ALASKA
Department of Transportation
And Public Facilities
Central Region

Evaluation of Reinforced Soil Slopes Constructed on the 2003 Kwethluk Airport Relocation Project

AIP# 3-02-0435-0101 **AKSAS Project # 53872**

March 2005

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Central Region Materials Engineer

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INTRODUCTION

A common construction practice in the Yukon-Kuskokwim Delta region of Alaska has consisted of forming embankments by placing frozen, high moisture silts with little or no controlled compaction effort other than routing construction traffic over the embankment. The embankment is then allowed to firm up through thaw and consolidation for some period of time before surfacing course is placed. Upon thawing, the fore slopes of the embankment frequently become super saturated and the slopes begin to flow. This problem is compounded if the toe of the slope intercepts open water.

The purpose of this research project is to investigate the effectiveness of using geotextiles to construct a more stable embankment that results in fewer slope failures and a reduction of longitudinal cracking, which will reduce maintenance costs and provide increased safety to the users.

This report documents the construction and performance of a runway embankment in Kwethluk Alaska, which was constructed of frozen, high moisture, fine-grained, low cohesive sandy silts, reinforced with woven geotextiles in 2003. This report also addresses the use of the Dynamic Cone Penetrometer (DCP) to measure strength gains over time in the embankment.

Kwethluk is located on the Kuskokuak Slough, which is an extension of the Kuskokwim River about 19 miles upstream from Bethel. The project relocated the Kwethluk airport about 1 mile south of the existing airport. Construction plans showing these locations are found in Appendix A.

REINFORCED SOIL SLOPES

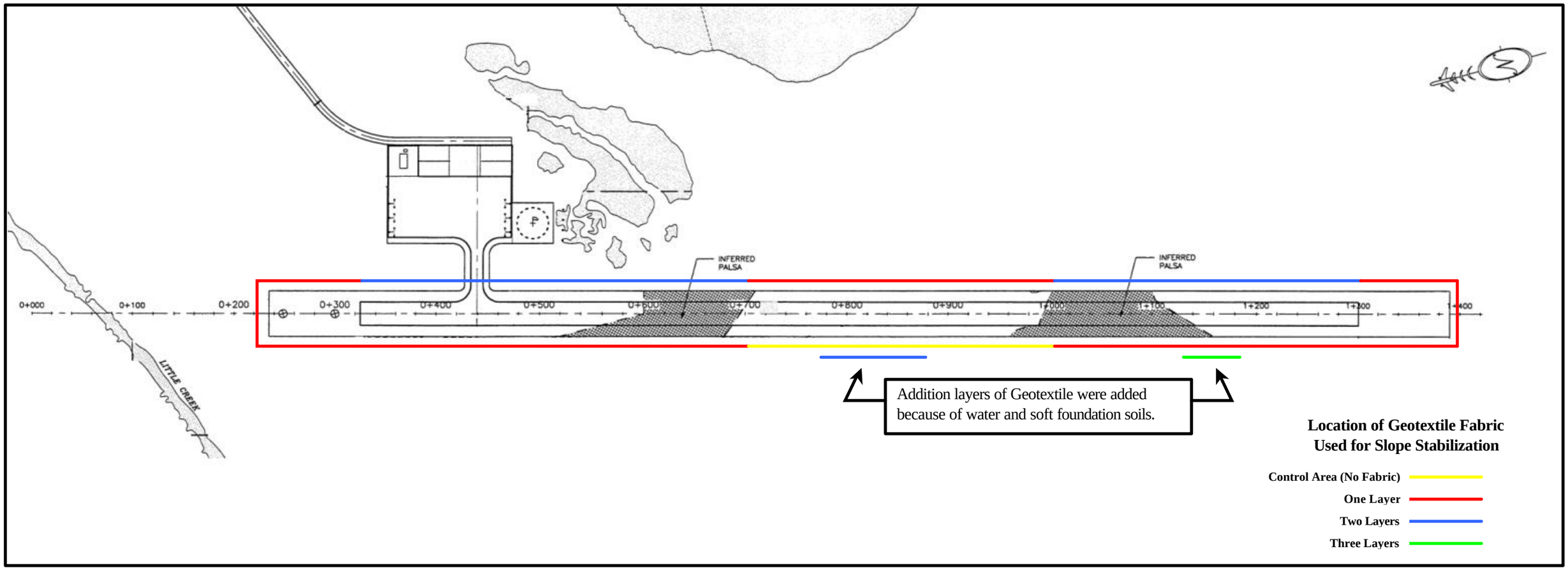
The reinforced slopes were constructed by placing horizontal layers of woven geotextiles in the fore slope of the runway embankment. There are three primary reasons for using geotextiles as reinforcement in the runway embankment.

1. Decrease the tendency for surface sloughing and slope erosion during periods of saturation.
2. Provide improved compaction at the edges of the slope.
3. Lower the likelihood of long-term stability problems developing in slopes constructed with marginal materials, which include fine-grained low cohesive sandy silts.

Four different sections were constructed along the runway fore slopes:

1. Control area with no geotextiles
2. One layer of geotextiles
3. Two layers of geotextiles
4. Three layers of geotextiles

The location of each section can be found on Figure 1. See Appendix F for specifications of the fabric that was used.



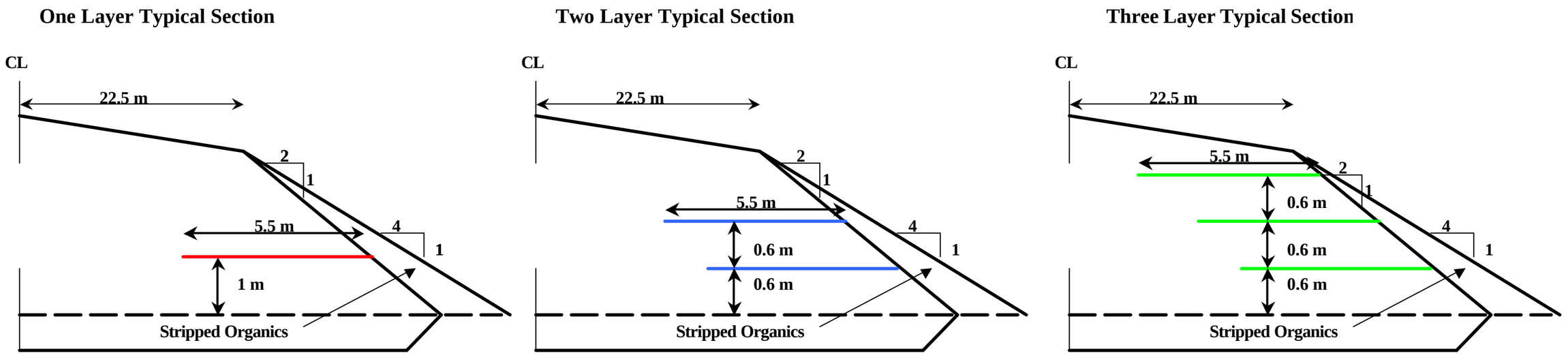
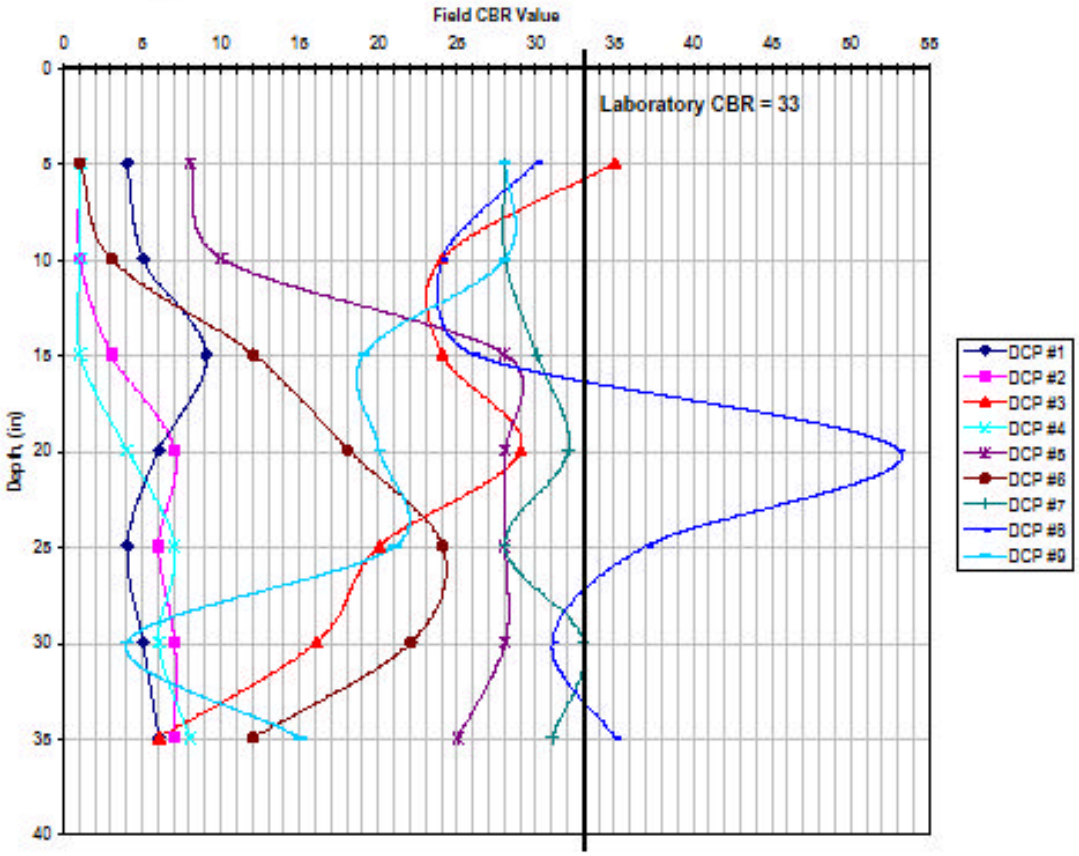


Figure 1: Layout and detail of each reinforced area used at Kwethluk Airport

DYNAMIC CONE PENETROMETER TESTING

Dynamic cone penetrometer (DCP) tests were conducted at various locations along the embankment roughly 7 months after the embankment had been placed. The DCP test data were converted to an equivalent California Bearing Ratio (CBR). The Laboratory CBR tests were performed on the sandy silt material used to construct the airport embankment. Figure 2 compares the laboratory CBR value to DCP tests taken in the runway after the surface course was placed. See Appendix B for DCP data and test locations.

Figure 2: Field and Laboratory CBR Values



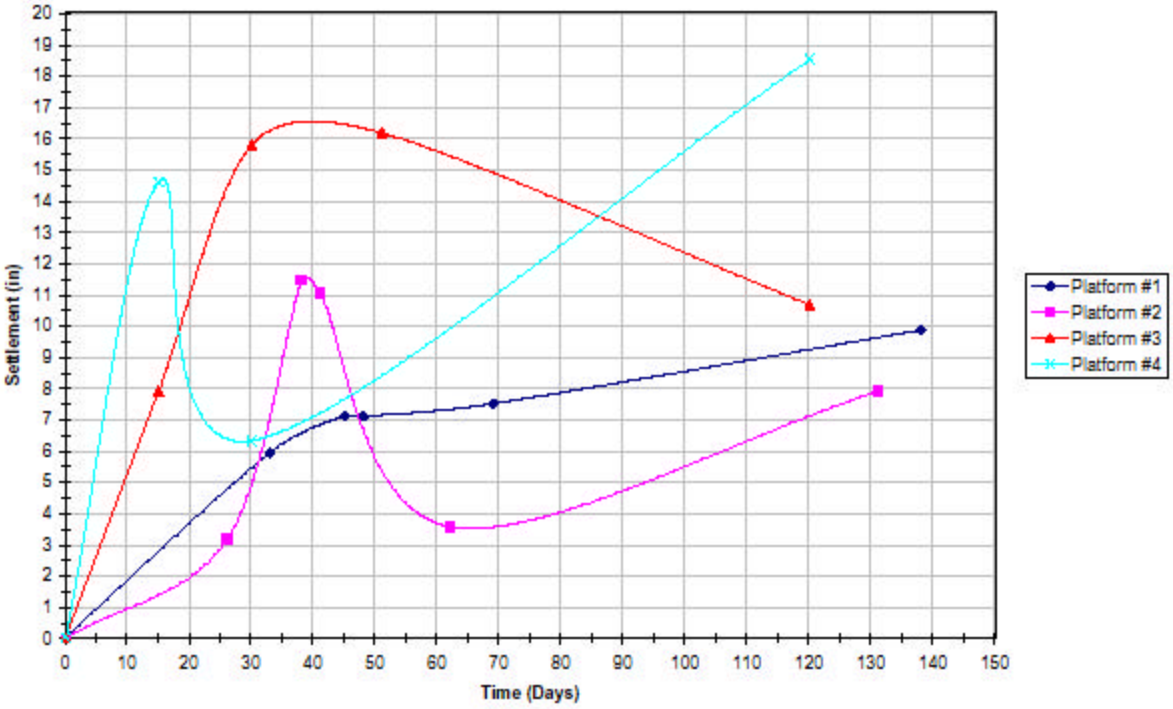
In Figure 2, the first 10 inches below ground surface is surfacing course material. The DCP data demonstrates that once thawed, the embankment is well below its potential density. There appears to be some strength gain from the top of the embankment at 10" depth to about 25" in depth. Deeper than 25", the embankment appears to loose strength.

The laboratory CBR test samples were prepared with moisture content of 12.5%. The in-place moisture content of the embankment ranged from 8% to 22.4% (measured within 2 feet of the ground surface) during the DCP testing.

