Table S1. Supplementary material highlighting key method details for the RFFE estimation methods applied to headwater catchments in the Pilbara, WA.

Method	Method details and catchment details	Validation/Testing	Findings
ARR (Australian Rainfall and Runoff Regional Flood Frequency Estimation Model) RFFE Model [1,2]	55 stations were selected from the arid areas in Australia. Stations record lengths are frrom 10-46 years. Catchments range feom 0.1km² to 5975km². Of these stations, the Pilbara was given a distinct and separate region (Region 6) based on 11 catchments from the Pilbara, WA.	Index Flood method with Q_{10} as the index variable. R^2 for regression statistics of the developed prediction quations were $R^2 = 0.96$. Median relative error values ranfe from 35 to 43% for Region 6 compared to 49 to 67% for Region 7.	The arid areas of Australia use an Index Flood Method over a Bayesian GLS regression – PRT. Growth factors for the Pilbara arid areas (Region 6) for smaller AEP floods (e.g. 5%, 2% and 1%) are higher than the all over arid areas (Region 7).
Index Flood Method (IFM) (Davies and Yip, 2014) [3]	10 river basins in the Indian Ocean Drainage Divsion Division VII.. Individual catchments from 0.13 to 86,78km². Index Flood Method was used where design discharge was for 20%AEP was used as the Index Flood. Annual maximum series (AMS) was used to develop 3 predictive equations separated into small (up to 1000km²), medium (1000-10,000km²) and large catchments (more than 10.000km²).	Exponents on catchment area were intuitively reasonable and consistent with values from published studies worldwide. Rainfall intesicty exponents were higher than expected.	Study suggests that equations derived from this study have advantages over other recent studies as they cover the widest spatial distribution and catchment area range. Additionally they can be applied throughout the Indian Ocean Drainage Division. The study approach is simple and uses only catchment area and rainfall intensity from ARR87 in the design discharge equations. There is one set of frequency factors for three sets of design discharges.
Parameter Regression Technique (PRT) (Taylor et al., 2011) [4]	Prediction equations for the Quantile Regression Technique (QRT) and the Parameter Regression Technique (PRT) were developed for six flood quantiles (Q2 to Q100) in each of the	Due to the lack of catchments available in Drainage Division VII, a bootstrapping technique was adopted where one catchment was left	The final prediction equations for both methods contained two predictor variables, including catchment area and rainfall intensity of a given duration and ARI, which are easily obtainable from

	three regions across WA. Drainage division VII. 12 catchments ranging from 0.1km² to 1000km², with a mean catchment area of 346.7km².	out and the regression equation was developed, the developed equation is then applied to the catchment that was left out. The procedure was repeated for all the sites in Division VII. $R^2 = 0.963$, $R^2_{adj} = 0.954$, SEE = 0.421, DW = 2.160.	published data. Both the QRT and PRT performed relatively well, based on the independent testing, however a small number of catchments produced estimates which were grossly above or below the at-site flood frequency estimates.
Fixed Region Parameter Regression Technique (PRT) (Rahman et al., 2012a) [5]	Threshold streamflow length was reduced from 25 years to 10 years. 57 catchments were used for all arid regions and these ranged from 0.1 to 5,975km². Streamflow record lengths range from 10 to 46 years. A partial duration series was adopted as Annual maximum flood series contained many zero values. The WA (Pilbara region) had 12 stations and the stations ranged from 0.1 to 1000km². Median was 347km².	Once catchment at a time was left out for cross validation and was repeated 12 times so that each of the 2 catchments was tested independently. No region of influence approach was used. Basis Point Values (BPV) values were calculated to assess the statistical significance of the predictor variables.	The expected error in flood quantile estimates is much higher in the semi-arid and arid regions due to much greater hydrologic variability and limited streamflow data. PRT values over all of the ARIs provided smaller values compered ot the QRT from the same study (Rahman et al., 2012). PRT was deemed to perform slightly better over all the ARI.
Quartile Regression Technique QRT (Taylor et al., 2011) [4]	Prediction equations for the Quantile Regression Technique (QRT) and the Parameter Regression Technique (PRT) were developed for six flood quantiles (Q2 to Q100) in each of the three regions across WA. Drainage division VII. 12 catchments ranging from 0.1km² to 1000km², with a mean catchment area of 346.7km².	Due to the lack of catchments available in Drainage Division VII, a bootstrapping technique was adopted where one catchment was left out and the regression equation was developed, the developed equation is then applied to the catchment that was left out. The procedure	The final prediction equations for both methods contained two predictor variables, including catchment area and rainfall intensity of a given duration and ARI, which are easily obtainable from published data. Both the QRT and PRT performed relatively well, based on the independent testing, however a small number of catchments produced estimates which were grossly above or below the at-

