MEMORANDUM

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

CENTRAL REGION MATERIALS

5750 E. TUDOR ROAD
ANCHORAGE, ALASKA 99507-1225
PHONE (907) 269-6200 FAX (907) 269-6201

To:	Kelly Petersen, PE Preliminary Highway Design Project manager	Date:	April 19, 2016
Thru:	Mitch Miller, PE Regional Geotechnical Engineer	Project:	Sterling Hwy: MP 45-60: Sunrise to Skilak Lake Rd AK 100 (53014)
From:	Craig Boeckman, CPG CB Regional Engineering Geologist	Re:	Assessment of Deep Cut Section STA 1675+00 to STA 1700+00 Cooper Creek Alternative

BACKGROUND & PROJECT DESCRIPTION

The section of the Sterling Highway from MP 37 – 60 that winds along the upper Kenai River and lower Kenai Lake area was first evaluated in the early 1980s. Proposed improvements included a possible bypass through Cooper Landing. In 1995 the Alaska Department of Transportation & Public Facilities (ADOT&PF) split the Sterling Highway MP 37 – 60 Project into two separate projects. The segment between MP 37 – 45 was designed and later constructed in 2000 – 2001. The second segment between Sterling Highway MP 45 – 60, which includes various proposed alternatives to bypass Cooper Landing, is currently being evaluated. A pavement preservation project for MP 45 – 60, through Cooper Landing, was constructed in 2012 – 2013.

A number of alternatives have been evaluated to route the highway around Cooper Landing (see Attachment 1 - Proposed Alternatives Map – Sheet 1).

The alternatives have included proposed routes north of the Kenai River:

- Bean Creek/G-South, and
- Juneau Creek Alternative(s)

Alternatives were also considered along the existing highway and south of the Kenai River:

- The Cooper Creek Alternative, and
- The "B" Alternative (existing highway alignment)

The B Alternative form the early 1980s generally followed the existing highway alignment. There were two or three different concepts for this alternative such as cutting into the hillside to provide better sight distances at corners (B Alternative) or short realignments that required multiple bridges over the Kenai River (BA Alternative). See the Proposed Alternatives Map – Sheet 2 (Attachment 1).

In April 1983 the ADOT&PF Central Region Materials Section (CRM) generated a memo regarding the "B" Alternative recommending that "proposed cuts from Sta 1668 to 1685 and Sta 1702 to 1712 on the 55 MPH BA Alignment for the Sterling Hwy MP 37 – 58 Project should not be attempted" (an excerpt of the memo is in Attachment 1). This 1983 memo referred to proposed deep cuts in the slope adjacent to the existing highway as shown in Sheet 2 of the Proposed Alternatives Map. The concern was that the cuts would become unstable and possibly allow silt-laden runoff to drain into the Kenai River.

The Cooper Creek alternative does not follow the existing highway through Cooper Landing but leaves the highway south of the Kenai River Bridge and winds up the hillside, behind Cooper Landing, and then generally follows the power line corridor (Attachment 1).

SCOPE OF WORK

The Cooper Creek Alternative was the focus of our geotechnical evaluation. In particular the area proposed for deep cuts, as much as 120 feet deep, from about station (STA) 1675 to STA 1700, just east of Cooper Creek (Attachment 1).

GEOTECHNICAL ASSESSMENT OF THE CURRENT COOPER CREEK ALTERNATIVE

Groundwater Conditions

Groundwater was indicated in one of the five test holes drilled next to the highway in the 1983 memo from CRM. Test hole TH83-4 closest to Kenai River encountered groundwater at 30 ft (Attachment 1). These test holes were drilled with solid flight auger and did not have piezometers installed after drilling.

Groundwater was not encountered in the 2013 test holes during drilling along the new Cooper Creek alignment. Test holes in the deepest part of the cut encountered similar soils as those drilled in 1983 (variable layers of gravel, sand, silt). Piezometers were installed and groundwater levels were monitored (March 22nd, April 26th, and October 17, 2013). The only time groundwater was indicated during these monitoring events was in October 2013 at TH13-03 which had water at 46.6 ft below ground surface.

Proposed Deep Cut Recommendations

Based on the results of our investigation we would recommend:

- Use a 2H:1V slope with 12ft benches at every 30 ft of cut height up from ditch bottom (see Typical Section for Cut in Attachment 1).
- Use a 4H:1V highway embankment fore slope.

Further modifications to the backslope may be necessary, especially if groundwater or perched groundwater could possibly be encountered during excavation. These modifications could include flatter slopes, wider benches, soil anchors and mesh, or rock blankets.

Some relatively newer methods for controlling erosion are the pinned mesh such as Propex Armormax ® Anchored Reinforced Vegetation System (or equivalent) to stabilize the slope to avoid erosional failures (see Attachment 2). This system uses anchors driven into the soil face to help stabilize the Armormax grid. General Specifications and Typical Drawings are provided for this application (Attachment 2). The general cost for this product to stabilize the slopes is about $45/SY to $65/SY.

In addition rip rap can be placed on the slopes from the ditch level up the side slopes a few tens of feet to reduce erosion potential. Rip rap can also line the ditches to further reduce erosion. Sedimentation basins might also be considered if there is room between the cut section and Cooper Creek.

Groundwater is always a possibility to be encountered in a cut. In addition exposure of the soils in an open cut to climatic patterns (rainfall and spring melt) will introduce shallow water into the soils. In general, erosion control and SWPP provisions during construction will be a concern and requirement for any new alignment chosen in this project area.

The management and storage of possibly a large amount of waste material will need to be considered if this Cooper Creek alternative is selected. It would be best to find areas along the alignment to waste these soils as slope flattening or wider pullouts.

REFERENCES

The references used for this project were provided by the Central Region Materials Section and as follows:

- ADOT&PF. Sterling Hwy MP 37-58 Central Region Materials Memo. Project #F-021-2(15)/A09812. April 25, 1983.
- ADOT&PF. Sterling Hwy MP 37-58 "*Reconnaissance Geology Report*". Project #F-021-2(15). August 1983.
- ADOT&PF. "*Reconnaissance Engineering Geology Report, Sterling Hwy MP 37-60*". Project # F-021-2-(15). August 1989.
- R&M Consultants Inc. "*Preliminary Geotechnical Memo, Cooper Creek Alternative, Sterling Hwy MP 45-60*" Project #F-021-2(15)/53014. January 31, 2001.
- HDR Alaska, Inc. "*Sterling Hwy, Milepost 45-60, Supplemental Draft Environmental Impact Statement, Alternative Evaluation*", dated May 2003.

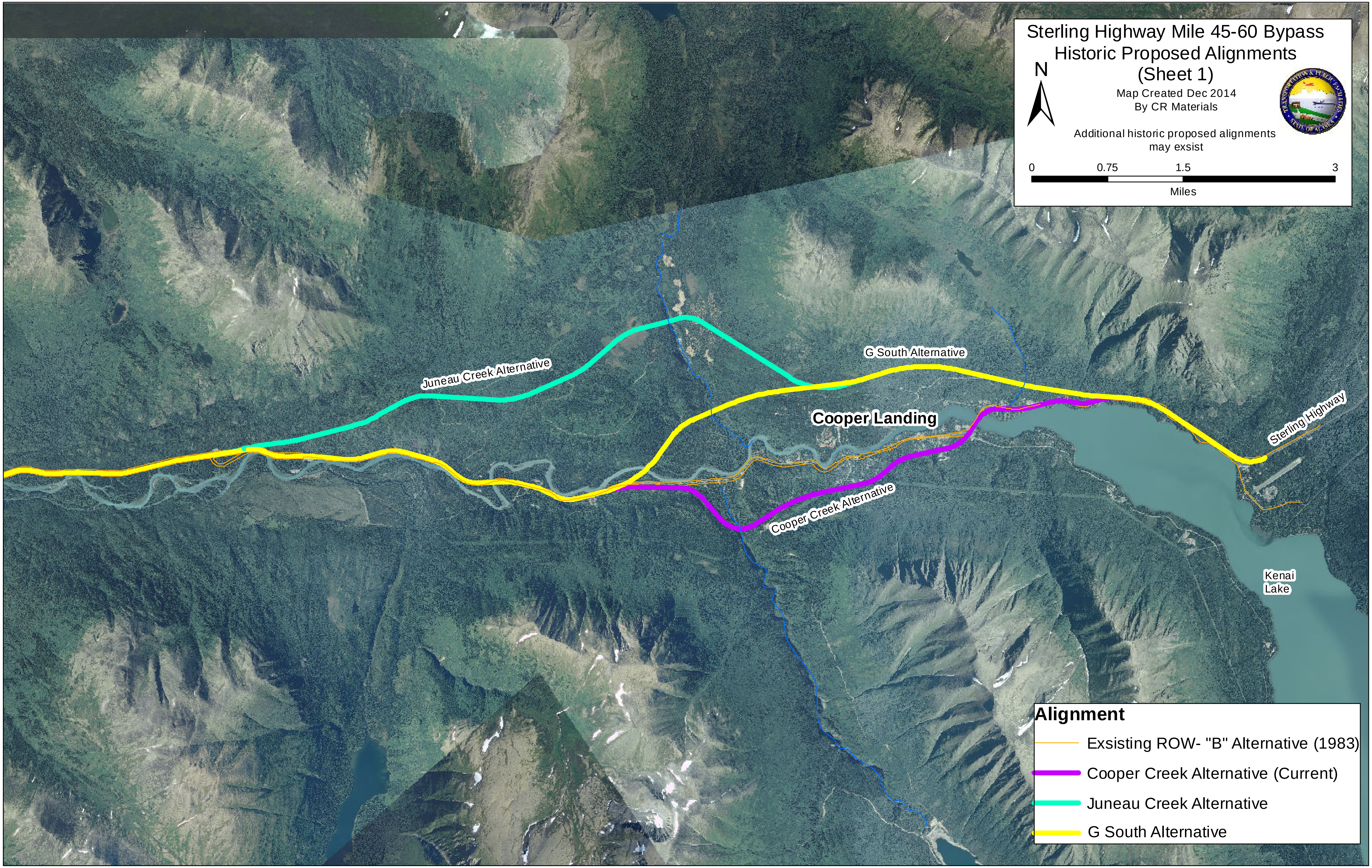
ATTACHMENT 1

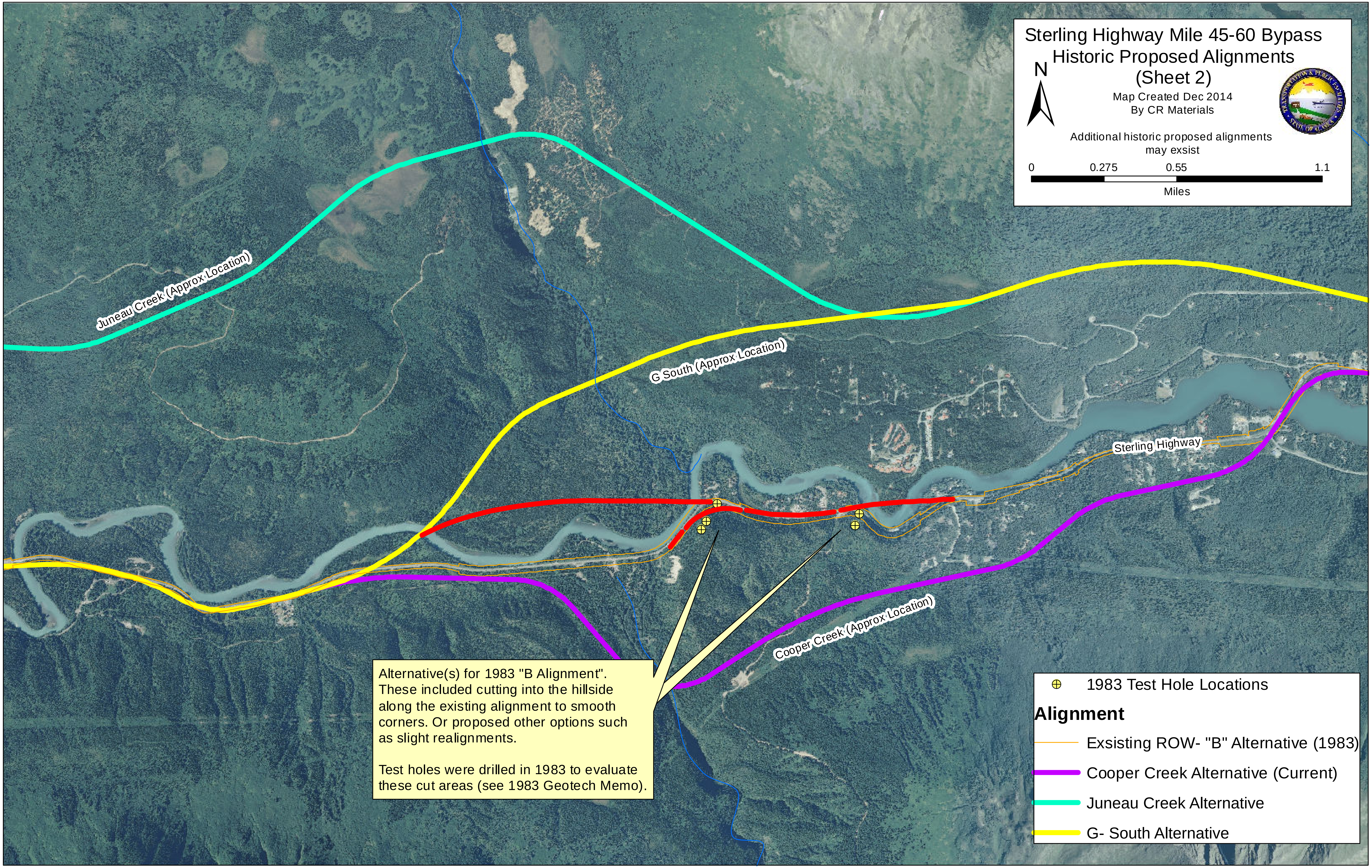
Proposed Alternatives Map

1983 Geotechnical Memo from Central Region Materials

Proposed Cut Typical Section, Cross Section of Test Holes, Profile of Cut

Maps of Proposed Alternatives


Sterling Highway Mile 45-60 Bypass
Historic Proposed Alignments
(Sheet 1)
N
Map Created Dec 2014
By CR Materials
Additional historic proposed alignments
may exsist
0
0.75
1.5
3
Miles
Juneau Creek Alternative
G South Alternative
Cooper Landing
Sterling Highway
Cooper Creek Alternative
Kenai
Lake
Alignment
Exsisting ROW- "B" Alternative (1983)
Cooper Creek Alternative (Current)
Juneau Creek Alternative
G South Alternative



Sterling Highway Mile 45-60 Bypass
Historic Proposed Alignments
(Sheet 2)
N
Map Created Dec 2014
By CR Materials
Additional historic proposed alignments
may exsist
0
0.275
0.55
1.1
Miles
Juneau Creek (Approx Location)
G South (Approx Location)
Sterling Highway
Cooper Creek (Approx Location)
Alternative(s) for 1983 "B Alignment". These included cutting into the hillside along the existing alignment to smooth corners. Or proposed other options such as slight realignments.
Test holes were drilled in 1983 to evaluate these cut areas (see 1983 Geotech Memo).
1983 Test Hole Locations
Alignment
Exsisting ROW- "B" Alternative (1983)
Cooper Creek Alternative (Current)
Juneau Creek Alternative
G- South Alternative

1983 Geotech Memo,
1983 Test Hole Logs,
1983 Plan Drawings (Topo Maps)

MEMORANDUM State of Alaska

TO: Don Morfield
Highway Design Engineer
Central Region

DATE: April 25, 1983

FILE NO: F-021-2(15)

TELEPHONE NO: 338-4200

FROM: Frank P. Narusch
Materials Engineer
Central Region

SUBJECT: Project No. F-021-2(15)
A09812 - Sterling Highway
M.P. 37-58

Since the preliminary memo of March 10, 1983 from this office, and your transmission of additional data and cross sections, much thought has been given and additional research performed regarding the two proposed cuts along the existing highway route between Cooper Creek and Cooper Landing.

Based on the following data and considerations, it is the recommendation of this office that the proposed cuts from Station 1668 to Station 1685 and from Station 1702 to Station 1712 on the 55 m.p.h. "BA" line for subject project should not be attempted.

Literature pertaining to large cuts in glacial materials similar to that in the Cooper Landing area reveals that such cuts are rarely attempted in areas with the type of climatic conditions prevalent in the vicinity of Cooper Landing. (See exhibits A and B, precipitation data, and climatological summary.) Because of the silty glacial soils, the magnitude of the cuts, the precipitation and runoff potential, the effects of freezing and thawing, and the difficulty of revegetating glacial soils on north facing slopes, the proposed cuts will pose an extreme exposure to the following risks:

(1) Mud Flows

Mud flows are common in glacial deposits containing lenses, zones or significant percentages of silt and/or clay particles. (See photos Exhibit C and Associated Press releases Exhibits D1 and D2).

(2) Slumps and/or shear-type failures.

Slumps and/or deep seated shear-type failures in glacial soil cut slopes are always a possibility. The presence of ground water greatly increases this possibility. Ground water was encountered in the cut from Sta. 1702 to 1712, and its presence is suspected from Sta. 1668 to 1685.

(3) Surficial failures.

Surficial failures in glacial soils are caused by (a) runoff producing erosional scars such as gullying, down slope movement ditch fillings, and siltation in nearby streams, (b) frost penetration and subsequent thawing of saturated ground producing turf slides (see photos Exhibit C), and reexposure of erodible soils to runoff.

Utilizing a 2:1 backslope from Station 1669 to Station 1686 would expose 81,000+ square yards (16.7 acres) of erodible soil. The proposed cut from Station 1702 to Station 1711+31 would expose approximately 22,600 square yards (4.6 acres of erodible soil utilizing the 2:1 backslope. Cutting the slopes at 2:1 will expose more erodible soils during construction than can be reasonably expected to be manageable due to environmental considerations. Utilizing a 1½:1 backslope from Station 1668 to Station 1685 would expose 40,500 square yards (8.4 acres) of erodible soil. The proposed cut from Station 1702 to Station 1712 would expose approximately 15,500 square yards (3.2 acres) of erodible soil utilizing the 1½:1 backslope.

It is the opinion of this office that cutting a 1½:1 slope in the subject soils is too steep for consideration.

Construction Problems

(1) Application of erosion control matting or mesh and seeding of all exposed backslopes and installation of subdrainage systems would be required as cut excavation proceeded downward. There is no assurance that these measures would be successful. If slope failures (either shear failures of mud-flow failures) occur after completion of the full cut section, it is doubtful that lasting repairs could be successfully accomplished. Mud flow failures are considered to be quite likely.

(2) In addition to the poor soils quality in the cut areas a water table was encountered at elevation 474+ in TH-4 at Station 1708+50. This could cause extensive erosion and slumping of soils where the water seeps out of the cut slope. Although a definable water table was not detected in the three preliminary borings placed in the interval from Station 1668 to Station 1685, it is the opinion of this office and the Standards and Technical Services Geotechnical Staff that it is highly probable that ground water will be encountered during construction of this cut also.

