

## APPENDIX A

### MAPS

- Annual Rainfall
- Annual Potential Evapotranspiration (PET)
- 50 Year Rainfall Intensity 12 Hour Storm
- 100 Year Rainfall Intensity 12 Hour Storm

Note: Additional rainfall intensity maps are available on the web site.

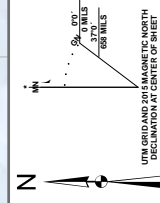
| Return Period | Storm Duration |        |        |        |        |        |         |         |
|---------------|----------------|--------|--------|--------|--------|--------|---------|---------|
| 5 years       | 10 min         | 30 min | 1 hour | 2 hour | 3 hour | 6 hour | 12 hour | 24 hour |
| 10 years      | 10 min         | 30 min | 1 hour | 2 hour | 3 hour | 6 hour | 12 hour | 24 hour |
| 25 years      | 10 min         | 30 min | 1 hour | 2 hour | 3 hour | 6 hour | 12 hour | 24 hour |
| 50 years      | 10 min         | 30 min | 1 hour | 2 hour | 3 hour | 6 hour | 12 hour | 24 hour |
| 100 years     | 10 min         | 30 min | 1 hour | 2 hour | 3 hour | 6 hour | 12 hour | 24 hour |

# Annual Precipitation (mm)



**Legend**

- Isohyte
- Town
- Country Boundary
- Water Body
- County Boundary



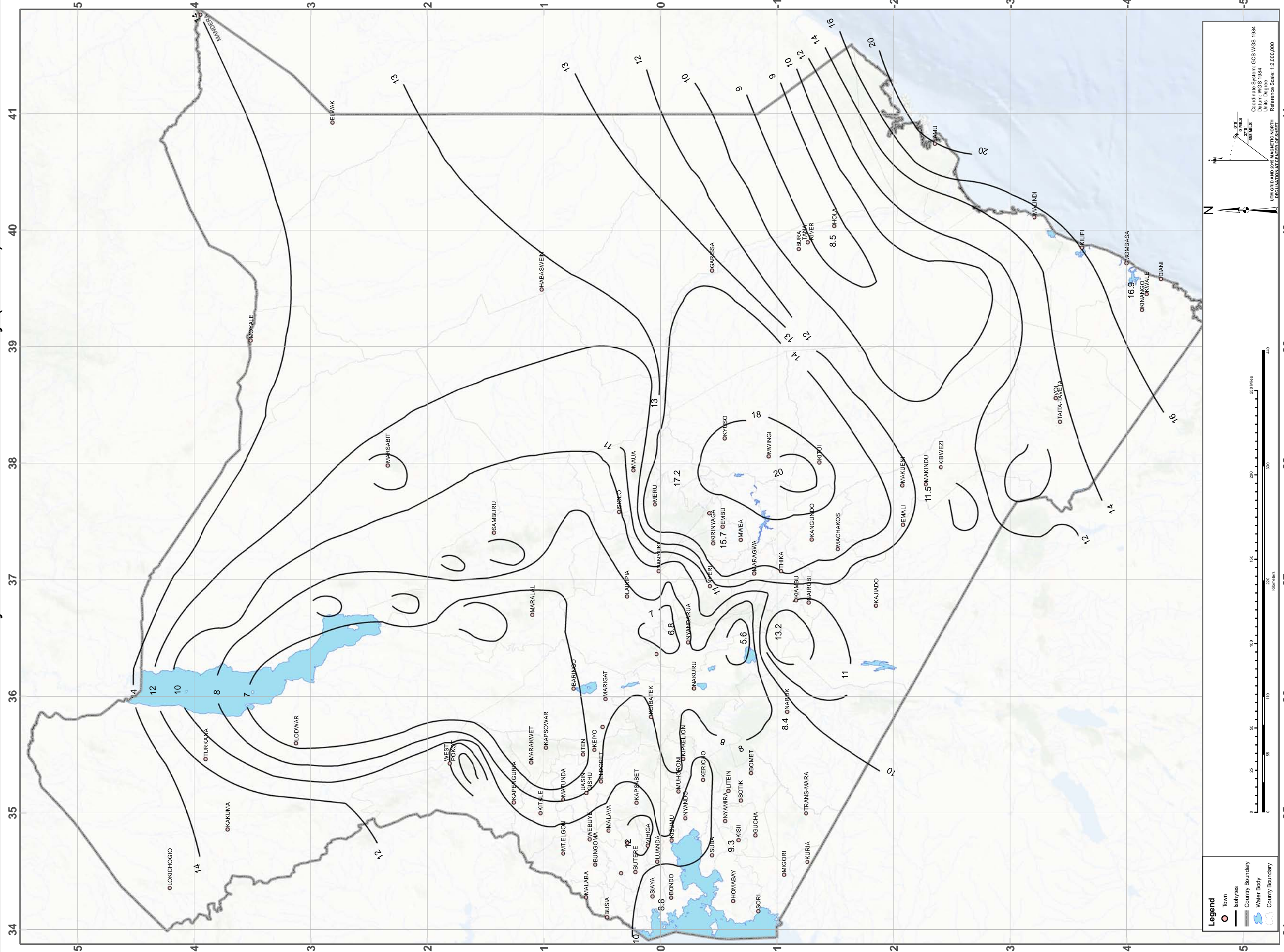
Coordinate System: GCS WGS 1984  
Datum: WGS 1984  
Units: Degree  
Reference Scale: 1:2,000,000

Referenced from the ILRI Surface Climate Dataset

# Annual Evapotranspiration (mm)

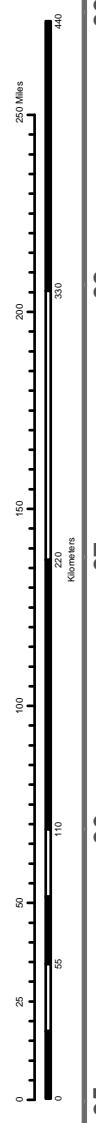


# Fifty Year 12 Hour Rainfall Intensity (mm/hr)



- Town
- Isohyets
- Country Boundary
- Water Body
- County Boundary

Coordinate System: GCS WGS 1984  
Datum: WGS 1984  
UTM GRID AND 2018 MAGNETIC NORTH  
Reference Scale: 1:2,000,000  
DECLINATION AT CENTER OF SHEET



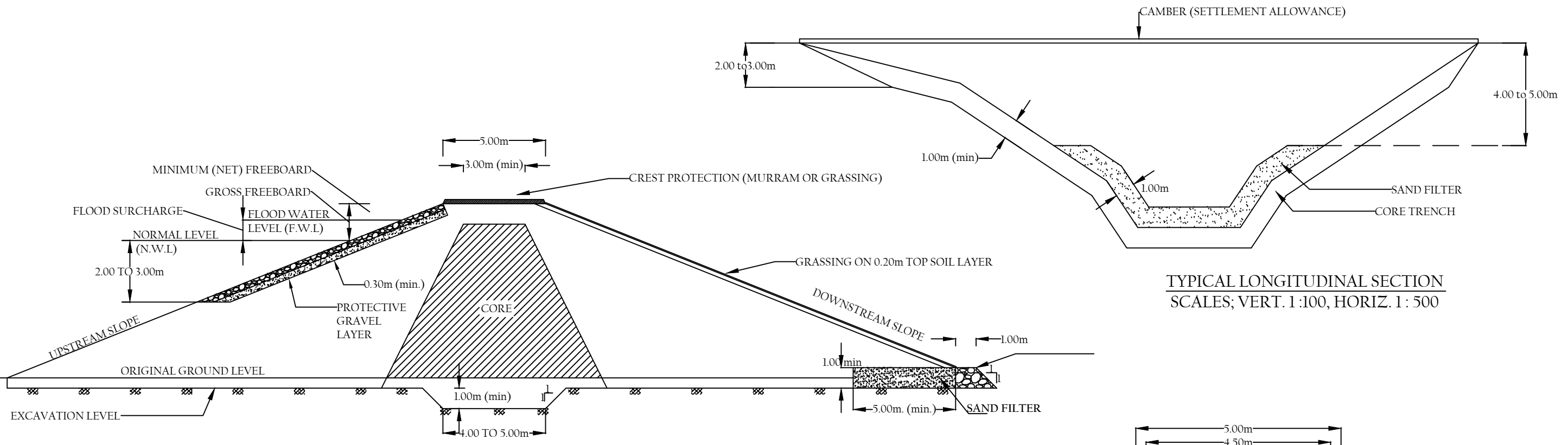


## APPENDIX B

### REFERENCE DRAWINGS

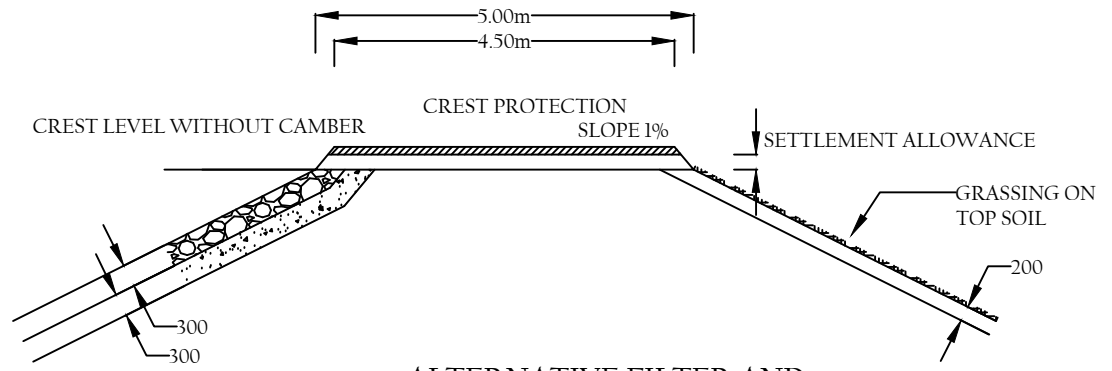
- 1/17 Type Drawing I: Small Earth Dam;
- 2/17 Type Drawing II: Spillway for Small Earth Dam (1/2);
- 3/17 Type Drawing II: Spillway for Small Earth Dam (2/2);
- 4/17 Type Drawing III: Intake, Drawoff and Valve Chamber for Small Earth Dam;
- 5/17 Type Drawing IV: Cattle Trough (1/2);
- 6/17 Type Drawing IV: Cattle Trough (2/2);
- 7/17 Type Drawing V: Communal Water Point;
- 8/17 Type Drawing VI: Water Storage Pan, Capacity 11,600 Cubic Metres (1/2);
- 9/17 Type Drawing VI: Water Storage Pan, Capacity 11,600 Cubic Metres (2/2);
- 10/17 Type Drawing VII: Water Storage Pan, Capacity 20,000 Cubic Metres (1/2);
- 11/17 Type Drawing VII: Water Storage Pan, Capacity 20,000 Cubic Metres (2/2);
- 12/17 Type Drawing VIII: Water Storage Pan on Inclined Location, Capacity 17,000 Cubic Metres, Dug Well and Filter (1/2);
- 13/17 Type Drawing IX: Standard Cross Sections Concrete Sand Storage Dams;
- 14/17 Type Drawing X: Gabion Sand Storage Dam (1/2);
- 15/17 Type Drawing X: Gabion Sand Storage Dam (2/2);
- 16/17 Type Drawing XI: ALDEV Weir Cross Section;
- 17/17 Type Drawing XII: Lagoon on an Inclined Site, 38,000 Cubic Meters.

Note: Additional drawings (Autocad and PDF) available on the web site.

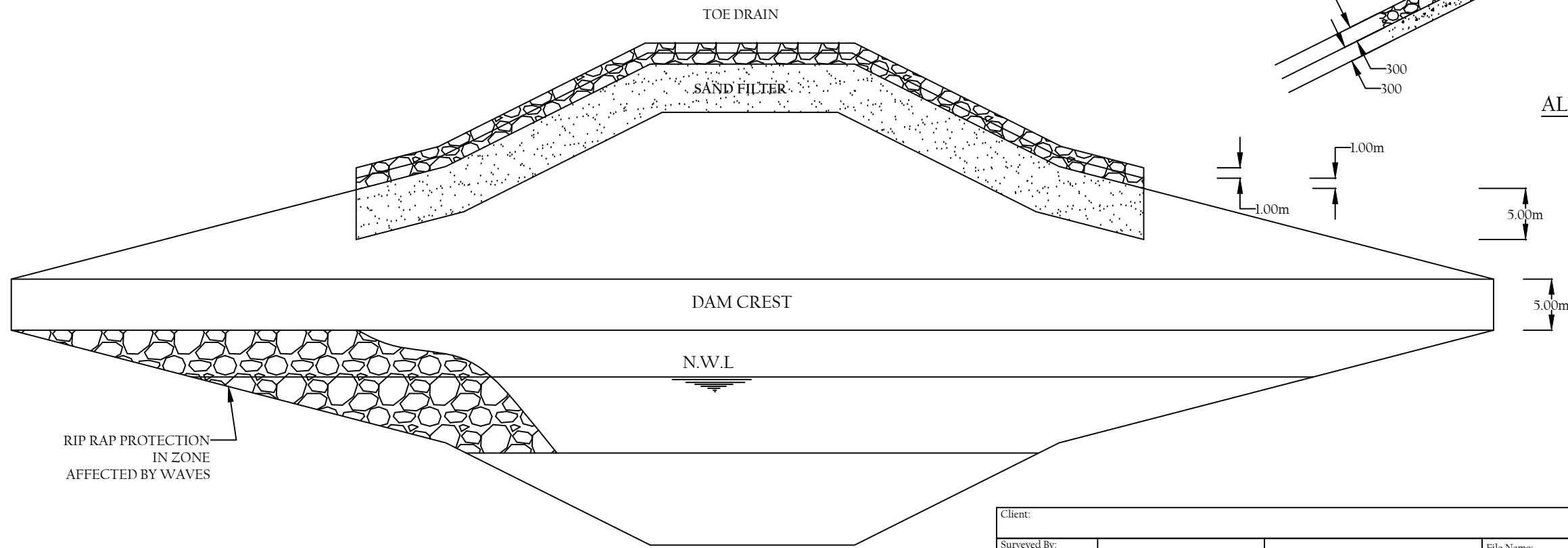


**TYPICAL LONGITUDINAL SECTION**  
 SCALES; VERT. 1 : 100, HORIZ. 1 : 500

**TYPICAL CROSS-SECTION**  
 SCALE 1 : 200

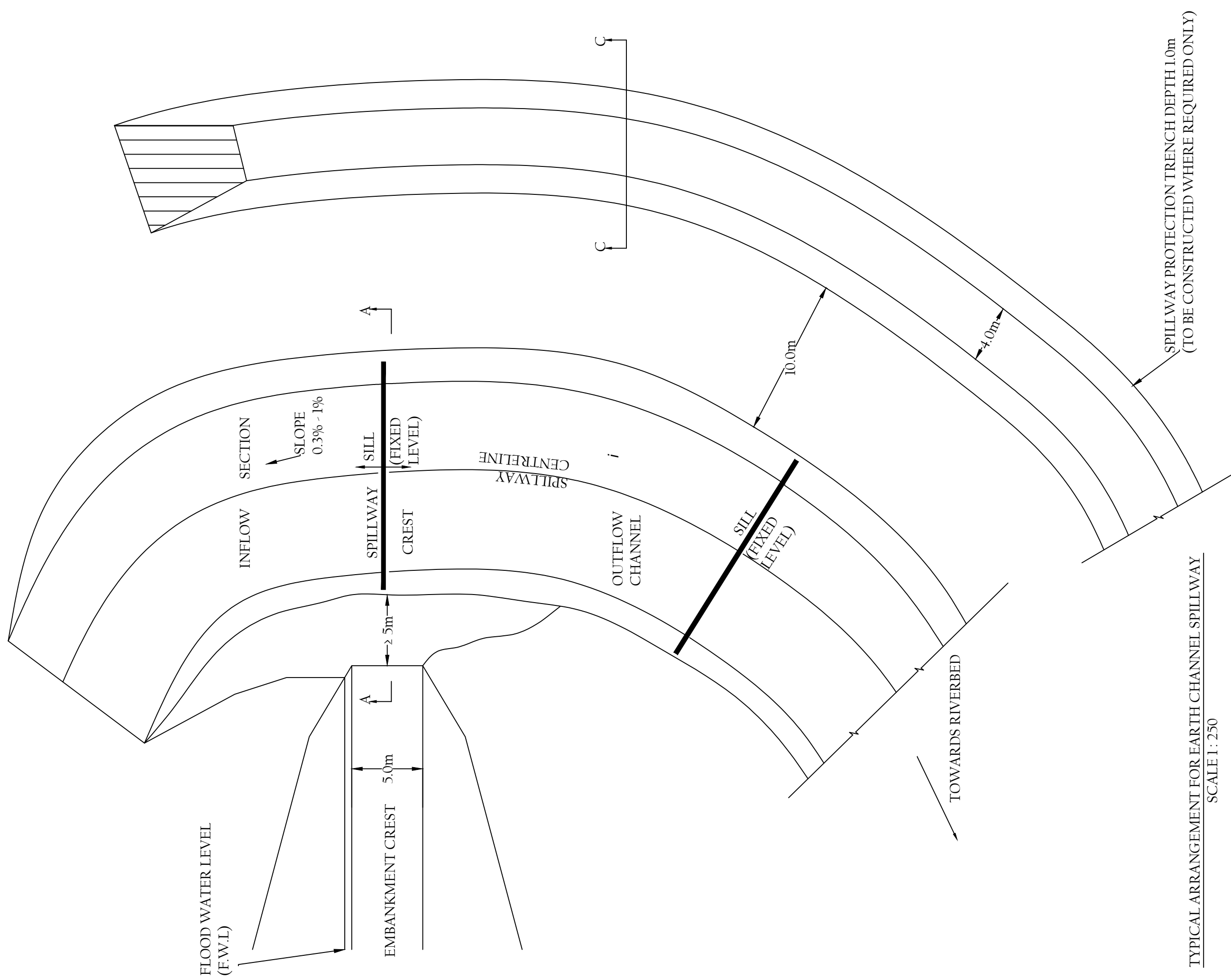


**ALTERNATIVE FILTER AND TOE ARRANGEMENT**  
 SCALE 1 : 100



**TYPICAL PLAN**  
 SCALE 1 : 500

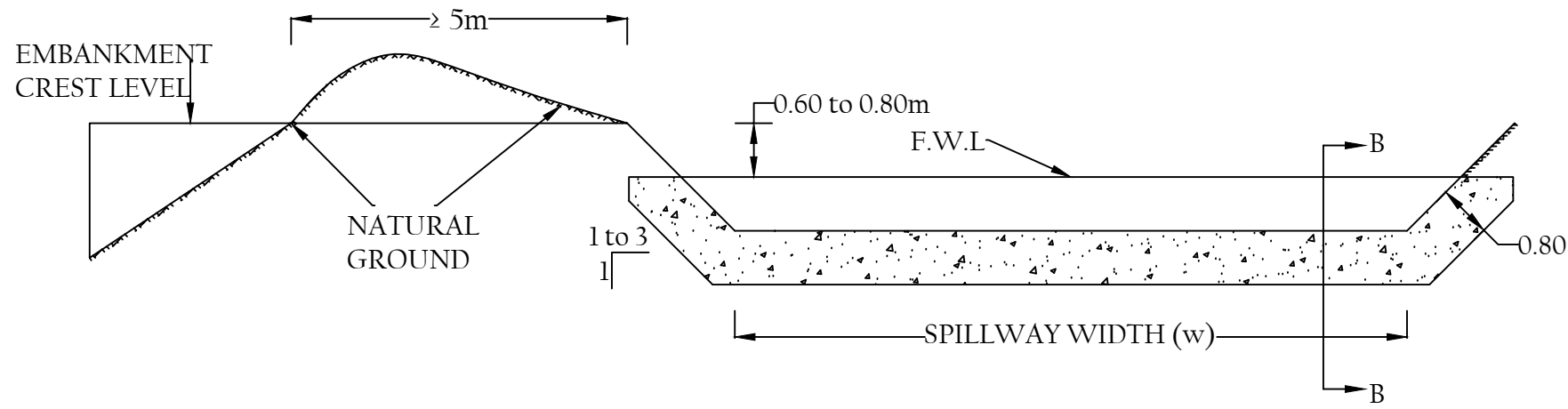
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|--------------|--|--|----------------|-----------------|-------------|
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| Surveyed By: |  |  | File Name:     | Scale: AS SHOWN |             |
| Drawn By:    |  |  | Project:       |                 |             |
| Designed By: |  |  | Drawing Title: | SMALL EARTH DAM |             |
| Checked By:  |  |  | Drawing No:    | TYPE DRAWING I  | Rev:        |
| Approved By: |  |  |                |                 | Sheet: 1/16 |