EMBANKMENT SETTLEMENT

Settlement platforms were installed on the runway and apron. Readings were taken between January 19, 2003 and June 6, 2003. Settlement readings fluctuated during the construction phases. Total settlement ranged from 7.9 inches to 18.5 inches. See Appendix C for settlement data and platform locations. The settlement readings should be reviewed with caution due to the unexplained heave found in all readings.

Figure 3: Settlement Platform Readings



PERFORMANCE

As of this writing, all of the slopes have performed well with no sloughs reported. No distinction can be made between any of the reinforced or non-reinforced sections.

CONCLUSION

One of the benefits of using reinforcement on the fore slopes of embankments is to achieve improved compaction at the edges of the embankment, which will improve the shear strength of the material. However, the benefit in compaction on this project is difficult to quantify because of the winter construction techniques that were used.

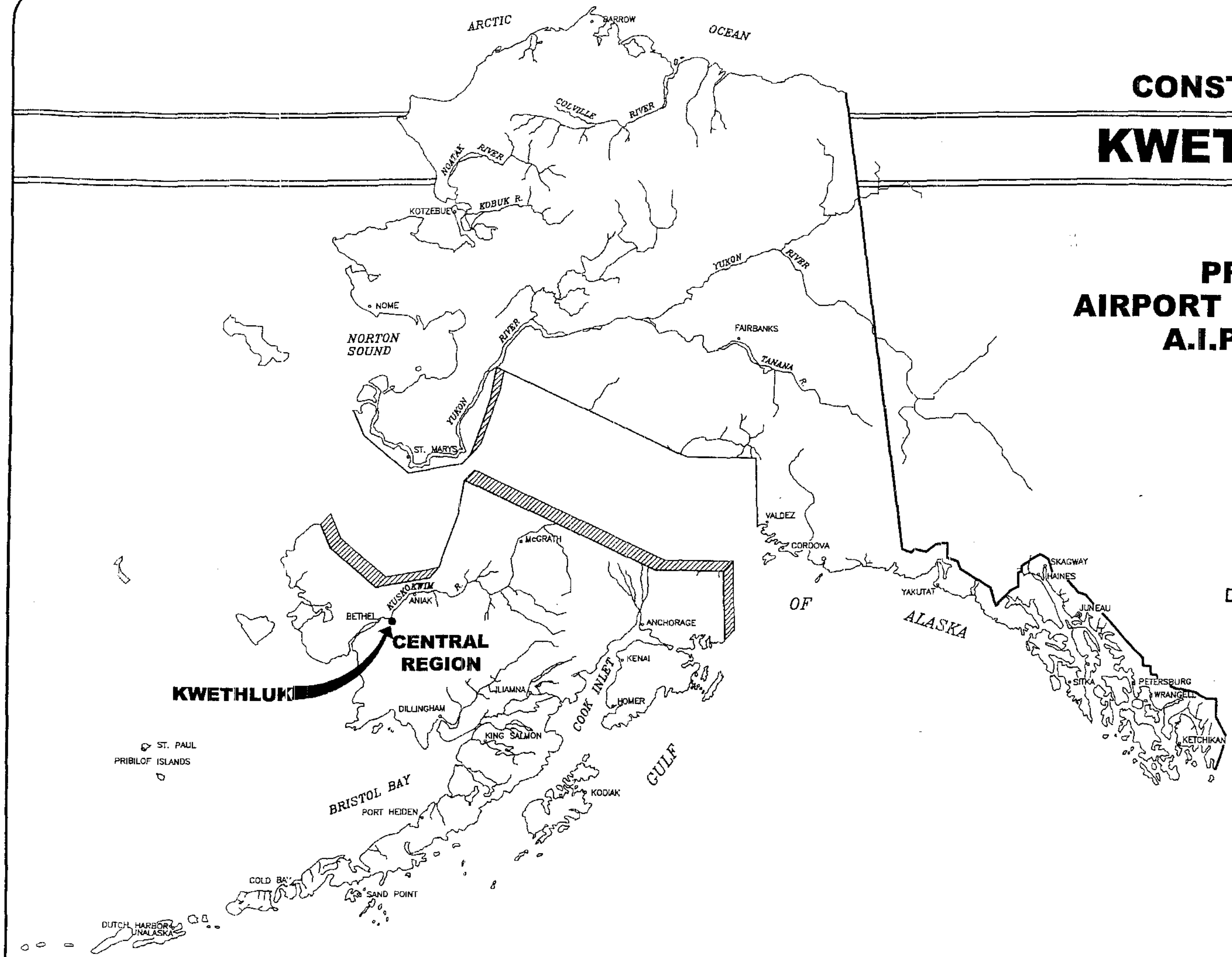
No slope failures have yet been observed in any of the four different sections of varying levels of reinforcement. The effectiveness of the reinforcement will become more apparent in the spring of 2005, the first breakup season since the airport was completed.

Observations made during construction indicate that the woven fabric that was used for the reinforcement was pooling water. In the future, it may be beneficial to use a fabric that has a higher permittivity, such as a nonwoven fabric.

We recommend that future reinforced soil slopes be designed on a project specific basis. We recommend using the FHWA publication entitled, "Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines" Publication No. FHWA-NHI-00-043, as a starting point for the design and analysis of reinforced slopes.

APPENDIX A

Kwethluk Airport Construction Plans



CONSTRUCTION PLANS FOR

KWETHLUK AIRPORT

RELOCATION
PROJECT No. 53872
AIRPORT IMPROVEMENT PROGRAM
A.I.P. No. 3-02-0435-0101
2001

METRIC

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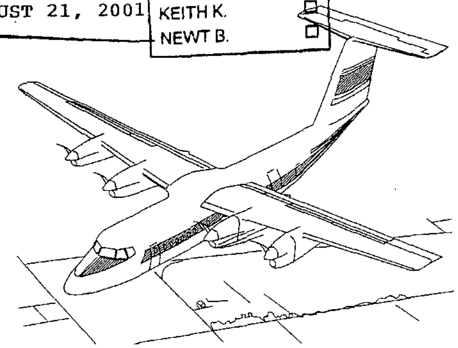
AUG 24 '01
SUZIE J ☐
DAVE S. ☐
BOB F. ☐
KEITH K. ☐
NEWT B. ☐

AS ADVERTISED
CENTRAL REGION
DATE: AUGUST 21, 2001



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CONCUR Gordon C. Keith — GORDON C. KEITH, P.E.	DATE 8/21/01 — DIRECTOR OF CONSTRUCTION AND OPERATIONS
APPROVED [signature] — STEVEN R. HORN, P.E.	DATE 8/21/01 — REGIONAL PRECONSTRUCTION ENGINEER
APPROVED [signature] — STEPHEN M. RYAN, P.E.	DATE 8/21/01 — DESIGN SECTION CHIEF
APPROVED John G. Wahl — JOHN G. WAHL, P.E.	DATE 8/21/01 — PROJECT MANAGER

KWETHLUK AIRPORT
RELOCATION
PROJECT No. 53872

SHEET 1 OF 23

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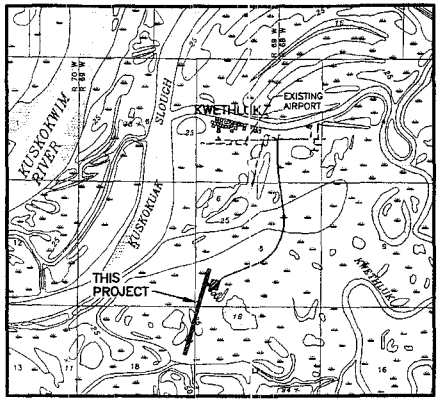

VICINITY MAP

SCALE 1:31 680

0.5 0 0.5 1 1.5 2

SCALE IN MILES

CONVERSION FACTORS FROM SI UNITS

TO CONVERT FROM	TO	MULTIPLY BY
STATION (1000 METERS)	FEET	3280.84
KILOMETER (km)	MILE	0.6214
METER (m)	MILE	0.00062137
METER (m)	FOOT	3.28084
METER (m)	U.S. SURVEY FOOT	3937/1200
MILLIMETER (mm)	FOOT	0.00328084
MILLIMETER (mm)	INCH	0.03937008
SQUARE METER (m^2)	SQUARE FOOT	10.76391042
SQUARE METER (m^2)	SQUARE YARD	1.19599
HECTARE	ACRE	2.4711
CUBIC METER (m^3)	CUBIC FOOT	35.3146667
CUBIC METER (m^3)	CUBIC YARD	1.3079506
CUBIC METER (m^3)	GALLON (US LIQUID)	264.17204
CUBIC METER (m^3)	M. GAL.	0.26417204
KILOGRAM (kg)	POUND-MASS (LBM)	2.2046225
MEGAGRAM (Mg)	TON (SHORT)	1.10231
NEWTON (n)	POUND-FORCE (LBF)	0.2248089
LUX (lx)	FOOTCANDLE	0.092903
DEGREE CELSIUS (°C)	DEGREE FAHRENHEIT (°F)	TF=(1.8 x TC)+32

ESTIMATED QUANTITIES

No.	ITEM	QUANTITY	UNIT
G-100	MOBILIZATION AND DEMOBILIZATION	ALL REQ'D	L.S.
G-130a	FIELD OFFICE	ALL REQ'D	L.S.
G-130b	FIELD LABORATORY	ALL REQ'D	L.S.
G-130d	MEAL	1000	EACH
G-130e	LODGING	300	EACH
G-131a	ENGINEERING TRANSPORTATION (TRUCK)	1	EACH
G-131b	ENGINEERING TRANSPORTATION (SNOWMACHINE)	1	EACH
G-131c	ENGINEERING TRANSPORTATION (ATV)	1	EACH
G-135a	CONSTRUCTION SURVEYING BY THE CONTRACTOR	ALL REQ'D	L.S.
G-135b	THREE PERSON SURVEY PARTY	6	HOUR
G-135c	MONUMENTS BY THE CONTRACTOR	7	EACH
G-700	TRAFFIC MAINTENANCE	ALL REQ'D	C.S.
L-100d	MEDIUM INTENSITY RUNWAY EDGE & THRESHOLD LIGHT, L-861 & L-861E	44	EACH
L-100e	TAXIWAY EDGE LIGHT, L-861T	14	EACH
L-100f	HANDHOLE, L-867, SIZE B	9	EACH
L-101b	ROTATING BEACON, MEDIUM INTENSITY, L-802A	1	EACH
L-107a	2.5 m LIGHTED WIND CONE	1	EACH
L-107c	2.5 m UNLIGHTED WIND CONE	1	EACH
L-108b	UNDERGROUND CABLE, #8 AWG, COPPER, 5kV, TYPE "C", L-824	ALL REQ'D	L.S.
L-108d	#6 BARE COPPER GROUND CONDUCTOR	ALL REQ'D	L.S.
L-108g	GROUND ROD	10	EACH
L-109c	ELECTRICAL ENCLOSURE AND FOUNDATION IN PLACE	1	EACH
L-109d	INSTALLATION OF ELECTRICAL EQUIPMENT IN NEW OR EXISTING STRUCTURE	1	EACH
L-110h	50 mm PE CONDUIT	ALL REQ'D	L.S.
P-151b	CLEARING	ALL REQ'D	L.S.
P-152a	UNCLASSIFIED EXCAVATION	43 000	m3
P-152h	BORROW EMBANKMENT (TYPE 1)	240 000	m3
P-152k	HAUL ROAD CONSTRUCTION, REMOVAL, AND RESTORATION	ALL REQ'D	L.S.
P-157a	EROSION AND POLLUTION CONTROL ADMINISTRATION	ALL REQ'D	L.S.
P-157b	EROSION AND POLLUTION CONTROL	ALL REQ'D	C.S.
P-208a	CRUSHED AGGREGATE SURFACE COURSE	11 000	m3
* P-208e	CRUSHED AGGREGATE SURFACE COURSE, STOCKPILE	100	m3
P-640b	SEGMENTED CIRCLE (PANEL TYPE)	ALL REQ'D	L.S.
P-650a	SOIL ANCHOR TIE-DOWN	6	SET

* NON-A.I.P.

INDEX

QUANTITIES (CONTINUED)

No.	ITEM	QUANTITY	UNIT
P-660b	REFLECTIVE MARKER, TYPE II	58	EACH
P-660c	REFLECTIVE MARKER, TYPE III	20	EACH
P-670a	STANDARD SIGNS	1.56	m2
P-671	RUNWAY CLOSURE MARKER	3	EACH
P-680	GEOTEXTILE FENCE, SEDIMENT CONTROL	1777	m
P-681b	GEOTEXTILE, REINFORCEMENT	83 000	m2
S-142b	EQUIPMENT STORAGE BUILDING (STEEL FLOOR)	ALL REQ'D	L.S.
S-143a	FUEL TANK (3800 L)	2	EACH
S-143b	FUEL	ALL REQ'D	L.S.
T-901b	SEEDING	120	Kg
T-905a	TOPSOILING	20 100	m2
T-908a	MULCHING	20 100	m2

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Checked By: JDW
Drawn By: DLB
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BY	DATE	REVISIONS
VLC	9-4-01	REVISED ITEMS G-130a, P-152h, P-640b, P-660b, S-142b, AND S-143a. ADD ITEMS G-700 AND P-152k.

