KLEINFELDER
Bright People. Right Solutions.

December 28, 2009
Project No. 107104

City of Long Beach
Department of Parks, Recreation, and Marine
2760 North Studebaker Road
Long Beach, California 90802

Attention: Sandra J. Gonzalez, Manager

Subject: **DRAFT**
Possible Slope Improvement Options for
Project Cost Estimating
Bluff Park
E. Ocean Blvd. between Loma Ave. and Lindero Ave.
Long Beach, California

References: "DRAFT Geotechnical Study, Proposed Slope Improvements, Bluff Park, E. Ocean Blvd. between Loma Ave. and Lindero Ave., Long Beach, California", dated December 14, 2009, project No. 107104.

"Ocean Avenue Bluff Erosion and Enhancement", Email form RJM Design Group, Inc., dated December 10, 2009.

Dear Ms. Gonzalez:

This supplemental letter provides information to aid RJM Design Group, Inc. in preparing cost estimates for various options to better control erosion and facilitate irrigation and planting of the Bluff Park slope. As requested by RJM Design Group, Inc., we have roughly identified the extent of our recommended slope modifications on the plans and cross sections from our draft report for the purposes of determining preliminary quantities. This letter and the attached plans and sections include three different levels of options for increasing slope stability and/or reducing slope erosion. The attached cross sections and plans have been prepared for cost estimating purposes only and are not intended for design. Any final quantities should be based on field verifications.

2 Ada, Suite 250, Irvine, CA 92618 p | 949.727.4466 f | 949.727.9242

OPTION 1 (Improve Slope Stability)

Option 1 is a relatively extensive fill option that will improve erosion resistance, surficial stability, global stability and will facilitate planting and irrigation. This option was separated as Option 1A, which uses Geogrids in the fill, and Option 1B which has no Geogrids. Both options consist of placing fill against the lower and/or steep portions of the slope to buttress the existing erosion areas, slide debris areas, and gabion walls. Plates 2A through 2E in Attachment 1 show the approximate outline of the proposed fill for Options 1A and 1B.

Option 1A is proposed to reduce the amount of import fill and encroachment on the beach by constructing a portion of the fill at an inclination of 1.5:1 (horizontal:vertical) using Geogrids. Fill buttressing the gabion walls will be at an inclination of 2:1 and will also have Geogrids. Above the proposed terrace drain, the slope can be constructed at an inclination of 2:1 and will not require Geogrids. All fill below the terrace drain should be at least 10 feet wide. With this option, the encroachment on to the beach south of the existing wall at the toe of the slope will be generally between 10 and 15 feet. The stairways and storm drain outlets can remain in place, except for the relocation of the lower three stairway steps at Station 7+60. The Edison vault near Station 8+20 can also remain in place; however, the buried lines along the slope toe wall and power poles further east may require relocation.

Option 1B is similar to Option 1A except that no Geogrids are used within the fill. All fill below the terrace drain and gabion walls will be at an inclination of at least 2¼:1 (horizontal:vertical). The fill encroachment on to the beach, south of the slope toe wall will be generally between 15 and 30 feet wide. The anticipated volume of import fill may be 50 to 70 percent greater than for Option 1A. The cross sections in Attachment 1 can be used to calculate rough estimates of anticipated quantities.

Both Options 1A and 1B will still require the use a permanent erosion protection fabric with planting in steep slope segments above the fill. We recommend that an erosion protection fabric be used in areas steeper than 1¾:1. Because of the relatively low height (about 10 feet) of the upper portion of the slope that will remain, the use of curb or railing to anchor the erosion fabric along with deadman anchors and/or posts will not be necessary. For cost estimating purposes, permanent erosion protection fabric should be used above the stabilization fill from Stations 0+00 to 5+10, from 13+90 to 19+50, from 20+40 to 31+00, from 32+00 to 35+50 and from 37+00 to 40+50, as shown on Attachment 1, Options 1A and 1B, Cross Sections and Plates 2A through 2E.

OPTION 2 (Partial Improvements to Stabilize Critical Slope Areas)

Option 2 consists of fill placement only in the areas that contain the most oversteepen slope segments, which would be very difficult to protect with vegetation. Sloughing and sliding will continue to occur between and beyond these stabilized areas. The proposed fill as described in Options 1A and 1B is applicable to the oversteepen slope segments.

These areas are located from Stations 0+00 to 5+10, from 13+90 to 19+50 and from Stations 20+20 to 27+00. This option will not improve the existing low factor of safety for stability of the gabion walls. The portion of the slope above the fill will have an erosion fabric as discussed previously for Option 1 and the remainder of the slope will have an erosion fabric as discussed in Option 3 below.

OPTION 3 (Erosion Protection Only)

Option 3 consists essentially of only improving erosion and beautifying the slope with additional planting. This option will not reduce slumping, landsliding, or stability in any portions of the slope. Erosion protection will likely require periodic maintenance of slumping areas.

In accordance with the referenced draft geotechnical study report, we recommend shrub planting only on portions of the slope that are not steeper than 1¾:1 (horizontal:vertical). No shrubs should be planted within 10 feet of the top or within 5 feet of the toe of gabion walls. For steeper portions of slope, we recommended ground cover (only sparse shrubs should be used in these areas, as necessary). The ground cover should be of low height (preferably not taller than 6 inches) and light-weight vegetation that can shed water (i.e. reduce water penetration below the surface). The ground cover will need to be held in place with a permanent erosion fabric. The preferred shrub height is a maximum of two feet, with taller shrubs located at approximately 50 feet on center, as necessary. Plates 2A through 2E of Option 3 in Attachment 2 shows the approximate locations where shrubs may be used and where thin light-weight ground cover that can adhere to the ground surface is preferable. The shrubs should be staggered not to create planes of weakness.

The shrubs and ground covers selected should require very low maintenance because of difficulties to access steep slopes with trimming equipment, and poorly maintained vegetations will be detrimental to the slope. The irrigation system for the upper two third of the slope should be located at the top of the slope, and placed on the ground surface where it can be accessed for maintenance. The lower portion of the slope may be irrigated from the bottom where irrigation piping can be accessed for maintenance. Irrigation in the steep portions of the slope should consist of low flow or light mist to prevent water from flowing and causing erosion on the slope, soaking the flatter and lower portions of the slope, and creating slide prone areas.

We strongly recommend the construction of two or three experimental test segments to optimize the design, the specifications and construction procedures for the slope enhancement project. Slope segments with different configurations should be selected. The test segments should be at least 200 feet long.

SIDEWALK UNDERMINING

The sidewalk at the top of the slope has been undermined in several locations as previously reported. For cost estimating purpose, the most prevalently undermined areas are located in the vicinity of Stations 3+80 to 4+00, 5+10 to 5+20, 10+45 to 10+50, 14+60 to 15+20, 18+30 to 18+50, 22+10 to 22+20, 26+65 to 26+85, 29+20 to 29+35, 30+55 to 30+65, 32+15 to 32+25, 34+15 to 34+30, 34+35 to 34+65, 34+75 to 34+95 and 35+25 to 36+10. Posts and boards, as described in the referenced draft geotechnical study report, are recommended. An alternative to posts and boards would be to remove the sidewalk, overexcavate and level the eroded areas, and backfill using soil reinforced with Geogrids. The reinforced soil zones should be used in combination with Verdura wall blocks (or equivalent) as facing to prevent further soil loss from under the sidewalk. The recommended permanent erosion fabric could be installed prior to recasting the sidewalk.

The options presented above can be intermixed and modified as required to fit the site conditions, access and other site constraints.

CLOSURE

Unless specifically superseded in this letter, the recommendations in the above-referenced geotechnical report remain applicable. This document is intended to provide specific recommendations for the subject project. Accordingly, it cannot be considered an independent document, as it does not contain adequate background information. This document is directed only to the personnel with detailed knowledge of the subject project. The conclusions and recommendations presented herein were prepared under the conditions and limitations presented in our December 10, 2009 report.

We trust that this letter meets your current needs. We appreciate the opportunity to be of continued service to you on this project. If you have any questions or require additional information, please do not hesitate to contact the undersigned at (949) 727-4466.

We appreciate the opportunity to be of professional service to you on this project. If you have any questions or require additional information, please do not hesitate to contact the undersigned at 949-727-4466.

Respectfully submitted,

KLEINFELDER WEST, INC.

Jacques B. Roy, P.E. G.E.
Principal Geotechnical Engineer

P. Jared Mechetti, P.E.
Project Manager

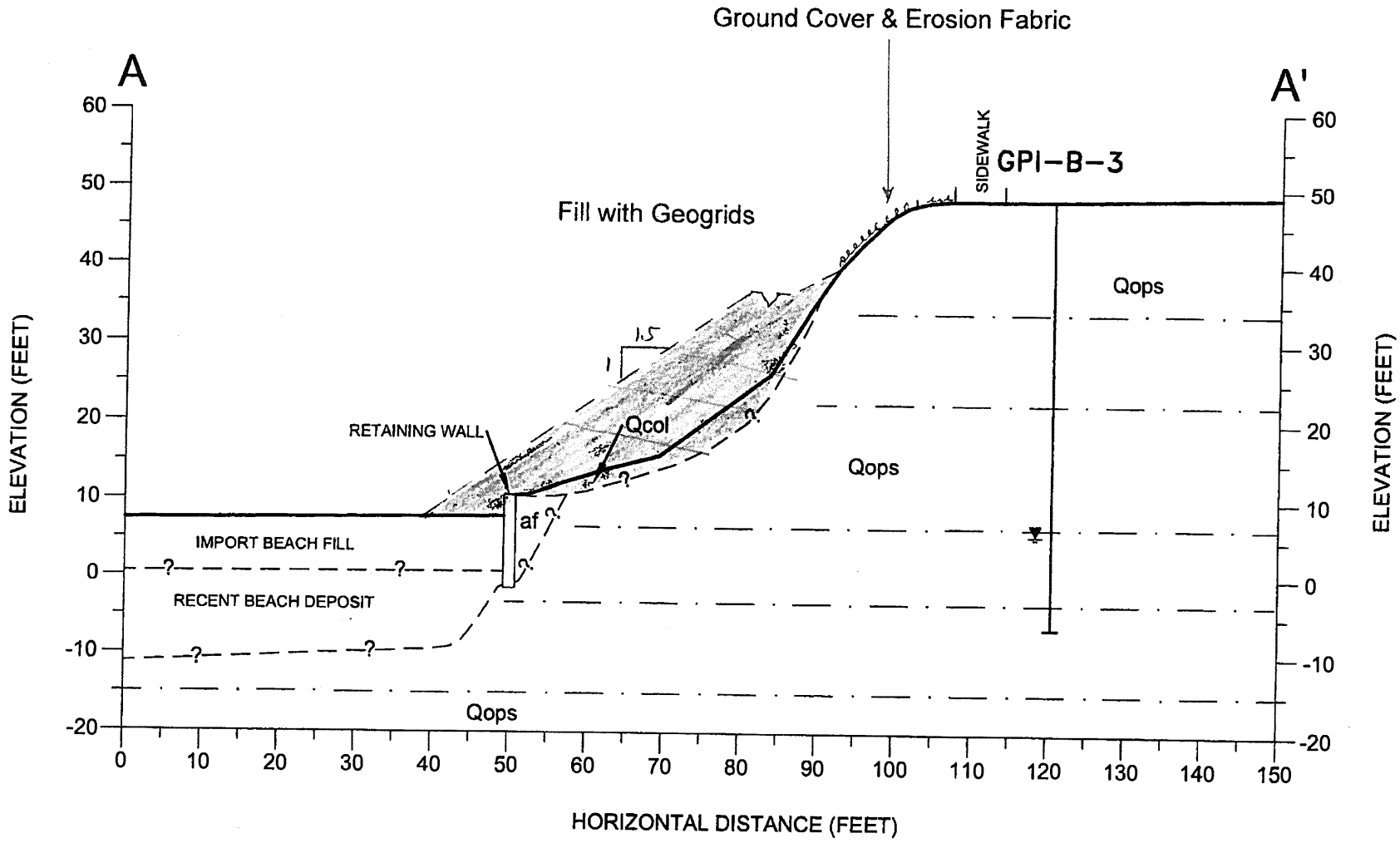
Attachments: **1)** Geologic Map, Option 1A, Plates 2A through 2E, and Cross Sections per order of Stationing (A, B, 1, 2, C, 3, 4, D, E, 5, F, 6, 7, G, 8, 9, 10, 11, H, 12, I, 13, 14)
Geologic Map, Option 1B, Plates 2A through 2E, and Cross Sections per order of Stationing (A, B, 1, 2, C, 3, 4, D, E, 5, F, 6, 7, G, 8, 9, 10, 11, H, 12, I, 13, 14)

2) Geologic Map, Option 3, Plates 2A through 2E, and Cross Sections per order of Stationing (A, B, 1, 2, C, 3, 4, D, E, 5, F, 6, 7, G, 8, 9, 10, 11, H, 12, I, 13, 14)

ATTACHMENT 1

Geologic Map, Option 1A, Plates 2A through 2E, and Cross Sections per order of Stationing (A, B, 1, 2, C, 3, 4, D, E, 5, F, 6, 7, G, 8, 9, 10, 11, H, 12, I, 13, 14)

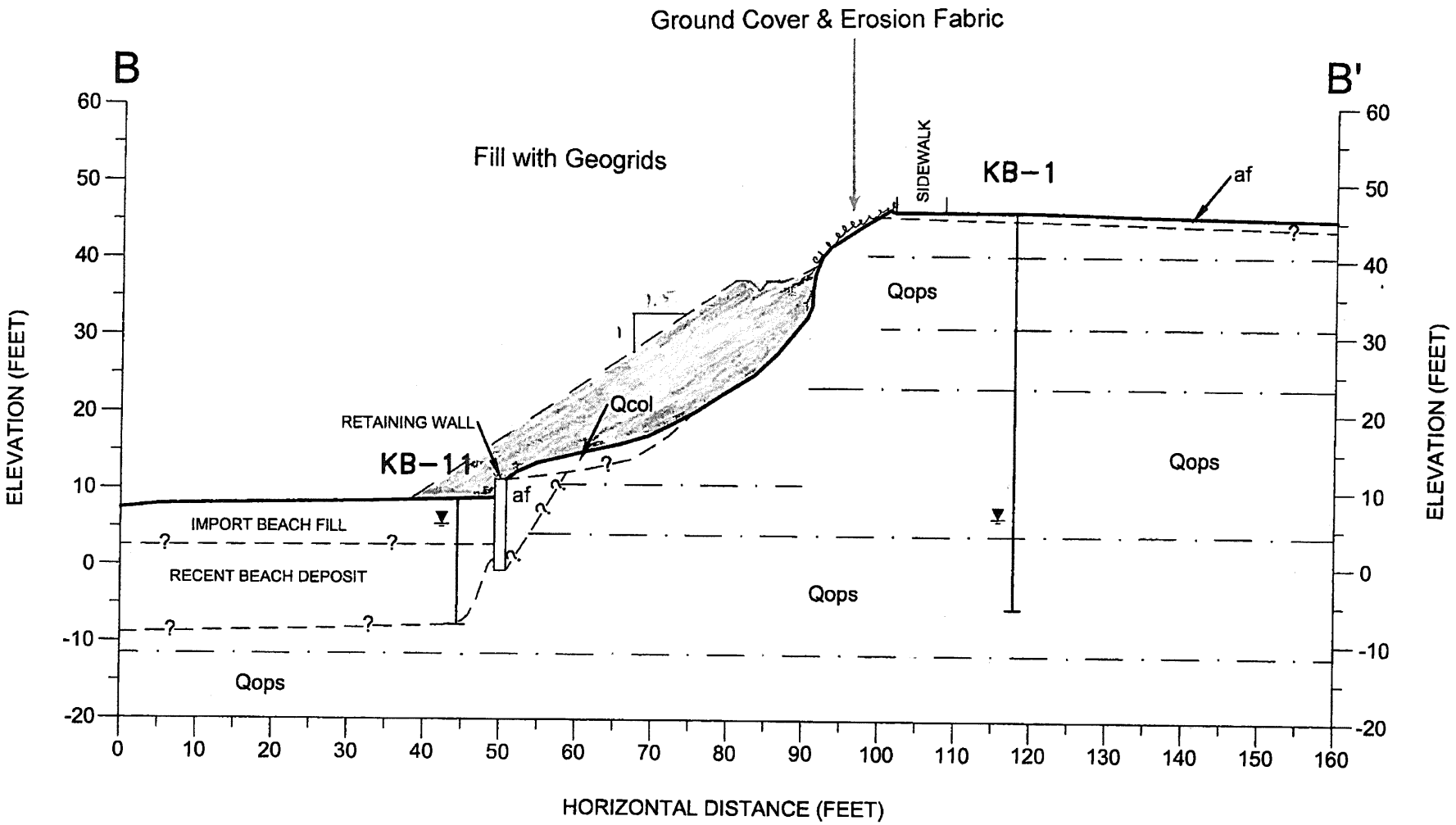
Geologic Map, Option 1B, Plates 2A through 2E, Cross Section per order of Stationing (A, B, 1, 2, C, 3, 4, D, E, 5, F, 6, 7, G, 8, 9, 10, 11, H, 12, I, 13, 14)



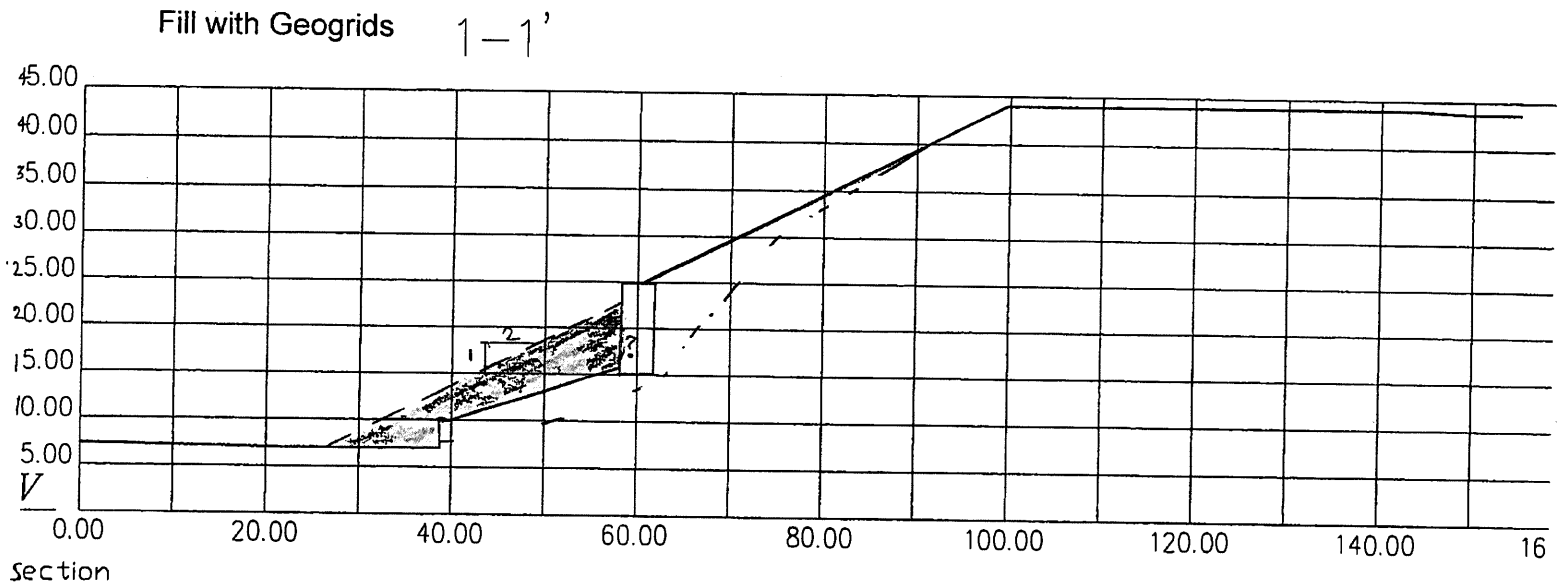
EXPLANATION

af	ARTIFICIAL FILL
Qcol	COLLUVIUM
Qls	LANDSLIDE
Qops	QUATERNARY OLD PARALIC DEPOSITS

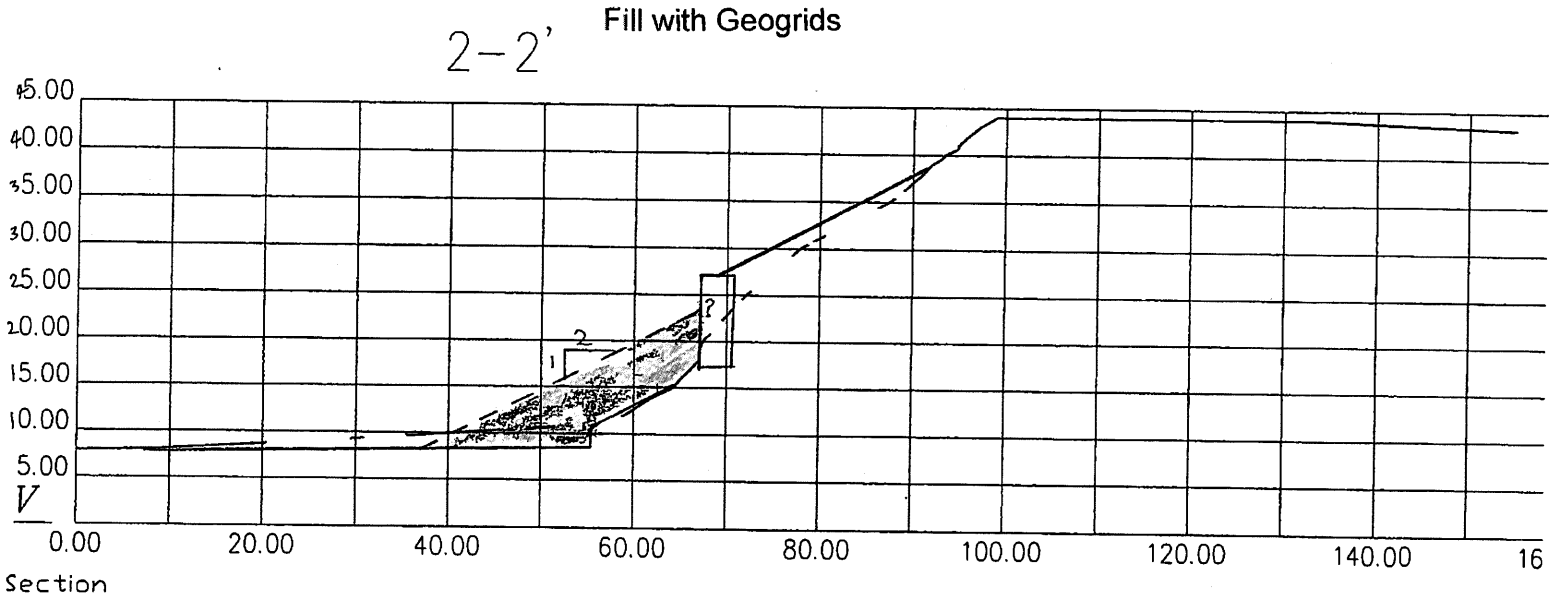
OPTION 1A


Ground Cover & Erosion Fabric
B
B'
Fill with Geogrids
SIDEWALK
KB-1
af
Qops
RETAINING WALL
Qcol
KB-11
af
Qops
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

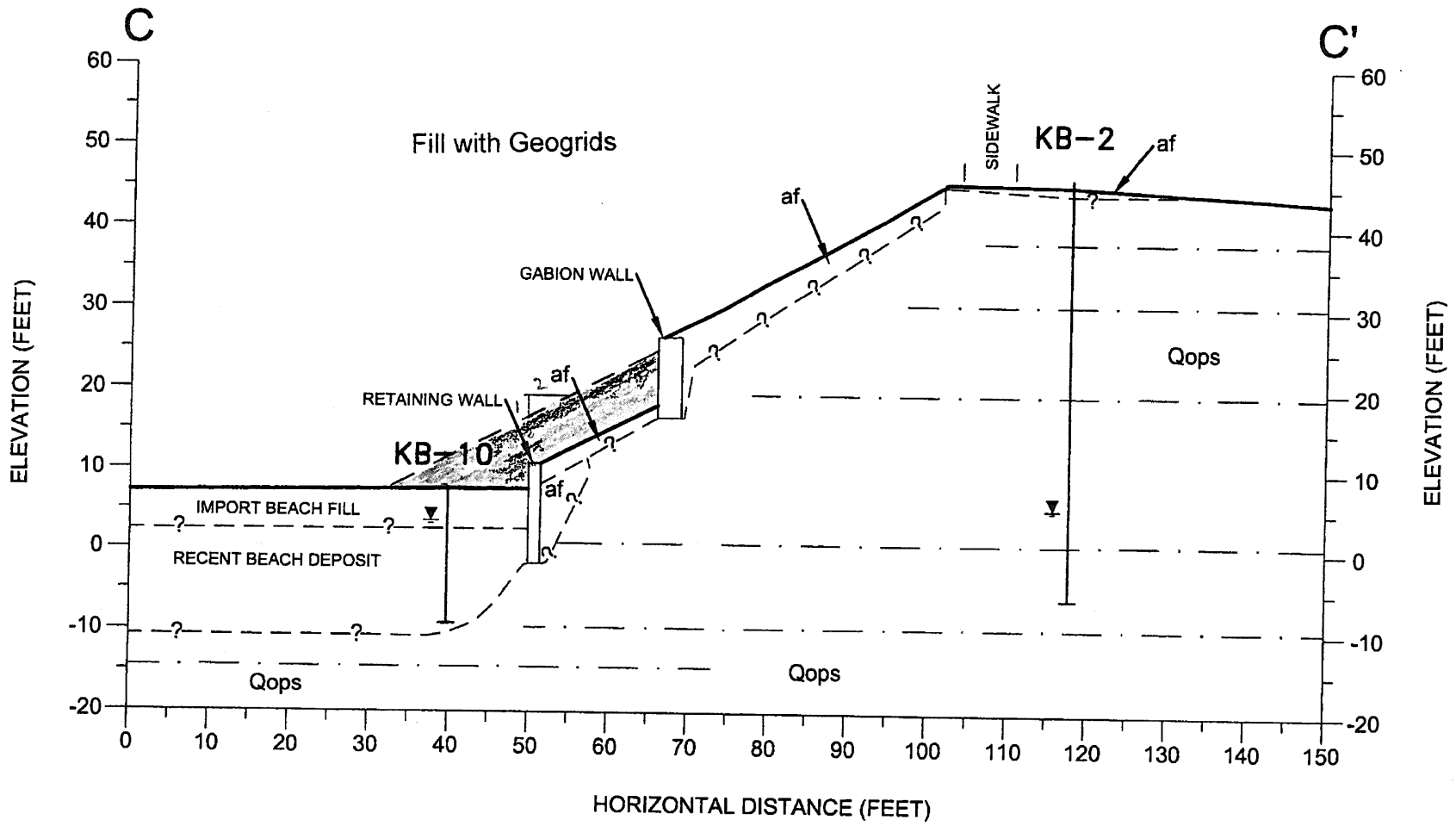
OPTION 1A


Fill with Geogrids
1 – 1'
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

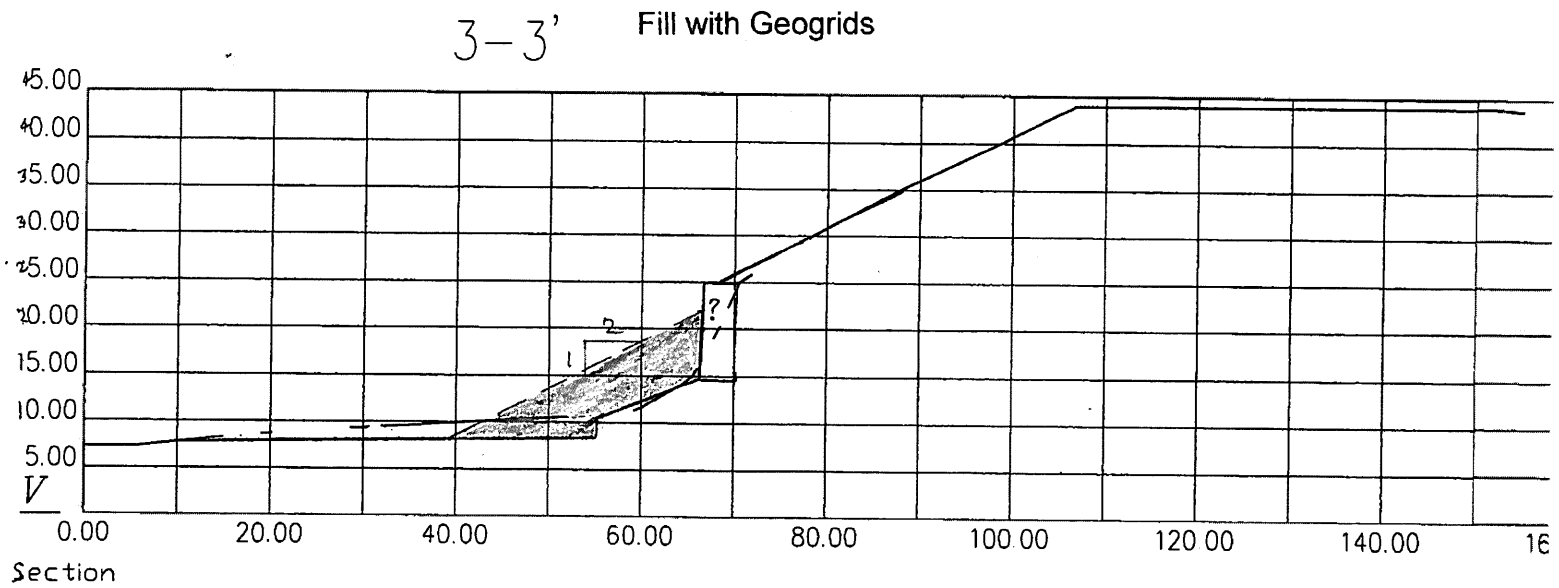
OPTION 1A


Fill with Geogrids
2-2'
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2
1
?

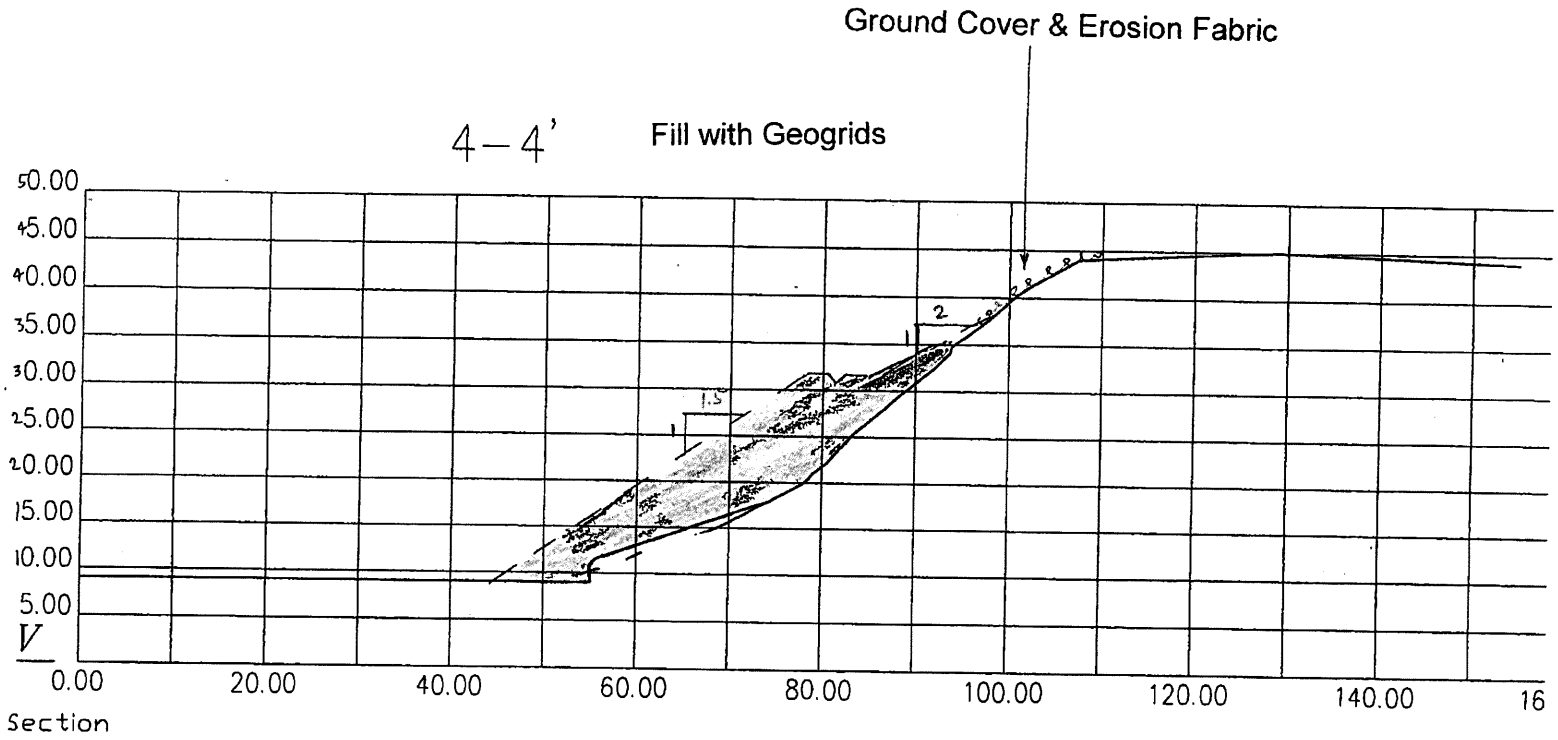
OPTION 1A


C
C'
Fill with Geogrids
SIDEWALK
KB–2
af
af
GABION WALL
RETAINING WALL
2
1
af
KB–10
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

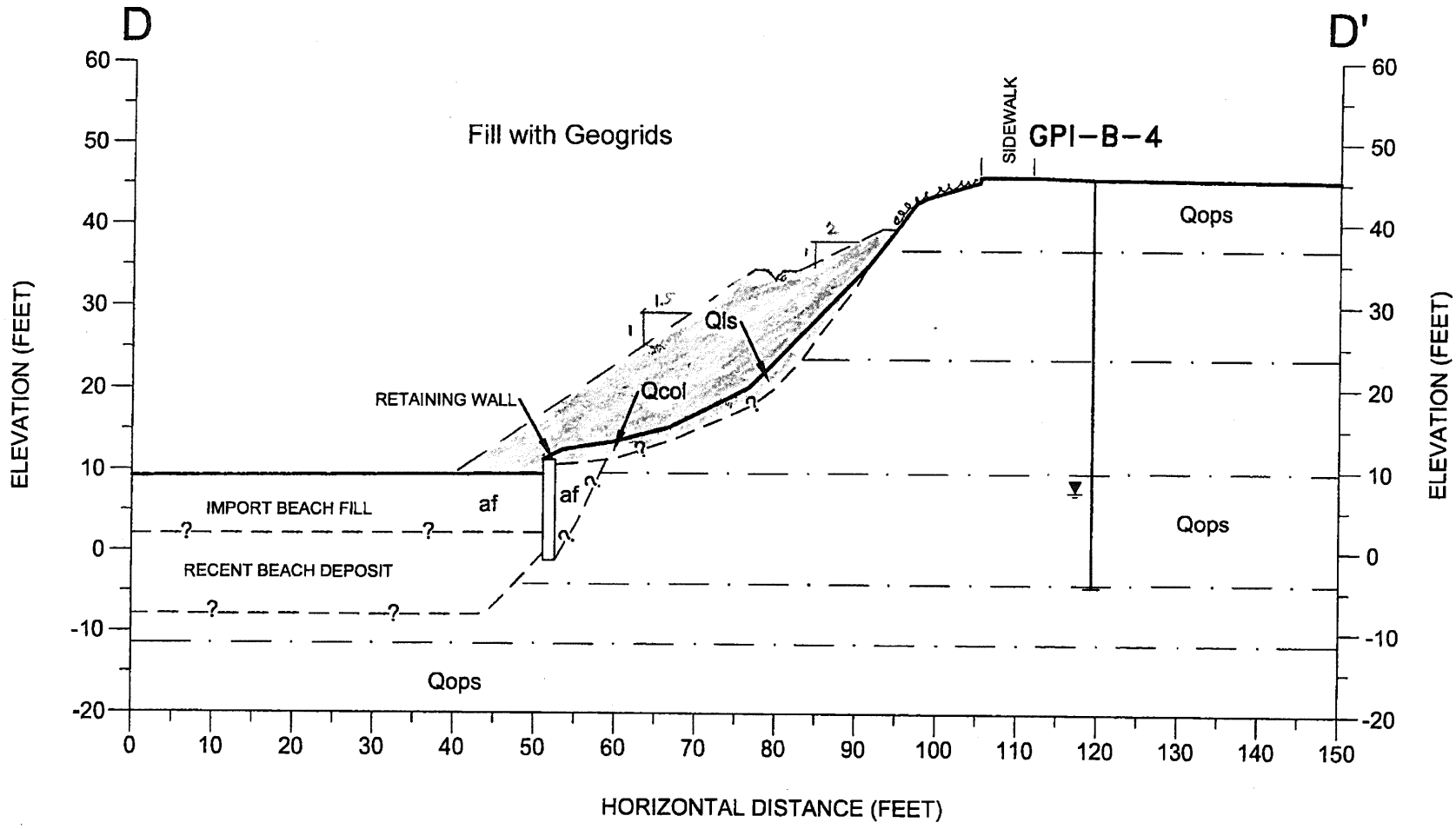
OPTION 1A


3-3'
Fill with Geogrids
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
Section