(3) The silty soils and other waste from the subject cuts would be difficult for the contractor to handle, particularly during a wet season (see photos Exhibit C). Since most of the cut materials are glaciofluvial silty soils (deposited by stream runoff from glaciers) they will be waste.

Utilizing a 2:1 cut slope will result in a cut 280+ feet high from Station 1669 to Station 1687 and a cut 150 feet high from Station 1701 to 1712. This will produce 775,000 cubic yards of waste in the first interval requiring a disposal area of 40+ acres to pile it 12 feet high and 268,000 cubic yards of waste in the second interval requiring a disposal area of 14+ acres to pile it 12 feet high.

(4) Because of the magnitude of the proposed cuts and the large areas of slope, it is unlikely that runoff during construction can be controlled sufficiently to prevent silt laden water from entering the Kenai River, particularly during wet seasons.

(5) The subject cut slopes are north facing and will develop vegetation slowly, if at all. Even the use of mechanical stabilization aids such as chain-link fencing combined with seeding will not produce satisfactory and lasting results in the glacial soils.

Maintenance Problems

If the subject cut slopes are constructed, long term maintenance efforts will consist of:

(a) Removing mud and turf from ditches.
(b) Reconstructing drainage control and filtration devices.
(c) Installing fences to block falling pebbles and cobbles.
(d) Constructing gravel blankets and filling erosional scars along lower slopes.
(e) Reseeding, replanting and refertilizing slopes inaccessible to equipment.
(f) Repairing and/or replacing erosion control matting or mesh.
(g) Maintenance efforts on a far larger scale should major mud flows or deep seated shear failures occur.

It should be noted that because of the height of the proposed backslopes, it may be nearly impossible to get on to these slopes with equipment for the inevitable maintenance efforts.

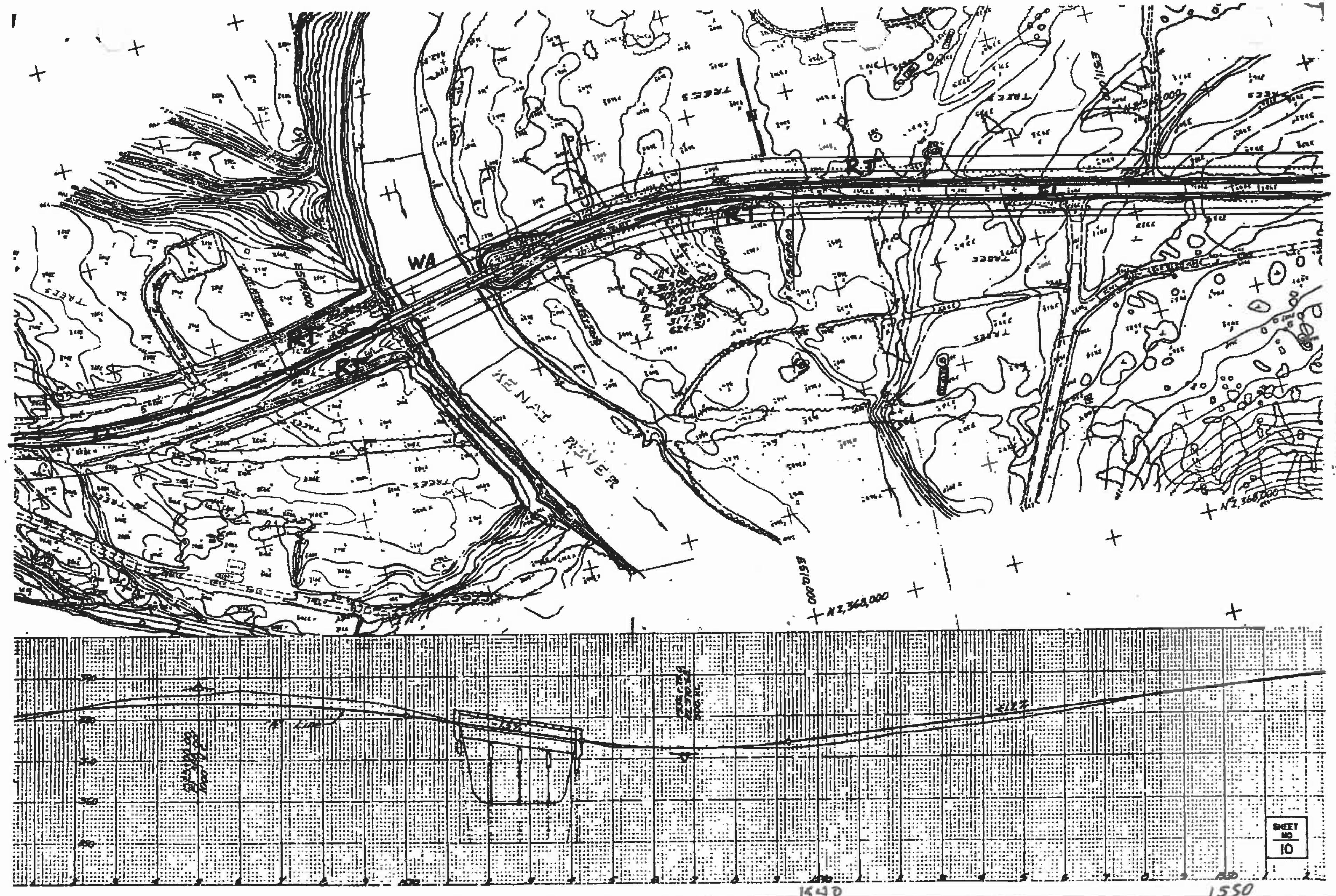
Summary

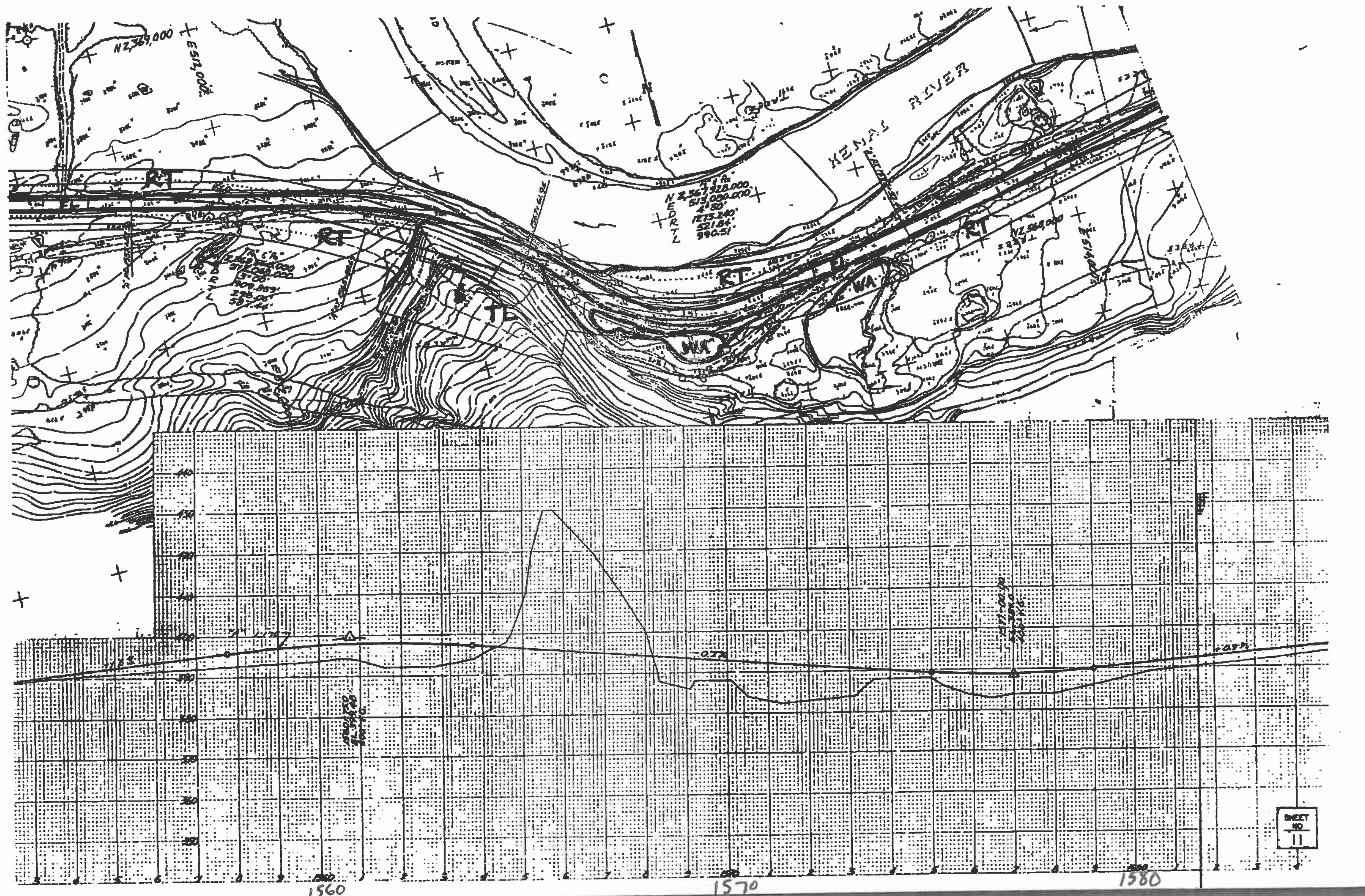
The foregoing data and considerations and the attached exhibits present a variety of problems which are very serious both individually and in combination. Because of geotechnical considerations and the hazards to the traveling public and the environment it is recommended that alternatives to the major cuts on the "BA" alignment be actively sought.

MGH

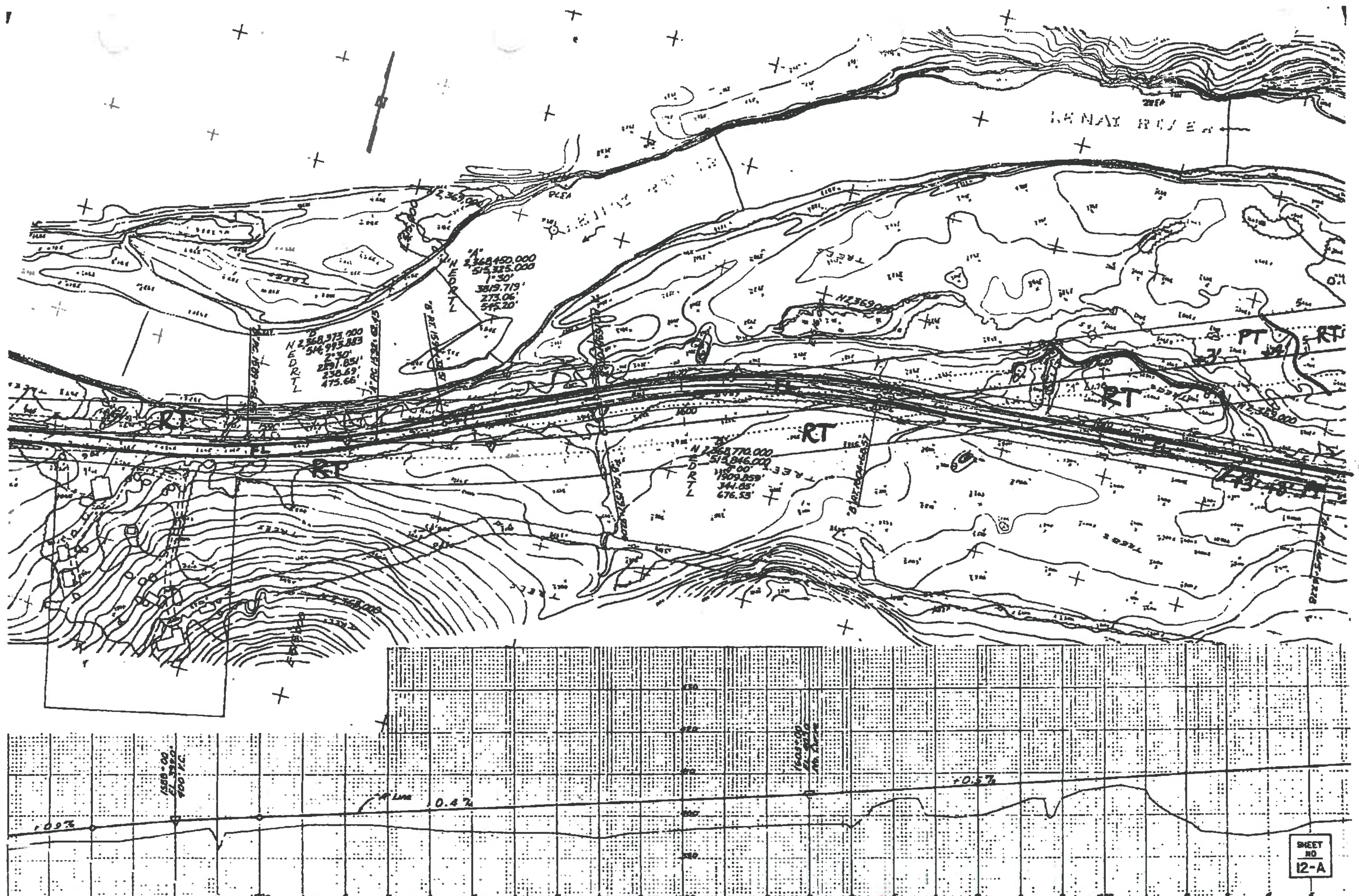
FPN/MGH/sd

F-021-2(15)

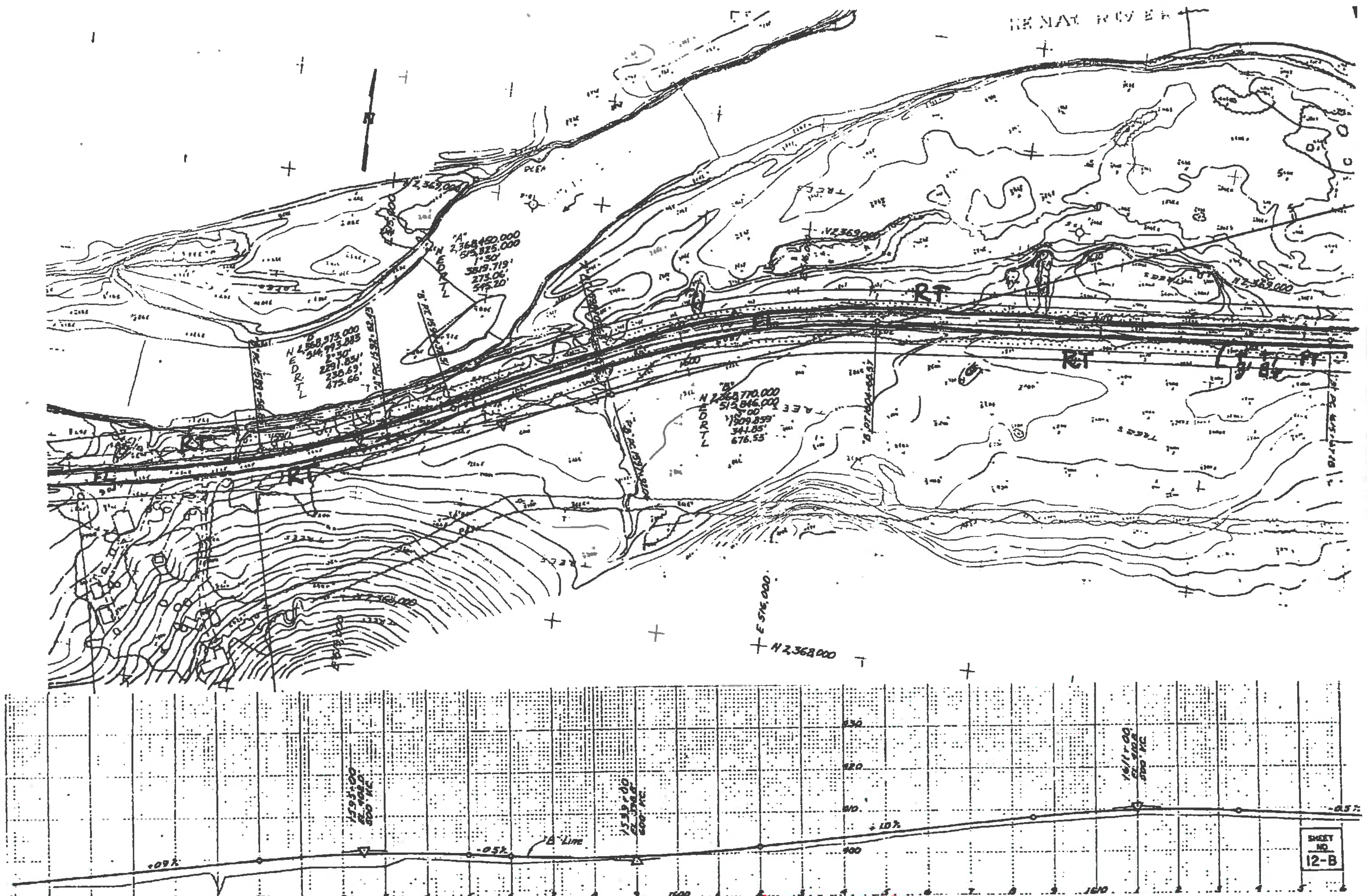



KENAI RIVER
SHEET NO 11
1560
1570
1580

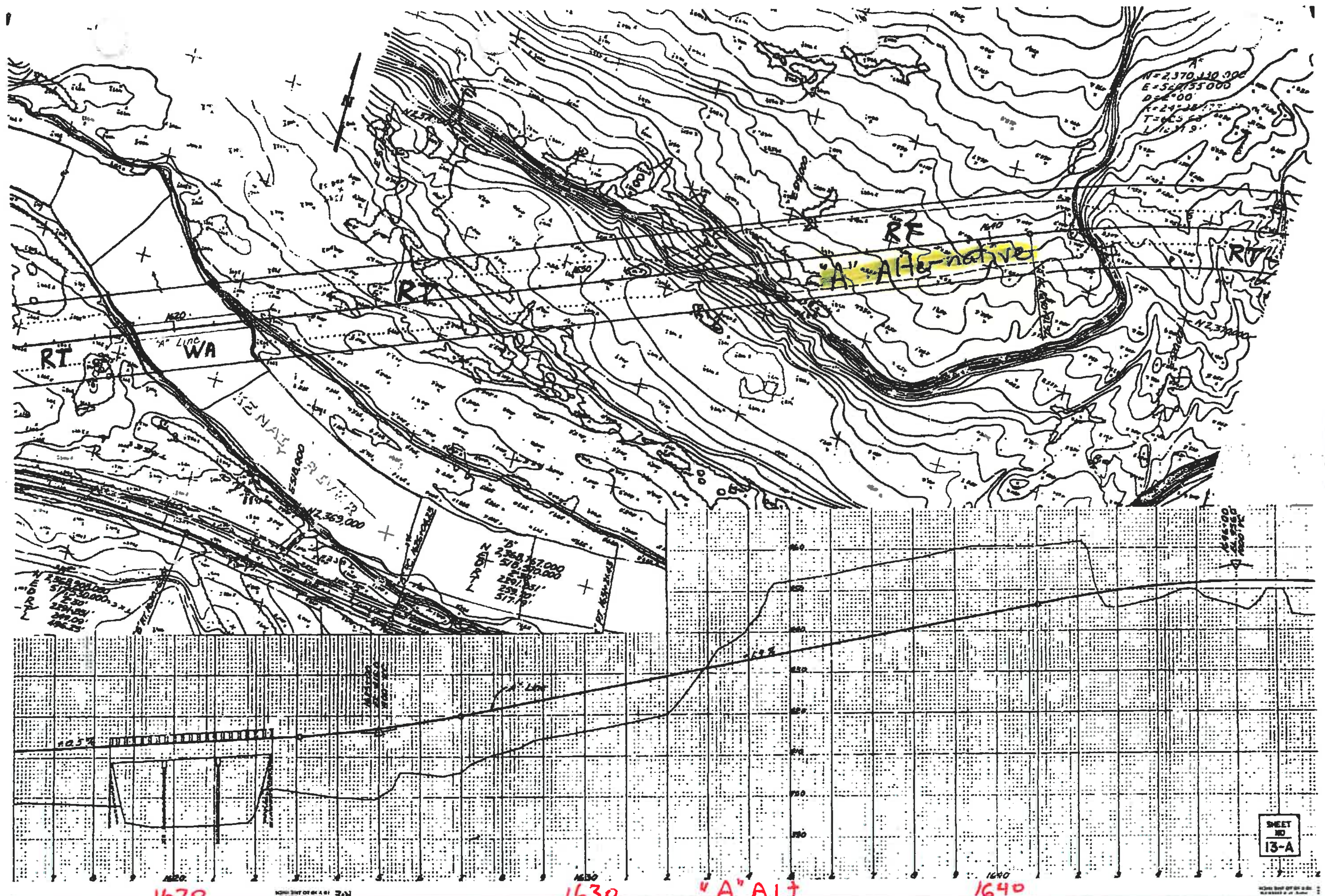
F-021-2(15)