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Walton L. Gibson
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CENTRAL REGION

KWETHLUK AIRPORT
RELOCATION
53872
AIP No. 3-02-0435-0101
QUANTITIES AND INDEX

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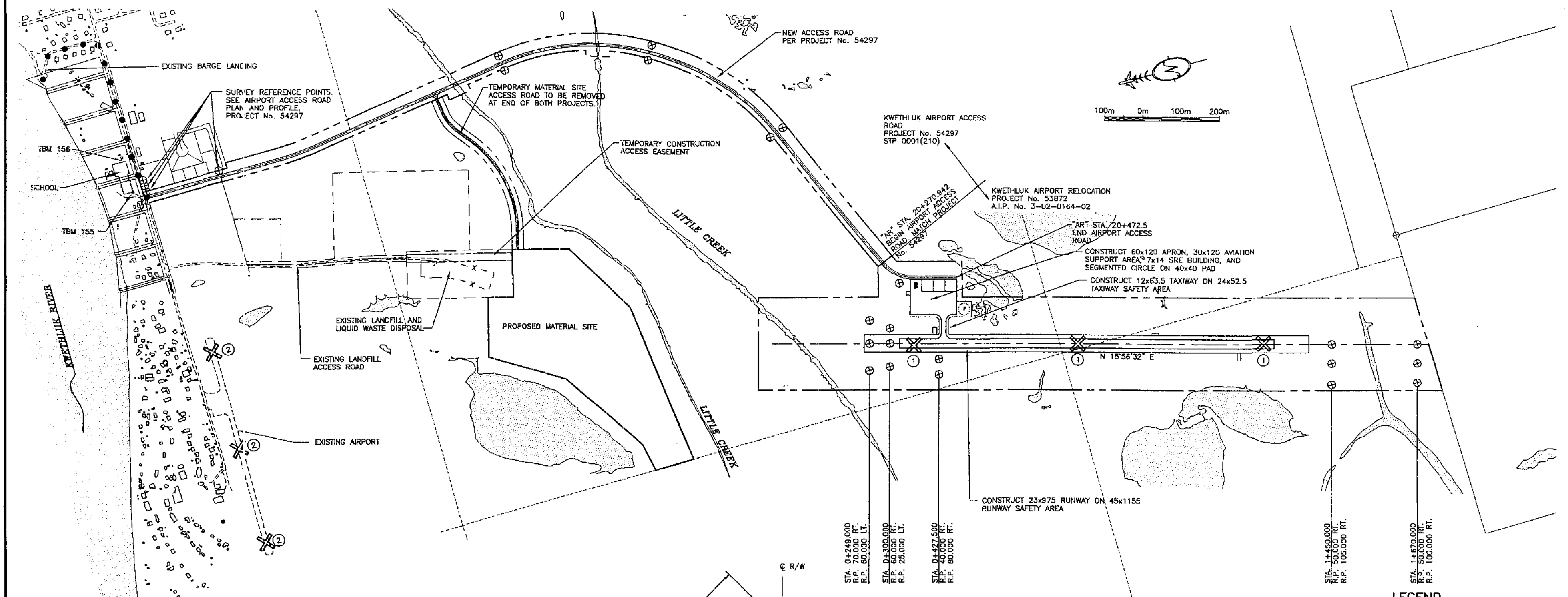


LEGEND

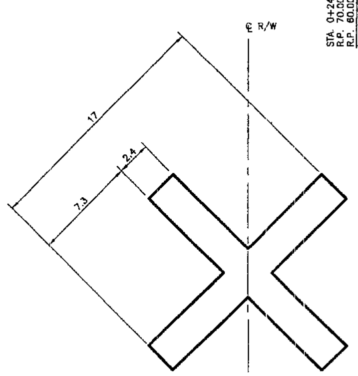
⊕ ALUMINUM CAP MONUMENT

○ REFERENCE POINT (RP), #19 REBAR

● ● ● HAUL ROUTE FOR AGGREGATE SURFACING

TBM DATA:

TBM 155 SPIKE IN SW CORNER PILING, SCHOOL BUILDING, ELEV. 7.785
TBM 156 SPIKE IN SE CORNER PILING, SCHOOL BUILDING, ELEV. 7.110
RUNWAY CENTERLINE MONUMENT, STA 0+300, ELEV. 6.425
RUNWAY CENTERLINE MONUMENT, STA 1+450, ELEV. 6.649



CLOSED RUNWAY MARKER
NO SCALE

NOTES:

1. PLACE RUNWAY CLOSURE MARKERS ON NEW SAFETY AREA AFTER COMPLETING INITIAL LIFT. RELOCATE THEM AS REQUIRED WHILE COMPLETING EMBANKMENT AND SURFACING.
2. PLACE RUNWAY CLOSURE MARKERS ON OLD RUNWAY AS SOON AS NEW AIRPORT IS OPEN.

DIMENSIONS ARE IN METERS

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Drawn By: DLB
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Victor L. Cason
No. CE-7859
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PROJECT LAYOUT AND SAFETY PLAN

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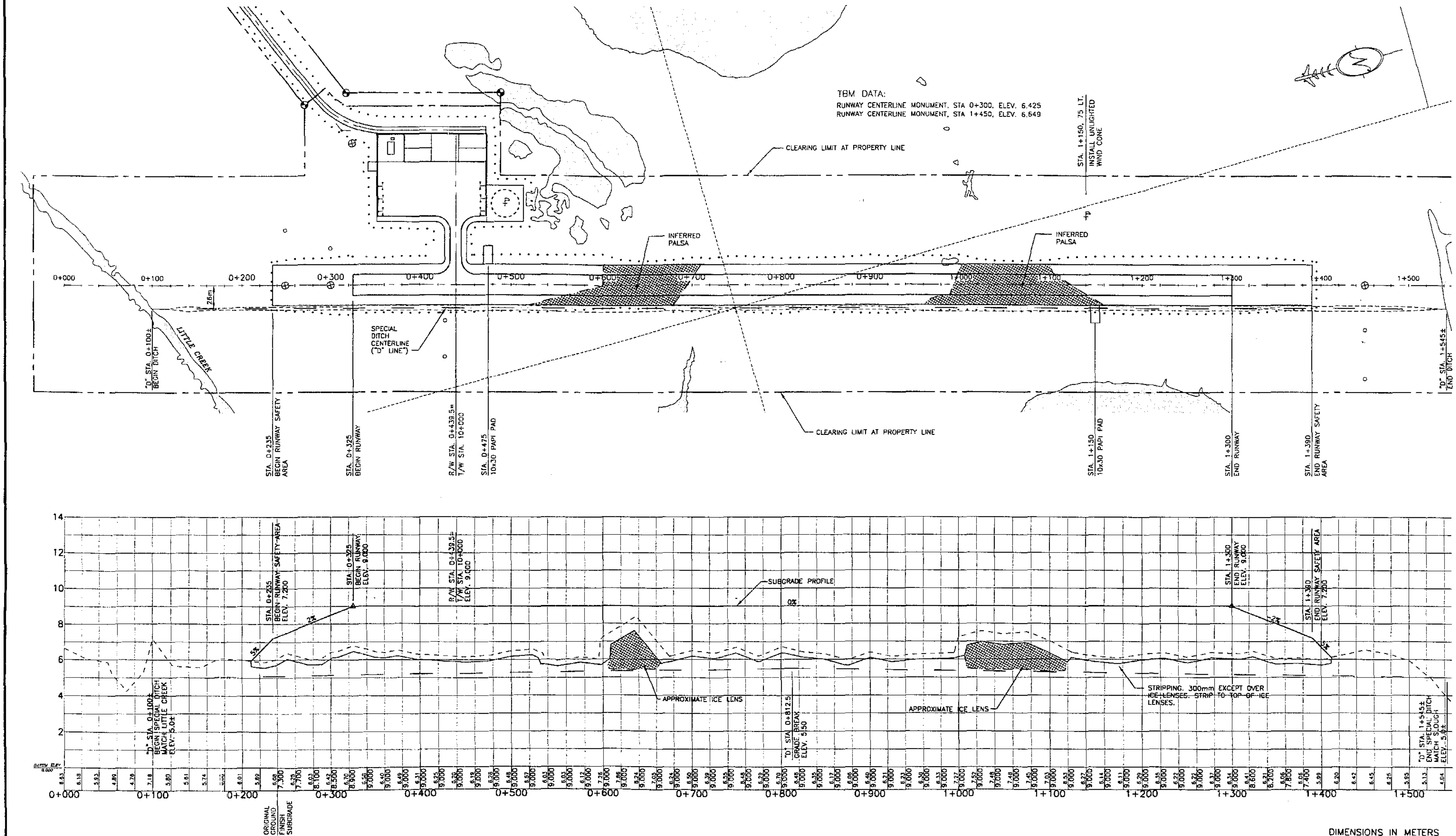

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BY	DATE	REVISIONS

STATE OF ALASKA · 49TH · Velton L. Cason · No. CE-7859 · REGISTERED PROFESSIONAL ENGINEER

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CENTRAL REGION

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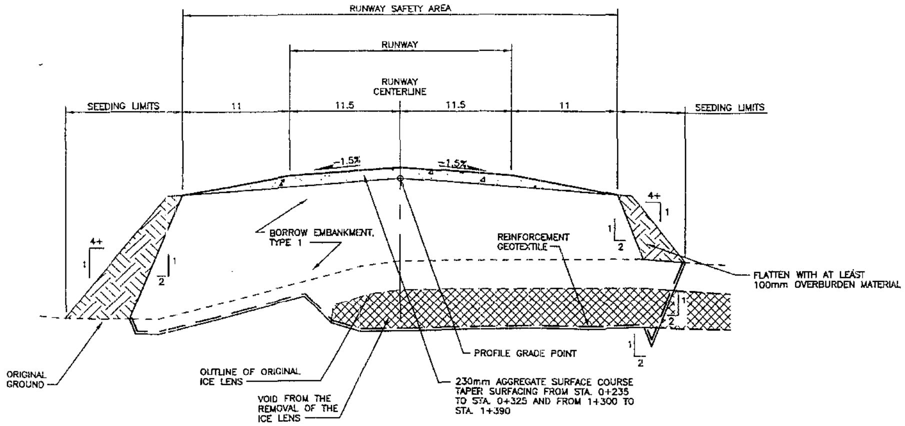
53872
AIP No. 3-02-0435-0101
RUNWAY PLAN AND PROFILE

SHEET 4 OF 23



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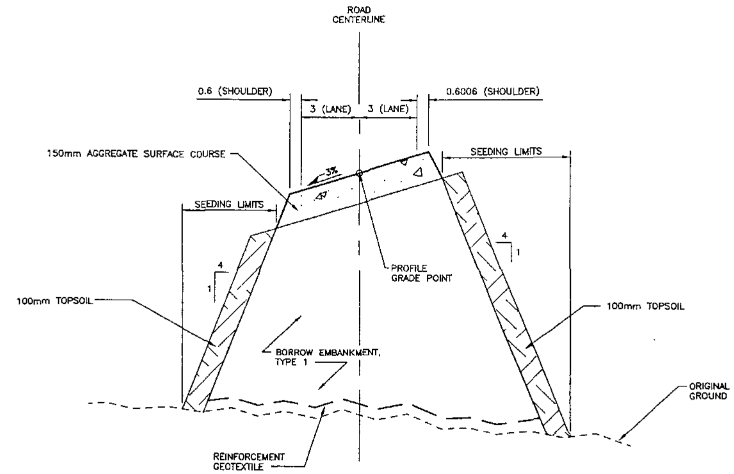

AIRPORT ACCESS ROAD TYPICAL SECTION
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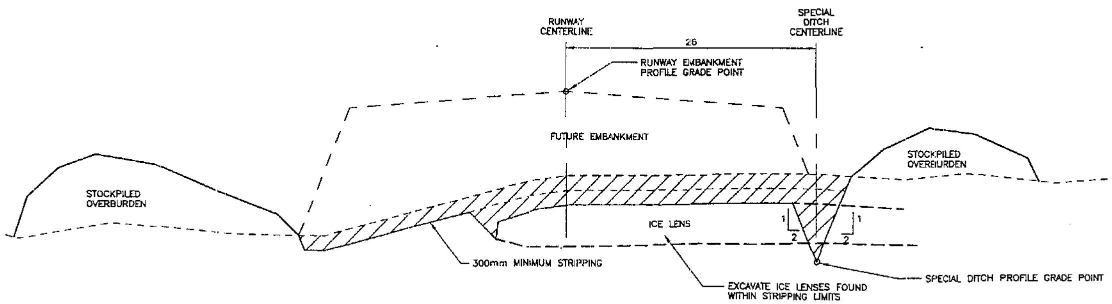

RUNWAY, TAXIWAY, AND APRON TYPICAL STRIPPING SECTION
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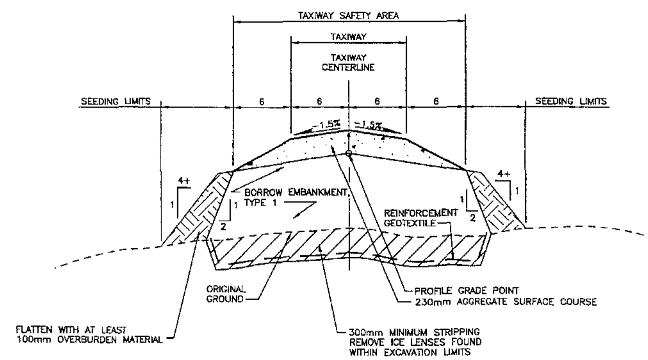
T/W STA. 10+028 TO T/W STA. 10+165



TAXIWAY TYPICAL SECTION
TAXIWAY STA. 10+011.5 TO STA. 10+063.5

DIMENSIONS IN METERS UNLESS OTHERWISE STATED

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Drawn By: DLB
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BY	DATE	REVISIONS

