includes T/Ws A, E, F, H, U, J

Pavement Rehabilitation Procedures – Deep-Seated Distress

TABLE NO. 3-1

TRUCKEE TAHOE AIRPORT

PAVEMENT REHABILITATION PROCEDURES
DEEP-SEATED DISTRESS

Code	Rehabilitation Method	
A	Pulverize and Remove Pavement Section and Reconstruct	
	New Section - ASB - Pulverized Existing AC & AB	8"
	AB - Crushed Aggregate Base (New)	4"
	AC - Asphalt Pavement (New)	3"
	Total Thickness	15"
	Cost per square foot	$5.20
B	Rehabilitate Existing Section - Option 1	
	New Section - ASB - Pulverize Existing AC & AB & Recompact	10"
	AB - Crushed Aggregate Base (New)	3"
	AC - Asphalt Pavement (New)	3"
	Total Thickness	16"
	Cost per square foot	$4.05
C	Rehabilitate Existing Section - Option 2	
	New Section - Place 2" Crushed Rock on Existing AC	12"
	Pulverize and Mix New Rock & Existing AC & AB and Recompact	
	AC - Asphalt Pavement (New)	3"
	Total Thickness	15"
	Cost per square foot	$3.75
D	Remove AC and Reconstruct	
	New Section - Remove Existing AC	
	Scarify and Recompact Existing AB	6"
	AC - Asphalt Pavement (New)	3"
	Total Thickness	9"
	Cost per square foot	$3.77
E	Strengthen Existing Section	
	New Section - Remove Existing AC	
	Scarify and Recompact Existing AB	8"
	Add AB - Aggregate Base (New)	3"
	AC - Asphalt Pavement (New)	3"
	Total Thickness	14"
	Cost per square foot	$4.70

Note: Costs indicated are based on 2011 prices and do not include any costs other than the pavement section itself.

Pavement Rehabilitation Procedures – Surface Distress

TABLE NO. 3-3

TRUCKEE TAHOE AIRPORT

PAVEMENT REHABILITATION PROCEDURES
SURFACE DISTRESS

Code	Rehabilitation Method	Estimated Unit Costs
F	Saw & Seal New Joints to Control Thermal Cracking	$3.50/ln. ft.
G	Crack Repair, Seal Existing Cracks and Joints and/or Remove and Patch AC	$18/sq. ft. for 3 1/2" AC
H	New Seal Coat - Fog Seal, Reclamite, etc.	$1.25/sq. yd.
I	Mill & Fill or Hot Recycle	$2.60/sq. ft.
J	Remark Pavements	$1.00/sq. ft.

Maximum Load Limits

Element	Gear Type	Maximum Load Limit – Pounds
Runway 10-28 & Associated Taxiways	Dual Single	80 50
Runway 1-19 and Associated Taxiways	Dual Single	65 40
Aprons and Hangar Taxilanes	Dual Single	65 40

Rehabilitation Plan – Runway 10-28 Complex

TABLE NO. 4-1
TRUCKEE TAHOE AIRPORT
REHABILITATION PLAN

Required for Deep Seated Distress
Estimated - Surface Distress

Year	Element	Station	2011 PCI	2011 Remaining Life-Years	Recommended Rehabilitation Code	Recommended Rehabilitation Description	Estimated Construction Cost
RUNWAY 10-28 COMPLEX							
2012	Runway 10-28	0+00 to 47+00	50		C	Add Rock, Pulverize, Recompact + 3" AC (lower hump)	$ 2,842,000
2026					F, H	Saw & Seal New Joints, Fog Seal	$ 570,000
2015	Runway 10-28	47+00 to 70+00	80-85		F	Saw & Seal New Joints - Supplemental	$ 105,000
2016	(East Blast Pad)		(55)		D	Remove AC and Reconstruct	$ 64,000
2020					G, H	Crack Repair, Seal Cracks and Joints, Fog Seal	$ 290,000
2026					A or E	Strengthen Existing Section	$ 1,220,000
2011	T/Ws A, B, C, D	0+00 to 28+00	51		G	Crack Repair, Seal Cracks	$ 100,000
	(Holding Apron)	(T/W A)					
2014					G, H	Crack Repair, Seal Cracks, Fog Seal	$ 50,000
2019					G	Crack Repair, Seal Cracks	$ 25,000
2024					B	Rehabilitate - Reconstruct	$ 1,120,000
2036					F, H	Saw & Seal New Joints, Fog Seal	
2011	T/Ws A, E, F, H, U, J	28+00 to 72+00	51		G	Crack Repair, Seal Cracks	$ 120,000
	(Holding Apron)	(T/W A)					
2014					G, H	Crack Repair, Seal Cracks, Fog Seal	$ 75,000
2018					B	Rehabilitate - Reconstruct	$ 1,900,000
2034					F, H	Saw & Seal New Joints, Fog Seal	

