ANNEX 1: DIKE 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 dike for which bids are requested is:

Lowlanders in the dike-protected area in Akon North experience sustainable protection against flooding and potential for resettlement in lowland areas and restoration of their livelihoods.

Location and distances

Akon North Payam in Gogrial West County is located in the northwest of South Sudan (figure 1). The area is surrounded by rivers, lakes and marshes and is prone to flooding, typically during the annual rainy season (roughly between June until November). To protect the population in the lowlands from the risk of flooding and allow for resettlement and rebuilding of livelihoods in the area.

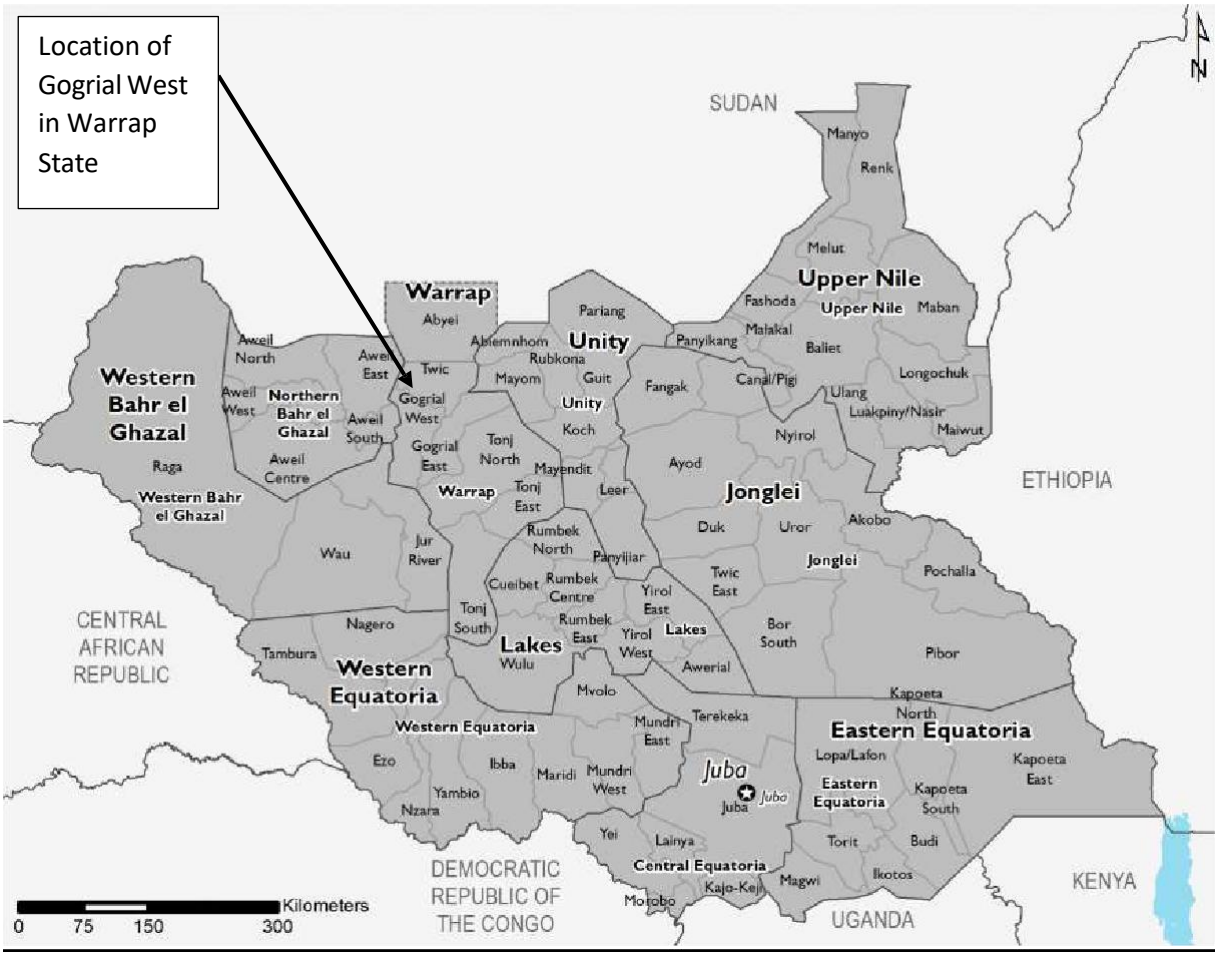

Figure 1 Map of South Sudan with indication of Gogrial West County.