STATE OF ALASKA 49TH · Velton L. Cason · No. CE-7859 · REGISTERED PROFESSIONAL ENGINEER

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KWETHLUK AIRPORT
RELOCATION
53872
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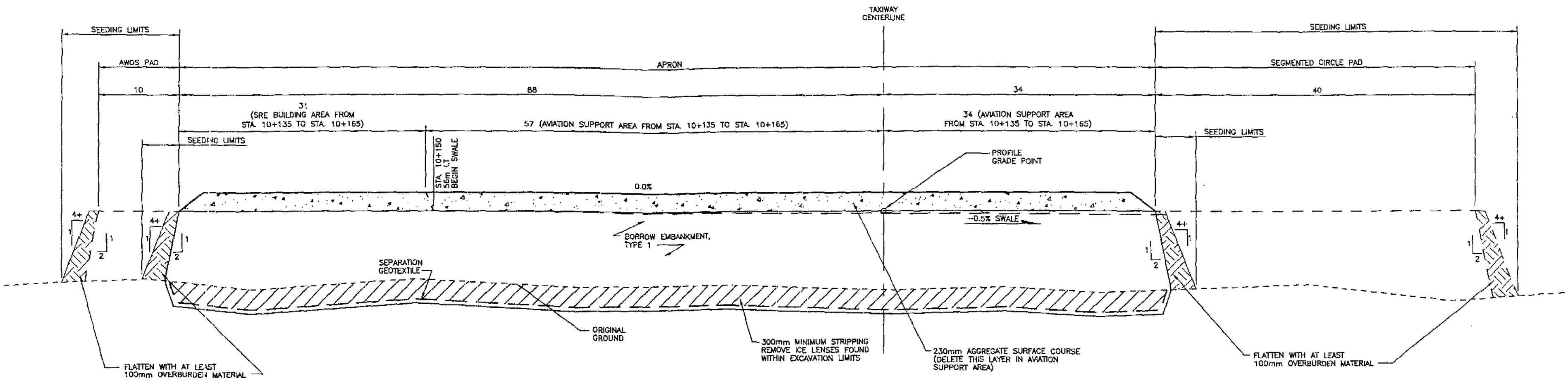
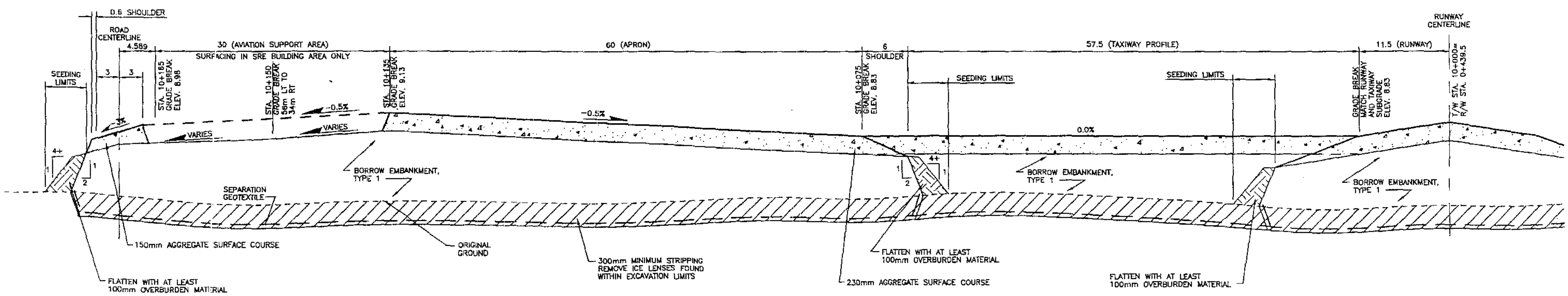
RUNWAY, TAXIWAY AND ACCESS ROAD TYPICAL SECTIONS

SHEET 8 OF 23



APRON TRANSVERSE SECTION

STA. 10+063.5 TO STA. 10+165



APRON TYPICAL SECTION & TAXIWAY PROFILE

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BY	DATE	REVISIONS

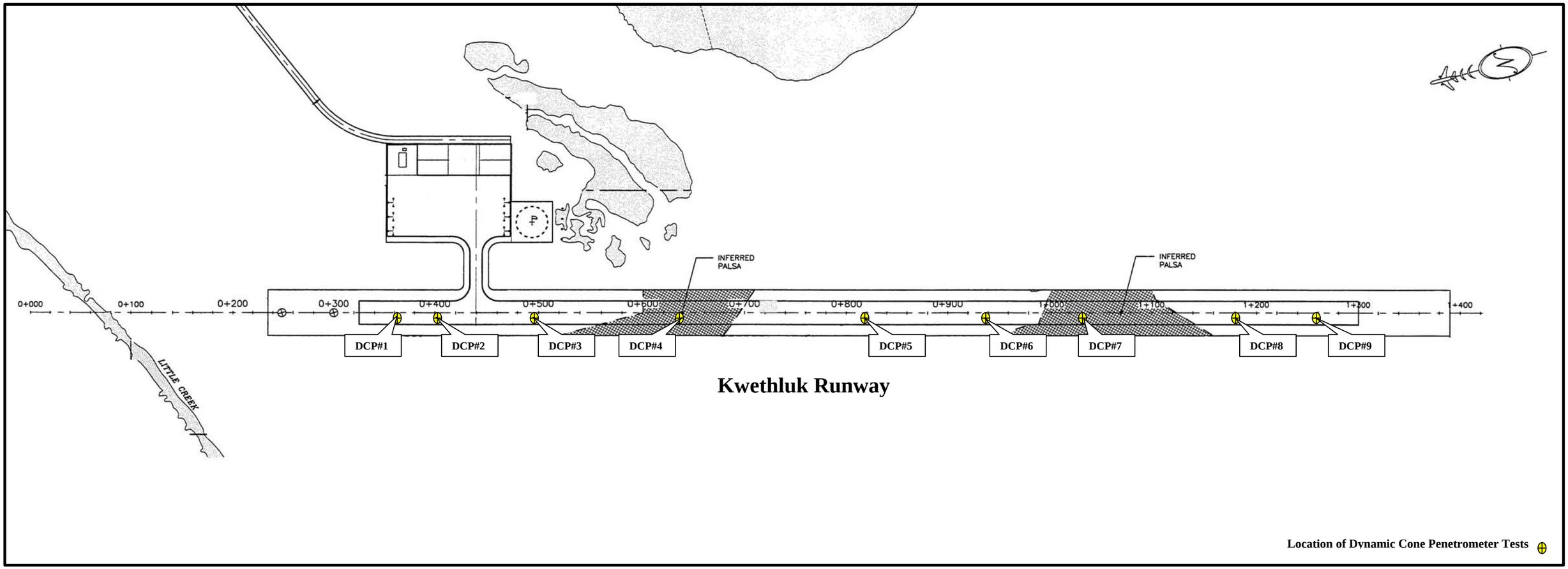
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
CENTRAL REGION

KWETHLUK AIRPORT
RELOCATION
53872
AIP No. 3-02-0435-0101
APRON
TYPICAL SECTIONS

SHEET 9 OF 23

APPENDIX B

Dynamic Cone Penetrometer Data



Kwethluk Runway

Location of Dynamic Cone Penetrometer Tests ⊕

Kwethluk Airport
Project No. 53872

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #1 Station 0+362 CL **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	78	1
1	130	1
1	175	1
1	216	1
1	256	1
1	291	1
1	323	1
1	350	1
2	395	1
2	432	1
2	488	1
2	548	1
2	641	1
2	706	1
2	774	1
2	853	1
2	915	1
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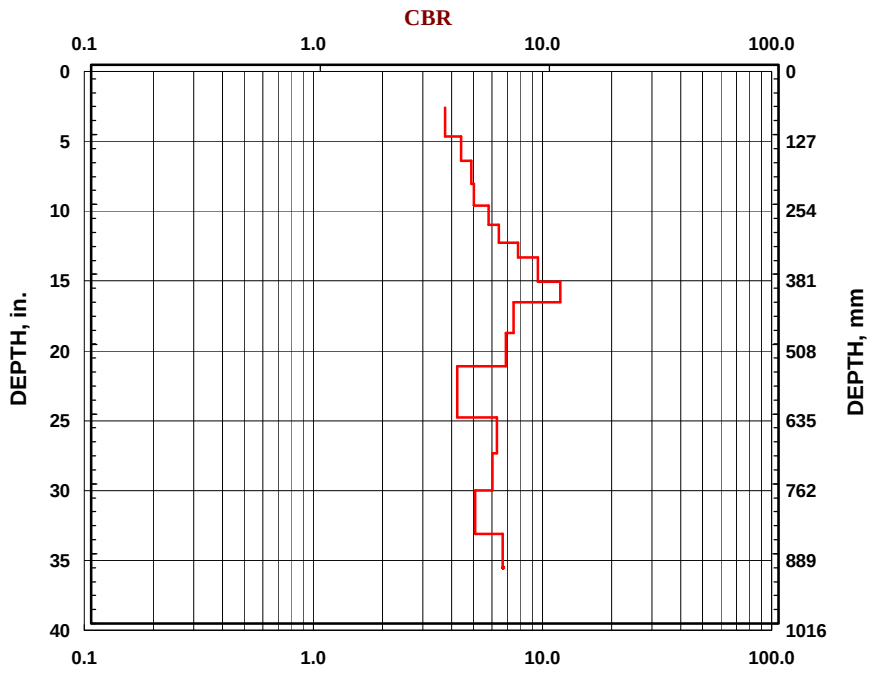

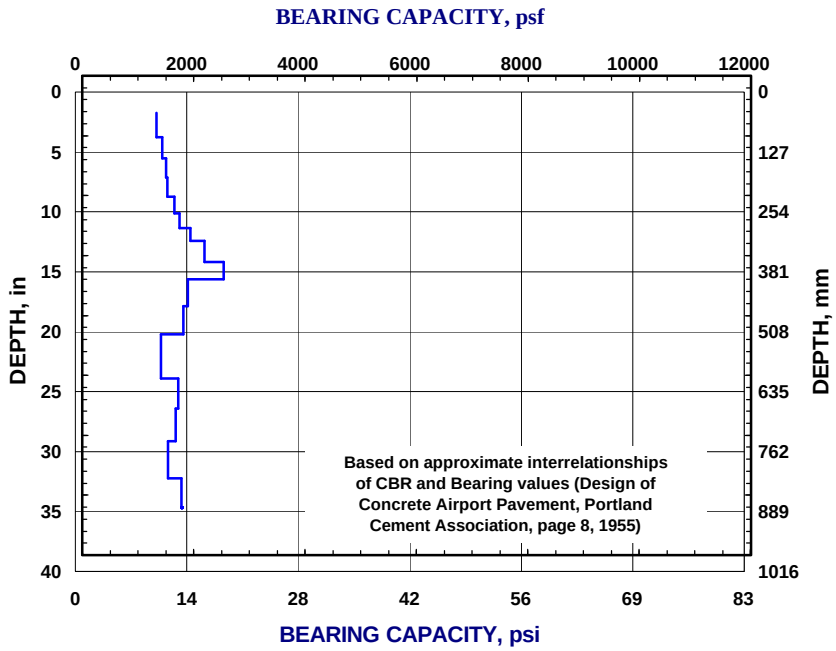

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #2 Station 0+407 CL **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	166	1
1	281	1
1	341	1
1	405	1
1	447	1
3	527	1
3	621	1
3	721	1
3	812	1
3	895	1
2	957	1
3	1108	1
3	1203	1
3	1300	1
3	1397	1
3	1564	1
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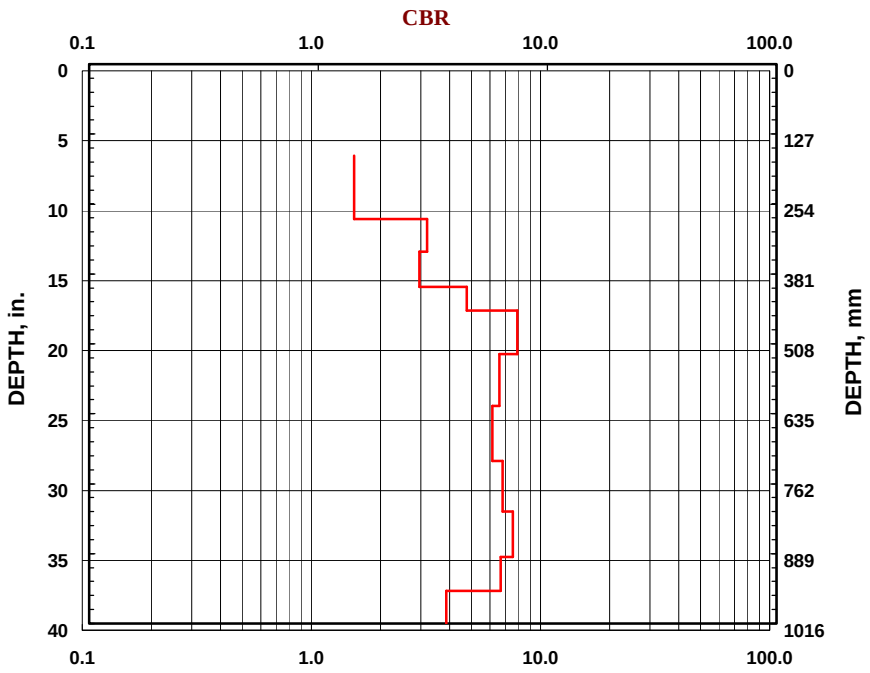

