DRAFT REPORT

FEASIBILITY STUDY TO NYITAWUTA NEAR AKATSI (Volta Region) TO ESTABLISH THE APPROPRAITENESS OF A SITE FOR MINI DAM CONSTRUCTION

29th January 2020

1.0 INTRODUCTION AND BACKGROUND

Home of Care and Protection (HOCAP) based in Tema, Ghana is an NGO that assists communities in need to develop their wellbeing in the area of health, agriculture and community development. HOCAP employs about xxxxx members who are dedicated to improving the wellbeing of communities throughout Ghana. As part of their mission and meeting their objectives, HOCAP contacted this technical team made of hydrologists and water resources engineers for an assistance.

As background the technical team received a call from a friend Engineer on Wednesday 15th January seeking /assistance on the possibility of an NGO by name Home of Care and Protection (HOCAP) for assistance on mini dam construction at a site. We got in touch with HOCAP for discussion. After briefing by the Founder of HOCAP, it became clear that they needed assistance with mini dam development at a village called Nyitawata in the Dapka District of the Akatsi North in the Volta Region for irrigation development. Following discussions a team of two Technical Engineers paid a visit to the site on Tuesday 21st January, 2020.

1.1 Objectives of study

The main objectives of this study are in two folds: 1) is to assess the feasibility of the development of a mini irrigation earth dam for the people of NYITAWUTA; and 2) To aid and supervise the development of the proposed dam

The specific objectives for (1) are,

- undertake a reconnaissance visit to the area to get first hand information on the area with regard to the main objective
- estimate levels/gradients of the area (Preliminary Survey)
- source of water that may feed the dam
- types of soils of the area to aid borrow areas and foundation conditions for dam design and where to get core materials for the dam
- establish the appropriateness of the area for a mini dam a development

Specific objectives for (2) are:

- Establish the catchment yield for the proposed earth dam

- Compute Storage Capacity of the dam
- Determine preliminary volume of earth works to be excavated
- Compute catchment area and spillway dimension
- Design the proposed earth dam
- Supervise the construction of the earth dam

2.0 STUDY AREA

The NYITAWUTA village (coordinates 06.32947^{o}N and 000.77470^{o}E) with altitude around 59m falls in the Akatsi North District (Figure 1) of the Volta Region (Akatsi North District, 2015). It is one of the newly established Districts in the Volta Region. The district capital is Ave-Dakpa. The District was established by L.I. 2161 in 2012.The District is located in the south eastern part of the Volta Region and has an approximate land area of 324 km2 and is bounded in the south by Akatsi South District and to the east by Ketu North, to the west is Akatsi South, and to the north by Agortime Ziope Districts and Republic of Togo. The District has about 132 communities. The survey of demographic characteristics of the district conducted in 2010 population and housing census and collation from community water and sanitation agency population data is estimated at 44,961 with a breakdown of 46%(20,683) males and 54%(24,278) females. 11,926 constitute the urban population with 33,035 being the rural population. Economically, agriculture is the main stay of the Akatsi North District of which 67% of the population is into agriculture. The remaining are into mining and quarrying, construction, manufacturing and the services sector. The District is predominantly agrarian and boasts of the production of food crops such as cassava, tomato, carrot, pepper, maize, sweet potatoes and pineapple. Maize is the staple food of the Ave people, and thus there is a festival, “Ave Bliza” to mark this on an annual basis.The major road in Akatsi North District is the road that links Dakpa to Ho and Denu.There are a number of feeder roads which also link towns and villages to Dakpa. The Ho-Dakpa-Denu road is the only first class road in the District. The extent of road development is not satisfactory in terms of average road length, quality and distribution.