The dike construction in Akon North started in 2023 and is being carried out in phases. In 2023, ZOA Dorcas implemented a Pilot Dike project to protect an area selected by the communities fitting in the available resources of the pilot project. In 2024, an additional Phase 1 dike of 18 km was constructed to protect the northwest lowland communities of Akon North. This dike runs from the pilot dike to the main marketplace. However, in October 2024, this constructed dike was flooded due to poor construction and a lack of adherence to the indicated safety level. In 2025, the Phase 1 dike will be extended with a Phase 2 dike that connects the Phase 1 dike with the new road near the bridge under construction. The Phase 2 Dike concerns the final dike compartment. The location and route of the dikes are shown in figures below.This tender focuses on three specific elements related to these phases:

1) **Pilot Dike:** The extension of the pilot dike (+- 3,5 km)
2) **Phase 1 Dike:** The repair & reinforcement, and upgrade of the Phase 1 Dike to the indicated safety level following the quality engineering standards as outlined in this annex. (+- 18 km)

3) **Phase 2 Dike**: The construction of the Phase 2 Dike following the quality engineering standards as outlined in this annex (+- 18 km).

Below a sketch of Akon North Payam with at the bottom the pilot area protected by the pilot dike in 2023 and the orange line indicating the dike surrounding the flood prone area, including the following Boma's: Majock-Achiir, Luethbeny, Ameth-Achuil, Mangar Deng Akol, Rual, Mangarrhii, Mangardit and Apath.

