

# ANNEX 1: DYKE SPECIFICATIONS

This annex provides relevant information for interested companies to consider and prepare a bid for the work to be done. The main objective of the dyke for which bids are requested is:

***Lowlanders behind the constructed dyke in Akon South sustainably experience security and potential for restoring their livelihoods.***

## Location and distances

Akon South Payam in Gogrial West County borders the Lol river to the north and as such prone to flooding. In 2023 ZOA Dorcas investigated the possibility of dyke construction and proposes a dyke project along the Lol river starting from the bridge under construction linking Akon South with Akon North. Depending on the budget and costs some points are identified from where the dyke will turn inland towards the main road in the direction of Kuajok. Experiences with such a dyke construction in Akon North is an asset in the design and cooperation with local authorities and communities. Based on discussions with the Payam administration the proposed dyke protects the maximum number of people and agricultural land. Below the location of the to be constructed dyke is shown in figures.

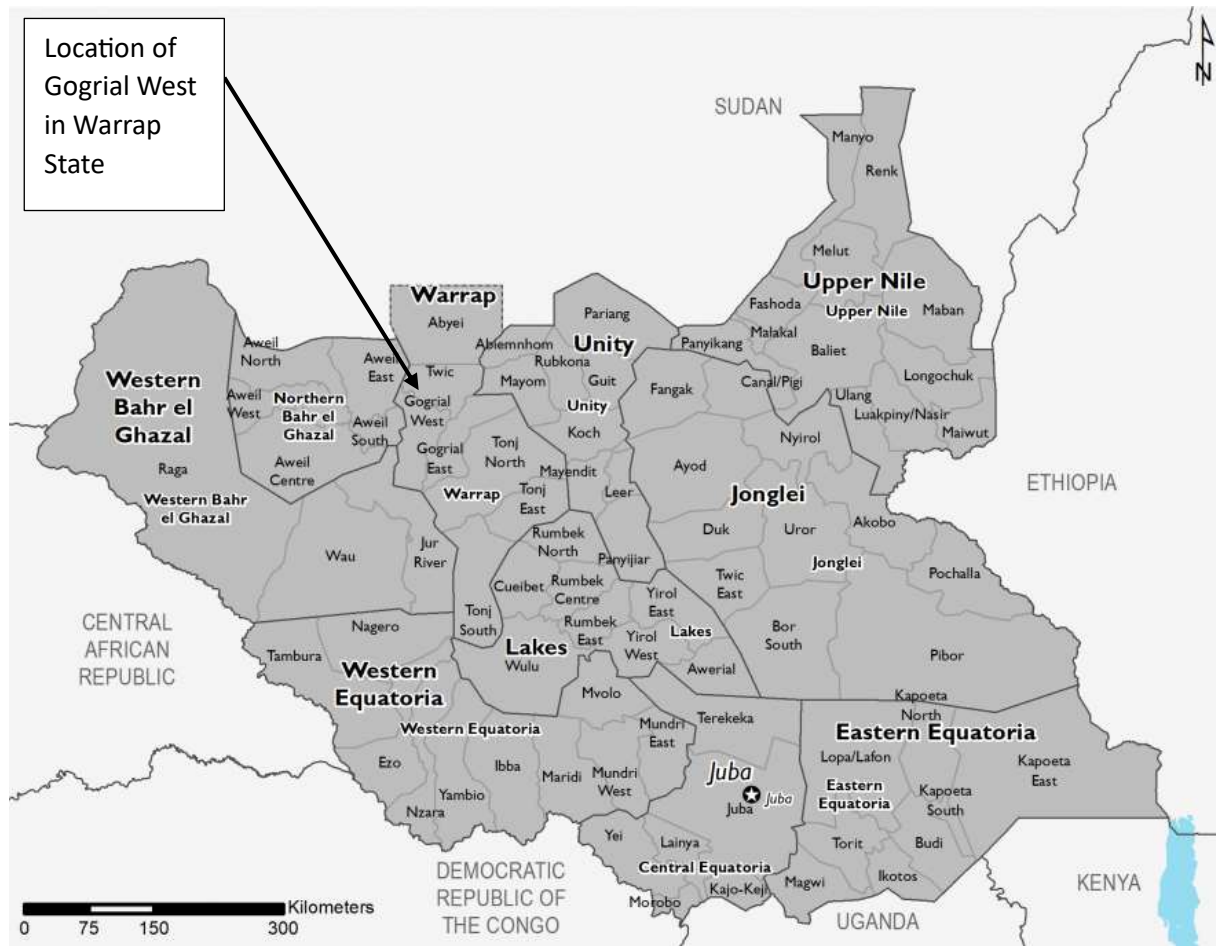


Figure 1: Map of South Sudan with indication of Gogrial West County.

The next figure shows in detail the trajectories of the proposed dyke in Akon South from the bridge under construction along the river towards main road that is considered at safety level.



Figure 2: Shows the options for dyke construction

#### Explanation of the options

Depending on the budget and offers received a final decision on the possible trajectory will be taken by ZOA Dorcas and offered to the winning contractor. The options are not just dyke construction over the same type of land. Near the river the land is considered near to safety level that needs just a small dyke for extra safety and ensuring that the dyke will be visible enough for local people to maintain the dyke. However at spots along the river there might be spots that are lower causing the flooding to the land beyond the high land along the river. Also local fishermen made some small canals to catch fish when water flows from the river to the low land. These canals and other low spots needs extra attention to ensure safety level is acquired at all places.

Priority option 1: the dark grey part is priority area requiring:

- 1.125km strong dyke through lowland
- 10.578km over high land with a small dyke depending on safety level and a few kms (green that are short cuts) through low land. The offers need to specify which trajectory to follow after consultation with ZOA Dorcas staff. What is the best option for the local people taking into account the costs: **short cuts a bit away from the river or follow the river on high land.** Where possible, the dyke should be minimum 30 meters from the river bank. The river bank is not stable due to erosion making it risky to be close to the river.