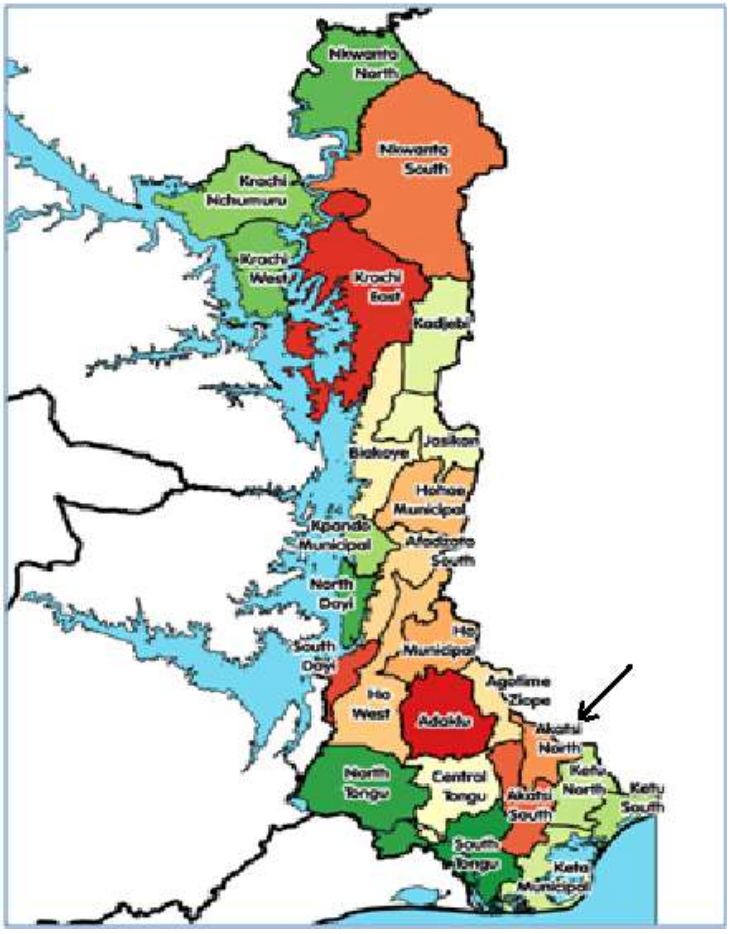

Figure 1: The Akatsi North District

3.0 MATERIALS AND METHODS

3.1 Reconnaissance Visit

A reconnaissance trip was arranged by the Founder of HOCAP and was undertaken by the combined technical team and the Founder on 21st January, 2020 to ascertain the prevailing field conditions at the proposed project area. The Founder organized a few local people to assist with the visit which included the District Assembly Officer of the area. Pleasantries were exchanged. The place where the proposed dam was being envisaged was visited. Interactions with the community members was undertaken to understand and comprehend what the project was all about. Also visits were made to nearby small earth dams to see how they work and also land survey work and soil sampling for laboratory analysis were undertaken

3.2 Land Surveying

The landscaping was examined and identified areas earmarked for surveying to establish the levels of those points. The instruments Automatic level by Sokkia (TTL6), Differential GPS by Trimble GeoXH and hand held GPS by GAMIN were employed in this exercise. Survey points were surveyed at 10m intervals using the *rise and fall survey method* (Figure 2).

Figure 2: Leveling at dam site

The schematic plan view of the profiling is shown in Figure 3. Elevations of the area were made taking into consideration changes in elevation along the landscape from the highest points and the lowest points. These measurements were used to develop the profiles for the dam design.

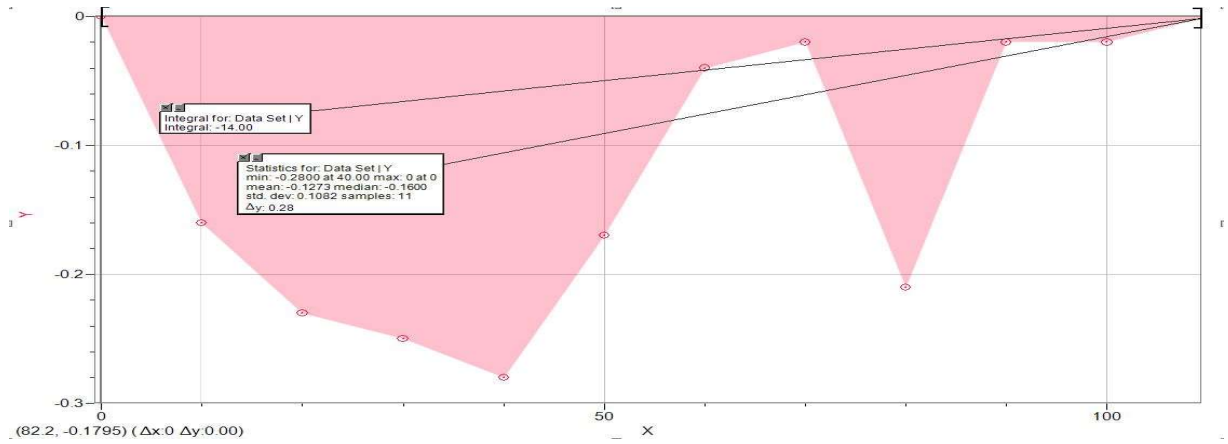

Figure 3: Cross section profile of the dam site

3.3 Soil Sampling

Soil samples (Figure 4)were taken at depths 20-50-80 cm per point at three different spots. Samples collected were bagged and labeled for laboratory analysis at the CSIR-Sediment lab. Analysis was undertaken using the United States Department of Agriculture (USDA) Classification method i.e. the *trilinear triangle method*.

