November 12, 2019

Response to TWIA Actuarial and Underwriting Committee Open Issues from the October 17, 2019 Committee Meeting

Background

At its October 17, 2019 meeting, the Texas Windstorm Insurance Association (TWIA) Actuarial & Underwriting Committee (the "Committee") directed TWIA staff to provide written comments on certain issues raised by the Committee during the meeting for the purpose of considering the information at a follow-up meeting of the Committee and formulating a recommendation to the TWIA Board of Directors on a proposed rate filing. The Committee's recommendation would be considered at the TWIA Board's quarterly meeting scheduled for December 10, 2019 in Corpus Christi.

The issues identified by the Committee in the meeting are summarized as follows:

(1) TWIA's compliance with recently enacted legislation;
(2) TWIA's compliance with Actuarial Standard of Practice No. 39: Treatment of Catastrophe Losses in Property/Casualty Insurance Ratemaking;
(3) Use of the Texas industry historical hurricane frequency in the Association's rate adequacy analysis;
(4) TWIA's Series 2014 Bond debt service obligations and alternative refunding structures;
(5) The impacts of near-term and long-term frequency assumptions on catastrophe model results;
(6) TWIA's use of the Marshall Swift Boeckh (MSB) system for calculating replacement cost on residential dwellings; and
(7) Loss Adjustment Expense (LEA) assumptions in the Association's rate adequacy analysis.

Discussion of Issues

(1) TWIA's compliance with recently enacted legislation, and
(2) Actuarial Standard of Practice (ASOP) No. 39: Treatment of Catastrophe Losses in Property/Casualty Insurance Ratemaking

TWIA's rate adequacy analysis is in full compliance with applicable Texas law and actuarial standards of practice. As these issues are interrelated, we have combined the discussion of issues (1) and (2) related to the Association's compliance with recently enacted legislation and ASOP No. 39.

Senate Bill 615 and House Bill 1900 (86th Legislature) both require TWIA to make the Association's rate adequacy analysis available on its website "in a searchable electronic format that allows for efficient analysis and is sufficiently detailed to allow the historical experience in this state to be compared to results produced by the model." The 2019 rate adequacy analysis information posted on TWIA's website on July 22, 2019 satisfies the legislative requirement because, in addition to other information, it includes an explicit comparison of the expected losses based on industry experience and the expected losses for each of the hurricane models. This comparison can be found in Exhibit 5 of the Residential Exhibit 2019 and the Commercial Exhibit 2019 the rate adequacy analysis.

There is no statutory requirement for TWIA to validate the accuracy of the AIR and RMS hurricane models against Texas historical experience. Since 2008, TWIA has used the results of two different hurricane simulation models—one is the proprietary product of Applied Insurance Research (AIR) and the other is the proprietary product of Risk Management Solutions (RMS). In connection with its use of the models TWIA reviews the model outputs against actual TWIA experience for Hurricanes Ike and Harvey, among others. These storms represent the two largest storms impacting the Association in the past 11 years.

TWIA staff is satisfied that the Associations' ratemaking procedures appropriately reflect the expected frequency and severity distribution of catastrophes, as well as anticipated class, coverage, geographic, and other relevant exposure distributions as outlined by ASOP 39.

Additionally, in compliance with ASOP No. 38: Using Models Outside the Actuary's Area of Expertise (Property and Casualty), which requires the actuary to evaluate the user input and the reasonableness of the model output:

a. TWIA, in using the computer simulation models, has relied on documentation provided directly by the modeling firms and submission documentation provided to the Florida Commission on Hurricane Loss Projection Methodology in compliance with ASOP No. 38; and

b. TWIA actuarial staff prepares and provides the user input exposure data for models and evaluates the reasonableness of the model output as outlined by ASOP No. 38.

Appendix A includes the text of Texas Insurance Code Section 2210.3511 related to the posting requirements for TWIA's rate adequacy analysis and a detailed analysis of TWIA's compliance with the statute.

Appendices B, C, and D provide the validation work done by TWIA's actuarial staff in response to the issues raised by the Committee regarding the comparison between the model output and TWIA's actual hurricane loss experience from Hurricanes Ike and Harvey.

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(3) Use of the Texas industry historical hurricane frequency in the Association's rate adequacy analysis.

The methods TWIA uses to calculate its annualized hurricane loss ratio result in a more accurate hurricane loss provision estimate:

a. TWIA's hurricane frequency is based on National Oceanic and Atmospheric Association (NOAA) records for the 168-year period from 1851 to 2018. Exhibit 9 of the Residential Exhibit 2019 and the Commercial Exhibit 2019 of the rate adequacy analysis details Texas hurricanes since 1966. This 53-year period (1966-2018) represents all years for which TWIA has been provided industry loss experience data by TDI. However, in determining the frequency of hurricanes, we are not limited to the years in which insurance industry loss data is available. Given the relatively infrequent occurrence of hurricanes, the longest possible frequency experience period should be considered in order to obtain the most credible result. TWIA's selected hurricane frequency is therefore set equal to the 168-year historical hurricane frequency.

b. In its calculation of a hurricane loss provision based on industry historical experience, TWIA has relied on the number of individual hurricanes that have occurred during the historical period, not the number of years in which a hurricane occurred. In the 14 years from 1966 to 2018, 16 hurricanes have occurred. Two of the years experienced more than one hurricane: there were two hurricanes in 1989 (Hurricanes Chantal and Jerry) and two hurricanes in 2008 (Hurricanes Dolly and Ike). For those two years, it is not possible to distinguish the specific losses associated with the individual hurricanes. TWIA used the average annual loss ratio for years in which there is a hurricane as a proxy for the average loss ratio per hurricane.

In response to discussion about TWIA's use of the Texas industry historical frequency in the Association's rate adequacy analysis, TWIA staff recalculated the rate adequacy analysis assuming the two hurricanes occurring together in one year are of equal severity (i.e., dividing the combined annual loss ratio by two). This adjustment results in a minor change in the industry hurricane loss provision decreasing it from 96% to 81% and a resulting overall rate adequacy of 37% from the Association's original estate of 42%.