- 4.207km through lowland from the river to the road. However, some highland “islands” are seen along the 4.207km and offers need to specify which trajectory to follow after consultation with ZOA Dorcas staff. The offer should demonstrate the **best trajectory as to utilise the highland areas and compare costs with dykes through low areas.**
- **ZOA Dorcas Team will point out safety level markers and coordinates on the trajectory options**

As shown in the figure 2, some options are possible for which each offer should give the additional costs.

Option 1 = extension 1.

If possible option one will be added to the dark grey area discussed above. Consequences and requirements:

- If option 1 will be included the extra kms are: 4.750km starting at the bridge building site linking with the dyke on the high land from the dark grey area. If option 1 is included it will save 1.125km dyke through low land.
- The offer should demonstrate the additional costs for 4.750 km over high land and the savings as with option 1 1.125km dyke through low land is not required.
- Any offer should include option 1 proposal next to priority 1 including the additional costs and saved costs.

### Options 2 and 3 = extension 2 and 3

These options depends on the offered costs and the budget available. Each offer should indicate the additional costs for option 2 and 3.

In order for ZOA Dorcas to calculate the kms dyke that can be build each offer should indicate 2 per meter costs as:

- ❖ Per meter dyke costs over the average high land
- ❖ Per meter dyke costs over the average low land
- ❖ High land is along the river, if at some spots lower meters are along the river, these should be included in the average costs/m high land
- ❖ Low land is from the river to the main road, making use of "islands" in the low land should be included in the average costs/m low land

Depending on the winning bid (offered costs, technical proposal and budget available) the length will vary but ensure the offer demonstrate closing the dyke around the indicated land to be protected.

With the successful bidder the precise dyke length (low land- and high land dyke) will be agreed upon.

Note: The distances mentioned are an estimate using Google Earth.

### **Technical specifications**

Below various technical specifications are discussed and are the be mentioned in the bid if will be used or alternative solutions are proposed with proper justification.