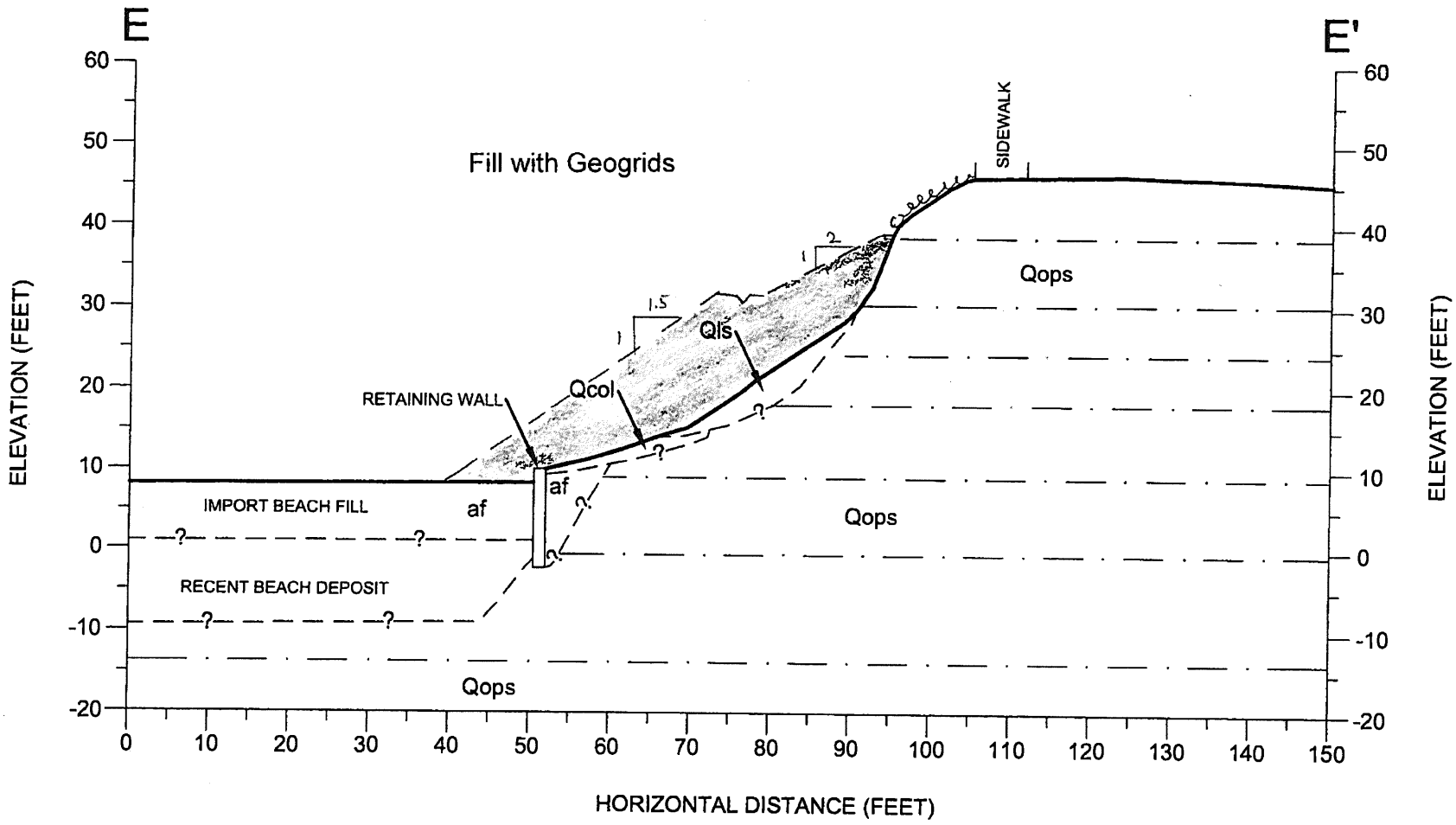
OPTION 1A


Ground Cover & Erosion Fabric
4 – 4'
Fill with Geogrids
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
1.5
1
2
1

OPTION 1A

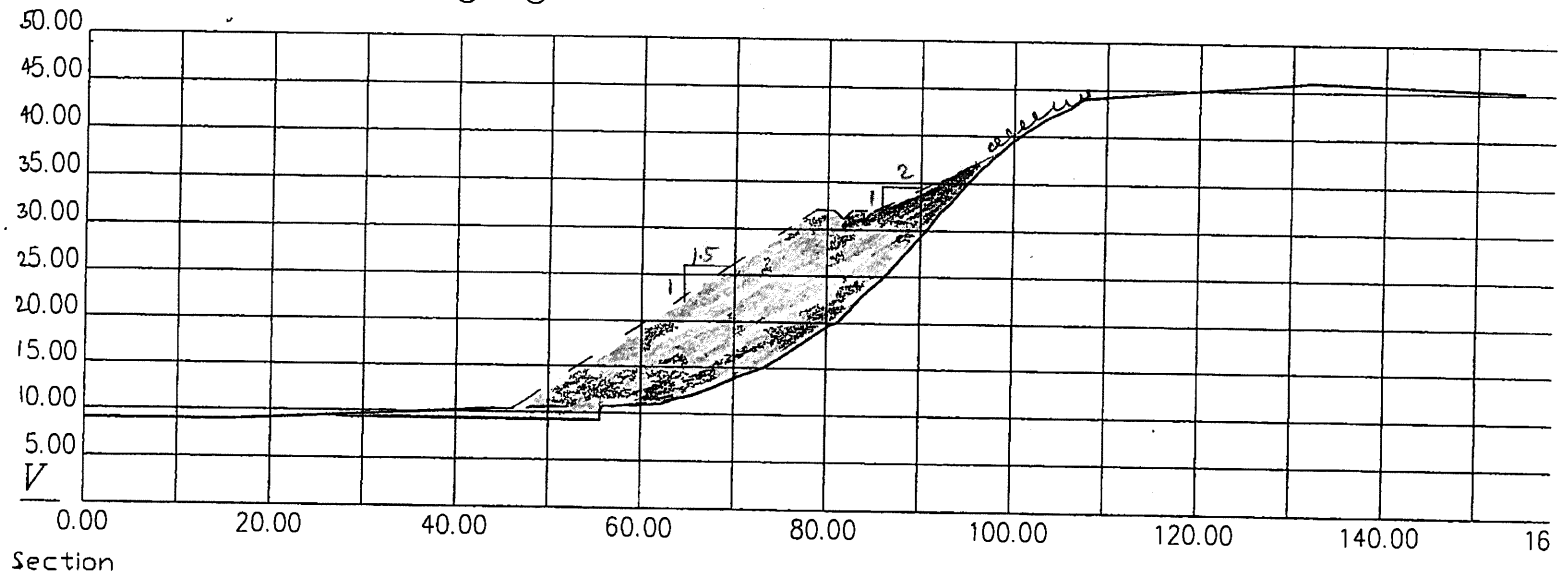

D
D'
Fill with Geogrids
SIDEWALK
GPI–B–4
Qops
Qls
Qcol
RETAINING WALL
IMPORT BEACH FILL
af
af
RECENT BEACH DEPOSIT
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

OPTION 1A

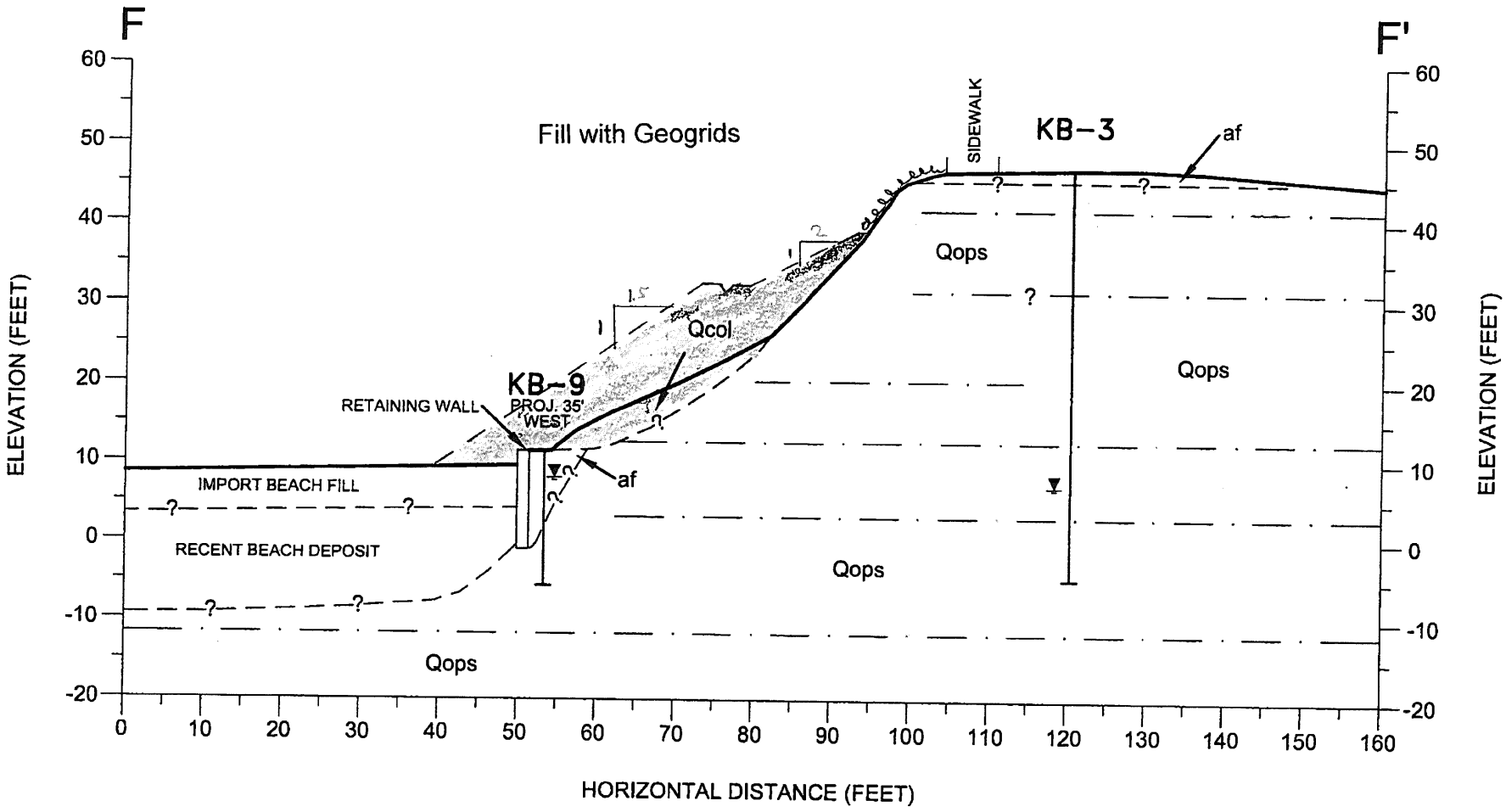

E
E'
Fill with Geogrids
SIDEWALK
Qls
Qcol
RETAINING WALL
IMPORT BEACH FILL
af
af
Qops
Qops
RECENT BEACH DEPOSIT
Qops
1.5
1
2
1
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

OPTION 1A

5–5' Fill with Geogrids



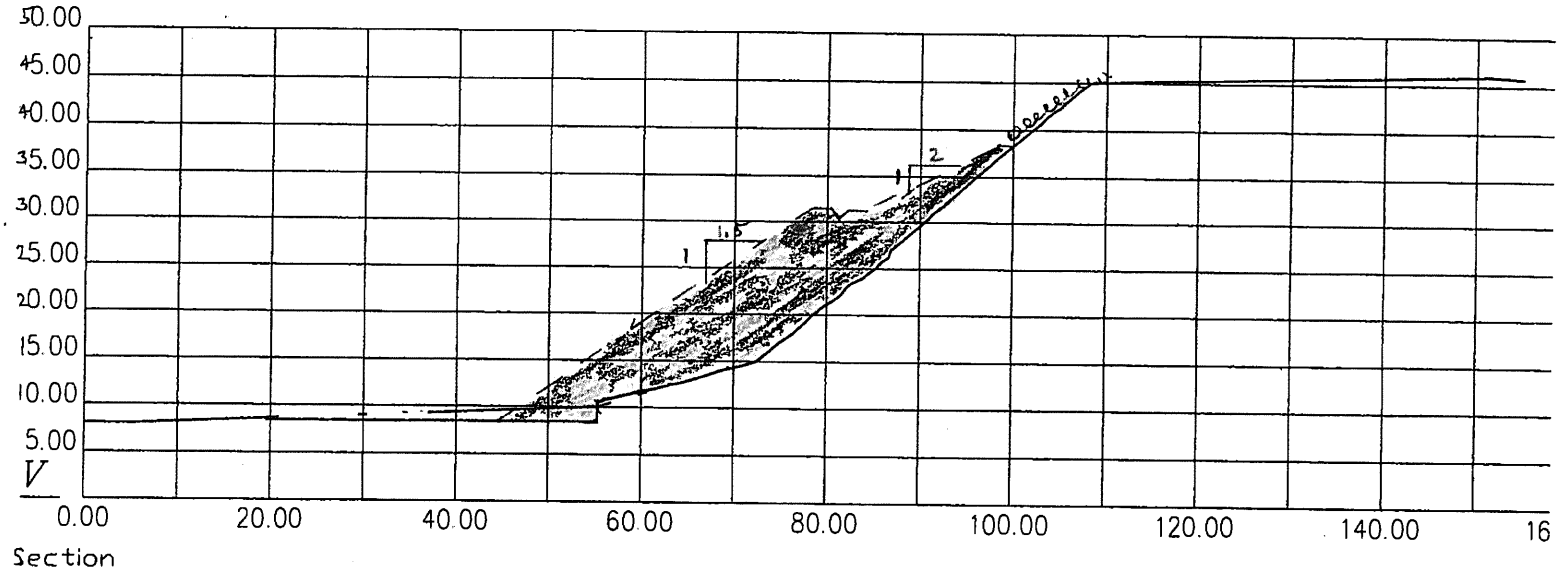
OPTION 1A


F
F'
Fill with Geogrids
SIDEWALK
KB-3
af
Qops
Qcol
KB-9
PROJ. 35' WEST
RETAINING WALL
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)

OPTION 1A

6-6'

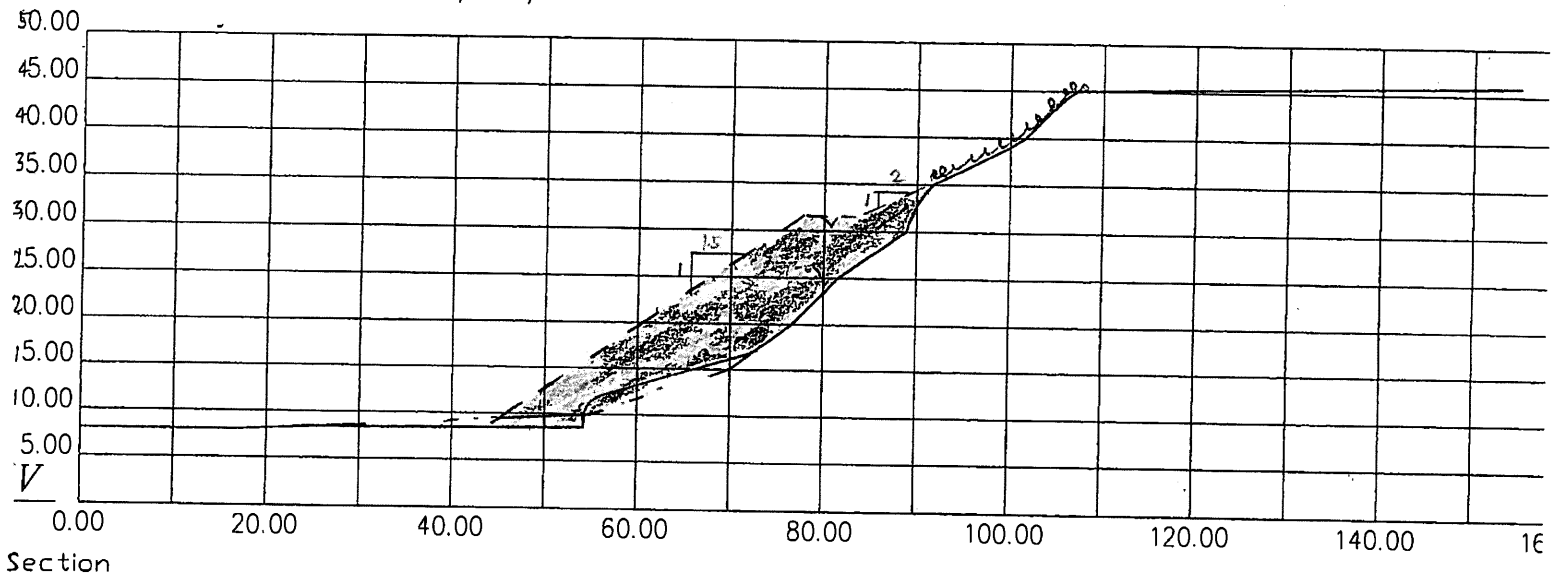
Fill with Geogrids



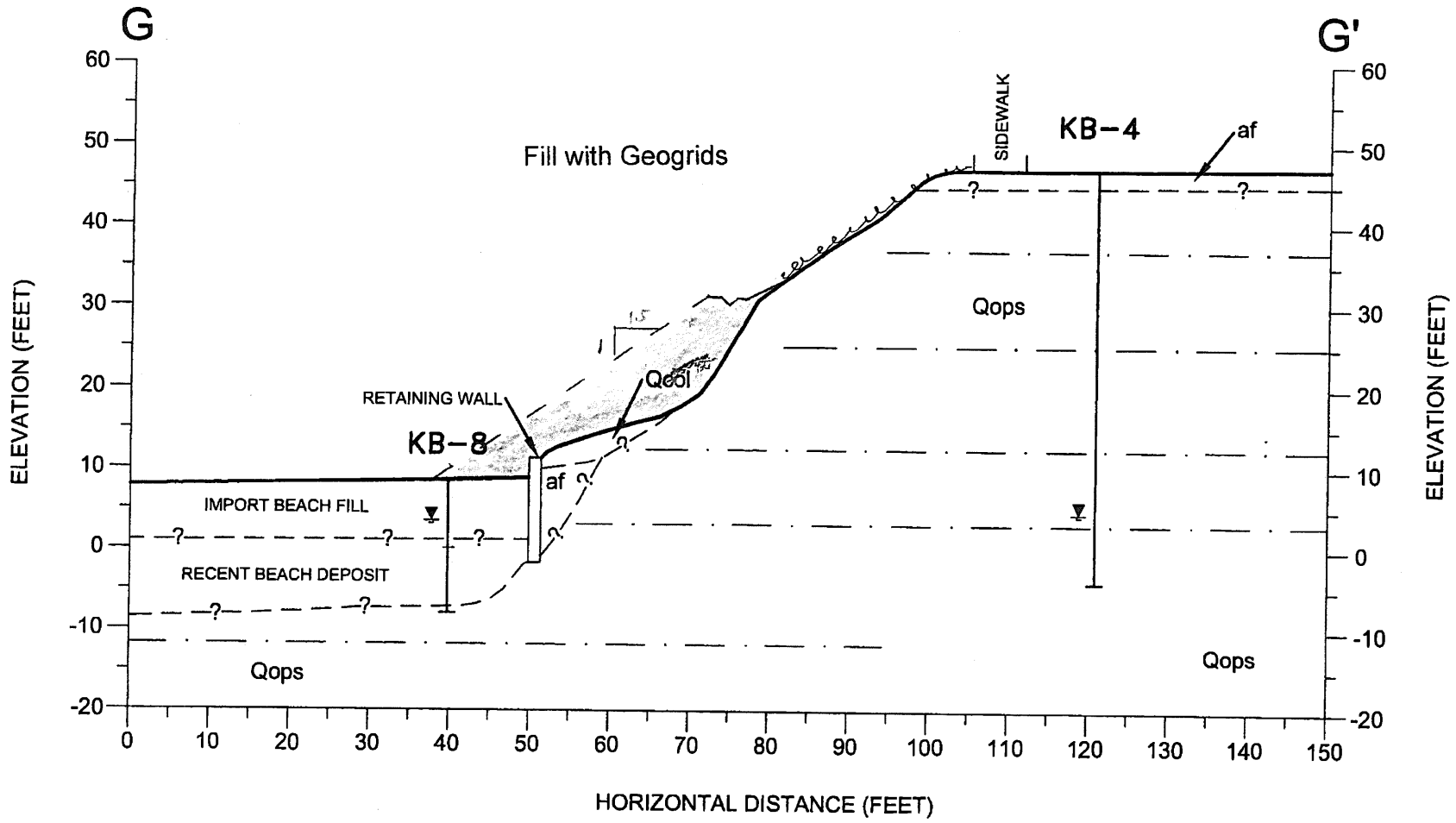
OPTION 1A

7-7'

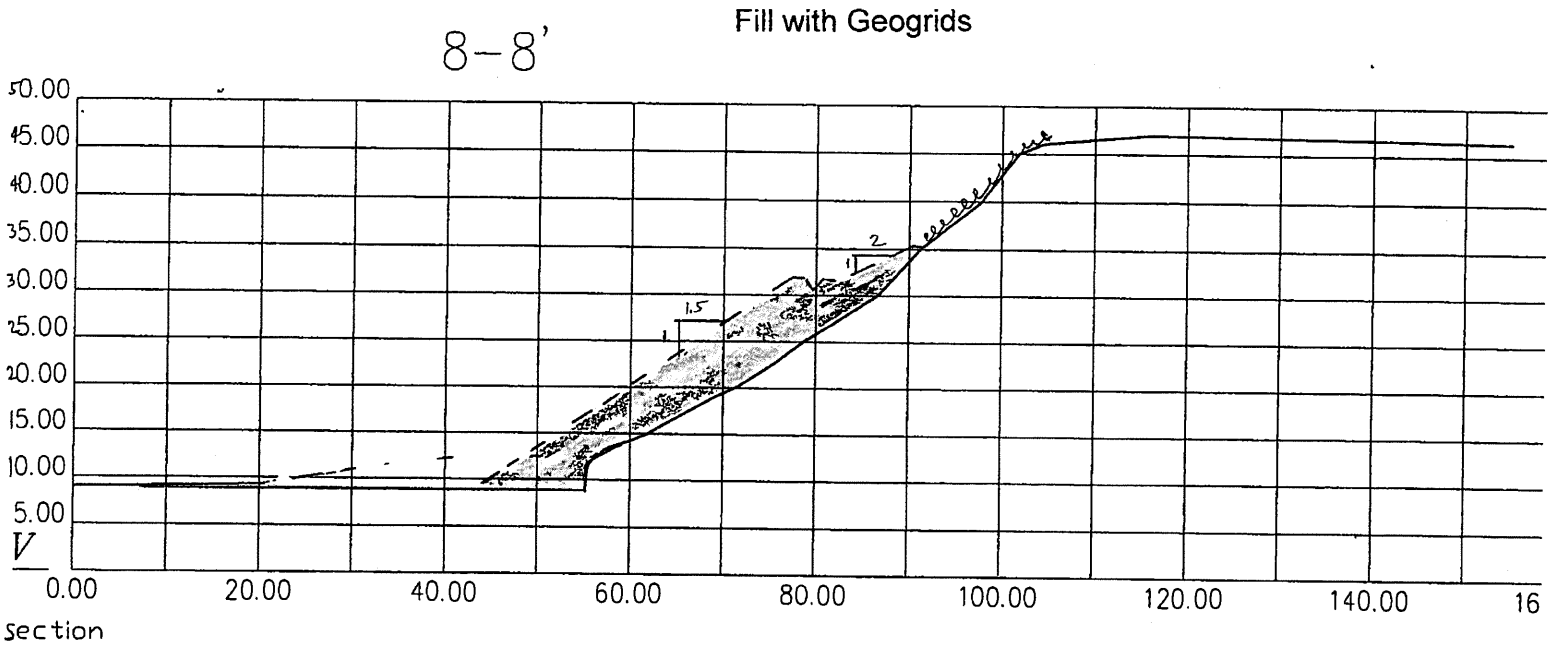
Fill with Geogrids



OPTION 1A

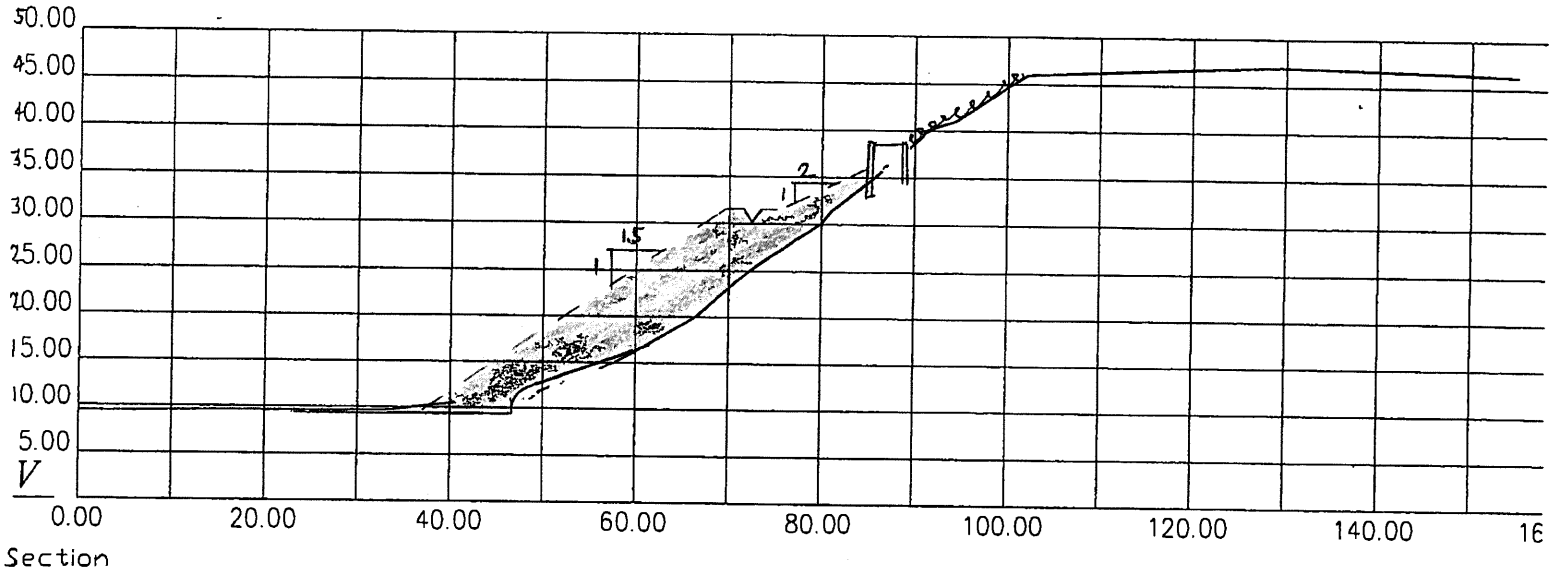

G
G'
Fill with Geogrids
SIDEWALK
KB-4
af
Qops
Qcol
RETAINING WALL
KB-8
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

OPTION 1A


8-8'
Fill with Geogrids
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
1.5
1
2
1

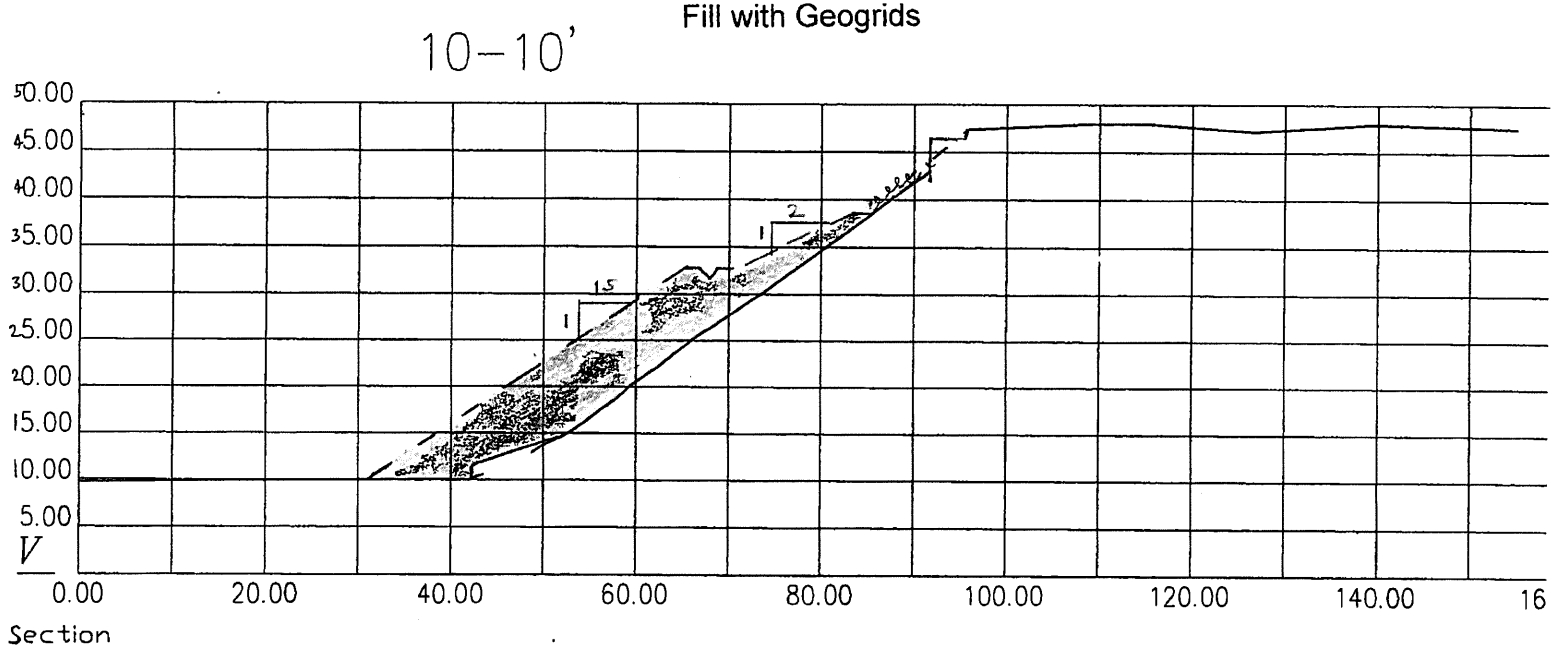
OPTION 1A

9–9' Fill with Geogrids



OPTION 1A

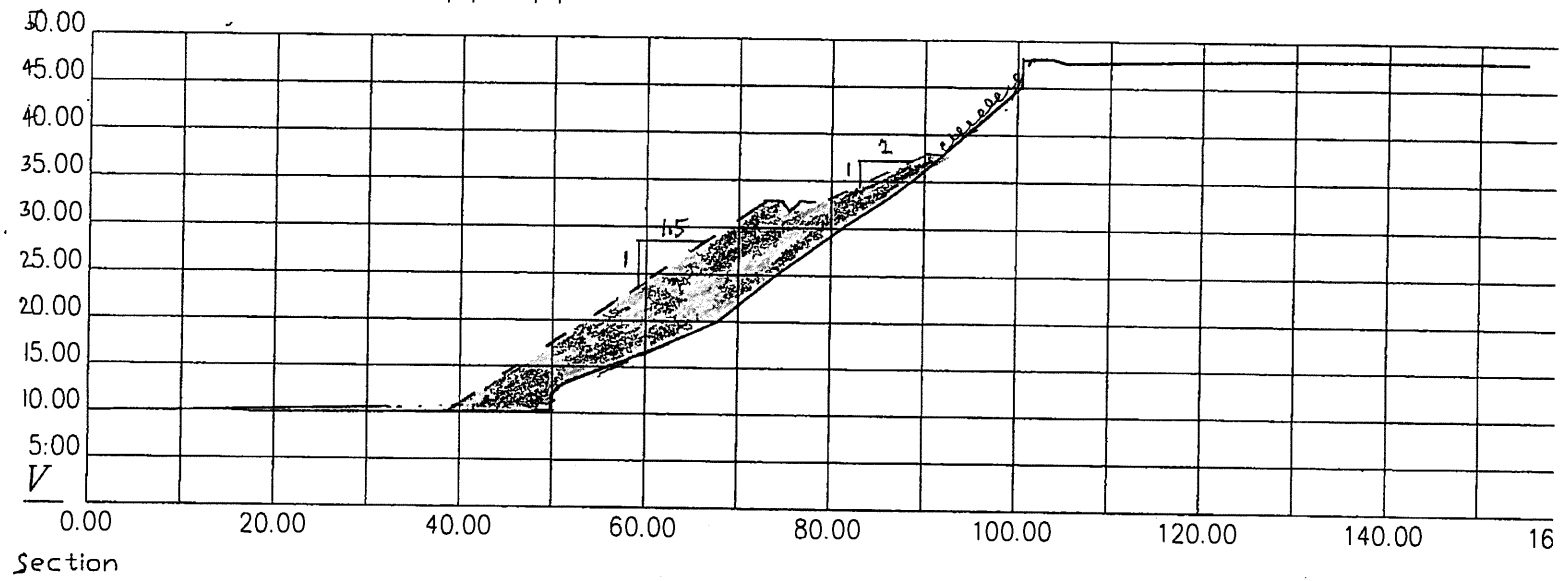
Fill with Geogrids



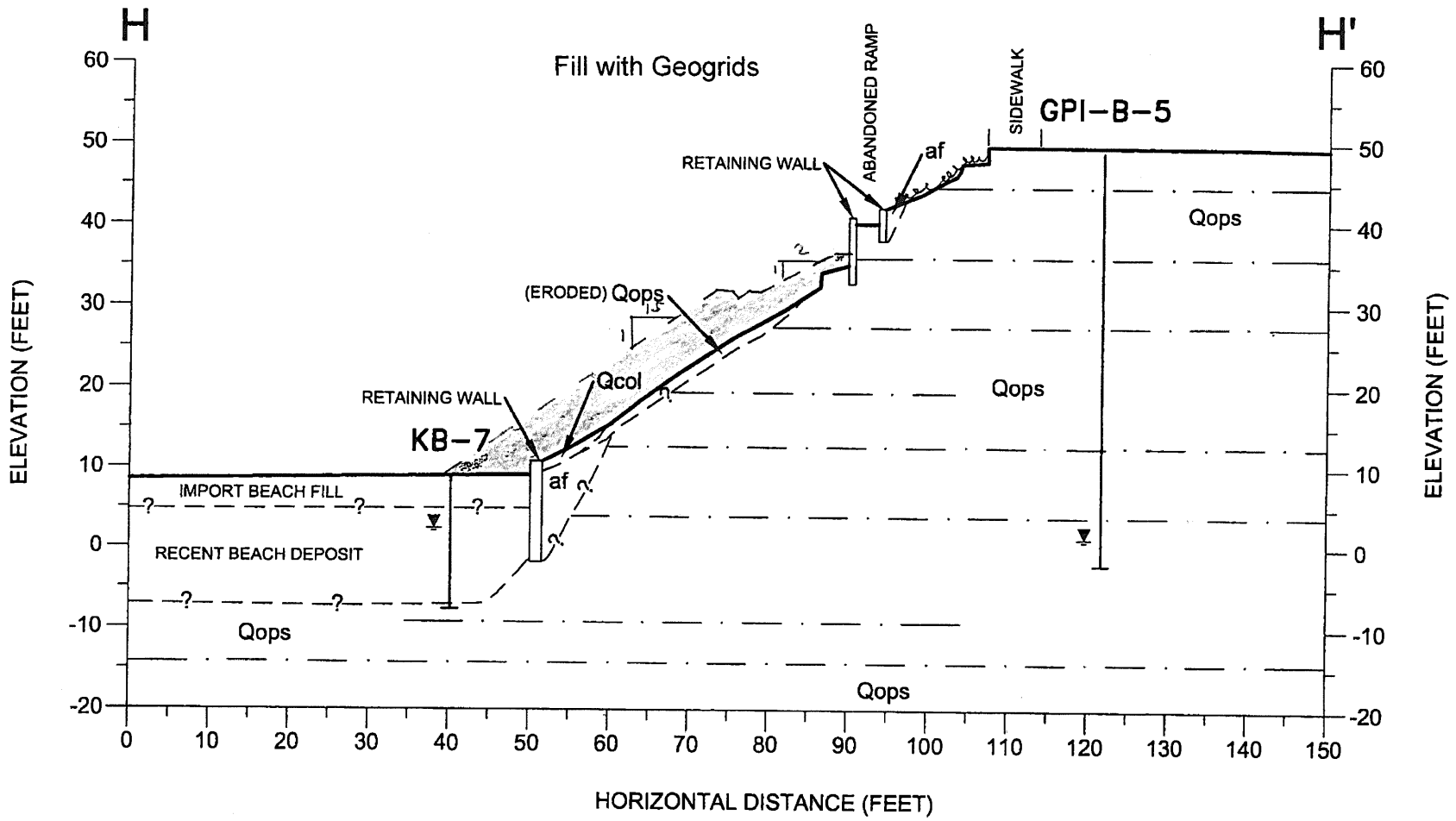
OPTION 1A

11-11'

