

G.I.-30 SEPT. 1976

GEOCRES No. 40I-12-24DIST. 2 REGION \_\_\_\_\_W.P. No. 300-92-00

CONT. No. \_\_\_\_\_

W. O. No. \_\_\_\_\_

STR. SITE No. \_\_\_\_\_

HWY. No. 2LOCATION Failure of Embankment4 km W of WardsvilleNo of PAGES - 1

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. \_\_\_\_\_

REMARKS: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



Ministry  
of  
Transportation

FILE No. \_\_\_\_\_ DATE \_\_\_\_\_

REMARKS

office 519-354-1400  
519-358-4329

@ Dennis Kay - District office (Chatham)

519-878-8083  
~~519-671-8009~~ (seller phone)

@ Bob Cook - Construction supervisor  
→ 519-871-0400

Jeff Trudell - Chatham District

519-358-4308

@ Al. Willie - project supervisor

519-671-8009

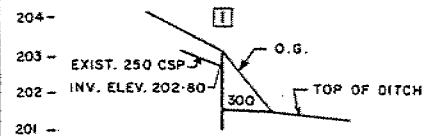
@ Peter Ginn - District Engineer

519-354-1400

@ Tae 416-818-1272

Martin 416-616-6789

SITE #1

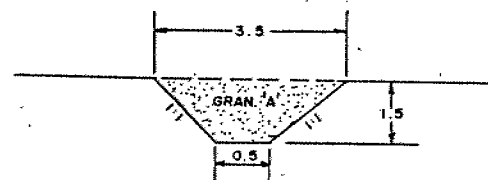
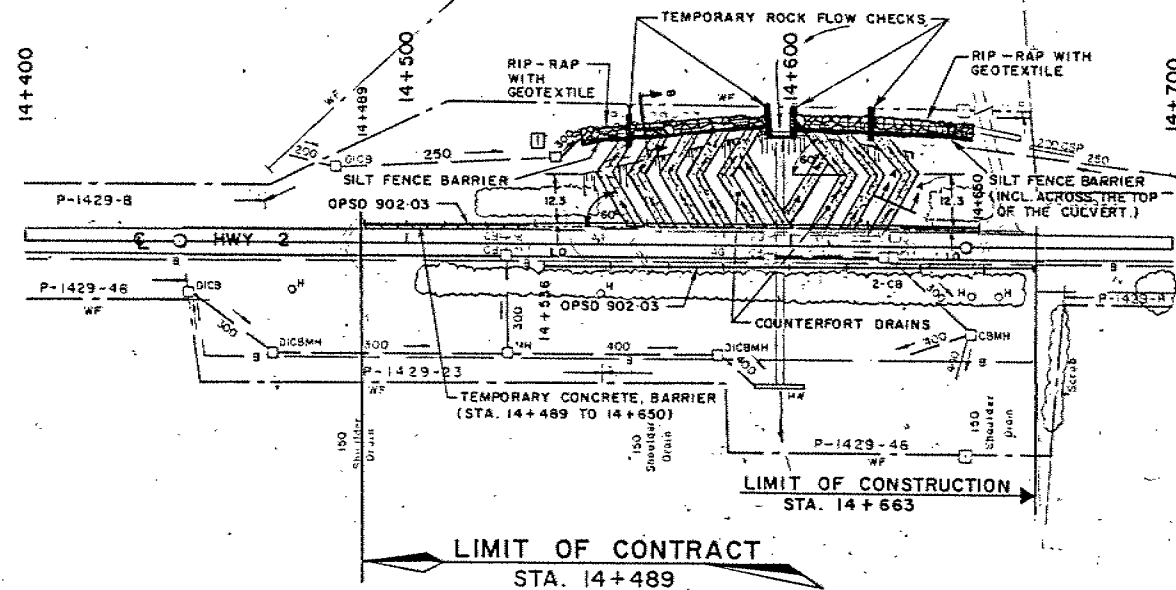


SEWER PROFILE

N.T.S.

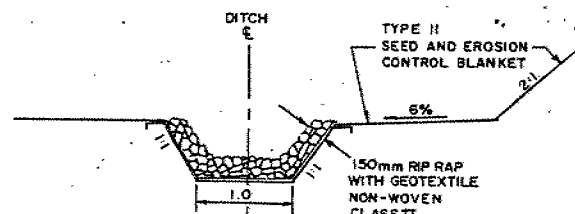
LOT 22

RINLR



SECTION A-A  
COUNTERFORT DRAINS

N.T.S.

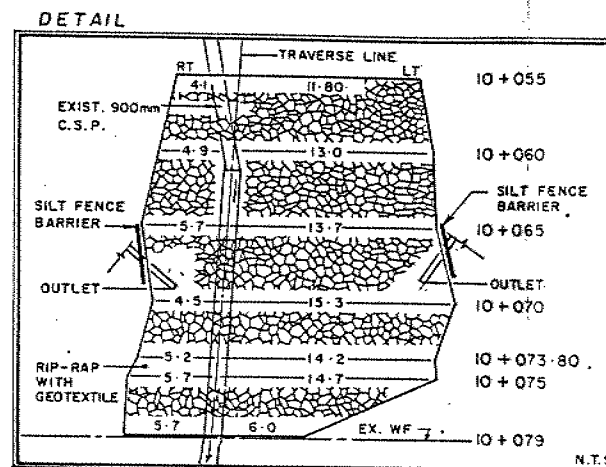


SECTION B-B  
DITCH

N.T.S.

METRIC

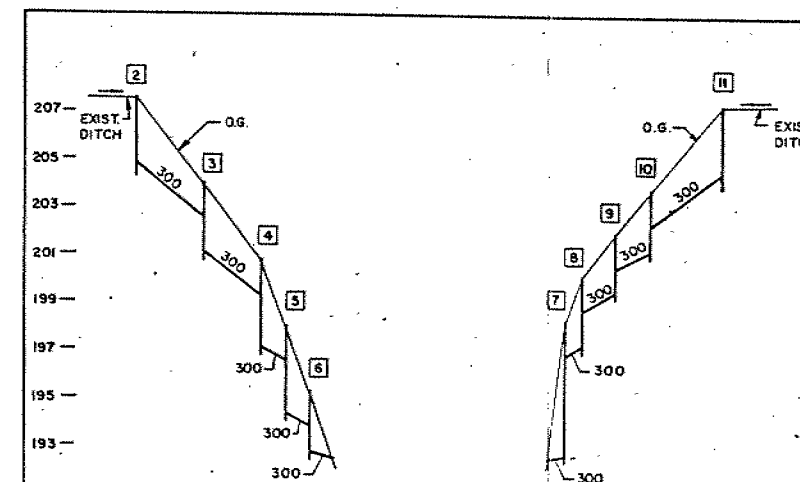
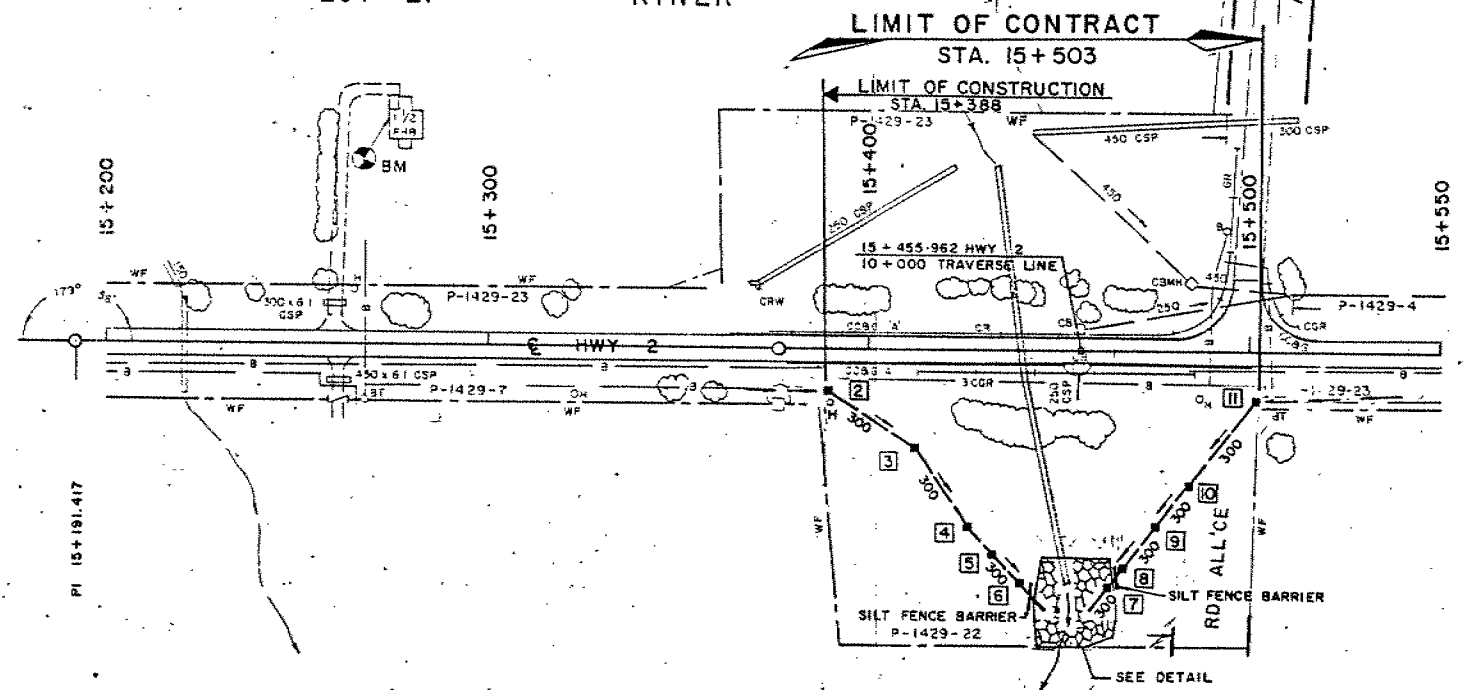
SITE #2



N.T.S.

LOT 21

RINLR



SEWER PROFILES

N.T.S.

