
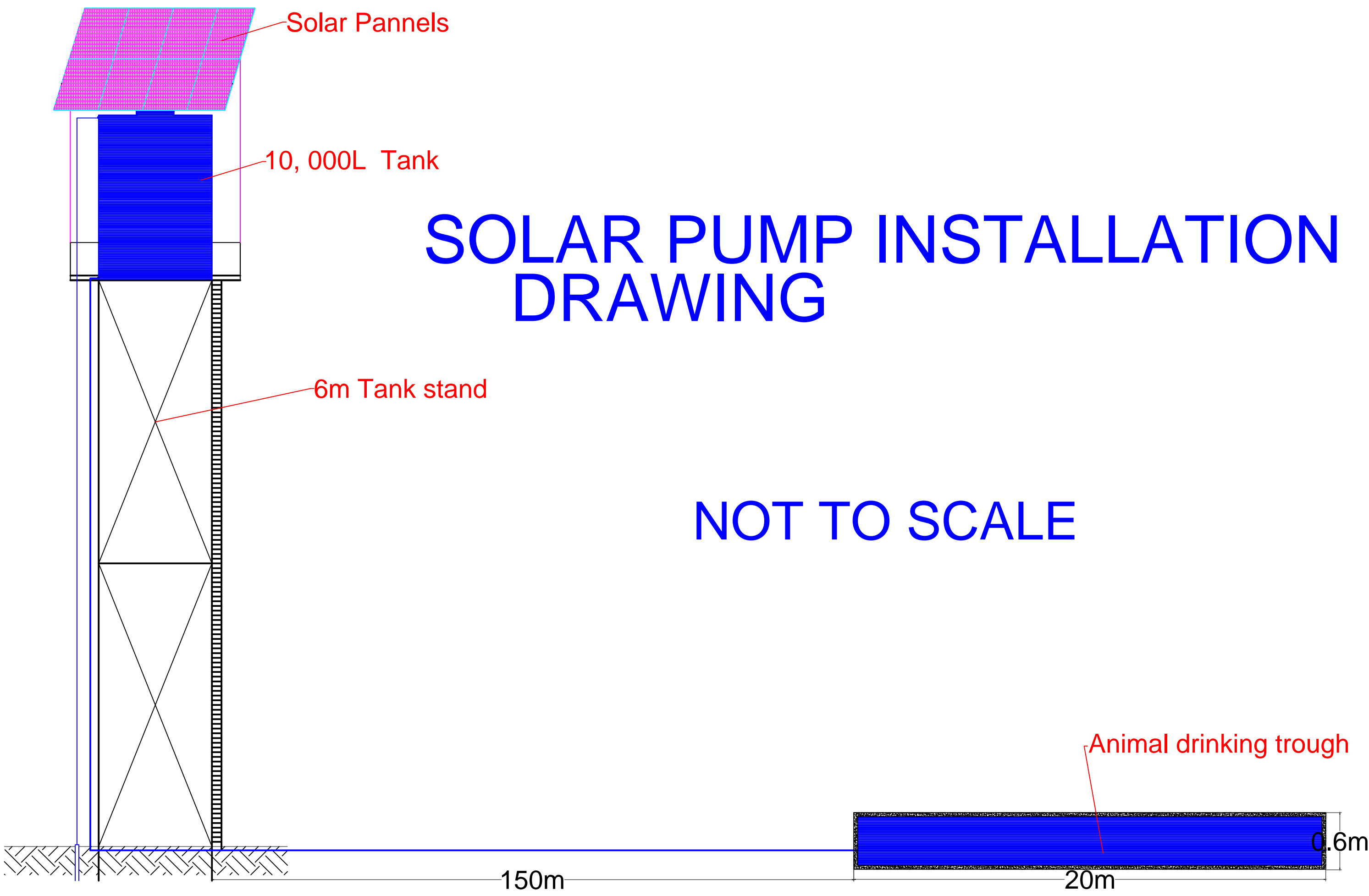
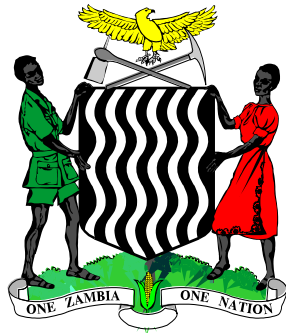


Oblast	Choma
Lokalita	Masopo
GPS koordináty	J 16,83261 V 27,10423 m.n.m. 1276
Činnost	4.3.1, 4.3.2
Popis technických prací	geofyzikální průzkum; realizace hydrogeologického průzkumného vrtu, konečný průměr vrtu 8", výstroj vrtu, obsyp a těsnění, zhlaví; hydrodynamická zkouška (čerpací 72h , stoupací 24h); dodávka a montáž technologie pro jímání podzemní vody (čerpadlo na solární energii, solární panely, měřicí a regulační technika, zásobník o objemu 20m ³) výtlačné a distribuční potrubí, odběrné místo, napájecí žlab.
Popis lokality	v širším okolí jsou v současnosti využívány mělké studny i vrty; lokalita je dostupná pro těžkou vrtnou techniku.
Související dokumentace	Masopo Design.dwg Masopo Report.pdf
Fotodokumentace	 <p>lokalita Masopo</p>

SOLAR PUMP INSTALLATION DRAWING



NOT TO SCALE



REPUBLIC OF ZAMBIA

MINISTRY OF WATER, SANITATION AND ENVIRONMENT PROTECTION

DEPARTMENT OF WATER RESOURCES DEVELOPMENT

REPORT

ON

MASOPO WATER SOURCES FOR FARM ANIMALS

OFFICE OF THE PROVINCIAL WATER DEVELOPMENT OFFICER

P.O BOX 630223

CHOMA

TEL. 26021322067

February 2017

COMPILED BY: T. MAKWAMBA

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1. INTRODUCTION

This report outlines the basic geological and hydrological survey done on the proposed water sources with regard to the recommendation by CZECH Republic Development Cooperation on Output 4. The main focus of the survey was to explore the inventory of wells (deep/shallow), brief description of pedology and geology, geological structure and geophysical survey of Masopo area.

2. INVENTORY OF WATER SOURCES

2.1 BOREHOLES

S/no	NAME	GPS READINGS		TOTAL DEPTH	SIZE	STATIC WATER LEVEL	REMARKS	TYPE OF PUMP INSTALLED
1	Nzumba Village	S 16.83396 ⁰	E027.11880 ⁰	30m	4"	9m	4Km away from proposed site	India Mark II
2	Sikalongo settlement	S 16.82647 ⁰	E027.09595 ⁰	54m	4"	20	3Km away from proposed sit	India Mark II

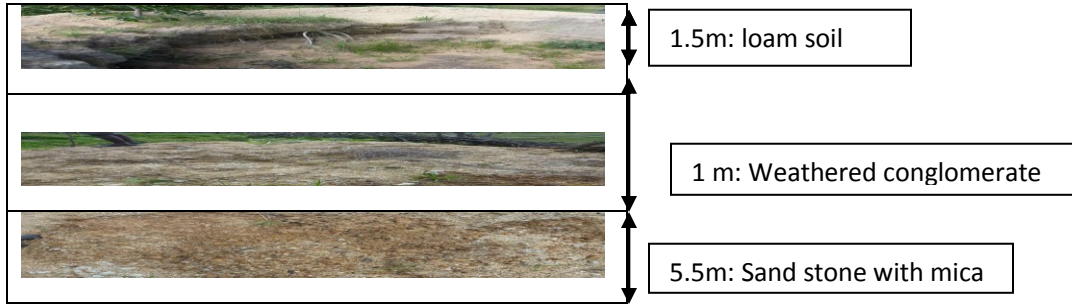
2.2 HAND DUG WELL

S/no	NAME	GPS READINGS		TOTAL DEPTH	SIZE	STATIC WATER LEVEL	REMARKS	TYPE OF WELL
1	Nzumba Village well	S 16.83379 ⁰	E027.11869 ⁰	5.5m	1.2m	2.6m	4Km away from proposed site and water finishes in June every year	Lined well
2	Siamungala Village well	S 16.83623 ⁰	E027.10371 ⁰	12m	1.2m	11.2	1.2Km away from proposed sit and water finishes in June every year	Lined well
3	Alex well	S 16.83182 ⁰	E027.10868	8m	1.5m	1m	Within proposed site and water finishes in September every year	Not lined well

3. PEDOLOGY AND GEOLOGY

The site condition's topography is a plateau, the geology is sand stone and the vegetation is short trees with grassland. Southern province including Choma – Masopo has low yielding aquifers with limited groundwater potential. These aquifers have discharge between 0 – 2L/sec due to low rainfall.

3.1 SOIL PROFILES



4. ANALYSIS

4.1 GEOPHYSICAL SURVEY

The geophysical survey was done to this area to ascertain the point with high ground water potential, how deep is the aquifers using the electrical – water relationship. This was done as well as to ascertain the kind of formation prevailing in in the chosen points using Werner spread configuration with the machine called Resistivity Meter (Japans make). Below are details of the survey.