While this proposed adjustment modestly improves the industry hurricane loss experience percentage, adjusting the historical data for loss cost inflation and premium changes would have a negative effect on TWIA's rate adequacy. Unfortunately, TWIA lacks the requisite data to calculate the industry loss trends and industry premium trends to adjust historical industry experience to the present value. If TWIA's non-hurricane premium trend (0.3%) and loss trend (1.8%) had been factored into historical industry hurricane experience and the hurricane severity had been calculated, TWIA's 2019 residential rate indication would have been 48%; or approximately 6% more than originally indicated and communicated.

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(4) TWIA's Series 2014 Bond debt service obligations and alternative refunding structures.

Texas Insurance Code Section 2210.355(b)(4) states that in "adopting rates" TWIA must consider several factors including the "payment of public security debt obligations". In TWIA's rate adequacy analysis, TWIA's projection of costs associated with the bonds for 2020 is based on the terms of the outstanding Series 2014 Bonds (see Exhibit 11 of the Residential Exhibit 2019 and the Commercial Exhibit 2019 of the rate adequacy analysis).

It was suggested at the October 17, 2019 Committee meeting that TWIA should have accelerated the payment of principal on the Series 2014 Bonds rather than make required contributions into the Association's Catastrophe Reserve Trust Fund (CRFT). In fact, TWIA explored the possibility of retaining all or a portion of the 2018 net gains from operations to redeem the Series 2014 Bonds instead of contributing to the CRTF in 2019. However, TDI indicated that this option was not authorized by statute.

The Committee also asked staff to evaluate the feasibility of refinancing the Series 2014 Bonds with a structure that would provide for more rapid repayment of the new debt or reduce the overall debt service. These proposals included issuing separate tranches for one-, two-, and three-year terms or seeking an optional early redemption feature. While the Association hopes to reduce the overall interest rate in refinancing the Series 2014 bonds, the proposed structures will not enhance TWIA's overall rate adequacy and none of the proposals discussed at the Committee meeting would reduce the projected 2020 debt service (without deferring debt service payments to future years).

As stated above, TWIA is obligated to contribute its net gains from operations into the CRTF. While having the ability to retain these funds to prepay outstanding debt would be economically attractive, this flexibility is not provided for in the current statutes and rules. Obligating the Association to make larger principal payments than otherwise required may not be financially wise. Additionally, as outlined in the table below, the annual principal payments for bonds with terms of two and three years are greater than the current scheduled principal *and* interest payments, and therefore not a financially prudent option for the Association.

	Expected 2020 Payment
Original Schedule	$80.3 Million (Principal & Interest)
Pending Refinance	$80.3 Million (Principal & Interest)
1-Year Term	$318.6 Million (Principal Only)
2-Year Term	$159.3 Million (Principal Only)
3-Year Term	$106.2 Million (Principal Only)

(5) The impacts of near-term and long-term frequency assumptions on catastrophe model results.

TWIA has consistently relied on the long-term model outputs in the catastrophe models to produce the projected average annual loss (AAL) for its rate adequacy analysis to avoid volatility in the rate indications. TWIA staff also considers near-term model outputs particularly useful to the reinsurance purchasing decision, since changes in aggregate reinsurance limit purchases can be made annually and because near-term model outputs better match the reinsurance pricing. In any event, the impact of using the near-term over the long-term model outputs or vice versa is marginal because there is very little difference between the model outputs.

This below table compares the use of long-term frequency versus near-term frequency assumptions to generate the projected average annual loss used in the Association's rate adequacy analysis and to determine the Association's probable maximum loss (PML) used for its annual reinsurance purchasing decision.

	Long-term AAL	Near-term AAL	Long-term PML	Near-term PML
AIR	198,011,885	211,724,473	4,157,966,654	4,456,000,000
RMS	168,245,499	155,154,360	3,036,520,539	2,848,000,000
50/50 Blend	**183,128,692**	**183,439,417**	**3,597,243,597**	**3,652,000,000**

(6) TWIA's use of the Marshall Swift Boeckh (MSB) system for calculating replacement cost on residential dwellings.

TWIA's use of the MSB replacement cost calculator has no impact on the Association's current rates. TWIA has used the Marshall Swift Boeckh (MSB) system as a tool for calculating replacement cost on residential dwellings for over 15 years. The MSB system for replacement cost calculation is widely used by the industry as a tool to determine the amount of policy coverage needed by the policyholder.

In August 2019, TWIA upgraded the version of the MSB used by the Association because the older version was no longer supported by Corelogic (MSB's parent company). The new version of MSB provided for enhanced functionality in calculating replacement cost by providing a more accurate replacement cost for agents and policyholders. TWIA relies on the policyholder's agent to calculate the replacement cost and to select the limits of coverage that best meet the needs of the policyholder. If the agent has different information that they want TWIA to consider, the Association allows for that.

TWIA actuarial staff does not expect that the upgraded MSB version will have a significant, quantifiable impact on replacement cost or written premium. If there is any impact, direct or indirect, this type of uncertainty is reflected in the 5% funding and expense contingencies provision used in the 2019 rate adequacy analysis. This provision is intended to address any unquantifiable factors that could impact the Association's rate adequacy.

(7) Loss Adjustment Expense (LEA) assumptions in the Association's rate adequacy analysis.

TWIA uses a 15% loss adjustment expense (LAE) provision for Hurricane loss estimates. The 15% provision is the average amount of LAE experienced by TWIA from hurricane events over the past 10 years. This amount is larger than the level of loss adjustment experienced by TWIA for Hurricane Ike, but smaller than the proportion of loss adjustment expense experienced, so far, for Hurricane Harvey. It reflects our careful consideration of the different types and strengths of hurricane events which may affect the Texas coastal area.

There is a significant amount of uncertainty inherent in estimating LAE from hurricanes, including major hurricanes. While a major hurricane may result in higher average loss severity (loss per claim) and a relatively lower percentage of costs for loss adjustment expenses, a major hurricane may also lead to shortages in claim adjusting resources and therefore higher adjusting costs. In the absence of any additional credible historical experience, the loss adjustment expense assumption for major hurricanes makes a very modest impact on the resulting average annual loss given the relatively low frequency of these events.

Appendix E shows TWIA's development of its LAE factor based on historical commercial and residential LAE experience.