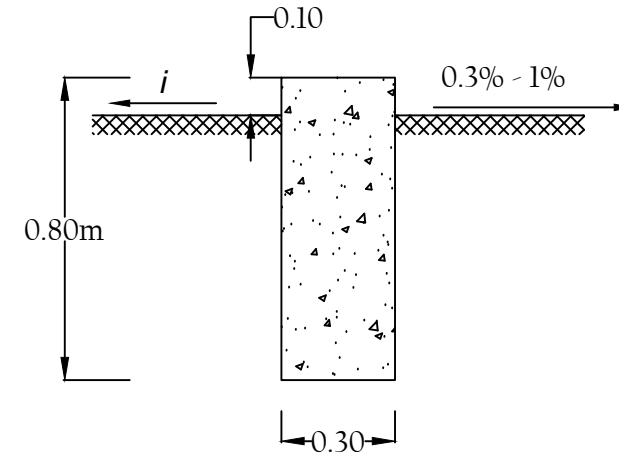
TYPICAL ARRANGEMENT FOR EARTH CHANNEL SPILLWAY  
SCALE 1 : 250

|              |                |                               |         |
|--------------|----------------|-------------------------------|---------|
| Client:      |                | Location:                     |         |
| Surveyed By: | File Name:     | Scale:                        | 1 : 250 |
| Drawn By:    | Project:       | SPILLWAY FOR SMALL EARTH DAMS |         |
| Designed By: | Drawing Title: |                               |         |
| Checked By:  | Drawing No:    | Rev:                          | A       |
| Approved By: | Sheet:         | 2/16                          |         |
|              |                | TYPE DRAWING II               |         |

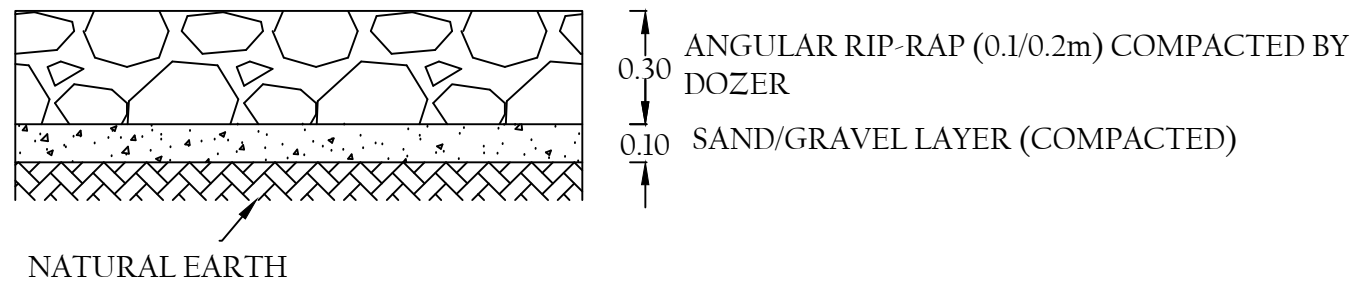




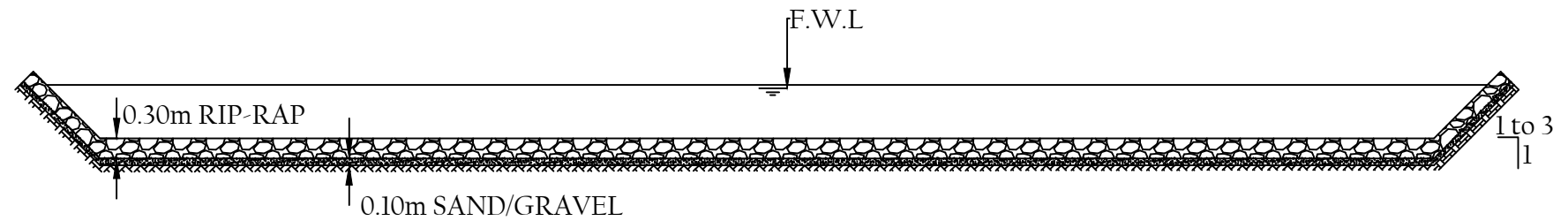
CROSS-SECTION A-A (SPILLWAY CREST)  
SCALE 1 : 100



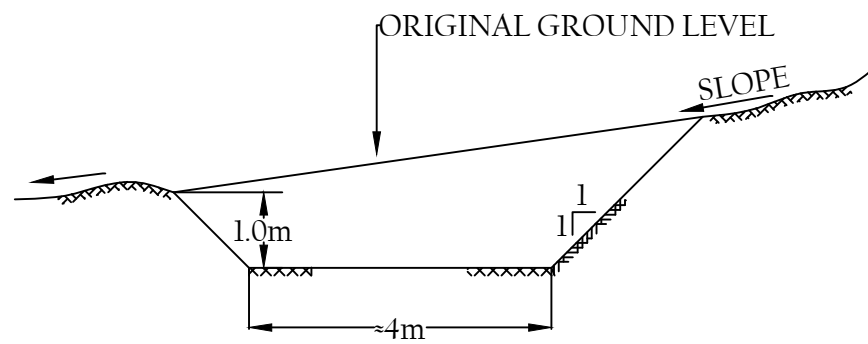
SILL CROSS-SECTION B-B  
SCALE 1 : 20



DETAIL OF SPILLWAY PROTECTION  
SCALE 1 : 20

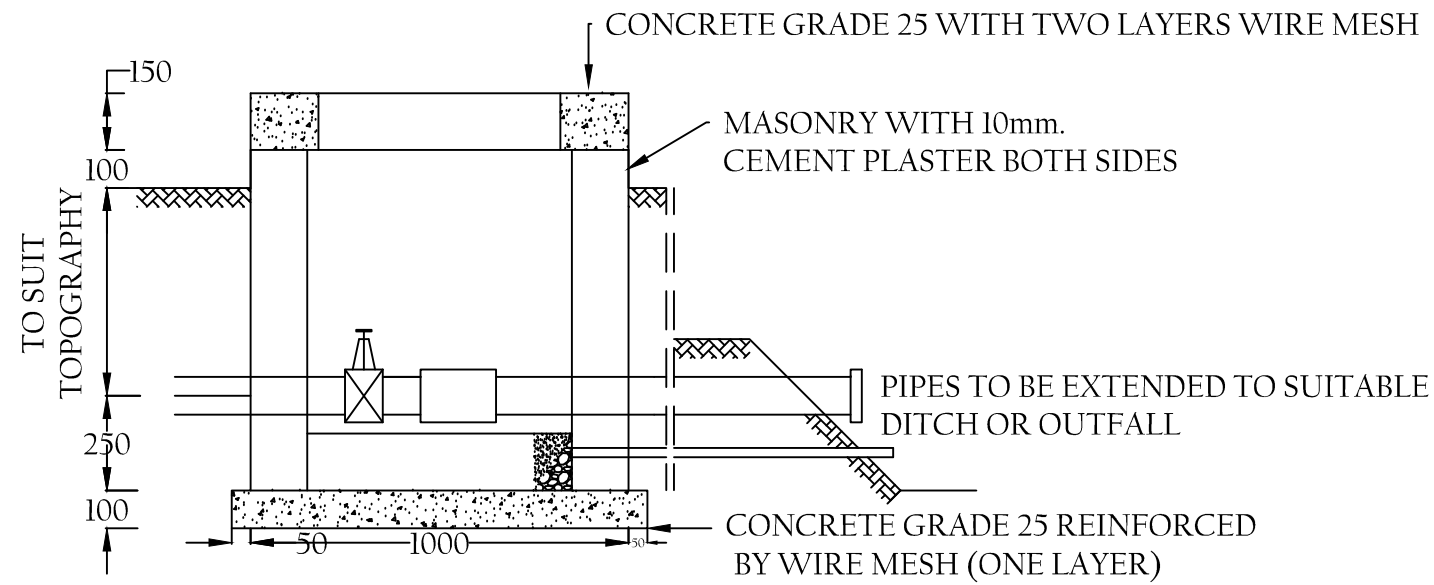


CROSS-SECTION A-A (SPILLWAY DETAIL)  
SCALE 1 : 100

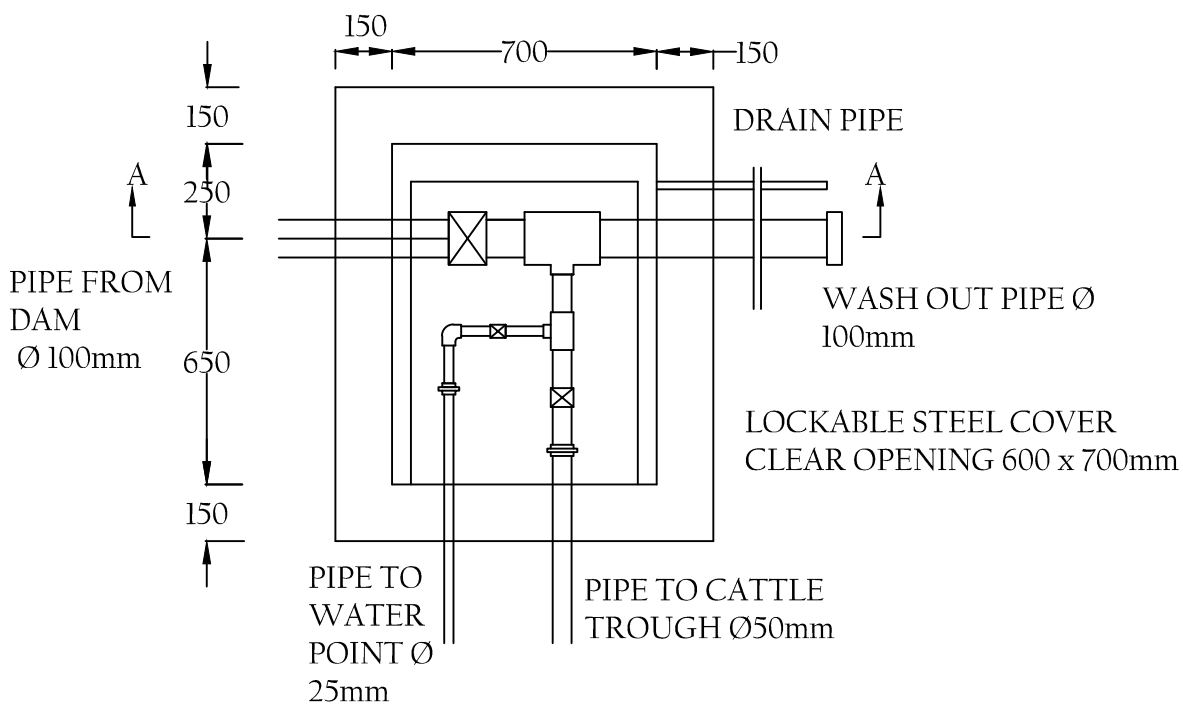


CROSS-SECTION B-B PROTECTIVE TRENCH  
SCALE 1 : 100

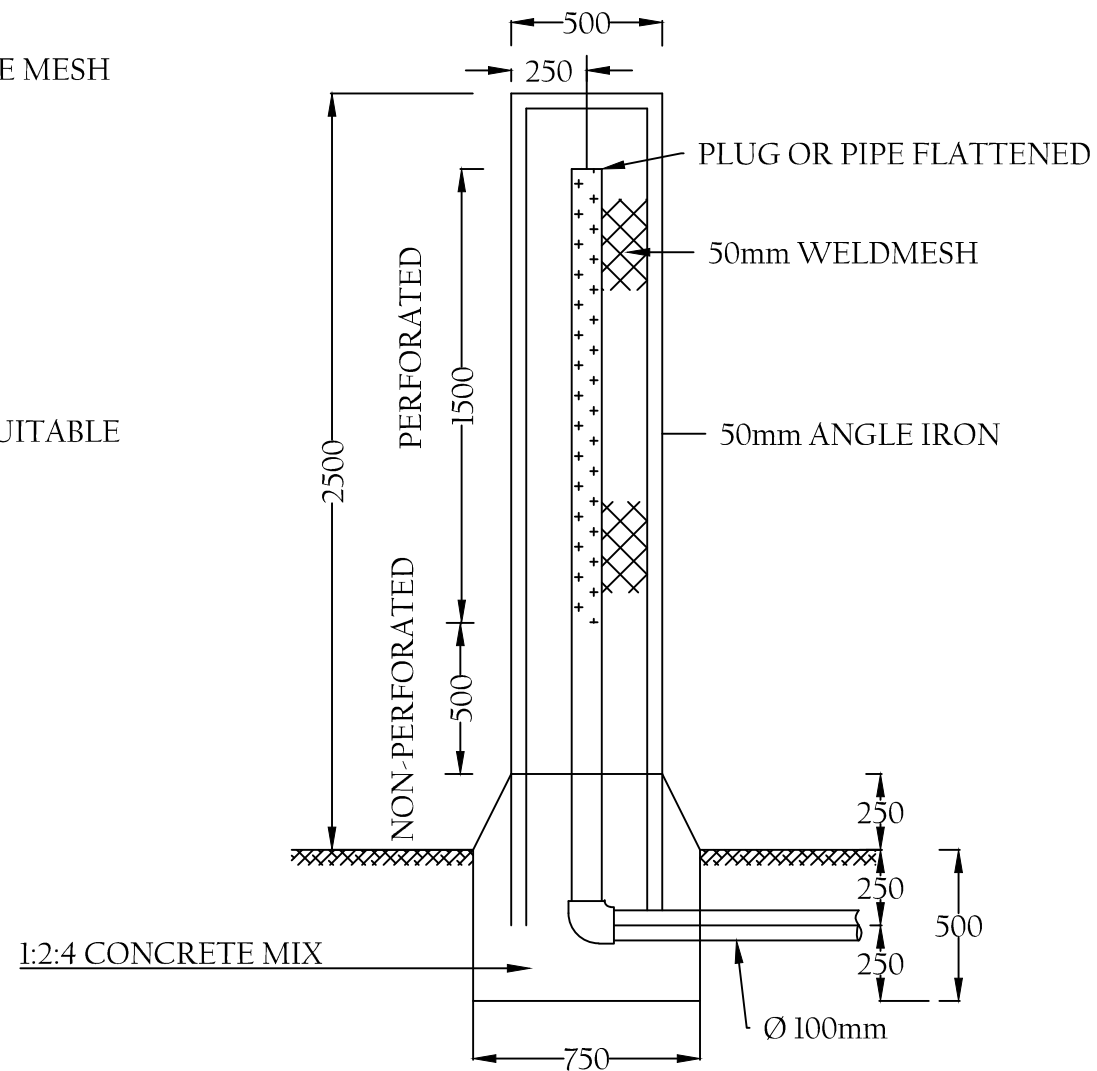
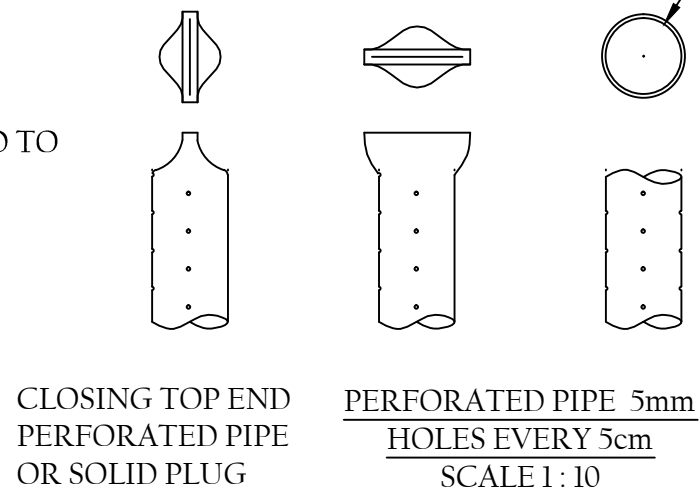
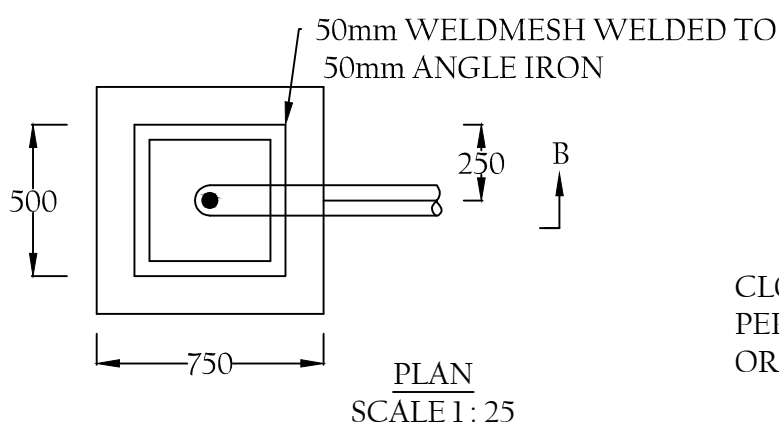
|              |  |  |  |      |                 |
|--------------|--|--|--|------|-----------------|
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| Surveyed By: |  |  | File Name:                                   |      | Scale: AS SHOWN |
| Drawn By:    |  |  | Project:                                     |      |                 |
| Designed By: |  |  | Drawing Title: SPILLWAY FOR SMALL EARTH DAMS |      |                 |
| Checked By:  |  |  | Drawing No: TYPE DRAWING II                  | Rev: | Sheet: 3/16     |
| Approved By: |  |  |  |      |                 |



