BBSW Methodology

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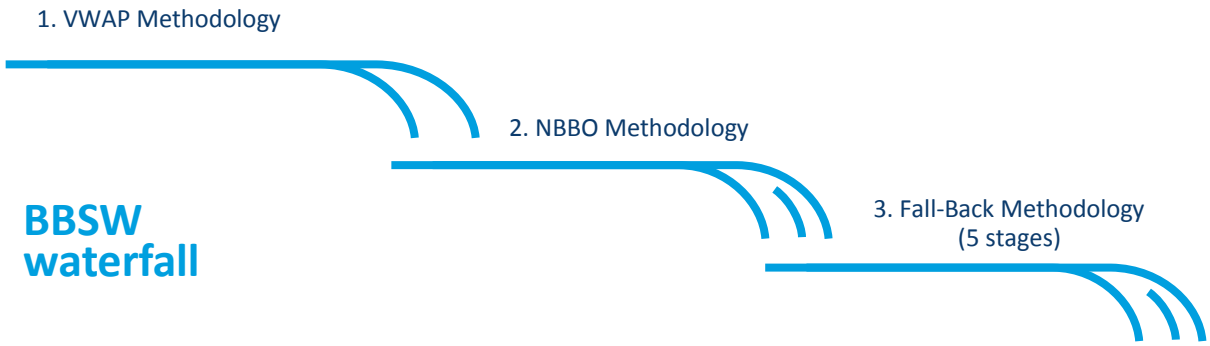
Overview of Calculation Waterfall

ASX's BBSW waterfall implements a three stage calculation process as follows:



1. A volume weighted average (VWAP) calculation methodology ("the VWAP Methodology") based on Eligible Trades during the Rate Set Window is used as the primary methodology for determining the BBSW rate for each tenor.
2. Where a BBSW rate cannot be formed under the VWAP method for a Tenor, the NBBO[1] ("NBBO Methodology") calculation method will be used to determine the rate for that tenor or tenors[2].

3. In the event that a BBSW rate cannot be formed under the NBBO method for one or more tenors, the fall-back ("Fall Back Methodology") calculation waterfall will be used[3].

1. BBSW Calculation Waterfall

Waterfall Step	Description
VWAP Methodology	The VWAP calculation is performed using all Eligible Trades reported to ASX, under the following equation: $$BBSW\ Rate_{Tenor} = \frac{\sum_{i}^{Eligible\ Trades} FV_i * Rate_{i)}}{\sum_{i}^{Eligible\ Trades} FV_i}$$ Where: • **FV_i:** Face Value of Eligible Trade i. • **$Rate_i$:** Traded yield of Eligible Trade i.

[1] National Best Bid and Offer
[2] Further details on the NBBO calculation can be found in the ASX BBSW conventions: http://www.asx.com.au/documents/products/asx-bbsw-conventions.pdf
[3] Further details on the Fall-back waterfall can be found in the ASX BBSW conventions: http://www.asx.com.au/documents/products/asx-bbsw-conventions.pdf

VWAP Eligibility Criteria

Rolling Maturity Pool

To be eligible for use in the calculation under the VWAP Methodology, a transaction must have a maturity date that falls within a rolling maturity pool. The rolling maturity pool is defined as being +/- 3 Business Days either side of the straight run date for the 1 month tenor and +/- 5 Business Days either side of the straight run date for tenors 2, 3, 4, 5 and 6. The straight run dates are defined as the same calendar date in the corresponding maturity month for tenors 1-6. Where the straight run date falls on a weekend or public holiday, modified following rules will apply unless that day falls in the next calendar month, in which case the straight run date will revert to the first preceding day that is a Business Day. The Business Days either side of the straight run date may fall in the previous or following calendar month. It is only the straight run date that is required to fall within the tenor's calendar month.

Example 1- if today is the 11th January 2019 the straight run date for the 1 month tenor would be the 11th February 2019. Acceptable Bank Paper for the purpose of calculating BBSW would fall within the range of 6th February 2019 and 14th February 2019 (7 Business Days in total).

Example 2- if today is the 11th January 2019 the straight run date for the 3 month tenor would be 11th April 2019. Acceptable Bank Paper for the purpose of calculating BBSW would fall within the range of 4th April 2019 and 18th April 2019 (11 Business Days in total).Anything quoted prior to 12pm Sydney time is assumed to be priced out of the same day (T+0) unless otherwise agreed. At 12pm Sydney time the straight run date will switch over to the following Business Day. Anything quoted post 12pm Sydney time will be priced out of T+1, unless otherwise agreed.