Appendix A: Texas Insurance Code Section 2210.3511 and TWIA's Compliance with the Rate Adequacy Analysis Posting Requirements

Texas Insurance Code Section 2210.3511. PUBLIC ACCESS TO RATE ADEQUACY ANALYSIS.

(a) The association shall make the association's rate adequacy analysis publicly available on its Internet website for at least 14 days before the date the board of directors votes on the submission of a proposed rate filing based on the analysis to the department. The rate adequacy analysis must include:

- (1) all user selected hurricane model input assumptions; and
- (2) output data:
  - (A) with the same content and in the same format that is customarily provided to:
    - (i) the association by hurricane modelers; and
    - (ii) the department by the association; and
  - (B) in a searchable electronic format that allows for efficient analysis and is sufficiently detailed to allow the historical experience in this state to be compared to results produced by the model.

(b) The association shall accept public comment with respect to the association's rate adequacy analysis at a public meeting of the board of directors before the board of directors votes on the submission of a proposed rate filing to the department.

Detailed analysis of TWIA's compliance with Texas Insurance Code Section 2210.3511:

a. As required by Texas Insurance Code Section 2210.3511(a), TWIA's rate adequacy analysis was made publicly available on the TWIA's website at least 14 days before the date the TWIA Board of Directors voted on the submission of a proposed rate filing. TWIA posted the analysis on July 22, 2019, slightly exceeding the 14-day requirement.

b. As required by Section 2210.3511(a)(1), TWIA included all user selected hurricane model input assumptions.

c. As required by Section 2210.3511(a)(2)(A), TWIA provided the catastrophe model "output data with the same content and in the same format that is customarily provided to (i) the association by hurricane modelers and (ii) the Department by the Association". The model output used for TWIA's ratemaking is the average annual loss by county for the TWIA portfolio based on the policies-in-force on November 30, 2018. There is no requirement that TWIA provide alternative model output using different assumptions.

d. The catastrophe models produce other data that are not specifically used in the ratemaking process, such as per occurrence and annual aggregate loss estimates at different exceedance probability thresholds. In the interest of greater transparency, *Appendix F* includes the per occurrence and annual aggregate loss estimates from the hurricane models (this information may also be found on

TWIA's website with the 2019 Rate Adequacy Analysis documents under the title "TWIA Hurricane Model Output").

e. As required by Section 2210.3511(a)(2)(B), the rate adequacy analysis was posted in Microsoft Excel and Adobe Acrobat PDF files to provide "a searchable electronic format that allows for efficient analysis".

f. As required by Section 2210.3511(a)(2)(B), the posted material is sufficiently detailed to allow the historical experience in this state to be compared to results produced by the model. Exhibit 6.1 of the Residential Exhibit 2019 file provides detailed premium and loss information for the Texas insurance industry (Residential Extended Coverage policies) for each of the years in which there were hurricanes from 1966 through 2019. This information is used to calculate an "Indicated Hurricane Loss Ratio" based on industry experience. Exhibit 5 of the Residential Exhibit 2019 and the Commercial Exhibit 2019 of the rate adequacy analysis provides a direct comparison of the historical experience in the state compared to the results produced by each of the models. The statutory requirement that the historical experience be compared to the model results does not impose an obligation to present a reconciliation of the historical results to the hurricane model output.

g. Section 2210.3511 contains no requirement that TWIA "validate" the hurricane models with actual hurricane experience in the State of Texas. Further, TWIA does not rely on the Florida Commission on Hurricane Loss Projection Methodology's approval in connection with its use of the RMS and AIR models. TWIA has instead relied on documentation provided directly by the modeling firms and submission documentation provided to the Florida Commission on Hurricane Loss Projection Methodology to comply with ASOP No. 38 and ASOP No. 39.

h. TWIA's use of the widely accepted RMS and AIR hurricane models in its rate adequacy analysis is consistent with Section 2210.355 which states: "In adopting rates under this chapter, recognized catastrophe models may be considered."

Appendix B: Assumptions (AIR Model vs Actual for Hurricane Ike)

TWIA Model Output Validition
Analysis based on AIR ALERT IKE Landfall Posting and Exposure as of 11/30/07

Loss Perspective	Expected	Minimum	Maximum	10th Percentile	90th Percentile
Ground-Up	1,738,637,228	1,421,909,030	2,176,256,128	2,000,571,777	1,457,632,470

Total Direct Limits as of 11/30/2007
58,011,994,303

Total Direct Limits as of 8/31/2008
60,906,981,276

Adjusted Analysis

Growth	5.0%	(Average for 6 counties from 11/30/07 to 8/31/08)
LAE	14.0%	ALAE + ULAE
ALE	5.0%	
Surge (Demand/Storm)	10.0%	

Loss Perspective	Expected	Minimum	Maximum	10th Percentile	90th Percentile
Ground-Up Model Output	2,403,505,331	1,965,657,860	3,008,473,027	2,765,605,644	2,015,042,215
TWIA actual case incurred loss and LAE	2,588,356,306				

Appendix C: Assumptions (AIR Model vs Actual for Hurricane Harvey)

TWIA Model Output Validition
AIR TS v7.0 Harvey Historical Event, TWIA 12/31/16

Loss Perspective	Expected
Ground-Up	353,382,823

Total Direct Limits as of 12/31/2016
73,393,573,009

Total Direct Limits as of 8/31/2017
68,585,960,997

Adjusted Analysis

Growth	-6.6%	
LAE	18.6%	ALAE + ULAE
ALE	0.0%	
Surge (Demand/Storm)	2.0%	

Loss Perspective	Expected
Ground-Up Model Output	399,491,455
TWIA Ultimate estimate of incurred loss and LAE	1,700,000,000

TWIA Actuairal and Claims are conducting the research on why AIR understated loss cost for Harvey

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Appendix D: Assumptions (RMS Model vs Actual for Hurricane Ike)

TWIA Model Output Validition
Inforce Exposure as of 12/31/2010
RMS v11.0 Event Losses - Net of Deductibles
Catalog of Actual Historical Events

Loss Perspective	Expected
Ground-Up	716,885,225

Total Direct Limits as of 12/31/2010
67,452,356,800

Total Direct Limits as of 8/31/2008
60,906,981,276

Adjusted Analysis

Growth	-9.7%	(Average for 6 counties from 11/30/07 to 8/31/08)
LAE	14.0%	ALAE + ULAE
ALE	5.0%	
Surge (Demand/Storm)		