PLAT No  
CONT No  
WP No 300-92-00

NEW CONSTRUCTION

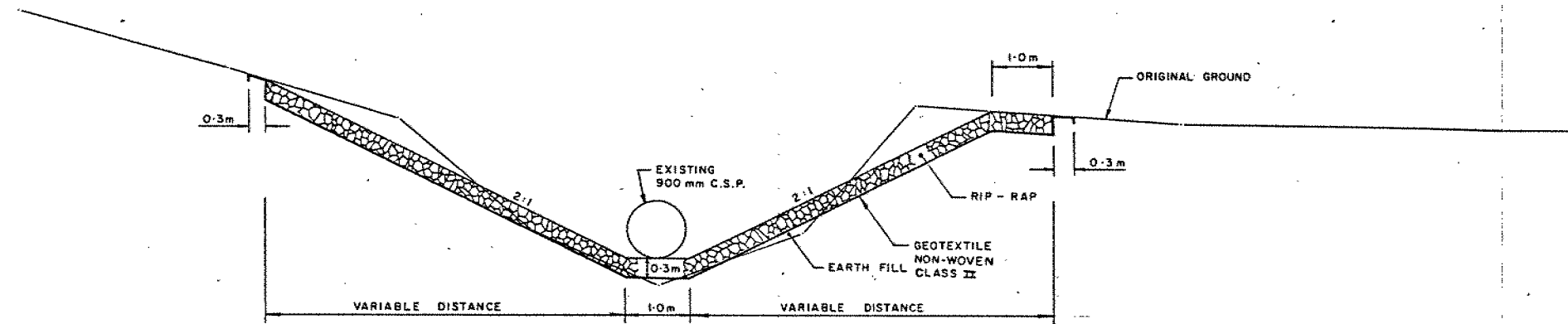


SHEET  
4

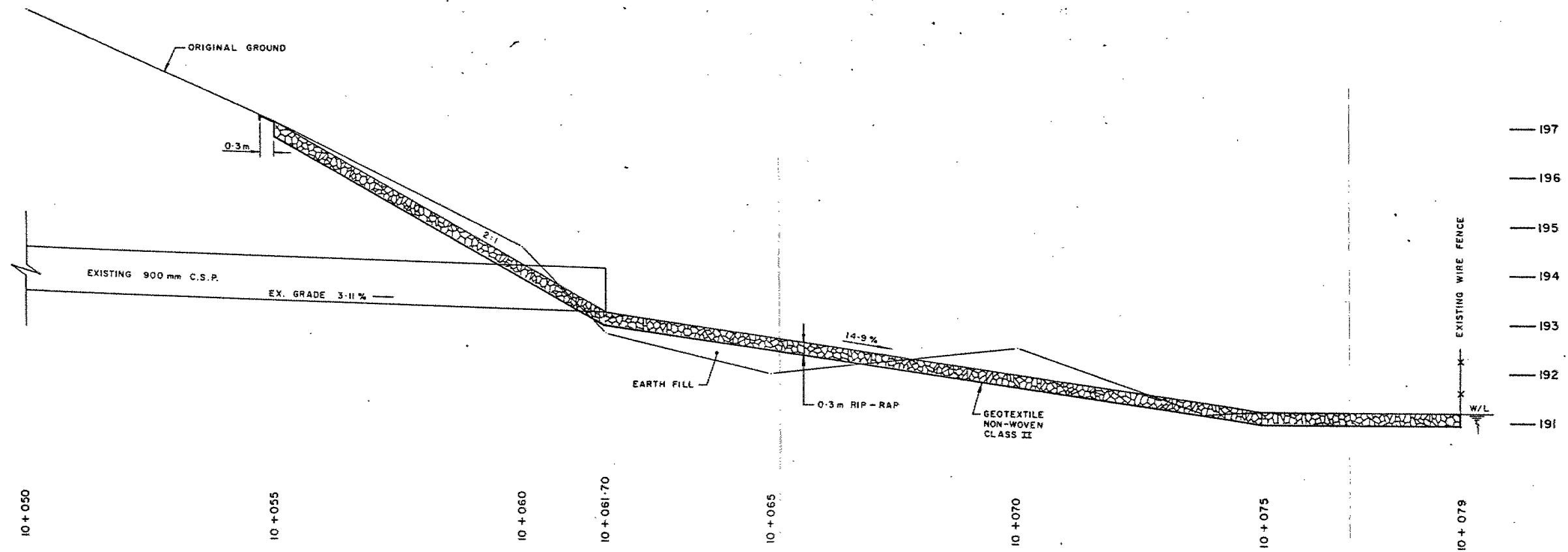
SCALE  
10 m 20 m

TYPICAL SECTION  
and  
PROFILE

SITE #2



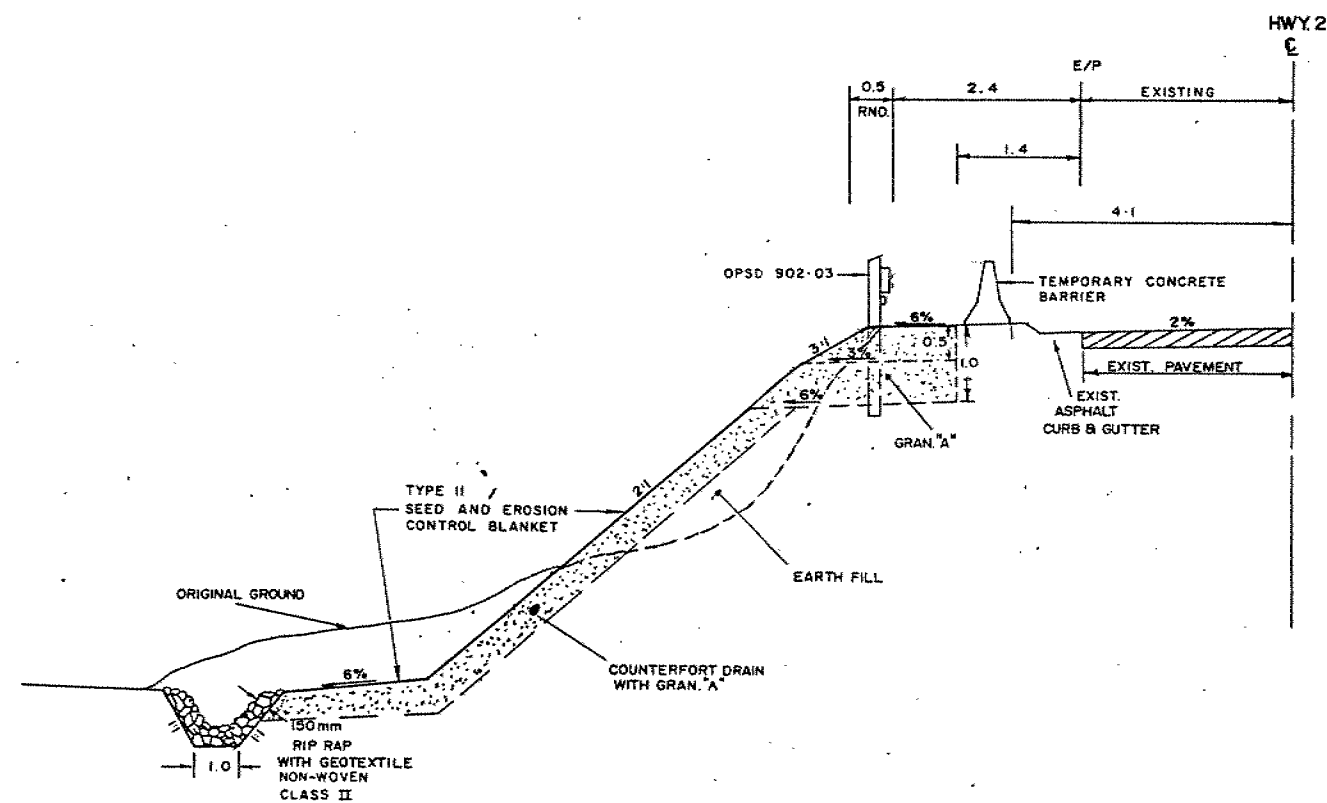
TYPICAL SECTION  
STA. 10+061.70 — STA. 10+075

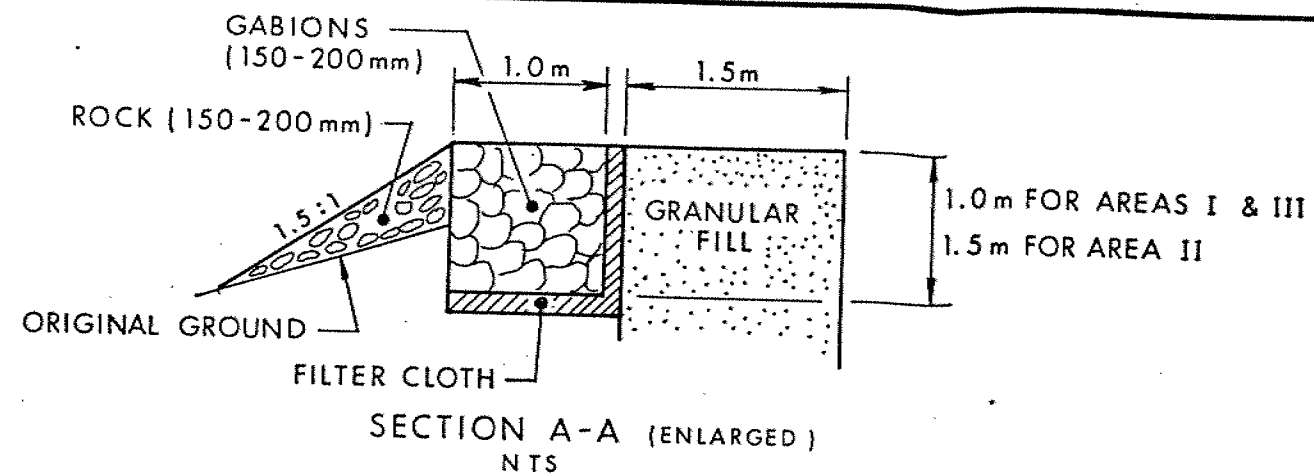


PROFILE

SCALE  
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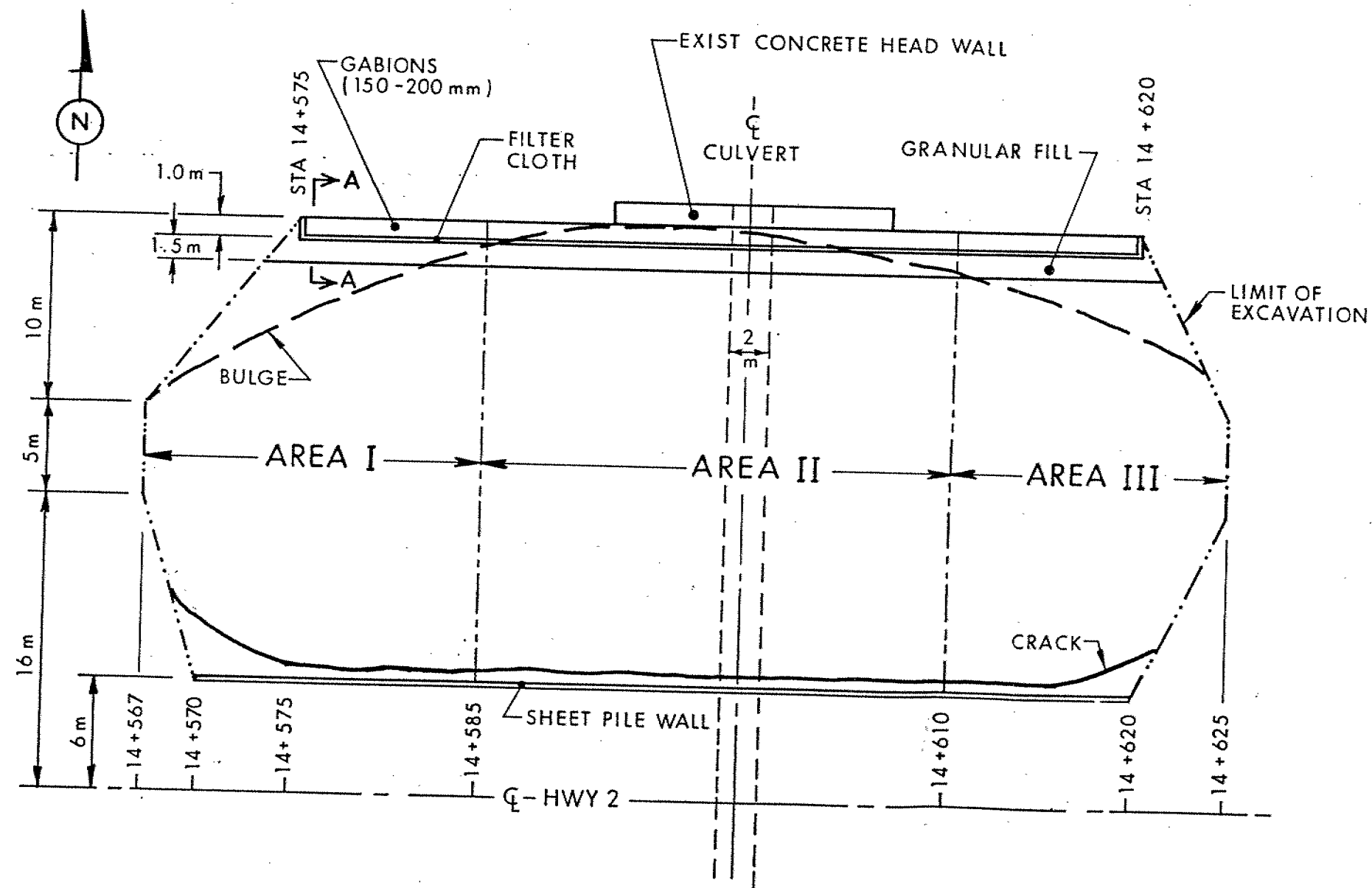
SITE # 1