		was repeated for all the sites in Division VII. $R^2 = 0.907$, $R^2_{adj} = 0.883$, SEE = 0.562, DW = 2.266.	site flood frequency estimates. The findings from this study and other relevant RFFA studies would form the basis of recommendation of a new RFFA for WA in the upcoming edition of ARR.
Quartile Regression Technique QRT (Rahman et al., 2012) [5]	Threshold streamflow length was reduced from 25 years to 10 years. 57 catchments were used for all arid regions and these ranged from 0.1 to 5,975km^2. Streamflow record lengths range from 10 to 46 years. A partial duration series was adopted as Annual maximum flood series contained many zero values. The WA (Pilbara region) had 12 stations and the stations ranged from 0.1 to 1000km^2. Median was 347km^2.	One catchment at a time was left out for cross validation and was repeated 12 times so that each of the 2 catchments was tested independently. No region of influence approach was used. Basis Point Values (BPV) values were calculated to assess the statistical significance of the predictor variables.	For QRT approach (for all ARI tested) the BPV values were 0% for area and rainfall intensity ($^2I_{12}$) justifying the inclusion of these predictor variables. BVP for skew models were 30% and 8% for area and sden indicating that area and sden may not be good predictors for skew. Regression coefficients in the QRT equation vary in normal way with increasing ARI. Pseudo ANOVA indicated that model errors are relatively high with the Q_2 model showing highest heterogeneity (shown through an analysis of sampling error to model error ratio (EVR value). Generally, the Pilbara estimates are subject to great uncertainty due to possibly higher heterogeneity in the region. QRT shows more cases of overestimation on average compared to the PRT method from the same study (Rahman et al., 2012).
RFFP (Flavell, 2012) [6]	16 gauging stations were used with an average of 26.8 years. An RFFE was developed for the Pilbara prior to 2000. It was redeveloped in 2006 with longer stream flow records. The data (record up to 1996/97) from 15	Multiple linear regression was used. Predictive equations using mean annual rainfall gave a coefficient of determination (R^2) of about 0.7, the statistical rainfall	The Flavell RFFP 2000 has been adopted for major infrastructure projects over the last 30 years. The year 2000 version of the RFFP has higher coefficients of determination and lower standard errors of estimate. It gives larger peak flows

	gauging stations was used to develop the RFFP. The range of catchment characteristics of these stations are: A = 52.5 to 7983 km2 ; L = 25.1 to 375 km; Se = 0.84 to 10.1 m/km; LAT = 21.13° to 23.74°; LONG = 116.61° to 119.81°; MAR = 200 to 350 mm; R1250 = 138.0 to 234.0 mm and L2 /A = 2.10 to 6.89.	totals an R^2 of about 0.8 and latitude and longitude an R^2 of about 0.9. Latitude and longitude were adopted therefore, as the climate factor in the regression analysis.	above the 10-year level than the later version. The reasonf or this was attributed to closure of gauges and the inclusion of a latger number of underestimated floods and missing flood events in operating gauges. The 2000 version of the RFFP is recommended for use in the Pilbara rather than the 2006 version. The recommended RFFP is also applicable to all typical catchments in the Pilbara.

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