Loss Perspective	Expected
Ground-Up Model Output	774,843,022
TWIA actual case incurred loss and LAE	2,588,356,306

The difference between model and actual could reflect new roof, new constructions

Appendix E: Development of LAE Factor Using TWIA Commercial and Residential Experience

Texas Windstorm Insurance Association
Residential Property - Wind & Hail
Rate Level Review
Development of LAE factor Using TWIA Commercial + Residential Experience

Accident Year	Projected Ultimate Loss	Projected Ultimate LAE	Ultimate LAE to Loss Ratio	Hurricane Indicator
(1)	(2)	(3)	(4)	(5)
1980	12,911	1,318	0.102	H
1981	2,512	543	0.216	
1982	796	565	0.710	
1983	148,999	9,127	0.061	H
1984	999	324	0.324	
1985	512	297	0.580	
1986	881	505	0.573	H
1987	1,897	1,056	0.557	
1988	1,160	357	0.308	
1989	12,296	3,528	0.287	H
1990	335	225	0.672	
1991	1,217	729	0.599	
1992	489	554	1.133	
1993	3,375	1,375	0.407	
1994	679	507	0.747	
1995	2,977	903	0.303	
1996	1,166	582	0.499	
1997	2,964	1,343	0.453	
1998	22,401	4,732	0.211	
1999	8,773	2,388	0.272	H
2000	6,227	1,885	0.303	
2001	24,605	1,880	0.076	
2002	5,167	5,226	1.011	
2003	155,001	5,122	0.033	H
2004	5,167	1,471	0.285	
2005	154,981	20,235	0.131	H
2006	4,276	1,110	0.260	
2007	15,745	4,941	0.314	H
2008	2,583,017	346,615	0.134	H
2009	10,407	2,219	0.213	
2010	18,030	4,281	0.237	
2011	96,290	15,170	0.158	
2012	67,586	15,858	0.235	
2013	70,855	13,910	0.196	
2014	7,047	6,892	0.978	
2015	137,960	39,988	0.290	
2016	28,417	15,797	0.556	
2017	1,374,572	274,654	0.200	H
2018	13,184	6,424	0.487	
All Years Total	5,005,873	814,636	0.163	
Hurricane Years Total	4,467,176	668,433	0.150	
Non-Hurricane Years				
Total	538,697	146,203	0.271	
10 Year	454,052	121,649	0.268	

Notes:
(2) Exhibit 4, Sheet 2
(3) Exhibit 4, Sheet 4
(4) = (3) / (2)
(5) "H" indicates hurricane year

Appendix F

Texas Windstorm Insurance Association

Estimated Aggregate Annual Losses
Based on Industry Accepted
Hurricane and Severe Thunderstorm Catastrophe Models
Based on Data as of November 30, 2018

Cautionary Language Regarding Catastrophe Model Loss Estimates

The following tables present hurricane and severe thunderstorm loss estimates prepared by the Association based on two leading industry models: AIR Touchstone and RMS RiskLink. Developing models to estimate losses resulting from catastrophes or other large-scale events is an inherently subjective and imprecise process, involving judgment about a variety of environmental, demographic and regulatory factors. Such factors are inherently uncertain and the Association does not model all the types of perils that may result in losses to the Association.

The assumptions and/or methodologies used in connection with the preparation of estimated losses derived by the Association may not constitute the exclusive set of reasonable assumptions, and the use of alternative assumptions and/or methodologies could yield results materially different from those generated or relied upon by the Association. Each model run is based on exposure information that will differ from the Association's actual exposure in the future based on future action the Association may take, including changes to existing policies and the writing of new business. Loss distribution models are not facts and should not be relied upon as such. Actual loss experience can materially differ from the modeled loss estimates used by the Association.

The Board of Directors considers the results of the models and other factors in connection with its decisions with respect to the purchase of reinsurance, including the amount of total limits sought. The Board also considers the results of the models in considering to its obligations under Chapter 2210.453 which require that the Association maintain total available loss funding in an amount not less than the probable maximum loss for the association for a catastrophe year with a probability of one in 100.

These models simulate thousands of hurricane and severe thunderstorm scenarios and compare the simulated hurricanes and severe thunderstorms to the Association's insured business to calculate the probability of losses of certain sizes, both for single occurrences and aggregate losses for the entire year. The results below were generated using Association exposures as of November 30, 2018 and November 30, 2017. The loss estimates are used by the Association in the course of its business operations. The data and analysis provided by TWIA herein are provided "as is", without warranty of any kind whether express or implied.

The loss estimates were prepared by the Association based on certain accepted industry models of Air Worldwide Corporation and Risk Management Solutions. The modeled estimates were prepared by the Association from model output prepared by Guy Carpenter & Company LLC in connection with their provision of reinsurance brokerage services and not in connection with the preparation of this information. The information contained herein reflects the professional judgment and analysis of the Association in respect to certain hurricane occurrence loss estimates derived from industry models. Neither Air Worldwide Corporation, Risk Management Solutions, Inc., nor Guy Carpenter & Company LLC have reviewed, commented on, or approved this report or the information contained herein.

Definitions

Aggregate Loss Estimate: The most basic output of a catastrophe model is the estimate of losses for every simulated event. Losses presented on an aggregate basis include estimated total losses from ALL events in any given year. In contrast, an "occurrence basis" reflects the losses from the largest single event in any given year. The aggregate loss estimates do not include a provision for loss adjustment expenses. TWIA staff would recommend adding an amount equal to 15% of the estimated aggregate losses to represent the estimated loss adjustment expenses. Loss adjustment expenses represent costs associated with investigating and settling claims.

Aggregate Exceedance Probability: Aggregate Exceedance Probability represents the probability of the total losses from ALL events in any given year meeting or exceeding a given threshold.

Average Annual Loss (AAL): The AAL is the expected value of losses to be experienced in any given year. It is equal to the sum of all simulated event losses multiplied by the probability of each of those events. Average annual losses are also calculated by dividing the total losses for all simulated storms by the number of simulated years in the computer simulation.