#### NOTES:

1. SHEET PILE SHALL BE DRIVEN TO EL. 203m FROM STA 14+570 TO STA 14+620.
2. BENCHING SHALL BE PROVIDED AS SHOWN ON SECTIONS AT STA 14+582 FOR AREA I, STA 14+598.5 FOR AREA II AND STA 14+616 FOR AREA III.
3. SLOPE FOR EXCAVATION MAY BE 1:1 OR AS STEEP AS POSSIBLE UNLESS OTHERWISE SPECIFIED.
4. ANY SPONGY OR SOFT AREA OBSERVED BELOW THE BENCH LEVEL SHOULD BE SUBEXCAVATED AND BACKFILLED WITH ACCEPTABLE FILL MATERIAL.
5. PERTINENT MTO SPECIFICATIONS AND STANDARDS SHALL BE USED.



#### AREA OF RESTORATION

HWY 2

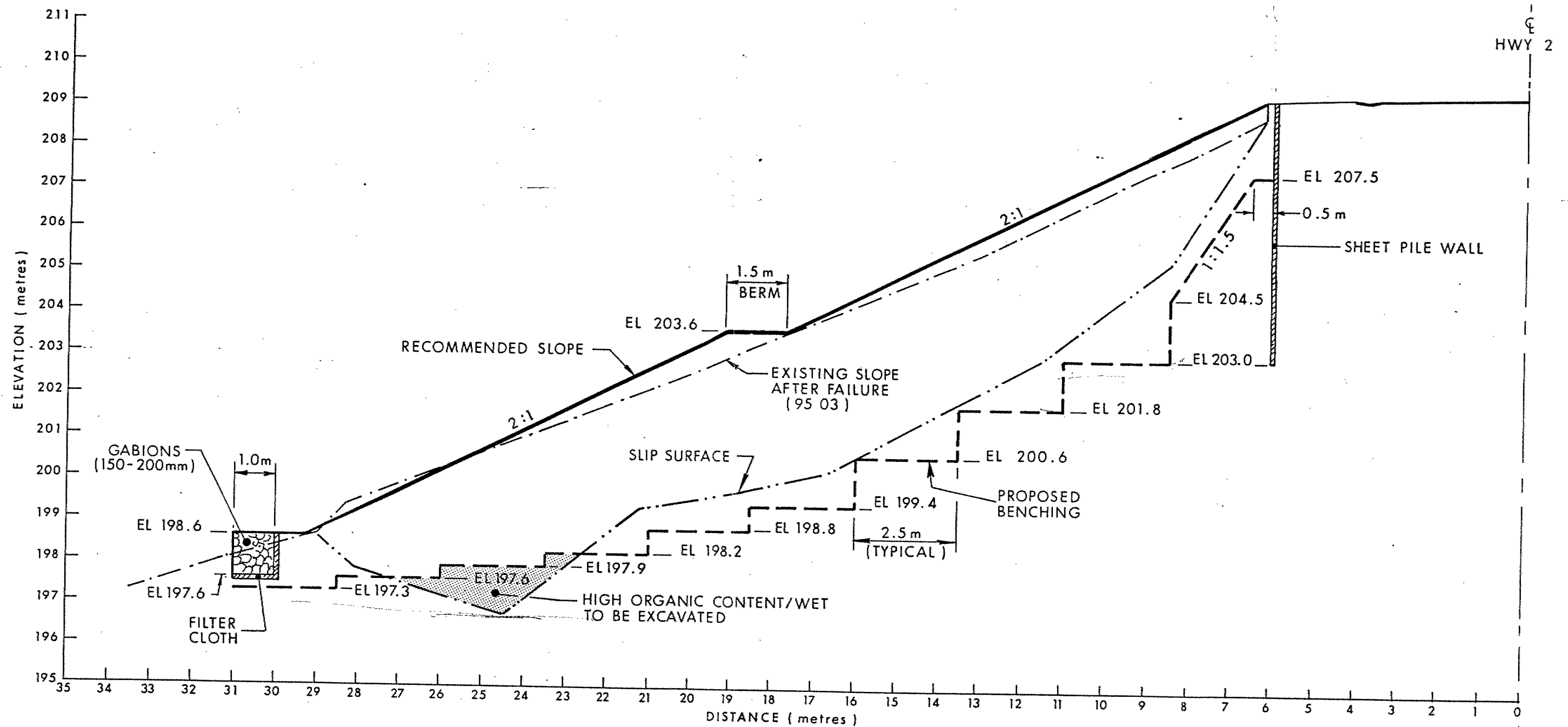
DIST 32

WP 300 - 92 - 00

Geocres No 40112 - 24

1995 06 22

FIGURE No 1



SECTION AT STA 14+582

**RECOMMENDED SLOPE & BENCHING  
FOR RESTORATION**

HWY 2

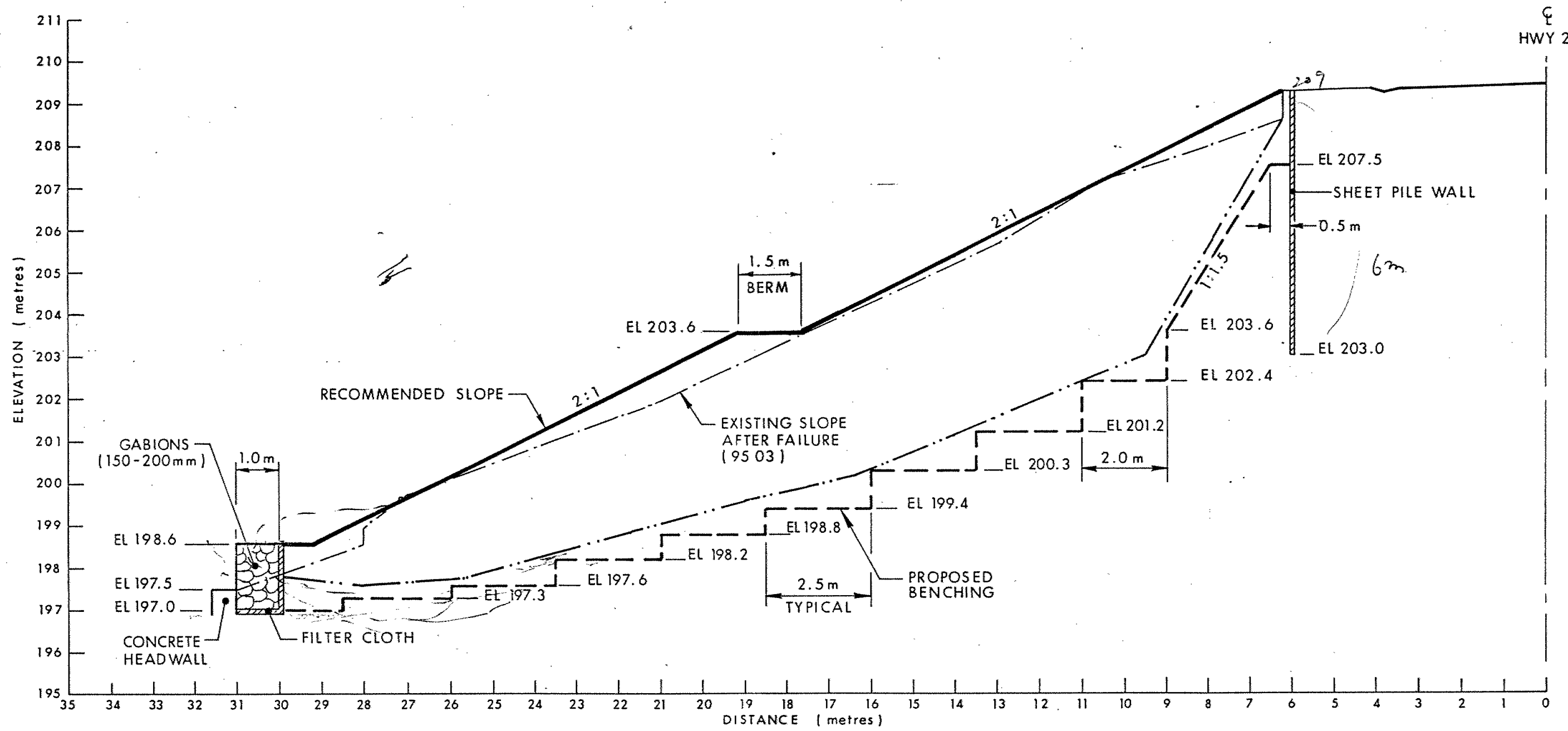
DIST 32

WP 300 - 92 - 00

Geocres No 40 I12 - 24

1995 06 22

FIGURE No 2



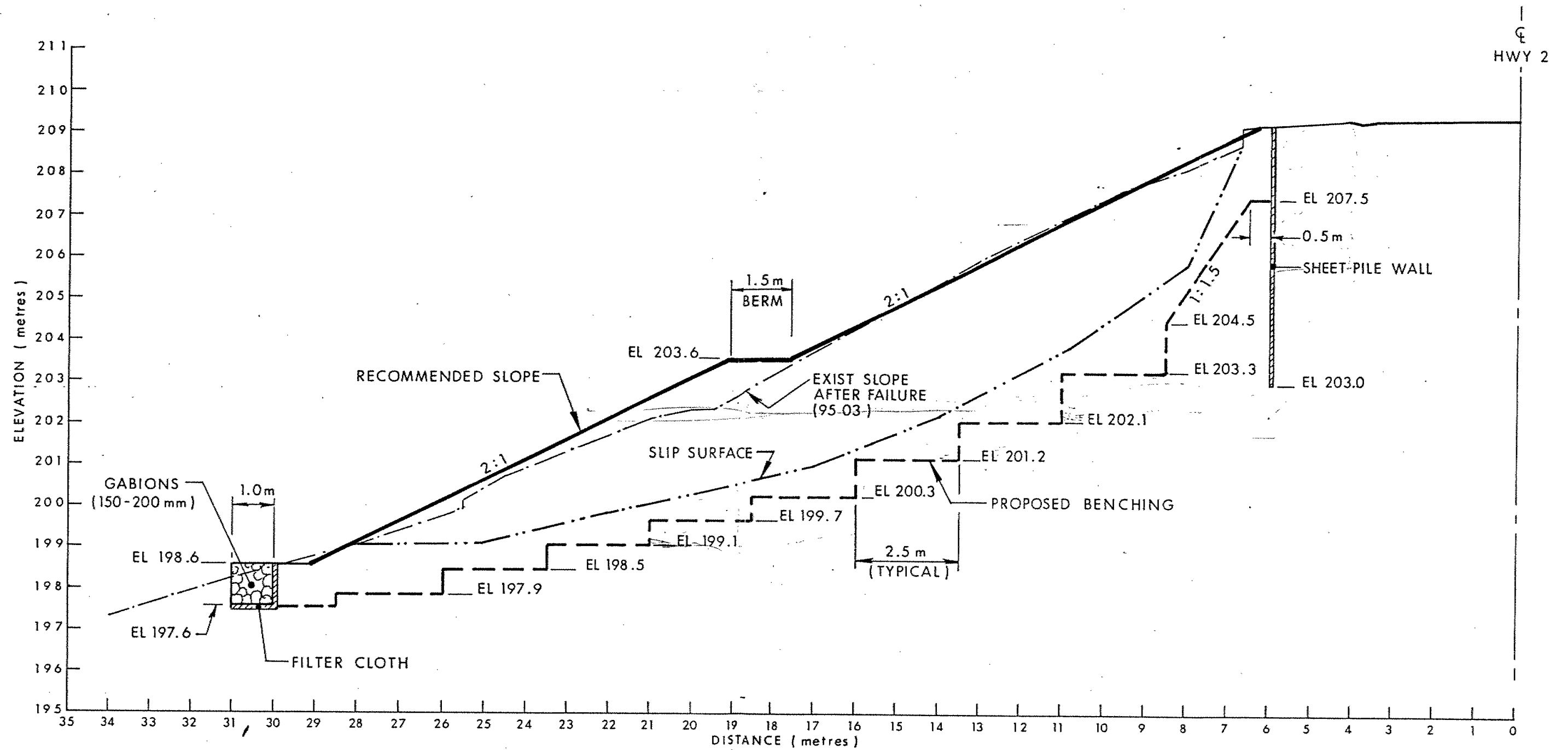
SECTION AT STA 14+598.5

**RECOMMENDED SLOPE & BENCHING  
FOR RESTORATION**

HWY 2 DIST 32  
WP 300-92-00 Geocres No 40I12-24  
1995 06 22 FIGURE No 3

209  
197  
12





SECTION AT STA 14+616

# RECOMMENDED SLOPE & BENCHING FOR RESTORATION

HWY 2

DIST 32

WP 300 - 92 - 00

Geocres No 40I12 - 24

1995 06 22

FIGURE No 4

# memorandum

*file please*

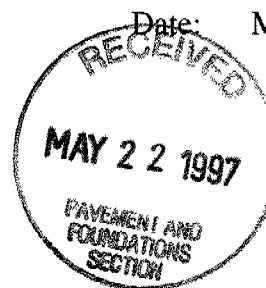


Geotechnical Section, Southwestern Region, London

Fax: (519) 649-3108

To: P. Ginn  
District Engineer  
Chatham

Att: R. Cook



Date: May 20, 1997

**Re: Inspection of Highway 2 Embankment  
4 km West of Wardsville  
Highway 2, District 32, Chatham**

At the top of this slope, pavement runoff was overtopping the asphalt curbs and flowing down slope. As discussed, a line of sand bags has been constructed which is successfully diverting flow to the catch basins and preventing overtopping.

In the summer, probably August, 1997 when the slope will be drier, carry out recommendations of Pavements and Foundations Section to remove wet soil and replace with granular. On top of the granular place 150 to 200 mm of earth and 50 mm of topsoil. Seed and apply erosion control blanket. It is important to ensure that the granular is extended to the rockfill at the toe of slope.

A handwritten signature in black ink, appearing to read "Eric R. Magni".

Eric R. Magni, Head  
Geotechnical Section  
Southwestern Region London  
(519) 649-3017

W: \DATA\WP\CS\ERIC\EM309.WPD

cc: T. Kim  
N. Zohorsky/K. Helwig



# MEMORANDUM

## Engineering Materials Office

Room 313, Central Building, Downsview

Tel. (416) 235-3732 Fax. (416) 235-5240

To: Peter Ginn, P. Eng.  
District Engineer  
District 32, Chatham

Date: April 22, 1997

From: Pavements and Foundations Section  
Room 315, Central Building

Re: Inspection of Highway 2 Embankment  
4 Km West of Wardsville  
Highway 2, District 32, Chatham

The above site was inspected on April 17, 1997 along with Mr. Dennis Kay, Engineering Services, Chatham District and Mr. Eric Magni, Head, Geotechnical Section, Southwestern Region.

It appears that the bulge at the west end of the embankment is due the sloughing of soil caused by the surface run-off from the road. The run-off from the road should be directed away from the slope to prevent surficial erosion and further sloughing of fill material.

It is recommended that all the sloughed fills at this location be removed and replaced with granular material. The granular material should be extended to the toe of the embankment to facilitate proper drainage.

As we discussed during our meeting, the Geotechnical Section, Southwestern Region will provide the recommendations for the surficial erosion and diversion of run-off away from the fill.

c. c E. Magni

A handwritten signature in cursive script, likely belonging to M. Vasavithasan.

M. Vasavithasan, P. Eng  
Foundation Engineer

For

Tae C. Kim, P.Eng.  
Sr. Foundation Engineer

A1. Willie

REPLY  
COPYContract Administration  
District 32. ChathamSEND  
TO

DEPT

DATE

SUBJECT

Restoration of Embankment Hwy. 2. Wadswille

- As per the instruction of Joe C Kim, of Oct 10, 1998, Please Carry out the following:
- 1) Remove all the material behind the sheet pile wall to a depth of 3m below the road level.
  - 2) Subexcavate all the spoil & organics in area 1 and backfill with acceptable material.
  - 3) Prod soil to compact excavated area before placing new material.
  - 4) Backfill as high as possible.
  - 5) Identify failure surface by screwing failed soil.
  - 6) Remove the sheet pile wall and proceed in slope.

REPLY

- Slopes should not be steeper than 1:1.
- 2) Break the clay block & source of water that coming into the fill.
  - 4) Use granular fill behind the gabion wall throughout the length.

William Thomas  
for Joe C Kim

REPLY FROM

REPLY DATE

# memorandum



To: Bob Cook, Construction Supervisor  
Chatham District  
P.O. Box 910, 870 Richmond St.  
Chatham, ON., N7M 5L3

Frm: Pavements and Foundations  
Room 315, Central Building

Re: Restoration of Embankment  
Hwy. 2, 4 km West of Wardsville  
Contract No. 32-95-02 (WP 300-92-00)  
District 32, Chatham

Further to the site meeting on October 4 1995 and subsequent telephone conversation between Mr. E. Magni, head of Geotechnical Section and the writer on October 5 1995, this memo summarizes our recommendations as follows:

1. Any organic material found in Area 1 below the elevation of 197 m, should be removed and replaced by new material.
2. Due to the excessive movement of sheet piles and the cracks developed on the pavement shoulder, the construction method should be modified to prevent further slope instability. As discussed at the meeting, it is recommended that excavation and backfilling operations should be carried out in stages, rather than completed all at one time, eg. excavate and backfill area 1 and then move on to the next.
3. The quality of compaction of material at the interface between the new and old material, together with that of the material which makes up the embankment shall be crucial.
4. It is understood that during the excavation the west side of the embankment was found to be wet from an unknown source of water. It is therefore recommended that the existing sewer and manholes be excavated by backhoe or a geotechnical hole be drilled in order to locate the source of the seepage. Proper remedial action will be necessary to prevent further slope instability in this area.

We believe that the above is sufficient for your present purposes. Should you have any questions, please contact this office.

cc: E. Magni  
A. Ho  
G. Tronghton

*Tae Chul Kim*  
T. C. Kim, P. Eng.  
Sr. Foundation Engineer

OCT 6 '95 9:52

1 19 649 3108 PAGE.002

From: Eric Magni  
To: MTOSC.CHATHAM.GinnP, MTOSC.CHATHAM.CookR  
Date: 10/5/95 5:13pm  
Subject: Wardsville Slope

I spoke to Tae Kim at about 4.40pm. If needed he can be contacted at home during the long weekend at (905)-897-6705 and will come to site if needed. Area of deep muskeg excavation must be backfilled as soon as possible with well compacted borrow earth to provide toe stability. Monitor crack over weekend. Continue excavation on Tues and please keep us informed. Tae and /or I will come down next week as required.

Coralie...fax this to Tae Kim, copy to me please

cc: Strathyc

519-649-3109

# memorandum



To: Bob Cook, Construction Supervisor  
Chatham District  
P.O. Box 910, 870 Richmond St.  
Chatham, ON., N7M 5L3

Frm: Pavements and Foundations  
Room 315, Central Building

Re: Restoration of Embankment  
Hwy. 2, 4 km West of Wardsville  
Contract No. 32-95-02 (WP 300-92-00)  
District 32, Chatham

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4. It is understood that during the excavation the west side of the embankment was found to be wet from an unknown source of water. It is therefore recommended that the existing sewer and manholes be excavated by backhoe or a geotechnical hole be drilled in order to locate the source of the seepage. Proper remedial action will be necessary to prevent further slope instability in this area.

We believe that the above is sufficient for your present purposes. Should you have any questions, please contact this office.

cc: E. Magni  
✓ A. Ho  
G. Troughton

*Tae Chul Kim*  
T. C. Kim, P. Eng.  
Sr. Foundation Engineer



# MEMORANDUM



To: G. Troughton  
Project Engineer  
Planning & Design Section  
Southwestern Region

Date: July 12, 1995

Tel: (416) 235-3731  
Fax: (416) 235-5240

From: Pavements & Foundations Section  
Room 315, Central Building

Re: Restoration of Embankment (Stn. 14 + 567 to Stn. 14 + 625)  
W.P. 300-92-00, Highway 2, District 32, Chatham

In reference to your fax dated July 07, 1995, the following parameters are suggested for the design of Roadway Protection Scheme at the above location.

|                                      |                              |
|--------------------------------------|------------------------------|
| Effective Angle of Internal Friction | $\phi' = 27^\circ$           |
| Bulk Unit Weight                     | $\gamma = 19 \text{ kN/m}^3$ |
| Undrained Shear Strength             | $C_u = 0$                    |

Considering the steep slope recommended near the sheet pile wall, passive resistance down to elevation 206.0 shall be neglected.