Figure 4: Soil sampling at the dam site

3.4 Catchment yield

Catchment yield "Y" will be calculated based on the expected annual runoff from the catchment area and is an important factor in assessing the feasibility of a dam and determining the required height of the embankment. In this report the equation

$$\boldsymbol{Y = Rr\ x\ A\ x\ 1000}$$ (FAO, 2010)

where **Rr** is the (10% of annual rainfall of the catchment)
A is Catchment Area in km^2 upstream of the proposed embankment

3.5 Storage Capacity

Will be computed with the formula

$$\boldsymbol{Q = \frac{LTH}{6}}$$

Where **Q** is the storage capacity in m^3 and should not exceed Y above

L is the length of the dam wall at full supply level (FSL) in m.
T is the throwback, in m and approximately in a straight line from the wall.
H is the maximum height of the dam, in m, at FSL
6 is a factor (conservative generally) that can be adjusted (to 5 or 4) with experience and local knowledge.

3.6 Preliminary Volume of earth works to be excavated

The volume of the earth works can be estimated as follows:

$$V = 0.216\,HL\,(2C + HS)$$

Where:

V is the volume of earthworks in m3.
H is the crest height (FSL+ freeboard) of the dam in m.

L is the length of the dam, at crest height H, in m (including spillway).
C is the crest width in m.
S is the combined slope value.

4.0 RESULTS AND DISCUSSIONS

4.1 Reconnaissance Visit

The Technical team arrived in Akatsi-**NYITAWATA** on the 21st of January, 2020 at approximately 9:45am. The first point of call was to visit a community mini dam at Kporher (coordinates, 6.33851ºN and 0.77907ºE, Alt 56m)). The group interacted with locals (that included the assembly man of the area and two others) (Figure mmm) and Madam Barbara the Founder of HOCAP to understand the terrain, when the dam was built, why the use of the dam water though there is a borehole in the area. On why the use of dam water at this area they answered that the borehole water was hard and therefore they visit the dam site to fetch for domestic washing. There were no visible streams around but the community members said the dam water was just rainfall runoff water.

The visit continued to the intended site at NYITAWUTA (coordinates 06.32947ºN and 000.77470ºE) with altitude around 59m. Here, more volunteers from the village joined to assist the reconnaissance visit. The team was ushered to the proposed site the community had earmarked for the development should the place be found appropriate. Our initial observations was that the place may be suitable having in mind the pre conditions mentioned above.

4.2 Land Surveying

At the site, minimal clearing of land was undertaken to cut pathways for the survey instruments. Thereafter, some land survey measurement (with instruments as: Automatic level by Sokkia (TTL6), Differential GPS by Trimble GeoXH and hand held GPS by GAMIN) was undertaken (figure A) to establish the levels of the area. Results of these survey are shown in Figure B.
Slopes were observed to be generally gentle with a rise of about 1-2m over about 200 meters indicating that the slopes are very gentle.

4.3 Soil Analysis

The soil analysis showed (Table 1) that the soils are mainly sandy clay loams to clay. .

Table 1: Soil type at the dam site

Sample ID (Depth)	Clay Fraction	Silt Fraction	Sand Fraction	Gravel Fraction	Soil Texture
	(%)	(%)	(%)	(%)	(USDA)
0-20cm	28	8	64	0	Sandy Clay Loam
20-50cm	38	10	52	0	Sandy Clay
50-80cm	40	17	43	0	Clay

4.4 Catchment yield

From computation of the catchment yield by clipping the drainage area from using ArcGIS tool,

Rr =120mm,

A= 4.5km^2

$\boldsymbol{Y = Rr\ x\ A\ x\ 1000}$ = **540,000m^3**

4.5 Storage Capacity (Q)

Storage capacity was computed with the following data taken from design (Appendix A)

L=250m

H=2.5m

T=100m

Q=562, 500m^3

4.6 Preliminary Volume of earth works to be excavated (Appendix B)

The computations of this gave 851m^3 (about 43 trucks of capacity 20m^3 each) with embankment slopes of 1:2 and 1:1.75 giving an S=3.75

5.0 PRELIMINARY ASSESSMENT:

From the knowledge acquired on the field it is established that the place will be suitable for excavation for mini dam development as signs picked from the field indicated that that place was water locked during rainy season period. Also it was established through the interactions with the village folks that at the peak of the rainy season the road network gets inundated with water to

depths of around 80cm to 1m indicating enough water for impoundment. Slopes were observed to be generally gentle i.e. ranging between 0-2%. The visit did not establish the existence of any stream because the visit was done in the dry season, however, it was noted that the water that floods parts of the field during the rainy season are runoff water from rainfall. Average annual rainfall for the area is about 1200mm.