Demand Surge: Demand surge estimates the degree to which losses are escalated by a combination of economic, social and operational conditions that follow after a given event. Demand Surge accounts for three separate mechanisms of escalation arising from (1) increase in the costs of building materials and labor costs as demand exceeds supply, (2) cost inflation due to the difficulties in fully adjusting claims following a catastrophic event, and (3) under certain extreme scenarios, coverage and loss expansion due to a complex collection of factors such as containment failures, evacuation effects, and systemic economic downturns in selected urban areas.

Gross Basis: Gross basis refers to the total losses before any recoveries from reinsurance or other funding mechanisms.

Near Term vs. Long Term (Historical) Event Set: Hurricanes in the Atlantic basin are known to follow multidecadal periods of heightened or diminished activity in terms of frequency of events, intensity and landfall frequency. To account for these frequency changes, catastrophe model vendors provide alternative event catalogs or rates set alongside the long-term mean. Near-Term or Medium-Term Rates represent the five-year, medium-term outlook of North Atlantic hurricane activity. Long-Term Rates represent the event rates that are consistent with the long-term historical average.

Return Period: The return period is simply the inverse of the exceedance probability. For example, a 1% exceedance probability is equal to a 100-year return period. The return-period term can be misleading by implying a period of time that would be expected to pass between events of that magnitude, when in reality they are representative of the probability of meeting or exceeding that level of loss in any given year.

Risk count: Risk Count refers to the number of individual structures insured. Some policies may cover more than one structure.

Storm Surge: Storm surge refers to the damage caused by rising ocean water levels along coastlines affected by a hurricane that can cause widespread flooding.

Catastrophe Model Results

Occurrence Loss Estimates

RMS RiskLink

		Occurrence Loss Estimate - Gross[1,2]		
Exceedance Probabillity[3]	Return Period	11/30/17 Exposures[4] RMS v17.0	11/30/18 Exposures RMS v18.0	11/30/17 v17 to 11/30/18
10.00%	10	$353,479,188	$327,100,317	-7.5%
5.00%	20	$800,077,698	$741,556,301	-7.3%
4.00%	25	$990,007,755	$917,996,799	-7.3%
2.00%	50	$1,783,978,113	$1,658,479,961	-7.0%
1.00%	100	$2,947,350,492	$2,743,171,730	-6.9%
0.40%	250	$4,933,241,203	$4,603,113,633	-6.7%
0.20%	500	$7,212,159,842	$6,734,800,715	-6.6%
0.10%	1000	$9,832,975,676	$9,149,727,705	-6.9%
Average Annual Loss (AAL)		$184,614,256	$171,247,275	-7.2%

AIR Touchstone

		Occurrence Loss Estimate - Gross[1,2]		
Exceedance Probabillity[3]	Return Period	11/30/17 Exposures[4] AIR v5	11/30/18 Exposures AIR v6	Change % 11/30/17 v5 to 11/30/18
10.00%	10	$416,538,167	$382,624,690	-8.1%
5.00%	20	$1,056,691,836	$982,254,930	-7.0%
4.00%	25	$1,310,887,014	$1,221,004,232	-6.9%
2.00%	50	$2,578,410,605	$2,421,004,472	-6.1%
1.00%	100	$4,599,362,232	$4,288,394,836	-6.8%
0.40%	250	$6,976,074,849	$6,577,478,186	-5.7%
0.20%	500	$9,935,695,922	$9,297,247,467	-6.4%
0.10%	1000	$11,955,637,602	$10,747,350,035	-10.1%
Average Annual Loss (AAL)		$245,286,711	$227,819,572	-7.1%

Average of RMS and AIR Models

		Occurrence Loss Estimate - Gross[1,2]		
Exceedance Probabillity[3]	Return Period	11/30/17 Exposures[4] Average of RMS and AIR	11/30/18 Exposures Average of RMS and AIR	Change % 11/30/17 v5 to 11/30/18
10.00%	10	$385,008,678	$354,862,503	-7.8%
5.00%	20	$928,384,767	$861,905,615	-7.2%
4.00%	25	$1,150,447,384	$1,069,500,515	-7.0%
2.00%	50	$2,181,194,359	$2,039,742,217	-6.5%
1.00%	100	$3,773,356,362	$3,515,783,283	-6.8%
0.40%	250	$5,954,658,026	$5,590,295,909	-6.1%
0.20%	500	$8,573,927,882	$8,016,024,091	-6.5%
0.10%	1000	$10,894,306,639	$9,948,538,870	-8.7%
Average Annual Loss (AAL)		$214,950,484	$199,533,423	-7.2%
Limits		$72,589,462,935	$65,266,085,268	-10.1%
TIV		$78,944,281,103	$71,089,007,728	-10.0%
Risk Count		243,333	218,439	-10.2%
AAL per Risk Count		$883.36	$913.45	3.4%
Ave. Limits per Risk Count		$298,313.27	$298,784.03	0.2%
Average TIV per Risk Count		$324,429.00	$325,441.01	0.3%

Aggregate Loss Estimates

RMS RiskLink

		Aggregate Loss Estimate - Gross[1,2]		
Exceedance Probabillity[3]	Return Period	11/30/17 Exposures[4] RMS v17.0	11/30/18 Exposures RMS v18.0	Change % 11/30/17 v17 to 11/30/18 v18.0
10.00%	10	$386,797,580	$357,714,082	-7.5%
5.00%	20	$856,261,703	$793,329,741	-7.3%
4.00%	25	$1,054,960,777	$977,894,806	-7.3%
2.00%	50	$1,877,216,884	$1,744,497,300	-7.1%
1.00%	**100**	**$3,061,106,710**	**$2,847,973,101**	**-7.0%**
0.40%	250	$5,084,707,577	$4,744,088,210	-6.7%
0.20%	500	$7,377,726,624	$6,886,833,316	-6.7%
0.10%	1000	$10,004,033,550	$9,310,183,033	-6.9%
Average Annual Loss (AAL)		$184,614,256	$171,247,275	-7.2%