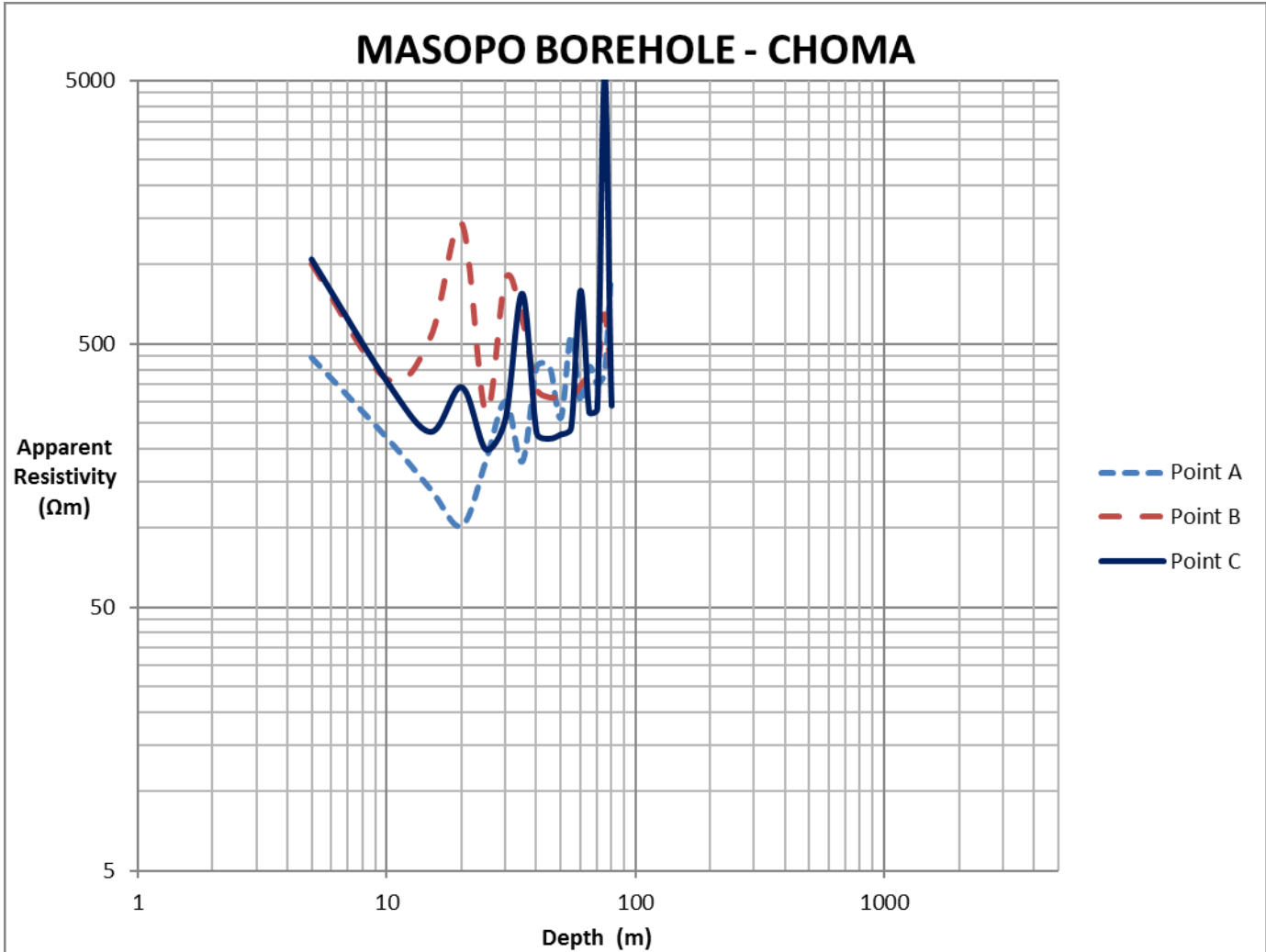
4.1.1 GEOPHYSICAL SURVEY DATA

MASOPO SITE

Choma District.

Depth (m)	A		B		C	
	Resistance (R)	Apparent Resistivity	Resistance (R)	Apparent Resistivity	Resistance (R)	Apparent Resistivity
5	14.180	445	32.230	1012	33.32	1046
10	3.515	221	5.900	371	5.748	361
15	1.490	140	5.653	533	2.458	232
20	0.809	102	11.500	1444	2.725	342
25	1.144	180	1.765	277	1.265	199
30	1.610	303	4.729	891	1.379	260
35	0.813	179	2.830	622	3.528	775
40	1.634	410	1.350	339	0.912	229
45	1.464	414	1.115	315	0.772	218
50	0.835	262	1.012	318	0.721	226
55	1.577	545	0.912	315	0.694	240
60	0.798	301	0.929	350	2.111	795
65	1.006	411	0.937	382	0.671	274
70	0.801	352	0.927	408	0.643	283
75	0.827	390	1.385	652	11.24	5294
80	1.840	924	0.739	371	0.58	291
85	1.204	643	0.635	339	0.578	309
90	0.000	0	0.000	0	0	0

4.1.2 GEOPHYSICAL SURVEY GRAPH



4.1.3 GEOPHYSICAL SURVEY REPORT

The general geological formation for the area as shown from the graph is sandstone ranging from loose to consolidated sandstone. If drilling is the preferred intervention, the recommended site is point number C drilled up to 80m. According to the results water is expected to be struck at 15m -30m, 40m – 55m and 65m – 70m respectively. The expected yield cannot be ascertained now due to other factors but the assumption can be gotten from the hydrogeological zone that the area falls in which is low yield (0 – 2L/sec.)

4.2 HAND DUG WELL

There are three Hand dug well in the area as shown above namely Nzumba, Alex and Siamungala which had water at the time of the survey. According to the community the water last only up August/September of each and every year, and the water quality is not good according to the community.

Pictures 1 & 2: Siamungala Well: GPS S16° 50' 14.52999", E027° 6' 13,300"



Pictures 3 & 4: Nzumba Well: GPS S16° 50' 6.0299", E027° 7' 6.6699"



Pictures 5 & 6: Alex Well: GPS S16° 50' 0.9700", E027° 6' 16.71"



4.2 BOREHOLES

There are two drilled borehole which are installed with India Mark II handpump about 4km from the site as shown above namely Nzumba and Sikalongo Settlement which were operation at the time of the survey. According to the community the water never finishes during the year, and the water quality is good.

Pictures 1 & 2: Nzumba Borehole: GPS S16° 50' 6.6399", E027° 7' 7.2200"



Pictures 1 & 2: Sikalongo Settlement Borehole: GPS S16° 49' 39.9999", E027° 5' 44.7700"



5. RECOMMENDATION

The water demand per day according to the number of cattle is 58 900 Litres per day. From the findings and analysis above the area has ground water potential which is in two categories that sub-surface (1 – 15) and groundwater (15 – 80m). The sub – surface water dries up every year between June and September meaning the option of hand dug well is not an option since it not sustainable and it is not recommended.

- The recommended source of water is drilling the borehole that can be used for this purpose not far from homes.
- The recommended water pumping device to be used is the solar driven pump because it is user friendly and able to meet the demand of the community. Installation of India Mark II pump is the second option depending of the available funds as shown on the Bill of quantities.
- Animal drinking trough should be constructed as a way of animals accessing water from the water source.

5.1 BILL OF QUANTITY

5.1.1 DRILLING A BOREHOLE AND INSTALL IT WITH SOLAR DRIVEN PUMP

S/NO	DESCRIPTION	QUANTITY	RATE (K)	AMOUNT (K)
1	Borehole drilling (80m), pumping test and water quality measurement	1	30, 000.00	30, 000.00
2	Supply and installation of solar pump and accessories	1	31, 815.00	31, 815.00
3	Supply and installation of solar panels (8) and the stand	1	18, 100.00	18, 100.00
4	Supply and installation of pipe network and accessories	Lumpsam	8, 000.00	8, 000.00
5	Supply and installation of tank	Lumpsam	8, 000.00	8, 000.00
6	Supply and installation of tank stand	Lumpsum	12, 000.00	12, 000.00
7	Construction of animal drinking trough	Lumpsum	10, 000.00	10, 000.00
8	Supervision (5%)			5, 895.75
9	Contingency (10%)			11, 791.5
	Total amount			135, 602.25

5.1.2 DRILLING A BOREHOLE AND INSTALL IT WITH SOLAR DRIVEN PUMP

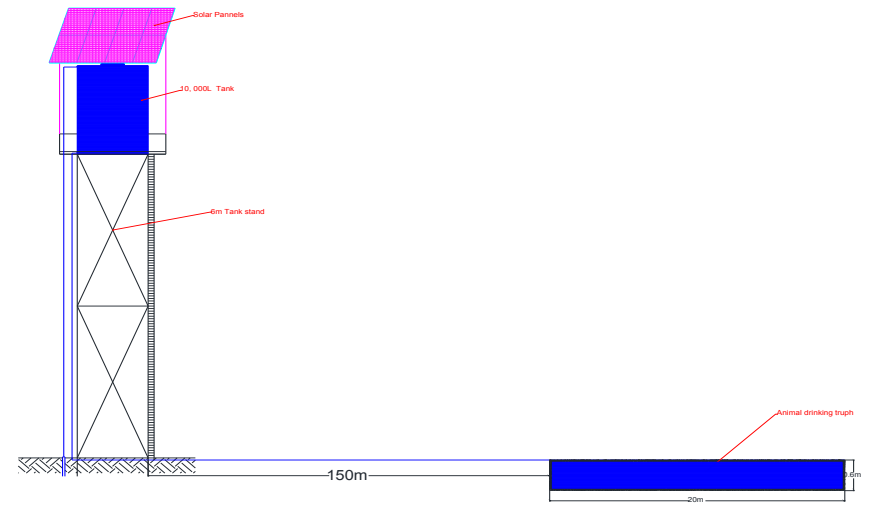
S/NO	DESCRIPTION	QUANTITY	RATE (K)	AMOUNT (K)
1	Borehole drilling (80m), pumping test and water quality measurement	1	30, 000.00	30, 000.00
6	Supply and installation of India Mark II pump	Lumpsum	10, 000.00	10, 000.00
7	Construction of animal drinking trough	Lumpsum	10, 000.00	10, 000.00
8	Supervision (5%)			2, 500.00
9	Contingency (10%)			5, 000.00
	Total amount			57, 500.00


6. CONCLUSSION

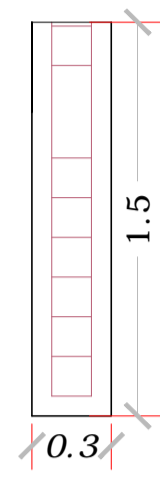
The building of water sources once implemented will help the identified communities in terms of house hold food security and mitigate the impact of climate change for small scale daily farmers. The country has no cases of landslides and the area Masopo doesn't experience floods.