Minimum Criteria for Eligible Trades

The following minimum criteria govern which transactions which are Eligible Trades that can be used for the BBSW rate calculation under the VWAP Methodology:

- transactions in Bank Paper for maturities that fall within the rolling maturity pool;
- have a notional of greater than or equal to A$10 million;
- have at least one counterparty in Australia; and
- were executed during the Rate Set Window,

other than where the BBSW Guidelines provide that they are not intended to apply to such trades or that those trades do not need to be reported (such as Internal Trades which occur within the same Market Participant).

In order for the VWAP Methodology to be used, the following minimum thresholds must be met:

	1M	2M	3M	4M	5M	6M
Minimum volume threshold (millions)	200	100	200	100	100	200
Minimum number of transactions	3	3	3	3	3	3

	Minimum number of counterparties	4	4	4	4	4	4

NBBO Methodology

The Administrator determines the BBSW rate for each tenor by first sampling quotes from ATVs at three sample periods (or "sessions") and then calculating the average mid-point for valid bid/offer spreads from each sample period. The sample periods are as follows:

Sample 1: 8:45:00 ± 5 seconds
Sample 2: 9:15:00 ± 5 seconds
Sample 3: 9:45:00 ± 5 seconds

At each sample period the following calculation steps are implemented:

1) Identify qualifying transactions based on the following rules
   - Quotes originated from an ATV.
   - Quotes must meet minimum transaction size of AUD $20 million.

2) The National Best Bid and National Best Offer, denoted in terms of yield are calculated through the following equations:

$$NationalBestBid_{Session:i} = \min(All\ Valid\ Bids_{Session:i})$$
$$NationalBestOffer_{Session:i} = \max(All\ Valid\ Offers_{Session:i})$$

3) Each sample period is then evaluated to determine if a qualifying NBBO rate can be calculated based on the following criteria:
   - There is a valid National Best Bid.
   - There is a valid National Best Offer.
   - The National Best Offer cannot be greater than the National Best Bid by more than 1 basis point.

   The NBBO for the sample period is calculated through:

$$NBBO^{T+0}_{Session\ i} = \frac{NationalBestBid_{Session:i} + NationalBestOffer_{Session:i}}{2}$$

   If the sample period criteria is met then the sample is deemed to be valid.

4) The BBSW rate is calculated if there is at least 1 valid sample using the following equation:

$$BBSW^{T+0}_{x} = \frac{\sum_i^n NBBO^{T+0}_{Session\ i}}{n}$$

   Where n is the number of qualifying sample periods

5) The BBSW rate is rounded to 4 decimal places.

Maximum Spread for NBBO data

The three market types below assist in defining what are considered to be normal and dislocated markets. In normal markets, Prime Banks should endeavour to price at

	spreads as outlined in the Prime Bank Conventions. In accordance with the Prime Bank Conventions, Prime Banks will advise the Administrator if they consider markets to be dislocated. The Administrator will notify the market of any dislocation when publishing BBSW. • **Type 1 (Normal markets)** For all tenors, a market will be a normal market where the maximum spread is 10 basis points, provided the sample National Best Bid is higher in yield than the sample National Best Offer. • **Type 2 (Dislocated markets)** In any circumstance where type 1 ("normal market") conditions are not met for NBBO data for one or more tenors (i.e. "dislocated markets"), then for the relevant tenor(s), samples will be valid provided the sample National Best Bid is higher in yield than the sample National Best Offer. • **Type 3 (Inverted NBBO Samples)** For any tenor, where the National Best Bid is lower in yield than the National Best Offer for all samples, then samples where the National Best Bid is no more than 1 basis point lower in yield than the National Best Offer will be deemed to be valid samples.
Fall-back Methodology stages	The fall-back calculation is designed to calculate BBSW tenors which were unable to be formed under either of the VWAP or NBBO Methodologies. The fall-back calculation is separated into four stages based on what tenors still require calculation and what neighbouring tenors have been set in previous stages. ***Stage 1: Tenors 2, 4, 5 month set off neighbouring tenors*** This calculation methodology is only applicable for the 2, 4 or 5 month tenors. Additionally a particular tenor is only calculated through this fall-back stage if there are valid BBSW rates set in either the VWAP or NBBO calculation stages for particular tenors either side as set out below. If the previous conditions are satisfied then that tenor will be calculated by interpolation as prescribed below: – Interpolation of the 2 month tenor requires BBSW rates in the 1 month tenor ($BBSW_{Earlier}$) and 3 month tenor ($BBSW_{Later}$); – Interpolation of the 4 month tenor requires BBSW rates in the 3 month tenor, ($BBSW_{Earlier}$), and either of the 5 month or 6 month tenor, the 6 month tenor being used in the event that no 5 month tenor exists ($BBSW_{Later}$); – Interpolation of the 5 month tenor requires BBSW rates in the 6 month tenor ($BBSW_{Later}$) and either of the 3 month or 4 month tenor, the 3 month tenor being used in the event that no 4 month tenor exists ($BBSW_{Earlier}$). The calculation used is specified through the following equation: $$BBSW_x^{T+0} = \ BBSW_x^{T-1} + (BBSW_{avg}^{T+0} - \ BBSW_{avg}^{T-1})$$ **Where:**

$$BBSW_{avg}^{T} = \frac{BBSW_{Earlier}^{T} + BBSW_{Later}^{T}}{2}$$

Stage 2: Tenors 1, 3, 6 month set off a single valid tenor

A prerequisite for the implementation of this stage is that at least a single tenor has formed in either the VWAP or NBBO stages.