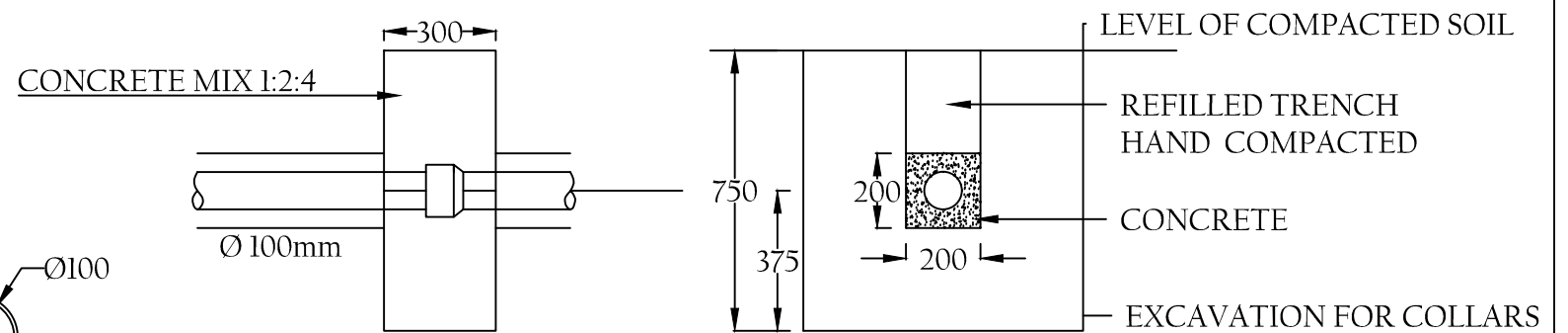
SECTION A-A  
SCALE 1 : 20



GROUND PLAN  
SCALE 1 : 20

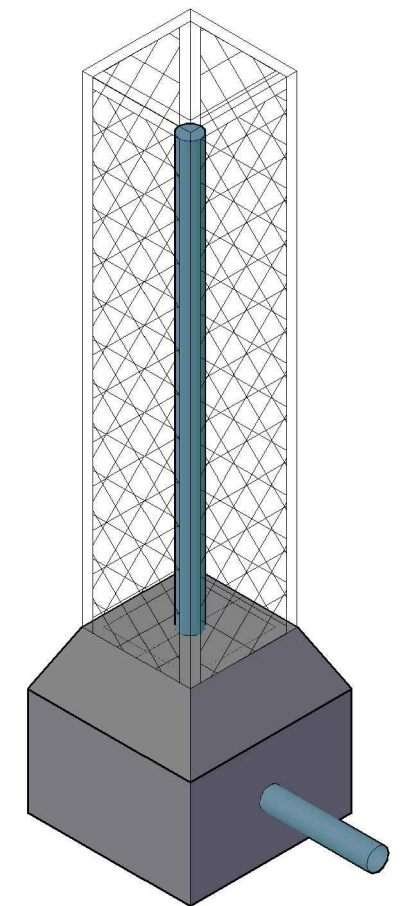


SECTION B-B  
SCALE 1 : 25



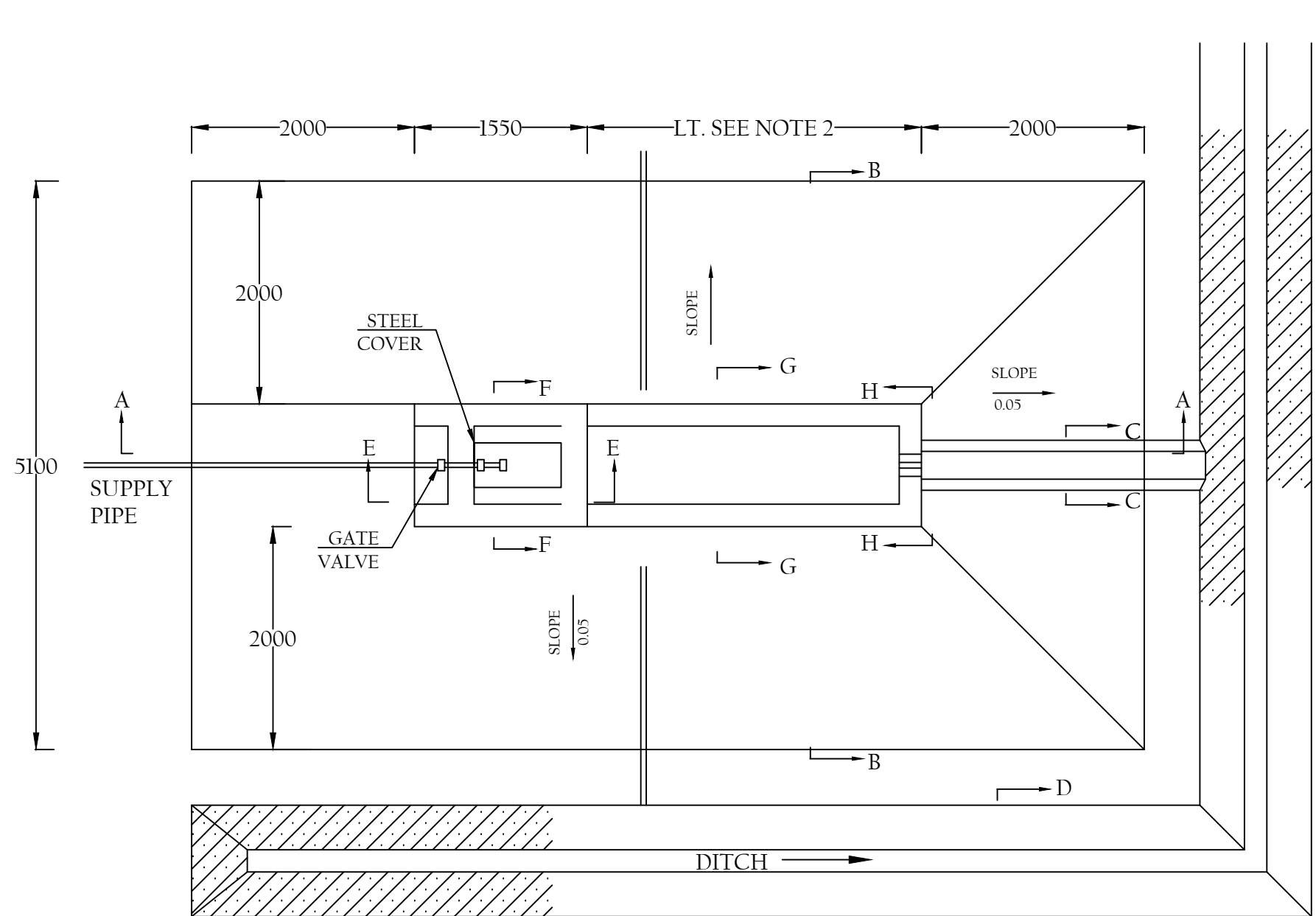
DETAIL OF DRAW PIPE WITH COLLARS  
SCALE 1 : 20

- COLLARS AROUND EVERY JOINT UNDER EMBANKMENT
- PIPE TO BE LAID IN EXCAVATION TRENCH EMBEDDED IN CONCRETE 1:2:4
- COLLARS TO BE CASTED STRAIGHT IN EXCAVATION, NO SHUTTERING TO BE USED



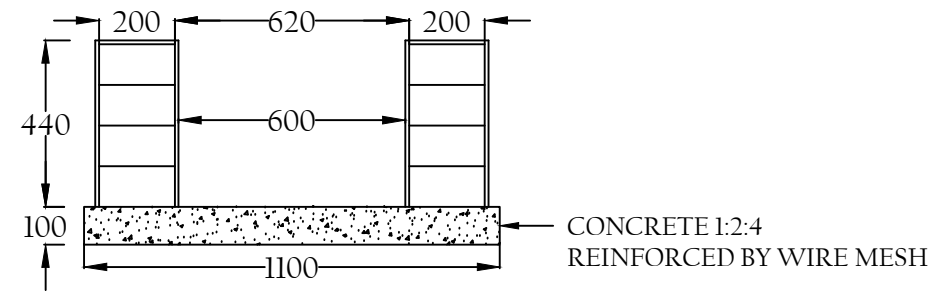
INTAKE STRUCTURE

|              |  |                  |   |
|--------------|--|------------------|---|
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| Surveyed By: |  | File Name:       | Scale: AS SHOWN   |
| Drawn By:    |  | Project:         |   |
| Designed By: |  | Drawing Title:   | INTAKE, DRAW OFF AND VALVE CHAMBER FOR SMALL EARTH DAMS |
| Checked By:  |  | Drawing No:      | Rev: Sheet: 4/17  |
| Approved By: |  | TYPE DRAWING III |   |

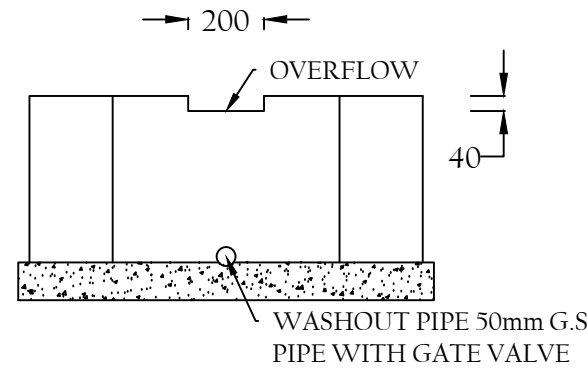


DITCH IS ONLY REQUIRED IF SURROUNDING AREA SLOPES TOWARDS TROUGH

PLAN  
SCALE 1 : 50

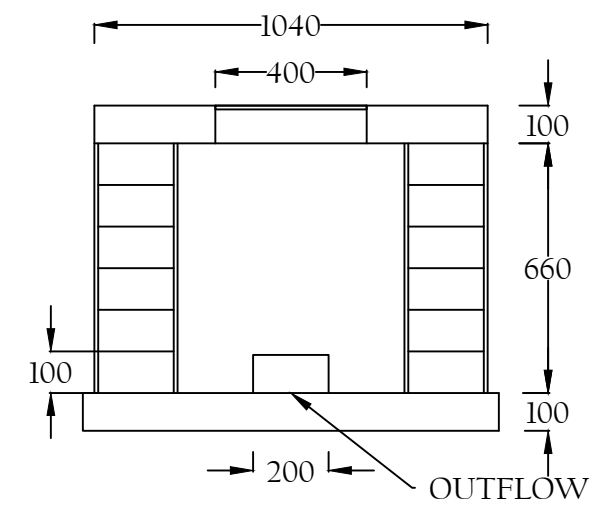


SECTION G-G  
SCALE 1 : 20

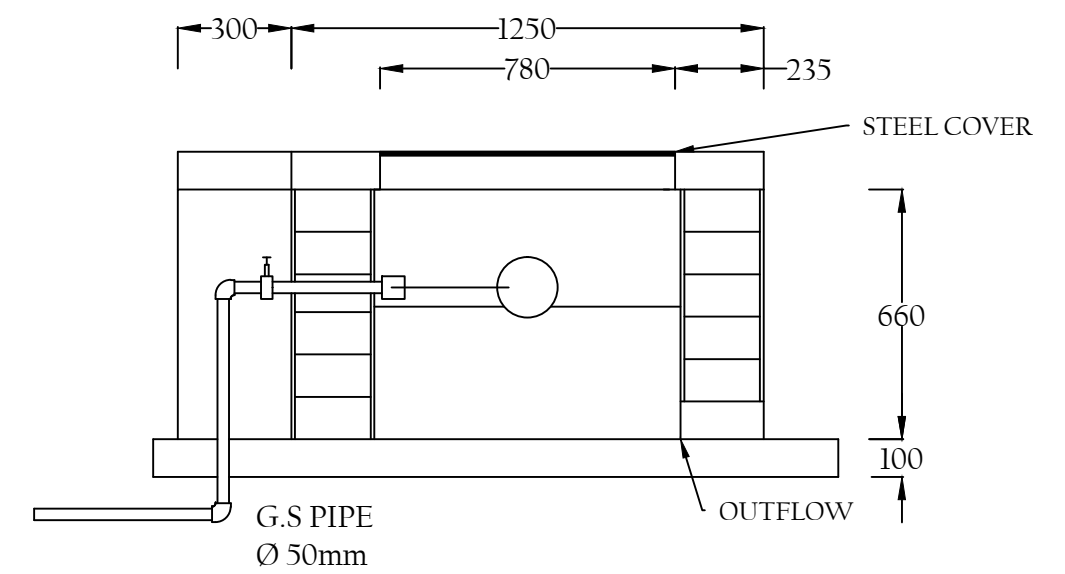


FRONT VIEW H-H  
SCALE 1 : 20

DITCH LEADING TO RIVER OR DEPRESSION

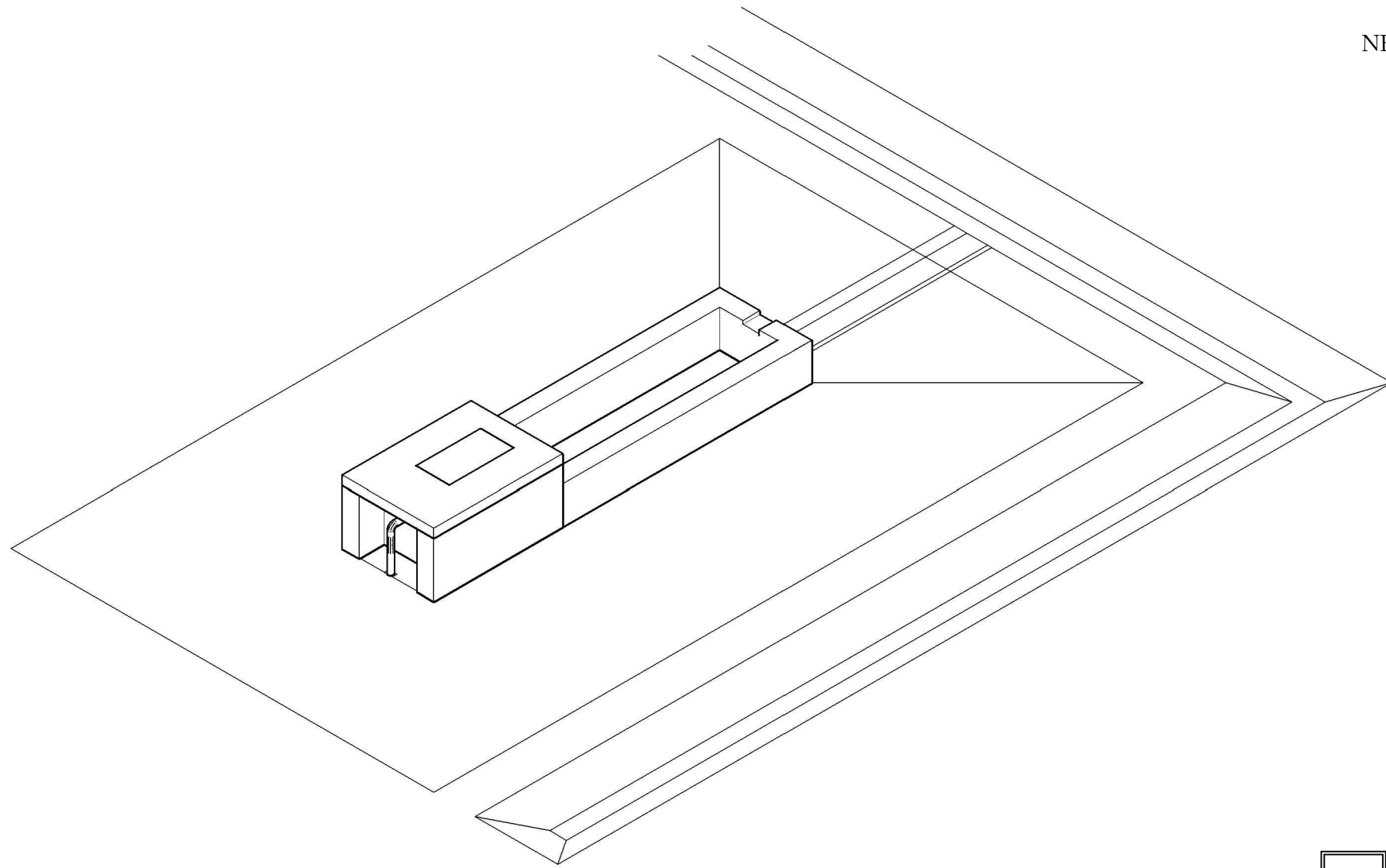


SECTION F-F  
SCALE 1:20



SECTION E-E  
SCALE 1 : 20

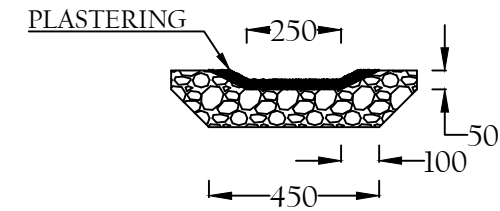
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| Drawn By:    |  | Project:       |                 |
| Designed By: |  | Drawing Title: | CATTLE TROUGH   |
| Checked By:  |  | Drawing No:    | TYPE DRAWING IV |
| Approved By: |  | Rev:           | Sheet: 5/17     |



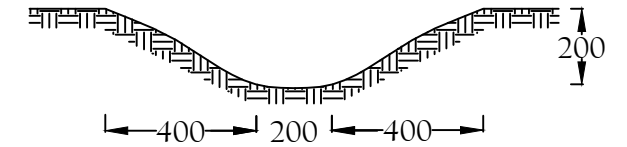
ISOMETRIC VIEW  
SCALE 1 : 50

NB:

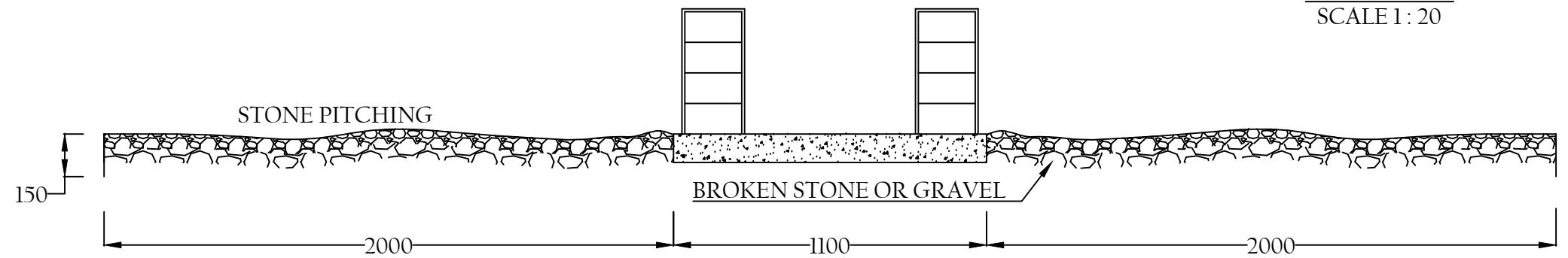
1. STRUCTURE IN 400 x 200 x 100mm CEMENT BLOCKS  
PLASTERED 1 : 3 MIX ON ALL SHOWING SURFACES
2. LENGTH OF TROUGH ACCORDING TO EXPECTED HERD SIZES  
L.T = 5.00m - SMALL CATTLE HERDS, GOATS AND SHEEP  
L.T = 10.00m - BIG CATTLE HERDS



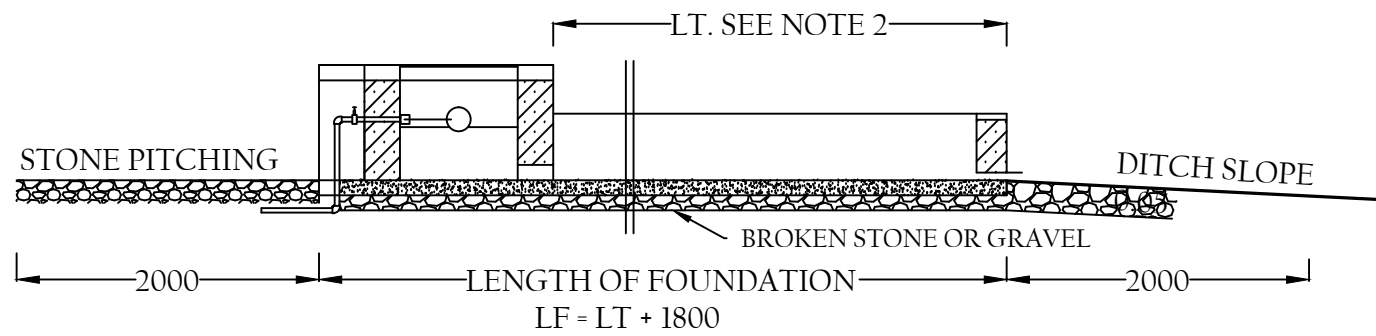
SECTION C-C  
SCALE 1 : 20



SECTION D-D  
SCALE 1 : 20

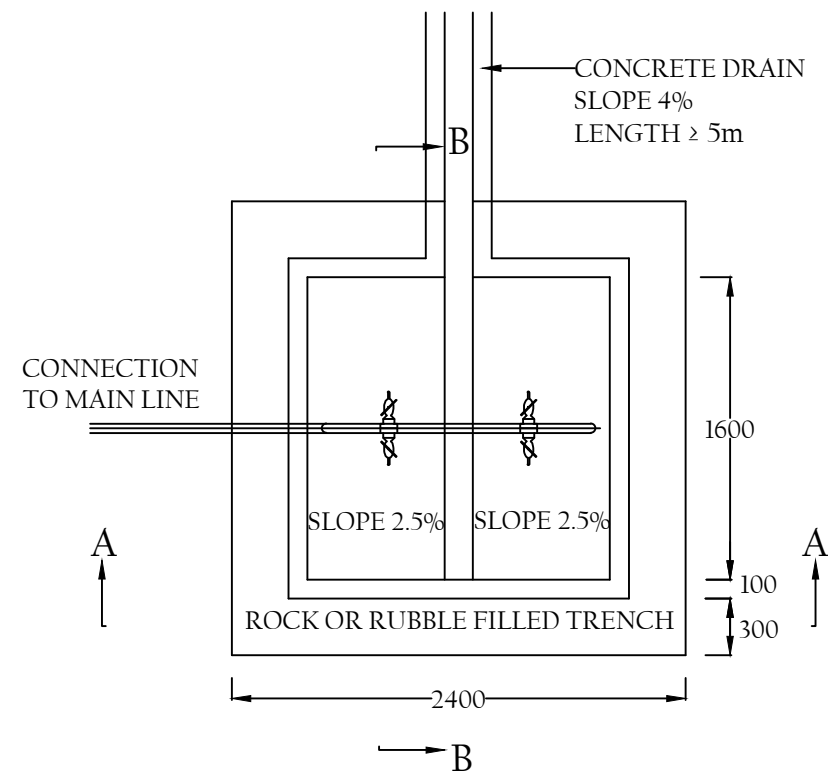


SECTION B-B  
SCALE 1 : 50

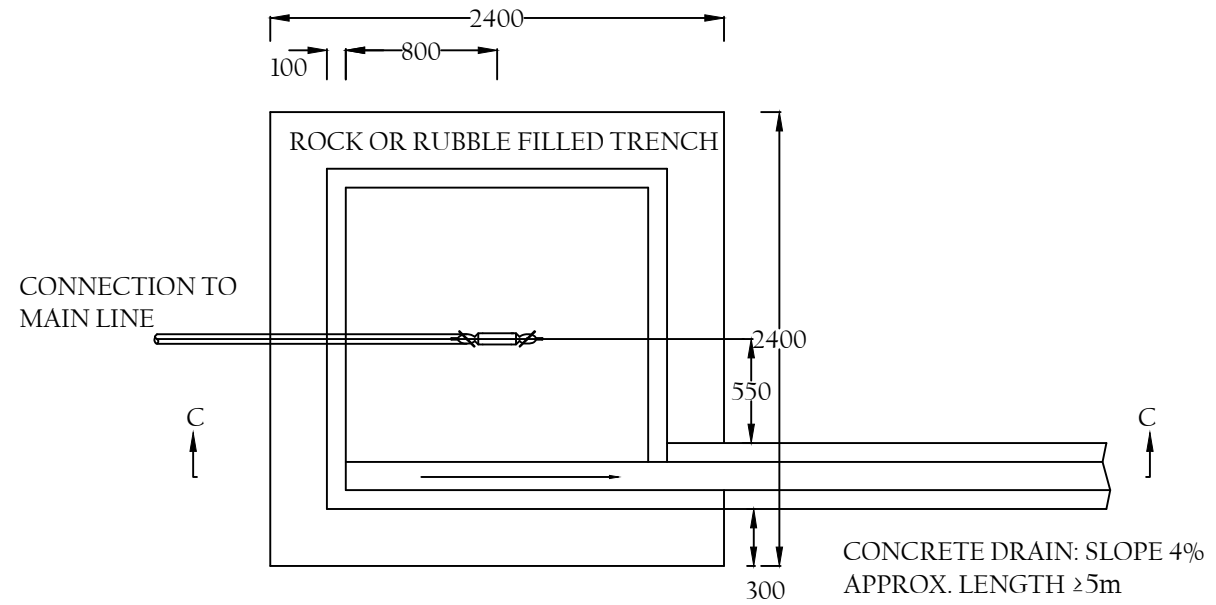


SECTION A-A  
SCALE 1 : 50

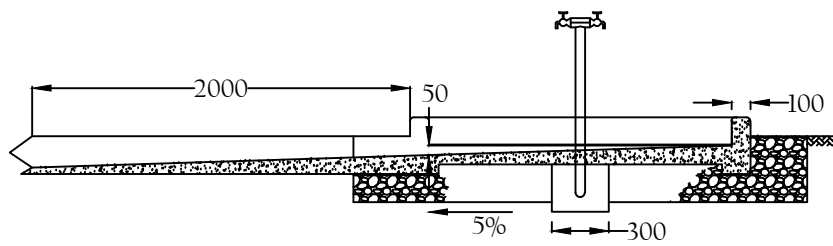
|              |  |  |                                 |      |                    |
|--------------|--|--|---------------------------------|------|--------------------|
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| Surveyed By: |  |  | File Name:                      |      | Scale:<br>AS SHOWN |
| Drawn By:    |  |  | Project:                        |      |                    |
| Designed By: |  |  | Drawing Title:<br>CATTLE TROUGH |      |                    |
| Checked By:  |  |  | Drawing No:<br>TYPE DRAWING IV  | Rev: | Sheet:<br>6/17     |
| Approved By: |  |  |                                 |      |                    |



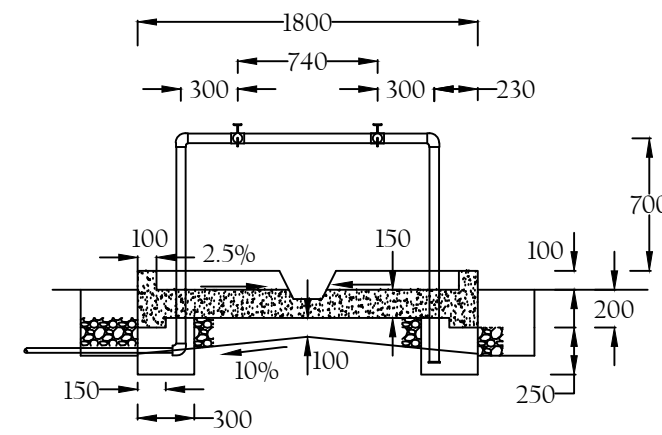
PLAN 4 TAP CWP  
SCALE 1:40



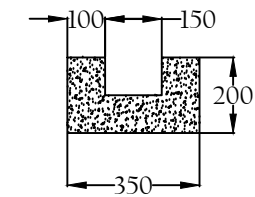
PLAN 2 TAP CWP  
SCALE 1:40



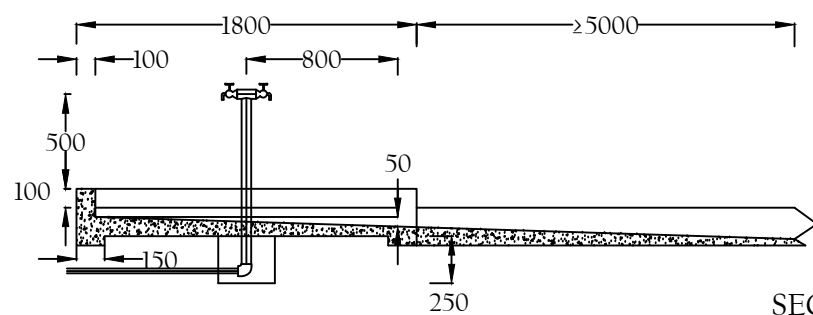
SECTION B-B  
SCALE 1:40



SECTION A-A  
SCALE 1:40

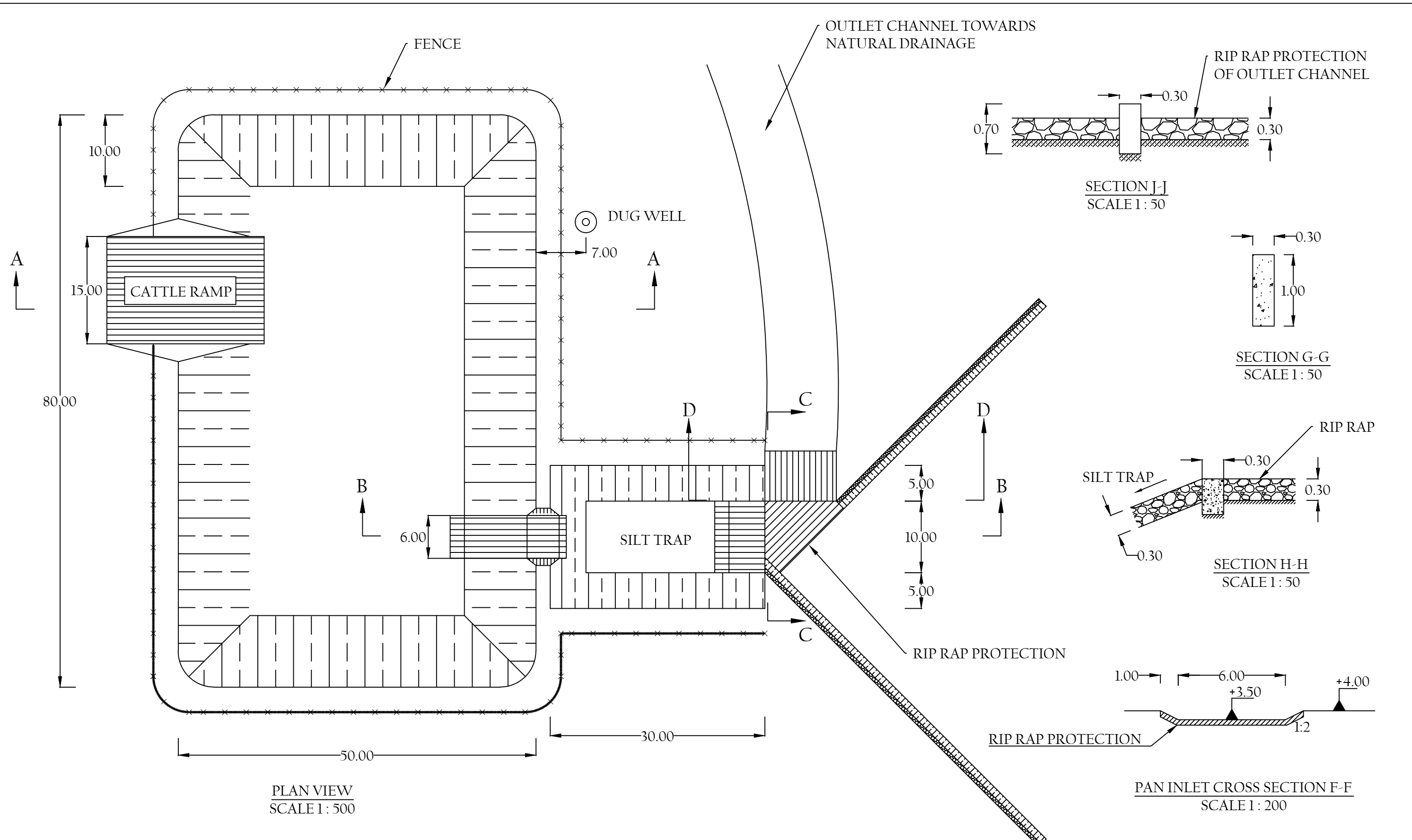


SECTION THROUGH DRAIN  
SCALE 1:40



SECTION C-C  
SCALE 1:40

|              |  |  |  |                            |                |
|--------------|--|--|--|----------------------------|----------------|
| Client:      |  |  | Location:                              |                            |                |
| Surveyed By: |  |  | File Name:                             | Scale:<br>1:40 OR AS SHOWN |                |
| Drawn By:    |  |  | Project:                               |                            |                |
| Designed By: |  |  | Drawing Title:<br>COMMUNAL WATER POINT |                            |                |
| Checked By:  |  |  | Drawing No:<br>TYPE DRAWING V          | Rev:                       | Sheet:<br>7/17 |
| Approved By: |  |  |  |                            |                |



PLAN VIEW  
SCALE 1 : 500

SECTION J-J  
SCALE 1 : 50

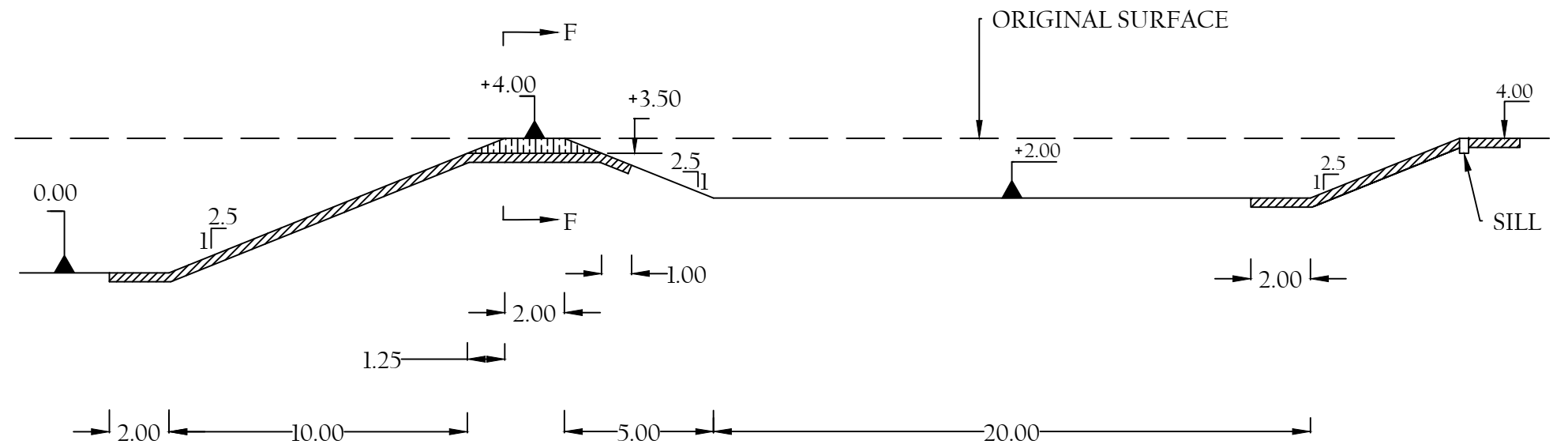
SECTION G-G  
SCALE 1 : 50

SECTION H-H  
SCALE 1 : 50

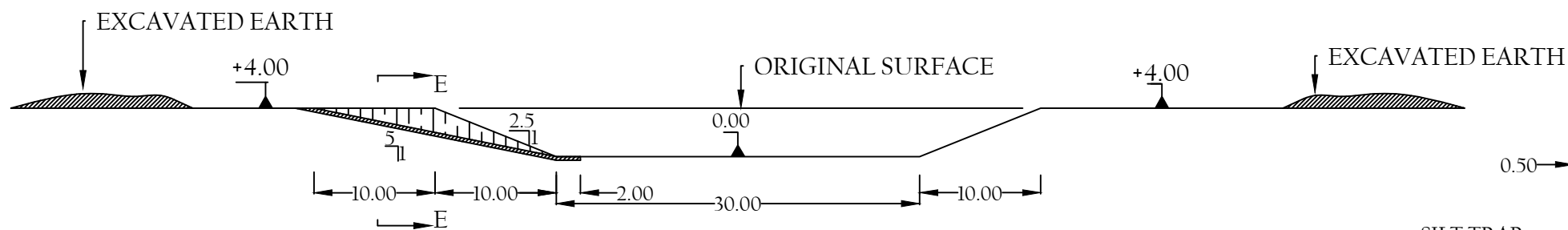
PAN INLET CROSS SECTION F-F  
SCALE 1 : 200