Note: Pavement Maintenance Remarking Projects are not shown in this table. See Table 4-2

Maintenance and Rehabilitation Schedule – 2011-2015

TABLE NO. 4-2
TRUCKEE TAHOE AIRPORT
MAINTENANCE AND REHABILITATION SCHEDULE

Required for Deep Seated Distress
Estimated - Surface Distress

Year	Element	Station	2011 PCI	Recommended Rehabilitation Code	Recommended Rehabilitation Description	Estimated Construction Cost
2011	T/Ws A, B, C, D, E, F, H, U, J	0+00 to 72+00	51	G	Crack Repair, Seal Cracks	
	Runway 1-19 Blast Pads	All	42	G	Crack Repair, Seal Cracks & Joints	$ 363,000
	North End of East Hangars (C&D, G&H)	All	59	D	Remove AC and Reconstruct	
	Chandelle Ave	All			Rehabilitate - Reconstruct	$ 260,000
	Runway 1-19, T/W G, Apron A1, A2, A3	All		H	Reclamite Seal	$ 130,000
					2011 Total Cost	**$ 753,000**
2012	Runway 10-28	0+00 to 47+00	50	C	Add Rock, Pulverize, Recompact + 3" AC (Lower Hump)	$ 2,842,000
	T/Ws A, D, E, F, H, U, Hangar H1	Various	51	G	Crack Repair, Seal Cracks	$ 100,000
	Apron A2 (50% of Apron)	(50% of Apron)	40	I	Mill and Fill or Hot Recycle	$ 255,000
	Apron A3 and Apron A4	All	37-40	G	Crack Repair, Seal Cracks & Joints	$ 130,000
	H2 - Taxiways at Hangars J & K	All	35		Rehabilitate - Reconstruct	$ 733,000
	H3 - Taxilanes and Warehouse Area	All	83	F	Saw & Seal New Joints - Supplemental	$ 115,000
					2012 Total Cost	**$ 4,175,000**
2013	Apron A1 (30% of Apron)	(30% of Apron)	45	I	Mill and Fill or Hot Recycle	$ 200,000
	Apron A2 (50% of Apron)	(50% of Apron)	40	I	Mill and Fill or Hot Recycle	$ 255,000
	South Jet Apron	All	55	G	Crack Repair, Seal Cracks	$ 40,000
	H1 - Rows d, e, f, and g	All	63-75	F	Saw & Seal New Joints - Supplemental	$ 45,000
	All Airfield Pavements	All			Remark Airfield Pavements as Needed	$ 176,000
					2013 Total Cost	**$ 716,000**
2014	T/Ws A, B, C, D	0+00 to 28+00	51	G, H	Crack Repair, Seal Cracks, Fog Seal	$ 50,000
	T/Ws A, E, F, H, U, J	28+00 to 72+00	51	G, H	Crack Repair, Seal Cracks, Fog Seal	$ 75,000
	Apron A1 (70% of Apron)	(70% of Apron)	45	I	Mill and Fill or Hot Recycle	$ 460,000
					2014 Total Cost	**$ 585,000**
2015	Runway 10-28	47+00 to 70+00	80-85	F	Saw & Seal New Joints - Supplemental	$ 105,000
	T/W North End of East Hangars A-H	All	59	G	Crack Repair, Seal Cracks	$ 20,000
	H1 - Rows h, i, l, & m	All	55-61	D	Remove AC and Reconstruct	$ 675,000
	All Airfield Pavements	All			Remark Airfield Pavements as Needed	$ 345,000
					2015 Total Cost	**$ 1,145,000**

Rehabilitation Schedule – 2012-2015