Drilling of boreholes is what the government of the Republic Zambia promotes as well as installation of solar driven pump due to multiplicity use of water in rural communities.

7. DRAWING OF SOLAR SYSTEM INSTALLATION

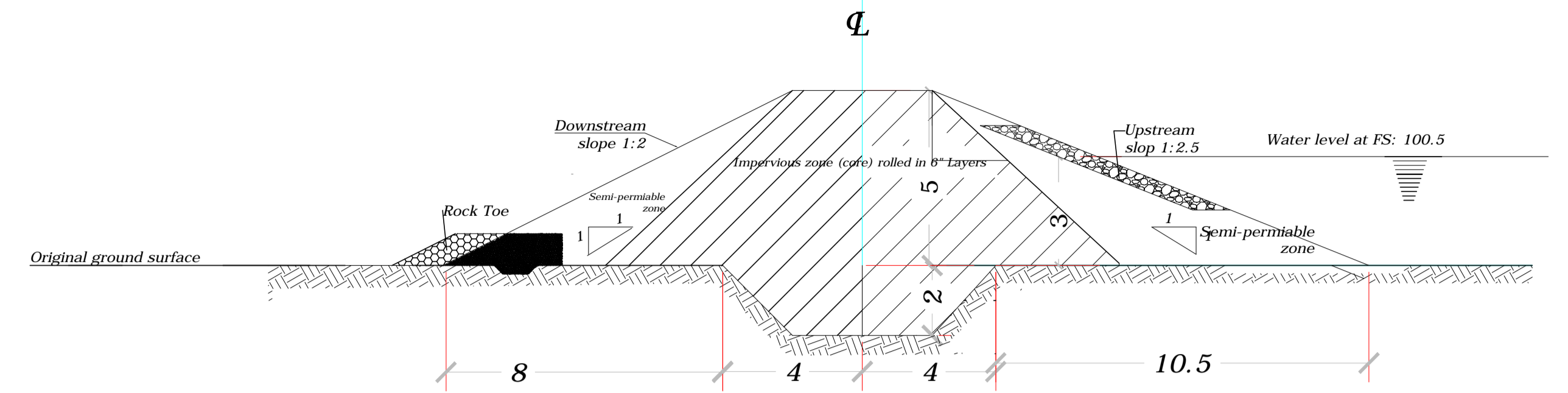


Oblast	Choma
Lokalita	Mutandalike
GPS koordináty	J 16,91729 V 26,93949 m.n.m. 1257
Činnost	4.3.1, 4.3.2
Popis technických prací	geofyzikální průzkum; realizace hydrogeologického průzkumného vrtu, konečný průměr vrtu 8", výstroj vrtu, obsyp a těsnění, zhlaví; hydrodynamická zkouška (čerpací 72h , stoupací 24h); dodávka a montáž technologie pro jímání podzemní vody (čerpadlo na solární energii, solární panely, měřicí a regulační technika, zásobník o objemu 20m ³) výtlačné a distribuční potrubí, odběrné místo, napájecí žlab.
Popis lokality	v okolí jsou v současnosti využívány mělké studny (cca 4m), které celoročně poskytují dostatek vody pro obyvatele; vydatnější zdroje podzemní vody lze očekávat v hlubších zvodněných horizontech; lokalita je dostupná pro těžkou vrtnou techniku.
Související dokumentace	Mutandalike Design.dwg Mutandalike Report.pdf
Fotodokumentace	 <p>lokalita Mutandalike</p>



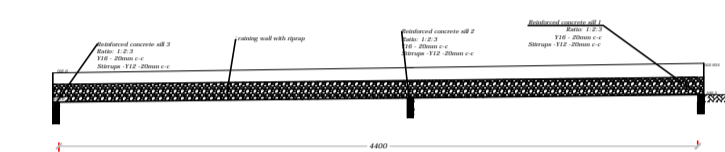
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DIMENSION IN METRES

Spillway sills

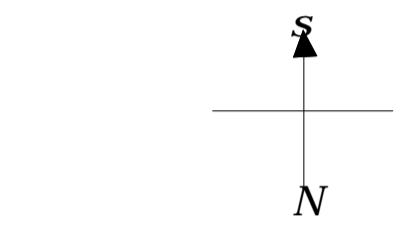


Cross section X-X

SCALE 1:30
DIMENSION IN METRES



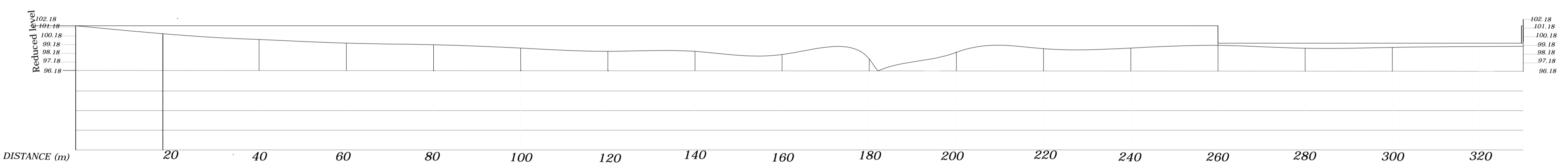
Longitudinal section of spillway Z-Z



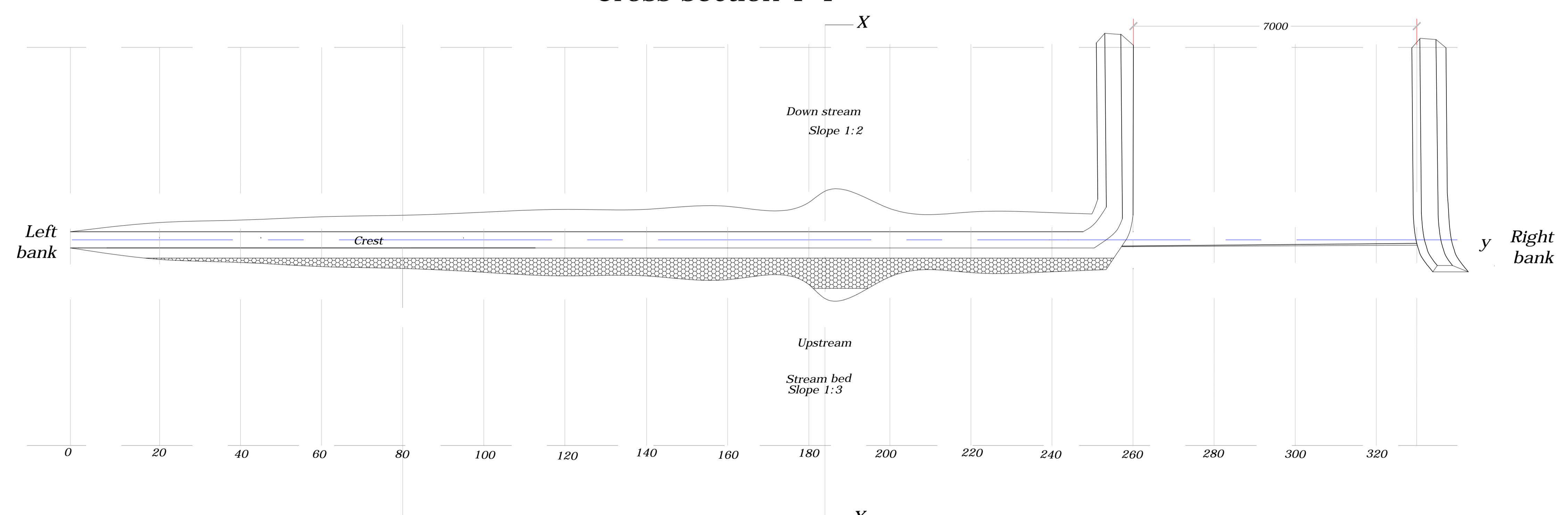
LOCATION MAP
TORY SHEET No: 1405 D4
GPS READING LEFT BANK: 33 X 423479
414080

CONSTRUCTION NOTES

- The following must be seen, inspected and approved by the Engineer before being covered:
 - Site Clearing and Stripping
 - Removal of tree stumps and roots from the site foundation
 - Removal of ant-hills and workings
 - River bed foundation preparation including removal of inferial material
 - Core trench excavation and backfilling
 - All the outlet works installations
 - Rock surface preparation under the core, heelwall and drop structures
 - Excavation and exploration of any joints, faults or faults in the rock, and their treatment
- The specified embankment densities are likely to be achieved by careful routing of construction machinery. Periodic tests, as specified, must be carried out to verify this, and if necessary additional measures, including moisture conditioning and/or extra compaction must be done.