*M. Vasavithasan*

M. Vasavithasan, P. Eng.  
Foundation Engineer

for

T.C. Kim, P. Eng.  
Sr. Foundation Engineer

MV/TCK/mmj

c.c. - K. Mossop/A. Ho

RECEIVED  
JUL 15 1995  
FOUNDATION DESIGN SECTION

# FAXGRAM

July 12, 1995

PAGE / of /

|   |   |
|---|---|
| To: Mark Vasavithasan<br>Foundation Engineer<br>Foundation Design Section<br><br>fax (416) 235 5240 | From: Gord Troughton<br>Project Engineer<br>Planning and Design<br>ph. (519) 649 3123<br>fax (519) 649 3109 |
| Subject: Embankment Failure at Wardsville   |   |

Could you please review the following and questions from our design staff who are currently completing the contract package, and respond by July 14, 1995. *HA*

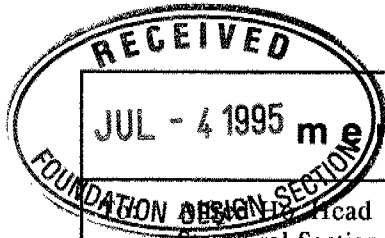
- 1) Are the drawings which accompanied your June 22, 1995 Memo available in digital (AutoCAD) format? If so can they be sent to me by e-mail? *No*
- 2) The granular fill specified on Figure 1 - what type of material should be specified (ie Granular A, Granular B, etc)? What is the lower limit of this material (bottom of gabion or subgrade)? *'Granular B' OK.*
- 3) Figures 3 and 4 show the gabion basket and filter cloth resting on subgrade, Figure 2 shows gabion installation above subgrade. Should figure 2 show the gabion placement on subgrade as well? *This should be as shown in Figure 2*



Gord Troughton

c Eric Magni  
Peter Ginn

*Talked to Gord  
on 95/07/12 @ 10:15  
& answered all the questions.  
He does not want any  
written reply. mark*



|   |  |
|---|--|
| <b>memorandum</b>   | phone (519) 649-3123 fax (519) 649-3109  |
| To: Head<br>Structural Section<br>London<br>cc: Mark Vasavithasan, Foundations Design<br>Jeff Trudell, Chatham District | Date: June 30, 1995<br><br>From: Gord Troughton<br>Project Engineer<br>Planning & Design Section<br>London |
| Re: WARDSVILLE SLOPE FAILURE, SHEET PILING DESIGN   |  |

Further to our recent conversation on the above topic, I have contacted Mark Vasavithasan of the Foundation Design Section regarding the possible change from Sheet Piling to Roadway Protection. Sheet Piling was recommended in Mark's Memo dated June 22, 1995. I contacted Mark and discussed the possibility of changing from a sheet pile wall to a roadway protection scheme. Our discussion on this topic indicated that roadway protection would be preferable because:

- a) under the roadway protection item it is the contractor's responsibility to design the scheme and the in house design time would be reduced.
- b) if problems are encountered while driving sheet piles (boulders, concrete, etc.) then the ministry would have little recourse because we specified sheet piling in the contract could.
- c) the cost of sheet piling is higher than the cost of roadway protection.
- d) sheet piling, if left in place as proposed would hinder the drainage of the road sub-base.

I discussed these points with Mark and with Jeff Trudell and both of them favoured the use of sheet piles for the following reasons:

- Mark a) The use of roadway protection, particularly soldier piles and wood lagging, would not necessarily prevent the movement of soil located below the bottom of lagging and between the soldier piles.
- b) the compaction of material at the interface between new and old material is crucial and the compactive effort where wood lagging was removed would be suspect
- Jeff c) If problems arise during construction such that the excavation cannot be completed before winter (dates are quite tight on the project) the at least the sheet piling can be completed and the roadway prevented from further settlement during the winter and subsequent spring.

For the above reasons the sheet piling option is still being recommended for the project. Could you please assign someone in your office to complete the appropriate design. I believe that Mark completed an engineering design for the sheet piles prior to his recommendation and you may wish to verify with him, (416) 235-3731, what additional design is required.

Gord Troughton

# MEMORANDUM



To: G. Troughton  
Project Engineer  
Planning & Design Section  
Southwestern Region

Date: June 22, 1995

From: Pavements & Foundations Section  
Room 315, Central Building

Tel: 235-3731  
Fax: 235-5240

Re: Restoration of Embankment (Stn. 14 + 567 to Stn. 14 + 625)  
4 km West of Wardsville  
W.P. 300-92-00, Highway 2, District 32, Chatham

Subsequent to the meeting we had on March 30, 1995, Engineering Services, District 32, Chatham made arrangements for excavation of trenches and flooding of auger holes with dye. Trenches were excavated at three locations (Stns. 14 + 582, 14 + 598.5 & 14 + 616) on June 1, 1995 to locate the failure surface. The elevations of the slip surface were established by taking spot level within the trenches. Based on this information, the cross-sections showing the slip surface were prepared by Dennis Kay, Engineering Services, District 32.

The area of subexcavation as well as details such as location of gabion and sheet pile wall are shown on Figure 1. Benching arrangements are shown on Figures 2, 3 & 4.

The subexcavation and placement of fill for the restoration of embankment shall be carried out as follows:

- 1) Drive the sheet pile to El. 203 from Stn. 14 + 570 to Stn. 14 + 620
- 2) Provide benching as shown on Sections 14 + 582 for Area I, 14 + 598.5 for Area II and 14 + 615 for Area III
- 3) Remove any spongy or soft areas observed below the bench level specified and backfill with acceptable fill material.
- 4) Place the gabion and filter cloth as shown on Figures 1, 2, 3 & 4.
- 5) Place the fill in layers and compact.

In order to ensure the integrity and the future performance of the embankment, pertinent MTO Specifications and Standards should be used.

Indications at the site are that several minor failures have taken place since the slide in May, 1994 and the conditions have deteriorated. It may be advisable to carry out the restoration work this year to avoid further deterioration.

If you need more information or have any questions, please contact this office.



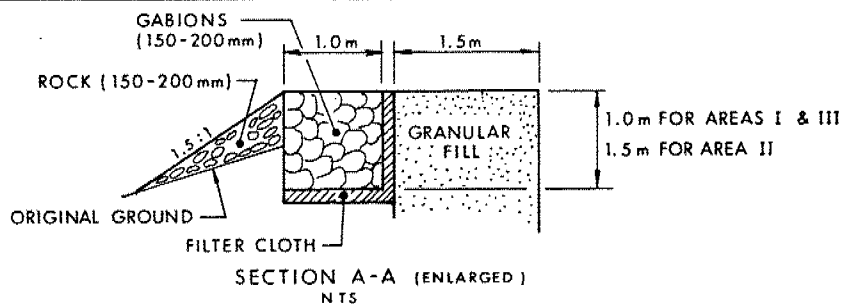
M. Vasavithasan, P. Eng.  
Foundation Engineer

for

T.C. Kim, P. Eng.  
Sr. Foundation Engineer

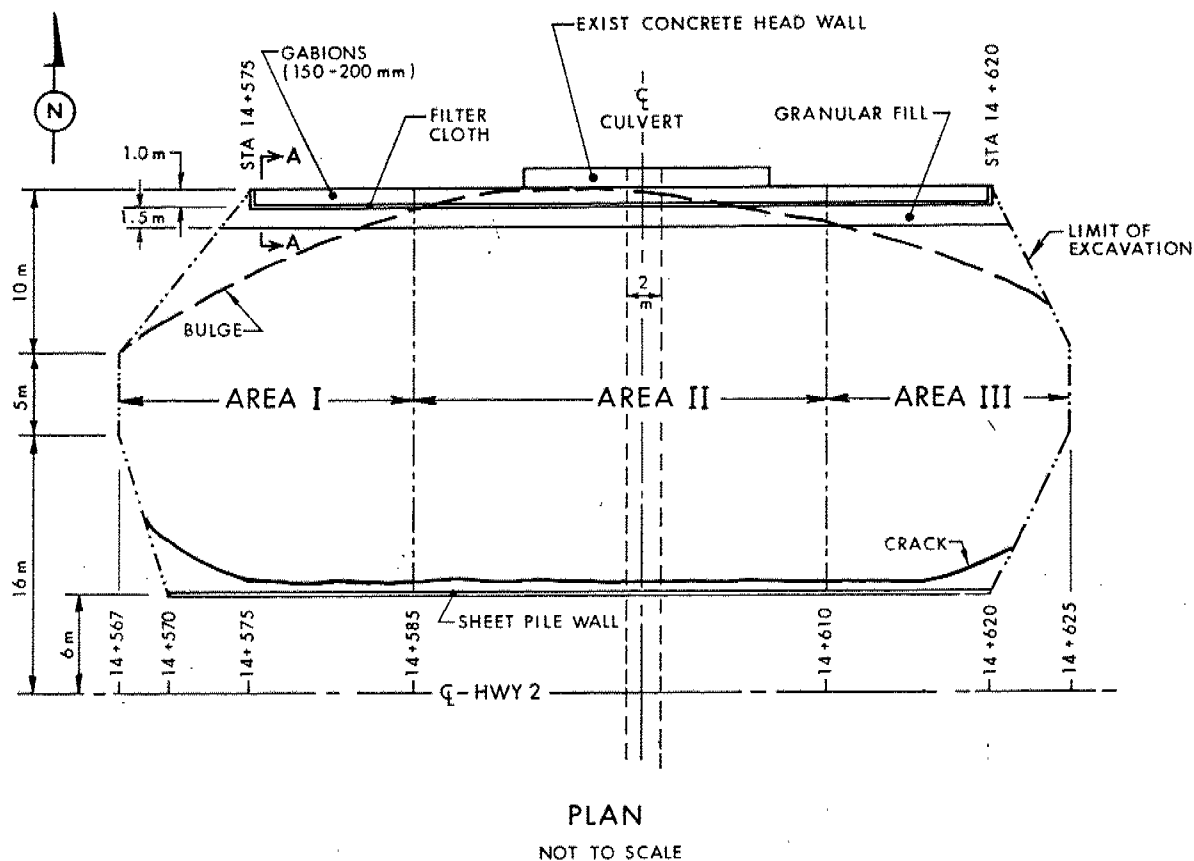
MV/TCK/mmj

c.c. - J. Trudell  
D. Kay  
E. Magni



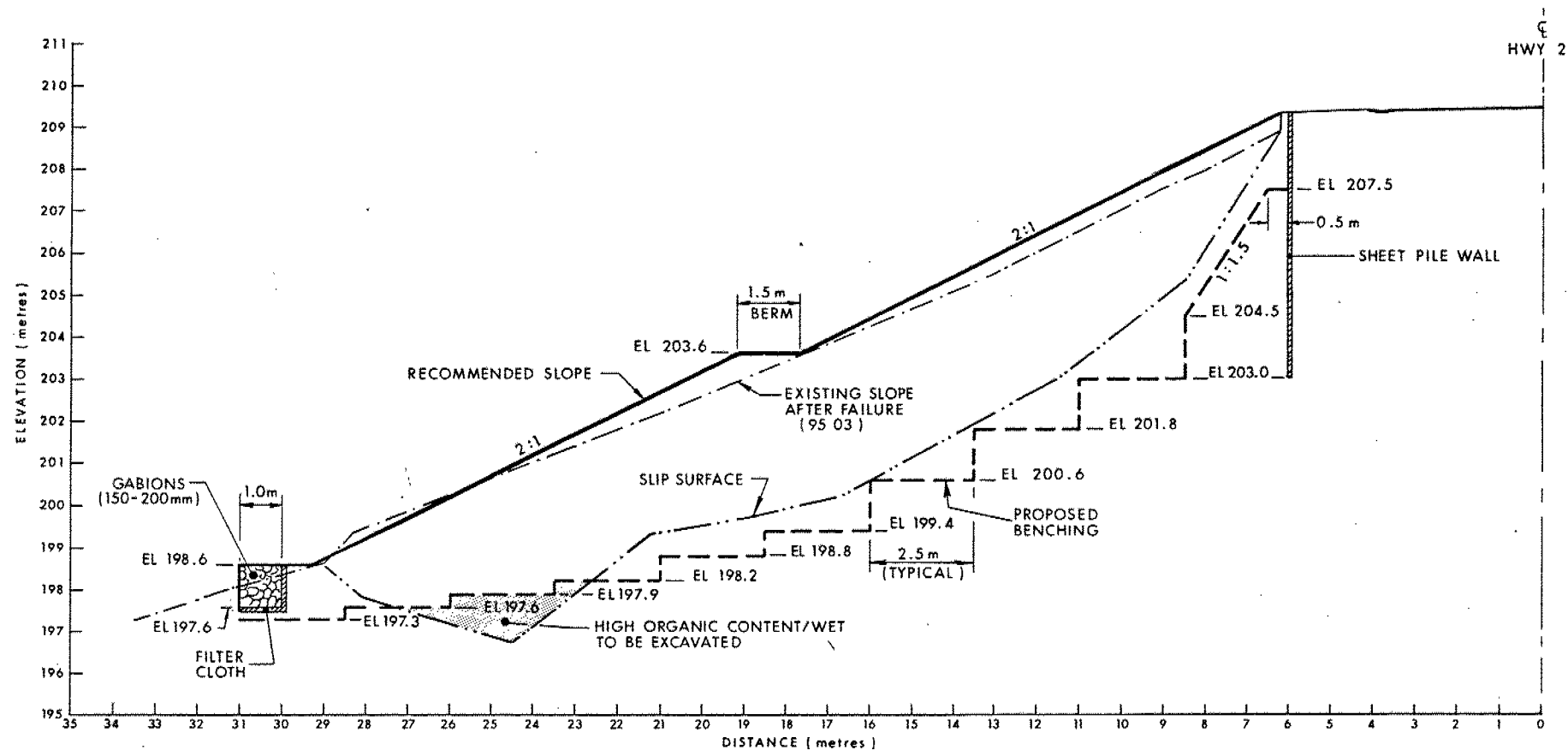
#### NOTES:

1. SHEET PILE SHALL BE DRIVEN TO EL. 203m FROM STA 14+570 TO STA 14+620.
2. BENCHING SHALL BE PROVIDED AS SHOWN ON SECTIONS AT STA 14+582 FOR AREA I, STA 14+598.5 FOR AREA II AND STA 14+616 FOR AREA III.
3. SLOPE FOR EXCAVATION MAY BE 1:1 OR AS STEEP AS POSSIBLE UNLESS OTHERWISE SPECIFIED.
4. ANY SPONGY OR SOFT AREA OBSERVED BELOW THE BENCH LEVEL SHOULD BE SUBEXCAVATED AND BACKFILLED WITH ACCEPTABLE FILL MATERIAL.
5. PERTINENT MTO SPECIFICATIONS AND STANDARDS SHALL BE USED.



#### AREA OF RESTORATION

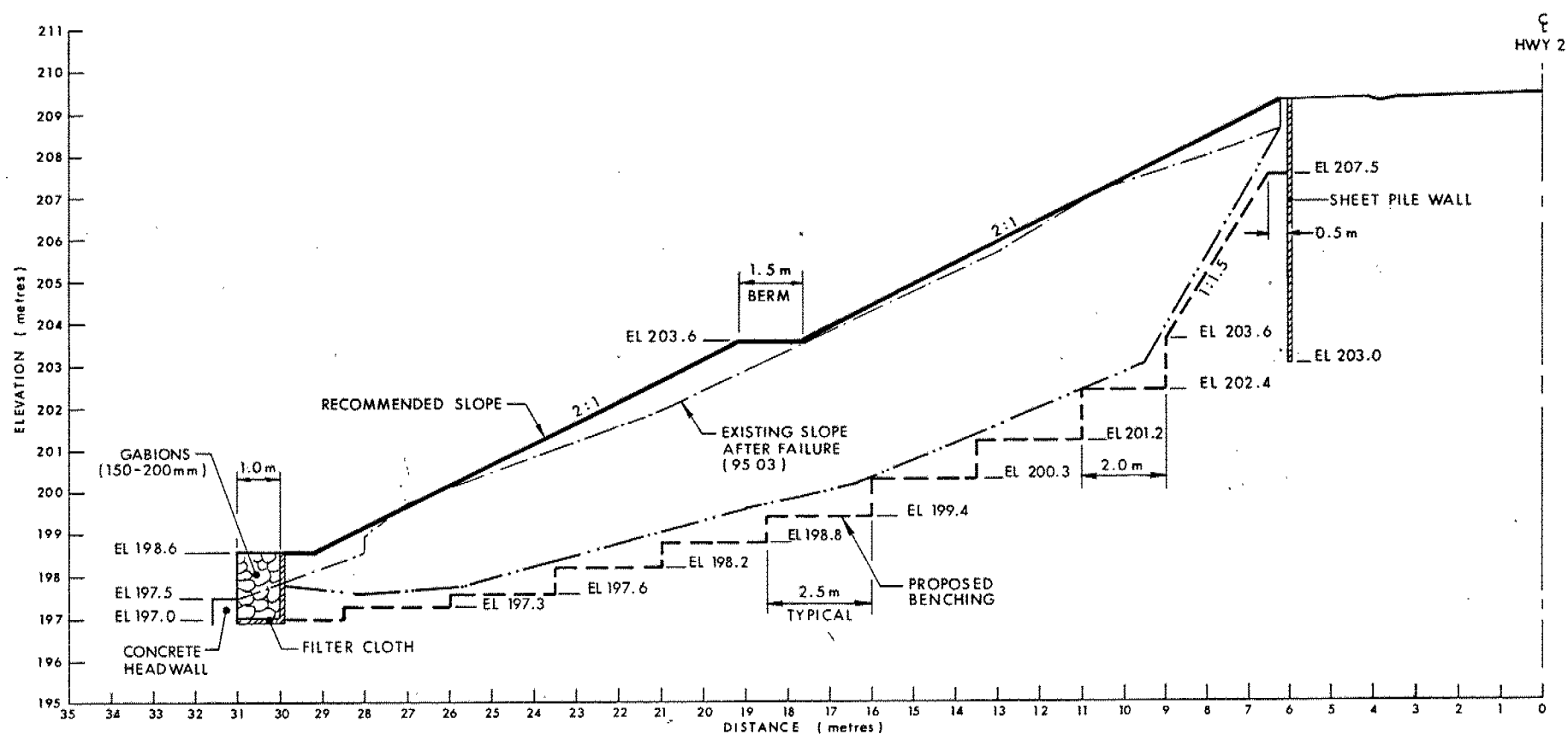
HWY 2 DIST 32  
WP 300 - 92 - 00 Geocres No 40112 - 24  
1995 06 22 FIGURE No 1



SECTION AT STA 14+582

**RECOMMENDED SLOPE & BENCHING  
FOR RESTORATION**

HWY 2 DIST 32  
 WP 300-92-00 Geocres No 40 112-24  
 1995 06 22 FIGURE No 2

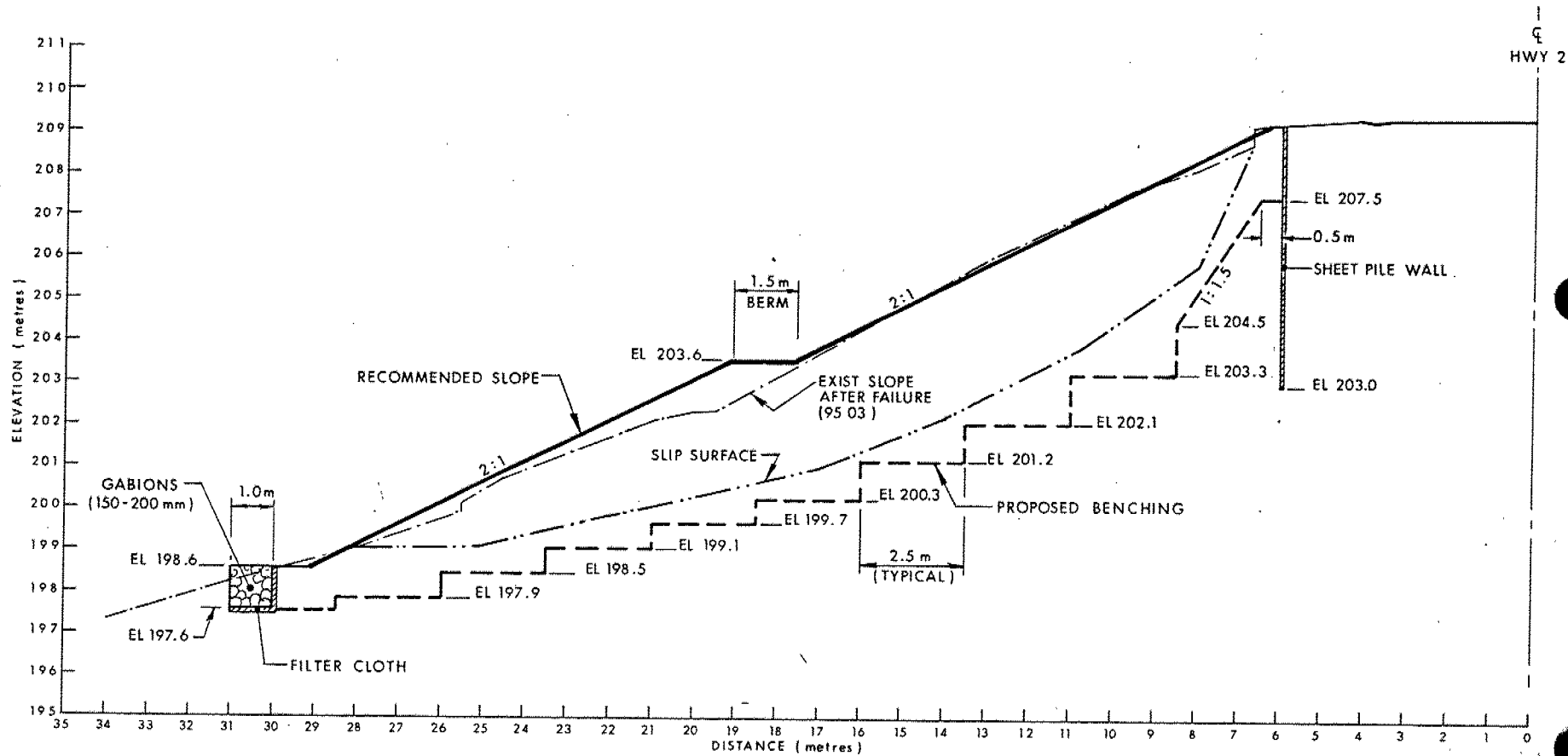


SECTION AT STA 14+598.5

### RECOMMENDED SLOPE & BENCHING FOR RESTORATION

HWY 2 DIST 32  
 WP 300-92-00 Geocres No 40112-24  
 1995 06 22 FIGURE No 3





# MEMORANDUM



To: M. Bond  
Head, Geotechnical Section  
Southwestern Region

Date: August 23, 1994

From: Foundation Design Section  
Room 315, Central Bldg.

Tel: 235-3731  
Fax: 235-5240

Re: Failure of Embankment (Stn. 14+563 to Stn. 14+635)  
4 km West of Wardsville  
W.P. 300-92-00  
Highway 2, District 2, London  
Geocres No: 40I12-24

The above site was initially inspected on 94 06 01 by Tae Kim, Senior Foundation Engineer and Eric Magni, Soils Supervisor, Geotechnical Section, Southwestern Region. Subsequent to this visit, the site was inspected by the undersigned on 94 08 16.

The information available in this office indicate that the 13.0 m high embankment was constructed with a side slope of 2:1 on the north side and 2.5:1 on the south side. The fill material used consisted of clayey soil with varying proportions of sand and gravel.

The surface run-off from the road is directed to the catch-basins via shoulder drainage ditch and in turn the storm water from the catch-basins is discharged into the creek through pipes.

The failure at this location is not recent and this site has a history of repeated failures. Restoration work by providing counterfort drains was carried out in summer of 1993 after the failure in May 1991. The recent slide (May 1994) may have taken place along the same slip surface along where previous failures occurred.