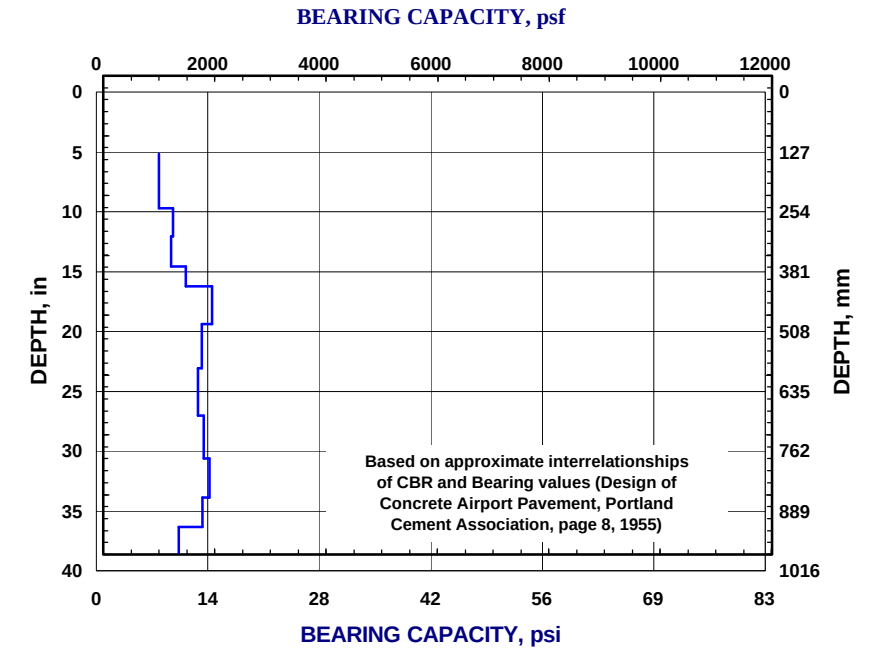

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #3 Station 0+496 CL **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	21	1
7	68	1
10	117	1
10	187	1
10	249	1
10	349	1
10	450	1
10	534	1
10	648	1
10	793	1
5	888	1
2	947	1
1	977	1
		1
		1

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #4 Station 0+656 3.7 m LT **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	87	1
1	196	1
1	222	1
1	375	1
1	485	1
1	528	1
1	572	1
1	604	1
1	636	1
1	664	1
1	685	1
1	717	1
2	786	1
2	857	1
2	908	1
2	959	1
1	982	1
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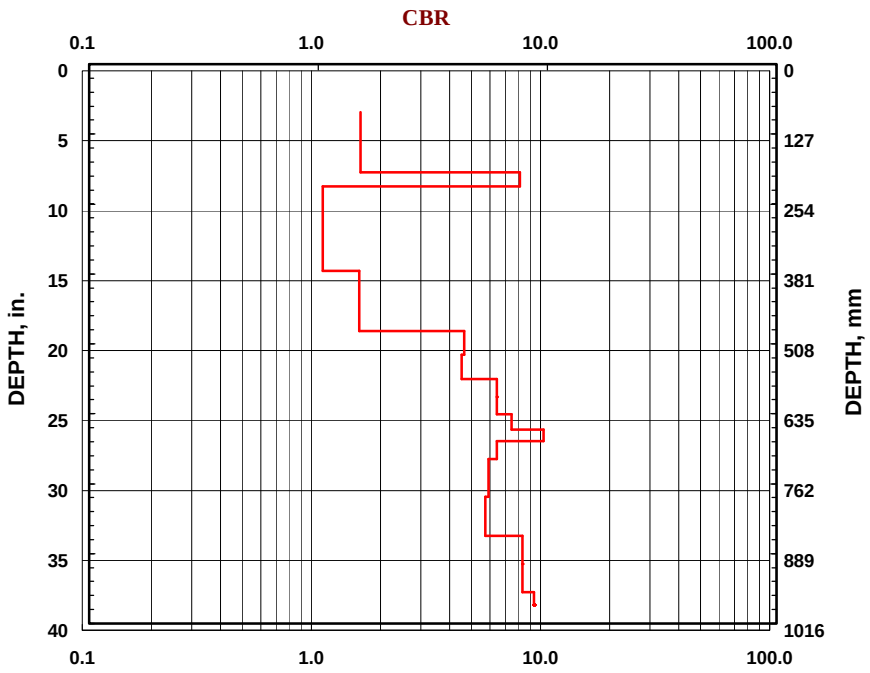

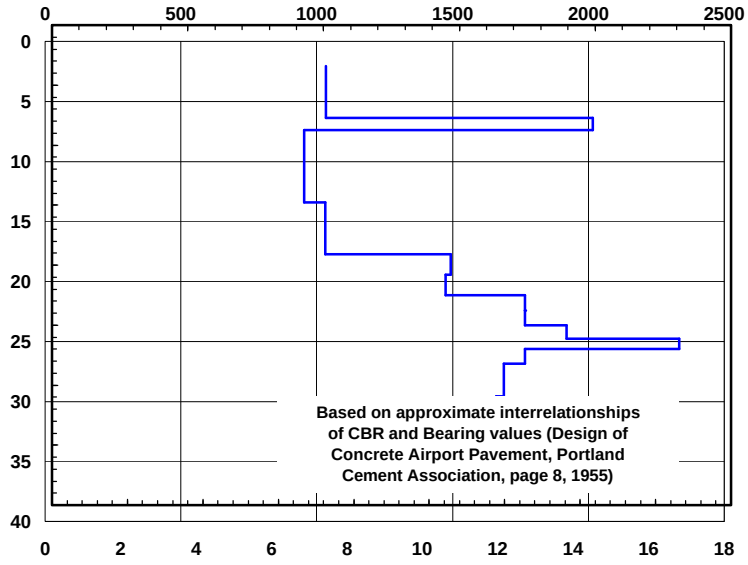

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #5 Station 0+822 10.7 m RT **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	14	1
2	93	1
1	119	1
1	137	1
1	162	1
1	173	1
1	204	1
1	227	1
1	248	1
1	269	1
2	290	1
3	326	1
3	355	1
3	384	1
5	426	1
5	466	1
5	504	1
10	589	1
10	673	1
10	744	1
10	828	1
10	922	1
5	978	1
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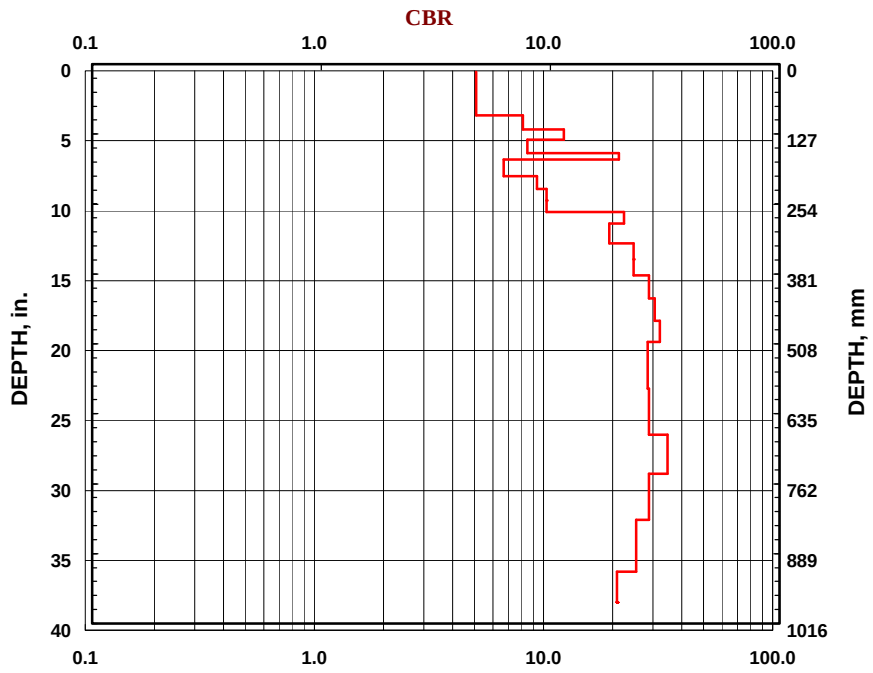

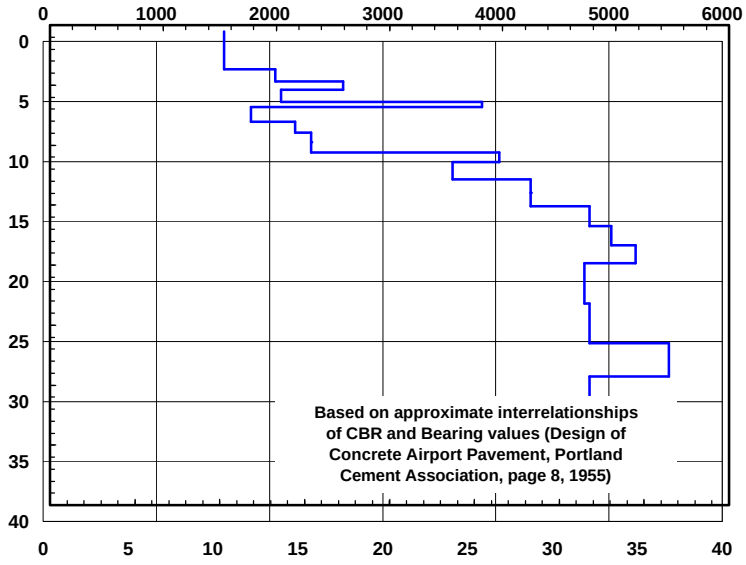

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #6 Station 0+942 10.7m RT **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	108	1
1	206	1
1	267	1
1	294	1
1	313	1
5	398	1
5	458	1
5	521	1
5	578	1
5	628	1
5	677	1
5	728	1
5	781	1
5	839	1
5	910	1
4	989	1
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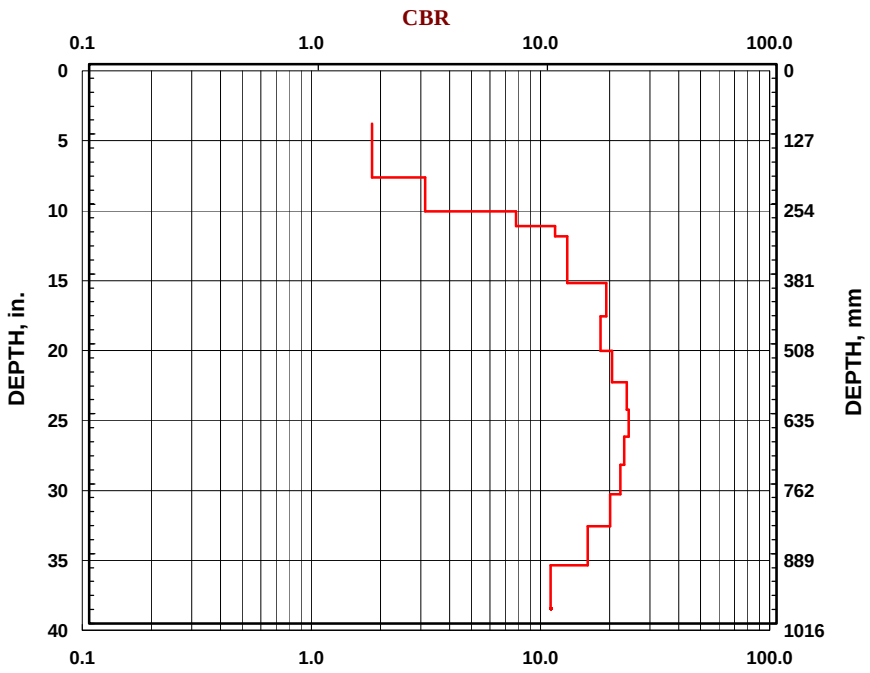

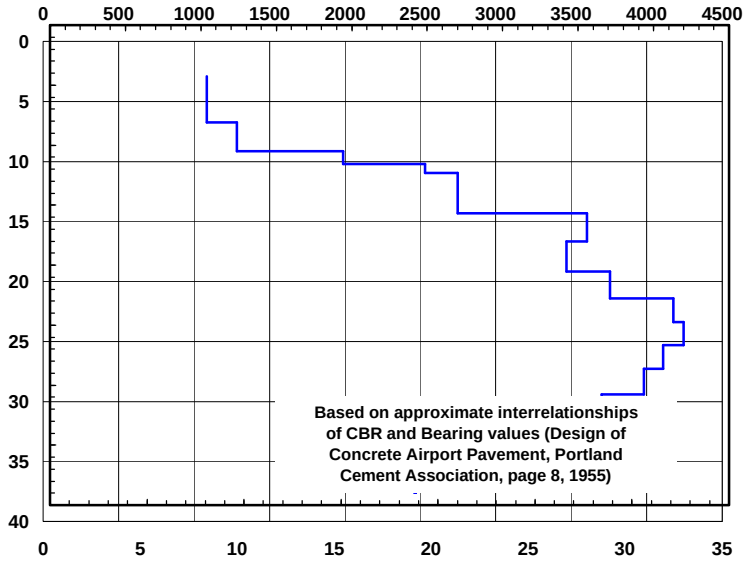

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #7 Station 1+051 4.6m RT **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	27	1
10	111	1
5	154	1
5	190	1
5	233	1
5	276	1
5	326	1
5	372	1
5	411	1
5	447	1
5	488	1
5	525	1
5	563	1
5	602	1
5	644	1
5	689	1
5	728	1
10	801	1
10	886	1
10	964	1
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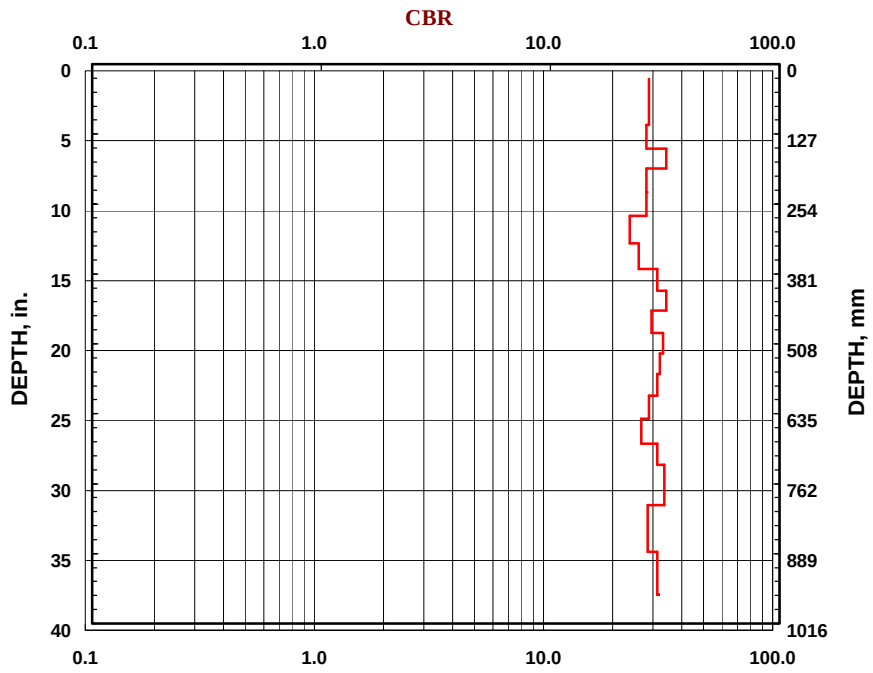