AIR Touchstone

		Aggregate Loss Estimate - Gross[1,2]		
Exceedance Probabillity[3]	Return Period	11/30/17 Exposures[4] AIR v5	11/30/18 Exposures AIR v6	Change % 11/30/17 v5 to 11/30/18 v6
10.00%	10	$464,909,903	$428,358,697	-7.9%
5.00%	20	$1,166,886,568	$1,082,196,419	-7.3%
4.00%	25	$1,423,519,226	$1,336,472,767	-6.1%
2.00%	50	$2,729,121,042	$2,527,174,700	-7.4%
1.00%	**100**	**$4,782,128,460**	**$4,456,015,673**	**-6.8%**
0.40%	250	$7,483,431,477	$7,011,995,680	-6.3%
0.20%	500	$10,055,421,570	$9,489,757,263	-5.6%
0.10%	1000	$12,002,577,153	$10,790,076,705	-10.1%
Average Annual Loss (AAL)		$245,286,711	$227,819,572	-7.1%

Average of RMS and AIR Models

		Aggregate Loss Estimate - Gross[1,2]		
Exceedance Probabillity[3]	Return Period	11/30/17 Exposures[4] Average of RMS and AIR	11/30/18 Exposures Average of RMS and AIR	Change % 11/30/17 v5 to 11/30/18 v6
10.00%	10	$425,853,742	$393,036,390	-7.7%
5.00%	20	$1,011,574,136	$937,763,080	-7.3%
4.00%	25	$1,239,240,002	$1,157,183,787	-6.6%
2.00%	50	$2,303,168,963	$2,135,836,000	-7.3%
1.00%	**100**	**$3,921,617,585**	**$3,651,994,387**	**-6.9%**
0.40%	250	$6,284,069,527	$5,878,041,945	-6.5%
0.20%	500	$8,716,574,097	$8,188,295,290	-6.1%
0.10%	1000	$11,003,305,352	$10,050,129,869	-8.7%
Average Annual Loss (AAL)		$214,950,484	$199,533,423	-7.2%
Limits		$72,589,462,935	$65,266,085,268	-10.1%
TIV		$78,944,281,103	$71,089,007,728	-10.0%
Risk Count		243,333	218,439	-10.2%
AAL per Risk Count		$883.36	$913.45	3.4%
Ave. Limits per Risk Count		$298,313.27	$298,784.03	0.2%
Average TIV per Risk Count		$324,429.00	$325,441.01	0.3%

Footnotes:

(1) Loss estimates are presented on a gross basis, including hurricane and severe convection storm ("SCS") losses, excluding loss adjustment expenses. Hurricane losses include demand surge and exclude storm surge. Hurricane losses are based on the near-term (Warm Sea Surface Temperature) event set.

(2) For Severe Thunderstorm, the Standard catalog was used which includes the lower severity/higher frequency events.

(3) Exceedance probability represents the probability that losses exceed a certain amount from either single or multiple occurrences.

(4) The "11/30/17 Exposures" exclude the 2017 Depop policies (6,425 policies and 6,682 locations).

Exceedance Probabillity[3]	Return Period	Aggregate Loss Estimates 11/30/18 Exposures: RMS RiskLink v 18.0	AIR Touchstone v 6.0	Average	Average plus 15% LAE factor
10.00%	10	357,714,082	428,358,697	393,036,390	451,991,848
5.00%	20	793,329,741	1,082,196,419	937,763,080	1,078,427,542
4.00%	25	977,894,806	1,336,472,767	1,157,183,787	1,330,761,354
2.00%	50	1,744,497,300	2,527,174,700	2,135,836,000	2,456,211,400
1.00%	**100**	**2,847,973,101**	**4,456,015,673**	**3,651,994,387**	**4,199,793,545**
0.40%	250	4,744,088,210	7,011,995,680	5,878,041,945	6,759,748,237
0.20%	500	6,886,833,316	9,489,757,263	8,188,295,290	9,416,539,583
0.10%	1000	9,310,183,033	10,790,076,705	10,050,129,869	11,557,649,349
Average Annual Loss (AAL)		171,247,275	227,819,572	199,533,423	229,463,437
	TIV	$71,089,007,728	71,089,007,728	71,089,007,728	71,089,007,728
	Risk Count	218,439	218,439	218,439	218,439

Footnotes:

(1) Loss estimates are presented on a gross basis, including hurricane and severe convection storm ("SCS") losses, excluding loss adjustment expenses. Hurricane losses include demand surge and exclude storm surge. Hurricane losses are based on the near-term (Warm Sea Surface Temperature) event set.

(2) For Severe Thunderstorm, the Standard catalog was used which includes the lower severity/higher frequency events.

(3) Exceedance probability represents the probability that losses exceed a certain amount from either single or multiple occurrences.

Alexander Actuarial Consulting
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Principal

November 18, 2019

Background

This report is in rebuttal to TWIA's *Response to TWIA Actuarial and Underwriting Committee Open Issues from the October 17, 2019 Committee Meeting dated November 12, 2019.*

Compliance with Texas Law and Actuarial Standards of Practice

TWIA's rate adequacy analysis is not in full compliance with applicable Texas law and actuarial standards of practice. The 2019 rate adequacy analysis information posted on TWIA's website on July 22, 2019 does not satisfy the legislative requirement, because the model "output data" is not "sufficiently detailed to allow the historical experience in this state to be compared to results produced by the model". To compare means "to examine the character, or qualities of, especially in order to discover resemblances or differences".[1]

TWIA's minimal disclosure only included estimated modeled losses. Information was insufficient to "discover resemblances or differences" between modeled losses and the National Oceanographic and Atmospheric Association (NOAA) 169-year history of actual Texas hurricane experience[2].

Furthermore, TWIA failed to disclose why its modeled 2020 hurricane losses were nearly twice as large as estimated losses based upon Texas historical experience (hurricane modeled loss ratio of 51.9% compared to Texas historical experience loss ratio of 27.7%[3]). Failing to provide sufficient data to explain such a large discrepancy between modeled and historical results does not comply with HB 1900 or with Actuarial Standard of Practice 39 (attached).

The NOAA data included Texas hurricane experience by Saffir-Simpson Wind Scale Category (Wind Category) and by landfall location. To satisfy HB 1900, one reasonability check, which could have been easily done if TWIA had provided appropriate model output (for each model it relied upon) would have been to compare the number of modeled hurricanes by Wind Category to actual Texas experience by the same categories.