Fill with Geogrids

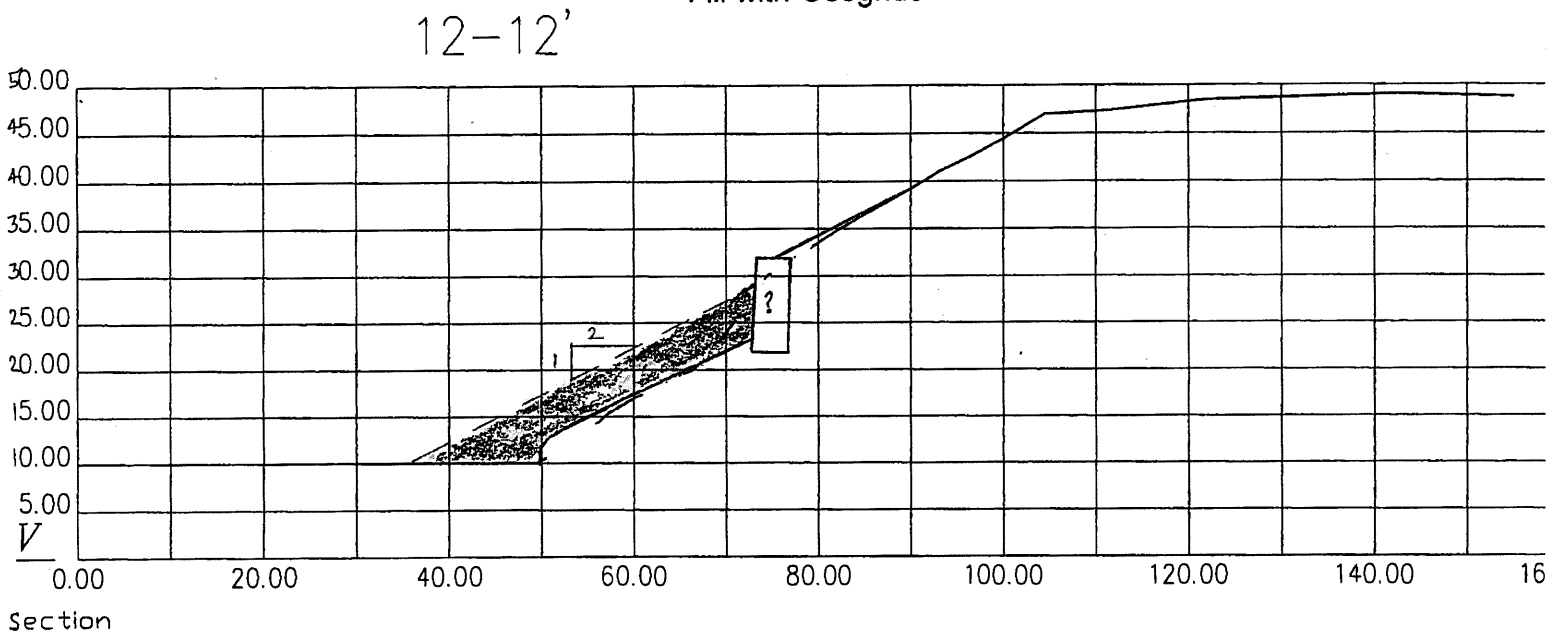


OPTION 1A

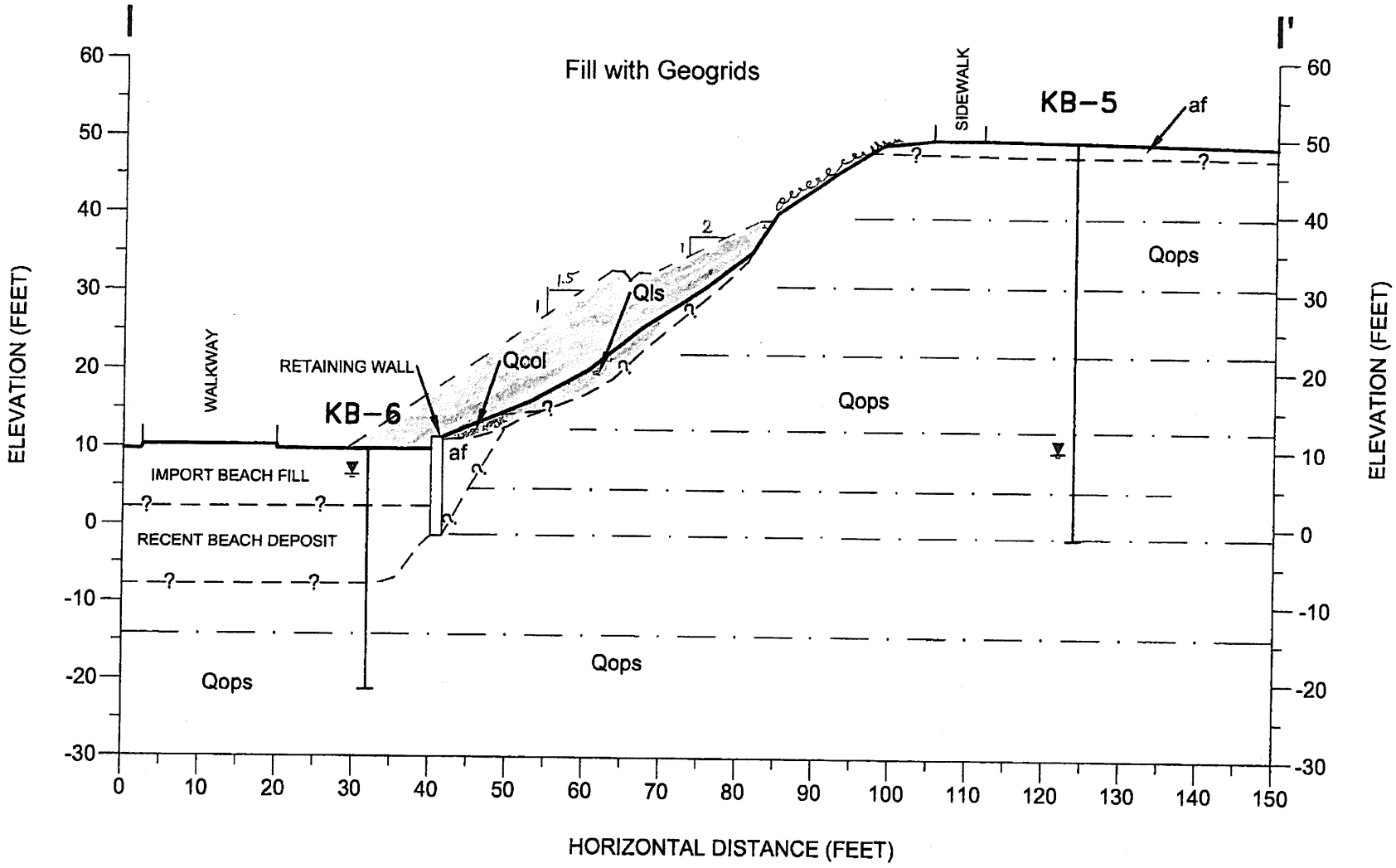

H
H'
Fill with Geogrids
ABANDONED RAMP
SIDEWALK
GPI–B–5
RETAINING WALL
af
Qops
(ERODED) Qops
Qcol
RETAINING WALL
KB–7
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

OPTION 1A

Fill with Geogrids

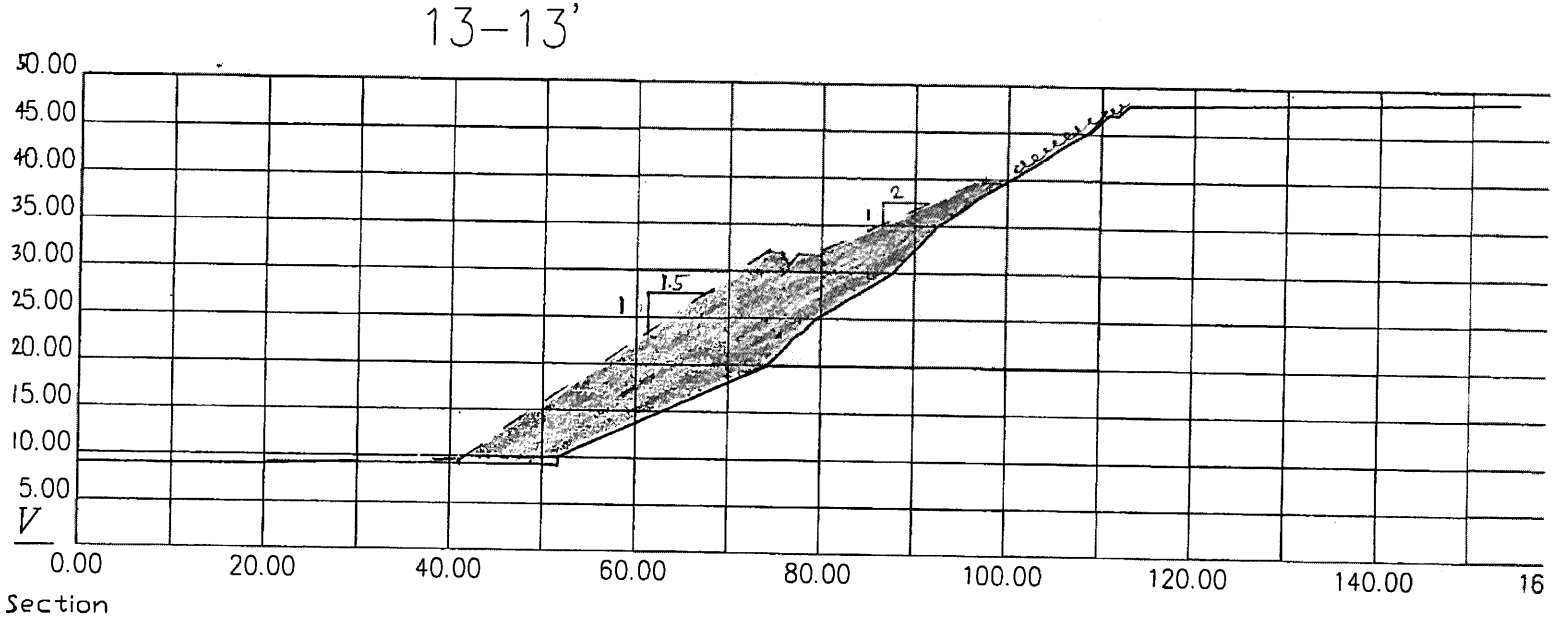


OPTION 1A


I
I'
Fill with Geogrids
SIDEWALK
KB–5
af
WALKWAY
RETAINING WALL
KB–6
Qcol
Qls
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
-30
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

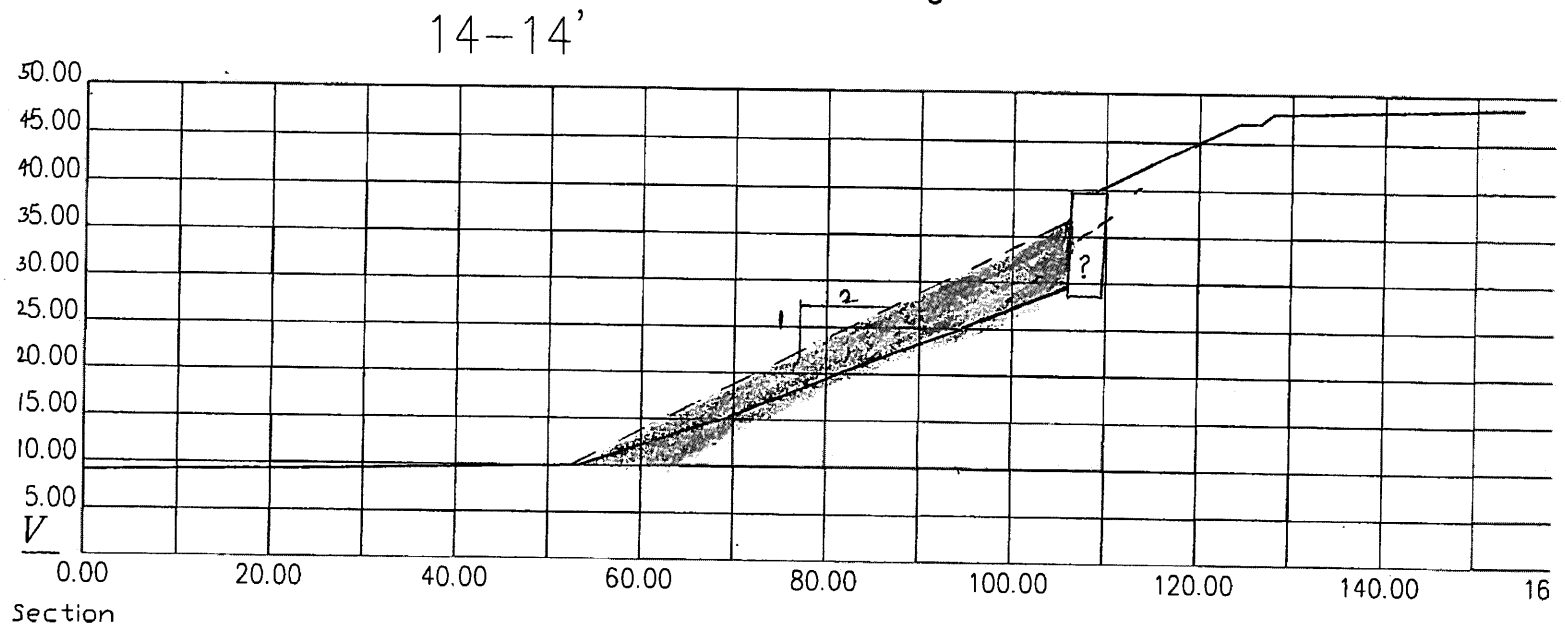
OPTION 1A

Fill with Geogrids

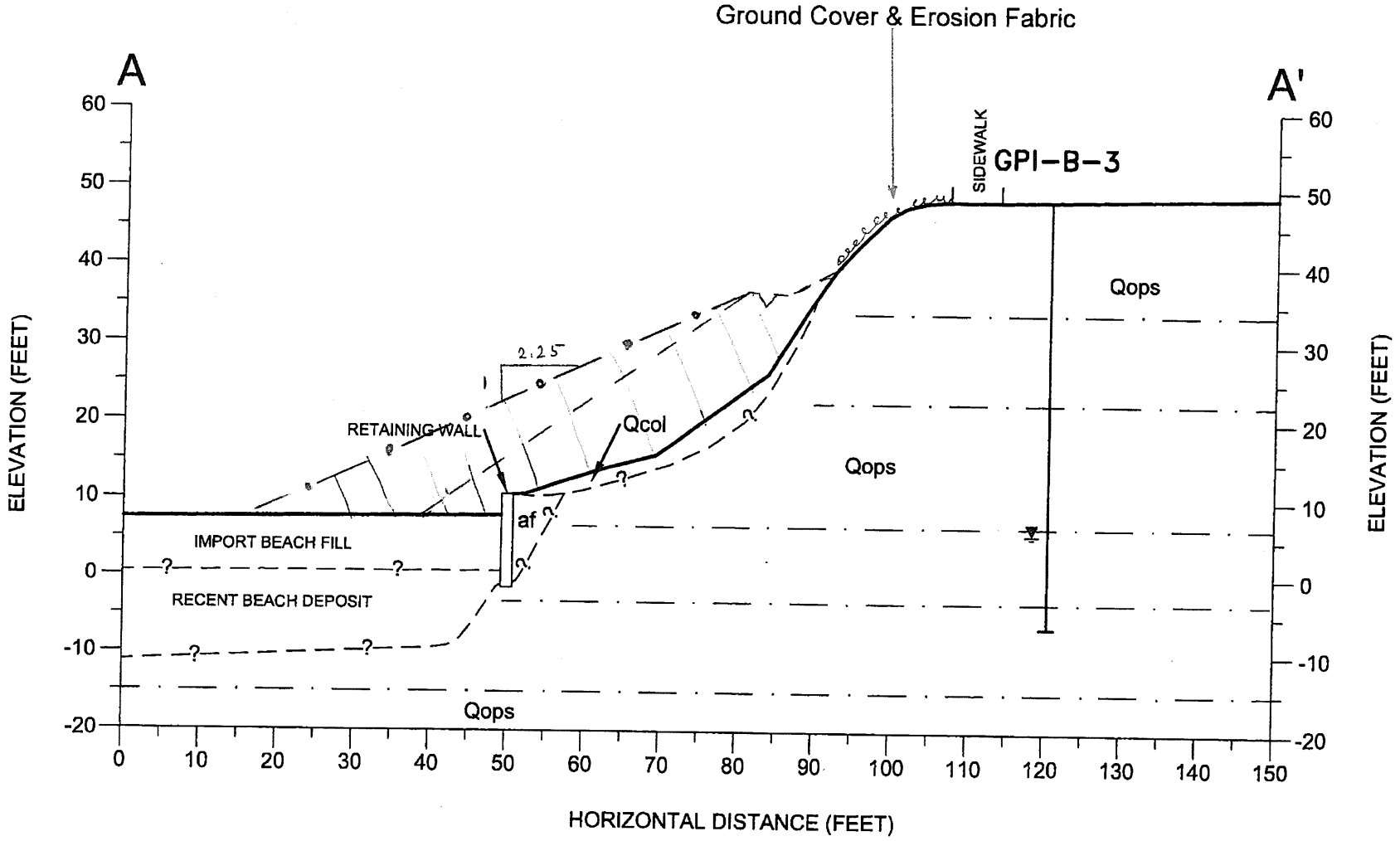


OPTION 1A

Fill with Geogrids



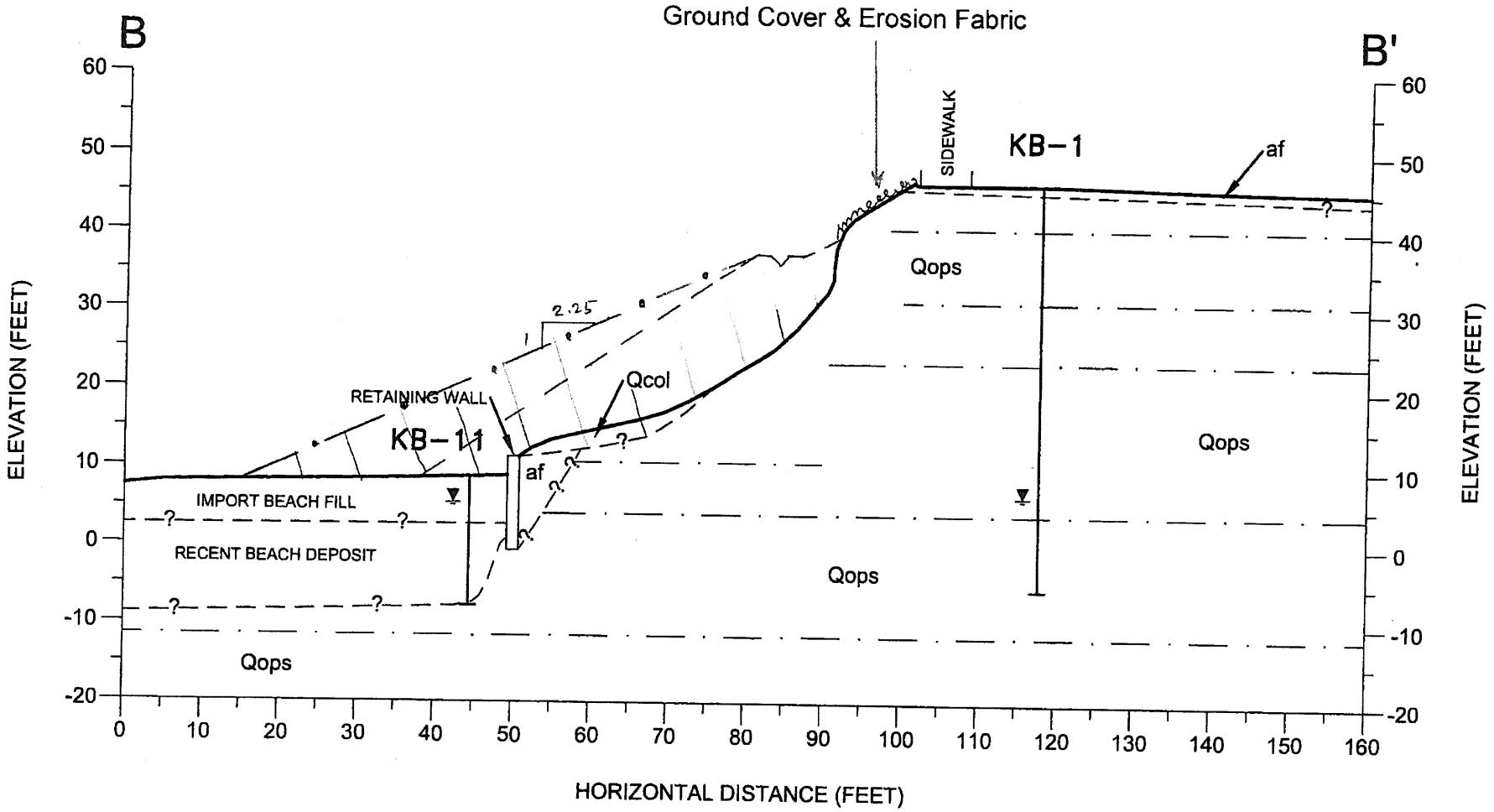
OPTION 1A



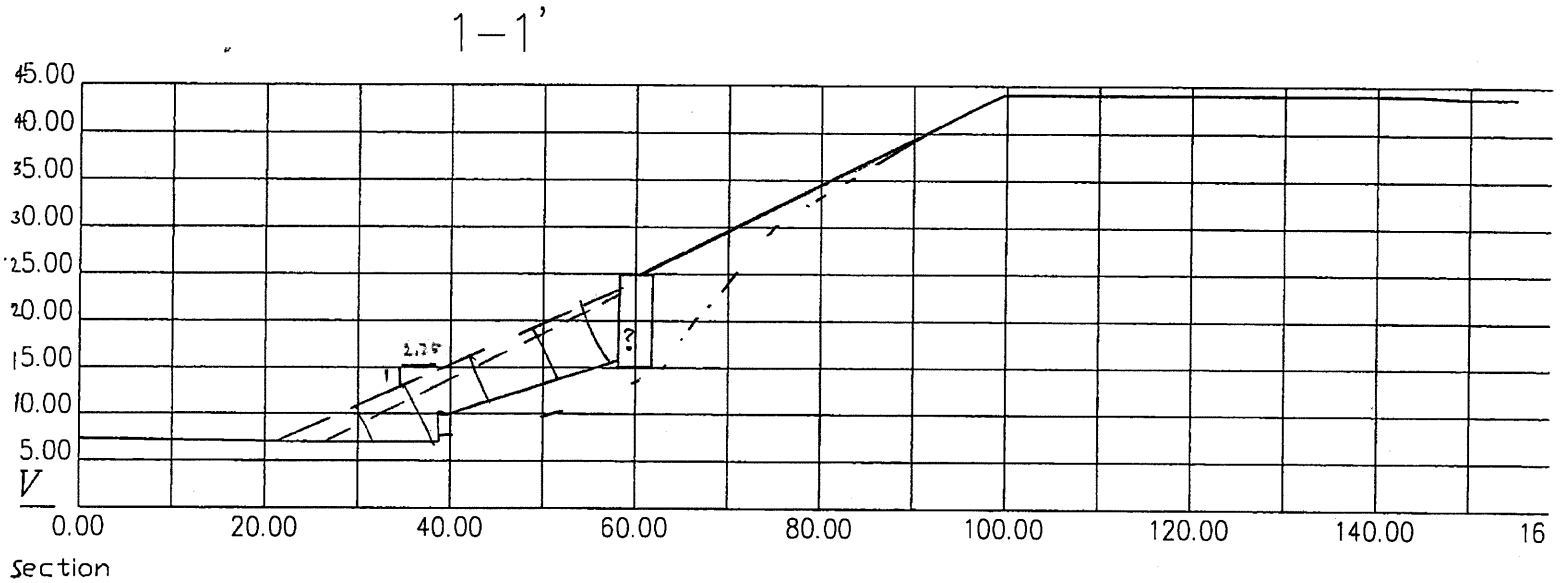
EXPLANATION

af	ARTIFICIAL FILL
Qcol	COLLUVIUM
Qls	LANDSLIDE
Qops	QUATERNARY OLD PARALIC DEPOSITS

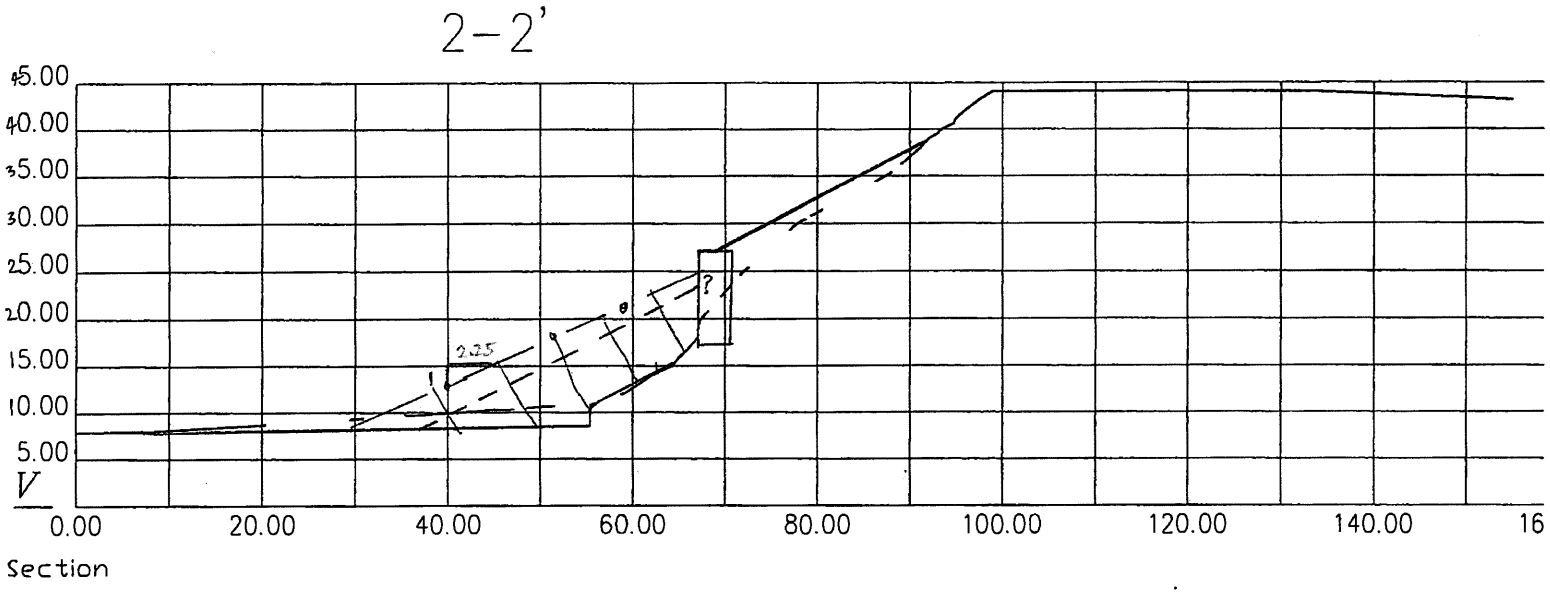
OPTION 1B


B
B'
Ground Cover & Erosion Fabric
SIDEWALK
KB-1
af
Qops
2.25
1
Qcol
RETAINING WALL
KB-11
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

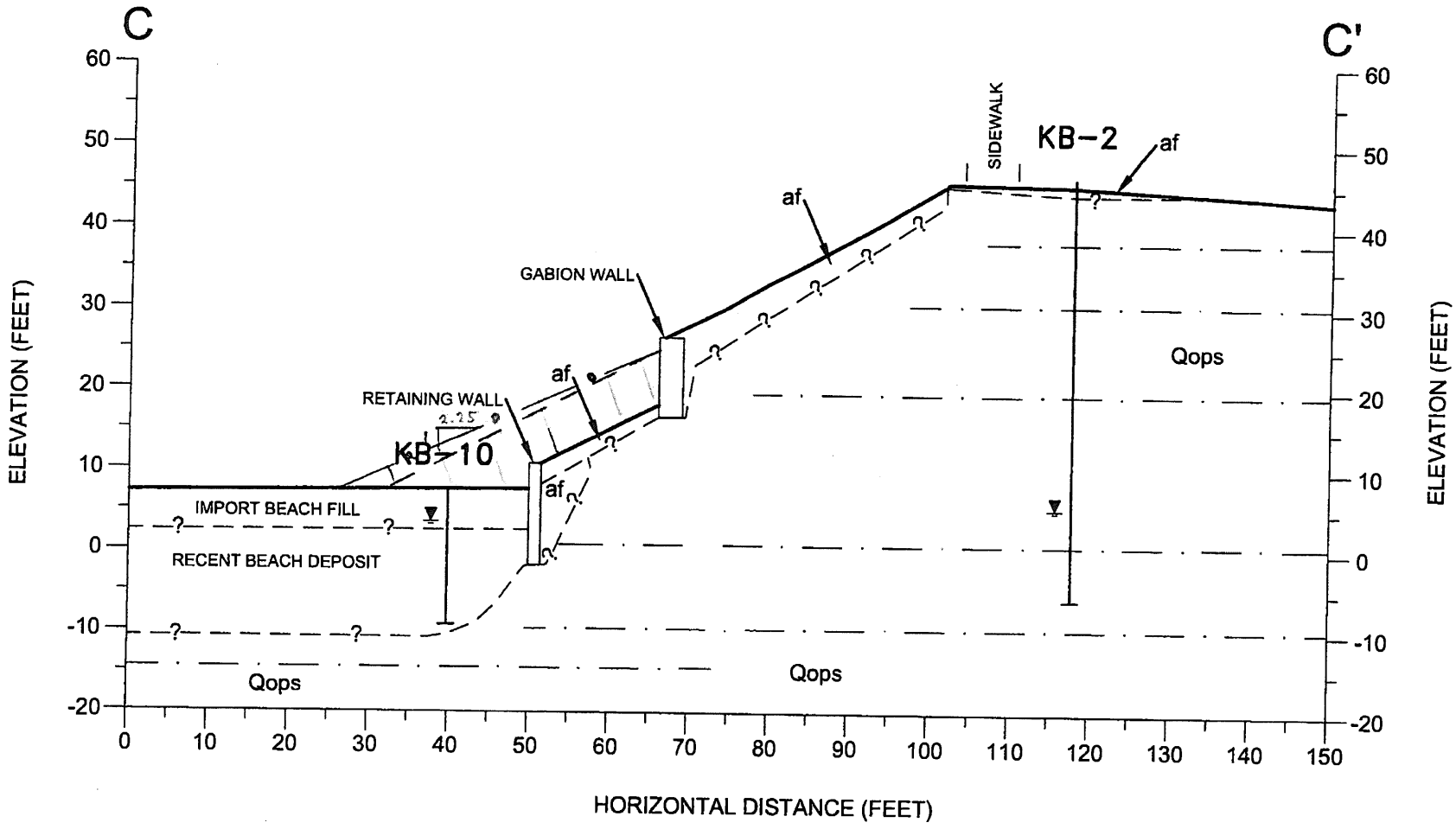
OPTION 1B


1–1'
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

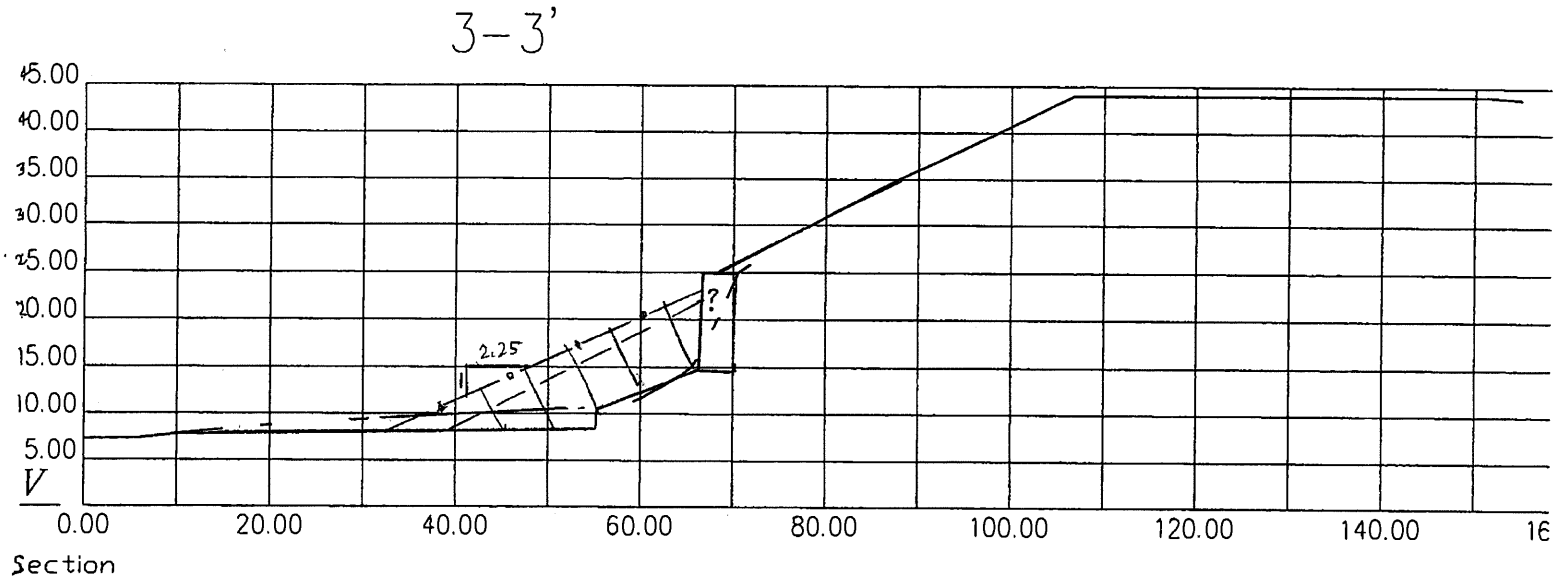
OPTION 1B


2-2'
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

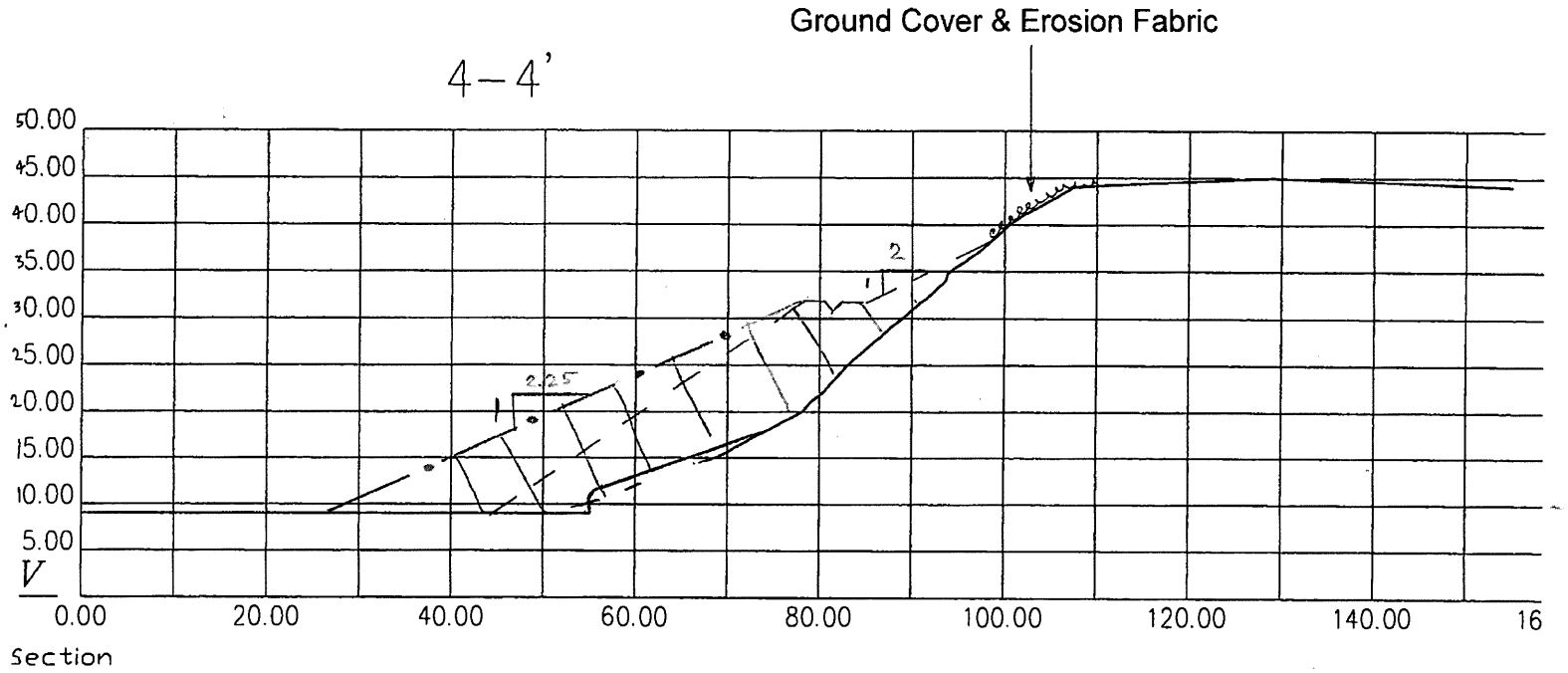
OPTION 1B


C
C'
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
SIDEWALK
KB-2
af
af
GABION WALL
af
RETAINING WALL
2:1
KB-10
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

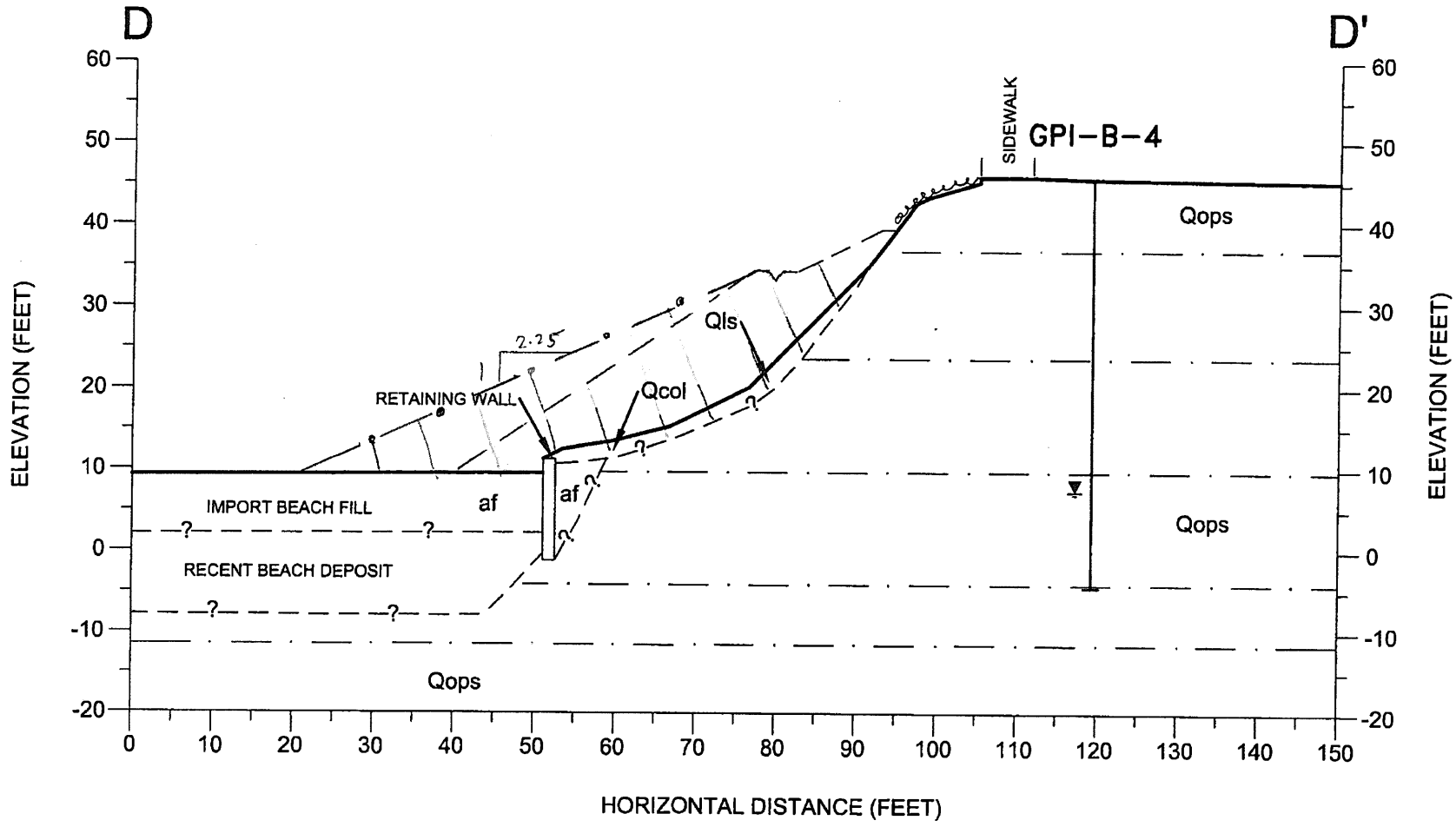
OPTION 1B


3-3'
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
Section
2.25
?