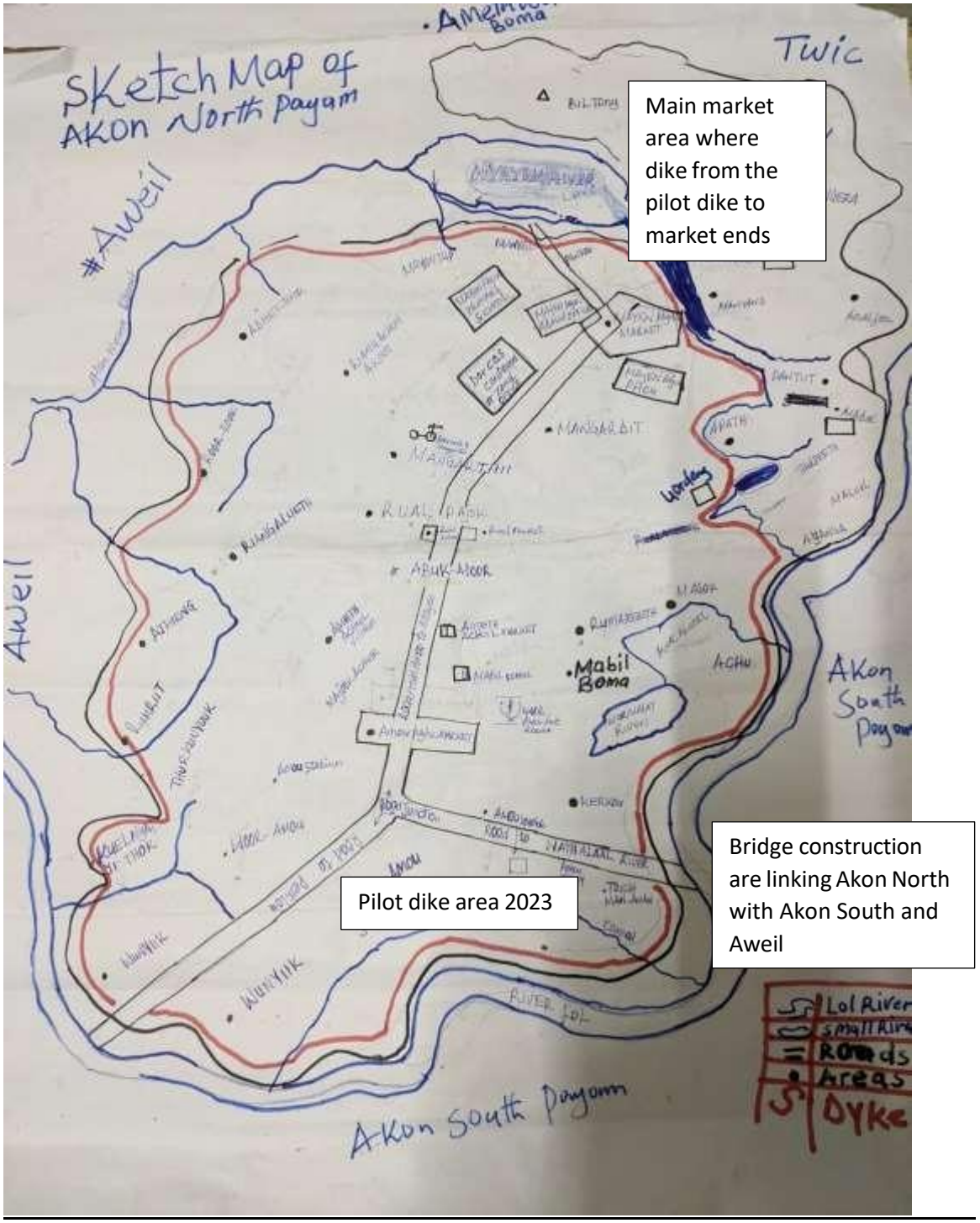

Figure 2 Sketch of Akon North Payam and the dike trajectory surrounding Aakon North's flood prone area.

Below more specific images of the dike route created in Google Earth and broken down per phase.

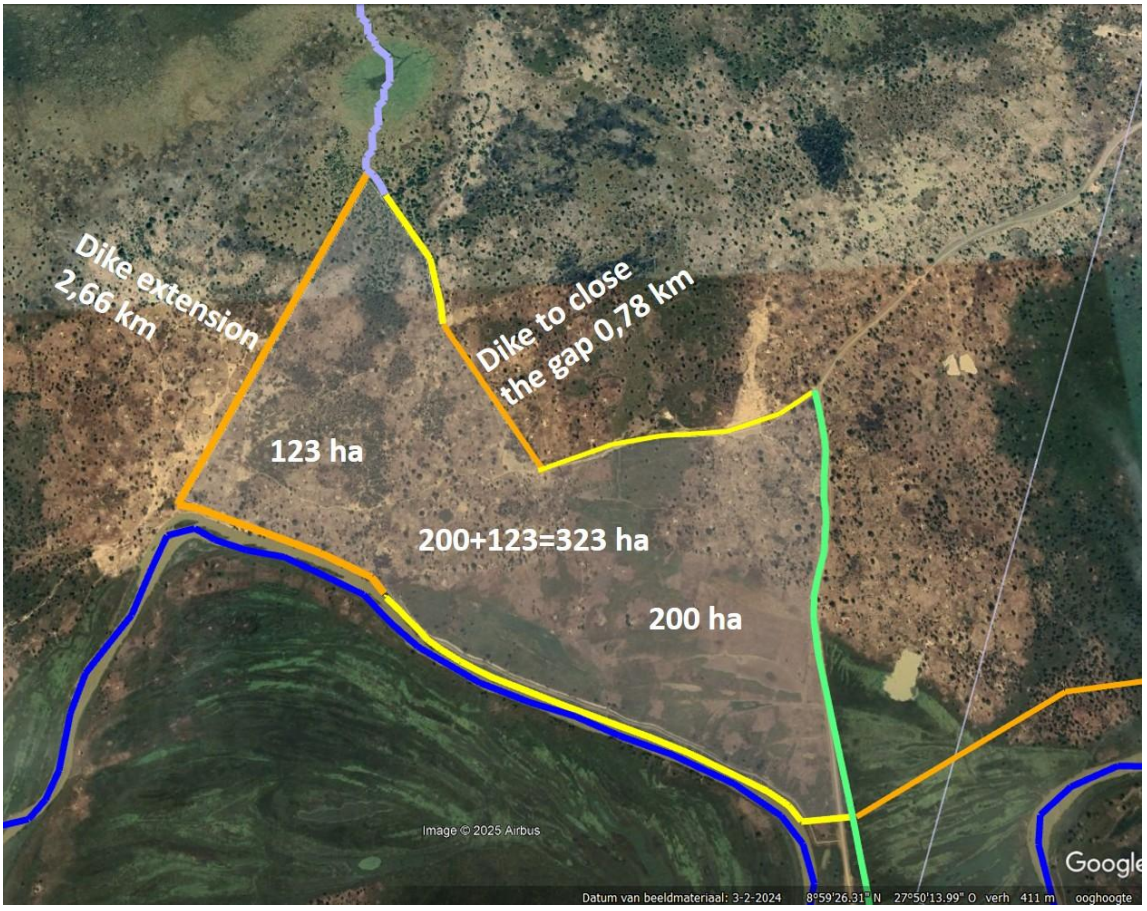

Figure 3 Pilot Dike: the orange lines ('dike extension 2,66km' and ' dike to close the gap 0,78km') is the to-be-constructed extension of the existing pilot dike under this tender. Yellow and green lines represent the already constructed parts of the pilot dike.