TWIA only used the NOAA data to estimate Texas long-term historical hurricane frequencies for all Wind Categories combined. TWIA did not compare modeled to actual hurricane frequency by Wind Category for all modeled outputs. If the hurricane models produced more severe storms, more frequent storms or more storms impacting more populated areas, this could explain the much higher losses produced by the models.

[1] Merriam-Webster dictionary
[2] NOAA Technical Memorandum NWS TPC-59. TWIA used this document in its Analysis.
[3] CWIC revised TWIA Exhibit 1, CWIC rate adequacy analysis of 8-6-19. TWIA's historical hurricane frequencies should have been based on years with one or more hurricanes not the total number of hurricanes.

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It is reasonable to expect that 2020 modeled probabilities of hurricanes by Wind Category and by segment of Texas coastline to be comparable to actual experience unless TWIA can reference to credible scientific evidence to the contrary. The following table, based upon NOAA data, shows actual landfalling Texas hurricane experience by Wind Category for the last 169 years.

Landfalling Texas Hurricanes
Actual Historical Experience
1851 to Present

Category at Landfall	Total Years in Historical Period	Number of Actual Hurricanes	Average Number of Years Between Occurrences	Frequency
5		0	n/a	0%
4		8	21	5%
3		12	14	7%
2		19	9	11%
1		23	7	14%
	169	62	3	37%

This table shows that Texas: 1) has on average experienced one landfalling hurricane about every 3 years, 2) hurricane frequency decreases as Wind Category intensity increases and 3) has never experienced a category 5 storm at landfall since 1851.

Because TWIA's hurricane models produced losses significantly greater than Texas historical experience, TWIA should have provided model outputs for each model relied upon to comply with *Actuarial Standard of Practice 39*, *Treatment of Catastrophe Losses in Property Casualty Insurance Ratemaking* (attached): "If … the actuary believes that the available historical insurance data do not sufficiently represent the exposure to catastrophe losses, the actuary should … be satisfied that the resulting ratemaking procedures [using hurricane models] appropriately reflect the expected frequency and severity distribution of catastrophes …".

A second reasonability check, which could have been easily performed, if appropriate data had been provided by TWIA in compliance with HB 1900 and Actuarial Standard of Practice 39, would have been to compare modeled losses for storms of similar intensity, landfall and track to actual hurricane losses (adjusted for inflation, changes in exposure and changes in Texas law) for the following actual recent Texas hurricanes: Harvey (2017), Ike (2008), Gustav (2008), Dolly (2008), Humberto (2007), Rita (2005) and Claudette (2003). It would be reasonable to expect that the modeled losses for these storms would be comparable to adjusted actual experience.

In its November 12, 2019 response (Response), TWIA did compare modeled to actual losses for Hurricanes Ike and Harvey. Modeled losses for Ike matched well with actual losses, however modeled losses for Harvey were far less than actual losses (353 million AIR modeled vs 1.7 billion actual incurred, no RMS modeled results for Hurricane Harvey were provided by TWIA).[4] It is not clear if the AIR modeled results provided by TWIA are net of policyholder deductibles.

Although it is reasonable to expect some deviation from actual losses, such a large discrepancy for Hurricane Harvey does not inspire confidence in the accuracy of the AIR hurricane model. For this reason, it is recommended that comparisons be made for both the AIR and RMS models for all of the above listed recent hurricanes.

A third comparison, which should have been performed to comply with HB 1900 and Actuarial Standard of Practice 39, would have been to compare modeled versus actual hurricane landfalls by segment of Texas coastline. The 367-mile Texas coastline could have been divided into segments corresponding to the average diameter of maximum sustained hurricane winds (usually assumed to be about 45 miles). To determine "resemblances or differences", modeled landfalls by coastal segment could have been compared to actual landfalls for the 169-year history of Texas landfalling hurricanes.

Without disclosure of sufficiently detailed model output data to make the above types of comparisons, TWIA has not demonstrated that its "ratemaking procedures appropriately reflect the expected frequency and severity distribution of catastrophes, as well as anticipated class, [c]overage, geographic, and other relevant exposure distributions as outlined by ASOP 39."[5]

[4] November 12, 2019 Response to TWIA Actuarial and Underwriting Committee Open Issues from the October 17, 2019 Committee Meeting, Appendices C and D

[5] November 12, 2019, Response to TWIA Actuarial and Underwriting Committee Open Issues from the October 17, 2019 Committee Meeting, Page 2

Historical Hurricane Frequencies

The method TWIA uses to calculate its annualized hurricane loss ratio is not at issue. What is at issue is how TWIA calculates its hurricane frequency. The historical hurricane frequency should be calculated on the same basis as the historical loss ratios on TWIA's Exhibit 6, Sheet 1. The historical hurricane year loss ratios in column (3) include all hurricane losses in each hurricane year from one or more hurricanes.

Therefore, TWIA should be determining hurricane frequency on the same basis: counting the number of years with one or more hurricanes instead of the number of hurricanes. TWIA's expected hurricane loss ratio for 2020 of 36.7% (Row (8)) is too high, because TWIA multiplies its selected hurricane frequency (1 hurricane every 2.6 years (Row (7)) times the average hurricane year expected loss ratio of 96.3% (Row (6)).

A more appropriate selection for hurricane frequency is one or more hurricanes every 4 years and an expected 2020 average hurricane loss ratio of 24.1% (1/4 x 96.3%). The year 2008 illustrates the correct calculation. In 2008, two hurricanes made landfall in Texas: Ike and Dolly. In TWIA's rate adequacy analysis, TWIA incorrectly counted both hurricanes instead of counting 2008 as a single year with one or more hurricanes.

TWIA claims that it was not able to adjust industry historical hurricane loss ratios for trends in premiums and losses (could not in actuarial terminology "put them on-level") because of a lack applicable industry data. Consequently, TWIA claims that its indicated rate inadequacy may be "approximately 6% more than originally indicated".[6] TWIA's basis for this claim is its own non-hurricane premium and loss trends.

TWIA claims its non-hurricane loss trend of 1.8% exceeds its non-hurricane premium trend of .3% resulting in a net annual non-hurricane positive trend of 1.015% (1.018/1.003), which if applied to industry historical hurricane loss ratios would increase industry hurricane loss ratios and TWIA's indicated rate inadequacy. TWIA did not provide documentation to support the derivation of its non-hurricane trends.