Cross section Y-Y

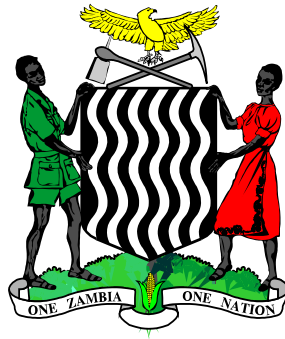


SCALE 1:0.91278
DIMENSION IN METRES

Dam design data

- Catchment Area: 35.175km²
- Catchment length: 9.55km
- Catchment slope: 1.64%
- Wet free board: 1.5m
- Dry free board: 0.5m
- Max Peak flood: 265.5m³/s
- Spillway width: 70m
- Earth volume: 9303m³
- Reservoir capacity:m³
- Embankment length: 260m
- Volume training wall: 2760m³
- Volume core trench: 3094m³
- Dam height@ cl: 5m
- Dam height@FSL: 3m
- crest width: 4m
- Training wall length: 80m

Min. of Water, Sanitation & Environmental Protection, Dept. of Water Resources Development, Southern Province	SURVEYED BY: T. Makwamba	DRAWN BY: T. Makwamba	APPROVED BY:
PROJECT: PROPOSED DESIGN FOR CHOMA MUTANDALIKE EARTH DAM- CHOMA DISTRICT	DATE: February, 2017	DESIGNED BY: T. Makwamba	DESIGNATION:
	SCALE: AS SHOWN ABOVE		DATE:



REPUBLIC OF ZAMBIA

MINISTRY OF WATER, SANITATION AND ENVIRONMENT PROTECTION

DEPARTMENT OF WATER RESOURCES DEVELOPMENT

REPORT

ON

CHOMA MUTANDALIKE WATER SOURCES FOR FARM ANIMALS

OFFICE OF THE PROVINCIAL WATER DEVELOPMENT OFFICER

P.O BOX 630223

CHOMA

TEL. 26021322067

February 2017

COMPILED BY: T. MAKWAMBA

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1. INTRODUCTION

This report outlines the basic geological and hydrological survey done on the proposed water sources with regard to the recommendation by CZECH Republic Development Cooperation on Output 4. The main focus of the survey was to do a detailed survey on the expected location for the dam/weir, exploration of dam shores, do a measurement or estimation flow rate of the river, brief description of pedology and geology, estimating the length of the flood area, geological structure and geophysical survey of Choma Mutandalike area.

2. INVENTORY OF WATER SOURCES

2.1 BOREHOLES

No information was gotten with regard to boreholes

2.2 HAND DUG WELL

- There is no hand wells in the area because the water table is low according information gotten from members of the community.

3. PEDOLOGY AND GEOLOGY

The site condition's topography is a plateau, the geology is basalt and the vegetation is scattered trees with grassland. Southern province including Choma – Mutandalike has as well low yielding aquifers with limited groundwater potential.

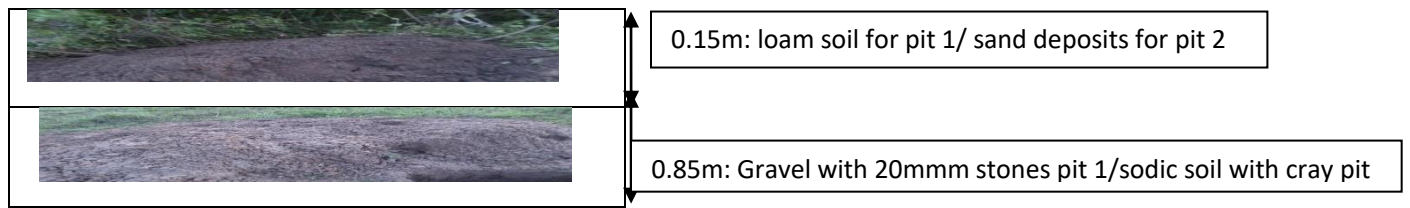
Picture showing the cleared dam centre liner shows: GPS S 16° 54' 59.4", E 026° 56' 16.0"



4. EXPLORATION OF DAM SHORES

- The dam shore were explored by excavation of four (4) pits; two on the right bank and two on the left bank. The pits dug had the following dimension, 0.5m width, 1m length and 1m depth and profiled

4.1 PIT 1 & 2 LEFT BANK SOIL PROFILES



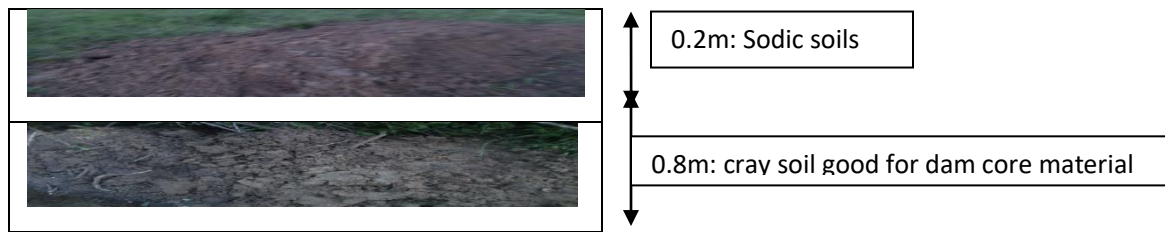
4.1.1 PIT 1 (S 16° 54' 59.2", E 026° 56' 20.6")



4.1.2 PIT 2 (GPS S 16° 54' 59.4", E 026° 56' 16.0")



4.2 PIT 3 & 4 RIGHT BANK SOIL PROFILES



4.1.1 PIT 3(S 16° 54' 59.4", E 026° 56' 15.7")



4.1.2 PIT 4 (GPS: S 16° 54'59.4", E026° 56' 13.9")



4.3 MEASUREMENT OR ESTIMATION FLOW RATE OF THE RIVER

- The flow measurement was done using the float method to get the stream's velocity and the stream area was measured.
- A. Maximum discharge : 3.33m³/sec ; between December & March every after a storm
- B. Mean discharge : 0.4m³/sec ; between December & April
- C. Lowest discharge : 0m³/sec ; between May & December

5. ANALYSIS

5.1 DETAILED SURVEY OF THE DAM SITE

The detailed survey was done and the design was done to ascertain the suitability of the site for the dam/weir construction. The survey was done using the dampy - level using the grid method in order come up with contour that were used for the design.

After the analysis of the data gotten, it was concluded that any earth could more ideal for this since the site meet all the requirement for earth dam construction. The area has good cray material which can be used for the dam construction within the e reservoir area that would as well increase the dam capacity.

All the design consideration was gotten from The Manual for Small Dams and the centre line was marked with beacon. The details or dimension of the dam has been given in the design drawing attached.

5.1.2 CATCHMENT YIELD

Average annual rainfall = 32 inches or 800mm

Catchment area = 35.175 km²

Catchment Length: 9.55km

Assuming that 30% of the rainfall will reach the dam site as runoff

$$\therefore y = 9.55 \times 1000 \times 1000 \times 0.8 \times 0.30 = 2,292,000\text{m}^3$$

MAXIMUM DESIGN

Time of concentration:

$$\begin{aligned} T_c &= (0.87 \times l^3/h)^{0.385} & L &= 9.55\text{km} = 9,550 \text{ metres} \\ &= (0.87 \times 9.55^3/76.2)^{0.385} & H &= 250 \times 0.3048 = 76.2\text{km} \\ &= 2.42 \text{ hours} \end{aligned}$$

Peak flood:

$$\begin{aligned} R &= 1.25 \log (CD/33.2) + 2.083 \\ &= 1.25 \log (20 \times 32/33.2) + 2.083 \\ &= 3.69 \end{aligned}$$

Area factor (fa) = 0.985

Average annual rainfall intensity (i)

$$\begin{aligned} I &= RF(a) / (t + \frac{1}{2}) \\ &= \frac{3.69 \times 0.985}{2.42 + \frac{1}{2}} = 1.247 \text{ inches} \end{aligned}$$

$Q_p = 0.278 \text{ APRCr}/T_c$

$$\begin{aligned} &= 0.278 \times 35.175 \times 240 \times 0.37 \times 0.74/2.42 \\ &= 265.5\text{m}^3/\text{s} \end{aligned}$$

A = 35.175km, R = 0.74

P = 240 CR = 0.37

Spillway width

Discharge over a broad crest weir

$$\begin{aligned} Q &= 1.71 \text{ cd.LH}^3/2 & H &= 2\text{m} \\ 265.5 &= 1.71 \times 0.61 \times L \times 2^3/2 & \text{cd} &= 0.61 \\ L &= 63.6 \text{ approx. } 70 \text{ metre} \end{aligned}$$

5.1.3 DAM DATA

Catchment Area.....	35.1755km ²
Catchment length.....	9.55km
Catchment slope.....	1.6%
Time of concentration.....	2.42 hours
Dam wall length.....	260m
Water depth at F.S.L.....	3m
Free board total.....	2 m
Wet free board.....	1.5m
Spillway (Right bank) width.....	70.0m
Maximum height of dam.....	5 m
Training wall length.....	80m
Core trench width.....	4.0 m
Throwback.....	m
Upstream slope.....	2.5:1
Downstream slope.....	2:1
Full supply level.....	99.18 m
Temporary Bench Mark Level (T.B.M).....	100. m GPS:s16 ⁰ 54'59,3", E 026 ⁰ 56' 20.9"
Maximum Design Flood	265.5m ³ /s
Embankment volume.....	9303.0m ³
Training wall volume to cut or placed.....	1034m ³
Volume of earthwork to be cut on spillway.....	1000m ³
Volume of earthwork to be cut on core trench.....	3094m ³
Dam water capacity F.S.L.....	m ³
Location sheet.....	1626 D4
River	Kanywabaumba
GPS Readings.....	RB S 16 ⁰ 54' 59.5", E 026 ⁰ 56' 13.3" LB S 16 ⁰ 54' 59.1", E 026 ⁰ 56' 21.3"

5.1.4 CAPACITY

The total dam capacity, areas and depths are as in the table below:

DEPTH BETWEEN CONTOURS (m)	SURFACE AREA (m ²)	VOLUME (m ³)	CUMULATIVE VOLUME (m ³)	REMARKS
0.5				River bed
0.5				Contour 96.18m
0.5				Contour 96.68m
0.5				Contour 97.18m
0.5				Contour 97.68m
0.5				Contour 98.18m
0.5				Contour 98.68m
0.5				Contour 99.18m

Therefore the dam capacity is about **m³**

5.2 GEOPHYSICAL SURVEY

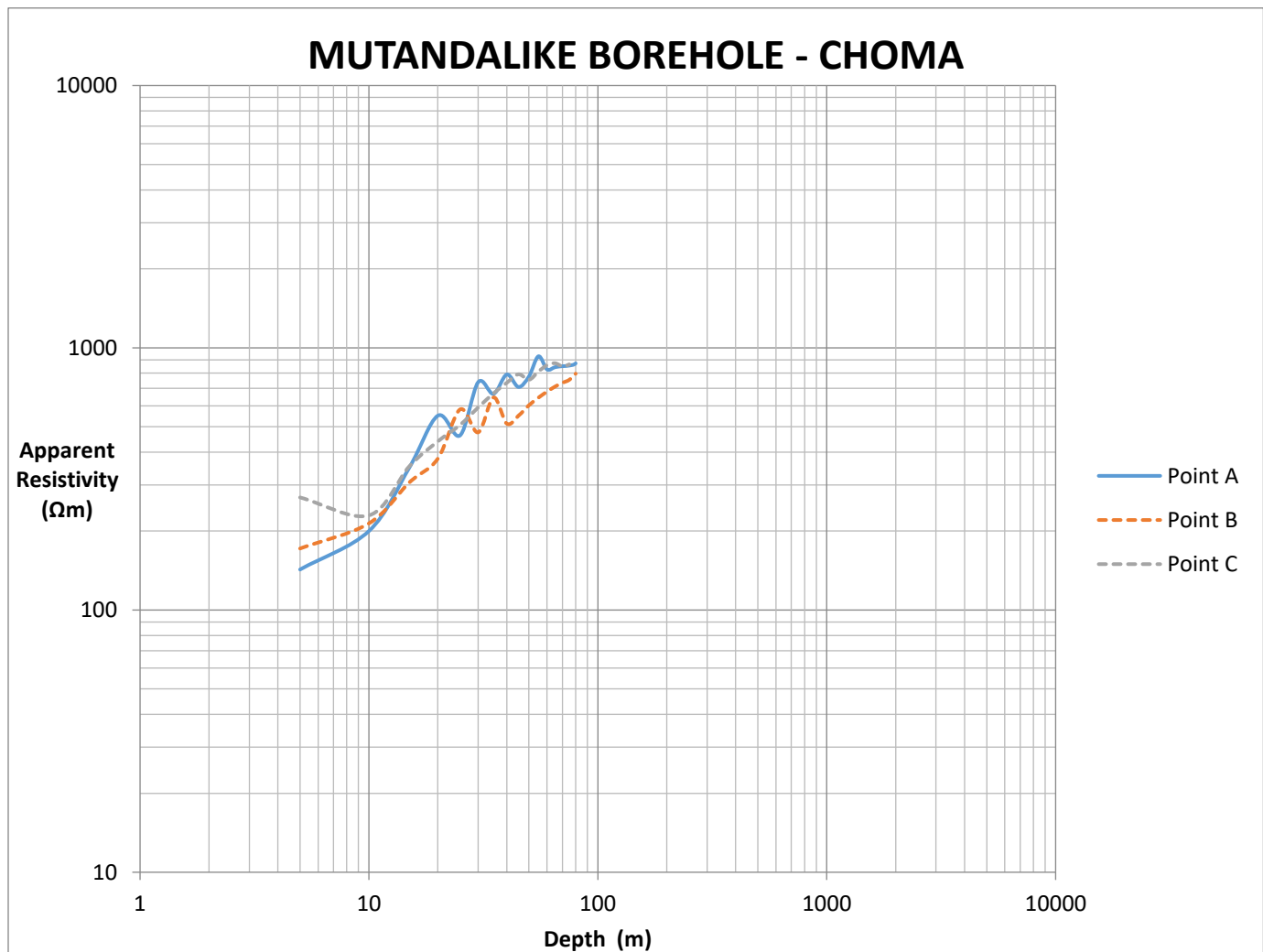
The geophysical survey was done to this area to ascertain the point with high ground water potential, how deep is the aquifers using the electrical – water relationship. This was done as well as to ascertain the kind of formation prevailing in in the chosen points using Werner spread configuration with the machine called Resistivity Meter (Japans make). Below are details of the survey.

5.2.1 GEOPHYSICAL SURVEY DATA

MUTANDALIKE SITE**Choma District.****1/30/2017**

Depth (m)	A		B		C	
	Resistance (R)	Apparent Resistivity	Resistance (R)	Apparent Resistivity	Resistance (R)	Apparent Resistivity
5	4.544	143	5.466	172	8.557	269
10	3.186	200	3.407	214	3.655	230
15	3.704	349	3.251	306	3.747	353
20	4.387	551	3.008	378	3.5	440
25	2.951	463	3.707	582	3.235	508
30	3.924	739	2.526	476	3.142	592
35	3.036	667	2.942	647	3.049	670
40	3.148	791	2.046	514	2.9265	735
45	2.508	709	1.949	551	2.804	792
50	2.475	777	1.922	604	2.405	755
55	2.687	928	1.868	645	2.351	812
60	2.195	827	1.806	681	2.277	858
65	2.066	843	1.742	711	2.139	873
70	1.935	851	1.672	735	1.933	850
75	1.816	855	1.602	755	1.835	864
80	1.736	872	1.586	797	1.774	891
85	1.776	948	1.552	828	0	0
90	0.000	0	0.000	0	0	0
95	0.000		0.000	0	0	0
100	0.000		0.000	0	0	0

5.2.2 GEOPHYSICAL SURVEY GRAPH



5.2.3 GEOPHYSICAL SURVEY REPORT

The general geological formation for the area as shown from the graph is basaltic ranging from weathered to consolidated. If drilling is the preferred intervention, the recommended site is point number B drilled up to 60m. According to the results water is expected to be struck at 25m – 55m respectively. The expected yield cannot be ascertained now due to other factors but the assumption can be gotten from the hydrogeological zone that the area falls in which is low yield (0 – 2L/sec).

6. RECOMMENDATION

The water demand per day according to the number of cattle is 122,200 Litres per day. From the findings and analysis above the area has ground water potential and surface water potential. From the analysis and water demand it is showing that ground water exploration not sustainable due to over whelming water demand of the area. However, the site for the dam is generally flat

- The earth dam be constructed as shown on the design drawing as a first option.
- The second recommendation is drilling a borehole and install it with pumping device to be used is the solar driven pump because it is user friendly and able to meet the demand of the community. Installation of India Mark II pump is the third option depending of the available funds as shown on the Bill of quantities.

6.1 BILL OF QUANTITY

6.1.1 DRILLING A BOREHOLE AND INSTALL IT WITH SOLAR DRIVEN PUMP

S/NO	DESCRIPTION	QUANTITY	RATE (K)	AMOUNT (K)
1	Borehole drilling (80m), pumping test and water quality measurement	1	30,000.00	30,000.00
2	Supply and installation of solar pump and accessories	1	31,815.00	31,815.00
3	Supply and installation of solar panels (8) and the stand	1	18,100.00	18,100.00
4	Supply and installation of pipe network and accessories	Lumpsam	8,000.00	8,000.00
5	Supply and installation of tank	Lumpsam	8,000.00	8,000.00
6	Supply and installation of tank stand	Lumpsam	12,000.00	12,000.00
7	Construction of animal drinking trough	Lumpsam	10,000.00	10,000.00
8	Supervision (5%)			5,895.75
9	Contingency (10%)			11,791.5
	Total amount			135,602.25

6.1.2 DRILLING A BOREHOLE AND INSTALL IT WITH HANDPUMP

S/NO	DESCRIPTION	QUANTITY	RATE (K)	AMOUNT (K)
1	Borehole drilling (80m), pumping test and water quality measurement	1	30,000.00	30,000.00
6	Supply and installation of India Mark II pump	Lumpsam	10,000.00	10,000.00
7	Construction of animal drinking trough	Lumpsam	10,000.00	10,000.00
8	Supervision (5%)			2,500.00
9	Contingency (10%)			5,000.00
	Total amount			57,500.00

6.1.3 CONSTRUCTION OF EARTH DAM

**BILLS OF QUANTITIES FOR THE CONSTRUCTION OF CHOMA
MUTANDALIKE DAM****ENGINEERS' ESTIMATE:****BILL NO 1 PRELIMINARY AND GENERAL**

Item	Clause	Description	Unit	QTY	Rate(ZK)	Amount (ZK)
1..1		Mobilization, including but not limited to preparing, transporting and erecting constructional plant, equipment, offices, field laboratory on site, and preparatory works in commencing the execution of the works, including clearing and grubbing maintenance and upkeep of construction road, and bonds, insurances, fees, permits, and the like	L.S	Each	32,00 0.00	32,000.00
1..2	107	Site meetings, including but not limited to refreshments, fuels and any other requirements	L.S	-	30,00 0.00	30,000.00
1..3		Demobilization, including but not limited to removing and shipping construction plant and equipment, returning staff, removing temporary works, and cleaning the site as specified	L.S	Each	32,00 0.00	32,000.00
		TOTAL FOR THIS SHEET				94,000.00

BILL No 3 SITE CLEARING

Item	Clause	Description	Unit	Quantity	Rate(ZK)	Amount (ZK)
3..1	2103	Site clearance in the spillway area and dispose of material to environmentally friendly area	m ²	5,600	15.00	84,000.00
3..2	2104	Cut, Clear and Grabing of vegetation on the for embankment)	m ²	10,500	5.50	57,750.00
		TOTAL FOR THIS SHEET				141,750.00