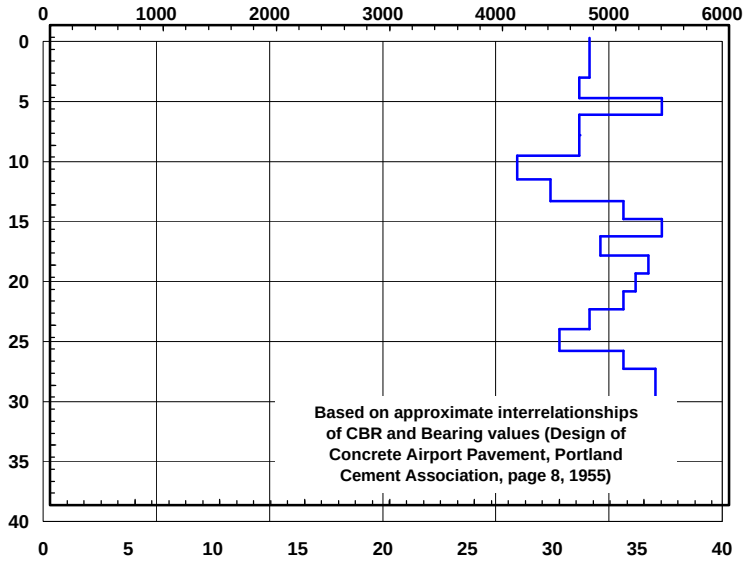

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #8 Station 1+174 4.0m RT **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	25	1
5	81	1
5	123	1
5	164	1
5	201	1
5	246	1
10	348	1
10	439	1
10	500	1
10	548	1
10	596	1
10	651	1
10	719	1
10	797	1
10	868	1
10	939	1
5	975	1
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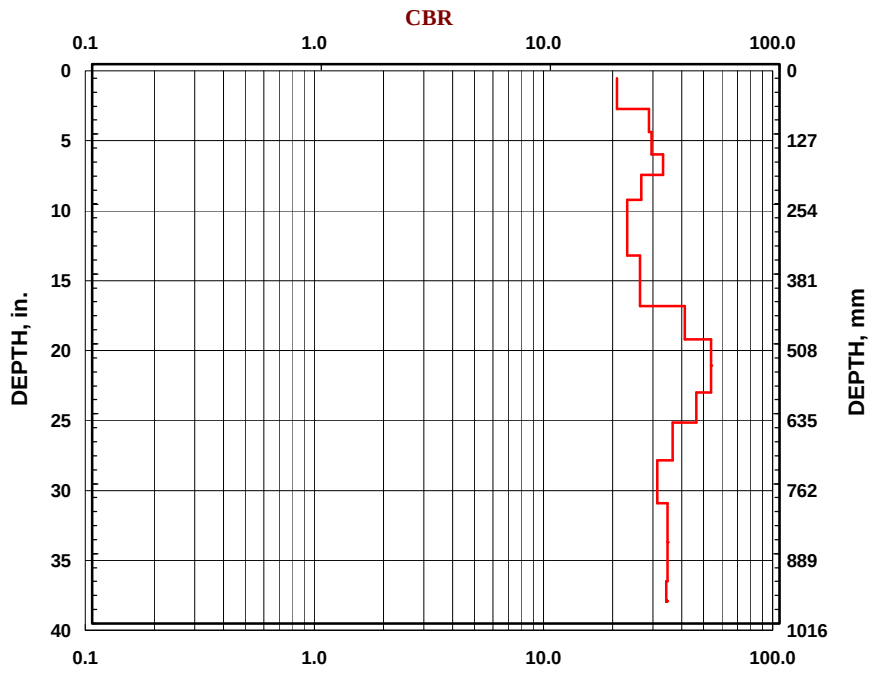

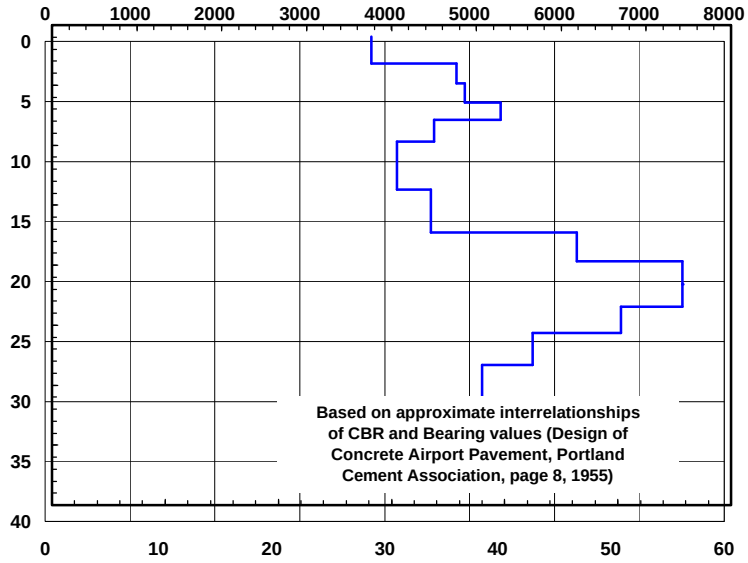

DCP TEST DATA

File Name: DCP2001

Project: *Kwethluk Airport Relocation* **Date:** 2-Oct-03

Location: DCP #9 Station 1+260 CL **Soil Type(s):** Fine Sandy Silt

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	21	1
5	76	1
5	118	1
5	162	1
5	205	1
5	243	1
5	287	1
5	344	1
5	404	1
2	434	1
2	468	1
2	496	1
5	553	1
5	602	1
5	649	1
5	703	1
4	771	1
1	819	1
1	855	1
1	877	1
1	894	1
2	924	1
4	975	1
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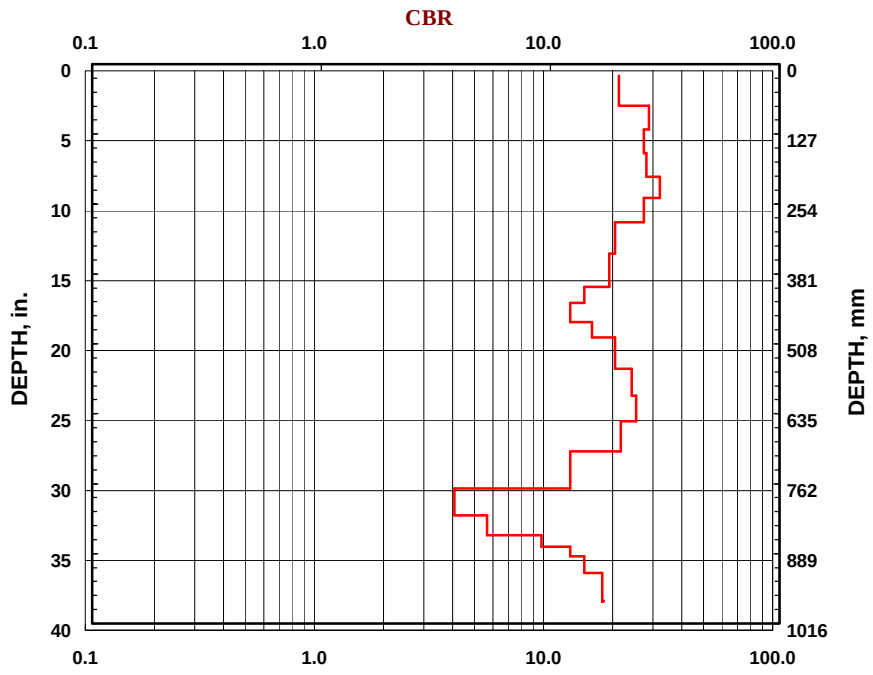
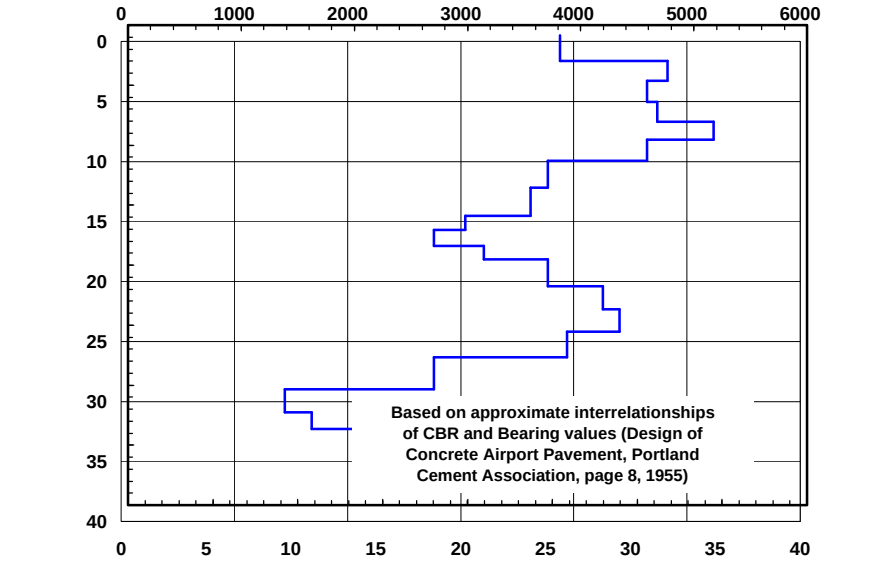
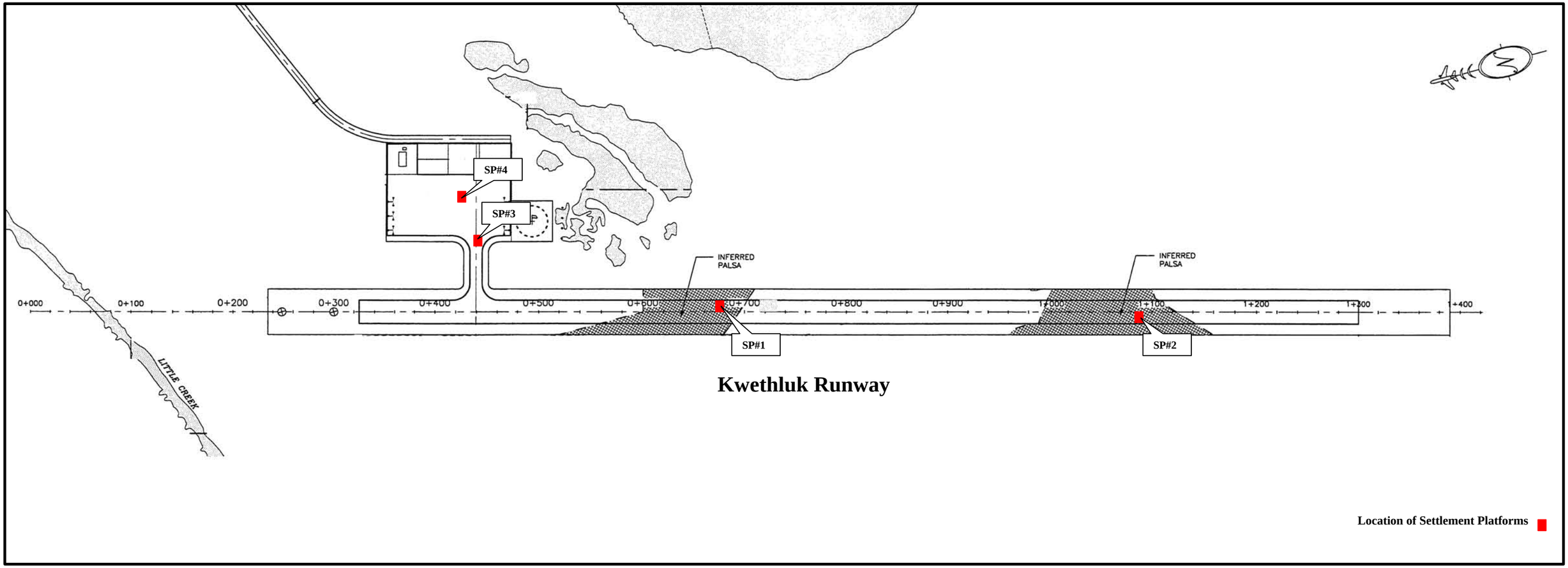