Furthermore, TWIA did not disclose its own hurricane loss and premium trends, which would be more applicable to industry hurricane loss ratios. It's more likely that after Hurricane Andrew in 1992 both Texas industry and TWIA's own hurricane premium trends substantially exceeded loss trends as private insurers raised rates or withdrew entirely from the Texas coast. Therefore, if TWIA had adjusted industry hurricane loss ratios for its own trends in hurricane premiums and losses, TWIA's rate inadequacy would likely be reduced, not increased, as TWIA claims.

[6] November 12, 2019, Response to TWIA Actuarial and Underwriting Committee Open Issues from the October 17, 2019 Committee Meeting, Page 3

Repayment of Bonds

An optional early redemption feature or accelerated bond repayment option will enhance rather than detract from TWIA's overall rate adequacy. Use of underwriting gains to pay off debt more quickly appears to be permitted by Texas law and will reduce TWIA's future debt service.

It does not make economic sense to remain locked into a fixed debt repayment schedule at an exorbitant interest rate (currently 8.0%) while earning only 2.0% or less on funds deposited in the CRTF. Contrary to TWIA's claims, providing TWIA with the financial flexibility to make larger principal payments than otherwise required is financially wise.

Texas law provides:
"At the end of each calendar year or policy year, the association shall use the net gain from operations of the association, including all premium and other revenue of the association in excess of incurred losses, operating expenses, public security obligations, and public security administrative expenses, to make payments to the trust fund, procure reinsurance, or use alternative risk financing mechanisms, or to make payments to the trust fund and procure reinsurance or use alternative risk financing mechanisms."[7]

The law provides that net gains from operations include all premium and revenue in excess of public security obligations. If a public security obligation includes an optional early redemption feature or accelerated repayment option, then the net gain from operations should be after the exercise of such feature or option – not before as claimed by TWIA. TWIA does not appear to be restricted by Texas law to use underwriting gains to pay down its debt as quickly as possible as long as its debt obligation contracts include an early redemption or accelerated repayment feature.

Contrary to the best interests of both its policyholders and its member insurers, TWIA has not demonstrated any interest in including early redemption features or accelerated repayment options in its bond agreements. The longer it takes for TWIA to pay off its debt, the more it pays in interest expense, the more it demands in policyholder rate increases and the less funds it has to pay losses.

[7] Sec. 2210.452, (c), Establishment and Use of Trust Fund

Near-Term vs. Long-Term Hurricane Models

"TWIA has consistently relied on long-term models … to avoid volatility in [its] rate indications".[8] Why then doesn't TWIA apply this same principle to avoid volatility in its reinsurance costs? "TWIA staff also considers near-term model outputs particularly useful to the reinsurance purchasing decision, … because near-term model outputs better match the reinsurance pricing." [9]

Reinsurers' pricing is well known to be volatile and to follow their capital positions. After major "capital events", which deplete capital, reinsurers will aggressively raise rates regardless of their near-term or long-term hurricane model indications.

Reinsurers only reduce rates gradually as their capital positions improve. Therefore, it makes no sense for TWIA to match models used by reinsurers. TWIA's 100-year PML should be independent of reinsurers' volatile pricing decisions. TWIA's mixing of near-term and long-term models only further creates unnecessary volatility in its rate indications.

TWIA uses a 50/50 blend of the AIR and RMS long-term model results to estimate expected average annual hurricane losses and a 50/50 blend of the AIR and RMS near-term model results to estimate its 100-year PML. The AIR near-term 100-year PML is $1.61 billion greater than the RMS 100-year PML ($4.46 billion for AIR vs $2.85 billion for RMS). The AIR model may be estimating more severe storms, more frequent storms or more storms impacting more populated areas contrary to Texas historical long-term experience.

The weight given to each model should be based upon how well it matches the historical frequency and severity of Texas hurricanes - barring any credible scientific evidence to the contrary. Until TWIA provides the full disclosure, as outlined in this rebuttal, to satisfy the requirements of HB 1900 and Actuarial Standard of Practice 39, none of the hurricane modeled results should be used in its rate adequacy analysis or in the determination of its 100-year PML.

Until full disclosure, TWIA's rates, its 100-year PML and its provision for reinsurance should be based solely upon its historical experience. On that basis, the projected year 2020 100-year PML should be about $2.4 billion, as documented in my 8/6/19 actuarial rate review, not $4.2 billion as claimed by TWIA.

A $2.4 billion 100-year PML based on TWIA's historical experience is consistent with the RMS near-term 100-year PML of $2.8 billion as 11/30/18 projected to 11/30/20 at a negative exposure trend of -7.0% per year. In Appendix F, TWIA provides probability of exceedance tables for the AIR and RMS near-term models for exposures as of 11/30/17 and 11/30/18. Exposures for this period declined by over 7.0%. For the period 4/30/18 to 4/30/19 exposures declined 9.9%[10]. Therefore, it is reasonable to assume exposures will continue to decline in 2020.

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[8] Page 5, TWIA Response
[9] Ibid
[10] Page 19, Texas Windstorm Insurance Association, Annual Report Card, June 1, 2018 - May 31, 2019

MSB Replacement Cost Estimator

TWIA has not done any analysis to determine the impact of the upgrade to its MSB replacement cost estimator. This author has been told by some TWIA agents that the MSB replacement cost values are consistently higher (and frequently much higher) for wind than private insurers' replacement cost values for all other perils.

Agent testimony at the August 6, 2019 board meeting in Galveston was consistent with this anecdotal evidence. TWIA's opinion that "the upgraded MSB version will [not] have a significant, quantifiable impact on replacement cost or written premium"[11] has not been supported by any randomized scientific study of TWIA's book of business.

An increase in replacement costs has a similar impact upon premiums as a rate increase. If the upgrade to the MSB replacement cost estimator had an accelerated impact on replacement costs, this reduces TWIA's 2020 rate indication and should be reflected in its rate adequacy analysis.

[11] November 12, 2019, Response to TWIA Actuarial and Underwriting Committee Open Issues from the October 17, 2019 Committee Meeting, Page 5