- **Height of the dyke**

The height of the future dyke is equal to the safety level that is established for the area. This safety level at reference points, will be made available to interested contractors and in more detail to the winning contractor.

ZOA Dorcas staff will point out during orientation visits by interested parties the safety level at reference points for interested bidders to understand the situation completely. In picture 2 reference points are already shown and it is advised to make appointments with ZOA Dorcas staff for orientation visits. [at the final stage 2-3 dates can be included that ZD staff will be on call for orientation? Or just wait for calls and make appointments?] During implementation the level of the reference points should be extended towards the whole length of the dyke. It is possible that the ground level varies over high- and low land and the offer should take that in to account. Deviations from the average dyke height at reference points, are at the contractor's risk and are not grounds for additional work.

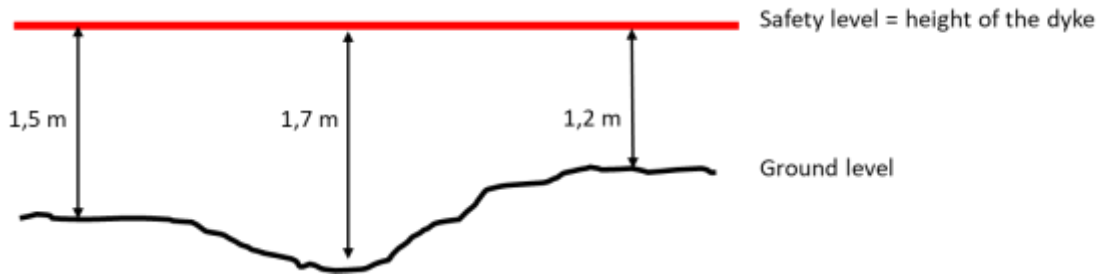


Figure 3: Dyke height and safety level: sometimes the ground level varies

- **Dyke construction**

To ensure a strong dyke that will be erosion- and high water against the dyke resistant, the contractor need to compact the dyke as in figure 5. Depending on the local situation and the need of the local people, the excavation will be done preferably on the inland side of the dyke to create water reservoirs. The topsoil put aside need to be put in the water reservoir. As per demand and need of the local people ramps need to be made interrupting the water reservoirs to allow easy passage over the dyke.

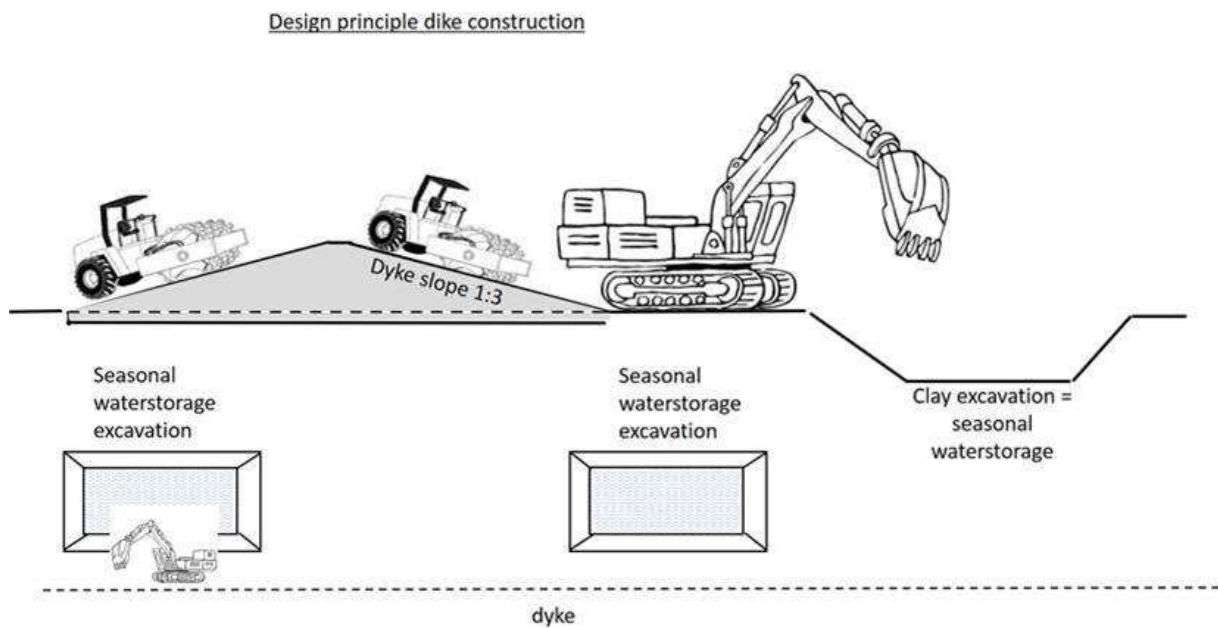
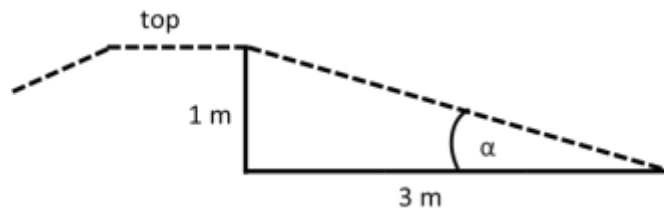