BILL No 4 EMBANKMENT AND SPILLWAY CONSTRUCTION

Item	Clause	Description	Unit	Quantity	Rate (ZK)	Amount (ZK)
4.0	2102	Common excavation of cut-off trench and dispose of material as specified.	m ³	3,094	45.00	139,230.00
4..1	2103	Foundation treatment of cut off trench as specified	m ²	1,500	4.00	6,000.00
4..2	2104	Excavate spillway and level the approach and tail and make good of the slopes and dispose of material as specified	m ³	1,000	45.00	45,000.00
4..3	2105	Supply, place, compact and trim topsoil on slopes and crest of the embankment as specified.	m ³	9,303	60.00	558,180.00
4.4	2105	Excavation of cut off trench in rock (provisional item)	m ³	250	85.00	21,250.00
4.5	2105	Foundation treatment of area for the spillway	m ²	200	75.00	15,000.00
4..6		Supply, plant and maintain grass on top-soiled areas as specified	m ²	3,114	40.00	124,560.00
4..7	2109	Provide grout stone pitching to side walls or cascades along the spillway as specified	m ²	861	150.00	129,150.00
4.8		Supply and place geofabric in blanket drain and toe drain as specified	m ²	40	35.00	1,400.00
4..9		Supply and place coarse filter material for toe drain as specified	m ³	30	60.00	1,800.00
4..10	2109	Concrete class A - ³ / ₄ (19) for sills across the spillway, and cut-off wall as specified,	m ³	50	1,500.00	75,000.00
		TOTAL FOR THIS BILL				977,340.00

**COLLECTION PAGE BILL OF
QUANTITIES**


**SUMMAR
Y**

Bill No 1	PRELIMINERY AND GENERAL	ZK	94,000.00
Bill No 3	SITE CLEARING	ZK	141,750.00
Bill No 4	EARTHWORKS, DAM FILL AND SPILLWAY	ZK	977,340.00
	Sub Total	ZK	1,213,090.00
	10% Contingency	ZK	121,309.00
Total for Contract to Form Tender		ZK	1,334,399.00
5% Engineer's Monitoring and Supervision		ZK	66,719.95
Total for Cost of Project		ZK	1,401,118.95

7. CONCLUSION

The building of water sources once implemented will help the identified communities in terms of house hold food security and mitigate the impact of climate change for small scale daily farmers. The country has no cases of landslides and the area Choma Mutandalike doesn't experience floods.

Construction of small hydraulic structures or dam is as well what the government of the Republic Zambia is promoting to increase drought resilience amongst small scale beef or daily farmers.

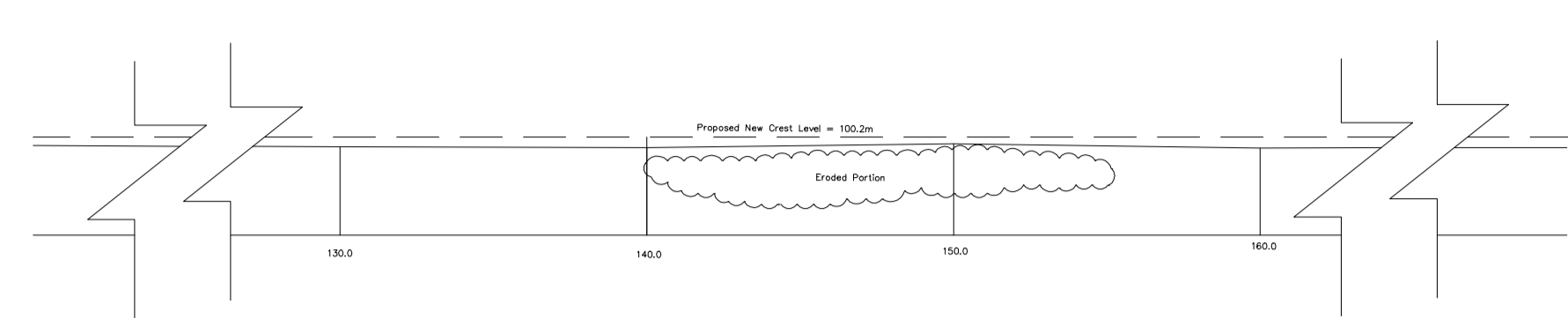
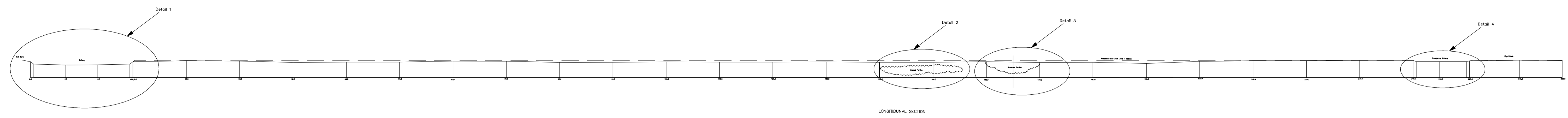
Oblast	Monze
Lokalita	Siggubu
GPS koordináty	J 16,21598 V 27,38832 m.n.m. 1075
Činnost	4.3.1, 4.3.3
Popis technických prací	geotechnický průzkum; oprava protržené části hráze (v délce cca 25m; stupňovité napojení na neporušené a vhodné zeminy, dosypání vhodným materiálem); oprava částí hráze s detekovanými poruchami (viz příloha 3 tohoto dokumentu) a odtěžba nevhodných zemín z tělesa hráze a jejich nahrazení vhodným materiálem; odtěžba nevhodných zemín a dosypání návodní strany hráze vhodnými zemínami; provedení opevnění návodní části hráze; oprava přelivu a bezpečnostního přelivu; odstranění náletové vegetace z tělesa hráze; průběžné hutnění vrstev zemín ve vrstvách max. 10-15cm; monitoring kvality prací - objemové zkoušky za účelem prokázání požadované míry hutnění materiálů; odtěžba dnových sedimentů nebo zvýšení koruny hráze (cca 240 m).
Popis lokality	hráz postavena v roce 1962, její návodní strana poškozena v celé délce snosem materiálu v důsledku vodní eroze, v lednu 2015 došlo k protržení hráze v délce cca 15 metrů, zřejmě v důsledku subhorizontálně uložené propustnější vrstvy zemín; hráz je porostlá křovinami i vzrostlými stromy; vzdušná strana hráze nevykazuje průsaky tělesem hráze; lokalita je dostupná pro těžkou techniku.
Související dokumentace	Siggubu Design.pdf Siggubu Report.pdf
Fotodokumentace	
	Návodní strana hráze