CATTLE RAMP PROTECTION  
SCALE 1 : 200

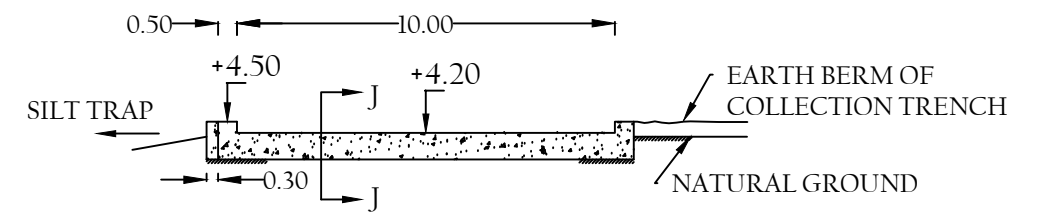
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| Surveyed By: |  | File Name:      | Scale: AS SHOWN                                  |
| Drawn By:    |  | Project:        |  |
| Designed By: |  | Drawing Title:  | WATER STORAGE PAN; CAPACITY 11,600m <sup>3</sup> |
| Checked By:  |  | Drawing No:     | Rev: Sheet:                                      |
| Approved By: |  | TYPE DRAWING VI | 8/17   |



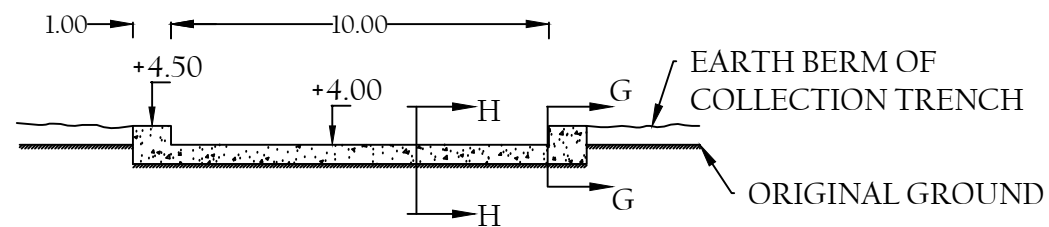
CROSS SECTION B-B  
SILT TRAP DETAIL  
SCALE 1: 200



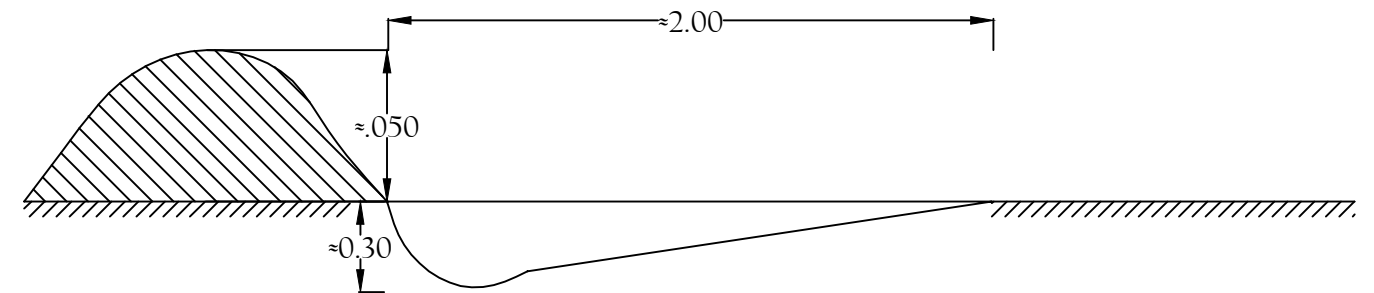
CROSS SECTION A-A  
SCALE 1: 500



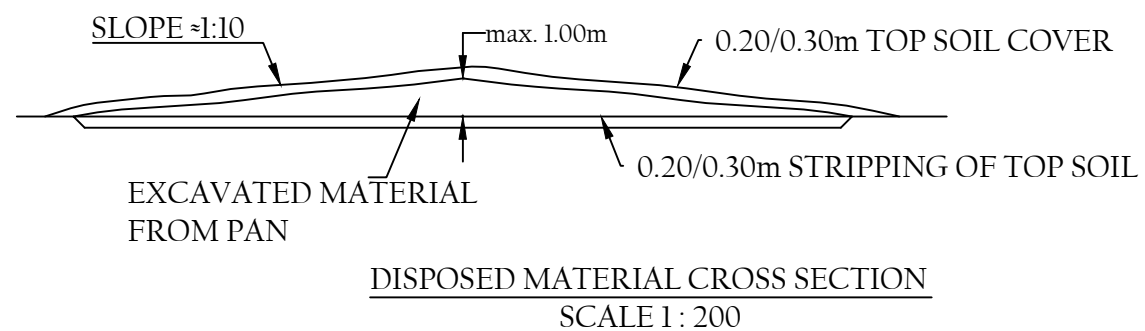
OVERFLOW TO OUTLET CHANNEL SECTION D-D  
SCALE 1: 200



INLET TO SILT TRAP CROSS SECTION C-C  
SCALE 1: 200

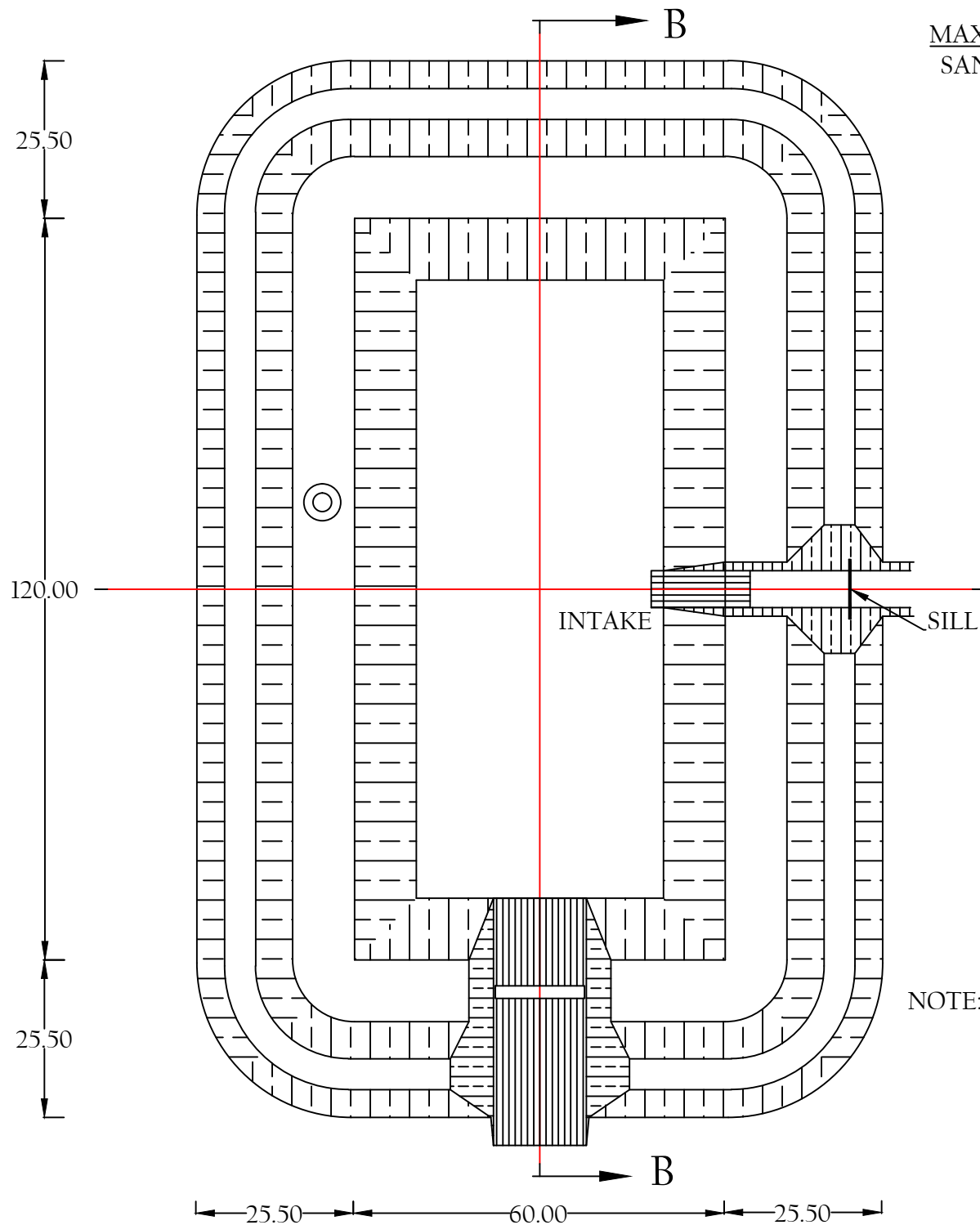


COLLECTION TRENCH CROSS SECTION  
SCALE 1: 25

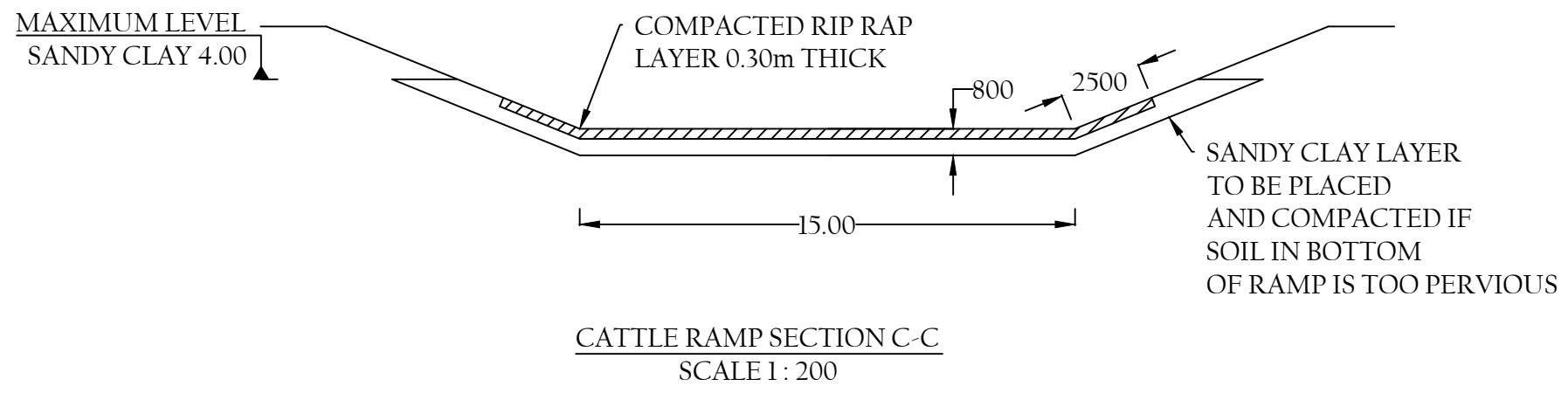


DISPOSED MATERIAL CROSS SECTION  
SCALE 1: 200

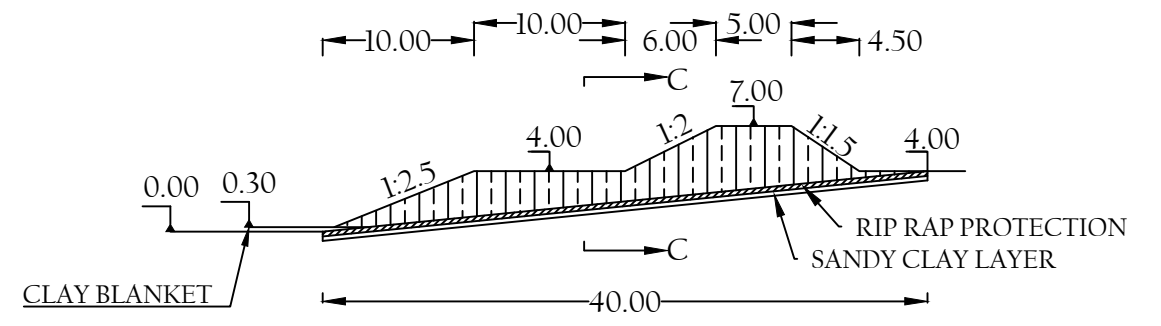
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|--------------|--|-----------------|--|--------|
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| Surveyed By: |  | File Name:      | Scale:<br>AS SHOWN                               |        |
| Drawn By:    |  | Project:        |  |        |
| Designed By: |  | Drawing Title:  | WATER STORAGE PAN; CAPACITY 11,600m <sup>3</sup> |        |
| Checked By:  |  | Drawing No:     | Rev:   | Sheet: |
| Approved By: |  | TYPE DRAWING VI |  | 9/17   |



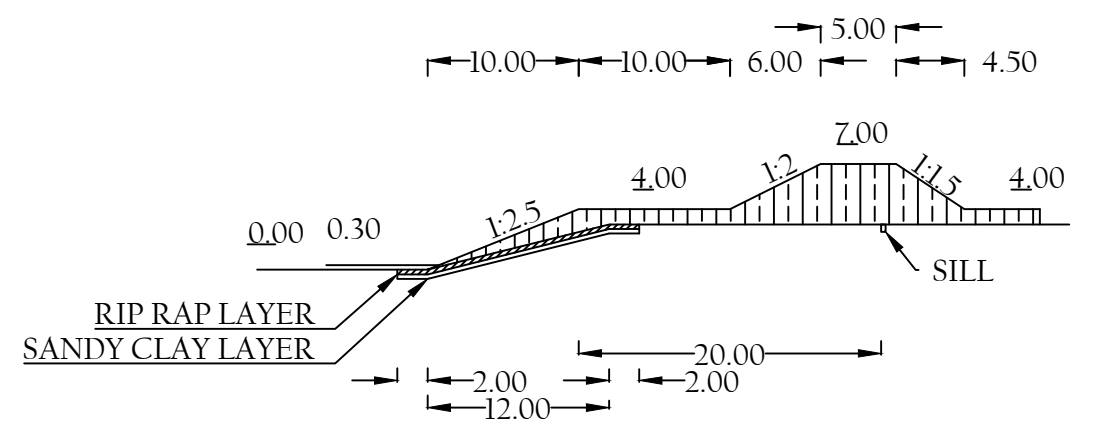
PLAN TANK  
SCALE 1 : 1000



CATTLE RAMP SECTION C-C  
SCALE 1 : 200

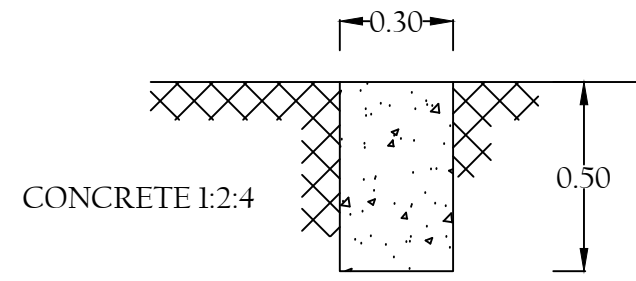


CATTLE RAMP SECTION D-D  
SCALE 1 : 500



INTAKE SECTION A-A  
SCALE 1 : 500

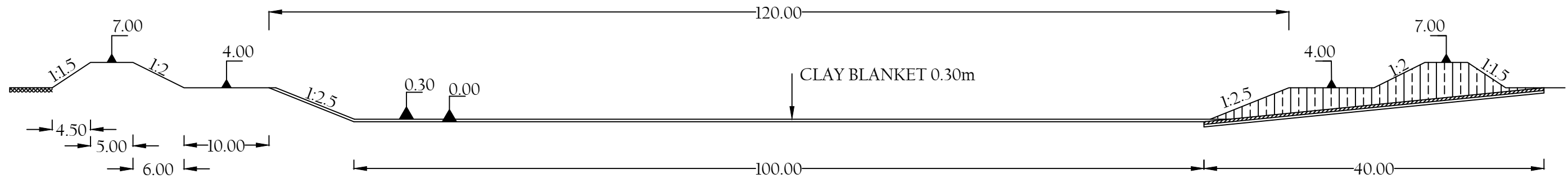
NOTE:  
EXACT LOCATION OF  
CATTLE RAMP AND INTAKE  
TO BE DECIDED FOR EACH SITE  
INDEPENDENTLY  
(SEE LAYOUT)



SILL DETAIL  
SCALE 1 : 20

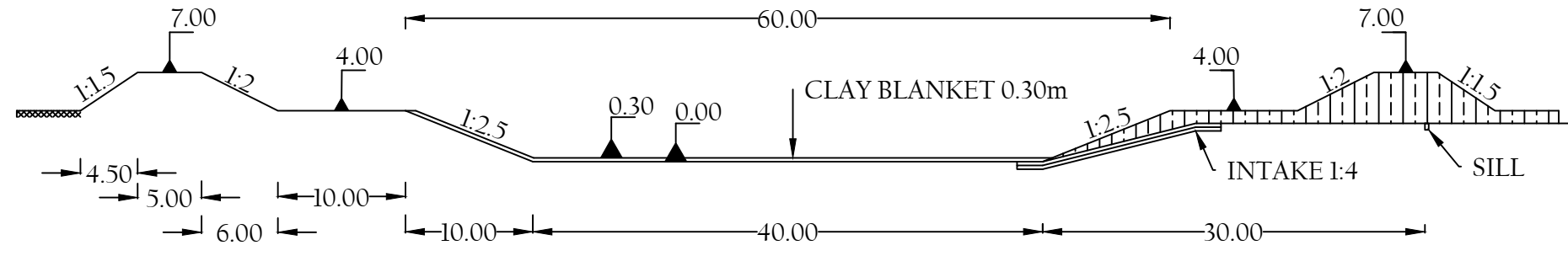
|              |  |                  |  |
|--------------|--|------------------|--|
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| Surveyed By: |  | File Name:       | Scale:<br>AS SHOWN                               |
| Drawn By:    |  | Project:         |  |
| Designed By: |  | Drawing Title:   | STANDARD WATER PAN CAPACITY 20,000m <sup>3</sup> |
| Checked By:  |  | Drawing No:      | Rev: Sheet:                                      |
| Approved By: |  | TYPE DRAWING VII | 10/17  |