APPENDIX C

Settlement Platform Data



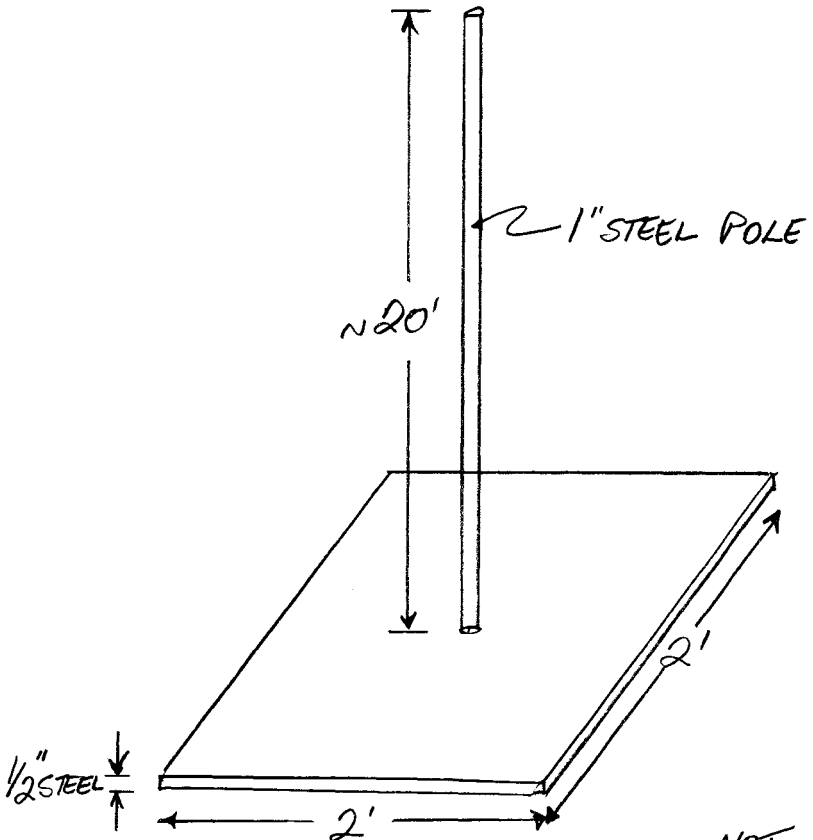
Kwethluk Runway

Location of Settlement Platforms

Kwethluk Airport
Project No. 53872

KWETHLUK AIRPORT 53872

SETTLEMENT PLATFORM DIAGRAM



NOT TO SCALE

Settlement Platform Readings for The Kwethluk Airport

Platform #	Date Installed	Location	Date	Elevation (m)	Total Days	Settlement to Date (m)	Settlement to Date (in)
1	1/19/2003	0+680 10 Lt	1/19/2003	5.97	0		0
			2/21/2003	5.82	33	0.15	5.9
			3/5/2003	5.79	45	0.18	7.1
			3/8/2003	5.79	48	0.18	7.1
			3/29/2003	5.78	69	0.19	7.5
			6/6/2003	5.72	138	0.25	9.8
2	1/26/2003	1+075 10 Rt	1/26/2003	6.75	0		0.0
			2/21/2003	6.67	26	0.08	3.1
			3/5/2003	6.46	38	0.29	11.4
			3/8/2003	6.47	41	0.28	11.0
			3/29/2003	6.66	62	0.09	3.5
			6/6/2003	6.55	131	0.2	7.9
3	2/6/2003	TW 10+132 2.8 Lt	2/6/2003	5.92	0		0.0
			2/21/2003	5.72	15	0.2	7.9
			3/8/2003	5.52	30	0.4	15.7
			3/29/2003	5.51	51	0.41	16.1
			6/6/2003	5.65	120	0.27	10.6
4	2/6/2003	TW 10+098 7.2 Rt	2/6/2003	5.57	0		0.0
			2/21/2003	5.2	15	0.37	14.6
			3/8/2003	5.41	30	0.16	6.3
			6/6/2003	5.1	120	0.47	18.5

APPENDIX D

Photos

Kwethluk Airport, 53872
February 5, 2003

Kwethluk Airport, 53872
February 5, 2003

Kwethluk Airport, 53872
February 5, 2003

DCP #2 Sta. 0+407

Kwethluk Airport
October 2, 2003

Kwethluk Airport
October 2, 2003

Kwethluk Airport, 53872
February 5, 2003

Kwethluk Airport, 53872
February 5, 2003

Kwethluk Airport, 53872
February 5, 2003

DCP #2 Sta. 0+407

Kwethluk Airport
October 2, 2003

Kwethluk Airport
October 2, 2003

DCP #5 Sta. 0+822

DCP #5 Sta. 0+822

Kwethluk Airport
October 2, 2003

DCP #5 Sta. 0+822

DCP #5 Sta. 0+822

Kwethluk Airport
October 2, 2003

DCP #7 Sta. 1+051

DCP #9 Sta. 1+260

Kwethluk Airport
October 2, 2003

APPENDIX E

Laboratory Reports

25D-208
9-96

STATE OF ALASKA
Department of Transportation & Public Facilities
Statewide Materials

5750 EAST TUDOR RD, ANCHORAGE AK 99507
Phone (907)-269-6200 FAX (907) 269-6201

Laboratory Report

INFORMATION

PROJECT NAME: Kwethluk Airport Relocation
PROJECT NO. 3-02-0435-0101 / 53872

SAMPLE OF: Borrow Embankment Type I
ITEM/SPECIFICATION NO.: P-152h
SAMPLED FROM: BE-G-8 & 18 and BE-SD-2
SOURCE/SUPPLIER: State Furnished Borrow Pit
QUANTITY REPRESENTED As Required
LOCATION/ADDRESS: Kwethluk
SUBMITTED BY: J. Rajek
EXAMINED FOR: Standard Density Comparison (See 03A-0044)

LABORATORY NO. 03A-0043
FIELD NO.: I-BE-SD-1 698
DATE SAMPLED: 01/20/2003
DATE RECEIVED: 02/06/2003
DATE COMPLETED: 02/10/2003
DATE REPORTED: 02/10/2003

SIEVE ANALYSIS BY: ASTM C 136 & C 117

SIEVE	%PASS	-4.75	Specs.
75			
50			
37.5			
25.0			
19.0			
12.5			
9.5			
6.3	100		
4.75			
2.36			
2.00			
1.18			
.600			
.425	100		
.300	98		
.180			
.150	80		
.075	37.3		0-60

% Fracture	Specs.
Single Face	
Double Face	

LL	
PL	
PI	

	Coarse	Fine
SpG		2.60
Absorp.		

Fine SpG by: ASTM D 854
Coarse BSpG by: ASTM C 127

SAMPLE PREPARATION BY: ASTM D421 & C 702

MOISTURE DENSITY RELATIONSHIP BY: ASTM D 698 Method A

Optimum Moisture = 15.0 Max. Dry Density = 1740 kg/cu m

Remarks:

The Material as Submitted Conforms to Specifications
Yes [X] No [ ] NA [ ]

Signature Robert F. Lewis, PE
State Quality Assurance Engineer

D8 THE TEST RESULTS ARE ONLY REPRESENTATIVE OF THE MATERIAL AS SUBMITTED.

25D-208
9-96

STATE OF ALASKA
Department of Transportation & Public Facilities
Statewide Materials

5750 EAST TUDOR RD, ANCHORAGE AK 99507
Phone (907)-269-6200 FAX (907) 269-6201

Laboratory Report

INFORMATION

PROJECT NAME: Kwethluk Airport Relocation
PROJECT NO. 3-02-0435-0101 / 53872

SAMPLE OF: Borrow Embankment Type I
ITEM/SPECIFICATION NO.: P-152h
SAMPLED FROM: BE-G-8 & 18 and BE-SD-2
SOURCE/SUPPLIER: State Furnished Borrow Pit
QUANTITY REPRESENTED As Required
LOCATION/ADDRESS: Kwethluk
SUBMITTED BY: J. Rajek
EXAMINED FOR: Standard Density Comparison (See 03A-0043)

LABORATORY NO. 03A-0044
FIELD NO.: I-BE-SD-1 1557
DATE SAMPLED: 01/20/2003
DATE RECEIVED: 02/06/2003
DATE COMPLETED: 02/10/2003
DATE REPORTED: 02/10/2003

SIEVE ANALYSIS BY: ASTM C 136 & C 117

SIEVE	%PASS	-4.75	Specs.
75			
50			
37.5			
25.0			
19.0			
12.5			
9.5			
6.3	100		
4.75			
2.36			
2.00			
1.18			
.600			
.425	100		
.300	98		
.180			
.150	80		
.075	37.3		0-60

% Fracture	Specs.
Single Face	
Double Face	

LL	
PL	
PI	

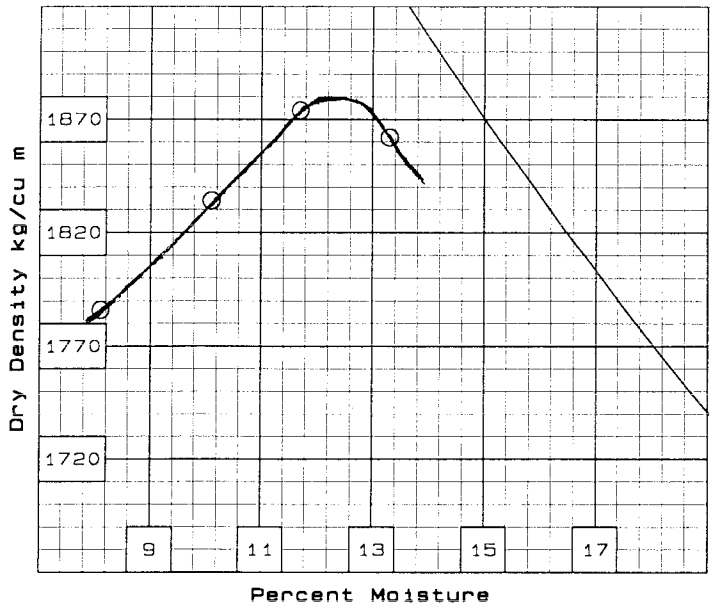
	Coarse	Fine
SpG		2.60
Absorp.		

Fine SpG by: ASTM D 854
Coarse BSpG by: ASTM C 127

SAMPLE PREPARATION BY: ASTM D421 & C 702

MOISTURE DENSITY RELATIONSHIP BY: ASTM D 1557 Method A

Optimum Moisture = 12.5 Max. Dry Density = 1880 kg/cu m



Remarks:

The Material as Submitted Conforms to Specifications
Yes [X] No [ ] NA [ ]

THE TEST RESULTS ARE ONLY REPRESENTATIVE OF THE MATERIAL AS SUBMITTED.

Signature Robert F. Lewis

Robert F. Lewis, PE
State Quality Assurance Engineer

D8

25D-229M
1-95

STATE OF ALASKA
Department of Transportation & Public Facilities
Statewide Materials

5750 EAST TUDOR RD, ANCHORAGE AK 99507
Phone (907)-269-6200 FAX (907) 269-6201

Laboratory Report

INFORMATION

PROJECT NAME: Kwethluk Airport Relocation PROJECT NO. 3-02-0435-0101 / 53872

SAMPLE OF: Borrow Embankment Type I ITEM/SPECIFICATION NO.: P-152h
SAMPLED FROM: See Below
SOURCE/SUPPLIER: State of Alaska Pit QUANTITY REPRESENTED
LOCATION/ADDRESS: Southwest Const., Kwethluk, AK SUBMITTED BY: J. Rajek
EXAMINED FOR: Moisture Content

LABORATORY NO. See Below
FIELD NO.: See Below
DATE SAMPLED: 02/04/2003
DATE RECEIVED: 02/06/2003
DATE COMPLETED: 02/10/2003
DATE REPORTED: 02/10/2003

Lab. No.	Field No.	Sampled From, Location, Depth	Moist. %	Org. %
03A-0045	I-BE-MC-1	Runway, Southwest Const., Kwethluk, AK 0+695 15 m Lt., +2.0 m OG	33.2	
03A-0046	I-BE-MC-2	Runway, Southwest Const., Kwethluk, AK 0+930 15 m Lt., +2.0 m OG	50.8	
03A-0047	I-BE-MC-3	Runway, Southwest Const., Kwethluk, AK 0+710 15 m Rt., +2.0 m OG	30.1	
03A-0048	I-BE-MC-4	Runway, Southwest Const., Kwethluk, AK 0+870 20 m Lt., +2.0 m OG	28.7	

Remarks:

When Processed to conform to grading requirements, this material is satisfactory for:

The Material as Submitted Conforms to Specifications
Yes[ ] No[ ] NA[X]

Signature Robert F. Lewis
Robert F. Lewis, PE
State Quality Assurance Engineer

D8 THE TEST RESULTS ARE ONLY REPRESENTATIVE OF THE MATERIAL AS SUBMITTED.