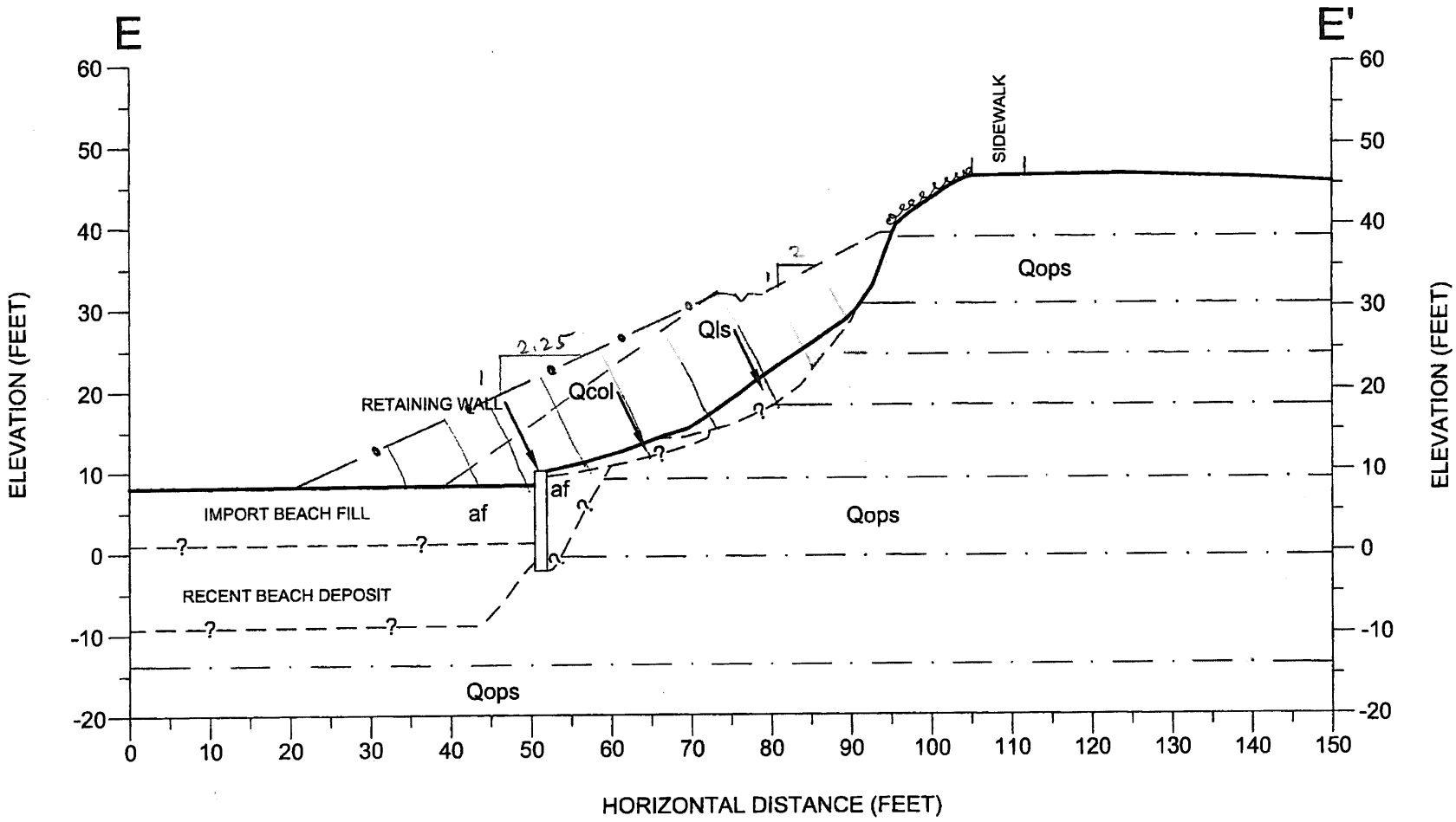
OPTION 1B


Ground Cover & Erosion Fabric
4-4'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2
1
2.25
1

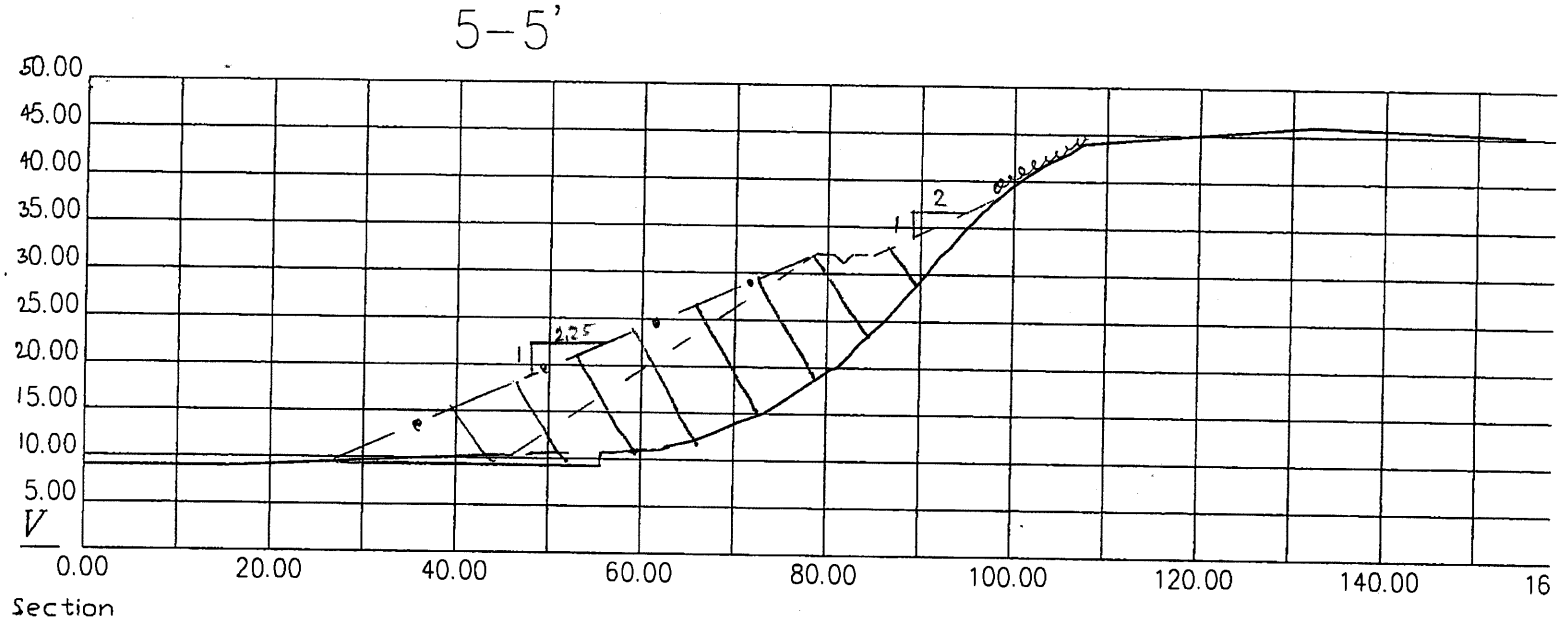
OPTION 1B


D
D'
SIDEWALK
GPI-B-4
Qops
Qls
Qcol
2.25
RETAINING WALL
af
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

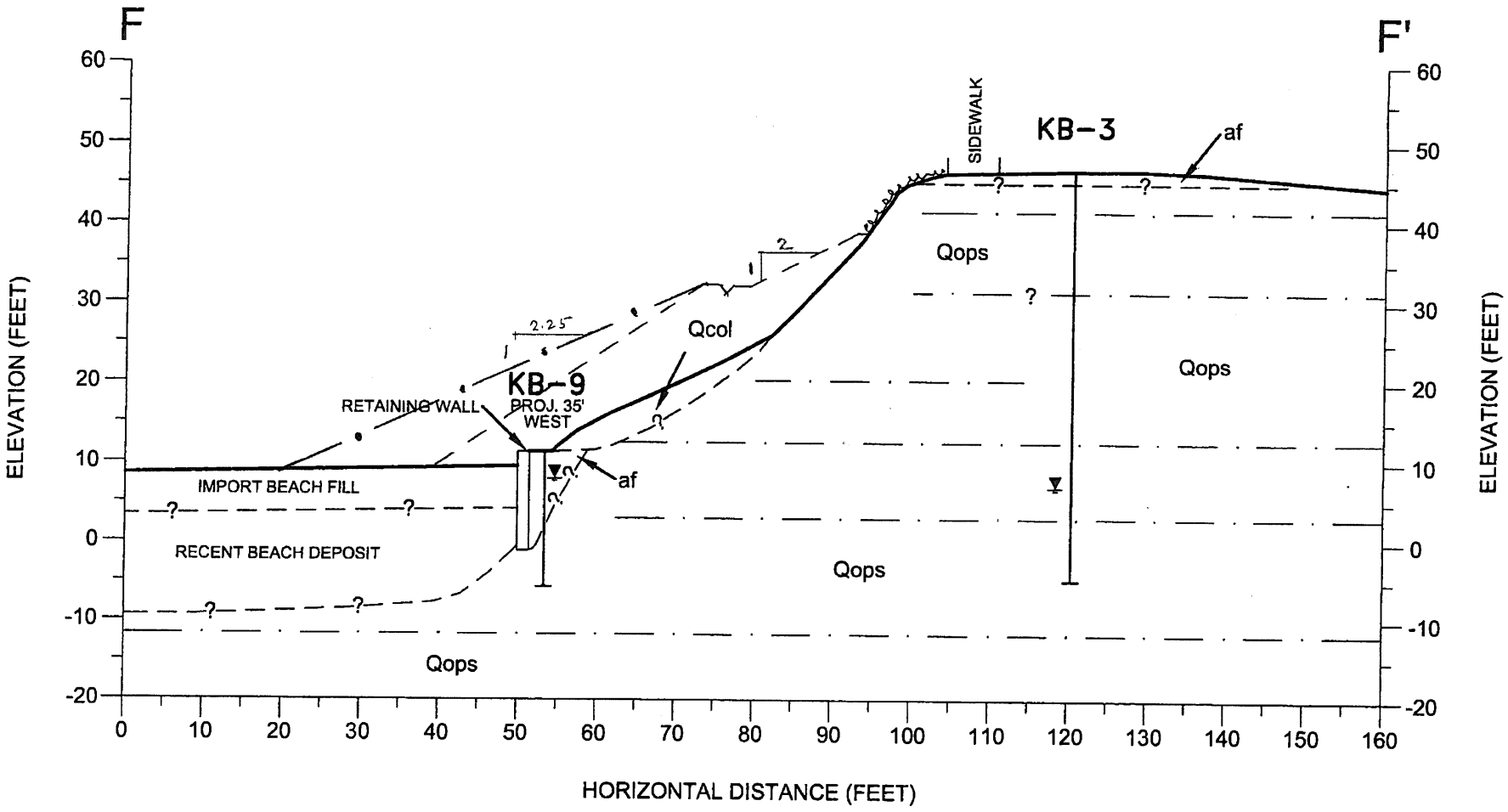
OPTION 1B


E
E'
SIDEWALK
Qops
Qls
Qcol
2.25
RETAINING WALL
IMPORT BEACH FILL
af
af
Qops
RECENT BEACH DEPOSIT
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

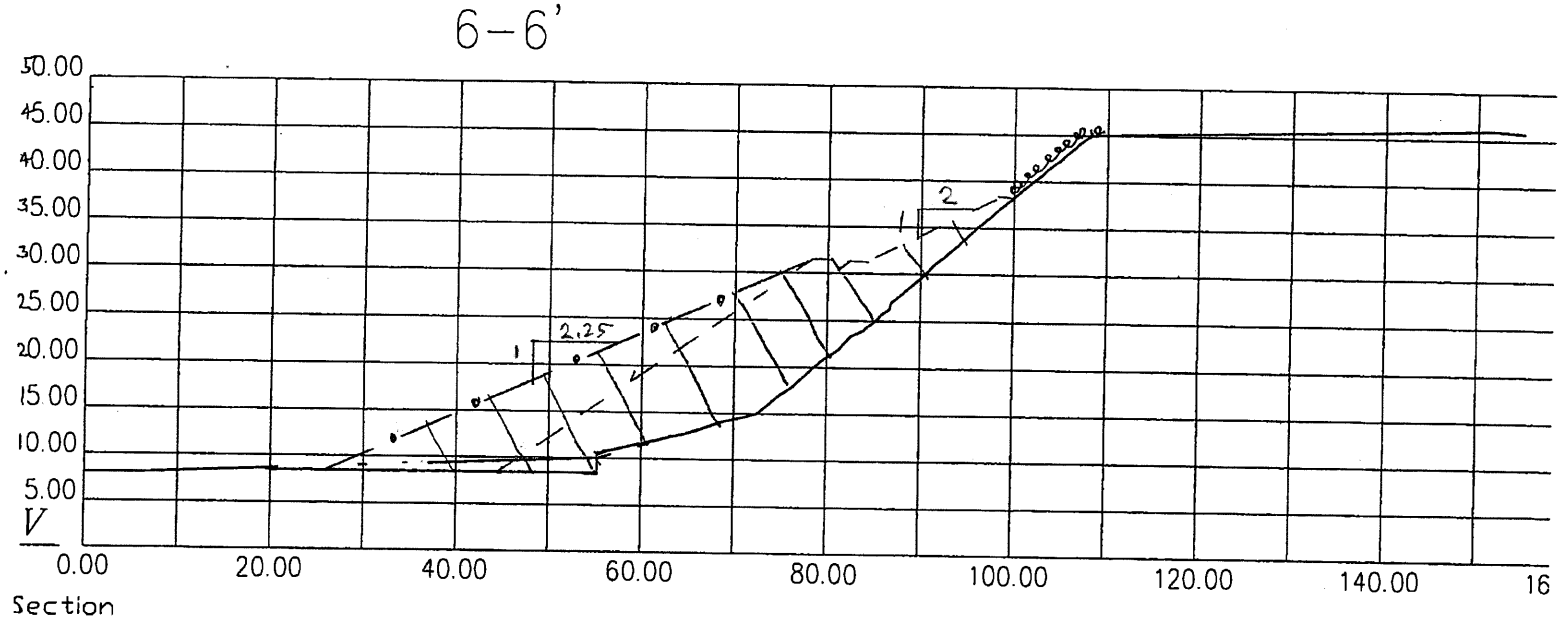
OPTION 1B


5-5'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2.25
1
2
1

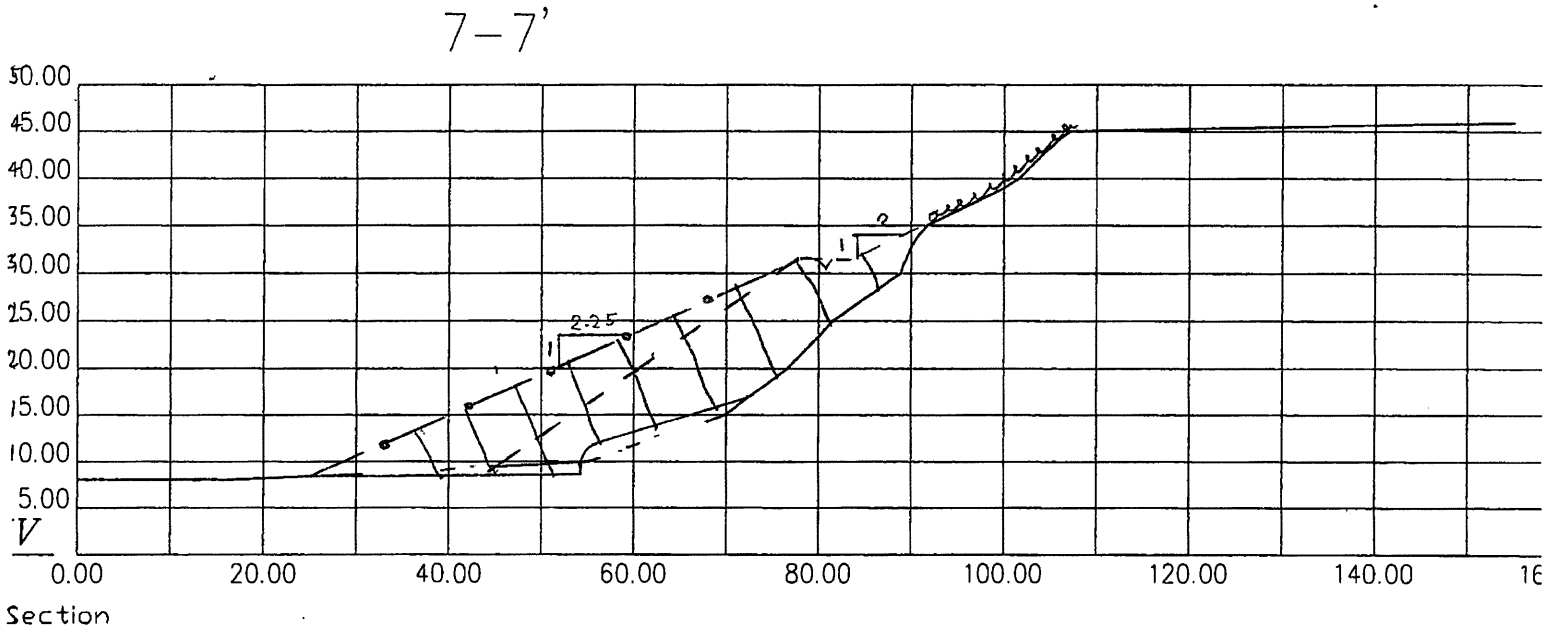
OPTION 1B


F
F'
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
SIDEWALK
KB-3
af
Qops
Qcol
KB-9
PROJ. 35' WEST
RETAINING WALL
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
af
2
1
2.25
1

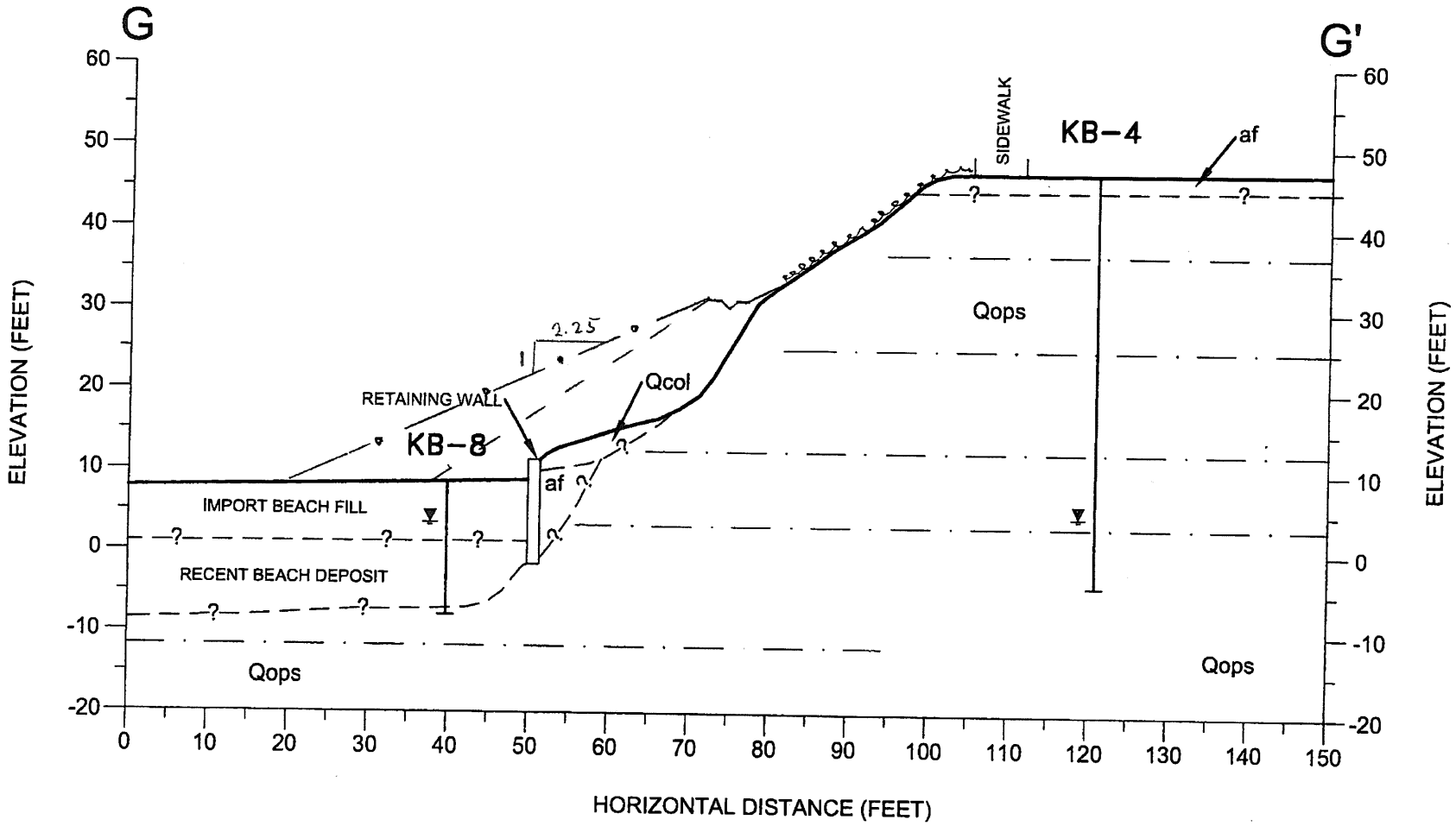
OPTION 1B


6-6'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2.25
1
2

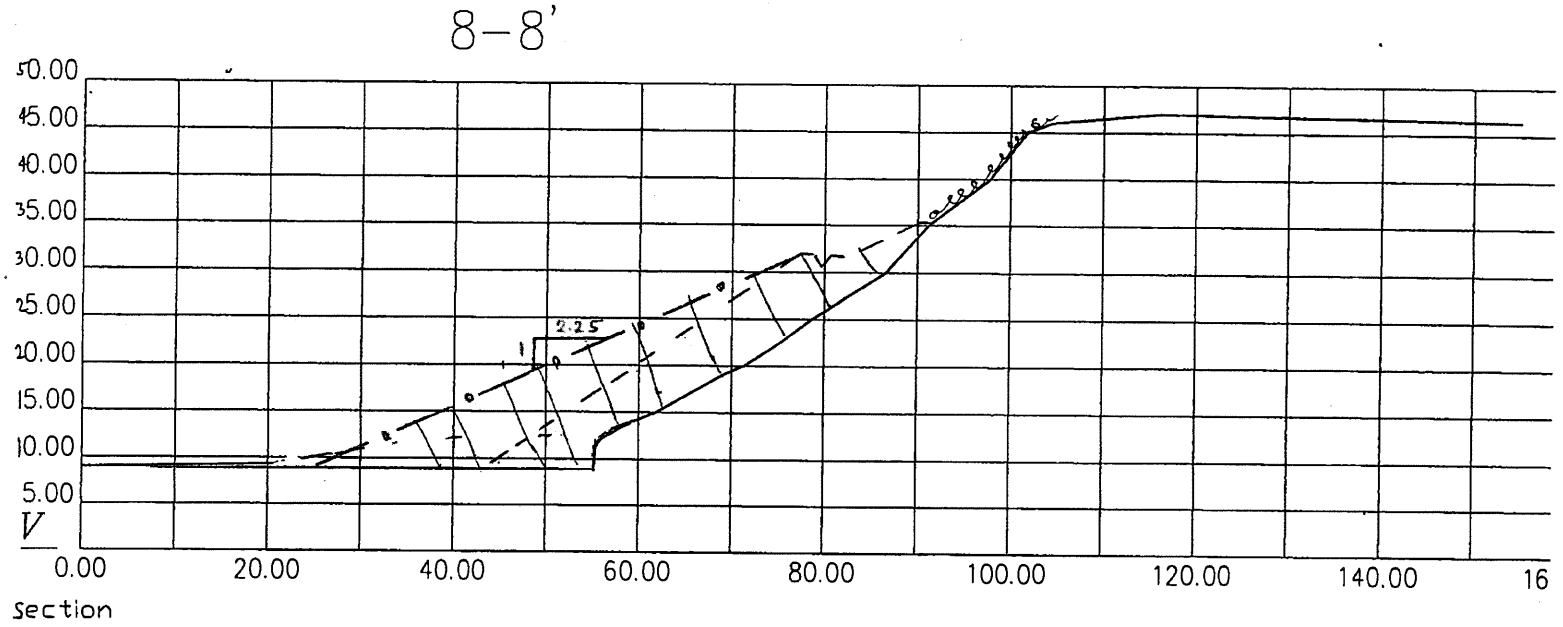
OPTION 1B


7-7'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
2.25
1
1
2
Section

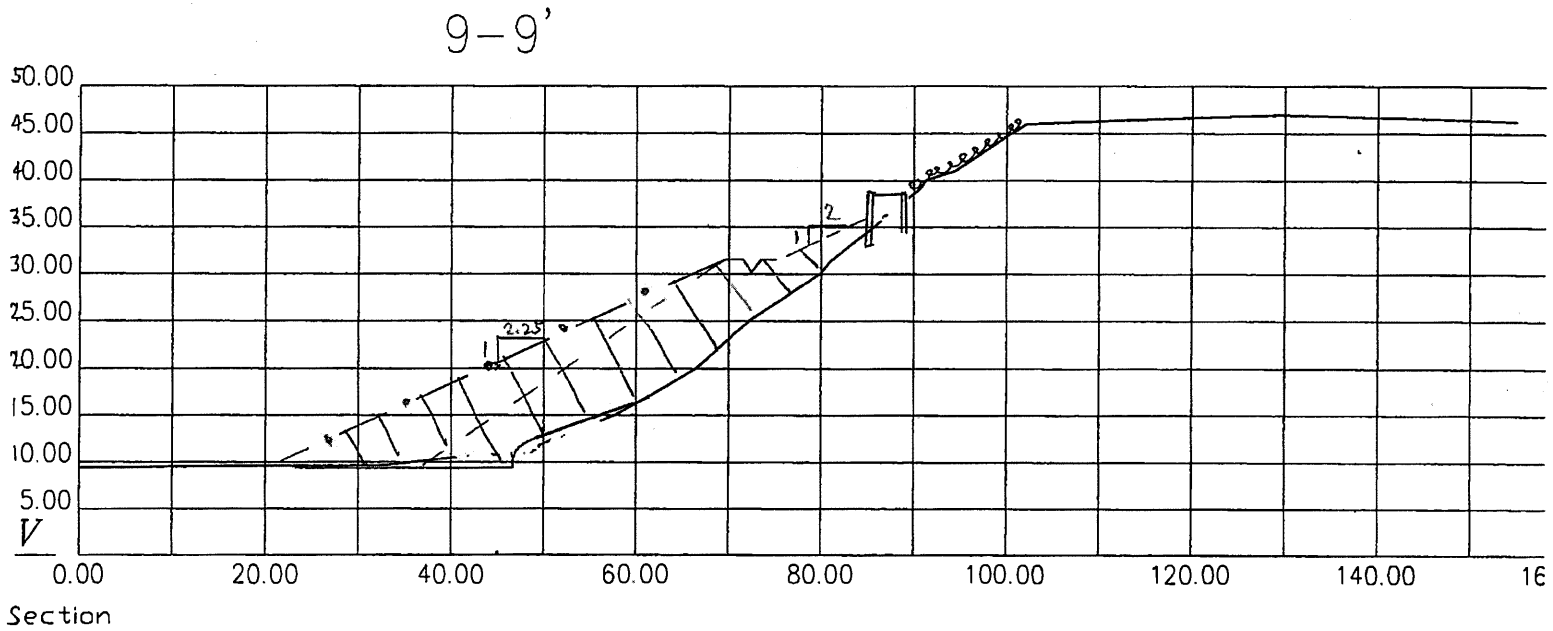
OPTION 1B


G
G'
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
SIDEWALK
KB-4
af
Qops
2.25
1
RETAINING WALL
KB-8
Qcol
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops

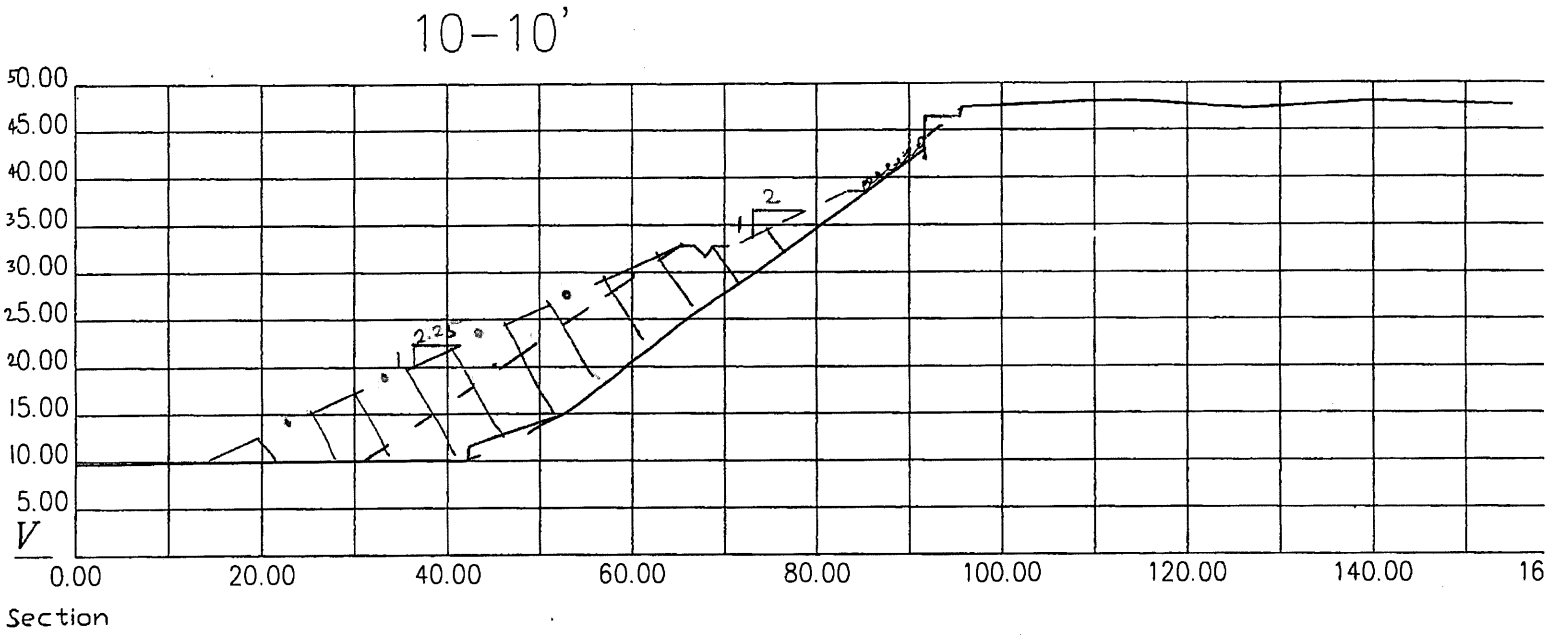
OPTION 1B


8-8'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2.25
1

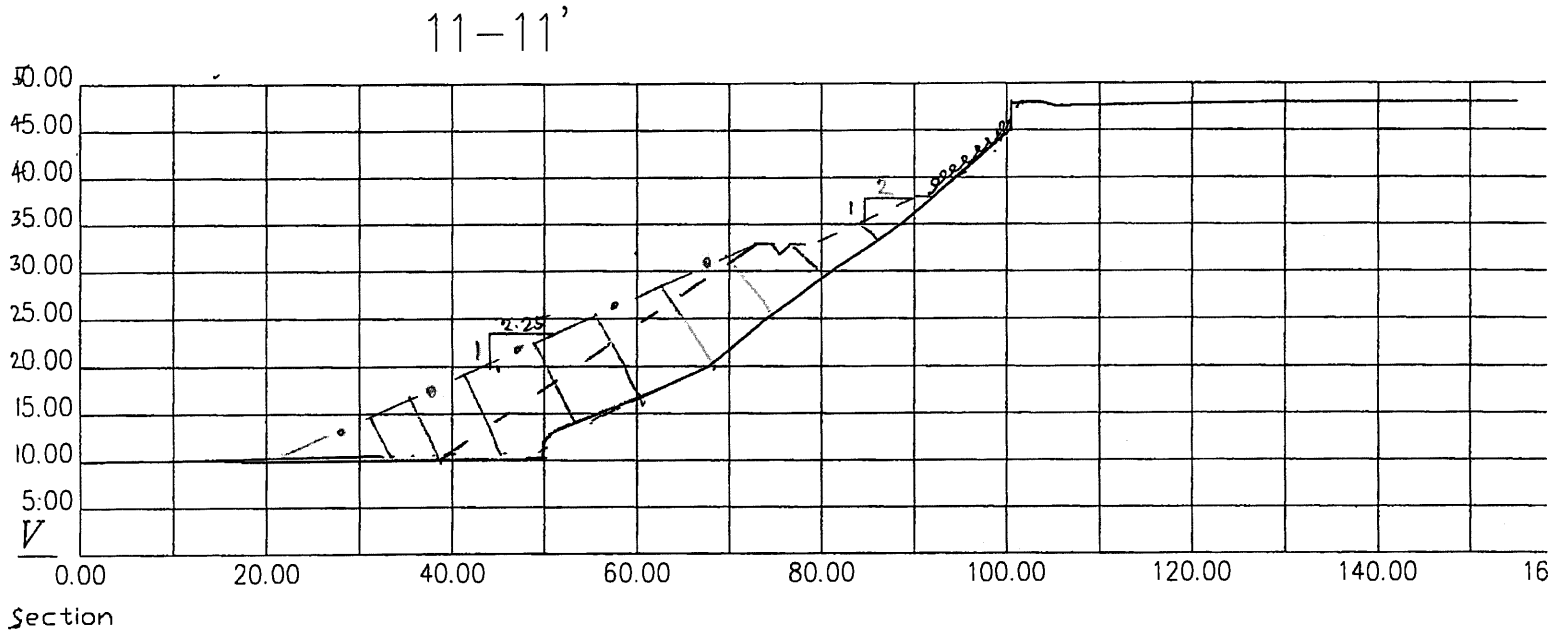
OPTION 1B


9-9'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2.25
1
2
1

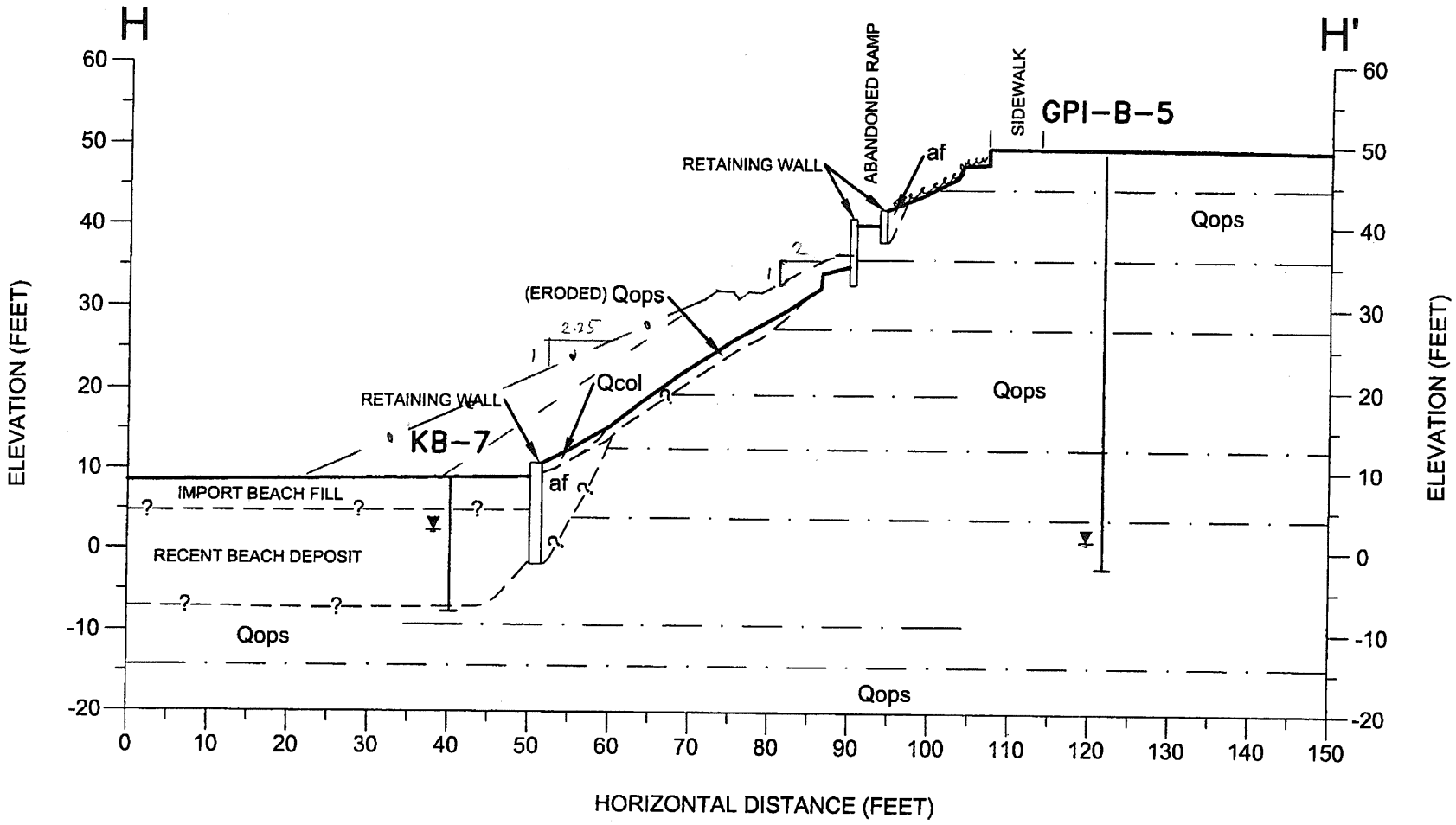
OPTION 1B


10-10'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
2.25
1
2
1
Section

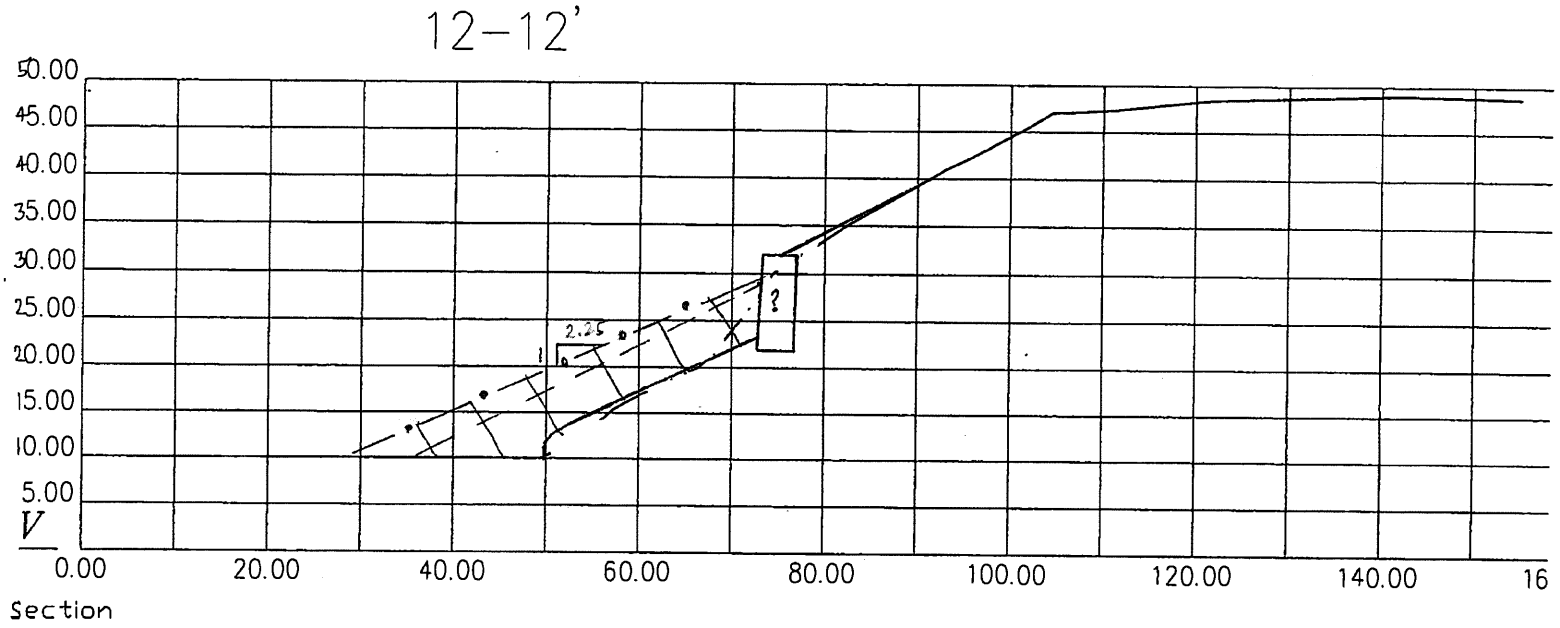
OPTION 1B


11-11'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5:00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2.25
1
2
1