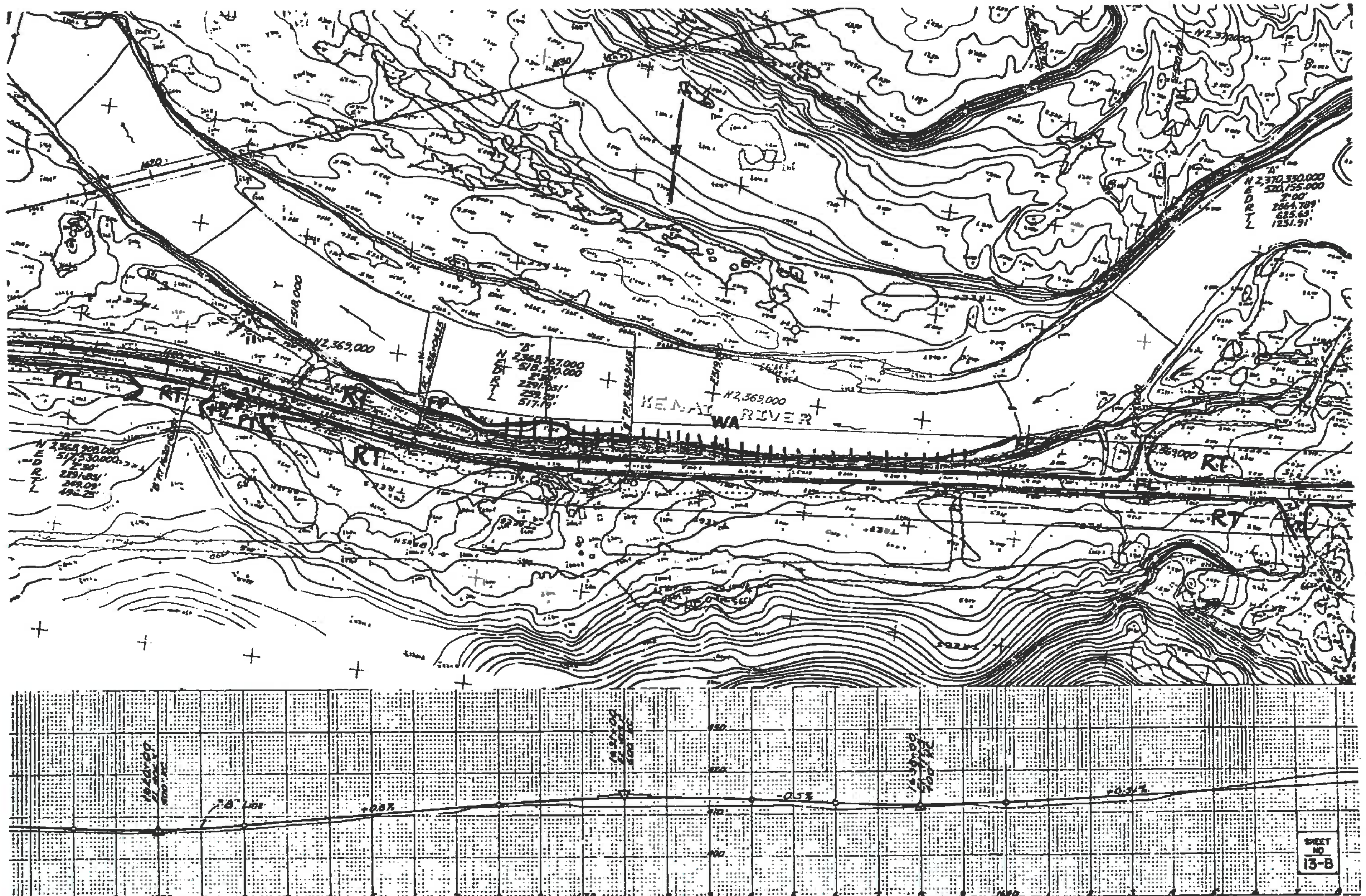


1590 A Alternative 1610

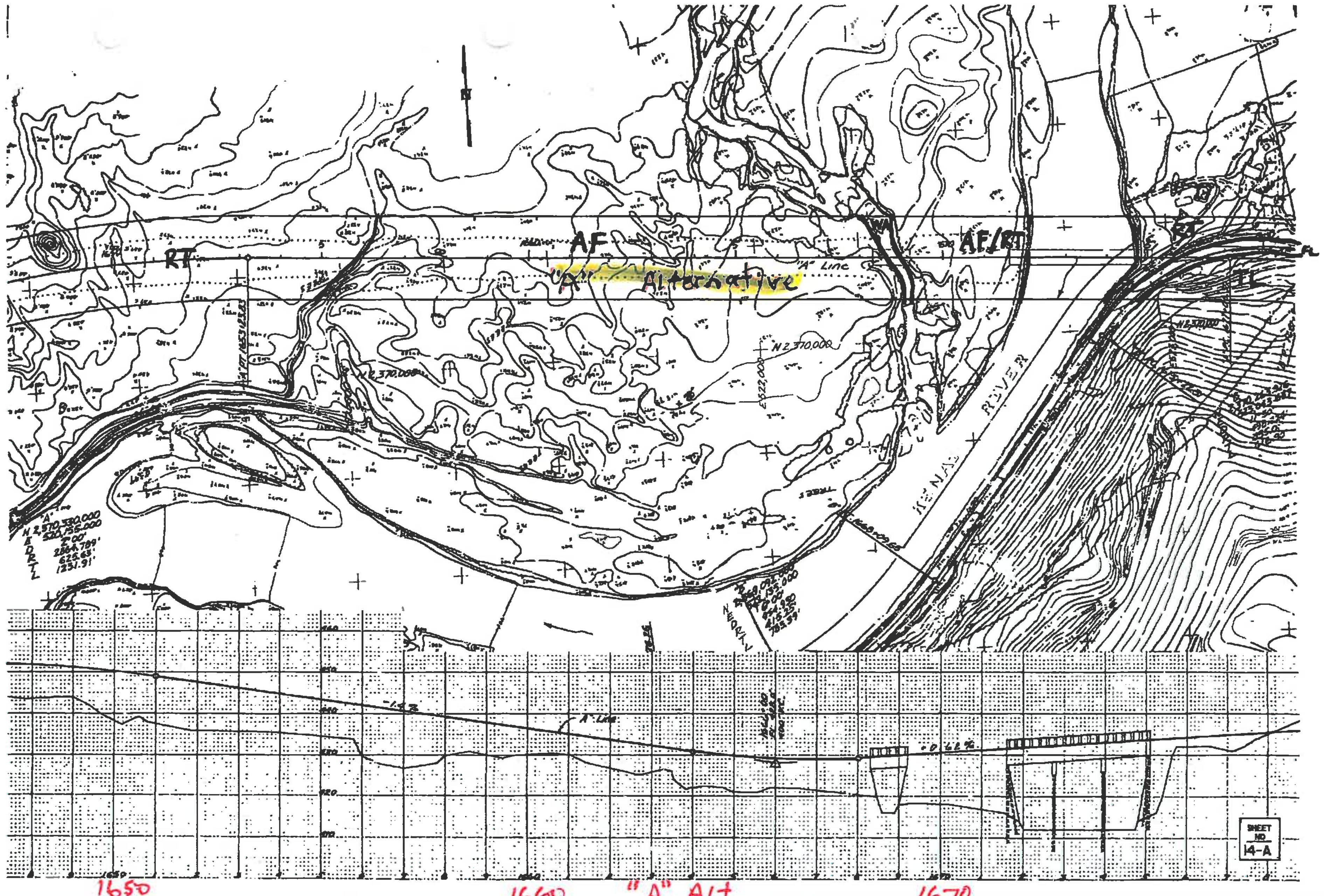


1590 B Alternative 1610


RT
WA
RT
RF
"A" Alternative
RT
"A" Line
KENAI RIVER
SHEET NO
13-A
1620
1630
"A" ALT
1640

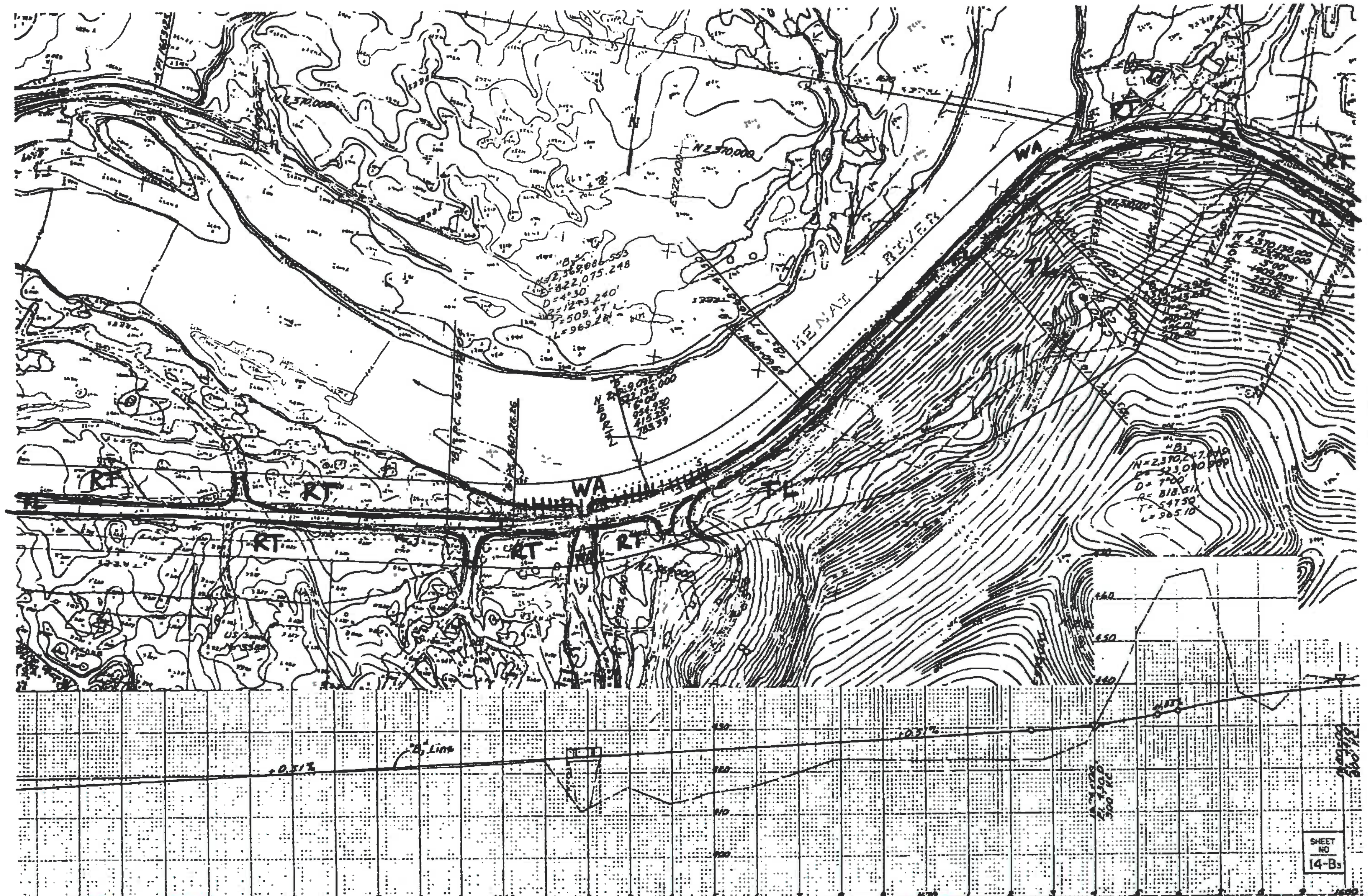


1620 "B" Alt. 1630 1640

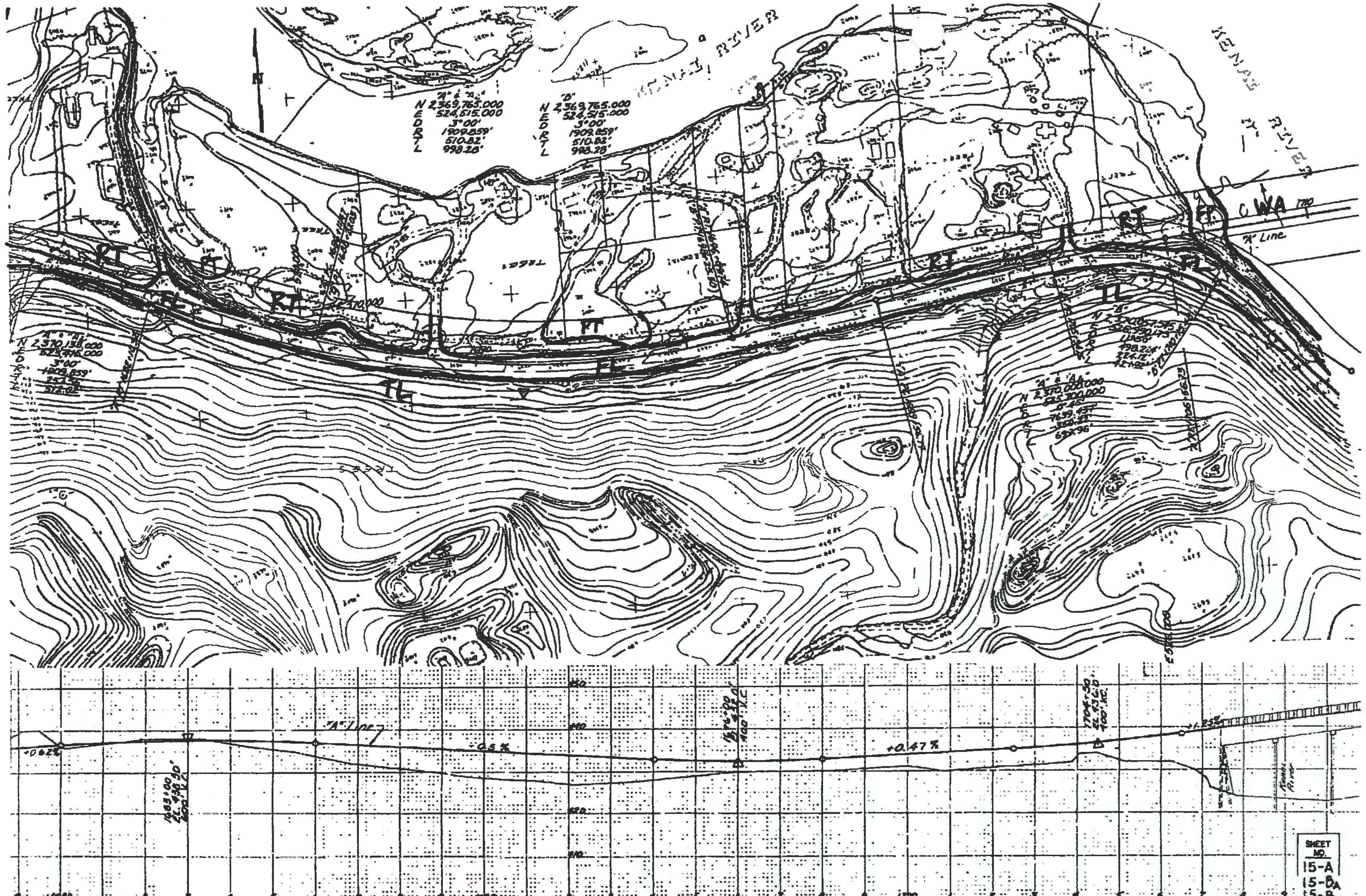


RT
AF
AF/RT
"A" Alternative
"A" Line
N 2,370,000
KENAI RIVER
SHEET NO 14-A
1650
1660
"A" Alt
1670

F-021-2(15)