Soil samples taken at depths of about 80 cm (Table 1) established from soil test that the soils ranged between sandy clay loams to clayey soils. With the knowledge that the soils are clayey the characteristics of the core or borrow materials will be appropriate for dam construction. Physical signs of soil cracks were noticed indicating clayey soils confirming the test results.

The catchment yield (Y) was computed as 540,000m^3; Storage Capacity (Q) as 562,500m^3; Preliminary Volume of earth works to be excavated computed as 851m^3.

Following the characteristics of the proposed dam as designed from the data collected above, the Design of the dam is shown in Appendix A and B.

5.0 CONCLUSIONS AND RECOMMENDATIONS

From the preliminary findings made, the following recommendations are suggested:

- That the place will be suitable for small mini dam development,
- The Design of the dam has been accomplished
- The catchment yields, storage capacity and preliminary volume of earth works to be excavated established.
- Designed the proposed dam (Appendix A and B)
- HOCAP boss should liaise with the technical team to get logistics in place for the project to begin before the onset of the rainy season in March/April.
- The Technical Team is ready to commence supervision when given the nod.

The recommendations and the necessary action steps to be taken may be considered and any clarifications can be sought from the Technical team.

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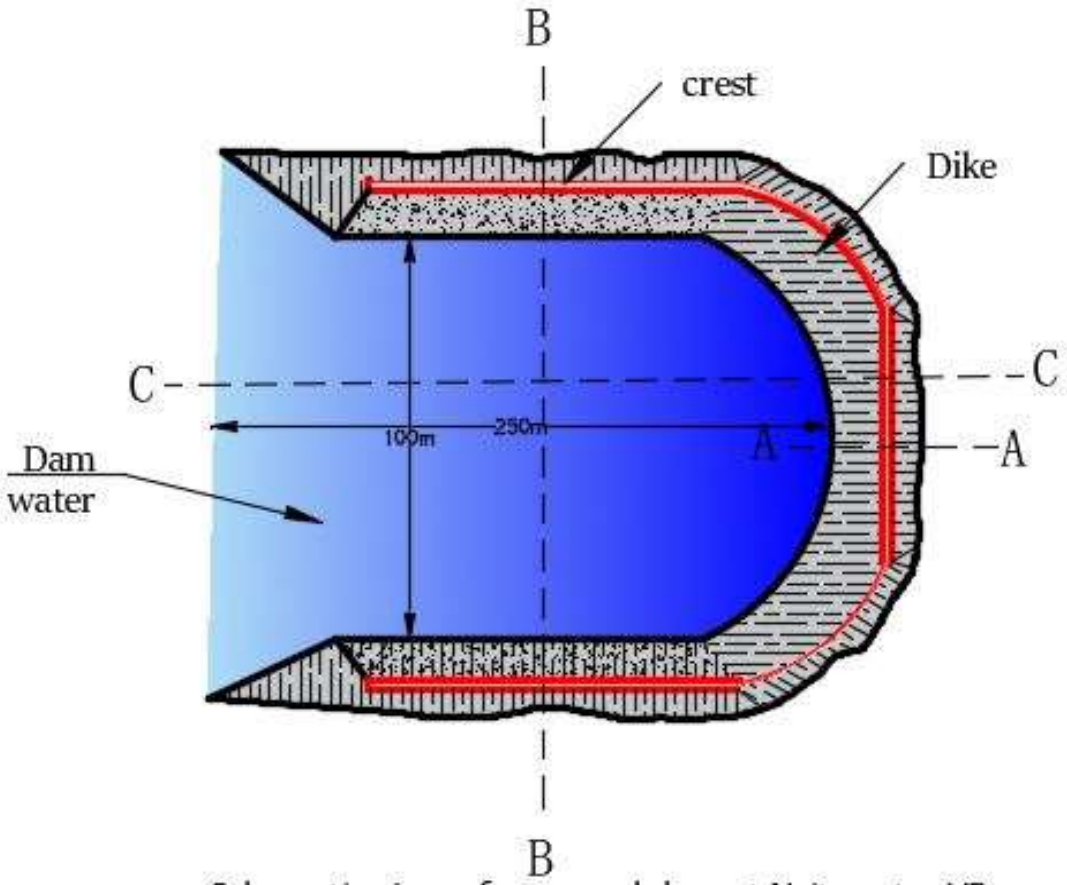
Water Resources Engineer.

