Key Questions

How were the new IFDs estimated?

How do the new IFDs compare to the ARR87 IFDs?

Can I use the new IFDs now?

How do I incorporate climate change into the new IFDs?

Where can I find out more about the new IFDs?

New ARR probability terminology

GENERAL IFD QUERIES

What are IFDs?

IFDs are Intensity-Frequency-Duration design rainfall intensities (mm/h) or design rainfall depths (mm) corresponding to selected Annual Exceedance Probabilities (AEPs), based on the statistical analysis of historical rainfall.

What are the IFD values used for?

IFDs are used in the design of infrastructure including gutters, roofs, culverts, stormwater drains, flood mitigation levees, retarding basins and dams. They can also be used to assess the severity of observed rainfall events.

USING THE NEW IFDS

How do I use the new IFDs?

Follow the steps as outlined on the new IFD website:

- Select the location required for analysis (sub-catchment centroid, site coordinates, location coordinates) in decimal degrees, degrees- minutes-seconds or Eastings and Northings. These coordinates can now be checked by clicking ‘Map Preview’.

- Add a location name or description for ‘label’. The new IFD extracted does not depend on the label given, however, it is useful to have a title on your output table and/or chart as a reminder of the location.

- Don’t forget to acknowledge and accept the Conditions of Use and Coordinates Caveat.

- Click ‘Submit’ once you are happy with the location.

- Update the durations to suit your analysis requirements.

- You can download the table and/or chart.

Where should I select the coordinates I use for my analysis?

For hydrological and hydraulic calculations for small catchments, the catchment centroid can be used. However, for large catchments or for catchments where there is a steep gradient it may be necessary to select multiple locations.

For analysis of a particular rainfall event, the coordinates of the rainfall recording site should be used.

I'm confused about when to use new IFDs and when to use old IFDs. What if I use the wrong version?

Guidance on the application of the new IFDs has been prepared jointly by the Bureau and Engineers Australia. This advice is available on both the new IFD webpage and the ARR Revision website. In most cases it would be prudent to use the ARR87 design parameters and conduct sensitivity testing with revised ARR design parameters (including the new IFD design rainfalls) as they become available.

Why are they still called IFDs when intensities are not being provided?

After discussions with Engineers Australia it was agreed to continue using the acronym IFDs as it is in common usage.

Why are the IFDs being released prior to other Australian Rainfall and Runoff inputs?

The new IFD design rainfall estimates are being released prior to the other Australian Rainfall and Runoff inputs to ensure that all inputs to design flood estimation are developed consistently and to allow engineers to undertake early testing of the sensitivity of existing infrastructure to the new IFD estimates.

Also, IFD design rainfall estimates are used in a number of other applications besides design flood estimation, including telecommunications design.

How accurately do I have to specify the coordinates when I estimate a new IFD?

The new IFDs are gridded at a resolution of 0.025 degrees of latitude and longitude which is approximately 2.8 km^2. The new IFD webpage provides a new IFD for the nearest grid point to the coordinates specified. If the input coordinates are not specified accurately enough, the new IFDs could be provided for a grid point that is not the closest to the desired location. While in some cases there may not be much difference in IFD analyses for points that are located close together, there are some locations in Australia which are characterised by high gradients in IFD data, particularly in mountainous regions.

However, you should also note that, given the grid size, specifying coordinates at very small distances will not result in greater accuracy in the new IFDs that are provided.

When working on two projects a few kilometres apart you may choose to estimate two new IFDs or use the same one for both projects. You will need to consider what the IFDs are being used for and where the projects are located. For design purposes it is necessary to be as accurate as possible.

What if I have set up a local database of IFD values for specific locations that I work with regularly?

Using the new IFDs from the website to set up a local database is not recommended as any locally stored values will not necessarily remain current. The new IFDs on the Bureau's website may be periodically updated if new information becomes available.

However, for major projects, it may be necessary to store the IFD values used as part of the documentation. If you need to do this, you should clearly label the new IFDs with the date they were extracted from the IFD website.

Will the old (ARR87) IFD values still be available?