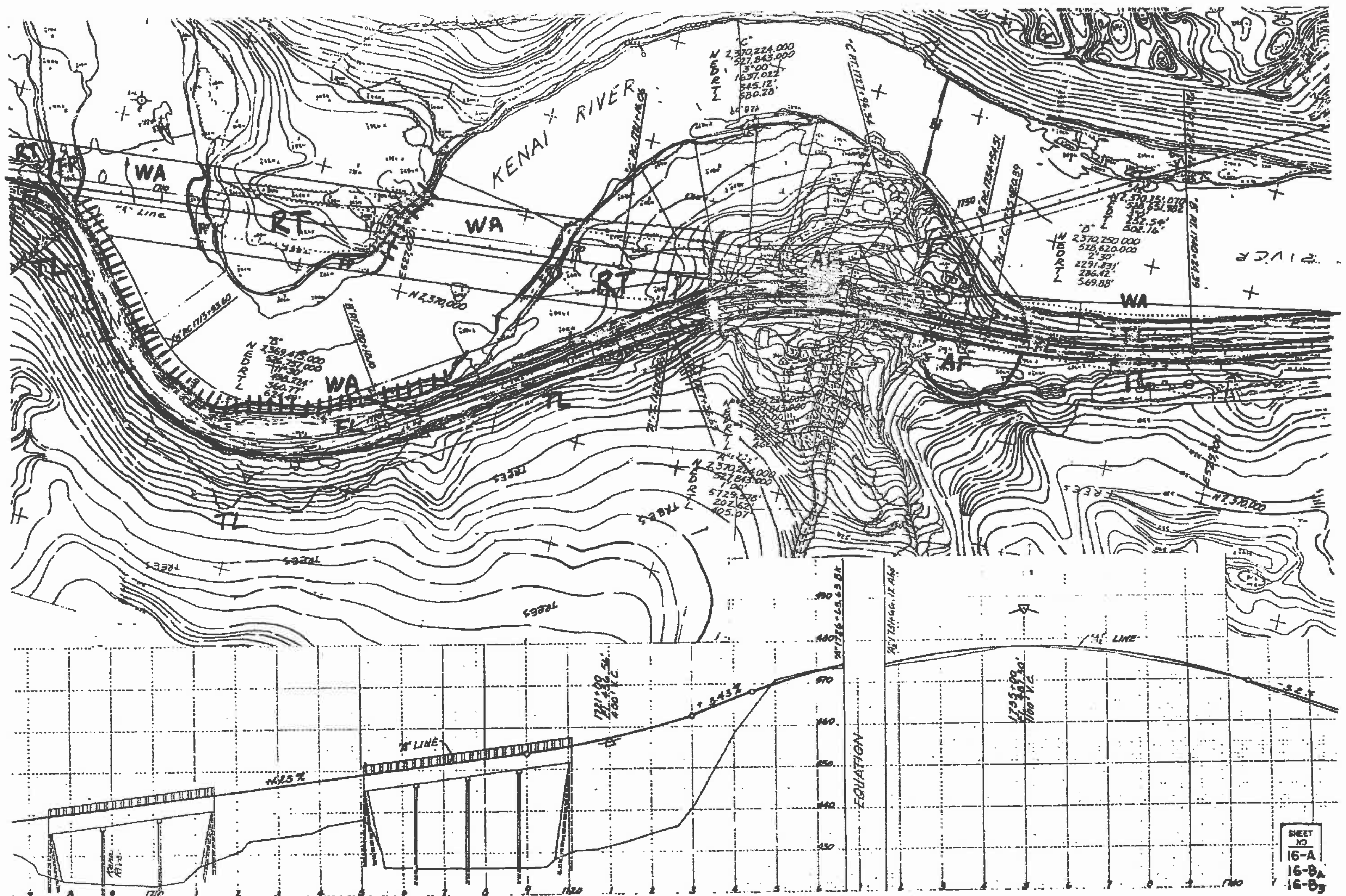


1650 "B" Alt "B" 1660 1670 1680

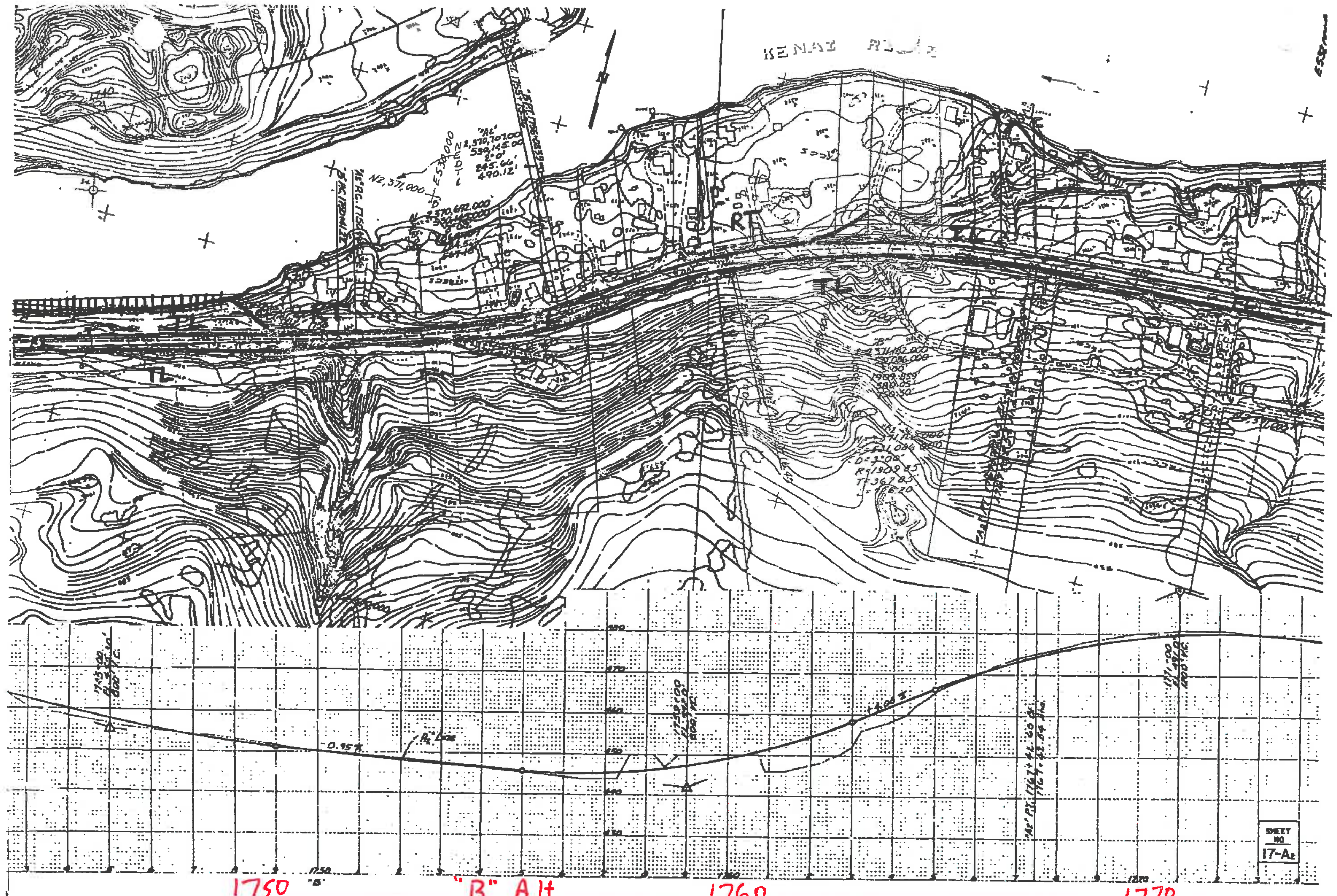


1680 1690 1700

F-021-2(15)



1710 1720



SHEET NO
17-A2
1750
"B" Alt.
1760
1770

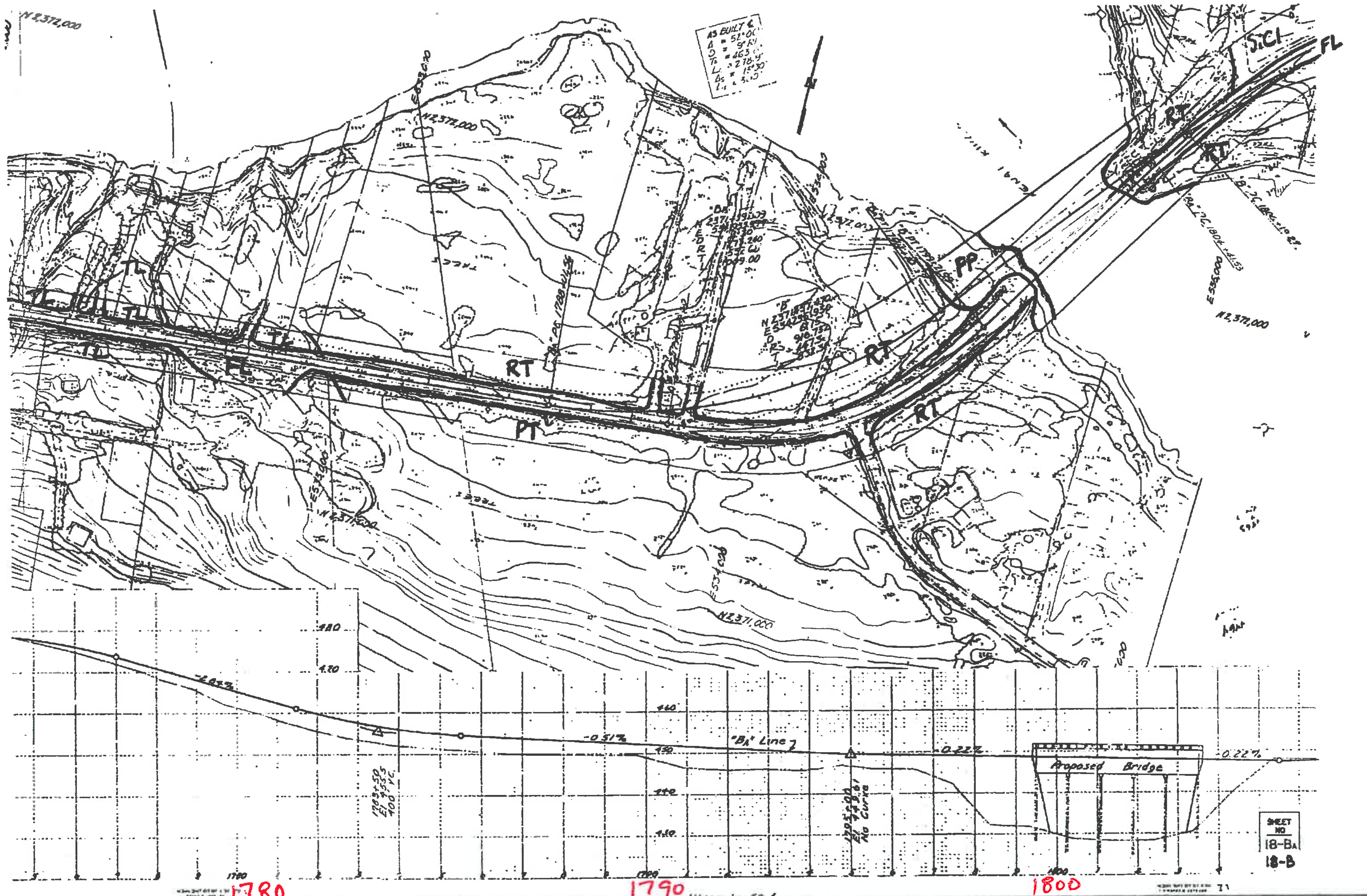
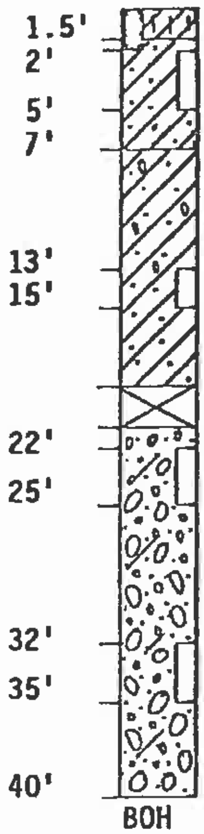

RT
PT
PP
FL
"BA" Line
-0.51%
-0.22%
0.22%
Proposed Bridge
SHEET NO
18-BA
18-B
1780
1790
1800

Exhibit E
Boring and Laboratory test data

TH-2
Sta. 1672+00, 240' Rt. ℄ "B_3"
01-18-83



Dark brown Organic Silt, with roots.
FS-9 Gray-brown Sandy Silt, A-4.
50% P_{200}. 14.9% NM.

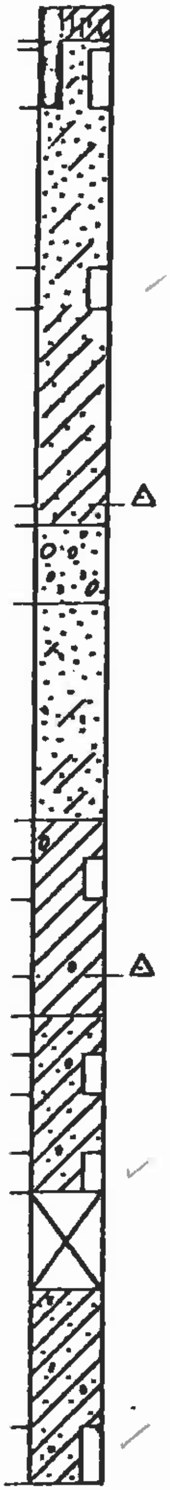
Gray Gravelly Sandy Silt, Damp.
Some Cobbles.

FS-10 Gray Sandy Silt, A-4.
61% P200. 22.2% NM.

FS-11 Gray Silty Sandy Gravel, A-1-b.
23% P200. 6% NM.
Some cobbles.

FS-12 Gray Silty Sandy Gravel, A-1-b.
17% P200. 4.6% NM.

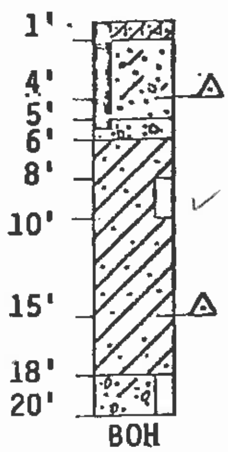
TH-1
Sta. 1674+90, 210' Rt. L "B3"
01-18-83



1.5'	Brown Organic Silt, with roots.
2'	FS-1 Gray Slightly Silty Sand, A-2-4.
5'	11% P200.
	Damp, thin Silty layers.
	Easy, rapid drilling.
13'	FS-2 Sandy Silt, A-4.
15'	38% P200. 7.6% NM.
25'	Δ MS-3 16.1% NM.
26'	Gray Gravelly Sand. Damp. Tougher drilling.
30'	Gray Sand. Some thin Silt layers. Trace Gravel, flattish, rounded shale. Becomes siltier with depth.
41'	Trace Gravel.
43'	FS-4 Light brown-gray Silt, A-4.
45'	80% P200. 13.7% NM.
49'	Δ MS-5 17.3% NM. Silt balls off auger.
51'	Trace Gravel.
53'	FS-6 Gray Sandy Silt, A-4.
55'	68% P200. 11.1% NM.
58'	FS-7 Gray Sandy Silt, A-4.
60'	46% P200. 11.1% NM.
65'	
72'	FS-8 Gray Gravelly Sandy Silt, A-4.
75'	43% P200. 10.3% NM.

BOH

TH-5
Sta. 1679+00, 50' Rt. ℄ "B_3"
01-21-83



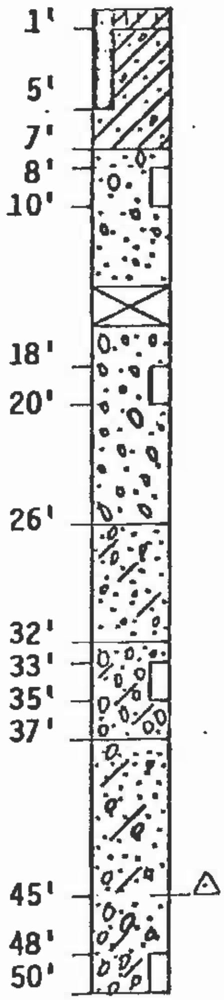
Dark brown Organic Sandy Silt, with roots.
Brown-gray Silty Sand, trace Gravel. Some roots.
MS-24 12.6% NM.
Gray Gravelly Sand.

FS-25 Brown Sandy Silt, A-4.
60% P_{200}.

MS-26 15.5% NM.

FS-27 Brown Silty Gravelly Sand, A-1-b.
24% P_{200}. 14.2% NM.
Trace Cobbles.

TH-3
Sta. 1710+50, 210' Rt. ℄ "B_A"
01-20-83



Dark brown Organic Silt, with roots.
Gray Gravelly Sandy Silt, with roots.
Some Cobbles.

FS-13 Gray Gravelly Sand, A-1-b.
6% P_{200}. 3.4% NM.
Round to subround Gravel

Easy drilling.

FS-14 Gray Sandy Gravel, A-1-a.
5% P_{200}. 3.2% NM.

Gray Silty Gravelly Sand. Damp.

FS-15 Gray Slightly Silty Sandy Gravel, A-1-a.
7% P_{200}. 3.4% NM.
Tougher drilling.

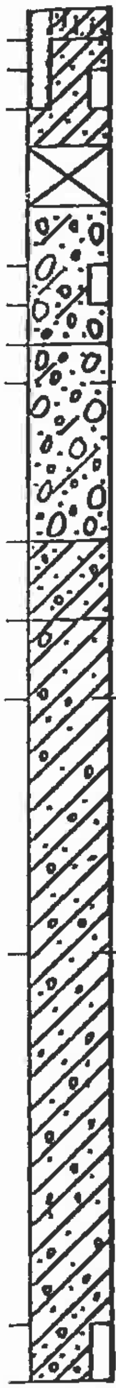
Gray Silty Gravelly Sand. Damp.
Easier drilling.

MS-16 2.9% NM.

FS-17 Gray Slightly Silty Sandy Gravel, A-1-a.
9% P_{200}.

BOH

TH-4
Sta. 1708+50, ℄ "B_A"
01-20-83



1.5' — Dark brown Organic Sandy Silt.

3' — 5' — FS-18 Gray Sandy Silt, A-4.
51% P_{200}. 29.1% NM.

Some Cobbles.

13' — 15' — FS-19 Gray Slightly Silty Sandy Gravel, A-1-a.
12% P_{200}.

17' — 19' — MS-20 Gray Silty Sandy Gravel, A-2-4.
30% P_{200}. 6% NM.

27' — Light gray Sandy Silt, trace Gravel. Wet.
Material is soupy coming off auger.

30' ▽

31'

35' — MS-21 10.4% NM.

Gray Sandy Gravelly Silt. Some Cobbles.

Cobbly. Coarse drilling.

48' — MS-22 18.7% NM.

Easy drilling.

Soupy material coming off auger.

Tough drilling.

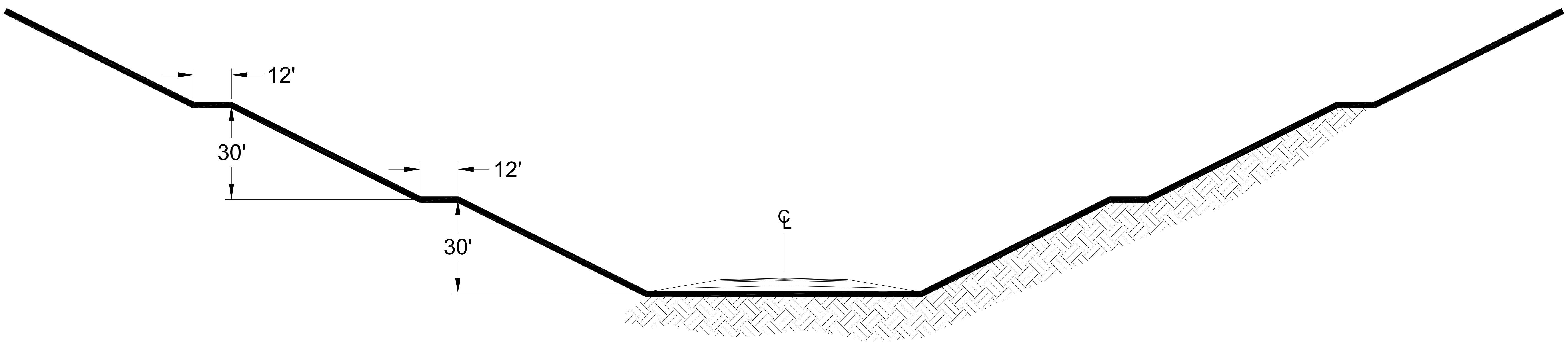
67' — 70' — FS-23 Gray Silty Gravelly Sand, A-1-b.
23% P_{200}. 9.7% NM.