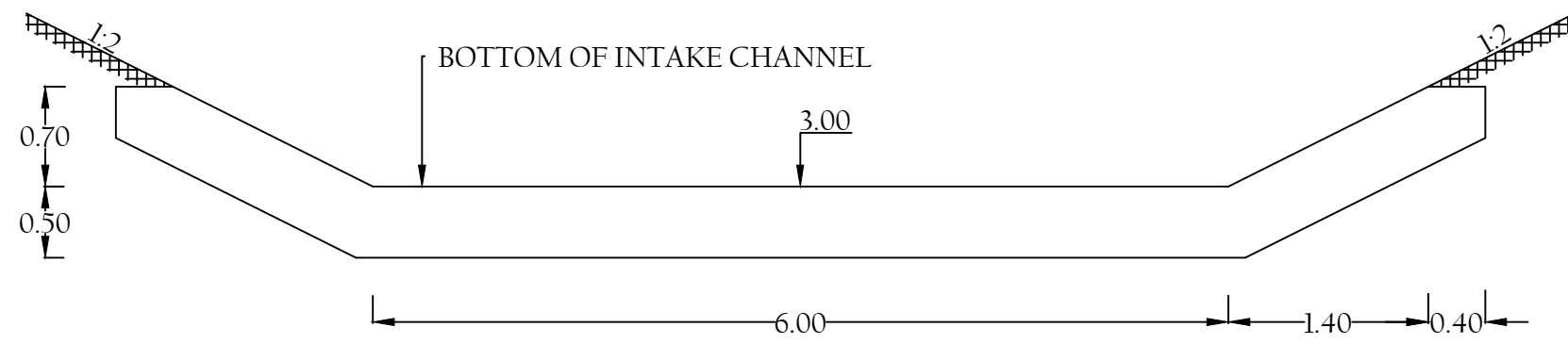


SECTION B-B  
SCALE 1 : 500

NOTE:  
DIMENSIONS OF WALL ARE SHOWN  
WITHOUT 0.15m TOP SOIL COVER

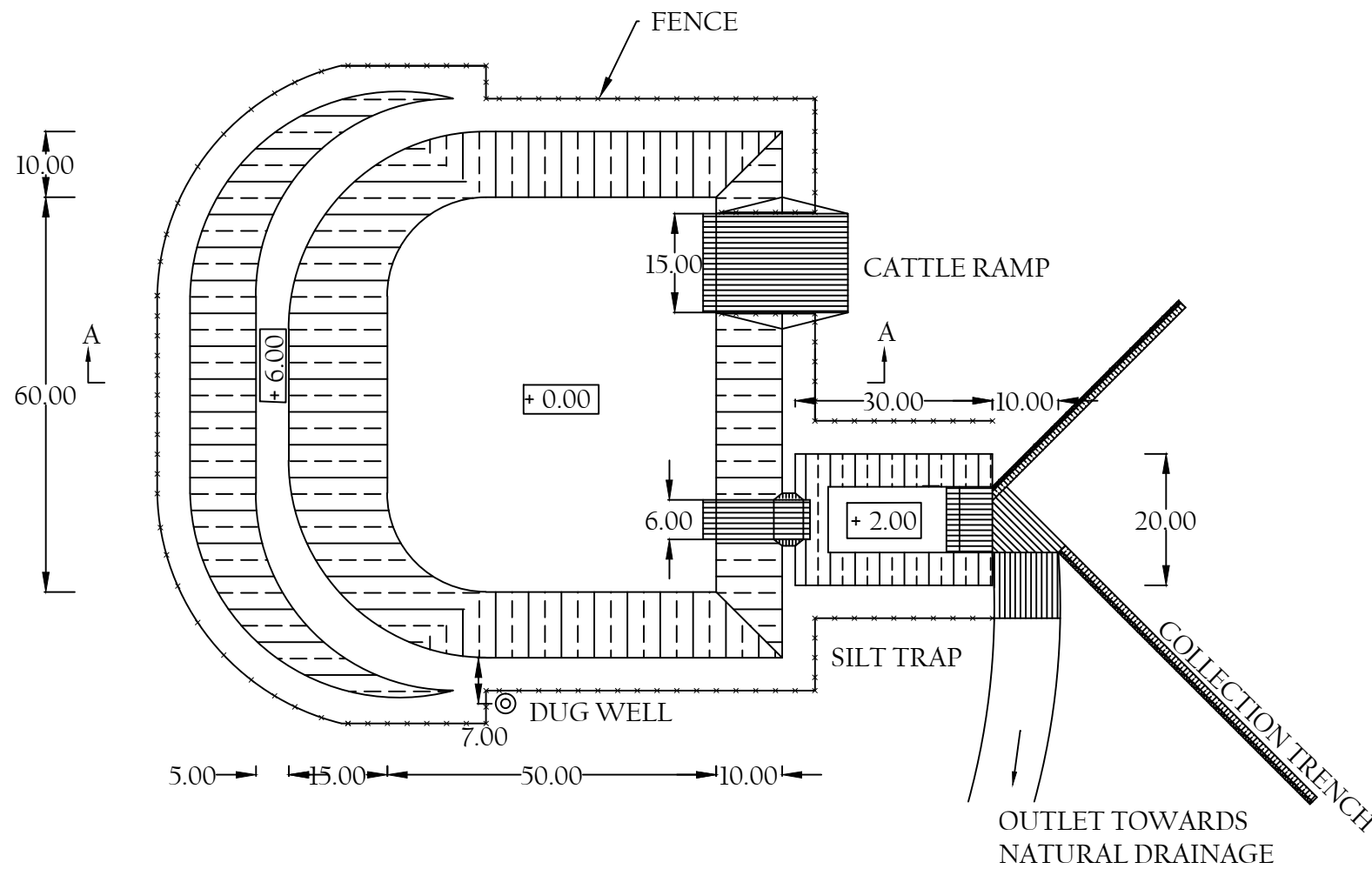


SECTION A-A  
SCALE 1 : 500

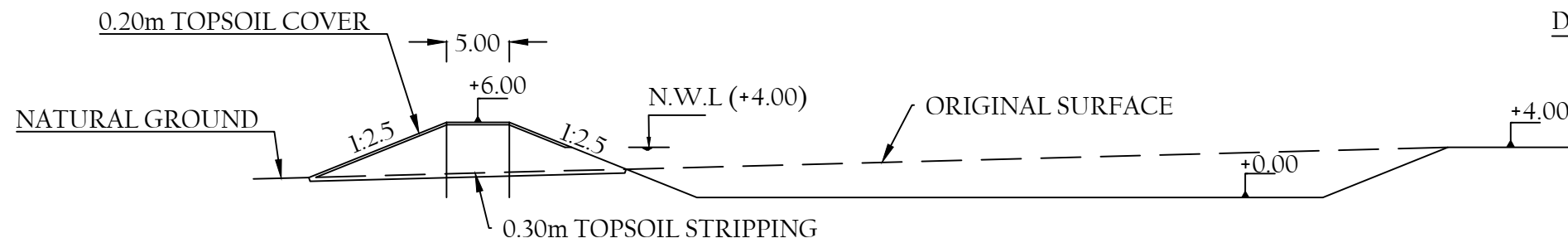
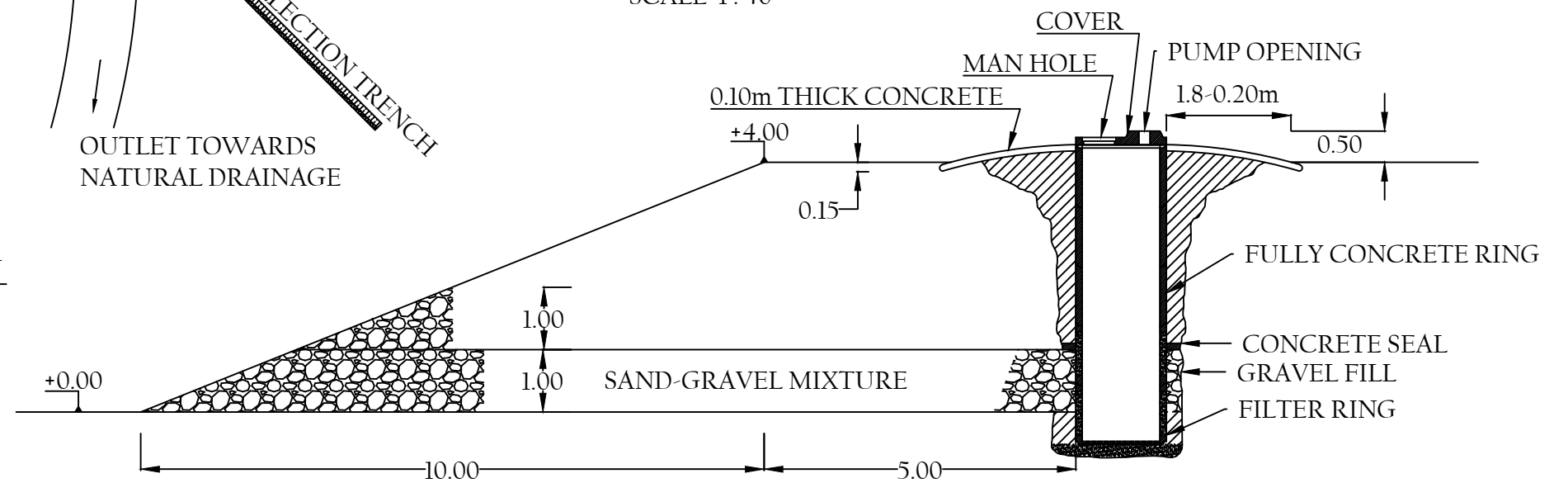
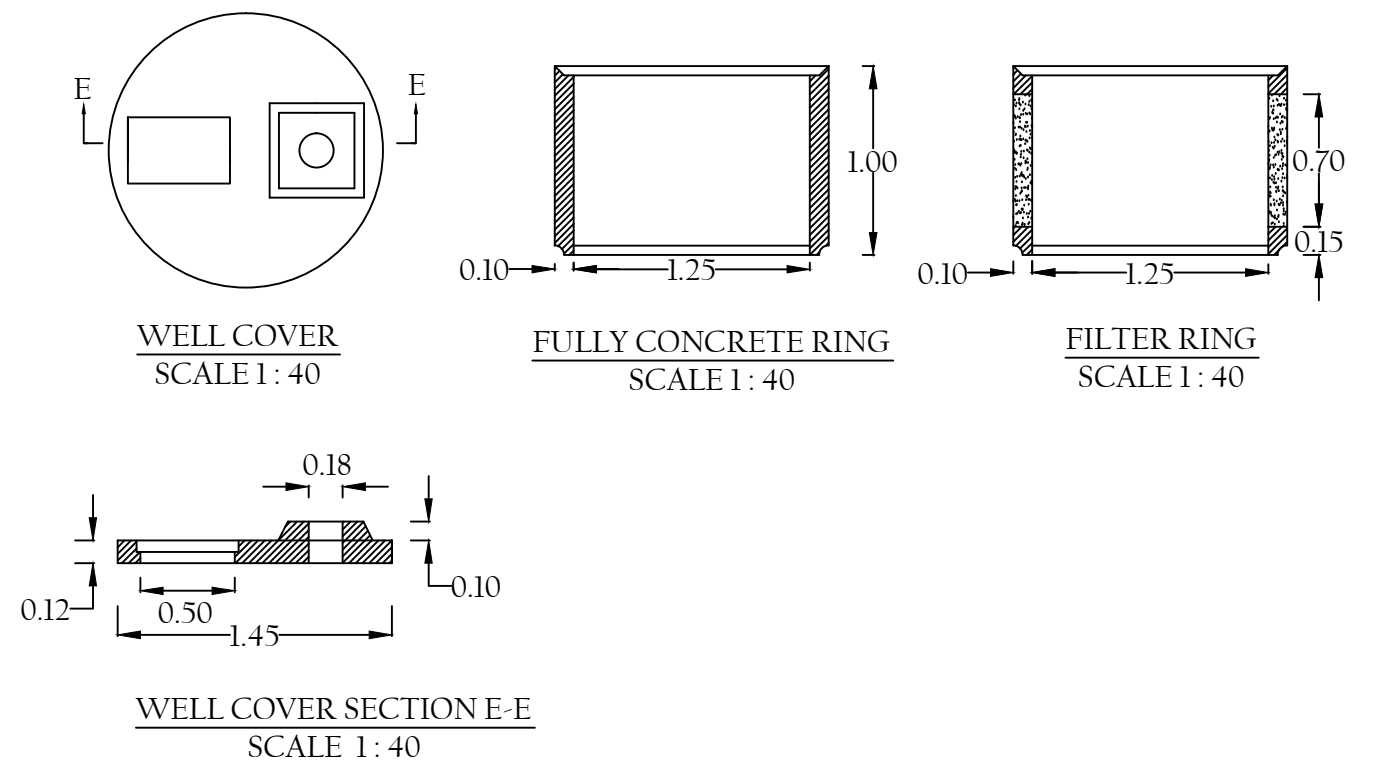


INTAKE CHANNEL SILL CROSS SECTION D-D  
SCALE 1 : 500

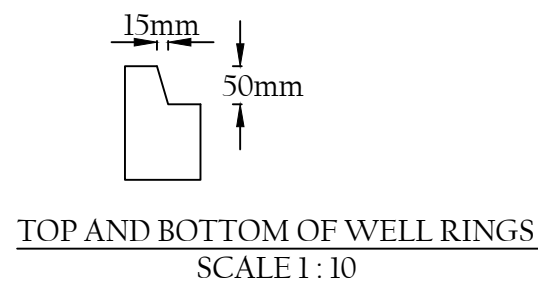
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|--------------|--|--|------------------|--|--------|
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| Surveyed By: |  |  | File Name:       | Scale:<br>AS SHOWN                               |        |
| Drawn By:    |  |  | Project:         |  |        |
| Designed By: |  |  | Drawing Title:   | STANDARD WATER PAN CAPACITY 20,000m <sup>3</sup> |        |
| Checked By:  |  |  | Drawing No:      | Rev:   | Sheet: |
| Approved By: |  |  | TYPE DRAWING VII |  | 11/17  |



WATER PAN ON INCLINED LOCATION  
PLAN VIEW  
SCALE 1 : 1000



CROSS SECTION A-A  
SCALE 1 : 500



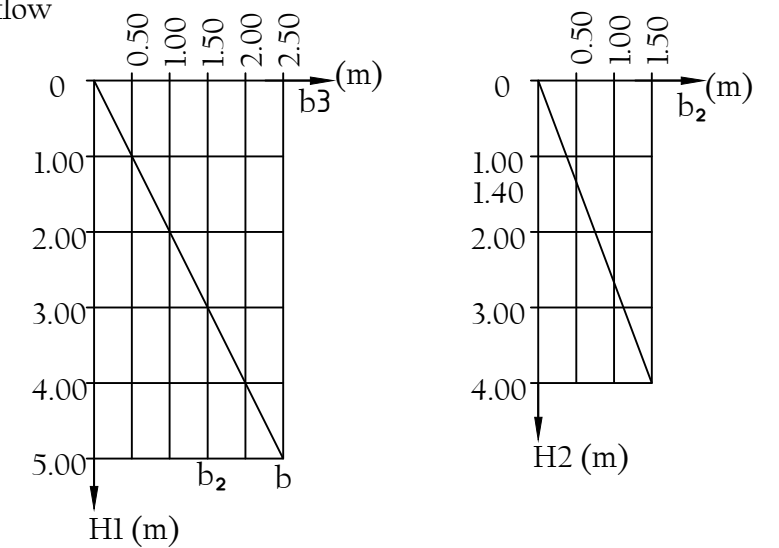
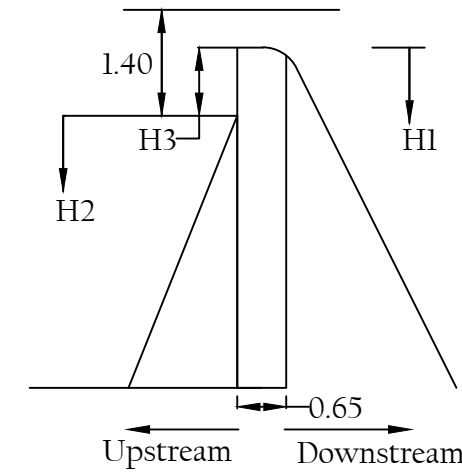
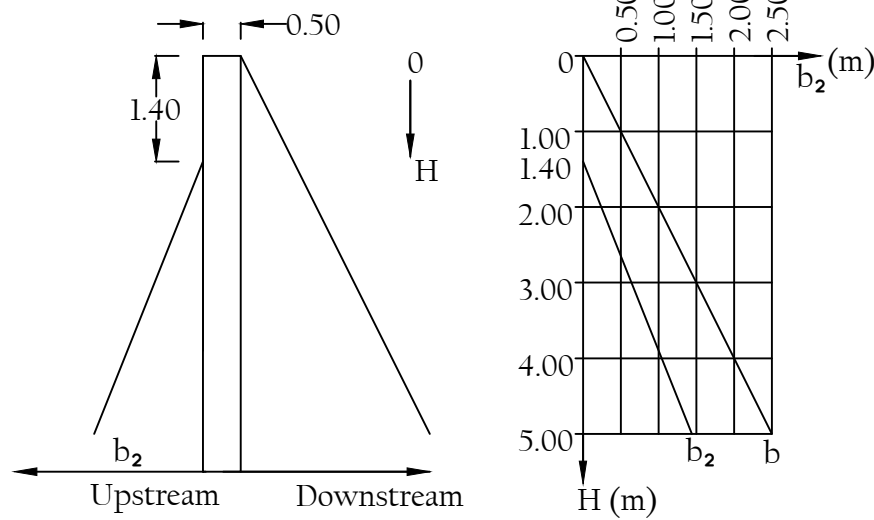
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| Surveyed By: |  |  | File Name:        | Scale:   |        |
| Drawn By:    |  |  | Project:          |  |        |
| Designed By: |  |  | Drawing Title:    | WATER PAN ON INCLINED LOCATION (17,000m <sup>3</sup> );<br>DUG WELL AND FILTER |        |
| Checked By:  |  |  | Drawing No:       | Rev:   | Sheet: |
| Approved By: |  |  | TYPE DRAWING VIII |  | 12/17  |