The ARR87 IFDs will be available for a transition period of at least 18 months while the revision of other inputs to design flood estimation (including design temporal patterns, losses, areal reduction factors) is completed as part of the overall Australian Rainfall and Runoff (ARR) revision being undertaken by Engineers Australia. Both the ARR87 IFDs and the new IFDs will be available from the Bureau website. The website also includes advice from Engineers Australia as to when the old and the new IFD estimates should be used.

Why are the new IFD curves 'backwards'?

The new IFDs are displayed in units of depth in millimetres (mm) rather than intensity in millimetres per hour (mm/hr). This means the new curves increase with rainfall duration rather than decreasing, so the slope of the curve is reversed.

NEW IFD WEBSITE FEATURES

What can I do with the new IFD website that I couldn't before?

- Design rainfall estimates can be extracted for non-standard durations.
- The location of the requested coordinates can be checked on a map.

Why are there no coefficients or raw values available?

These are no longer required as non-standard values can be extracted directly from the new webpage.

The Time of Concentration for my catchment is 7.5 minutes. Why can't I extract the new IFD values for this duration?

Due to the uncertainty in both the IFDs and the estimated Time of Concentration, times containing fractions of minutes are not permitted. Consider rounding up and down to whole minutes and running the analysis twice to investigate the magnitude of the difference in flow from the two rainfall inputs. Select the worst case for design purposes.

COMPARING THE NEW IFDS AND THE ARR87 IFDS

What is the spacing of grid points in kilometres?

The spacing of the grid points is 0.025 degrees, the same as the grids used in Australian Rainfall and Runoff 1987 (ARR87). This works out to be approximately 2.8 km2 at the equator but decreases with latitude.

I heard a rumour that there was an increase of X% right across Australia; is this true?

No, the best way to describe the differences between the ARR87 IFDs and the new IFDs is 'variable'. In some regions of the country the new IFDs are higher; in other regions they are lower and in some regions they are the same. These changes are the result of additional data and new analysis approaches used in the derivation process.

There are significant differences between the ARR87 IFDs and the new IFDs, how can I be sure that the new ones are right?

The differences between the old and new IFDs vary across Australia. Some of the difference is due to increased data availability in locations that previously had limited data, and some is due to the different methods for statistical analysis and interpolation used for the new IFDs.

Both the old and the new IFDs are estimates, but the new IFDs are the Bureau's best estimate of the design rainfalls for Australia based on the current rainfall database and the latest methods. They provide a clear, consistent point of reference for all hydraulic and hydrologic analysis in Australia.

How confident are you that these new IFDs are more accurate than the old ones?

The new IFDs are based on a greatly expanded rainfall database and use contemporary methods for analysis of the rainfall data. In addition, the length of record available for each station has been maximised through quality control processes and Region of Influence methods. The new IFDs provide a better overall fit to the current rainfall database than the old IFDs.

As with all statistical methods, there is always a level of uncertainty in the derived results due to the variability inherent in the data sample. In the new IFDs this uncertainty has been reduced through the increased sample size afforded by the additional years of recorded data and the inclusion of significant amounts of rainfall data from water agencies around the country.

The process of developing the new IFDs was guided and reviewed by a panel of experts set up by Engineers Australia.

Area X,Y or Z has experienced significant flooding in recent years, however IFD values have decreased – how can this be?

The new IFDs are derived using the complete available rainfall records – some dating back to 1800. It is important to consider recent events in the

context of the overall period of record and the cause of recent flooding. Rainfall events that are significant in recent memory are not necessarily ranked high in terms of the whole length of record for a particular location. Due to the nature of Australian topography, many significant floods are the result of river flooding rather than local flooding from local rainfall.

The differences between the old and the new IFDs are estimation differences. They do not imply trends over time. It is more correct to consider the new IFD estimates as being greater or lesser than the old IFD estimates rather than increasing or decreasing since the old IFDs were estimated.

COMPARING THE NEW IFDS TO AT-SITE FREQUENCY ANALYSES

Why don't the values from my observed rainfall event plot along one of the lines from the new IFDs?

The new IFDs are based on discrete statistical distributions derived from the Annual Maximum Series (AMS) of rainfall records which are then regionalised and gridded. They are not based on plots of individual rainfall events. The rainfall durations of the AMS used to derive the new IFDs range from one minute to seven days, whereas the frequency of an individual rainfall event will vary with the duration of the bursts within the storm. Therefore analysis of an individual rainfall event will not follow a single frequency line in the new IFDs.