Figure 4: Design principle of the dyke construction, for ramps to let people and animals pass, to slope will be less depending on the local situation and needs of the local people

A slope of 1 : 3 means that from the edge of the top, for every meter you descend you have to move 3 meters sideways to reach to foot of the dyke.

In a drawing:



With some simple math it is possible to calculate the angle  $\alpha$  :

$$\tan^{-1} \alpha = \arctan ( 1/3 ) = 18,3 \text{ degrees}$$

So the angle  $18^\circ$  should be not a problem for any compactor driving perpendicularly over the dike.

- **Built-up conditions:**

- For the construction of the dyke it is necessary to start with the removal of the top layer of the location (rich in organic matter). The estimated thickness of this layer is 0.25 m. This excavated soil must not be processed in the dyke. Later the excavated soil can be put back in the ditch/water storage.
- In order to compact the dyke properly, a layered structure is necessary. After applying each layer of approximately 0.5 m, these layers must be compacted with a compactor.
- To achieve the desired density with machines, the slope must not be less than 1:3.
- The crown width is 1 m. and the compacting need to be done as in picture 5.
- After every 300 m of constructed dike, the contractor must demonstrate that the height of this section of dike is at safety level. The contractor will place a marker every 100 m where, at the request of the ZOA Dorcas staff, he can demonstrate the height compared to the safety level by means of a measurement.

- **Geotechnical conditions:**

- By means of a global preliminary investigation it was established that the soil in the area generally consists of clay and is suitable for building a dyke. Nevertheless, it is possible that in certain places sand or sandy clay can be found in the surface or in the subsoil. The starting point is that the contractor determines this during the work. Sand and sandy clay may not be processed in the dyke.
- Clay with too high a content of organic matter (black soil) may also not be processed in the dyke.
- In order to limit future clay shrinkage, the amount of liquid (water) in the clay is limited. On the other hand the clay should not be too dry either. The plasticity of the clay should be in a condition to make sufficient compacting possible. To determine the optimal moisture content of the clay a simple, so called rollout test (or mouse tail test), is advised.

*rollout test: It's determined by repeatedly remolding a small ball of moist clay soil and manually rolling it out on a plate (or between two hands) into a 3 mm thick thread (= the mousetail). If the clay is too dry the "mousetail" will easily break. If the clay is too wet it is not possible to roll it out into a "mousetail" at all.*

- If the conditions in the field are too wet, the clay may need to be placed in piles for a period of time until the desired moisture content is reached.
- If the quality of the clay/soil for building the dyke, the contractor will in consultation with ZOA Dorcas staff and local communities from where to bring the right quality clay without any extra costs. The aim is to build a strong and lasting dyke requiring minimal maintenance.
- Because the window of opportunities for optimal field conditions (wet season - dry season - wet season) is limited in time, it is important that the work start in time. Immediately after the contract has been awarded, the contractor must start as soon as the circumstances are favorable. This in consultation with the ZOA Dorcas organization.
- ZOA Dorcas supervisor will be regularly available during the implementation of the project and directions by him should be followed at all times within the boundaries of the quality measures outlined above and below in the work method.