The surface crack adjacent to the guard rail extends to a distance of about 41 m, however, the failed area gradually spread to a distance of about 72 m near the middle of the embankment and narrows down to about 4.5 m at the toe. Surface cracks varying in width from a few millimetres to a maximum of 600 mm were observed. The failed portion is displaced by approximately 0.9 m to 1.1 m vertically and 0.3 m to 0.6 m horizontally. However, near the toe of the embankment, bulge of soil varying in thickness from a few millimetres to a maximum of about 300 mm was observed. The details of the failure are shown on Figure 1.

Based on the information gathered, it appears that the failure is confined to the fill itself and centred around the culvert location. The probable failure surface is shown on Figure 1 and it is expected to extends to a depth of 2.5 m to 3.0 m below the existing slope at the deepest location.

In order to stabilize the slope, it is recommended to subexcavate and backfill as suggested below. The subexcavation should extend below the slip surface and the benching for the restoration work shall be carried out in accordance with OPSD 208.01.

The recommended gabion adjoining the head wall should be placed at least 0.3 m to 0.4 m below ground level and extend to a height of 1.0 m (El. 198.6) above the head wall to accommodate 1.5 m wide berm around El. 203.6 (refer to Figure 2 & 3). However, near the crown of the culvert, depth of 0.3 m to 0.4 m into the ground may not be feasible and this may be reduced according to the availability of space.

The subexcavation and placement of fill for restoration of embankment may be carried out as follows:

- 1) Subexcavate in 3 m strips toward the slope as shown on figure 4 to avoid any failure of adjoining area.
- 2) Place the gabion, crushed stone (20 mm to 25 mm) and Granular "A" as per Figure 3.
- 3) On completion of placing crushed stone and Granular "A" and compacting, subexcavate the rest of the strip below the slip surface with the provision for benching and backfill (for sequence of construction refer to figure 4).
- 4) Backfilling of the subexcavated portion should be carried out prior to the commencement of the excavation of a new strip.

In order to ensure the integrity and the future performance of the embankment, pertinent MTO Specifications and Standards should be used. The failure surface should be identified by an engineer during construction to ensure that the excavation extends below the slip surface..

If you need more information or have any questions, please contact this office.