The IFD lines connect rainfall depths of equal probability of exceedance across a range of discrete durations. This results in a relationship in the vertical direction, based on the rainfall probability at each duration, rather than a horizontal relationship across multiple durations that would be representative of an observed rainfall event.

Around the country, the significant rainfall totals recorded across this wide range of durations are often the result of different meteorological conditions. Although a single rainfall event might produce annual maximum values across more than one duration for a particular year at one location, statistically it is unlikely that it will cover the full range of durations.

Why doesn't the at-site frequency analysis that I did for a specific rain gauge match up with the IFDs extracted for that location?

Although at-site frequency analysis of the Annual Maximum Series (AMS) of observed rainfall was an integral part of the method adopted for the new IFDs, it was only one of many steps used to produce the new gridded, regional IFDs.

A regionalisation method was applied to give more weight to longer record stations within each region. This improved the estimates of rare (less frequent) events. A spline interpolation method was then applied to the regionalised rainfall data from across Australia to estimate gridded values for the whole country. Factors including latitude, longitude, elevation and consistency with neighbouring sites were used, in addition to rainfall

characteristics at recording sites, thus allowing more reliable interpolation of rainfall depths in data sparse areas.

Rainfall values from a Generalised Extreme Value (GEV) distribution fitted to the AMS at a specific duration for a particular site will vary from the point values extracted from the grid of IFD values. Although each event in the AMS is a record of the actual rainfall at a site, these measured rainfall values are effectively point samples of the rainfall distribution across Australia. Each point sample has its own uncertainty and does not represent completely the underlying population of rainfall values. The extracted grid values, created from the regionalised rainfall inputs, will generally fall within the 95% confidence limits of the GEV distribution for the specific duration at each location.

The length and period of record at a site makes a significant difference in the level of uncertainty of any at-site comparisons. Regionalisation was applied to the measured rainfall data to effectively smooth out the effects of sampling uncertainty.

INTEGRATING THE NEW IFDS WITH HYDROLOGIC AND HYDRAULIC DESIGN METHODS

Can I keep using my hydrologic and hydraulic design spreadsheet for projects in the future?

The new IFDs will not change the spreadsheet model only the design rainfall input to the model. However, some changes to the spreadsheet will be required to allow for the new format, particularly durations and depths. It is recommended that you check regularly for updates to the IFDs; it is probably best to do this at the start of each project or design cycle. In addition, the spreadsheet method may also need to be revised at a later date as revisions of Australian Rainfall and Runoff are released.

Will the IFD values in current design software be updated?

Several software companies have been notified of the IFD Revision project. For further information, contact your supplier directly.

Can I use the Probabilistic Rational Method with the new IFDs to estimate peak flow rates?

No, the Probabilistic Rational Method was calibrated using the ARR87 IFDs not the new IFDs. The Probabilistic Rational Method and other flood estimation techniques are also being revised as part of the current Australian Rainfall and Runoff Revision project. Please refer to the ARR revision website for updates on design guidelines.

My hydraulic calculation sheet uses rainfall intensity rather than rainfall depth. How do I convert the rainfall depths to intensities so that I can use the revised values?

Rainfall depth and rainfall intensity are related as follows:

- intensity (mm/h) = depth (mm) / duration (hours)

- depth (mm) = intensity (mm/h) x duration (hours)

So the rainfall depths can be converted into intensities by dividing the depth with the duration in hours.

Consider updating the hydraulic method to change the inputs into depths so it is consistent with the new outputs, as the standard durations have also changed.

ESTIMATING THE PROBABILITY / SEVERITY OF AN OBSERVED RAINFALL EVENT

Why can't I estimate the Exceedance per Year (EY)/Annual Exceedance Probability (AEP) of an observed rainfall event from the new webpage?

The functionality to estimate an EY/AEP of an observed rainfall event will be included in Phase 2 of the new IFD webpage. Phase 2 of the new webpage will be released in stages during 2013/14. Until then it is possible to determine the approximate EY/AEP of an observed rainfall event from the new IFD chart for the site at which the rainfall was observed using the approach outlined below.

- Obtain rainfall data detailing what depth of rain fell over a particular duration at a particular location. This could be from a private rain gauge, or you can contact the National Climate Centre or your nearest Climate Services Centre. Note the latitude/longitude coordinates of the rain gauge.