Figure 4 Phase 1 Dike to be repaired, reinforced and topped-up to the safety level standard (18km)

The next figure shows in detail the trajectory of the required dike in Akon North from the pilot dike to the main market in Mayen Pajok. Trajectory 2 is the trajectory for the current tender and trajectory 3 is for the next year 2025.

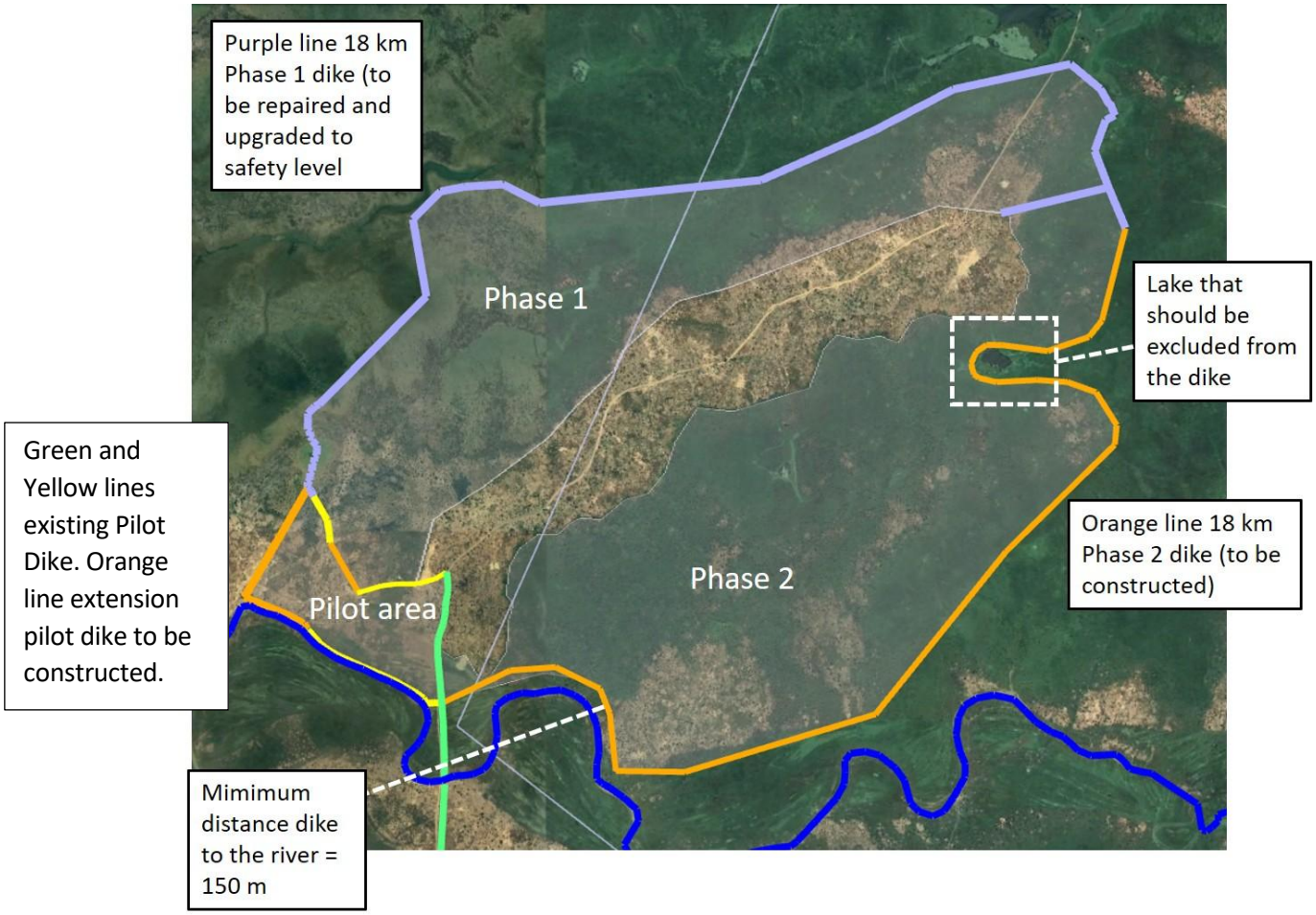

Figure 5 Dike trajectories Pilot phase, Phase 1 and Phase 2 in Akon North. The low left corner is the triangle area protected by the pilot project. A start was made towards the market called the flex dike. Now from the flex dike to the market is Phase 1 dike (purple line) representing the dike that needs repair, reinforcement and upgrade to the safety level (current tender). The orange line on the right links back to the pilot dike considered Phase 2 (current tender).

Technical specifications

In this section various technical specifications and engineering standards are outlined. Interesting bidding parties should mention in their bid if they can and will adhere to these standards and specifications or whether alternative solutions are proposed with proper justification.

Length of the dike

- The pilot dike needs to be extended with two additional dike parts of 2,66 km and 0,78 km respectively, as shown in figure 3.
- The phase 1 dike needs to be repaired, reinforced and upgraded to the safety level over the total length of 18 km.
- The trajectory of the Phase 2 dike to be constructed is also estimated to be 18 km long.