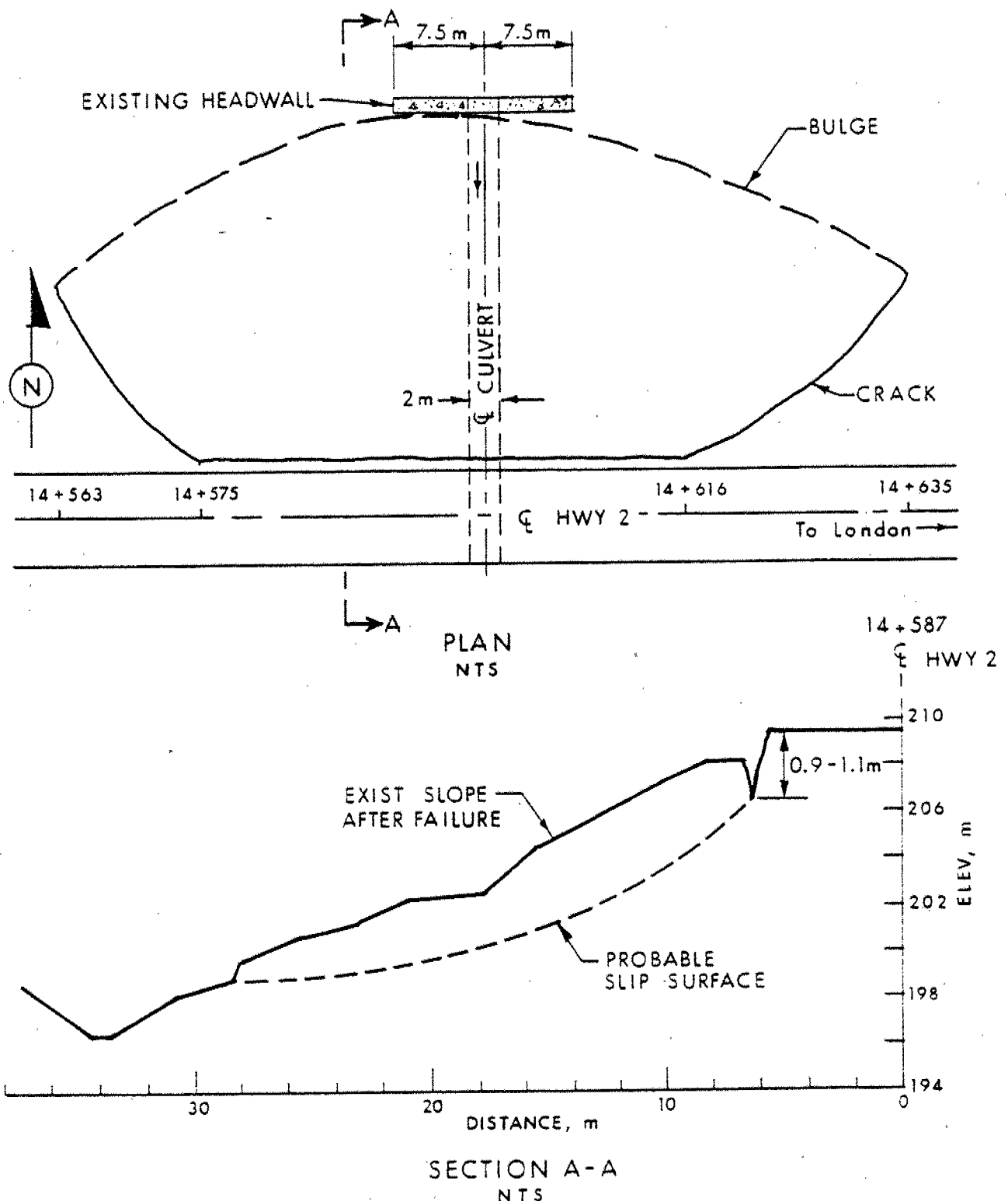
*M. Vasavithasan*

M. Vasavithasan, P. Eng.  
Foundation Engineer

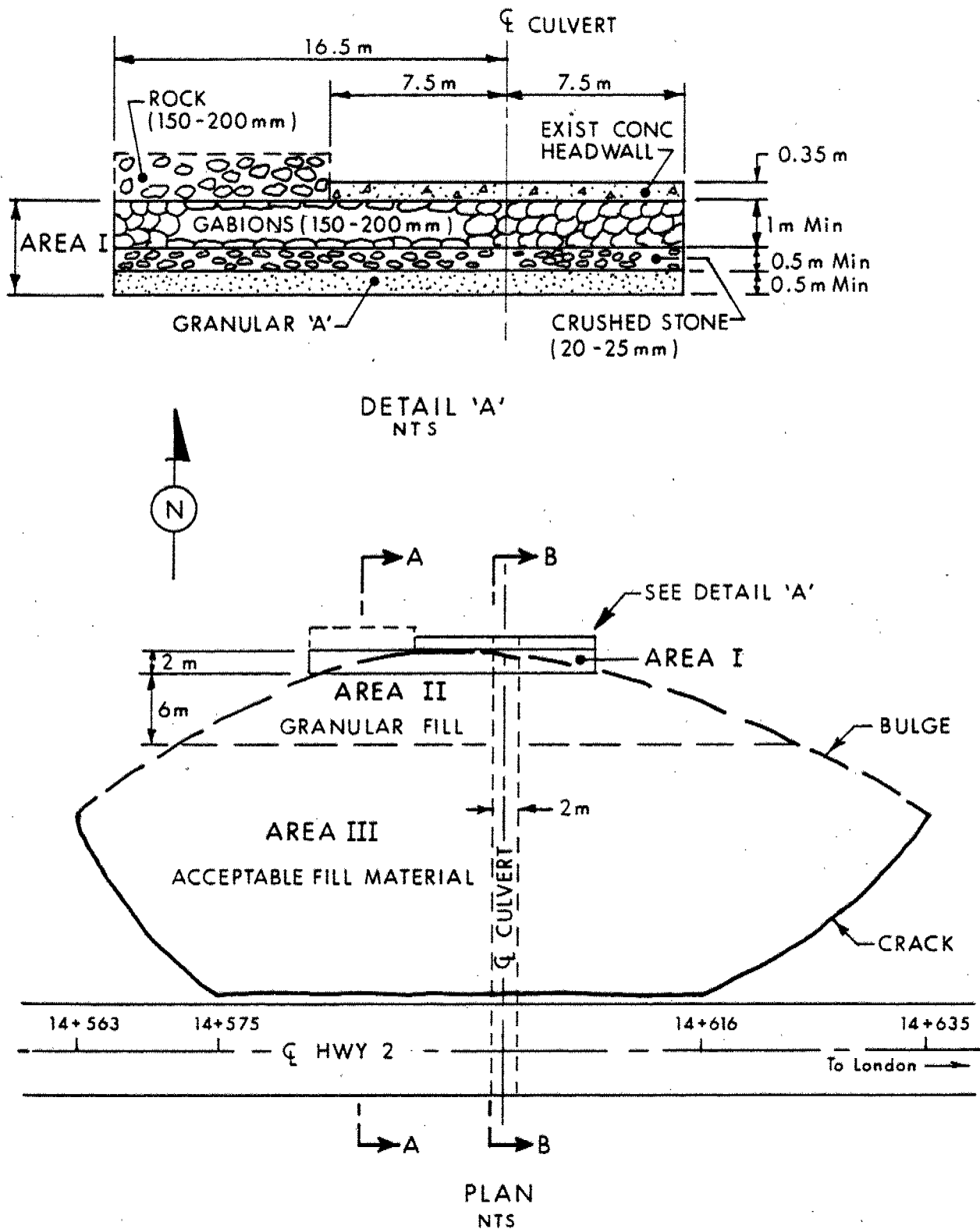
for

T.C. Kim, P. Eng.  
Sr. Foundation Engineer

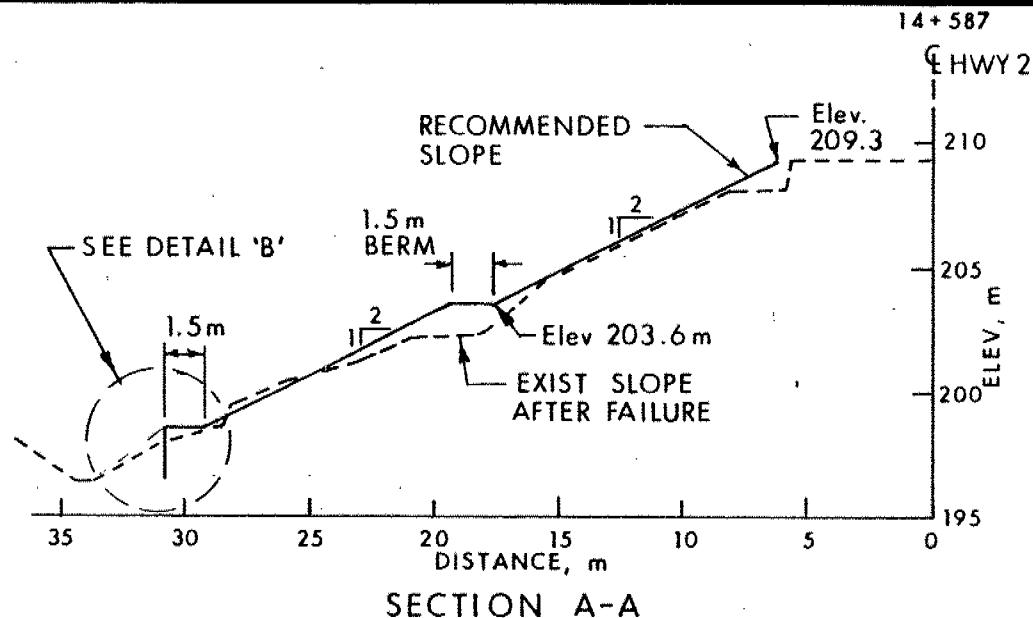
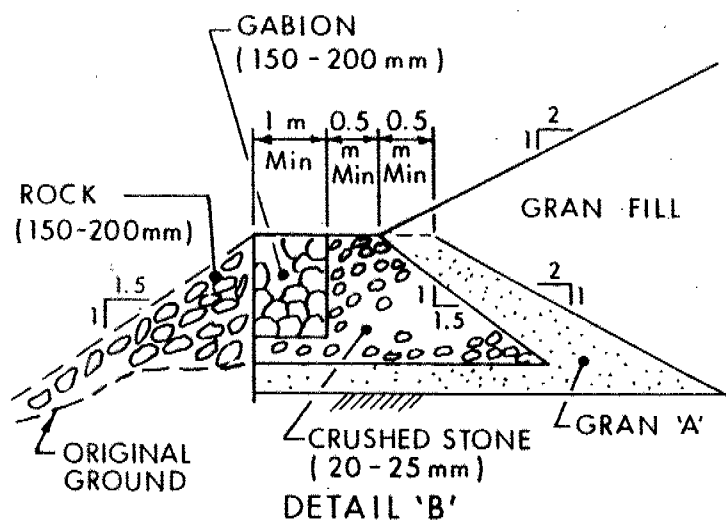
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**Fig 1 - EMBANKMENT INSTABILITY**  
(BETWEEN STA 14+563 & 14+635 HWY 2 )



**Fig 2 - RESTORATION OF EMBANKMENT**



NOT TO SCALE