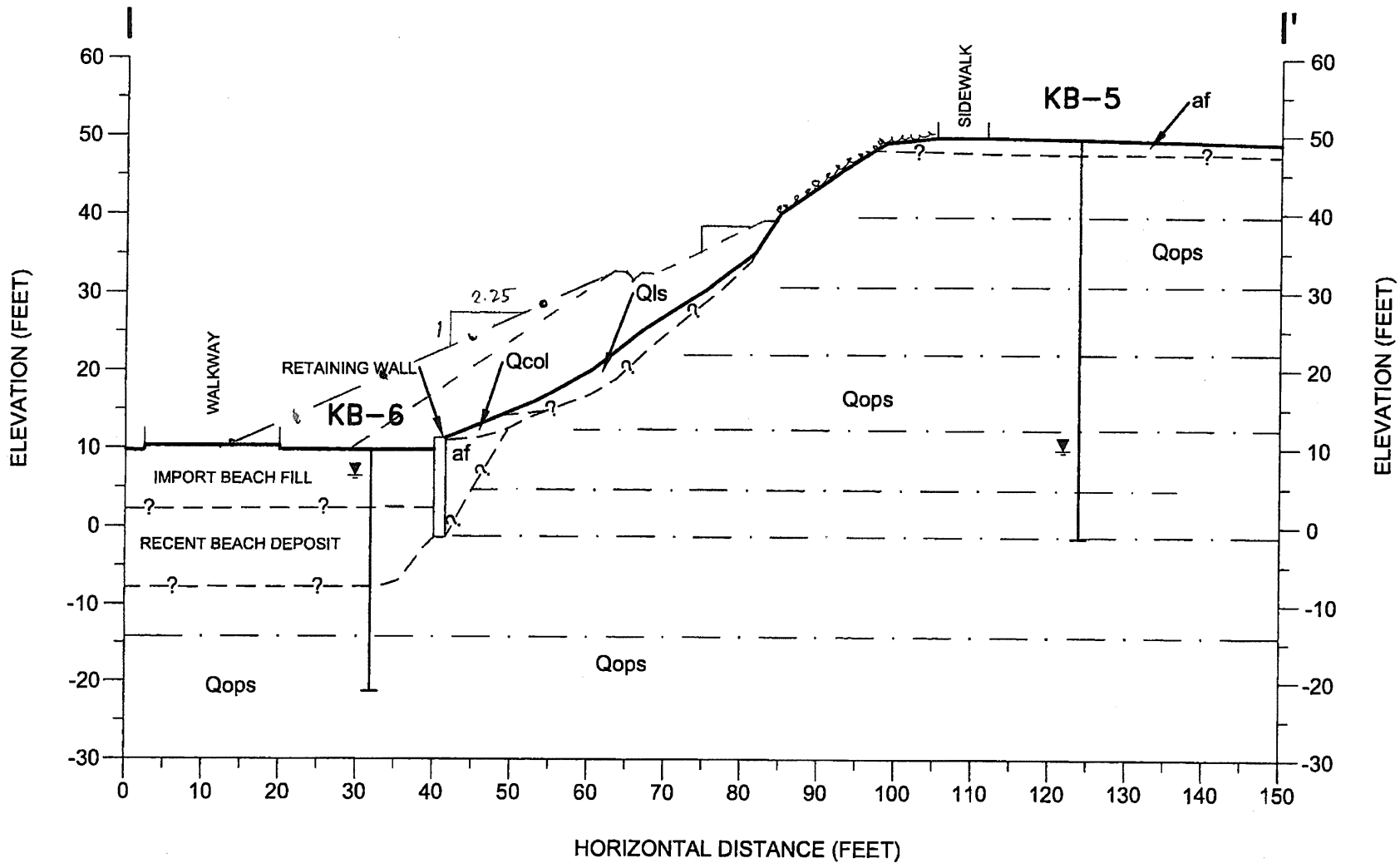
OPTION 1B


H
H'
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
RETAINING WALL
ABANDONED RAMP
SIDEWALK
GPI-B-5
af
Qops
(ERODED) Qops
2:25
1
2
Qcol
RETAINING WALL
KB-7
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops

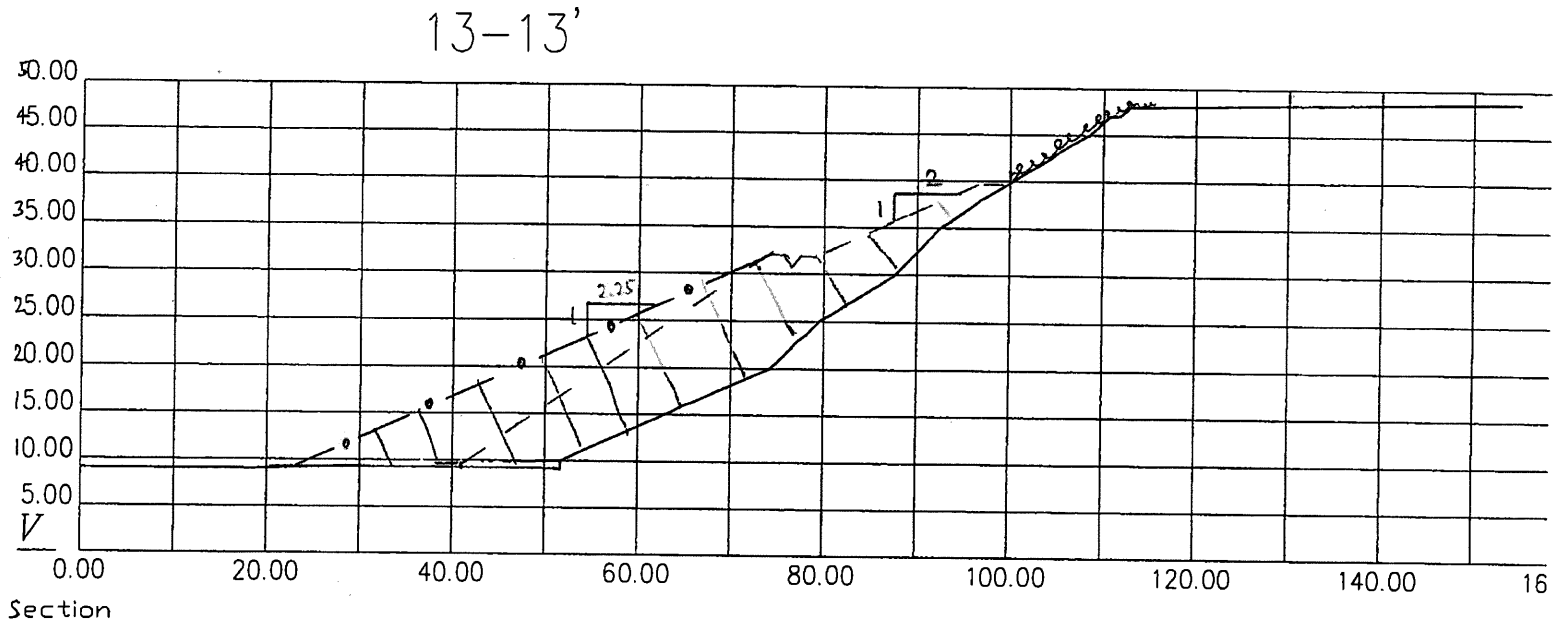
OPTION 1B


12-12'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2.25
1
?

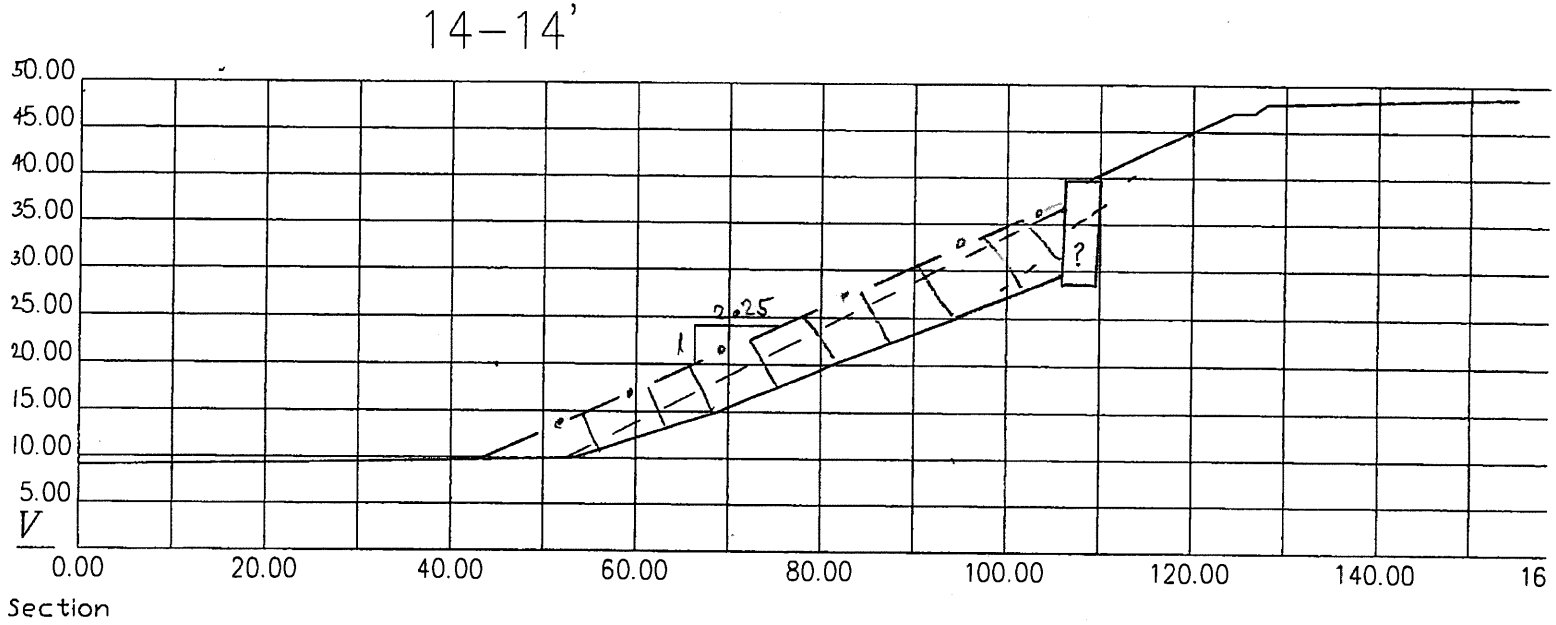
OPTION 1B


I
I'
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
WALKWAY
RETAINING WALL
KB-6
KB-5
SIDEWALK
af
Qcol
Qls
2.25
1
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
Qops

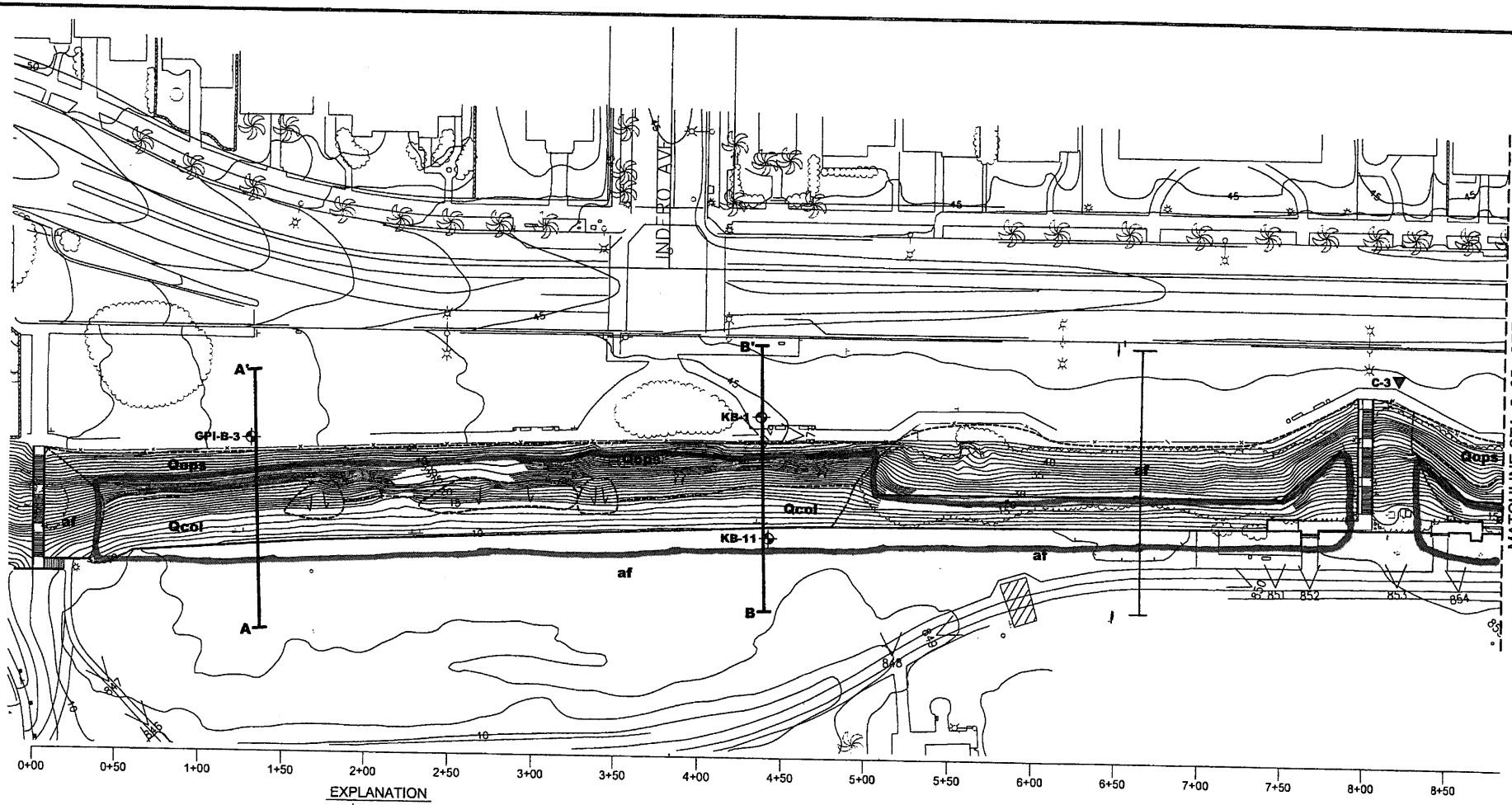
OPTION 1B


13-13'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
2.25
1
2

OPTION 1B


14-14'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
0.25
1
?

OPTION 1B



EXPLANATION

- **af** ARTIFICIAL FILL
- **Qls** LANDSLIDE
- **Qcol** COLLUVIUM
- **Qops** QUATERNARY OLD PARALIC DEPOSITS
- BORING LOCATION BY GPI (GPI-B-3) AND BY KLEINFELDER (KB-11)
- CONE PENETRATION TEST BY GPI (C-5)
- CROSS-SECTION LOCATION
- LANDSLIDE DEBRIS/SLUMP MATERIAL
- EROSION AREA
- APPROXIMATE GEOLOGIC CONTACT

Fill with Geogrids

Ground Cover and Erosion Fabric

N

60 30 0 60

APPROXIMATE SCALE (feet)

OPTION 1A

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 0+00 TO 8+85

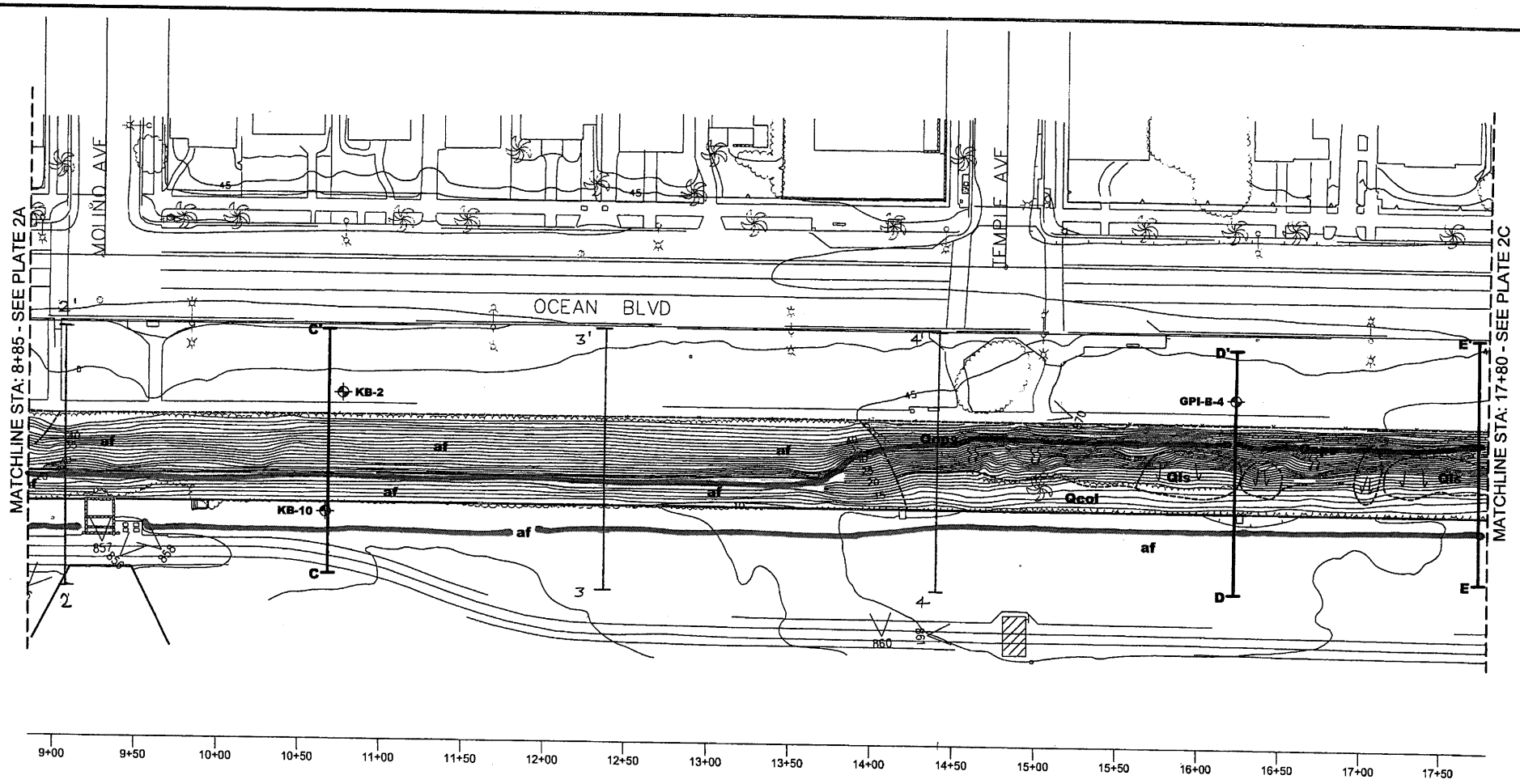
PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2A**

ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

PLOTTED: 09 Dec 2009, 4:22pm, MGriffin

CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2a



Fill with Geogrids

Ground Cover and Erosion Fabric

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

OPTION 1A

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

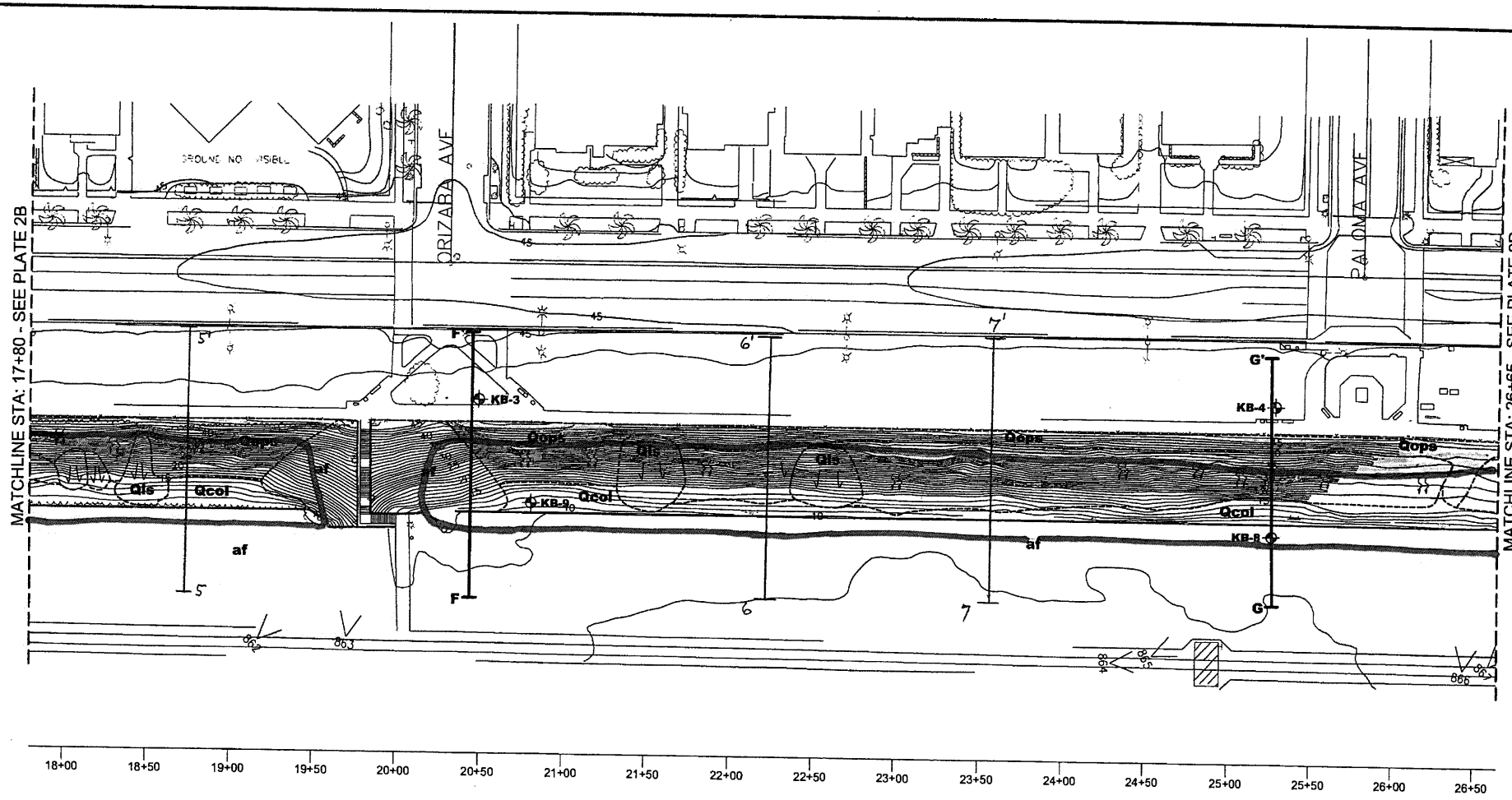
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 8+85 TO 17+80

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2B**

PLOTTED: 09 Dec 2009, 4:23pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2b
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



OPTION 1A

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

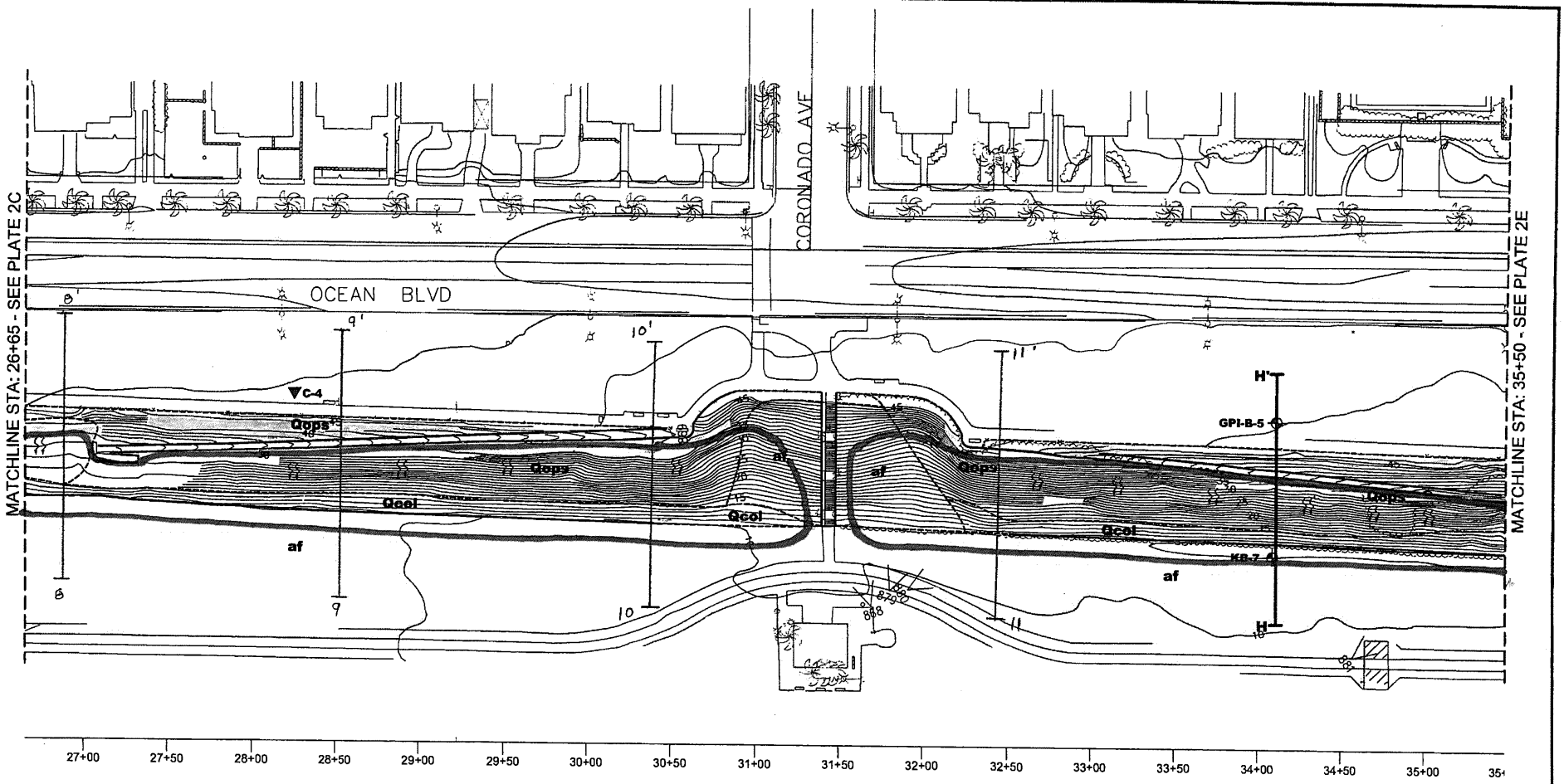
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 17+80 TO 26+65

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2C**

PLOTTED: 09 Dec 2009, 4:23pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2c
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



Fill with Geogrids

Ground Cover and Erosion Fabric

OPTION 1A

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

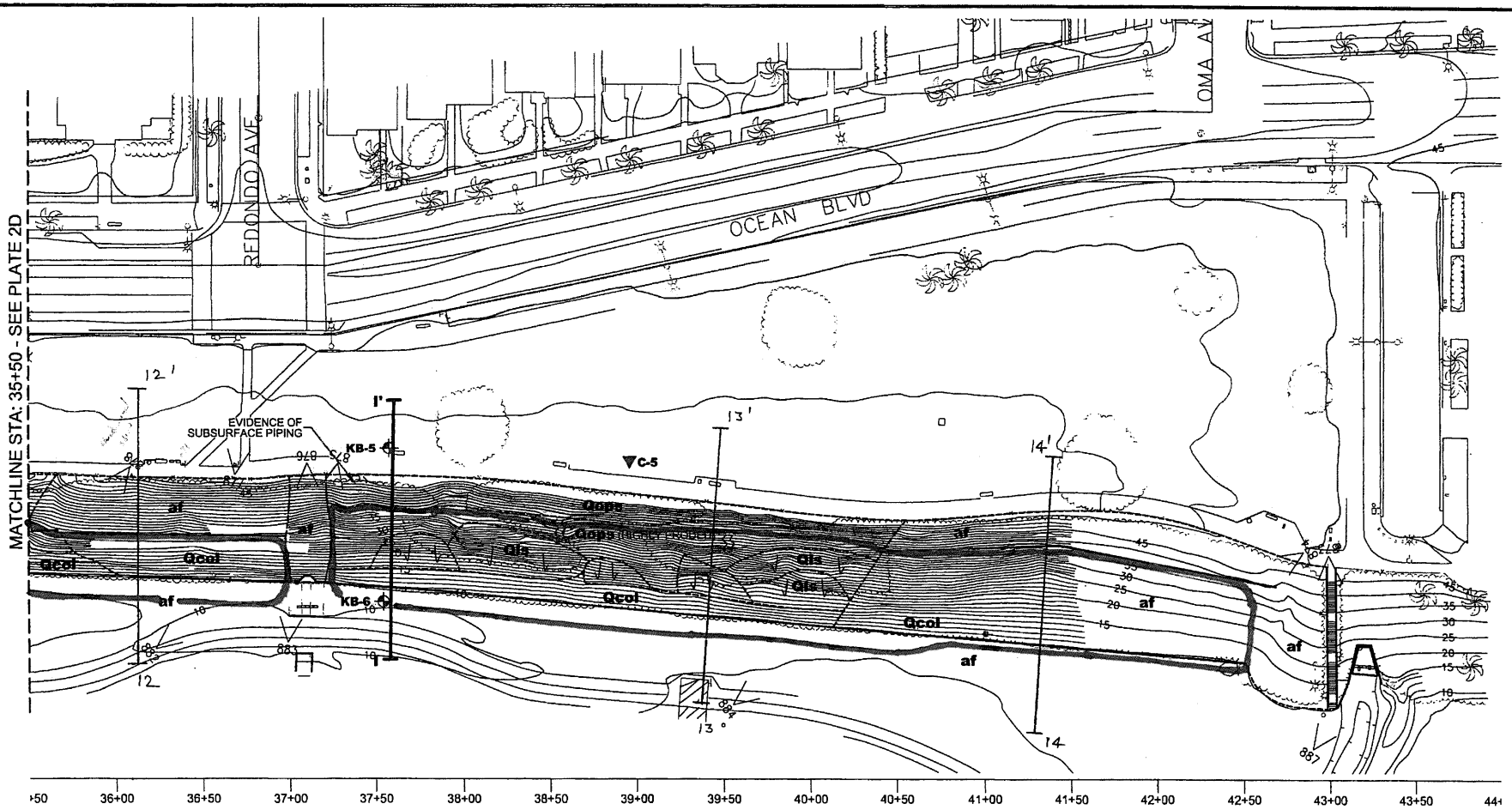
KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 26+65 TO 35+50

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE
2D



Fill with Geogrids

Ground Cover and Erosion Fabric

OPTION 1A

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 35+50 TO END

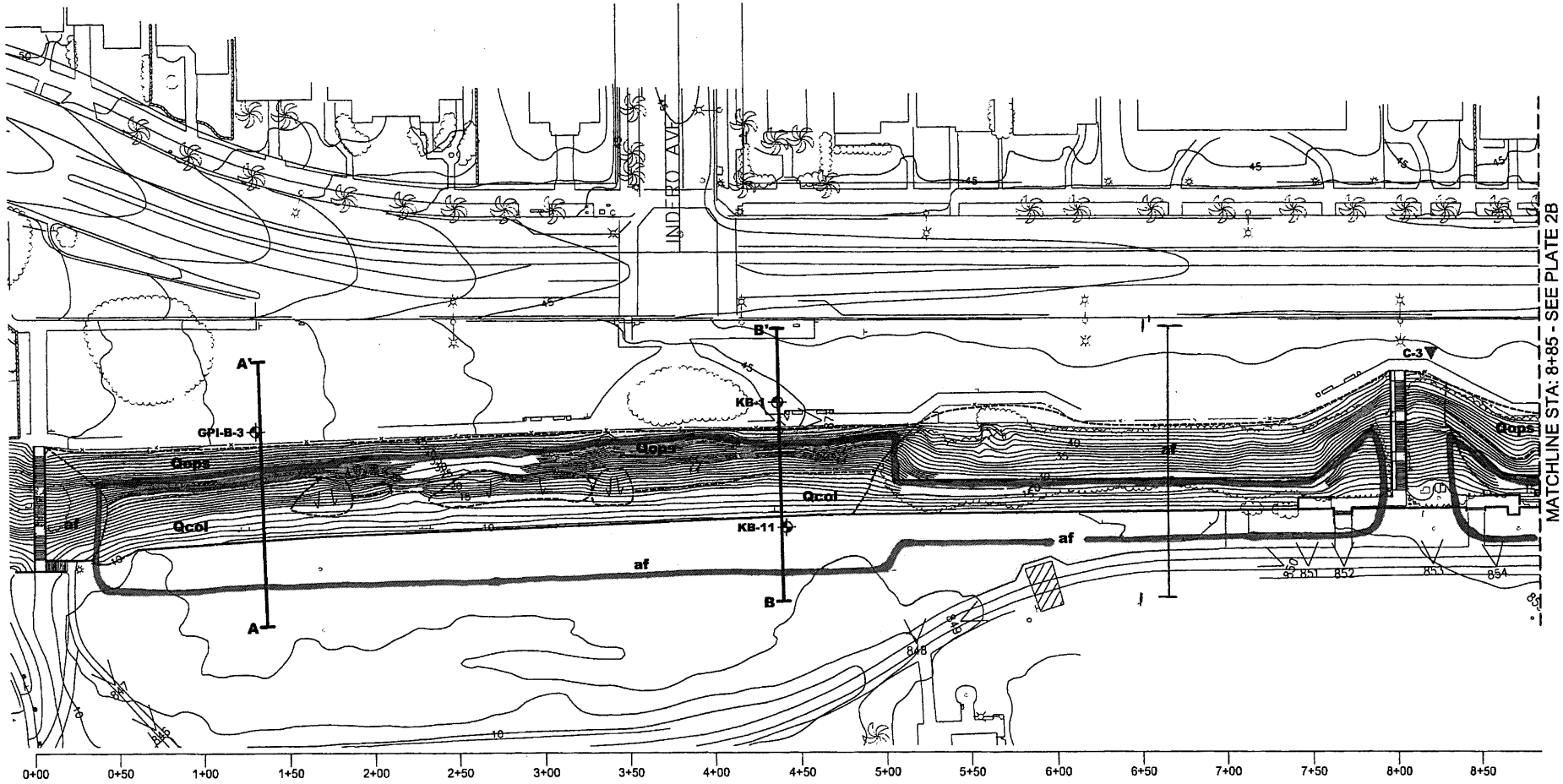
PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2E**

ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2e

PLOTTED: 09 Dec 2009, 4:24pm, MGriffin



EXPLANATION

- af — ARTIFICIAL FILL
- Qls — LANDSLIDE
- Qcol — COLLUVIUM
- Qops — QUATERNARY OLD PARALIC DEPOSITS
- BORING LOCATION BY GPI (GPI-B-3) AND BY KLEINFELDER (KB-11)
- CONE PENETRATION TEST BY GPI (C-5)
- CROSS-SECTION LOCATION
- LANDSLIDE DEBRIS/SLUMP MATERIAL
- EROSION AREA
- APPROXIMATE GEOLOGIC CONTACT

Fill with Geogrids

Ground Cover and Erosion Fabric

N

60 30 0 60

APPROXIMATE SCALE (feet)