### **Work method regarding seasonal water storages:**

The necessary soil with which the dyke is constructed, is excavated nearby the future dyke. A hole is created at these places that can be used as seasonal storage. Precipitation water can be stored here for later use by people for irrigation.

These seasonal water storage facilities will be created along the future dyke route at the locations where the clay will be excavated. For safety reasons the slope of the edges of this seasonal water storage must not be less than 1:2. The depth of these facilities depends on the clay layer thickness and the boom length of the excavator. The topsoil need to be put back in the water storage holes in such a way that all looks neat. If on both or at one side of the dyke water storages will be made depends on the local situation and discussions with ZOA Dorcas staff and local population.

The work method is shown schematically in the below figure.

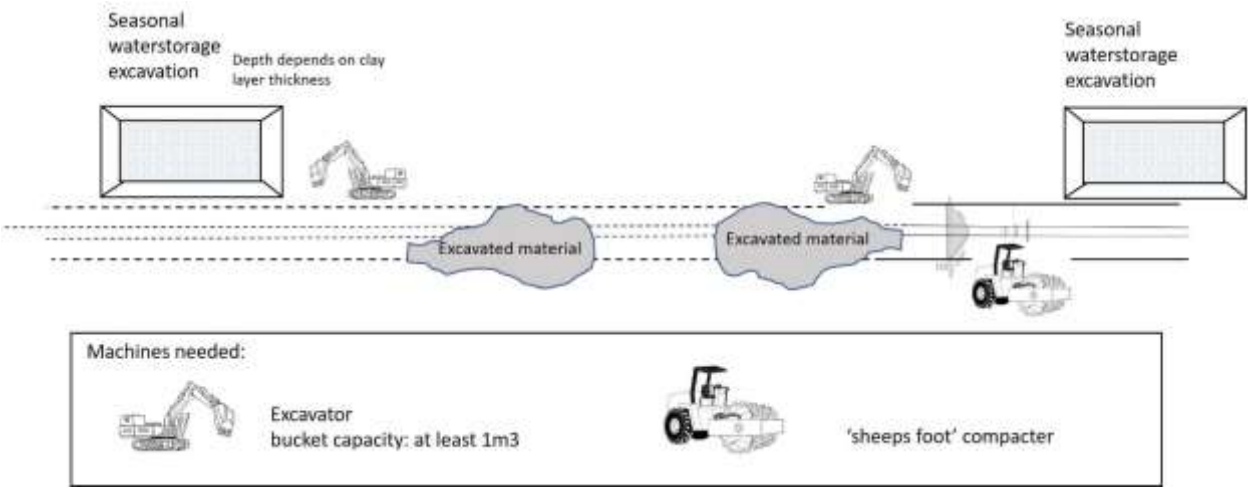


Figure 4: work method dyke construction

**Other important issues**

The local population needs to be consulted together with ZOA Dorcas staff to follow as much as possible the inclusion of community wishes for small adjustments and the need to add ramps for people and animals to cross the dyke without difficulty. Each bidder is advised to visit the dyke location and meet with local communities and ZOA Dorcas staff.

In general, houses and large trees should not be disturbed. In case of insurmountable difficulties, consultation must take place with ZOA Dorcas.

It is possible and advised that the interested bidder makes an appointment with the ZOA Dorcas organization to visit the location and ask any questions.

Besides the requirements in the tender, the bidder should provide details of technical approach, calculated length (high+low land), costs per meter (high+low land) and in total for the project. ZOA Dorcas will discuss with the winning bidder, before the contract is made, the actual length over high- and low land and available budget.