70'

BOH

2013 Cooper Creek Alternative Drawings and Cross Sections

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
ALASKA	53014	2014	1	5



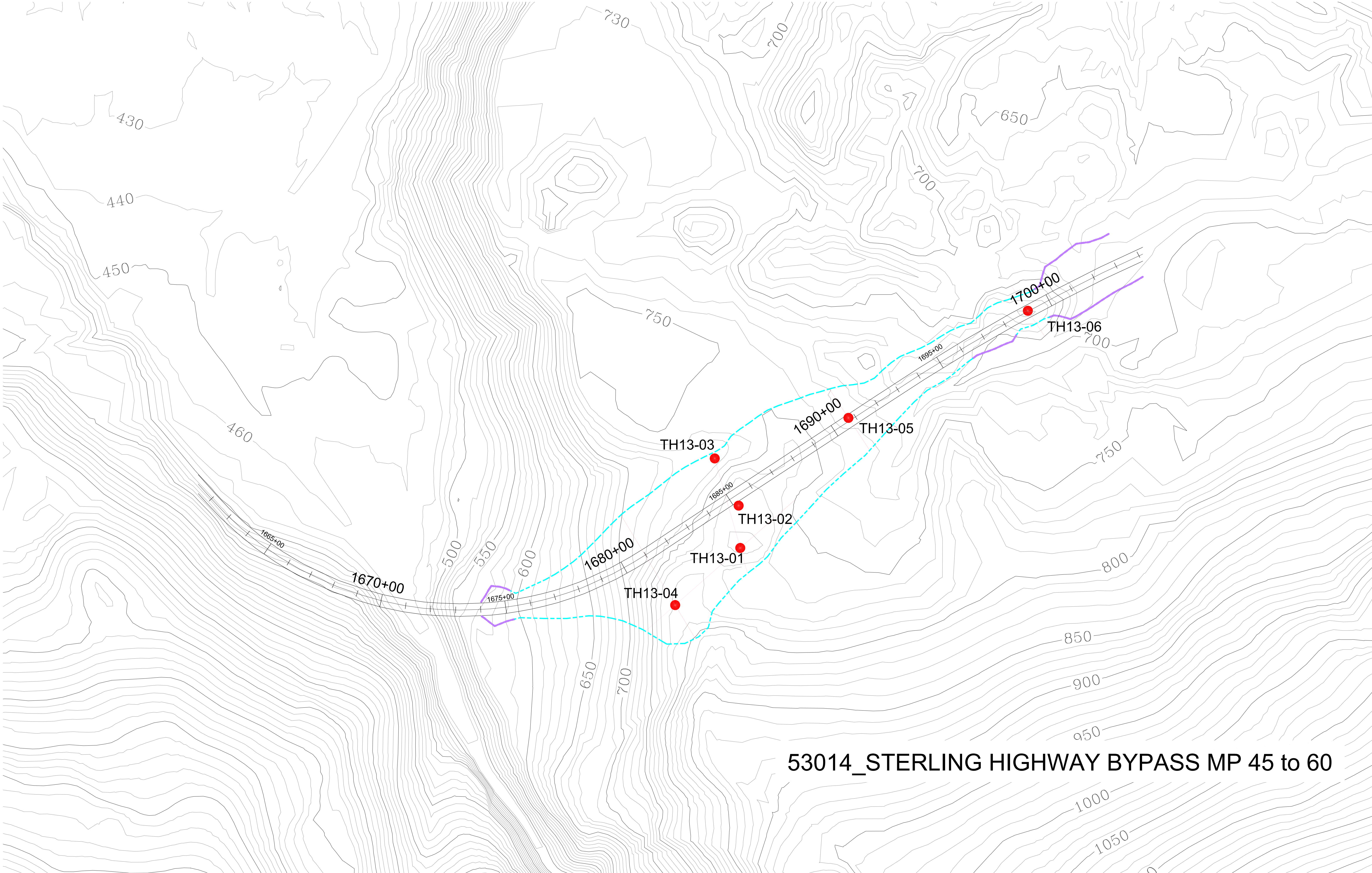
TYPICAL SECTION

DESIGNED BY:	CHECKED:		
DRAWN BY: D.R.DODGE			
FILE: N:\Central\Hwy\Sterling Hwy MP 45-60 Bypass #53014\Data\ACAD\53014_Sterling Hwy MP45-60 X-Section 12-08-14.dwg			

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
CENTRAL REGION MATERIALS

STERLING HIGHWAY
MP 45 to 60
TYPICAL SECTION

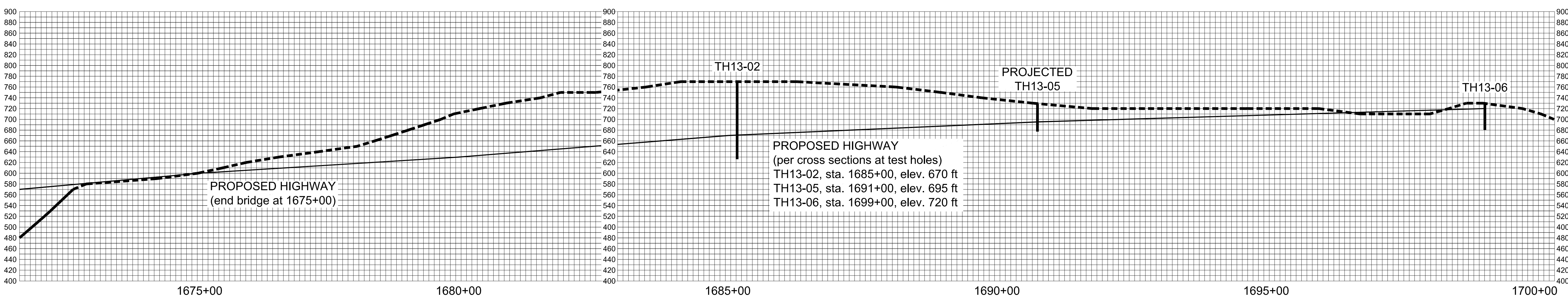
DWG. No. 1



53014_STERLING HIGHWAY BYPASS MP 45 to 60

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
ALASKA	53014	2014	1	1

PROPOSED COOPER CREEK ALTERNATIVE
PROFILE VIEW



DESIGNED BY:	CHECKED:		
DRAWN BY: D.R.DODGE			

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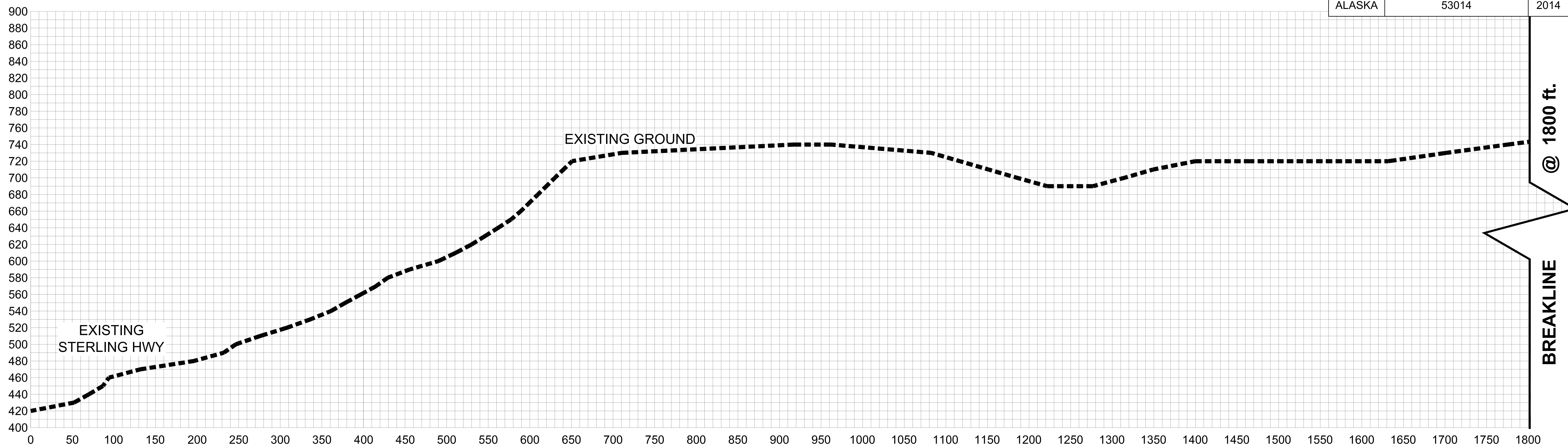
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES
CENTRAL REGION MATERIALS

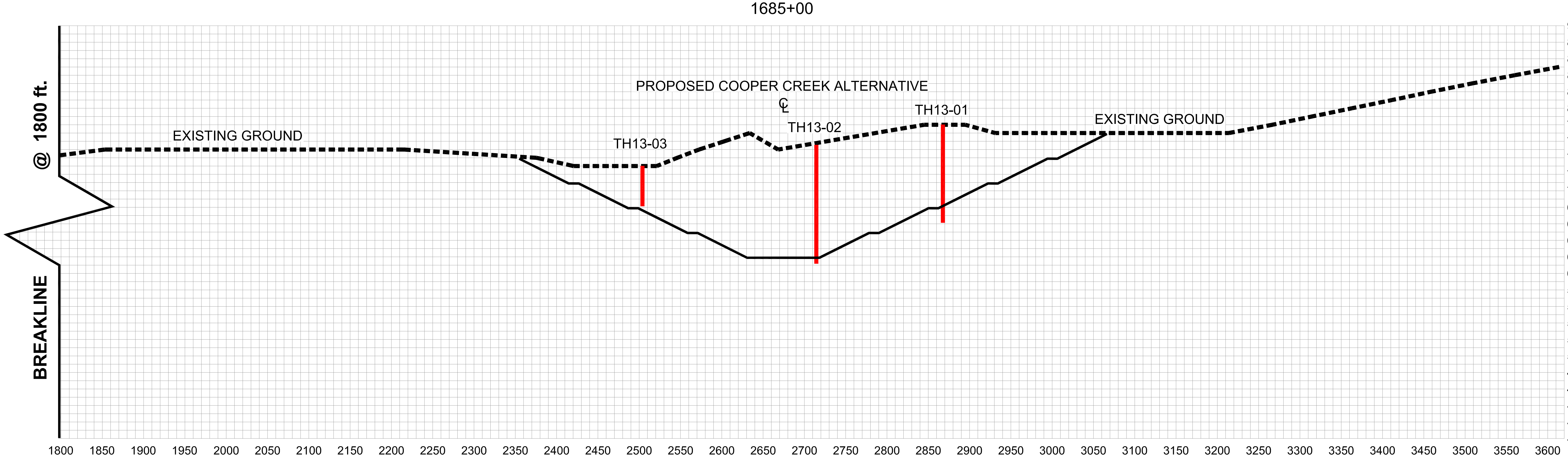
STERLING HIGHWAY
MP 45 to 60
PROPOSED COPPER CREEK
ALTERNATIVE

DWG. No. 1

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
ALASKA	53014	2014	1	2



1685+00



DESIGNED BY:

CHECKED:

DRAWN BY: D.R.DODGE

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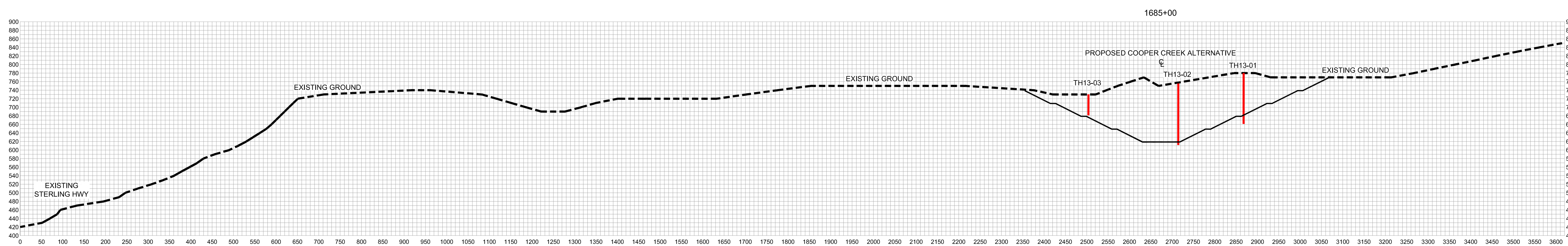
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES
CENTRAL REGION MATERIALS

STERLING HIGHWAY MP 45 to 60
PROPOSED COPPER CREEK ALTERNATIVE
CROSS SECTION @ 1685+00

DWG. No. 1

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
ALASKA	53014	2014	1	2



DESIGNED BY:	CHECKED:			STATE OF ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES CENTRAL REGION MATERIALS		STERLING HIGHWAY MP 45 to 60 PROPOSED COPPER CREEK ALTERNATIVE	DWG. No. 2
DRAWN BY: D.R.DODGE							

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STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
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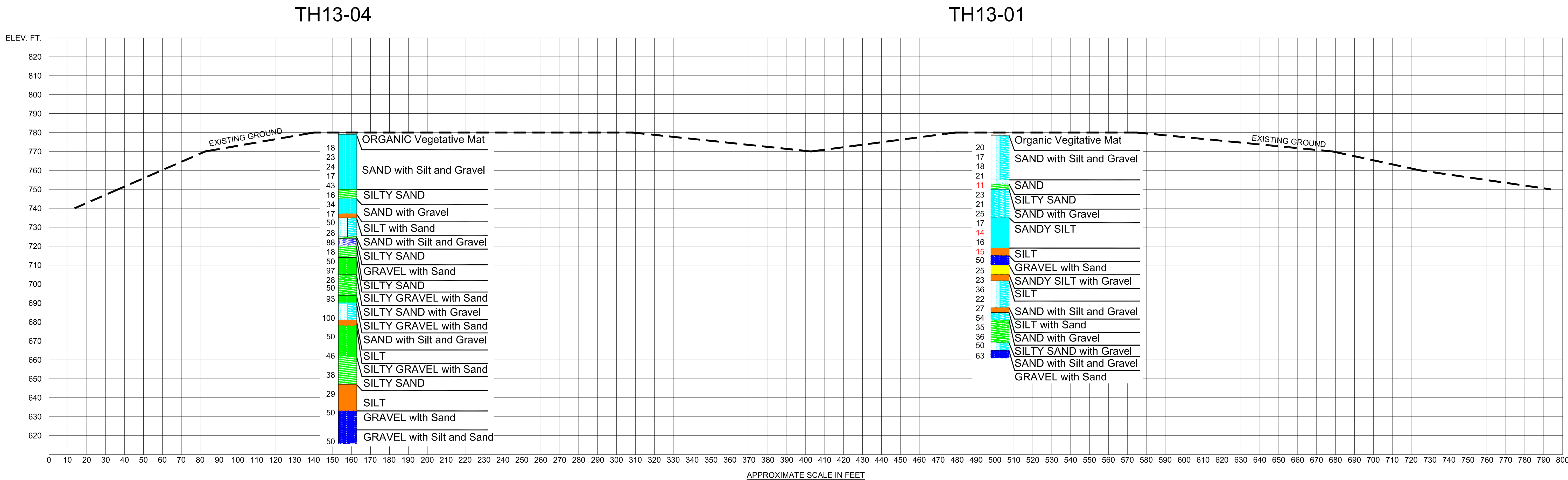

DESIGNED BY:	CHECKED:		
DRAWN BY: D.R.DODGE			

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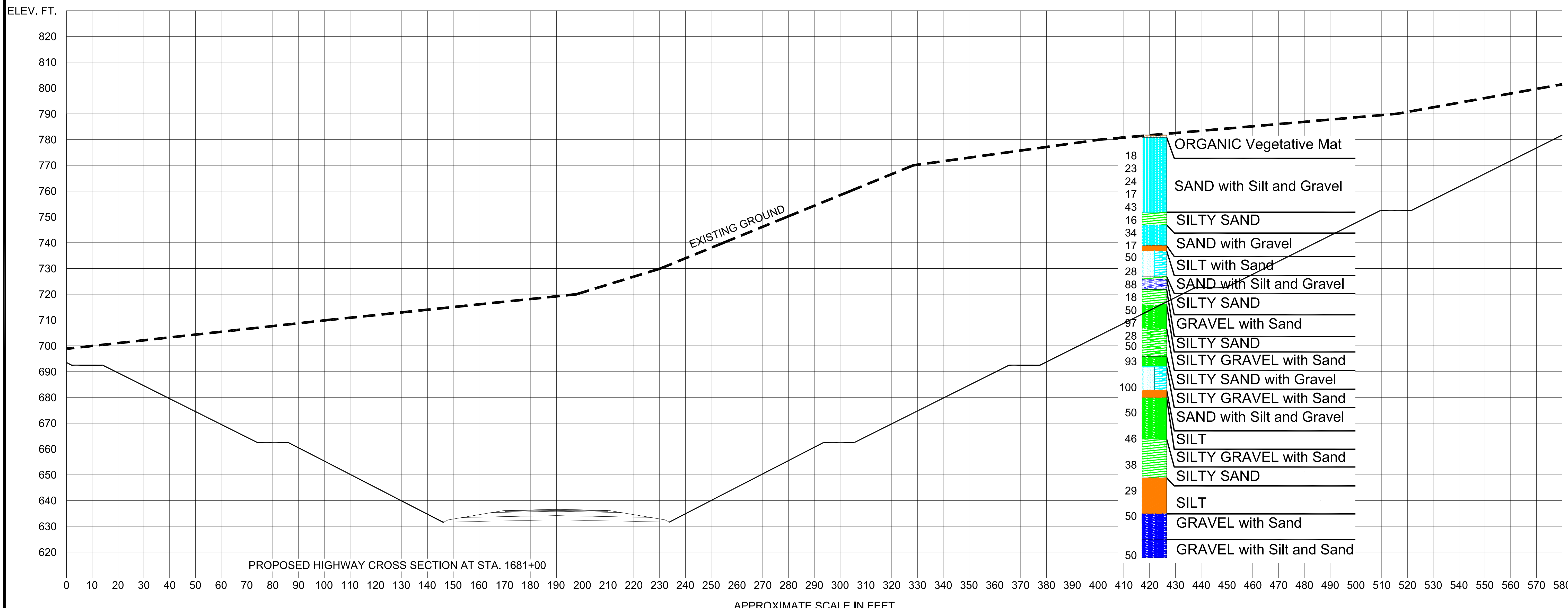
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES
CENTRAL REGION MATERIALS