OPTION 1B

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 0+00 TO 8+85

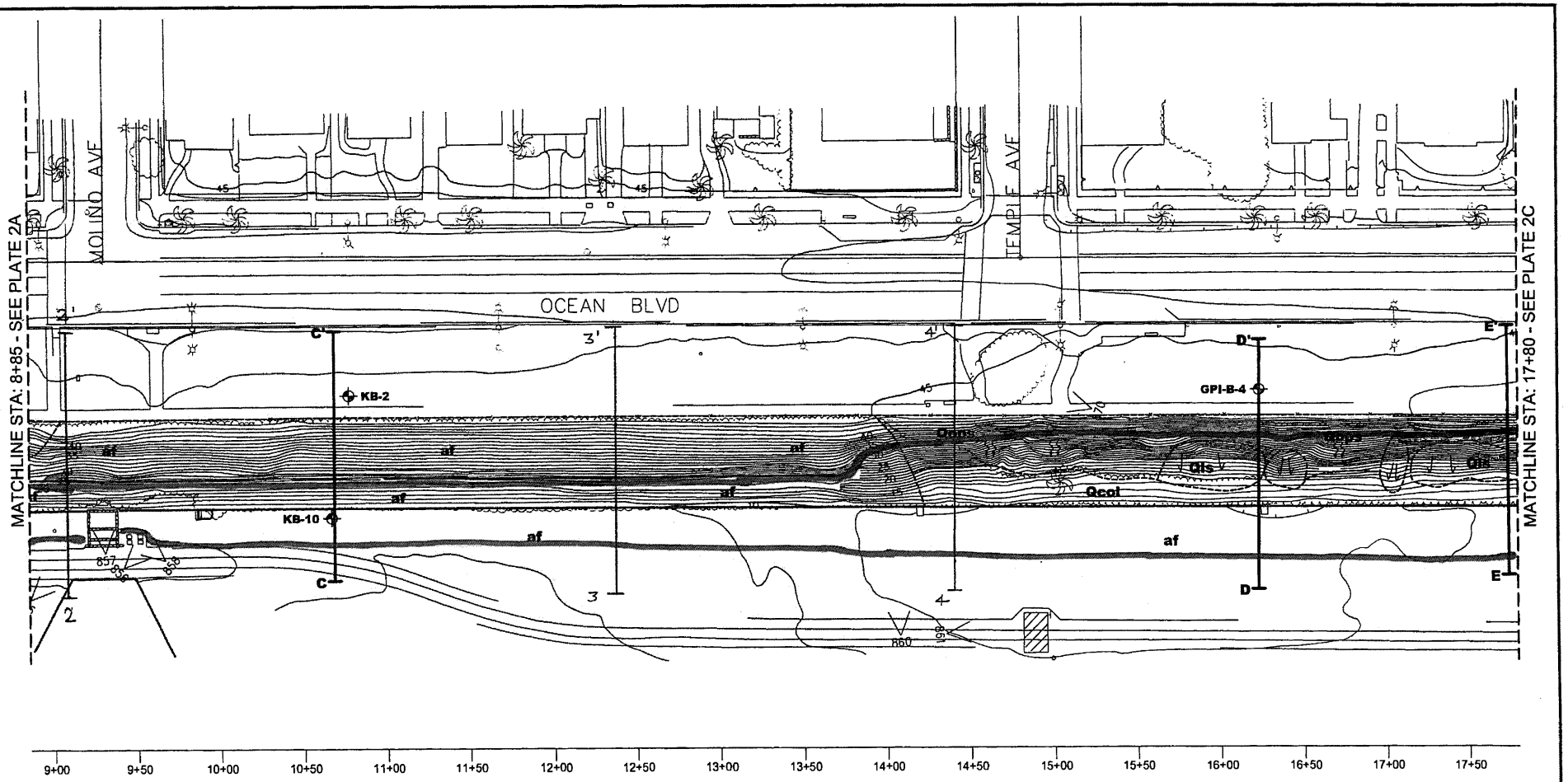
PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2A**

ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2a

PLOTTED: 09 Dec 2009, 4:22pm, MGriffin



Ground Cover and Erosion Fabric

OPTION 1B

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

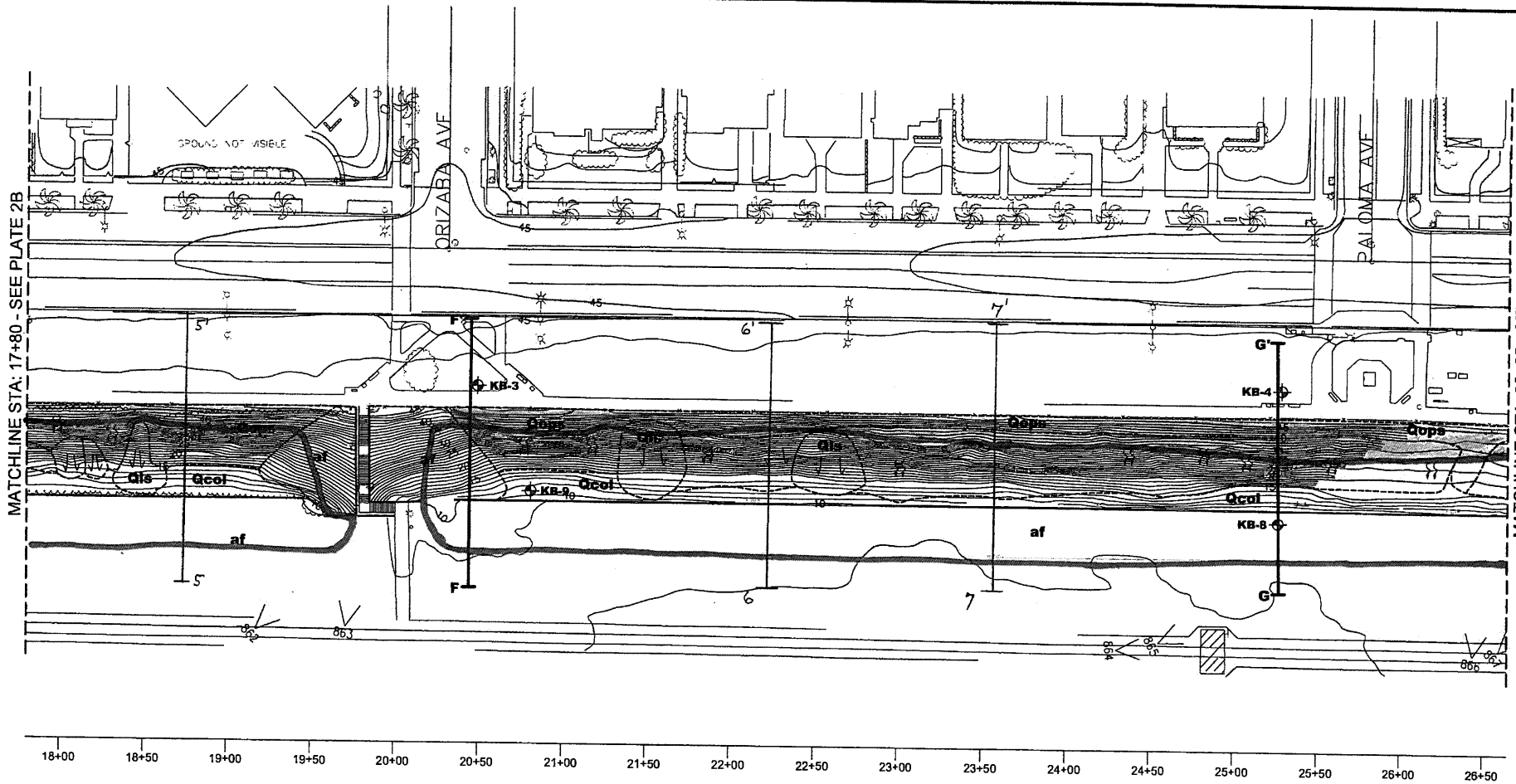
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 8+85 TO 17+80

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2B**

PLOTTED: 09 Dec 2009, 4:23pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2b
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



Fill with Geogrids

Ground Cover and Erosion Fabric

OPTION 1B

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

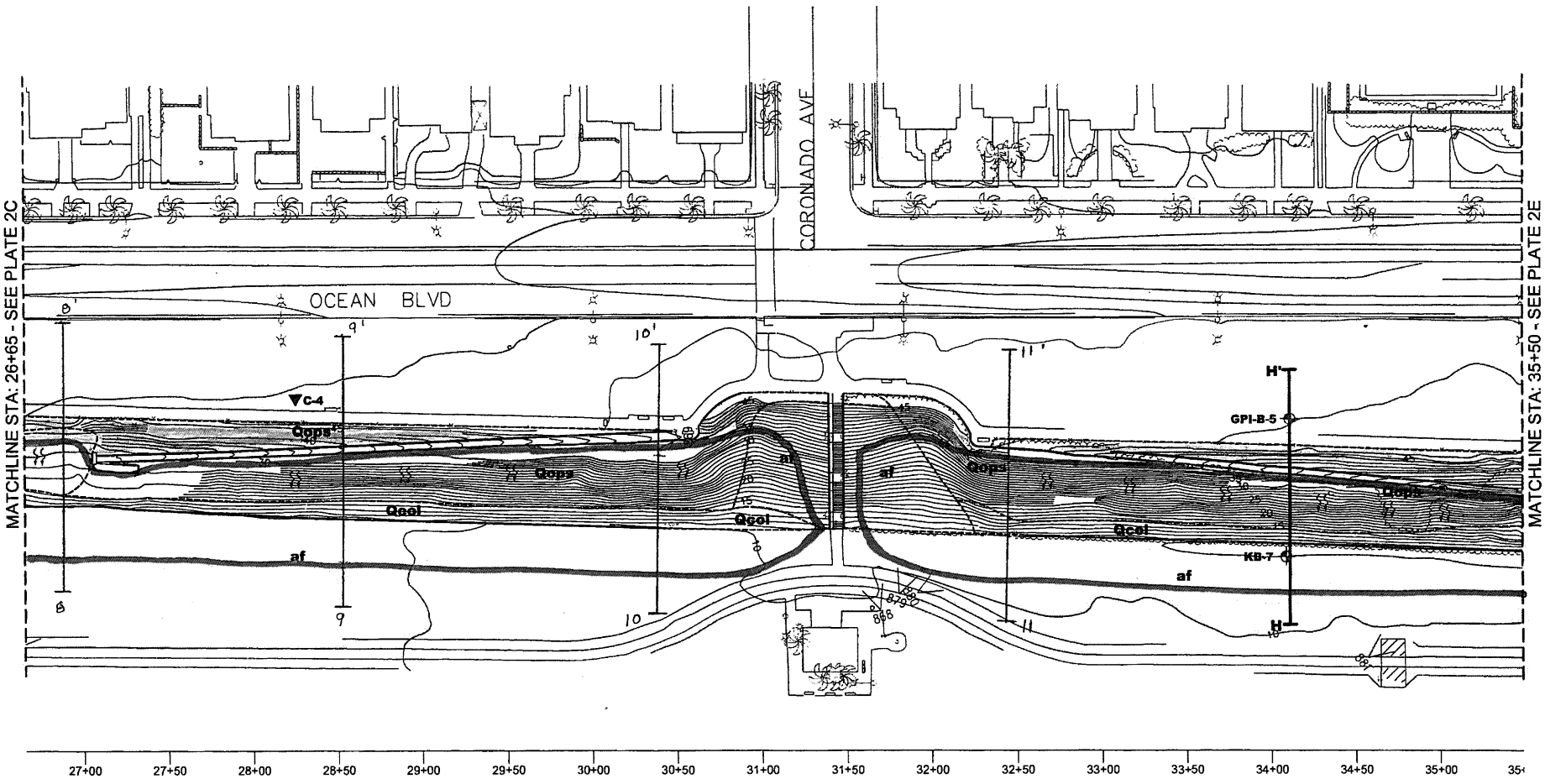
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 17+80 TO 26+65

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2C**

PLOTTED: 09 Dec 2009, 4:23pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2c
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



Fill with Geogrids

Ground Cover and Erosion Fabric

OPTION 1B

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

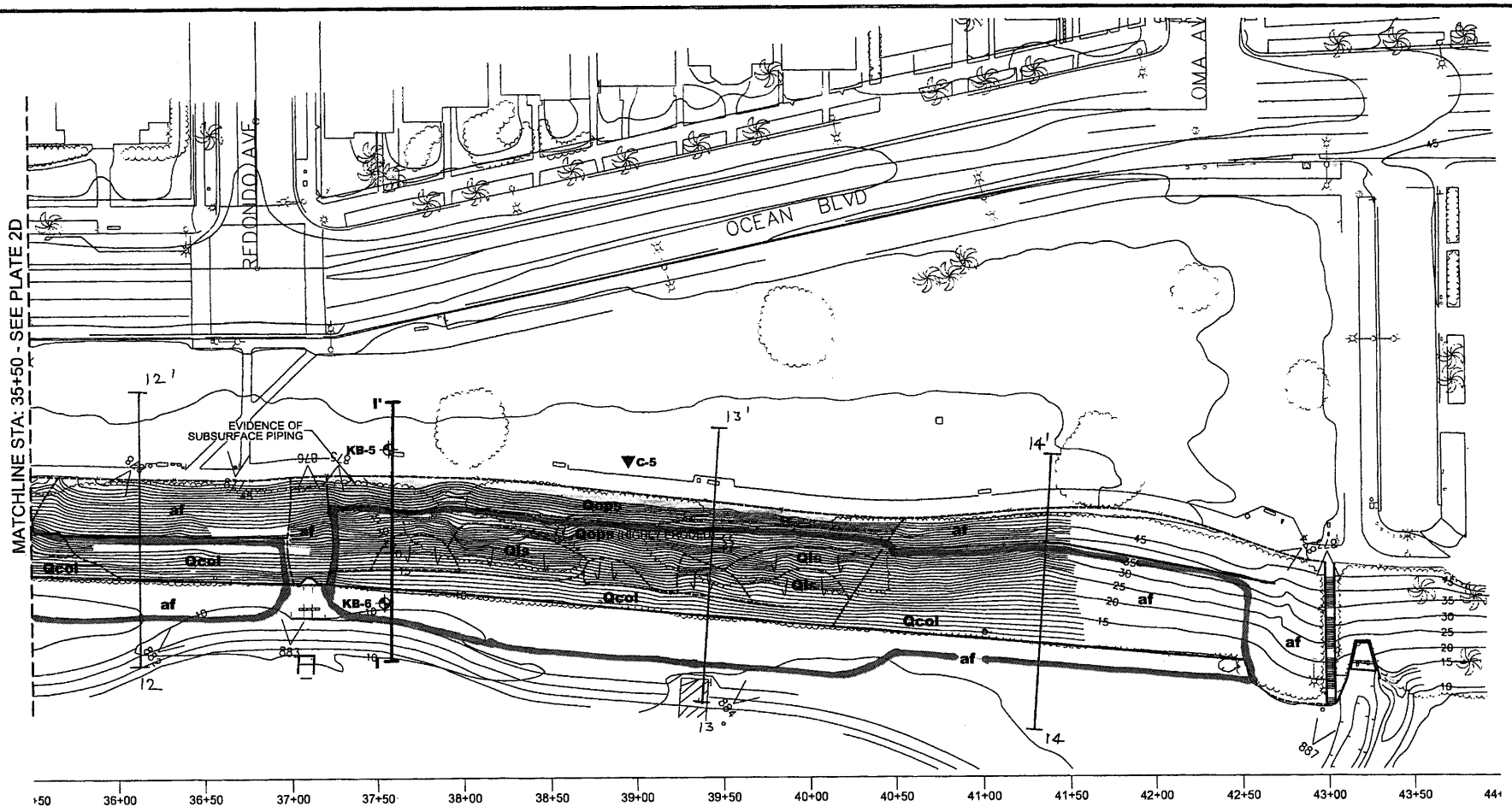
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 26+65 TO 35+50

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2D**

PLOTTED: 09 Dec 2009, 4:23pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2d
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



Fill with Geogrids

Ground Cover and Erosion Fabric

OPTION 1B

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 35+50 TO END

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE
2E

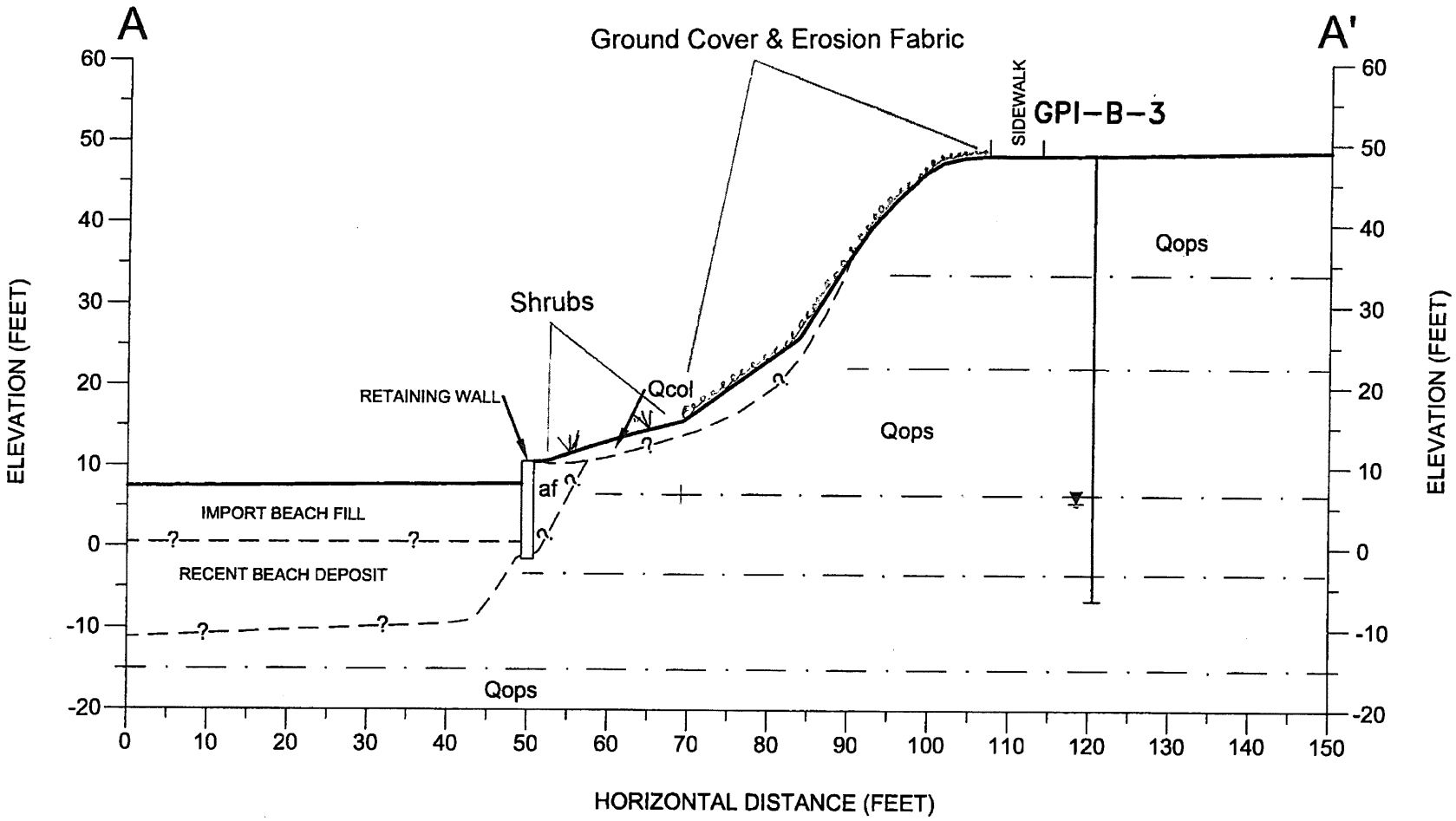
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2e

PLOTTED: 09 Dec 2009, 4:24pm, MGriffin

ATTACHMENT 2

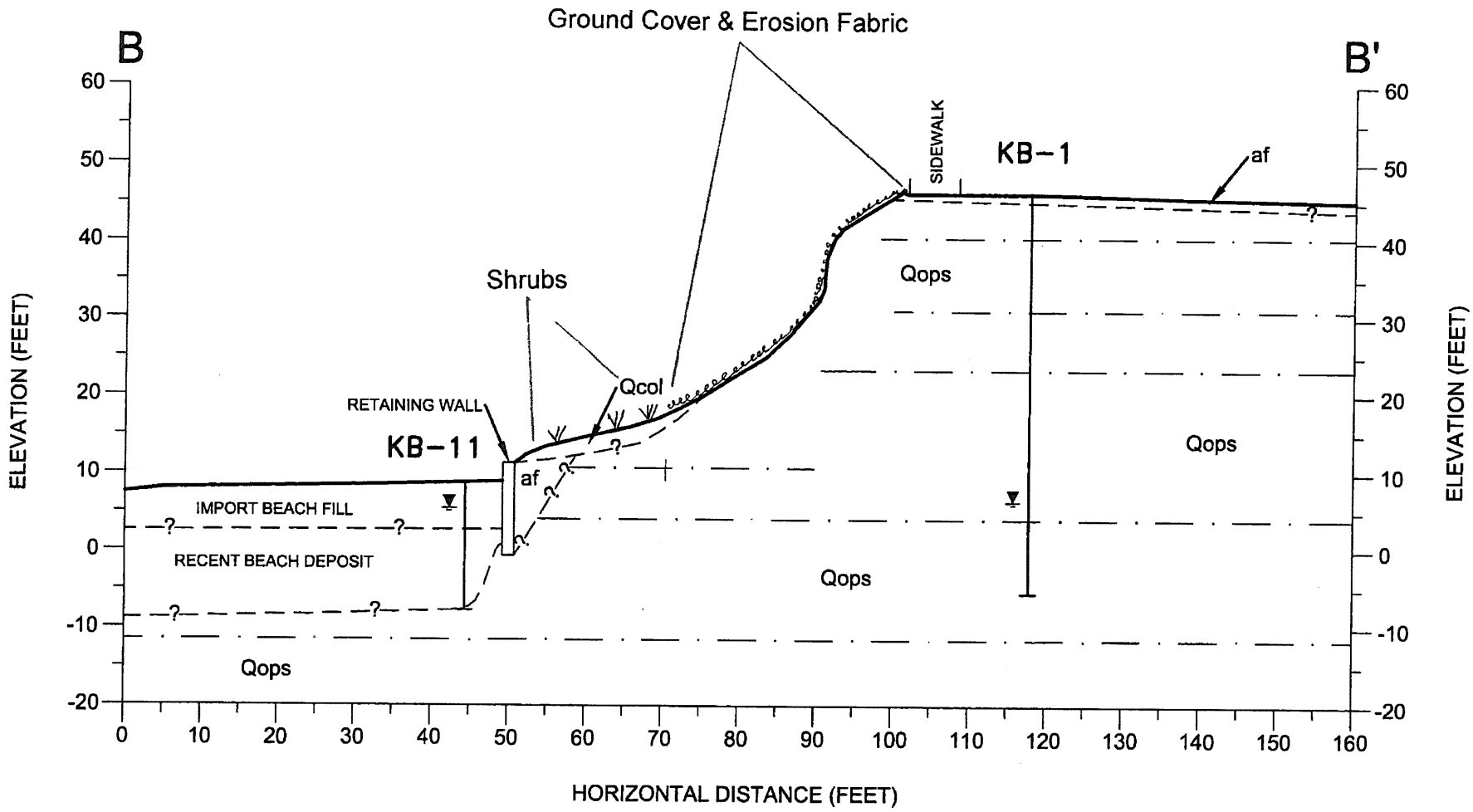
Geologic Map, Option 3, Plates 2A through 2E, and Cross Sections per order of Stationing (A, B, 1, 2, C, 3, 4, D, E, 5, F, 6, 7, G, 8, 9, 10, 11, H, 12, I, 13, 14)



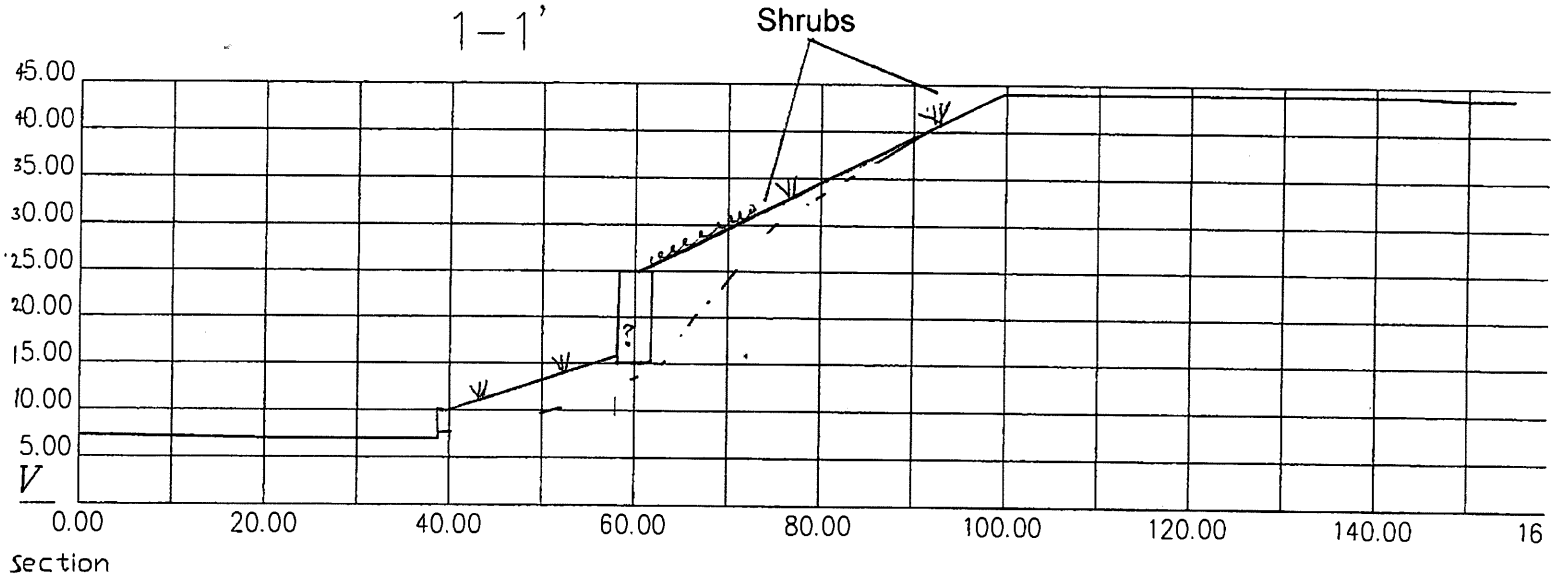
EXPLANATION

af	ARTIFICIAL FILL
Qcol	COLLUVIUM
Qls	LANDSLIDE
Qops	QUATERNARY OLD PARALIC DEPOSITS

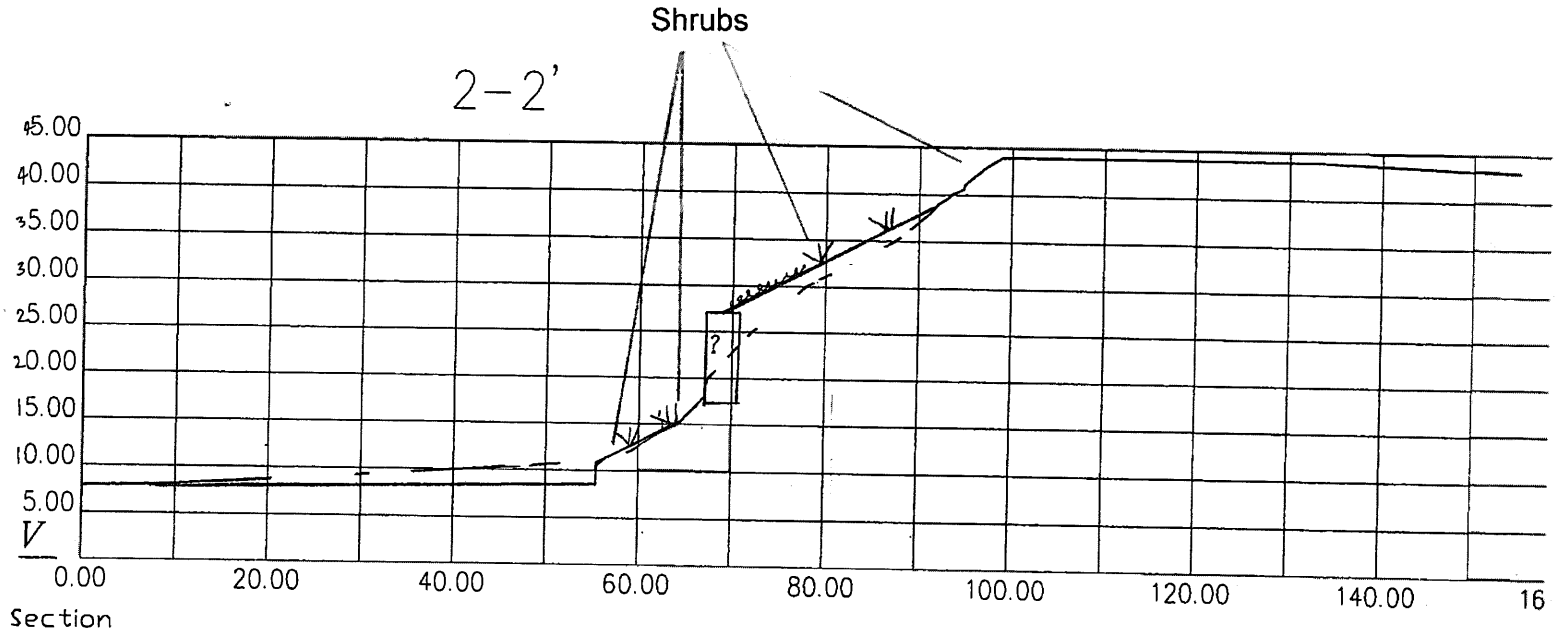
OPTION 3


B
B'
Ground Cover & Erosion Fabric
SIDEWALK
KB-1
af
Shrubs
Qcol
RETAINING WALL
KB-11
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

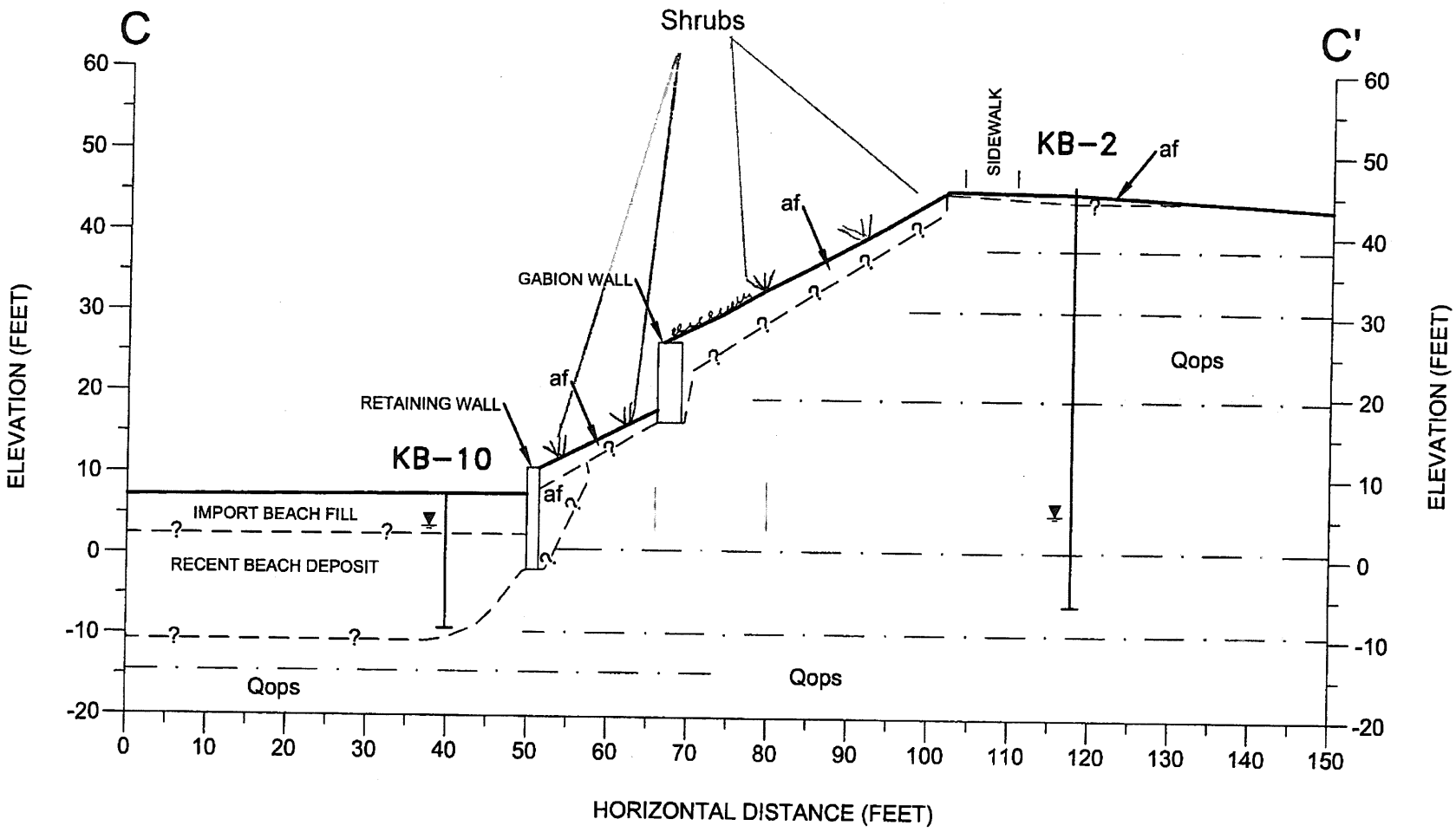
OPTION 3


1–1'
Shrubs
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

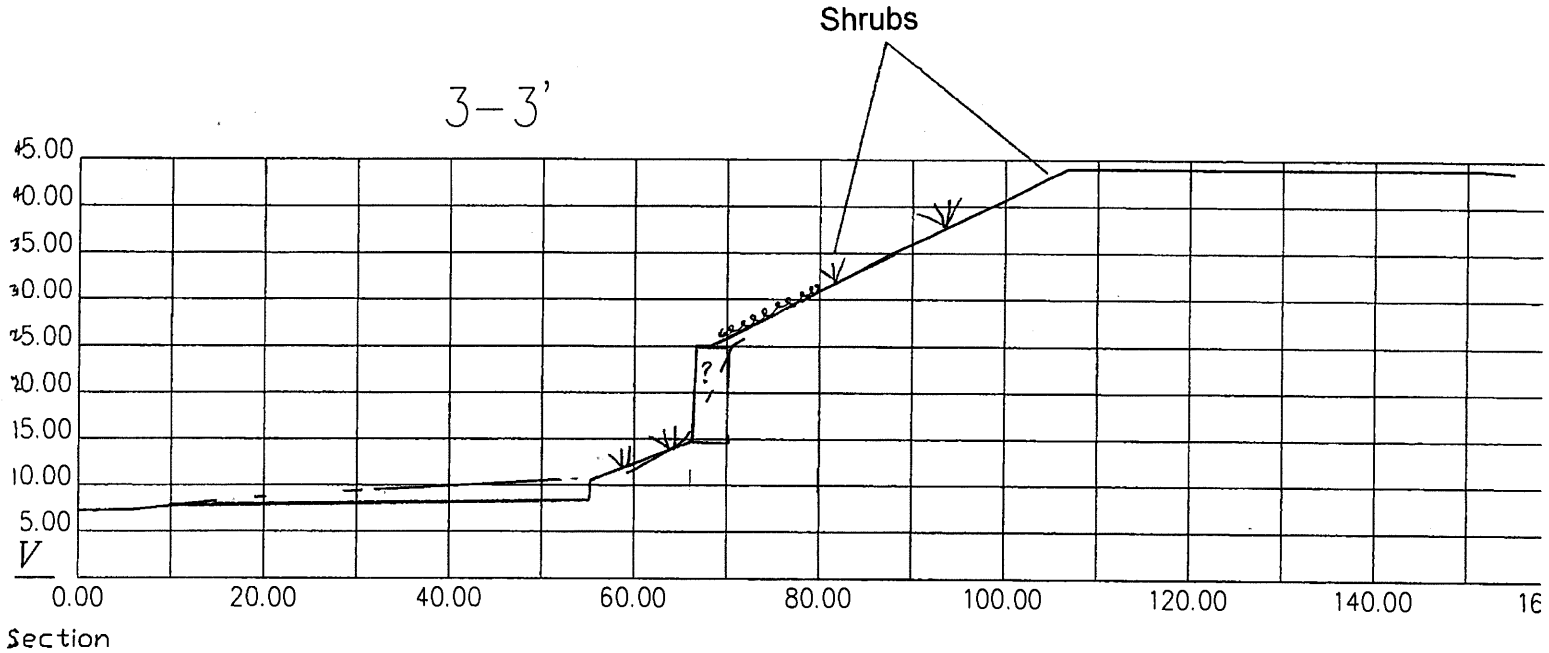
OPTION 3


Shrubs
2-2'
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

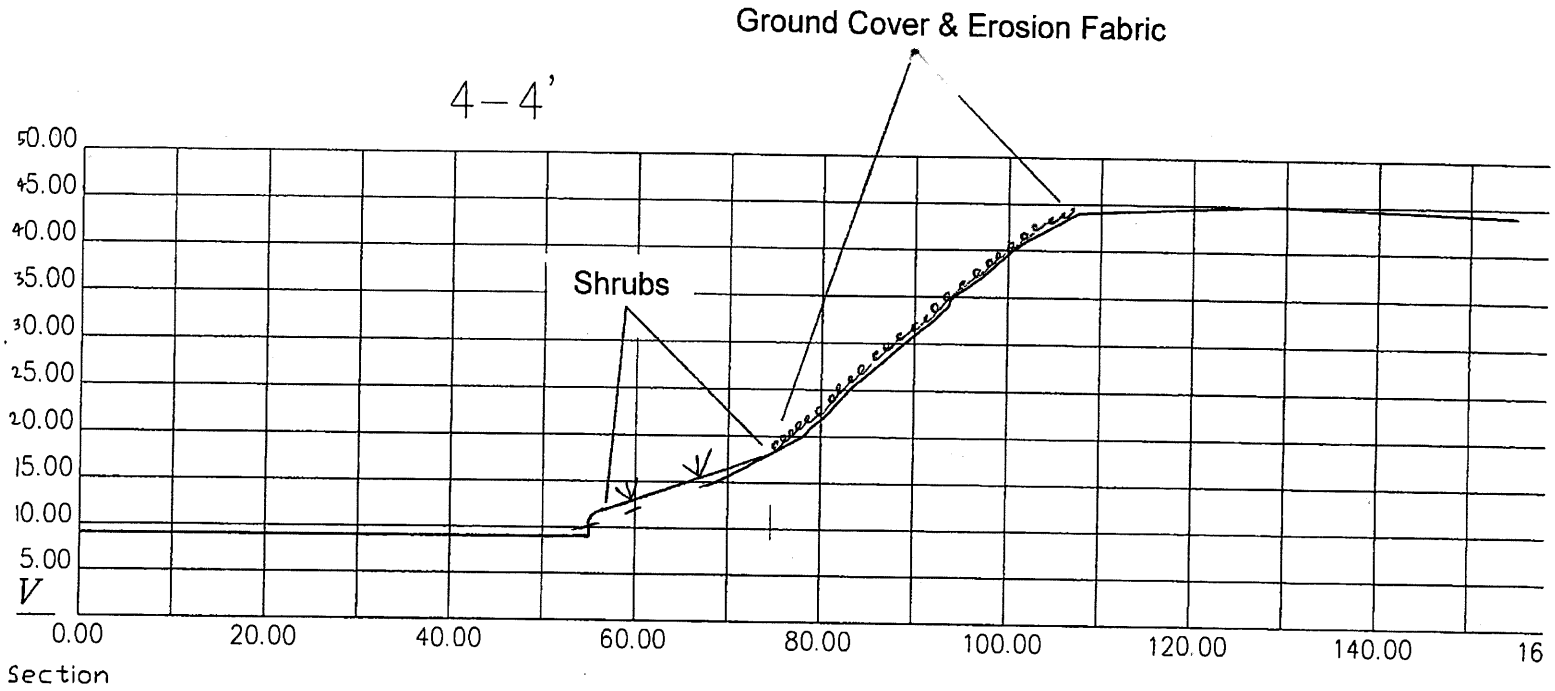
OPTION 3


C
C'
Shrubs
SIDEWALK
KB-2
af
af
GABION WALL
af
RETAINING WALL
KB-10
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

