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To Whom It May Concern:

Generic Quotation for Modelling of 2-, 5-, 10-, 20-, 50- and 100-year Flood Lines and Bridge Backwater calculations for Rivers/Streams in the Republic of South Africa and other Southern African countries

Validity Period: 01/03/2018 to 28/02/2019

We have standard prices for the development of flood lines and bridge backwater calculations. The prices for a single flood line set (i.e. one flood line on each side of the river/stream) are as follows:

- **R17 500** per 2-Km length of stream/river, or part thereof, for streams/ivers with small/medium catchments under 700 Km²,
- **R40 500** per 4-Km length of river, or part thereof, for rivers with medium/large catchments over 700 Km² and
- **R65 000** per 4-Km, or part thereof, for very large catchments such as the Vaal and Orange Rivers.
- **R6 500** per bridge for each bridge backwater calculation.

We do not model shorter river sections than quoted above, e.g. even if the waterfront of a property is only 50 m, the price will still be the same as a 2-Km reach of stream (in the case of streams with catchments <700 Km²).

The standard prices quoted above will be amended if any of the following conditions exist at the area to be modelled:

- When there is a complicating factor such as the confluence of two rivers/streams, bridges, narrows, dams/weirs or other geographical features that could have an impact on the upstream flood lines, we will add an additional amount for including these features in our model. The extra amount will depend on the physical

Members: E. M. Krige

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complexity of the feature to be modelled and will be quoted on after investigating the particular job. Note, there is a standard price for a bridge above.

- The price for modelling more than one flood line set (say 50- and 100-year flood line for the same river section) will increase the price by 1.5 times (i.e. for modelling both 50- and 100-year flood lines for the same section of the Orange River, the price will increase from R65 000 to R97 500, as we will re-use some of the input data for the one model in the second one), provided that we model the two flood lines concurrently, i.e. as a single project.
- If only discharge volumes are required (and not the actual flood lines, such as in the case where a bridge or culvert is being designed or where a dam is being planned – i.e. sizing of the spillway, etc.), the price will be 65% of the price quoted above, provided there are no additional complicating factors, as described above.

We use modelling techniques described in the publications, Report No. 1/72, *“Design Flood Determination in South Africa”*, 1972, and Report No 1/74 *“A Simple Procedure for Synthesizing Direct Runoff Hydrographs”* 1974, produced by a joint venture between the CSIR and the Hydrological Research Unit (a division of the Department of Civil Engineering) of the University of the Witwatersrand, in the modelling of the design storm/s. The modelling techniques have been updated by AED using the latest research available. The flood model will produce hydrographs for different return intervals of storm events (ranging from 1 to 24 hours for small/medium catchments and 1 to 80 hours or longer, for large and very large catchments). Once the peak discharge (flow) is known, we model the flow, and determine the maximum elevation, produced by this discharge through 10 cross sections of the river/stream per 2-Km length of river/stream, using *Mannings* formulas for open channel flow. African Environmental Development developed this second hydrological model. This gives us the elevations of the maximum floodwaters at each of the cross sections across the river. The flood lines will then be drawn using these elevations and will be presented to you as a CAD file.

In the case of large rivers, e.g. the Orange, Vaal or Komati Rivers, in addition to the purely mathematical modelling of the flood lines, we will also liaise with the authorities, in particular the Dept. of Water Affairs, in order to acquire actual measured flood flow under flood stage conditions for significant floods that occurred in recent (recorded) history. Due to the large catchments of these rivers, spanning areas with different run-off coefficients



and rainfall values, we use this additional (actual) information to verify our mathematically modelled discharge volumes.

Please note the following general terms and conditions:

- All prices above are quoted excluding VAT.
- We require contour lines of the area for which the flood lines are intended. Ideally the contour lines should be to a resolution of at least 1-meter for very large catchments and 0.5- or 0.25-m for smaller catchments and should cover the river itself as well as the banks and floodplains on either side of the river for the reach of the river/stream for which the flood lines are required. The contour lines must extend at least <1 - 3 Km (or further) up and downstream from the study area; the exact distance will be communicated when we do the official quotation. The contour lines should also extend at least 600 m from the centreline of the river on either side of the river in the case of large and very large catchments. In the case of small catchments up to 700 Km², we will advise you on the extent of the contour lines required, based on the physical features of the land.
- If you are unable to supply us with sufficiently accurate contour lines we will commission land surveyors to survey the required area. This survey will be billed separately, as an additional cost.
- It should be noted that, in order to model the flood elevations for small portions of land with small river frontage, we still have to model at least a 2- or 4-Km length of river (depending on the size of the catchment), in some cases even longer lengths of river/stream, irrespective of the actual size of the land being modelled.
- As per queries often received in the past, the following clarification on flood lines: We are unable to model flood lines on one side of a river only. All flood line modelling always include both sides of the river (for the simple reason that floodwaters always flow across the entire width of a river and not just on one side of a river) and therefore we always require contour lines on both sides of the river. It does not matter if the development is only on one side of the river, we cannot produce a flood line on one side of a river only. Keep this in mind when commissioning a surveyor to do the survey.



- We will require an AutoCAD drawing of the property, which includes the boundaries of the property in a properly georeferenced AutoCAD, DXF or ArcView/ArcGIS file format. Alternatively, a list of the X and Y coordinates of the pegs (corners) of the property will suffice, such as is included in a Surveyor General Drawing (SG Drawing) of the portion of land.
- In most (but not all) cases it will be required to carry out a site visit to the river/stream that has to be modelled. The prices quoted above do **not** include the time and kilometres that will be required/travelled for this site visit. When the survey is carried out, we normally request that the surveyors measure certain features (bridges, culverts, or any other features we identify using Google Earth. We also request them to take photographs of these features. This will then obviate the need for the hydrologist to visit the site in person. This must be kept in mind if you appoint a surveyor before commissioning AED to do the flood lines.
- A report will be produced upon completion of the modelling of flood lines. This report will be verified and signed by our professional civil engineer. A drawing of the flood lines will be included as part of the report and an AutoCAD and/or ArcView GIS file of the actual flood lines will also be included with the report. The standard coordinate system for this/these file/s will be Metres, Transverse Mercator, WGS84 (using the Hartbeesthoek'94 Datum), or whatever other coordinate system you may request (particularly in areas outside South Africa. If you require a coordinate system other than a standard one, however, the conversion will be done at an additional cost.
- An invoice will be submitted to you together with the report. The invoice is payable within 30 days of submission. Interest at a rate of 18.5% pa will be levied should the invoice not be paid within the prescribed period.
- Please also note that all work produced by AED, be it intellectual, physical or other, remains the property of African Environmental Development and may not be used in any format whatsoever until full payment is received.
- The placing of an order automatically assumes that you agree to the terms and conditions in this document.



We trust that you will find this cost estimate in order. Should you require any additional information, please contact us at any time.

Sincerely,

A handwritten signature in black ink, appearing to be 'G. Krige', written in a cursive style.

Garfield Krige Pr.Sci.Nat.(Aquatic Science)

Director: Technical Services
E&OE