The distances mentioned are an estimate using Google Earth and more accurate measurements on the ground. It is requested that a cost per 10 (ten) meters for this project is provided as well as a total costs in the bids. With the successful bidder (offered costs, technical proposal, technical capacity and quality, and budget available) the precise length will be agreed upon.

Height of the dike

The height of the dike is indicated by the so-called established safety level for the respective area, which is a horizontal line 0.70 m above the highest measured water level known. Note that the height of the dike varies depending on the level of the ground along the dike route (see figure 4 for an example of varying ground level in relation to the safety level). The variations in height of the dike resulting from the fluctuating ground level are at the contractor's risk and are not grounds for additional work: the safety level must be adhered to at all times.

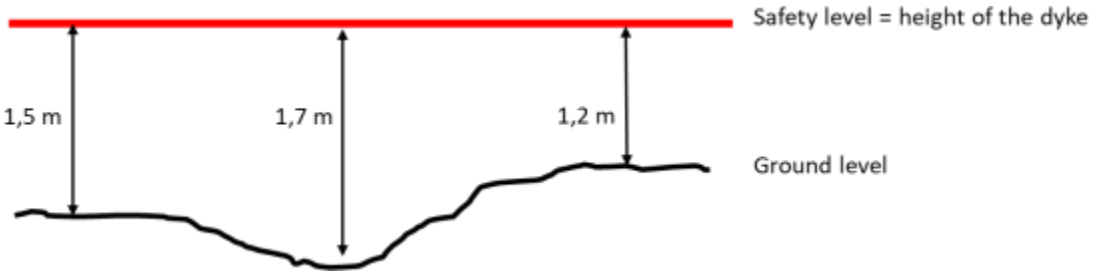

Figure 6 Dike height and safety level: note that the ground level varies

For the repair and upgrade of the Phase 1 dike, the Dike must be upgraded to the safety level. Figure 5 shows the current dike's height in comparison to the safety level to be met during construction work.

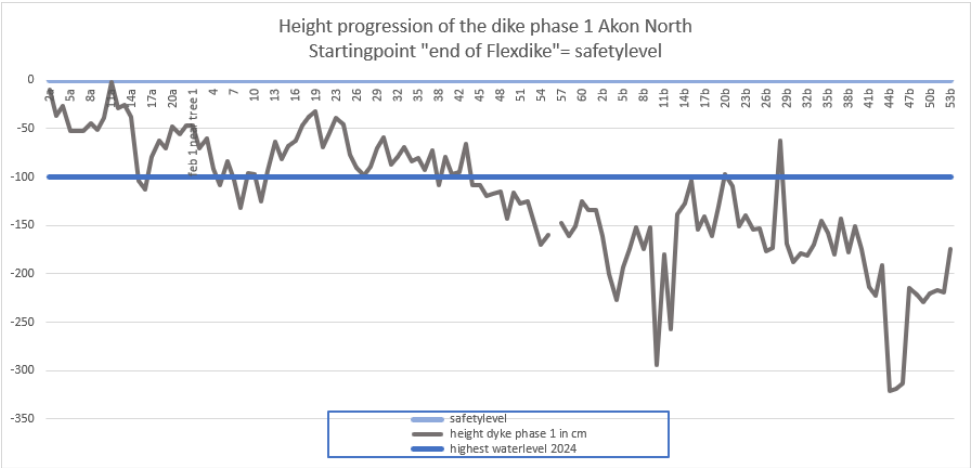

Figure 7 Phase 1 Dike to be upgraded to the Safety Level

The extension of the pilot dike and the construction of the phase 2 dike needs to be build at the height of the same horizontal safety level as the safety level indicated for Phase 1.