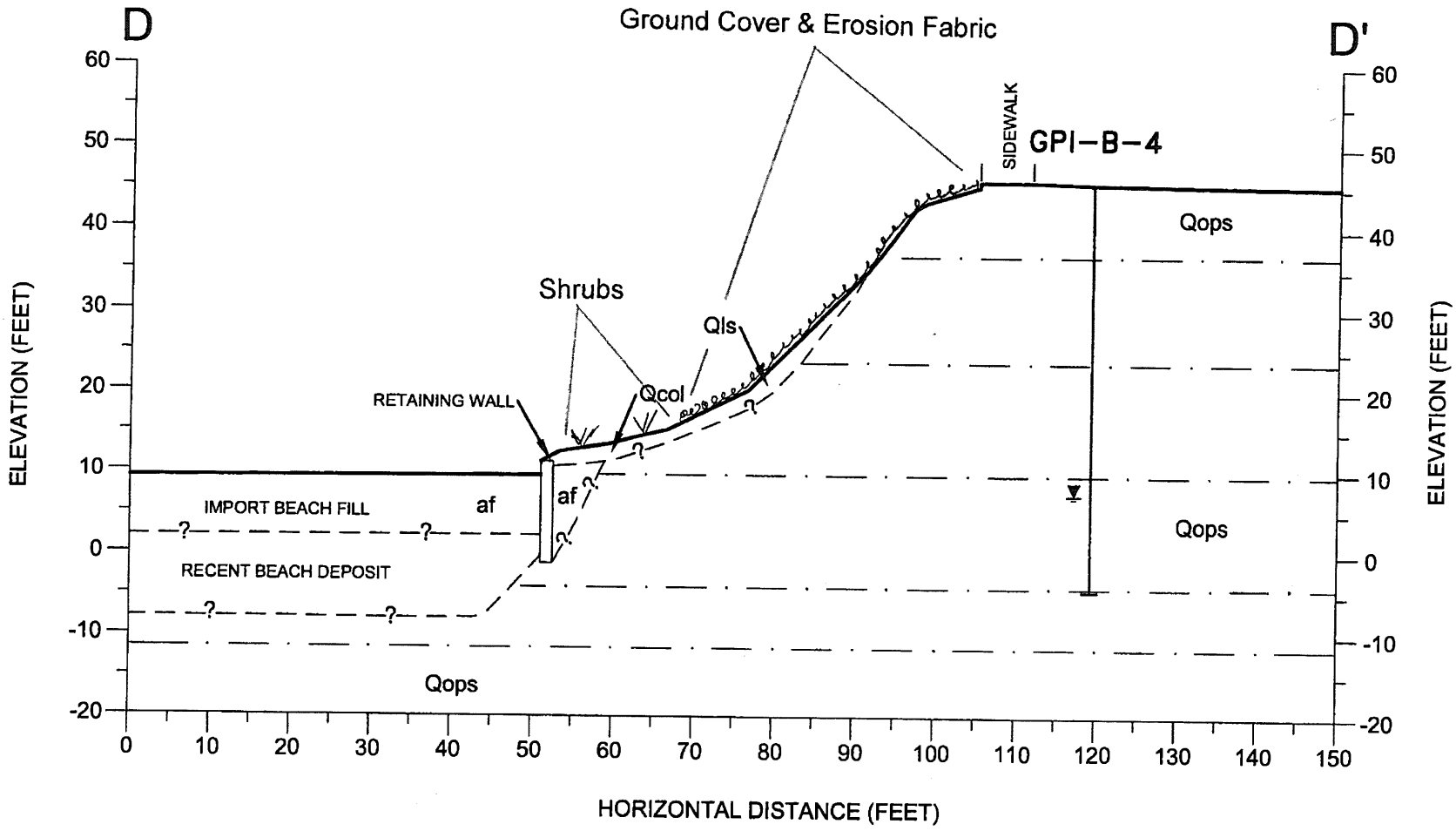
OPTION 3


Shrubs
3–3'
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
Section

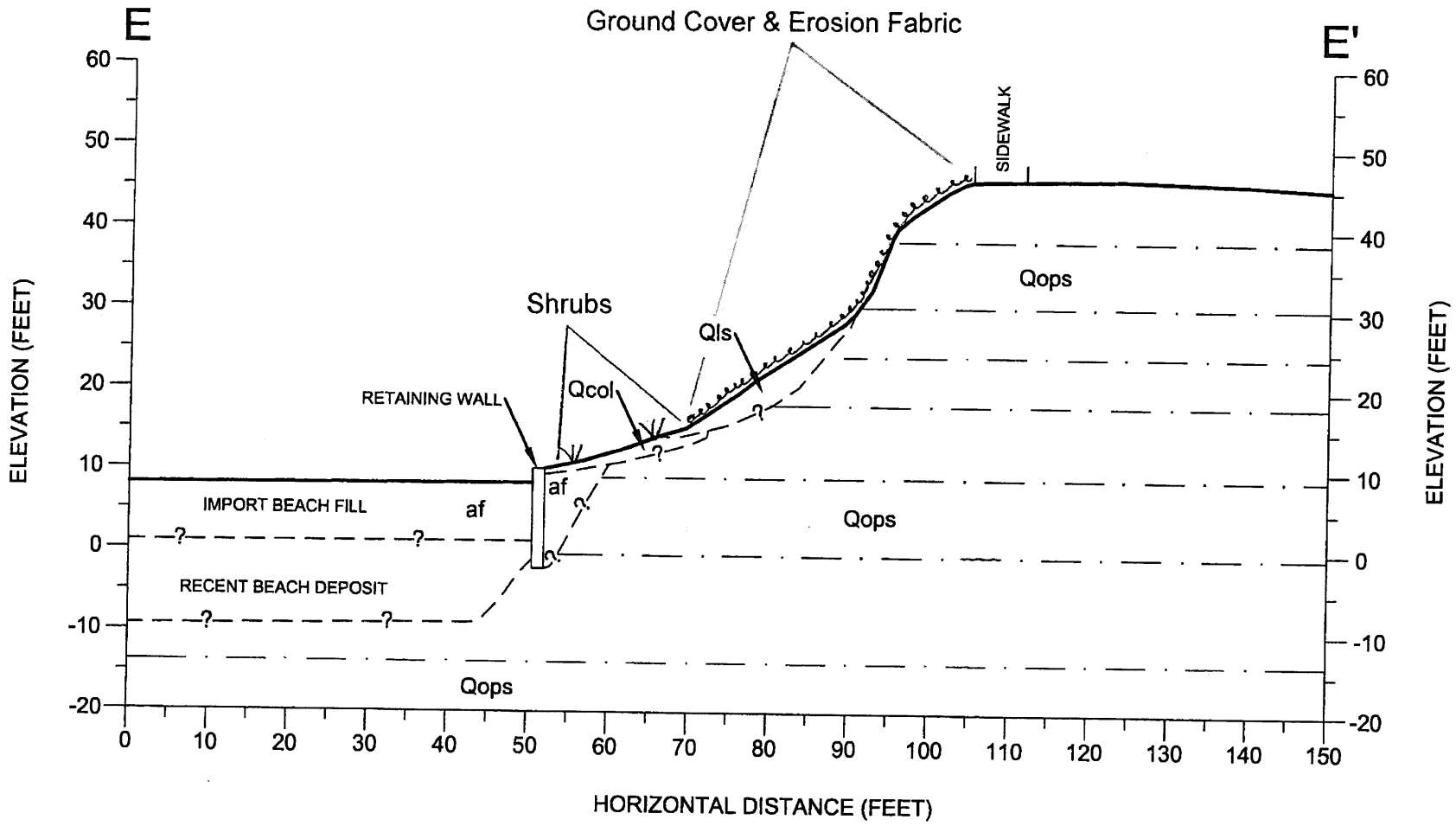
OPTION 3


Ground Cover & Erosion Fabric
4-4'
Shrubs
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

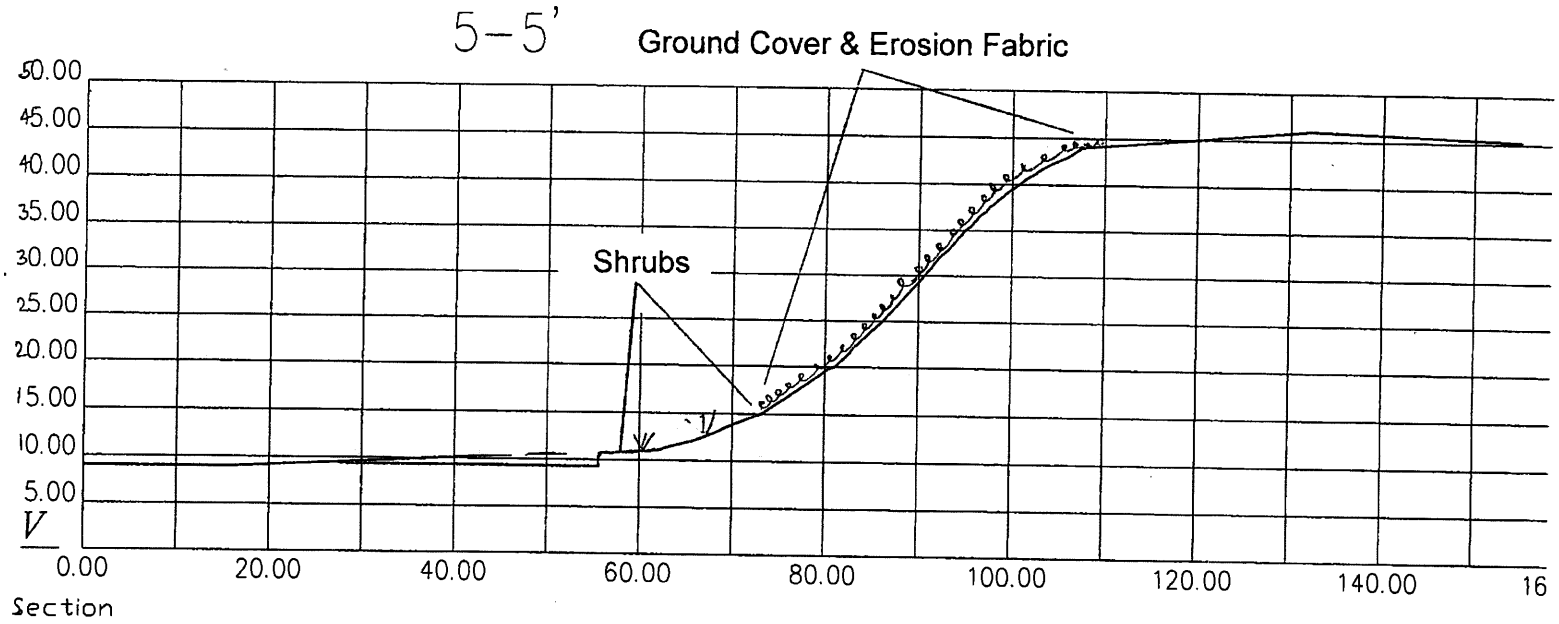
OPTION 3


D
D'
Ground Cover & Erosion Fabric
SIDEWALK
GPI-B-4
Shrubs
Qls
Qcol
RETAINING WALL
IMPORT BEACH FILL
af
af
RECENT BEACH DEPOSIT
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

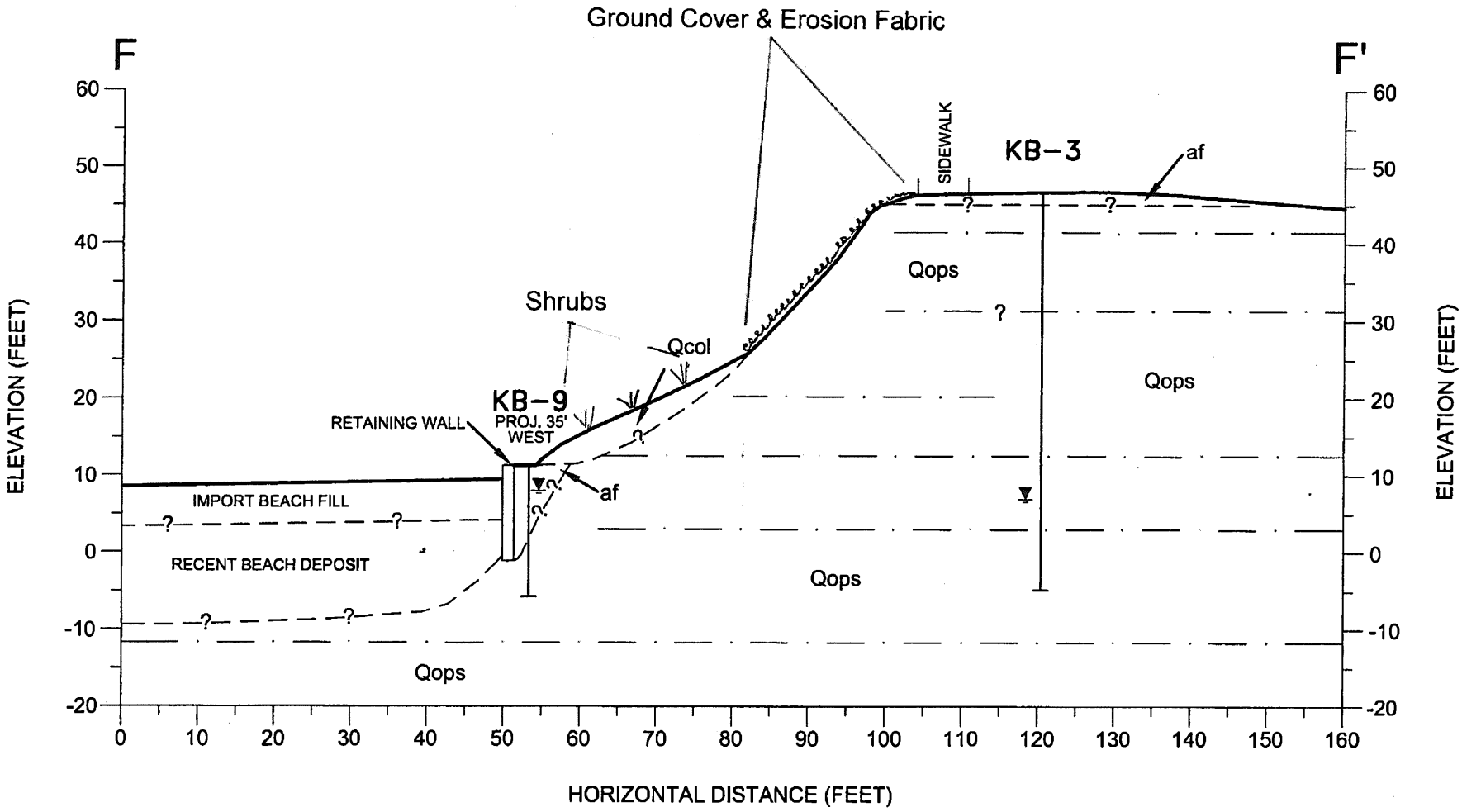
OPTION 3


E
E'
Ground Cover & Erosion Fabric
SIDEWALK
Shrubs
Qls
Qcol
RETAINING WALL
IMPORT BEACH FILL
af
af
Qops
Qops
RECENT BEACH DEPOSIT
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

OPTION 3

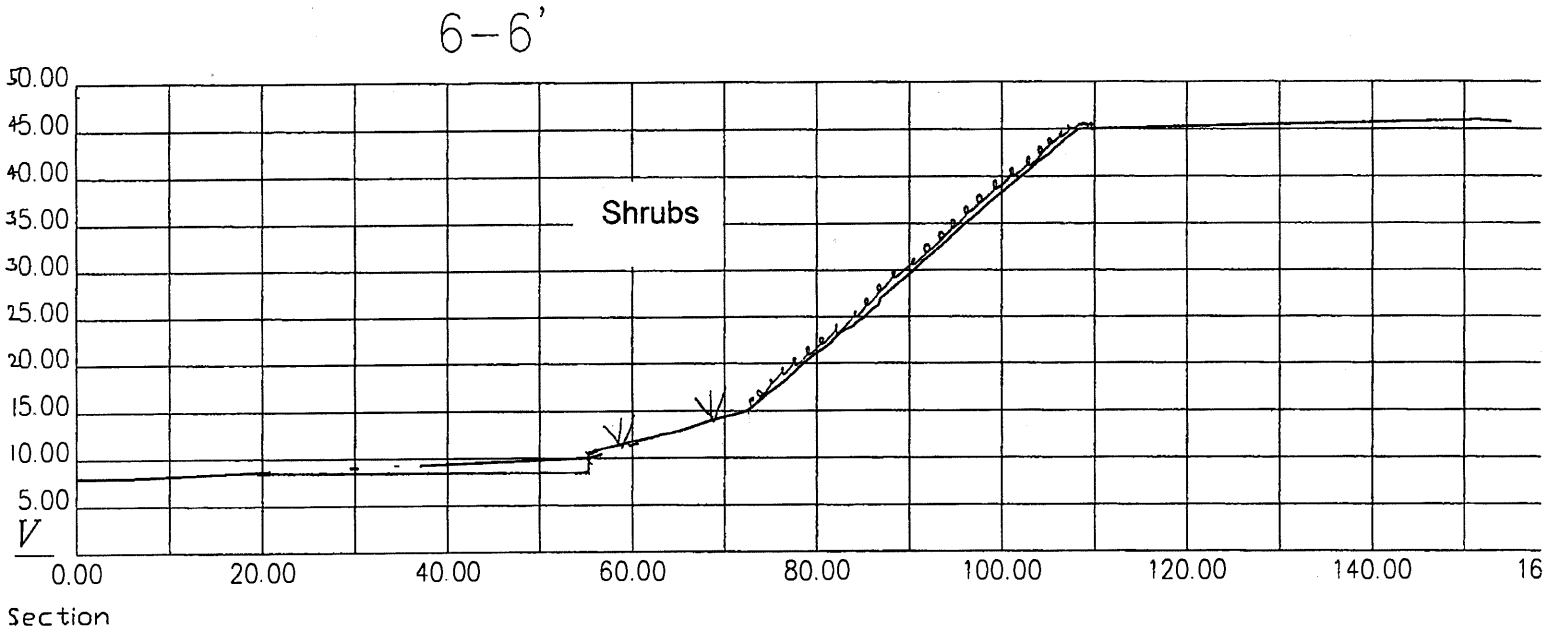

5-5'
Ground Cover & Erosion Fabric
Shrubs
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

OPTION 3

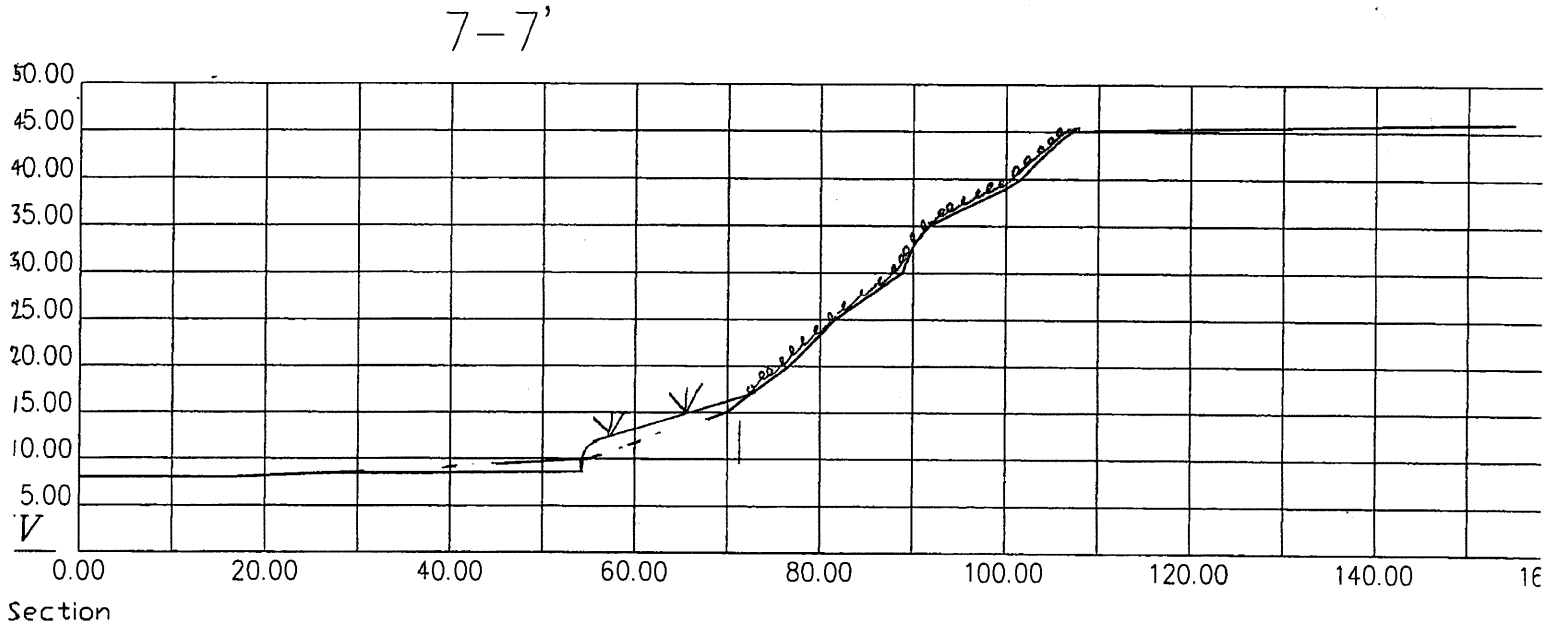

F
F'
Ground Cover & Erosion Fabric
SIDEWALK
KB-3
af
Shrubs
Qcol
KB-9
PROJ. 35' WEST
RETAINING WALL
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

OPTION 3

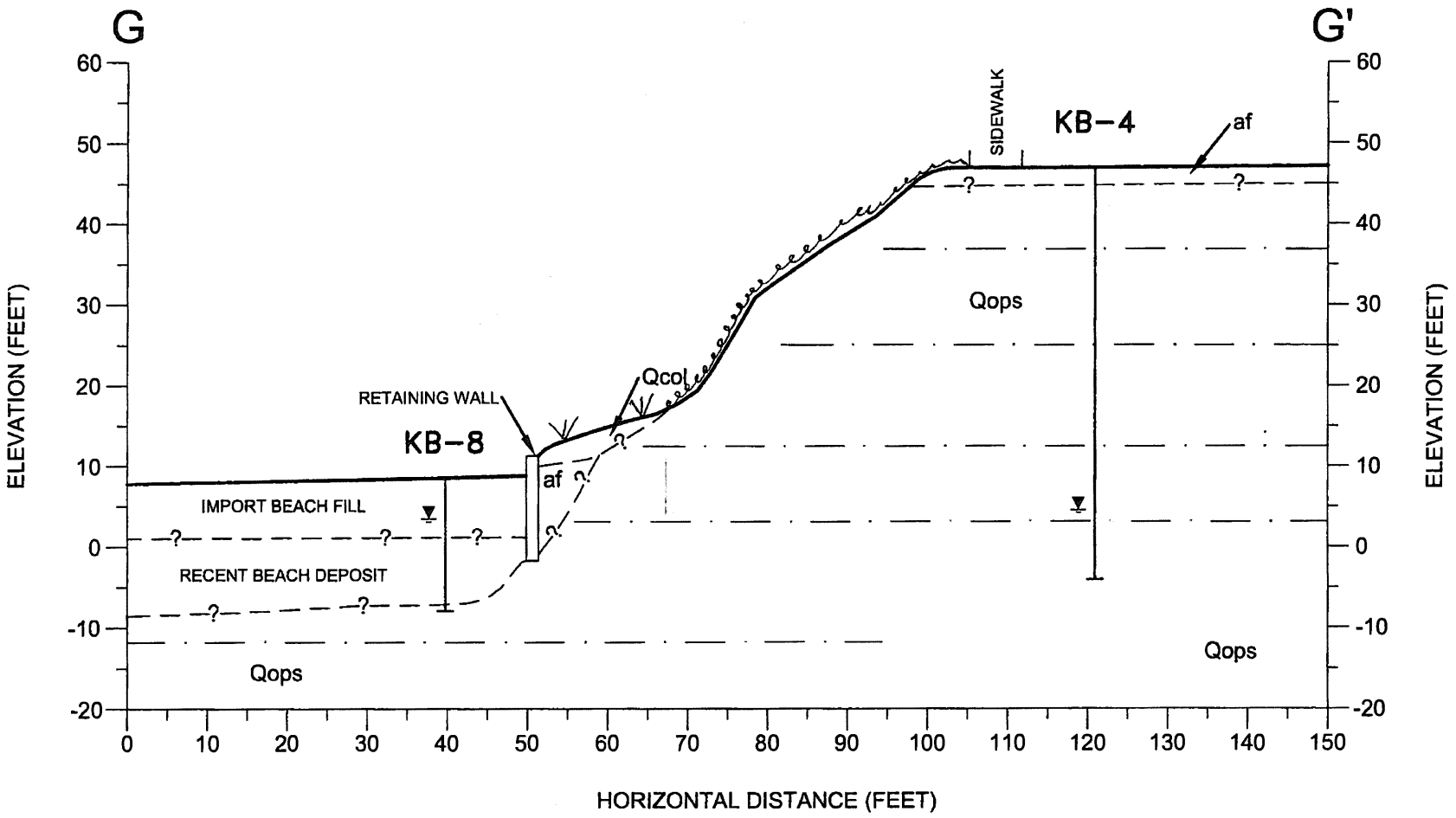
Ground Cover & Erosion Fabric



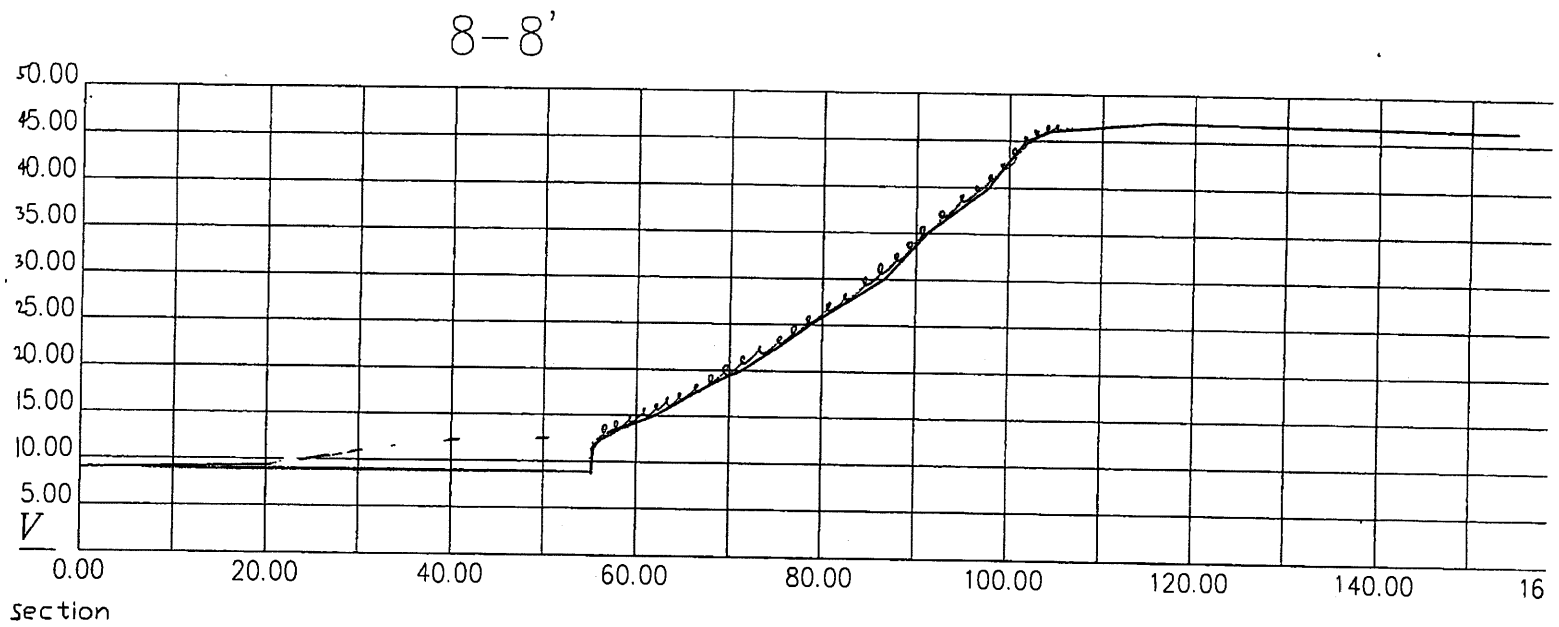
OPTION 3


7-7'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
Section

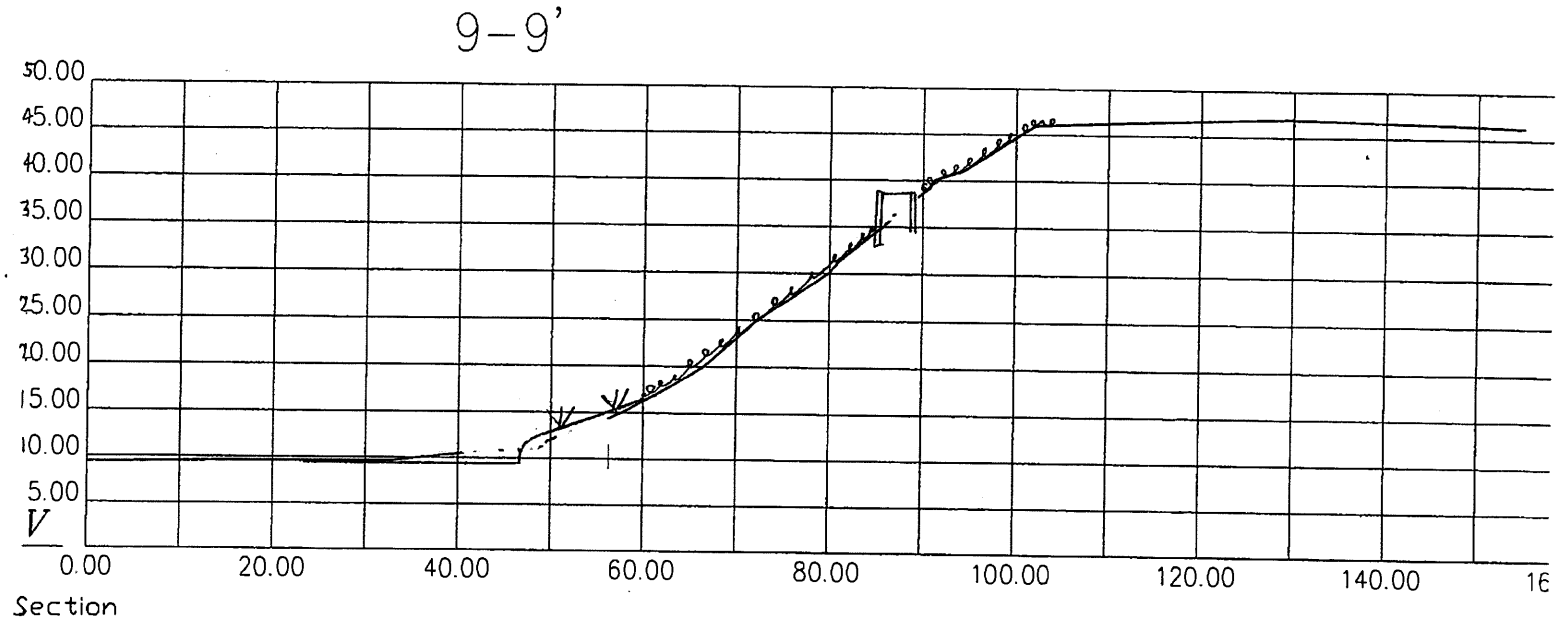
OPTION 3


G
G'
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
SIDEWALK
KB-4
af
Qops
Qcol
RETAINING WALL
KB-8
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops

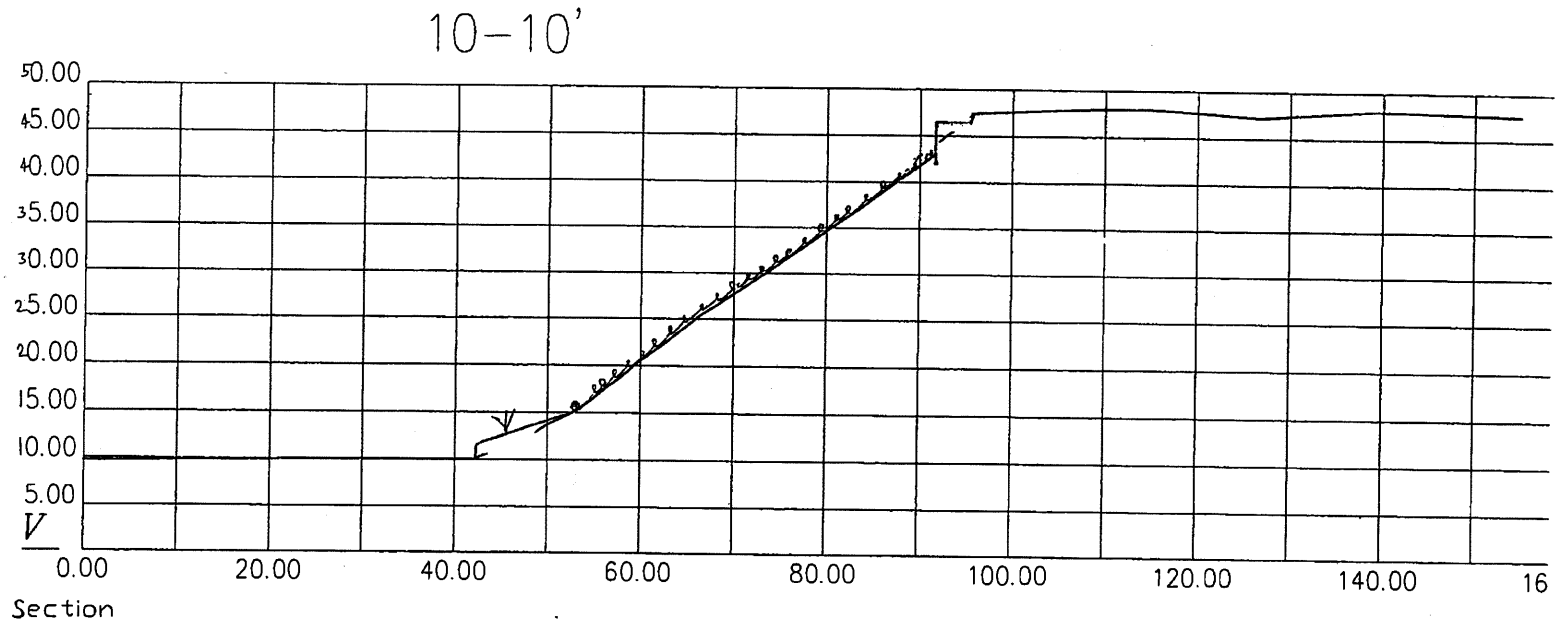
OPTION 3


8-8'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

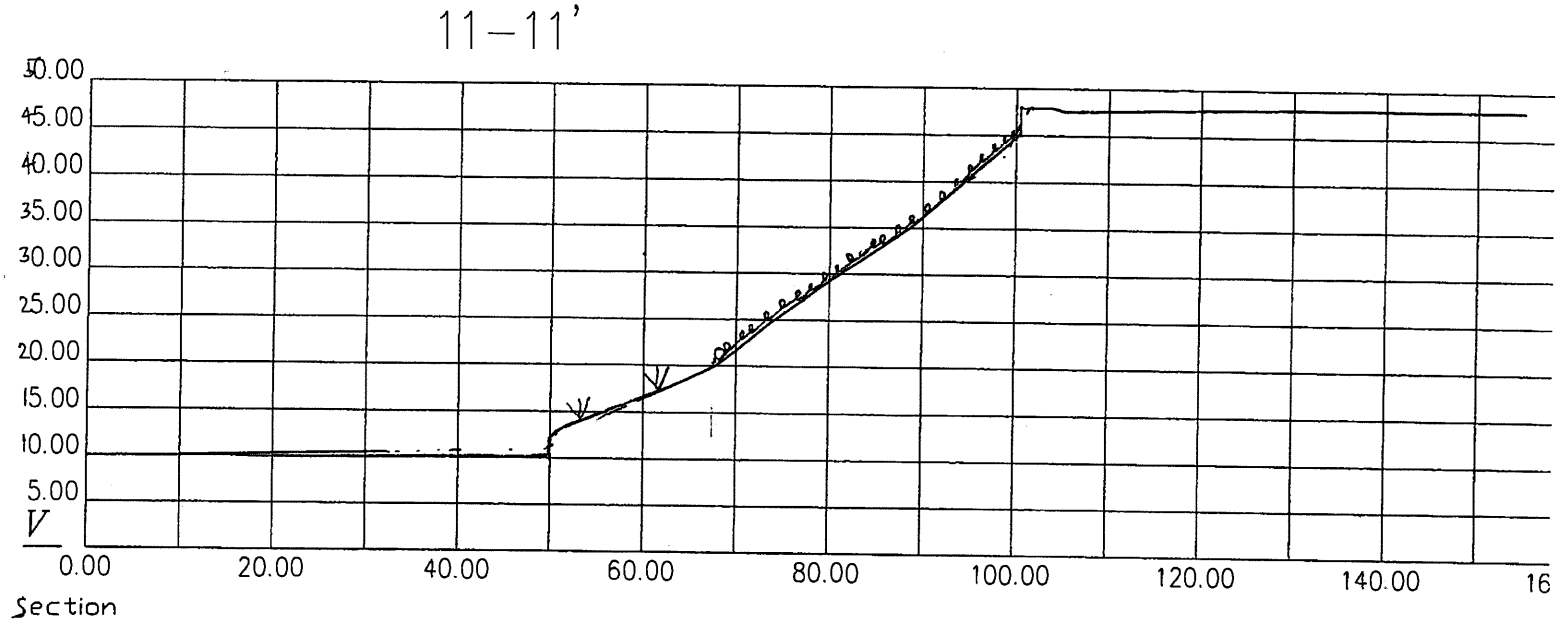
OPTION 3


9–9'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
Section

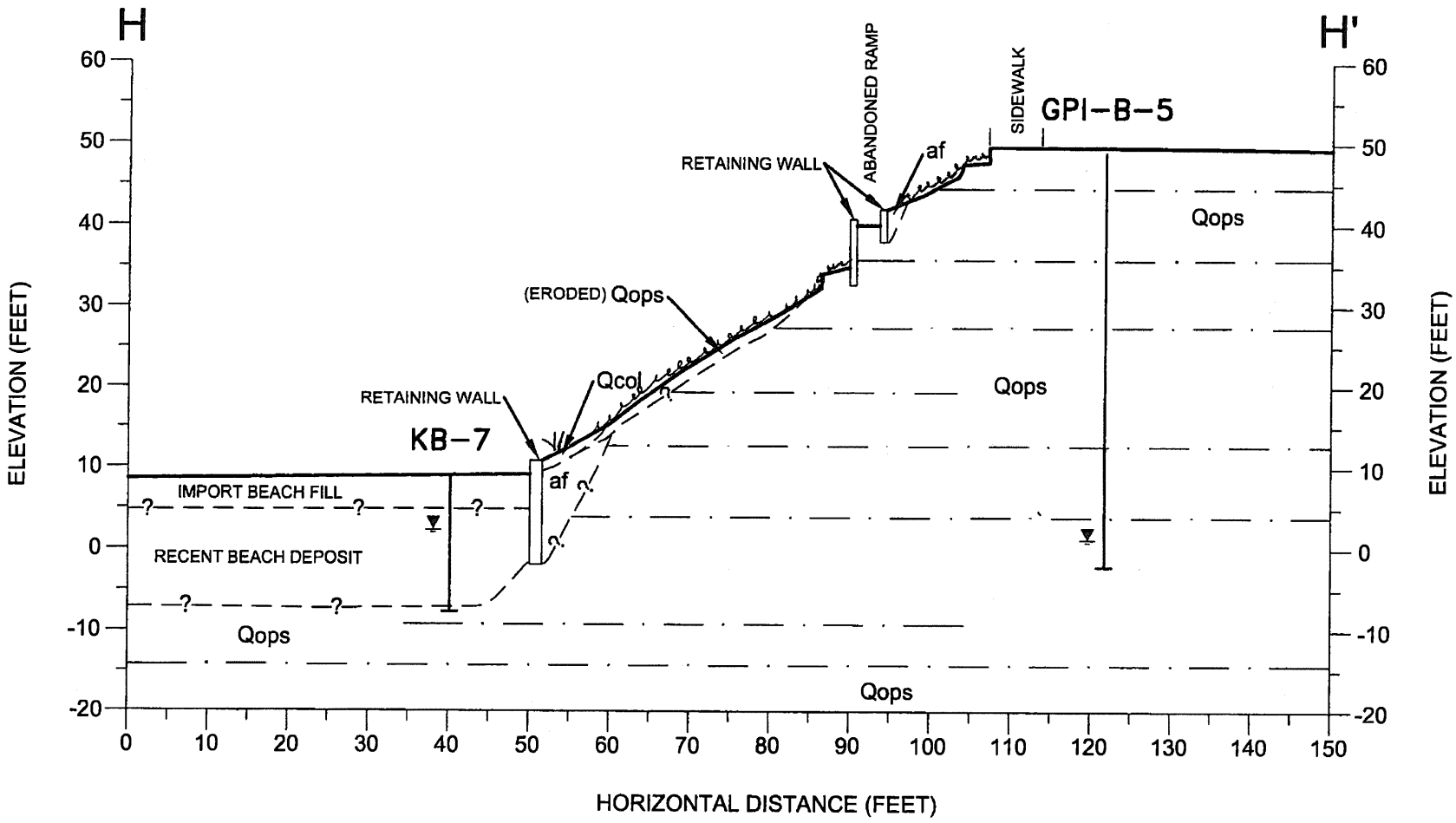
OPTION 3


10-10'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

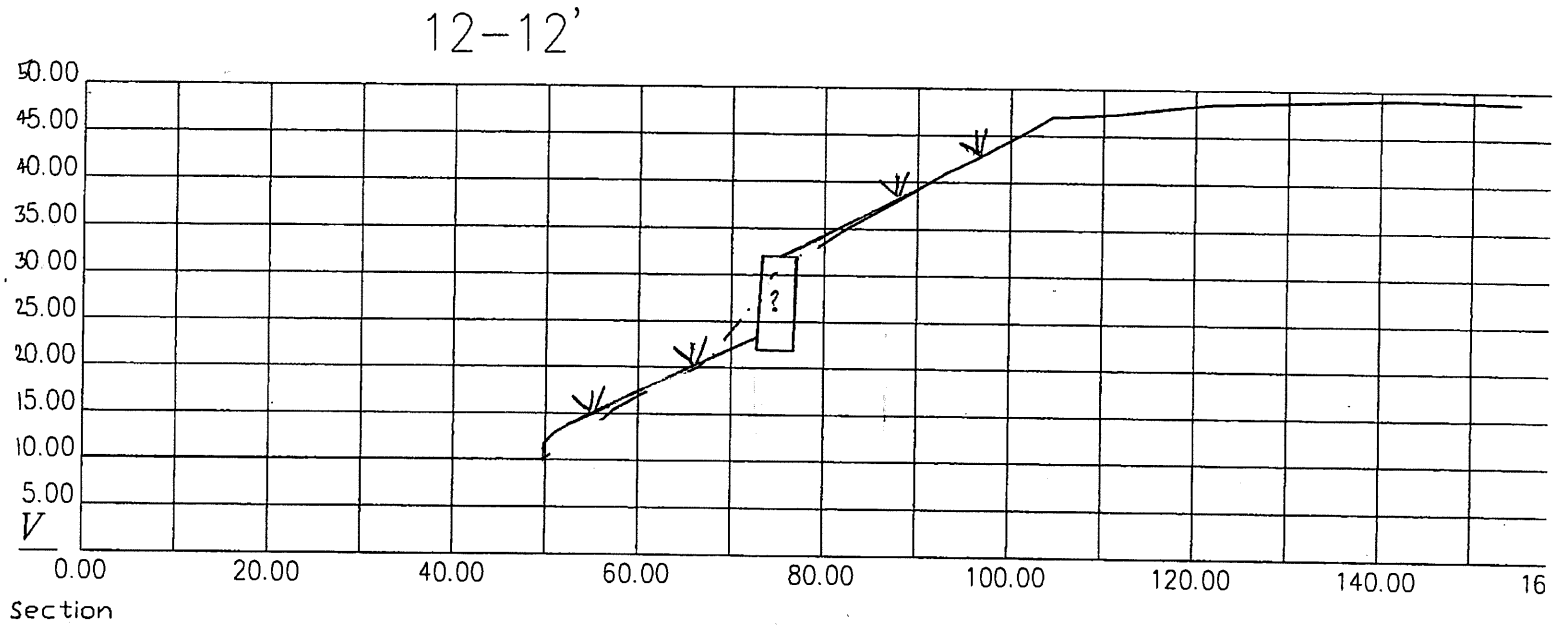
OPTION 3


11–11'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

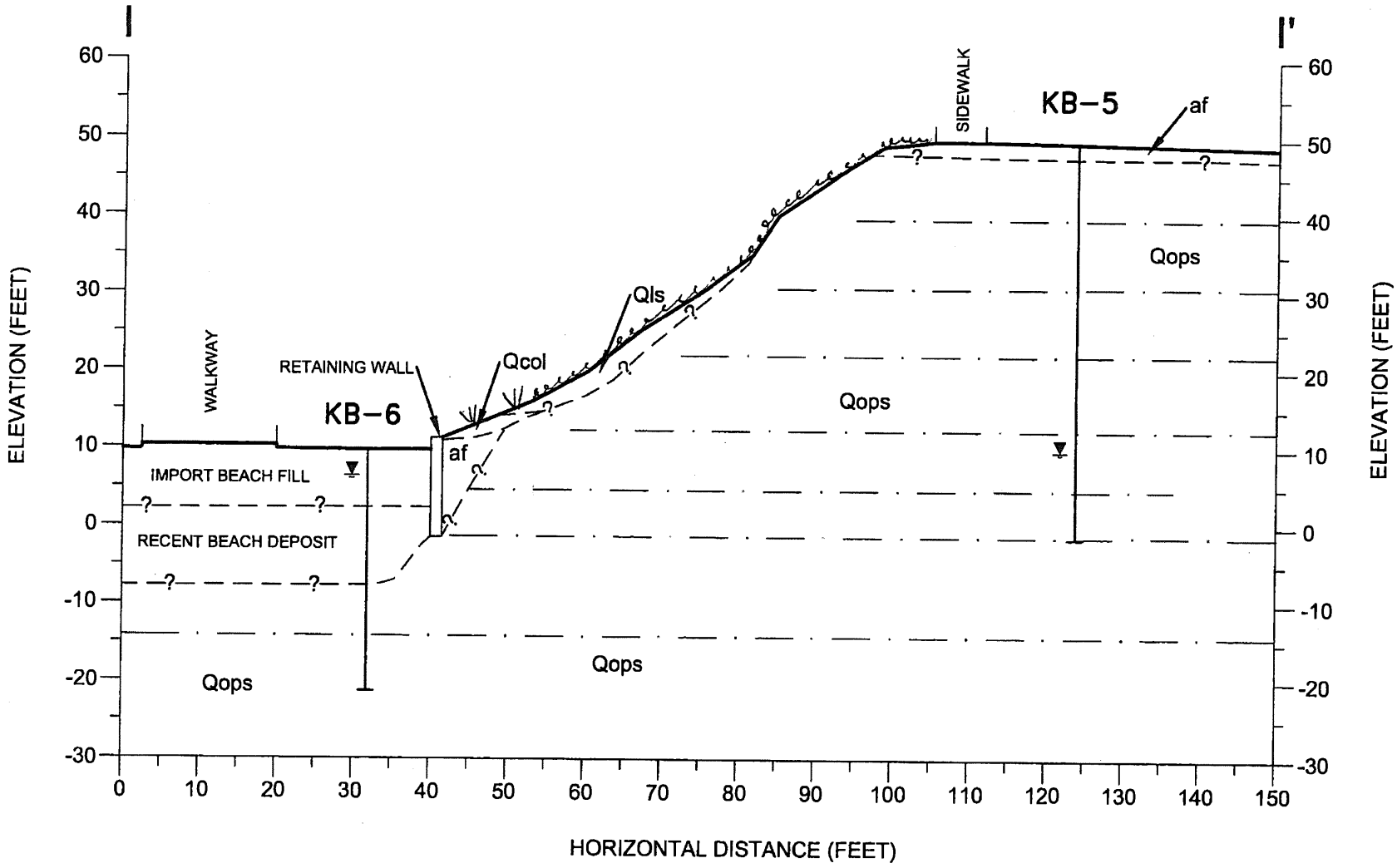
OPTION 3


H
H'
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
RETAINING WALL
KB-7
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
(ERODED) Qops
Qcol
af
RETAINING WALL
ABANDONED RAMP
af
SIDEWALK
GPI-B-5
Qops
Qops
Qops

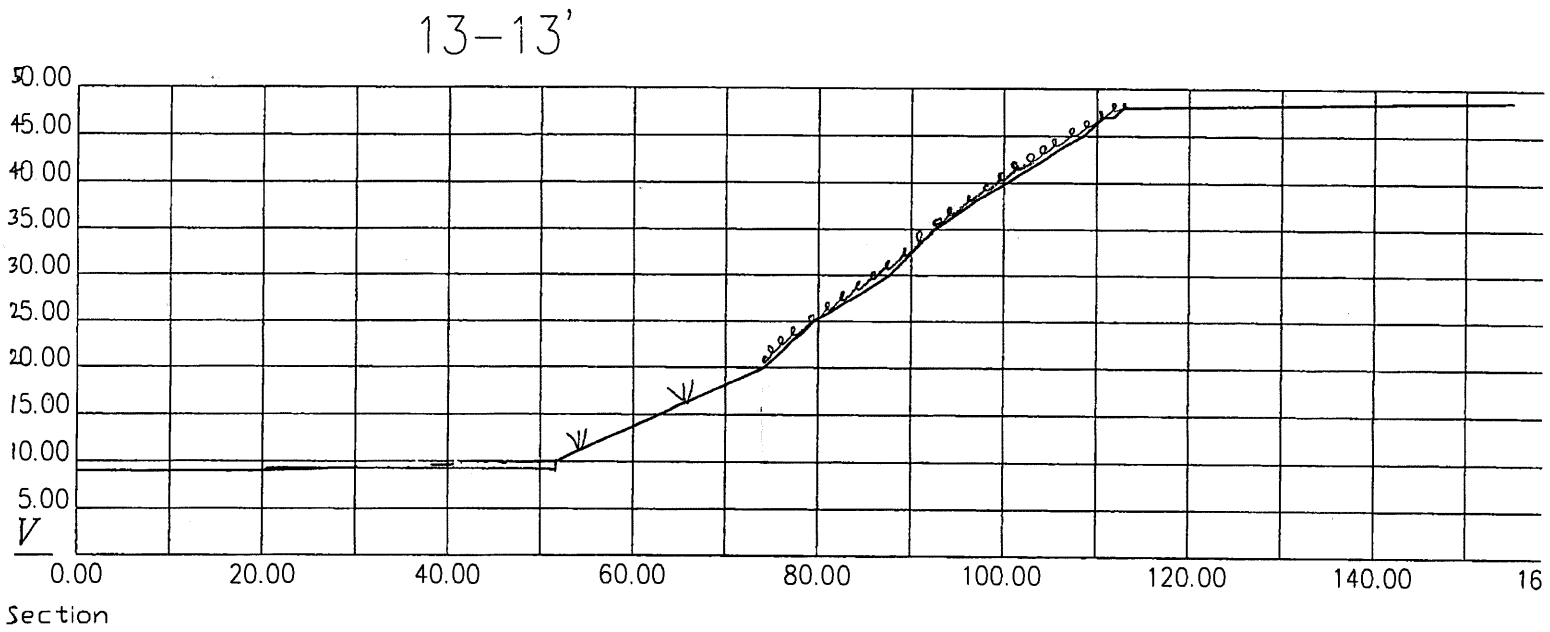
OPTION 3


12-12'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

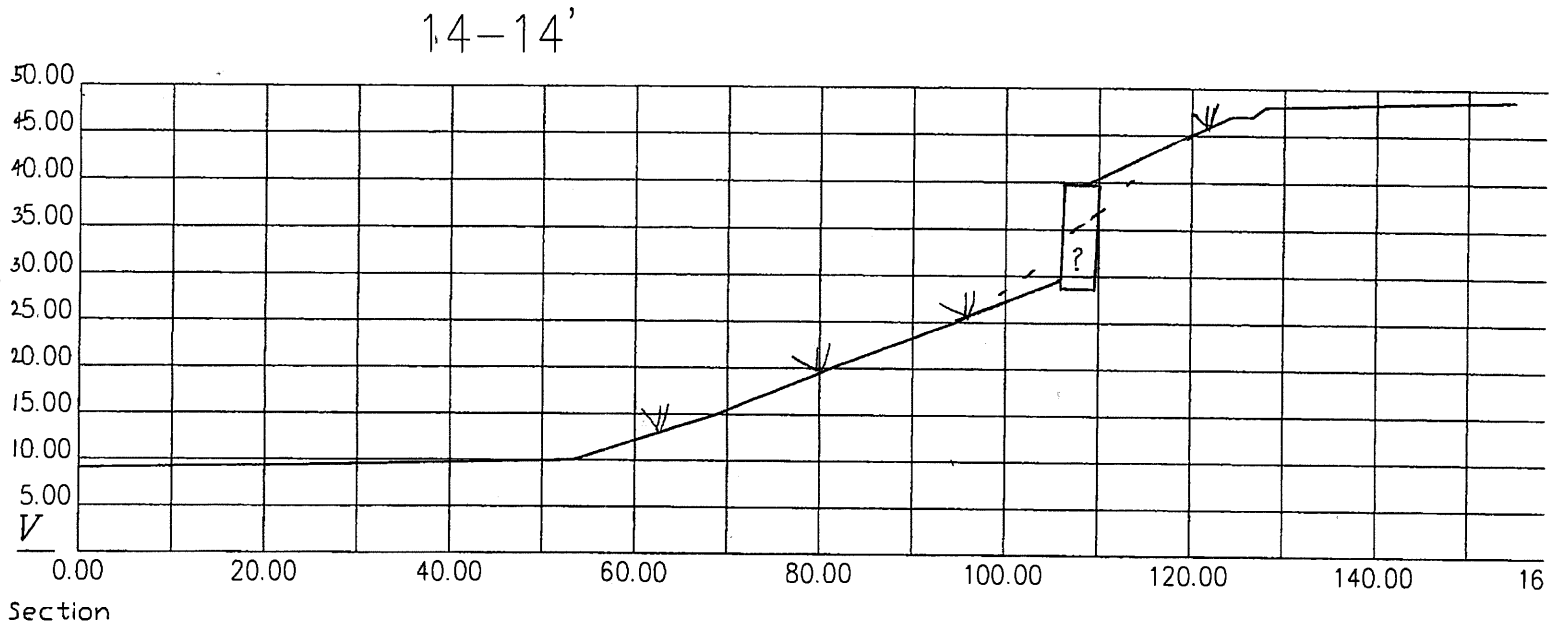
OPTION 3


I
I'
WALKWAY
RETAINING WALL
KB-6
Qcol
Qls
af
SIDEWALK
KB-5
af
IMPORT BEACH FILL
RECENT BEACH DEPOSIT
Qops
Qops
Qops
Qops
ELEVATION (FEET)
ELEVATION (FEET)
HORIZONTAL DISTANCE (FEET)
60
50
40
30
20
10
0
-10
-20
-30
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

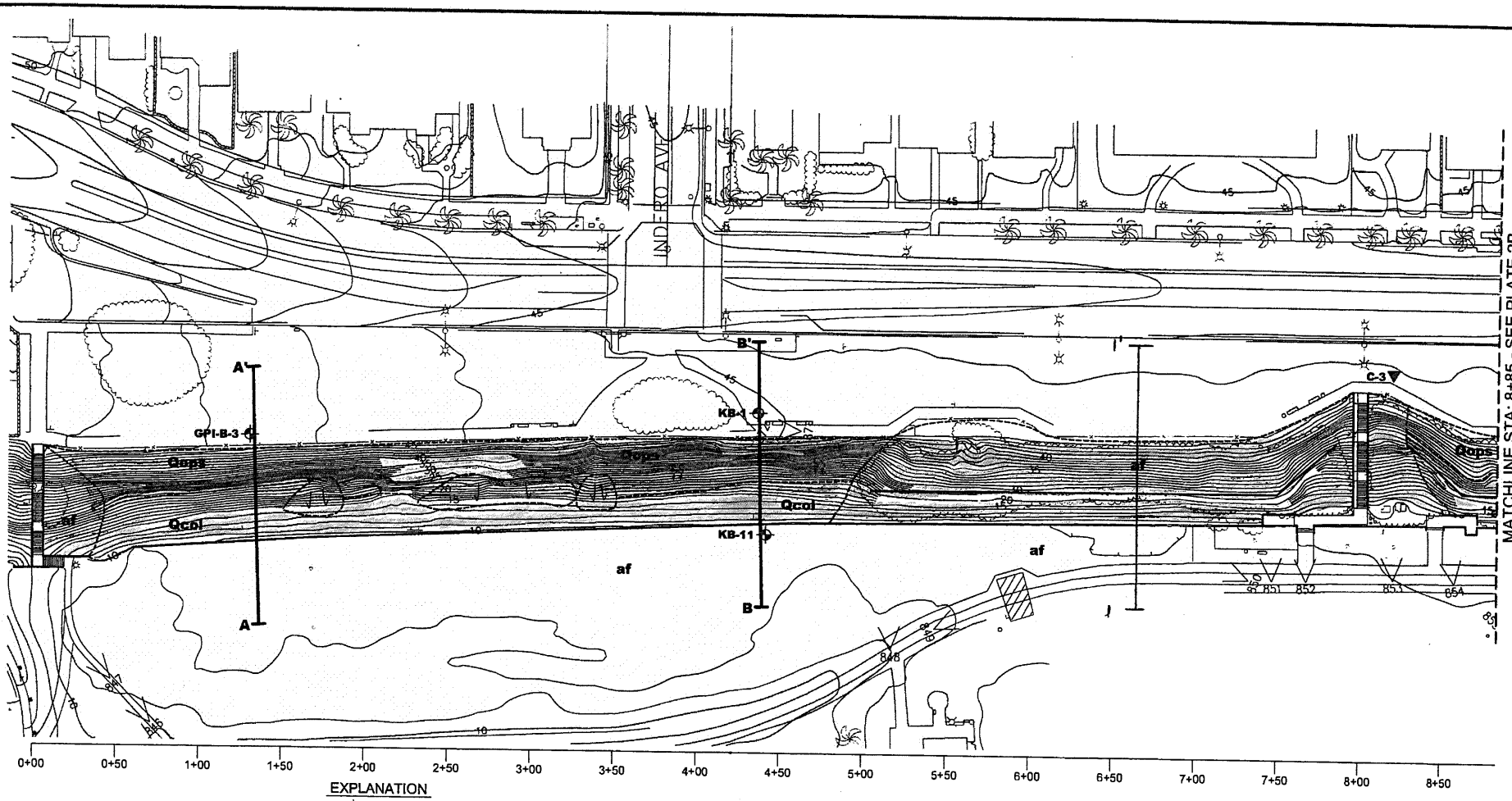
OPTION 3


13-13'
50.00
45.00
40 00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section

OPTION 3


14–14'
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
V
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
16
Section
?

OPTION 3



EXPLANATION

af	ARTIFICIAL FILL
Qls	LANDSLIDE
Qcol	COLLUVIUM
Qops	QUATERNARY OLD PARALIC DEPOSITS
	BORING LOCATION BY GPI (GPI-B-3) AND BY KLEINFELDER (KB-11)
	CONE PENETRATION TEST BY GPI (C-5)
	CROSS-SECTION LOCATION
	LANDSLIDE DEBRIS/SLUMP MATERIAL
	EROSION AREA
	APPROXIMATE GEOLOGIC CONTACT

Shrubs

Ground Cover

Ground Cover and Erosion Fabric

OPTION 3

N

60 30 0 60

APPROXIMATE SCALE (feet)

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

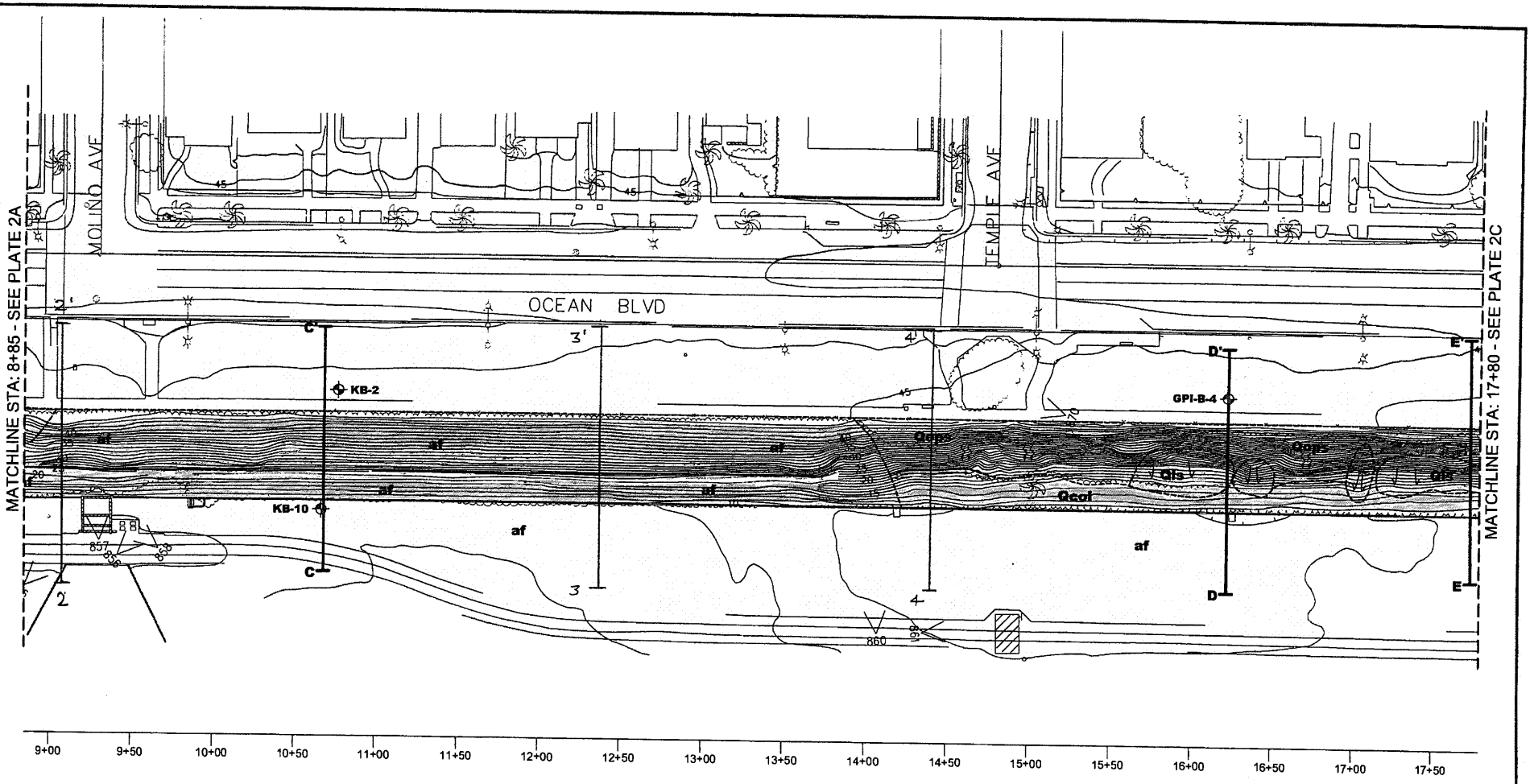
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 0+00 TO 8+85

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2A**

PLOTTED: 09 Dec 2009, 4:22pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeach\Bluffs\ LAYOUT: 2a
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



Shrubs

Ground Cover

Ground Cover and Erosion Fabric

OPTION 3

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

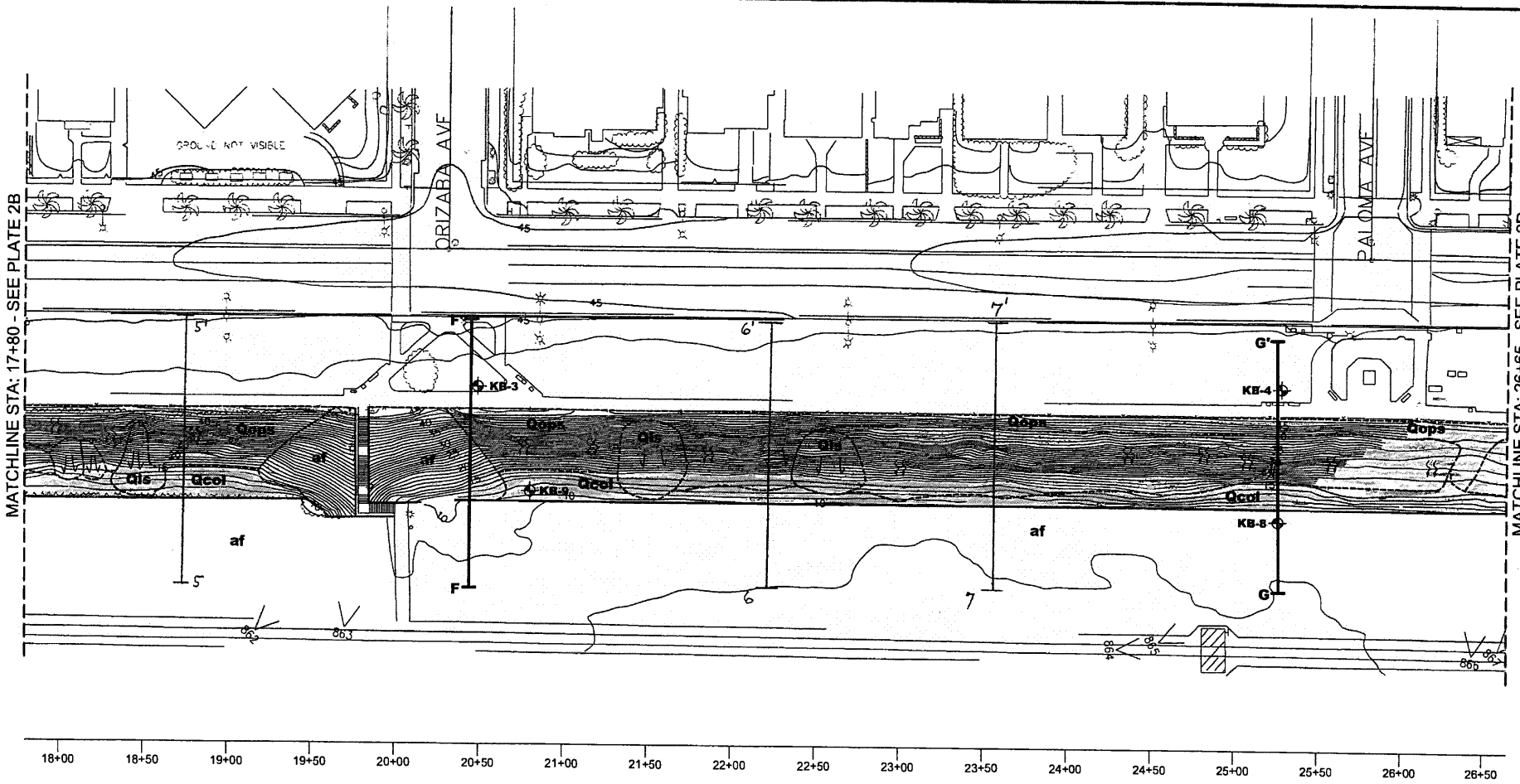
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 8+85 TO 17+80

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2B**

PLOTTED: 09 Dec 2009, 4:23pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2b
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



Shrubs

Ground Cover

Ground Cover and Erosion Fabric

OPTION 3

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

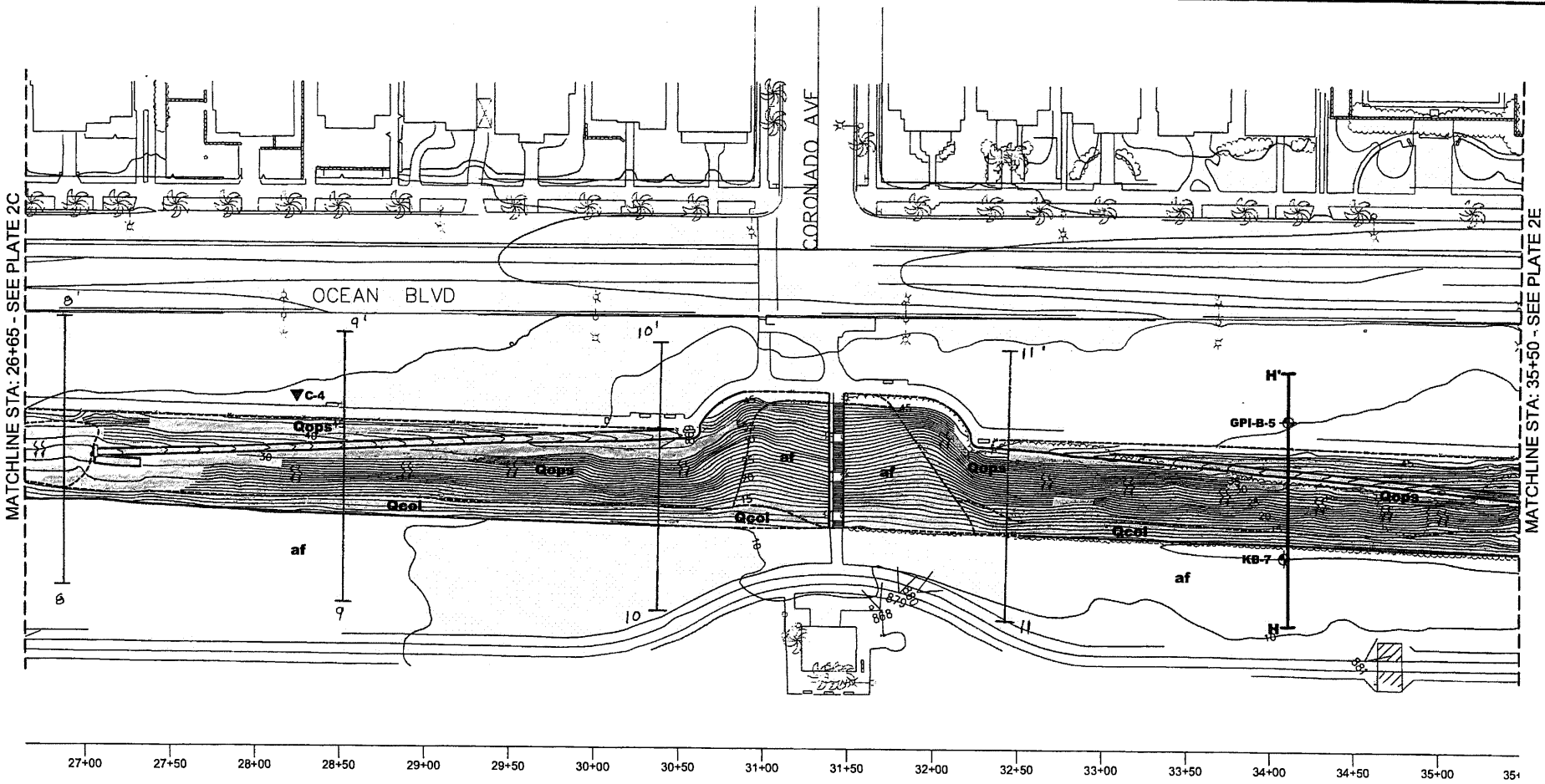
PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 17+80 TO 26+65

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2C**

PLOTTED: 09 Dec 2009, 4:23pm, MGriffin
CAD FILE: L:\2009\CADD\107104\LongBeachBluffs\ LAYOUT: 2c
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA



Shrubs

Ground Cover

Ground Cover and Erosion Fabric

N

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

OPTION 3

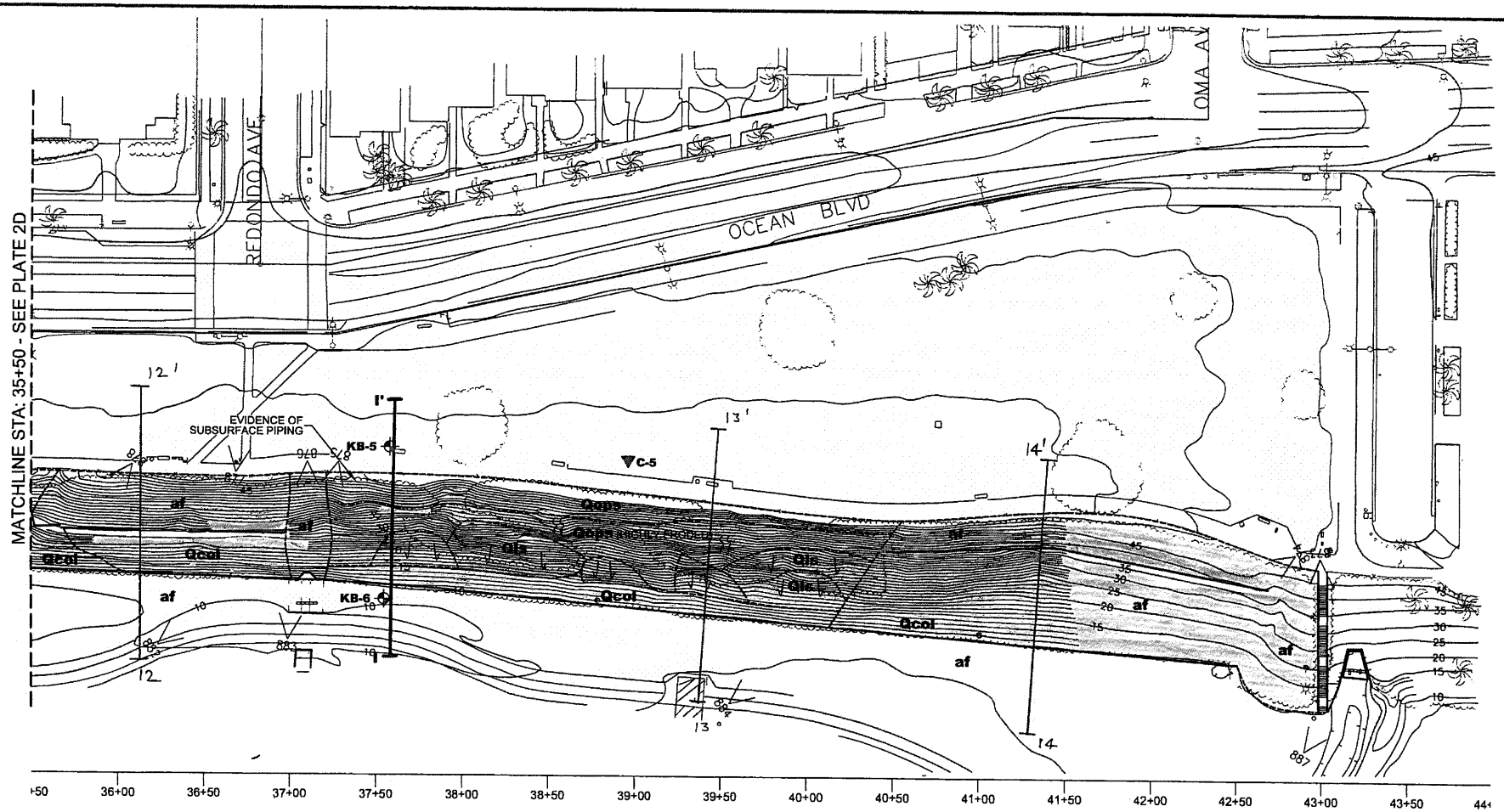
KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 26+65 TO 35+50

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2D**



Shrubs

Ground Cover

Ground Cover and Erosion Fabric

60 30 0 60

APPROXIMATE SCALE (feet)

NOTE: SEE PLATE 2A FOR GEOLOGIC EXPLANATION

OPTION 3

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	107104
DRAWN:	12/2009
DRAWN BY:	MRG
CHECKED BY:	JR
FILE NAME:	107104p2A to 2E_GM.dwg

GEOLOGIC MAP
STATION 35+50 TO END

PROPOSED SLOPE IMPROVEMENTS
BLUFF PARK
LONG BEACH, CALIFORNIA

PLATE **2E**