For 1 and 6 month, BBSW will be extrapolated from the daily absolute directional movement (T+0, T-1) in the nearest previously formed tenor ($BBSW_n$) calculated through the following equation:

$$BBSW_x^{T+0} = BBSW_x^{T-1} + (BBSW_n^{T+0} - BBSW_n^{T-1})$$

The 3 month tenor is calculated as per Stage 1 with the exception that there is no requirement that the previously set tenors either side must be within two months of the 3 month tenor.

Once any missing 1, 3, 6 month tenors have been calculated, any previously uncalculated 2, 4 and 5 month tenors will thereafter be calculated using stage 1.

Stage 3: Tenors 1, 3, 6 formed from movements in the spot month ASX 90 Day Bank Bill Futures

In the event that no tenors were formed under the VWAP or NBBO stages in the waterfall, the 1, 3 and 6 month BBSW tenors will be extrapolated from the absolute movement in the Time Weighted Average Mid-Price of bids and offers in the front ASX 90 Day Bank Bill Futures contract, expressed as the implied yield, for the period 9.40am to 10:00am; T+0 as compared to T-1. The unformed BBSW tenors would be calculated as follows:

$$BBSW_x^{T+0} = BBSW_x^{T-1} + ((100 - IR_{Active}^{T+0}) - (100 - IR_{Active}^{T-1}))$$

Where IR_{Active} refers to the price of the front ASX 90 Day Bank Bill Futures contract.

The use of the ASX 90 Day Bank Bill Futures contract is subject to and provided that:

i. On the Monday prior to the expiry day of the futures contract, the reference instrument reverts to the second contract. If the Monday is not a Business Day, then the change of futures reference month will occur on the previous Business Day. The unformed BBSW tenors would be calculated in the following way:

$$BBSW_x^{T+0} = BBSW_x^{T-1} + ((100 - IR_2^{T+0}) - (100 - IR_2^{T-1}))$$

Where IR_2 refers to the price of the second ASX 90 Day Bank Bill Futures contract.

ii. On the day following the futures expiry date, the reference change is based on the first contract (T+0) less the second contract for (T-1) i.e.; using the same underlying contract. The unformed BBSW tenors would be calculated as follows:

$$BBSW_x^{T+0} = \quad BBSW_x^{T-1} + ((100 - IR_1^{T+0}) - \ (100 - IR_2^{T-1}))$$

iii. ASX 90 Day Bank Bill Futures data will represent a Time Weighted Average Mid-Price of the best bid and best offer for the current Business Day and prior Business Day. The Time Weighted Average Price will be calculated from data observed between 9:40am and 10:00am.

iv. A bid and an offer exists on both T+0 and T-1.

2, 4 and 5 month tenors will thereafter be calculated as described in Stage 1.

Stage 4: Revert to prior days BBSW

In any instance where the previous fall-back stages fail to derive any BBSW rates, then the prior day's BBSW rate will be republished as T+0 BBSW.

In the event of reliance on stage 4, the Administrator will inform the Council of Financial Regulators and Committee in a timely manner.

Reliance on stage 4 to derive BBSW will not extend beyond two consecutive Business Days.

Stage 5: Final Stage Methodology

If BBSW is not or will likely not be determined using prior stages in the BBSW calculation methodology[4], the Final Stage Methodology will apply, as detailed in the BBSW Conventions and Methodology Appendix C[5].

[4] Note: Stage 5 may be used ahead of Stage 4 if required submission data is available.
[5] See Rule 2.2.5 of the ASIC Financial Benchmark (Administration) Rules 2018.

Change control

This document has been revised according to the table below:

Author	Comment	Date
ASX		18th May 2017
ASX	Change NBBO times ahead of change to methodology (addition of VWAP layer) and implementation of trade reporting.	4th December 2017
ASX	Implementation of VWAP methodology and change in publication time.	21st May 2018
ASX	Change to rolling maturity pool parameters for 1 month BBSW.	25th March 2019
ASX	BBSW Final Stage Methodology added as stage 5 in the calculation waterfall.	29th April 2019
ASX	Methodology updated to reflect change in NBBO sample times (section 4.1).	9th September 2019