# STANDARD CROSS SECTIONS

SCALE 1 : 100

D = depth of overflow plus safety

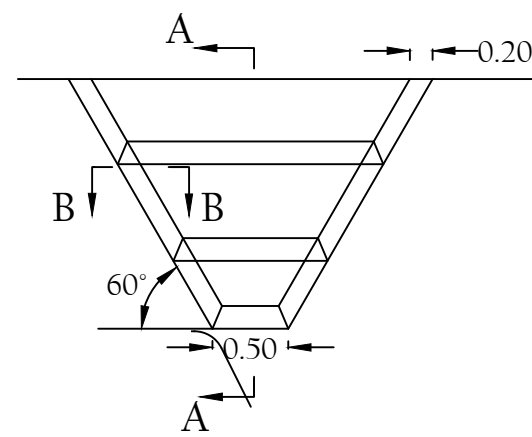
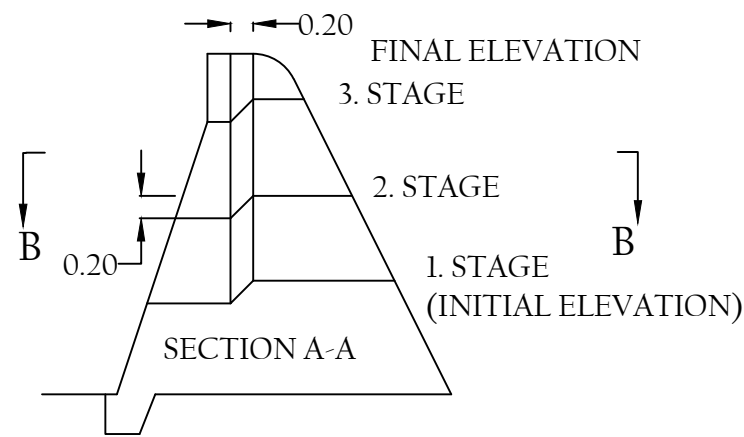
HEIGHT OF WINGWALL



## DESIGN PROCEDURE

1. Storage requirements - H1
2. Q50 and length of overflow section - Depth of overflow d
3. Depth of overflow plus safety  
 $D = 1.5d + 0.10m$
4. Height of wing wall  
 $H = H1 + D$
5.  $H2 = H - 1.40m$   
(1.40m fixed by stability calculations)
6.  $H = 1.40m - D$
7. Base width from graphs

NOTE: max. D = 1.40m



H = 3.80m no overflow

INCLINED LUMBER SHUTTERING

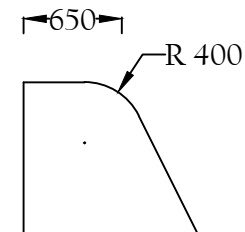
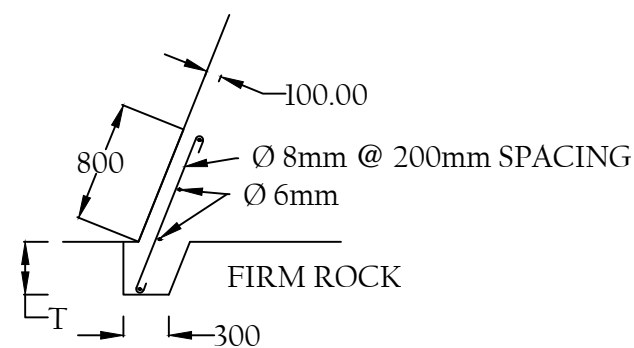
H = 3.20m D = 0.30m. overflow

VERTICAL LUMBER SHUTTERING

NUMBER AND ELEVATIONS OF REQUIRED CONSTRUCTION STAGES HAVE TO BE ESTIMATED ACCORDING TO SEDIMENT TRANSPORT OF RESPECTIVE RIVER

## DETAIL OF FOUNDATION

SCALE 1 : 50



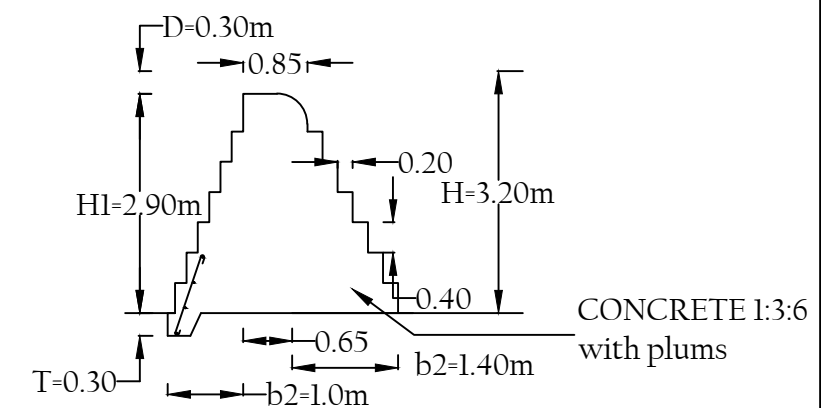
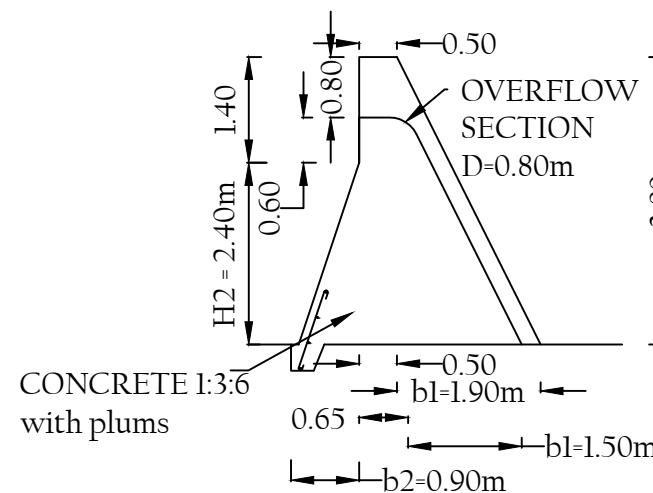
SECTIONS WITH OVERFLOW ONLY

## CREST DETAIL

SCALE 1 : 50

|        |    |    |    |    |    |
|--------|----|----|----|----|----|
| H (m)  | 1  | 2  | 3  | 4  | 5  |
| T (cm) | 20 | 25 | 30 | 35 | 40 |

THE DEPTH OF THE TRENCH MIGHT BE ALTERED ACCORDING TO THE ROCK ENCOUNTERED

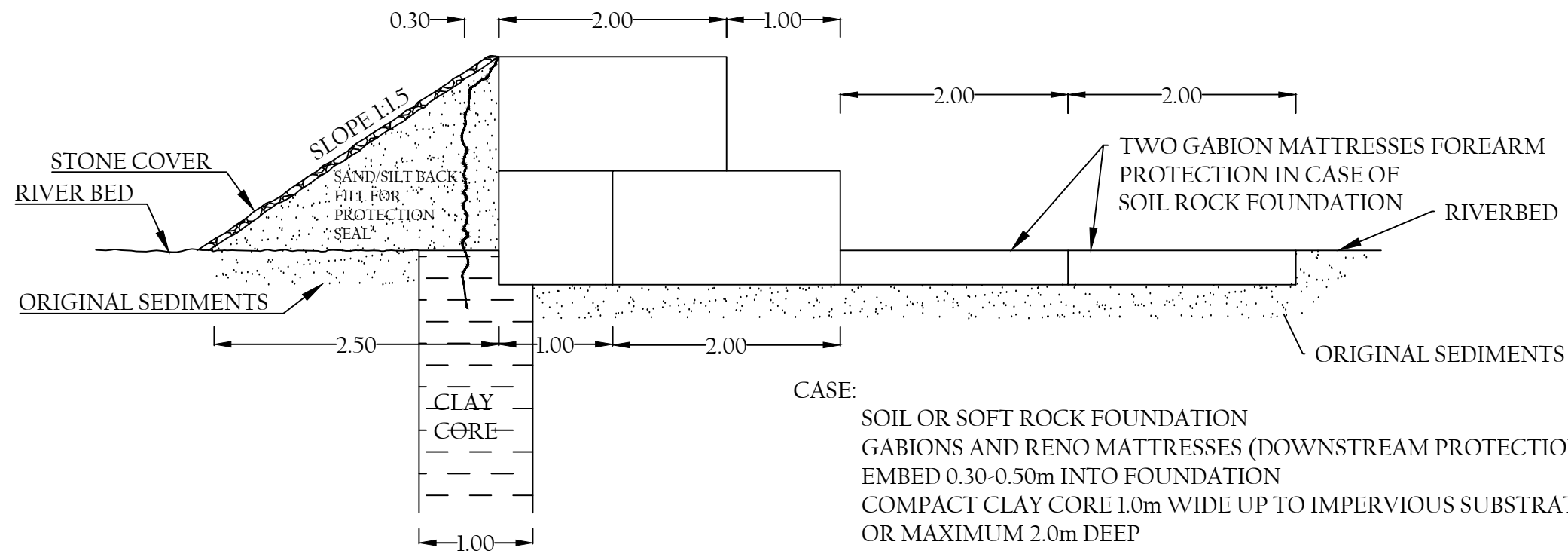


|              |  |   |                   |
|--------------|--|---|-------------------|
| Client:      |  | Location:   |                   |
| Surveyed By: |  | File Name:  | Scale: AS SHOWN   |
| Drawn By:    |  | Project:  |                   |
| Designed By: |  | Drawing Title: STANDARD CROSS SECTIONS CONCRETE SAND STORAGE DAMS |                   |
| Checked By:  |  | Drawing No: TYPE DRAWING IX                                       | Rev: Sheet: 13/17 |
| Approved By: |  |   |                   |

CONSTRUCTION PHASE 1: BASE GABIONS EMBEDDED IN FOUNDATION; UPSTREAM ROW OF GABIONS PLACED LENGTHWISE ACROSS THE RIVERBED; DOWNSTREAM ROW PLACED SIDEWISE ACROSS THE RIVERBED (TRANSVERSE) A ROW OF TRANSVERSE GABIONS ON TOP ALIGNED WITH THE UPSTREAM ROW OF BASE GABIONS AN IMPERVIOUS SEAL IS ADDED UPSTREAM PROTECTED BY SAND/SILT BACKFILL AS SHOWN BELOW

CASE 1: SOFT ROCK/ SOIL FOUNDATION (SEE DRAWING BELOW)  
 BASE GABIONS EMBEDDED 0.30m TO 0.50m DEEP ACCORDING TO HARDNESS OF SUBSTRATE  
 DOWNSTREAM APRON OF TWO GABION MATTRESSES EMBEDDED 0.30m DEEP  
 UPSTREAM CLAY CORE 1.0m WIDE DOWN ONTO IMPERVIOUS LAYER OR 2.0m MAX DEPTH  
 IMPERVIOUS SEAL FIXED MINIMUM 0.50m DEEP IN CLAY CORE

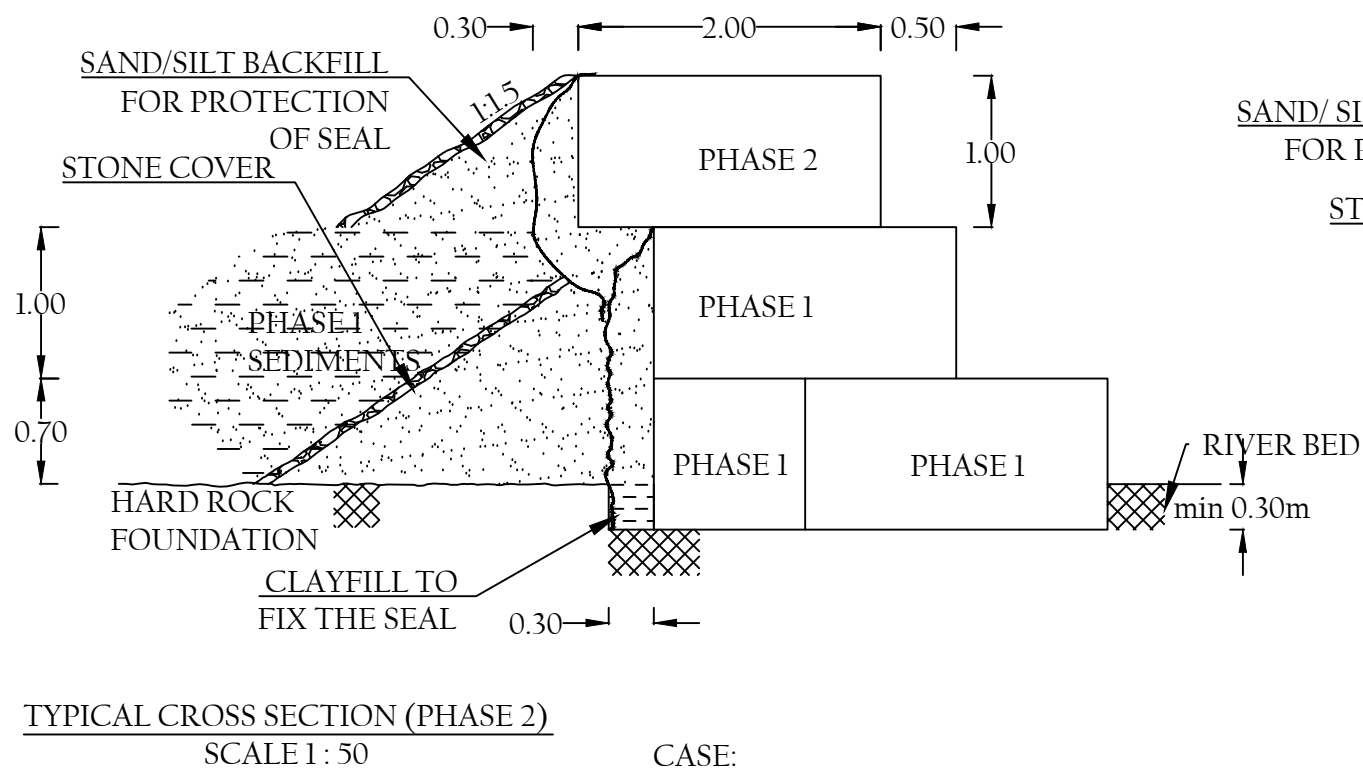
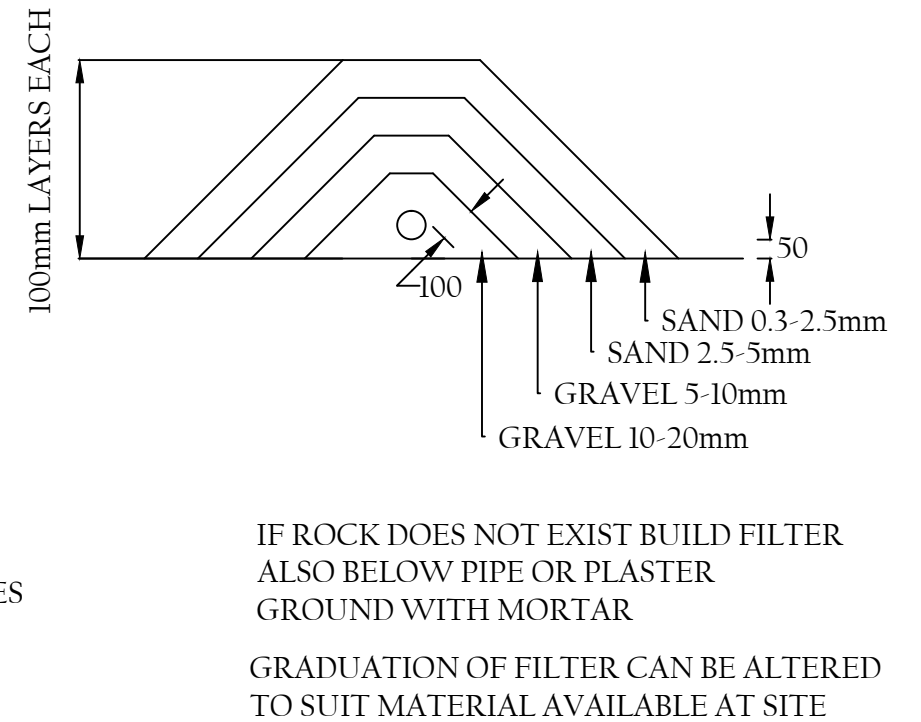
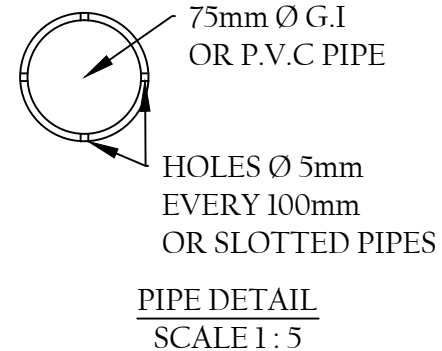
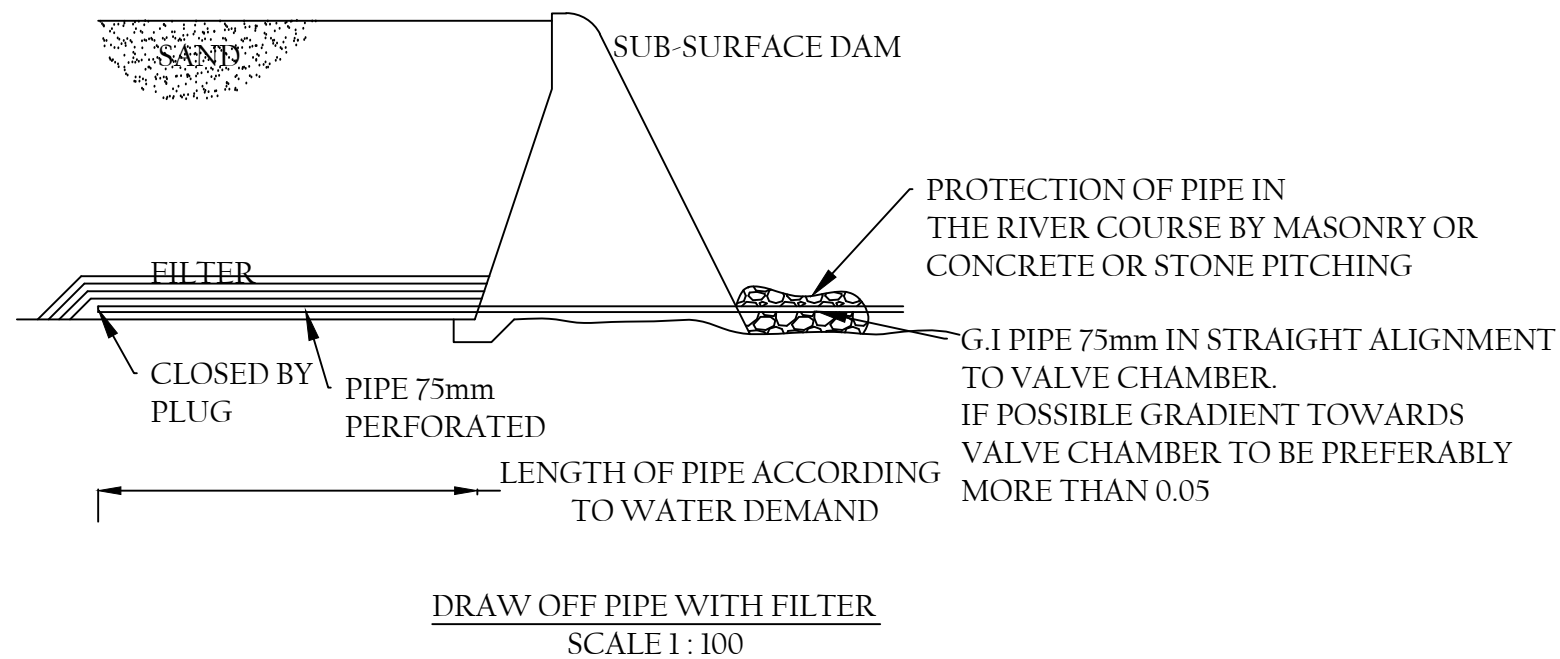
CASE 2: HARD ROCK FOUNDATION (SEE MIDDLE DRAWING)  
 BASE GABIONS EMBEDDED 0.20m TO 0.50m IN FOUNDATION  
 NO DOWNSTREAM APRON NECESSARY  
 UPSTREAM CLAY CORE 0.30m WIDE 0.30m DEEP TO FIX THE IMPERVIOUS SEAL