STERLING HIGHWAY
MP 45 to 60
CROSS SECTION

DWG. No. 1

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
ALASKA	53014	2014	2	5

TH13-04



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DRAWN BY: D.R.DODGE			DWG. No. 2
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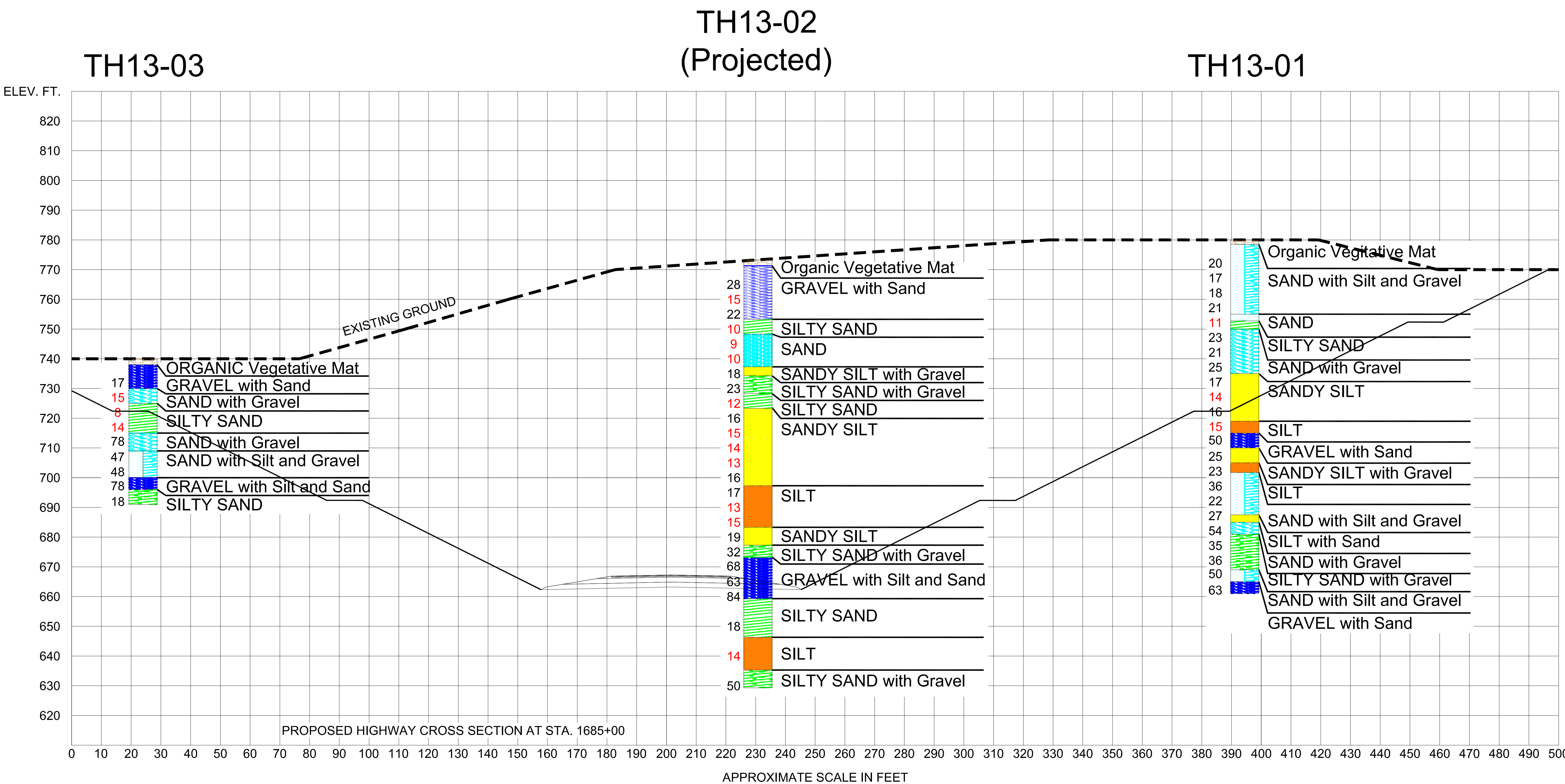

DESIGNED BY:

CHECKED:

DRAWN BY: D.R.DODGE

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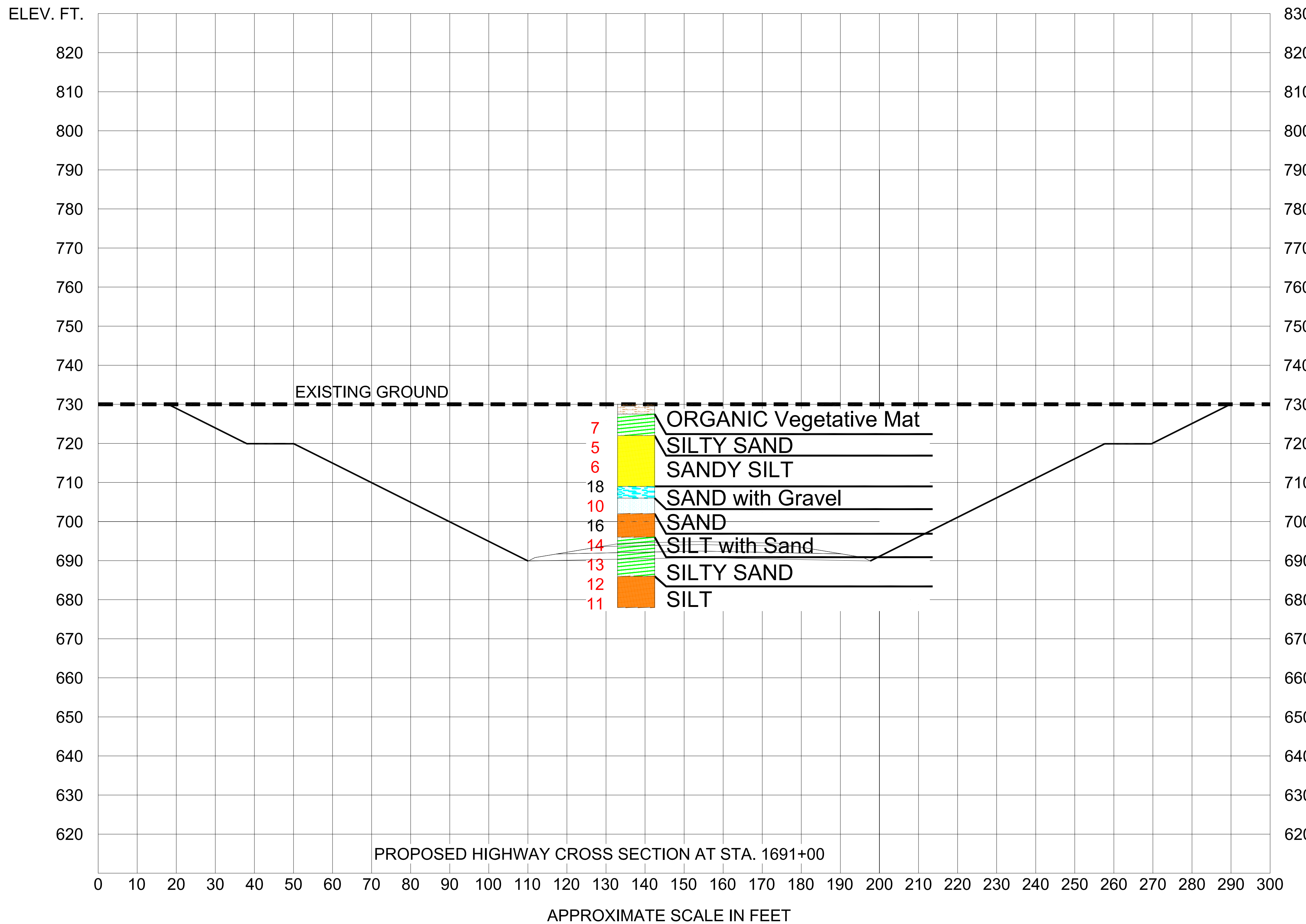
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES
CENTRAL REGION MATERIALS

STERLING HIGHWAY
MP 45 to 60
CROSS SECTION

DWG. No. 3

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
ALASKA	53014	2014	4	5

TH13-05



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DRAWN BY: D.R.DODGE			

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STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES
CENTRAL REGION MATERIALS

STERLING HIGHWAY
MP 45 to 60
CROSS SECTION

DWG. No. 4

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
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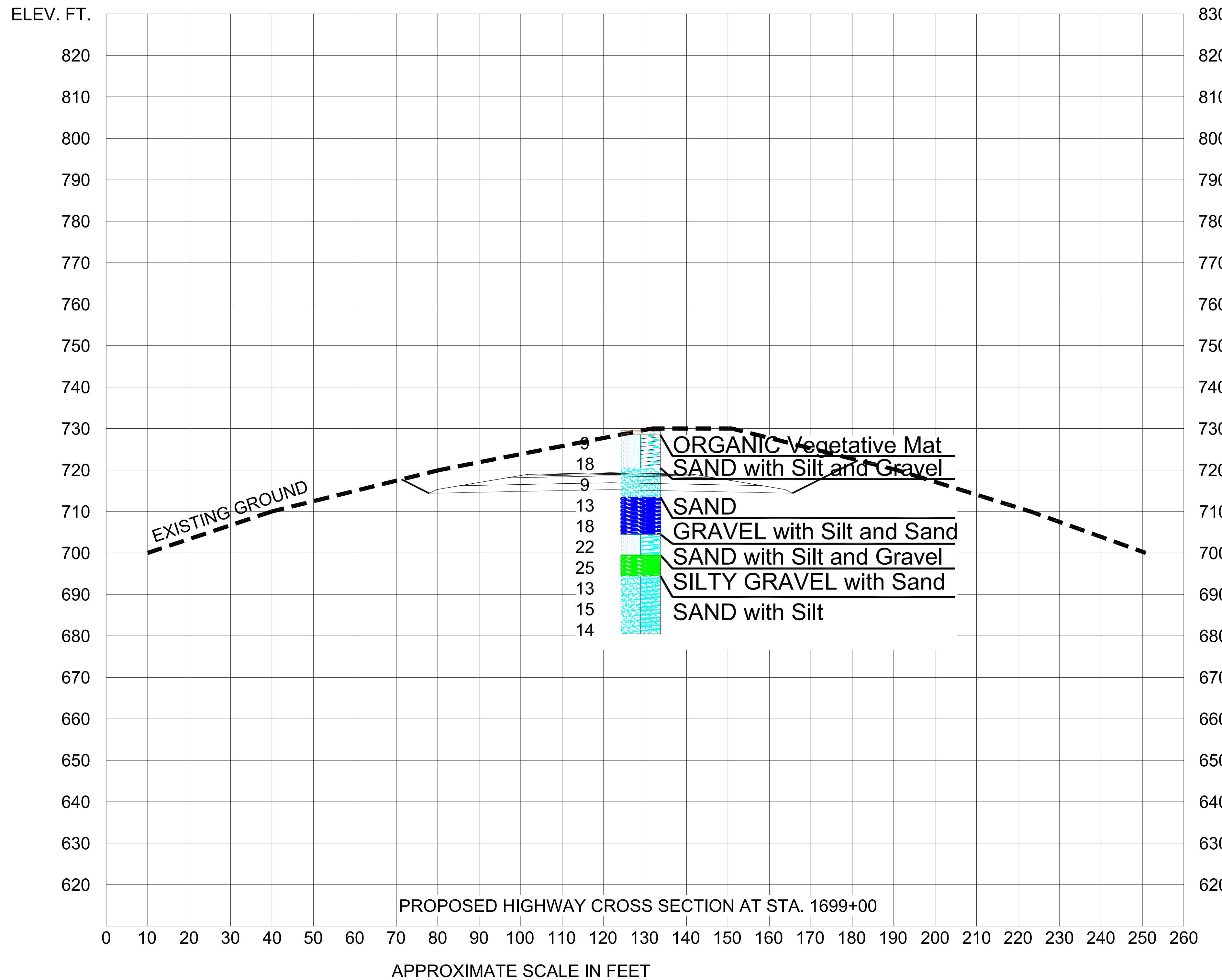
TH13-06



DESIGNED BY:	CHECKED:		
DRAWN BY: D.R.DODGE			

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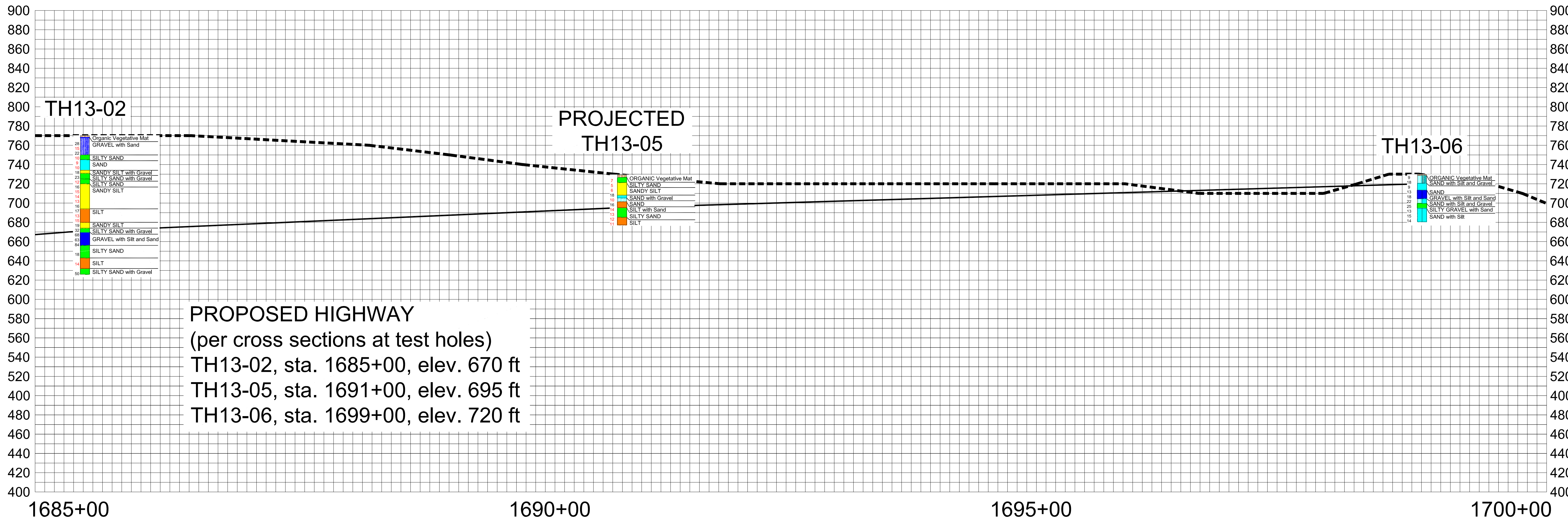
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES
CENTRAL REGION MATERIALS

STERLING HIGHWAY
MP 45 to 60
CROSS SECTION

DWG. No. 5

STATE	PROJECT DESIGNATION	YEAR	SHEET No.	TOTAL SHEETS
ALASKA	53014	2014	1	1

PROPOSED COOPER CREEK ALTERNATIVE
PROFILE VIEW



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DRAWN BY: D.R.DODGE							
FILE: N:\Central\Hwy\Sterling Hwy MP 45-60 Bypass #53014\Data\ACAD\53014_Sterling Hwy MP45-60 Profile 12-16-14.dwg							

ATTACHMENT 2

Propex Armormax ™

Specifications, Typical Drawing, and Costs

Boeckman, Craig T (DOT)

From: John Oldenburger <John.Oldenburger@propexglobal.com>
Sent: Friday, May 01, 2015 8:29 AM
To: Boeckman, Craig T (DOT)
Subject: RE: Armormax to stabilize erosion features

Craig – that should not change the price much, maybe bump it up $5/SY.

- The ArmorMax System (Pyramat HPTRM with specialized tie-down 9 ft anchors) for slope stability applications installs for approximately $45 to $65/SY, depending on the size, frequency, and length of anchors, the size of the job, site access, wage rates, etc. This is a contractor installed price and includes material, delivery, labor, etc.; grading and site preparation is excluded. When determining the quantity of ArmorMax required for installation, include sufficient material for trenches, overlaps, and overages – add 15 to 25% (sometimes more depending on site specifics) to surface/coverage area.

Thanks!

John

John Oldenburger III, P.E.
Propex Operating Company, LLC
Territory Business Manager
Mobile: 916-416-1670
http://www.propexglobal.com

From: Boeckman, Craig T (DOT) [mailto:craig.boeckman@alaska.gov]
Sent: Friday, May 01, 2015 12:27 PM
To: John Oldenburger
Subject: RE: Armormax to stabilize erosion features

100x50 =

Hi John
They actually recommended the longer Anchor (9ft). Does that change the cost?
Thanks

From: John Oldenburger [mailto:John.Oldenburger@propexglobal.com]
Sent: Friday, May 01, 2015 8:23 AM
To: Boeckman, Craig T (DOT)
Subject: RE: Armormax to stabilize erosion features

200x50

Craig,

Sorry I am just getting back to you. AK installation costs may be higher than the information below, but this will be a good starting point.

ARMORMAX®
BY PROPEX

Product Data

ARMORMAX FOR SLOPE STABILITY

The **ArmorMax®** Anchor Reinforced Vegetation System (ARVS) is an engineered solution used for permanent erosion protection or surficial slope stability in vegetated and unvegetated applications. It is composed of two components: Pyramat® High Performance Turf Reinforcement Mat (HPTRM) and Percussion Driven Earth Anchors (PDEAs). ArmorMax is available in green or tan to provide for an aesthetically pleasing solution with proven performance. The PDEA component is specifically designed and tested for compatibility and performance with Pyramat to provide a system solution. Propex offers several PDEA options to provide the ArmorMax system designed for specific challenges and needs. The expected design life of **ArmorMax** is 50 years because of its superior UV resistance, resistance to corrosion, strength, and durability in the most demanding environments.

The Pyramat component of **ArmorMax®** has been tested and conforms to the property values listed below[1] while manufactured at a Propex facility having achieved ISO 9001:2000 certification. Propex also performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP).

The Type B2 Anchor model is used for surficial slope stability applications and has a working load of up to 3,000 lbs. The Type B2 Anchor consists a hot dip galvanized ductile iron anchor head, a zinc plated steel 3/8" all thread rod, and a galvanized sheet steel load bearing plate. The Type B2 Anchor is also designed with a recessed cavity so the top of the rigid tendon can be cut below the surface being protected.