References:

Akatsi North District, 2015. Ministry of Finance-The composite budget of the Akatsi North District Assembly for the 2015 fiscal year. https://www.mofep.gov.gh/sites/default/files/composite-budget/2015/VR/Akatsi-North.pdf

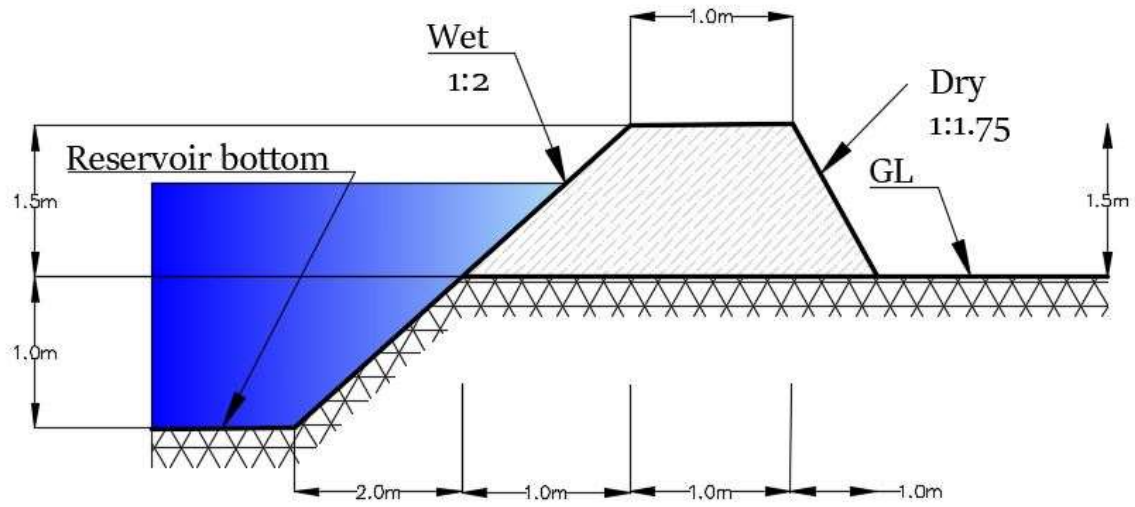
FAO (Food and Agriculture Organization), 2010. Manual on small earth dams. A guide to siting, design and construction, FAO-64)

Appendix A



Schematic view of proposed dam at Nyitawuta- VR

Appendix B



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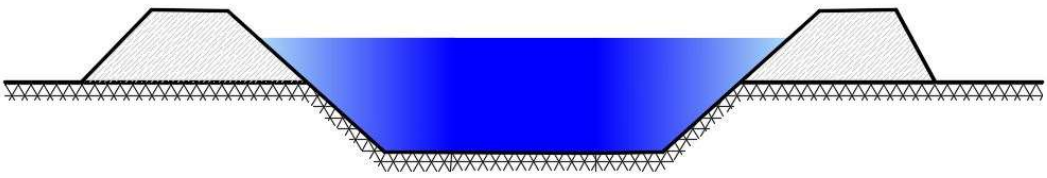
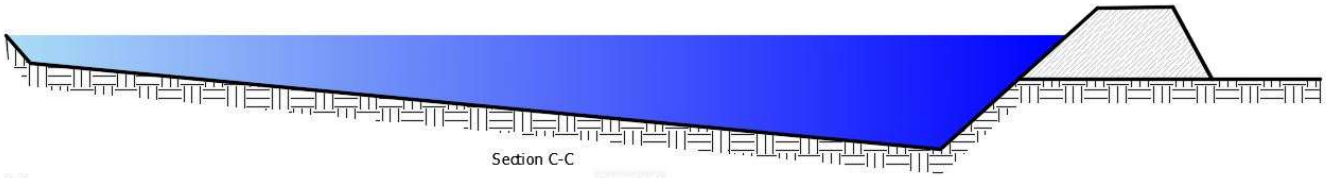


Section B-B



Section C-C