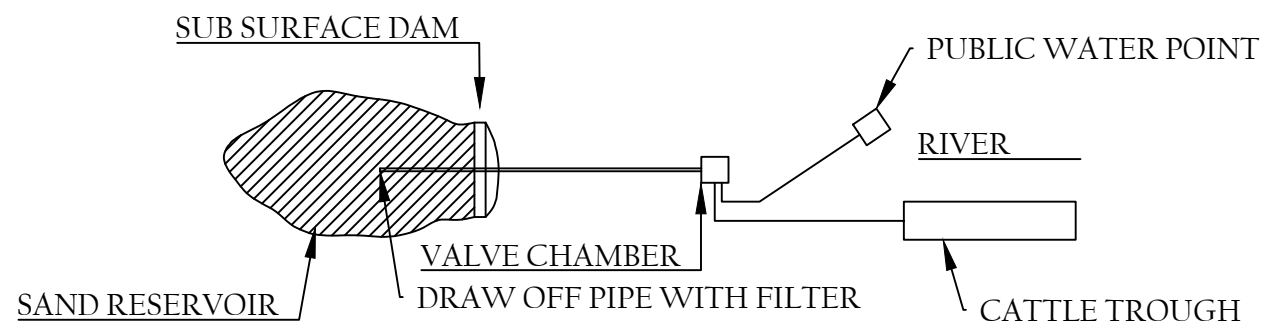
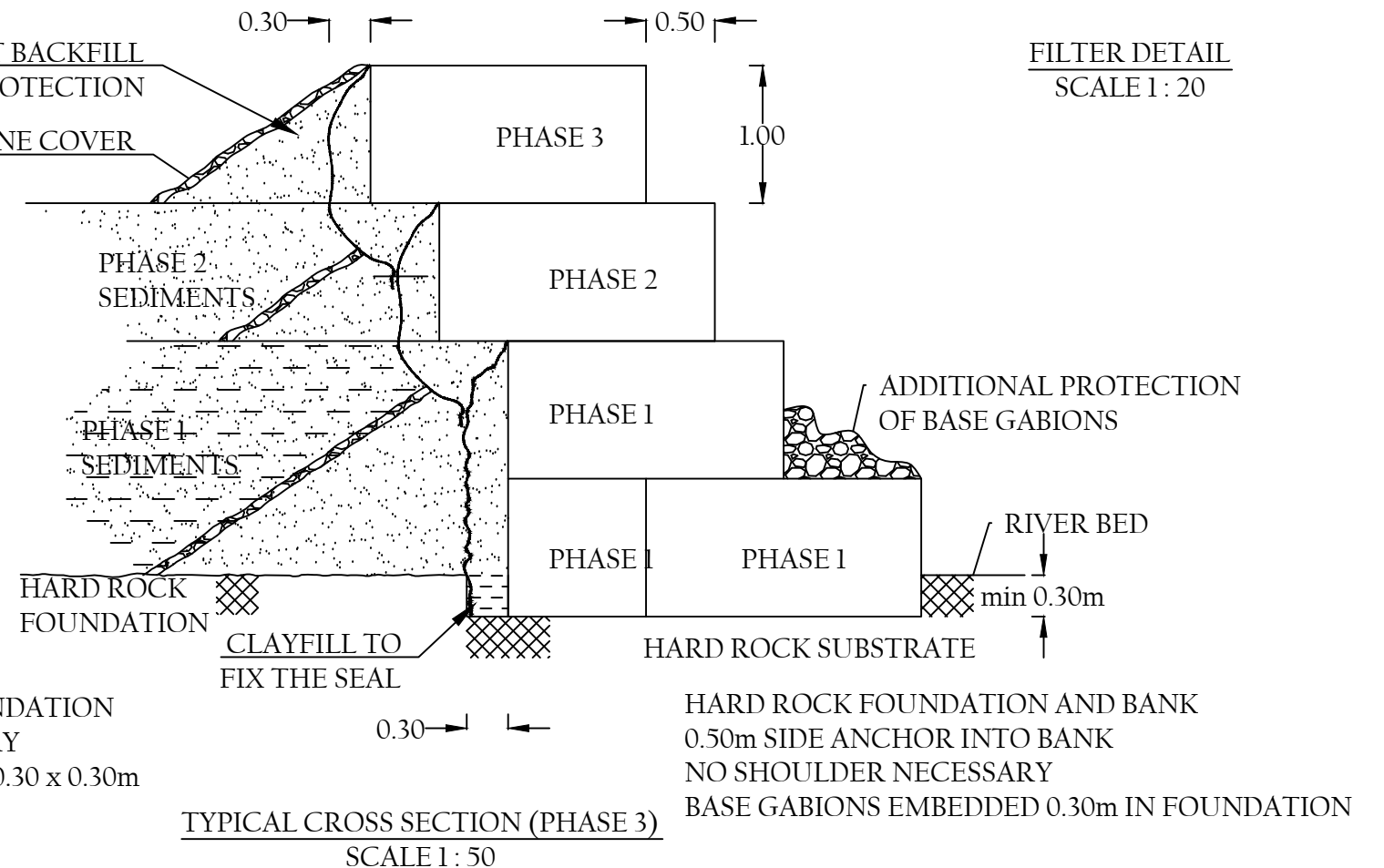
CASE:  
 SOIL OR SOFT ROCK FOUNDATION  
 GABIONS AND RENO MATTRESSES (DOWNSTREAM PROTECTION)  
 EMBED 0.30-0.50m INTO FOUNDATION  
 COMPACT CLAY CORE 1.0m WIDE UP TO IMPERVIOUS SUBSTRATE  
 OR MAXIMUM 2.0m DEEP  
 IMPERVIOUS SEAL ANCHORED 0.50m MINIMUM IN CLAY CORE

TYPICAL CROSS SECTION (PHASE 1)  
 SCALE 1:50

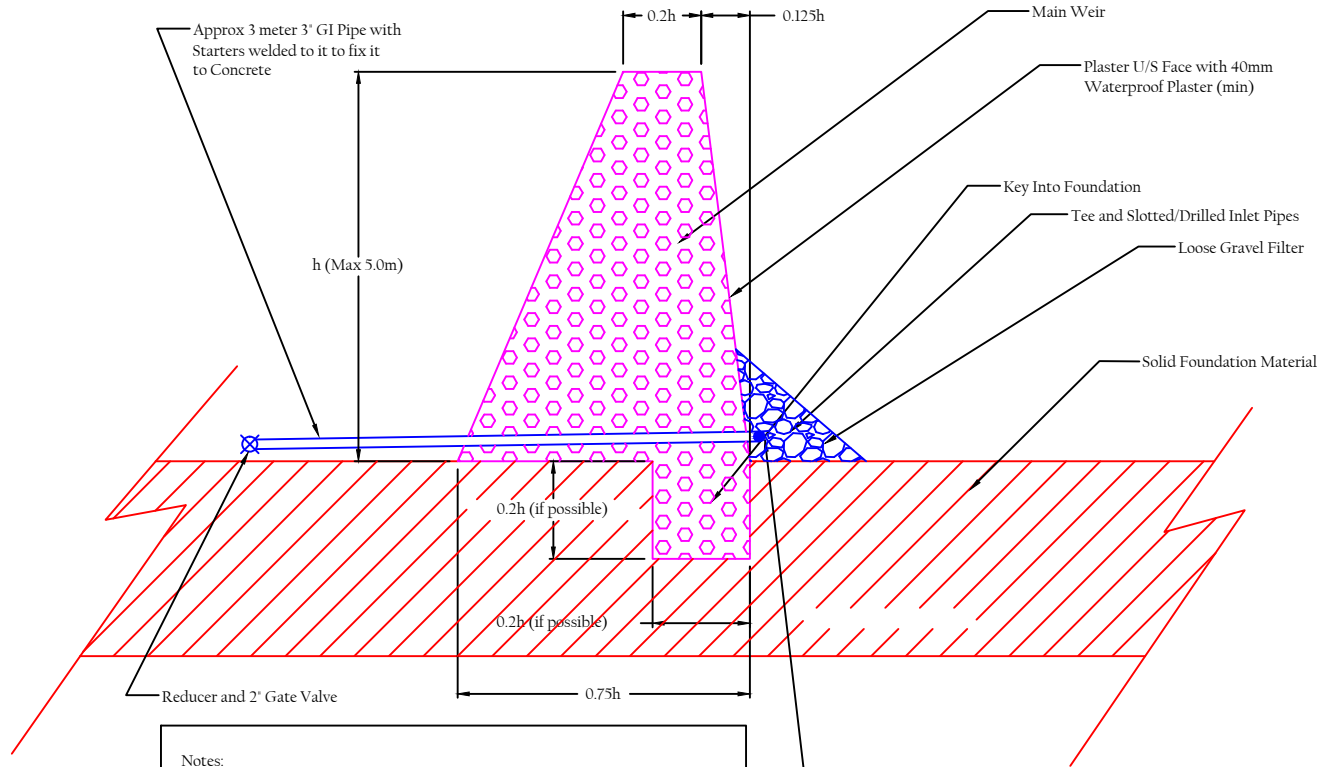
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| Surveyed By: |  |  | File Name:  | Scale: |              |
| Drawn By:    |  |  | Project: GABION SAND STORAGE DAM; WATER SUPPLY BY GRAVITY FROM SAND STORAGE DAM |        |              |
| Designed By: |  |  | Drawing Title:  |        |              |
| Checked By:  |  |  |   |        |              |
| Approved By: |  |  | Drawing No: TYPE DRAWING X  | Rev:   | Sheet: 14/17 |



CASE:  
HARD ROCK FOUNDATION  
BASE GABIONS EMBEDDED 0.30m INTO FOUNDATION  
NO DOWNSTREAM PROTECTION NECESSARY  
IMPERVIOUS SEAL FIXED IN CLAY TRENCH 0.30 x 0.30m



|              |  |   |              |
|--------------|--|---|--------------|
| Client:      |  | Location:   |              |
| Surveyed By: |  | File Name:  | Scale:       |
| Drawn By:    |  | Project: GABION SAND STORAGE DAM; WATER SUPPLY BY GRAVITY FROM SAND STORAGE DAM |              |
| Designed By: |  | Drawing Title:  |              |
| Checked By:  |  | Drawing No:   | Rev:         |
| Approved By: |  | TYPE DRAWING X  | Sheet: 15/17 |

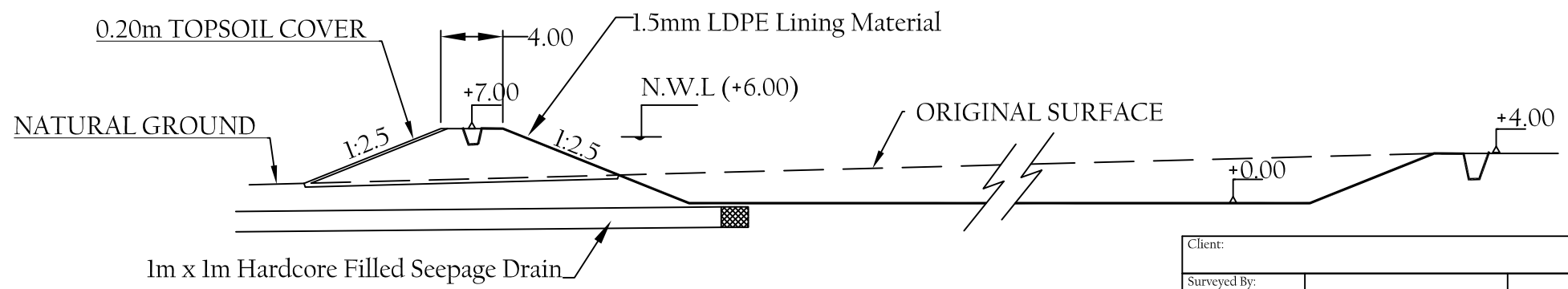
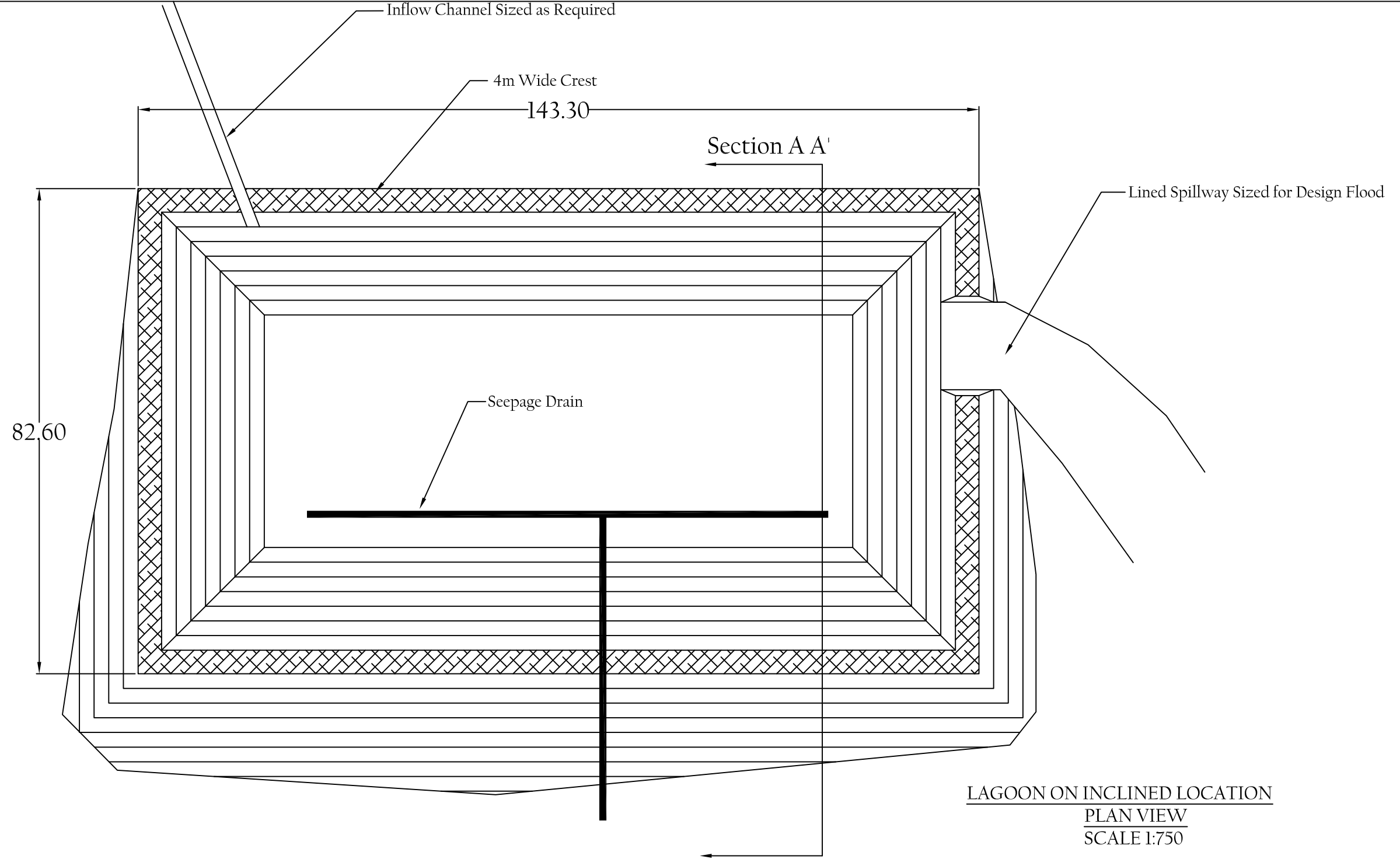


Notes:

- Weir constructed of Rubble Stone Masonry with 25% mortar to 75% rock.
- Mortar 1:3 mix with waterproof cement
- Weir to be bedded on firm rock throughout.
- Key to be cut into foundation material as shown
- Pipe positioned as shown with gravel filter. Scrap iron lugs should be welded on to fix pipe in wall.
- Weir Height not to Exceed 5.0m
- Weir Length not to Exceed 50m without buttressing
- Suitable downstream slope protection to be placed after construction
- Take additional advice for weirs over 3.0m tall or 30m long
- Keep Crest Width Constant based on Max Height

3 metre 3" GI with 4 times  $\frac{3}{8}$ " dia holes  
 Every 5cm. (offset each row 45 deg)  
 Include End Cap (pr similar arrangement)

|             |               |      |  |                  |                     |          |              |
|-------------|---------------|------|--|------------------|---------------------|----------|--------------|
| Client      |               |      |  | Standard Drawing |                     | Location |              |
| Surveyed by |               |      |  | Filename         | ALDEV Weir.dwg      | Scale    | Not to Scale |
| Designed by | ALDEV Project | 1950 |  | Project          | Standard ALDEV Weir |          |              |
| Drawn by    |               |      |  | Drg. Title       | ALDEV Cross Section |          |              |
| Checked by  |               |      |  | Drg. No.         | TYPE DRAWING XI     | Revision | A            |
| Approved by |               |      |  |                  |                     | Sheet    | 16/17        |



|              |  |  |                  |   |        |
|--------------|--|--|------------------|---|--------|
| Client:      |  |  | Location:        |   |        |
| Surveyed By: |  |  | File Name:       |   |        |
| Drawn By:    |  |  | Project:         |   |        |
| Designed By: |  |  | Drawing Title:   | LAGOON ON INCLINED LOCATION (38,000m <sup>3</sup> ) |        |
| Checked By:  |  |  | Drawing No:      | Rev:  | Sheet: |
| Approved By: |  |  | TYPE DRAWING XII |   | 17/17  |