Propex™ Geotextile Systems

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ph 423 899 0444 · ph 800 621 1273 · fax 423 899 7619

ARMORMAX®
BY PROPEX

Product Data

PYRAMAT PROPERTIES

		MARV[2]	
PROPERTY	TEST METHOD	ENGLISH	METRIC
ORIGIN OF MATERIALS			
% U.S. Manufactured Inputs		100%	100%
% U.S. Manufactured		100%	100%
PHYSICAL			
Mass/Unit Area	ASTM D-6566	13.5 oz/yd^2	457.7 g/m^2
Thickness	ASTM D-6525	0.4 in	10.2 mm
Light Penetration (% Passing)	ASTM D-6567	15% (Max)	15% (Max)
Color	Visual	Green or Tan	
MECHANICAL			
Tensile Strength (Grab)	ASTM D-6818	4000 x 3000 lb/ft	58.4 x 43.8 kN/m
Elongation	ASTM D-6818	40 x 35%	40 x 35%
Resiliency	ASTM D-6524	80%	80%
Flexibility	ASTM D-6575	0.534 in-lb (avg)	615,000 mg-cm (avg)
ENDURANCE			
UV Resistance % Retained 6000 hrs	ASTM D-4355	90%	90%
UV Resistance % Retained 10000 hrs	ASTM D-4355	85%	85%
PERFORMANCE			
Velocity[3] (Fully Vegetated)	Large Scale	25 ft/sec	7.6 m/sec
Shear Stress[3] (Fully Vegetated)	Large Scale	16lb/ft^2	766 Pa
Manning's "n"[4] (Unvegetated)	Calculated	0.028	0.028
Seedling Emergence[4]	ECTC Draft Method #4	296%	296%
ROLL SIZES		8.5 ft x 90 ft	2.6 m x 27.4 m

TYPE B2 ANCHOR PROPERTIES

PHYSICAL		**ENDURANCE/ COMPONENT MATERIALS**	
Anchor Head Length	4.75 in	Anchor Head	Hot Dip Galvanized Ductile Iron
Anchor Head Width	1.2 in	Rigid Tendon	Zinc Plated Steel 3/8” All Thread Rod
Anchor Head Bearing Area	5.0 in^2	Load Bearing Plate	Galvanized Sheet Steel
Anchor Head Weight	0.8 lbs	Locking Nut	Zinc Plated Steel
PERFORMANCE		Shackle Casting	Hot Dip Galvanized Investment Cast Steel
Load Range (Cohesive through Non Cohesive Soils)	Up to 1,500 lbs	**MECHANICAL**	
		Ultimate Strength	5,000 lbs
Embedment Depth	6 to 12 ft	Working Load	3,000 lbs

NOTES:
1. The property values listed are effective 04/2011 and are subject to change without notice.
2. MARV indicates minimum average roll value calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed the value reported.
3. Maximum permissible velocity and shear stress has been obtained through vegetated testing programs featuring specific soil types, vegetation classes, flow conditions, and failure criteria. These conditions may not be relevant to every project nor are they replicated by other manufacturers. Please contact Propex for further information.
4. Calculated as typical values from large-scale flexible channel lining test programs with a flow depth of 6 to 12 inches.

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ph 423 899 0444 · ph 800 621 1273 · fax 423 899 7619

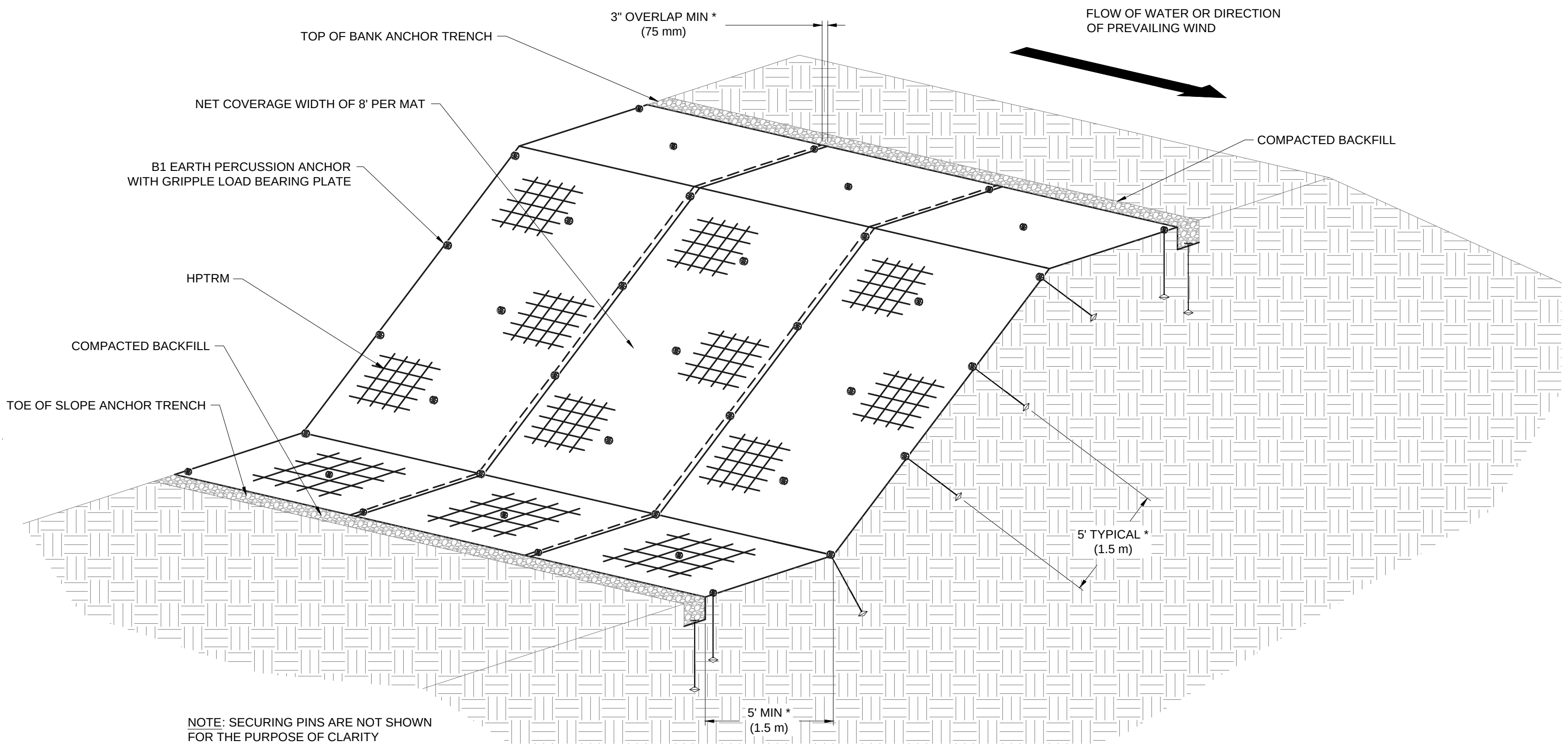

FIGURE 1: INSTALLATION OF ARMORMAX SYSTEM ON A SLOPE OR LEVEE

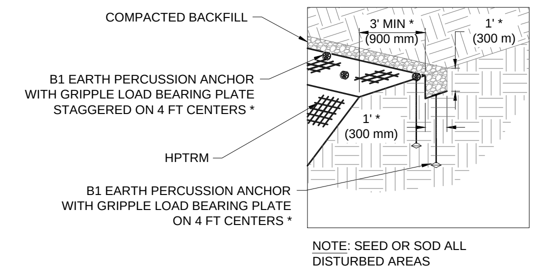

FIGURE 2:TOP OF BANK (TOB) ANCHOR TRENCH

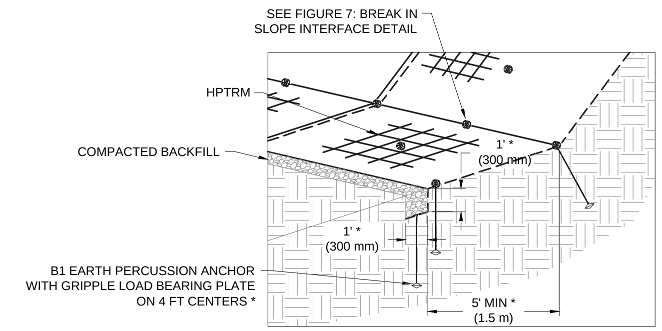

FIGURE 3: TOE OF SLOPE ANCHOR TRENCH

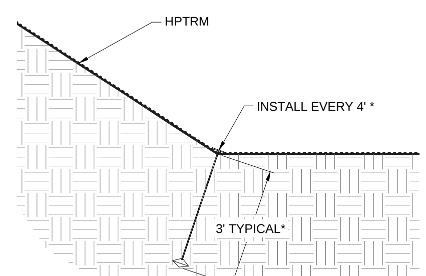

FIGURE 6: BREAK IN SLOPE INTERFACE DETAIL FOR CHANNELS

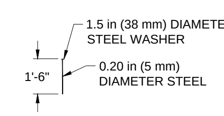

FIGURE 7: SECURING PIN DETAIL

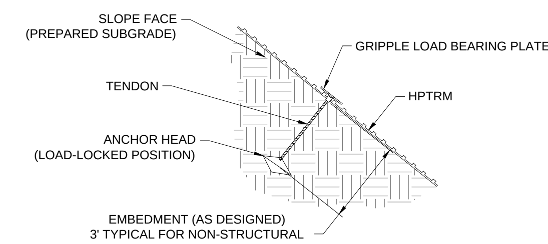

FIGURE 8: EARTH PERCUSSION ANCHOR DETAIL

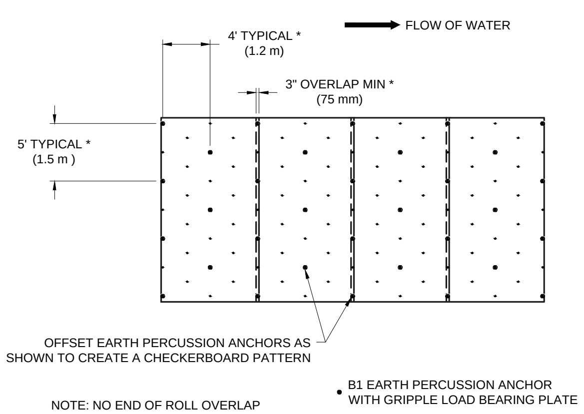

FIGURE 4: ANCHOR / PIN PATTERN AND LONGITUDINAL EDGE DETAIL

NOTE: FOR EARTH PERCUSSION ANCHOR RATIOS OTHER THAN THE ABOVE, PLEASE CONSULT WITH PROPEX ENGINEERING SERVICES AT 423-553-2450)

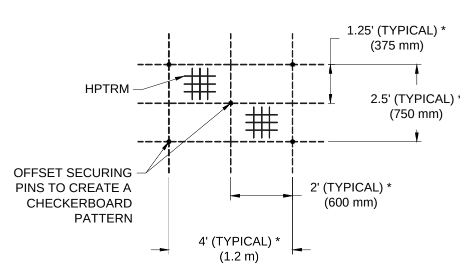

FIGURE 5: PIN PATTERN DETAIL SPECIFIC TO B1 ANCHOR RATIO OF 0.5 ANCHORS/YD]

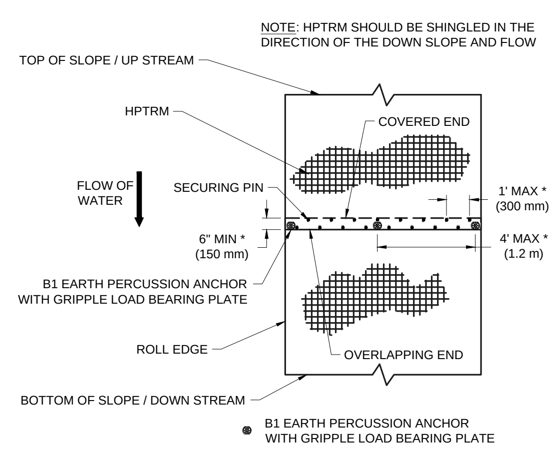

FIGURE 9: OVERLAP AT ROLL END DETAIL

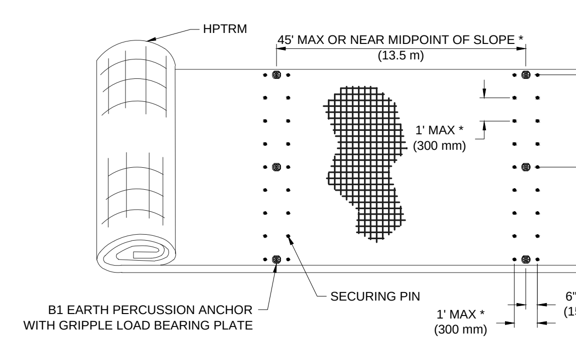

FIGURE 10: SIMULATED CHECK SLOT DETAIL

NOTES:
1) These Installation details are for slope and levee applications and are not to scale. For channels, please consult the Propex Website for the Channel Drawing C100.
2) Please consult the Propex Website for the most up to date details.

Propex™ Geotextile Systems

Please note that the information presented herein is general information only. It is for conceptual use only and not intended to be used for construction. While every effort has been made to ensure its accuracy, this information should not be used for a specific application without independent professional examination and verification of its suitability, applicability, and accuracy.

ARMORMAX BY PROPEX

ANCHOR REINFORCED VEGETATED SYSTEM (ARVS)
CONCEPTUAL ARMORMAXÈ INSTALLATION DETAILS FOR SLOPES AND LEVEES

Rev	S100	Date: 02/15/2012	Drawn By: D.LOIZEAUX	Scale: NTS	*ALL DIMENSIONS ARE TO BE VERIFIED BY THE ENGINEER

ARMORMAXÈ SYSTEM ON A LEVEE OR SLOPE (NON-STRUCTURAL APPLICATION) GENERAL INSTALLATION GUIDELINES

PRE-CONSTRUCTION
A pre-construction meeting shall be held with the construction team and a representative from Propex È. This meeting shall be scheduled by the contractor with at least two weeks notice. Also, Propex suggests that installation monitoring of the ArmorMax System be performed by a qualified independent third party.

SITE PREPARATION
- Grade and compact area of ArmorMax System installation as directed and approved by Engineer. Subgrade shall be uniform and smooth. Remove all rocks, clods, vegetation or other objects so the installed mat will have direct contact with soil surface.
- Prepare seedbed by loosening the top 2-3 in (50-75 mm) minimum of soil. This may be accomplished with a rotary tiller on slopes 3:1 or flatter.
- Perform a site specific soil test to determine what amendments such as lime and fertilizer to incorporate.
- Do not mulch areas where mat is to be placed.

SEEDING
- Keep seeded areas moist as necessary to establish vegetation. When watering seeded areas, use fine spray to prevent erosion of seeds or soil. If as a result of a rain, prepared seedbed becomes crusted or eroded, or if eroded places, ruts or depressions exist for any reason, rework soil until smooth and reseed such areas.
- Apply an amount equivalent to 50% of the total seed mixture required to be installed on the soil surface before installing the High Performance Turf Reinforcement Mat (HPTRM).
- Disturbed areas shall be reseeded.
- Consult project plans and/or specifications for seed types and application rates.

GENERAL INSTALLATION GUIDELINES FOR A LEVEE OR SLOPE
- Figure 1 shows general installation layout and details for ArmorMax System on a slope. (The details on this page are for 8.5 ft wide HPTRM roll widths. for 10.5 ft wide applications see Drawing #S100A)
- Excavate an Top of Bank (TOB) Anchor Trench 12 in wide x 12 in deep (300 mm x 300 mm) minimum of 3 ft (900 mm) over the crest of the slope (see Figure 2). For a levee, the TOB Anchor Trench may start 3 ft (900 mm) from the crest of the slope on the ñwetòside. (see Figure 2). Deeper TOB Anchor Trench and/or hard armoring may be required for slopes or levees that have the potential for scour.
- Beginning at the downstream end of the levee or the downwind end of the prevailing winds on a slope, place HPTRM roll end into the TOB Anchor Trench and secure with Gripple Earth Percussion Anchors on 4 ft (1.2 m) centers (see Figure 2). Position adjacent HPTRM rolls and secure in trench in same manner. Backfill and compact soil into trench as directed and approved by Engineer.
- Unroll HPTRM down the slope.
- Secure HPTRM longitudinal edge with Securing Pins on 12 in (300 mm) centers and with Gripple Earth Percussion Anchors on 5 ft (1.5 m) centers (see Figure 4). When required, the Engineer is to create project details for transition to structures along the longitudinal edge or to address water flowing perpendicular to the seams.
- Continue installation as described above, overlapping adjacent rolls as follows:
  A. HPTRM roll edge overlap: 3 in (75 mm) minimum overlap with upslope HPTRM on top. Secure with one row of Securing Pins on 12 in (300 mm) centers and with one row of Gripple Earth Percussion Anchors on the designed anchor pin pattern detail in Figure 4. A typical spacing on the overlapping seams for the Gripple Earth Percussion Anchors is 5 ft (1.5 m).
  B. HPTRM roll end overlap for slopes: 6 in (150 mm) minimum overlap with upslope HPTRM on top. Secure with two rows of Securing Pins staggered 6 in (150 mm) apart on 12 in (300 mm) centers and with one row of Gripple Earth Percussion Anchors on 4 ft (1.2 m) centers (see Figure 9). No HPTRM roll end overlaps or seams parallel to the centerline will be allowed on levees.
- Secure HPTRM using Securing Pins and Gripple Earth Percussion Anchors. For appropriate frequency and pattern, see the typical Anchor/Pin Pattern Detail (see Figure 4) and the Pin Pattern Detail (see Figure 5).
- For slope heights or levee slope lengths greater than 45 ft (13.7 m), install simulated check slots per Figure 10. This method includes placing two rows of Securing Pins staggered 6 in (150 mm) apart on 12 in (300 mm) centers and one row of Gripple Earth Percussion Anchors between the rows of pins on 4 ft (1.2 m) centers at 45 ft (13.7 m) maximum intervals (see Figure 10) or across the midpoint of the slope for slope lengths less than 60 ft (18.2 m).
- Excavate Toe of Slope (TOS) Anchor Trench 12 in wide x 12 in deep (300 x 300 mm) minimum at least 5 ft (1.5 m) from the toe of the slope or levee. (see Figure 3). Deeper TOS Anchor Trench and/or hard armoring may be required when slopes or levees have scour potential at their toes. See Toe Interface Detail (Figure 7) for special anchoring patterns for breaks in slope.
- Anchor, backfill and compact end of HPTRM in terminal trench (see Figure 3). Terminal Gripple Earth Percussion Anchors should be spaced on 4 ft (1.2 m) centers (see Figure 3).

GROUND PINNING AND ANCHORING DEVICES
- Metal Securing Pins should be at least 0.20 in (5 mm) diameter steel with a 1 1/2 in (38 mm) steel washer at the head of the pin (see Figure 8). Metal pins should be driven flush to the soil surface. Securing Pins should be between 12-24 in (300-600 mm) long and have sufficient ground penetration to resist pullout. Longer pins may be required for looser soils. Heavier metal stakes may be required in rocky soils. Depending on soil pH and design life of the pin, galvanized or stainless steel pins may be required. Consult project plans and/or specifications for tie down device details.
- Gripple Earth Percussion Anchor assembly consists of an anchor head, stranded cable, gripping device and two crimping ferrules. Materials of each component have been selected to achieve an expected life of more than 50 years. The anchor head is made from die cast aluminum and is bullet nosed in shape to penetrate a turf mat without breaking strands of the mat. The cable is zinc-aluminum coated carbon steel and is of 1 x19 construction. The ferrules are made from aluminum. The grip is die cast from zinc and uses a ceramic roller to clamp the cable in place. The one piece zinc top plate will have openings on the top to facilitate vegetative growth and the grip plate is approximately 0.2 inches thick and so will only protrude above the surface of the mat that far after installation. The grip is designed such that the top of the cable can be cut below the top surface of the grip in a recessed cavity. See Figure 10.

SPECIAL TRANSITIONS
- For applications that require special transitions (i.e. connections to riprap, concrete, T-Walls, etc.), refer to the project specific drawings or consult with Propex Engineering Service at 423-553-2450.