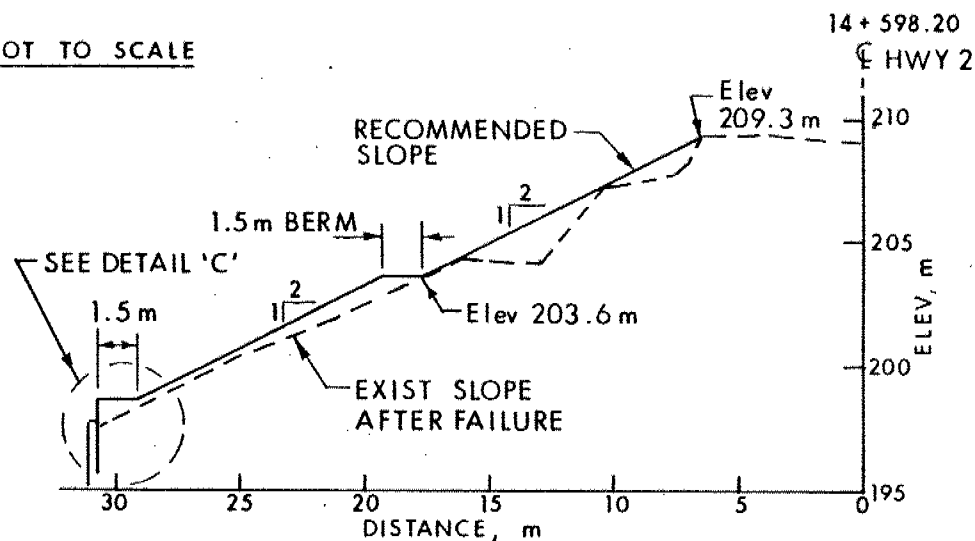
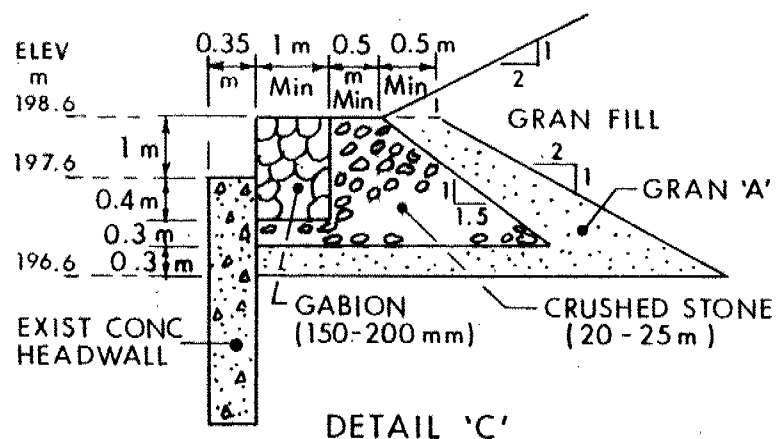
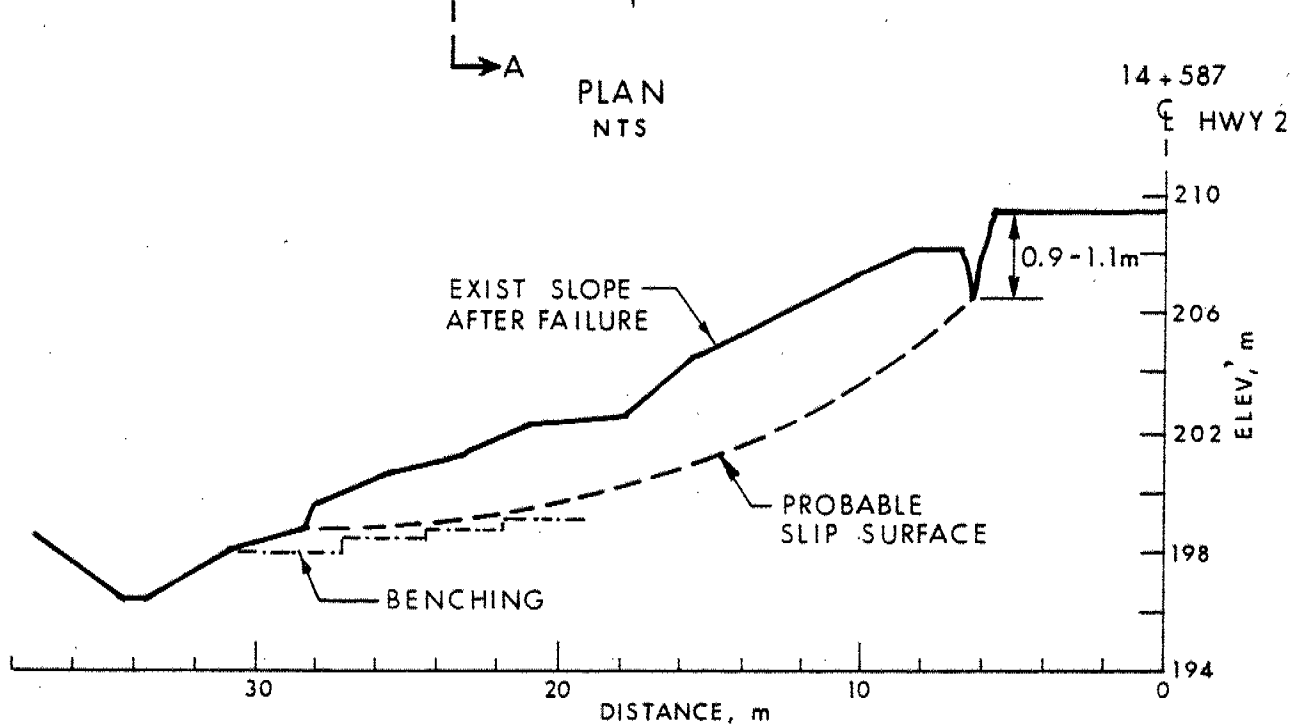
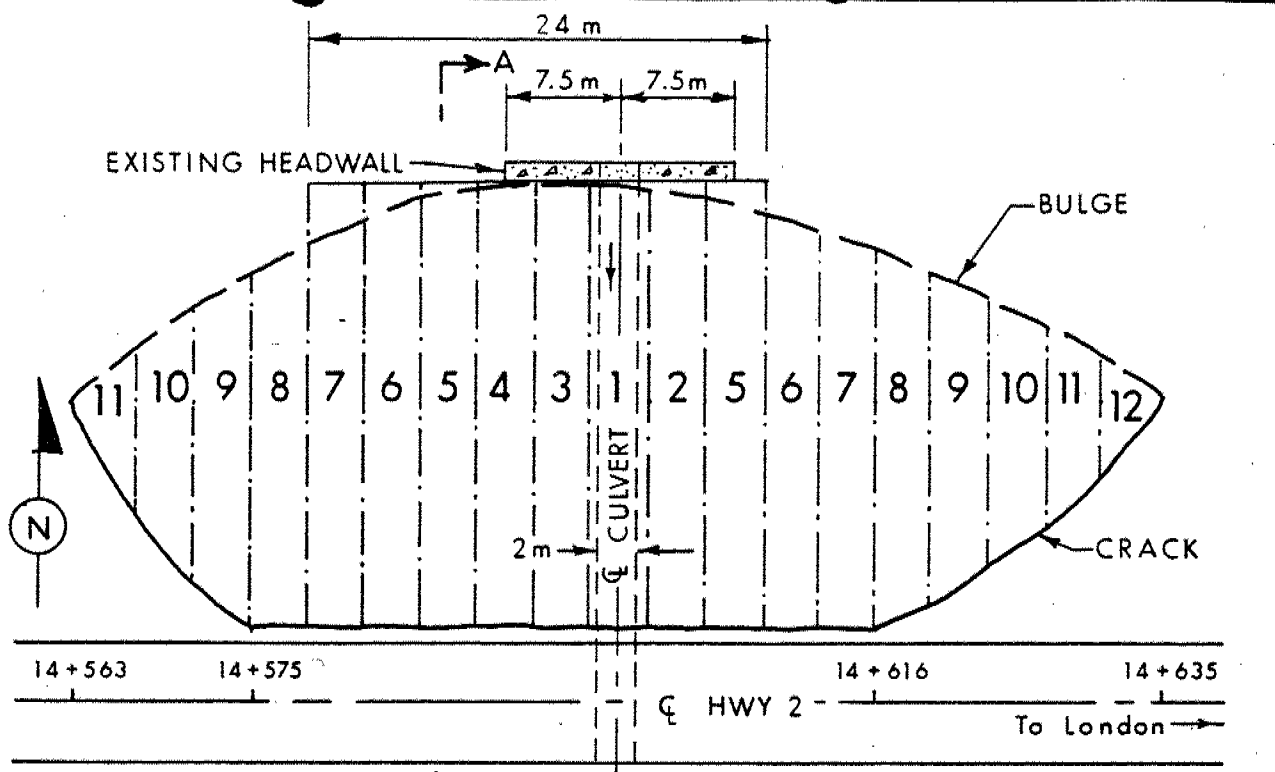


Fig 3 - RECOMMENDED SLOPE FOR RESTORATION



SECTION A-A  
NTS

**NOTES:**

- SEQUENCE OF EXCAVATION SHOULD BE IN THE ORDER OF 1 TO 11.
- BENCHING SHALL BE IN ACCORDANCE WITH OPSD - 208.01.
- ENSURE EXCAVATION EXTENDS BELOW FAILURE SURFACE.
- SLOPE FOR EXCAVATION MAY BE 1:1 OR AS STEEP AS POSSIBLE.

**Fig. 4 - SEQUENCE OF EXCAVATION**