The reference point of the safety level is determined at one location on the dike trajectory (the end of the so-called 'flexdike'). During implementation the level of the reference point should be extended towards the whole length of the dike. From the safety level at the indicated location, the winning contractor can derive the correct safety level to any desired point along the dike route.

ZOA Dorcas staff will provide the reference point of the safety level at one location to the winning bidder and to all interested bidders during an orientation visit to help them understand the situation completely. It is therefore advised to make appointments with ZOA Dorcas staff for orientation visits. The adherence to the safety level can and will be checked for correctness by the ZOA Dorcas staff.

Dike construction

To ensure a strong dike that will be resistant to erosion and high water against the dike, the contractor needs to compact the dike per layer as shown in figure 8.

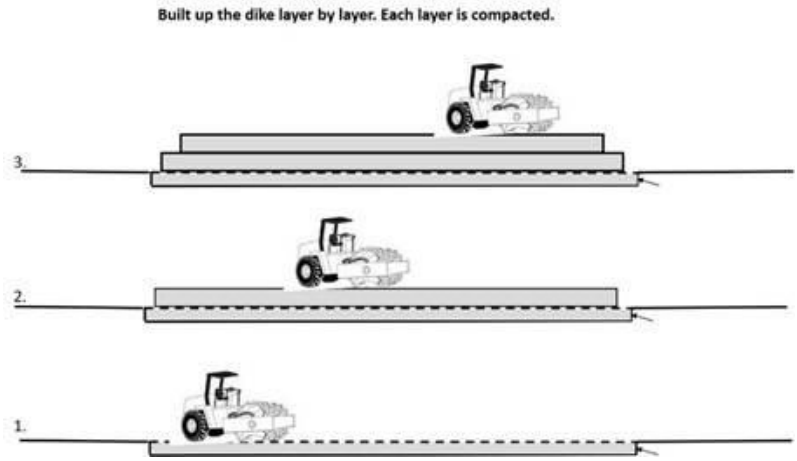

Figure 8 Layered compaction required to guarantee a solid and sustainable dike that is resistant to erosion and high water levels.

Depending on the local situation and the need of the local people, the excavation will be done preferably on the inland side of the dike 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 dike.