VEGETATION ESTABLISHMENT
- Installed ArmorMax System shall be re-seeded and soil-filled or sodded as is required by the project documents.
- After seeding, spread and lightly rake 1/2 - 3/4 in (12-19 mm) of fine site soil or topsoil into the mat and completely fill the voids using backside of rake or other flat tool. For slopes 3:1 or flatter, roll the entire ArmorMax installation with a drum roller to compact seed and soil tightly into the matrix.
- Smooth soil-fill in order to just expose the top of the HPTRM. Do not place excessive soil above the mat.
- If equipment must operate on the mat, make sure it is of the rubber-tired type. No tracked equipment or sharp turns are allowed on the mat.
- Avoid any traffic over the mat if loose or wet soil conditions exist.
- Broadcast additional seed and install a LandlokÈ Erosion Control Blanket (ECB) above the soil-filled mat as required by the Engineer. For levees or slopes steeper than 3:1, the addition of the ECB may be required or alternate methods of retaining the soil fill may be considered. Please contact the project engineer or Propex Engineering Services at (423) 553-2450.
- Irrigate as necessary to establish and maintain vegetation. Frequent, light irrigation will need to be applied to seeded areas if no natural rain events have occurred within two weeks of seeding and shall continue until 75% of vegetation has established and has reached a height of 2 inches. Do not over irrigate.

CONTRACTORS MAINTENANCE AND GUARANTEE PERIOD

It shall be the responsibility of the Owner to maintain all seed and ArmorMax areas after Engineer's acceptance. Maintenance shall consist of watering and weeding, repair of all erosion and any re-seeding as necessary to establish a uniform stand of the specified grasses. A minimum of 70% of the area seed shall be covered with no bare or dead spots greater than 10 ftļ (1 mļ). Seeded areas shall not be mowed prior to establishment of 70% vegetative density and a minimum grass growth of 4 inches (100 mm). Mower height shall not be set lower than 4 inches (100 mm). Throughout the duration of the project, the contractor shall be responsible for mowing to facilitate growth and shall not let the vegetation in the seeded areas exceed 18 inches (450 mm). In addition, the Contractor shall water all grassed areas as often as necessary to establish satisfactory growth and to maintain its growth throughout the duration of the project.
Replanting is to be performed within 14 calendar days of notification by the Engineer.

INSTALLATION GUIDELINES FOR GEOTEX® GEOTEXTILE

This document provides general installation guidelines for GEOTEX Geotextiles used in reinforced soil slopes. GEOTEX Geotextiles have shown no degradation in pH situations as high as 12 and can be used in both dry and wet-cast environments.

SITE PREPARATION

- Subgrade shall be excavated to proper lines and grades based on construction plans.
- Any over-excavated areas should be filled with backfill material and any depressions should be filled so that there are no depressions that exceed 6 in (15 cm) in depth.
- The subgrade shall be fairly smooth and free of sharp objects and debris that may damage the geotextile.
- The soils should be proof rolled prior to geotextile and backfill placement.
- The soils should be compacted to 95 percent of the relative density based on the Geotechnical Engineer's recommendations.
- For each layer of the slope, repeat these preparation steps before laying the geotextile.

GEOTEXTILE INSTALLATION

- Before unrolling the geotextile, verify the roll for size, damage, and installation orientation according to construction plans and the Engineer.
- Geotextile should be placed in correct orientation as shown on the construction plans and approved by the Engineer. The Contractor should verify the orientation. The orientation of the geotextile should be such that it is rolled in the direction of the slope – not perpendicular to it.
- The Geotextile should be cut to length based on construction plans using an Engineer approved cutting tool.
- Each sheet of Geotextile should be pulled taut by hand to get rid of any wrinkles.
- Adjacent sheets should be overlapped based on the soil properties. Refer to Table 1 for suggested grid overlap lengths.

Table 1 – Recommended Geosynthetic Overlaps

Subgrade CBR Value	Subgrade R-Value (California)	Subgrade Shear Strength (lb/in²)	Field Estimation of CBR	Recommended Minimum Overlap
< 0.5	-	< 2	-	Sewn seam required
> 0.5 to 1	-	> 2 to 4.5	A person can easily walk on the site	3 ft.
> 1 to 2	> 0 to 10	> 4.5 to 8.5	A low ground pressure bulldozer can access the site without significant rutting	2.5 ft.
> 2	> 10	> 8.5	A D4 bulldozer can access the site without significant rutting	1.5 ft.

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- The preceding steps should be repeated for additional sheets.
- Each sheet may be secured in place using staples, pins, sandbags, backfill, or by other Engineer approved methods to help prevent disruption during the installation of adjacent sheets on the same elevation.
- Do not piece together separate sheets in the primary strength direction through any mechanical connection unless directed by Engineer. Each sheet should be installed as one continuous piece, extending the full length of the area. (Figure 1)
- Only place the amount of Geotextile needed for the pending steps of construction to avoid excess exposure of the Geotextile to the elements.
- After each layer of Geotextile has been placed, prepare, place, and compact the overlying layer of soil according to the construction plans and the Engineer. (Figure 2)
- After the soil layer has been completed, the next layer of Geotextile can be installed by following all preceding steps.
- Repeat all steps for each additional level according to the construction plans, until all levels are installed.

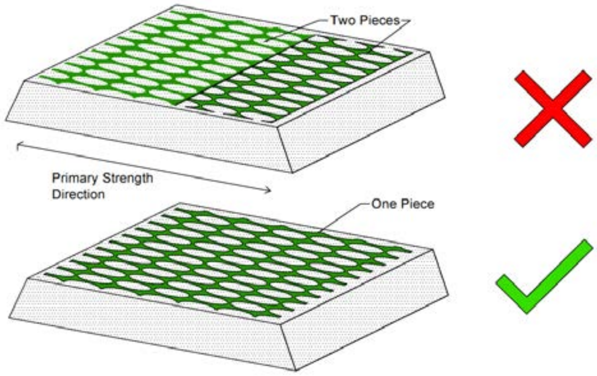


Figure 1

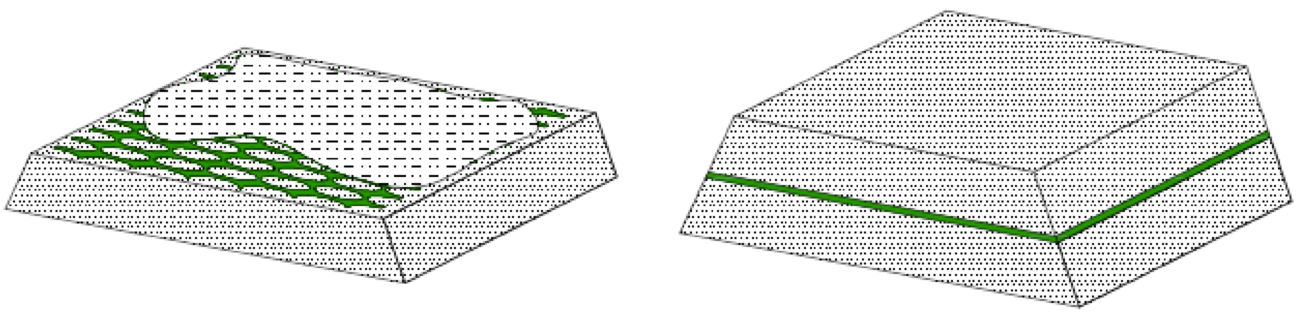


Figure 2

Notes on Backfill

- It is recommended that the soil fill be compacted to 95 percent of the relative density as determined by the Geotechnical Engineer.
- Cohesive soils should be placed in lifts of 6 to 8 in (15 to 20 cm) and granular soils should be placed in lifts of 9 to 12 in (23 to 30 cm) compacted thickness. Each layer of compacted fill should be, at a minimum, 6 in (15 cm). (Figure 3)

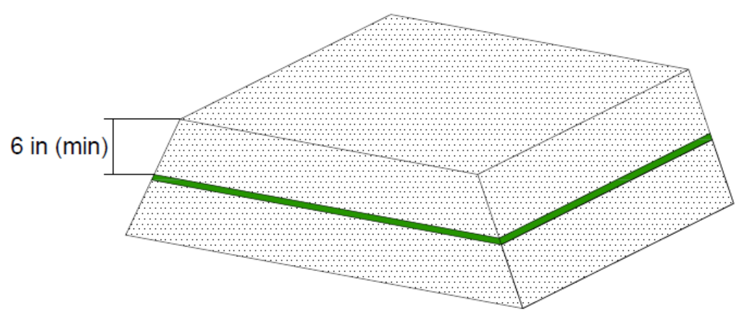
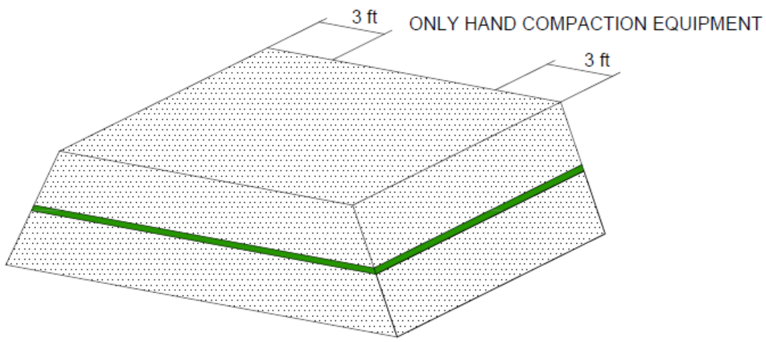


Figure 3

- Care should be taken when placing fill soil as to not disturb the geotextile.



- Only hand compaction equipment should be used within 3 feet (1 meter) of the slope face. (Figure 4)
- At the end of each workday the fill should be graded away from the slope and rolled to prevent ponding of water.

Figure 4

- Rubber-tired vehicles may travel across geotextile at low speeds while avoiding sudden stops and sharp turns.
- A minimum fill thickness of 6 in (15 cm) is required before operation of tracked vehicles over the geotextile. Sudden stops and turning should be minimized to prevent damage.

Protection

- If the slope has not been designed with extra reinforcement to handle reduced soil strengths in a saturated soil situation, a drainage system should be installed according to the Engineer to prevent saturation of soil fill.
- The slope face should be vegetated with an appropriate rolled erosion control product (RECP), in accordance with the Design Engineer, to properly mitigate soil erosion. (Figure 5)
- Please Contact Engineering Services at (423)553-2450 for additional technical support regarding this Installation Guide or for suggestions on mitigating soil erosion through the use of Landlok® RECP.

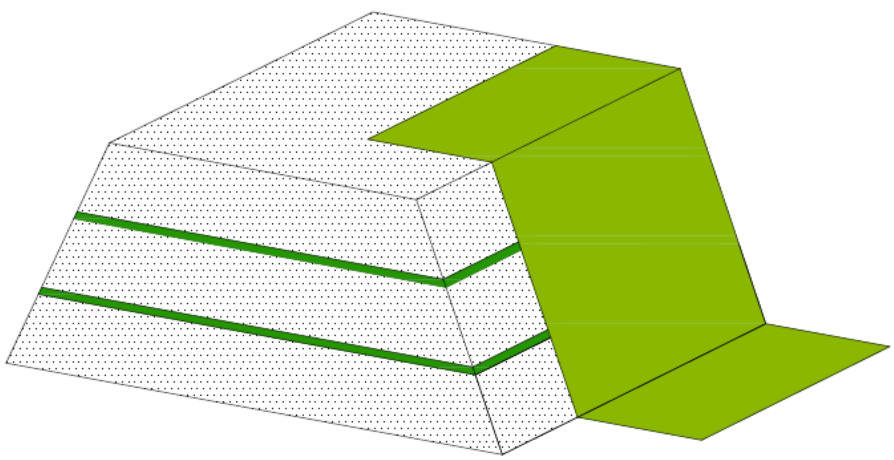


Figure 5

BARTLETT BOULEVARD SLOPE STABILIZATION

ROADWAY SLOPE PROTECTION
CITY OF BARTLETT, TENNESSEE

ARMORMAX®
BY PROPEX

Application:
Structural Slope Stabilization

Product:
ARMORMAX® Anchor Reinforced Vegetation System

Location:
Bartlett, TN

Owner:
City of Bartlett

Engineer:
City of Bartlett Engineering Department

THE PROBLEM
Heavy erosion and slope failure from heavy rain events

THE SOLUTION
ARMORMAX® designed and installed for steep slope stability

THE INSTALLATION
Significant time and cost savings over hard armor solutions

THE PERFORMANCE
Vegetated engineered slope stabilization solution

PROJECT SUMMARY:

Heavy rainfall in Bartlett, Tennessee caused slope instability along Bartlett Boulevard. City of Bartlett Engineering Department sought a low impact, vegetated solution to stabilize the steep roadway slope for shallow plane slope failure reinforcement. Propex worked with the City's Engineering Department to model and design slope stabilization using the ARMORMAX® Anchor Reinforced Vegetation System, and provided installation assistance in 2013 for the successful completion of the project.

ARMORMAX® FEATURES & BENEFITS:

- UV-Stabilized for 50-year Design Life
- Engineered Solution for Slope Stabilization
- Designed for Shallow Plane Slope Failure Mitigation
- Easy and Rapid Installation
- More Cost-Effective than Traditional Solutions
- Proven Technology
- Sustainable Results

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SOUTH CANYON ROAD SLOPE STABILIZATION
CACHE COUNTY, UT EMERGENCY WATERSHED PROTECTION PROGRAM PROJECT

ARMORMAX®
BY PROPEX

Application:
Slope Stabilization

Product:
ARMORMAX®

Location:
South Canyon Rd.
Cache County, UT

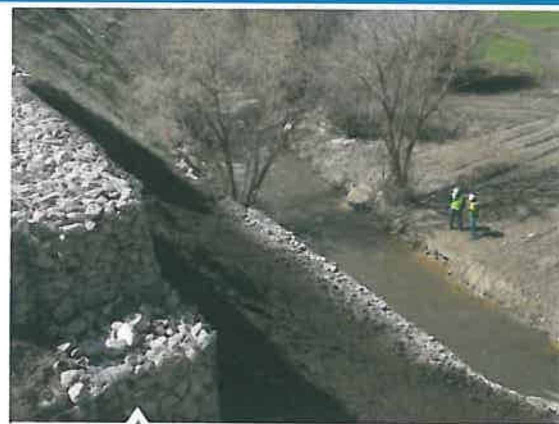
Owner:
Cache County, UT

Engineer:
IGES (Draper, UT)

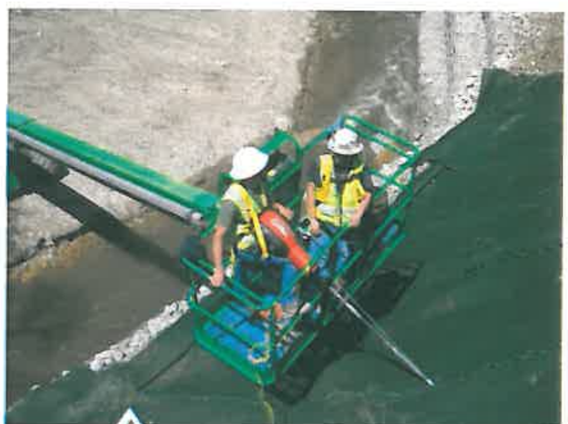
Contractor:
Geneva Rock

Distributor:
ACF West (Salt Lake City, UT)

THE PROBLEM
Sloughing / Sliding Slope Failure to Roadway Slope



THE SOLUTION
ARMORMAX® Installed atop Hydraulic Growth Medium



THE INSTALLATION
Rapidly deployed for immediate protection

THE PERFORMANCE
Reduced Cost, Vegetated Slope Reinforcement

PROJECT SUMMARY:

As part of the Cache County, UT Emergency Watershed Protection Program administered through the NRCS, several failing roadway slopes were identified for repair as the County sought to improve overall transportation infrastructure. A section of South Canyon Road near Paradise, UT was undermined by Davenport Creek, and sloughing / sliding failures led to collapse of the county road. ARMORMAX® was selected as a lower-cost, rapidly installed, vegetated alternative to a full slope gabion installation.

ARMORMAX® FEATURES & BENEFITS:

- UV Stabilized for 50-year Longevity
- Structurally Designed Slope Reinforcement
- Easy and Rapid Installation
- Vegetated with Custom Hydraulic Growth Medium
- More Cost-Effective than Traditional Solutions
- Proven Technology
- Sustainable Results

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ARMORMAX® BY PROPEX

ROUTE 26 SLOPE STABILIZATION

CALAVERAS COUNTY, CA - CALTRANS DISTRICT 10 MAINTENANCE – EMERGENCY STABILIZATION PROJECT

Application:
Roadside Embankment Slope Stabilization

Product:
ARMORMAX® Anchor Reinforced Vegetation System

Location:
Calaveras County, CA

Owner:
CALTRANS District 10 (Maintenance)

Engineer:
CALTRANS

Contractor:
Thunder Mountain Enterprises (Sacramento, CA)

THE PROBLEM
Sliding failure of slope causing downstream sediment pollution

THE SOLUTION
ARMORMAX® ARVS used as a structural slope reinforcement measure

THE INSTALLATION
Much faster and less expensive than rock slope protection

THE PERFORMANCE
Rapid vegetation establishment above stabilized slope

PROJECT SUMMARY:
Slopes along narrow rural highway corridors are not easy to stabilize once they begin to fail. Deposited sediment from a slope along Route 26 in Calaveras County was costing CALTRANS District 10 expensive pollution fines, requiring emergency repairs with a short construction schedule. Limited right-of-way and access dictated an innovative solution – as the conventional rock slope placement measures just weren't feasible. Propex worked with CALTRANS and the contractor to implement ARMORMAX® as a structural reinforcement system yielding rapidly vegetated stability.

ARMORMAX® FEATURES & BENEFITS:
- Structural Slope Stabilization for Sliding Failure Mitigation
- Easy and Rapid Installation – Even with Access Challenges
- Value Engineered to Eliminate Rock Slope Protection
- Aesthetic, Vegetated, Pollutant-reducing System
- Proven Technology & Sustainable Results

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ARMORMAX®
BY PROPEX

TRANSCANADA PIPELINE CROSSING

ST. MAURICE RIVER CROSSING SLOPE STABILIZATION
CAP DE LA MADELEINE, QUEBEC, CANADA

Application:
Structural Slope Reinforcement

Product:
ARMORMAX® Anchor Reinforced Vegetation System

Location:
St. Maurice River
Quebec, Canada

Owner:
TransCanada Pipeline

Engineer:
Golder Associates (Calgary, AB)

Contractor:
Louisbourg Pipelines (Mississauga, ON)

THE PROBLEM
Sliding failures resulting from pipeline crossing

THE SOLUTION
ARMORMAX® designed and installed for structural slope stability

THE INSTALLATION
Rapid installation of lightweight materials on steep slopes

THE PERFORMANCE
Vegetated slope reinforcement enhancing natural beauty

PROJECT SUMMARY:

TransCanada successfully ran a large diameter gas pipeline below the St. Maurice River in 2008, but didn't anticipate failing slopes that would be left behind at areas cleared for the crossing construction. Sandy soils caused slides and deposited sediments along the natural bank. Extreme slopes and remote access prohibited almost all solutions that were considered – except ARMORMAX®! Pipeline workers were able to tether to the top of slope and install mat and anchors with ease – providing a return to the pristine vegetated conditions that existed before the crossing construction

ARMORMAX® FEATURES & BENEFITS:

- Engineered Slope Stabilization
- Easy and Rapid Installation with Remote Access
- Green, Naturally Vegetated Solution
- Cost-Effective Over Traditional Stabilization Solutions
- Proven Technology
- Sustainable Results

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