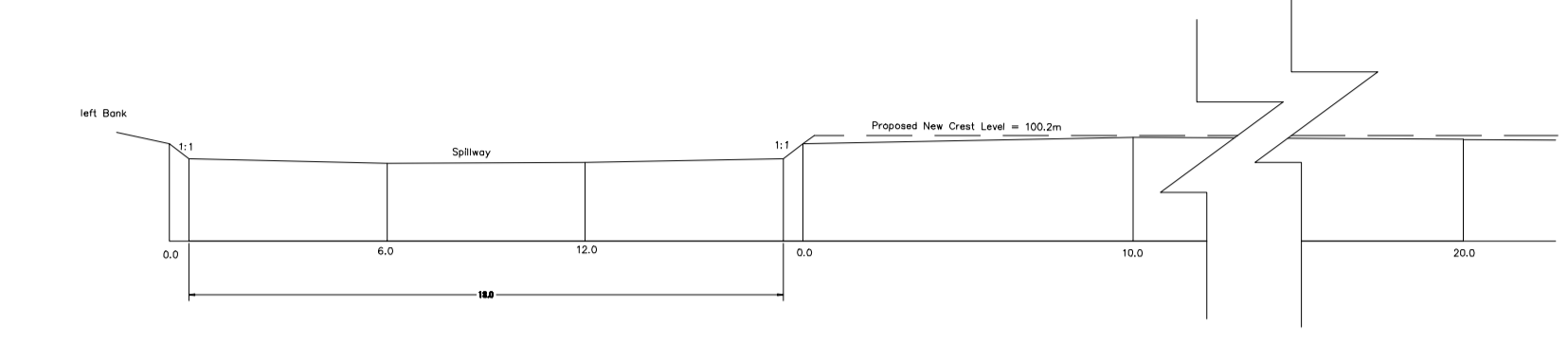
Protržená část hráze



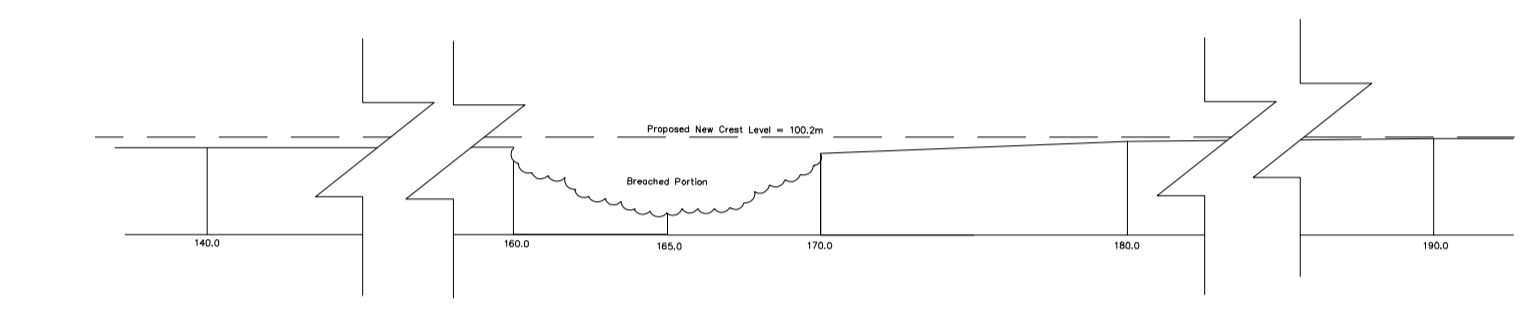
Vzdušná strana hráze



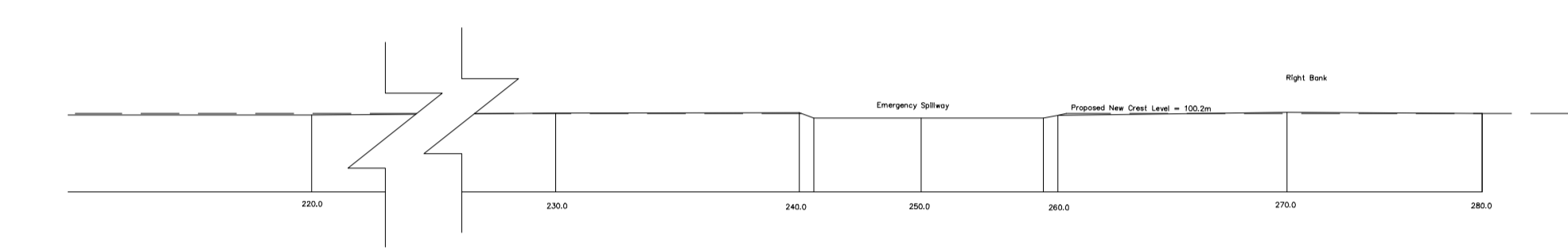
DETAIL 3



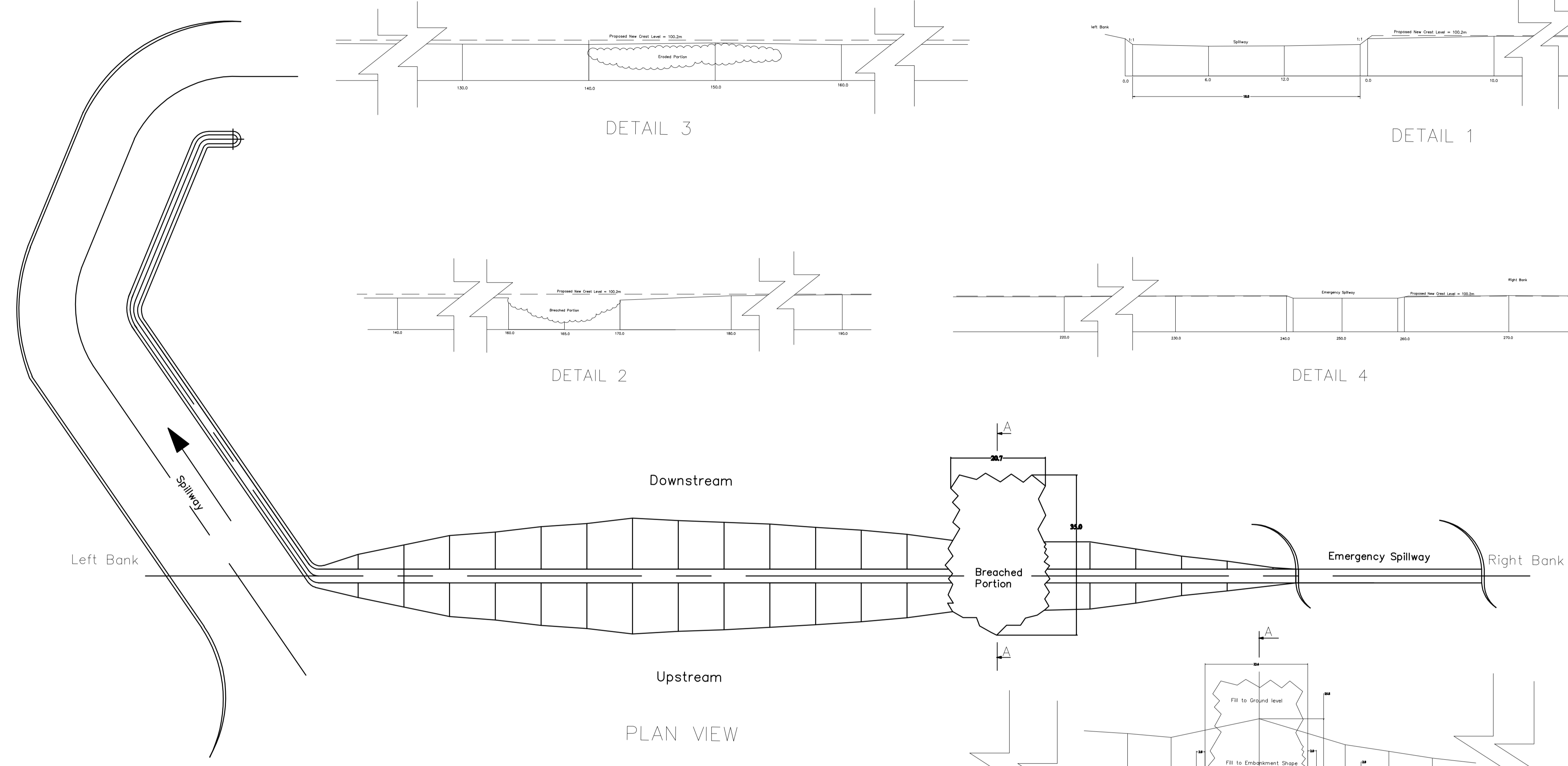
DETAIL 1



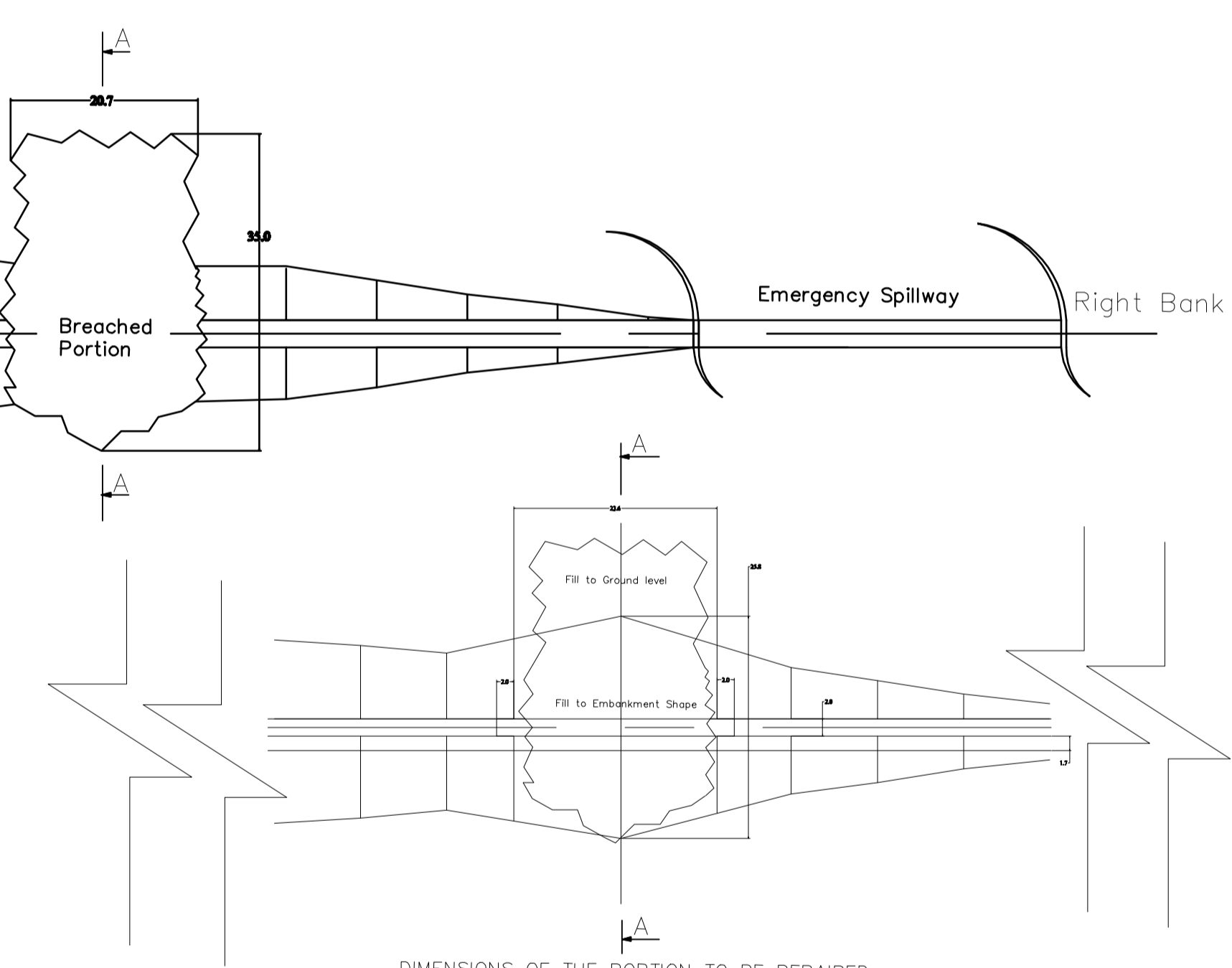
DETAIL 2



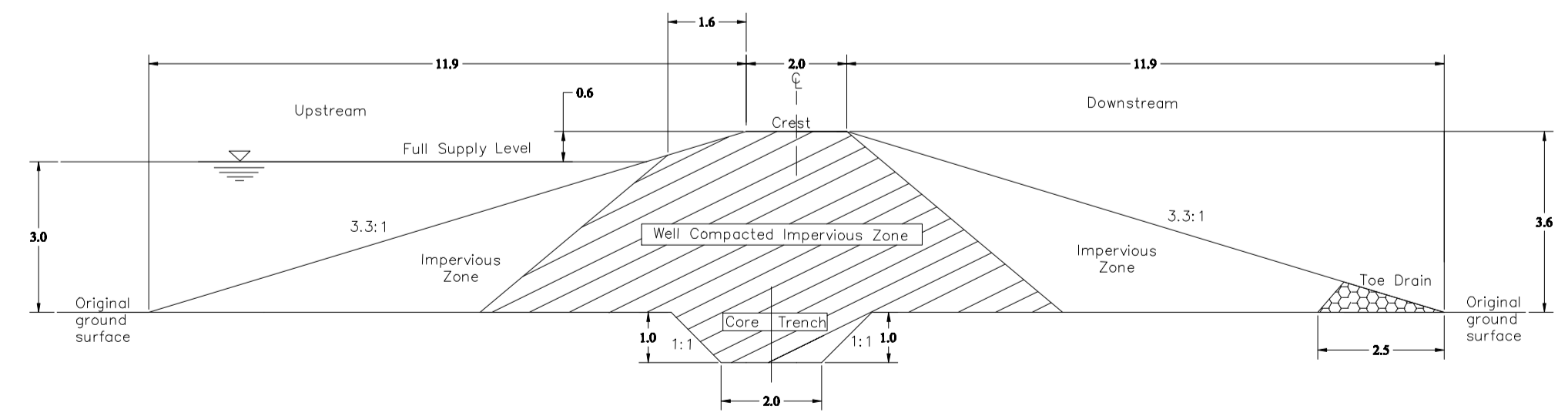
DETAIL 4



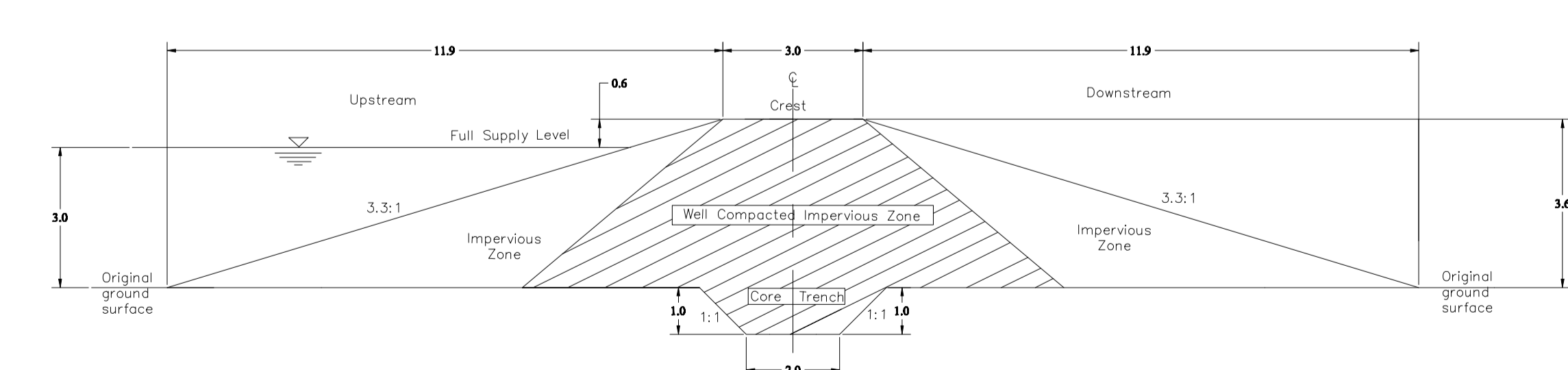
PLAN VIEW



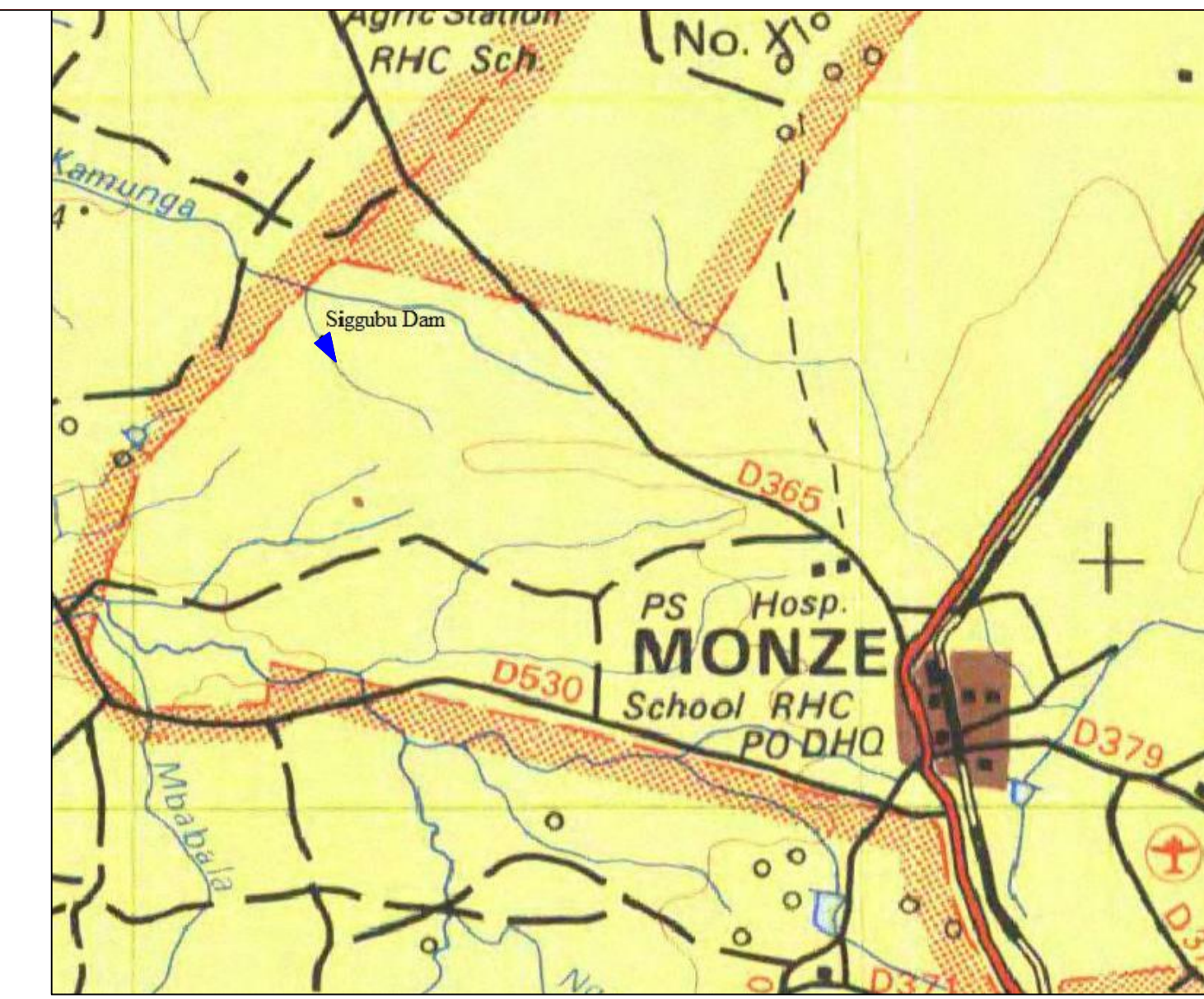
DIMENSIONS OF THE PORTION TO BE REPAIRED



CROSS SECTION A-A AS PROPOSED REPAIRS



CROSS SECTION A-A AS ORIGINAL DESIGN



DAM DATA

Catchment area:	3.8km ²
Catchment length:	2.24km
Catchment slope:	2.2%
Total dam height:	3.6m
Length of dam:	240m
Length at F.S.L:	215m
Throw back:	0.44km
Crest width:	3.0m
Dam height to spillway:	3.0m
Spillway width left bank:	18.0m
Upstream slope:	3.3:1
Downstream slope:	3.3:1
Embankment volume:	5,600m ³
Maximum flood:	32.84m ³ /s
Estimated amount of water for use:	46,000m ³
Available water for use:	18,000m ³
G.P.S location:	S16°13'13.1" E027°23'54.7"
Stream:	Tributary to Kamunga
Type of stream:	Non-perennial
Purpose:	Animal Watering, Irrigation and Fish Stocking.
Average rainfall:	800mm
Formation:	Laterites/quartzite

- NOTES:
- The repairs to be done at the time of the water level is at it's lowest and allowing more time before rainy season.
 - All loose and poor soils must be removed from the surface of the embankment - Suitable soil material must be placed and compacted in layers of 150mm to repair the breached portion.
 - The upstream should be sliced to a reasonable slope and thereby reducing the crest width to 2 metres.
 - The crest level should be raised (built) to 100.2 metres.
 - Ant-workings found, must be suitably treated with a recommended fumigant, dug-out and the excavations backfilled in layers with good soils. All shapes must be retored to the reasonable design shape.
 - A toe-drain must be constructed on the downstream.



Surveyed by: J. Ngambi	Title: Proposed Rehabilitations of Sigubu dam
Drawn by: J. Ngambi	District: Monze
Approved by: M. Sinfukwe	Date: February, 2017.
Designed by: J. Ngambi	Ownership: Community