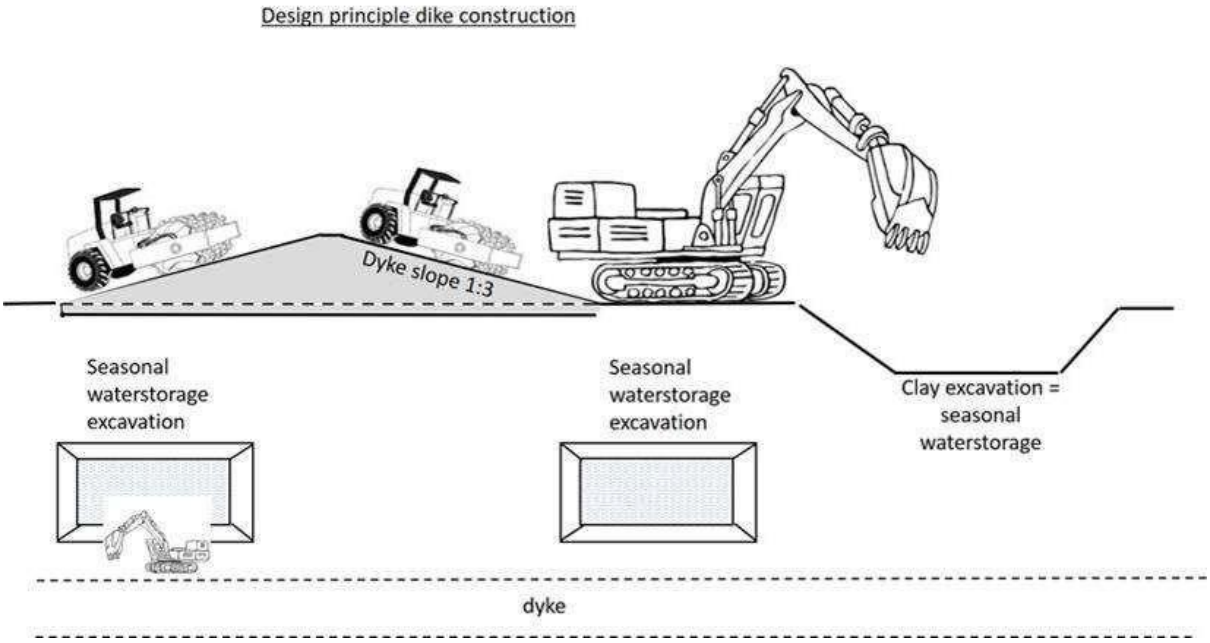

Figure 9 Design principle of the dike construction, for ramps to let people and animals pass, to slope will be less depending on the local situation and needs of the local people.

To allow for any compactor driving perpendicularly over the dike, a minimum slope of 1:3 is required with an angle of 18°. This means that from the edge of the top, for every meter you descend you have to move 3 meters sideways to reach the foot of the dike (figure 8).

Figure 10 Dike Slope of 1:3

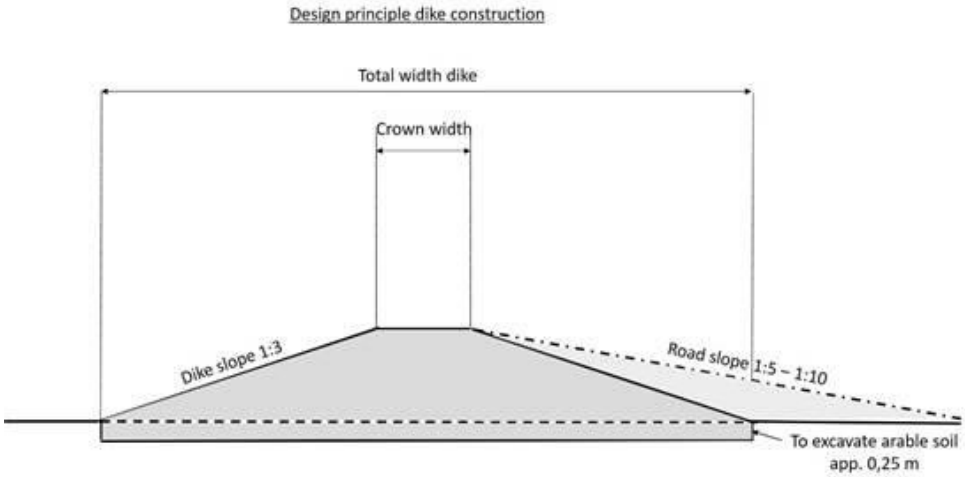

Figure 11 Dike Width including dike slope and crown width

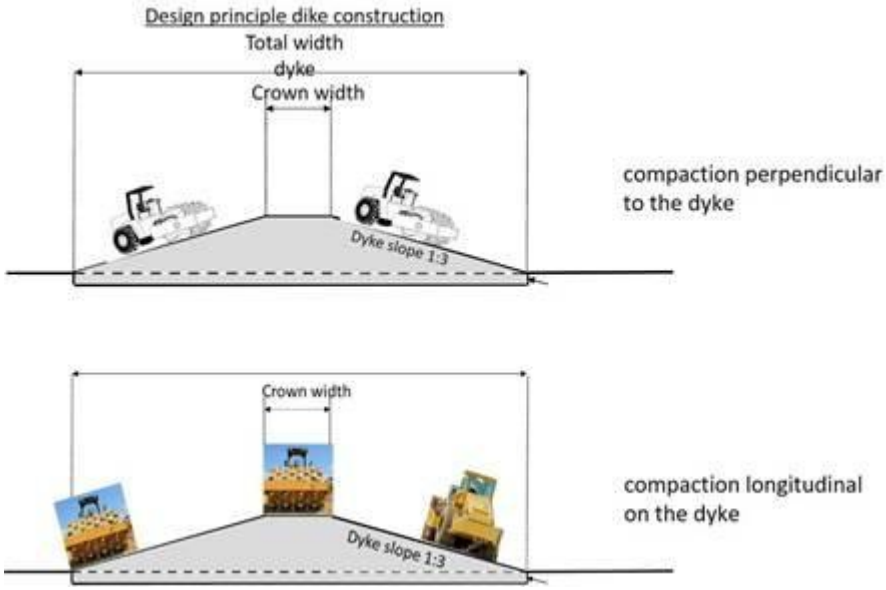

Figure 12 Dike design perpendicular and longitudinal compaction

Built-up conditions:

- For the construction of the dike 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 dike. Later the excavated soil can be put back in the ditch/water storage.
- In order to compact the dike properly, a layered structure is necessary. After applying each layer of approximately 0.5 m, these layers must be compacted with a sheepfoot compactor.
- To achieve the desired density with machines, the slope must not be less than 1:3.
- The crown width is at least 1 m. and the compacting need to be done as in picture 6 and 9.
- 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 dike. 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 dike, as it compromises the overall solidity and strength of the dike.
- Clay with too high a content of organic matter (black soil) may also not be processed in the dike.

- 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 dike does not meet the required standards, the contractor will consult with ZOA Dorcas staff and local communities to determine from where to bring the right quality clay without any extra costs. The aim is to build a strong and lasting dike 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 starts in time. Immediately after the contract has been awarded, the contractor must start as soon as the circumstances are favorable. This is in consultation with the ZOA Dorcas organization.
- ZOA Dorcas supervisor (technical engineer and project staff) will be regularly available during the implementation of the project and the directions of ZOA Dorcas supervisor and project staff should be followed at all times within the boundaries of the quality measures outlined above and below in the work method.

Timeline

- The repair of the Phase 1 dike and the construction of the extension of the pilot dike and Phase 2 dike should commence as soon as possible and ideally take place in parallel to ensure the completion of the work before the start of the rainy season. The contractor must ensure sufficient capacity (required machines and construction workers a.o.) for the timely completion of the work.
- During implementation, ZOA Dorcas holds the right to halt the construction and/or repair work if the conditions are deemed insufficient for constructing a solid dike that meets the quality standards. The contractor must take the possibility of work stoppage under such circumstances into account, assuming full responsibility for this risk. This does not justify any claims for additional payments. Furthermore, this risk is inherently tied to the timing of the project's commencement, and the contractor must consider it in both planning and cost estimation.

Work method regarding seasonal water storages:

The necessary soil with which the dike is constructed, is excavated nearby the future dike. 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 dike 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 dike 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.

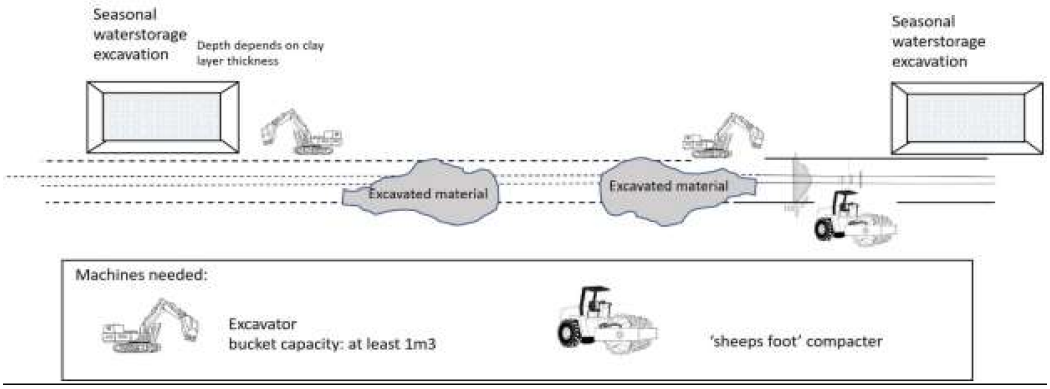

Figure 13 Work method dike construction

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 dike without difficulty. In general, houses and large trees should not be disturbed. In case of insurmountable difficulties, consultation must take place with ZOA Dorcas. Please note that the contractor consults with the community exclusively through ZOA Dorcas. The contractor may only receive orders from the designated ZOA Dorcas supervisor and must not act on orders directly from community members.

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

Besides the requirements in the tender, the bidder should provide details of the technical approach, including capacity (required machines and construction workers available), timeline and workplan for the repair and construction works, calculated length, and costs per meter and in total for the project.