- Next, obtain a new IFD estimate for the same coordinates as the rain gauge for which you have rainfall data from the new IFD webpage.

- Plot the data you obtained from the rain gauge on the new IFD chart. To do this you need the rainfall depth in millimetres for a particular duration of the rainfall event. (You may need to convert rainfall intensity to rainfall depth). Find the point on the new IFD chart that corresponds with your rainfall depth/duration combination.

- Find the EY / AEP by interpolating between the curves of AEP on your chart.

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More information on EYs and AEPs can be found on the Frequently Asked Questions page.

Alternatively, the Bureau can provide an estimate if you contact ifdrevision@bom.gov.au

Which IFDs should I use to estimate the probability of an observed rainfall event – the ARR87 IFDs or the new IFDs?

The new IFDs should be used to estimate the probability of an observed rainfall event as they represent the best estimate of the probability that should

be assigned to an observed rainfall event. However, as the AEP assigned to an observed rainfall event using the new IFDs may differ from the AEP assigned to the same event using the ARR87 IFDs, you should specify which IFD version you are using.

RAINFALL DATA USED FOR THE NEW IFDS

Was the rainfall event that flooded my backyard, stormwater system, treatment plant, local shopping centre…in XXXX year included?

In the development of the new IFDs, rainfall data from Bureau of Meteorology sites as well as other organisations was used. In order to ensure reliability of the statistics from the data, minimum record lengths for the rainfall sites included were set. If one of the sites used was located near the rainfall event and it was recording at the time of the event and the recorded rainfall was the highest recorded for that year, then yes.

For your own interest, you could try extracting the IFDs for your specific location and then plot up the rainfall from the storm event recorded at the nearby gauge to check the significance of the event. Daily values will need to be converted to unrestricted values prior to any comparison. Remember flooding from rainfall events can be exacerbated by blockages of infrastructure or obstacles in the usual overland flow paths.

My neighbour recorded xx mm in his own rain gauge which was much larger than the rainfall recorded at the Bureau gauge during the same rainfall event; was my neighbour's record included in the data base for the new IFDs?

The Bureau has made every effort to include data recorded for all large rainfall events in order to ensure the new IFDs are based on as complete a data base as possible. However, the collection of rainfall data is a complex process which needs to be undertaken by trained observers from rain gauges that meet quality control requirements specified by the Bureau in terms of instrument type, location, etc., and all rainfall stations must meet minimum record length criteria to be used in the derivation of IFD estimates. Therefore, records from private rain gauges were not included in the new IFDs.

CLIMATE CHANGE AND THE NEW IFDS

Do the new IFDs incorporate/accommodate climate change models?

No – the new IFDs are for a climatology based on past data. Research is being undertaken through Engineers Australia to specifically assess the impact of projected climate change on the new IFDs. This research is focused on the Greater Sydney Region and southeast Queensland in the first instance. The outcomes of this work are expected in 2015 and will be included in Phase 2 of the IFD revision project.

The climate change science community is saying that severe weather (including intense rainfall) is more likely under climate change. Your analysis is the most detailed analysis of rainfall ever undertaken in

Australia. However, you have assumed a-priori, and validated with stationarity tests, that there is no trend in rainfall data for particular regions, nor for particular durations. Doesn't this prove that Climate Change doesn't exist?

The time series of extreme rainfall was examined for evidence of trends (non-stationarity) to determine whether the full rainfall record should be used in deriving the new IFDs.

Although the analyses found that the full record at some stations shows significant changes over time, there were no clear indications of trends or non-stationarity in rainfall bursts across regions or durations.

These analyses do not contradict the observed trends in temperature that indicate that the climate is changing because:

- Rainfall in Australia is highly variable in time and space, so tracking rainfall changes is not as straight-forward as tracking temperature changes

- Climate change proposes more frequent extreme rainfall bursts (not necessarily bigger extreme bursts) but the 'frequency' of an extreme burst cannot be determined without looking at a long time series

- Any climate change-related changes in extreme bursts would be swamped in a long and highly variable series.

For these reasons, we did not expect to see a clear climate change trend in the series of extreme rainfalls but this does not mean that a trend won't become apparent in the future.