25D-208
9-96

STATE OF ALASKA
Department of Transportation & Public Facilities
Statewide Materials

5750 EAST TUDOR RD, ANCHORAGE AK 99507
Phone (907)-269-6200 FAX (907) 269-6201

Laboratory Report

INFORMATION

PROJECT NAME: Kwethluk Airport Relocation PROJECT NO. 3-02-0435-0101 / 53872

SAMPLE OF: Borrow Embankment Type I ITEM/SPECIFICATION NO.: P-152h
SAMPLED FROM: Runway, Various Sample Locations
SOURCE/SUPPLIER: State of Alaska Pit QUANTITY REPRESENTED Source
LOCATION/ADDRESS: Southwest Const., Kwethluk AK SUBMITTED BY: J. Rajek
EXAMINED FOR: California Bearing Ratio

LABORATORY NO. 03A-0062
FIELD NO.: I-CBR-1
DATE SAMPLED: 01/20/2003
DATE RECEIVED: 02/12/2003
DATE COMPLETED: 02/25/2003
DATE REPORTED: 02/25/2003

SIEVE	%PASS	-4.75	Specs.
75			
50			
37.5			
25.0			
19.0			
12.5			
9.5			
6.3	100		
4.75			
2.36			
2.00			
1.18			
.600			
.425	100		
.300	98		
.180			
.150	80		
.075	37.3		0-60

% Fracture	Specs.
Single Face	
Double Face	

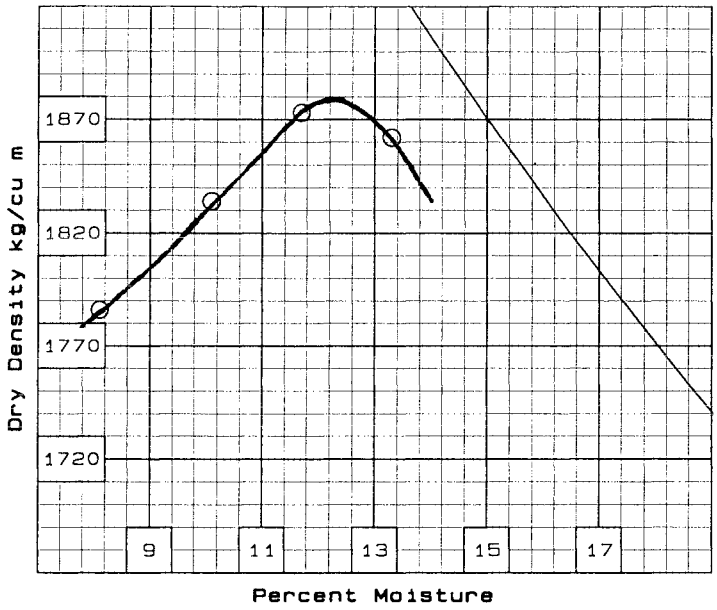
LL	
PL	
PI	

	Coarse	Fine
SpG		2.60
Absorp.		

Fine SpG by:
Coarse BSpG by:

MOISTURE DENSITY RELATIONSHIP BY: ASTM D 1557 Method A

Optimum Moisture = 12.5 Max. Dry Density = 1880 kg/cu m



California Bearing Ratio = 33 ASTM D 1883

Remarks: CBR performed UNsoaked.

The Material as Submitted Conforms to Specifications
Yes [X] No [ ] NA [ ]

Signature Robert F. Lewis, PE
State Quality Assurance Engineer

D8 THE TEST RESULTS ARE ONLY REPRESENTATIVE OF THE MATERIAL AS SUBMITTED.

03A-2476+

25D-229M
1-95

STATE OF ALASKA
Department of Transportation & Public Facilities
Statewide Materials

5750 EAST TUDOR RD, ANCHORAGE AK 99507
Phone (907)-269-6200 FAX (907) 269-6201

Laboratory Report

PRECONSTRUCTION

PROJECT NAME: Kwethluk Airport Relocation PROJECT NO. 3-02-0435-0101 / 53872

SAMPLE OF: ITEM/SPECIFICATION NO.:
SAMPLED FROM: See Below
SOURCE/SUPPLIER: Existing QUANTITY REPRESENTED
LOCATION/ADDRESS: SUBMITTED BY: D. Hemstreet
EXAMINED FOR: Moisture Content

LABORATORY NO. See Below
FIELD NO.: See Below
DATE SAMPLED: 09/19/2003
DATE RECEIVED: 09/29/2003
DATE COMPLETED: 10/29/2003
DATE REPORTED: 11/07/2003

Lab. No.	Field No.	Sampled From, Location, Depth	Moist. %	Org. %
03A-2476	FS-18	TH, 0+600 , 0.0-0.3 m	20.8	1.6
03A-2477	FS-19	TH, 0+600 , 0.3-0.6 m	22.4	2.1
03A-2478	FS-20	TH, 0+600 , 0.6-0.9 m	21.0	2.1
03A-2479	FS-21	TH, 0+790 , 0.0-0.3 m	12.0	1.4
03A-2480	FS-22	TH, 0+790 , 0.3-0.6 m	17.3	1.2
03A-2481	FS-23	TH, 0+790 , 0.6-0.9 m	19.6	1.4
03A-2482	FS-24	TH, 0+790 , 0.9-1.2 m	20.3	1.4

Remarks:

When Processed to conform to grading requirements, this material is satisfactory for:

The Material as Submitted Conforms to Specifications
Yes[ ] No[ ] NA[X]

Signature Robert F. Lewis, PE
State Quality Assurance Engineer

D2 THE TEST RESULTS ARE ONLY REPRESENTATIVE OF THE MATERIAL AS SUBMITTED.

03-2547+

25D-229M
1-95

STATE OF ALASKA
Department of Transportation & Public Facilities
Statewide Materials

5750 EAST TUDOR RD, ANCHORAGE AK 99507
Phone (907)-269-6200 FAX (907) 269-6201

Laboratory Report

PRECONSTRUCTION

PROJECT NAME: Kwethluk Airport Relocation PROJECT NO. 3-02-0435-0101 / 53872

SAMPLE OF: ITEM/SPECIFICATION NO.:
SAMPLED FROM: See Below
SOURCE/SUPPLIER: Centerline QUANTITY REPRESENTED
LOCATION/ADDRESS: SUBMITTED BY: D. Hemstreet
EXAMINED FOR: Organic & Moisture Contents

LABORATORY NO. See Below
FIELD NO.: See Below
DATE SAMPLED: 10/02/2003
DATE RECEIVED: 10/09/2003
DATE COMPLETED: 10/22/2003
DATE REPORTED: 10/24/2003

Lab. No.	Field No.	Sampled From, Location, Depth	Moist. %	Org. %
03A-2547	1	TH 0+384, , 0"-6"	8.0	1.3
03A-2548	2	TH 0+384, , 6"-12"	16.4	1.8
03A-2549	3	TH 0+689, , 6"-12"	15.4	2.0
03A-2550	4	TH 0+822, , 6"-12"	19.8	2.0

Remarks:

When Processed to conform to grading requirements, this material is satisfactory for:

The Material as Submitted Conforms to Specifications
Yes[ ] No[ ] NA[X]

Signature Newton Bingham for
Robert F. Lewis, PE
State Quality Assurance Engineer

D2 THE TEST RESULTS ARE ONLY REPRESENTATIVE OF THE MATERIAL AS SUBMITTED.

25-229J
10-97

STATE OF ALASKA
Department of Transportation & Public Facilities
Statewide Materials

5750 EAST TUDOR RD, ANCHORAGE AK 99507
Phone (907)-269-6200 FAX (907) 269-6201

Laboratory Report

PRECONSTRUCTION

PROJECT NAME: Kwethluk Airport Relocation PROJECT NO. 3-02-0435-0101 / 53872

SAMPLE OF: ITEM/SPECIFICATION NO.:
SAMPLED FROM: TH, Sta. 0+790 & 0+600 , Depth 0.0-1.2 m
SOURCE/SUPPLIER: Existing QUANTITY REPRESENTED
LOCATION/ADDRESS: SUBMITTED BY: D. Hemstreet
EXAMINED FOR: Particle Size Analysis

LABORATORY NO. 03A-2483
FIELD NO.: FS-18 TO 24
DATE SAMPLED: 09/19/2003
DATE RECEIVED: 09/29/2003
DATE COMPLETED: 11/07/2003
DATE REPORTED: 11/07/2003

Sieve Analysis ASTM D 422

SIZE	Lab		Specs.
4"			
3"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"			
1/4"			
#4	100		
#8			
#10	100		
#16	100		
#30	100		
#40	99		
#50	96		
#80			
#100	65		
#200	39.0		
.02mm	16.1		
.002mm	5.4		

Fineness Modulus

SAMPLE PREPARATION BY: ASTM D421 & C 702

	Dry Prep	Wet Prep	Specs
LL			
PL			
PI			
% Fracture			
Single Face			
Double Face			
Thin Elongated, 3:1			
5:1			
% Organic			
pH			
% Nat. Moisture			
% Sticks & Roots			
Dry Unit Wt., pcf			

% +3"	
% Gravel	0
% Sand	61
% Silt	34
% Clay	5
FSV	
AASHTO Class	
DOTTSD	
Unified Class	

	Coarse	Specs	Fine	Specs
Friable Particles				
Sulfate Soundness, % Loss				
L.A. Abrasion, Total % Loss				
% Loss @ 100 revs				
Degradation				
Nordic Abrasion, % Loss				

Remarks:

When Processed to conform to grading requirements, this material is satisfactory for:

The Material as Submitted Conforms to Specifications
Yes[ ] No[ ] NA[X]

Signature Robert F. Lewis

Robert F. Lewis, PE
State Quality Assurance Engineer

D2 THE TEST RESULTS ARE ONLY REPRESENTATIVE OF THE MATERIAL AS SUBMITTED.

APPENDIX F

Geotextile Fabric Specifications

Amoco Fabrics and Fibers Company

260 The Bluffs
Austell, GA 30168
PH: (770) 944-4569
FX: (770) 944-4584

STYLE 2006

Amoco Style 2006 is a polypropylene woven fabric. This engineered geotextile is stabilized to resist degradation due to ultraviolet exposure. It is resistant to commonly encountered soil chemicals, mildew and insects, and is non-biodegradable. Polypropylene is stable within a pH range of 2 to 13, making it one of the most stable polymers available for geotextiles today. We wish to advise that **Amoco Style 2006** meets the following minimum average roll values:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Grab Tensile	ASTM-D-4632	315 lb	1.40 kN
Grab Elongation	ASTM-D-4632	15 %	15 %
Wide Width Tensile	ASTM-D-4595	175/175 lb/in	30.7/30.7 kN/m
Wide Width Elongation	ASTM-D-4595	15/8 %	15/8 %
Mullen Burst	ASTM-D-3786	600 psi	4130 kPa
Puncture	ASTM-D-4833	120 lb	0.530 kN
Trapezoidal Tear	ASTM-D-4533	120 lb	0.530 kN
UV Resistance	ASTM-D-4355	70 % at 500 hr	70 % at 500 hr
AOS	ASTM-D-4751	40 sieve	0.425 mm
Permittivity	ASTM-D-4491	0.05 sec^{-1}	0.05 sec^{-1}
Flow Rate	ASTM-D-4491	4 $gal/min/ft^2$	160 $L/min/m^2$

Amoco Fabrics and Fibers Company manufacturers the woven fabric indicated above. The values listed are a result of testing conducted in on-site laboratories. A letter certifying the minimum average roll values will be issued from the manufacturing plant by the Quality Control Manager at the time shipment is made.

DATE ISSUED: 04/05/01

Properties of CONTECH Nonwoven Geotextiles - METRIC

CONTECH CONSTRUCTION PRODUCTS INC.

Property	Test Method	Units	Roll Value	C-30NW	C-40NW	C-45NW	C-50NW	C-60NW	C-70NW	C-80NW	C-100NW	C-120NW
MECHANICAL												
Grab Tensile Strength	ASTM D4632	N	MARV	423	512	534	668	712	801	912	1113	1335
Grab Elongation	ASTM D4632	%	MARV	50%	50%	50%	50%	50%	50%	50%	50%	50%
Puncture Strength	ASTM D4833	N	MARV	245	289	289	378	378	445	490	668	779
Mullen Burst	ASTM D3786	kPa	MARV	1275	1446	1599	1930	1930	2275	2413	3171	3999
Trapezoidal Tear	ASTM D4533	N	MARV	178	223	223	267	267	334	378	445	512
HYDRAULIC												
(AOS) Apparent Opening Size	ASTM D4751	mm	MARV	0.212	0.212	0.212	0.212	0.212	0.212	.180	.150	.150
Permittivity	ASTM D4491	sec^{-1}	MARV	2.00	2.00	1.56	1.40	1.30	1.50	1.50	1.20	1.00
Permeability	ASTM D4491	cm/sec	MARV	0.25	0.22	0.22	0.23	0.24	0.34	0.38	0.30	0.29
Water Flow Rate	ASTM D4491	$l/min/m^2$	MARV	4482	5784	4889	4666	4482	4482	4482	3483	3066
ENDURANCE												
UV Resistance	ASTM D4355 Xenon Arc	% Retained @ 500 hrs.	MARV	70%	70%	70%	70%	70%	70%	70%	70%	70%
PHYSICAL												
Weight	ASTM D4533	g/m^2	MARV	101.7	119.0	136.0	163.0	170.0	200.0	220.0	266.00	366.0
Thickness	ASTM D5199	mm	MARV	1.0	1.2	1.1	1.3	1.5	1.7	1.7	2.5	2.8
STANDARD ROLL DIMENSIONS												
Roll Width	Measured	M	Nominal	3.81/4.57	3.81/4.57	3.81/4.57	3.81/4.57	3.81/4.57	3.81/4.57	4.57	4.57	4.57
Roll Length	Measured	M	Nominal	109.8	109.8	109.8	109.8	91.5	91.5	91.5	91.5	91.5
Roll Area	Calculated	M^2	Nominal	418 / 501.66	418 / 501.66	418 / 501.66	418 / 501.66	348.5 / 418	348.5 / 418	418	418	418

Notes:

1. *Values are reported for the weaker principle direction.*
2. *"MARV" INDICATES minimum average roll values, which is calculated as the mean minus two standard deviations, yielding a 97.5% confidence level.*

This data sheet supercedes all previous data sheets for these styles of CONTECH Nonwoven Geotextiles, and is subject to change without notice.
Your CONTECH Regional office can advise if any values listed herein have changed since this data sheet was issued.

CONTECH CONSTRUCTION PRODUCTS INC 97 Inner Springer Loop, Palmer, Alaska 99645
Bryan R. Epley Supervisor: Sales & Production (907) 745-4282 (800) 909-7662 Fax: (907) 746-1554

Rev 07/06/00 BM AP

APPROVED
SUBJECT TO FIELD INSPECTION
Tom Moses, P.E.
Materials Engineer
6/27/01